U. S. DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
California/Nevada Operations Office

Evaluation of Pesticides in Vernal Pools of the Central Valley, California

Final Report, Investigation ID #: 200210103.1
Congressional Districts – CA 2, 18

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Sacramento, California
June 2006

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ABSTRACT.

Vernal pools are a unique ephemeral wetland feature of California's native landscape which has been heavily impacted over the past century by agricultural and urban development. Current estimates of habitat losses in the Central Valley range from 50 to 85 percent of pre-settlement acreage. While physical effects have been emphasized in most research on vernal pools there are reasons to suspect contaminant impacts may also imperil these isolated and vulnerable ephemeral wetlands. Vernal pools and National Wildlife Refuges often exist within a matrix of agricultural activity in the Central Valley and may receive pesticides and other contaminants through aerial deposition or runoff. Vernal pool water was collected for pesticide analysis from the Sacramento National Wildlife Refuge Complex and the San Luis National Wildlife Refuge Complex representing the northern and southern geography of the Central Valley respectively. Pesticide residues were extracted from the water samples using Solid Phase Micro-Extraction (SPME) and confirmed via gas chromatography-mass spectrometry (GC-MS). Analysis on the GC was run in SCAN mode to simultaneously evaluate multiple analytes. Standards from each pesticide class were used for retention time confirmation and quantification. Concentrations of detected analytes include legacy organochlorines (heptachlor), organophosphates (diazinon), organonitrogens (trifluralin), and a number of pthalates are reported.

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INTRODUCTION

Vernal pools (Figure 1a-f) are features of California's native landscape which have been heavily impacted over the past century by agricultural and urban development. Current estimates of habitat losses in the Central Valley range from 50 percent to 85 percent of pre-settlement acreage (King 1996). It has been estimated that up to 33 percent of the original biodiversity of the Central Valley vernal pool crustaceans has been lost since the 1800s (King 1996). With regard to vernal pools, most research has focused on physical effects; however, there are reasons to suspect contaminant impacts may also occur. Many of the remaining vernal pools occur on or very near private lands and are unprotected through direct management. As agriculture, particularly viticulture, continues to expand into vernal pool ecosystems there is an increasing need to develop information to ascertain the need for agricultural buffer zones and to also assess the tolerances of vernal pool systems to various pesticides. Since there are hundreds of pesticides in use in California, the first step in this process is to identify pesticides, their concentrations, and pathways to vernal pools within different agricultural regions and vernal pool landscapes.

Vernal Pools

Vernal pools result from an unusual combination of soil conditions, summer-dry Mediterranean climate, topography, and hydrology. Vernal pools typically occur in depressions which are underlain by a subsurface layer which prevents downward percolation of water. The impervious substrate of vernal pools is typically a hardpan or clay-pan consisting of cemented silica, clay, or basaltic bedrock. Vernal pools are distinguished by periodic or continuous ponding

during the winter and spring, followed by desiccation during the dry season. Direct precipitation appears to be the primary water source; however, overland runoff also plays an important role in supplying some pools with water in some years (Keeler-Wolf *et al.* 1998).

Figure 1a-f. Vernal pools at various stages (Photos: 2003 Cathy Johnson, USFWS)

California's vernal pools begin to fill with the winter rains. Some pools are primarily fed by the surrounding watershed; others may fill almost entirely from rain falling directly into the pool (Hanes and Stromberg 1998). Although exceptions are not uncommon, the watershed generally contributes more to the filling of larger or deeper pools. Both the amount and timing of winter and spring rainfall in California vary greatly from year to year. For this reason and others, pools may fill to different extents at different times. The duration of ponding of vernal pools also varies and in some years certain pools may not fill at all.

Vernal pools vary from 1 square meter (approximately 1 square yard) to 1 hectare (2.5 acres) or more. Some larger vernal pools, such as the 36-hectare (90-acre) Olcott Lake in the Jepson Prairie Preserve in Solano County, are also referred to as vernal lakes, playa pools, or lakes. Playa pools or lakes with high alkalinity are termed alkali sinks. These larger vernal pools share much of the flora and fauna of smaller pools, including many rare and endangered species.

Many characteristics of the plants and animals associated with vernal pools are dynamic adaptations to the highly variable and unpredictable nature of the vernal pool environments. The chemical characteristics of California vernal pools are also diverse and dynamic. For example, the pH has been observed to vary between 6 and 10 in a southern California vernal pool (Keeley and Zedler 1998). When conditions become to alkaline photosynthetic production in the pools may become limited (Keeley 1990). Seasonal variation also is a factor in the diversity of vernal pool water chemistry (Helm 1998). When a pool fills there may be a dilution effect and with

regard to water soluble materials, as the pool draws down later in the season, there will be a concentration effect.

Vernal pool ecosystems support specialized biota, including a relatively large number of threatened and endangered invertebrate species (Table 1), such as vernal pool tadpole shrimp (*Lepidurus packardi*), and vernal pool fairy shrimp (*Branchinecta lynchi*). They also support unique flora such as Colusa grass (*Neostapfia colusana*) and Solano grass (*Tuctoria mucronata*), and many other unique endemic plant species (Figure 2a-d).

Figure 2a: Vernal Pool Tadpole Shrimp
(Photo: © Larry Serpa)

Figure 2b. Vernal Pool Fairy Shrimp
(Photo: © Larry Serpa)

Figure 2c. Colusa Grass
(Photo: © Rick York and CNPS)

Figure 2d. Solano Grass
(Photo: © 2004 Carol W. Witham)

The insect fauna of vernal pools is numerous, varied, and primarily native, including aquatic beetles (Coleoptera: Dytiscidae, Hydrophilidae, Gyrinidae, Halipidae, Hydraenidae), aquatic bugs, including backswimmers (Hemiptera: Notonectidae), water boatmen (Corixidae), and water striders (Gerridae), springtails (Collembola), mayflies (Ephemeroptera), dragonflies and damselflies (Odonata), and various flies with aquatic larvae, including midges (Diptera: Chironomidae), crane flies (Tipulidae) and mosquitoes (Culicidae), to name a few.

The plants and animals of vernal pools are important providers of food and habitat for waterfowl, shorebirds, and other species (Silveira 1998). Vernal pool complexes contribute to the continuity of wetland habitats along the Migratory Pacific Flyway. Ducks feed on vernal pool crustaceans and other invertebrates, which are sources of protein and calcium needed for migration and egg production.

In addition to providing food for some species, vernal pools provide habitat for others. Cliff swallows (*Petrochelidon pyrrhonota*) glean mud from vernal pool beds for their nests, lesser nighthawks (*Chordeiles acutipennis*) nest in dry vernal pool beds, burrowing owl (*Athene cunicularia*) and pocket gopher (*Thomomys* spp.) burrows are found in mima mounds, and many species graze or hunt along vernal pool shorelines. Certain species appearing to live outside the vernal pool community are nonetheless essential to it. For example, many vernal pool plants rely on insect pollinators, which do not reside in the pools themselves. Many native pollinators of vernal pool plants are solitary bees that make their individual nests in holes in the ground of the

grasslands surrounding the pools (Thorp and Leong 1998). California ground squirrel (*Spermophilus beecheyi*) burrows provide summer refuges for adult and juvenile California tiger salamanders. Upland plant communities around vernal pools are essential for the vigor of the pools and the species that reside in them; they can regulate runoff, remove nutrients, and filter out sediment.

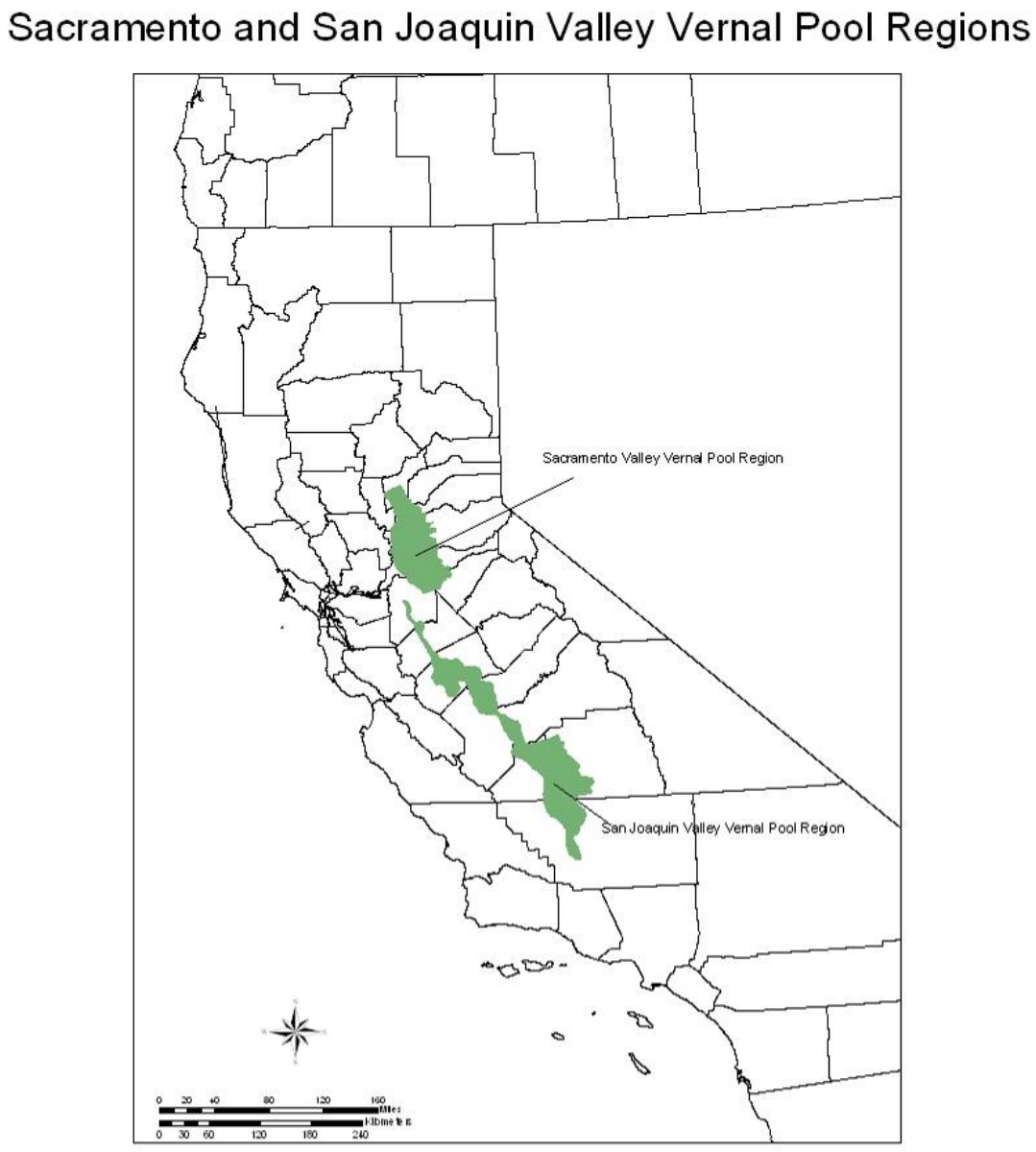

Figure 3. Vernal pool regions in California's Central Valley where water sampling occurred.

Many of the species in California vernal pools are endemic, *i.e.* found nowhere else in the world. Seventy-five to 95 percent of plant species found in vernal pools are native, and natives dominate in biomass as well as number (Holland and Jain 1988, Jokerst 1990, Spencer and Rieseberg 1998). In other words, vernal pool communities dominated by natives persist even while surrounded by grassland composed of nonnative vegetation. Vernal pool plant communities are able to resist invasion of nonnative plants in the portion of the pool that experiences prolonged inundation, where plants are severely constrained by environmental conditions with which nonnative plants have not evolved.

Vernal pools are commonly found in agricultural regions and thus, in many cases, collect drainage/run-off from adjacent agricultural fields. Often included within the run-off are a variety of agrochemicals including soil conditioners, fertilizers, and pesticides. In addition, pesticides may enter vernal pools via drift or direct over spray. Therefore, many of the organisms endemic to vernal pools can be exposed to a wide variety of potentially toxic chemicals during their short (less than 6 months) life cycles. Moreover, the ephemeral nature of vernal pools may enhance concentrations of such chemicals during the dry-down phase in late spring. Also, some compounds do not degrade in a single season, resulting in long term accumulation (Cahill et al, 2000). Ultimately, the collection and concentration of agrochemicals in vernal pools may represent a serious risk to the resident threatened and endangered species.

Little is known about relative sensitivity of vernal pool invertebrates to commonly used agricultural pesticides and chemical concentrations likely to occur or persist in these wetlands; however, non-endangered tadpole shrimp have been poisoned in rice fields by carbofuran (Domagalski, 1997) a carbamate insecticide. Organophosphates, another class of insecticides, are highly toxic to aquatic vertebrates but the susceptibility of freshwater crustacean to them has not been adequately evaluated.

Since the major source of water for vernal pools is represented by direct precipitation as well as runoff, the water pathways for pesticides to enter vernal pools are of particular concern. Water facilitates pesticide transport via a number of mechanisms. For instance, pesticides applied to agricultural fields and orchards in the Central Valley can volatize to the atmosphere. Once in the atmosphere the pesticides can be transported by bulk air movement and directly enter the vernal pool system from rainfall (Seiber *et al.* 1993). Storm events may also cause run-off from non-point sources (Domagalski *et al.* 1997).

Vernal pools occur throughout the Central Valley as well as in selected regions of southern California. Federally protected vernal pools occupied by endangered species exist on the San Luis National Wildlife Refuge (NWR) Complex, Sacramento NWR Complex and Stone Lakes NWR. This study concentrates on the Southern end of the Valley – San Luis NWR and the Northern end of the Valley – Colusa NWR (Figure 3).

Table 1. Vernal Pool Species, Status and Regional Occurrence.

Scientific name	Common name(s)	Status [1]	Vernal Pool Region[2]
Listed Plant Species			
Castilleja campestris ssp. *succulenta*	fleshy owl's clover	FT, SE	So. Sierra Foothills
Chamaesyce hooveri	Hoover's spurge	FT	NE Sac, So. Sierra Foothills, Solano-Colusa
Eryngium constancei	Loch Lomond button-celery	FE, SE	Lake-Napa
Lasthenia conjugens	Contra Costa goldfields	FE	Central Coast, Lake-Napa, Livermore, Mendocino, Solano-Colusa
Limnanthes floccosa ssp. *californica*	Butte County meadowfoam	FE, SE	NE Sac
Navarretia leucocephala ssp. *Pauciflora*	few-flowered navarretia	FE, ST	Lake-Napa
Navarretia leucocephala ssp. *Plieantha*	many-flowered navarretia	FE, SE	Lake-Napa
Neostapfia colusana	Colusa grass	FT, SE	Solano- Colusa, So. Sierra Foothills, San Joaquin
Orcuttia inaequalis	San Joaquin Valley Orcutt grass	FT, SE	So. Sierra Foothills
Orcuttia pilosa	hairy Orcutt grass	FE, SE	NE Sac, So. Sierra Foothills, Solano-Colusa
Orcuttia tenuis	slender Orcutt grass	FT, SE	Lake-Napa, Modoc Plateau, NE Sac, NW Sac, SE Sac
Orcuttia viscida	Sacramento Orcutt grass	FE, SE	SE Sac
Sedella leiocarpa	Lake County stonecrop	FE, SE	Lake-Napa
Tuctoria greenei	Greene's tuctoria	FE, SR	Modoc Plateau, NE Sac, NW Sac, So. Sierra Foothills
Tuctoria mucronata	Solano grass; Crampton's tuctoria	FE, SE	Solano-Colusa
Branchinecta conservatio	Conservancy fairy shrimp	FE	NE Sac, NW Sac, San Joaquin, Solano-Colusa,, SE Sac, So. Sierra Foothills
Branchinecta longiantenna	longhorn fairy shrimp	FE	Carrizo, Livermore, San Joaquin
Branchinecta lynchi	vernal pool fairy shrimp	FT	Carrizo, Central Coast, Klamath Mtn.[4], Livermore, NE Sac, NW Sac, San Joaquin, Solano-Colusa, SE Sac, So. Sierra Foothills, W. Riverside
Elaphrus viridis	delta green ground beetle	FT	Solano-Colusa
Lepidurus packardi	vernal pool tadpole shrimp	FE	NE Sac, NW Sac, San Joaquin, Solano-Colusa, SE Sac, So. Sierra Foothills
Proposed Plant Species and Plant Species of Concern			
Astragalus tener var. *ferrisiae*	Ferris' milk vetch	none	NE Sac, Solano-Colusa
Astragalus tener var. *tener*	alkali milk vetch	none	Central Coast, Lake-Napa, Livermore, San Joaquin, Santa Rosa, Solano-Colusa
Atriplex persistens	persistent-fruited saltscale	none	San Joaquin, Solano- Colusa
Eryngium spinosepalum	spiny-sepaled button-celery	none	So. Sierra Foothills
Gratiola heterosepala	Boggs Lake hedge-hyssop	SE	Lake-Napa, Modoc Plateau, NE Sac, NW Sac, Solano- Colusa, SE Sac, So. Sierra Foothills
Juncus leiospermus var. *ahartii*	Ahart's dwarf rush	none	NE Sac, SE Sac

Legenere limosa	legenere	none	Lake-Napa, NE Sac, NW Sac, Santa Rosa, Solano- Colusa, SE Sac, So. Sierra Foothills
Myosurus minimus var. *apus*	little mouse tail	none	San Diego, San Joaquin, So. Sierra Foothills, W. Riverside
Navarretia myersii ssp. *deminuta*	pincushion navarretia	none	Lake-Napa
Plagiobothrys hystriculus	bearded popcorn flower	none	Solano-Colusa
Animal Species of Concern			
Branchinecta mesovallensis	mid-valley fairy shrimp	none	San Joaquin, SE Sac, So. Sierra Foothills
Linderiella occidentalis	California linderiella	none	Central Coast, NE Sac, Santa Barbara, San Joaquin, Santa Rosa, SE Sac, So. Sierra Foothills
Spea hammondii	western spadefoot toad	none	11 of 17 vernal pool vernal pool regions

[1] Status: FE = federally endangered, FT = federally threatened, FPE = federally proposed as endangered, FC = federal candidate for listing, SE = State endangered, ST = State threatened, SR = State rare

[2]Vernal Pool Regions as based on Vernal Pool Regions from Keeler-Wolf 1995.

NE Sac= northeastern Sacramento Valley
NW Sac= northwestern Sacramento Valley
W.= western
SE Sac= southeastern Sacramento Valley
So.= southern

STUDY AREA

Over 35 vernal pools were sampled at least once in a two year period in the Sacramento and San Joaquin Valleys (Appendix 1). Since vernal pool existence and presence of water is erratic and for results and discussion purposes, this report concentrates on six representative vernal pools, three each at the Colusa NWR and San Luis NWR, for which a complete data sets are available and where 5 pesticides were detected at each pool during each sampling trip.

Sacramento National Wildlife Refuge Complex

Colusa National Wildlife Refuge

The Colusa National Wildlife Refuge (NWR) is part of the Sacramento NWR Complex and is located about 90 miles north of Sacramento, CA. It consists of 4,040 acres of intensively managed land that is a mixture of seasonal and permanent wetlands, riparian habitat, native

grasslands, plus a vernal pool system which hosts a variety of endangered crustaceans and unique plants (U.S. Fish and Wildlife Service 1995). There is extensive agriculture in adjacent lands and neighboring counties. Historically, this area has been a wintering area for millions of waterfowl. Much of the land that surrounds the Refuge is irrigated rice lands and orchards. The topography is flat with a slight slope to the southeast toward the Sacramento River. Predominant soil types are poorly drained alkaline clays. The Refuge is divided into 30 units, and wetlands comprise about 78 percent of the total acreage. The wetlands consist of seasonally flooded (fall and winter) ponds, permanent ponds, and water grass (millet) production units. Approximately 900 acres are in upland, some of which are burned to maintain green browse (U.S. Fish and Wildlife Service 1995).

San Luis National Wildlife Refuge Complex

San Luis National Wildlife Refuge – Kesterson Unit

The Kesterson Unit of San Luis NWR consists of 10,621 acres and is located approximately 18 miles north of Los Banos in Merced County. It is a mixture of seasonal and permanent wetlands, riparian habitat associated with 3 watercourses, native grasslands, plus an extensive vernal pool network which hosts a variety of endangered crustaceans and unique plants (U.S Fish and Wildlife Service 2000). The Kesterson Unit of San Luis NWR is within the historic floodplain of the San Joaquin River. The lands are primarily native grasslands (7,061 acres), wetlands (1,612 acres), 36 miles of riparian habitat (totaling 1,232 acres) , and 700 acres of vernal pools and floodplain habitat. The flat grasslands, typical of this area, are disrupted by

narrow meandering channels of former streams and sloughs. The Kesterson Unit is bisected by Mud Slough, a tributary of the San Joaquin River. The management objective for this sub-unit is to provide migratory bird habitat, protect native fauna and flora, and improve habitat of listed species. Intensive management of moist soil units within the wetland and riparian complex produce extensive benefits for avian species and aquatic organisms.

METHODS

Sample Collection

Water was collected in triplicate from over 35 vernal pools in the Sacramento – San Joaquin Valley. Since water volume varied among the pools - some of the pools were not consistently sampled (Appendix 1). This report addresses six pools that were sampled over the course of two years. Water was collected from three vernal pools on the Colusa NWR and three vernal pools on the Kesterson NWR. Sampling locations, times and dates are presented in Table 2**.** The sampling was conducted within 24 hours after major storm events and at intervals that coincide with seasonal months during which the pools contain water and are drawing down. Three grab samples from each pool were randomly obtained in certified chemically clean 60 mL short amber jars (Eagle-Picher). Jars were put into zip locked bags and immediately placed in ice filled ice-chests for transport to lab at the University of California, Davis (UCD) where samples were frozen until analysis. Water quality was measured at the beginning of each site visit within an hour start time.

Table 2. Sample site, location and date of sampling.

Site	Location	Collection Dates
Colusa NWR T7 VP2	N 39 11.255 W122 02.712	30 Dec 2002 07 Jan 2003 27 Feb 2003 03 Apr 2003
Colusa NWR T24 VP2	N39 08.095 W122 02.552	30 Dec 2002 07 Jan 2003 27 Feb 2003 03 Apr 2003
Colusa NWR T23 VP2	N39 07.374 W122 02.528	30 Dec 2002 07 Jan 2003 27 Feb 2003 03 Apr 2003
San Luis NWR KST 62	N37 16.033 W120 53.983	23 Dec 2002 09 Jan 2003 25 Feb 2003 15 Mar 2003
San Luis NWR KST 63	N37 16.054 W120 53.871	23 Dec 2002 09 Jan 2003 25 Feb 2003 15 Mar 2003
San Luis NWR KST 70	N37 16.501 W120 54.384	23 Dec 2002 09 Jan 2003 25 Feb 2003 15 Mar 2003

Laboratory Analysis

Pesticides were extracted using solid-phase microextraction (SPME); modified from the methods of Boyed-Boland *et al.* (1996). SPME is a technique that involves direct extraction of the analytes with the use of a small-diameter optical fiber that has been coated with a polymeric stationary phase and housed in a syringe assembly for protection. SPME eliminates the clean up step (filtration), the extraction step (solid phase extraction, liquid-liquid extraction), and the concentration step (nitrogen gas blow down), because the analytes diffuse directly into the coating

of the SPME device where all the steps are efficiently combined. This device is then transferred directly into the injection port of the gas chromatograph where all the analytes are thermally desorbed and deposited at the head of the GC column. The SPME methodology allows for smaller sample sizes, fewer steps where contamination may occur, and elimination of dangerous and expensive chemicals. The savings leads to an increase in sample size.

SPME Fibers

The 100 um thick polydimehtylsiloxane fibers are commercially available from Supelco. The fibers were conditioned according to the manufactures instructions to ensure that any contaminants that might be present were removed prior to use. This involves exposing the fiber to the hot GC injection port (250 ^{o}C) for at least 3 hours until no peaks were detected in blank analysis.

Instrumentation

All GC/MS analyses were performed with a Hewlett Packard Model 6890 GC coupled with a single quadrapole Hewlett Packard MSD 5972. A 30m x 0.25 mm id SPB-5 (0.25 um) column was used. The column temperature program was as follows: 40 ^{o}C held for 5 min., ramped to 100 ^{o}C at 30 ^{o}C min^{-1}, ramped to 275 ^{o}C at 5 ^{o}C min^{-1} and ramped to 300 ^{o}C at 30 ^{o}C min^{-1}, with a final hold for 2 min. The injector, the transfer line and the quadrapole manifold were held at 250 ^{o}C. Mass spectra were collected in the total ion current mode for each analysis; however, one or two characteristic mass fragments were chosen for quantification and calibration.

Analytical Procedure

Aqueous standard solutions of diazinon, endosulfan, hexazinone, simazine and trifluralin in concentrations of 0.2, 1.0, 10 and 20 nanogram per milliliter (ng/mL); were prepared to determine retention time, spectra confirmation and quantification. The standards were used by spiking an appropriate amount of working standard solution into 4.6 ml amber vials containing 4 ml of HPLC water, that were sealed with hole-caps and Teflon-lined septa. The fiber was then exposed to the aqueous phase for 50 min with stirring at room temp. (about 22 ^{o}C). After extraction, the fiber was directly exposed to the hot injector of the GC for 5 min and subsequently analyzed.

Equipment Blanks

HPLC grade water was used for equipment (background) blanks. The HPLC grade water is pipetted into a 4mL amber vial and is analyzed using the same procedure as the sample.

Replicate Samples

All samples from the vernal pools were collected in triplicate. Composite samples for each site were run for detection of target pesticides. When detection occurs in a composite sample all three grab samples from the site are analyzed concurrently in triplicate and reanalyzed if agreement of the calculated concentration for any detected analyte is not within 25 percent as determined by the relative percent difference (RPD). The average concentration of the triplicate anlaysis will be used as the reporting concentration.

Matrix Spikes

Recovery of all target compounds was checked for each matrix on a regular basis (approximately every fifth run). The matrix spike was a 1:4 methanol-hexane solution with 1 ng/uL concentration for each of the analytes. The matrix spike is added to water prior to extraction. The recovery of each analyte is compared to the recovery of each standard to validate the method. Three samples were spiked, and two samples were extracted without the matrix spike to determine any background analyte concentration.

Sample Analysis and Data Validation

The samples were analyzed on the GC/MS immediately after initial calibration had been evaluated. The GC/MS conditions must remain the same for analysis of the target compounds and the calibration standards. Data validation consists of assessing the regression lines of standards, assessing the recovery of standards, and verifying the presence or absence of targeted compounds. The blanks, matrix spike samples, and replicates are evaluated as part of the data validation. Blanks were checked to verify that no equipment or laboratory contamination occurred. The recovery of the analytes is verified using the matrix spike samples, and the results of the replicate samples are compared.

The method detection limit varies with individual compounds according to their chromatographic properties. Each chromatogram is examined to verify the presence or absence of targeted analytes by first searching the chromatogram at the analytes expected retention time and, by examining the mass spectrum, confirming or denying the presence of the target compound. The mass spectrum is compared to the mass-spectral library acquired on the

quadrapole detector. Verification of presence and relative abundance of the major fragment ions for the analyte of interest in conducted. If the fragments are not consistent with library spectrum, the data for that analyte is rejected as a false positive for the target compound and the unknown spectra is saved for further examination and identification.

RESULTS

Water Quality

Overall water quality was good at all the sites (Table 3). All the vernal pools had acceptable levels of DO (5.23 to 7.67 mg/L) and all the pools from both the Colusa and San Luis NWR had similar pH which ranged from 6.72 at 7.56. There was also little variation in the water temperature of the vernal pools; 19.25 to 20.48 ^{o}C. Total suspended solids (TSS) were quite low (Table 3), yet predictable, considering there was little sediment disturbance at the time of sampling. The TSS concentrations for the first sample event for each pool were higher than later sampling events. In summary all the vernal pools sampled had similar range in all water quality parameters as the six listed below (Appendix 1).

Pesticides at Colusa NWR and San Luis NWR

After evaluating over 35 vernal pools and 25 pesticides and degredates (not listed); five pesticides were present in the same three pools at Colusa NWR and in the same three pools at San Luis NWR (Table 4 and Figures 5a-f). Pesticides detected at all pools sampled from each refuge are found in Table 5.

Table 3. Water quality of vernal pools at Colusa and San Luis NWR.

Dates	Site	Dissolved Oxygen (mg/L)	pH	Temp. (^{o}C)	Total Suspended Solids (mg/L)
30 Dec 2002	Colusa NWR T7 VP2	6.80	6.86	19.80	5.38
07 Jan 2003		5.65	7.25	19.25	2.18
27 Feb 2003		5.25	7.32	20.25	2.14
03 Apr 2003		4.23	6.91	20.48	3.27
30 Dec 2002	Colusa NWR T24 VP2	7.63	6.72	19.27	4.38
07 Jan 2003		6.52	7.19	19.85	3.31
27 Feb 2003		5.62	7.41	20.12	1.07
03 Apr 2003		4.98	7.32	20.32	0.67
30 Dec 2002	Colusa NWR T23 VP2	5.93	7.12	19.68	3.86
07 Jan 2003		6.27	7.56	20.05	1.70
27 Feb 2003		6.61	7.29	20.19	2.60
03 Apr 2003		5.21	7.09	20.22	1.35
23 Dec 2002	San Luis NWR KST62	7.67	6.83	19.80	4.18
09 Jan 2003		6.85	7.43	19.86	3.57
25 Feb 2003		6.52	7.36	20.12	3.68
15 Mar 2003		5.73	7.17	20.41	2.35
23 Dec 2002	San Luis NWR KST63	6.64	7.09	19.78	6.09
09 Jan 2003		5.92	7.21	20.08	3.85
25 Feb 2003		6.35	7.16	20.31	4.64
15 Mar 2003		6.22	7.14	20.36	2.63
23 Dec 2002	San Luis NWR KST 70	6.68	7.44	19.66	8.02
09 Jan 2003		6.73	6.68	19.87	3.58
25 Feb 2003		6.48	7.01	20.32	2.12
15 Mar 2003		5.98	6.91	20.44	2.40

Table 4. Pesticides found in vernal pools at Colusa NWR and San Luis NWR. Concentrations are reported in nanogram per liter.

DATE	SITE	DIAZINON	ENDOSULFAN	HEXAZINONE	TRIFLURALIN	SIMAZINE
30 Dec 2002	Colusa	206.2	35.2	199.0	26.2	144.1
07 Jan 2003	NWR	184.0	20.8	241.0	20.7	84.9
27 Feb 2003	T7	223.0	42.3	237.0	18.1	211.3
03 Apr 2003	VP2	166.8	21.2	409.0	35.3	341.6
30 Dec 2002	Colusa	189.3	12.8	301.5	6.9	92.7
07 Jan 2003	NWR	229.1	22.4	258.6	10.8	118.0
27 Feb 2003	T24	85.4	31.8	224.7	16.3	279.0
03 Apr 2003	VP2	92.0	16.1	363.9	12.4	251.0
30 Dec 2002	Colusa	43.4	15.6	251.3	15.8	136.6
07 Jan 2003	NWR	53.8	20.2	266.0	20.6	208.3
27 Feb 2003	T23	68.3	11.8	301.6	13.7	331.5
03 Apr 2003	VP2	52.2	13.6	324.6	14.5	309.0
23 Dec 2002	San	47.2	63.2	72.4	21.4	243.5
09 Jan 2003	Luis	36.8	55.2	96.3	18.3	321.8
25 Feb 2003	NWR	21.5	67.3	72.6	8.1	311.5
15 Mar 2003	KST62	24.2	52.0	118.7	35.4	286.4
23 Dec 2002	San	40.6	65.8	108.3	16.3	293.2
09 Jan 2003	Luis	34.1	54.6	213.6	19.7	310.5
25 Feb 2003	NWR	41.7	46.7	92.5	11.3	119.2
15 Mar 2003	KST63	53.4	51.1	118.7	14.4	165.7
23 Dec 2002	San	51.4	59.0	205.3	15.6	116.0
09 Jan 2003	Luis	55.9	58.4	98.1	17.3	129.0
25 Feb 2003	NWR	39.5	31.2	111.6	19.4	242.0
15 Mar 2003	KST 70	56.7	28.9	97.4	18.6	315.0

Table 5. Analytes detected in vernal pool water samples.

SITE SAMPLED (REFUGE)	NO. POOLS SAMPLED	NO. POOLS WITH DETECTIONS	COMPOUNDS DETECTED
Sacramento National Wildlife Refuge Complex	18	11	atrazine [1] BHT [5] dibutyl phthalate [4,6] endosulfan I [1] endosufan II [1] endosulfan sulfate [1] heptachlor epoxide [2] dieldrin [2] ddt [2] dde [2] 3-keto carbofuran [1] metolachlor [1] phenanthrene [3] trifluralin [1] tetrachlorobiphenyl [3] hexachlorobiphenyl [3]
San Luis National Wildlife Refuge Complex	19	15	bisphenol A [6] chlorthion [1] carbaryl [1] diazinon [1] dibutyl phthalate [4,6] endosulfan I [1] endosufan II [1] endosulfan sulfate [1] fluorene [3] heptachlor epoxide[2] hexazinone [1] dieldrin [2] ddt [2] dde [2] deet [4] naphthalene [3] tributylphosphate [7] trifluralin [1] tetrachlorobiphenyl [3] dichorobiphenyl [3]

[1] Current use pesticide.
[2] Legacy organochlorine pesticide.
[3] PAH and PCB. Not part of current study objective, so standards have not been run.
[4] Formerly used as insect repellent, "inert" ingredient in pesticide formulations. Not part of current study objective, so standards have not been run.
[5] Antioxidant food additive. Not part of current study objective, so standards have not been run.
[6] Plasticizer. Not part of current study objective, so standards have not been run.
[7] Fire retardant. Not part of current study objective, so standards have not been run.

Samples were run in scan mode, so other analytes were also detected (Table 5); however, not with the 100 percent frequency at each sample event as diazinon, endosulfan, hexazinone, simazine and trifluralin. Concentrations of the targeted pesticides were well over detection limits. For example, hexazinone (commonly used herbicide) concentrations ranged 72.6 ng/L to 409 ng/L throughout the sample sites at the Colusa NWR and San Luis NWR. The levels that were found for the five evaluated pesticides are common in surface waters in the Central Valley during late winter, early spring (U. S. Geological Survey 2004, U.S. Geological Survey 2005).

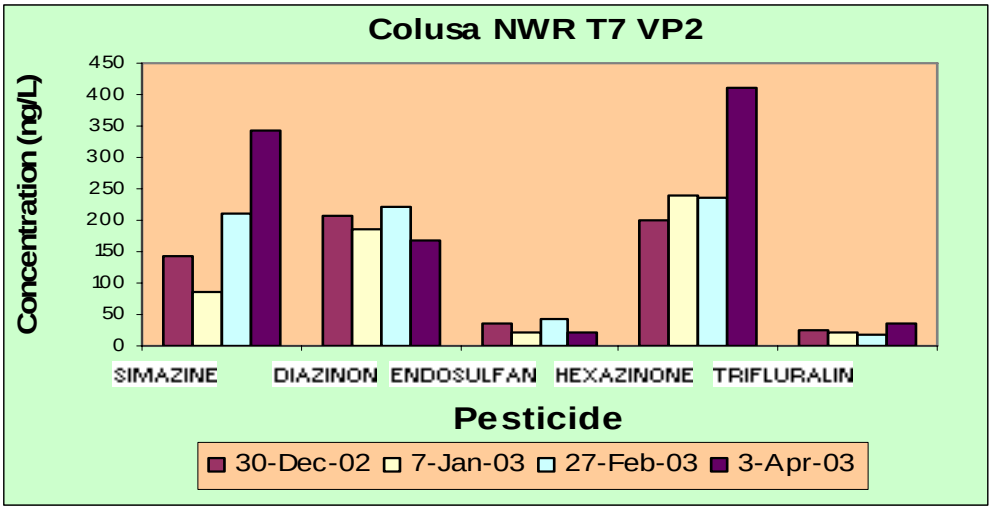

Figure 4a. Graphical display of pesticides evaluated at site T7 VP2, Colusa NWR.

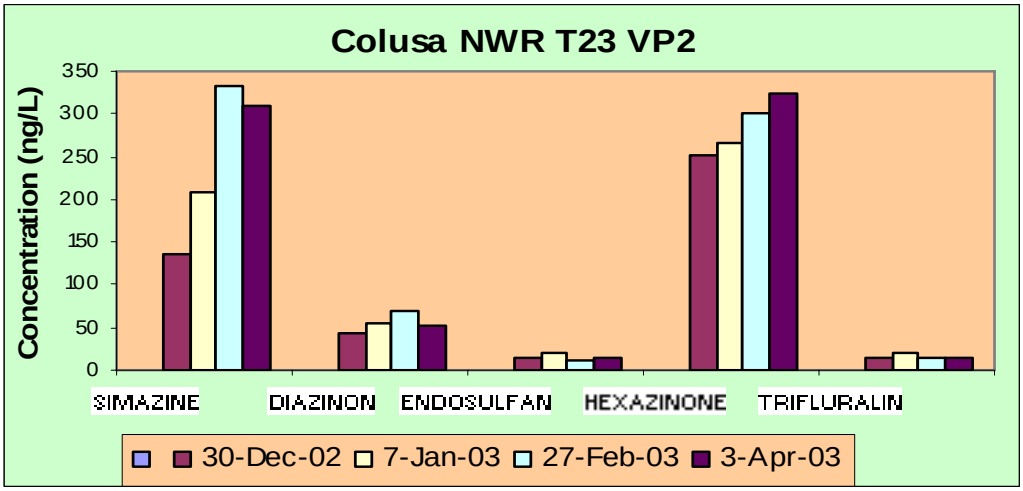

Figure 4b. Graphical display of pesticides evaluated at site T237 VP2, Colusa NWR.

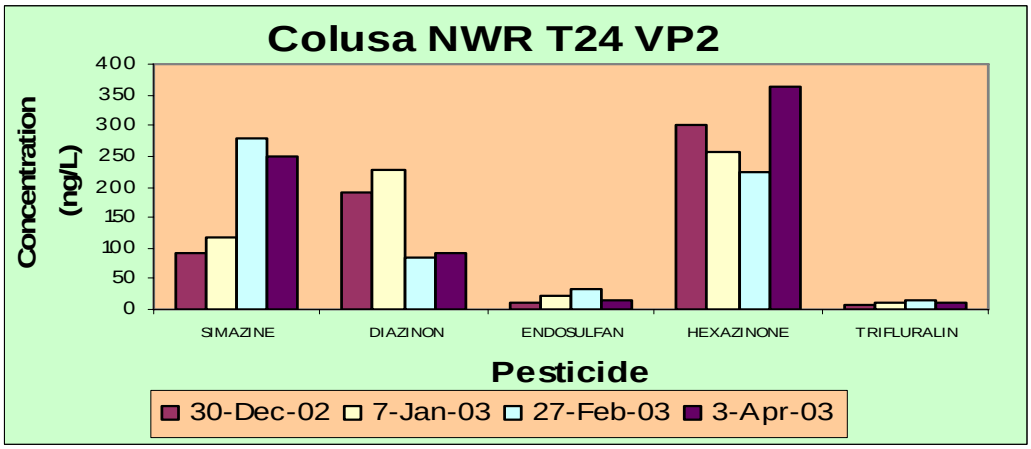

Figure 4c. Graphical display of pesticides evaluated at site T24 VP2, Colusa NWR.

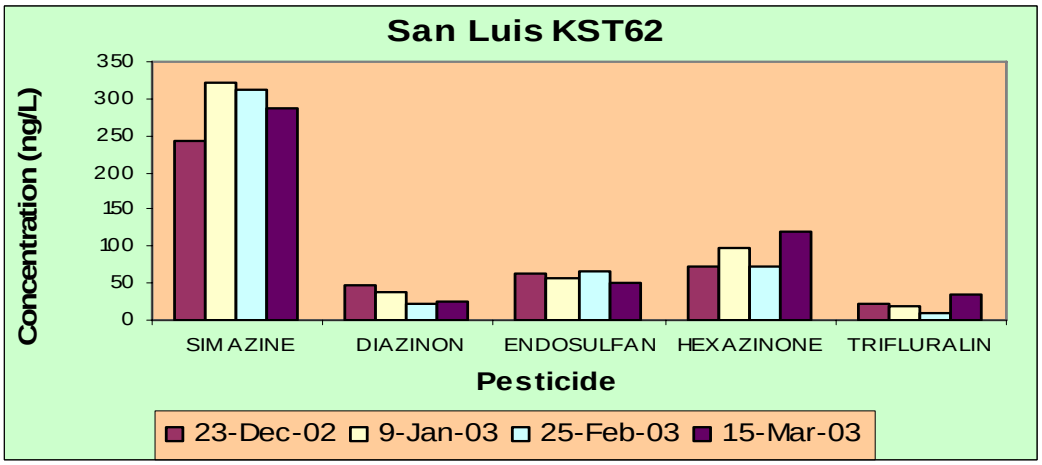

Figure 4d. Graphical display of pesticides evaluated at site KST62, San Luis NWR

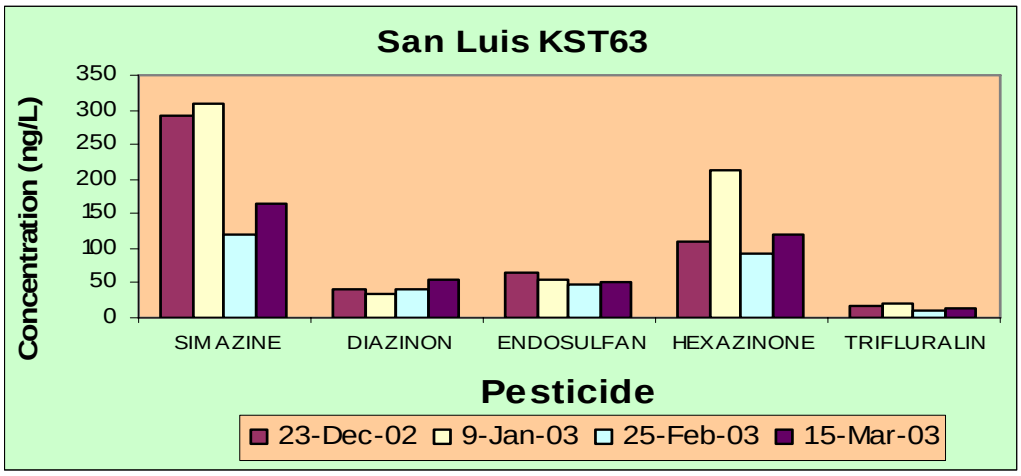

Figure 4e. Graphical display of pesticides evaluated at site KST63, San Luis NWR

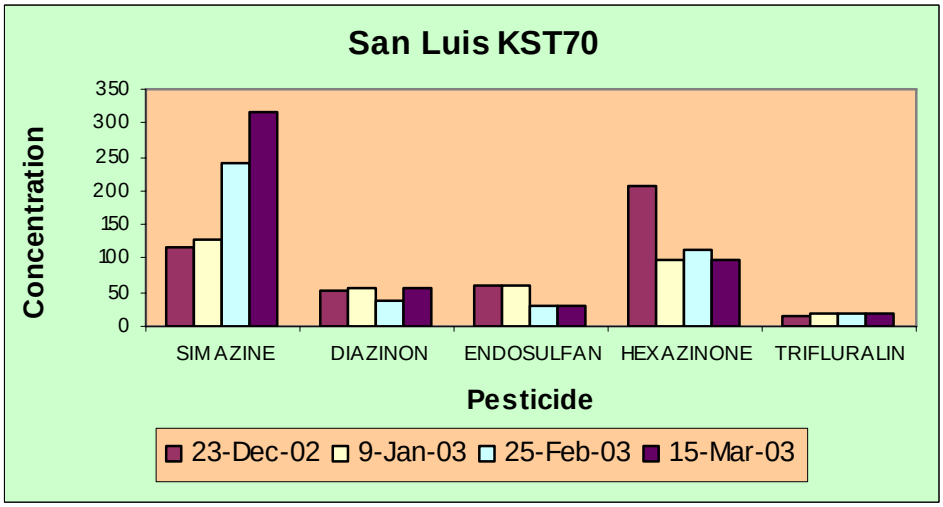

Figure 4c. Graphical display of pesticides evaluated at site KST70, San Luis NWR

DISCUSSION

Water Quality

During the four sampling visits between the months of December 2002 and April 2003, water quality was not impaired in any of the vernal pools. The pH at all the sites were in the

neutral range; 6.72 to 7.56 at Colusa NWR and 6.68 to7.43 at San Luis NWR. All dissolved oxygen measurements taken were well within the basin standard of 5.0 milligram per liter (mg/L) for surface water (U.S. Geological Survey 2004); 4.23 mg/L to 7.63 mg/L at Colusa NWR and 5.73 mg/L to 7.67 mg/l at San Luis NWR. The water temperature in the vernal pools ranged from 19.25 ^{o}C to 20.48 ^{o}C at Colusa NWR and 19.66 ^{o}C to 20.44 ^{o}C at San Luis NWR. Total dissolved solids (TSS) were fairly constant in all the pools. None of the vernal pools sampled exceeded 8.02 mg/L and some were as low as 0.67 mg/L; however, in all the pools the first samples obtained for the season were the highest. This could be from the first rain disturbing sediment and mixing residual loose soil particles from the dry season.

Pesticides

For simplicity and continuity, the pesticides selected for detailed analysis were among the most commonly used in the study areas during the sampling year. The pesticides evaluated are well studied and commonly found in surface waters throughout the Central Valley (www.cdpr.ca.gov); furthermore, they are still being applied throughout California. Although numerous pesticides (and other compounds) were detected, several were found below the reporting limit, and they will not be discussed here.

High level concentrations of pesticides in storm water runoff have been detected in swales leading onto Stone Lakes NWR (USFWS 1999), which is surrounded by residential and agricultural lands. Several studies have demonstrated that potentially toxic pesticide levels exist, travel in, and deposit out of mist and rain droplets. For instance, levels as high as 300 ng/cm^3 of atmospheric diazinon sprayed near orchards have been reported (Seiber *et al.* 1993).

Recommended aquatic chronic and acute criteria for diazinon are 40 and 80 ng/L respectively (Davies *et al*. 1996). Therefore, once in the atmosphere, diazinon can be transported by bulk air movement and directly enter the vernal pool system from rainfall. This is of particular concern for vernal pools, since their primary source of water is represented by direct precipitation as well as runoff.

Environmental concentrations of pesticides may vary depending on region, weather conditions, and season. For example, the U.S. Geological Survey found that toxic levels of diazinon from dormant sprayed orchards can be detected (up to 5.3 ug/l) along most of the San Joaquin River and its tributaries following winter storms (Domagalski *et al.* 1997). When water samples were collected from the Sacramento and San Joaquin rivers following February rains 100 percent mortality was observed in *Ceriodaphnia dubia*; all samples had diazinon concentrations in excess of 9 ng/L (Kuivila, 1993). Further, diazinon's toxic degradation product, diazoxon, has been detected (1 to 3 percent of the diazinon load) in stormwater runoff in the Sacramento River Basin (Domagalski, 1996).

Pesticide Use in California

In 2003, there were 175,127,171 pounds of pesticide applied in California (CDPR PUR 2005). Highest use is in the counties of the Central Valley where there are extensive vernal pool networks that support unique biota. The five pesticides addressed in this report were heavily applied in 2003 season, with a majority being applied during the rainy season when pesticides can easily be transported away from target site and into bodies of water. Between the months of

December 2002 and April 2003 approximately 523,785 pounds diazinon, 134,080 pounds endosulfan, 114,026 pounds hexazinone, 1,062,580 pounds trifluralin, and 674,141 pounds simazine was applied in the counties where the vernal pool water was sampled.

Diazinon

Diazinon is a non-systemic organophosphate insecticide used to control a variety of insects for stone-fruit, pear, apple and tomato crops. It is also used for structural pest-control but is currently no longer registered for residential home use. However, it is still used extensively for agricultural applications.

Diazinon is an acetylcholinesterase inhibitor. The concentration range that results in toxic effects varies widely with formulation and with the individual species being exposed. Some formulations of diazinon can be degraded to more toxic forms. This transformation may occur in air, particularly in the presence of moisture, and by ultra-violet radiation. Most modern formulations of diazinon do not degrade easily (U.S. Public Health Service 1995).

Diazinon is highly toxic to fish. In rainbow trout, the diazinon LC_{50} is 2.6 to 3.2 mg/L. In hard water, lake trout and cutthroat trout are somewhat more resistant. Warm water fish such as fathead minnows and goldfish are even more resistant with diazinon LC_{50} values ranging up to 15 mg/L (EXTOXNET). There is some evidence that saltwater fish are more susceptible than freshwater fish. Bioconcentration ratios range from 200 in minnows to 17.5 for guppies. These studies show that diazinon does not bioconcentrate significantly in fish (Howard 1991). There are no available data on the effects of diazinon on listed vernal pool species; however, according to

Davies *et al.* (1996), recommended aquatic chronic and acute criteria for diazinon are 40 and 80 ng/L, respectively. The concentrations found in the vernal pools in this study (Table 4) far exceeded those levels indicating that diazinon could have adverse impacts on vernal pool species.

The breakdown rate of diazinon is dependent on the acidity of water. Under aqueous acid conditions the half-life of diazinon is approximately 12 hours, while at neutral pH it is approximately 6 months. Therefore, under the aqueous neutral condition of the vernal pools at the time sampling occurred (Table 3), it is likely that very little of the diazinon degraded during the wet season. Less than half of the diazinon would degrade during the crucial times listed species rely on the vernal pools for reproduction.

Endosulfan

Endosulfan is a highly toxic chlorinated hydrocarbon insecticide and acaricide of the cyclodiene subgroup which acts as a poison to a wide variety of insects and mites on contact. Although it may also be used as a wood preservative, it is used primarily on a wide variety of food crops including tea, coffee, fruits, and vegetables, as well as on rice, cereals, maize, sorghum, or other grains. Technical endosulfan is made up of a mixture of two molecular forms (isomers) of endosulfan, the alpha- and beta-isomers. In this report the term endosulfan is referred to the technical product.

Endosulfan is moderately persistent in the soil environment, with a reported average half-life of 50 days (ATSDR). It has very low water solubility and has a moderate ability to adhere to

soils. Transport of this pesticide is most likely to occur if endosulfan is absorbed to soil particles in surface run-off. In California, especially in the southern part of the Central Valley, endosulfan is applied to cotton fields during the late spring and summer. Many of these fields are in close proximity or adjacent to vernal pools. Even though the pools are dry at the time, it is possible for endosulfan to be transported over the flat landscape during light winds and deposited with soil particles into the vernal pool.

Endosulfan is highly toxic to four fish species and both of the aquatic invertebrates studied. In fish species, the reported 96-hour LC_{50} values were (in ug/L): rainbow trout, 1.5; fathead minnow, 1.4; channel catfish, 1.5; and bluegill sunfish, 1.2. In two aquatic invertebrates, scuds (G. lacustris) and stoneflies (Pteronarcys), the reported 96-hour LC_{50} values were, respectively, 5.8 ug/L and 3.3 ug/L (EXTOXNET). Although there is no information available for listed vernal pool species, it is important to note that each of the six pools evaluated had detectable concentrations of endosulfan (Table 4).

In unfiltered river water at room temperature and exposed to light, both isomers of endosulfan disappeared in 4 weeks. A breakdown product first appeared within the first week. The breakdown in water is faster (5 weeks) under neutral conditions than at more acidic conditions or basic conditions (5 months). The life span of vernal pool fairy and tadpole shrimp is short. The neutral pH of the vernal pools (Table 3) may allow the endosulfan to persist long enough in the pools to coincide with the sensitive life stages for listed tadpole shrimp and fairy shrimp. Under high alkaline conditions the half-life of the compound is 1 day. Large amounts of endosulfan can be found in surface water near areas of application. It has also been found in

surface water throughout the country at very low concentrations (EXTOXNET).

Hexanzinone

Hexazinone is a triazine herbicide used against many annual, biennial, and perennial weeds, as well as some woody plants. It is commonly used in forests and on wheat, alfalfa and cotton crops. Hexazinone is a systemic herbicide that works by inhibiting photosynthesis in the target plants. Rainfall or irrigation water is needed before it becomes activated (EXTOXNET).

Hexazinone is slightly toxic to fish and other freshwater organisms. Some of the reported 96-hour LC_{50} values include: rainbow trout, 320 mg/L; bluegill, 370 mg/L; fathead minnow, 274 mg/L. The 48-hour LC_{50} for hexazinone in the water flea, Daphnia magna, is 151 mg/L, (ASTDR website); these toxic levels were observed in vernal pools. To date there is no toxicity data available for listed species; however, Daphnia magna is a commonly used surrogate species for toxicity. The concentrations found in this study (Table 4) suggest that vernal pool species such as the vernal pool fairy shrimp and tadpole may be exposed to toxic levels of hexazinone during their critical aquatic life stage. Comparison of adverse impacts to listed vernal pool species is difficult since data is not available for the listed vernal pool species and chronic effects are not reported.

Photodegradation and biological decomposition are the major routes of hexazinone degradation (Ghassemi et al. 1981). Hexazinone is generally stable in water and shows little tendency to hydrolyze over a period of up to two months. In aqueous solution under light,

hexazinone is slowly degraded to metabolite A, by hydroxylation, and to metabolites B and H by demethylation (Rhodes, 1986). In natural stream water hexazinone did not dissipate noticeably in 260 days (Bouchard et al., 1985). The hydrolysis half-life of hexazinone has been reported to be greater than 56 days by Kollman and Segawa (1995) and Linders et al. (1994).

Trifluralin

Trifluralin is a selective, pre-emergence dinitroaniline herbicide used to control many annual grasses and broadleaf weeds in a large variety of tree fruit, nut, vegetable, and grain crops, including sunflowers, cotton, and alfalfa. Pre-emergence herbicides are applied before weed seedlings sprout (EXTOXNET).

Trifluralin is highly toxic to fish and other aquatic organisms. The 96-hour LC_{50} is 0.02 to 0.06 mg/L in rainbow trout, and 0.05 to 0.07 mg/L in bluegill sunfish. The 96-hour LC_{50} in channel catfish is approximately 1.4 to 3.4 mg/L. Variables such as temperature, pH, life stage, or size may affect the toxicity of the compound. There is no data available on this herbicide in regards to listed vernal pool species. Trifluralin is highly toxic to *Daphnia magna*, a species of small freshwater crustacean, with a 48-hour LC_{50} of 0.5 to 0.6 mg/L. *Daphnia magna* is commonly used as a surrogate for toxicity testing for many aquatic organisms. Concentrations found in this study do not exceed the reported LC_{50}, however, trifluralin shows a moderate tendency to accumulate in aquatic organism (Kamrin 1997).

Simazine

Simazine is a selective triazine herbicide. It is used to control broad-leaved weeds and annual grasses in field, plum and pear orchard, citrus crops, rice and vineyards. At higher rates, it is used for nonselective weed control in industrial areas. Before 1992, simazine was used to control submerged weeds and algae in large aquariums, farm ponds, fish hatcheries, swimming pools, ornamental ponds, and cooling towers (EXTOXNET).

Simazine is slightly to practically nontoxic to aquatic species. The 96-hour LC_{50} for simazine is >100 mg/L in rainbow trout, 100 mg/L (wettable powder) in bluegill sunfish, 0.100 mg/L in fathead minnows, as well as carp (Briggs 1992). It may be more toxic to *Daphia magna* and stoneflies (Johnson 1980). A 96-hour LC50 of >3.7 mg/L is reported in oysters (USEPA 1993). Although some of the highest concentrations in this study were simazine (Table 4), the concentrations do not exceed the documented LC_{50} levels. However, as with many current use pesticides, data is lacking on listed aquatic species.

MANAGEMENT RECOMMENDATIONS AND ACTION ITEMS

Numerous pesticides are found in California surface waters (U.S. Geological Survey 2004). Most of these pesticides are applied for agricultural activities and are transported throughout the environment via atmospheric deposition and runoff. In regards to vernal pools, the species that occur in these vulnerable ecosystems rely on the aquatic phase of the pools to

reproduce and develop. If levels of pesticides are above documented thresholds then reproduction and survival may be adversely effected.

Data on acute as well as chronic effects of pesticides on listed threatened and endangered species is lacking. Surrogate species have to be evaluated to try and determine if a pesticide is going to adversely affect the species directly or indirectly. Due to drift and atmospheric deposition, regulating agricultural practices is difficult since pesticides can travel for many miles. This study is the first step in trying to evaluate possible impacts pesticides may have on vernal pools. By sampling a large number of pools across various regions within the Central Valley for a broad spectrum of pesticides we have identified those pesticides which pose the greatest potential risk to vernal pool species; however, toxicity to these listed species can only be inferred using data on surrogate species.

The logical next step to evaluate pesticides in vernal pools would be to conduct toxicity tests using listed species or good surrogates with water from vernal pools and with laboratory test water at the concentrations found in this study to better assess risk of these pesticides to listed vernal pool species. To accomplish this work would require coordination with federal and state agencies responsible for the use and regulation of pesticides in California.

Another issue of recent concern is sediment toxicity. As this study was done there was a shift in pesticide use in California agriculture. Over the course of the last 2 years organophosphate insecticides have been slowly replaced by pyrethroids insecticides. Unlike organophosphates, pyrethroids strongly bind to the sediment and are difficult to detect in surface

water. This is particularly important to vernal pool species such as the vernal pool fairy shrimp and the tadpole shrimp. These species rely on the sediment for feeding and reproduction. Any shifts in the quality of the sediment (*i.e.* increase in pesticide) could interrupt their life cycle and lead to a decrease in population. Recent studies have found toxicity to midge *Chironomus tentans* and amphipod *Hyalella azteca* from sediment in Central Valley streams located in highly urban or agricultural settings (Weston, et.al 2004). Pyrethroids were detected in 75 percent of the sediment samples analyzed.

Buffers for spray zones may not be sufficient to protect vernal pools from pesticides. It is well documented that pesticides can move via the atmosphere and are found many miles away from where they are applied. The ultimate solution to this problem is the reduction of pesticide use via integrated pest management and the use of less toxic chemicals. There are many ecologically based pest management practices now being used to control insects, weeds, and fungi in agricultural settings. These methods rely on the natural interactions of plants, animals, and microorganisms and if fully or partially adopted could lessen the inputs of chemicals in the environment.

Action Items:

1) Prepare and submit a manuscript of this work for publication in an appropriate peer reviewed journal.

2) Provide copies of the manuscript to state and federal pesticide and agriculture regulatory agencies to open a dialogue on the potential risks of pesticides to vernal pool species.

3) Work with the above agencies to identify next level investigations to address the issues identified. These studies should include: GIS spatial analysis of pesticide use and vernal pool concentrations to identify likely sources of detected pesticides in this study and assess atmospheric transport; lab and field toxicity studies; sediment toxicity studies; development and implementation of best management practices to reduce high risk pesticide use and minimize off-site transport.

Acknowledgements

The author would like to thank: Joe Silveira, Meghan Gilbart and Mike Carpenter of the Sacramento NWRC, Tim Keldsen of the San Luis NWRC for access to refuges, field assistance, and site selection; and Matt Hengel of the University of California, Davis, IR4 Lab, for analytical expertise, guidance and advice. This project was funded by the U.S. Fish and Wildlife Service Environmental Contaminants On-Refuge Investigations Program (Project ID #200210103.1).

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APPENDIX A

Water Quality and Pesticide Data
February - March 2002

Dissolved oxygen, pH, total suspended solids, and pesticide concentrations in vernal pool water samples collected in February and March, 2002. Each pesticide concentration is the average of triplicate runs.
Values are nanograms per liter (ng/L). NA: not analyzed, ND: no detect, RL: reporting limit, --: Not sampled, SJR: San Joaquin River, D.O.: Dissolved Oxygen, TSS: Total Suspended Solids.

Sample Event One		MDL =>	2.1	4.1	11.1	1.8	4.2	4.2	1.2	3.6	1.0	2.2	1.0	4.5	8.4	8.6	5.7
Sacramento NWRC	**Site**	**Date**	**Alachlor**	**Atrazine**	**Azinphos methyl**	**Butylate**	**Carbaryl**	**Chlor-pyrifos**	**Dacthal**	**Diazinon**	**Dieldrin**	**Endosulfan**	**Endrin**	**EPTC**	**Heptachlor**	**Heptachlor Epoxide**	**Hexa-zinone**
Colusa NWR	T7 VP1	26-Feb-02	8.6	30.4	ND	ND	ND	ND	ND	132.8	ND	20.8	ND	12.9	<RL	<RL	103.5
Colusa NWR	T7 VP2	26-Feb-02	ND	32.2	ND	ND	<RL	ND	ND	201.2	ND	57.3	ND	ND	<RL	<RL	99.8
Colusa NWR	T24 VP1	26-Feb-02	17.7	37.5	ND	ND	<RL	ND	ND	147.0	ND	21.6	ND	15.8	<RL	<RL	145.6
Colusa NWR	T24 VP2	26-Feb-02	10.3	33.7	ND	ND	<RL	ND	ND	181.3	ND	45.6	ND	<RL	<RL	<RL	193.2
Colusa NWR	T23 VP2	26-Feb-02	ND	29.2	ND	ND	ND	46.7	ND	74.9	ND	32.8	ND	<RL	<RL	<RL	165.7
Delevan NWR	T4 VP1	26-Feb-02	ND	43.8	ND	ND	21.6	ND	ND	68.2	ND	76.3	ND	<RL	<RL	<RL	56.6
Delevan NWR	T12 VP1	26-Feb-02	108	32.4	ND	ND	ND	51.2	ND	82.7	ND	50.9	ND	ND	<RL	<RL	87.3
Delevan NWR	T12 VP2	26-Feb-02	13.2	23.5	ND	ND	<RL	36.7	ND	164.9	ND	25.6	ND	12.2	<RL	<RL	99.2
Delevan NWR	T18 VP1	26-Feb-02	9.4	18.4	ND	ND	12.2	21.8	ND	89.9	ND	34.8	ND	17.9	<RL	<RL	115.8
Delevan NWR	T31.2 VP1	26-Feb-02	ND	ND	ND	ND	<RL	18.2	ND	143.5	ND	21.8	ND	ND	<RL	<RL	221.8
Llano Seco	T5 VP	26-Feb-02	ND	ND	ND	ND	ND	ND	ND	221.8	ND	26.4	ND	9.8	<RL	<RL	189.7
Llano Seco	T15 SW VP	26-Feb-02	ND	ND	ND	ND	ND	ND	ND	116.9	ND	30.1	ND	ND	<RL	<RL	98.7
Sacramento NWR	T11.5 VP2	26-Feb-02	ND	19.6	ND	ND	ND	ND	ND	74.9	ND	22.5	ND	ND	<RL	<RL	201.3
Sacramento NWR	T18 VP5	26-Feb-02	ND	15.3	ND	ND	<RL	<RL	ND	82.6	ND	22.3	ND	18.3	<RL	<RL	225.8
Sacramento NWR	P1.1 VP1	26-Feb-02	5.6	26.8	ND	ND	30.1	<RL	ND	184.3	ND	42.6	ND	ND	<RL	<RL	146.7
Sacramento NWR	TC VP1	26-Feb-02	8.5	25.4	ND	ND	<RL	ND	ND	202.9	ND	36.1	ND	<RL	<RL	<RL	153.8
Sacramento NWR	TC VP5	26-Feb-02	13.3	ND	ND	ND	ND	ND	ND	185.7	ND	38.2	ND	<RL	<RL	<RL	96.5
Sacramento NWR	TG VP1	26-Feb-02	ND	38.1	ND	ND	ND	ND	ND	116.4	ND	20.9	ND	<RL	<RL	<RL	82.4
San Luis NWRC			**Alachlor**	**Atrazine**	**Azinphos methyl**	**Butylate**	**Carbaryl**	**Chlor-pyrifos**	**Dacthal**	**Diazinon**	**Dieldrin**	**Endosulfan**	**Endrin**	**EPTC**	**Heptachlor**	**Heptachlor Epoxide**	**Hexa-zinone**
Merced NWR	ARP4	28-Feb-02	ND	ND	ND	ND	ND	ND	ND	189.4	ND	36.5	ND	<RL	<RL	<RL	56.8
Merced NWR	ARP25	28-Feb-02	ND	18.2	ND	ND	ND	ND	ND	156.4	ND	19.4	ND	<RL	<RL	<RL	69.2
Merced NWR	ARP35	28-Feb-02	ND	26.8	ND	ND	ND	18.1	ND	98.7	ND	26.9	ND	<RL	<RL	<RL	63.7
Merced NWR	ARP19	28-Feb-02	ND	19.4	ND	ND	ND	ND	ND	128.7	ND	31.8	ND	<RL	<RL	<RL	88.2
Merced NWR	ARP13	28-Feb-02	ND	ND	ND	ND	ND	21.2	ND	90.9	ND	16.7	ND	<RL	<RL	<RL	71.3
Merced NWR	Wild Site	Not Sampled	--	--	--	--	--	--	ND	--	--	--	--	--	--	<RL	--
Merced NWR	Deadman	Not Sampled	--	--	--	--	--	--	ND	--	--	--	--	--	--	<RL	--
SJR NWR	Airport South	Not Sampled	--	--	--	--	--	--	ND	--	--	--	--	--	--	<RL	--
SJR NWR	Airport North	Not Sampled	--	--	--	--	--	--	ND	--	--	--	--	--	--	<RL	--
SJR NWR	Airport Central	Not Sampled	--	--	--	--	--	--	ND	--	--	--	--	--	--	<RL	--
San Luis NWR	Shop Pool	28-Feb-02	6.2	28.3	ND	ND	ND	ND	ND	112.8	ND	65.1	ND	16.2	<RL	<RL	46.5
San Luis NWR	KST 62	28-Feb-02	4.1	19.4	ND	ND	ND	ND	ND	145.6	ND	46.2	ND	10.9	<RL	<RL	67.8
San Luis NWR	KST 70	28-Feb-02	ND	29.1	ND	ND	20.8	ND	ND	89.6	ND	41.6	ND	<RL	<RL	<RL	55.2
San Luis NWR	KST 63	28-Feb-02	ND	26.4	ND	ND	ND	16.7	ND	107.9	ND	39.7	ND	<RL	<RL	<RL	76.9
San Luis NWR	KST Gate	28-Feb-02	6.4	17.2	ND	ND	16.9	46.8	ND	150.3	ND	50.9	ND	13.7	<RL	<RL	125.4
San Luis NWR	WBC 2	1-Mar-02	ND	6.2	ND	ND	ND	32.9	ND	221.6	ND	32.1	ND	ND	<RL	<RL	96.5
San Luis NWR	WBC 1	1-Mar-02	ND	12.9	ND	ND	ND	ND	ND	158.7	ND	45.8	ND	<RL	<RL	<RL	56.8
San Luis NWR	WBC 9	1-Mar-02	ND	8.7	ND	ND	ND	ND	ND	96.5	ND	20.7	ND	ND	<RL	<RL	87.2
San Luis NWR	WBC 30	1-Mar-02	ND	15.3	ND	ND	ND	<RL	ND	104.7	ND	19.2	ND	<RL	<RL	<RL	66.3

Sample Event One		MDL =>	2.1	3.3	4.2	5.4	7.2	4.2	3.3	6.0	6.0	2.4	6.8	3.0			
Sacramento NWRC	**Site**	**Date**	**Malathion**	**Metalo-chlor**	**Methyl parathion**	**Methidia-thion**	**Napro-pramide**	**Oxyfluor-fen**	**PBO**	**DDE**	**DDT**	**Pendi-methalin**	**Simazine**	**Trifluralin**	**D.O. (mg/L)**	**pH**	**TSS (mg/L)**
Colusa NWR	T7 VP1	26-Feb-02	ND	9.6	ND	ND	ND	41.8	NA	<RL	<RL		95.0	26.3	6.98	7.02	2.61
Colusa NWR	T7 VP2	26-Feb-02	ND	31.5	ND	ND	<RL	36.1	NA	<RL	<RL		80.8	18.4	5.83	7.14	1.65
Colusa NWR	T24 VP1	26-Feb-02	ND	16.1	ND	33.8	18.3	<RL	NA	<RL	<RL		123.0	15.2	7.67	6.98	4.16
Colusa NWR	T24 VP2	26-Feb-02	ND	23.1	ND	30.1	36.7	26.7	NA	<RL	<RL		99.6	25.1	7.24	6.92	1.87
Colusa NWR	T23 VP2	26-Feb-02	ND	10.2	ND	20.9	31.7	39.3	NA	<RL	<RL		136.0	24.4	6.54	7.11	5.21
Delevan NWR	T4 VP1	26-Feb-02	ND	34.6	ND	30.7	<RL	37.2	NA	<RL	<RL		470.0	19.1	7.36	7.06	3.84
Delevan NWR	T12 VP1	26-Feb-02	ND	25.1	ND	28.5	<RL	<RL	NA	<RL	<RL		461.0	18.4	7.24	6.86	4.58
Delevan NWR	T12 VP2	26-Feb-02	ND	26.9	ND	40.4	<RL	52.4	NA	<RL	<RL		111.0	17.0	6.65	7.05	2.65
Delevan NWR	T18 VP1	26-Feb-02	ND	38.2	ND	22.3	22.7	65.8	NA	<RL	<RL		304.0	19.9	6.98	7.15	4.32
Delevan NWR	T31.2 VP1	26-Feb-02	ND	26.7	ND	14.9	<RL	44.8	NA	<RL	<RL		121.3	18.2	7.25	7.04	3.65
Llano Seco	T5 VP	26-Feb-02	ND	12.1	ND	22.2	46.2	29.7	NA	<RL	<RL		44.6	16.5	5.72	6.87	1.95
Llano Seco	T15 SW VP	26-Feb-02	ND	22.5	ND	29.8	22.8	<RL	NA	<RL	<RL		52.6	12.7	6.67	6.92	3.24
Sacramento NWR	T11.5 VP2	26-Feb-02	ND	23.9	ND	24.2	16.7	11.4	NA	<RL	<RL		151.9	10.3	6.95	6.86	5.35
Sacramento NWR	T18 VP5	26-Feb-02	ND	31.5	ND	10.3	21.7	9.3	NA	<RL	<RL		267.3	24.1	6.35	7.15	6.09
Sacramento NWR	P1.1 VP1	26-Feb-02	ND	16.8	ND	26.8	ND	<RL	NA	<RL	<RL		324.5	18.7	6.54	6.93	2.65
Sacramento NWR	TC VP1	26-Feb-02	ND	10.1	ND	30.8	30.9	21.7	NA	<RL	<RL		133.3	29.0	7.64	7.05	3.45
Sacramento NWR	TC VP5	26-Feb-02	ND	38.2	ND	22.7	21.8	<RL	NA	<RL	<RL		128.7	25.3	6.64	7.12	2.84
Sacramento NWR	TG VP1	26-Feb-02	ND	33.6	ND	18.2	<RL	45.2	NA	<RL	<RL		404.3	19.5	5.58	6.89	2.68
San Luis NWRC			**Malathion**	**Metalo-chlor**	**Methyl parathion**	**Methidia-thion**	**Napro-pramide**	**Oxyfluor-fen**	**PBO**	**DDE**	**DDT**	**Pendi-methalin**	**Simazine**	**Trifluralin**	**D.O. (mg/L)**	**pH**	**TSS (mg/L)**
Merced NWR	ARP4	28-Feb-02	ND	11.5	ND	ND	ND	44.8	NA	<RL	<RL	22.3	86.1	23.2	7.12	7.08	5.21
Merced NWR	ARP25	28-Feb-02	ND	16.9	ND	ND	ND	29.7	NA	<RL	<RL	37.2	111.0	27.8	6.32	7.19	2.65
Merced NWR	ARP35	28-Feb-02	ND	12.8	ND	ND	ND	33.5	NA	<RL	<RL	28.6	183.1	30.3	5.98	6.97	2.45
Merced NWR	ARP19	28-Feb-02	ND	17.3	ND	ND	ND	68.5	NA	<RL	<RL	40.9	179.2	29.1	5.84	7.02	3.27
Merced NWR	ARP13	28-Feb-02	ND	14.2	ND	ND	ND	<RL	NA	<RL	<RL	28.1	187.4	25.5	6.37	7.07	3.84
Merced NWR	Wild Site	Not Sampled	--	--	--	--	--	--	NA	--	--	--	--	--	--	--	--
Merced NWR	Deadman	Not Sampled	--	--	--	--	--	--	NA	--	--	--	--	--	--	--	--
SJR NWR	Airport South	Not Sampled	--	--	--	--	--	--	NA	--	--	--	--	--	--	--	--
SJR NWR	Airport North	Not Sampled	--	--	--	--	--	--	NA	--	--	--	--	--	--	--	--
SJR NWR	Airport Central	Not Sampled	--	--	--	--	--	--	NA	--	--	--	--	--	--	--	--
San Luis NWR	Shop Pool	28-Feb-02	ND	32.1	ND	30.8	<RL	53.4	NA	<RL	<RL	20.5	238.1	38.9	6.38	7.14	4.26
San Luis NWR	KST 62	28-Feb-02	ND	26.5	ND	<RL	13.7	46.7	NA	<RL	<RL	31.5	344.8	18.8	6.35	7.36	4.12
San Luis NWR	KST 70	28-Feb-02	ND	33.7	ND	<RL	24.1	22.9	NA	<RL	<RL	26.7	173.6	24.6	6.54	7.24	3.87
San Luis NWR	KST 63	28-Feb-02	ND	12.6	ND	<RL	12.5	<RL	NA	<RL	<RL	33.0	286.3	26.1	5.68	6.87	3.64
San Luis NWR	KST Gate	28-Feb-02	ND	18.9	ND	26.3	32.7	61.3	NA	<RL	<RL	22.4	431.8	41.4	5.77	7.38	4.34
San Luis NWR	WBC 2	1-Mar-02	ND	34.6	ND	<RL	24.6	34.5	NA	<RL	<RL	31.3	45.6	10.6	7.09	7.06	4.08
San Luis NWR	WBC 1	1-Mar-02	ND	21.8	ND	<RL	22.8	22.7	NA	<RL	<RL	41.1	99.1	11.4	7.21	7.32	4.21
San Luis NWR	WBC 9	1-Mar-02	ND	16.7	ND	ND	12.6	<RL	NA	<RL	<RL	23.7	72.0	13.7	6.27	7.22	3.67
San Luis NWR	WBC 30	1-Mar-02	ND	19.2	ND	ND	<RL	<RL	NA	<RL	<RL	30.7	63.7	10.9	6.81	6.97	2.45

Sample Event Two		MDL =>	2.1	4.1	11.1	1.8	4.2	4.2	1.2	3.6	1.0	2.2	1.0	4.5	8.4	8.6	5.7
Sacramento NWRC			**Alachlor**	**Atrazine**	**Azinphos methyl**	**Butylate**	**Carbaryl**	**Chlor-pyrifos**	**Dacthal**	**Diazinon**	**Dieldrin**	**Endosulfan**	**Endrin**	**EPTC**	**Heptachlor**	**Heptachlor Epoxide**	**Hexa-zinone**
Colusa NWR	T7 VP1	6-Mar-02	ND	13.7	ND	ND	ND	ND	ND	225.6	ND	1637	ND	ND	<RL	<RL	125.8
Colusa NWR	T7 VP2	6-Mar-02	ND	ND	ND	ND	ND	ND	ND	198.7	ND	13.1	ND	ND	<RL	<RL	213.5
Colusa NWR	T24 VP1	6-Mar-02	ND	5.5	ND	ND	31.7	ND	ND	236.1	ND	20.3	ND	ND	<RL	<RL	56.4
Colusa NWR	T24 VP2	6-Mar-02	ND	6.4	ND	ND	23.6	ND	ND	245.3	ND	14.5	ND	ND	<RL	<RL	88.2
Colusa NWR	T23 VP2	6-Mar-02	ND	6.8	ND	ND	ND	42.9	ND	228.7	ND	17.6	ND	ND	<RL	<RL	191.5
Delevan NWR	T4 VP1	6-Mar-02	ND	ND	ND	ND	ND	39.1	ND	168.4	ND	26.8	ND	ND	<RL	<RL	167.4
Delevan NWR	T12 VP1	6-Mar-02	ND	12.8	ND	ND	ND	54.2	ND	308.7	ND	31.2	ND	ND	<RL	<RL	67.8
Delevan NWR	T12 VP2	6-Mar-02	ND	14.1	ND	ND	25.7	ND	ND	331.8	ND	18.4	ND	ND	<RL	<RL	95.6
Delevan NWR	T18 VP1	6-Mar-02	ND	ND	ND	ND	ND	ND	ND	298.0	ND	16.8	ND	ND	<RL	<RL	182.4
Delevan NWR	T31.2 VP1	6-Mar-02	ND	ND	ND	ND	ND	26.8	ND	167.9	ND	17.7	ND	ND	<RL	<RL	176.5
Llano Seco	T5 VP	6-Mar-02	ND	ND	ND	ND	19.1	47.3	ND	225.3	ND	20.1	ND	ND	<RL	<RL	223.8
Llano Seco	T15 SW VP	6-Mar-02	ND	ND	ND	ND	15.7	ND	ND	246.7	ND	33.2	ND	ND	<RL	<RL	210.6
Sacramento NWR	T11.5 VP2	6-Mar-02	ND	ND	ND	ND	ND	ND	ND	301.1	ND	12.8	ND	ND	<RL	<RL	196.5
Sacramento NWR	T18 VP5	6-Mar-02	ND	ND	ND	ND	ND	ND	ND	221.3	ND	11.1	ND	ND	<RL	<RL	231.5
Sacramento NWR	P1.1 VP1	6-Mar-02	ND	ND	ND	ND	ND	ND	ND	312.5	ND	15.9	ND	ND	<RL	<RL	186.5
Sacramento NWR	TC VP1	6-Mar-02	ND	ND	ND	ND	ND	<RL	ND	196.7	ND	10.6	ND	ND	<RL	<RL	228.9
Sacramento NWR	TC VP5	6-Mar-02	ND	ND	ND	ND	ND	<RL	ND	253.6	ND	12.2	ND	ND	<RL	<RL	210.8
Sacramento NWR	TG VP1	6-Mar-02	ND	ND	ND	ND	ND	ND	ND	307.2	ND	26.4	ND	ND	<RL	<RL	173.2
San Luis NWRC			**Alachlor**	**Atrazine**	**Azinphos methyl**	**Butylate**	**Carbaryl**	**Chlor-pyrifos**	**Dacthal**	**Diazinon**	**Dieldrin**	**Endosulfan**	**Endrin**	**EPTC**	**Heptachlor**	**Heptachlor Epoxide**	**Hexa-zinone**
Merced NWR	ARP4	12-Mar-02	ND	8.3	ND	ND	ND	ND	ND	212.5	ND	23.5	ND	ND	<RL	<RL	68.9
Merced NWR	ARP25	12-Mar-02	ND	7.4	ND	ND	ND	ND	ND	165.7	ND	37.2	ND	ND	<RL	<RL	99.8
Merced NWR	ARP35	12-Mar-02	ND	ND	ND	ND	ND	ND	ND	97.3	ND	21.9	ND	ND	<RL	<RL	45.6
Merced NWR	ARP19	12-Mar-02	ND	ND	ND	ND	<RL	ND	ND	200.5	ND	33.6	ND	ND	<RL	<RL	72.1
Merced NWR	ARP13	12-Mar-02	ND	ND	ND	ND	ND	ND	ND	198.3	ND	22.5	ND	ND	<RL	<RL	56.8
Merced NWR	Wild Site	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Merced NWR	Deadman	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SJR NWR	Airport South	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SJR NWR	Airport North	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SJR NWR	Airport Central	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
San Luis NWR	Shop Pool	12-Mar-02	ND	11.1	ND	ND	ND	ND	ND	86.7	ND	60.1	ND	ND	<RL	<RL	82.3
San Luis NWR	KST 62	12-Mar-02	8.5	14.3	ND	ND	ND	ND	ND	68.1	ND	58.2	ND	ND	<RL	<RL	79.9
San Luis NWR	KST 70	12-Mar-02	10.2	8.9	ND	ND	<RL	ND	ND	76.9	ND	45.8	ND	ND	<RL	<RL	102.3
San Luis NWR	KST 63	12-Mar-02	ND	6.2	ND	ND	<RL	37.6	ND	102.6	ND	32.5	ND	ND	<RL	<RL	66.4
San Luis NWR	KST Gate	12-Mar-02	11.8	22.4	ND	ND	<RL	42.0	ND	124.2	ND	62.7	ND	ND	<RL	<RL	175.3
San Luis NWR	WBC 2	12-Mar-02	ND	ND	ND	ND	ND	ND	ND	99.6	ND	44.6	ND	ND	<RL	<RL	56.9
San Luis NWR	WBC 1	12-Mar-02	ND	ND	ND	ND	ND	ND	ND	84.5	ND	52.1	ND	ND	<RL	<RL	34.8
San Luis NWR	WBC 9	12-Mar-02	ND	ND	ND	ND	ND	ND	ND	71.2	ND	31.7	ND	ND	<RL	<RL	65.8
San Luis NWR	WBC 30	12-Mar-02	ND	ND	ND	ND	ND	ND	ND	68.5	ND	22.1	ND	ND	<RL	<RL	74.1

Sample Event Two		MDL =>	2.1	3.3	4.2	5.4	7.2	4.2	3.3	6.0	6.0	2.4	6.8	3.0			
Sacramento NWRC			**Malathion**	**Metalo-chlor**	**Methyl parathion**	**Methidia-thion**	**Napro-pramide**	**Oxyfluor-fen**	**PBO**	**DDE**	**DDT**	**Pendi-methalin**	**Simazine**	**Trifluralin**	**D.O. (mg/L)**	**pH**	**TSS (mg/L)**
Colusa NWR	T7 VP1	6-Mar-02	ND	31.7	ND	22.3	23.7	31.8	NA	<RL	<RL	16.4	62.5	31.4	6.47	7.14	4.09
Colusa NWR	T7 VP2	6-Mar-02	ND	38.2	ND	ND	20.2	15.9	NA	<RL	<RL	8.8	74.1	44.6	6.81	7.21	3.87
Colusa NWR	T24 VP1	6-Mar-02	ND	41.2	ND	ND	16.6	<RL	NA	<RL	<RL	12.5	54.1	32.4	7.21	6.87	4.31
Colusa NWR	T24 VP2	6-Mar-02	ND	33.8	ND	ND	ND	<RL	NA	<RL	<RL	24.1	45.2	41.0	5.96	7.16	3.81
Colusa NWR	T23 VP2	6-Mar-02	ND	16.9	ND	28.12	<RL	42.2	NA	<RL	<RL	20.5	67.6	24.6	7.31	7.14	3.65
Delevan NWR	T4 VP1	6-Mar-02	ND	25.6	ND	16.3	35.2	31.8	NA	<RL	<RL	22.3	112.6	28.9	7.33	7.16	4.02
Delevan NWR	T12 VP1	6-Mar-02	ND	20.9	ND	12.7	41.0	25.6	NA	<RL	<RL	30.8	116.0	10.3	5.67	7.08	5.21
Delevan NWR	T12 VP2	6-Mar-02	ND	14.3	ND	9.6	<RL	22.9	NA	<RL	<RL	14.6	145.3	15.8	6.54	6.87	4.36
Delevan NWR	T18 VP1	6-Mar-02	ND	35.3	ND	8.1	ND	16.4	NA	<RL	<RL	19.8	337.2	11.3	7.02	6.91	6.21
Delevan NWR	T31.2 VP1	6-Mar-02	ND	32.9	ND	15.4	<RL	<RL	NA	<RL	<RL	17.0	315.1	10.1	6.97	7.06	3.67
Llano Seco	T5 VP	6-Mar-02	ND	21.5	ND	22.9	14.8	53.1	NA	<RL	<RL	<RL	242.0	23.6	6.74	7.04	3.24
Llano Seco	T15 SW VP	6-Mar-02	ND	25.8	ND	31.2	25.4	55.7	NA	<RL	<RL	23.8	129.8	28.1	6.87	7.08	2.84
Sacramento NWR	T11.5 VP2	6-Mar-02	ND	35.2	ND	18.3	37.1	46.8	NA	<RL	<RL	25.4	68.3	19.9	6.67	7.18	3.64
Sacramento NWR	T18 VP5	6-Mar-02	ND	39.4	ND	21.7	<RL	23.7	NA	<RL	<RL	31.8	79.5	26.7	6.14	7.12	4.25
Sacramento NWR	P1.1 VP1	6-Mar-02	ND	28.1	ND	10.4	43.0	35.5	NA	<RL	<RL	33.6	145.7	22.1	6.74	7.13	4.64
Sacramento NWR	TC VP1	6-Mar-02	ND	16.8	ND	25.3	ND	41.2	NA	<RL	<RL	28.1	321.1	23.3	6.67	7.08	3.98
Sacramento NWR	TC VP5	6-Mar-02	ND	17.5	ND	22.6	ND	30.9	NA	<RL	<RL	16.7	341.0	24.0	6.48	6.97	4.67
Sacramento NWR	TG VP1	6-Mar-02	ND	13.7	ND	36.7	ND	29.7	NA	<RL	<RL	<RL	251.0	9.0	6.25	7.21	4.29
San Luis NWRC			**Malathion**	**Metalo-chlor**	**Methyl parathion**	**Methidiat hion**	**Napro-pramide**	**Oxyfluor-fen**	**PBO**	**DDE**	**DDT**	**Pendi-methalin**	**Simazine**	**Trifluralin**	**D.O. (mg/L)**	**pH**	**TSS (mg/L)**
Merced NWR	ARP4	12-Mar-02	ND	31.2	ND	6.3	34.7	<RL	NA	<RL	<RL	23.5	58.7	19.9	5.87	7.18	4.13
Merced NWR	ARP25	12-Mar-02	ND	18.2	ND	ND	<RL	34.1	NA	<RL	<RL	37.0	42.6	18.6	7.23	6.94	3.82
Merced NWR	ARP35	12-Mar-02	ND	20.1	ND	ND	18.2	26.7	NA	<RL	<RL	16.8	59.6	22.4	6.98	7.19	4.61
Merced NWR	ARP19	12-Mar-02	ND	25.6	ND	<RL	23.5	21.1	NA	<RL	<RL	24.7	112.8	21.6	7.12	7.08	4.82
Merced NWR	ARP13	12-Mar-02	ND	15.6	ND	<RL	20.3	38.4	NA	<RL	<RL	33.2	86.1	31.7	6.68	7.06	5.09
Merced NWR	Wild Site	Not Sampled	--	--	--	--	--	--	NA	--	--	--	--	--	--	--	--
Merced NWR	Deadman	Not Sampled	--	--	--	--	--	--	NA	--	--	--	--	--	--	--	--
SJR NWR	Airport South	Not Sampled	--	--	--	--	--	--	NA	--	--	--	--	--	--	--	--
SJR NWR	Airport North	Not Sampled	--	--	--	--	--	--	NA	--	--	--	--	--	--	--	--
SJR NWR	Airport Central	Not Sampled	--	--	--	--	--	--	NA	--	--	--	--	--	--	--	--
San Luis NWR	Shop Pool	12-Mar-02	ND	22.5	ND	14.9		43.6	NA	<RL	<RL	20.5	145.0	33.5	6.35	7.05	4.28
San Luis NWR	KST 62	12-Mar-02	ND	28.7	ND	25.4		47.5	NA	<RL	<RL	31.5	236.0	29.4	7.02	7.21	3.61
San Luis NWR	KST 70	12-Mar-02	ND	31.4	ND	16.9		38.3	NA	<RL	<RL	26.7	242.0	28.3	5.63	7.06	4.35
San Luis NWR	KST 63	12-Mar-02	ND	30.6	ND	17.4		<RL	NA	<RL	<RL	33.0	267.0	18.4	6.35	7.17	3.81
San Luis NWR	KST Gate	12-Mar-02	ND	22.8	ND	26.4		61.4	NA	<RL	<RL	22.4	321.7	40.6	6.84	7.23	3.97
San Luis NWR	WBC 2	12-Mar-02	ND	13.8	ND	12.5		<RL	NA	<RL	<RL	31.3	65.8	12.4	6.21	7.16	4.12
San Luis NWR	WBC 1	12-Mar-02	ND	15.9	ND	17.3		59.4	NA	<RL	<RL	19.1	54.4	16.7	6.84	7.21	4.58
San Luis NWR	WBC 9	12-Mar-02	ND	14.2	ND	9.4		41.8	NA	<RL	<RL	22.8	67.6	19.4	7.21	7.15	2.37
San Luis NWR	WBC 30	12-Mar-02	ND	30.1	ND	10.8		31.8	NA	<RL	<RL	30.4	74.1		6.58	7.14	3.72

APPENDIX B

Water Quality and Pesticide Data
December 2002 - March 2003

Highlighted sites and data cells are discussed in the report.

Dissolved oxygen, pH, total suspended solids, and pesticide concentrations in vernal pool water samples collected in the winter of 2002-2003. Each pesticide concentration is the average of triplicate runs.
Values are nanograms per liter (ng/L). NA: not analyzed, ND: no detect, RL: reporting limit, --: Not sampled, SJR: San Joaquin River, D.O.: Dissolved Oxygen, TSS: Total Suspended Solids.

Sample Event One		MDL=>	2.1	4.1	11.1	1.8	4.2	4.2	1.2	3.6	1.0	2.2	5.0	4.5	8.4	8.6	5.7
Sacramento NWRC			**Alachlor**	**Atrazine**	**Azinphos methyl**	**Butylate**	**Carbaryl**	**Chlor-pyrifos**	**Dacthal**	**Diazinon**	**Dieldrin**	**Endosulfan**	**Endrin**	**EPTC**	**Heptachlor**	**Heptachlor Epoxide**	**Hexa-zinone**
Colusa NWR	T7 VP1	30-Dec-02	ND	17.4	ND	ND	ND	ND	ND	183.2	ND	28.4	ND	ND	<RL	<RL	106.1
Colusa NWR	**T7 VP2**	30-Dec-02	ND	22.8	ND	ND	ND	ND	ND	206.2	ND	35.2	ND	ND	<RL	<RL	199.0
Colusa NWR	T24 VP1	30-Dec-02	ND	25.1	ND	ND	ND	ND	ND	133.0	<RL	22.8	ND	ND	<RL	<RL	217.0
Colusa NWR	**T24 VP2**	30-Dec-02	ND	19.9	ND	ND	ND	ND	ND	128.0	<RL	12.8	ND	ND	<RL	<RL	301.5
Colusa NWR	**T23 VP2**	30-Dec-02	ND	18.6	ND	ND	ND	ND	ND	113.0	<RL	15.6	ND	ND	<RL	<RL	251.3
Delevan NWR	T4 VP1	30-Dec-02	ND	<RL	ND	ND	ND	ND	ND	52.9	<RL	38.1	<RL	ND	<RL	<RL	99.3
Delevan NWR	T12 VP1	30-Dec-02	ND	<RL	ND	ND	ND	ND	ND	88.9	<RL	20.8	<RL	ND	<RL	<RL	45.8
Delevan NWR	T12 VP2	30-Dec-02	ND	24.2	ND	ND	22.6	ND	ND	114.0	<RL	17.3	<RL	ND	<RL	<RL	202.6
Delevan NWR	T18 VP1	30-Dec-02	ND	19.1	ND	ND	19.7	ND	ND	77.1	<RL	14.4	<RL	ND	<RL	<RL	154.5
Delevan NWR	T31.2 VP1	30-Dec-02	ND	ND	ND	ND	31.2	ND	ND	89.5	ND	22.3	<RL	ND	<RL	<RL	36.7
Llano Seco	T5 VP	30-Dec-02	ND	6.0	ND	ND	ND	ND	ND	116.2	ND	18.9	ND	ND	<RL	<RL	225.1
Llano Seco	T15 SW VP	30-Dec-02	ND	8.1	ND	ND	ND	ND	ND	137.0	ND	20.7	ND	ND	<RL	<RL	113.5
Sacramento NWR	T11.5 VP2	30-Dec-02	ND	12.3	ND	ND	ND	ND	ND	119.2	ND	25.6	ND	11.9	<RL	<RL	93.7
Sacramento NWR	T18 VP5	30-Dec-02	ND	ND	ND	ND	<RL	ND	ND	107.5	ND	36.4	ND	16.4	<RL	<RL	45.2
Sacramento NWR	P1.1 VP1	30-Dec-02	ND	22.1	ND	ND	<RL	ND	ND	121.3	ND	16.8	ND	7.1	<RL	<RL	22.8
Sacramento NWR	TC VP1	30-Dec-02	ND	13.8	ND	ND	<RL	ND	ND	96.4	ND	22.4	<RL	<RL	<RL	<RL	125.6
Sacramento NWR	TC VP5	30-Dec-02	ND	14.5	ND	ND	ND	ND	ND	101.1	ND	31.8	<RL	<RL	<RL	<RL	55.1
Sacramento NWR	TG VP1	30-Dec-02	ND	14.1	ND	ND	ND	ND	ND	74.5	ND	16.1	<RL	<RL	<RL	<RL	20.2
San Luis NWR			**Alachlor**	**Atrazine**	**Azinphos methyl**	**Butylate**	**Carbaryl**	**Chlor-pyrifos**	**Dacthal**	**Diazinon**	**Dieldrin**	**Endosulfan**	**Endrin**	**EPTC**	**Heptachlor**	**Heptachlor Epoxide**	**Hexa-zinone**
Merced NWR	ARP4	23-Dec-02	ND	8.3	ND	ND	ND	ND	ND	206.0	ND	36.2	ND	<RL	ND	<RL	14.2
Merced NWR	ARP25	23-Dec-02	ND	6.1	ND	ND	ND	ND	ND	113.5	<RL	25.5	ND	<RL	ND	<RL	9.4
Merced NWR	ARP35	23-Dec-02	ND	13.4	ND	ND	ND	ND	ND	217.6	<RL	31.6	<RL	<RL	ND	<RL	8.3
Merced NWR	ARP19	23-Dec-02	ND	14.0	ND	ND	ND	ND	ND	100.9	ND	18.2	ND	<RL	ND	<RL	14.4
Merced NWR	ARP13	23-Dec-02	ND	6.2	ND	ND	ND	ND	ND	237.1	ND	23.0	ND	<RL	ND	<RL	11.1
Merced NWR	Wild Site	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Merced NWR	Deadman	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SJR NWR	Airport South	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SJR NWR	Airport North	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SJR NWR	Airport Central	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
San Luis NWR	Shop Pool	23-Dec-02	ND	28.7	ND	ND	18.4	ND	ND	74.5	ND	48.1	<RL	15.9	ND	<RL	26.7
San Luis NWR	**KST 62**	23-Dec-02	ND	17.1	ND	ND	21.3	ND	ND	47.2	ND	63.2	ND	18.8	<RL	<RL	72.4
San Luis NWR	**KST 70**	23-Dec-02	ND	10.3	ND	ND	ND	ND	ND	51.4	ND	59.0	<RL	ND	<RL	<RL	205.3
San Luis NWR	**KST 63**	23-Dec-02	ND	18.4	ND	ND	20.5	ND	ND	40.6	ND	65.8	ND	ND	<RL	<RL	108.3
San Luis NWR	KST Gate	23-Dec-02	ND	13.4	ND	ND	19.7	ND	ND	60.4	<RL	47.3	ND	17.5	<RL	ND	46.8
San Luis NWR	WBC 2	23-Dec-02	ND	10.5	ND	ND	17.8	ND	ND	37.8	ND	54.6	ND	6.2	<RL	<RL	63.1
San Luis NWR	WBC 1	23-Dec-02	ND	16.1	ND	ND	ND	ND	ND	44.7	ND	55.1	ND	<RL	<RL	<RL	207.2
San Luis NWR	WBC 9	23-Dec-02	ND	8.5	ND	ND	ND	ND	ND	60.2	<RL	60.2	<RL	<RL	ND	<RL	65.2
San Luis NWR	WBC 30	23-Dec-02	ND	11.2	ND	ND	ND	ND	ND	59.7	ND	70.1	ND	<RL	ND	ND	71.4

Sample Event One		MDL=>	2.1	3.3	4.2	5.4	7.2	4.2	3.3	6.0	6.0	2.4	6.8	3.0			
Sacramento NWRC			**Malathion**	**Metalo-chlor**	**Methyl parathion**	**Methidia-thion**	**Napro-pramide**	**Oxyfluor-fen**	**PBO**	**DDE**	**DDT**	**Pendi-methalin**	**Simazine**	**Trifluralin**	**D.O. (mg/L)**	**pH**	**TSS (mg/L)**
Colusa NWR	T7 VP1	30-Dec-02	ND	60.3	ND	26.0	ND	40.1	24.7	<RL	<RL	20.5	136.1	23.3	6.30	7.10	2.68
Colusa NWR	**T7 VP2**	30-Dec-02	ND	33.0	ND	ND	ND	49.2	10.1	<RL	<RL	31.5	144.1	26.2	6.80	6.86	5.38
Colusa NWR	T24 VP1	30-Dec-02	ND	15.7	ND	ND	ND	38.3	ND	<RL	<RL	26.7	30.5	36.1	5.86	7.25	4.57
Colusa NWR	**T24 VP2**	30-Dec-02	ND	13.2	ND	<RL	ND	60.9	ND	<RL	<RL	33.0	6.9	92.7	7.63	6.72	4.38
Colusa NWR	**T23 VP2**	30-Dec-02	ND	85.5	ND	44.8	ND	46.3	ND	<RL	<RL	22.4	15.8	136.6	5.93	7.12	3.86
Delevan NWR	T4 VP1	30-Dec-02	ND	15.4	ND	51.4	ND	42.2	ND	<RL	<RL	31.3	16.6	102.6	7.36	7.03	2.34
Delevan NWR	T12 VP1	30-Dec-02	ND	22.4	ND	33.0	ND	44.8	ND	<RL	<RL	41.1	18.1	83.4	5.96	6.97	4.18
Delevan NWR	T12 VP2	30-Dec-02	ND	69.1	ND	<RL	35.1	39.3	ND	<RL	<RL	27.8	99.2	45.6	6.35	7.14	2.38
Delevan NWR	T18 VP1	30-Dec-02	ND	47.6	ND	17.6	35.3	37.2	<TL	<RL	<RL	8.8	91.7	18.2	5.82	7.43	6.07
Delevan NWR	T31.2 VP1	30-Dec-02	ND	ND	ND	29.0	42.9	28.6	11.1	<RL	<RL	12.5	106.4	65.8	7.01	6.94	3.89
Llano Seco	T5 VP	30-Dec-02	ND	<RL	ND	<RL	ND	49.7	6.9	<RL	<RL	24.1	92.8	36.7	7.22	7.21	4.64
Llano Seco	T15 SW VP	30-Dec-02	ND	<RL	ND	<RL	28.4	33.8	ND	<RL	<RL	20.5	88.1	22.3	5.51	7.09	5.47
Sacramento NWR	T11.5 VP2	30-Dec-02	ND	<RL	ND	<RL	38.9	30.2	ND	<RL	<RL	22.3	23.4	37.9	5.81	7.21	2.63
Sacramento NWR	T18 VP5	30-Dec-02	ND	35.8	ND	<RL	37.3	40.9	ND	<RL	<RL	37.2	99.1	91.8	6.46	6.97	3.46
Sacramento NWR	P1.1 VP1	30-Dec-02	ND	17.9	ND	<RL	45.7	64.2	ND	<RL	<RL	28.6	102.6	65.7	5.28	7.17	4.91
Sacramento NWR	TC VP1	30-Dec-02	ND	22.9	ND	<RL	12.7	51.7	ND	<RL	<RL	40.9	16.7	45.8	6.08	6.67	5.65
Sacramento NWR	TC VP5	30-Dec-02	ND	15.4	ND	<RL	ND	87.6	ND	<RL	<RL	42.3	29.3	22.4	6.87	7.12	5.32
Sacramento NWR	TG VP1	30-Dec-02	ND	67.2	ND	<RL	ND	41.3	ND	<RL	<RL	21.9	108.1	39.7	5.96	7.09	4.65
San Luis NWR			**Malathion**	**Metalo-chlor**	**Methyl parathion**	**Methidia-thion**	**Napro-pramide**	**Oxyfluor-fen**	**PBO**	**DDE**	**DDT**	**Pendi-methalin**	**Simazine**	**Trifluralin**	**D.O. (mg/L)**	**pH**	**TSS (mg/L)**
Merced NWR	ARP4	23-Dec-02	ND	15.4	ND	ND	ND	35.3	ND	<RL	<RL	12.8	12.6	88.2	5.27	6.91	5.03
Merced NWR	ARP25	23-Dec-02	ND	11.0	ND	ND	ND	16.1	ND	<RL	<RL	16.7	25.7	47.4	6.35	6.89	4.374
Merced NWR	ARP35	23-Dec-02	ND	<RL	ND	ND	ND	12.8	ND	<RL	<RL	23.6	29.1	34.2	7.22	7.05	2.36
Merced NWR	ARP19	23-Dec-02	ND	ND	ND	ND	ND	<RL	ND	<RL	<RL	<RL	13.8	18.2	6.58	6.97	3.94
Merced NWR	ARP13	23-Dec-02	ND	ND	ND	ND	ND	34.1	ND	<RL	<RL	<RL	21.8	20.1	6.49	7.12	4.25
Merced NWR	Wild Site	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Merced NWR	Deadman	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SJR NWR	Airport South	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SJR NWR	Airport North	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SJR NWR	Airport Central	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
San Luis NWR	Shop Pool	23-Dec-02	ND	43.4	ND	42.6	34.0	42.8	14.1	<RL	<RL	33.8	--	--	6.95	7.14	4.21
San Luis NWR	**KST 62**	23-Dec-02	ND	32.8	ND	32.8	22.6	39.4	22.4	<RL	<RL	<RL	243.5	21.4	7.67	6.83	4.18
San Luis NWR	**KST 70**	23-Dec-02	ND	22.9	ND	12.4	ND	49.7	<RL	<RL	<RL	26.1	116.0	15.6	6.68	7.44	8.02
San Luis NWR	KST 63	23-Dec-02	ND	14.3	ND	<RL	45.4	<RL	<RL	<RL	<RL	27.0	293.2	16.3	6.64	7.09	6.09
San Luis NWR	KST Gate	23-Dec-02	ND	35.8	ND	50.9	36.4	51.7	7.4	<RL	<RL	22.5	89.1	23.8	5.67	7.12	4.96
San Luis NWR	WBC 2	23-Dec-02	ND	<RL	ND	22.3	<RL	<RL	ND	<RL	<RL	25.3	76.4	17.5	7.52	7.09	6.28
San Luis NWR	WBC 1	23-Dec-02	ND	36.1	ND	19.5	<RL	<RL	ND	<RL	<RL	37.2	167.2	22.9	5.92	7.14	4.05
San Luis NWR	WBC 9	23-Dec-02	ND	74.2	ND	<RL	23.4	<RL	ND	<RL	<RL	39.8	125.7	24.6	6.23	7.06	6.31
San Luis NWR	WBC 30	23-Dec-02	ND	42.1	ND	22.5	62.7	<RL	ND	<RL	<RL	12.9	59.7	22.9	7.15	6.87	4.35

Sample Event Two		MDL=>	2.1	4.1	11.1	1.8	4.2	4.2	1.2	3.6	1.0	2.2	5.0	4.5	8.4	8.6	5.7
Sacramento NWRC			**Alachlor**	**Atrazine**	**Azinphos methyl**	**Butylate**	**Carbaryl**	**Chlor-pyrifos**	**Dacthal**	**Diazinon**	**Dieldrin**	**Endosulfan**	**Endrin**	**EPTC**	**Heptachlor**	**Heptachlor Epoxide**	**Hexa-zinone**
Colusa NWR	T7 VP1	7-Jan-03	ND	ND	ND	ND	ND	12.3	ND	200.7	ND	33.4	<RL	ND	ND	<RL	91.3
Colusa NWR	**T7 VP2**	7-Jan-03	ND	ND	ND	ND	ND	62.7	ND	184.0	ND	20.8	ND	ND	ND	<RL	241.0
Colusa NWR	T24 VP1	7-Jan-03	ND	ND	ND	ND	ND	41.2	ND	196.1	ND	44.2	<RL	ND	ND	<RL	181.3
Colusa NWR	**T24 VP2**	7-Jan-03	ND	ND	ND	ND	ND	ND	ND	229.1	ND	22.4	ND	ND	ND	<RL	258.6
Colusa NWR	**T23 VP2**	7-Jan-03	ND	6.2	ND	ND	ND	ND	ND	53.8	ND	20.2	ND	ND	ND	<RL	266.0
Delevan NWR	T4 VP1	7-Jan-03	ND	5.6	ND	ND	ND	ND	ND	191	ND	36.7	ND	ND	ND	<RL	297.3
Delevan NWR	T12 VP1	7-Jan-03	ND	8.4	ND	ND	ND	ND	ND	103.7	ND	21.6	ND	ND	ND	<RL	101.9
Delevan NWR	T12 VP2	7-Jan-03	ND	8.3	ND	ND	ND	ND	ND	74.5	<RL	40.8	<RL	ND	ND	<RL	56.8
Delevan NWR	T18 VP1	7-Jan-03	ND	ND	ND	ND	ND	ND	ND	46.7	<RL	32.4	ND	ND	ND	<RL	87.2
Delevan NWR	T31.2 VP1	7-Jan-03	ND	ND	ND	ND	ND	ND	ND	30.6	ND	30.1	ND	ND	ND	<RL	199.6
Llano Seco	T5 VP	7-Jan-03	ND	4.7	ND	ND	ND	ND	ND	48.7	ND	20.5	ND	ND	ND	<RL	85.0
Llano Seco	T15 SW VP	7-Jan-03	ND	9.4	ND	ND	ND	ND	ND	52.1	ND	19.2	ND	ND	ND	<RL	20.1
Sacramento NWR	T11.5 VP2	7-Jan-03	ND	<RL	ND	ND	ND	ND	ND	44.6	ND	28.4	ND	ND	ND	<RL	77.5
Sacramento NWR	T18 VP5	7-Jan-03	ND	6.5	ND	ND	ND	ND	ND	24.8	ND	49.5	<RL	ND	<RL	<RL	254.9
Sacramento NWR	P1.1 VP1	7-Jan-03	ND	7.2	ND	ND	20.7	23.8	ND	32.9	<RL	38.1	<RL	ND	<RL	<RL	182.4
Sacramento NWR	TC VP1	7-Jan-03	ND	16.4	ND	ND	ND	22.7	ND	13.1	ND	22.5	<RL	ND	<RL	ND	92.6
Sacramento NWR	TC VP5	7-Jan-03	ND	18.4	ND	ND	18.2	38.2	ND	17.8	ND	46.2	ND	ND	<RL	ND	83.2
Sacramento NWR	TG VP1	7-Jan-03	ND	11.9	ND	ND	ND	16.2	ND	22.2	ND	35.2	ND	ND	<RL	ND	45.8
San Luis NWR			**Alachlor**	**Atrazine**	**Azinphos methyl**	**Butylate**	**Carbaryl**	**Chlor-pyrifos**	**Dacthal**	**Diazinon**	**Dieldrin**	**Endosulfan**	**Endrin**	**EPTC**	**Heptachlor**	**Heptachlor Epoxide**	**Hexa-zinone**
Merced NWR	ARP4	9-Jan-03	ND	12.8	ND	ND	ND	18.4	ND	35.4	ND	32.4	ND	ND	ND	<RL	22.3
Merced NWR	ARP25	9-Jan-03	ND	9.4	ND	ND	ND	26.9	ND	40.3	<RL	49.2	<RL	ND	ND	<RL	49.1
Merced NWR	ARP35	9-Jan-03	ND	10.1	ND	ND	ND	37.6	ND	23.9	ND	44.1	ND	ND	ND	<RL	36.6
Merced NWR	ARP19	9-Jan-03	ND	ND	ND	ND	ND	11.2	ND	31.4	ND	36.2	ND	ND	ND	<RL	18.4
Merced NWR	ARP13	9-Jan-03	ND	ND	ND	ND	ND	19.7	ND	23.5	ND	28.3	ND	ND	ND	<RL	52.3
Merced NWR	Wild Site	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Merced NWR	Deadman	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SJR NWR	Airport South	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SJR NWR	Airport North	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SJR NWR	Airport Central	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
San Luis NWR	Shop Pool	9-Jan-03	ND	8.4	ND	ND	33.4	ND	ND	32.1	ND	41.3	ND	ND	ND	<RL	85.1
San Luis NWR	**KST 62**	9-Jan-03	ND	11.6	ND	ND	20.1	ND	ND	36.8	ND	55.2	<RL	ND	ND	<RL	96.3
San Luis NWR	**KST 70**	9-Jan-03	ND	ND	ND	ND	19.2	ND	ND	55.9	ND	58.4	<RL	ND	<RL	<RL	98.1
San Luis NWR	KST 63	9-Jan-03	ND	ND	ND	ND	18.7	ND	ND	34.1	ND	54.6	<RL	ND	<RL	<RL	213.6
San Luis NWR	KST Gate	9-Jan-03	ND	16.4	ND	ND	13.5	ND	ND	18.5	ND	62.7	<RL	ND	<RL	<RL	209.3
San Luis NWR	WBC 2	9-Jan-03	ND	ND	ND	ND	17.6	ND	ND	14.2	ND	42.1	<RL	ND	<RL	<RL	89.6
San Luis NWR	WBC 1	9-Jan-03	ND	ND	ND	ND	ND	ND	ND	21.7	ND	50.7	<RL	ND	ND	<RL	74.8
San Luis NWR	WBC 9	9-Jan-03	ND	ND	ND	ND	ND	ND	ND	18.9	ND	39.3	<RL	ND	ND	<RL	89.1
San Luis NWR	WBC 30	9-Jan-03	ND	ND	ND	ND	ND	ND	ND	26.2	ND	46.0	<RL	ND	ND	<RL	76.3

Sample Event Two		MDL=>	2.1	3.3	4.2	5.4	7.2	4.2	3.3	6.0	6.0	2.4	6.8	3.0			
Sacramento NWRC			**Malathion**	**Metalo-chlor**	**Methyl parathion**	**Methidia-thion**	**Napro-pramide**	**Oxyfluor-fen**	**PBO**	**DDE**	**DDT**	**Pendi-methalin**	**Simazine**	**Trifluralin**	**D.O. (mg/L)**	**pH**	**TSS (mg/L)**
Colusa NWR	T7 VP1	7-Jan-03	ND	32.8	ND	<RL	68.2	43.6	ND	<RL	<RL	19.8	66.3	18.1	6.35	7.04	4.91
Colusa NWR	**T7 VP2**	7-Jan-03	ND	58.8	ND	<RL	45.6	47.5	ND	<RL	<RL	21.6	84.9	20.7	5..65	7.25	3.06
Colusa NWR	T24 VP1	7-Jan-03	ND	22.4	ND	<RL	32.7	38.3	ND	<RL	<RL	20.5	162.4	16.4	7.23	6.93	3.51
Colusa NWR	**T24 VP2**	7-Jan-03	ND	18.9	ND	<RL	ND	<RL	ND	<RL	<RL	14.6	118.0	10.8	6.52	7.19	3.31
Colusa NWR	**T23 VP2**	7-Jan-03	ND	17.2	ND	<RL	ND	61.4	ND	<RL	<RL	19.8	208.3	20.6	6.27	7.56	1.73
Delevan NWR	T4 VP1	7-Jan-03	ND	<RL	ND	<RL	<RL	<RL	ND	<RL	<RL	17.0	79.1	12.1	6.87	7.13	3.27
Delevan NWR	T12 VP1	7-Jan-03	ND	ND	ND	<RL	35.2	59.4	ND	<RL	<RL	<RL	65.3	28.7	6.35	7.21	4.84
Delevan NWR	T12 VP2	7-Jan-03	ND	<RL	ND	<RL	41	41.8	ND	<RL	<RL	23.8	151.2	17.4	7.00	6.78	2.58
Delevan NWR	T18 VP1	7-Jan-03	ND	<RL	ND	<RL	<RL	53.4	ND	<RL	<RL	25.4	45.6	16.4	7.22	7.18	3.14
Delevan NWR	T31.2 VP1	7-Jan-03	ND	ND	ND	<RL	ND	71.4	ND	<RL	<RL	31.8	135.8	10.3	5.83	7.06	4.29
Llano Seco	T5 VP	7-Jan-03	ND	ND	ND	<RL	<RL	47.8	ND	<RL	<RL	33.6	164.2	24.1	6.57	7.02	3.46
Llano Seco	T15 SW VP	7-Jan-03	ND	ND	ND	<RL	<RL	36.4	ND	<RL	<RL	28.1	119.7	18.7	6.32	6.97	2.81
Sacramento NWR	T11.5 VP2	7-Jan-03	ND	13.8	ND	<RL	<RL	38.2	ND	<RL	<RL	26.3	203.7	29.0	5.89	6.87	4.65
Sacramento NWR	T18 VP5	7-Jan-03	ND	33.2	ND	<RL	<RL	55.2	ND	<RL	<RL	21.7	63.7	33.7	7.21	7.01	4.21
Sacramento NWR	P1.1 VP1	7-Jan-03	ND	15.7	ND	<RL	<RL	65.1	ND	<RL	<RL	26.3	55.2	26.7	5.69	7.14	3.65
Sacramento NWR	TC VP1	7-Jan-03	ND	30.7	ND	<RL	<RL	37.9	ND	<RL	<RL	21.7	116.1	22.6	6.91	7.03	5.02
Sacramento NWR	TC VP5	7-Jan-03	ND	65.1	ND	<RL	<RL	<RL	ND	<RL	<RL	18.9	97.2	21.9	7.08	6.91	3.54
Sacramento NWR	TG VP1	7-Jan-03	ND	47.6	ND	<RL	<RL	<RL	ND	<RL	<RL	13.6	63.7	25.3	6.98	7.08	2.84
San Luis NWR			**Malathion**	**Metalo-chlor**	**Methyl parathion**	**Methidia-thion**	**Napro-pramide**	**Oxyfluor-fen**	**PBO**	**DDE**	**DDT**	**Pendi-methalin**	**Simazine**	**Trifluralin**	**D.O. (mg/L)**	**pH**	**TSS (mg/L)**
Merced NWR	ARP4	9-Jan-03	ND	<RL	ND	ND	ND	<RL	ND	<RL	<RL	7.6	115.7	14.5	6.89	6.91	3.61
Merced NWR	ARP25	9-Jan-03	ND	<RL	ND	ND	ND	22.1	ND	<RL	<RL	19.2	75.9	22.1	5.96	6.85	4.25
Merced NWR	ARP35	9-Jan-03	ND	<RL	ND	ND	ND	18.3	ND	<RL	<RL	8.3	65.8	24.8	7.02	7.92	4.37
Merced NWR	ARP19	9-Jan-03	ND	<RL	ND	ND	ND	<RL	ND	<RL	<RL	<RL	72.6	19.3	7.21	7.09	3.29
Merced NWR	ARP13	9-Jan-03	ND	<RL	ND	ND	ND	20.4	ND	<RL	<RL	<RL	20.1	12.7	6.94	7.24	4.08
Merced NWR	Wild Site	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Merced NWR	Deadman	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SJR NWR	Airport South	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SJR NWR	Airport North	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SJR NWR	Airport Central	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
San Luis NWR	Shop Pool	9-Jan-03	ND	26.9	ND	<RL	65.4	41.7	6.2	<RL	<RL	21.1	138.4	12.1	6.57	7.19	4.14
San Luis NWR	**KST 62**	9-Jan-03	ND	ND	ND	28.7	21.4	87.6	ND	<RL	<RL	20.5	321.8	18.3	6.58	7.43	3.57
San Luis NWR	**KST 70**	9-Jan-03	ND	ND	ND	<RL	<RL	40.7	ND	<RL	<RL	<RL	129.0	17.3	6.73	6.68	3.58
San Luis NWR	**KST 63**	9-Jan-03	ND	35.8	ND	<RL	<RL	52.4	11.1	<RL	<RL	<RL	119.2	11.3	5.92	7.21	3.58
San Luis NWR	KST Gate	9-Jan-03	ND	17.3	ND	51.2	62.3	30.5	10.5	<RL	<RL	19.1	89.1	20.9	6.67	7.21	3.62
San Luis NWR	WBC 2	9-Jan-03	ND	<RL	ND	<RL	ND	<RL	ND	<RL	<RL	8.6	186.4	38.9	5.98	6.95	4.31
San Luis NWR	WBC 1	9-Jan-03	ND	<RL	ND	<RL	ND	ND	ND	<RL	<RL	6.1	65.7	18.8	7.18	6.92	3.27
San Luis NWR	WBC 9	9-Jan-03	ND	13.4	ND	<RL	ND	ND	ND	<RL	<RL	13.2	70.1	24.6	6.97	7.16	4.23
San Luis NWR	WBC 30	9-Jan-03	ND	22.9	ND	8.3	ND	ND	ND	<RL	<RL	<RL	62.3	13.5	5.78	7.08	2.08

Sample Event Three		MDL=>	2.1	4.1	11.1	1.8	4.2	4.2	1.2	3.6	1.0	2.2	5.0	4.5	8.4	8.6	5.7
Sacramento NWRC			**Alachlor**	**Atrazine**	**Azinphos methyl**	**Butylate**	**Carbaryl**	**Chlor-pyrifos**	**Dacthal**	**Diazinon**	**Dieldrin**	**Endosulfan**	**Endrin**	**EPTC**	**Heptachlor**	**Heptachlor Epoxide**	**Hexa-zinone**
Colusa NWR	T7 VP1	27-Feb-03	ND	22.1	ND	ND	ND	ND	ND	206	ND	52.7	<RL	<RL	<RL	<RL	69.5
Colusa NWR	**T7 VP2**	27-Feb-03	ND	33.3	ND	ND	ND	ND	ND	223	ND	42.3	<RL	<RL	<RL	<RL	237.0
Colusa NWR	T24 VP1	27-Feb-03	ND	24.7	ND	ND	ND	ND	ND	113.7	ND	35.1	<RL	<RL	<RL	<RL	200.1
Colusa NWR	**T24 VP2**	27-Feb-03	ND	16	ND	ND	ND	ND	ND	85.4	ND	31.8	<RL	<RL	<RL	<RL	224.7
Colusa NWR	**T23 VP2**	27-Feb-03	ND	17.8	ND	ND	ND	ND	ND	68.3	ND	11.8	<RL	<RL	<RL	<RL	301.6
Delevan NWR	T4 VP1	27-Feb-03	ND	5.9	ND	ND	ND	ND	ND	74.5	ND	22.7	<RL	<RL	<RL	<RL	323.2
Delevan NWR	T12 VP1	27-Feb-03	ND	6.2	ND	ND	ND	ND	ND	89.6	ND	16.8	<RL	<RL	<RL	<RL	189.7
Delevan NWR	T12 VP2	27-Feb-03	ND	19.1	ND	ND	ND	ND	ND	68.4	ND	14.3	<RL	<RL	<RL	<RL	98.5
Delevan NWR	T18 VP1	27-Feb-03	ND	27.8	ND	ND	ND	ND	ND	87.3	ND	29.9	<RL	<RL	<RL	<RL	264.8
Delevan NWR	T31.2 VP1	27-Feb-03	ND	24.2	ND	ND	ND	ND	ND	119.1	ND	30.8	<RL	<RL	<RL	<RL	307.5
Llano Seco	T5 VP	27-Feb-03	ND	ND	ND	ND	ND	ND	ND	103.4	ND	18.2	<RL	<RL	<RL	<RL	96.5
Llano Seco	T15 SW VP	27-Feb-03	ND	18.3	ND	ND	ND	ND	ND	68.2	ND	22.8	<RL	<RL	<RL	<RL	115.8
Sacramento NWR	T11.5 VP2	27-Feb-03	ND	26.2	ND	ND	ND	ND	ND	95.4	ND	40.9	<RL	<RL	<RL	<RL	112.7
Sacramento NWR	T18 VP5	27-Feb-03	ND	13.1	ND	ND	ND	ND	ND	92.1	ND	12.3	<RL	<RL	<RL	<RL	200.9
Sacramento NWR	P1.1 VP1	27-Feb-03	ND	17.4	ND	ND	ND	ND	ND	89.3	ND	23.1	<RL	9.2	<RL	<RL	265.7
Sacramento NWR	TC VP1	27-Feb-03	ND	26.2	ND	ND	ND	ND	ND	106.7	ND	31.1	<RL	15.6	<RL	<RL	189.7
Sacramento NWR	TC VP5	27-Feb-03	ND	24.8	ND	ND	ND	ND	ND	105.3	ND	12.5	<RL	22.1	<RL	<RL	193.1
Sacramento NWR	TG VP1	27-Feb-03	ND	31.1	ND	ND	ND	ND	ND	99.9	ND	9.1	<RL	7.3	<RL	<RL	200.8
San Luis NWR			**Alachlor**	**Atrazine**	**Azinphos methyl**	**Butylate**	**Carbaryl**	**Chlor-pyrifos**	**Dacthal**	**Diazinon**	**Dieldrin**	**Endosulfan**	**Endrin**	**EPTC**	**Heptachlor**	**Heptachlor Epoxide**	**Hexa-zinone**
Merced NWR	ARP4	25-Feb-03	ND	10.4	ND	ND	ND	ND	ND	62.7	ND	73.6	ND	ND	<RL	<RL	106.7
Merced NWR	ARP25	25-Feb-03	ND	9.1	ND	ND	ND	ND	ND	45.2	ND	41.8	ND	ND	<RL	<RL	92.3
Merced NWR	ARP35	25-Feb-03	ND	11.4	ND	ND	ND	ND	ND	67.3	ND	33.1	ND	ND	<RL	<RL	72.9
Merced NWR	ARP19	25-Feb-03	ND	ND	ND	ND	ND	ND	ND	42.1	ND	50.8	ND	ND	<RL	<RL	112.8
Merced NWR	ARP13	25-Feb-03	ND	ND	ND	ND	ND	ND	ND	52	ND	28.3	ND	ND	<RL	<RL	60.9
Merced NWR	Wild Site	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Merced NWR	Deadman	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SJR NWR	Airport South	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SJR NWR	Airport North	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SJR NWR	Airport Central	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
San Luis NWR	Shop Pool	25-Feb-03	ND	22.5	ND	ND	ND	ND	ND	68.2	ND	34.0	<RL	<RL	<RL	<RL	115.2
San Luis NWR	**KST 62**	25-Feb-03	ND	31.2	ND	ND	ND	ND	ND	21.5	ND	67.3	<RL	<RL	<RL	<RL	72.6
San Luis NWR	**KST 70**	25-Feb-03	ND	31.5	ND	ND	ND	ND	ND	39.5	ND	31.2	<RL	<RL	<RL	<RL	111.6
San Luis NWR	**KST 63**	25-Feb-03	ND	29.6	ND	ND	ND	ND	ND	41.7	ND	46.7	<RL	<RL	<RL	<RL	92.5
San Luis NWR	KST Gate	25-Feb-03	ND	18.4	ND	ND	ND	ND	ND	56.7	ND	58.5	<RL	<RL	<RL	<RL	168.1
San Luis NWR	WBC 2	25-Feb-03	ND	8.6	ND	ND	ND	ND	ND	66.1	ND	38.1	<RL	<RL	<RL	<RL	68.3
San Luis NWR	WBC 1	25-Feb-03	ND	9.4	ND	ND	ND	ND	ND	47.9	ND	16.7	ND	ND	<RL	<RL	83.2
San Luis NWR	WBC 9	25-Feb-03	ND	11.8	ND	ND	ND	ND	ND	62.7	ND	10.2	ND	ND	<RL	<RL	89.9
San Luis NWR	WBC 30	25-Feb-03	ND	ND	ND	ND	ND	ND	ND	29.5	ND	9.7	ND	ND	<RL	<RL	45.3

Sample Event Three		MDL=>	2.1	3.3	4.2	5.4	7.2	4.2	3.3	6.0	6.0	2.4	6.8	3.0			
Sacramento NWRC			**Malathion**	**Metalo-chlor**	**Methyl parathion**	**Methidia-thion**	**Napro-pramide**	**Oxyfluor-fen**	**PBO**	**DDE**	**DDT**	**Pendi-methalin**	**Simazine**	**Trifluralin**	**D.O. (mg/L)**	**pH**	**TSS (mg/L)**
Colusa NWR	T7 VP1	27-Feb-03	ND	9.4	ND	<RL	<RL	22.6	<RL	<RL	<RL	21.5	85.7	11.9	5.65	7.16	3.09
Colusa NWR	**T7 VP2**	27-Feb-03	ND	22.9	ND	<RL	<RL	18.3	<RL	<RL	<RL	36.4	211.3	26.2	5.52	7.32	2.14
Colusa NWR	T24 VP1	27-Feb-03	ND	25.4	ND	<RL	ND	<RL	<RL	<RL	<RL	12.8	196.1	22.6	5.94	7.04	3.41
Colusa NWR	**T24 VP2**	27-Feb-03	ND	37.1	ND	<RL	ND	12.5	<RL	<RL	<RL	20.5	279.0	16.3	5.62	7.41	1.07
Colusa NWR	**T23 VP2**	27-Feb-03	ND	<RL	ND	<RL	<RL	31.8	<RL	<RL	<RL	<RL	331.5	13.7	6.61	7.29	2.60
Delevan NWR	T4 VP1	27-Feb-03	ND	43	ND	<RL	<RL	15.9	<RL	<RL	<RL	22.8	237.5	31.8	5.80	7.24	3.64
Delevan NWR	T12 VP1	27-Feb-03	ND	ND	ND	<RL	<RL	<RL	<RL	<RL	<RL	17.5	186.4	22.6	6.45	7.16	4.81
Delevan NWR	T12 VP2	27-Feb-03	ND	ND	ND	<RL	<RL	<RL	<RL	<RL	<RL	10.3	204.6	26.4	6.67	6.92	2.06
Delevan NWR	T18 VP1	27-Feb-03	ND	ND	ND	<RL	28.4	42.2	<RL	<RL	<RL	11.8	221.5	20.1	6.54	6.94	3.72
Delevan NWR	T31.2 VP1	27-Feb-03	ND	23.5	ND	<RL	29.7	31.8	<RL	<RL	<RL	28.6	87.2	18.4	6.80	7.05	3.61
Llano Seco	T5 VP	27-Feb-03	ND	34.7	ND	<RL	62.1	25.6	<RL	<RL	<RL	14.6	264.8	17.3	7.05	7.16	4.33
Llano Seco	T15 SW VP	27-Feb-03	ND	11.1	ND	<RL	23.7	22.9	<RL	<RL	<RL	12.9	183.1	11.5	7.30	6.84	3.94
Sacramento NWR	T11.5 VP2	27-Feb-03	ND	8.3	ND	<RL	<RL	16.4	<RL	<RL	<RL	40.1	156.7	24.1	6.34	7.24	4.26
Sacramento NWR	T18 VP5	27-Feb-03	ND	ND	ND	<RL	<RL	<RL	<RL	<RL	<RL	15.0	142.8	16.9	6.91	6.87	1.64
Sacramento NWR	P1.1 VP1	27-Feb-03	ND	ND	ND	<RL	46.2	22.3	<RL	<RL	<RL	32.8	106.8	14.2	5.89	7.12	4.27
Sacramento NWR	TC VP1	27-Feb-03	ND	6.1	ND	<RL	ND	18.6	<RL	<RL	<RL	36.0	112.5	11.3	6.37	7.16	3.17
Sacramento NWR	TC VP5	27-Feb-03	ND	<RL	ND	<RL	ND	17.1	<RL	<RL	<RL	26.4	89.1	29.7	5.96	6.82	2.64
Sacramento NWR	TG VP1	27-Feb-03	ND	<RL	ND	<RL	ND	13.5	<RL	<RL	<RL	12.9	176.2	19.2	5.98	7.01	2.27
San Luis NWR			**Malathion**	**Metalo-chlor**	**Methyl parathion**	**Methidia-thion**	**Napro-pramide**	**Oxyfluor-fen**	**PBO**	**DDE**	**DDT**	**Pendi-methalin**	**Simazine**	**Trifluralin**	**D.O. (mg/L)**	**pH**	**TSS (mg/L)**
Merced NWR	ARP4	25-Feb-03	ND	13.2	ND	<RL	22.4	8.6	<RL	<RL	<RL	8.3	134.8	33.7	6.54	6.98	2.84
Merced NWR	ARP25	25-Feb-03	ND	17.4	ND	<RL	16.8	6.1	<RL	<RL	<RL	5.6	89.6	20.3	7.61	7.26	3.82
Merced NWR	ARP35	25-Feb-03	ND	29.5	ND	<RL	<RL	12.7	<RL	<RL	<RL	10.7	186.4	12.8	5.69	7.35	2.37
Merced NWR	ARP19	25-Feb-03	ND	13	ND	<RL	<RL	<RL	<RL	<RL	<RL	<RL	136.7	15.4	6.37	6.98	4.09
Merced NWR	ARP13	25-Feb-03	ND	<RL	ND	<RL	14.7	12.2	<RL	<RL	<RL	6.2	98.2	16.8	6.42	6.71	1.96
Merced NWR	Wild Site	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Merced NWR	Deadman	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SJR NWR	Airport South	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SJR NWR	Airport North	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SJR NWR	Airport Central	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
San Luis NWR	Shop Pool	25-Feb-03	ND	26.2	ND	<RL	<RL	10.1	<RL	<RL	<RL	35.4	252.4	21.1	5.23	6.86	4.27
San Luis NWR	**KST 62**	25-Feb-03	ND	18.6	ND	<RL	18.9	11.4	<RL	<RL	<RL	28.9	311.5	8.1	6.52	7.36	3.68
San Luis NWR	**KST 70**	25-Feb-03	ND	22.3	ND	<RL	ND	9.3	<RL	<RL	<RL	<RL	242.0	19.4	6.48	7.01	2.12
San Luis NWR	**KST 63**	25-Feb-03	ND	ND	ND	<RL	<RL	<RL	<RL	<RL	<RL	23.8	119.2	11.3	6.35	7.16	4.64
San Luis NWR	KST Gate	25-Feb-03	ND	25.6	ND	<RL	23.7	21.7	<RL	<RL	<RL	14.6	97.3	24.8	7.60	6.78	3.47
San Luis NWR	WBC 2	25-Feb-03	ND	35.2	ND	<RL	16.2	<RL	<RL	<RL	<RL	12.1	173.2	26.3	5.96	7.25	2.94
San Luis NWR	WBC 1	25-Feb-03	ND	<RL	ND	<RL	13.8	<RL	<RL	<RL	<RL	6.3	221.5	10.3	6.68	6.87	3.61
San Luis NWR	WBC 9	25-Feb-03	ND	ND	ND	<RL	15.5	<RL	<RL	<RL	<RL	8.1	87.2	9.7	6.17	6.94	
San Luis NWR	WBC 30	25-Feb-03	ND	ND	ND	<RL	<RL	<RL	<RL	<RL	<RL	5.7	264.8	13.9	6.61	7.21	

Sample Event Four		MDL=>	2.1	4.1	11.1	1.8	4.2	4.2	1.2	3.6	1.0	2.2	5.0	4.5	8.4	8.6	5.7
Sacramento NWRC			**Alachlor**	**Atrazine**	**Azinphos methyl**	**Butylate**	**Carbaryl**	**Chlor-pyrifos**	**Dacthal**	**Diazinon**	**Dieldrin**	**Endosulfan**	**Endrin**	**EPTC**	**Heptachlor**	**Heptachlor Epoxide**	**Hexa-zinone**
Colusa NWR	T7 VP1	3-Apr-03	ND	24.7	ND	ND	ND	23.7	ND	200.8	ND	9.1	<RL	<RL	<RL	<RL	336.7
Colusa NWR	**T7 VP2**	3-Apr-03	ND	27.1	ND	ND	31.7	49.2	ND	166.8	ND	21.2	<RL	<RL	<RL	<RL	409.0
Colusa NWR	T24 VP1	3-Apr-03	ND	32.5	ND	ND	22.4	36.1	ND	86.4	ND	12.7	<RL	<RL	<RL	<RL	225.3
Colusa NWR	**T24 VP2**	3-Apr-03	ND	39.1	ND	ND	18.9	18.2	ND	92.0	ND	16.1	<RL	<RL	<RL	<RL	363.9
Colusa NWR	**T23 VP2**	3-Apr-03	ND	15.7	ND	ND	ND	26.5	ND	52.2	ND	13.6	<RL	<RL	<RL	<RL	324.6
Delevan NWR	T4 VP1	3-Apr-03	ND	28.1	ND	ND	ND	ND	ND	78.2	ND	4.5	<RL	<RL	<RL	<RL	189.7
Delevan NWR	T12 VP1	3-Apr-03	ND	26.1	ND	ND	ND	18.4	ND	75.2	ND	31.4	<RL	<RL	<RL	<RL	417.2
Delevan NWR	T12 VP2	3-Apr-03	ND	17.6	ND	ND	ND	17.3	ND	66.8	ND	6.7	<RL	<RL	<RL	<RL	328.4
Delevan NWR	T18 VP1	3-Apr-03	ND	21.6	ND	ND	ND	32.8	ND	94.2	ND	5.9	<RL	<RL	<RL	<RL	226.3
Delevan NWR	T31.2 VP1	3-Apr-03	ND	22.4	ND	ND	ND	ND	ND	78.5	ND	14.2	<RL	<RL	<RL	<RL	402.9
Llano Seco	T5 VP	3-Apr-03	ND	14.6	ND	ND	ND	ND	ND	69.1	ND	19.8	<RL	ND	<RL	<RL	441.2
Llano Seco	T15 SW VP	3-Apr-03	ND	26.1	ND	ND	11.1	ND	ND	84.6	ND	20.1	ND	ND	<RL	<RL	198.4
Sacramento NWR	T11.5 VP2	3-Apr-03	ND	27.3	ND	ND	9.7	ND	ND	74.5	ND	25.4	ND	<RL	<RL	<RL	181.0
Sacramento NWR	T18 VP5	3-Apr-03	ND	18.6	ND	ND	15.4	ND	ND	48.7	ND	8.7	ND	6.1	<RL	<RL	76.4
Sacramento NWR	P1.1 VP1	3-Apr-03	ND	33.2	ND	ND	7.8	ND	ND	52.1	ND	17.0	ND	9.7	<RL	<RL	97.0
Sacramento NWR	TC VP1	3-Apr-03	ND	18.4	ND	ND	18.3	ND	ND	67.3	ND	21.8	ND	<RL	<RL	<RL	309.1
Sacramento NWR	TC VP5	3-Apr-03	ND	13.6	ND	ND	16.2	ND	ND	66.1	ND	16.5	<RL	<RL	<RL	<RL	236.0
Sacramento NWR	TG VP1	3-Apr-03	ND	19.1	ND	ND	ND	ND	ND	46.7	ND	12.2	<RL	<RL	<RL	<RL	353.1
San Luis NWR			**Alachlor**	**Atrazine**	**Azinphos methyl**	**Butylate**	**Carbaryl**	**Chlor-pyrifos**	**Dacthal**	**Diazinon**	**Dieldrin**	**Endosulfan**	**Endrin**	**EPTC**	**Heptachlor**	**Heptachlor Epoxide**	**Hexa-zinone**
Merced NWR	ARP4	14-Mar-03	ND	10.1	ND	ND	ND	55.7	ND	22.1	ND	37.0	<RL	<RL	<RL	<RL	65.1
Merced NWR	ARP25	14-Mar-03	ND	ND	ND	ND	ND	62.1	ND	48.2	ND	21.6	<RL	<RL	<RL	<RL	26.9
Merced NWR	ARP35	14-Mar-03	ND	ND	ND	ND	ND	37	ND	62.4	ND	21.9	ND	<RL	<RL	<RL	48.3
Merced NWR	ARP19	14-Mar-03	ND	ND	ND	ND	ND	34.4	ND	62.7	ND	14.3	ND	<RL	<RL	<RL	74.6
Merced NWR	ARP13	14-Mar-03	ND	ND	ND	ND	ND	ND	ND	58.9	ND	7.5	ND	<RL	<RL	<RL	51.0
Merced NWR	Wild Site	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Merced NWR	Deadman	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SJR NWR	Airport South	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SJR NWR	Airport North	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SJR NWR	Airport Central	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
San Luis NWR	Shop Pool	15-Mar-03	ND	18.2	ND	ND	ND	ND	ND	57.6	ND	66.4	<RL	<RL	<RL	<RL	150.9
San Luis NWR	**KST 62**	15-Mar-03	ND	11.4	ND	ND	15.2	ND	ND	24.2	ND	52.0	<RL	<RL	<RL	<RL	118.7
San Luis NWR	**KST 70**	15-Mar-03	ND	6.7	ND	ND	13.8	ND	ND	56.7	ND	28.9	<RL	<RL	<RL	<RL	97.4
San Luis NWR	**KST 63**	15-Mar-03	ND	8.9	ND	ND	11.6	ND	ND	53.4	ND	51.1	<RL	<RL	<RL	<RL	118.7
San Luis NWR	KST Gate	15-Mar-03	ND	ND	ND	ND	10.1	ND	ND	64.2	ND	43.2	<RL	<RL	<RL	<RL	96.7
San Luis NWR	WBC 2	14-Mar-03	ND	ND	ND	ND	9.4	ND	ND	67.1	ND	61.5	<RL	<RL	<RL	<RL	46.2
San Luis NWR	WBC 1	14-Mar-03	ND	ND	ND	ND	12.2	ND	ND	23.7	ND	27.2	<RL	<RL	<RL	<RL	52.1
San Luis NWR	WBC 9	14-Mar-03	ND	13.5	ND	ND	ND	ND	ND	68.9	ND	19.7	ND	<RL	<RL	<RL	31.1
San Luis NWR	WBC 30	14-Mar-03	ND	10.1	ND	ND	ND	ND	ND	70.1	ND	12.8	ND	<RL	<RL	<RL	40.5

Sample Event Four		MDL=>	2.1	3.3	4.2	5.4	7.2	4.2	3.3	6.0	6.0	2.4	6.8	3.0			
Sacramento NWRC			**Malathion**	**Metalo-chlor**	**Methyl parathion**	**Methidia-thion**	**Napro-pramide**	**Oxyfluor-fen**	**PBO**	**DDE**	**DDT**	**Pendi-methalin**	**Simazine**	**Trifluralin**	**D.O. (mg/L)**	**pH**	**TSS (mg/L)**
Colusa NWR	T7 VP1	3-Apr-03	ND	35.3	ND	<RL	23.5	40.1	<RL	<RL	<RL	64.2	226.4	28.7	7.23	6.64	4.28
Colusa NWR	**T7 VP2**	3-Apr-03	ND	26.2	ND	<RL	46.8	49.2	<RL	<RL	<RL	70.3	341.6	35.3	4.23	6.91	3.64
Colusa NWR	T24 VP1	3-Apr-03	ND	32.8	ND	48.1	31.7	38.3	<RL	<RL	<RL	64.8	197.4	16.5	5.88	7.15	2.48
Colusa NWR	**T24 VP2**	3-Apr-03	ND	42.9	ND	<RL	<RL	60.9	<RL	<RL	<RL	66.2	251.1	12.4	4.98	7.32	0.67
Colusa NWR	**T23 VP2**	3-Apr-03	ND	13.2	ND	36.7	<RL	46.3	<RL	<RL	<RL	78.3	309.0	14.5	5.21	7.09	1.35
Delevan NWR	T4 VP1	3-Apr-03	ND	15.7	ND	<RL	<RL	42.2	<RL	<RL	<RL	65.1	256.7	17.2	6.48	6.74	3.54
Delevan NWR	T12 VP1	3-Apr-03	ND	ND	ND	15.6	<RL	44.8	<RL	<RL	<RL	60.9	263.4	14.9	7.33	7.21	4.18
Delevan NWR	T12 VP2	3-Apr-03	ND	ND	ND	22.7	<RL	39.3	<RL	<RL	<RL	56.9	212.5	24.6	6.83	7.01	2.12
Delevan NWR	T18 VP1	3-Apr-03	ND	<RL	ND	12.9	46.2	37.2	<RL	<RL	<RL	40.3	278.1	18.4	6.18	7.19	3.57
Delevan NWR	T31.2 VP1	3-Apr-03	ND	9.1	ND	<RL	22.8	<RL	<RL	<RL	<RL	15.8	299.3	17.0	5.88	6.95	2.77
Llano Seco	T5 VP	3-Apr-03	ND	16.8	ND	<RL	16.7	52.4	<RL	<RL	<RL	68.3	257.6	19.9	6.36	7.21	3.42
Llano Seco	T15 SW VP	3-Apr-03	ND	12.5	ND	18.7	49.2	65.8	<RL	<RL	<RL	22.8	246.8	18.2	7.06	6.91	4.63
Sacramento NWR	T11.5 VP2	3-Apr-03	ND	32.7	ND	<RL	28.4	44.8	<RL	<RL	<RL	36.7	196.4	26.7	6.37	7.44	2.81
Sacramento NWR	T18 VP5	3-Apr-03	ND	24.6	ND	36.5	43.2	29.7	<RL	<RL	<RL	21.5	182.7	20.5	6.84	7.09	3.09
Sacramento NWR	P1.1 VP1	3-Apr-03	ND	22.8	ND	<RL	18.4	33.5	<RL	<RL	<RL	27.5	176.9	21.1	7.01	6.83	4.27
Sacramento NWR	TC VP1	3-Apr-03	ND	12.6	ND	45.9	23.5	68.5	<RL	<RL	<RL	32.8	165.8	13.8	7.12	6.87	3.62
Sacramento NWR	TC VP5	3-Apr-03	ND	<RL	ND	<RL	<RL	<RL	<RL	<RL	<RL	60.7	181.2	18.9	6.84	7.28	5.06
Sacramento NWR	TG VP1	3-Apr-03	ND	9.6	ND	<RL	<RL	49.7	<RL	<RL	<RL	59.9	92.4	17.3	6.92	6.68	3.64
San Luis NWR			**Malathion**	**Metalo-chlor**	**Methyl parathion**	**Methidia-thion**	**Napro-pramide**	**Oxyfluor-fen**	**PBO**	**DDE**	**DDT**	**Pendi-methalin**	**Simazine**	**Trifluralin**	**D.O. (mg/L)**	**pH**	**TSS (mg/L)**
Merced NWR	ARP4	14-Mar-03	ND	15.9	ND	<RL	ND	7.2	ND	<RL	<RL	21.1	86.1	25.4	7.21	7.16	4.39
Merced NWR	ARP25	14-Mar-03	ND	10.1	ND	<RL	ND	14.1	<RL	<RL	<RL	34.6	77.9	13.7	6.97	6.98	5.14
Merced NWR	ARP35	14-Mar-03	ND	12.8	ND	<RL	ND	ND	ND	<RL	<RL	15.9	109.8	22.9	6.35	6.92	3.67
Merced NWR	ARP19	14-Mar-03	ND	14.6	ND	8.2	ND	ND	ND	<RL	<RL	22.7	72.3	20.6	6.41	7.18	4.83
Merced NWR	ARP13	14-Mar-03	ND	4.2	ND	<RL	ND	<RL	<RL	<RL	<RL	56.3	51.2	12.8	6.52	6.88	4.52
Merced NWR	Wild Site	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Merced NWR	Deadman	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SJR NWR	Airport South	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SJR NWR	Airport North	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SJR NWR	Airport Central	Not Sampled	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
San Luis NWR	Shop Pool	15-Mar-03	ND	16.1	ND	<RL	12.2	32.5	11.6	<RL	<RL	26.3	167.2	26.4	7.21	6.83	4.04
San Luis NWR	**KST 62**	15-Mar-03	ND	35.4	ND	<RL	22.8	44.2	14.7	<RL	<RL	31.8	286.4	35.4	5.73	7.36	2.35
San Luis NWR	**KST 70**	15-Mar-03	ND	12.8	ND	6.1	<RL	<RL	<RL	<RL	<RL	44.2	315.0	18.6	5.98	6.91	2.40
San Luis NWR	**KST 63**	15-Mar-03	ND	14.3	ND	<RL	37.3	<RL	<RL	<RL	<RL	19.5	165.7	14.4	6.22	7.14	2.63
San Luis NWR	KST Gate	15-Mar-03	ND	20.1	ND	16.4	38.2	47.1	10.2	<RL	<RL	31.8	186.7	25.1	6.81	7.06	3.48
San Luis NWR	WBC 2	14-Mar-03	ND	22.7	ND	<RL	<RL	<RL	<RL	<RL	<RL	32.6	192.2	9.3	6.37	7.31	3.62
San Luis NWR	WBC 1	14-Mar-03	ND	16.5	ND	<RL	<RL	<RL	ND	<RL	<RL	33.1	225.6	15.8	5.98	6.84	2.83
San Luis NWR	WBC 9	14-Mar-03	ND	18.7	ND	<RL	<RL	<RL	ND	<RL	<RL	20.9	194.7	12.4	6.30	7.08	3.29
San Luis NWR	WBC 30	14-Mar-03	ND	32.1	ND	<RL	<RL	<RL	ND	<RL	<RL	36.1	192.8	11.9	6.94	7.15	3.38