Appendix A

SMVMA Monitoring Program

Monitoring Program for the Santa Maria Valley Management Area

prepared for

Superior Court of California, County of Santa Clara
and
Twitchell Management Authority

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October 2008

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I. INTRODUCTION

The terms and conditions of a Stipulation in the Santa Maria Valley Groundwater Basin Litigation passed down by the Superior Court of the State of California, County of Santa Clara, on June 30, 2005, are intended to "impose a physical solution establishing a legal and practical means for ensuring the Basin's long-term sustainability." Under the Stipulation, the groundwater, imported and developed water, and storage space of the Basin are to be managed in three management areas, including one for the Santa Maria Valley (SMVMA) (Figure 1). The management area is approximately 175 square miles in size encompassing the Santa Maria and Sisquoc Valleys, extending north to the Nipomo Mesa, east to the cliffs above the Santa Maria River and terraces along the Sisquoc River, south to the Casmalia and Solomon Hills, and west to the coast.

According to the Stipulation, a monitoring program is to be established for each of the three management areas to collect and analyze data regarding water supply and demand such that the following objectives are met:

1) assessment of groundwater conditions, both levels and quality;
2) determination of land use, water requirements, and water supply; and
3) accounting of amounts and methods of disposition of water utilized.

This monitoring program has been prepared to meet these objectives in the SMVMA. Also in accordance with the Stipulation, it is expected that the monitoring results will be utilized for preparation of annual reports on the SMVMA, including an assessment of whether conditions of severe water shortage are present. The monitoring program for the SMVMA is described by individual element in the following section.

Among other components, the monitoring program includes networks of historically monitored wells, stream gauges, and climatic stations. These monitoring points were selected based on publicly available information about their locations, characteristics, and historical data records with the intent of continuing those records as much as possible. It is recognized that, as implementation of the program proceeds, the inclusion of some network wells may be determined to be impractical or impossible due to problems of access or abandonment. Further, the reestablishment of inactive (or installation of new) wells, stream gauges and climatic stations will depend on interagency coordination, permitting procedures, and budgetary constraints. Thus, it is anticipated that the overall monitoring program will be incrementally implemented as practicalities like those mentioned above dictate. Similarly, it is expected that, with time, the program will undergo modification in response to various factors (e.g. replacing network wells abandoned in the future), while maintaining the overall goal of facilitating interpretation and reporting on water requirements, water supplies, and the state of groundwater conditions in the SMVMA.

II. MONITORING PROGRAM

As a basis for designing the monitoring program, all pertinent historical data on the geology and water resources of the SMVMA were updated and compiled into a Geographic Information System (GIS). The data include the following:

- well location, reference point elevation (RPE), depth, and construction information;
- surface water gauge locations and characteristics;
- precipitation gauge and weather station locations and characteristics;
- groundwater levels and quality;
- Twitchell Reservoir releases, stream discharge and quality;
- precipitation and reference evapotranspiration (ETo) records;
- topographic, cultural, soils, and land use maps;
- geologic map and geologic structure contours;
- water purveyor wellfield areas;
- wastewater treatment plant (WWTP) locations.

The GIS was first utilized to define aquifer depth zones for groundwater monitoring purposes. In the central and major portion of the SMVMA, there is a shallow zone comprised of the Quaternary Alluvium, Orcutt formation, and uppermost Paso Robles formation and a deep zone comprised of the remaining Paso Robles formation and Careaga Sand. In the eastern portion of the SMVMA where these formations are much thinner and comprised of coarser materials, particularly in the Sisquoc Valley, the aquifer system is essentially uniform without distinct aquifer depth zones. In the coastal area where the surficial deposits (upper members of Quaternary Alluvium and Orcutt formation) are extremely fine-grained, the underlying formations (lower members of Quaternary Alluvium and Orcutt formation, Paso Robles formation, and Careaga Sand) comprise a confined aquifer.

The GIS was then used to classify a majority of wells into the shallow or deep aquifer zones based on well depth and completion information, although a number of wells could not be classified because this information is either unavailable or indicates completion across both the shallow and deep zones. An evaluation was made of the distribution of wells across the SMVMA completed in each depth zone. Wells actively or historically monitored for water levels and quality by the U.S. Geological Survey (USGS) and its cooperating local agencies[1] (Agencies) were identified, and an evaluation was made of the adequacy of coverage of the SMVMA to meet the objective in the Stipulation of assessing groundwater conditions.

It was determined that the wells actively monitored by the Agencies for groundwater levels provide extensive but somewhat incomplete coverage of the SMVMA, with areas

[1] Cooperating local agencies include Santa Barbara County, San Luis Obispo County, and the Santa Maria Valley Water Conservation District (SMVWCD).

left unmonitored in both aquifer zones. Based on this assessment, the groundwater monitoring program for the SMVMA was designed to first incorporate all of the actively monitored wells (denoted herein as "active wells"). Thus, those wells will continue to be monitored for water levels by the Agencies with the resulting data used toward assessing groundwater conditions in the SMVMA.

Secondly, in order to fill the gaps in coverage around the active wells, the groundwater monitoring program includes a number of additional wells historically monitored by the Agencies that are no longer monitored (denoted herein as "inactive wells", but intended to be actively monitored as part of this program). Thus, water level monitoring in these wells will need to be restarted in collaboration with the Agencies. This will provide the additional benefit of bringing forward the historical water level records of the inactive wells, some of which begin in the 1920s.

Regarding the active and inactive wells, those that could not be classified by aquifer depth zone (noted as "unclassified wells") are nonetheless included in the monitoring program because they contribute to completing well coverage of the SMVMA. It is possible that the wells will later be classified based on additional well information or water level and quality data collected under the monitoring program.

Third, the groundwater monitoring program includes new monitoring wells to be installed in both the shallow and deep aquifer zones in an area north of downtown Santa Maria to fill a gap in coverage by existing wells. Arrangements will need to be made for the well installations, and monitoring will need to be implemented in collaboration with the Agencies.

This groundwater monitoring program designates a subset of wells for the purpose of monitoring groundwater quality, with well selection based on evaluation of well depths, completion information, and historical water level and quality data. It was determined that, of those wells actively monitored for groundwater levels, very few are actively monitored for groundwater quality. The subset of groundwater quality wells under this monitoring program incorporates the few active water quality wells, which will continue to be monitored by the Agencies. In addition, the subset includes wells historically (but no longer) monitored for water quality and wells historically monitored for water levels (but never for water quality) by the Agencies. Thus, water quality monitoring in these wells will need to be restarted or implemented in collaboration with the Agencies. Lastly, in order to fill a gap in coverage by existing wells, the new monitoring well to be installed in the deep aquifer zone north of downtown Santa Maria is included in the subset of groundwater quality wells.

Thus, the groundwater monitoring program designates two well networks, one each for the shallow and deep aquifer zones, primarily comprised of wells that are actively monitored. The networks include additional wells that are currently inactive (monitoring to be restarted) and some new wells (installation and monitoring to be implemented). All

network wells are to be monitored for groundwater levels, with a subset of those wells to be monitored for groundwater quality, as described in detail in the subsection below.

Another use of the GIS was for the evaluation of actively and historically monitored surface water and climatic gauges by their location and period of record, specifically for Twitchell Reservoir releases, stream discharge, precipitation, and reference evapotranspiration (ETo) data, in order to assess adequacy of coverage in the SMVMA to meet monitoring objectives in the Stipulation. In this case, it was determined that the actively monitored gauges provide a substantial but incomplete accounting of surface water resources in the SMVMA, with several streams no longer monitored and the Valley floor without any climatic gauges. The SMVMA monitoring program was designed to incorporate the active gauges and reestablish inactive gauges to provide a comprehensive record of surface water and climatic data.

A description of the groundwater, surface water, and climatic monitoring included in the SMVMA monitoring program is provided in the following subsection. Three monitoring program elements designate the data collection to be conducted across the area including 1) hydrologic data with which groundwater conditions, surface water conditions, and agricultural water requirements may be assessed, 2) water requirements and supply data for agricultural irrigation and municipal use; and 3) water disposition data for agricultural and municipal land uses.

2.1 Hydrologic Data

Hydrologic data include groundwater levels and quality from two well networks, one each for the shallow and deep aquifer zones. Also to be collected are data on Twitchell Reservoir releases and stream stage, discharge, and quality, from a designated set of surface water monitoring locations. The data also include precipitation and ETo data, which will be used to estimate agricultural water use in the SMVMA.

2.1.1 Groundwater Levels and Quality

Well Networks

Evaluation of historical groundwater level and quality data from the SMVMA indicates that groundwater conditions differ across the area and with depth; accordingly and as described above, the groundwater monitoring program designates both shallow and deep well networks. The monitoring networks include along the coast three sets of existing grouped monitoring wells that are completed at varying depths for the purpose of detecting conditions of saltwater intrusion. However, the networks lack coverage inland in an area north of downtown Santa Maria adjacent to the Santa Maria River, necessitating the installation of at least one shallow and one deep well.

The monitoring networks are primarily comprised of wells actively monitored by the USGS and cooperating agencies (Agencies). The networks include additional wells that are currently inactive (monitoring to be restarted) and some new wells (installation and monitoring to be implemented). The shallow well network consists of 65 wells for groundwater level monitoring with a subset of 38 wells for water quality monitoring (Table 1a and Figure 2a), including one new well to be installed north of Santa Maria and monitored for shallow groundwater levels. The deep well network consists of 43 wells for water level monitoring with a subset of 35 water quality wells (Table 1b and Figure 2b), including one new well to be monitored for groundwater levels and quality in the deep zone. In addition, 38 unclassified wells are included for groundwater level monitoring with a subset of 6 water quality wells (Table 1c); they are shown on both the shallow and deep well network maps (see Figures 2a/2b) to illustrate the areal distribution of network wells across the SMVMA.

To augment the monitoring program results, data from water supply well monitoring conducted by the Cities of Santa Maria and Guadalupe and by the Golden State Water Company to meet California Dept. of Health Services requirements will be compiled. Likewise, data from sanitation facility well monitoring conducted under their respective permit conditions will augment the monitoring program results. Finally, data collected from wells in the Nipomo Mesa Management Area (NMMA) monitoring program (not part of the SMVMA well networks) will be compiled in order to assess groundwater conditions in the area along the northern boundary of the SMVMA.

Overall, the groundwater monitoring networks for the SMVMA include:

- 146 wells for water levels (65 shallow, 43 deep, 38 unclassified), of which:

- 88 of the 146 wells are active (39 shallow, 19 deep, 30 unclassified) and will continue to be monitored for water levels by the Agencies,
- 56 wells are inactive (25 shallow, 23 deep, 8 unclassified) and will need to have water level monitoring restarted in collaboration with the Agencies,
- 2 wells are new (1 shallow and 1 deep) and will need to have arrangements made for their installation and water level monitoring implemented in collaboration with the Agencies, and

- 79 of the 146 wells are also for water quality (38 shallow, 35 deep, 6 unclassified), of which:
- 12 wells are active (4 shallow, 7 deep, 1 unclassified), and will continue to be monitored for water quality by the Agencies,
- 35 wells are inactive (20 shallow, 11 deep, 4 unclassified), and will need to have water quality monitoring restarted in collaboration with the Agencies,
- 31 wells not monitored (14 shallow, 16 deep, 1 unclassified), and will need to have water quality monitoring implemented in collaboration with the Agencies,
- 1 well is new (deep) and will need to have water quality monitoring implemented in collaboration with the Agencies.

The areal coverage of wells for groundwater levels and quality is comparable to previous groundwater resources investigations periodically conducted by the USGS. The groundwater monitoring networks are comprehensive and conservative in that they provide areal coverage of the SMVMA in two depth zones, including focused monitoring for potential saltwater intrusion along the coast. Upon implementation of the groundwater monitoring program and analysis of the initial groundwater level and quality results, an assessment will be made of whether the well network requires modification, e.g., more or less wells, while ensuring the monitoring objectives of the Stipulation are met.

Monitoring Specifications

Under the monitoring program, groundwater level measurements in each network well will be made from an established wellhead reference point to an accuracy of 0.01 foot. Groundwater quality monitoring will include general mineral constituents to facilitate description of the general groundwater chemistry throughout the SMVMA. In addition, specific inorganic constituents are included to assess effects of historical and current land uses and groundwater quality relative to potential saltwater intrusion along the coast. The initial monitoring constituents for both the shallow and deep well networks are:

General Minerals *(including Total Dissolved Solids (TDS), Electrical Conductivity (EC), pH, sodium (Na), calcium (Ca), magnesium (Mg), potassium (K), chloride (Cl), sulfate (SO4), and bicarbonate (HCO3)*
Nitrate as Nitrate *(NO3-NO3)*
Bromide *(Br)*

All sample collection, preservation, and transport will be according to accepted EPA protocol. Sample analyses are to be conducted by laboratories certified by the State of California utilizing standard EPA methodologies. Analyses for NO3-NO3 and Br are to achieve minimum reporting limits of 0.10 mg/l.

The great majority of existing wells in the SMVMA have reported reference point elevations (RPEs) that appear to have been derived from USGS 7-1/2' topographic quadrangles, with variable levels of accuracy. Therefore, a wellhead survey will need to be conducted establishing the RPE for each network well to an accuracy of less than one foot, preferably to 0.01 foot, in order to allow accurate assessment of groundwater conditions throughout the SMVMA. The wellhead survey would most easily be completed using survey-grade global positioning system (GPS) equipment. Upon evaluation of the initial monitoring results, an assessment will be made regarding the need to verify RPEs or modify the set of water quality constituents and/or reporting limits.

Monitoring Frequency

Historical groundwater level data from the SMVMA indicate that water levels typically peak between January and April and decline to the seasonal low between July and October. Accordingly, the initial frequency of groundwater level monitoring is semiannually during the spring and fall, as has typically been the practice of the USGS and some cooperating agencies.

Review of historical groundwater quality data indicates that some quality constituents, such as sulfate, nitrate, and associated TDS and EC values, can change substantially over two to three years. As a result, the initial frequency of groundwater quality sampling is every two years, and preferably during the summer to allow any necessary followup sampling. Coastal monitoring wells will be sampled twice annually, during spring and fall, to evaluate seasonal water quality changes with the seasonal fluctuation in Valley groundwater levels.

The annual groundwater level and quality monitoring results from purveyors and sanitation facility wells will be compiled with the results from the SMVMA monitoring program, at which time an assessment will be made regarding the need for additional monitoring of selected purveyor/facility wells. Regarding the SMVMA well network, following evaluation of the initial groundwater level and quality results, an assessment will be made whether monitoring frequencies need to be modified.

Data Sources, Agency Coordination, and Plan Implementation

Implementation of the groundwater monitoring program will necessitate completing several tasks augmenting the groundwater monitoring currently conducted by the Agencies. It is recommended that program implementation proceed through the following tasks in order:

1) Coordination with the Agencies (primarily the USGS) and landowners to assess site conditions at each designated program well, including field determinations of well and wellhead conditions and access (as needed), with the objective of establishing final well networks (shallow and deep) for the ongoing measurement of water levels and collection of water quality samples;

2) Installation of monitoring wells in those areas lacking coverage by the established networks;

3) Coordination with the Agencies and landowners to make arrangements for conducting groundwater level and quality monitoring, per the monitoring program, on an ongoing basis; and

4) Completion of a wellhead survey to record the reference point elevation and ground surface elevation at each network well.

On an annual basis, the designated groundwater monitoring activities for the SMVMA will need to be coordinated with the USGS and cooperating agencies to confirm their continued monitoring of network wells. During each year, groundwater level and quality data from the Agencies will be compiled with the SMVMA dataset, and an assessment will be made of the remaining data needs to fulfill the groundwater monitoring program. The annual agency coordination, planning of monitoring activities, data collection, and data compilation will be jointly conducted by LSCE and the TMA.

2.1.2 Surface Water Storage, Discharge, Stage, and Quality

Monitoring Locations

Twitchell Reservoir stage, storage, and surface water releases are recorded on a daily basis. Also, four stream gauges in the SMVMA currently provide average daily discharge data, specifically two on the Sisquoc River ("near Sisquoc" and "near Garey"), one on the Santa Maria River ("at Suey Crossing near Santa Maria"), and one on Orcutt Creek ("near Orcutt"). Together, the reservoir release data and current stream gauge measurements account for the primary components of streamflow into the Santa Maria Valley (Figure 3).

Additional data are needed for the main streams associated with the Santa Maria Valley for the purpose of assessing surface water resources and stream/aquifer interactions in the SMVMA. The main component of streamflow into the Santa Maria Valley is not measured, specifically from the Cuyama River (inactive gauge), and streamflow from the Santa Maria Valley cannot be accounted because the gauge located on the Santa Maria River at Guadalupe is inactive. Further, for all streams in the SMVMA, stage measurements are not reported and water quality monitoring is limited to the Sisquoc River ("near Sisquoc") and Orcutt Creek ("near Orcutt").

Accordingly, the surface water monitoring program specifies that reservoir stage, storage, and releases from the Twitchell Project continue to be recorded on a daily basis. The program also designates a set of stream gauges on the Sisquoc, Cuyama, and Santa Maria Rivers and Orcutt Creek for the determination of average daily stage and discharge (see Figure 3). Gauge locations will serve as water quality sampling points. An additional water quality sampling point (without gauge) is to be located on Oso Flaco Creek.

The main surface water monitoring locations for the SMVMA include:

- Twitchell Project, which will continue to be monitored for reservoir stage, storage, and releases (with water quality monitoring to be implemented) by the SMVWCD;

- 6 stream gauges, of which:
  2 gauges will continue to be monitored for stream discharge and quality by the USGS:

"Sisquoc River near Sisquoc"
"Orcutt Creek near Orcutt"

2 gauges will continue to be monitored for stream discharge by the USGS (with water quality monitoring to be implemented in collaboration with the USGS):

"Sisquoc River near Garey"
"Santa Maria River at Suey Crossing near Santa Maria"

2 gauges for which stream discharge and water quality monitoring will need to be reestablished in collaboration with the USGS:

"Cuyama River below Twitchell"
"Santa Maria River at Guadalupe"; and

- Oso Flaco Creek, for which water quality monitoring will need to be implemented in collaboration with the USGS.

The inactive gauges on the Cuyama River ("below Twitchell) and Santa Maria River ("at Guadalupe") need to be reestablished, and rating curves relating stage measurements to discharge need to be redeveloped. If possible, it would be preferable to establish an alternate location for the Cuyama River gauge closer to its confluence with the Sisquoc River. At the present time, streamflow entering the Santa Maria Valley from the Cuyama River can be estimated from Twitchell Project release data (streamflow losses occur on the Cuyama River between Twitchell Dam and its confluence with the Sisquoc River). Streamflow data from the former Cuyama River gauge facilitated better estimation of streamflow entering the Valley but did not preclude estimation errors.

Operation of the Santa Maria River gauge at Suey Crossing, located in the primary recharge area of the River, will need evaluation. Currently, stream discharge data are reported only sporadically; it appears that stage data have been collected but not yet converted to discharge pending development by the USGS of appropriate rating curves. However, data collection may be being compromised by technical problems with the gauge, in which case timely resolution of the problems or consideration of an alternate gauge location in this reach of the River would be necessary.

It should be noted that, in order to provide for the most complete assessment of surface water resources of the SMVMA, data would also be needed for its tributary streams. Streamflows into the Sisquoc Valley from La Brea Ck, Tepusquet Ck, and Foxen Canyon cannot be accounted because their respective gauges are inactive. Also, streamflows into the Santa Maria Valley from Nipomo and Suey Creeks have not been monitored (see Figure 3). Thus, stream gauges for the determination of average daily stage and discharge would need to be reestablished for La Brea, Tepusquet, and Foxen Canyon Creeks and installed on Nipomo and Suey Creeks in collaboration with the USGS.

To augment the surface water monitoring program results, water quality data from stream studies periodically conducted by the Central Coast Regional Water Quality Control Board and from sanitation facility monitoring will be compiled.

Monitoring Specifications

For the Twitchell Project, reservoir stage will need to be related to storage volume. For all stream gauges, stage measurements will need to be reported relative to some known elevation datum. Under the monitoring program, initial surface water quality analyses to be performed are for the same general mineral and specific inorganic constituents as for groundwater. Reservoir and stream sample collection will be according to accepted protocol; sample preservation, transport, analyses, and reporting limits will be according to groundwater quality monitoring specifications.

Monitoring Frequency

For the Twitchell Project, daily releases and reservoir stage are to be recorded. For all streams, gauge operations will provide average daily stream stage and discharge data. Water quality monitoring will be conducted on a semi-annual basis during the period of maximum winter/spring runoff and minimum summer flows to evaluate changes in surface water quality with fluctuations in stream discharge.

Data Sources, Agency Coordination, and Plan Implementation

Implementation of the surface water monitoring program will necessitate completing several tasks augmenting the stream monitoring currently conducted by the USGS. It is recommended that program implementation proceed through the following tasks in order:

1) Coordination with the USGS to assess site suitability for stream gauges on the Cuyama River ("below Twitchell") and Santa Maria River ("at Guadalupe"), with the objective of establishing the locations and specifications for gauge installation to conduct ongoing measurement of stream stage, discharge, and quality;

2) Coordination with the USGS to install stream gauges and develop rating curves for the Cuyama River ("below Twitchell") and Santa Maria River ("at Guadalupe") locations;

3) Coordination with the Agencies to make arrangements for conducting surface water monitoring, per the monitoring program, on an ongoing basis on the designated streams (USGS) and Twitchell Reservoir (SMVWCD);

4) Coordination with the USGS to assess site suitability for stream gauges on the tributaries La Brea, Tepusquet, Foxen Canyon, Suey, and Nipomo Creeks, with the objective of establishing the locations and specifications for gauge installation to conduct ongoing measurement of stream stage, discharge, and quality;

5) Coordination with the USGS to install stream gauges and develop rating curves for the La Brea, Tepusquet, Foxen Canyon, Suey, and Nipomo Creeks locations; and

6) Coordination with the Agencies to make arrangements for conducting surface water monitoring, per the monitoring program, on an ongoing basis on the designated streams and tributaries (USGS) and Twitchell Reservoir (SMVWCD).

On an annual basis, the designated surface water monitoring activities for the SMVMA will need to be coordinated with the USGS to confirm their continued operation of each monitoring program gauge. During each year, Twitchell Project data from the SMVWCD will be compiled with stream stage, discharge, and water quality data from the USGS. Annual agency coordination, planning of monitoring activities, data collection, and data compilation will be jointly conducted by LSCE and the TMA.

2.1.3 Precipitation and Reference Evapotranspiration (ETo)

Monitoring Locations

There currently are three active NCDC[2] precipitation gauges in the SMVMA providing long-term daily precipitation data through the present, specifically at Guadalupe, the Santa Maria airport (formerly downtown), and Garey. In addition, daily precipitation is recorded at three locations surrounding the SMVMA, at the Twitchell Dam (by the SMVWCD) and two active CIMIS[3] weather stations near Sisquoc and on the Nipomo Mesa. Daily ETo data are also currently recorded by these two CIMIS weather stations (see Figure 3).

While there are adequate precipitation data for the SMVMA, additional ETo data are needed to provide better assessment of current and future agricultural water requirements. Specifically, CIMIS weather stations are no longer in operation on the Valley floor (three CIMIS stations once located in Santa Maria, Betteravia, and Guadalupe are now inactive). Review of historical ETo values from the active and inactive CIMIS stations indicates a moderate difference exists across the SMVMA that may limit the utility of ETo data from the active stations in estimating agricultural water requirements.

Accordingly, the monitoring program designates the set of four active precipitation gauges (NCDC and Twitchell) and two active CIMIS weather stations, with an additional CIMIS station to be reestablished on the Valley floor, for the determination of daily precipitation and ETo (see Figure 3).

The climatic monitoring stations include:

- Four precipitation gauges, which will continue to be monitored by current operators:
  Twitchell Dam (SMVWCD)
  Guadalupe (NCDC)

[2] NCDC: National Climatic Data Center, administered by the National Oceanic and Atmospheric Administration (NOAA).
[3] CIMIS: California Irrigation Management Information System, administered by California Department of Water Resources (California DWR).

Santa Maria Airport (NCDC)
Garey (NCDC)

- Three weather stations for precipitation and ETo, of which:
  2 CIMIS stations will continue to be monitored by California DWR:
    'Sisquoc'
    'Nipomo'
  1 CIMIS station, for which monitoring will need to be reestablished in collaboration with California DWR:
    Santa Maria Valley floor

To provide the data for the Valley floor, the inactive CIMIS weather station at either Betteravia or Santa Maria needs to be reestablished. Should both stations be determined to be inadequate or infeasible, an alternate location in the central portion of the Valley floor will need to be determined.

Monitoring Specifications and Frequency

Precipitation gauges will continue to collect total daily precipitation data, and weather stations will report daily ETo values. Operation of the weather stations will be according to CIMIS standards to collect all data utilized in the calculation of ETo values (e.g., air temperature, relative humidity, air speed).

Data Sources, Agency Coordination, and Plan Implementation

Implementation of the climatic monitoring program will necessitate coordination with the California DWR to assess the site suitability of, as well as install and operate, a CIMIS station on the Santa Maria Valley floor. Should the inactive Betteravia and Santa Maria stations be determined inadequate or infeasible, an alternate location in the central portion of the Valley floor will need to be determined.

On an annual basis, the designated climatic monitoring activities for the SMVMA will need to be coordinated with the NCDC, California DWR, and SMVWCD to confirm their continued operation of each gauge/station. The annual coordination with these agencies and data compilation will be jointly conducted by LSCE and the TMA.

2.2 Water Requirements and Supply Data

These data include agricultural land use derived from land use surveys as input to the estimation of applied agricultural water requirements and, thus, groundwater pumping (sole supply) in the SMVMA. Data also include municipal and private purveyor records of water supplies, which include groundwater and imported water that in total equal the municipal water requirements in the SMVMA.

2.2.1 Agricultural Land Use and Water Requirements

Under the monitoring program, land use surveys of the SMVMA will be conducted on an annual basis from analysis and field verification of aerial photography. In the event that aerial photographs of the SMVMA are unavailable from existing agricultural service companies, arrangements for the aerial photography work will need to be made.

Survey results will be utilized to determine crop distribution and acreages, which in turn will be used in conjunction with standard crop coefficient values, ETo and precipitation data, and Valley-specific irrigation efficiency values to estimate annual applied agricultural water requirements. With groundwater serving as the sole source of water supply for agricultural irrigation in the SMVMA, the estimated applied agricultural water requirements will be considered equal to the agricultural groundwater pumping in the SMVMA.

Aerial photography arrangements and analysis, field verification, determination of crop distribution and acreages, and estimation of agricultural water requirements will be jointly conducted by LSCE and the TMA.

2.2.2 Municipal Water Requirements

As part of the monitoring program, records will be compiled of groundwater pumping and imported water deliveries from the State Water Project, Central Coast Authority (SWP), to municipal and private water purveyors, including the Cities of Santa Maria and Guadalupe, and the Golden State Water Company. All data will be recorded by subsystem on a monthly basis; groundwater pumping will be by individual water supply well; and all water transfers within the SMVMA between purveyors are to be noted. Also included are data on the number of service connections, any estimates of water usage on a per capita or per connection basis, and historical and current projections of water demand.

During the first year, purveyors will also provide current service area boundaries and all available water supply well location, depth, and completion information. With groundwater pumping and imported water deliveries as the two sources of water supply for municipal water use in the SMVMA, their total will be considered equal to the municipal water requirements in the SMVMA.

During each year, water supply data from the purveyors will be compiled into the SMVMA dataset. Annual coordination with purveyors will be jointly conducted by LSCE and the TMA.

2.2.3 Groundwater Pumping

The estimated groundwater pumping for agricultural irrigation will be summed with the reported pumping for municipal use in order to calculate total annual groundwater pumping in the SMVMA.

2.2.4 Imported Water

Imported water data will be obtained to summarize SWP deliveries to municipal and private water purveyors, specifically the Cities of Santa Maria and Guadalupe and the Golden State Water Company. Those data will be summed to calculate total annual imported water supplies in the SMVMA.

2.3 Water Disposition Data

In order to provide an accounting of amounts and methods of disposition of water utilized in the SMVMA, several data are to be reported. These include treated water volumes processed and disposed at wastewater treatment plants (WWTPs); records of any water exported from the SMVMA; and estimates of agricultural drainage disposed outside the SMVMA. "Disposition" of applied irrigation not consumptively used by crops, e.g., return flows to the aquifer system, will also be accounted.

2.3.1 Treated Water Discharge

Under the monitoring program, records of influent and treated effluent volumes will be compiled for WWTPs, including the Cities of Santa Maria, Guadalupe, and Laguna Sanitation District. All data will initially be recorded on a monthly basis to assess seasonal variation in the disposition of water (e.g., percentage of water utilized that becomes WWTP influent; losses during treatment). Effluent volumes will be recorded by disposal method and location, including any reuse of recycled water.

These data will be utilized to provide an accounting of municipal water disposed in the SMVMA. During each year, water disposal data from the WWTPs will be compiled into the SMVMA dataset. Annual coordination with the WWTPs will be jointly conducted by LSCE and the TMA.

2.3.2 Exported Water

As part of the monitoring program, records will be compiled of any groundwater or imported (SWP) water that is exported from the SMVMA. All data will be recorded by subsystem on a monthly basis and the receiving entities are to be noted. During each year, the data acquisition and compilation into the SMVMA dataset will be jointly conducted by LSCE and the TMA.

2.3.3 Agricultural Drainage and Return Flows

Under the monitoring program, estimation will be made of water drained from agricultural fields (e.g., by tile drains) for disposal outside of the SMVMA. Finally, while not formally "monitored," the disposition of applied irrigation will include estimates of the fate of that fraction of water not consumptively used by crops, primarily as return flow to the aquifer system.

III. SUMMARY

The monitoring program for the SMVMA includes the collection of hydrologic data, including: groundwater levels and quality; surface water storage, stream stage, discharge, and quality; and precipitation and ETo. The program provides designated shallow and deep well networks (Tables 1a/b/c and Figures 2a/b) and a surface water and climatic monitoring network (Figure 3) for collection of these data. Also specified are water requirements and supply data to be compiled for agricultural irrigation and municipal use, the disposal data for municipal water use, data on water exported from the SMVMA, and estimates of agricultural drainage and return flows.

The monitoring program components and frequencies are summarized as follows:

- groundwater levels: 146 wells (65 shallow, 43 deep, 38 unclassified), of which:
  88 wells are actively monitored (with monitoring to continue),
  56 wells are inactive (with monitoring to be reactivated), and
  2 wells are new (with monitoring to be implemented);
  semiannual frequency.

- groundwater quality: subset of 79 wells (38 shallow, 35 deep, 6 unclassified); of which:
  12 wells are actively monitored (with monitoring to continue),
  35 wells are inactive (with monitoring to be reactivated),
  31 wells are unmonitored and
  1 well is new (with monitoring to be implemented;
  analyzed for General Minerals (incl. NO3-NO3) and Bromide;
  biennial frequency.

- Twitchell Reservoir: stage, storage, and releases, which are actively monitored (with monitoring to continue), and
  quality, which is unmonitored (with monitoring to be implemented);
  stage, storage, and releases monitored daily;
  quality analyzed for General Minerals (incl. NO3-NO3) and Bromide on a biennial frequency.

- streams: 6 designated gauges for discharge, stage, and quality, of which:
  2 gauges are actively monitored for discharge and quality (to be continued),
  2 gauges are actively monitored for discharge (to be continued) but not monitored for water quality (to be implemented), and
  2 gauges are inactive (discharge and water quality monitoring to be reestablished);
  discharge and stage monitored daily;
  quality analyzed for General Minerals (incl. NO3-NO3) and Bromide on a biennial frequency.

- stream tributaries: 5 potential gauges for daily discharge and stage, that are inactive and would need to be reestablished.

- precipitation: 4 active gauges (to be continued);
  daily frequency.

- ETo: 3 stations, of which:
  2 stations are active (to be continued) and
  1 station is inactive (to be reestablished);
  daily frequency.

- land use; annually.

- municipal water requirements, supplies (groundwater pumping and SWP imported water), disposal, and exportation; monthly.

- agricultural drainage and return flow; annually.

Table 1a
Well Network for Monitoring Shallow Groundwater
Santa Maria Valley Management Area
(corresponds to Figure 2a)

Township/Range	State Well Number	Well Map ID	Actively Monitored for Water Levels	Actively Monitored for Water Quality	To Be Sampled for Water Quality
SHALLOW WELLS					
9N/32W	009N032W07A001S	07A1	x		x
	009N032W08N001S	08N1	x		
	009N032W16L001S	16L1	x		
	009N032W17G001S	17G1	x		x
	009N032W22D001S	22D1	x		
	009N032W23K001S	23K1	x		x
9N/33W	009N033W02A001S	02A1			x
	009N033W05B001S	05B1			
	009N033W09A001S	09A1			x
	009N033W11K001S	11K1			
	009N033W12R002S	12R2	x		
	009N033W15D002S	15D2			
	009N033W24L001S	24L1	x		x
9N/34W	009N034W03A002S	03A2	x	x	x
	009N034W04F001S	04F1			
	009N034W08H001S	08H1	x		x
	009N034W10J001S	10J1			
	009N034W14H001S	14H1			x
10N/33W	010N033W07M001S	07M1	x		x
	010N033W07R001S	07R1	x		
	010N033W07R006S	07R6	x		
	010N033W16N001S	16N1	x		
	010N033W16N002S	16N2	x		
	010N033W19B001S	19B1	x		
	010N033W20H001S	20H1	x	x	x
	010N033W21P001S	21P1	x		
	010N033W21R001S	21R1	x		x
	010N033W27G001S	27G1	x		
	010N033W28A001S	28A1	x		
	010N033W31A001S	31A1			x
	010N033W34N001S	34N1			
	010N033W35B001S	35B1	x		x
10N/34W	010N034W06N001S	06N1	x		x
	010N034W09D001S	09D1	x		x
	010N034W12D001S	12D1			x
	010N034W13C001S	13C1	x		
	010N034W13G001S	13G1	x		
	010N034W13J001S	13J1	x		
	010N034W14E004S	14E4	x		
	010N034W14E005S	14E5	x		x
	010N034W20H003S	20H3	x		x
	010N034W23R002S	23R2	x		x
	010N034W28A002S	28A2	x		x
	010N034W31F001S	31F1			

Table 1a (continued)
Well Network for Monitoring Shallow Groundwater
Santa Maria Valley Management Area
(corresponds to Figure 2a)

Township/Range	State Well Number	Well Map ID	Actively Monitored for Water Levels	Actively Monitored for Water Quality	To Be Sampled for Water Quality
SHALLOW WELLS					
10N/35W	010N035W06A001S	06A1	x		x
	010N035W15C001S	15C1			x
	010N035W24B001S	24B1	x		x
	010N035W24Q001S	24Q1	x		
	010N035W27E002S	27E2			x
	010N035W27R001S	27R1			
	010N035W36M001S	36M1			x
10N/36W	010N036W02Q007S	02Q7	x	x	x
	010N036W12R001S	12R1			x
11N/34W	011N034W29R002S	29R2	x		x
	011N034W30Q001S	30Q1	x		x
	011N034W34K001S	34K1			x
11N/35W	011N035W19C002S	19C2			x
	011N035W25H001S	25H1			
	011N035W33C003S	33C3			x
	011N035W35D004S	35D4			x
11N/36W	011N036W13K002S	13K2			x
	011N036W13K003S	13K3			x
	011N036W35J005S	35J5	x	x	x
	011N036W35J006S	35J6			x

Table 1b
Well Network for Monitoring Deep Groundwater
Santa Maria Valley Management Area
(corresponds to Figure 2b)

Township/Range	State Well Number	Well Map ID	Actively Monitored for Water Levels	Actively Monitored for Water Quality	To Be Sampled for Water Quality
DEEP WELLS					
9N/33W	009N033W02F001S	02F1			x
	009N033W05A001S	05A1	x		
	009N033W06G001S	06G1	x		x
	009N033W08P001S	08P1			
	009N033W18R001S	18R1			x
9N/34W	009N034W03F001S	03F1	x		x
	009N034W04N001S	04N1			
	009N034W09R001S	09R1	x		x
	009N034W13B006S	13B6			x
10N/33W	010N033W19K001S	19K1	x		x
	010N033W30G001S	30G1	x	x	x
10N/34W	010N034W07E004S	07E4			x
	010N034W12P002S	12P2			x
	010N034W13H001S	13H1	x		
	010N034W14D001S	14D1			
	010N034W16K001S	16K1			x
	010N034W24K001S	24K1	x		
	010N034W24K003S	24K3	x		x
	010N034W31J001S	31J1			x
	010N034W34G002S	34G2	x		
10N/35W	010N035W07F001S	07F1			x
	010N035W11E004S	11E4	x		x
	010N035W18R001S	18R1			x
	010N035W25F001S	25F1			
	010N035W35J002S	35J2	x		x
10N/36W	010N036W02Q001S	02Q1	x	x	x
	010N036W02Q002S	02Q2			x
	010N036W02Q003S	02Q3	x	x	x
	010N036W02Q004S	02Q4	x	x	x
	010N036W02Q005S	02Q5			x
	010N036W02Q006S	02Q6			x
	010N036W12P001S	12P1	x		x
	010N036W13R002S	13R2			x
11N/35W	011N035W19E002S	19E2			x
	011N035W26K002S	26K2			x
	011N035W29R001S	29R1			x
11N/36W	011N036W13K004S	13K4			x
	011N036W13K005S	13K5			x
	011N036W13K006S	13K6			x
	011N036W35J002S	35J2	x	x	x
	011N036W35J003S	35J3	x	x	x
	011N036W35J004S	35J4	x	x	x

Table 1c
Unclassified Wells for Groundwater Monitoring
Santa Maria Valley Management Area
(shown on Figures 2a and 2b)

Township/Range	State Well Number	Well Map ID	Actively Monitored for Water Levels	Actively Monitored for Water Quality	To Be Sampled for Water Quality
UNCLASSIFIED WELLS					
9N/32W	009N032W06D001S	06D1	x		
	009N032W19A001S	19A1			
	009N032W27K002S	27K2			
	009N032W29F001S	29F1			
	009N032W31F003S	31F3			
	009N032W33F001S	33F1	x		
	009N032W33M001S	33M1	x		
	009N032W33M002S	33M2	x		
9N/33W	009N033W12C001S	12C1	x		
	009N033W14F001S	14F1			
	009N033W15N001S	15N1			
9N/34W	009N034W06C001S	06C1	x		
	009N034W15Q001S	15Q1			
10N/33W	010N033W18G001S	18G1	x		
	010N033W26N001S	26N1	x		
	010N033W28F001S	28F1	x		
	010N033W28F002S	28F2	x		
	010N033W29F001S	29F1	x		
	010N033W30M002S	30M2	x		
	010N033W31Q002S	31Q2	x		
	010N033W34E001S	34E1	x		
10N/34W	010N034W26H002S	26H2	x		x
	010N034W29N002S	29N2	x		
10N/35W	010N035W05P002S	05P2	x		
	010N035W06A003S	06A3	x		
	010N035W07E005S	07E5	x		
	010N035W09F001S	09F1	x		
	010N035W09N002S	09N2	x		x
	010N035W11J001S	11J1	x		
	010N035W14P001S	14P1 (D3)[1]	x	(x)	(x)
	010N035W18F002S	18F2	x		
	010N035W21B001S	21B1	x		x
	010N035W23M002S	23M2	x		
11N/34W	011N034W31H001S	31H1			
11N/35W	011N035W20E001S	20E1	x		
	011N035W25F003S	25F3	x		x
	011N035W28M001S	28M1	x		
	011N035W33G001S	33G1	x		x

[1]14P1 actively monitored for levels but not quality. 14D3 actively monitored for quality but not levels.

NORTHERN CITIES

NIPOMO MESA

SAN LUIS OBISPO COUNTY

SANTA BARBARA COUNTY

SANTA MARIA VALLEY

11N/36W 11N/35W 11N/34W 11N/33W 11N/32W 11N/31W

10N/36W 10N/35W 10N/34W 10N/33W 10N/31W

09N/36W 09N/35W 09N/34W 09N/33W 09N/32W 09N/31W

08N/36W 08N/35W 08N/34W 08N/33W 08N/32W 08N/31W

Legend

Management Area Boundaries

N

0 1.5 3 6 Miles

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Figure 1
Santa Maria Valley Groundwater Basin and Management Areas

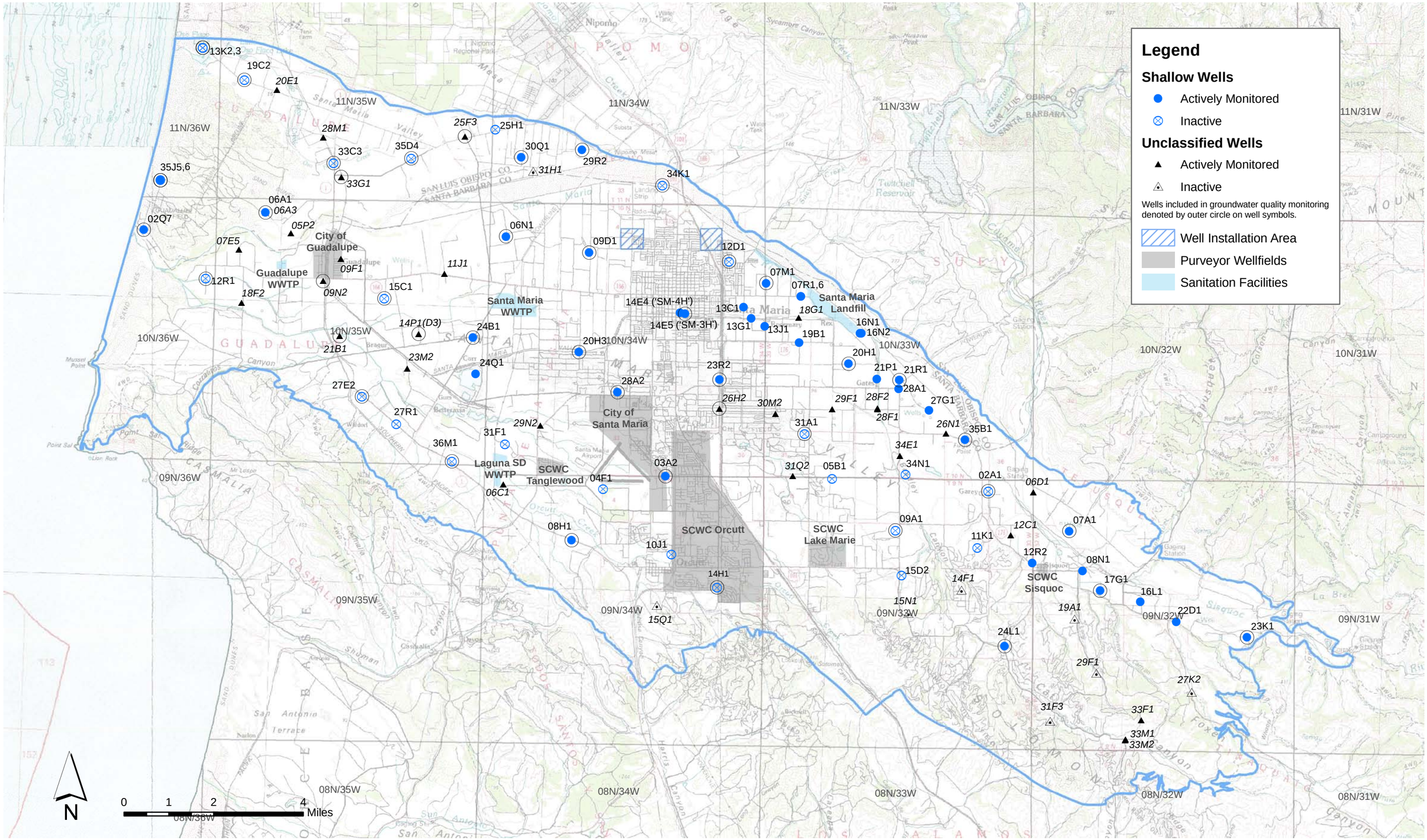

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Figure 2a
Well Network for Monitoring Shallow Groundwater
Santa Maria Valley Management Area

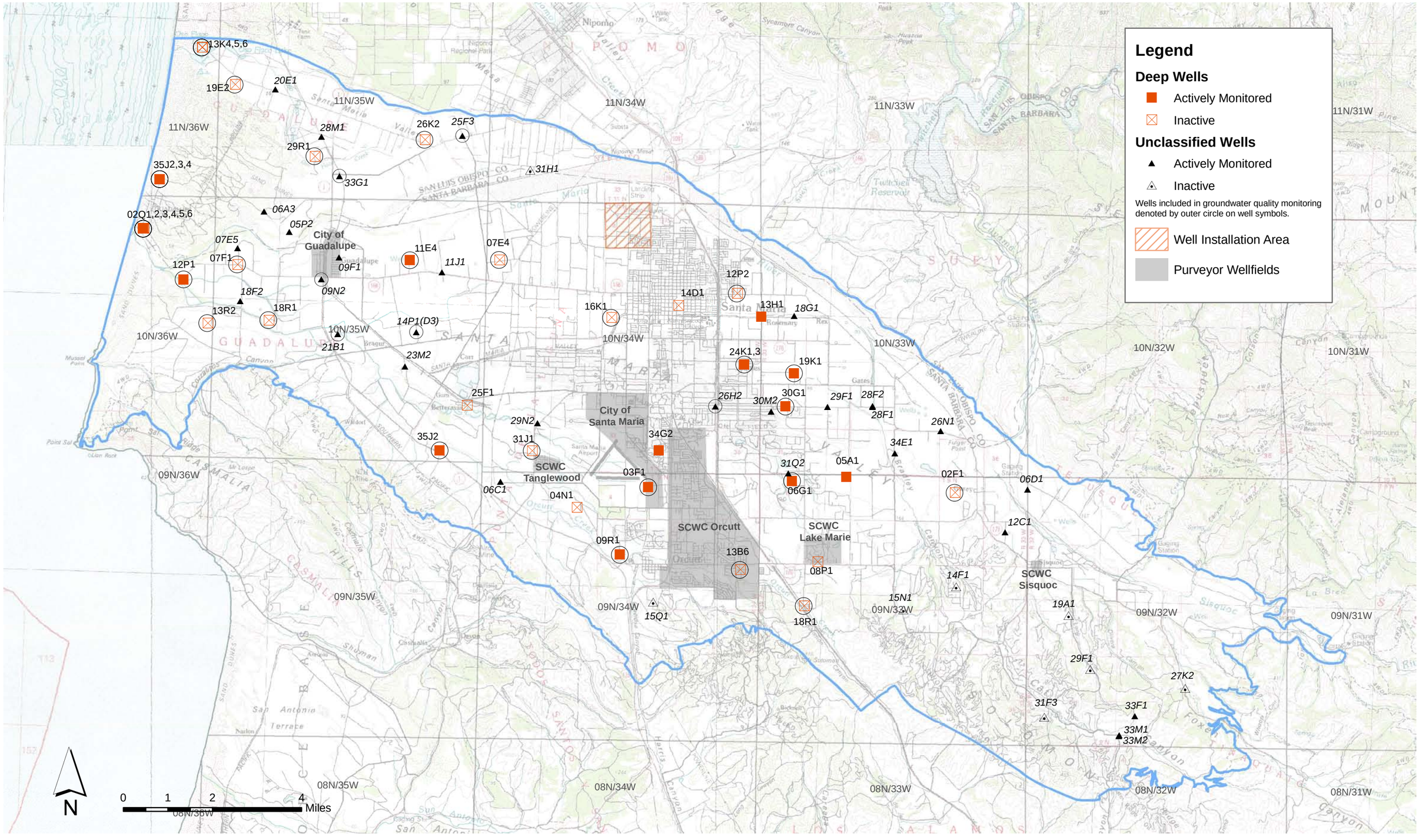

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Figure 2b
Well Network for Monitoring Deep Groundwater
Santa Maria Valley Management Area

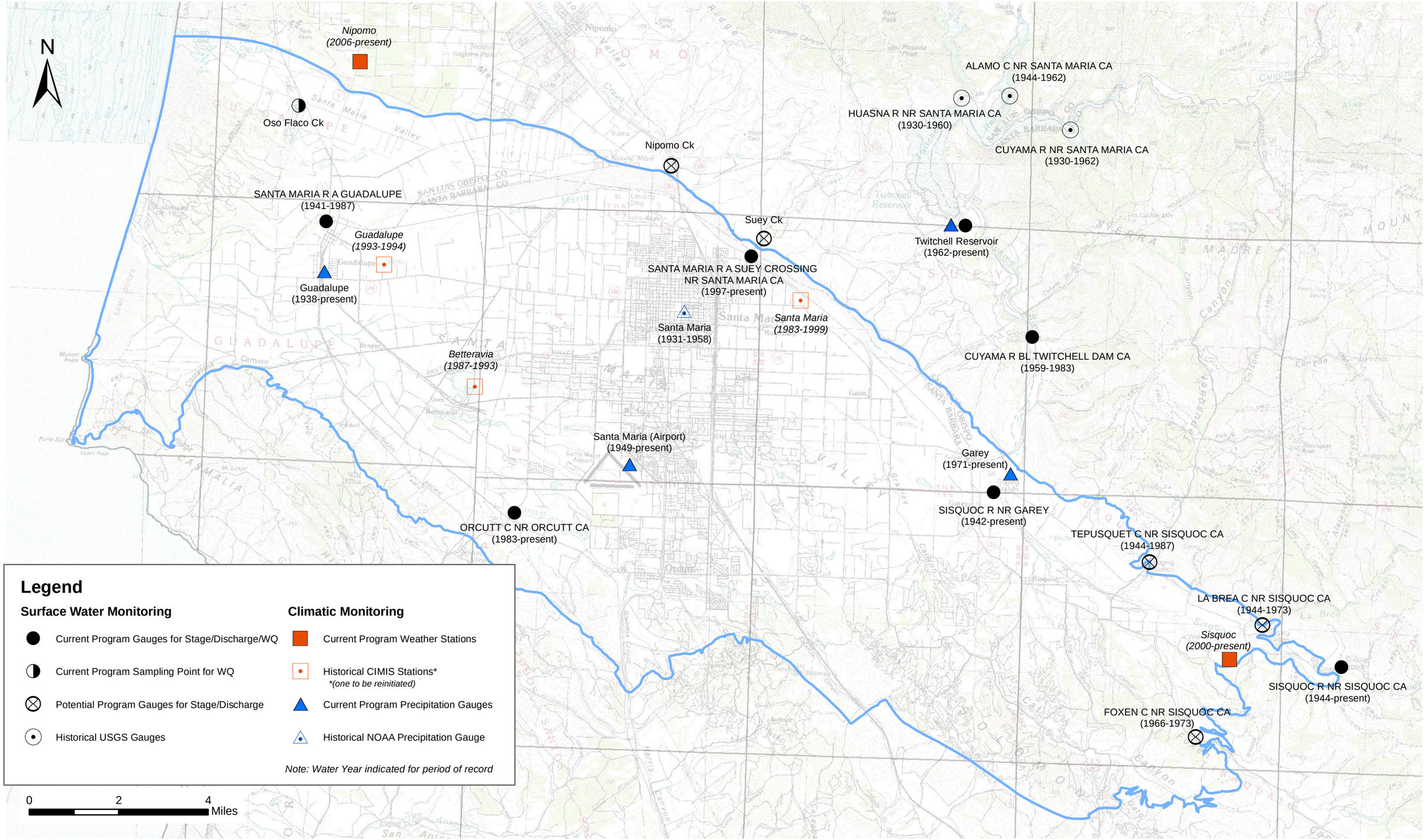

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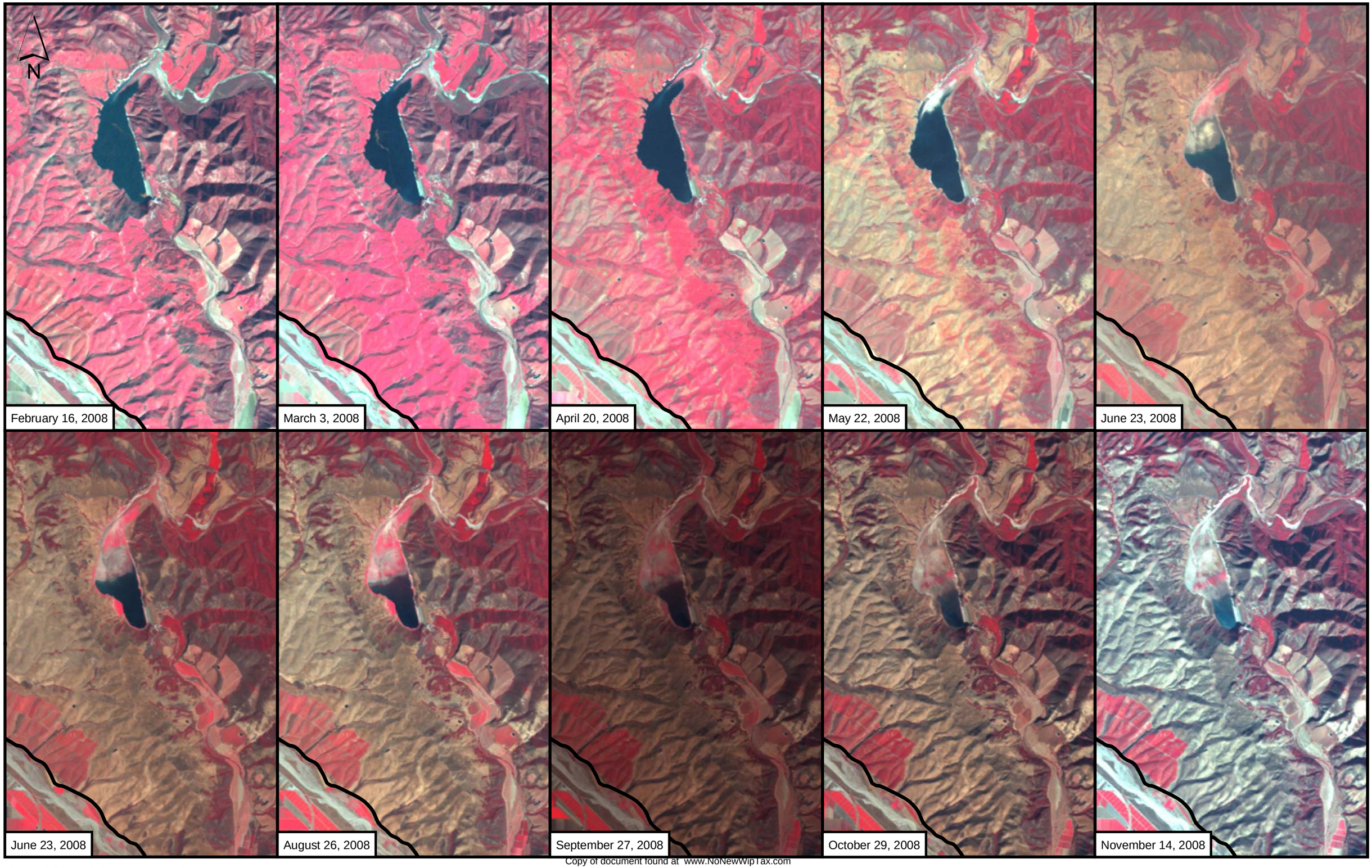
Figure 3
Surface Water and Climatic Monitoring Network
Santa Maria Valley Management Area

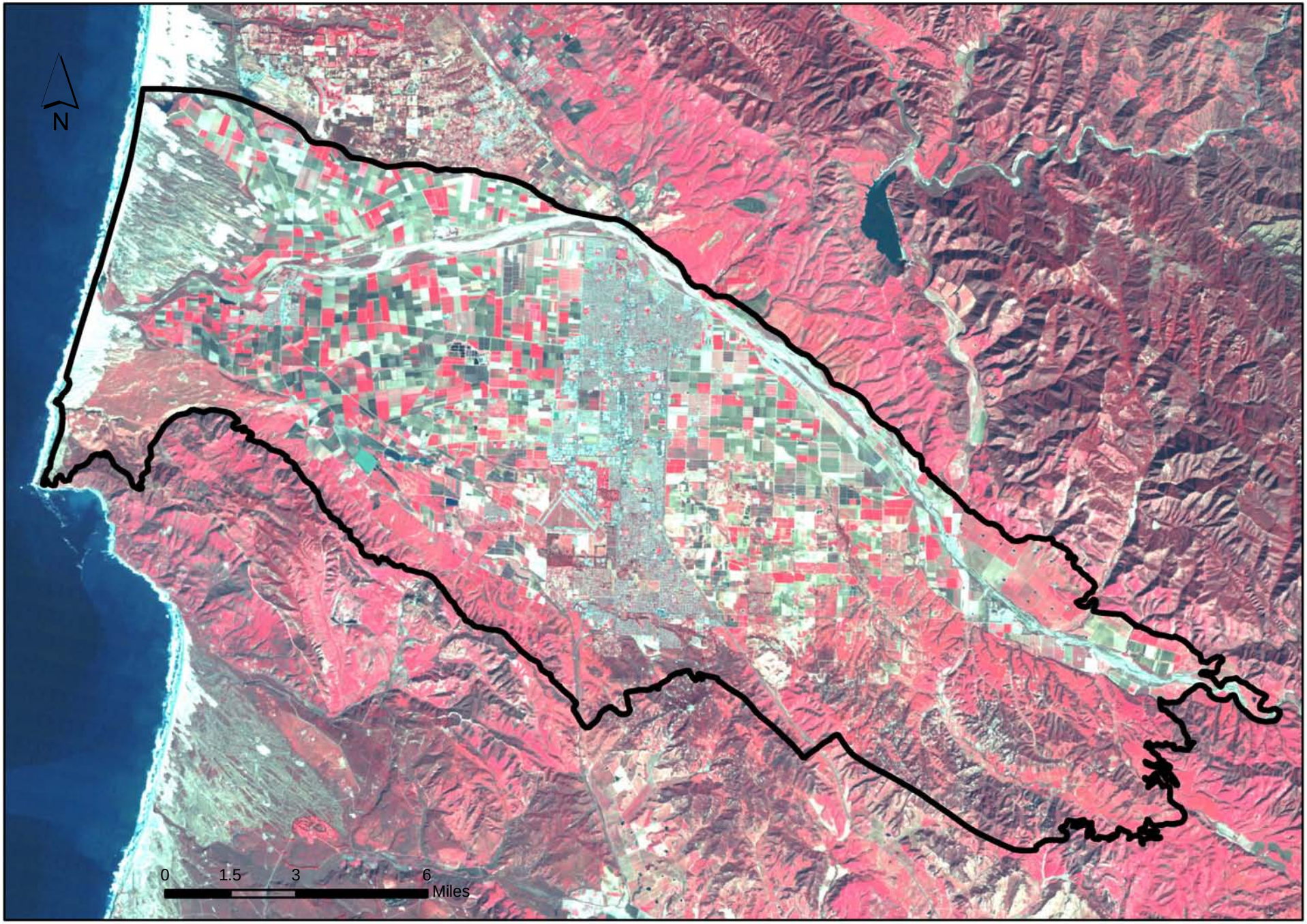
Appendix B

Progressive Images of Twitchell Reservoir Surface Area, 2008

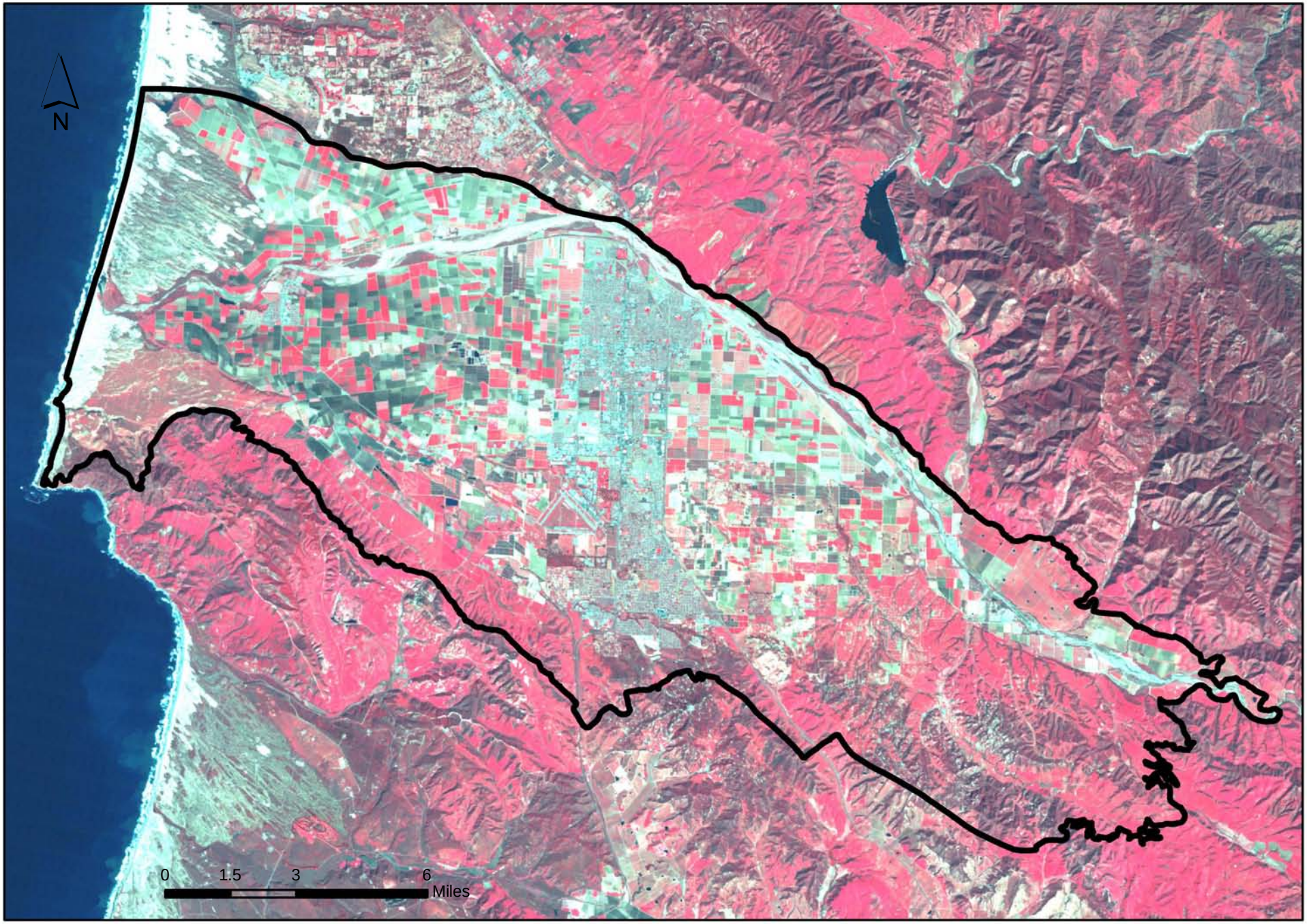


Appendix C

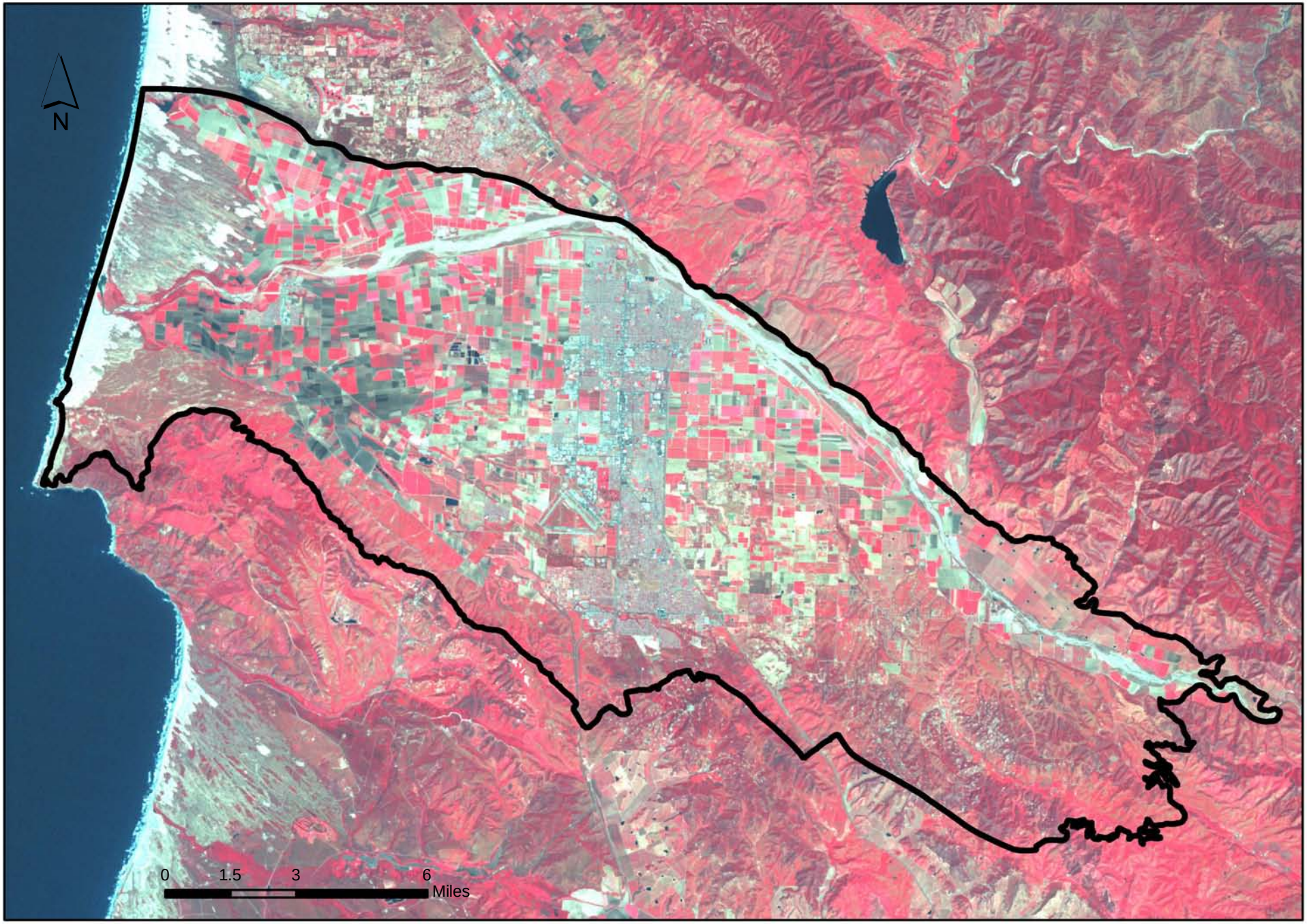
Satellite Images of SMVMA in 2008



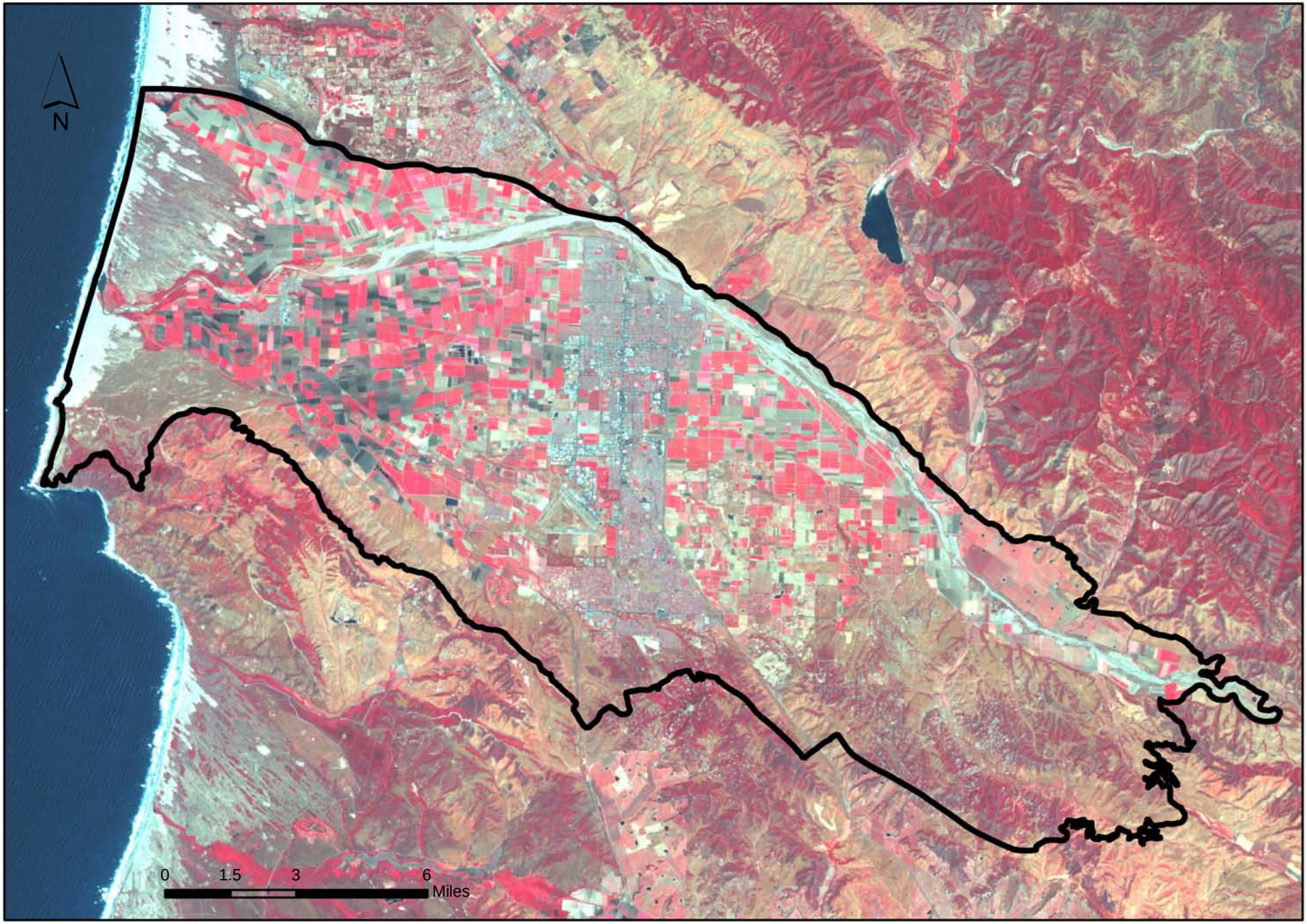
Color-infrared composite of Landsat 5 satellite data of the Santa Maria Valley taken February 26, 2008



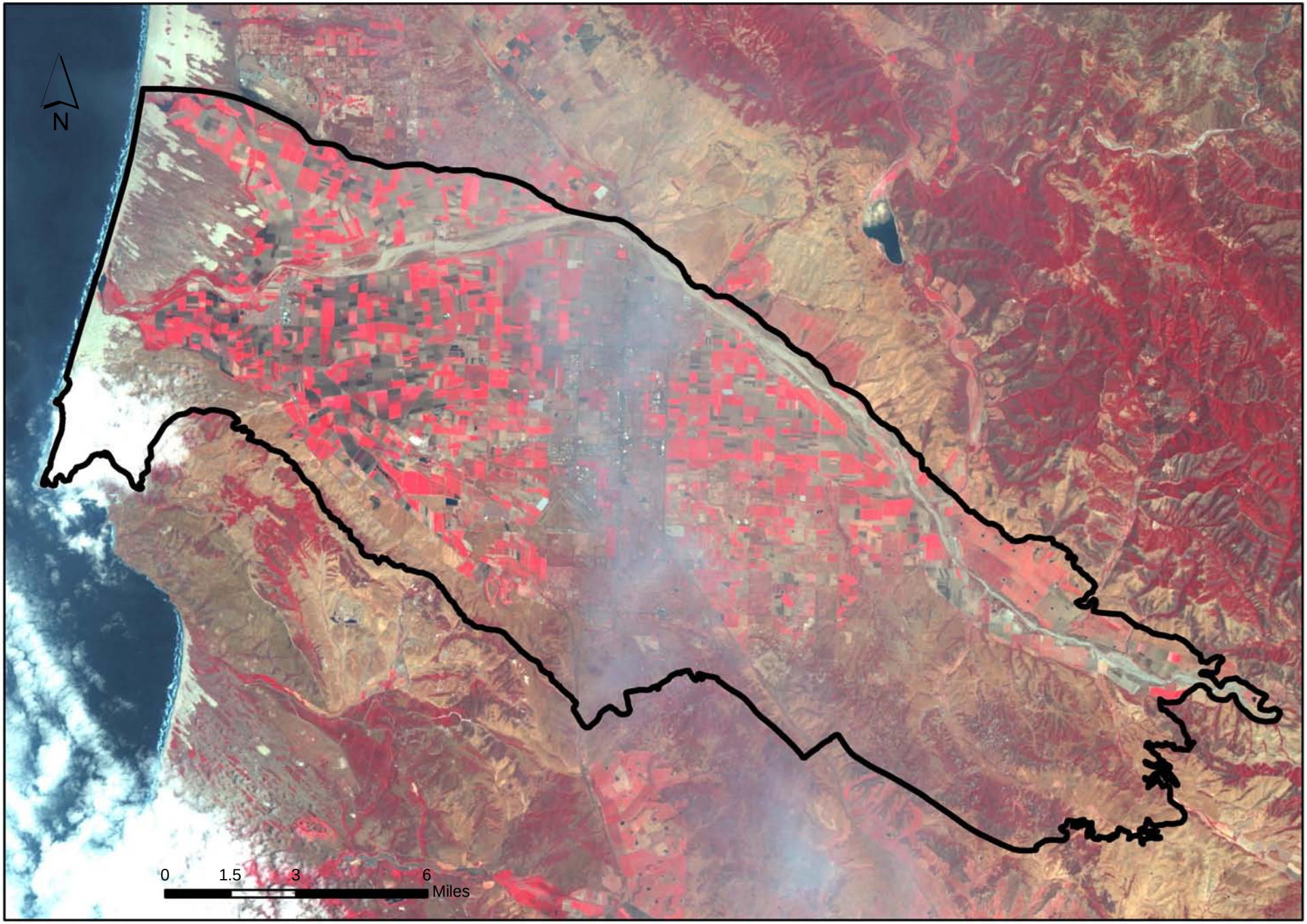
Color-infrared composite of Landsat 5 satellite data of the Santa Maria Valley taken March 3, 2008



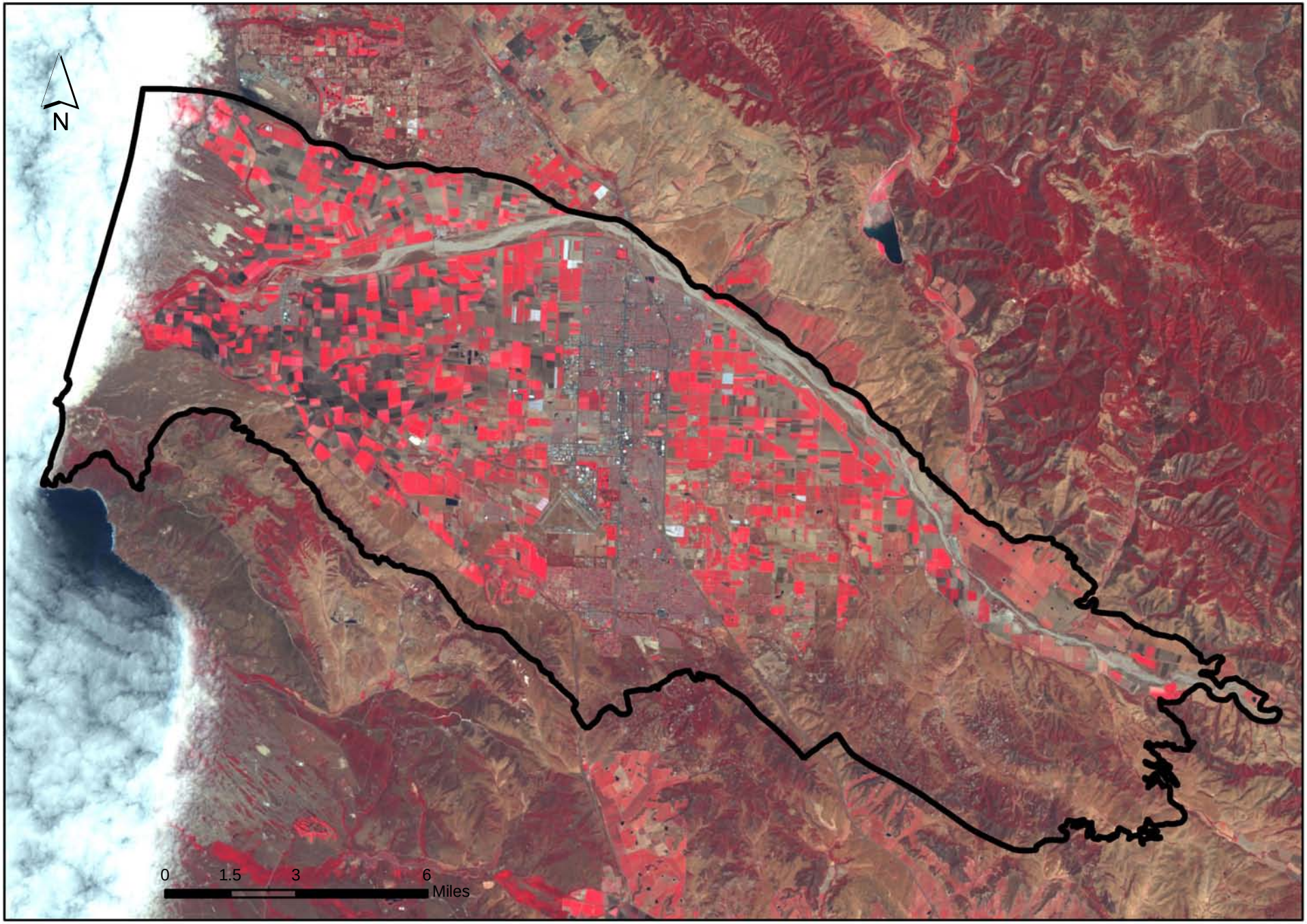
Color-infrared composite of Landsat 5 satellite data of the Santa Maria Valley taken April 20, 2008



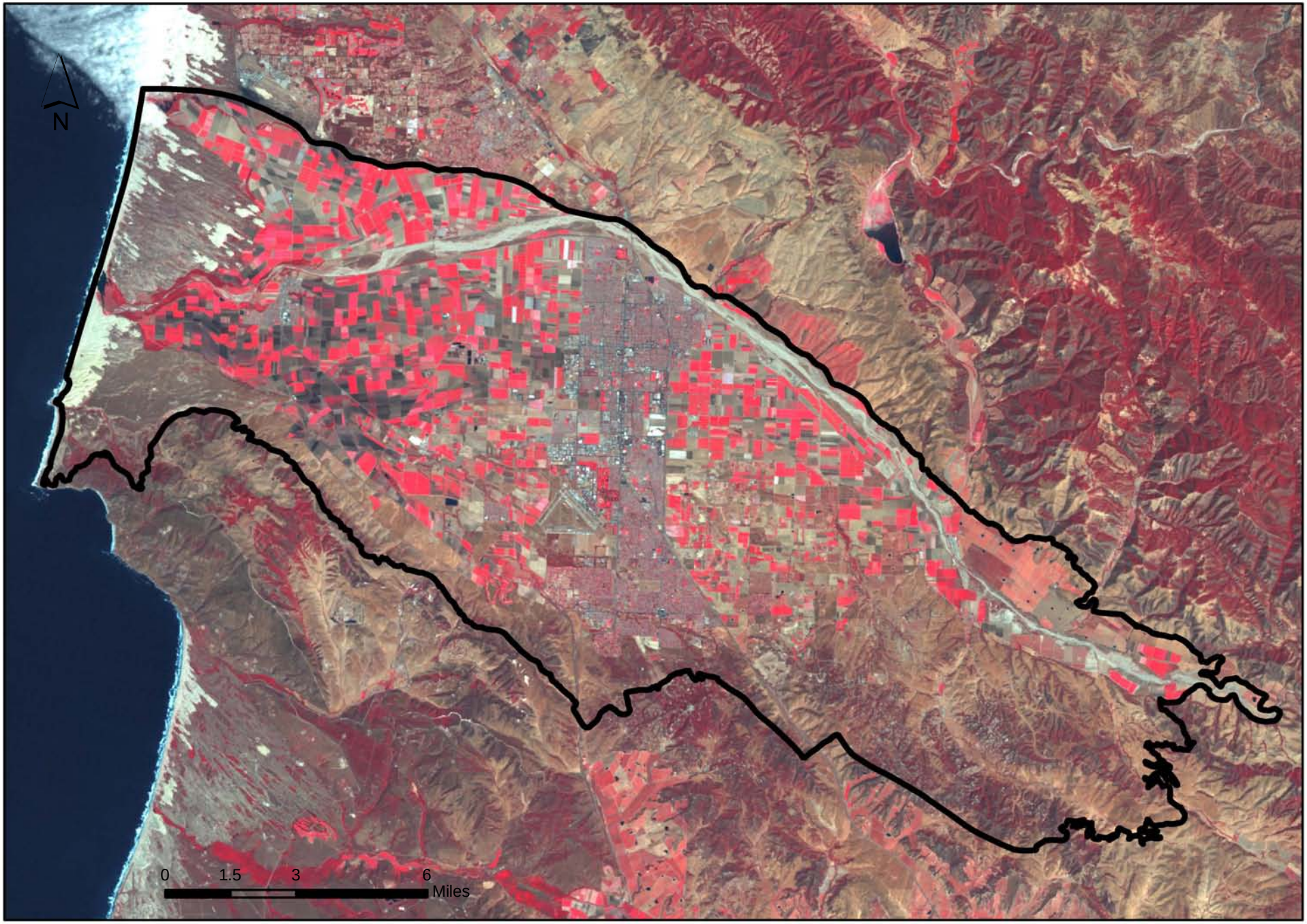
Color-infrared composite of Landsat 5 satellite data of the Santa Maria Valley taken May 22, 2008



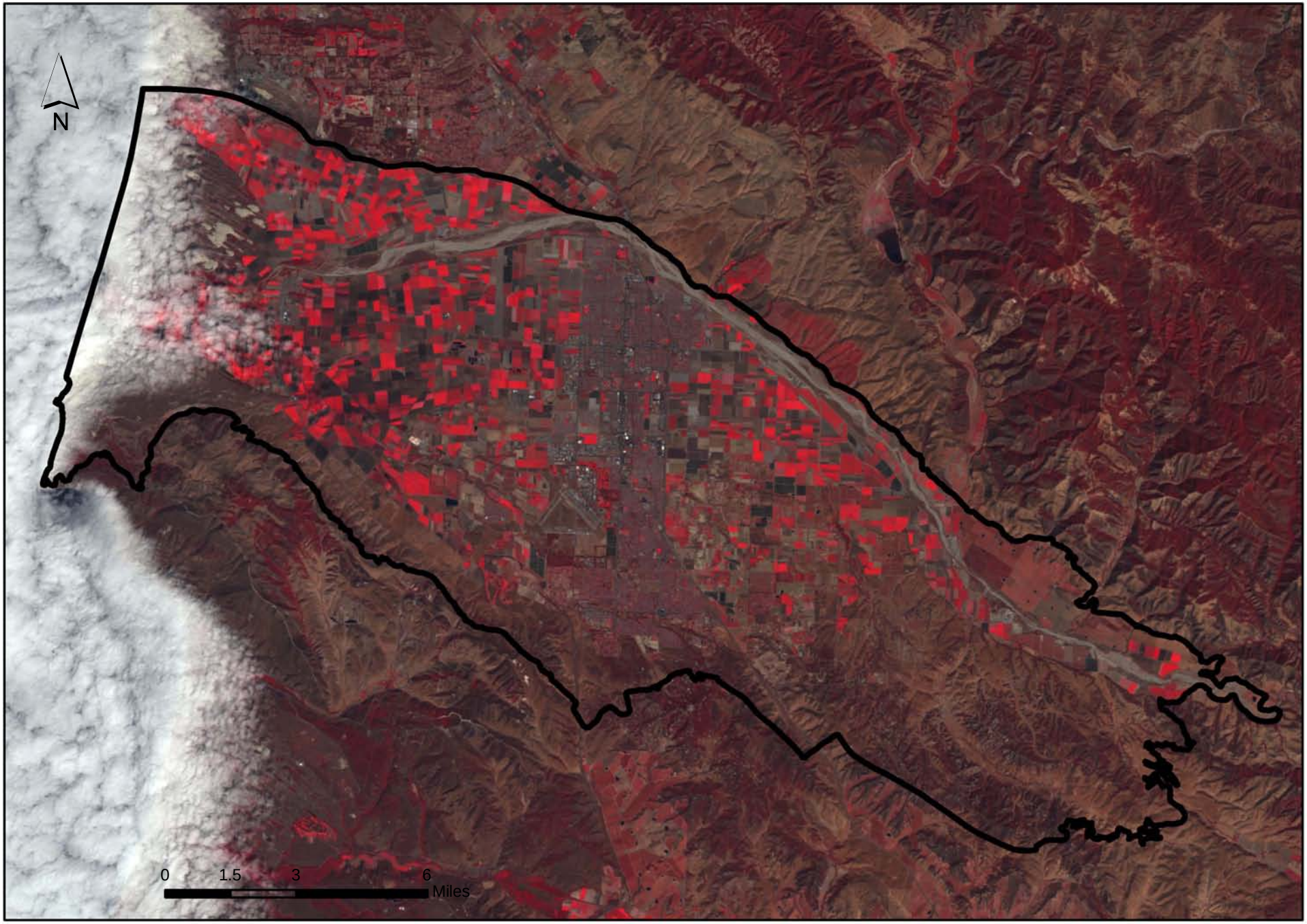
Color-infrared composite of Landsat 5 satellite data of the Santa Maria Valley taken June 23, 2008



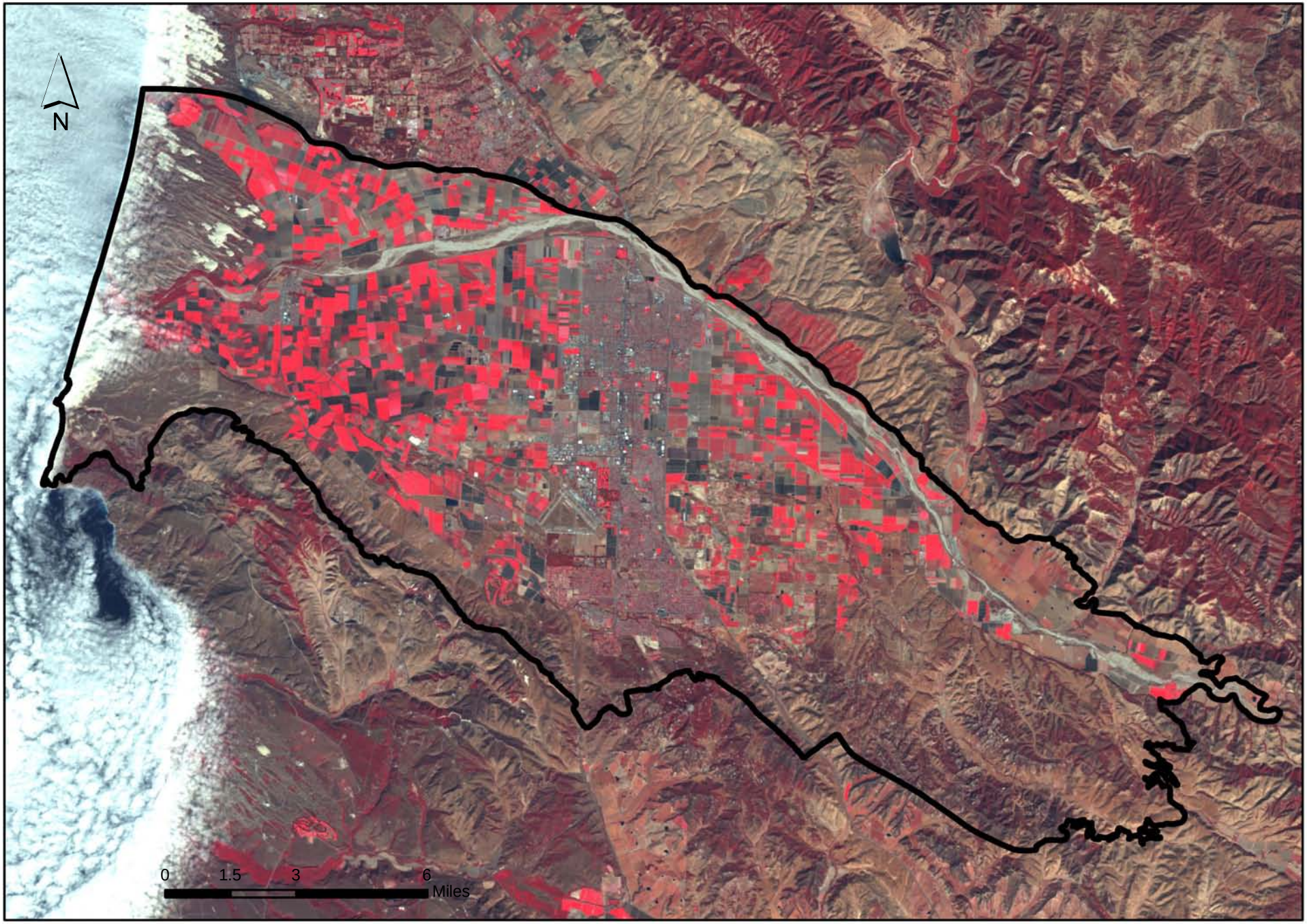
Color-infrared composite of Landsat 5 satellite data of the Santa Maria Valley taken July 25, 2008



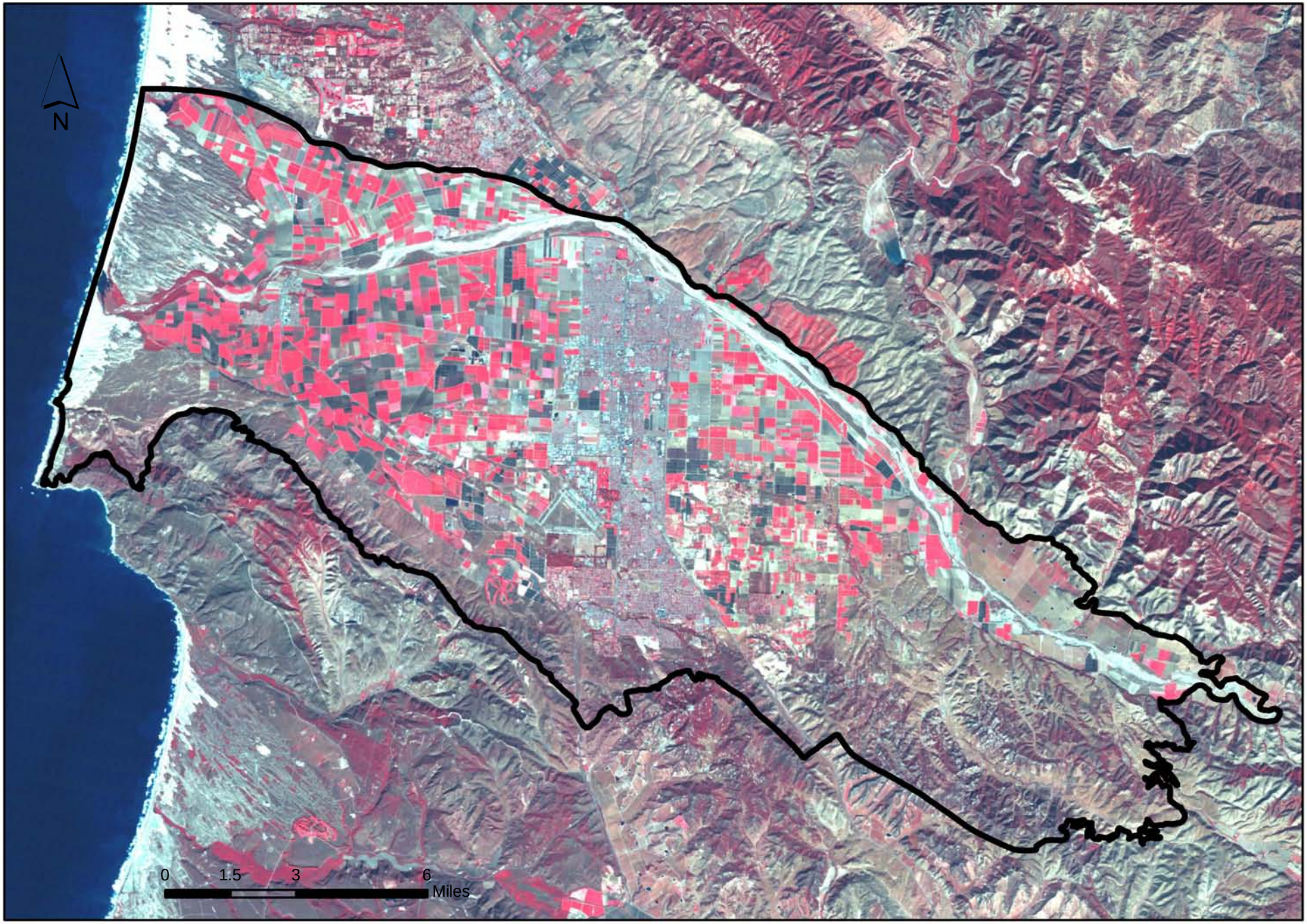
Color-infrared composite of Landsat 5 satellite data of the Santa Maria Valley taken August 26, 2008



Color-infrared composite of Landsat 5 satellite data of the Santa Maria Valley taken September 27, 2008



Color-infrared composite of Landsat 5 satellite data of the Santa Maria Valley taken October 29, 2008



Color-infrared composite of Landsat 5 satellite data of the Santa Maria Valley taken November 14, 2008