KRWCA SURFACE WATER MONITORING PLAN

Approach to monitoring surface waters within the approved Kings River Water Quality Coalition service area in accordance with requirements set forth by the General Order of Waste Discharge for the Tulare Lake Basin, R5-2013-0120

May 19, 2014

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INTRODUCTION

The Kings River Watershed Coalition Authority is a Joint Powers Authority formed by the 28 member agencies of the Kings River Water Association (KRWA) plus the Kings River Conservation District (KRCD) for the express purpose of assisting member growers in the compliance with the regulations regarding surface and groundwater quality as specified by the California Regional Water Quality Control Board, Central Valley Region. Initially formed to monitor surface water, the adoption of the General Order of Waste Discharge for the Tulare Lake Basin (excluding Westlands), R5-2013-0120 on September 19, 2013 and the subsequent approval of the Kings River Watershed Coalition Authority (Kings River Water Quality Coalition or Coalition) on November 20, 2013 has expanded the scope of effort for the Coalition for those interests within the Kings River service area. The KRCD provides the staffing support for the Coalition.

This Surface Water Monitoring Plan relies heavily on the existing surface monitoring program in use since 2008. Changes in site classification to match the current General Order definitions plus the addition of two sites under the Assessment phase should provide adequate classification of surface waters within the defined service area. The Coalition's analysis of the surface water monitoring results collected since 2006 shows that the Kings River is not impaired by the surrounding agricultural activities that depend upon this resource.

This document will discuss the following with regards to the Coalition:

- The geographical and hydrological conditions related to surface water within the Coalition service area;
- The locations and results from the current monitoring sites in use by the Coalition;
- Discussion of the basic questions posed in the General Order and how the proposed monitoring program will address each;
- Results of the existing Monitoring Program;
- The Site selection process, including cropping patterns and pesticide usage analysis;
- Proposed monitoring parameters and schedules;
- And the Identification of Priority study areas, demonstration of and implementation of management practices.

A revised QAPP document reflecting changes in Standard Procedures and analytical methods and updated to reflect current Coalition management structure will complete the document.

BACKGROUND

The Kings River Watershed Coalition Authority is a Joint Powers Authority formed amongst the 28 entities that comprise the Kings River Water Association (KRWA) and the Kings River Conservation District (KRCD) for the express purpose of conducting the necessary monitoring required by the Central California Regional Water Quality Control Board (Regional Board) under Order R5-2008-0005. On November 20, 2013, the Kings River Watershed Coalition Authority (Kings River Water Quality Coalition or Coalition) was approved by the Regional Board to act as the "third-party" under the requirements set forth in R5-2013-0120, General Order of Waste Discharge for members of a Third Party Group in the Tulare Lake Basin (excluding Westlands) (General Order).

The Coalition serves the Kings River and Tulare Lake Basins, plus selected outlying areas located adjacent to the KRCD boundaries. These supplemental areas were covered to insure complete coverage of the Tulare Lake hydrologic basin once all the other 'third-parties" within the General Order area had formalized their service areas. The service area covered by the Kings River Water Quality Coalition is shown in Figure 1.

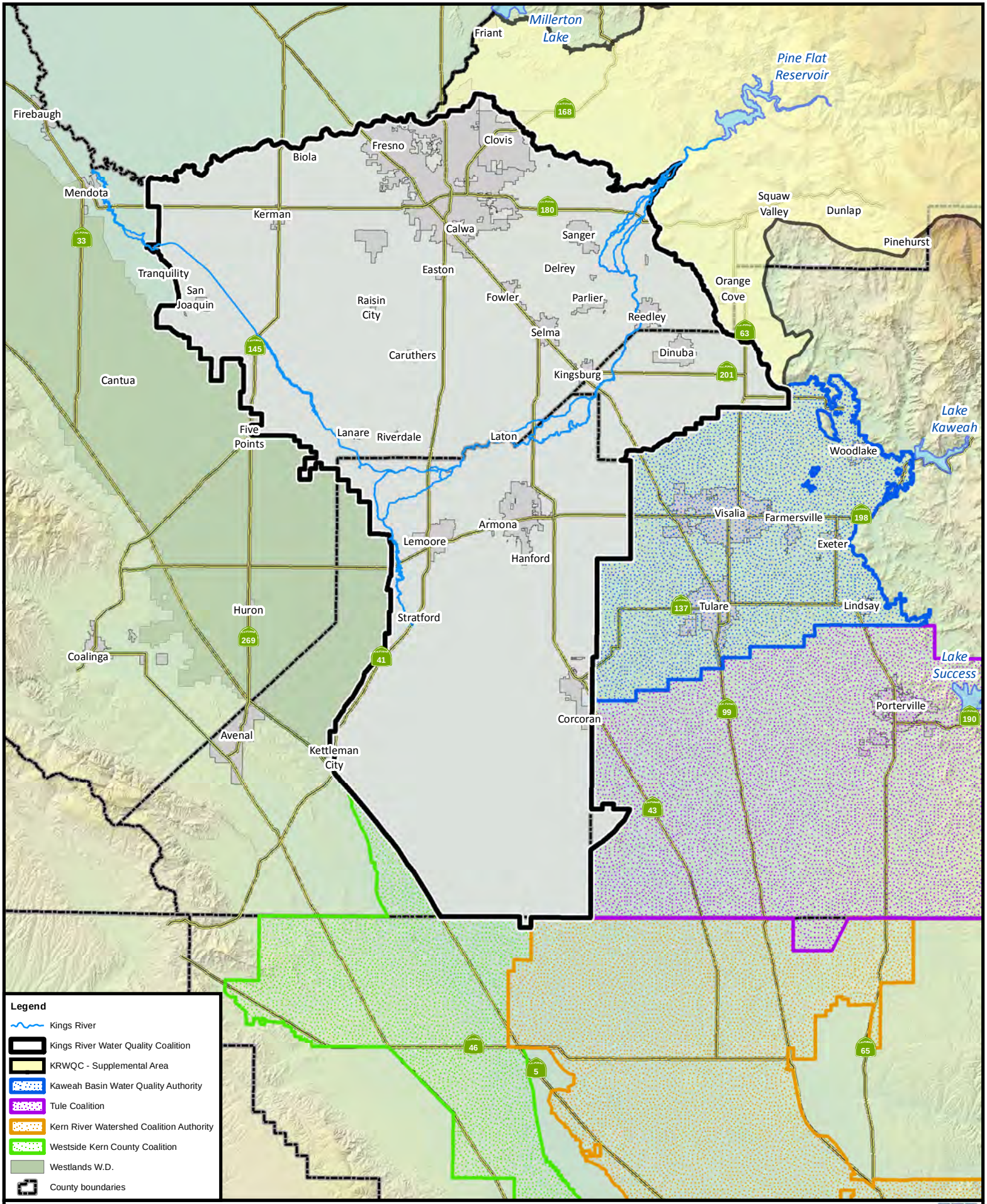
General Hydrology of the Kings River Basin

The Kings River is located in the Tulare Lake Basin in the southern portion of the San Joaquin Valley. It is comprised of the Kings River North and the Kings River South (splitting at the Army Weir/Island Weir complex), the Tulare Lakebed, and the Kings River Watershed above the Valley floor.

The Kings River watershed area includes about 1,700 square miles above Piedra, 1,545 of which lies above Pine Flat Dam. It lies along the westward face of the highest portion of the Sierra Nevada. Elevations in the watershed area range from a maximum of about 14,000 feet at the headwaters to about 400 feet at the edge of the Valley floor. This watershed area is among the most rugged of the entire Sierra Nevada and is characterized by sharp peaks and ridges, precipitous canyons, and granite domes. Kings River headwaters are comprised of many small glacier lakes at elevations of 12,000 feet or more, near the crest of the Sierra Nevada. Nearly all of the tributaries flow in deep granite canyons and the main canyon below the junction of the Middle and South Forks is more than 5,000 feet deep. The soil cover, except for granite outcroppings and precipitous canyons, ranges from moderate in the lower area to non-existent above 10,000 feet elevation. No irrigated agriculture takes place in the watershed above Pine Flat Dam.

Just below Pine Flat Lake, from the mouth of the canyon below Piedra, the Kings River flows southwesterly to near Centerville and on to Centerville Bottoms. Beginning near Kingsburg, the river is provided with continuous levees through the lower reaches of the river. The principal diversion of flow between the North Fork and the South Fork is accomplished by the Army Weir at the head of the Clarks and South Forks and by Island Weir below the Clarks Fork. The capacity of the river system decreases progressively downstream from 50,000 cubic feet per second (cfs) just below the dam to 11,000 cfs at the head of Army Weir.

Mill Creek and Hughes Creek are uncontrolled drainages that join the Kings River just below Pine Flat Dam. Mill Creek, being the larger of the two drainages, has an Army Corps of Engineers gauging station to monitor its flow. Hughes Creek, being much smaller, does not have a gauging station, and its flows are estimated by the change in river flows measured at the Piedra gauging station (Piedra flow rate minus the sum of Pine Flat releases and Mill Creek flow rates yields estimated Hughes Creek flow). Water rights on the Kings are determined by the calculated natural flows as measured at Piedra.


Millerton Lake
Friant
Pine Flat Reservoir
Firebaugh
Fresno
Clovis
Biola
Mendota
Kerman
Squaw Valley
Dunlap
Pinehurst
Calwa
Sanger
Tranquility
San Joaquin
Easton
Delrey
Orange Cove
Raisin City
Fowler
Parlier
Reedley
Selma
Caruthers
Dinuba
Cantua
Kingsburg
Lake Kaweah
Five Points
Lanare
Riverdale
Laton
Woodlake
Visalia
Farmersville
Armona
Exeter
Lemoore
Hanford
Huron
Tulare
Lindsay
Stratford
Coalinga
Lake Success
Porterville
Corcoran
Avenal
Kettleman City
Legend
Kings River
Kings River Water Quality Coalition
KRWQC - Supplemental Area
Kaweah Basin Water Quality Authority
Tule Coalition
Kern River Watershed Coalition Authority
Westside Kern County Coalition
Westlands W.D.
County boundaries
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E
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Kings River Water Quality Coalition
Boundary Map
KRCD
4/4/2014

Most of the land in the lower Kings River Basin has been developed for agricultural use. The Tulare Lakebed serves as the terminus for eastern Valley streams, as well as western Valley streams during periods of high flow. This lakebed area receives runoff from the Kings, Kaweah, Tule, and Kern Rivers. Additional inflows are possible from several uncontrolled streams (Deer Creek, Poso Creek, and White River).

The Tulare Lakebed is effectively a closed depression with a bottom elevation of about 175 ft. The only natural outlet is to the north (at elevation 207 ft.) into the San Joaquin River. Water has not risen to this elevation and naturally flowed out the basin since the 1870s. The subsequent development of intensive irrigated agriculture in the tributary basins, including the reclamation of land in the Lakebed, the construction of reservoirs in the major tributary watersheds, and other flood control measures have significantly reduced the potential for Lakebed filling and flowing north in the future.

Soil types within the Kings River Basin range from coarse textured sands to fine clays. The coarse textured soils are typically located in the eastern to center regions of the basin, with the finer textured soils in the west and southern portions of the Coalition service area. A more detailed review of the soils present within the Coalition service area will be presented in the Groundwater Assessment Report in November 2014.

The Kings River is managed by the Kings River Water Association (KRWA) and the Army Corps of Engineers to provide maximum beneficial use for the river's resources. To this end, wet season snow and rain runoff is collected and stored in Pine Flat Reservoir for use during peak irrigation demand. Should storage levels reach certain criteria, the Corps of Engineers can release water for flood space control. This water is available to all water users on the river for diversion, and is usually channeled into existing basins for groundwater recharge.

The river is divided into the "upper river" (Pine Flat to Hwy 99) and the "lower river" (Hwy 99 to the north and south forks). Water is typically present in the upper river year round, while the lower river receives water during irrigation deliveries or flood releases.

An agreement reached between the water rights holders (KRWA members), the Kings River Conservation District (KRCD) and the California Department of Fish and Game (DFG) provides for continuous releases of water from Pine Flat Reservoir for the downstream fishery located between the dam and the Hwy 180 bridge. Depending upon the river conditions in the previous year, the flows within the river between the dam and Fresno Weir can range from 50 to 250 cfs during the winter months. Once past Fresno Weir, the water is available for distribution according to the terms of the agreement. This means that water is available for sampling year round at the Manning Ave site, and in certain years within the Gould Canal.

When hydrologic conditions permit, water can be delivered to lower river interests during the spring. Such water is carried in Cole Slough (the original river channel below Kingsburg) until it returns to the main channel at Laton. Peak irrigation season deliveries are typically coordinated so that their water deliveries coincide so that the channel losses encountered when water is released into the lower river channel (Cole Slough plus Dutch John Cut) is shared by all water users. Such deliveries usually commence on June 1 and may extend into August or September, depending upon water supply.

Lower river deliveries typically reach Lemoore Weir even in dry years. In wetter years, water is released below Lemoore Weir to the next structure in the river, the Army Weir/Island Weir complex. Here, the water is diverted to the South Fork (Army Weir) or the North Fork (Island Weir) or both. Water flowing south eventually passes through the Empire Weir #1 pool (Jackson Ave sample site) on its way to Empire

Weir #2 and the Tulare Lake bed. Water flowing north next encounters Crescent Weir, and in very wet years, the flows reach Stinson Weir.

Flood releases are preferentially released into the North Fork of the Kings for eventual disposal into the San Joaquin River at Mendota Pool. Flows are temporarily impounded at James Weir, the last diversion point on the North Fork of the Kings River. Should flood releases approach channel capacity, the additional flows are directed down the South Fork and into Tulare Lake.

In drier than normal years, such as 2013, the south fork is avoided altogether. Alternate conveyance routes are employed to get water to the Tulare Lake interests that have lower channel losses (but also lower rates of delivery).

Available water for sampling at each of the existing ILRP sites is shown in Table One. The table shows when water can be expected at each site in a wetter than normal year.

Table One: Months when Water is likely to be present at each of the ILRP Sampling Sites

Site	January	February	March	April	May	June	July	August	September	October	November	December
Tivy Creek	Storm	Storm	Storm								Storm	Storm
Gould Canal	***	X	X	X	X	X	X	X	X	X	***	***
Manning Ave	X	X	X	X	X	X	X	X	X	X	X	X
Lemoore Weir		X	X			X	X	X				
Crescent Weir						X	X	X				
Stinson Weir						X	X					
Jackson Ave*	X	X	X	X	X	X	X	X	X	X	X	X
Empire Weir #2**						X	X	X				

*Special Study site, when sufficient water is present. **Irrigation deliveries only. ***Fisheries flow recovery (when available).

A number of sites are used to monitor for impacts to surface water from agricultural practices. They represent changes in cropping patterns within the region and are typically located at diversion structures for ease of access. Currently, there are 8 sites in use within the Kings Basin, along with several previously used sites.

The active sites for the previous program include Tivy Creek, Gould Canal, Manning Ave, Lemoore Weir, Crescent Weir, Stinson Weir, Jackson Ave, and Empire Weir #2. These sites cover a wide range of conditions within the watershed. A description of each site follows.

> Tivy Creek is an ephemeral stream in the foothills above the Kings River. This land is planted to citrus and is managed by a single owner. The slopes of the irrigated land are high enough that normal frost protection methods are not required. The creek is subject to rapid rises and falls during rainfall events, so timing of sample collection is critical. The high clay content of the soils means poor surface infiltration rates, and generally high sediment loads when the stream is flowing. The creek enters a channel that parallels the Kings River and finally enters the river further downstream.
>
> Gould Canal is a distribution canal for the Fresno Irrigation District that was constructed in the late 1800's. It also lies in an area of citrus production, but in an area that requires frost protection measures. The canal can be subject to surface runoff due to its low construction and high clay

content soils, and it has multiple sources of water (Kings River water at the headgates or through a connection to the Fresno Main, plus a turnout from the Friant-Kern Canal).

Manning Ave is one of the oldest monitoring sites in the program, and is located on the Kings River below the confluence with Wahtoke Creek near Reedley College. Water is present year round at this site. Crops have transitioned from citrus to stone fruit, with limited areas of field crops.

Lemoore Weir is a major diversion point on the lower Kings River. It is also one of the oldest monitoring sites. Water samples can be collected at two locations, depending upon flow conditions. Water being diverted only for Lemoore Canal Co. is handled upstream of the weir, while water being delivered to the North and/or South Forks is sampled below the weir structure. Here, stone fruit has given way to nuts and field crops.

Crescent Weir is a major diversion structure on the North Fork and the gauging station for flood releases. Field crops dominate this region of the river system.

Stinson Weir is considered the last practical diversion point on the North Fork of the Kings due to the high channel losses incurred in bringing water to this point. Field crops are the dominant pattern in this region. Crescent and Stinson Weirs were added to the program after the removal of James Weir (discussed below).

Jackson Ave is a sampling site that looks at the water impounded behind Empire Weir #1 on the South Fork of the Kings. The site is listed as impaired for multiple water quality criteria (toxaphene, molybdenum, electrical conductivity) by the US EPA. The site is listed as a special study site and is monitored for physical parameters and tested for toxaphene and molybdenum levels on a monthly basis, as conditions permit.

Empire Weir #2 is the last diversion point on the South Fork of the Kings. Here, water is split into three canals: the Tulare Lake Canal along the north rim, the Blakely Canal along the west rim, and the remaining reach of the Kings River which flows into Tulare Lake. Field crops are the dominant pattern in this region. Both Jackson Ave and Empire Weir #2 are impacted by high salt soils due to the perched groundwater in the region and the deposits that have formed in the area due to flood and drying cycles.

Several sites have been discontinued from the program as questions regarding river conditions have been answered or the sites were determined to not be useful.

Army Corps of Engineers Bridge is located approximately ½ mile downstream of Pine Flat Dam. This weir/bridge is the gauging station for releases from Pine Flat, and was sampled periodically in the early stages of the surface water program as a means of getting baseline water quality data before any irrigated agricultural activities had taken place. It also served to prove that the algal testing organism *Selenastrum capricornutum* was negatively impacted by the native water quality of the Kings, not by any agricultural chemistry that may have been in the samples. Specific questions were answered and the site was dropped.

Mill Creek is a large ephemeral creek that joins the Kings River just below Pine Flat Dam. Flows in this creek can start after several rain events in the fall/winter and continue to flow into late spring. No significant irrigated agriculture is present in this region. The flows were monitored because of the influence Mill Creek can have on the overall chemistry of the Kings River,

specifically the electrical conductivity and color parameters. No additional knowledge was gained from monitoring activities, so the site was dropped.

The last of the discontinued sites on the Kings River is James Weir. This is the last diversion point on the North Fork of the Kings before any flows reach Mendota Pool. The lack of water at this site (except in flood releases) persuaded the KRCD to move the monitoring points upstream to Crescent and Stinson Weirs. Cropping patterns at James are similar to the other sites and the probability of water being present upstream of James is higher.

Several other sites were investigated during the early portions of the surface water program. Once specific questions were answered, they were also discontinued.

Two of these sites were located near Avocado Lake on the Kings River. Avocado Lake is a pit formed during the construction of Pine Flat Dam and has since been filled by seepage from the King River. Its use as recreational area led to the question of whether the lake contributes to bacteria levels within the Kings. Samples collected upstream and downstream of the lake showed no statistical difference in bacterial counts, so sampling was discontinued.

The other two sites that were evaluated were located on the San Joaquin River. A joint project between the KRWQC and the East San Joaquin Valley Water Quality Coalition, the monitoring was supposed to look for potential runoff from either bank of the San Joaquin River (the common border between the two coalitions). Physical parameters and Water Column Toxicity samples were collected for 3 years with no issues related to agricultural chemistries detected. The sampling occurred at a fishing access point below Friant Dam and at a Fresno County park at the bridge where Hwy 145 crosses the San Joaquin River near Kerman. With no toxicity events recorded, and no evidence of runoff observed during a 3-day trip down the river by kayak, the sites were discontinued.

Several basic questions are posed in the General Order related to both surface and groundwater. As the groundwater monitoring has yet to be conducted by the KRWQC, we can only address these questions as they pertain to the surface water monitoring conducted to date.

1. *Are receiving waters to which irrigated lands discharge meeting applicable water quality objectives and Basin Plan provisions?*

   The answer to this question with regards to surface waters would have to be yes. There have been isolated incidents where agricultural chemistries have been detected within the surface waters tested, and one incidence that has triggered the requirement for the development of a management plan (chlorpyrifos in Gould Canal), but the detections are either below the Basin Plan Objectives or have not occurred since the triggering of the management plan requirements. Even with the detections, the beneficial uses of the receiving waters were not impacted.

2. *Are irrigated agricultural operations causing or contributing to identified water quality problems? If so, what are the specific factors or practices causing or contributing to the identified problems?*

   It can be said the one group of detections that triggered the development of a management plan on Gould Canal was the result of agricultural operations. It was not due to the practice of irrigation, rather it was the failure of a farm employee (either the direct employee of a grower or a contracted applicator) to properly observe the label restrictions for the material applied and the

improper operation of the equipment involved. Once the growers in the affected area were notified of the issue, no further detections were made.

3. *Are water quality conditions changing over time (e.g. degrading or improving as new management practices are implemented?*

   The overall quality of the surface waters within the KRWQC's boundaries is exceedingly good, and has been since the initiation of testing in 2006.

4. *Are irrigated agricultural operations of Members in compliance with the provisions of the Order?*

   From a surface water standpoint, we would have to conclude that based on the available data, the operations are in compliance with the provisions of the Order.

5. *Are implemented management practices effective in meeting applicable receiving water limitations?*

   Growers by nature are very efficient in their operations. Water use has been effectively reduced to crop demand, tillage operations are limited by the desire to reduce fuel expenditures, fertilizer applications are being based on plant need (soil and tissue testing results), and pest control practices are based on Integrated Pest Management, which looks at the whole picture when making an application decision (nutritional status of the plant, upcoming weather, crop value, beneficial insect presence/absence, and the level of pest pressure present). If the cost of the application is not justified, it is not done and the grower will wait. More than likely, the pest population will crash on its own from natural predation.

6. *Are the applicable surface water quality management plans effective in addressing identified water quality problems?*

   The results seen to date in the one site that requires a management plan seems to indicate that the communication of a problem to the growers involved is sufficient to correct the issue. Since the incident that triggered the management plan requirement occurred in 2010, 25 samples have been collected without an agriculturally applied detection for the offending material.

RESULTS OF EXISTING MONITORING

The existing monitoring program has collected a substantial amount of data showing that irrigated agriculture has no impact on the beneficial uses of the Kings River. The data collected has cast doubt on the suitability of the testing methods required by the Regional Water Quality Control Board with respect to algae testing, since the organism used in the testing does not do well in the low hardness conditions found in the Kings or in other Sierra-sourced streams. The low hardness of the waters also means that some metals that are native to the Kings are technically toxic according to the formulae used by the California Toxics Rule.

Review of physical parameters

The required physical parameters to be monitored in all sampling events includes: electrical conductivity (EC), dissolved oxygen (DO), pH, and temperature. Of these parameters, only temperature does not have a BPO, but is included as a reference as it does impact the numeric values of the other readings. Knowing

the temperature of the water is also useful in determining if a pH issue is due to a chemical contaminant or due to high biologic activity in warm waters.

Looking at the Manning Ave data (the largest dataset available, 76 samples since 2006), EC, DO and pH values generally fluctuated in relation to the flow rates (as the flow rates increased, the EC values decreased). The general trend was to see an increase in EC values in the winter months (typically when Mill Creek was flowing) and then to see the values fall as releases from Pine Flat increased (either as irrigation releases for Lemoore Weir in the spring, or during the coordinated irrigation deliveries in June).

Dissolved oxygen is a component that is continuously monitored both in the reservoir and in the river immediately below the dam in compliance with the KRCD's FERC license. Variations occur as the amount of water flowing over the Cobbles Weir (Alta Irrigation District's diversion structure), Gould Weir (headgates for Gould Canal) and Fresno Weir (headgates for the Fresno Main Canal) churn the water within the river. Where the water is released from the dam also impacts DO levels. Water released from the sluice gates will pick up oxygen as the water passes over the "flip bucket" at the bottom of the spillway, or from the release of water through the turbine bypass which sprays water into the river below the spillway. If water is passing through the power plant, supplemental oxygen can be introduced via compressed air in the discharge tubing below the turbines. This only has a limited effect, and depending upon the levels already in the reservoir, the KRCD may request the ACOE to release water directly from the dam to raise DO levels.

Temperature control is critical to the fisheries in the lower river, and this is done via a complex intake structure on the dam face or through the controlled release of colder water from the bottom of the reservoir. Late season flows (usually after irrigation deliveries cease and the reservoir levels are lowest) pose the biggest problem to maintaining ideal temperatures for the trout fishery downstream of the dam.

The last physical parameter is pH. This one is highly subject to biologic activity within the water itself, as algae cells either consume CO_2 (thus raising pH) or O_2 (thus lowering pH) on a diurnal basis. Again, this is temperature sensitive and more likely to be seen in the summer months.

Review of Metals

Trace amounts of metals are present in the Kings River due to natural erosive processes. Water samples collected at Pine Flat Dam (from the ACOE Bridge sample site early in the program) established that some metals are attributed to agricultural operations are present in the water before any influence from irrigated agriculture has taken place (copper and molybdenum being the primary metals found).

Metals are biologically important as catalysts for certain reactions, primarily protein synthesis and photosynthesis. Certain metals (namely copper) can have antibacterial/algaecide properties in higher concentrations. For this reason, metals have Basin Plan Objectives (either numeric or narrative). Those with a narrative standard rely on the calculations of the California Toxics Rule to establish what these levels are.

The problem with these calculations is the reliance on the sample's hardness (concentration of Ca and/or Mg ions as carbonates) to determine the toxicity of the metal in question. The relationship is such that as the hardness decreases, so too does the concentration of metal that is deemed to be toxic.

In the case of the Kings River, the water is exceedingly soft (low Ca/Mg carbonate levels), so very low concentrations of metals are required for the sample to be judged as toxic. An analysis of water collected at ACOE Bridge showed that the native levels of copper and other metals in the river were already in the

toxic range prior to any contact with irrigated agricultural activity because of the low hardness of the sample waters.

Molybdenum is listed as one of the parameters that have caused the listing of certain reaches of the lower Kings River (South Fork) on the 303(d) Impaired Waters list. Molybdenum is found in Kings River water at a level of approximately 2 parts per billion and this level is remarkably consistent from the upper to lower reaches of the river system. Levels increase at sites where water is stagnant for long periods of time, or when the inflows are shut off and local groundwater moves back into the channel/pool. This is apparent at the pool behind Empire Weir #1 (the Jackson Ave monitoring site) where levels increase during the winter months and fall back below Basin Plan Objectives once irrigation deliveries resume. The molybdenum is present within the soils surrounding this pool (and throughout this portion of the Tulare Lake Basin) from many years of deposition from the Sierra Nevada and the frequent wetting and drying that occurred as the Tulare Lake filled and drained. These soils are basically the "beach" of the lake prior to the construction of Pine Flat Dam, and the salt loading in these soils is considerable.

Other minor metals have been tested for (lead, nickel, selenium, cadmium, arsenic, and zinc), but none were found in appreciable amounts.

Review of Water Column Toxicity and Sediment Toxicity

Water Column Toxicity (WCT) testing consists of a three-tiered approach that evaluates potential water-borne toxic substances on each level of the food chain: algae (*Selenastrum capricornutum*), an invertebrate (*Ceriodaphnia dubia*) and a vertebrate (*Pimephales promelas*). Six gallons of water is collected for sampling purposes, enough for the initial testing and any retesting that may be needed should toxicity occur. WCT testing has been conducted on the Kings River since testing began in 2006. Isolated incidences of toxicity have been noted, but the causes remain unknown.

The biggest issue with the testing has been the persistent results seen in the algae tests. The tests would show positive algae growth in all testing, but never a level that matched the control, so a statistical case of toxicity would be reported. None of the chemistry tests associated with the testing showed any cause for the failures. Split samples were collected by Coalition and Regional Board staffs from the same sample site and sent to separate labs for analysis. The Coalition's sample showed statistical toxicity, while the Board sample did not. A repeat of this test using the Coalition's lab and a lab used by other members of the Southern San Joaquin Valley Water Quality Coalition (SSJVWQC) showed the same pattern.

Further research showed that the control water used by the Coalition lab had markedly different physical characteristics from the sample water, namely the EC and hardness levels were much higher in the lab control waters than with the samples submitted. This issue was raised before Regional Board staff and before the Regional Water Quality Control Board when they approved the 303(d) report showing the Kings as impacted for "unknown toxicity."

The method used for algae testing (EPA 821-R-02-013) allows for the modification of the control water to more closely match that of the sample water submitted. The Coalition, in cooperation with the contracted laboratory, has conducted the testing with modified control waters for the last 2 years. During this time, we have found that the algae does not do well in low hardness waters, and frequently fails to produce acceptable tests according to the EPA testing standards (200,000 cells/ml minimum concentration and/or Coefficient of Variability < 20%). The laboratory director has found that algae cultures frequently fail these criteria once the hardness drops below 48 ppm. Kings River water typically runs approximately 30 ppm.

The same pattern of test performance was noted in the 3 years of testing on the San Joaquin River regardless of sample site (Friant Dam or Skaggs Bridge).

On 2 occasions, we observed high mortality rates in the *Pimephales* testing. The Order requires the initiation of a second test to verify the mortality, unless the level exceeds 50%, which then requires a Toxicity Identification Evaluation (TIE) study. TIEs were performed for both tests with negative results. The second test showed fungal coronas around the carcasses shortly after the test was terminated, leading to the conclusion that the issue was Pathogen Related Mortality (PRM). The Coalition thinks the first case of mortality was also PRM, but the lab did not investigate that possibility at the time.

No issues have been found in any of the sediment tests submitted.

Review of Agricultural Chemistries (Pesticides and Herbicides)

There is one term that best describes the agricultural chemistry testing for the Kings River: ***non-detect.*** This is not to say that all samples have come back clean, but out of the countless number of tests run since 2006, only one site has triggered the management plan requirements under the surface water MRP. A number of other detections, usually below the *Reporting Limit* of the laboratory, were noted in each of the data submissions.

Chemistries sampled for were those listed within the Agricultural Waiver requirements and at the specified limits of detection. The chemistries spanned a wide range of available pesticide classes, including organophosphates, organochlorines, carbamates, and pyrethroids. Some materials are long banned products (DDT, DDD, DDE), but because of their longevity in the environment, they are included in the program. Other materials, such as toxaphene, were included in the program due to its listing as a cause of water impairment on the lower reaches of the river.

One agricultural product triggered the management plan requirement under the regulations, which appeared to be applicator error rather than agricultural runoff. This based on an analysis that the affected reach mostly relies on microirrigation and the detections were made mid-summer. The review of the agricultural commissioner's records after the reported detections indicated that the chemistry in question was applied in the region prior to the sampling events, but the exact area of application could not be determined from these records (the applications occurred somewhere within that section of land, but do not pinpoint it to the parcel level). The issue has been brought to the landowner's attention in this region, and the issue has not resurfaced. The issue of the imprecise location of applications as reported to and from the agricultural commissioner was raised within the pending management plan for this sample site.

Pyrethroid sampling within the water column was discontinued in July 2013 as these hydrophobic compounds are not likely to be found within water samples. They will remain in the sediment testing program should toxicity to *Hyalella azteca* occur.

SITE SELECTION PROCESS

The process for the selection of sampling sites has been driven by several factors: the requirements expressed within the regulatory program, the known patterns of flows within the Kings River system, the distribution of crops within the Kings River basin (and how they are related to the river), known issues, and ease of access. Each of the selected sites has been successful in achieving its goal of providing reliable data regarding the potential of agricultural impacts to surface waters within the Coalition boundaries.

As the program matured, the Coalition found that some sites were not as useful to the program as others. These sites fell into two categories: lack of surface water flow or flows without irrigated land influences. When the program was reworked in 2008, these low performing sites were removed in favor of others that could potentially provide more of the data needed to answer the basic questions posed within the Waiver. Those sites that were not influenced by irrigated agriculture were dropped for cost considerations as well as the data provided did not add enough value to the monitoring program.

A small number of sites were designated as short term study sites, where specific data would be collected and once evaluated, testing would cease. One site answered specific questions regarding potential bacterial contamination to the Kings; the other site looked for influences on the San Joaquin River as it passed north of Fresno (potential agricultural runoff or municipal discharges).

New sites are being added to refresh our baseline water quality data for the Kings and to evaluate the flows of a creek that enters the Kings River service area from the Kaweah (also provides additional data from a waterway that Kaweah already monitors). These sites fall under the new "Assessment" guidelines, and will be monitored for 12 consecutive months on a rotating basis.

The first step in the selection process is to determine what can be learned from each site. This is done by looking at the types of agricultural operations that surround the potential site, evaluating the cultural practices common to the cropping pattern that might have impacts on the surface waters, and reviewing the flow patterns that can be expected at the site. The general geography of the region is also considered, as some sites in the eastern portions of the Coalition may pose a higher risk to surface waters than similar operations to the west, simply because of soil types or slopes.

The next step is to determine the best point within the region where a sampling station would be placed so as to allow ease of access for sampling and maximum safety for the samplers during periods of high flow and inclement weather. This includes looking at the banks of the waterways and the proximity of paved or other all-weather roads. Waterways prone to high flow rates with unstable streambeds or other hazards would be screened out at this stage. If the hazards are expected to be of short duration or occur on an infrequent basis, the site may remain in consideration unless a more suitable site is located.

Diversion structures are excellent locations for sampling as they provide all-weather access, are constructed in regions where flows are likely to occur, and are fixed points within a system that are easily mapped.

Many of the sites that are being proposed by the KRWQC are existing sites from previous monitoring efforts. These sites will be carried forward to the new Surface Water Monitoring Plan (SWMP) as Core sites, and will maintain the existing schedule for sampling. This schedule is shown in Table Two. The remaining sites will be reclassified according to the General Order.

Table Two: Core site Sampling Schedule

Site	2014	2015	2016	2017	2018	2019	2020
Gould Canal	Core +*	Core +	Assessment	Core +*	Core +	Assessment	Core +
Manning Ave	Core	Assessment	Core	Core	Assessment	Core	Core
Lemoore Weir	Core	Assessment	Core	Core	Assessment	Core	Core
Crescent Weir	Core	Core	Assessment	Core	Core	Assessment	Core
Stinson Weir	Core	Core	Assessment	Core	Core	Assessment	Core
Empire Weir #2**	Core						

*Core constituents plus chlorpyrifos per the pending management plan. **Dropped sample site.

Two sites are not included in the above table due to their special handling under the new General Order. Tivy Creek is to be reclassified as an Ephemeral site upon the approval of this SWMP. Jackson Ave is a special study site under the current program and will remain as such, with physical parameters, toxaphene, and molybdenum samples collected as conditions permit.

For the sites to be classified as Core, Table One showed when water is most likely to be present. All sites will be visited monthly as per the current plan and photo documentation to occur whether a sample is collected or not.

PESTICIDE USE ANALYSIS

To verify that the selected sites are indeed representative of the agricultural activities within the KRWQC, an analysis of the most recent 3 years of pesticide use data (2010 to 2012) within the KRWQC boundary was conducted. The data was obtained directly from the Department of Pesticide Regulation (DPR) in a GIS-compatible format and clipped to match the KRWQC boundaries. The objectives of the review were to (1) determine the top 20 pesticides applied during the 3-year period, (2) look at the zones of highest usage, (3) determine the times of maximum application, and (4) place the current monitoring points on this map to determine ultimate suitability.

Many of the chemistries tested for under the surface water program are not listed within the top 20 of any of the three years of study, and a vast majority of the tested chemistries do not make the list at all. As it is simpler to request that any analyte within a particular chemistry class (organophosphate e.g.) be reported, we will continue to test for the previously specified chemistries for the new surface water program.

The first review of the collected data showed that elemental sulfur was the dominant material applied within the KRWQC, regardless of year. Sulfur is used in vine crops as a preventative for a number of mildew and other plant pathogens, as well as providing an environment that is less appealing to harmful insects and spider mites. Residual sulfur powder that drops to the soil surface is eventually converted to a form that is absorbed by the plants as a nutrient, and helps regulate soil pH levels.

Other materials that top the applied list include unclassified petroleum oils (used during the dormant season in orchards for overwintering pest control), several soil fumigants, some assorted herbicides (glyphosate (multiple formulations), 2,4-D and Paraquat), some antifungal/antibacterial products (copper compounds) and some clay products that are used for sunscreens in sensitive crops.

The timing of application for the top 5 materials for each year (2010-2012) is shown in Figures 2 through 4.

Glyphosate occurs in multiple formulations within the records (glyphosate by itself, as an isopropylamine or potassium salt, or as a mono-ammonium salt). Each of the multiple manufacturers of the product has formulated the end product differently, and thus the multiple registrations. Glyphosate has a relatively high trigger limit within the Basin Plan (700 ppm), and the product has only been detected once in all the surface water testing within the Kings River. The trend for glyphosate usage is increasing from 2010 to 2012 (total of all glyphosate formulations for each year), but the nature of the chemistry's interaction with the soil means that it poses no risk to groundwater.

Chlorpyrifos is the first foliar insecticide to appear in the listings, and never within the top 10 of products applied within the KRWQC. The trend for usage showed a slight increase from 2010 to 2011, but a substantial drop from 2011 to 2012. The adoption of Integrated Pest Management as a pest control strategy drives the grower towards using more pest-specific materials (insect growth regulators (IGRs) or pheromone mating disruption) rather than the broad spectrum chemistries of the past. Such chemistries are beneficial when multiple pests are present at treatment levels, but for the most part, they are largely avoided if possible.

Chlorpyrifos is used year-round for various pest control programs, but peak usage appears to be in cleanup sprays in July, August, and September prior to harvest. The pattern of chlorpyrifos usage for the

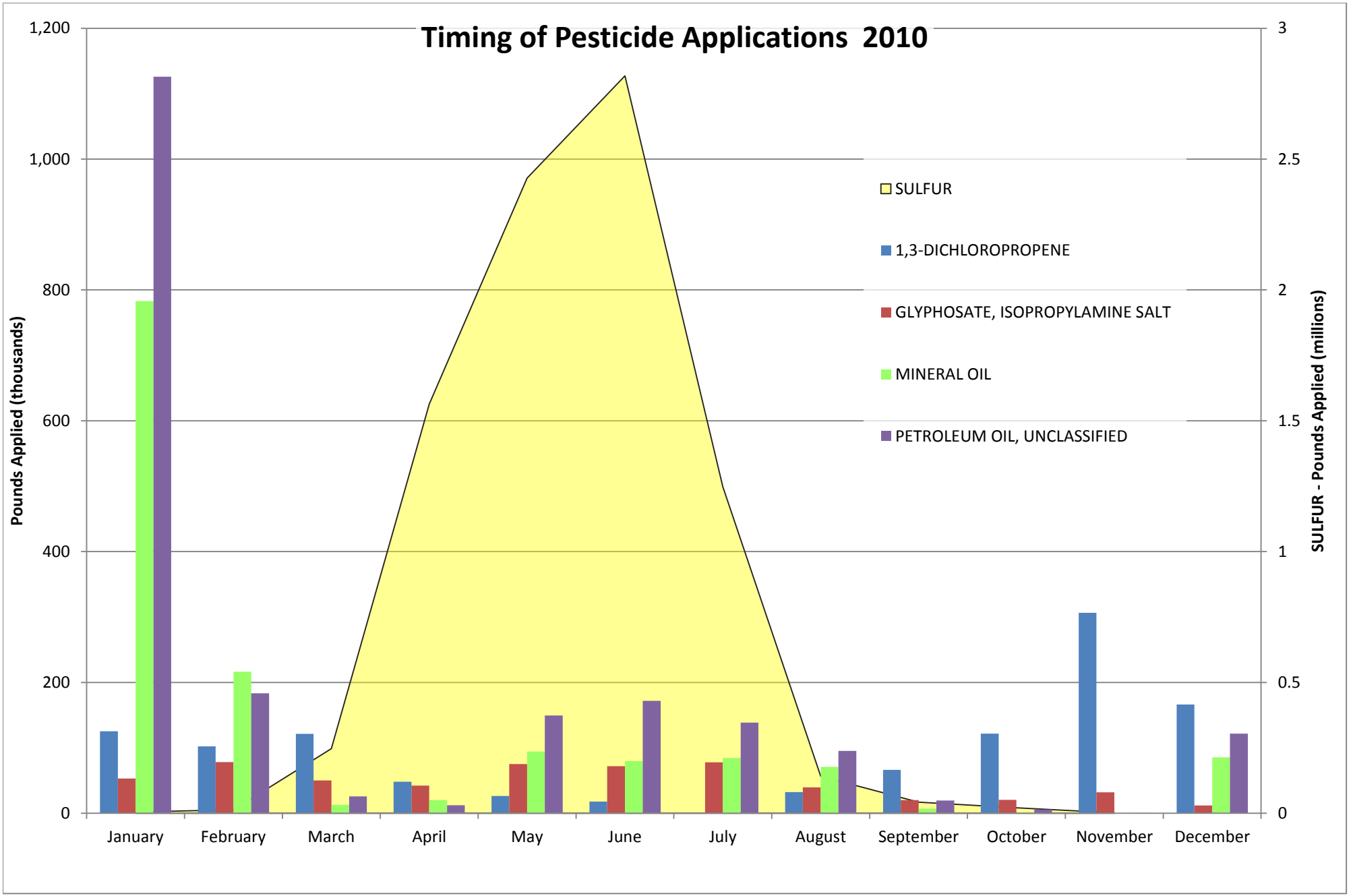
period of 2010-2012 is shown in Figure 5. As the chemistry is to remain within the testing program, no adjustments to sample collection schedules are warranted.

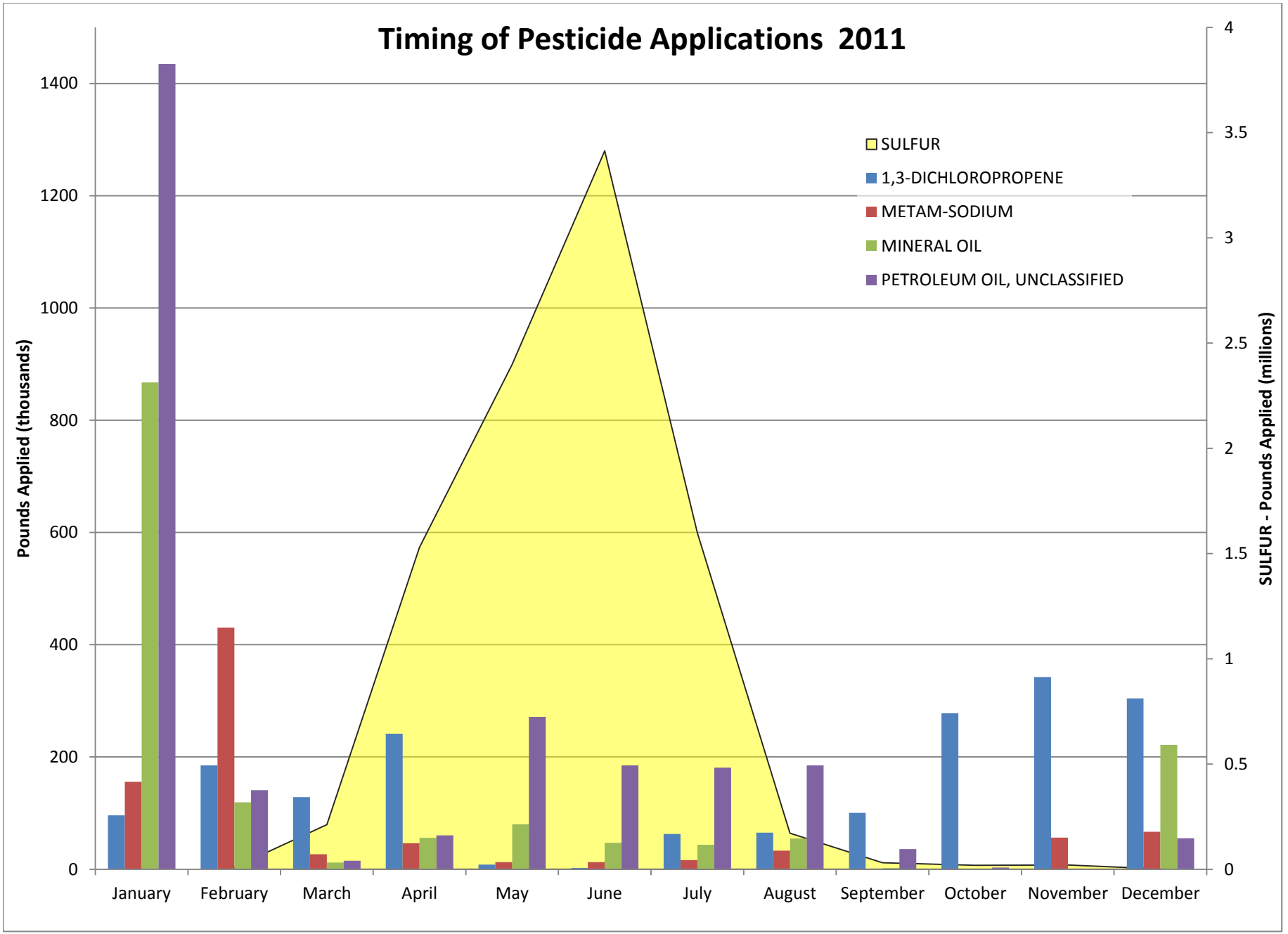
A geographic analysis of application density was performed on selected materials (top 5 by pounds applied, plus chlorpyrifos). The results of this analysis are shown in Figures 6 through 23. Sampling locations and known Dairy operations were placed on the map to evaluate risks to surface water and to explain any zones of higher usage.

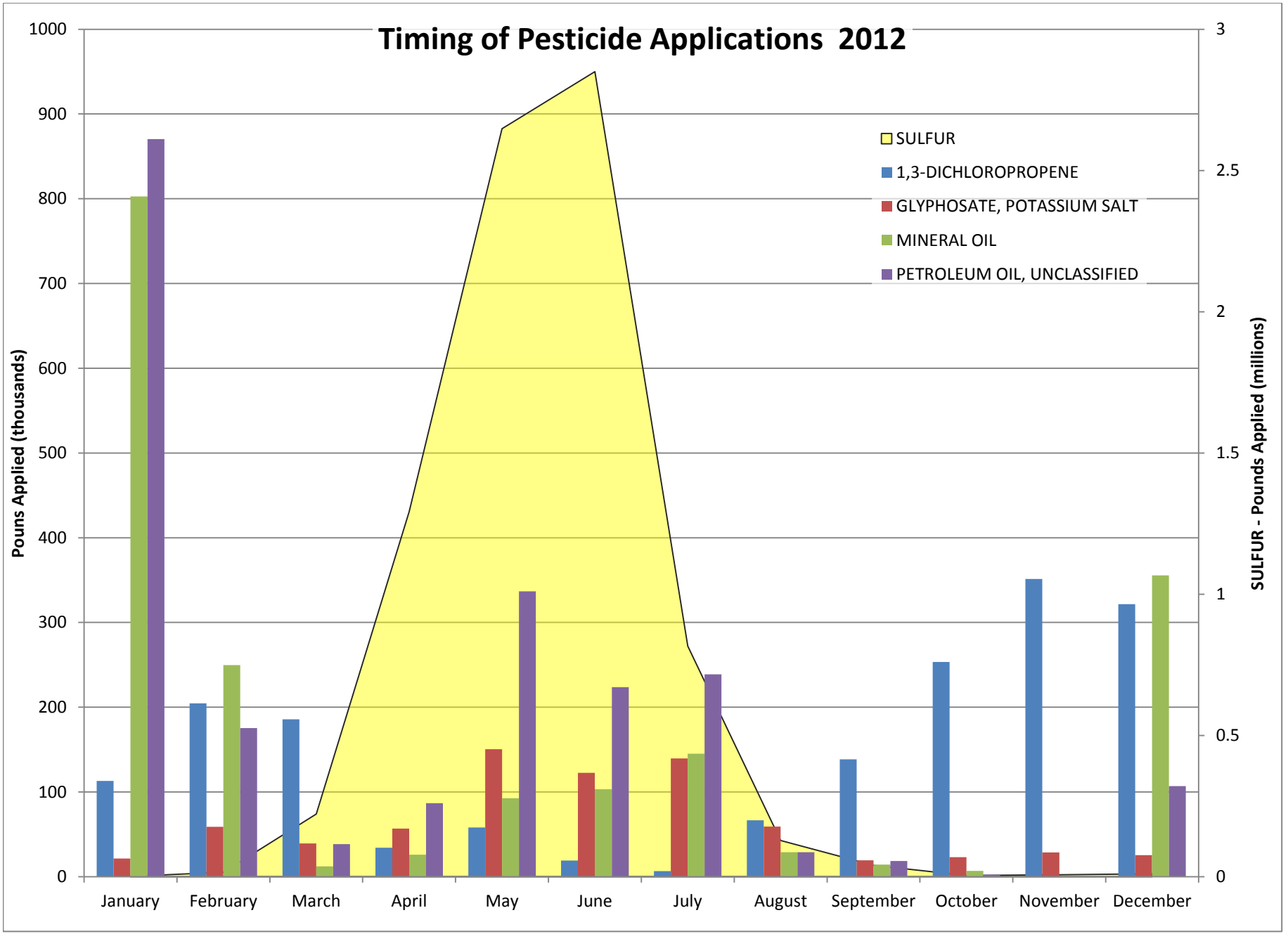
Table Three: Major Product Usage Trends in Total Pounds Applied, 2010-2012

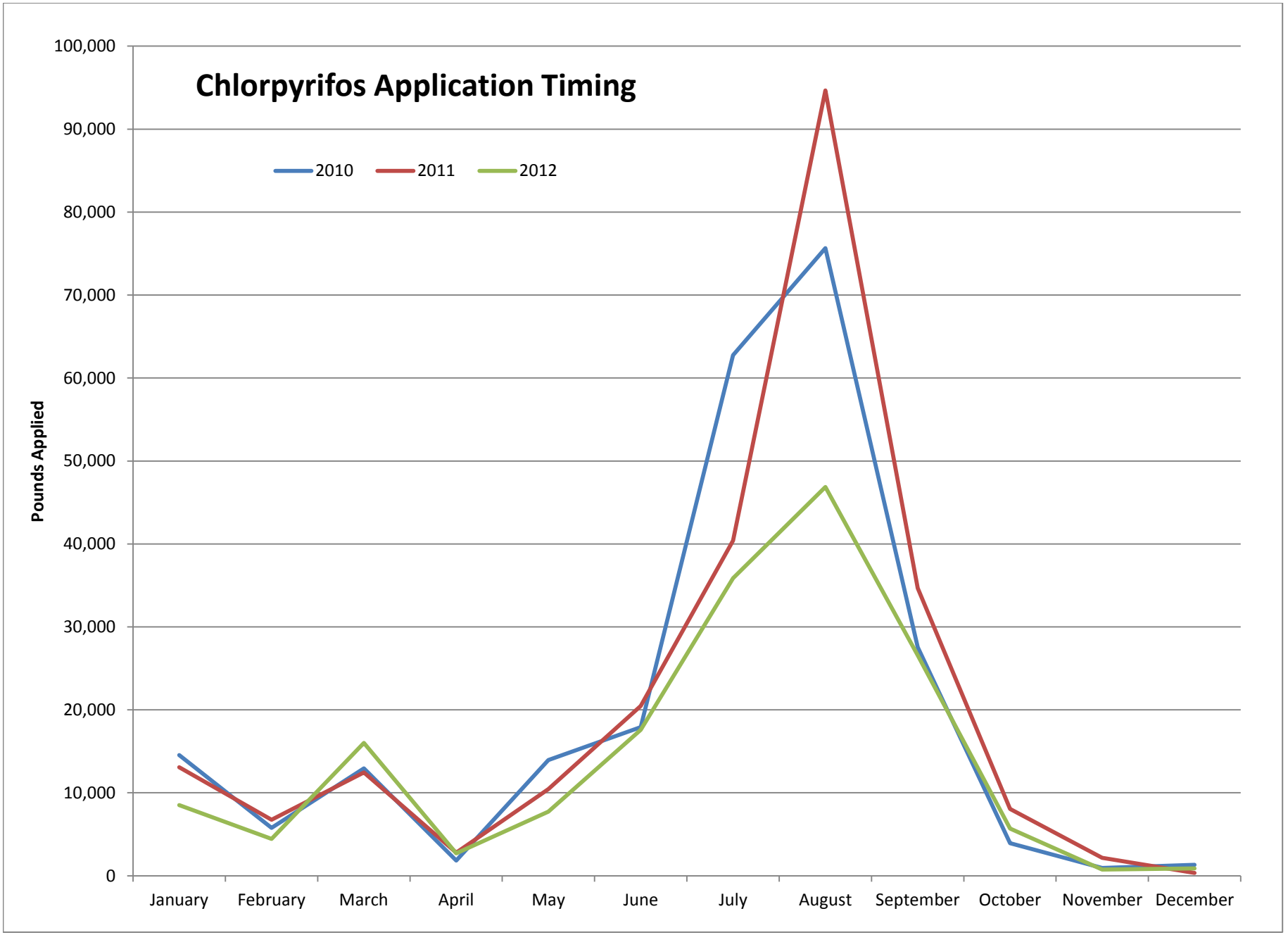
Product	Year	2010	2011	2012
Sulfur		8,527,111	9,401,685	8,034,830
Glyphosate		928,812	1,153,985	1,202,641
Chlorpyrifos		239,106	246,246	173,679

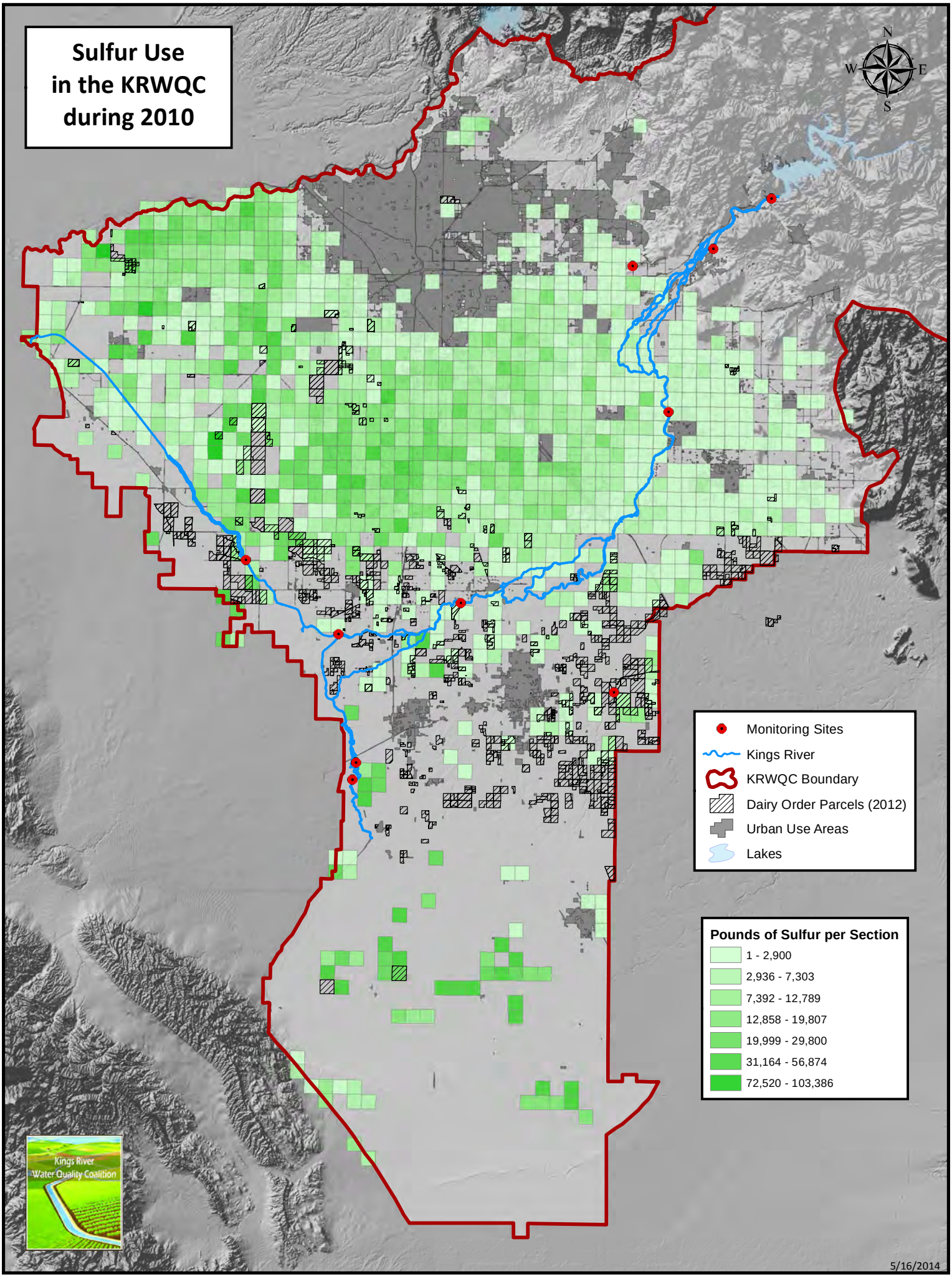
There are 33 agricultural chemistries that are being tested for within the water samples collected (see Table Four below). Table Four shows where the chemistries ranked in each of the three years used in the pesticide analysis. The majority of the chemistries rank very low in pounds used by year, and some are not listed at all. Legacy pesticides such as DDT (and its breakdown products DDD and DDE) and other organochlorines will remain within the testing program. As the methods used by the labs look at specific classes of chemistries, it is easy to keep the existing list of analytes within the program.

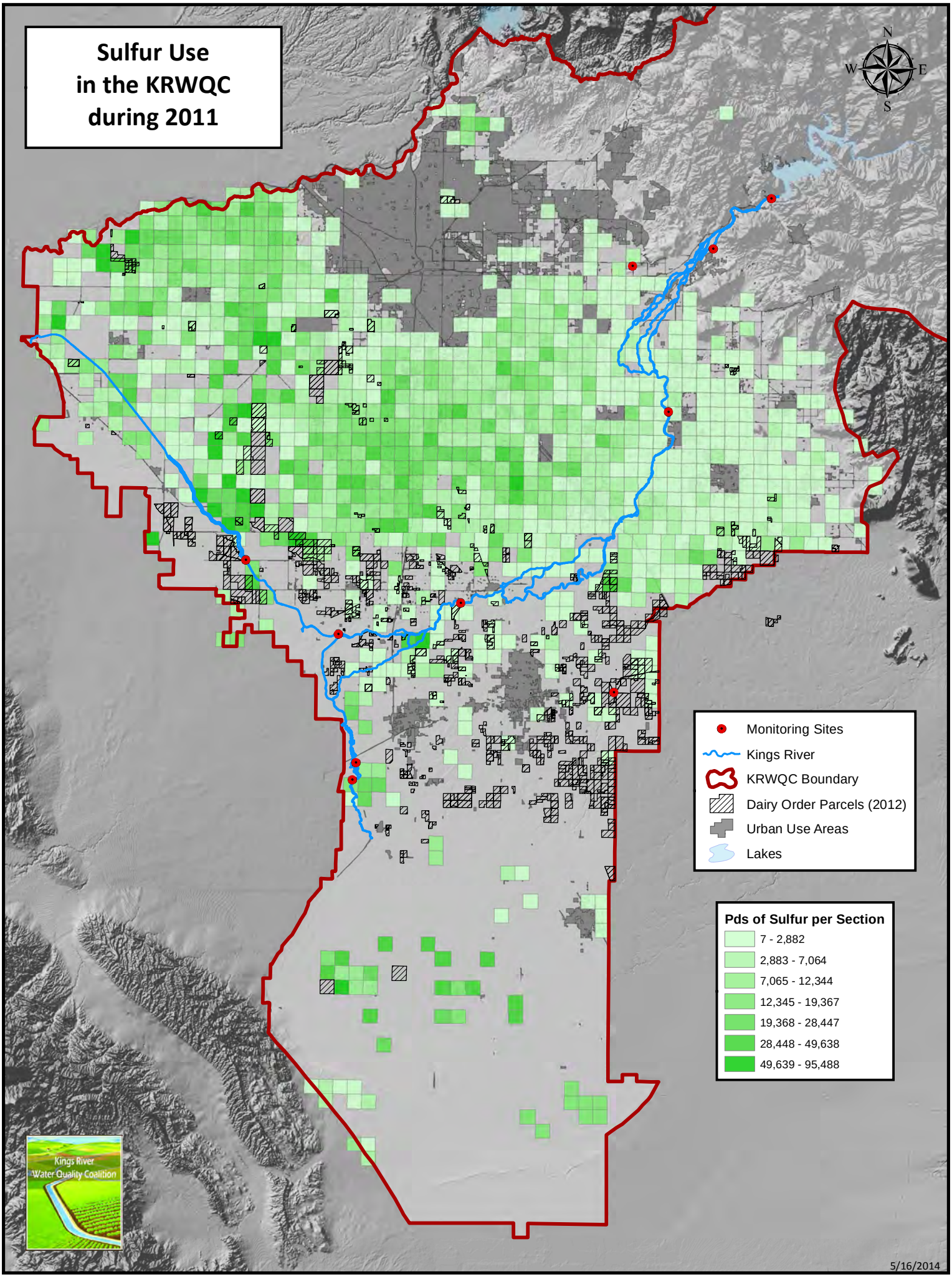

Timing of Pesticide Applications 2010
Pounds Applied (thousands)
SULFUR - Pounds Applied (millions)
1,200
1,000
800
600
400
200
0
3
2.5
2
1.5
1
0.5
0
January
February
March
April
May
June
July
August
September
October
November
December
SULFUR
1,3-DICHLOROPROPENE
GLYPHOSATE, ISOPROPYLAMINE SALT
MINERAL OIL
PETROLEUM OIL, UNCLASSIFIED

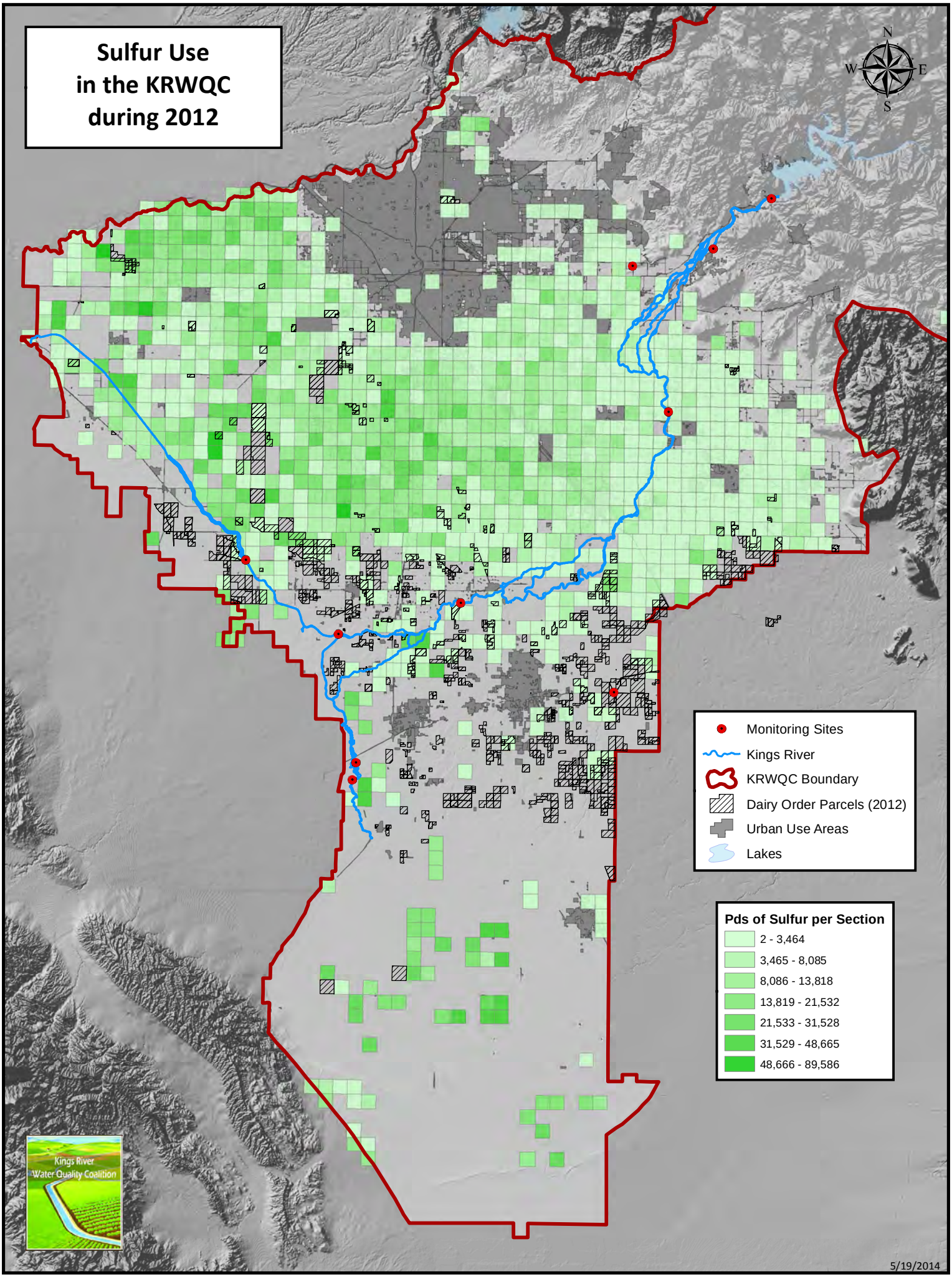

Timing of Pesticide Applications 2011
Pounds Applied (thousands)
SULFUR - Pounds Applied (millions)
SULFUR
1,3-DICHLOROPROPENE
METAM-SODIUM
MINERAL OIL
PETROLEUM OIL, UNCLASSIFIED
0
200
400
600
800
1000
1200
1400
0
0.5
1
1.5
2
2.5
3
3.5
4
January
February
March
April
May
June
July
August
September
October
November
December

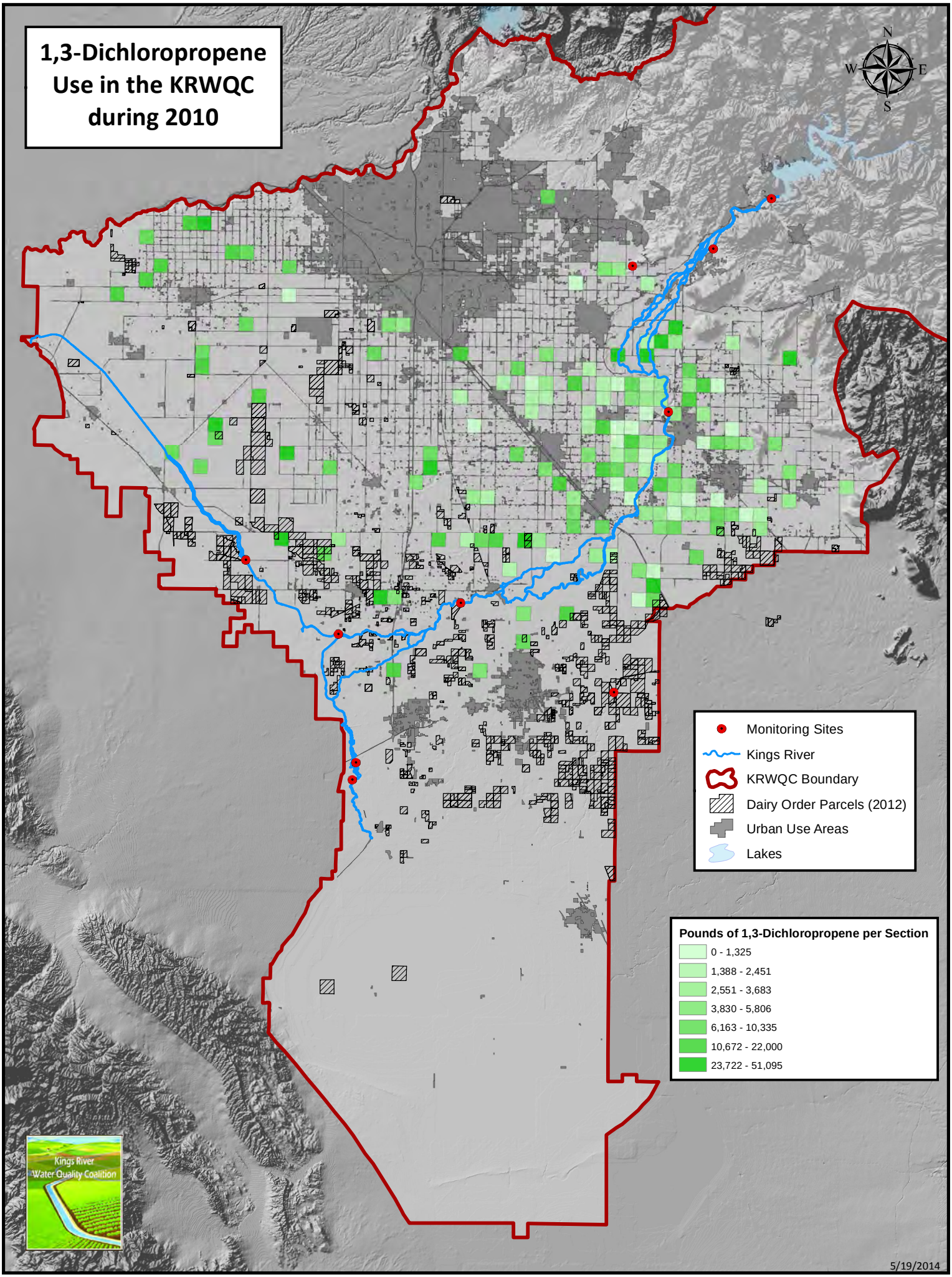

Timing of Pesticide Applications 2012
Pouns Applied (thousands)
SULFUR - Pounds Applied (millions)
SULFUR
1,3-DICHLOROPROPENE
GLYPHOSATE, POTASSIUM SALT
MINERAL OIL
PETROLEUM OIL, UNCLASSIFIED
1000
900
800
700
600
500
400
300
200
100
0
3
2.5
2
1.5
1
0.5
0
January
February
March
April
May
June
July
August
September
October
November
December

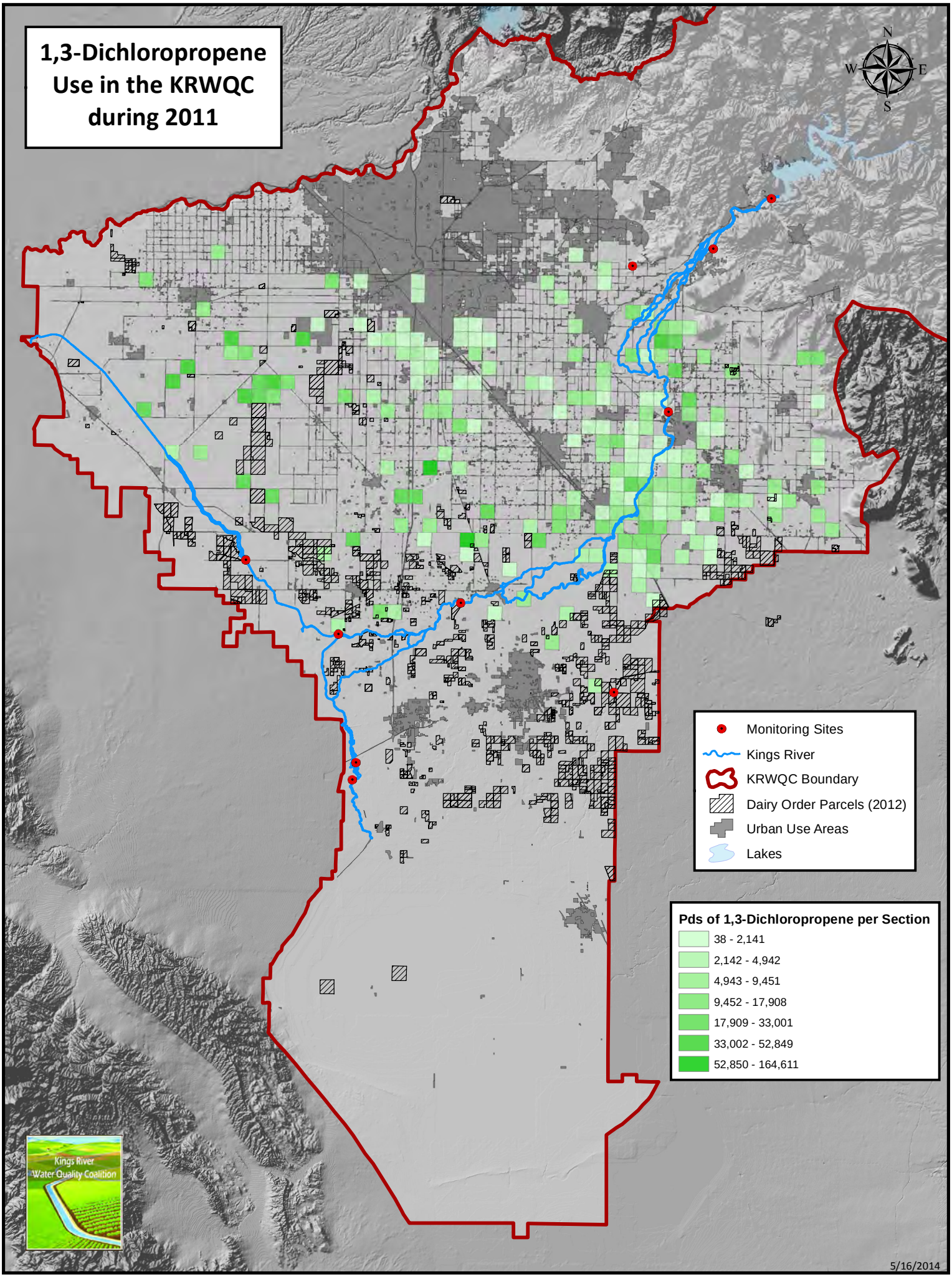

Chlorpyrifos Application Timing
2010
2011
2012
Pounds Applied
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
January
February
March
April
May
June
July
August
September
October
November
December

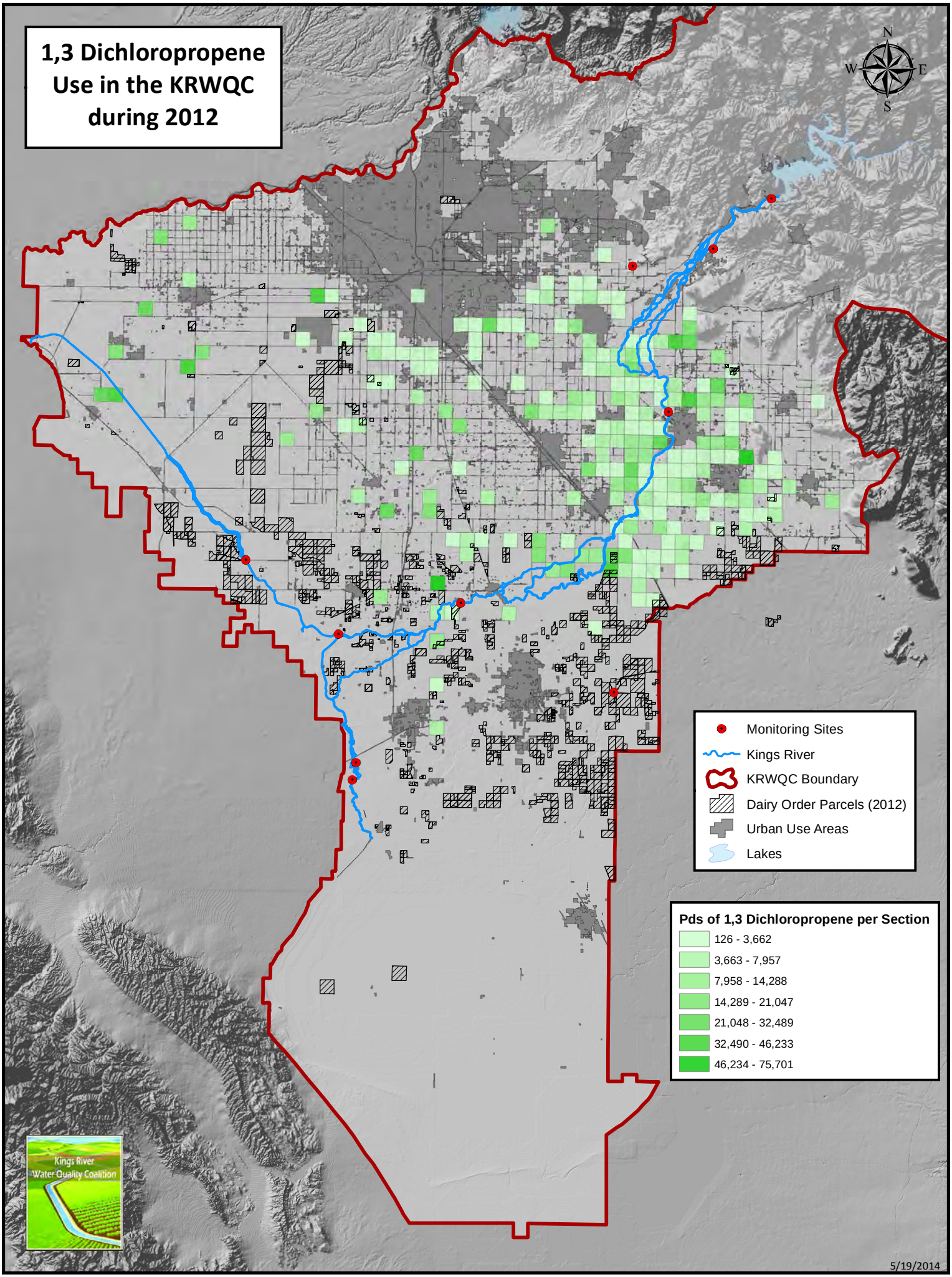

Sulfur Use
in the KRWQC
during 2010
N
W
E
S
Monitoring Sites
Kings River
KRWQC Boundary
Dairy Order Parcels (2012)
Urban Use Areas
Lakes
Pounds of Sulfur per Section
1 - 2,900
2,936 - 7,303
7,392 - 12,789
12,858 - 19,807
19,999 - 29,800
31,164 - 56,874
72,520 - 103,386
Kings River
Water Quality Coalition
5/16/2014

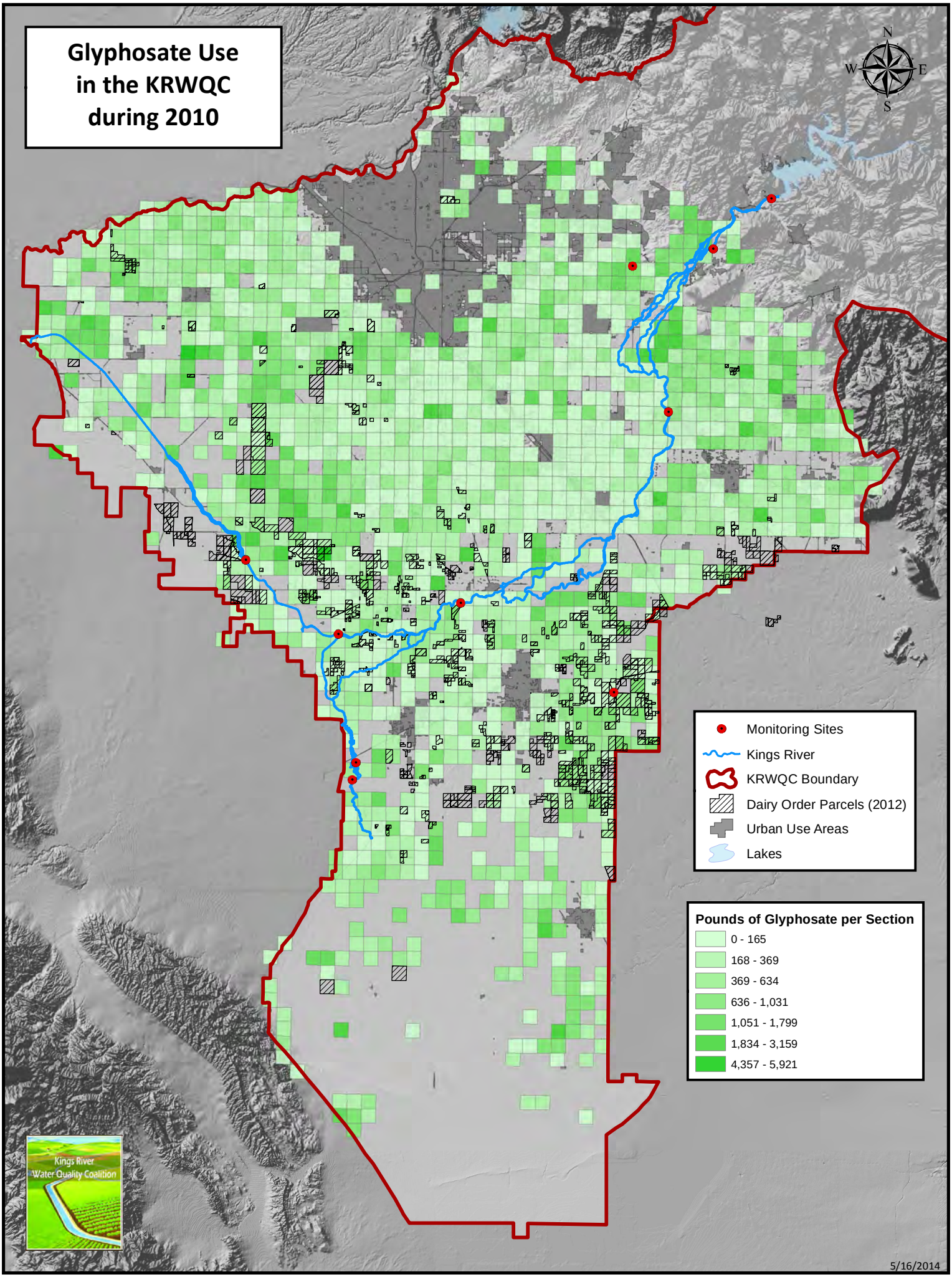

Sulfur Use
in the KRWQC
during 2011
N
W
E
S
Monitoring Sites
Kings River
KRWQC Boundary
Dairy Order Parcels (2012)
Urban Use Areas
Lakes
Pds of Sulfur per Section
7 - 2,882
2,883 - 7,064
7,065 - 12,344
12,345 - 19,367
19,368 - 28,447
28,448 - 49,638
49,639 - 95,488
Kings River
Water Quality Coalition
5/16/2014

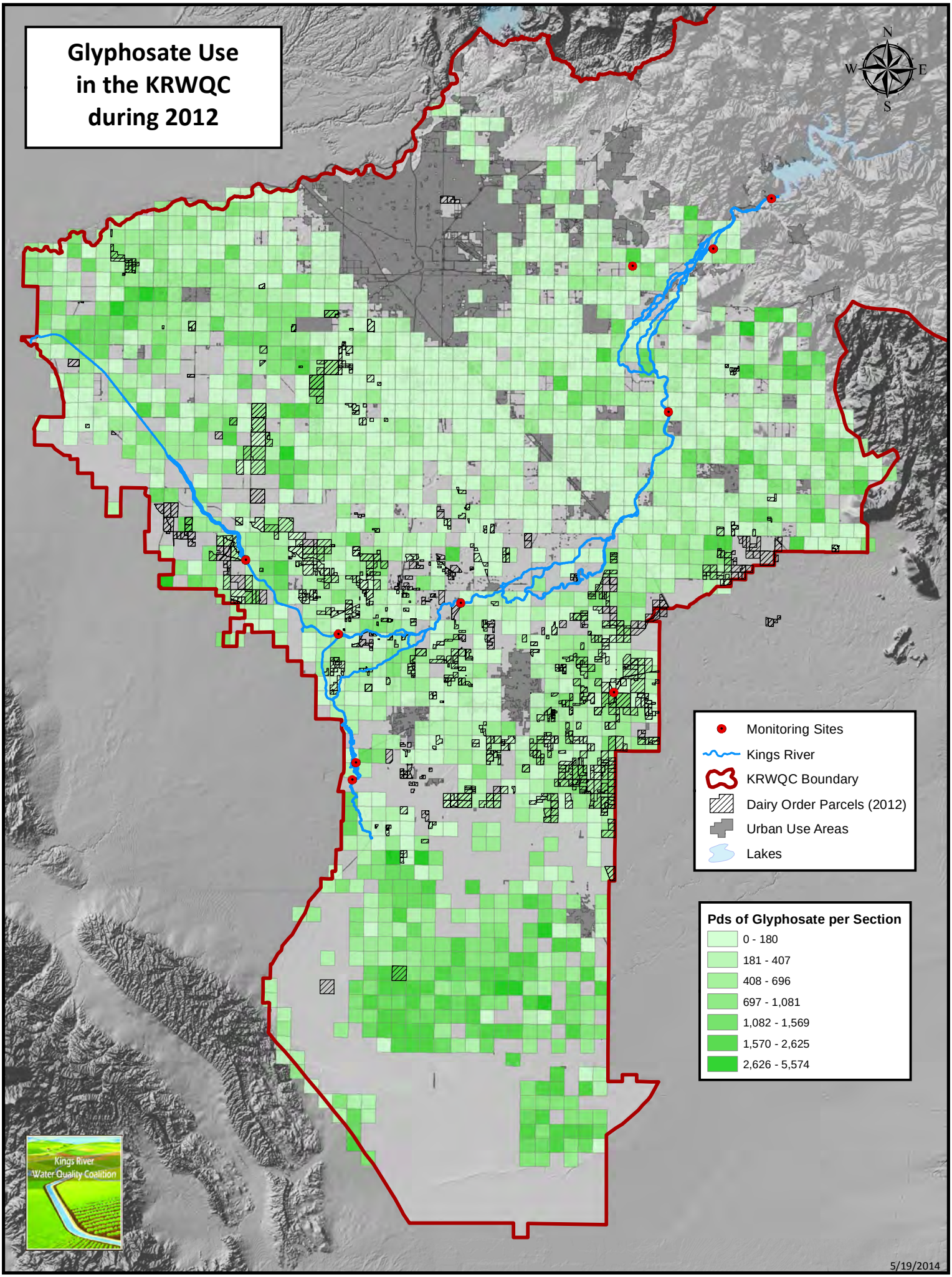

Sulfur Use
in the KRWQC
during 2012
N
W
E
S
Monitoring Sites
Kings River
KRWQC Boundary
Dairy Order Parcels (2012)
Urban Use Areas
Lakes
Pds of Sulfur per Section
2 - 3,464
3,465 - 8,085
8,086 - 13,818
13,819 - 21,532
21,533 - 31,528
31,529 - 48,665
48,666 - 89,586
Kings River
Water Quality Coalition
5/19/2014

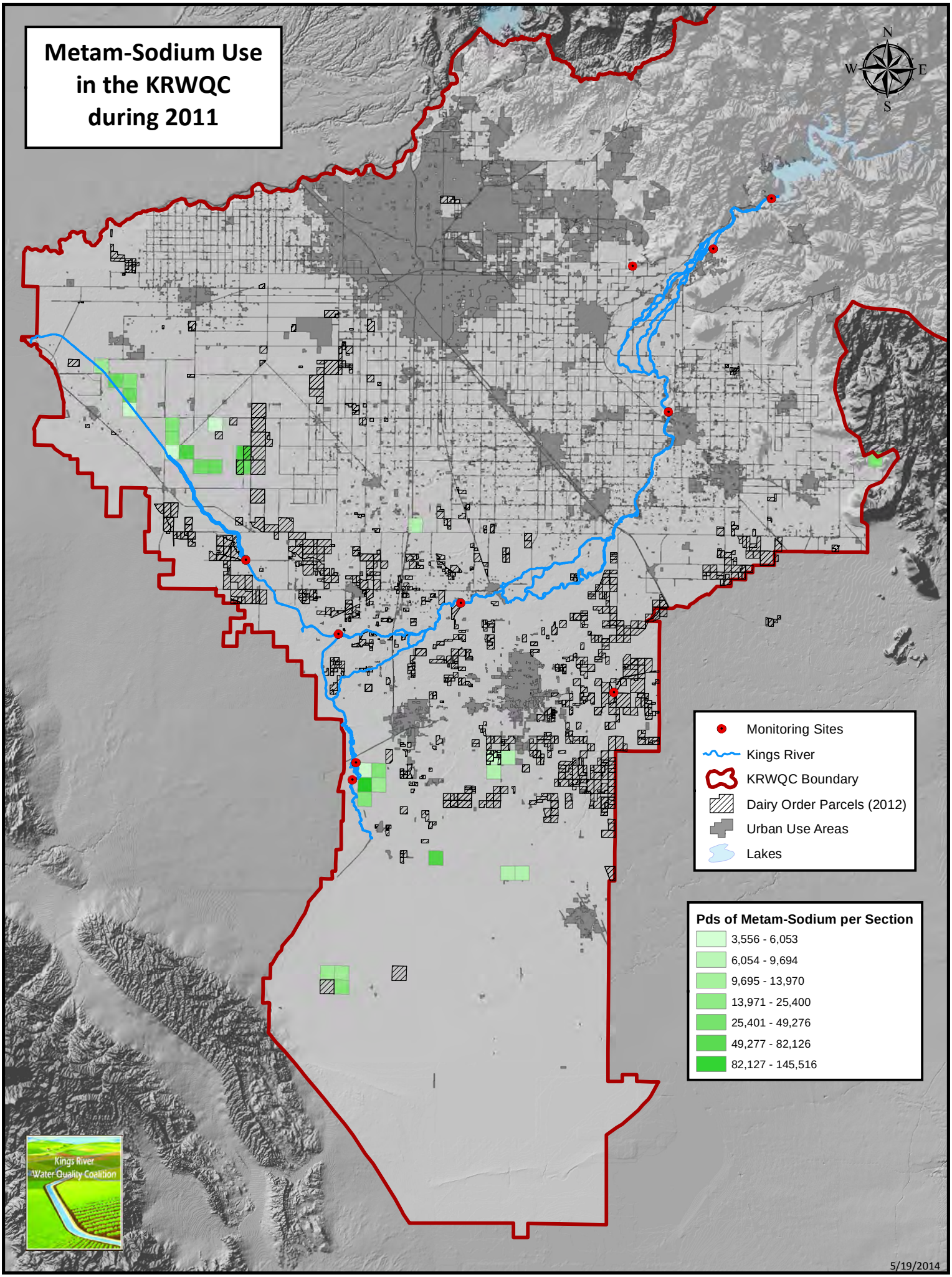

1,3-Dichloropropene Use in the KRWQC during 2010
N
W
E
S
Monitoring Sites
Kings River
KRWQC Boundary
Dairy Order Parcels (2012)
Urban Use Areas
Lakes
Pounds of 1,3-Dichloropropene per Section
0 - 1,325
1,388 - 2,451
2,551 - 3,683
3,830 - 5,806
6,163 - 10,335
10,672 - 22,000
23,722 - 51,095
Kings River Water Quality Coalition
5/19/2014

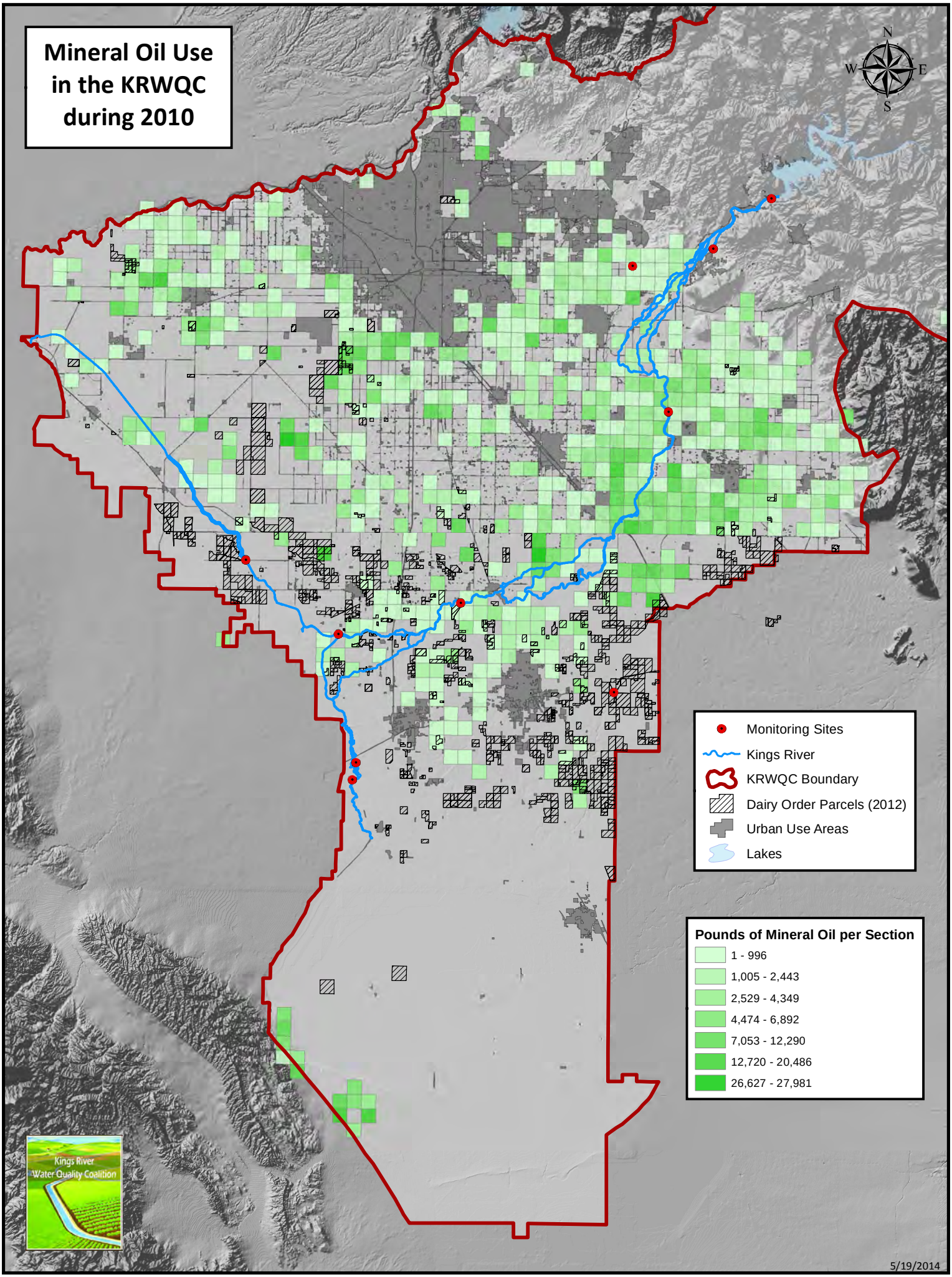

1,3-Dichloropropene Use in the KRWQC during 2011
N
W
E
S
Monitoring Sites
Kings River
KRWQC Boundary
Dairy Order Parcels (2012)
Urban Use Areas
Lakes
Pds of 1,3-Dichloropropene per Section
38 - 2,141
2,142 - 4,942
4,943 - 9,451
9,452 - 17,908
17,909 - 33,001
33,002 - 52,849
52,850 - 164,611
Kings River Water Quality Coalition
5/16/2014

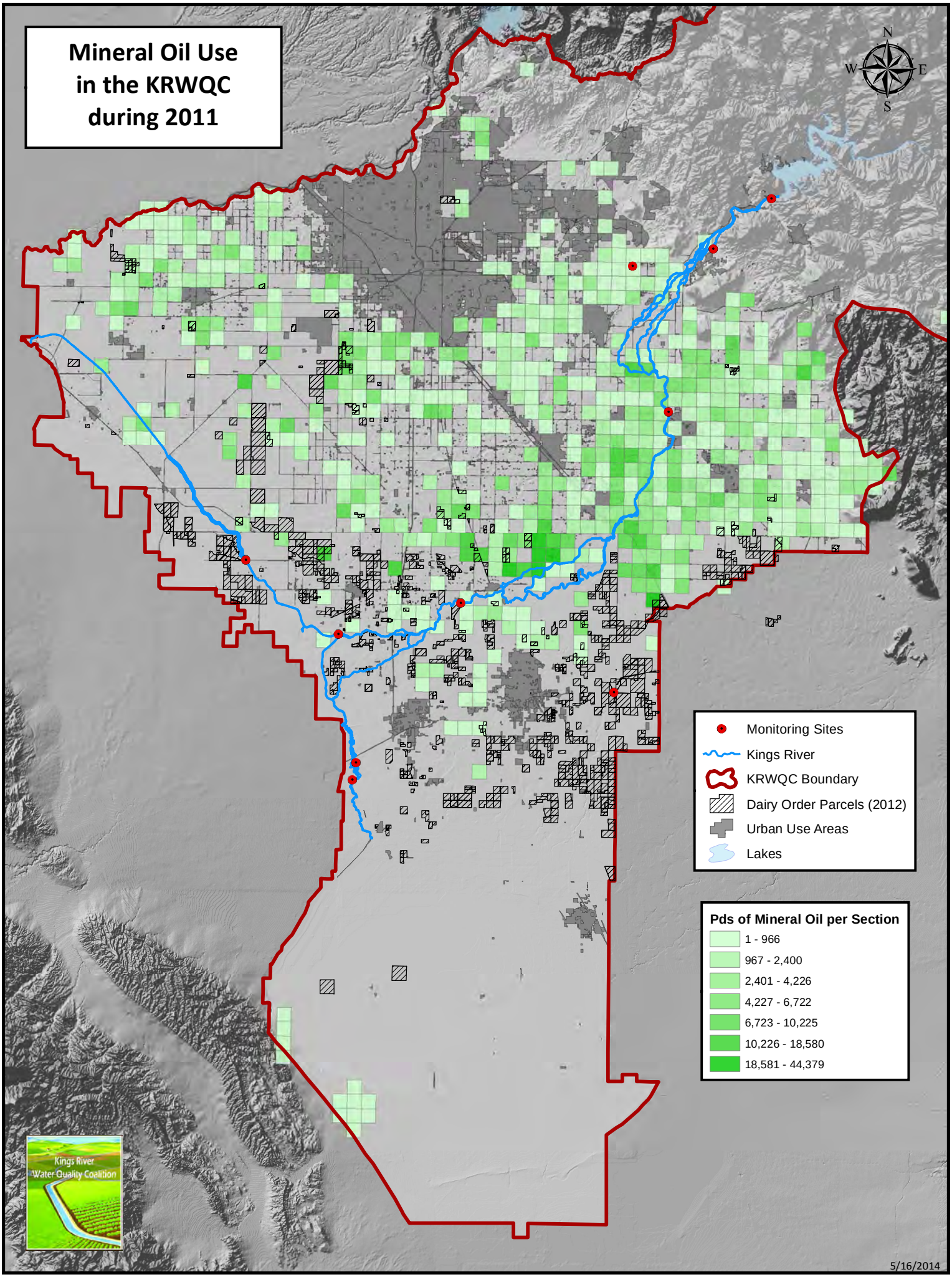

1,3 Dichloropropene Use in the KRWQC during 2012
N
W
E
S
Monitoring Sites
Kings River
KRWQC Boundary
Dairy Order Parcels (2012)
Urban Use Areas
Lakes
Pds of 1,3 Dichloropropene per Section
126 - 3,662
3,663 - 7,957
7,958 - 14,288
14,289 - 21,047
21,048 - 32,489
32,490 - 46,233
46,234 - 75,701
Kings River Water Quality Coalition
5/19/2014

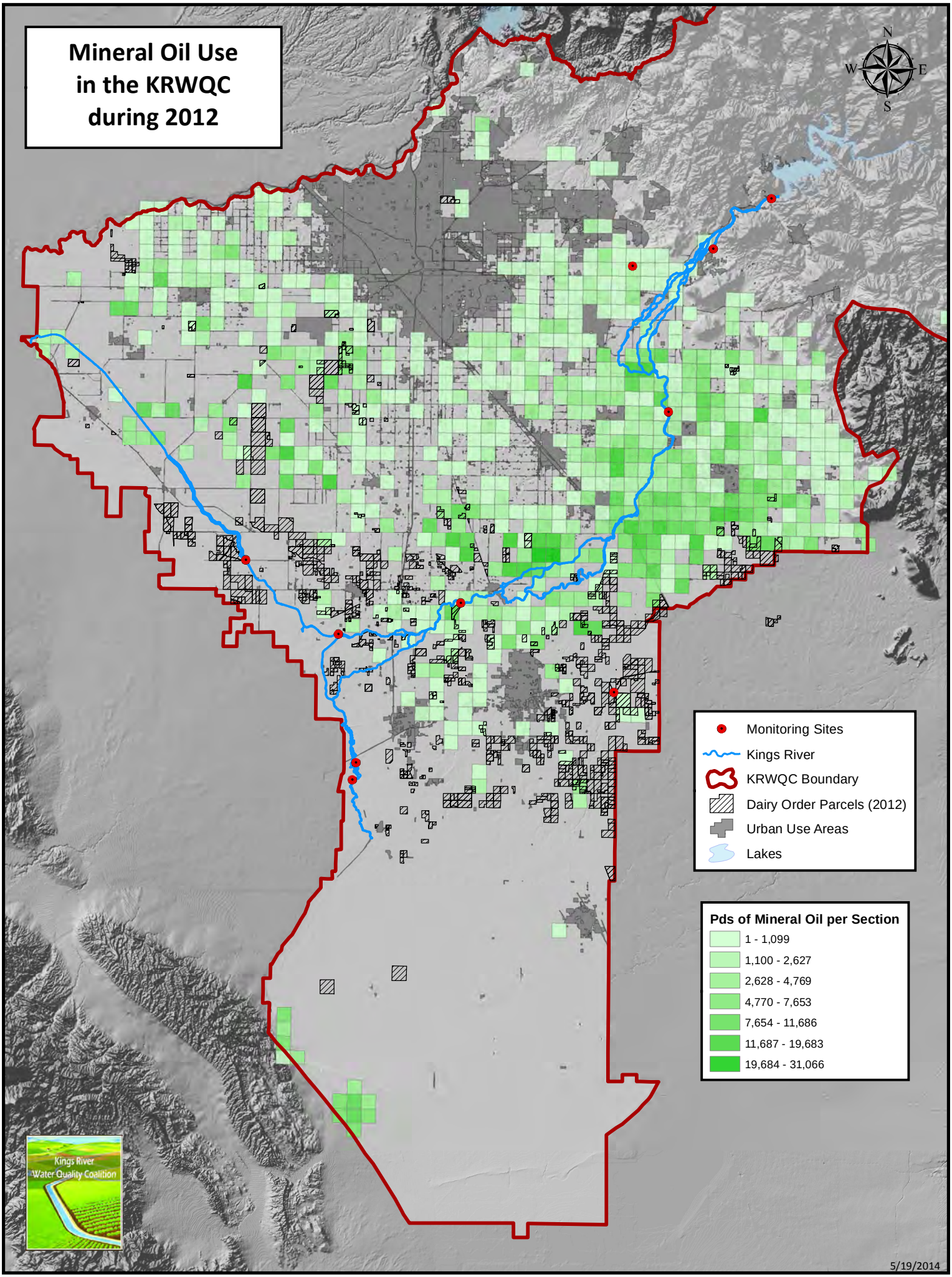

Glyphosate Use in the KRWQC during 2010
N
W
E
S
Monitoring Sites
Kings River
KRWQC Boundary
Dairy Order Parcels (2012)
Urban Use Areas
Lakes
Pounds of Glyphosate per Section
0 - 165
168 - 369
369 - 634
636 - 1,031
1,051 - 1,799
1,834 - 3,159
4,357 - 5,921
Kings River Water Quality Coalition
5/16/2014

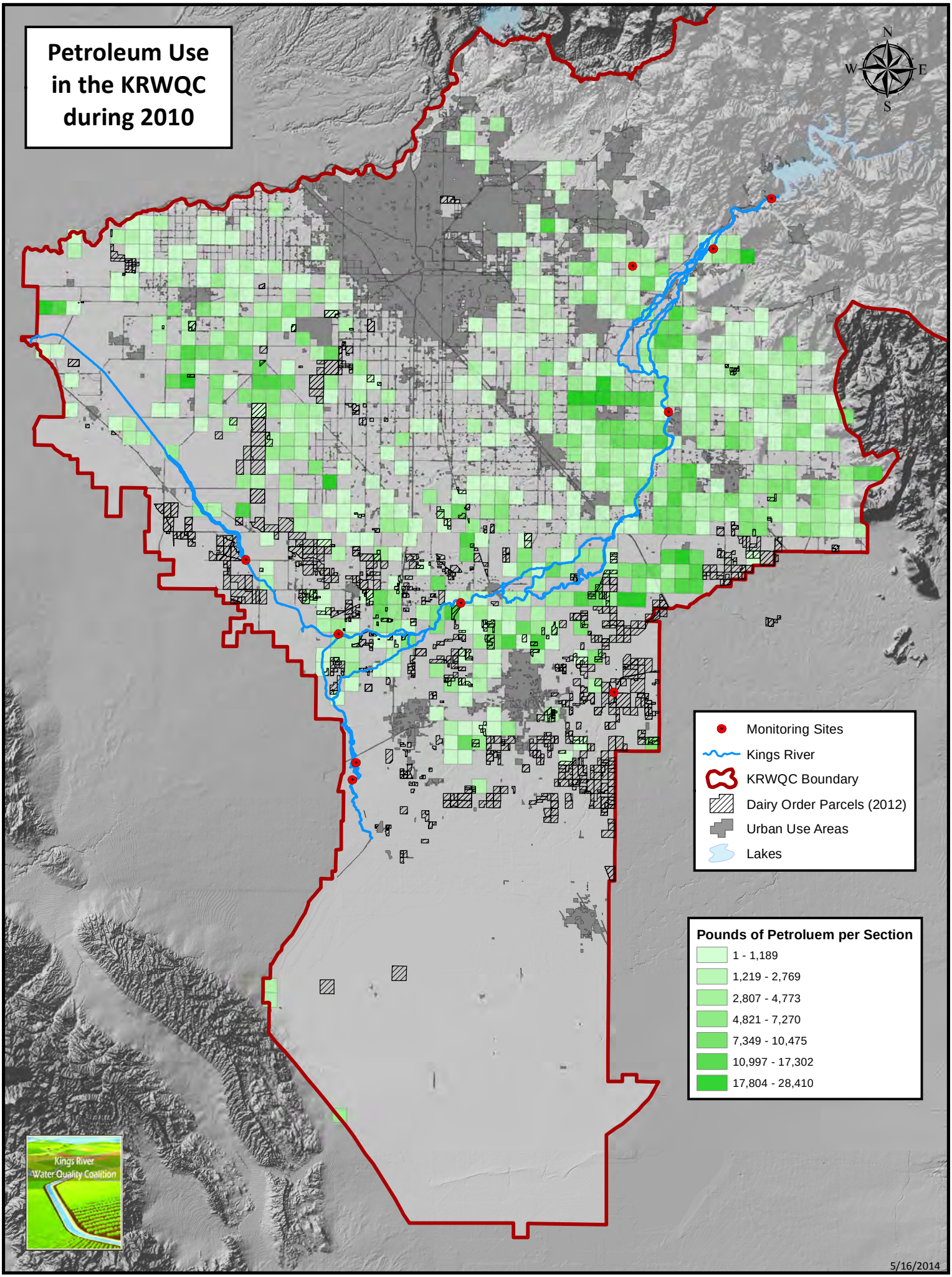

Glyphosate Use in the KRWQC during 2012
N
W
E
S
Monitoring Sites
Kings River
KRWQC Boundary
Dairy Order Parcels (2012)
Urban Use Areas
Lakes
Pds of Glyphosate per Section
0 - 180
181 - 407
408 - 696
697 - 1,081
1,082 - 1,569
1,570 - 2,625
2,626 - 5,574
Kings River Water Quality Coalition
5/19/2014

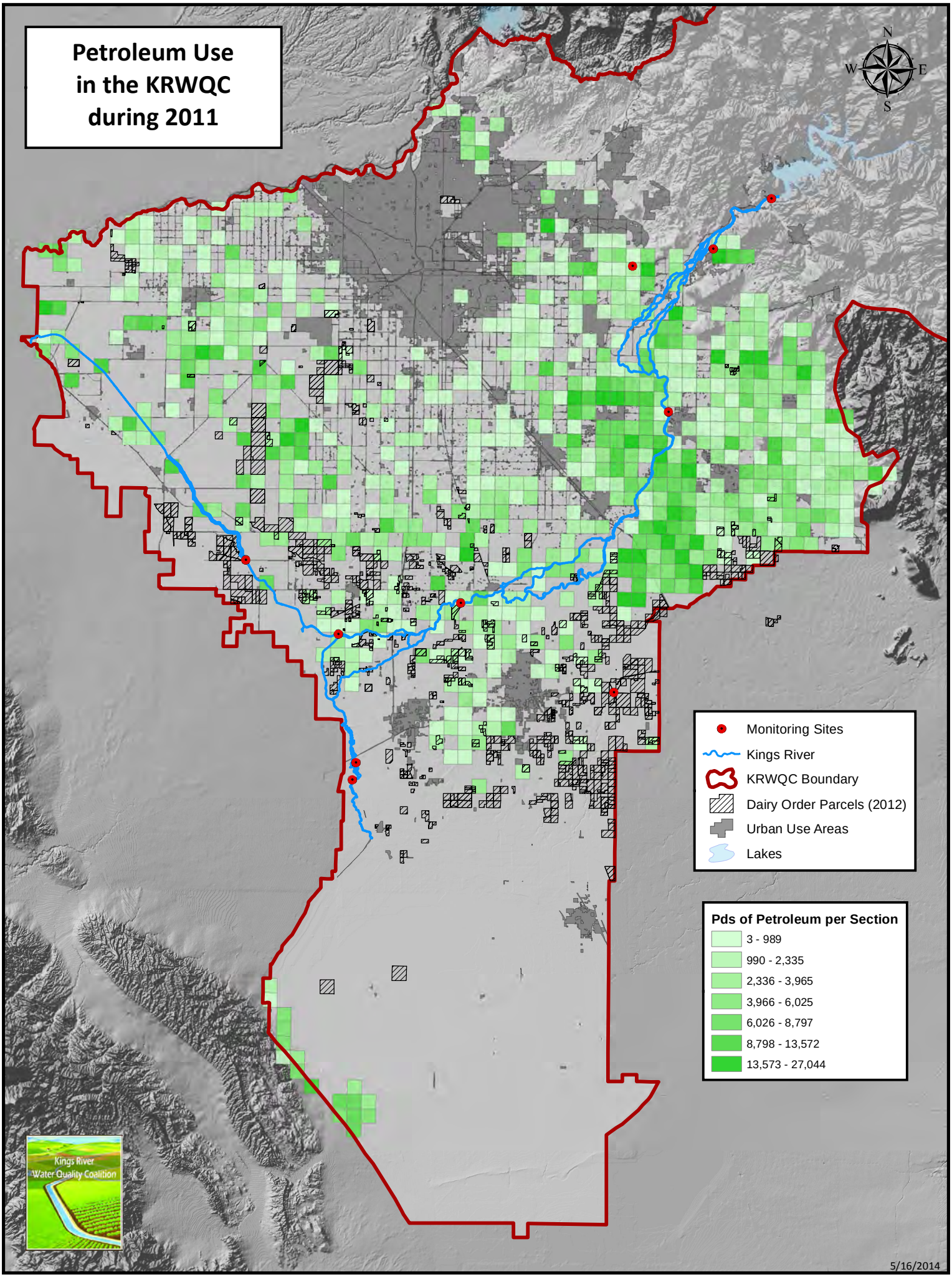

Metam-Sodium Use in the KRWQC during 2011
N
W
E
S
Monitoring Sites
Kings River
KRWQC Boundary
Dairy Order Parcels (2012)
Urban Use Areas
Lakes
Pds of Metam-Sodium per Section
3,556 - 6,053
6,054 - 9,694
9,695 - 13,970
13,971 - 25,400
25,401 - 49,276
49,277 - 82,126
82,127 - 145,516
Kings River Water Quality Coalition
5/19/2014

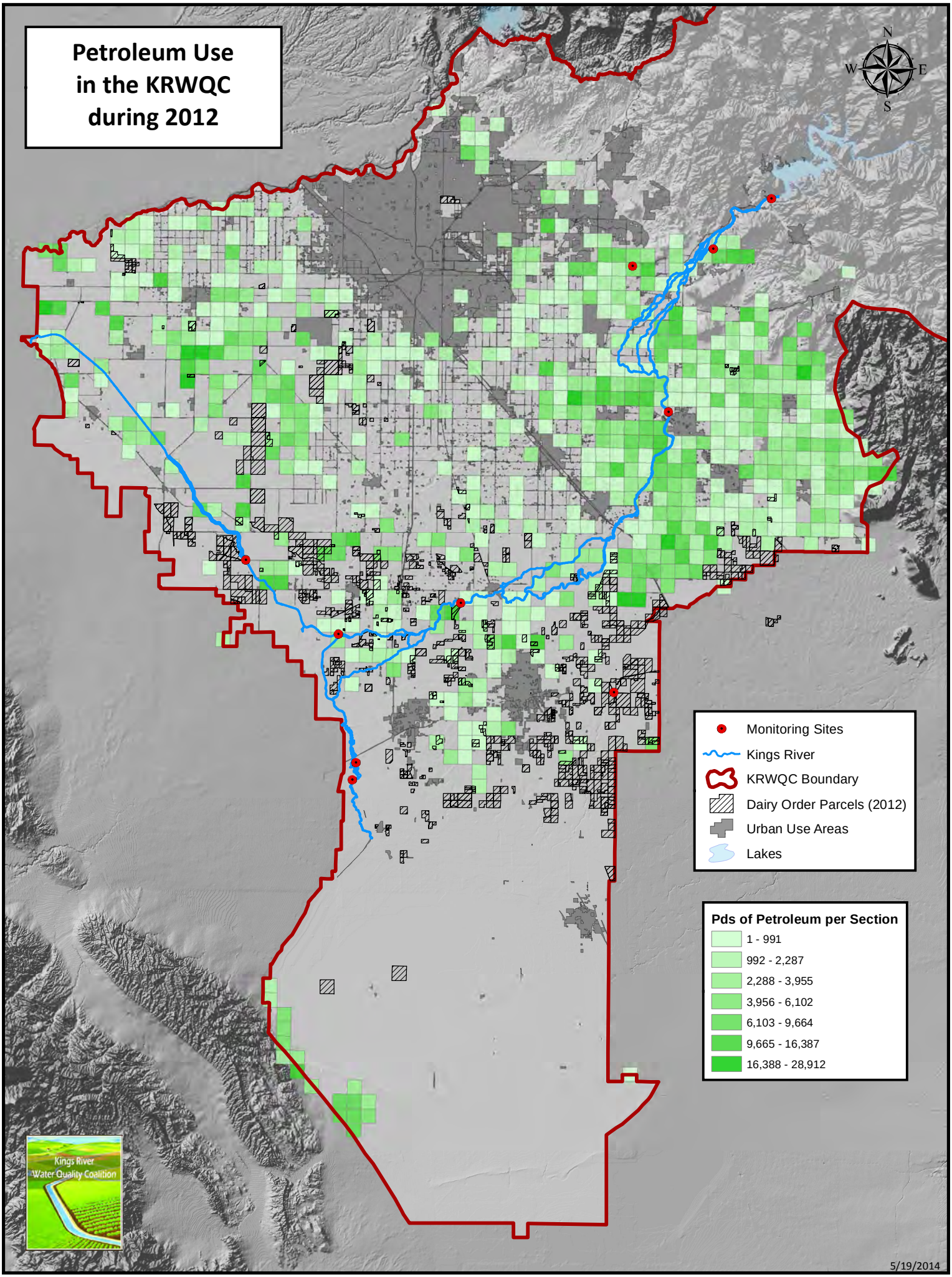

Mineral Oil Use in the KRWQC during 2010
N
W
E
S
Monitoring Sites
Kings River
KRWQC Boundary
Dairy Order Parcels (2012)
Urban Use Areas
Lakes
Pounds of Mineral Oil per Section
1 - 996
1,005 - 2,443
2,529 - 4,349
4,474 - 6,892
7,053 - 12,290
12,720 - 20,486
26,627 - 27,981
Kings River Water Quality Coalition
5/19/2014

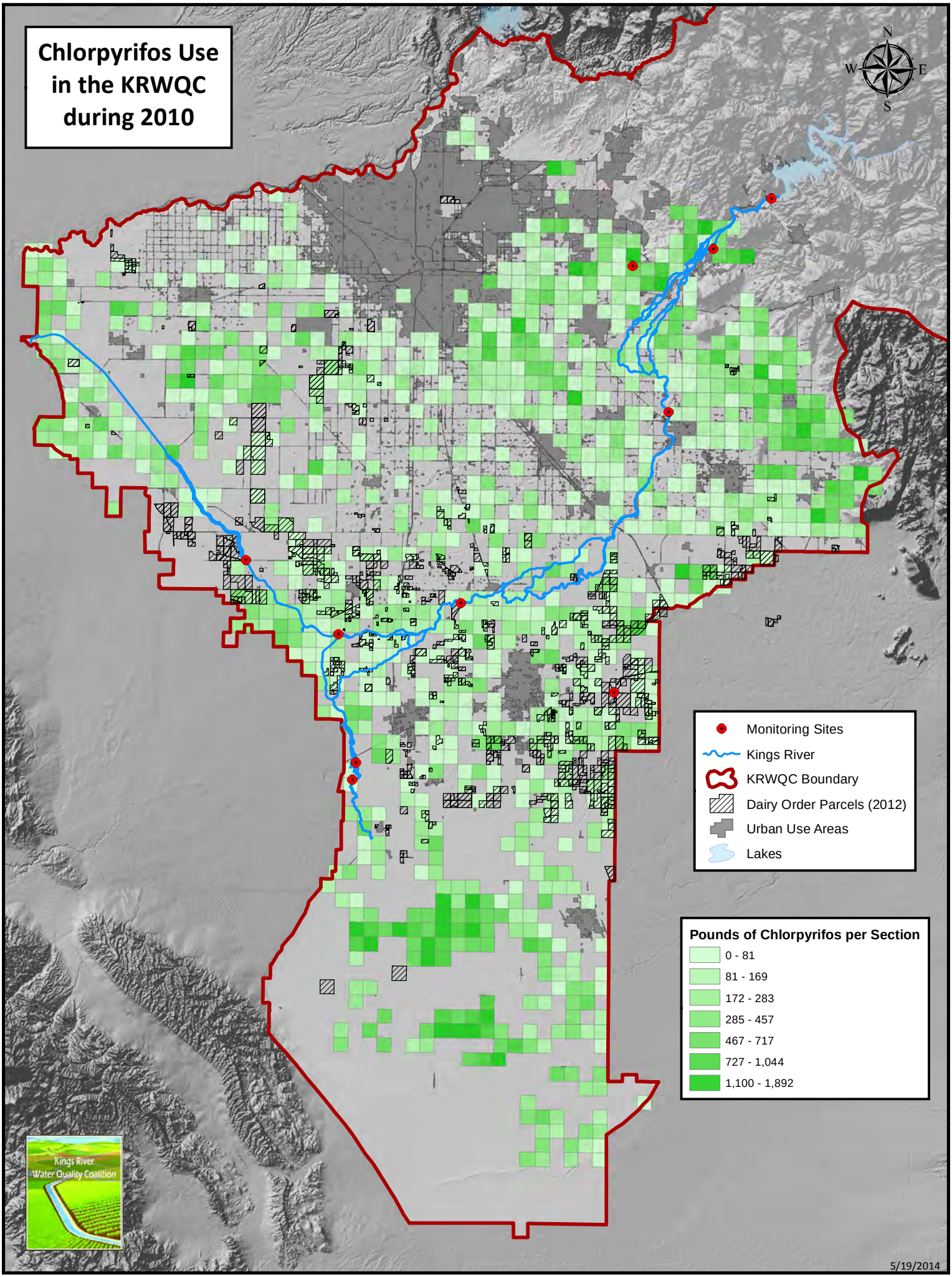

Mineral Oil Use in the KRWQC during 2011
N
W
E
S
Monitoring Sites
Kings River
KRWQC Boundary
Dairy Order Parcels (2012)
Urban Use Areas
Lakes
Pds of Mineral Oil per Section
1 - 966
967 - 2,400
2,401 - 4,226
4,227 - 6,722
6,723 - 10,225
10,226 - 18,580
18,581 - 44,379
Kings River Water Quality Coalition
5/16/2014

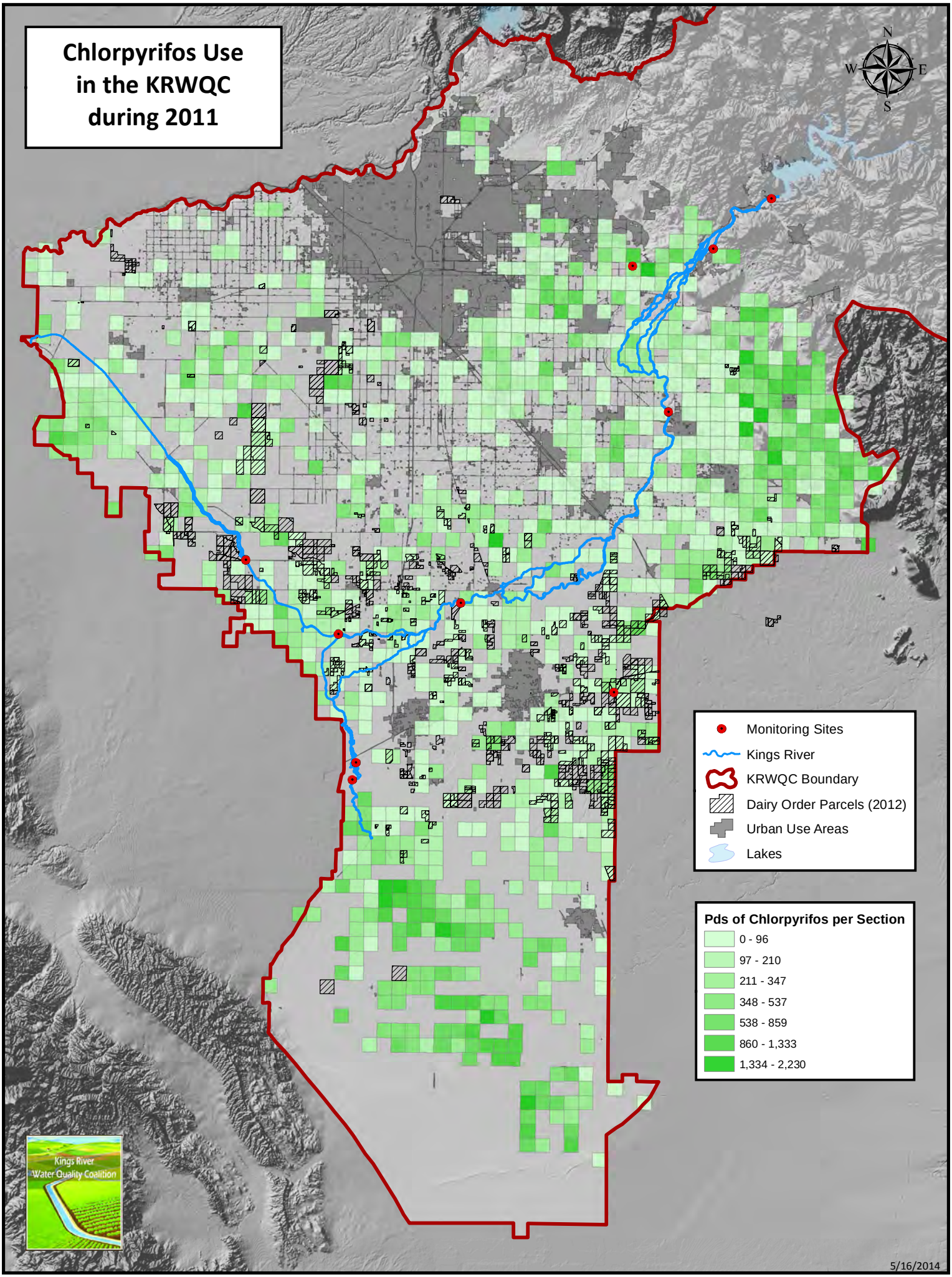

Mineral Oil Use in the KRWQC during 2012
N
W
E
S
Monitoring Sites
Kings River
KRWQC Boundary
Dairy Order Parcels (2012)
Urban Use Areas
Lakes
Pds of Mineral Oil per Section
1 - 1,099
1,100 - 2,627
2,628 - 4,769
4,770 - 7,653
7,654 - 11,686
11,687 - 19,683
19,684 - 31,066
Kings River Water Quality Coalition
5/19/2014

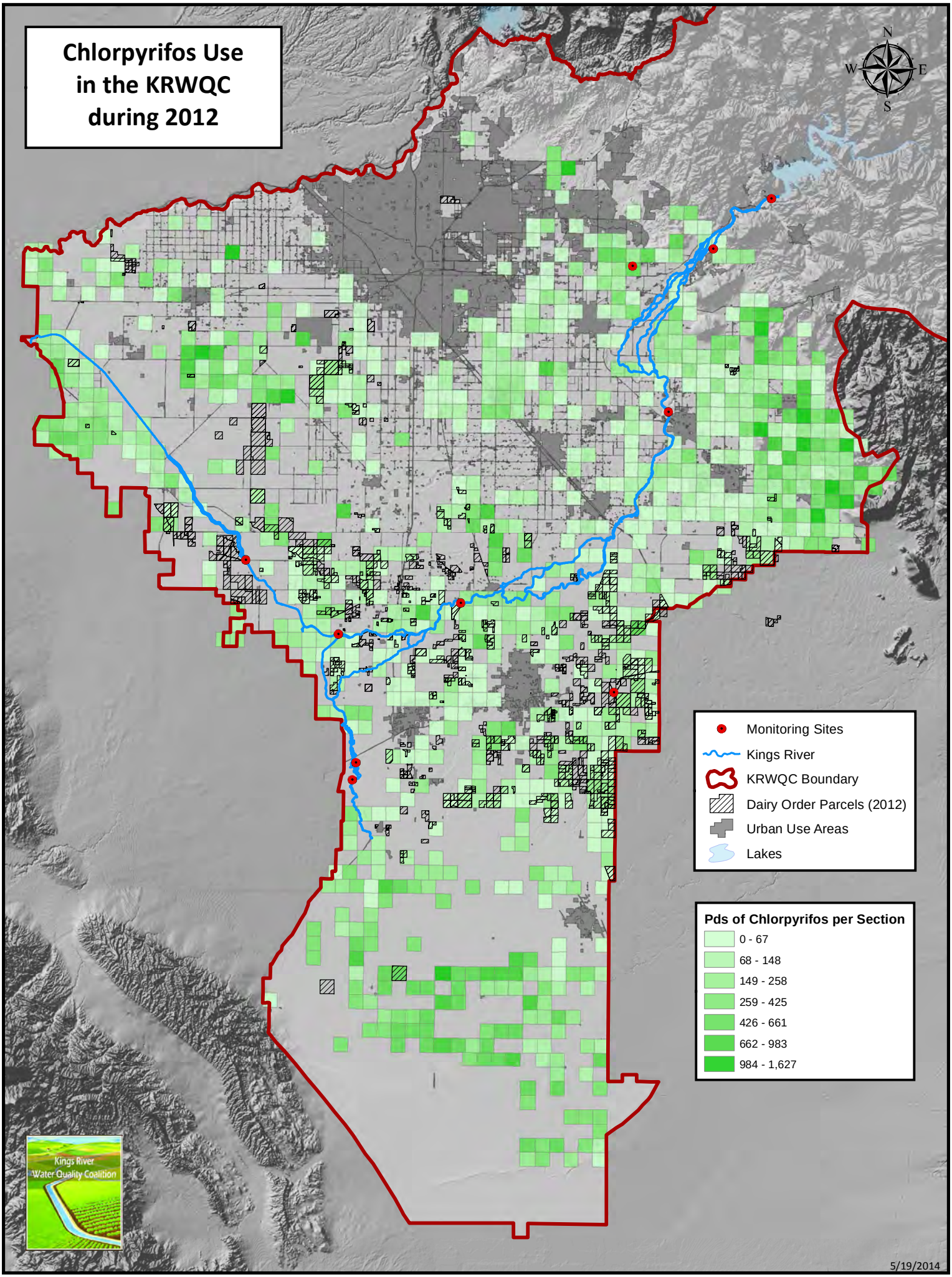

Petroleum Use in the KRWQC during 2010
N
W
E
S
Monitoring Sites
Kings River
KRWQC Boundary
Dairy Order Parcels (2012)
Urban Use Areas
Lakes
Pounds of Petroluem per Section
1 - 1,189
1,219 - 2,769
2,807 - 4,773
4,821 - 7,270
7,349 - 10,475
10,997 - 17,302
17,804 - 28,410
Kings River Water Quality Coalition
5/16/2014


Petroleum Use
in the KRWQC
during 2011
N
W
E
S
Monitoring Sites
Kings River
KRWQC Boundary
Dairy Order Parcels (2012)
Urban Use Areas
Lakes
Pds of Petroleum per Section
3 - 989
990 - 2,335
2,336 - 3,965
3,966 - 6,025
6,026 - 8,797
8,798 - 13,572
13,573 - 27,044
Kings River
Water Quality Coalition
5/16/2014


Petroleum Use in the KRWQC during 2012
N
W
E
S
Monitoring Sites
Kings River
KRWQC Boundary
Dairy Order Parcels (2012)
Urban Use Areas
Lakes
Pds of Petroleum per Section
1 - 991
992 - 2,287
2,288 - 3,955
3,956 - 6,102
6,103 - 9,664
9,665 - 16,387
16,388 - 28,912
Kings River Water Quality Coalition
5/19/2014


Chlorpyrifos Use in the KRWQC during 2010
N
W
E
S
Monitoring Sites
Kings River
KRWQC Boundary
Dairy Order Parcels (2012)
Urban Use Areas
Lakes
Pounds of Chlorpyrifos per Section
0 - 81
81 - 169
172 - 283
285 - 457
467 - 717
727 - 1,044
1,100 - 1,892
Kings River Water Quality Coalition
5/19/2014


Chlorpyrifos Use in the KRWQC during 2011
N
W
E
S
Monitoring Sites
Kings River
KRWQC Boundary
Dairy Order Parcels (2012)
Urban Use Areas
Lakes
Pds of Chlorpyrifos per Section
0 - 96
97 - 210
211 - 347
348 - 537
538 - 859
860 - 1,333
1,334 - 2,230
Kings River Water Quality Coalition
5/16/2014


Chlorpyrifos Use in the KRWQC during 2012
N
W
E
S
Monitoring Sites
Kings River
KRWQC Boundary
Dairy Order Parcels (2012)
Urban Use Areas
Lakes
Pds of Chlorpyrifos per Section
0 - 67
68 - 148
149 - 258
259 - 425
426 - 661
662 - 983
984 - 1,627
Kings River Water Quality Coalition
5/19/2014

PROPOSED MONITORING

The existing constituent list for the current surface monitoring program is comprehensive in that it covers the major chemistry classes used by agriculture, along with assorted metals of concern. It was anticipated during the development process for the General Order that this existing list would form the basis of the testing program when a sampling site was under the Assessment requirements. A review of the most applied materials (by total pounds) failed to show any new analyte that needed to be added to the sampling list.

Under the General Order, two testing levels are established. The first, Assessment level testing, is a comprehensive suite of testing that includes physical parameters, metals, bacteria, pesticides, and water column toxicity testing. This level of testing is mandated for those sites listed as Assessment (discussed below) and for a 12 month period during the Core testing phase of the program at the primary sampling sites. The second level is Core level testing, which monitors the physical parameters, selected metals, and bacteria levels at the various sites for a 2-year period in each 3-year testing cycle. Any exceedances detected during the Assessment phase would be tested for during the Core testing phase.

Exceedances are to be determined using the Interim Water Quality Trigger Limits tables provided by the Regional Water Quality Control Board in March 2011. This table contains both numeric standards directly obtained from the Tulare Lake Basin Plan and selected narrative standards as presented by the Regional Water Quality Control Board.

Parameters to be monitored

Physical Parameters

The physical parameters to be monitored are pH, dissolved oxygen (DO), electrical conductivity (EC), and temperature. These data points are collected in the field by the sampling crew and are a continuation of the existing program. Basin Plan Objectives exist for pH, DO, and EC, and need to be monitored. Temperature is important as it influences the other parameters. These are collected at all sites.

Additional physical parameters are measured at the laboratory. These include Total Dissolved Solids (TDS), color, Total Suspended Solids (TSS), Total Organic Carbon (TOC), hardness, and turbidity. These will be evaluated in all samples collected except for the Jackson Ave site.

Metals

Metals are both naturally occurring and artificially applied (either as nutrients or in pest control materials). The list of metals in the current program (arsenic, boron, cadmium, copper, lead, molybdenum, nickel, phosphorus, selenium, and zinc) appears to be sufficient.

Boron, copper, molybdenum, phosphorus, and zinc are agriculturally important. All but boron and molybdenum are regularly applied in the field unless specific nutritional deficiencies are noted. Molybdenum and nickel are common alloying metals in steel tools, and selenium is important to animal nutrition in small amounts. Copper has certain pest control properties (most notably bacterial, fungal, and algaecide products), and zinc is important for fruit crops.

Arsenic, cadmium, and lead are non-agricultural materials (arsenic is a major ingredient in pressure treated lumber and some pesticides (rat poisons and insecticides), but its use is declining). Cadmium is a major metal in batteries, as is lead. Lead is also found in fishing equipment and hunting ammunition.

The schedule for the monitoring for metals will continue as before. Jackson Ave samples will look at molybdenum levels only.

Bacteria

Monitoring for bacteria levels (*Escherichia coli* and fecal coliform) will continue as before for all sampling sites except Jackson Ave, since this site is looking only at molybdenum and toxaphene levels along with physical parameters.

Nutrients

Sampling of nutrients (ammonia, nitrate + nitrite, ortho-phosphate, TKN) will continue as in the previous program for all samples collected regardless of sampling level. These samples will be collected at all sites except Jackson Ave.

Pesticides

Pesticide monitoring is mandated at all Assessment level sites and is to occur once every three years at those sites designated as Core sites. Previously monitored pyrethroid chemistries within the water column samples have been discontinued (they were not previously required), but will remain in the sediment testing as needed.

Table Four: Pesticides to be sampled during Assessment Phase at Core Sites and at Assessment Sites within the KRWQC plus DPR use rankings

Pesticide	2010	2011	2012	Pesticide	2010	2011	2012
Atrazine	--	--	--	Aldicarb	47	86	151
Cyanazine	--	--	--	Carbaryl	74	81	46
Simazine	24	30	31	Carbofuran	--	--	--
Methamidophos	134	--	--	Diuron	33	34	36
DDE	--	--	--	Linuron	152	238	169
DDD	--	--	--	Methiocarb	269	298	265
DDT	--	--	--	Methomyl	78	78	91
Dicofol	166	145	140	Oxamyl	35	37	59
Endrin	--	--	--	Azinphos-methyl	--	--	--
Methoxychlor	--	--	--	Chlorpyrifos	11	14	16
Bifenthrin*				Demeton-S	--	--	--
Cyfluthrin*				Diazinon	112	119	130
Cypermethrin*				Dichlorvos	--	--	--
Esfenvalerate*				Dimethoate	43	41	38
Fenpropthrin*				Disulfoton	--	--	--
Lambda cyhalothrin*				Malathion	46	47	40
Permethrin*				Methidathion	53	64	63
Molinate	--	--	--	Methyl-parathion	100	152	142
Thiobencarb	--	--	--	Glyphosate	**	**	**
Paraquat	14	15	13	Trifluralin	25	21	24

*sediment samples only. **multiple formulations reported.

Water Column Toxicity

Water Column Toxicity is a three stage test to evaluate stressors within a water column to biological organisms of increasing complexity. Three levels of the aquatic food chain are tested. The basic level, algae, uses the organism *Selenastrum capricornutum.* This test looks at herbicidal compounds within the water column that may disrupt the bottom of the food chain.

The next level is the invertebrate water flea (*Ceriodaphnia dubia*). This organism represents the next level in the food chain that would feed on the available algae. Invertebrates would be susceptible to those chemistries that control insects in agricultural crops, and thus would provide a warning to the presence of a single or multiple chemistries within the water column.

The uppermost level in the testing program is a vertebrate organism, fathead minnow (*Pimephales promelas*). This organism is sensitive to those products that affect the invertebrates but at higher levels of exposure.

Water Column Toxicity testing is conducted at all sites that are subject to Assessment level testing. The testing will be performed according to the schedule outlined below.

Sediment toxicity

Sediment toxicity looks at the effects of pesticides that are hydrophobic in nature, and would be more likely to be found adhered to the sediments at the bottom of the sampling site. For this test, the invertebrate *Hyalella azteca* is used to evaluate the effects of prolonged contact of the test organism to the sediments from the sample site. Pesticides present within the sediments are likely to cause mortality in the test organism. Should such mortality occur at specified levels, the sample is then sent to a lab for extraction and analysis of any pesticides present within the sediment. Soil particle analysis is also performed to evaluate the overall texture of the sediment sampled.

Of the sampling sites to be utilized by the KRWQC, two will not have sediment samples collected during the Assessment phase of testing due to local site conditions. Proposed Assessment site Army Corps of Engineers Bridge does not have sediments available for sampling due to the nature of the river bottom (mostly cobbles), Gould Canal also does not have available sediment due to the cobbles that line the canal bottom). These conditions are known to Regional Board staff and are consistent with existing sampling protocols.

MONITORING SCHEDULE AND FREQUENCY

It is the intent of the KRWQC to monitor all sites on a monthly basis, with a maximum of one site visit per calendar month.

Current Program schedule

Under the current program, sampling was allowed to be set to a *fixed* schedule so that each site was visited at approximately 30 day intervals. The KRWQC found this schedule to be logistically practical, as it allowed for the efficient allocation of resources (staff time) for both the KRWQC and the contracted laboratories. An additional benefit was realized in that the special testing requirements needed for the algae testing at sites within the Kings River allowed for the laboratory to have the specialized control cultures available when the samples were delivered. The testing methods specify the age of the test organisms and by knowing when our samples would arrive allowed the laboratory to have properly aged specimens available.

The downside of this scheduling philosophy is the risk that storm events will not be captured. The nature of the single site that is most affected by such events is that even if sampling does occur on the date that a storm is present, there is no guarantee that water will be flowing in sufficient quantities (or that the conditions present will be safe for sampling) when the sampling crew arrives. An observation in 2014 of the site failed to detect runoff at the site after 6 + hours of rainfall.

Proposed Program schedule

The KRWQC proposes to retain the fixed monitoring schedule at the non-ephemeral sites (Core and Assessment) for the logistical reasons stated above. Also, agricultural chemical applications are just as likely to occur on any given day of the month as any other, so randomly selecting days within a month provides no more chance of capturing any potential contamination as any other day. The KRWQC will modify its sampling protocols to allow for storm events during the months that are most likely to have such events, namely October through March. Allowances will be made for holidays as necessary. Sampling will occur once per calendar month at each site. Sampling events will be separated by a minimum of 14 days.

Ephemeral sample sets will be kept available at the Coalition office for use during storm events, including the possibility of collections on weekends, which does not occur at present. The laboratory will be placed on alert to have appropriate organisms in place for analysis of samples. During the critical period, weather forecasts will be watched closely, and in the event of a rainfall event, staff will take the sample containers to the sample site and await the necessary flows for sampling. Waiting will be discontinued after sunset. Should a storm event occur on a weekend, a staff member who lives in close proximity to the site will report to the Program Manager the presence and intensity of the rainfall, and the presence of flow at the sample site. Approximately 2 hours after such notification, samples will be collected and transported to the appropriate laboratories. Should the notification occur after sunset, an effort to collect a sample the following morning will be made.

Date of transport will depend upon time of collection. Most samples will be transported the day after collection. Saturday samples collected early in the day will be transported the same day; otherwise they will be transported Sunday morning. Sunday samples will be transported Monday morning. Transport will take place as needed to insure the samples arrive within the 36 hour hold time. Water Column Toxicity samples collected late in the day Saturday (after 3 pm) will be transported the next morning. Chemistry samples (including bacteria samples) will be delivered the same day they are collected.

For Core sites under Assessment testing and any Assessment site testing, Water Column Toxicity samples will be transported the next business day and chemistry samples will be delivered to the laboratory on the date of collection. Collections at these sites will occur either on the Monday immediately before the third Tuesday of each month or on the third Tuesday, as scheduling permits. All Water Column Toxicity samples (and associated chemistry samples) will be collected on the same day for those sites that have that requirement. Adjustments for holidays (collections timed to avoid running tests during a holiday) will be made as necessary. Such accommodations have been made in the past.

Sampling during flood releases on the Kings River will be evaluated on a case by case basis, with the determining factor being flows at the sites to be sampled and the bank conditions. Such restrictions only apply to sites along the river (Manning Ave, Lemoore Weir, Crescent Weir, and Stinson Weir). Gould Canal, Jackson Ave, and Empire Weir #1 are not normally affected by such operations. Proposed Assessment sites Army Corps of Engineers Bridge and Cross Creek may be impacted by flood releases and will also be evaluated on a case by case basis. Recent or continuing rainfall that affects access to the sites or the safety of the sampling crew will be evaluated at each event.

SAMPLE SITES

This section discusses the sampling sites used by the KRWQC for surface water sampling. Many of the sites are carry-over sites from the previous program, with changes in nomenclature to reflect the General Order terminology. The sites are arranged from the upper river to the lower river, north fork and then south fork. The sites are shown in Figure 19. Site coordinates are shown in Table Five. New Assessment sites will be discussed in the next section. Table One (page 9) showed the most likely periods when water would be available for sampling at each site under normal conditions. Specific exceptions will be addressed as each site is discussed.

Table Five: Monitoring Site Coordinates

Site	Classification	Latitude	Longitude
ACOE Bridge	Assessment	36.829932	-119.336529
Tivy Creek	Ephemeral	36.778543	-119.409816
Gould Canal	Core	36.761009	-119.510943
Manning Ave	Core	36.613131	-119.464883
Lemoore Weir	Core	36.418295	-119.724272
Crescent Weir	Core	36.386084	-119.877422
Stinson Weir	Core	36.460275	-119.994085
Jackson Ave	Special Study	36.256057	-119.853877
Empire Weir #1	Assessment	36.238422	-119.858138
Cross Creek at Hwy 198	Assessment	36.328868	-119.531568

Core Site: Gould Canal

The upper most sampling site is the Gould Canal downstream of where it passes underneath Riverbend Ave. This site was recommended by Regional Board staff, and is located in a region where three of Fresno Irrigation District's (FID) primary canals are in close proximity to each other. It has been sampled monthly since 2009.

Gould Canal is located near the end of the "citrus belt" that occupies the eastern foothills of the valley, where the lands transition from foothills to flatter fields. Additional citrus has been planted to the west, but this is historically where citrus has been grown within the KRWQC. Areas not planted to orchards are typically open range land.

Gould Canal is subject to surface runoff from surface irrigation, frost protection, and storm runoff due to its lack of a "road cap" on its canal banks and the sandy-clay textured soils. Irrigated agriculture in the region has shifted from surface (furrow) irrigation to micro or drip systems, which has reduced runoff risk considerably, but the construction of the canal still leads to a risk to surface water. Cultural practices in this region (clean middles) means that no vegetation is available to slow surface runoff during storm events.

Water within the Gould Canal is comprised of three possibilities: (1) Kings River water only; (2) San Joaquin River water delivered directly from the Friant-Kern; or (3) a blend of the two. The Gould Canal serves as a conduit to the recharge basins located within the city of Fresno ("Leaky Acres"), which typically is filled with San Joaquin River water allocations.

Water is normally available between February and October in normal years. During exceptionally wet years, water may be present year-round. As part of FID's agreement with the Kings River Conservation District regarding the fishery below Pine Flat Dam, FID is entitled to the winter fish flows that reach Fresno Weir on a rotating basis. This water is diverted into the FID system and transferred to the Gould Canal for recharge purposes.

Chlorpyrifos has been detected at a frequency that would trigger a management plan (pending at Regional Board), and as such, the chemistry has been added to the basic Core chemistry list for this site. No further detections of agriculturally applied chlorpyrifos have been detected. This additional sampling will continue until the Regional Board grants a request for its removal.

Sampling will occur on a fixed monthly schedule, either on the Monday preceding the third Tuesday of each month or on the third Tuesday.

Core Site: Manning Ave

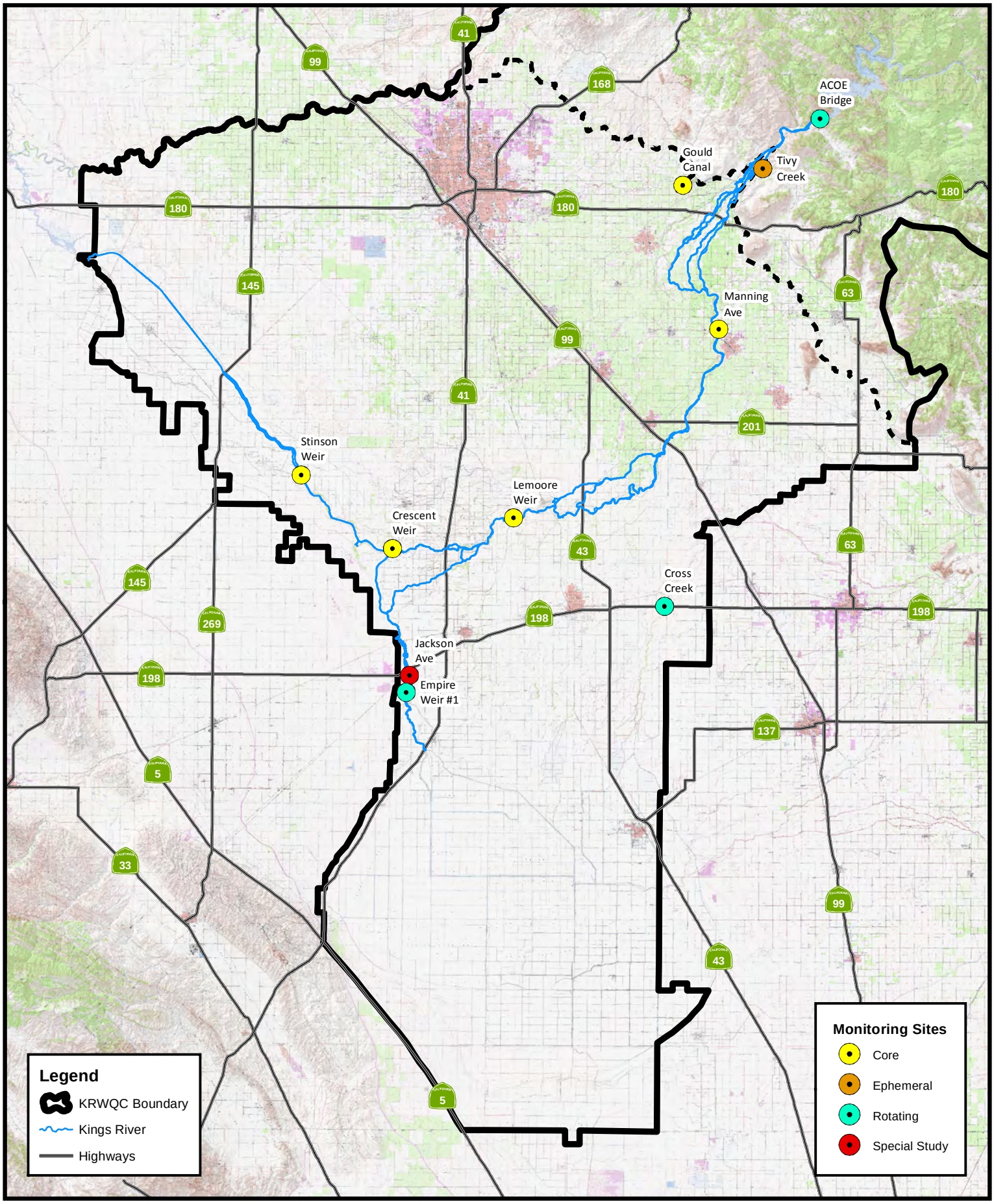
Manning Ave is perhaps the best sampling point in the Kings River system. Utilized since the program's inception, this site has water flows all year, excellent sediment for sampling, and is reflective of multiple land uses upstream. It is located in the stone fruit growing regions, but vineyards and citrus are present as well.

The monitoring site is located just downstream of the confluence with Wahtoke Creek, another ephemeral water body that passes through numerous orchard lands after emerging from the lower foothills. The site is located far enough upstream that it reflects the water quality of Mill Creek, a large drainage that joins the Kings River just below Pine Flat Dam. Mill Creek was monitored by the KRWQC in the early days of the program, but the lack of irrigated lands within this ephemeral watershed caused the site to be dropped prior to 2009.

No significant pesticide issues have been found at this site. Sampling will occur on the fixed monthly schedule discussed above.

Core Site: Lemoore Weir

Lemoore Weir is a major diversion point on the lower river. The site consists of two sampling points, one upstream of the weir structure that allows water samples when water is only being diverted into the Lemoore Canal, and one below the weir near the gauging station that monitors water being delivered downstream. The downstream monitoring site is the preferred site, but the upstream sampling point is used during spring irrigation deliveries for the lower river that only reach the weir structure.



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0 2.5 5 10 Miles

Kings River Water Quality Coalition
Monitoring Site Map 2014

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Lemoore Weir is in a transitional area from fruit orchards and nut trees to field crops, with numerous dairy operations within the general region. Flows vary according to the overall water year. When adequate supplies exist, water deliveries can be made during the late winter/spring period, although with considerable channel losses. Water is normally delivered during the summer "coordinated run" which starts in June, where all lower river interests take their deliveries at the same time so as to share the channel losses. Adequate sediment is available for sampling during the Assessment phase of testing, and winter access is excellent.

No significant issues have been found at this site. Sampling is to occur on the fixed monthly schedule discussed above.

Core Site: Crescent Weir

Crescent Weir is located on the North Fork of the Kings and would only receive irrigation water in normal to above normal years during the coordinated run that begins in June. Land use in the region is now predominantly field crops, although nut orchards (almonds) are scattered within the region.

The limited amount of data collected to date suggests no issues from irrigated lands between Lemoore Weir and Crescent Weir.

During flood operations, flows at Crescent Weir are used by the Kings River Conservation District to determine whether levee patrols are required. The nature of the site is such that once the flows downstream of Crescent Weir exceed 3000 cfs, sample collection can no longer be safely accomplished. Such conditions will be documented and sampling will resume once conditions permit.

Water is likely to be at this site June through August under normal to wet conditions. Flood operations would expand this window considerably.

Core Site: Stinson Weir

Stinson Weir is located downstream of Crescent Weir on the North Fork and would only receive deliveries during very wet years as part of the coordinated run and during flood releases. This site allows for the evaluation of the contributions of the interceptor drains installed on the land side of the flood levees between Island Weir (headgates of the North Fork) and Stinson Weir. Land use is a mix of field crops and permanent plantings (almonds and pistachios). Available surface water data from this site is even more limited than what has been collected from Crescent Weir.

The site was selected (with Crescent Weir) as replacements for James Weir (the last diversion point on the North Fork of the Kings) since it was reasoned that sample water would be present at these sites more often than at James.

Water would only be present at this site during June to perhaps August in very wet years unless flood operations are occurring.

SPECIAL STUDY SITE

Jackson Ave

Jackson Ave is a sample site located in the pool behind Empire Weir #1 on the South Fork of the King River. This site is a *Special Study* site that looks at the physical parameters (field measurements of pH,

DO, EC, and temperature) plus levels of molybdenum and toxaphene. The site is listed as impaired under the 303(d) criteria for molybdenum, toxaphene, and EC.

The pool is stagnant for much of the year (typically during the winter and early spring) and water quality degrades as groundwater accretion/surface evaporation takes place. This condition is known to the Regional Board staff.

Land use around the site is native vegetation and field crops that are highly salt tolerant (cotton, wheat, pomegranates). Salt levels in many of the surrounding soils cause bare patches in the fields and white crusts in the undeveloped ground.

Samples are collected when sufficient water is present to fill the sample containers without causing sediment disturbances. Until October 2013, sufficient water was present for sampling. With no irrigation deliveries being made through the South Fork, the water within the pool became isolated ponds.

Electrical Conductivity will continue to be an issue for this region due to the local hydrology. Perched water has brought considerable levels of salts to the surface in the region, and much of this accumulates within this pool as groundwater accretion occurs. Molybdenum is naturally occurring within the Kings River, and long term deposition has created elevated levels when the pool is stagnant for prolonged periods. Once irrigation flows resume, water quality quickly returns to within the limits defined within the Tulare Lake Basin Plan.

Toxaphene was detected in fish tissue during the 1982-1983 flood events, and the site was listed as impaired. Water samples (and 1 fish tissue sample) collected since the inception of the ILRP monitoring has failed to detect the presence of toxaphene.

Samples will be collected on a fixed monthly schedule as conditions permit.

PROPOSED ASSESSMENT SITES

Army Corps of Engineers Bridge (Pine Flat Dam)

Army Corps of Engineers Bridge is actually a calibrated weir used for the gauging station below Pine Flat Dam. The structure has a road deck above it to allow access to the land and facilities on the left bank of the river. This site is located approximately ½ mile downstream of the dam and was previously sampled by the KRWQC as part of its investigation as to the cause of algal toxicity results. No irrigated agricultural influences are present at this site, as it is upstream from the irrigated lands of the valley and no irrigated agricultural operations exist above Pine Flat Reservoir.

This site presents the opportunity to establish baseline water quality for the entire Kings River system, thus allowing for the tracking of impairments from site to site and providing a statistical control to any analysis of the water quality data.

The site will be the first Assessment site to be used under the General Order, and testing will begin January 2015. It will be revisited every third year (next sampling to occur 2018). Sampling will occur on a fixed, monthly schedule as the site is not impacted by storm activity. The site is not adversely affected by flood operations, as good sampling locations are available in the protected area immediately below the bridge/weir structure. Any detection in excess of Basin Plan Objectives would be monitored in off year sampling.

Cross Creek at Hwy 198

This site was selected due to the annexation of the portion of Kings County that previously was monitored by the Kaweah Sub-Watershed of the Southern San Joaquin Valley Water Quality Coalition. The boundary was adjusted to provide a clear boundary between the two groups (the county line) and to eliminate some of the overlap that existed previously.

A review of the cropping patterns in the annexed area shows field crops that are supportive of dairy operations as well as assorted nut orchards (walnuts, almonds, and pistachios). Cross Creek runs through much of this annexed region and it was decided that this area needed a monitoring point.

Flow patterns in this water body are much like the lower Kings River in that it takes a substantially wet year to get flows this far downstream. Terminus Dam on the Kaweah River is much smaller than Pine Flat, and the action levels for flood releases are much lower as a result. In exceptionally wet periods with moderate levels of storage behind the dam, it is likely that waters would be released in sufficient quantities to reach the sample site and eventually the Tulare Lake bottom.

The site selected is next to a relocated gauging station near the recently constructed bridges for the widened Hwy 198, just east of Hanford. Access to the site is good, with ample sediment for sampling purposes.

Per the Order, new sites must complete a year's worth of data collection at Assessment levels to be sufficiently characterized and become Core sites. It is not anticipated that sufficient volumes of water will be present in any given year to complete this requirement, so the site will remain as a rotating Assessment site with monthly sampling to commence in January 2016. Sampling would return to this site in 2019. Unlike the Army Corps of Engineer's Bridge site which can be sampled on a fixed schedule, this site will be sampled according to predicted flow rates and relevant storm activity. When storms of sufficient magnitude are forecast (0.25 inch storm totals or greater), the KRWQC staff will (1) notify the lab of a pending sample (standard algal cultures to start, since physical parameters are not yet known) and (2) begin daily observations of the site for the duration of the storm event. This can be accomplished by a simple detour by a staff member during the morning commute and phone calls later in the day to the agency that built the gauging station. Any detection in excess of Basin Plan Objectives would be monitored in off year sampling.

Kings River at Empire Weir #1

The South Fork of the Kings River begins at the Army Weir/Island Weir complex and passes through several miles of varied cropping patterns and undeveloped lands until it reaches the pool behind Empire Weir #1. Samples are collected at the Jackson Ave Bridge (see above) in accordance to known 303(d) issues. This site is located at the northern end of the pool. The proposed sample site will be located downstream of the weir structure and samples will be collected when water is flowing within the river channel. This site offers the possibility of flowing water on a more consistent basis than that of Empire Weir #2, and will not have the influence of water from the California Aqueduct. The nature of the channel may allow for sediment sampling (a process not currently supported at Empire Weir #2). Access during the winter months could be either from the west (Avenal Cutoff) or the east (along the flood control levee) depending on road conditions. The lack of agriculturally detected influences at Empire Weir #2 over the previous 5 years of sampling supports the movement of the site upstream.

The construction of the channel at this point has a high level of separation between the irrigated agriculture on either bank and the stream channel. Field crops are the dominate crop in this region, mostly crops with high salt tolerances. Many portions of surrounding fields have excessive salt levels and

are almost completely unsuitable for cultivation. Sampling would begin on at this site in January 2017 and be repeated again in 2020. Any detection in excess of Basin Plan Objectives would be monitored in off year sampling. This site would replace the sampling previously conducted at Empire Weir #2.

EPHEMERAL SITE

Tivy Creek

The next site is the ephemeral stream Tivy Creek**.** This stream is fed by the surrounding foothills and passes through approximately 1,500 acres of citrus before it discharges into a side channel of the Kings River and eventually into the main channel. The sampling point is located where Tivy Creek passes underneath Piedra Road.

Flows in this creek are highly variable and of short duration. The grower has left the creek bottom undisturbed with regards to native vegetation (usually weeds) in an effort to prevent channel erosion. Unlike the cultural practices used at Gould Canal, this grower does have plantings between the rows for erosion control (the higher slopes allows for more cold air drainage, so the frost risk is lower), but flows within Tivy Creek are still quite turbid.

Crop irrigation is by drip, so the majority of the soil surface is dry and readily absorbs light to moderate precipitation. Intense storms will always pose a problem, and the short duration of flows may make sampling extremely problematic. Limited data exists for this waterway, but no toxicity has ever been reported. A KRWQC employee lives in the region and will notify the Program Manager of storm activity and the presence of flows within the creek for sampling purposes.

Water for sampling is most likely to occur during the winter storm season, usually November through March. Monitoring of weather forecasts will intensify as fall progresses towards winter, and site visits to document conditions will occur monthly as before. Sampling will be limited to once per calendar month, and no closer than 14 days between samples.

REPRESENTATIVE SITES

This option will not be employed by the KRWQC.

IDENTIFY PRIORITIES

The data collected to date suggest that there is no specific area within the KRWQC that requires intensified monitoring for the protection of beneficial uses for surface water. It is known that contamination has been detected within Gould Canal and the analyte in question has been added to all sampling events conducted since the submission of the proposed Gould Canal Management Plan.

DEMONSTRATION OF EFFECTIVENESS

The best demonstration of effectiveness is the continued lack of detections in agricultural chemistries within the submitted samples. The data collected to date suggests that agricultural operations are already highly effective in preventing contamination and degradation of beneficial uses to the surface waters of the state within the KRWQC, and the goal of the program (as a whole) is to continue this pattern. In regions where continuing issues exist (EC et. al. on the lower river, e.g.), some sort of further research may be necessary. The difficulty is that the issue is based on naturally occurring geologic/hydrogeologic conditions, and such conditions are not easily overcome.

IMPLEMENTATION OF MANAGEMENT PRACTICE CHANGES

Changes in management practices will be more of a "sales" job to local growers, and the benefits of the changes (cost savings, crop health, no impacts to harvest operations, etc.) will need to be thoroughly researched before they are presented to what will surely be a skeptical audience. A considerable amount of inertia will have to be overcome, specifically if the cultural practice changes involve new capital investment or other short-term cost increases.

Changes in practices will be vetted by the UCCE specialist for the crop(s) involved, and grower meetings to be held as needed. Once presented, we could track the implementation through personal visits, annual questionnaires directed at the parties involved, or other means as deemed appropriate. An ad-hoc panel has been established at the Coalition level to discuss such approaches on an as-needed basis.

SUMMARY—MONITORING REQUIREMENTS

Monitoring requirements are spelled out within the Order. The KRWQC already is using the Field Data templates provided under the previous program, and submitting the forms in an electronic format would pose no significant issues. The laboratories are currently on the distribution list for all SWAMP/CEDEN reporting changes, and those changes are being implemented as they become active.

QAPP

The previously submitted QAPP document has been revised to reflect the consolidation of chemical testing services (no more "sub-contracting" of testing), thus providing a simplified oversight capability for the KRWQC. Additional changes have been introduced in the KRWQC's SOP section to allow for greater efficiencies in the field and to allow greater flexibility during flood operations.