GSI Water Solutions, Inc.

TECHNICAL MEMORANDUM

Los Olivos Groundwater Monitoring Plan

To: Doug Pike, Los Olivos Community Services District

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Introduction & Purpose

This technical memorandum presents the Groundwater Monitoring and Reporting Plan (GWMP) for Los Olivos, California and constitutes an initial element supporting development of the Los Olivos Community Services District's (LOCSD) Wastewater Reclamation Program Project. The purpose of this GWMP is to establish the methodology for (a) defining the baseline groundwater quality in the community of Los Olivos and (b) monitoring future changes in water quality as septic to sewer conversion plans are implemented. This plan provides the following elements:

- Establishment of a monitoring network
- Sampling protocols, program, and schedule to collect baseline and future water quality data
- Reporting guidelines and frequency

Included in this GWMP is a hydrogeological conceptual model (HCM) that is specific to the urbanized area of Los Olivos. The HCM characterizes local hydrogeologic setting and associated groundwater conditions and is used to inform the development of this GWMP. The HCM component of this memo includes the following technical components:

- Geologic conditions specific to the Los Olivos area
- Depths and hydrogeologic characteristics of aquifers and aquitards
- Recent and historical water level data
- Horizontal and vertical flow gradients
- Historical water quality trends
- Identification of data gaps

1. Site Setting and History

Los Olivos is an unincorporated community of Santa Barbara County, located in the Eastern Management Area (EMA) of the Santa Ynez River Valley Groundwater Basin (Basin), as illustrated on Figure 1. The town is located at the intersection of Highway 154 and Alamo Pintado Creek, one of the major tributaries in the EMA that flows from the Los Padres National Forest in the north to the Santa Ynez River in the south. Los Olivos

has a footprint of approximately 280 acres and includes approximately 340 residential and commercial parcels, all of which utilize onsite wastewater treatment systems (OWTS; i.e., septic systems).

In 1975, the Santa Barbara County Public Health Department (County Health) conducted a door-to-door sanitary survey of residences and businesses in Los Olivos to assess the status of septic system conditions. The study revealed that about 60% of the properties were served by drywells that generally extend into permeable alluvial deposits. Local water wells and monitoring wells in town indicated that seasonal perched groundwater levels range from 5 to 15 feet below ground surface, suggesting that many of the drywells discharge septic tank effluent into perched groundwater zones.

In 1977, County Health and the Central Coast Regional Water Quality Control Board (RWQCB) collected water samples from a series of wells located in and around Los Olivos. The samples were analyzed for typical water quality constituents, including nitrates. The results of these analyses appeared to show that the high density of septic systems in Los Olivos was contributing to a local increase in groundwater-nitrate concentrations, with some wells approaching or equaling the drinking water maximum contaminant levels (MCLs). In 1980, County Environmental Health Services again tested the same wells that were tested in 1977. However, because neither the depth to water in the sampled wells nor well construction information was reported, it is uncertain which of these results are specifically associated with the shallow groundwater of the area. The results and limitations of these investigations are discussed further in Section 3.1.1.

As a result of the apparent water quality challenges in the area Los Olivos was identified by County Health as a Special Problems Area (SPA). The SPA designation requires an additional review for proposed development projects to mitigate potential threats to public health. Additionally, the RWQCB has imposed wastewater flow restrictions on each parcel, thereby limiting the owner's use of the property (AECOM 2013). Los Olivos represents the first of ten SPAs in Santa Barbara County to develop a management plan addressing onsite wastewater issues.

LOCSD was formed in 2018 to provide a funding mechanism for the development, permitting, construction, and operation of facilities necessary to collect, treat, and dispose of sewage, wastewater, recycled water, and stormwater. LOCSD's Wastewater Reclamation Program Project represents an effort to develop an economically acceptable and technically feasible solution to the negative impacts caused by the high OWTS density in the community. Implementing a local groundwater monitoring plan is a key component of the initial phase of this project.

2. Hydrogeologic Conceptual Model

To establish a sufficient technical understanding of the local groundwater conditions, it is valuable to develop a clear hydrogeologic conceptual model (HCM) of the Los Olivos area. This HCM was developed using published hydrogeologic reports and publicly accessible online databases. Data were augmented with relevant resources from ongoing work currently being conducted to develop the Draft Groundwater Sustainability Plan for the Eastern Management Area (EMA) of the Santa Ynez Groundwater Basin (Basin).

2.1 Geology

Los Olivos is underlain by an unconsolidated to weakly consolidated Tertiary-aged marine sandstone deposit referred to as the Careaga Sand and non-marine Pliocene and Pleistocene aged sand, gravel, silt, and clay deposits that comprise the overlying Paso Robles Formation. These water-bearing formations extend to depths of over 1,500 feet in the area. Paso Robles Formation is exposed at the surface in the hills of the Santa Ynez Uplands that surround the town. To the southeast, Paso Robles Formation is overlain by Quaternary aged Older Alluvium. The urbanized area of Los Olivos, which is in a topographical low formed by Alamo Pintado Creek, Tributary Alluvium blankets the Paso Robles Formation in the form of channel deposits and extends from ground surface to a depth of approximately 75 feet.

The southeast to northwest trending Los Alamos Fault and Casmalia Fault Zone intersect the Los Olivos area. These faults do not exhibit vertical offset of adjacent materials and are not believed to be barriers to groundwater flow, but instead are likely semi-permeable because of the interbedded (layered) nature of the underlying Paso Robles Formation (Rick Hoffman & Associates, 1996). The surficial geology and major fault systems surrounding the Los Olivos area are illustrated on Figure 2.

2.2 Depths and Characteristics of Aquifers and Aquitards

Aquifers are commonly named based upon the presence of water-bearing sand and gravel deposits grouped together into similar zones. Aquifers can be vertically or horizontally separated by fine-grained layers ("aquitards") that can impede movement of groundwater between aquifers. Two Principal Aquifers have been identified in the Los Olivos Area: Paso Robles Formation and Tributary Alluvium. The Paso Robles Formation and Older Alluvium have similar characteristics and so have been combined into a single Principal Aquifer. The Careaga Sand is also present in the Basin, but it lies beneath the Paso Robles Formation, which is estimated to be upwards of 1,000 feet thick in the vicinity of Los Olivos and is therefore too deep to be considered a Principal Aquifer for Los Olivos.

2.2.1 Paso Robles Formation

The Paso Robles Formation makes up the majority of groundwater storage within the overall EMA. In Los Olivos, deeper well logs indicate that Paso Robles Formation extends to depths exceeding 1,300 feet below ground surface.

The Paso Robles Formation is a predominantly non-marine unit made of relatively thin, often discontinuous sand and gravel layers interbedded with thicker layers of silt and clay. These layers are often described on drillers logs as "shale gravel." The formation was deposited in alluvial fan, flood plain, and lacustrine depositional environments. The formation is unconsolidated and poorly sorted. The sand and gravel beds within the unit have a high percentage of Monterey shale gravel fragments and generally have lower permeability compared to the shallow, unconsolidated alluvial sand and gravel beds. The formation is typically sufficiently thick and permeable such that properly designed and maintained water wells can produce up to several hundreds of gallons per minute.

The Paso Robles Formation is considered a single aquifer, although the formation is known to vary with depth. The upper part consists of generally coarser-grained materials typical of alluvial fan deposits, whereas the lower part of the complexly folded formation is finer-grained. The coarser-grained portions of the Paso Robles Formation yield groundwater to wells at higher flow rates than the underlying portions.

Based on aquifer tests for 20 wells completed in the Paso Robles Formation throughout the EMA, the hydraulic conductivity of the aquifer varies between 1 and 100 feet per day, with an average of approximately 18 feet per day (GSI, 2021).

2.2.2 Tributary Alluvium

The Tributary Alluvium consists of alluvial deposits within the Alamo Pintado Creek that flows from north to south from the Santa Ynez Uplands towards the Santa Ynez River. The stream channel incises Paso Robles Formation in the Uplands areas (north of highway 154) and Quaternary Alluvium in the vicinity of Los Olivos. Tributary Alluvium is made up of thin, discontinuous lenses of silt, sand, and gravel and extends to a depth of up to approximately 75 feet below ground surface (bgs).

Tributary Alluvium is not a reliable aquifer because of its shallow depth as well as its tendency to become dewatered during drought periods (Rick Hoffman & Associates, 1996). Several wells located in the tributary valley are completed in both the Tributary Alluvium and the underlying Paso Robles Formation, which are hydraulically connected. These wells appear to benefit from higher hydraulic conductivity of the shallow

alluvium and the contribution of greater storage capacity and saturated thickness of the Paso Robles Formation.

There is a lack of published aquifer properties or aquifer tests in the Tributary Alluvium, not only within the Los Olivos Area but within the entire EMA. However, considering the generally coarse and permeable nature of the sediments, the Tributary Alluvium is assumed to have hydraulic properties similar to that of alluvial sediments elsewhere in the Basin. Based on criteria presented in the EMA Groundwater Sustainability Plan (GSI, 2021) the Tributary Alluvium is estimated to have an average hydraulic conductivity of approximately 200 feet per day.

2.2.3 Aquitards

Fine-grained sedimentary layers are common within the Paso Robles Formation and constitute localized confining layers. However, these zones are generally not laterally continuous and consequently do not represent barriers to regional groundwater flow.

Similar lithologic patterns of alternating fine and coarse-grained beds occur in the Tributary Alluvium. Lenses of fine-grained sediment are presumed to be the cause of localized, perched groundwater beds that have been observed in the Los Olivos area. A review of well logs in the vicinity indicates that these lenses are not continuous over the lateral extent of the area. Most well logs indicate a 5- to 15-foot-thick layer of fine sediments encountered within the upper 40 feet of drilling, but the depths and thicknesses vary significantly across the area, meaning that there is no single aquitard within the Tributary Alluvium that inhibits surface recharge and causes perched groundwater.

2.3 Recent and Historical Water Level Data

The most comprehensive source of water level data in the Los Olivos area is the National Water Information System (NWIS) database, which contains retrievable data through the United States Geological Survey (USGS) Water Resources website. The NWIS dataset includes data from the California Statewide Groundwater Elevation Monitoring (CASGEM) system in addition to data collected by the County of Santa Barbara. Well and water level data were compiled for all reported wells within the vicinity of Los Olivos. Well locations for all the NWIS wells contained in the database are shown on Figure 3.

There are limited water level data available for the Los Olivos area. Los Olivos constitutes a small portion of the overall groundwater basin, therefore very few actively monitored wells are located in the area. The majority of known wells in the area only have a single recorded water level, likely taken at the time of construction, which is typically between 1940 and 1960. The following sections describe available water level data in each of the Principal Aquifers in more detail.

2.3.1 Paso Robles Formation

Figure 4 illustrates hydrographs for two wells completed in the Paso Robles Formation: 7N/31W-22A03 and 7N/31W-23P01. These wells are the only two wells near Los Olivos with a record of water level data. These hydrographs present the water level elevation for the period of record relative to ground surface, in addition to periods of climatic variations, which were based on precipitation data representative of conditions in the EMA.

The Paso Robles Formation well hydrographs illustrate long-term stability of water levels over time. Water levels typically do not show drastic differences from the 1950s to present. However, water levels in the Paso Robles Formation show a strong correlation with climatic conditions. Some wells show water elevation decreases of more than 100 feet during prolonged drought cycles, but most wells appear to fully recover within a few years following the drought period.. Changes in water level are likely related to groundwater pumping as well. The Paso Robles aquifer is the most productive and most widely pumped aquifer in the

EMA; increased pumping demand during dry weather cycles likely contributes to declining water levels during drought periods.

Seasonal fluctuations in water levels in the Paso Robles Formation appear to be relatively small (less than 30 feet). This observation is based on water level records predating 1980, when the USGS began monitoring water levels annually in the spring, instead of bi-annually in the spring and fall.

Though there are limited data available to calculate lateral hydraulic gradients in the Paso Robles Formation, groundwater flow direction in the aquifer is generally south-southwest with lateral gradients between 0.02 to 0.03 feet per foot throughout the Santa Ynez Uplands (GSI, 2021). Gradients are likely affected by pumping depressions associated with nearby municipal supply wells.

2.3.2 Tributary Alluvium

There are no alluvial wells within the vicinity of Los Olivos that have a record of water level data. However, other wells completed in the alluvium of various tributaries throughout the Basin show that water levels vary relative to their completed depth. Because shallow alluvial wells do not benefit from completion in both the overlying alluvium and Paso Robles Formation, , they tend to rapidly de-water during drought periods. However, the same wells benefit often from rapid recovery in response to any substantial seasonal rainfall in wet years and to fully recharge during even a single wet year. Alluvial groundwater elevations are typically higher in the spring than in the fall, and generally fluctuate by ~30 feet annually.

There is a lack of groundwater elevation data available to calculate lateral hydraulic gradients in the Tributary Alluvium surrounding Los Olivos. However, it is understood that the groundwater flow direction generally follows the tributary valley from north to south, following the alignment of the Alamo Pintado Creek. Based on limited data in other portions of the Basin, it is assumed that the hydraulic gradient generally ranges from 0.0017 to 0.0019 feet per foot, roughly mimicking the topographic profile of the creeks

2.3.3 Vertical Flow Gradients

Characteristics of vertical flow of groundwater within the Principal Aquifers underlying Los Olivos are not known but would be valuable to understand the nature of the connection between shallow and deeper aquifers. The installation of monitoring wells that are discretely completed in either the alluvium or the Paso Robles Formation would provide information to better understand this relationship.

2.4 Pumping History and Status

Many small, domestic wells exist within Los Olivos. Documentation of well construction or pumping history is not available for these wells. The majority of the water demands for the Los Olivos community is served by wells operated by SYRWCD ID-1, using wells that pump from the Paso Robles Formation. Typical annual water demand for Los Olivos is approximately 350 to 400 acre-feet per year (AFY) (SBC EHS, 2010).

3. Historical Water Quality

Groundwater quality samples have been collected and analyzed within the Los Olivos area for various studies and programs over many years. A broad survey of groundwater quality was conducted by USGS as part of its Groundwater Ambient Monitoring and Assessment (GAMA) Program. This report summarizes a compilation of historical groundwater quality data from both the USGS-operated NWIS database and the State Water Resources Control Board's (SWRCB) GeoTracker GAMA database. Some water quality data were also obtained from various published reports.

For this report, data were collected and reviewed for over 40 wells located both upgradient and within the urbanized area of Los Olivos. Sampling dates for the data ranges from 1958 to 2018, although only 30% of

the data were collected within the last 10 years. Locations of these water quality sampling points are shown on Figure 5.

One of the major limitations for the water quality data analyzed for this study is that well construction details (i.e., depths of well completion, and specific aquifers contributing to the well) are not known for most of the wells. Thus, for most of samples collected, it is unknown which aquifer is represented. To understand the differences in water quality at various vertical horizons in the Principal Aquifers, water quality sampling will need to be conducted in wells with known construction details.

3.1 Constituents of Interest

Elevated nitrate concentrations in the shallow aquifer are the reason for the designation of the Los Olivos as a Special Problems Area, and are therefore the primary constituent of interest for this study and for the associated LOCSD Wastewater Reclamation Program Project. Historical concentrations of total dissolved solids (TDS), chloride, and sulfate were also assessed and are discussed in the following sections. While not directly related to septic systems, these constituents are general indicators of groundwater quality and also will be monitored (in addition to other constituents as identified in Section 6) as part of the sampling program for the Groundwater Monitoring Plan.

Water quality is typically evaluated with regard to drinking water standards (Maximum Contaminant Limit [MCL] or Secondary MCL [SMCL]) or basin water quality objectives (WQO). Drinking water standards are established by federal and state agencies by setting concentration thresholds for specific chemicals using MCLs and SMCLs. MCLs are regulatory thresholds and SMCLs are guidelines established for nonhazardous aesthetic considerations such as taste, odor, and color. WQOs are set by the Regional Water Quality Control Board (RWQCB) in published Basin Plans to protect beneficial uses of groundwater on a basin-by-basin basis.

Table 1 shows the MCLs and WQOs for the constituents discussed in this report.

Table 1. Water Quality Standards for Select Constituents

Constituent	MCL (mg/L)	SMCL[1] (mg/L)	WQO (mg/L)
Nitrate[2]	10	-	1
Total Dissolved Solids	-	1,000	600
Chloride	-	500	50
Sulfate	-	500	10

Notes

1 Upper SMCL (SWRCB, 2018)

2 Nitrate reported as nitrogen.

MCL: maximum contaminant level

SMCL: secondary maximum contaminant level

WQO: water quality objective

mg/L: milligrams per liter

-: no value established

3.1.1 Nitrate (as Nitrogen)

Elevated concentrations of nitrate in groundwater can be associated with agricultural activities, septic system discharges, confined animal facilities, landscape fertilizers, and wastewater treatment facility discharges. Nitrate is soluble in water and can easily pass through soil to the groundwater table. Nitrate can persist in groundwater for decades and accumulate to increased concentrations as more nitrogen is discharged onto the land surface or into water.

Data compiled from the USGS NWIS and SWRCB GAMA databases show that 46 nitrate samples were collected from 15 wells in the Los Olivos area, between 1958 and 2017. Concentrations of nitrate (reported by the lab as the concentration of nitrate as nitrogen, for which the MCL is 10 mg/L) ranged from 0.8 to 12 mg/L, with a mean of 3.3 mg/L. Only one sample, collected in 1980, reported a nitrate concentration above the MCL of 10 mg/L. Most wells in the dataset only have a single reported nitrate sample. The few wells with a period of record did not have discernible trends in nitrate concentrations. Of the 46 reported samples, 6 were collected from wells of known depth. All 6 of these wells are deeper than 130 feet and are therefore assumed to be completed in the Paso Robles Formation. The results from these wells were similar to those of the rest of the data set.

Wells upgradient (north) of Los Olivos were also evaluated. Upgradient wells showed similar concentrations to the wells in Los Olivos; most wells with a period of record showed nitrate concentrations ranging from 1 to 3 mg/L with no discernible trends.

The USGS NWIS and SWRCB GAMA databases do not include the nitrate samples collected by the Santa Barbara County Health Department in 1997 and 1980 (see Section 1). These samples were reported by the lab as the concentration of the nitrate molecule (NO_3), for which the MCL is 45 mg/L. The 1977 and 1980 concentrations ranged from 0.4 mg/L to 44 mg/L. The average nitrate concentration in the 10 wells during 1977 was 20.4 mg/L, and in the same wells during 1980 was 24.3 mg/L. These data suggest an upward trend in nitrate concentrations; however, there is uncertainty in the results because well completion depths are unknown for all 10 of the sampled wells. Additional uncertainty is also present because supporting documentation of these two sampling events is not provided (i.e., chain of custody, water levels, or information regarding sampling methods) to verify the legitimacy of the results.

3.1.2 Total Dissolved Solids

Data compiled from the USGS NWIS and SWRCB GAMA databases show that 43 TDS[1] samples were collected from 15 wells in the Los Olivos area, between 1958 and 2014. Concentrations of TDS ranged from 352 to 806 mg/L, with a mean of 656 mg/L. No samples exceeded the SMCL of 1,000 mg/L (upper limit). Most wells in the dataset only have a single reported TDS sample. The few wells with a period of record showed that TDS concentrations are relatively stable over time. Of the 43 reported samples, 6 were collected from wells of known depth. All 6 of these wells are deeper than 130 feet and are therefore representative of the Paso Robles Formation. The results from these wells were similar to those of the rest of the data set.

Wells upgradient of Los Olivos were also evaluated. Upgradient wells showed slightly lower concentrations compared to the wells in Los Olivos; most wells with a period of record showed stable TDS concentrations over time, ranging from roughly 400 to 600 mg/L.

[1] Total dissolved solids (TDS) is a water quality parameter defined as the concentration of minerals, salts or metals dissolved in a given volume of water. Elevated TDS concentrations in groundwater are commonly associated with rocks of marine origin that are present in the Basin. The SMCL for TDS has been established for color, odor, and taste, rather than human health effects. The SMCL includes a recommended standard of 500 mg/L, an upper limit of 1,000 mg/L and a short-term limit of 1,500 mg/L (SWRCB, 2018).

3.1.3 Chloride

Data compiled from the USGS NWIS and SWRCB GAMA databases show that 43 chloride[2] samples were collected from 15 wells in the Los Olivos area, between 1958 and 2014. The concentrations of chloride ranged from 24 to 59 mg/L, with a mean of 33 mg/L. All reported concentrations for chloride are well below the SMCLs. Most wells in the dataset only have a single reported chloride sample. The few wells with a period of record showed that chloride concentrations are relatively stable over time. Of the 43 reported samples, 6 were collected from wells of known depth. All 6 of these wells are deeper than 130 feet and are therefore assumed to be completed in the Paso Robles Formation. The results from these wells were similar to those of the rest of the data set.

Wells upgradient of Los Olivos were also evaluated. Upgradient wells showed slightly similar concentrations compared to the wells in Los Olivos; most wells with a period of record showed stable chloride concentrations over time, ranging from roughly 20 to 60 mg/L.

3.1.4 Sulfate

Data compiled from the USGS NWIS and SWRCB GAMA databases show that 43 sulfate[3] samples were collected from 15 wells in the Los Olivos area, between 1958 and 2014. The concentrations of sulfate ranged from 13 to 230 mg/L, with a mean of 173 mg/L. All reported concentrations for sulfate are below the SMCLs. Most wells in the dataset only have a single reported sulfate sample. The few wells with a period of record showed that sulfate concentrations are relatively stable over time. Of the 43 reported samples, 6 were collected from wells of known depth. All 6 of these wells are deeper than 130 feet and are therefore assumed to be completed in the Paso Robles Formation. The results from these wells were similar to those of the rest of the data set.

Wells upgradient of Los Olivos were also evaluated. Upgradient wells showed slightly similar concentrations compared to the wells in Los Olivos; most wells with a period of record showed relatively stable sulfate concentrations over time, ranging from roughly 20 to 200 mg/L.

3.2 Potential Point Source Contaminants

Potential point sources of groundwater contamination, or potentially contaminating activities (PCAs) were identified using the SWRCB GeoTracker data management system[4]. There are not any active PCAs within or upgradient of Los Olivos. There are two historical leaking underground storage tank (LUST) sites within Los Olivos, but both sites have been remediated and designated as “closed” cases by the SWRCB for over 10 years. These sites are not considered to pose a threat to groundwater quality in the Los Olivos area.

4. Data Gaps

4.1 Groundwater Elevation Data

Central to the understanding of groundwater conditions in Los Olivos are reliable, frequent, and well-distributed water elevation data for each of the Principal Aquifers. There are only two wells within the vicinity of Los Olivos that have a record of water level data, and both wells are completed in the Paso Robles

[2] Elevated chloride concentrations in groundwater may be associated with rocks of marine origin that are present in the Basin. The SMCL for chloride has been established for color, odor, and taste, rather than human health effects. The SMCL includes a recommended standard of 250 mg/L, an upper limit of 500 mg/L and a short-term limit of 600 mg/L (SWRCB, 2018).

[3] The SMCL for sulfate has been established for color, odor, and taste, rather than human health effects. The SMCL includes a recommended standard of 250 mg/L, an upper limit of 500 mg/L and a short-term limit of 600 mg/L (SWRCB, 2018).

[4] Geotracker data management system is available at https://geotracker.waterboards.ca.gov/. Accessed February, 2021

Formation. One of these wells, known by its State Well ID 7N/31W-23P01, was recently destroyed. leaves The remaining well (7N/31W-22A03) is located north of town and is monitored by the County of Santa Barbara once every spring. It would be worthwhile for LOCSD to contact and seek permission from local well owners to determine if any other nearby wells could be added to the monitoring network.

4.2 Well Construction Data

An accurate understanding of the completion of each well is central to its usefulness in representing groundwater levels and groundwater quality results for each Principal Aquifer. However, based on efforts to obtain this type of information has not resulted in any data for wells in the Los Olivos area.

It is likely that many of the domestic wells within Los Olivos are completed in both the Tributary Alluvium and the Paso Robles Formation. If historical data are to be used to characterize baseline water elevation and water quality conditions, confirming the construction details of existing wells with data will be necessary.

5. Monitoring Network

To define baseline groundwater quality conditions and to monitor changes over time as LOCSD's Wastewater Reclamation Program is implemented, a network of new monitoring wells will need to be constructed. Ideally, the monitoring network would include wells within Los Olivos in addition to wells upgradient, which would allow for the detection of any offsite groundwater contamination that may be migrating into the LOCSD area.

It is recommended that up to twelve new monitoring wells be installed to establish a sufficient monitoring network. As the immediate installation of twelve new wells is likely not economically feasible, a phased approach to the development of the monitoring network is recommended, as illustrated on Figure 6.

Phase 1 represents the six most important well locations, which are intended to capture groundwater quality characteristics immediately upgradient of Los Olivos, in the center of town, and downgradient towards the southern extent of the Special Problems Area. The Phase 2 wells could be constructed on an as-needed basis as baseline conditions are established and water quality data gaps become evident.

During the interim period between the beginning of baseline monitoring and the completion of the overall monitoring network, requesting the use of existing wells within the community for data collection would be of substantial benefit. If an existing well is in reasonably good condition and the total depth and screen interval are known, it may be used for water level and/or water quality sampling in lieu of a new monitoring well. LOCSD would need to coordinate with private well owners and obtain permissions for use.

5.1 Monitoring Well Design and Construction

Most monitoring wells are recommended to be constructed to allow for sampling from the Tributary Alluvium. Data from these wells will be representative of the shallow groundwater zones, will document water quality conditions associated with the most recent land use practices, and will also tend to respond most quickly to changes in management activities. Some wells should also be constructed in deeper portions of the aquifer to assess water quality differences in the deeper zones. Up to three of the proposed monitoring wells are recommended to be installed as nested monitoring wells to allow for discrete sampling of both shallow and deeper aquifers as well as determination of vertical hydraulic gradients. Calculating the vertical hydraulic gradient is important for understanding the extent that shallow groundwater may migrate into deeper zones. The locations for the three recommended nested monitoring wells are shown on Figure 6 by the black, dashed outline on the green site circle.

Since most monitoring wells are expected to be relatively shallow, it is likely that the boreholes will be drilled using a hollow stem auger drill rig. Wells will be constructed with 2 or 4-inch PVC casing and a slotted screen interval, the depth of which will be determined during well construction by reviewing the borehole cuttings.

Following drilling, borehole lithology will be logged and well construction (i.e., installing the casing and gravel pack) will be supervised by a qualified geologist. Following construction, the monitoring wells will be developed by the driller using bailing methods. A water quality sample will then be collected and analyzed at a State Certified laboratory.

Each completed well will be documented by a well construction report that provides the drilling methods employed, the final construction details, borehole lithology recorded from drill cuttings, and observations of static water level.

The locations and elevations of each completed monitoring well will be established by a licensed surveyor. Horizontal coordinates for the well will be measured to the nearest 1.0 foot. Elevations will be measured to the nearest 0.01 foot. Elevation measurements will be made at the top of the well casing and the top of the concrete pad. The measurements point on the casing will be clearly and permanently marked for future water level measurements. All elevations will be referenced to the North American Vertical Datum of 1988 (NAVD 88). All horizontal coordinates will be referenced to the North American Datum of 1983 (NAD 83).

6. Sampling Protocols

Following installation of the monitoring well network, a sampling program should be initiated to collect baseline water quality data. It is recommended that sampling be conducted quarterly.

Sampling will consist of both field measurements and laboratory analyses which are detailed in the following sections.

6.1 Groundwater Levels

Groundwater level measurements will be collected during each sampling event from all wells in the monitoring network. Measurements will be taken using a water level sounder with a precision of 0.01 foot and will be recorded to the nearest 0.01 foot. All measurements will be taken at a permanently marked point at the top of each well casing. Prior to use at each location, the sounding equipment will be properly decontaminated.

Groundwater levels, in addition to electrical conductivity and temperature, may also be collected at more frequent intervals by installing dedicated sensors in the monitoring wells. These sensors are commonly procured with the capability to automatically collect and store water level, electrical conductivity and temperature measurements at pre-determined intervals (such as hourly, daily, etc.) These data will be useful in monitoring the shallow aquifer, where water level and water quality are likely to change frequently.

6.2 Groundwater Quality

Water quality samples will be collected during each sampling event from all the wells in the monitoring network and analyzed for the constituents as specified in Table 2. Sampling will be conducted with a portable submersible sampling pump. Each well will be purged[5] before sampling to ensure that representative samples are collected. All samples will be collected and preserved according to the U.S. Environmental Protection Agency sample collection, handling, and preservation procedures appropriate for

[5] The physical parameters (pH, specific conductance, DO, ORP and temperature) of the purge water will be measured and recorded along with the date and time of measurement. Measurements will be recorded on a well purging and sampling form. Purging will continue until physical parameters are stable or three casing volumes have been purged. Stabilization shall be defined as an agreement between the last two sets of readings within plus or minus 0.1 pH units, plus or minus 1 degree Celsius, and plus or minus 10 percent of the reading for specific conductance. If these parameters have not stabilized during the removal of three well volumes, then a maximum of five well volumes will be removed. Purging and sampling will be documented on an associated form.

each analytical method. Chain-of-custody will be maintained and documented from the time of sample collection through completion of chemical analysis, which will be performed by a State certified environmental laboratory.

Table 2. Sampling Parameters

Field Parameters	Laboratory Analyses	
Constituent	**Constituent**	**Method**
pH	Nitrate as N	EPA 300
Temperature	Total Dissolved Solids	EPA 160.1
Electrical Conductivity	Total Suspended Solids	EPA 150.1
Oxidation Reduction Potential (ORP)	Chloride	EPA 300
Dissolved Oxygen (DO)	Sulfate	EPA 300
	Total Organic Carbon	SM 5310C
	Carbonate	EPA 310.1
	Bicarbonate	EPA 310.1
	Metals[1]	EPA 200.7/200.8
	Hexavalent Chromium	EPA 218.6
	Chlorine Residual	EPA 330.4
	Turbidity	EPA 180.1

Note:

1 Includes: Al, As, Cr, Se, Fe, Mn, Mg, B, Silica, Ca, Na, K

7. Well Abandonment Program

It is likely that a large percentage of private wells within Los Olivos are no longer in use. Furthermore, it is probable that most of the unused wells have not been properly abandoned. Before any kind of treated wastewater disposal (by injection or other means) occurs as part of LOCSD's Wastewater Reclamation Program Project, LOCSD must ensure that all inactive wells, particularly those in the shallow aquifer, are properly abandoned in accordance with public health and safety codes. Inactive or dilapidated wells can act as conduits for pollutants to enter groundwater and can also leak or cause surface flooding when groundwater levels rise.

8. Reporting

Quarterly groundwater monitoring reports will be prepared and submitted to County Health and the RWQCB for the first 2 years, after which the report will be prepared annually.

The reports will provide hydrographs showing groundwater data collected including both water level and water quality measurements and comparisons relative to baseline groundwater conditions as well as observation of trends over time. The documents will also verify all monitoring methods, describe progress of the monitoring network construction, and provide updated recommendations for modifications to the groundwater monitoring program.

9. References

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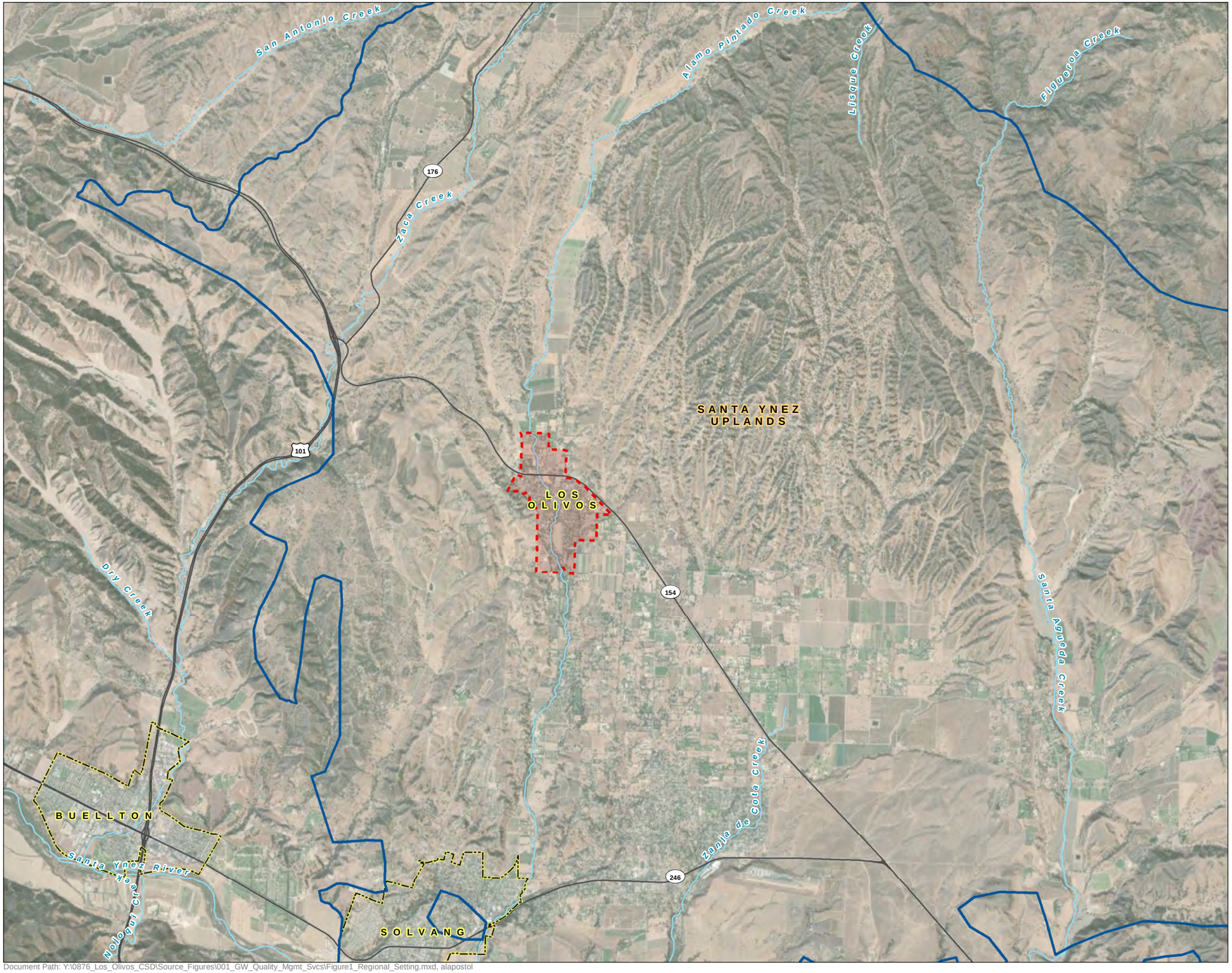
Figures

FIGURE 1

Regional Setting

Los Olivos Groundwater Monitoring Plan



LEGEND

- Los Olivos Special Problem Area
- Eastern Management Area Basin Boundary
- City Boundary
- Major Road
- Watercourse

N

0 2,600 5,200 7,800

Feet

Date: March 16, 2021
Data Sources: BLM, ESRI, DWR, USGS, Aerial Photo 2019

GSI Water Solutions, Inc.

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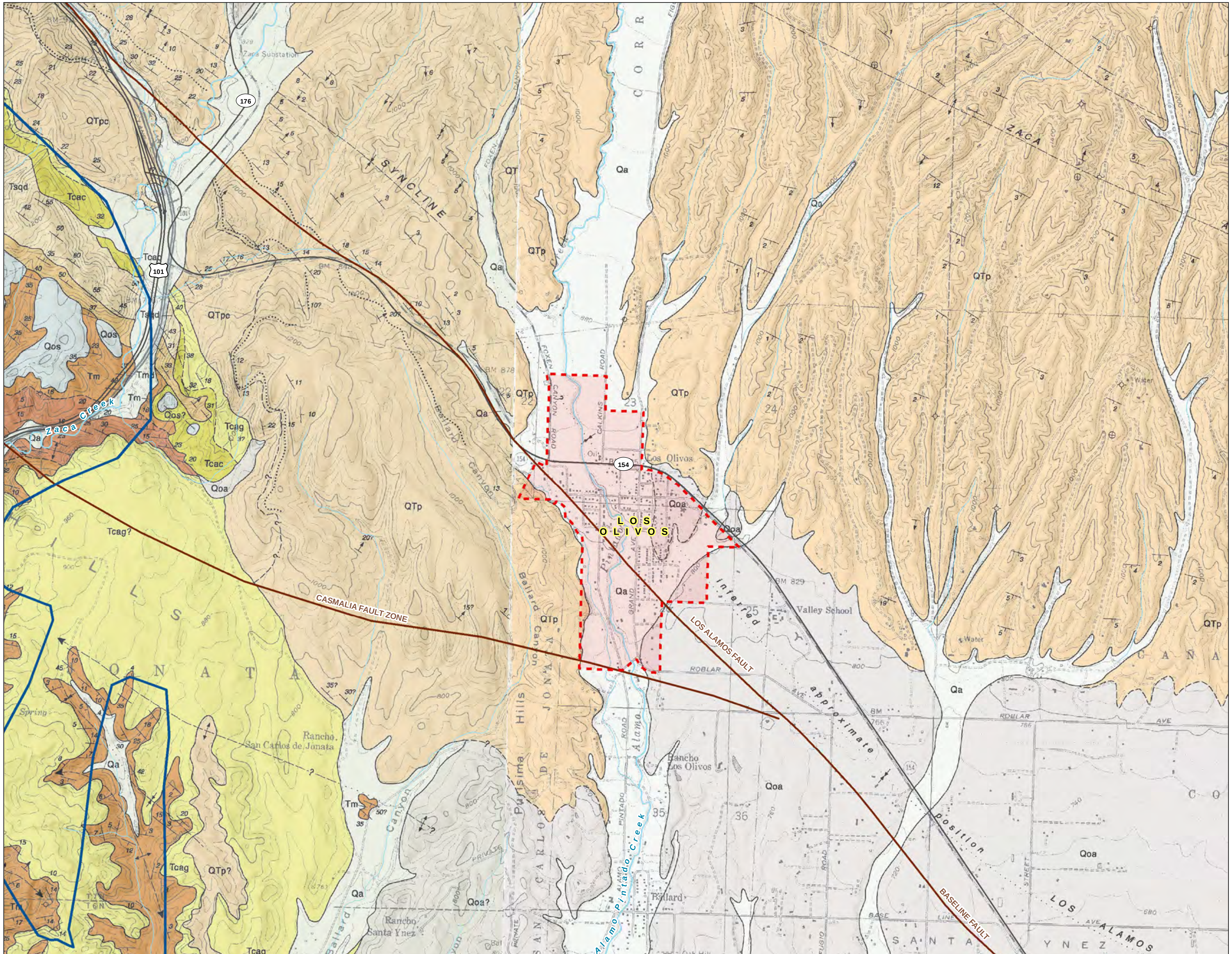

FIGURE 2

Surficial Geology

Los Olivos Groundwater Monitoring Plan

LEGEND

- Los Olivos Special Problem Area
- Eastern Management Area Basin Boundary

Geology

- Qa – Tributary Alluvium
- Qoa – Older alluvium
- QTp – Paso Robles Formation
- Tcag – Careaga Sand
- Fault

All Other Features

- Major Road
- Watercourse

N

0 1,250 2,500 3,750
Feet

GSI Water Solutions, Inc.

Date: March 19, 2021
Data Sources: ESRI, DWR, USGS

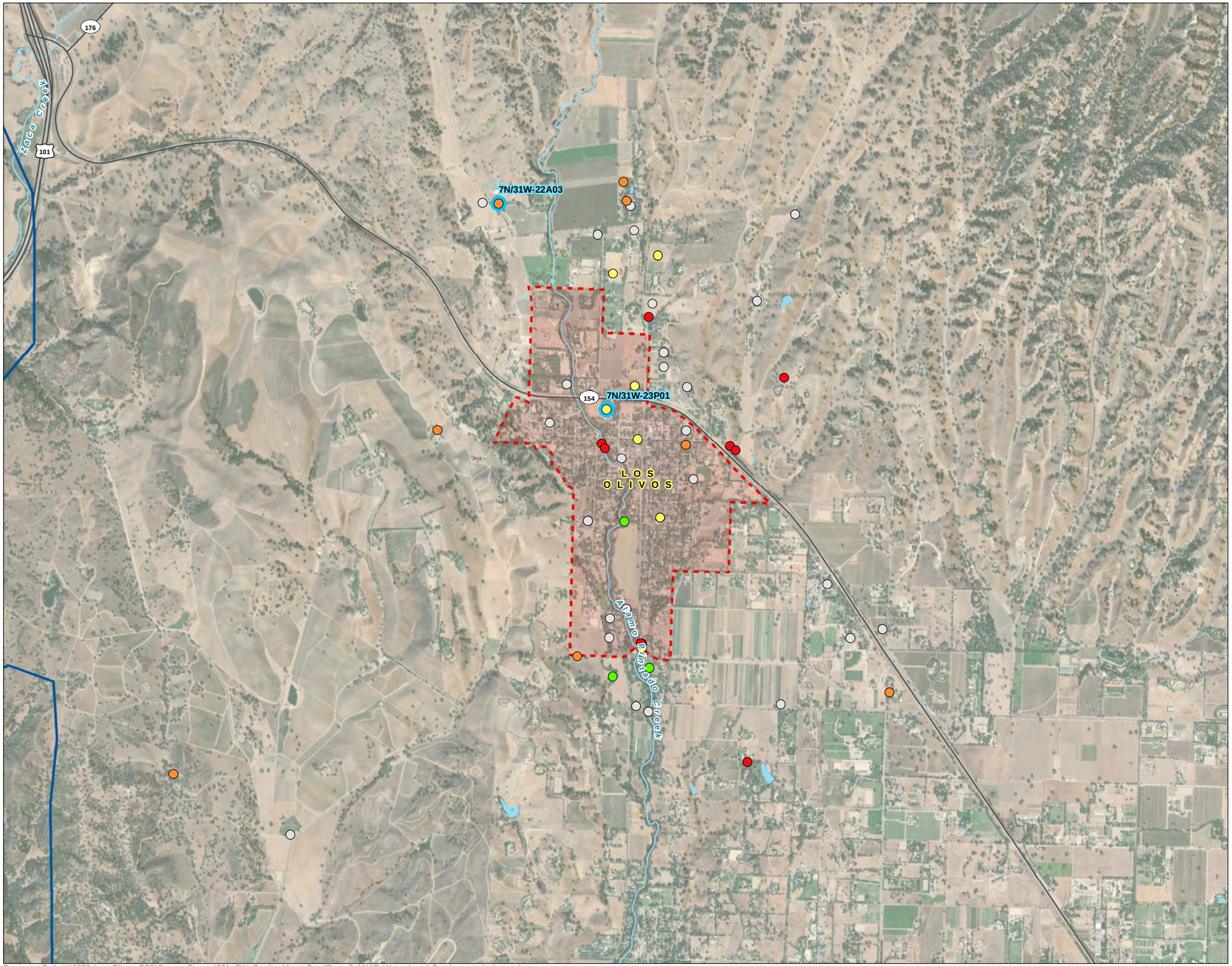

FIGURE 3

NWIS Water Level Database

Los Olivos Groundwater Monitoring Plan

LEGEND

NWIS Well

Known Well Depth (ft bgs)

- 0 - 50
- 51 - 100
- 101 - 200
- 201 - 500
- 501 - 1320
- Unknown Completion
- Well with Hydrograph

All Other Features

- Los Olivos Special Problem Area
- Eastern Management Area Basin Boundary
- Major Road
- Watercourse
- Waterbody

NOTES

bgs: below ground surface
NWIS: National Water Information System

N

0 1,000 2,000 3,000
Feet

Date: March 19, 2021
Data Sources: ESRI, DWR, USGS

GSI Water Solutions, Inc.

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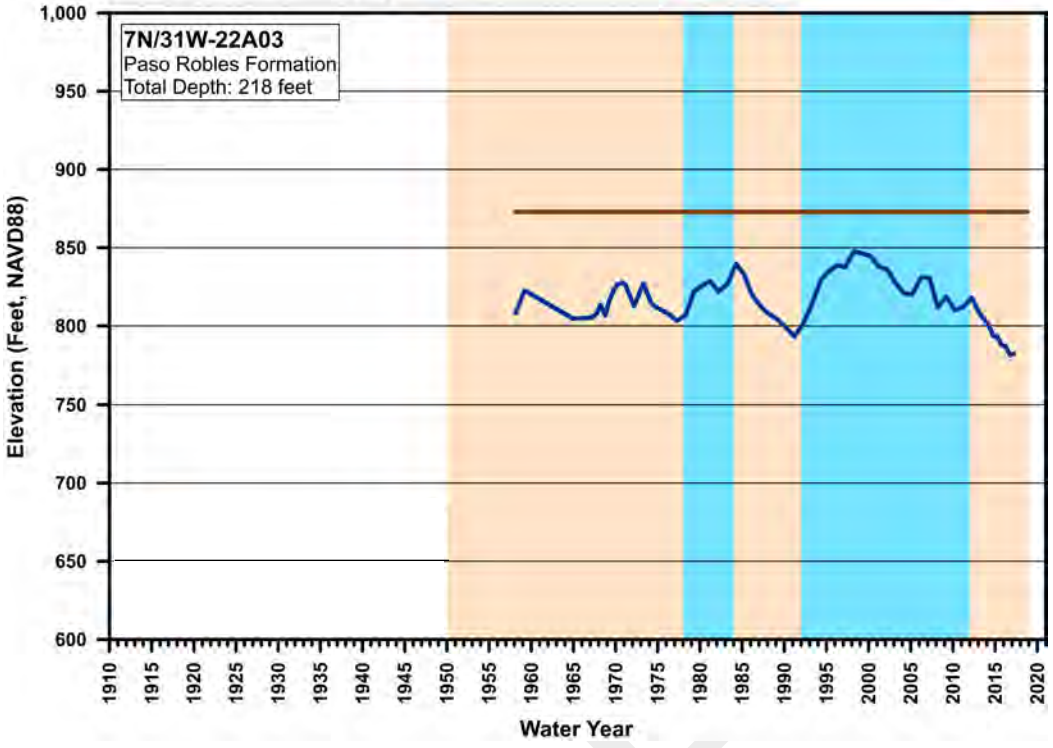

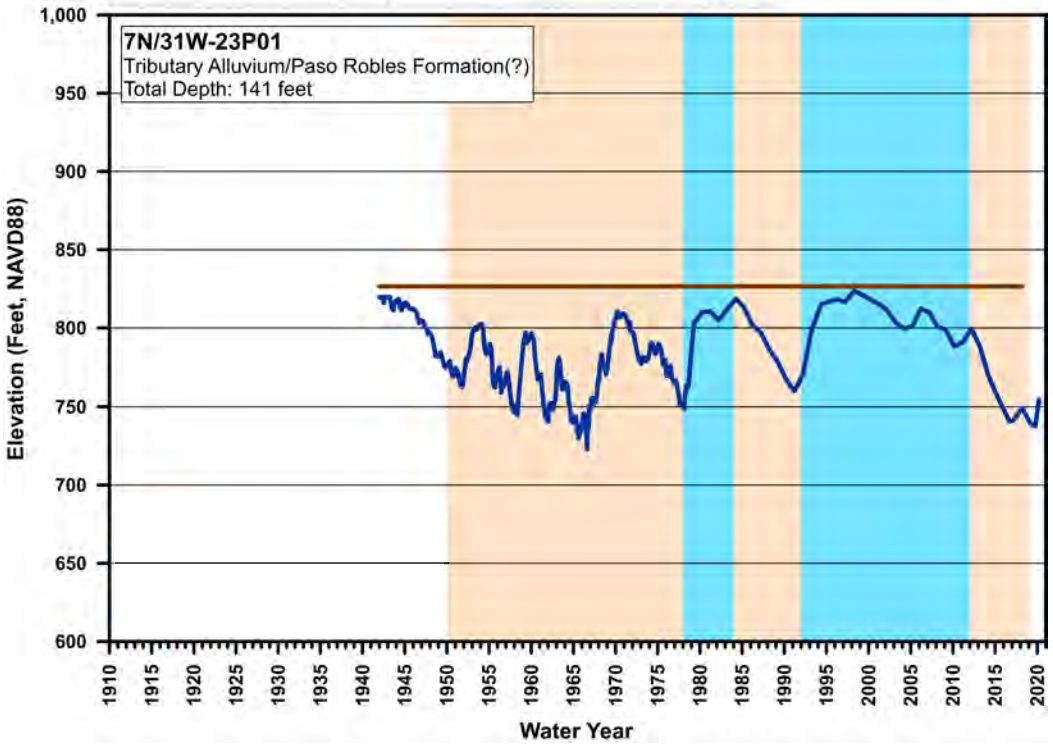

LEGEND

- Ground Surface Elevation
- Groundwater Elevation
- Dry Climatic Cycle
- Wet Climatic Cycle

FIGURE 4

Representative Paso Robles Formation Hydrographs: Wells 22A03 and 23P01

Los Olivos Groundwater Monitoring Plan

GSI Water Solutions, Inc.

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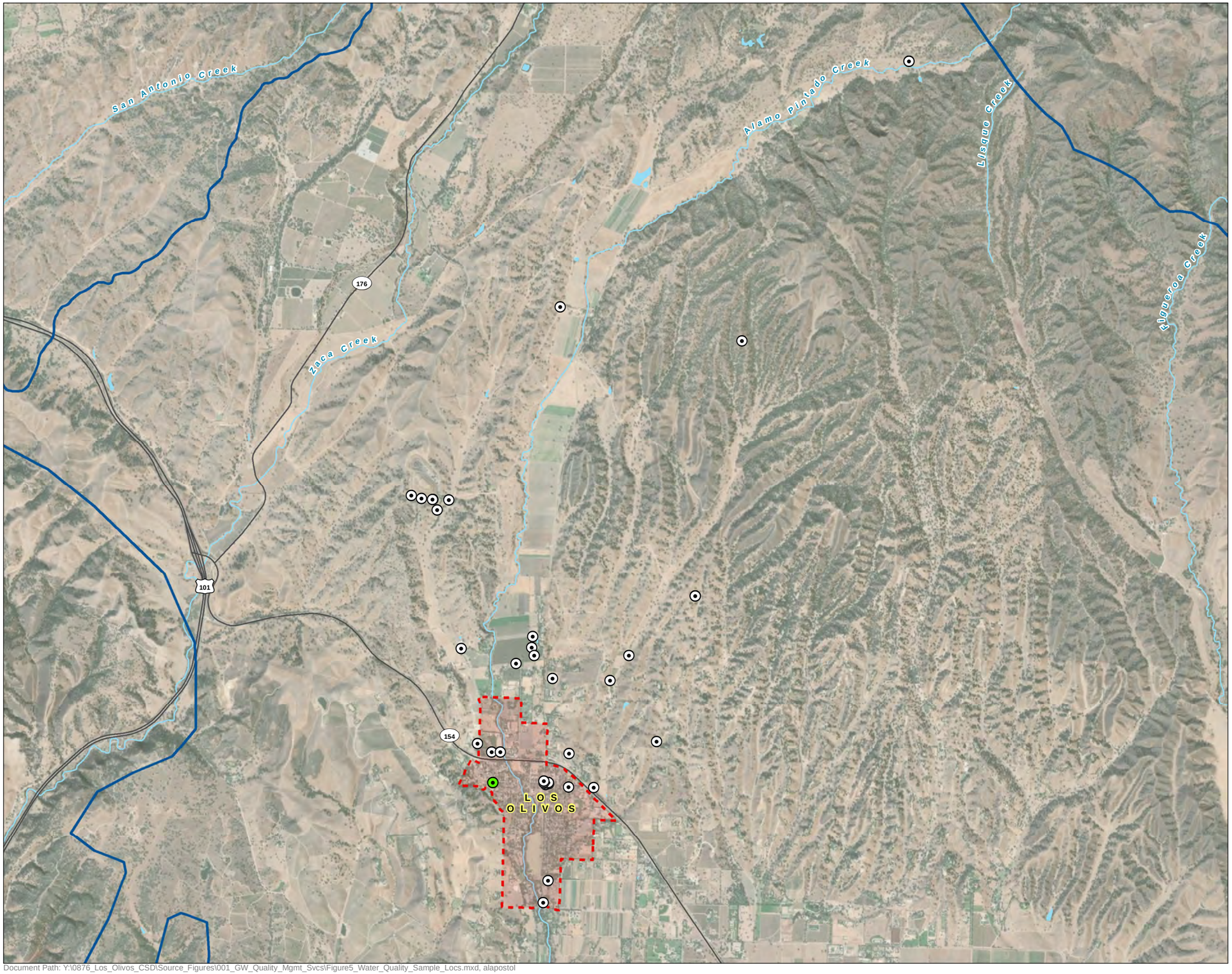


FIGURE 5

Water Quality Sample Locations

Los Olivos Groundwater Monitoring Plan

LEGEND

NWIS and GAMA Database Wells

- Nitrate MCL Exceedance - 1980
- Well

All Other Features

- Los Olivos Special Problem Area
- Eastern Management Area Basin Boundary
- Major Road
- Watercourse
- Waterbody

NOTES

bgs: below ground surface
GAMA: Groundwater Ambient Monitoring and Assessment
NWIS: National Water Information System
MCL: Maximum Contaminant Level

N

0 1,750 3,500 5,250
Feet

Date: March 19, 2021
Data Sources: ESRI, DWR, USGS

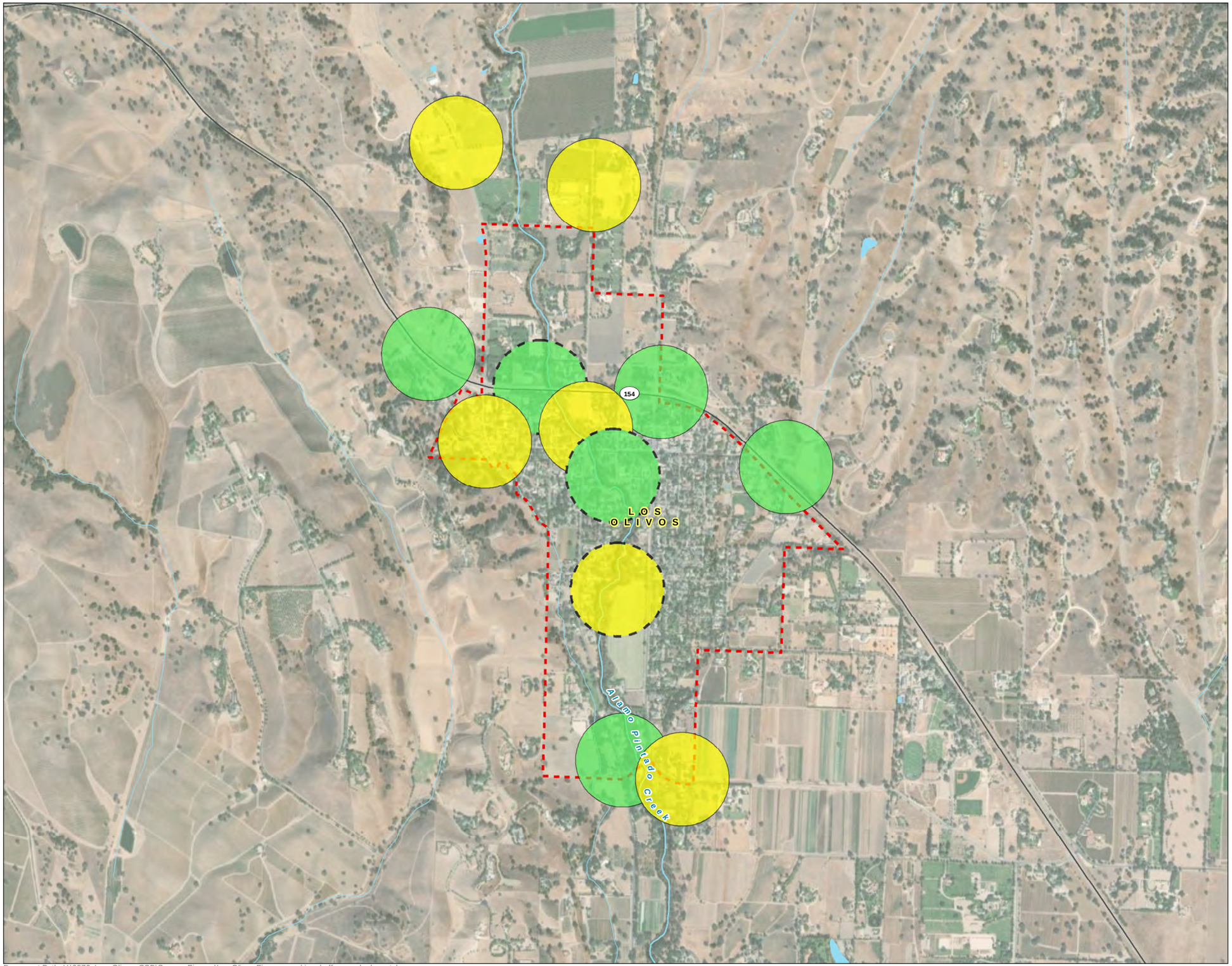
GSI Water Solutions, Inc.

Document Path: Y:\0876_Los_Olivos_CSD\Source_Figures\001_GW_Quality_Mgmt_Svcs\Figure5_Water_Quality_Sample_Locs.mxd, alapostol

FIGURE 6

Proposed Monitoring Network

Los Olivos Groundwater Monitoring Plan



LEGEND

Proposed New Monitoring Well Zone

- Phase 1
- Phase 2
- Nested Monitoring Well

All Other Features

- Los Olivos Special Problem Area
- Major Road
- Watercourse
- Waterbody

N

0 700 1,400 2,100

Feet

Date: March 16, 2021
Data Sources: ESRI, DWR, USGS

GSI Water Solutions, Inc.

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