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 AUG 13 2015

Attachment E – Notice of Intent

WATER QUALITY ORDER NO. 2013-0002-DWQ  
 GENERAL PERMIT NO. CAG990005

DIVISION OF WATER QUALITY

STATEWIDE GENERAL NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM  
 (NPDES) PERMIT FOR RESIDUAL AQUATIC PESTICIDE DISCHARGES TO WATERS OF  
 THE UNITED STATES FROM ALGAE AND AQUATIC WEED CONTROL APPLICATIONS

I. NOTICE OF INTENT STATUS (see Instructions)

Mark only one item A.  New Applicator  B. Change of Information: WDID# 3400512456  
 C.  Change of ownership or responsibility: WDID# \_\_\_\_\_

II. DISCHARGER INFORMATION

A. Name <i>The Land Conservancy of San Luis Obispo County</i>			
B. Mailing Address <i>PO Box 12206</i>			
C. City <i>San Luis Obispo</i>	D. County <i>San Luis Obispo</i>	E. State <i>CA</i>	F. Zip <i>93406</i>
G. Contact Person <i>Jonathan Hall</i>	H. E-mail address <i>jonh@lcslo.org</i>	I. Title <i>Restoration Manager</i>	J. Phone <i>805-544-9096</i>

III. BILLING ADDRESS (Enter Information only if different from Section II above)

A. Name			
B. Mailing Address			
C. City	D. County	E. State	F. Zip
G. E-mail address	H. Title	I. Phone	

**IV. RECEIVING WATER INFORMATION**

A. Algaecide and aquatic herbicides are used to treat (check all that apply):

- Canals, ditches, or other constructed conveyance facilities owned and controlled by Discharger.  
Name of the conveyance system: \_\_\_\_\_
- Canals, ditches, or other constructed conveyance facilities owned and controlled by an entity other than the Discharger.  
Owner's name: \_\_\_\_\_  
Name of the conveyance system: \_\_\_\_\_
- Directly to river, lake, creek, stream, bay, ocean, etc.  
Name of water body: San Luis Obispo Creek Watershed; Pismo Creek Watershed; Arroyo Grande Watershed

B. Regional Water Quality Control Board(s) where treatment areas are located  
(REGION 1, 2, 3, 4, 5, 6, 7, 8, or 9): Region 3  
(List all regions where algaecide and aquatic herbicide application is proposed.)

**V. ALGAECIDE AND AQUATIC HERBICIDE APPLICATION INFORMATION**

A. Target Organisms: Arundo donax

B. Algaecide and Aquatic Herbicide Used: List Name and Active ingredients  
Roundup Custom (a.i. glyphosate)  
Habitat (a.i. imazapyr)

C. Period of Application: Start Date October 1, 2015 End Date December 1, 2018

D. Types of Adjuvants Used: Competitor (Modified Vegetable Oil) Magnify: Activator. Penetrant (Alkyl polyglycoside, Ammonium sulfate; Ammonium nitrate)

**VI. AQUATIC PESTICIDE APPLICATION PLAN**

Has an Aquatic Pesticide Application Plan been prepared and is the applicator familiar with its contents?  
 Yes  No

If not, when will it be prepared? \_\_\_\_\_

**VII. NOTIFICATION**

Have potentially affected public and governmental agencies been notified?  Yes  No

**VIII. FEE**

Have you included payment of the filing fee (for first-time enrollees only) with this submittal?  
 YES  NO  NA

**IX. CERTIFICATION**

"I certify under penalty of law that this document and all attachments were prepared under my direction and supervision in accordance with a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment. Additionally, I certify that the provisions of the General Permit, including developing and implementing a monitoring program, will be complied with."

A. Printed Name: Karla Adriane Dettman Hooker  
 B. Signature: *Karla Dettman Hooker* Date: 08/11/2015  
 C. Title: Executive Director

**XI. FOR STATE WATER BOARD STAFF USE ONLY**

WDID:	Date NOI Received:	Date NOI Processed:
Case Handler's Initial:	Fee Amount Received: \$	Check #:
<input type="checkbox"/> Lyris List Notification of Posting of APAP	Date _____	Confirmation Sent _____

# **Aquatic Pesticide Application Plan**

For Application of Aquatic Pesticides to Portions of  
the San Luis Obispo, Arroyo Grande, and Pismo  
Creek Watersheds

Consistent with Statewide General NPDES Permit  
for the Discharge of Aquatic Pesticides for Weed  
Control in Waters of the United States

Water Quality Order No. 2013-0002-DWQ

Submitted by:

The Land Conservancy of San Luis Obispo County

August 2015

*Current funding for The Land Conservancy of San Luis Obispo County Arundo Management Program comes from The San Luis Obispo Zone 9 Flood Control District, The Central Coast Salmon Enhancement, The California Conservation Corps., The Avila Beach Trustee Council, and private Landowners.*

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## Project Summary

The objective of this project is to remove *Arundo donax* (hereafter: Arundo) from strategic reaches of San Luis Obispo Creek, Arroyo Grande Creek, and along the West Corral de Piedra in order to improve habitat for steelhead (*Oncorhynchus mykiss*) and other sensitive species. As a part of a watershed-wide eradication program, this project involves biomass removal and chemical treatments of Arundo. The watershed-wide effort is being addressed with an approach that works upstream to downstream in order to prevent re-introduction of Arundo.

The California Invasive Plant Council (CalIPC) has placed Arundo on their list of most invasive plants. Due to its impacts on local ecology and its ability to thrive in the local environment, it is listed as a high priority project in the Watershed Management Plans for the streams included in this project.

Inquiries on The Land Conservancy of San Luis Obispo Arundo Management Plan or The Aquatic Pesticide Application Plan can be made at:

*The Land Conservancy of San Luis Obispo County*

*1137 Pacific Street, Suite A*

*San Luis Obispo, CA 93401*

*(805) 544-9096*

*Attention: Jonathan Hall, Restoration Manager*

The Land Conservancy has the following two (2) Qualified Licensed Applicators through The Department of Pesticide Regulation on staff:

*Jonathan Hall, License # 115922, categories B, D and F, operator ID # 40-12-4000248*

*Daniel Bohlman, License # 127597, categories B and F*

## Description of Water System

### San Luis Obispo Creek Watershed

The San Luis Obispo Creek watershed, part of the Central Coast Watershed (HUC Code 18060006), is centrally located in San Luis Obispo County between the Santa Lucia Mountains and coastal hills of central California. San Luis Obispo Creek originates in the foothills of the Santa Lucia Range near Cuesta Grade, flowing approximately 29 km (18 miles) to its discharge mouth at the Pacific Ocean in San Luis Bay, near the community of Avila Beach. The stream closely follows State Highway 101 along most of the mainstream. The City of San Luis Obispo covers an area of approximately 9.5 square miles near the center of the watershed, with the remaining watershed area (approximately 217 sq km or 84 sq mi) in San Luis Obispo County jurisdiction.

## **Pismo Creek Watershed**

The Pismo Creek Watershed is part of the Central Coast Watershed (HUC Code 18060006) and covers approximately 47 square miles. The watershed area directly affected by the proposed project is 5% of the total area. The current land use in the watershed is farming, ranching, urban/residential and recreation. Watershed ownership is 90% private and 10% state. The Pismo Creek watershed drains approximately 47 square miles of land in the southern portion of San Luis Obispo County, California and carries the drainage to the Pacific Ocean at Pismo Beach. Pismo Creek was once a tributary to Arroyo Grande Creek (Pismo Creek/Edna Area Watershed Management Plan, 2009). The stream and its tributaries are, and have long been, a significant resource to the communities of Pismo Beach. The watershed provides habitat and migration corridors for many species of plants, animals and fish, while also offering recreational opportunities, a water supply for agriculture, and ground water recharge. The watershed lies within the South Central Coast Steelhead Evolutionarily Significant Unit (ESU), which was listed as threatened in 1997. Pismo creek has faced fish passage, erosion, and flooding problems in the past.

## **Arroyo Grande Watershed**

The Arroyo Grande Creek watershed, part of the Central Coast Watershed (HUC Code 18060006), drains approximately 153 square miles of land in the southern portion of San Luis Obispo County. Sixty-seven square miles of the watershed is located above Lopez Dam and the remaining 86 square miles are below the dam. The Arroyo Grande Creek leaves Lopez Dam and flows through a gently sloped terrain and empties into a flat valley that supports prime agricultural land and urban development. At the downstream end, the stream flows through the Arroyo Grande flood control channel (The County of San Luis Obispo Flood Control Zone 3 District) and into the Oceano Dunes State Vehicle Recreation Area (ODSVRA) where it drains into the Pacific Ocean. The watershed includes the tributaries of Tally Ho, Tar Springs and Los Berros Creeks. Meadow Creek is a remnant marsh drainage system that enters Arroyo Grande Creek, just upstream of the confluence with the ocean. Floodgates were installed at the point where Meadow Creek meets the Arroyo Grande Creek Flood Control Channel levee to prevent storm surges from infiltrating the lowland marsh area and damaging homes in that area. The main stem of the Arroyo Grande Creek is 13.9 miles long, Los Berros Creek is 13.7 miles, Tar Springs is 9.47 miles, Talley Ho is 4.25 miles, and Meadow Creek is 5.3 miles. Arroyo Grande Creek empties into an estuary adjacent to a lagoon, which is also the terminus of Meadow Creek. The watershed area directly affected by the project is less than 1%, approximately 22,000 square feet. The current land use in the watershed is farming, ranching, urban/residential and recreation. Watershed ownership is 72% private, 1.6% state, and 19.4% federal.

## **Description of Weeds to be Controlled**

### *General Description*

Arundo is a robust perennial grass that reaches heights of nine to thirty feet tall, growing in many-stemmed, cane-like clumps, spread from horizontal rootstocks below the soil, and often forms large colonies many feet across. Individual stems or culms are tough and hollow, divided by partitions at

nodes similar to bamboo. First-year culms are unbranched, with single or multiple lateral branches from nodes in the second year. The pale green to blue-green leaves, which broadly clasp the stem with a heart-shaped base and taper to the tip, are up to two feet or more in length. Leaves are arranged alternately throughout the culm, distinctly two-ranked (in a single plane). Arundo produces a tall, plume-like flowerhead at the upper tips of the stems, the flowers closely packed in a cream to brown cluster borne from early summer to early fall. Culms may remain green throughout the year, but often fade with semi-dormancy during the winter months or in drought. Arundo can be confused with cultivated bamboos and cord, and in earlier stages with some large-statured grasses such as giant wild rye (*Leymus condensates*) and especially with common reed (*Phragmites australis*).

### *Taxonomy*

Poaceae. Stems: 30 ft (<9m) tall, stems erect, hollow, and glabrous 1.6 in (<4 cm) in diameter with somewhat swollen nodes; thick, fleshy rhizomes form creeping rootstocks, yielding dense colonies. Leaves: cauline, sheaths > internodes, ligule thinly membranous and fringed with hairs; blade <3.3 ft (<1 m), 0.8-2.4 in (2-6 cm) wide at base, tapering to a sharp tip, flat or folded, margins scabrous; leaves alternate and conspicuously two-ranked. Inflorescence: as terminal panicle 1-2 ft (30-60 cm) with branches ascending, silver-cream-brown, the numerous spikelets laterally compressed; glumes > florets, membranous and 3-5 veined; florets 4-5, breaking above glumes; lemma 0.3-0.5 in (8-12 mm) and hairy, nerves ending in slender teeth, the middle forming an inconspicuous awn; palea < lemma, 0.12-0.2 in (3-5 mm); anthers 0.1-0.12 in (2.5-3 mm). It does not form viable achenes in North America. (Hickman, et al, 1993.)

### *Distribution*

Arundo occurs in low elevations throughout California and in Baja California, usually below 1,000 feet (350 m) elevation. It has invaded central California river valleys in San Luis Obispo and Monterey counties, the San Francisco Bay Area, and in the Sacramento and San Joaquin River valleys, and is also increasing in the North Coast region (Dudley and Collins 1995). Arundo has been the most serious problem in coastal river drainages of southern California, especially in the Santa Ana, Santa Margarita, Santa Clara, Tijuana, and other major and minor watersheds, where it sometimes occupies entire river channels from bank to bank (Jackson et al. 1994, Bell 1998). Although not currently considered a problem in California deserts, Arundo survives in regularly watered areas of lower-elevation deserts, but does not appear to tolerate high-elevation and continental environments where regular freezing occurs (Sunset 1967).

Arundo is naturalized and invasive in many regions, including southern Africa, subtropical United States through Mexico, the Caribbean islands and South America, Pacific Islands, Australia, and Southeast Asia (Hafliger and Scholz 1981). In California, the largest colonies occur in riparian areas and floodplains of medium-sized to large streams, from wet sites to dry river banks far from permanent water. Arundo tends to favor low-gradient (less than 2 percent) riparian areas over steeper and smaller channels, but scattered colonies are found in moist sites or springs on steeper slopes.

Arundo populations also occur in the upper reaches of coastal streams. Additionally, it is often found along drainage ditches, where the plant has been used for bank stabilization, and in other moist sites, including residential areas where it is used horticulturally. While it is usually associated with rivers that have been physically disturbed and dammed upstream, Arundo can also colonize within native stands of cottonwoods, willows, and other riparian species, even growing in sites shaded by tree canopy. Plants establish primarily in streamside sites, but expand beyond the margins of riparian vegetation.

Soil preferences are broad, as Arundo is known to establish in coarse sands to gravelly soil to heavy clays and river sediments. It grows best in well drained soil with ample moisture, from freshwater to semi-saline soils at margins of brackish estuaries. In Egypt, Rezk and Edany (1997) found that Arundo tolerates both higher and lower water table levels than common reed, which is native to California.

### *Biology*

Arundo in North America does not appear to produce viable seed, and seedlings are not seen in the field. Population expansion here occurs through vegetative reproduction, either from underground rhizomes extending from a colony or from plant fragments carried downstream, primarily during floods, to become rooted and form new clones. Horticultural propagation is routinely done by planting rhizomes, which readily establish, but stems with no basal material are less likely to root. Fresh stems form roots at nodes under laboratory conditions, but survival is poor (Zimmerman and Bunn unpubl. Data), and root formation does occur where an attached culm has fallen over and is in contact with the substrate.

New shoots arise from rhizomes in nearly any season, but are most common in spring. Growth likewise occurs in all seasons, but is highly sensitive to temperature and moisture (Perdue 1958). During warm months with ample water culms are reported to attain growth rates of 2.3 ft (70 cm) per week or about four inches (10 cm) per day, putting it among the fastest growing terrestrial plants. Biomass production has been estimated at 8.3 tons dry weight per acre (Perdue 1958). Young stems rapidly achieve the diameter of mature canes, with subsequent growth involving thickening of the walls (Perdue 1958). Age of individual culms is certainly more than one year, and branching seems to represent stem growth in later years, while rhizomes show indeterminate growth. Branches also form when a stem is cut or laid over. Dieback is infrequently observed, but culms fade or partially brown out during winter, apparently becoming dormant under cold conditions. The outstanding growth trait of this plant is its ability to survive and grow at almost any time under a wide variety of environmental conditions.

### **Discussion of Control Tolerances**

Arundo displaces native plants and associated wildlife species because of the massive stands it forms (Bell 1994, Gaffney and Cushman 1998). Competition with native species has been shown to result from monopolization of soil moisture and by shading (Dudley and Collins 1995). As Arundo replaces riparian vegetation in semi-arid zones, it reduces habitat and food supply, particularly insect populations, for several special status species such as least Bell's vireo (*Vireo bellii pusillus*), southwestern willow flycatcher (*Empidonax traillii extimus*), and yellow-billed cuckoo (*Coccyzus americanus*) (Frandsen and

Jackson 1994, Dudley and Collins 1995). Unlike native riparian plants, Arundo provides little shading of stream channels, leading to increased water temperatures and reduced habitat quality for aquatic wildlife, particularly the California red-legged frog (*Rana draytonii*) and salmonid species.

Eradicating Arundo from San Luis Obispo Creek, Arroyo Grande Creek, and along the West Corral de Piedra will provide many benefits, particularly to steelhead. Since Arundo can cause flooding and erosion by clogging stream channels and deflecting flow onto banks, the removal of Arundo will lead to less bank erosion, reduced turbidity and improved water quality. Removing Arundo will provide native plant species the opportunity to re-establish which will increase shade and cover, thus reducing surface water temperatures and providing additional places for steelhead to hide. Re-establishing natives will also provide increased food sources for steelhead. Finally, removing Arundo will help facilitate proper pool formation and will allow shelter and cover to be used by juvenile steelhead.

With these types of threats, the fertile environment of these streams, and the current size of the infestations, a zero tolerance policy (total eradication) is appropriate.

## Description of Herbicide

Herbicides have proven highly effective in controlling populations of Arundo.

Aquatic herbicide formulations such as those used by The Land Conservancy must be combined with a suitable surfactant to facilitate uptake and translocation of the herbicide down into the rhizomes. An inert marker dye or colorant is often added to the tank mix to assist the applicator at achieving full coverage while not over-applying to any areas. The following discussion addresses glyphosate (Roundup Custom®), imazapyr (Habitat®), Competitor® (surfactant), Magnify® (adjuvant) and Mark-it Blue® (colorant). Detailed descriptions of the chemical properties, degradation rates, environmental fate, and toxicity of glyphosate, imazapyr, and all of the aquatic surfactants evaluated are provided in **Appendix 4**.

**Glyphosate.** The aquatic formulation of glyphosate known as Roundup Custom® will be used. Roundup Custom® is an aqueous solution containing 53.8% glyphosate in its isopropylamine salt form or 4 lbs. acid per gallon, and contains no inert ingredients other than water. Glyphosate inhibits an enzyme needed to synthesize an intermediate product in the biosynthesis of the aromatic amino acids, essential for protein synthesis and to produce many secondary plant products such as growth promoters, growth inhibitors, phenolics, and lignin. Animals do not synthesize these aromatic amino acids and glyphosate therefore has low toxicity to these receptors. (Schuette 1998).

The primary decomposition product of glyphosate is aminomethylphosphonic acid (AMPA), and the commercial product contains an impurity, 2, 4-nitrosoglyphosate (NNG). The potential effects of AMPA and NNG are encompassed by the available toxicity data on glyphosate and glyphosate formulations (SERA 1997).

**Imazapyr.** The aquatic formulation of imazapyr known as Habitat® will be used. Habitat® is an aqueous solution containing 28.7% imazapyr in its isopropylamine salt form or 2 lbs. acid per gallon, and contains 71.3% inert ingredients. Imazapyr inhibits an enzyme in the biosynthesis of the three branched-chain

aliphatic amino acids valine, leucine, and isoleucine. Because animals do not synthesize branched-chained aliphatic amino acids but obtain them from eating plants and other animals, the engineered mechanism for plant toxicity is not generally relevant to birds, mammals, fish or invertebrates. Imazapyr is relatively slow acting and it takes several weeks for the plants to show effects. Plants cease to grow initially in the roots and later in the aboveground portions.

**Surfactants.** For most foliar applications of aquatic herbicide formulations, adjuvants must be added to spray solutions to improve the performance and minimize variation of herbicide efficacy. Surfactants are designed to improve the spreading, dispersing/emulsifying, sticking, absorbing, and/or pest-penetrating properties of the spray mixture (Tu et al. 2001) The pure herbicide formulation mixed with water will stand as a droplet on the waxy leaf surface and the small area of contact therefore provides little potential for uptake of the active ingredient into the foliage. Water droplets containing a surfactant will spread in a thin layer over a waxy leaf surface and improve herbicide uptake by maximizing herbicide distribution and forcing the fluid into the plant. The glyphosate herbicide, Roundup Custom®, requires the addition of surfactants for post-emergent applications such as the control of invasive Arundo.

The Roundup Custom® specimen label recommend the use of a non-ionic surfactant containing at least 50% active ingredient at a rate of 2 or more quarts per 100 gallons of tank mix (0.5% v/v).

Magnify® is a surfactant/ water conditioning agent formulated with ammonium salts, non-ionic surfactants and anti-foaming agents. Magnify enhances the biological activity and leaf-surface penetration of herbicides, defoliant and desiccants whose labels specify the addition of ammonium sulfate/ nitrate and/ or surfactants. Toxicity studies classified this surfactant as a toxicity category of 3-4 (Caution).

**Colorant.** There are several colorants suitable for use in the riparian environment, all of which are similar in composition and performance. Mark-it Blue®, a typical colorant, is a water-soluble polymeric product. As with most colorant products, the active ingredients in Mark-it Blue® are proprietary; the Material Safety Data Sheet (MSDS) indicates that it is non-hazardous and non-toxic.

**Herbicide application.** Impacts to water quality from herbicide application depend on environmental fate, degradation rates of active agents and decomposition products of the herbicides. The primary route by which herbicide solution may contact water is by overspray directly onto the water surface. Herbicide may also be washed off plants by precipitation.

Glyphosate and imazapyr solutions will be applied as sprays to Arundo foliage for control of this invasive plant. Spray mixtures will be dispersed from manually transported tanks (backpack sprayers). Application rates will be consistent with the product labels.

Applications from backpack sprayers entails workers walking through the riparian zone and applying herbicide directly to target plants, with limited overspray to surrounding plants or water surfaces.

## Environmental Fate of Herbicide

Herbicide mixtures may be indirectly discharged to surface waters by rainfall that rinses the herbicide solution from the plants. Rainfall is unlikely to occur during the planned application season, and herbicide applications would be postponed if rainfall were predicted. Applications to invasive *Arundo* along stream banks will result in a small percentage of the herbicide directly entering the water column.

Food-web exposures become significant only with chemicals that have a tendency to bioaccumulate or biomagnify. The adverse effects associated with bioaccumulative chemicals relate to their propensity to transfer through the food web and accumulate preferentially in adipose or organ tissue. For upper-trophic-level species, ingestion of contaminated prey is the predominant route of exposure, especially for hydrophobic chemicals.

**Glyphosate.** Under typical environmental conditions of pH 5-9, glyphosate is ionized. Glyphosate and its salts are readily soluble in water with a solubility of about 12,000 mg/L. Interactions with soil and sediment are primarily ionic, rather than hydrophobic and pH dependent. Laboratory and field studies indicate that glyphosate is strongly and reversibly adsorbed by soil, sediment, and suspended sediment. Glyphosate is deactivated through soil adsorption. Because glyphosate adheres strongly to particles, it does not readily leach to waters (Sprankle 1975), and potential movement of glyphosate to groundwater is unlikely. Due to its negligible vapor pressure ( $7.5 \times 10^{-8}$  mmHg) and its ionic state in water, glyphosate is not expected to volatilize from water or soil. Glyphosate's  $K_{ow}$  has been reported at 0.00033, indicating its high solubility in water, low solubility in lipids, and thus low potential to bioconcentrate.

All reported bioaccumulation factor values for glyphosate in aquatic organisms are well below 100 (Ebasco 1993; Heyden 1991; Wang et al. 1994). The highest bioaccumulation factor of 65.5 was reported for tilapia (a species of fish) in fresh water (Wang et al. 1994). Other studies report much lower bioaccumulation factors in the range of 0.03 to 1.6 for fish (Ebasco 1993). Most studies report rapid elimination and depuration from aquatic organisms after exposure stops (Ebasco 1993). Therefore, bioaccumulation of glyphosate is considered to be low and food-web transfer is not considered to be a significant exposure route.

Soil studies have determined glyphosate half-lives ranging from 3 to 130 days. In the soil environment, glyphosate is resistant to chemical degradation, is stable to sunlight, is relatively non-leachable, and has a low tendency to runoff (except as adsorbed to colloidal matter). It is relatively immobile in most soil environments as a result of its strong adsorption to soil particles. Glyphosate is rapidly and strongly adsorbed to sediment, which appears to be the major sink for glyphosate in aquatic systems. Like in soils, the herbicide is inactivated and biodegraded by microorganisms.

Several studies indicate that glyphosate is stable in water at pH ranging from 3 to 6. The photolytic half-life of glyphosate in deionized water exposed outdoors to sunlight was approximately 5 weeks at 100 ppm and 3 weeks at 2000 ppm. Glyphosate shows little propensity toward hydrolytic decomposition. Its hydrolysis half-life is greater than 35 days. It is also stable to photodegradation under visible light but photolyzes when exposed to UV radiation. Glyphosate's loss from water occurs mainly through sediment adsorption and microbial degradation. The rate of microbial degradation in water is generally

slower because there are fewer microorganisms in water than in most soils. Studies conducted in a forest ecosystem found that glyphosate dissipated rapidly from surface water ponds high in suspended sediment, with first order half-lives ranging from 1.5 to 11.2 days. In streams, residues were undetectable within 3 to 14 days. Other studies using water from natural sources determined glyphosate's half-life ranging from 35 to 63 days. For all aquatic systems, sediment appears to be the major sink for glyphosate residue. A review of the literature on glyphosate dissipation applied under estuarine conditions suggests that 24 to 48 hours after applications, glyphosate concentrations in water were reduced by more than 60-fold.

In summary, the use of glyphosate combined with a surfactant to treat infestations of non-native *Arundo* would result in less than significant impacts on water quality due to the rapid degradation rate and controlled application of herbicides only on target plants.

**Imazapyr.** The fate of imazapyr after application varies with environmental conditions. Movement through the environment of the weak acid is primarily determined by the pH of the environmental compartments.

*Air.* Because the vapor pressure and Henry's Law constant for imazapyr are very low, the fate pathway of this herbicide through volatilization is nonexistent.

*Soil.* Imazapyr is relatively mobile in soils because it adsorbs to soils and sediments only weakly. Adsorption increases with decreasing pH. Above a pH of 5, imazapyr is ionized and does not adsorb to soil. Volatilization of imazapyr from soil is insignificant. Aerobic degradation in soils occurs primarily by very slow microbial metabolism with quinoline as the main metabolite. Anaerobic metabolism in soils appears to be insignificant. (Entrix 10/30, pp. 32-33)

*Water.* In aquatic systems, imazapyr is not expected to be biodegraded or adsorbed to sediment particles. Volatilization of imazapyr from water is insignificant. Aquatic degradation studies under laboratory conditions demonstrated rapid initial photolysis of imazapyr with reported half-lives ranging from 3 to 5 days. (BASF 2004)

*Biological Tissues.* Imazapyr has a very low propensity to bioconcentrate or bioaccumulate as indicated by its low log Kow of 0.22 and its calculated BCF of 3. In plants, imazapyr residues decline rapidly in the first 24 hours following foliar application with the parent compound remaining as the major residue. (HSDB 04/05) Half-lives in plants have been determined to vary from 15 to 37 days. (Neary & Michael 1993)

## Potential Biological and Ecological Effects

The known properties of the herbicides, potential methods of application, and the ecological characteristics of the waterways were evaluated to develop a conceptual model and identify likely receptors and exposure pathways. This model includes identification of primary and secondary herbicide sources, release mechanisms, exposure media, exposure routes, and potential ecological receptors.

For effects to occur, a receptor and a complete exposure pathway must be present. An exposure pathway is only considered complete when all four of the following elements are present: project-related source of a chemical, a mechanism of release of the chemical from the source to the environment, a mechanism of transport of the chemical to the ecological receptor and a route by which the receptor is exposed to the chemical.

The exposure routes associated with the complete pathways include direct contact with the herbicide mixture during and immediately after application, ingestion of contaminated surface water and sediments, direct contact with contaminated surface water and sediments, and food-web exposure. The conceptual model illustrates the links between sources, release and transport mechanisms, affected media, exposure routes, and potentially exposed ecological receptors. Although several complete exposure pathways may exist, not all pathways are comparable in magnitude or significance. The significance of a pathway as a mode of exposure depends on the identity and nature of the chemicals involved and the magnitude of the likely exposure dose. For birds and mammals, ingestion is generally the most significant exposure pathway. Dermal contact is expected to be insignificant and unquantifiable due to the nature of the sites and frequent movement, ranging habits, and furry or feathery outer skin of most wildlife species.

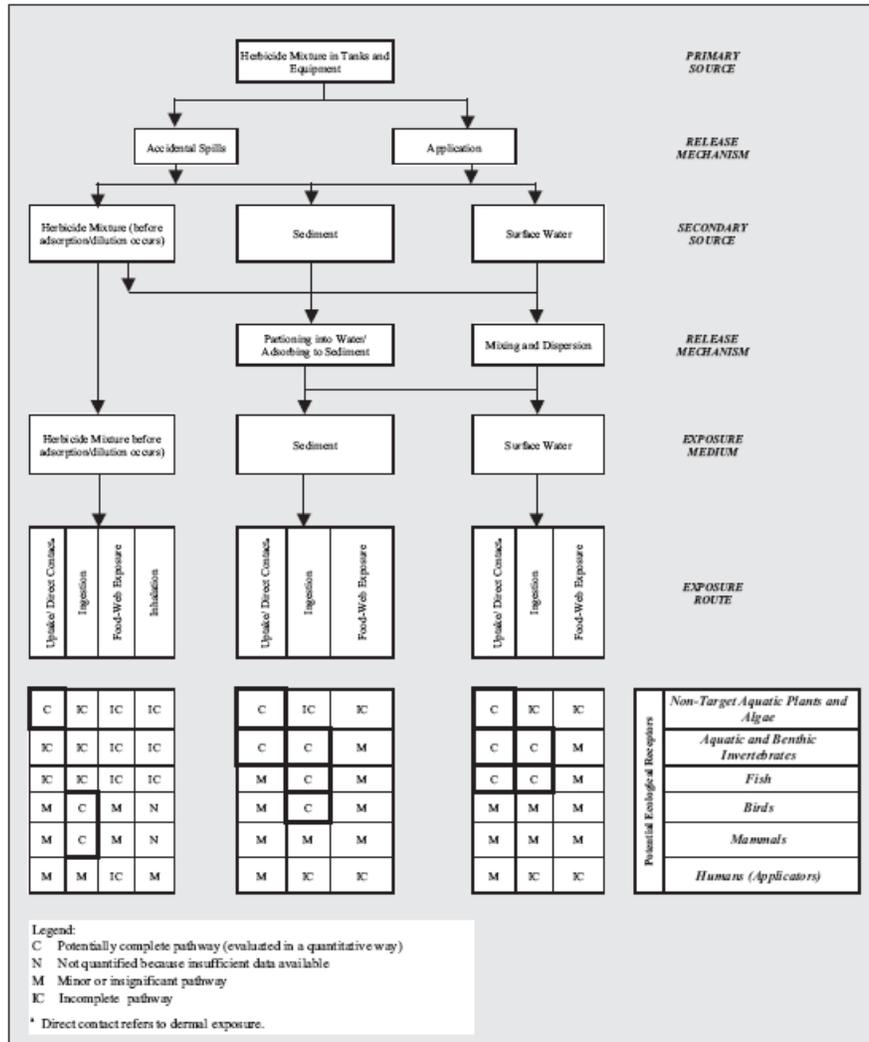


Figure 10 Food-Web Exposure Conceptual Model (Kerr 2010)

Because project applications of herbicides would occur only once or twice a season, and compounds in the herbicide mixture are not expected to persist in significant concentrations for more than several hours, chronic exposure is not likely. Therefore, this evaluation focuses on acute toxicity, which would occur when the compounds are present at relatively high concentrations during and immediately following an application. Herbicide solutions have the potential to affect organisms that live in the water column, including algae, non-target plants, fish, amphibians and aquatic invertebrates. While some other receptors such as mammals and birds may spend a considerable portion of their time in the water, they are generally more likely to be affected by other exposure routes, primarily dermal contact during application and incidental ingestion of contaminated sediment during foraging.

### Non-Target Aquatic Plants and Algae

Due to its engineered mechanisms of action, glyphosate and imazapyr are toxic to a wide variety of plants. Native plants and algae in the area where herbicides would be applied could be negatively affected. Glyphosate and imazapyr, however, are ineffective for treating submerged aquatic vegetation.

**Glyphosate.** In laboratory growth inhibition studies with submerged aquatic plants no adverse effects on the growth of elodea (*Elodea Canadensis*), water milfoil (*Myriophyllum spicatum*), and wild celery (*Vallisneria spiralis*) were found with glyphosate concentrations of up to 1 mg/L. (Monsanto Company 2000) These results are consistent with the findings of other investigators who report that submerged plants are either resistant or affected only by very high glyphosate concentrations. (Monsanto Company 2000.) A large number of studies with a variety of green algae, blue-green algae, diatoms, and periphyton indicate that glyphosate is slightly toxic to practically non-toxic to most algae. Most algae tolerate concentrations of glyphosate greater than 1 mg/L. (Monsanto Company 2000.)

**Imazapyr.** The most sensitive species appear to be aquatic macrophytes with reported EC<sub>25</sub> values for duckweed (*Lemna gibba*) of 0.013 mg/L for growth and for common water milfoil (*Myriophyllum sibiricum*) of 0.013 mg/L for shoot growth and 0.0079 mg/L for root growth. (Hughes 1987 in SERA 12/04) Aquatic algae appear to be substantially less sensitive. The most sensitive species of algae tested was a unicellular green algae (*Chlorella emersonii*) with an EC<sub>50</sub> of about 0.2 mg/L for growth. Some algal species appear to be stimulated rather than inhibited by imazapyr concentrations of up to 100 mg/L. (Hughes 1987 in SERA 12/04) Some species of plants, including aquatic plants, may develop resistance to imazapyr. Bioassays conducted on *Chlorella emersonii* indicated that resistant strains may be less sensitive by a factor of 10. (Landstein et al. 1993 in SERA 10/04) Due to the infrequent application, once per year, development of resistance to imazapyr is unlikely.

### Aquatic and Benthic Invertebrates

**Glyphosate.** Glyphosate is slightly toxic to practically non-toxic to marine and freshwater aquatic invertebrates. Acute toxicity for freshwater invertebrates varies from 545 to 780 mg/L for water flea (*Daphnia magna*), to 673 mg/L for mosquito 4<sup>th</sup> instar (*Anopheles quadrimaculatus*), to 1,157 mg/L for a leech (*Nepheleopsis obscura*). Acute toxicity for marine invertebrates was reported as greater than 10 mg/L for Atlantic oyster larvae (*Crassostrea virginica*), 281 mg/L for grass shrimp (*Palaemonetes vulgaris*), and 934 mg/L for fiddler crab (*Uca pugilator*). (ExToxNet 2005; Henry 1992, Heydens 1991; all in SERA 2004.) The wide variation in the aquatic toxicity of glyphosate has been attributed to the dilution water, temperature, formulation, and the amount of suspended sediment in the water. Toxicity appears to increase with temperature, and decrease with elevated pH and suspended sediment (Schuette 1998).

**Imazapyr.** Imazapyr has been found to have low toxicity to aquatic invertebrates. A study where *Daphnia* was exposed to an imazapyr formulation (~50%) produced a 48-hour EC<sub>50</sub> concentration of 373 mg imazapyr a.e./L (Cyanamid 1997 in Entrix 10/30). Another study with Arsenal (identical to Habitat) with an unspecified surfactant determined a 48-hour LC<sub>50</sub> of 350 mg Arsenal/L (79.1 mg imazapyr a.e./L) and a NOEC of 180 mg Arsenal/L (40.7 mg imazapyr a.e./L) for the freshwater flea (*Daphnia magna*),

highlighting the potential effects of surfactants on aquatic toxicity. Other studies also reported 24 and 48-hour LC<sub>50</sub> concentrations of greater than 100 mg/L, the highest dose tested (HDT), in static tests conducted with newly-hatched *Daphnia*. (Kinter & Forbix 1983 in SERA 12/04) Chronic studies reported no adverse exposure at concentrations up to 97.1 mg/L, the HDT. (Manning 1989 in SERA 12/04). Testing with other invertebrate species that exhibit alternative life cycles has been limited to survival of pink shrimp (*Penaeus duorarum*) and growth studies with the Eastern oyster (*Crassostrea virginica*). Acute toxicity to pink shrimp was determined at LC<sub>50</sub>>132 mg imazapyr a.e./L, the HDT, which was also the NOEC. The EC<sub>50</sub> for growth inhibition of the Eastern oyster was established at a concentration greater than 132 mg imazapyr a.e./L, with the NOEC set at this concentration, the HDT. (Mangels & Ritter 2000 in SERA 12/04)

A recent microcosm study analyzing benthic macroinvertebrates in a logged pond confirmed the low toxicity of imazapyr to benthic freshwater macroinvertebrates. The study analyzed macroinvertebrate community composition, chironomid deformity rate, and chironomid biomass and concluded that imazapyr did not affect the macroinvertebrate community at the concentrations tested. The NOEC was determined to be greater than 18.4 mg/L (Fowlkes et al. 2003)

## Fish

**Glyphosate.** Acute toxicity studies with warm and cold water fish indicate that the terrestrial formulation of glyphosate is slightly to practically non-toxic. (U.S. EPA 1993.) Acute toxicity LC<sub>50</sub> values were reported at 86 mg/L in rainbow trout (*Oncorhynchus mykiss*), 120 mg/L in bluegill sunfish (*Lepomis macrochirus*), and 168 mg/L in harlequin (*Trigonostigma heteromorpha*) (. (ExToxNet 2005.) Chronic toxicity studies with a terrestrial formulation of glyphosate, Roundup®, found no significant adverse effects on growth, carcinogenicity, feeding, and agonistic behavior in rainbow trout fingerlings. A recent study with the aquatic formulation Rodeo® determined the LC<sub>50</sub> for juvenile rainbow trout at 782 mg glyphosate a.e./L.

Giesy et al. (2000) reviewed the data available on glyphosate toxicity to fish. Although some data were available for anadromous species, it appears that all tests were conducted using freshwater test methods. Acute toxicity LC<sub>50</sub> values for glyphosate tested as isopropylamine salt ranged from 97 to greater than 1,000 mg/L and no-observed-effect concentrations (NOEC) values ranged from <97 to 1,000 mg/L. Data compiled by Ebasco (1993) on one-day acute toxicity tests indicate EC50 values ranging from 12.8 mg/L to 240 mg/L.

The lowest of these NOEC and LC<sub>50</sub> values (12.8 mg/L) for glyphosate or glyphosate/surfactant mixtures is well above the maximum glyphosate concentration of 0.026 mg/L reported by Pavaglio et al. (1996) and the immediate maximum geometric mean glyphosate concentration of 0.174 mg/L. Therefore, these data indicate that impacts to fish due to maximum post-application water concentrations of glyphosate are unlikely in experimental conditions.

**Imazapyr.** As detailed in both the 2003 Entrix and 2004 SERA reports, a number of standard bioassays submitted to the U.S. EPA in support of the registration of imazapyr indicate very low toxicity to fish with 96-hr LC<sub>50</sub> values greater than 100 mg/L in most studies. According to U.S. EPA's ecotoxicity

classification for aquatic organisms, these values classify imazapyr as practically non-toxic, the lowest category for addressing acute risk to aquatic organisms from use of chemicals. (U.S. EPA 04/05) A recent study suggests that Habitat has relatively low toxicity to juvenile rainbow trout. (King *et al.* 2004)

## Birds

**Glyphosate.** Effects of glyphosate on birds have been tested on mallard ducks (*Anas platyrhynchos*) (dabbling ducks which ingest wetland sediment along with seeds, insects, and vegetation) and bob-white quail (*Colinus virginianus*). Glyphosate is no more than slightly toxic to birds. Several single-dose acute oral studies indicate that glyphosate is practically non-toxic to upland birds and only slightly toxic to waterfowl. (U.S. EPA 1993.) As with mammals, very high dietary concentrations of glyphosate (a 4,640 mg/kg dietary concentration) resulted in no adverse reactions such as weight loss or mortality (Ebasco 1993). Chronic exposure studies with glyphosate determined a NOEC of 1,000 ppm in the diet. (Heydens 1991.) Little or no data are available on toxicity of surfactants to birds.

**Imazapyr.** Only few toxicity studies exist for birds. No adverse effects were noted at imazapyr concentrations of up to 5,000 ppm in the diet. Based on the highest doses tested and the U.S. EPA ecotoxicity categories, these results suggest that imazapyr is moderately or less toxic orally to birds. No data exist for the potential toxicity of imazapyr to shorebirds. (SERA 2004) No studies exist on toxicity to raptors or on preening or inhalation exposure potentials.

## Mammals

**Glyphosate.** Glyphosate has been determined to be practically non-toxic to mammals by ingestion with an acute oral LD<sub>50</sub> of 5,600 mg/kg b.w. in rats. The no-observed-effect level (NOEL) for chronic toxicity to rats has been determined at 362 mg/kg b.w./day (8,000 ppm) and LOEL at 940 mg/kg b.w./day (20,000 ppm). (Monsanto 1983) The reported acute LD<sub>50</sub> values for dermal effects range from >5,000 to 7,940 mg/kg for rabbits. Subchronic oral toxicity studies of glyphosate with rats and dogs indicate that oral doses of up to 2,000 ppm do not significantly affect behavior, survival, or body weight. Laboratory studies of the chronic effects of glyphosate show that it is slightly to practically non-irritation to rabbits' eyes. No significant reproductive, teratogenic, mutagenic, or carcinogenic effects from exposure to concentrations of up to 300 ppm were reported in 20-year laboratory studies with rats, dogs, rabbits and mice.

**Imazapyr.** Based on U.S. EPA ecotoxicity criteria, imazapyr is considered practically non-toxic to mammals via oral or dermal administration based on acute and chronic studies conducted with a variety of mammalian species. For example, the reported acute oral LD<sub>50</sub> for technical imazapyr in rats is greater than 5,000 mg/kg body weight. Rats were observed to rapidly excrete imazapyr in urine and feces with no residues detected in their liver, kidney, muscle, fat, or blood. No observable effect was noted for any formulation of imazapyr administered dermally. Very few inhalatory studies were performed and none tested concentrations high enough to determine acute toxicity. Inhalatory effects at sublethal concentrations (<5 mg/L aerosol) were found with technical grade imazapyr resulting in slight nasal discharge and congested lungs. Technical grade imazapyr and imazapyr isopropylamine salt were both found to be moderately irritating to rabbit eyes with complete recovery within 7 days.

Technical grade imazapyr is reported as mildly irritating to rabbit skin. Commercial formulations of imazapyr appear to be less toxic via dermal exposure. (Entrix 10/03, p. 42-44) Chronic and subchronic toxicity studies with imazapyr with dogs, mice, and rats did not suggest any systemic toxic or carcinogenic effects. (SERA 12/04)

## Description of the Application Area and the Treatment Area

### San Luis Obispo Creek

A topographic map of San Luis Obispo Creek treatment area is shown in **Figure 1** and all previously and currently known Arundo stands on this stream are shown in **Figure 2**. Arundo is currently targeted for eradication from the San Luis Creek Watershed. To achieve this, the entire length of San Luis Creek and its associated tributaries will be surveyed annually with treatment occurring on any detected live Arundo stands found throughout the project reach (approximately 30 miles of stream length). The project is located in Township 31S, Range 12E of the San Miguelito Land Grant, Pismo Beach U.S. Geological Survey (U.S.G.S.) 7.5 Minute Quadrangle, as depicted in **Figure 1**, Project Location Map..

### West Corral de Piedra

A topographic map of the West Corral de Piedra treatment area is shown in **Figure 3** and known Arundo stands on this stream are shown in **Figure 4**. There are currently 23 known Arundo stands on this stream that have been treated beginning since 2012. Work from 2015 to 2018 will involve retreatment of this entire project area until eradication is achieved. West Corral de Piedra is a tributary to the Pismo Creek Main Stem which leads to the Pacific Ocean. The area directly affected by the proposed project is approximately 5% of the whole watershed area (47 square miles). The treatment area covers an area of approximately 0.4 miles stream and 3 acres of riparian area.

### Arroyo Grande Creek

The Arroyo Grande Creek treatment area is shown in a topographic map (**Figure 5**) and known Arundo stands on this stream are shown in **Figure 6a** and **Figure 6b**. The project site encompasses approximately 5.5 miles of stream reaches in the main stem of Arroyo Grande Creek. The project's most downstream site is located near the mouth of Arroyo Grande Creek, approximately 0.20 miles from the Oceano Dunes State Vehicle Recreation Area (ODSVRA) beach. The project's most upstream site is located approximately 5.0 miles upstream from the stream mouth and 6.5 miles downstream of Lopez Dam. In total, 36 stands of Arundo have been identified and documented within the main stem Arroyo Grande Creek. Twenty-four of these Arundo stands are located on public-owned properties. Three (3) infestations have been located on State Parks property, 17 within the San Luis Obispo County's Flood Control channel, four (4) on property owned by the City of Arroyo Grande, and the rest located on private parcels. This will be a cooperative effort between State, County and City governments, The Land Conservancy, Central Coast Salmon Enhancement, and landowners to remove the Arundo from the Arroyo Grande Creek watershed. The bulk of the treatment will occur upstream of the San Luis Obispo County's Flood Control channel for approximately 2.25 miles. This includes the stream reaches located within downtown Arroyo Grande.

In 2008, The Coastal San Luis Resources Conservation District (CSLRCD) completed treatment of 17 Arundo stands located upstream from the Oceano Dunes State Vehicle Recreation Area's (ODSVRA) boundary along the San Luis Obispo County's Flood Control channel. These sites will be re-surveyed and re-treated if necessary. The re-occurrence of Arundo has already been identified at two of these sites.

## Monitoring Plan

### Objective

Conduct water quality monitoring sufficient to achieve compliance with National Pollutant Discharge Elimination System (NPDES) State-wide General Permit requirements.

### Monitoring Site Selection

This project contains three treatment areas; San Luis Obispo Creek, West Corral de Piedra, and Arroyo Grande Creek.

#### San Luis Obispo Creek Treatment Site

The San Luis Obispo Creek treatment area covers an area of approximately thirty (30) contiguous miles, as described in Description of the Application Area and the Treatment Area above. Background monitoring, event monitoring, and post-event monitoring will be conducted at this treatment area, pursuant to the requirements of the General Permit. Two sample locations have been designated for this sampling. The first sample location is within the treatment area, just downstream of San Luis Bay Drive. This is designated as S1 on **Figure 7** (Latitude: 35°11.699'N, Longitude: 120°41.858'W). The second sample location is located immediately downstream of the treatment area, and is designated as S2 on **Figure 7** (Latitude: 35°11.280'N, Longitude: 120°43.533'W).

A background sample will be collected within the treatment area at S1 and S2 within 24-hours prior to the herbicide application.

An event sample will be collected downstream of the treatment area at S1 and S2 immediately after the application event.

A post-event sample will be collected within the treatment area at S1 and immediately downstream of the treatment area at S2 between three and seven days after the treatment event.

#### West Corral de Piedra Treatment Site

The West Corral de Piedra treatment area covers an area of approximately four (4) contiguous miles, as described in Description of the Application Area and the Treatment Area above. Background monitoring, event monitoring, and post-event monitoring will be conducted at this treatment area, pursuant to the requirements of the General Permit. Two sample locations have been designated for this sampling. The first sample location is within the treatment area, designated as S1 on **Figure 8** (Latitude: 35°12.147'N, Longitude: 120°36.678'W). The second sample location is located immediately downstream of the treatment area, and is designated as S2 on **Figure 8** (Latitude: 35°11.863'N, Longitude: 120°36.649'W).

A background sample will be collected within the treatment area at S2 within 24-hours prior to the herbicide application.

An event sample will be collected downstream of the treatment area at S2 immediately after the application event.

A post-event sample will be collected within the treatment area at S1 and immediately downstream of the treatment area at S2 between three and seven days after the treatment event.

### **Arroyo Grande Creek Treatment Site**

The Arroyo Grande Creek treatment area covers an area of approximately six (6) contiguous miles, as described in Description of the Application Area and the Treatment Area above. Background monitoring, event monitoring, and post-event monitoring will be conducted at this treatment area, pursuant to the requirements of the General Permit. Two sample locations have been designated for this sampling. The first sample location is within the treatment area, designated as S1 on **Figure 9** (Latitude: 35°05.720'N, Longitude: 120°36.428'W). The second sample location is located immediately downstream of the treatment area, and is designated as S2 on **Figure 9** (Latitude: 35°06.001'N, Longitude: 120°37.103'W).

A background sample will be collected within the treatment area at S1 and S2 within 24-hours prior to the herbicide application.

An event sample will be collected downstream of the treatment area at S1 and S2 immediately after the application event.

A post-event sample will be collected within the treatment area at S1 and immediately downstream of the treatment area at S2 between three and seven days after the treatment event.

### **Sampling Design**

The sampling events are designed to characterize the potential risk involved with glyphosate and imazapyr applications relative to adjacent surface waters. Consistent with permit requirements, the monitoring program will include background/ pre-treatment sampling up to 24 hours prior to the application, application event monitoring immediately post-treatment, and one-week post-application event monitoring. Sample collection sites have been recorded using GPS and marked to aid Land Conservancy staff in locating the point for future sampling events.

### **Field Sampling Procedures**

The Land Conservancy will conduct its own water quality monitoring program. Water samples will be collected using a sampling rod and a pre-cleaned container provided by the laboratory. To collect the sample, the container is attached to the sampling rod with a clamp, extended out over the water at the application site, and lowered to approximately 50% of the water depth. When the container is full it is pulled back out of the water and the cap is affixed to the mouth of the bottle. The sample is labeled in permanent ink with the sample ID number, date, time, and initials of the sampler.

The sample ID number is determined by the following protocol: a four-letter code unique to the site, followed by the site visit number (e.g., 01 for pre-treatment, 02 for treatment, or 03 for one-week post-

treatment), followed by the time since the application (e.g., “pre” for the baseline sample, the number of hours since the application for the treatment sample, or “1w” for the one-week post-treatment).

### Equipment Calibration

Temperature, pH, conductivity, and salinity will be measured in the field with a portable Oakton Waterproof Multiparameter Meter, Model JB1-155825, while air temperature will be measured with a portable LaCrosse Technology Hand-Held Wind Meter. To assure accurate and reliable water temperature, pH, conductivity, and salinity, the Oakton Waterproof Multiparameter Meter will be calibrated, operated, and maintained in accordance with the manual specifications found.

### Field Data Sheets

At each sampling location, the sample ID number, the time of the sampling, the sample depth, and the water temperature, pH, conductivity, and salinity will be entered on a Field Data Collection Form (“FDCF”, **Appendix 1**). Also recorded on the FDCF will be site information, including the site ID number, the station location, wind conditions, water color, and the type of herbicide and surfactant that might be present. Any other unusual conditions or concerns will be noted, and any fish, birds, or other wildlife present will be recorded. The FDCFs will be dated and numbered consecutively for each site on that date. On return to the office, the data will be entered into an electronic spreadsheet for processing, and the FDCFs will be compiled into a data log and kept permanently in the office.

### Sample Shipment

Following collection, water samples will be stored on ice packs and delivered to the FGL Environmental Offices in San Luis Obispo, CA. If samples are not delivered until the following day, they will be stored in a cooler on ice until they can be transferred to a refrigerator. Samples shall be prepared according to the FGL Environmental document, Sampling Instructions for Aqueous Samples (**Appendix 2**).

### Sample Analysis

Glyphosate will be analyzed using the EPA method 547 (High Performance Liquid Chromatography with post column derivatization using orthophthalaldehyde (OPA) and fluorescence). Imazapyr will be analyzed using the NCL Method 213. Turbidity will be analyzed using the SM2130B method and dissolved oxygen (DO) will be analyzed using the SM4500-O G method. A quality assurance/ quality control report is supplied with all of the analyses. Results will be submitted to the San Luis Obispo Regional Water Quality Control Board and kept in the Land Conservancy of San Luis Obispo office.

### Lab QC & Data Quality Indicators

The contracted analytical laboratory (“lab”) is required to provide a Quality Assurance Plan (QAP) that meets USEPA standards prior to initiating analysis. The lab plan must specify the method of analysis to be used, and describe any variations from a standard protocol. The lab QAP is attached at **Appendix 3**.

## Gates and Control Structures

### *San Luis Obispo Creek*

A weir was installed just downstream of the treatment area and there are two levees located within the treatment area. (Figure 10)

### *West Corral de Piedra*

There are no gates or control structures within or adjacent to the application or treatment areas.

### *Arroyo Grande Creek*

Floodgates were installed at the point where Meadow Creek meets the Arroyo Grande Creek Flood Control Channel levee to prevent storm surges from infiltrating the lowland marsh area and damaging homes in that area. Also, a levee system constrains Arroyo Grande Creek from its confluence with Los Berros Creek downstream to the Pacific Ocean. (Figure 11)

## Section 5.3 Exception

The selected herbicides are not a priority pollutant, and therefore does not require an exception from Section 5.3.

## Description of Alternate Non-Chemical Control Methods

The Arundo Management Program implements a number of non-chemical control methods in situations where environmental impacts can be reduced. A number of criteria were used in the evaluation of control methods, including efficacy at controlling Arundo, human health and safety, damage to the riparian habitat and/or other aspects of the environment, impacts on water quality, etc. Several non-chemical methods have been incorporated into the Arundo Management Program. The remainder of the methods that were evaluated were found to have significant limitations, and are not part of the Arundo Management Program's current plans. However, some of these methods may be used in conjunction with out selected control methods at a later date. The entire set of possible control methods that were evaluated are discussed below, starting with the methods that were selected and incorporated into the plans.

### Selected Non-chemical Control Methods

**Manual methods.** Minor infestations can be eradicated by manual methods, especially where sensitive native plants and wildlife may be damaged by other methods. Hand Pulling is effective with new plants less than six feet (2 m) in height, but care must be taken that all rhizome material is removed. This may be most effective in loose soils and after rains have made the substrate workable. Plants can be dug up using hand tools (pick-ax, mattock, and shovel), especially in combination with cutting of stems near the base with pruning shears, machete, or chainsaw. Stems and roots should be removed, burned, or chipped on sit to avoid re-rooting. For larger infestations on accessible terrain, heavier tools (rotary brush-cutter, chainsaw, or tractor-mounted mower) may facilitate biomass reduction, followed by rhizome removal or chemical treatment. Such methods may be of limited use on complex or sensitive

terrain or on slopes over 30 percent, and may interfere with reestablishment of native plants and animals.

**Covering/blanketing.** This is technique that is aimed at exhausting the reserves of energy and nutrition in Arundo roots and rhizomes and increasing environmental and disease stress. Covering typically involves securing an opaque tarp completely over a cut stand of Arundo. This excludes light essential photosynthesis, and “bakes” the covered Arundo in a tent of high temperature and humidity. Given the length of time needed and limited control success, this method is not a first choice in the Arundo Management Program. This technique may be used in discrete stands where chemical treatment is not an option, as in close proximity to organic farms.

### Other Non-chemical Methods Evaluated

**Mechanical methods.** Mechanical eradication is extremely difficult, even with a backhoe, as rhizomes buried under three to ten feet (1-3 m) of alluvium readily resprout (Dale in Bossard, Randall, and Hoshovsky 2000). Removal of all such material is infeasible, especially where extensive soil disturbance would be disruptive.

**Prescribed burning.** In most circumstances burning of live or chemically treated material should not be attempted, as it cannot kill the underground rhizomes and probably favors Arundo regeneration over native riparian species (Gaffney and Cushman 1998). Burning in place is problematic because of the risks of uncontained fire, the possibility of damage to beneficial species, and the difficulties of promoting fire through patchily distributed stands. There may be some cases where burning of attached material can be done, but only if other means of reducing biomass cannot be carried out. Cut material is often burned on site, subject to local fire regulations, because of the difficulty and expense involved in collecting and removing or chipping all material.

**Insects and fungi.** No biological control agents against Arundo have been approved by the USDA, although some invertebrates are known to feed on the grass in Eurasia/Africa (Tracy and DeLoach 1999). The green bug (*Schizaphiz graminum*) has been observed to feed on Arundo in winter (Zuniga et al. 1983). In France, *Phothedes dulcis* caterpillars may feed on it. The insect *Zyginidia guyumi* uses Arundo as an important food source in Pakistan (Ahmed et al. 1983). A moth borer (*Diatraea saccharalis*) has been reported to attack it in Barbados. A USDA evaluation of the potential benefits of biological control against Arundo ranked it as a promising candidate and suggested several insects and pathogens as possible control agents (Tracy and DeLoach 1999).

**Grazing.** Vertebrate grazers such as cattle and sheep may be useful in controlling Arundo, and Angora goats have been partially successful in reducing this plant and other brush in southern California (Daar 1983). Grazers are unlikely to reduce population size sufficiently to eliminate the risks posed. Likewise, management of native plants to increase competition with Arundo probably provides insufficient control, and in fact seems to offer little resistance against the invading reeds.

## **Applicable Water Quality BMPs**

The following management practices were identified in the Arundo Control Program. These measures will be implemented at all herbicide treatment sites and verified by the The Land Conservancy's Field Staff.

### **Degradation of Water Quality Due to Herbicide Application**

Herbicides shall be applied directly to plants when streamflow is low, when there is no forecast for rainfall within 48 hours, and during the dry season, which extends from May through September. This will minimize the potential application of herbicide directly on the water surface, avoid the run-off of herbicide, as well as ensure proper dry times.

Drift will be avoided by calibrating spray pack nozzles to control droplet size and by applying herbicides only when local winds do not exceed 10 miles per hour. If at any time during herbicide application, drift is noticed to be occurring, application will immediately cease until ideal conditions allow the continuation of the application.

Arundo biomass will be cut prior to spraying to minimize the amount of herbicide needed to treat and avoid potential run-off into surface waters.

Herbicides shall be applied by a licensed or certified applicator and those properly trained in the application of herbicides and in accordance with application guidelines and the manufacturer's label.

The Arundo Management Program shall obtain coverage under the State NPDES Permit for the Use of Aquatic Herbicides and any necessary local permits. A monitoring program shall be implemented as part of the NPDES permit, and shall include appropriate toxicological studies to determine toxicity levels of the herbicide solution being used. The Arundo Management Program shall use adaptive management strategies to refine herbicide application methods to increase control effectiveness and reduce negative impacts.

### **Herbicide Spills**

Herbicides shall be applied by or under the direct supervision of trained, certified or licensed applicators. Storage of herbicides and adjuvants/surfactants on-site shall be allowed only in accordance with the Herbicide Safety and Spill Plan (Appendix 5); on-site mixing and filling operations shall be confined to areas appropriately bermed or otherwise protected to minimize spread or dispersion of spilled herbicide or surfactants into surface waters.

### **Fuel or Petroleum Spills**

Fueling operations or storage of petroleum products shall be maintained off-site, and a spill prevention and management plan shall be developed and implemented to contain and clean up spills. Transport vehicles, and other equipment shall not be serviced or fueled in the field except under emergency conditions; hand-held gas-powered equipment shall be fueled in the field using precautions to minimize or avoid fuel spills within the stream.

### **Herbicide Treatment Scheduling**

The herbicide treatment on Arundo shall be scheduled when the plant is most susceptible to the uptake of herbicides into the roots

### **Bird Nesting**

Prior to Arundo treatment during the migratory bird nesting season, a survey for active nests shall be conducted by The Land Conservancy Staff Biologist at the site no more than 48 hrs prior to any scheduled treatment.

If active nests associated with federally-listed species are found, the nests will be avoided per regulatory requirements until the time period after young have fledged and prior to the next season's breeding. The non-breeding season is generally September 1<sup>st</sup> to February 1<sup>st</sup>, although The Land Conservancy Staff Biologist shall confirm that breeding/nesting is completed and young have fledged the nest prior to the start of treatment. The Land Conservancy of San Luis Obispo will endeavor to avoid disturbing active nests of any species found in an Arundo stand.

## Figures

### Figure 1 – San Luis Obispo Creek Re-treatment Area 2015

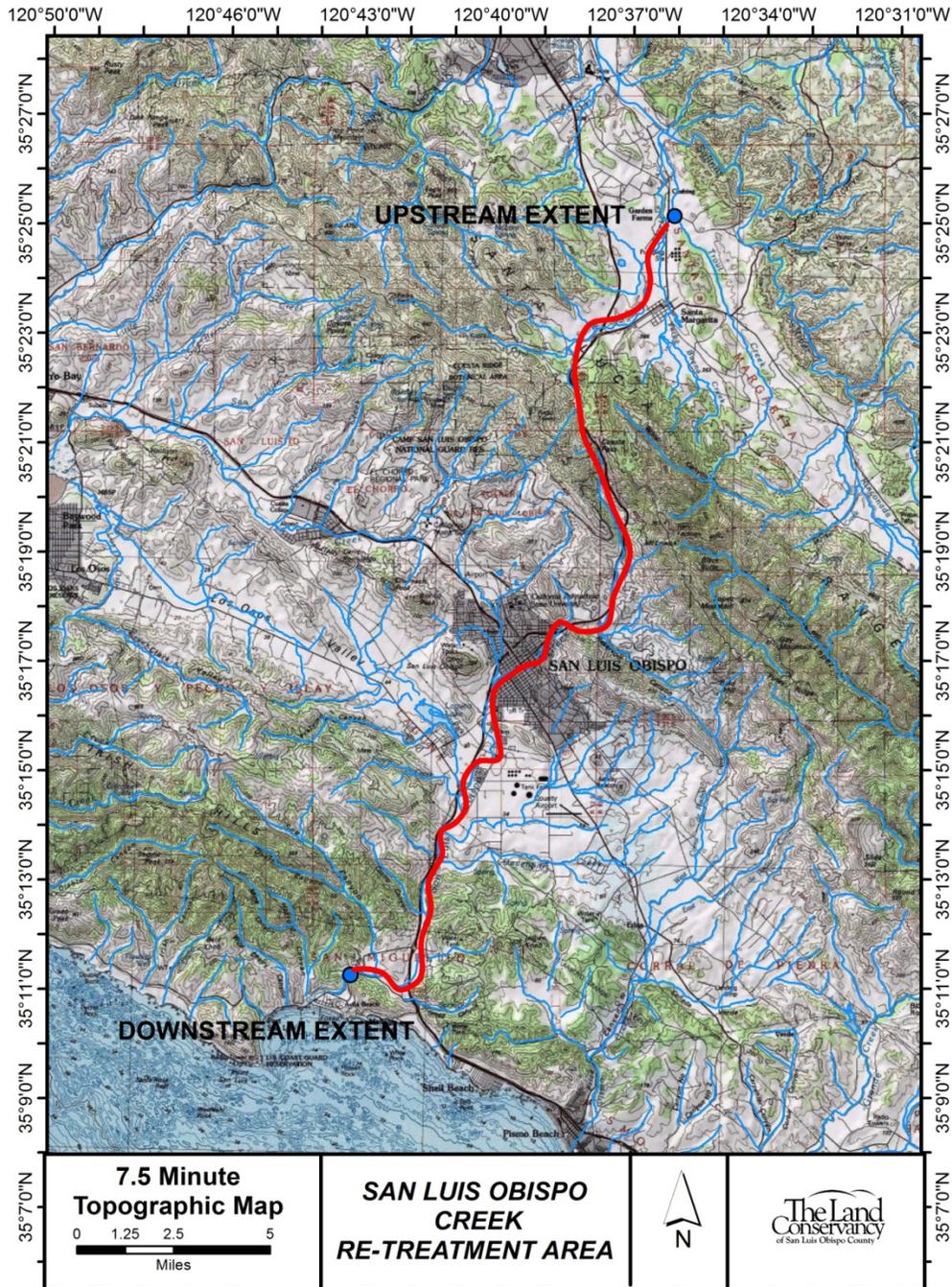


Figure 2 – San Luis Obispo Creek Arundo Stands

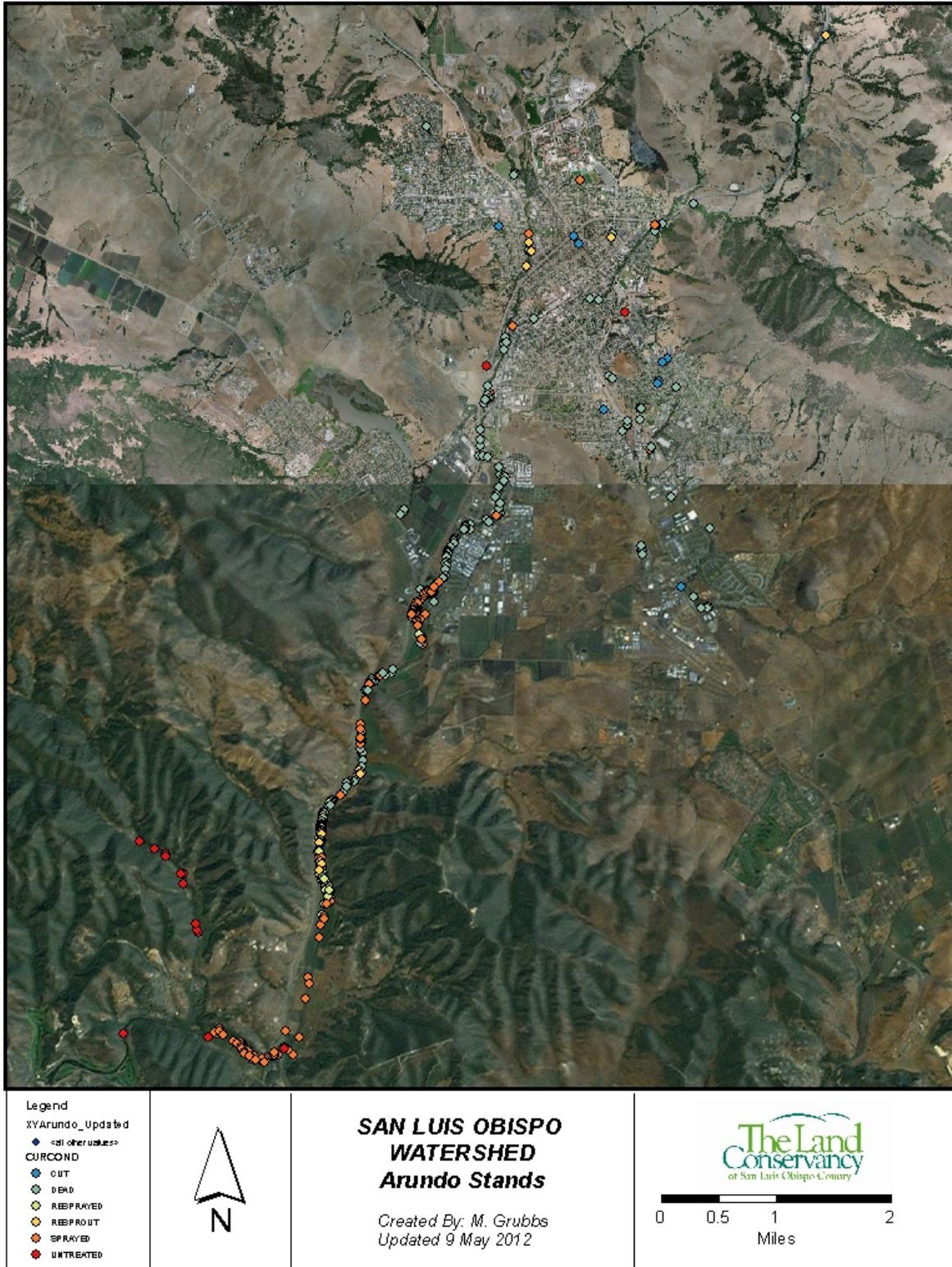
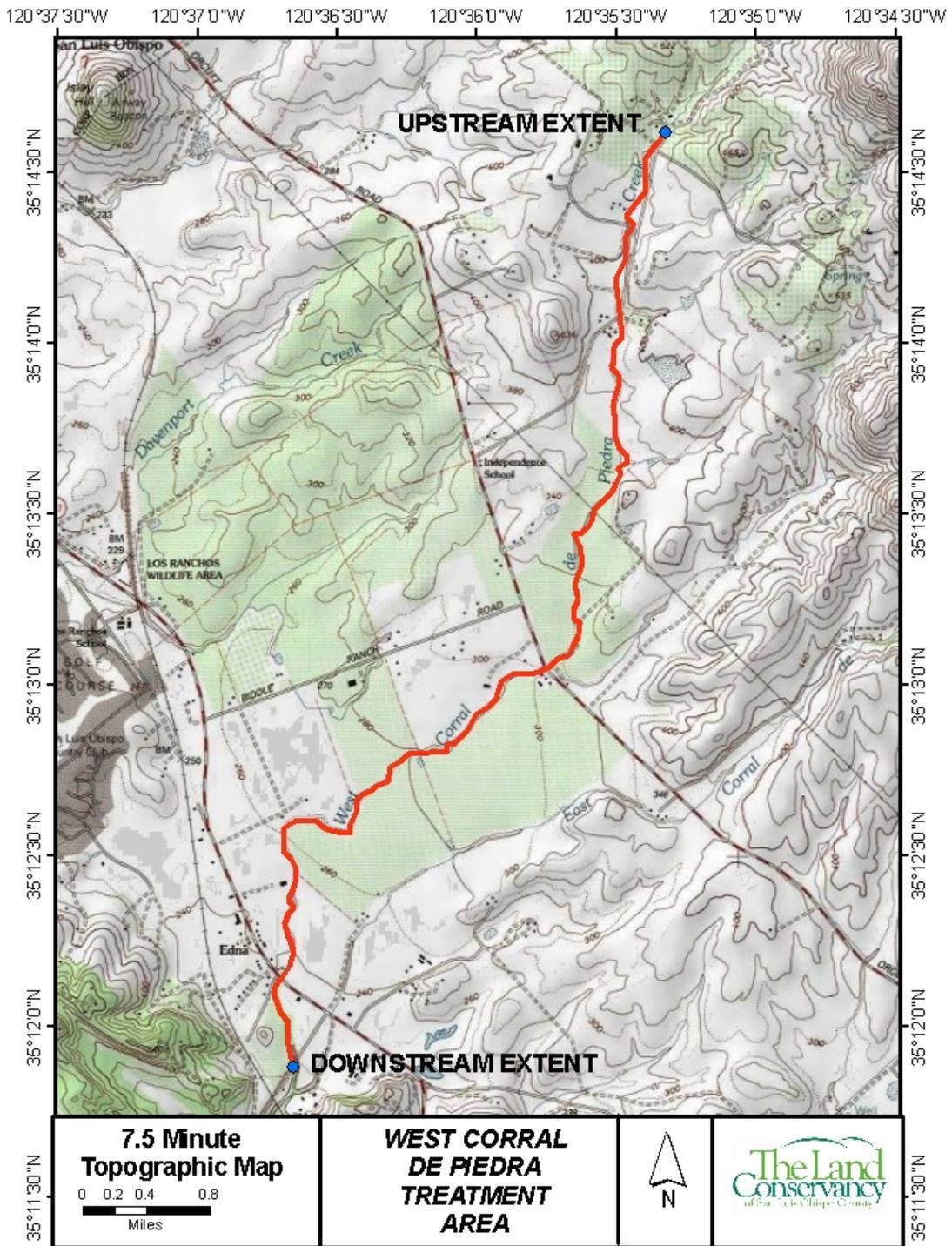


Figure 3 – West Corral de Piedra Treatment Area



**Figure 4 – West Corral de Piedra Arundo Stands**



Figure 5 – Arroyo Grande Creek Treatment Area

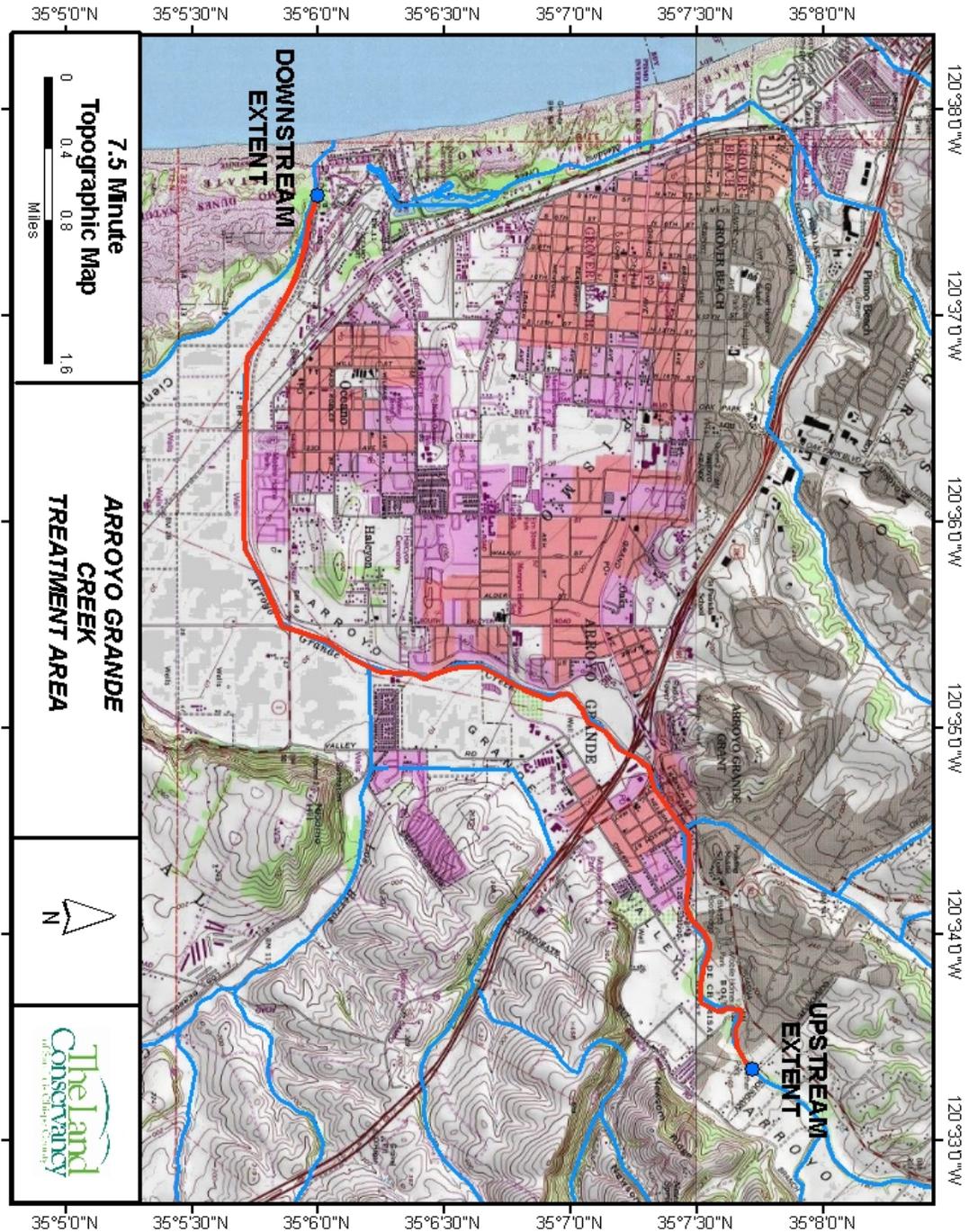


Figure 6 - Arroyo Grande Creek Arundo Stands

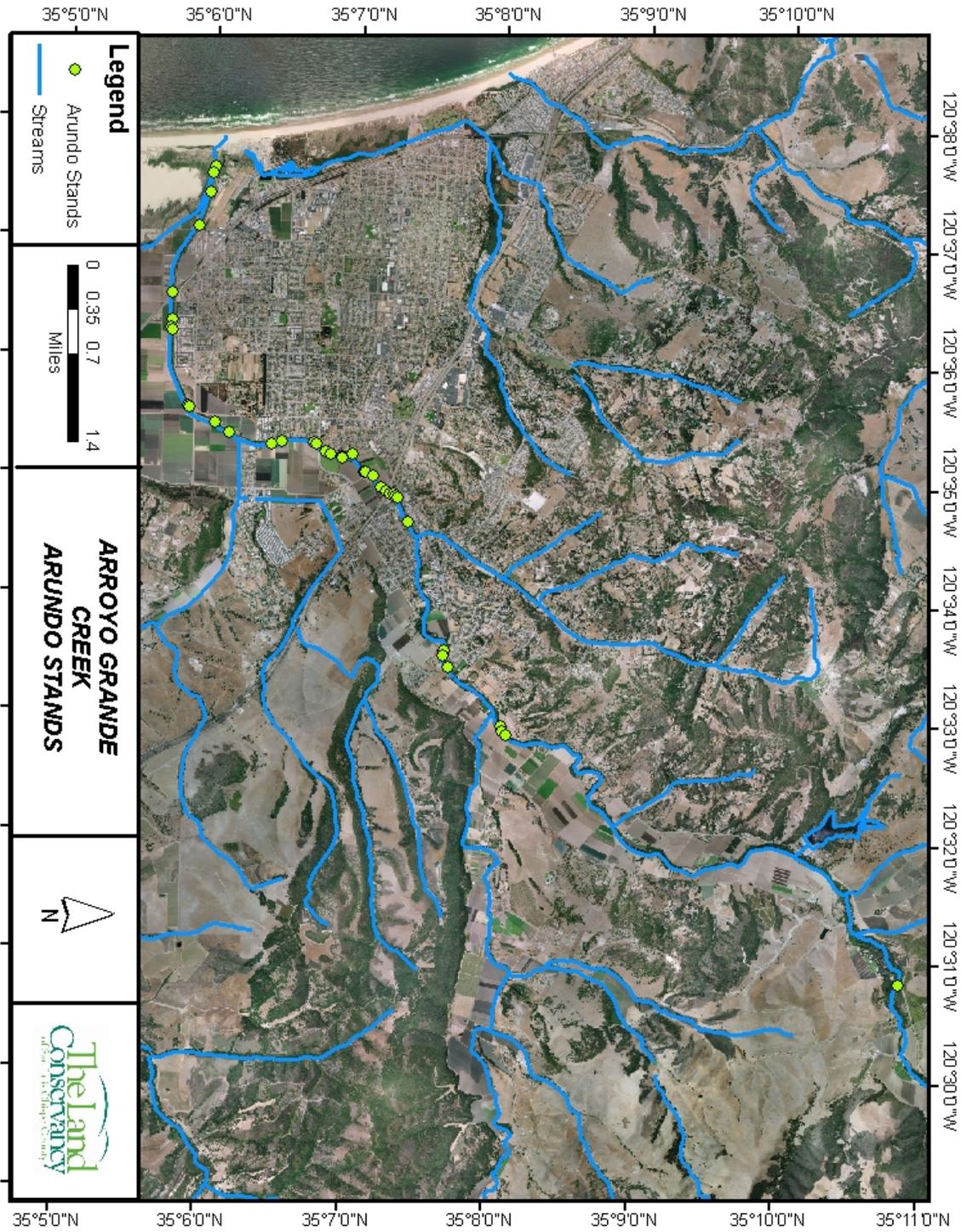


Figure 7 – San Luis Obispo Creek Monitoring Sites

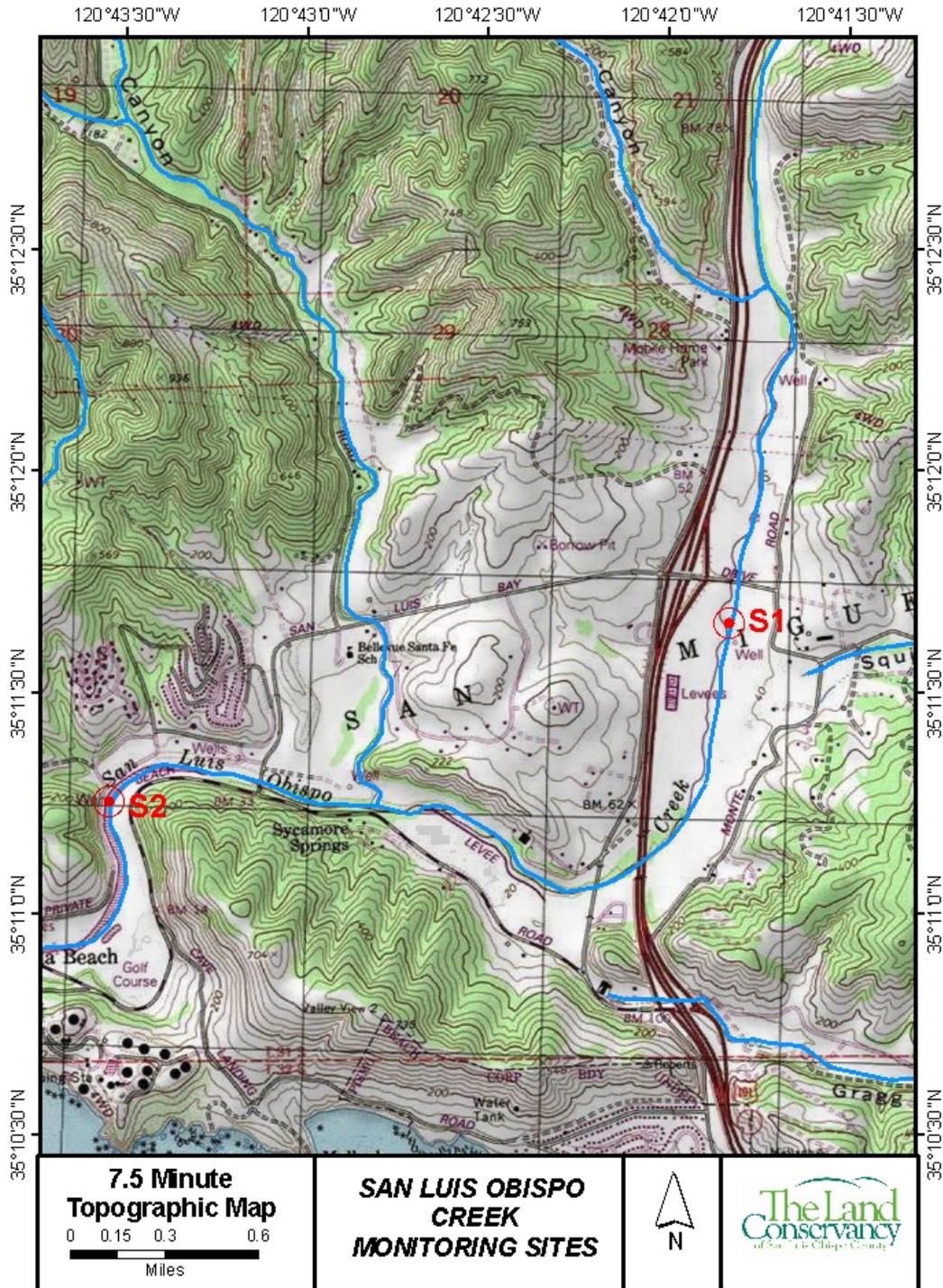


Figure 8 – West Corral de Piedra Monitoring Sites

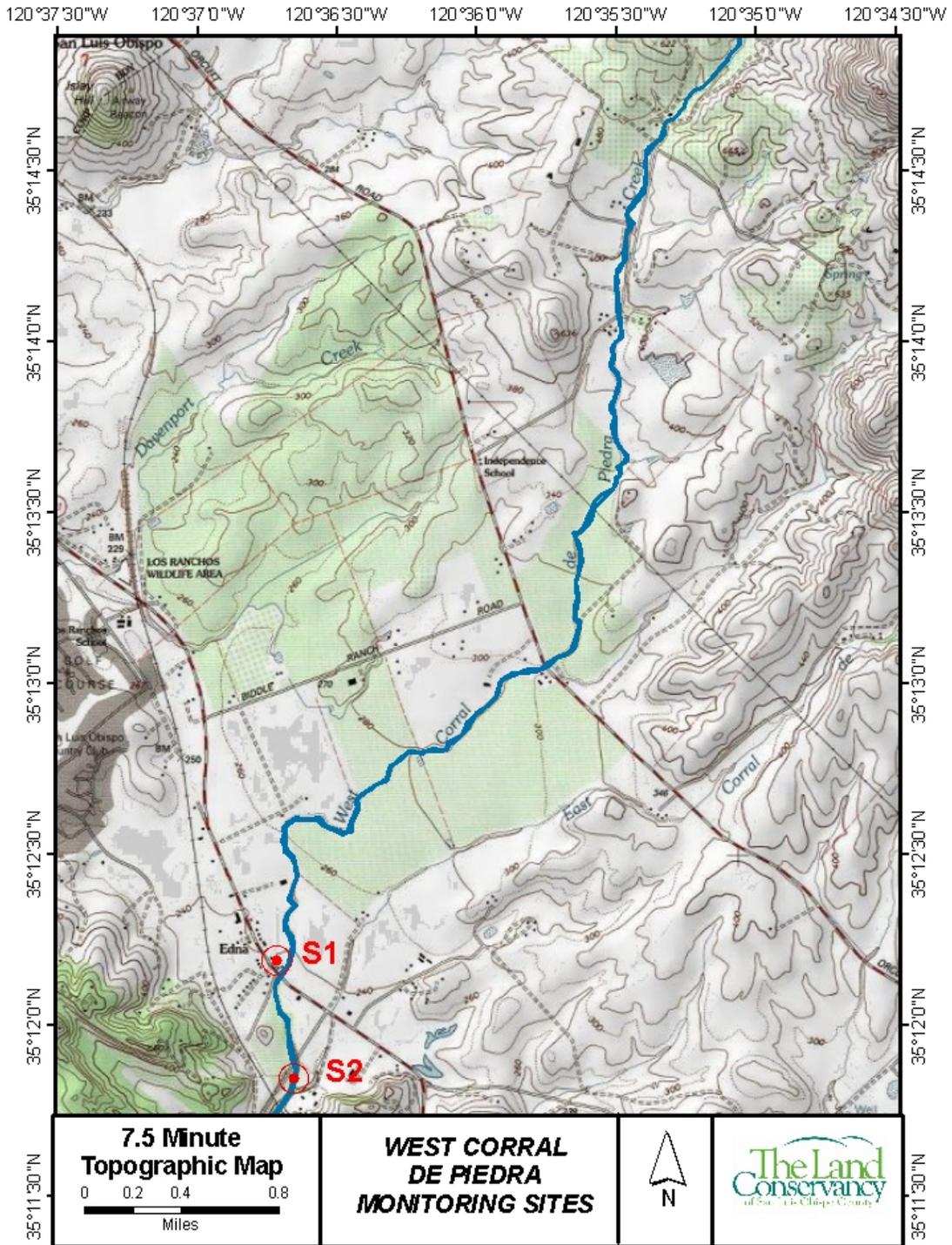


Figure 9 – Arroyo Grande Creek Monitoring Sites

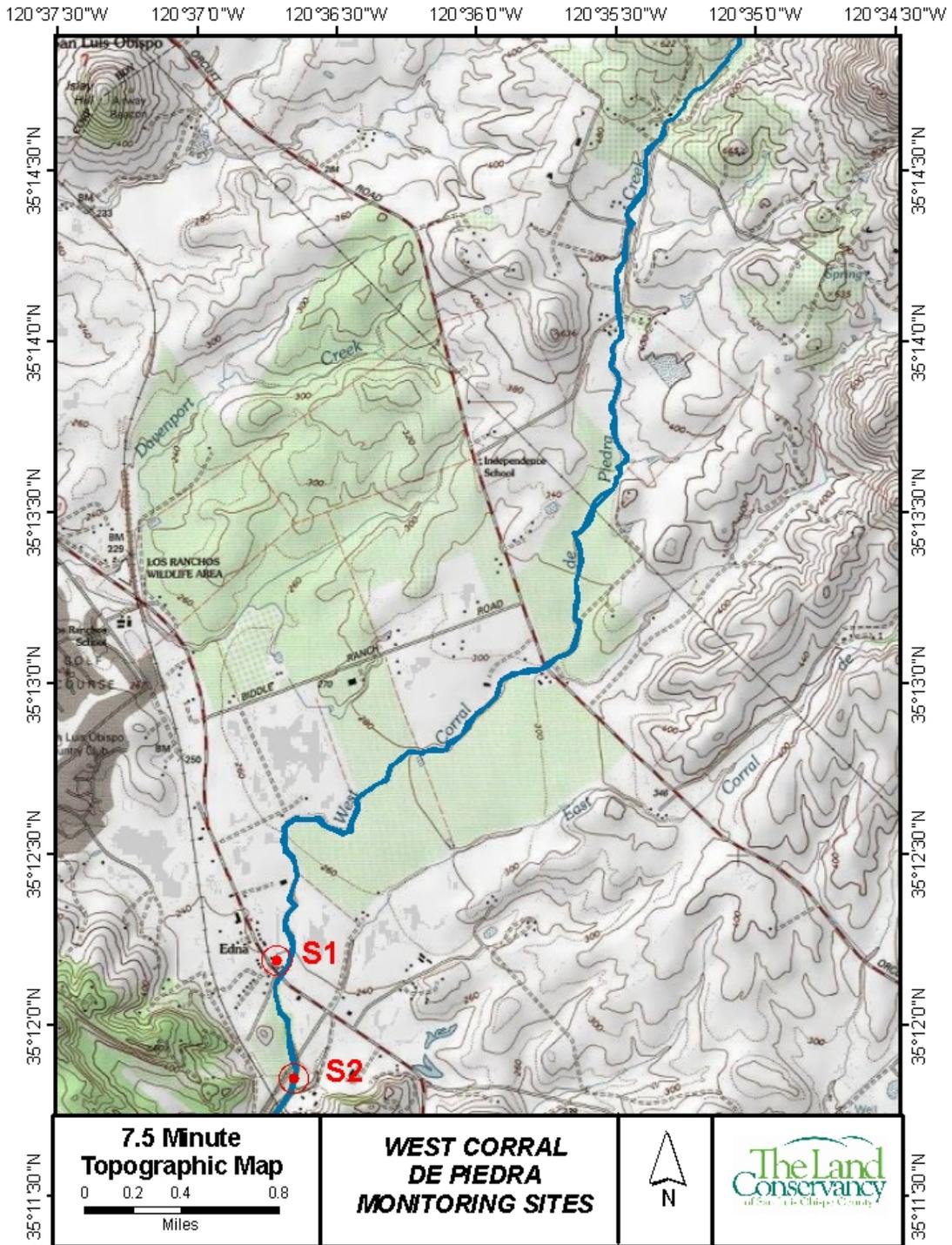


Figure 10 – San Luis Obispo Creek Gates and Control Structures

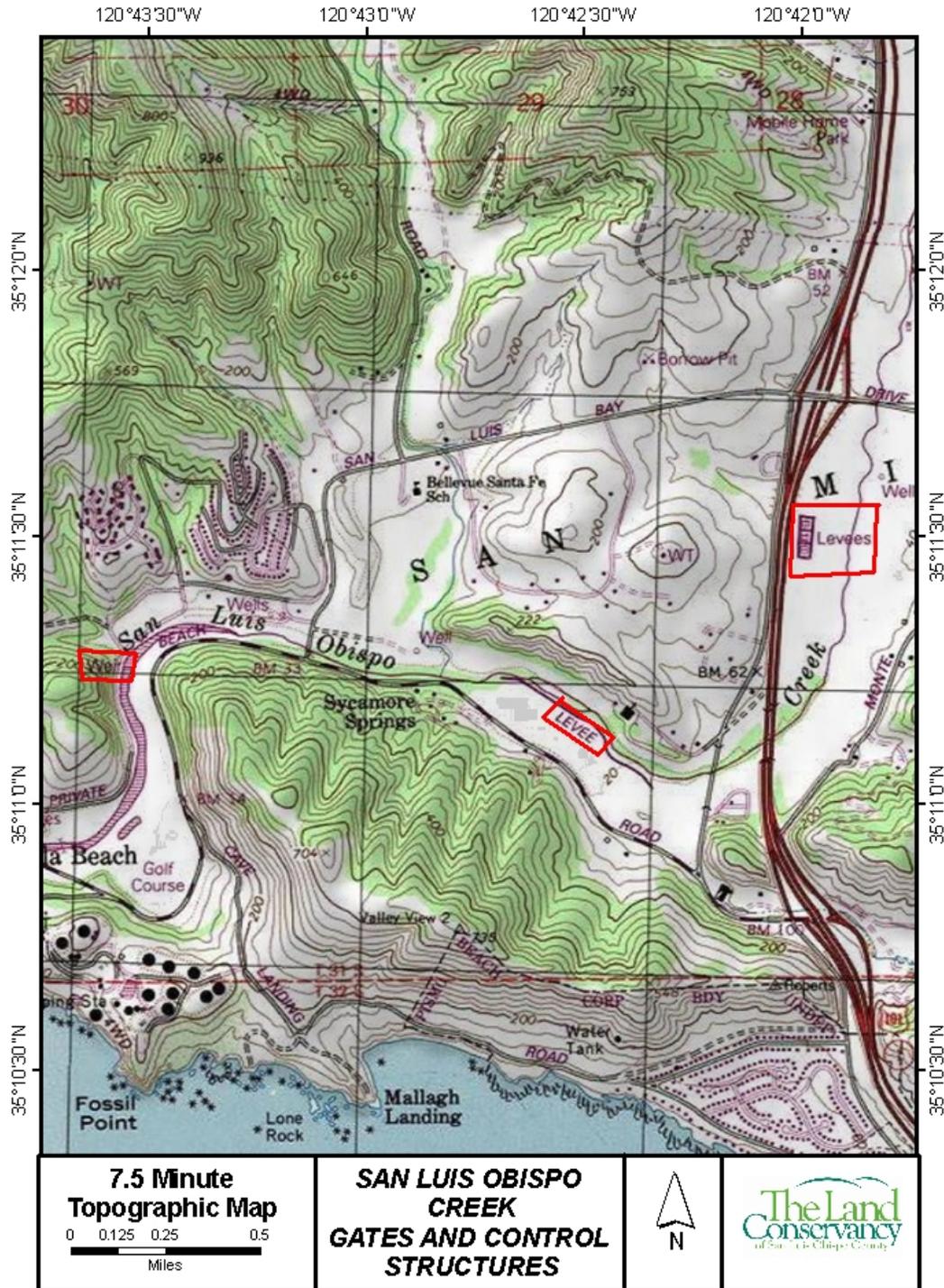
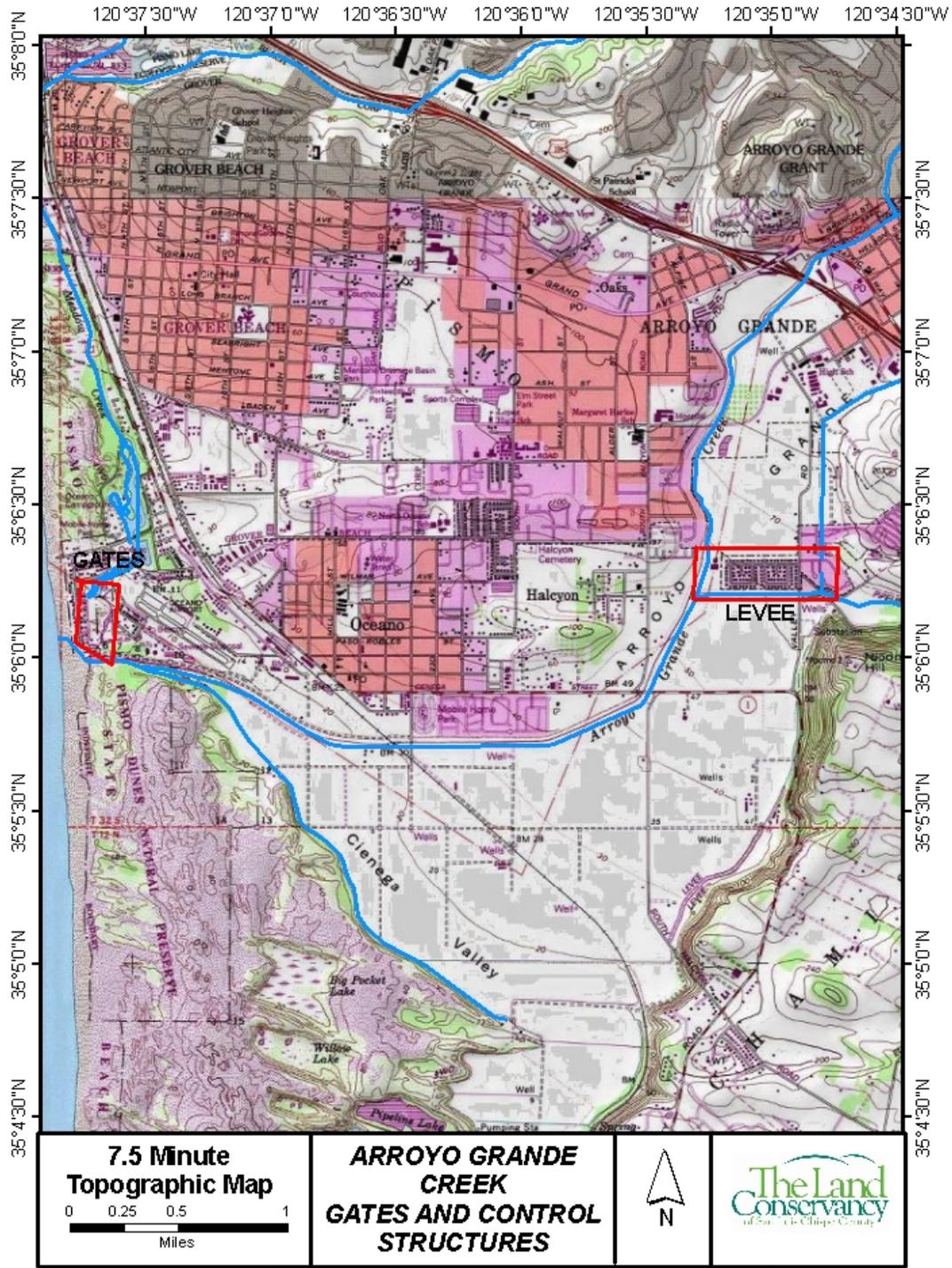


Figure 11 – Arroyo Grande Creek Gates and Control Structures



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## **Appendix**

### **Appendix 1- FDCF**

[Appendix\Field Data Collection Form - Appendix 1.pdf](#)

### **Appendix 2 – Sampling Instructions for Aqueous Samples**

[Appendix\Sampling Instructions FGL - Appendix 2.pdf](#)

### **Appendix 3 – Lab QAP**

[Appendix\FGL Quality Manual - Appendix 3.pdf](#)

### **Appendix 4 – Chemical description**

[Appendix\Appendix 4 - table A-1 Glyphosate.docx](#)

[Appendix\Appendix 4 – table A-1b Imazapyr.docx](#)

[Appendix\Appendix 4 - table A-2 Adjuvants.docx](#)

[Appendix\Appendix 4 - table A-3 Glyphosate and Imazapyr Mixture.docx](#)

### **Appendix 5 – The Land Conservancy of San Luis Obispo County Herbicide Safety and Spill Plan**

[..\Herbicide Info\Herbicide Safety and Spill Plan.docx](#)

# Field Data Collection Form

The Land Conservancy of San Luis Obispo Invasive Arundo Project, Aquatic Pesticide Application Plan, 547 Marsh St., San Luis Obispo, CA 93401

Site ID: \_\_\_\_\_ Date: \_\_\_\_\_ Collected By: \_\_\_\_\_

Station Location: (circle):   S1     S2   Application Time (Start/Finish): \_\_\_\_\_ / \_\_\_\_\_

Wind (circle):   low     high   Water Color (circle):   green     green-brown     brown     blue (dye)     clear  

Herbicide:   GLY     IMAZAPYR   Surfactant: \_\_\_\_\_

## Field Measurements

Air Temp	pH	Water Temp	Conductivity	Salinity	Meter Used
°C		°C	mS	ppt	

## Samples Collected

Sample ID (XXXX-YY-Ab)*	Time	Sample Depth (m)	Notes

\* **XXXX-YY-Ab** (eg. SANL-01-pre, WEST-02-1.5hr) = **XXXX**: Site, **YY**: site visit number (01-1st, 02-2nd, 03-3rd, etc.), **A**: time to application: either pre, increments thereafter in half hours - 0.5), **b**: time increment (h=hour, w=week (for 1 week post-treatment))

Additional Notes or Comments: \_\_\_\_\_

Wildlife Presence: \_\_\_\_\_

---

## Sampling Instructions for Aqueous Samples

FGL provides the appropriate containers, labels, chain of custodies, ice chests and blue ice at no charge. All samples should be cooled to approximately 4° C prior to shipping to the laboratory. A list of proper holding times and preservation techniques is available upon request. **If you have any questions concerning the containers or sampling techniques please call.** Please do not rinse out containers provided by FGL prior to filling. The containers are labeled as to the type of sampling.

### **Type 1 - Semi-volatile Organics, Inorganics, and Radio Chemistry (except Radon):**

- 1) Fill the sample container to the top and cap.

### **Type 2 - Volatile Organics:**

- 1) Fill the sample containers (two VOA vials) until there is a raised portion of water above the rim of the vial and cap carefully. It helps to run the water very slowly.
- 2) After capping, invert the sample vial, tap the vial, then check for bubbles (headspace).
- 3) If bubbles are present repeat sampling until no bubbles are observed. Having no headspace is very important to the overall quality of the analytical results.

### **Type 3 - Bacteriology:**

#### **Source sampling (testing the well) -**

- 1) Selecting a spigot closest to the well and run the water for approximately 5 minutes. If only air is vented, turn on spigots after the holding tank to drop the holding tank pressure which should turn on the pump. The well pump should turn on and run through at least one cycle.
- 2) If the spigot is not frequently used it should be flamed with a propane torch or wiped with bleach and run the water again for 1 minute (longer for very contaminated spigots).
- 3) Please take care opening the sample container and do not remove the powder or pill inside. Permit only the water sample to contact the inside of the bottle and cap.
- 4) Fill the sample container to slightly more than the 100 mL line. This will insure adequate sample volume and enough headspace for mixing.
- 5) Because the analysis needs to be started as soon as possible (maximum time is 8 hours). Please keep the samples cool and ship or deliver to the lab as soon as possible.

#### **System sampling (testing plumbing and faucets away from the well) -**

- 1) If possible, select a tap in frequent use. If the tap has an aerator screen it will need to be removed.
- 2) Turn on the faucet and allow the water to run for approximately 5 minutes.
- 3) If the spigot is not frequently used it should be flamed with a propane torch or wiped with bleach and run the water again for 1 minute (longer for very contaminated spigots).
- 4) Please take care opening the sample container and do not remove the powder or pill inside. Permit only the water sample to contact the inside of the bottle and cap.
- 5) Fill the sample container to slightly more than the 100 mL line. This will insure adequate sample volume and enough headspace for mixing.
- 6) Because the analysis needs to be started as soon as possible (maximum time is 30 hours). Please keep the samples cool and ship or deliver to the lab as soon as possible.

#### **Reservoir and stream sampling -**

- 1) Tilt the bottle approximately 45 degrees and hold at the base. In a scooping motion, move the bottle away from you, mouth first, as you fill the bottle.

- 2) Please take care opening the sample container. Permit only the water sample to contact the inside of the bottle and cap.
- 3) Fill the sample container to slightly more than the 100 mL line. This will insure adequate sample volume and enough headspace for mixing.
- 4) Because the holding time is 8 hours please ship or deliver to the lab as soon as possible.

**Type 4 - Radon:**

Radon is a gas and emanates quickly from agitated water. The hold time for regulated water is 4days. (8d for non-Reg.) Proper collection techniques and handling of the Radon sample is critical for valid data to be obtained. For best results follow the instructions listed below:

- 1) Sample by slowly run water from a hose into a 2 liter container until it overflows for 5 minutes. The water entering the container should be as free as possible of bubbles.
- 2) Fill 2 x 125 mL Boston round or 2 x 40 mL VOA vials under water by placing the hose into the bottle, taking care to release all of the air bubbles. Cap tightly under water.
- 3) Take the sample from container and turn it upside down to check for bubbles. If necessary, repeat sampling until no bubbles are observed.
- 4) Dry sample container and place electrical tape around cap.
- 5) Record time and date of the duplicate samples.
- 6) Pack in a cool ice chest and ship NEXT DAY AIR to the laboratory for analysis.

**Other considerations for proper sampling:**

- Make an accurate record on the chain of custody of every sample collected. Identify every container by attaching an appropriately inscribed tag or label which corresponds to the record on the chain of custody.
- Before collecting samples from a distribution system, be sure to flush lines sufficiently to insure that the sample is representative of the supply.
- Before sampling from a well, be sure to run the pump long enough to insure that the sample represents the groundwater source.
- When samples are collected from a river or stream, analytical values may vary with depth, stream flow, and distance from shore and channel width. If equipment is available, take and "integrated" sample from top to bottom in the middle of the stream in such a way that the sample is composited according to time or flow. If only a grab or catch sample can be collected, take it in the middle of the stream and, if possible, at mid-depth.
- Lakes and reservoirs are subject to considerable variations from normal influences such as seasonal stratification, rainfall, runoff, and wind. Choose the location, depth and frequency of sampling based on local conditions and the purpose of the investigation. Avoid surface scum.

**Well Cleanup Procedure for Bacterial Contamination:**

- FGL has a written procedure to help you through the well cleanup process. Please call to obtain a copy of this procedure.



## **Quality Manual**

**Prepared by**

**David Terz**

**Quality Assurance Director**

**for**

**Fruit Growers Laboratory**



# QUALITY MANUAL

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1.0 QUALITY MANUAL IDENTIFICATION AND APPROVALS

Document Title: FGL Quality Manual

Quality Manual Approvals:

Approved by:

Name: Mr. Kelly A. Dunnahoo  
Title: President/Lab Director

Signature:

Date:

  
4-6-09

Name: Mr. David E. Terz  
Title: Quality Assurance Director

Signature:

Date:

  
4-6-09

## 2.0 COMPANY INTRODUCTION

### 2.1 Company Identification:

Fruit Growers Laboratory, Incorporated (aka FGL Environmental or FGL)

Corporate Headquarters, Laboratory and Field Services:

853 Corporation Street  
Santa Paula, CA 93060

Tel: (805) 392-2000  
Fax: (805) 525-4172  
Web Site: [www.fglinc.com](http://www.fglinc.com)  
Quality Assurance email: [davidt@fglinc.com](mailto:davidt@fglinc.com)  
Marketing email: [denisb@fglinc.com](mailto:denisb@fglinc.com)

Satellite Laboratories and Field Services:

2500 Stagecoach Road  
Stockton, CA 95215

Tel: 209-942-0182  
Fax: 209-942-0423

563 East Lindo  
Chico, CA 95926

Tel: 530-343-5818  
Fax: 530-343-3807

Field Services:

3935 Victor  
Visalia, CA 93277

Tel: 559-734-9473  
Fax: 559-734-8435

### 2.2 Company Overview

Fruit Growers Laboratory, Inc. is a full service agronomic and environmental laboratory. The laboratory will be referred to throughout this plan as FGL.

FGL's organization consists of its primary laboratory and corporate offices in Santa Paula, satellite laboratories in Stockton and Chico; and a field service office in Visalia. The corporation employs approximately 80 employees and has annual revenues in excess of \$4,000,000. FGL is classified as a small business for federal projects and a large business for State of California projects. The Standard Industrial Classification (SIC) code is 8734.

## 2.3 Company History

FGL was established in 1925 as a Cooperative enterprise providing agronomic laboratory services to Sunkist contracted growers in California. Sunkist Growers (a cooperative) is a grower owned agricultural marketing organization.

In 1927 FGL secured its drinking water state certification and since then has provided this service to drinking water purveyors throughout the state. In 1973 Fruit Growers Laboratory was reincorporated as a standard California corporation and continued to expand its services to the environmental and agronomic industries. FGL provides environmental and agricultural analytical support services to a variety of clients out of both our laboratories. These include drinking water purveyors, wastewater and hazardous waste generators and handlers, farming groups, individuals growers, private companies, prime government contractors, municipalities, state and federal agencies. A substantial proportion of our business is made up of a large number of small clients thus distributing our business over a large base of customers. This helps prevent a small number of larger clients dominating our total business.

The corporation has grown at a conservative rate since its founding. Over the past 23 years it has shown consistent profitability. This has resulted in the corporation's strong financial position and available revenues to further invest in people, equipment and facilities.

### 3.0 QUALITY ASSURANCE POLICY

#### 3.1 Quality Assurance Policy Statement

*FGL Environmental's Quality Assurance Policy*

*“Management and staff are committed to providing analytical services that are scientifically valid, legally defensible and of known precision and accuracy in order to meet or exceed the definitions and expectations of quality of our clientele.”*

#### 3.2 Purpose

The FGL Quality Manual (QM) serves as an operational charter for the company. It defines the purpose, structure and operating principles of the laboratory and presents an overview of the primary factors of the quality assurance system.

This QM has been prepared according to guidelines presented in the USEPA document entitled “Quality Systems,” National Environmental Laboratory Accreditation Conference (NELAC), June 5, 2003.

A cross reference for the United States Department of Energy, Quality Systems for Analytical Services, Revision 2.2 (October 2006) is included in section 16.

The extension for a FGL Standard Operating Procedure (SOP) filename indicates the revision number of the document, i.e. S0QA010.003 indicates revision 3. This quality manual references the most recent version of any document by using a generic extension of .XXX.

#### 3.3 Scope

This QM applies to the services supporting, and generation of, analytical data for all FGL locations. As most environmental client needs are driven by various federal and state regulations, the plan has been designed to meet the requirements of the following services and programs:

- a) Analysis of Drinking Water supplies in support of the Safe Drinking Water Act (SDWA)
- b) Analysis of waste stream samples in accordance with National Pollution Discharge Elimination System/Clean Water Act requirements.
- c) Analysis and characterization of soil, water and waste samples per the Resource Conservation and Recovery Act (RCRA) for compliance or disposal purposes.
- d) Analysis and characterization of soil, water and waste samples for site assessment purposes.

### **3.4 Service and Data Integrity Policy**

FGL recognizes that maintaining a proper ethical standard is an important element of an effective QM. In order to ensure that all personnel understand the importance the company places on maintaining high ethical standards at all times, FGL has established a “Service and Data Integrity Policy” and it is presented as Figure 3.1 on the following page for your information. This policy is used to set the standard within the organization. Each employee is required to sign the policy, signifying agreed compliance with it’s stated purpose. Copies of all signed ethics policy statements are maintained in personnel files.

**Figure 3.1 Service and Data Integrity Policy**

### **Service and Data Integrity Policy**

Fruit Growers Laboratory Incorporated or FGL Environmental's business is to provide analytical data and support services to its customers. **Each employee of FGL plays a vital role in performing this task.**

**Providing a service of superior quality and integrity is impacted by three primary factors:**

- 1) FGL management's commitment to, and support of staff in, providing service and data of quality and integrity.
- 2) Each employee's personal commitment to provide a service of quality and integrity.
- 3) Each employee's personal skill and knowledge, gained through education and experience, relating to the job which he/she is performing.

***When these three factors are optimized the service being provided will be exceptional.***

FGL is pledging its full commitment and support to helping you provide the best possible service to our customers. To uphold this policy, FGL will provide the following:

- 1) the right to "stop the assembly line" when a problem or error is discovered.
- 2) a company wide training program to augment your education and/or experience and to provide you with the skills necessary to perform your job well.
- 3) a management "open door policy" is extended to all employees with a guarantee of no reprisal.

This ensures that each employee has the opportunity and the obligation to be a part of FGL's mission to provide the best possible level of analytical service.

As an employee of FGL, integrity in providing service and data must be the highest priority. Service or data quality problems must be immediately brought to the attention of your manager and/or supervisor for review and to initiate solutions to legitimately satisfy the customers' expectations. Ignoring a problem or the falsification of data or information cannot be tolerated since it could significantly impact the reputation and the long term viability of our customers and FGL Environmental.

In our efforts to provide excellent service and high quality defensible analytical data, FGL strives to employ staff of the highest character and personal integrity. Any staff member that knowingly deviates from this expectation of integrity compromises, not just his or her own position, but that of his/her colleagues and will be subject to immediate discharge.

I have read and understand the above information and agree to abide by this policy. I further understand that nothing contained in this policy alters my at-will employment relationship with FGL Environmental.

Employee Name: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

#### 4.0 MANAGEMENT AND ORGANIZATION

This is primarily referenced from section 5.4 of “Quality Systems,” National Environmental Laboratory Accreditation Conference, June 5, 2003.

The primary objective of the QM is to ensure that systems are in place so that the Quality Assurance Policy Statement is achieved. The management of FGL is committed to the execution of the QM to enable this objective. The company officers, lab directors and managers are required to comply with the program’s requirements and responsibilities.

#### 4.1 Management Responsibility and Authority

The following provides a listing of responsibilities and authority of key managerial personnel involved in laboratory analysis and oversight of the QM:

##### a) Laboratory Director

##### 1) Responsibility

- i. Ensure that the lab is organized in such a way that confidence in its independence of judgement and integrity is maintained at all times.
- ii. Establish the scope of this QM and implementing, assessing and continually improving an effective quality system.
- iii. Specify the responsibility, authority and interrelationships of all personnel who manage, perform or verify work affecting the quality of calibrations and tests.
- iv. Ensure that managers have overall responsibility for the technical operation of the laboratory, comply with the QM and require compliance by all personnel.
- v. Ensure that directors and managers have the necessary authority and resources in which to achieve the above.
- vi. Ensure supervision by persons familiar with the calibration or test methods and procedures, the objective of the calibration or test and the assessment of the results. The ratio of supervisory to non-supervisory personnel is such that adherence to laboratory procedures and accepted techniques is maintained.
- vii. Ensure that FGL personnel are free from any commercial and other undue pressures which might adversely affect the quality of their work.
- viii. Ensure that adequate review of new contracts are performed to verify that FGL has the appropriate facilities and resources to commence work.
- ix. Nominate replacements in case directors or managers are absent for a period exceeding 15 days. NELAP will be notified if this absence exceeds 65 consecutive calendar days.

##### 2) Authority

- i. Authority to council and terminate employees for dishonesty, unacceptable work behavior or non-compliance with established QA policies and procedures.
- ii. Authority is granted from the president of FGL.

b) Laboratory/Department Manager(s)

The department managers for technical areas of the lab are considered to be technical directors by NELAC definition and have overall responsibility for technical operations of the laboratory.

1) Responsibility

- i. Ensure that personnel with appropriate educational and/or technical background perform all tests for which the laboratory is accredited.
- ii. Ensure compliance with methods and procedures as written.
- iii. Ensure that analytical procedures are performed in accordance with the requested methods and SOP's.
- iv. Oversee prioritizing of work and perform client contact regarding analyses and data interpretation.
- v. Ensure that adequate review of new contracts are performed to verify that FGL has adequate technical capabilities to commence work.
- vi. Oversee preparation of analytical reports and data review.

2) Authority

- i. Authority to council and terminate employees for dishonesty, unacceptable work behavior or non-compliance with established QA policies and procedures.
- ii. Authority to perform client contact and, where necessary, remediate complaints.
- iii. Authority is granted from the Laboratory Director, to whom they report.

c) Quality Assurance Director

The Quality Assurance Director has direct access to technical directors and to the highest level of management at which decisions are taken on laboratory policy and resources. The Quality Assurance Director serves as the focal point for QA/QC in the laboratory and is independent from the laboratory functions and influence.

1) Responsibility

- i. Responsible for the QM and its implementation including recommending pertinent additions to the QM.
- ii. Responsible for monitoring and assessing compliance of the laboratory with the requirements contained in the QM.
- iii. Conducts annual audits and inspections to assess compliance with established methods, policies and procedures (SOP reference: S0QA040.XXX).
- iv. Maintains a document control system, containing current policies and procedures utilized by the company, to ensure that all documents clearly indicate the time period and locations in which the procedure or policy was in force (SOP reference: S0QA075.XXX).

- v. Maintains various analytical certifications for the laboratory.
- vi. Reviews laboratory performance on performance evaluation studies submitted to FGL by clients and regulatory agencies (SOP reference: S0QA130.XXX).
- vii. Responsible for the oversight and/or review of the quality control data (SOP references: S0QA095.XXX and S0QA105.XXX).
- viii. Investigates all inquiries relative to data quality issues and does follow up on corrective actions where necessary (SOP reference: S0QA035.XXX).
- ix. Ensures that adequate review of new contracts are performed to verify that FGL has an adequate Quality Assurance program to commence work.
- x. Prepares and issues reports to management in regard to the responsibilities listed above (SOP reference: S0QA190.XXX).

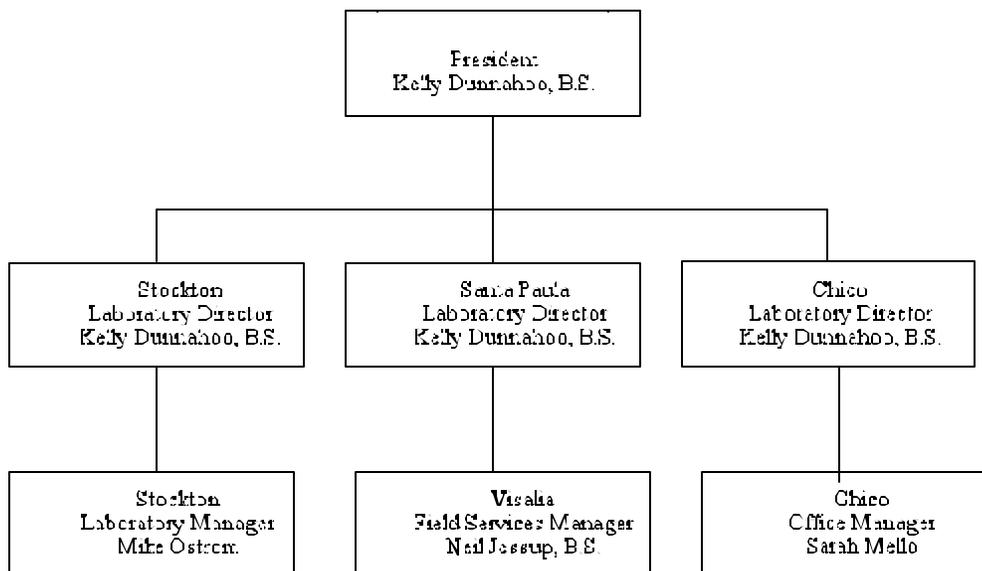
## 2) Authority

- i. The quality assurance staff have the authority to stop or change any analytical procedure in order to assure that data quality is maintained.
- ii. Authority is granted from the President of FGL.

## 4.2 Organizational Charts

The following pages contain general organizational charts for the FGL Laboratory network (Figure 4.1), FGL corporate personnel (Figure 4.2) and the Santa Paula Laboratory (Figure 4.3).

Detailed organizational charts listing all departments and all full time personnel will be provided upon request.



**Figure 4.1 Organizational Chart - Laboratory Network**

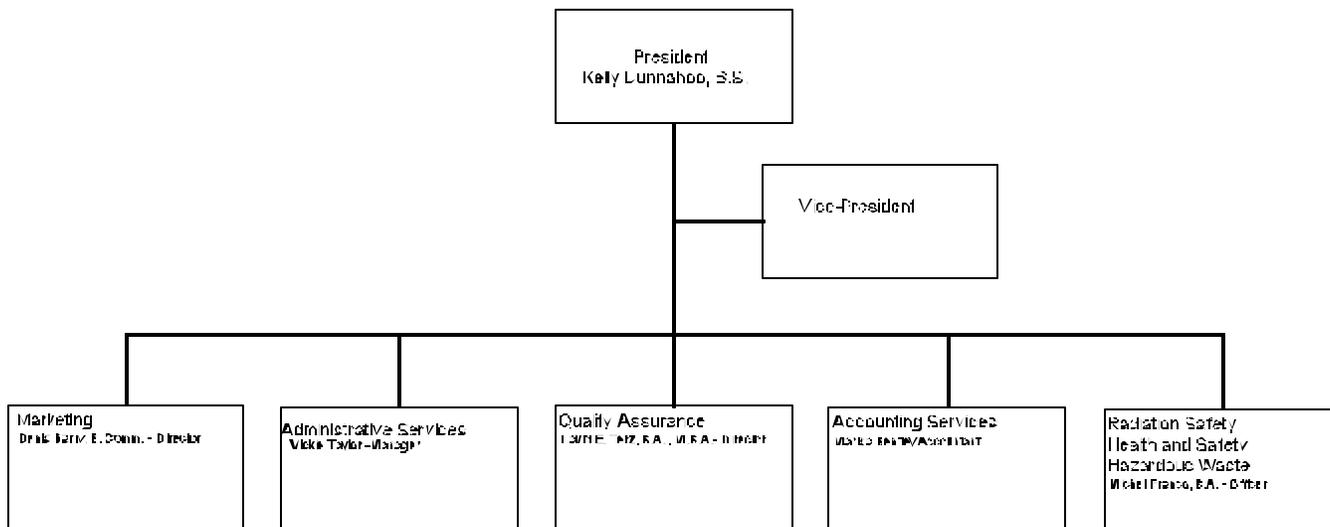
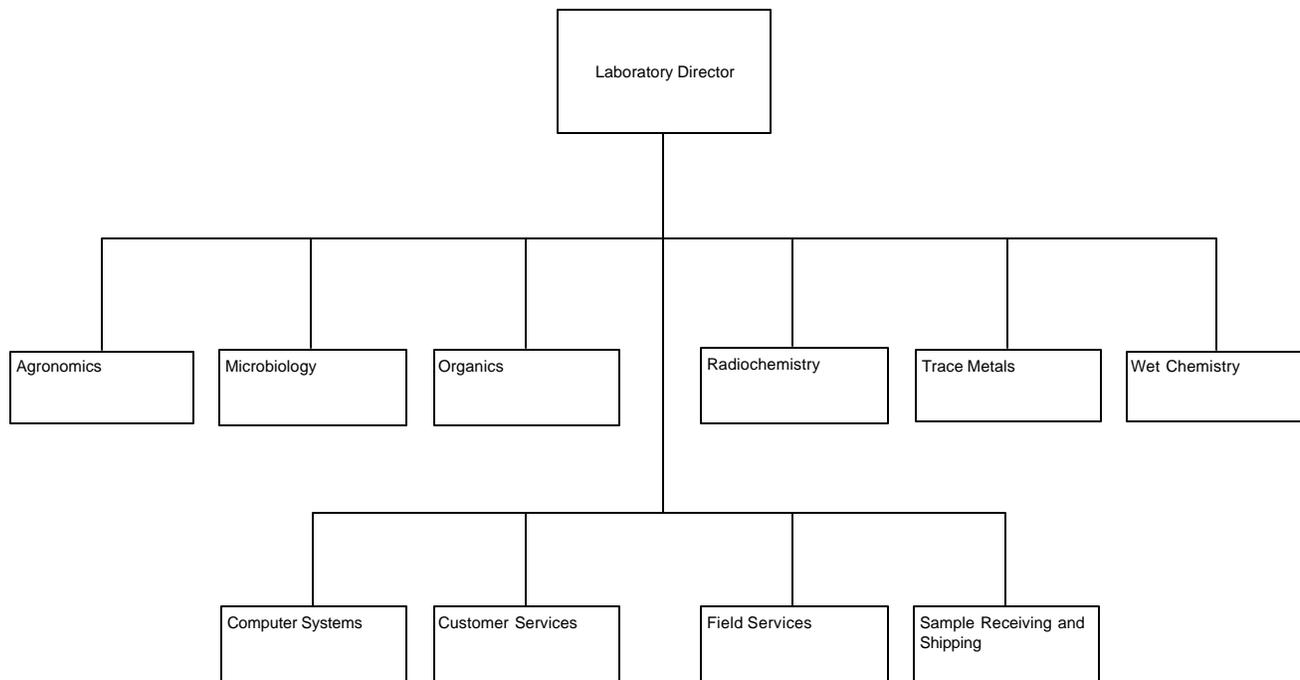


Figure 4.2 Organizational Chart - Corporate Personnel



**Figure 4.3 Organizational Chart - Santa Paula Laboratory**

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## PERSONNEL

This is primarily referenced from section 5.5.2 and Appendix C of "Quality Systems," National Environmental Laboratory Accreditation Conference, June 5, 2003.

### 5.1 General Requirements for Laboratory Staff

#### a) Responsibility

- 1) To comply with all quality assurance/quality control requirements that pertain to their organizational/technical function.
- 2) Maintain a combination of experience and education to adequately demonstrate a specific knowledge of their particular function and a general knowledge of laboratory operations, analytical test methods, quality assurance/quality control procedures and records management.

#### b) Authority

- 1) All personnel have the authority to initiate a stop-work order where detrimental ethical, contractual, quality, safety or health conditions exist. The stop-work order must be reported to their manager.
- 2) Authority is granted from the Lab Director and department manager to whom they report.

### 5.2 Education, Experience and Training

a) Minimal levels of qualification, experience and skills necessary for all positions in the laboratory are specified in the applicable job description.

b) To ensure that all technical staff are knowledgeable in regard to basic laboratory skills, such as using a balance or mechanical pipet, training is provided to each staff member (SOP reference: S0QA145.XXX). Such training will be documented.

c) To ensure initial proficiency, each analyst will be required to perform a demonstration of capability study using the Essential QC for the analysis being trained. A demonstration of capability for a similar test method using the same technology (e.g. GC/MS volatiles by purge and trap for 524.2, 624 or 5035/8260) will also be acceptable and may be applied.

d) To ensure that the training of the each employee is kept up-to-date, the following will be performed:

- 1) Evidence will be on file that demonstrates that each employee has read, understood, and is using the most recent version of the FGL QM procedures which relate to his/her job responsibilities.
- 2) Training courses or workshops on specific equipment, analytical techniques or laboratory procedures will be documented.
- 3) Evidence will be on file that demonstrate that each employee has read, understands and agrees to perform the most recent version of the standard operating procedure.
- 4) Each technical employee will be considered currently proficient by achieving at least one of the following once per year or whenever there is a significant change in instrument type or test method:
  - i. At least four consecutive laboratory control samples which meet all requirements as described in Appendix C, Section C.1.
  - ii. At least four consecutive laboratory control samples which meet all requirements as described

in Appendix C, Section C.1 on a similar test method using the same technology (e.g., GC/MS volatiles by purge and trap for 524.2, 624 or 5035/8260);

- iii. Method Detection Limit (MDL) studies may also be used for the Demonstration of Capability (DOC) provided that all requirements as described in Appendix C, Section C.1 are met.
- iv. Specific DOC requirements for the test methods are stored in FLG LIMS.

### **5.3 Records**

Records relevant to qualifications, training, skills and experience of the technical personnel will be maintained in a training file for each employee, including records on demonstrated proficiency for each laboratory test method.

## 6.0 FACILITIES

This is primarily referenced from section 5.5.3 of "Quality Systems," National Environmental Laboratory Accreditation Conference, June 5, 2003..

### 6.1 Facility descriptions

FGL Santa Paula occupies two buildings totaling 20,000 square feet of space. Approximately 70 percent is dedicated to the analytical laboratory functions. Separate laboratory areas are dedicated to GC/MS volatiles instrumentation, GC/MS semi-volatiles instrumentation, trace metals instrumentation, radiochemistry instrumentation, wet chemistry analysis and trace metals preparation, microbiological preparation and analysis, organic extractions, radiochemistry preparation and analysis (including defined HRAM and LRAM areas).

The GC/MS volatiles analysis area is operated in a positive pressure environment. The GC analysis area and organic extraction area is operated in a negative pressure environment. This coupled with separate HVAC systems for each area provides a contaminant free environment for trace-level volatiles analysis. The laboratory has 22 fume hoods totaling 130 linear feet of hood space. Electrical power for the instrumentation is provided by 110/220 volt circuits.

FGL Stockton occupies one building totaling 3000 square feet of space. Approximately 30 percent is dedicated to the analytical laboratory functions. Separate laboratory areas are dedicated to wet chemistry analysis and microbiology preparation and analysis. The laboratory has 3 fume hoods totaling 18 linear feet of hood space. Electrical power for the instrumentation is provided by 110/220 volt circuits.

### 6.2 Working Environment

a) Laboratory test areas, energy sources, lighting, heating and ventilation are adequate to facilitate proper performance of tests.

b) The environment in which these activities are undertaken will not invalidate the results or adversely affect the required accuracy of measurement.

c) In instances where monitoring or control of items specified in a test method or by regulation, such as fume hoods and safety showers, the laboratory will meet and document adherence to the laboratory facility requirements.

NOTE - FGL complies with the relevant health and safety requirements. This aspect, however, is outside the scope of this document.

### 6.3 Work Areas

a) FGL maintains effective separation between neighboring areas when the activities are incompatible including volatile organic analysis and volatile organic chemicals handling areas.

c) Adequate measures are taken to ensure good housekeeping in the laboratory.

d) Work spaces are available to ensure an unencumbered work area. Work areas include:

- 1) access and entryways to the laboratory;
- 2) sample receipt area(s);
- 3) sample storage area(s);
- 4) sample preparation and testing area(s);

5) data handling and storage area(s).

6) chemical and waste storage area(s);

#### **6.4 Security**

In Santa Paula, the 853 Corporation laboratory building is secured with a keypad access system. The 801 Corporation building has locks on the Volatile and Trace Metals laboratories. Only authorized FGL personnel have access to the facilities.

#### **6.5 Facility Floor Plans**

The following pages contain facility floor plans for the FGL Santa Paula Laboratory (figures 6.1) and FGL Stockton Laboratory (figure 6.2).







## 7.0 QUALITY SYSTEMS

This is primarily referenced from section 5.4 .13 and Appendix D of "Quality Systems," National Environmental Laboratory Accreditation Conference, June 5, 2003.

### 7.1 Audits

#### a) Internal Audits

The QM can only accomplish its objectives if management and personnel are committed to adherence to the program. In order to assess continued compliance and to identify strong and weak points within the plan, the FGL QA department performs annual internal audits (SOP reference: S0QA040.XXX). Such audits are carried out by the quality assurance director or designee(s) who are trained and who are, wherever possible, independent of the activity to be audited. Where the audit findings cast doubt on the correctness or validity of the laboratory's calibrations or test results, the laboratory will take immediate corrective action and will immediately notify, in writing, any client whose work may have been affected.

To verify that the Quality Assurance department is performing its duties as described by this document, on an annual basis FGL management (outside of quality assurance) will perform a review of the quality system (SOP reference: S0QA205.XXX). Where the review findings show the duties are not complete, the Quality Assurance Director will take corrective action.

#### b) External Audits

External audits are routinely on a bi-annual basis by regulatory agencies such as California Department of Health Services and Utah Bureau of Laboratory Management to maintain laboratory accreditation.

Client audits are also performed in order to verify compliance with client quality and contractual specifications.

#### c) Performance Audits

In addition to the audits listed above, FGL ensures the quality of results provided to clients by implementing checks to monitor the quality of the laboratory's analytical activities. Examples of such checks are:

- 1) internal quality control procedures using regulatory requirements or, whenever possible, statistical techniques (see section 6.3);
- 2) participation in proficiency testing or other inter-laboratory comparisons. FGL currently participates in the following studies:
  - I. Water Supply (WS), including Microbiology, semi-annual;
  - ii. Water Pollution (WP), including Microbiology, semi-annual (includes Discharge Monitoring Report (DMR) study);
  - iii. Soil/UST, semi-annual;
- 3) when necessary, replicate testings using the same or different test methods;

- 4) when necessary, re-testing of retained samples;
- 5) correlation of results for different parameters of a sample (for example: general mineral balancing or total phosphorus should be greater than or equal to phosphate-phosphorus).

### **7.1.1 Audit Review**

All audit findings and any corrective actions that arise from them are documented. The laboratory management will ensure that these actions are discharged within the agreed time frame.

### **7.1.2 Reports to Management**

a) Monthly nonconformance summary report is posted on the FGL internal website; this report summarizes number, type and status by department of all nonconformances generated by the laboratory operations.

b) Quarterly activity reports provide the following information to managers:

- 1) performance evaluation study summaries;
- 2) balance calibration verification summary;
- 3) water quality monitoring summary;
- 4) dissolved oxygen probe monthly calibrations;
- 5) temperature monitoring/excursion summary;
- 6) equipment status
- 7) lab certification status
- 8) audit schedules

c) The annual quality assurance report to management summarizes or verifies the following functions:

- 1) performance evaluation study summaries;
- 2) balance calibration verification summary;
- 3) water quality monitoring summary;
- 4) dissolved oxygen probe monthly calibrations;
- 5) temperature monitoring/excursion summary;
- 6) equipment status
- 7) lab certification status
- 8) audit schedules

## 7.2 Corrective Actions

a) FGL has implemented non-conformance procedures to be followed when departures from documented policies, procedures and quality control have occurred. This requires the use of a non-conformance report (or similar form such as the report/invoice amendment cover letter) which may require corrective action. This procedure is outlined in the Non-conformance/Corrective Action Program (SOP reference: SOQA035.XXX). These procedures include but are not limited to the following:

- 1) assign a unique non-conformance tracking number to track the non-conformance and, if necessary, the corrective action to final closure;
- 2) identifying the department in which the non-conformance occurred;
- 3) identifying the type of non-conformance which occurred, such as calibration failure, standard expiration or reporting;
- 4) record the pertinent details of the non-conformance, such as analytical method, batch ID, failure and probable cause;
- 5) quality assurance review to track the non-conformance and determine whether a corrective action will be required.

b) If a corrective action is deemed necessary the following procedures are performed:

- 1) identify the individual(s) responsible for performing the corrective action;
- 2) identify the remedial actions (short term) taken to prevent a similar non-conformance from occurring;
- 3) identify the corrective actions (long term) taken to prevent a similar non-conformance from occurring;
- 4) quality assurance review to verify the corrective actions taken are adequate;
- 5) quality assurance closure of the corrective action upon approval.

## 7.3 Essential Quality Control Procedures

The following essential quality controls, based on NELAC, Section 5 (Quality System) Appendix D, are utilized, where applicable, for all test methods performed at FGL. The manner in which they are implemented is dependent on the type of test. FGL considers certain quality controls as “critical to data defensibility” and other quality controls as “information only.” Quality controls considered to be “critical to data defensibility” are calibration blanks, calibration verifications, method blanks and LCS’s. In cases where controls “critical to data defensibility” fail, wherever possible, samples will be reprepared and/or analyzed to obtain acceptable data. If this is not possible the client will be notified of the failure and an acceptable resolution determined. In the cases of failing “information only” controls, the information will be provided to the client for their review and evaluation. Table 7.1 contains a comprehensive list of quality control types used by FGL (noted as “critical to data defensibility” and “information only”).

a) FGL has protocols in place to provide and/or monitor the following quality controls:

- 1) positive and negative controls to monitor sample preparation methods such as Method Blanks and Laboratory Control Samples (LCS), Matrix Spikes (MS), Surrogates (Surr);
- 2) measures to evaluate analytical variability/reproducibility, such as Matrix Spike Duplicates (MSD’s) or Laboratory Duplicates (Dup’s) (Note: the samples used for these quality controls are randomly

selected by the LIMS. In the case of the LIMS choosing a limited or inappropriate sample the analyst may override the selection);

3) measures to evaluate test method capability, such as Demonstration of Capability (DOC, SOP reference S0QA185.XXX) and Proficiency Testing Samples (PT's, SOP reference S0QA130.XXX);

4) measures to evaluate detection limits, such as method detection limits (MDL, SOP reference: S0QA060.XXX);

5) selection of appropriate formulas to reduce raw data to final results such as regression analysis, comparison to internal/external standard calculations, and statistical analyses;

6) measures to assure the accuracy of the analytical method including Initial and Continuing Calibration Blanks (ICB/CCB), Initial and Continuing Calibration Verifications (ICV/CCV), use of certified reference materials, performance evaluation samples (essential);

7) measures to assure clean glassware and the selection and use of reagents and standards of appropriate quality;

8) use of appropriate techniques to obtain representative subsamples (SOP reference: S0QA165.XXX).

b) The quality control protocols specified by the published test method and/or Standard Operating Procedure will be followed. Where no regulatory quality control protocols are specified FGL will implement those controls which are applicable to the type of sample preparation and analysis being performed (SOP reference: S0QA065.XXX).

c) All quality control measures are assessed and evaluated on an on-going basis. FGL maintains procedures for the development of acceptance/rejection criteria where no method or regulatory criteria exist (SOP reference: S0QA065.XXX);

#### **7.4 Data Validation**

In order to determine the validity of data generated the quality controls listed above are reviewed for acceptance. To the extent possible, samples are reported only if all quality control measures are acceptable. If a "critical to data defensibility" quality control measure is found to be out of control, and the data is to be reported, all samples associated with the failed quality control measure are reported with client approval and the appropriate data qualifier(s).

Calculations and data/information entry and transfers are reviewed at the following five specific points:

a) After sample login to verify analyses requested match those analyses which are to be performed. Sampling information such as sample identification, sampling dates and time are also reviewed for transcription accuracy (SOP reference: S0QA100.XXX).

b) After analysis to verify that the quality controls used for analysis and preparation were properly used and valid. Procedures have been defined to properly handle invalid data (SOP reference: S0QA095.XXX). At this time the LIMS performs comprehensive data reviews and reports including:

1) all calibration criteria are acceptable including a summary report;

2) all analytical and preparatory quality controls have been performed in the required frequencies including a summary report;

3) all quality control objectives including a summary report for each type of quality control, such as

continuing calibration blanks, continuing calibration verifications, internal standards, method blanks, laboratory control samples and matrix spikes. (Note: method blanks will be investigated if blank contamination exceed the established reporting limit for the associated method. Method blank contamination above reporting limits will require immediate corrective action).

4) all standards used are NIST traceable and are within expiration (included in the frequency report);

5) all manual data changes are documented on the data package printouts and an non-conformance is electronically created as an audit trail for review by the quality assurance director;

6) all critical information from the above checks are then presented on a data package summary report which serves as cover sheet and checklist for all data which is to be included in the package.

c) After data review and printing of data summary reports the analytical data package is reviewed for completeness (SOP reference: S0QA105.XXX) by a second analyst or manager. This review is primarily for failures and data integrity. The LIMS generates a summary indicating what failures occurred and any changes which were made to the data.

d) Prior to reporting to verify that data is historically reasonable and appropriate cross checks such as general mineral balances and COD is greater than BOD (SOP reference: S0QA110.XXX).

e) Prior to final signature to verify that the report package is complete in that all analyses requested are being reported and in the proper fashion such as nitrate versus nitrate nitrogen. At this time the invoice is also reviewed to verify that financial agreements are met (SOP reference: S0QA115.XXX).

#### **7.4.1 Calculations used in Data Validation**

a) Accuracy: the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator. Accuracy is usually expressed by FGL as percent recovery.

b) Precision: the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed by FGL as percent relative standard deviation or relative percent difference.

c) Completeness: the degree to which results are deemed to be valid relative to the total number of results reported. Completeness is usually expressed by FGL as the percentage of valid results. FGL does not normally perform this function but can report this calculation if a project requires.

d) Representativeness: the degree to which results are representative of the site which was sampled. FGL takes steps, such as sample homogenizing and appropriate quantities used for sub-sampling etc., to ensure that the results are relevant and applicable to a specific site/project. However, this is highly dependent on field activities which are out of control of the laboratory. Objectives for representativeness must be determined at the beginning of a project and included in the Field Sampling Plan and Quality Assurance Project Plan.

**Table 7.1 Summary list of Quality Controls used by FGL**

Quality Control ID	Full Name	
Analysis QC		
Tune	Instrument Tune	Critical to Data Defensibility
InStd	Internal Standard	Critical to Data Defensibility
CALS	Instrument Calibration	Critical to Data Defensibility
InstB	Instrument Blank	Critical to Data Defensibility
ICV	Initial Calibration Verification	Critical to Data Defensibility
ICB	Initial Calibration Blank	Critical to Data Defensibility
HiStd	Calibration Hi Standard	Critical to Data Defensibility
ICSA	Interference Check Sample A	Critical to Data Defensibility
ICSAB	Interference Check Sample AB	Critical to Data Defensibility
CCV	Continuing Calibration Verification	Critical to Data Defensibility
CCB	Continuing Calibration Blank	Critical to Data Defensibility
IDL	Instrument Detection Limit	Critical to Data Defensibility
LDR	Linear Dynamic Range	Critical to Data Defensibility
RTWin	Retention Time Window	Critical to Data Defensibility
Matrix QC		
PDS	Post Digestion Spike (ICP/GFAA)	Information Only
SDil	Serial Dilution (ICP)	Information Only
Preparation QC		
Surr	Surrogate	Information Only
MDL	Method Detection Limit	Critical to Data Defensibility
Blank	Method Blank	Information Only
LCS	Laboratory Control Standard/Sample	Critical to Data Defensibility
MS	Matrix Spike of MS/MSD pair	Information Only
MSD	Matrix Spike Duplicate of MS/MSD pair	Information Only
BS	Blank Spike of BS/BSD pair	Information Only
BSD	Blank Spike Duplicate of BS/BSD pair	Information Only
Dup	Duplicate Sample	Information Only
ExBlk	TCLP/STLC Extraction Blank	Critical to Data Defensibility
ExDup	TCLP/STLC Extraction Duplicate	Critical to Data Defensibility
SRC	Sample Replicate Check	Information Only

## 8.0 EQUIPMENT AND REFERENCE MATERIALS

This is primarily referenced from sections 5.5.5 of "Quality Systems," National Environmental Laboratory Accreditation Conference, June 5, 2003.

### 8.1 General Requirements

- a) The laboratory is furnished with all items of equipment including reference materials, such as certified balance weights and reference thermometers, required for the correct performance of tests for which it is accredited.
- b) Each major item of equipment is identified by the serial number, LIMS ID, and inventory control number.
- c) Records will be maintained in FGL LIMS of each major item of equipment and all reference materials significant to the tests performed. This list will be made available upon request. The records will include:
  - 1) the name of the item of equipment;
  - 2) the manufacturer's name, type identification, and serial number or other unique identification;
  - 3) date received and date placed in service (if available);
  - 4) current location, where appropriate.
- d) Table 8.1 contains a summary listing of equipment including which lab the equipment is located in, the division in which it is used, the quantity, and instrument type. A more detailed listing including information such as specific manufacturers, model numbers will be made available upon request.

### 8.2 Equipment Maintenance

- a) All equipment is routinely maintained, inspected and cleaned. Specific routine maintenance procedures are documented in section 15.0 of each analytical SOP.
- b) Any item of equipment which has been subjected to overloading or mishandling, or which gives suspect results, or has been shown by verification or otherwise to be defective, will be clearly identified and taken out of service until it has been repaired and shown by calibration, verification or test to perform satisfactorily (SOP reference: S0QA140.XXX). The laboratory will review the effect of this defect on previous analyses.
- c) Records will be maintained for all routine and non-routine maintenance performed. These procedures are outlined in the instrument maintenance SOP (SOP reference: S0QA140.XXX). Records of the maintenance will include:
  - 1) the manufacturer's name, model number, serial number and instrument identification;
  - 2) the date the maintenance was performed and the analyst or service technician who performed the maintenance;
  - 3) the symptoms of problems occurring on the instrument;
  - 4) the cause of the problems occurring on the instrument;
  - 5) the repair/maintenance performed to correct the problem.

### 8.3 Reference Equipment

a) Reference equipment of measurement held by the laboratory (such as calibrated weights or thermometers) shall be used for calibration only and for no other purpose. Reference equipment of measurement are calibrated by a body that can provide NIST or other appropriate national standards of measurement traceability.

b) FGL maintains a program for calibration and verification for reference equipment (SOP reference SOQA140.XXX). Please refer to section 9.3.2 for information regarding use of reference equipment and calibration of the support equipment such as thermometers, balances and mechanical pipets.

**Table 8.1 Summary list of equipment**

LAB	DIVISION	QUANTITY	INSTRUMENT TYPE
SP	Organic	7	Gas Chromatograph/Mass Spectrometer
SP	Organic	8	Gas Chromatograph
SP	Organic	1	High Performance Liquid Chromatograph
SP	Organic	1	Infra-red Spectrophotometer (Fixed wavelength)
SP	Organic	1	Total Organic Carbon Analyzer
SP	Organic	2	Analytical Balance
SP	Organic	1	Gas/Liquid Chromatograph MS/MS
SP	Organic	1	pH Meter
SP	Inorganic	2	Inductively Coupled Plasma/Mass Spectrometer
SP	Inorganic	2	Inductively Coupled Plasma Spectrophotometer
SP	Inorganic	2	Automated Mercury Analyzer
SP	Inorganic	3	Ion Chromatograph with autosampler
SP	Inorganic	1	Flow injection autoanalyzer
SP	Inorganic	2	UV/VIS Spectrophotometer
SP	Inorganic	1	Nephelometer
SP	Inorganic	1	Oxygen Meter
SP	Inorganic	2	pH/ISE Meter
SP	Inorganic	1	pH Meter
SP	Inorganic	1	Setaflash
SP	Inorganic	3	Analytical Balance
SP	Radio	1	Gamma Ray Spectroscope
SP	Radio	8	Alpha Spectrometer
SP	Radio	1	Alpha Scintillation
SP	Radio	1	Liquid Scintillation
SP	Radio	8	Alpha Counter
SP	Radio	3	Alpha/Beta Counter
SP	Radio	2	Balance
SP	Agronomics	4	Inductively Coupled Plasma Spectrophotometer
SP	Agronomics	2	UV/VIS Spectrophotometer
SP	Agronomics	1	pH Meter
SP	Agronomics	2	EC Meter
SP	Agronomics	1	Chloridometer
SP	Agronomics	1	Nitrogen Analyzer
SP	Agronomics	2	Carbon/Nitrogen/Sulfur Analyzer
SP	Agronomics	6	Analytical Balance
SP	Bacti	3	Incubators
SP	Bacti	3	Waterbaths
SP	Bacti	2	Autoclaves

LAB	DIVISION	QUANTITY	INSTRUMENT TYPE
SP	Field Service	9	Vehicles
SP	Field Service	10	Isco Autosamplers
SP	Computers	1	1 x 16 fibre optic backbone switch
SP	Computers	9	2 x 24 fibre optic to category 5 switches
SP	Computers	2	DSL/T1 Routers
SP	Computers	2	VMS/PCSA Servers for DOS Instrument Data
SP	Computers	2	UNIX/Samba Servers for Foxpro DOS LIMS ver2.0
SP	Computers	5	Linux/Samba Servers for NT File/Print Services
SP	Computers	2	Linux/Samba Servers for MySQL/VB6 LIMS ver3.0
SP	Computers	85	DOS/WIN95/NT Based Computers
STK	Inorganic	2	Incubators (for BOD's)
STK	Inorganic	2	DO Meters
STK	Inorganic	2	UV/VIS Spectrophotometer
STK	Inorganic	2	Conductivity Meter
STK	Inorganic	2	pH Meter
STK	Inorganic	1	Nephelometer
STK	Inorganic	12	Settleable Cones
STK	Inorganic	2	Vacuum Pumps
STK	Bacti	3	Incubators
STK	Bacti	5	Waterbaths
STK	Bacti	2	Autoclave
STK	Field Services	6	Field Chlorine Meters
STK	Field Services	5	Field pH, EC, DO, ORP and Temp Meters
STK	Field Services	6	Field Computers
STK	Field Services	6	Vehicles
STK	Field Services	15	Isco Autosamplers
STK	Field Services	1	Isco Pump
STK	Computers	14	Office Computers
STK	Computers	1	Office Copier
STK	Computers	8	Printers
CH	Field Services	4	Vehicles

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LAB	DIVISION	QUANTITY	INSTRUMENT TYPE
CH	Field Services	5	Field Conductivity Meters
CH	Field Services	5	Field pH Meters
CH	Inorganic	1	Conductivity Meters
CH	Inorganic	1	pH Meters
CH	Bacti	3	Incubators
CH	Bacti	2	Water Baths
CH	Bacti	2	Autoclaves
CH	Office	4	Office Computers

## 9.0 MEASUREMENT TRACEABILITY AND CALIBRATION

This is primarily referenced from section 5.5.6 of "Quality Systems," National Environmental Laboratory Accreditation Conference, June 5, 2005.

### 9.1 General Requirements

All measuring operations and testing equipment having an effect on the accuracy or validity of tests are calibrated and/or verified before being put into service and on a continuing basis. FGL maintains a program for the calibration and verification of its measuring and test equipment. This includes balances, thermometers and control standards.

### 9.2 Traceability of Calibration

The overall program of calibration and/or verification and validation of equipment has been designed and operated so as to ensure that, wherever applicable, measurements made by the laboratory are traceable to NIST or other appropriate national standards of measurement. All standards are documented at the laboratory for future traceability (SOP reference: S0QA030.XXX).

#### 9.2.1 Documentation and Labeling of Standards

Documented procedures are maintained for the purchase, reception and storage of calibration standards used for the technical operations of the laboratory.

- a) The laboratory retains records for all standards including the manufacturer/vendor, the manufacturer's Certificate of Analysis or purity (if supplied), the date of receipt, recommended storage conditions, and an expiration date after which the standard will not be used unless it is verified by the laboratory.
- b) The original stock standard containers (such as provided by the manufacturer or vendor) are labeled with an expiration date.
- c) Detailed records are maintained for standard preparation. These records indicate traceability to purchased stocks or neat compounds, reference to the method of preparation, date of preparation, expiration date and preparer's initials.
- d) All containers of stock and prepared standards bear a unique identifier and expiration date and are linked to the documentation listed in 9.2.1 a) above.

### 9.3 Calibration

#### 9.3.1 General Requirements

- a) Each calibration is dated and labeled with the test method, instrument, analysis date, and each analyte name, concentration and response (or response factor).
- b) Sufficient information is recorded to permit reconstruction of the calibration.
- c) Criteria for the acceptance of a calibration procedure, such as calibration curves and concentration (titer) determinations of titrants, are established. General criteria are listed below. Detailed criteria are listed in section 11.0 of each analytical SOP.

#### 9.3.2 Reference Equipment Calibrations

This equipment includes thermometers, balances, balance weights and radiation survey meters. All reference equipment is:

- a) Maintained in proper working order. The records of all calibrations are retained.
- b) Calibrated using NIST traceable references when available, over the entire range of use. The results of such calibration shall be within the specifications required of the application for which is equipment is used or:
  - 1) The equipment shall be removed from service until repaired; or
  - 2) FGL will prepare a deviation curve and correct all measurements for the deviation. All measurements will be recorded and maintained.
- c) Calibrated according to the following frequencies:
  - 1) The primary NIST traceable reference thermometer is calibrated by an outside source on an annual basis. Secondary thermometers used for verification of ovens, refrigerators, freezers, incubators and water baths shall be calibrated with the primary NIST traceable reference on an annual basis. Thermometers used for microbiological procedures are calibrated with the primary NIST traceable reference on a semi-annual basis. The temperature correction is posted on the thermometer (SOP reference: S0QA125.XXX).
  - 2) Balances and balance verification weights are calibrated with NIST traceable references on an annual basis (SOP reference: S0QA155.XXX).
  - 3) Radiation survey meters are calibrated on an annual basis (SOP reference: S2HWS010.XXX).

### 9.3.3 Support Equipment Calibration Verifications

This equipment includes balances, volumetric dispensing devices (such as Eppendorf®, or automatic dilutor/dispensing devices), autoclaves and ovens, refrigerators, freezers, incubators, water baths. Calibration verification of volumetric dispensing devices is performed if quantitative results are dependent on their accuracy, as in standard preparation and dispensing or dilution into a specified volume. All support equipment is:

- a) Maintained in proper working order. The records of all activities including service calls are retained.
- b) Verified using NIST traceable references when available. The results of the verification shall be within the specifications required of the application for which is equipment is used or the equipment shall be removed from service until repaired.
- c) Verifications according to the following frequencies:
  - 1) Ovens, refrigerators, freezers, incubators and water baths shall be verified with NIST traceable references prior to use on each working day. Additional monitoring as prescribed by the test method shall be performed for any device that is used in a critical test (such as incubators or water baths). The acceptability for use or continued use shall be according to the needs of the analysis or application for which the equipment is being used (SOP reference: S0QA125.XXX).
  - 2) Balances are verified with NIST traceable references prior to use on each working day (SOP reference: S0QA155.XXX).
  - 3) Volumetric dispensing devices (except Class A glassware) are verified for accuracy and precision on a quarterly basis (SOP reference: S0QA160.XXX).

- 4) Autoclave sterilization temperatures and pressures for each run are documented by the use of spore strips.

### 9.3.4 Instrument Calibrations

- a) Calibration curves are prepared as specified in the published test method. If the published test method does not provide guidance in the preparation of a calibration curve (e.g. number of calibration points and range), FGL will use a minimum of two standards plus a zero reference standard.
- b) The calibration curve is subjected to a calibration linearity test, such as a linear regression or percent RSD of response factors (internal standard calibration) or calibration factors (external standard calibration). For those methods which do not contain specific acceptance criteria FGL applies the following:
  - 1) Organics: if, spanning the range of calibration, the RSD of response factors is less than 15 percent, or the RSD of calibration factors is less than 30 percent, an average relative response factor may be used. If that fails then a linear least squares fit is used with a weighted coefficient of determination no less than 0.99. If that fails then a quadratic least squares fit is used with weighted coefficient of determination no less than 0.99.
  - 2) Inorganics: a linear regression or quadratic may be used with a correlation coefficient (R) no less than 0.995.
- c) Prior to specific analyte calibrations certain tests may require an instrument calibration such as a GC/MS or ICP/MS tune. Acceptance criteria are normally defined in the published test method and must be met prior to instrument use. These criteria are also listed in the specific SOP for that instrument.

### 9.3.5 Calibration Verification

#### 9.3.5.1 Initial Calibration Verification (ICV) and Blank (ICB)

- a) When available, all initial calibrations are verified with a matrix matched blank (ICB) and a standard obtained from a second or different source (ICV). The ICB and ICV are analyzed with each initial calibration and must be within acceptance range specified by the published test method or limits statistically derived by FGL.
- b) If the initial calibration verification fails, the analysis procedure will be stopped and evaluated. For example, a second standard may be analyzed and evaluated or a new initial calibration curve may be established and verified. In all cases, the initial calibration verification will be acceptable before analyzing any samples.

#### 9.3.5.2 Continuing Calibration Verification (CCV) and Blank (CCB)

Additional standards are analyzed after the initial calibration curve or the integrity of the initial calibration curve (see 9.3.4.1 above) has been accepted.

- a) These standards are analyzed at a frequency specified by the published test method. If published frequencies are not available a minimum frequency of 5% or every 12 hours whichever is more frequent will be used. The verification may use the standards from the original calibration curve or standards from another source.
- b) When an initial calibration curve is not established on the day of analysis, the integrity of the initial calibration curve is verified on each day of use (or 24 hour period) by initially analyzing an CCB and CCV at the method defined concentration or a mid-level concentration if not included in the test method.

c) If a calibration check standard fails, and routine corrective action procedures fail to produce a second consecutive calibration check within acceptance criteria, a new initial calibration curve is performed. When the continuing calibration verification acceptance criteria are exceeded high (i.e., high bias) on an automated analytical run, and there are non-detects for the corresponding analyte in environmental samples associated with the continuing calibration check, then those non-detects may be reported. Positive samples affected by the unacceptable check are reanalyzed after a new calibration curve has been established, evaluated and accepted. Additional automated sample analysis will not occur until a new calibration curve is established and verified. Non-automated analyses are corrected by recalibration at the time of analysis.

## 10.0 TEST METHODS

This is primarily referenced from section 5.5.4 of “Quality Systems,” National Environmental Laboratory Accreditation Conference, June 5, 2003.

### 10.1 Test Methods Documentation

FGL maintains published test methods and standard operating procedures which provide a reference for and specific instructions on the use and operation of all relevant equipment, handling and preparation of samples, calibration and/or testing and administrative procedures. All instructions, standards, manuals and reference data relevant to the work of the laboratory will be maintained up-to-date and be readily available to the staff. A list of all test methods accredited and/or performed by FGL will be made available upon request.

#### 10.1.1 Published Test Methods

- a) The laboratory maintains a collection of current published test method manuals for each accredited analyte or test method. The list of method references which FGL uses is listed in section 16.0 of this document.
- b) Copies of all published test methods are accessible to all personnel.
- c) A comprehensive list of all methods which FGL is capable of performing is available.

#### 10.1.2 Standard Operating Procedures (SOP)

FGL maintains internally written standard operating procedures that accurately reflect all phases of current laboratory activities such as assessing data integrity, corrective actions, performance evaluation study handling, and all test methods. FGL utilizes two standard SOP formats, analytical/preparation and administrative (SOP references: S0QA010.XXX and S0QA015.XXX respectively). Specific SOP's will be made available upon request.

- a) Copies of all SOPs are accessible to all personnel.
- b) The SOPs are organized by the location (e.g. department or customer) in which they are used. SOP's which are used by many locations are controlled to each applicable location (SOP reference: S0QA075.XXX).
- c) Each SOP clearly indicates the effective date of the document, the revision number and the signature(s) of the approving authorities.
- d) The SOPs are reviewed and updated every two years or more often if method updates or changes is warranted.

### 10.2 Method Certification

Prior to being accredited for a test method FGL will perform an initial demonstration of capability. This process is used to verify that the procedure is accurate, precise and meets all published regulatory criteria where applicable. Upon demonstrating acceptable results FGL will maintain the records and provide a report package to the appropriate regulatory agency to obtain certification.

#### 10.2.1 Demonstration of Capability

a) Prior to the use of any test method, each analyst must provide a demonstration of capability. The following demonstration of capability requirements are based on NELAC, Chapter 5 (Quality System) Appendix C:

1) A quality control sample will be obtained from an outside source. If not available, the QC check sample may be prepared by the laboratory using stock standards that are prepared independently from those used in instrument calibration.

2) The concentrate will be diluted in a volume of clean matrix sufficient to prepare four aliquots at the required method volume to a concentration approximately 10 times the method-stated or laboratory-calculated method detection limit.

3) The four aliquots shall be prepared and analyzed according to the test method either concurrently or over a period of days.

4) Using the four results, calculate the average recovery in the appropriate reporting units (such as ug/L) and the standard deviation of the population sample (-1) (in the same units) for each parameter of interest.

5) For each parameter, compare the standard deviation and average to the corresponding acceptance criteria for precision and accuracy in the test method (if applicable) or in laboratory-generated acceptance criteria (if a non-standard method). If the standard deviation and average for all parameters meet the acceptance criteria, the method will be considered acceptable and the certification process may continue. If any one of the parameters exceed the acceptance range, the performance is unacceptable for that parameter.

6) When one or more of the tested parameters fail at least one of the acceptance criteria, the analyst must proceed according to a) or b) below.

i) Locate and correct the source of the problem and repeat the test for all parameters of interest beginning with 3) above.

ii) Beginning with 3) above, repeat the test for all parameters that failed to meet criteria. Repeated failure, however, will confirm a general problem with the measurement system. If this occurs, locate and correct the source of the problem and repeat the test for all compounds of interest beginning with 3).

c) Thereafter, continuing demonstration of method performance (such as laboratory control samples) is required.

d) In all cases, the appropriate documentation is completed and retained by the laboratory to be made available upon request. All associated supporting data necessary to reproduce the analytical results is retained by the laboratory.

### 10.3 Agency Certification or Approval

Prior to performing a test method in a given region, FGL will obtain the necessary agency certification. Below is a list of all agencies for which FGL has been certified or approved for analysis (all certifications are available upon request):

a) FGL Santa Paula maintains certifications or approval for the following agencies:

California - Department of Public Health

Hawaii - Department of Health  
United States - Department of Energy

b) FGL Stockton maintains certifications or approval for the following agency:

California - Department of Public Health

c) FGL Chico maintains certifications or approval for the following agency:

California - Department of Public Health

## **11.0 SAMPLE HANDLING**

This is primarily referenced from section 5.5.8 of "Quality Systems," National Environmental Laboratory Accreditation Conference, June 5, 2003.

### **11.1 Sample Tracking**

a) The laboratory maintains a documented system for uniquely identifying the items to be tested, to ensure that there can be no confusion regarding the identity of such items at any time (SOP Reference: S0REC005.XXX). This system includes identification for all samples, subsamples and carried forward to subsequent extracts and/or digestates. The laboratory assigns a unique identification (ID) code to each sample container received in the laboratory.

b) This laboratory ID code will maintain an unequivocal link with the unique field ID code assigned each container.

c) The laboratory ID code is placed on the sample container as a durable label.

d) The laboratory ID code is entered into the LIMS and is the link that associates the sample with related laboratory activities such as sample preparation or calibration.

### **11.2 Sample Acceptance**

The laboratory maintains a written sample acceptance criteria that clearly outlines the circumstances under which samples will be accepted (SOP reference: S0REC005.XXX). This SOP is available to sample collection personnel and includes, but is not limited to, the following areas of concern:

- a) Proper, full, and complete documentation, which includes sample identification, the location, date and time of collection, collector's name, container type, preservation type, sample type and any special remarks concerning the sample. FGL maintains documented procedures listing proper containers and preservation (form reference: F0SHP005.XXX);
- b) Proper sample labeling to include unique identification and a labeling system for the samples with requirements concerning the durability of the labels (water resistant) and the use of indelible ink;
- d) Adherence to specified holding times;
- e) Adequate sample volume. Sufficient sample volume must be available to perform the necessary tests; and
- f) Procedures to be used when samples which show signs of damage or contamination.

### 11.3 Sample Receipt Protocols

a) Upon receipt, the condition of the sample, including any abnormalities or departures from standard condition as prescribed in the relevant test method, are recorded.

1) All samples which require thermal preservation are considered acceptable if the arrival temperature is either within  $\pm 2^{\circ}\text{C}$  of the required temperature or the method specified range. For samples with a specified temperature of  $4^{\circ}\text{C}$ , samples with a temperature ranging from just above the freezing temperature of water to  $6^{\circ}\text{C}$  shall be acceptable. Samples that are hand delivered to the laboratory immediately after collection may not meet this criteria. In these cases, the samples will be considered acceptable if there is evidence that the chilling process has begun such as arrival on ice.

2) FGL has documented procedures for checking chemical preservation such as pH at the time of sample receipt.

b) The results of all checks are recorded.

c) Where there is any doubt as to the item's suitability for testing, where the sample does not conform to the description provided, or where the test required is not fully specified, FGL will consult the client for further instruction before proceeding. If the sample does not meet the sample receipt acceptance criteria FGL will

either:

- 1) Retain correspondence and/or records of conversations concerning the final disposition of rejected samples; or
  - 2) Fully document any decision to proceed with the analysis of samples not meeting acceptance criteria.
    - i. The condition of these samples will be noted on the chain of custody or sample discrepancy form;
    - ii. The analysis data will be appropriately "qualified" on the final report.
- d) FGL utilizes a LIMS electronic database to document receipt of all sample containers.
- 1) At a minimum, the following is recorded in the LIMS:
    - i. Client Name and Address
    - ii. Project Name
    - iii. Sample description
    - iv. Sample date and time
    - v. Name of sampler and employer
    - vi. Date and time of laboratory receipt
    - vii. Name of person who received the sample
    - viii. Unique laboratory ID code
    - ix. Analytical test methods requested
    - x. Container types and preservation
    - xi. Initials of person making the entries.
- e) All documentation, such as a fax transmittal form, that is transmitted either by FGL or by the sample transmitter will be retained.
- f) A complete chain of custody record is retained.

#### 11.4 Storage Conditions

The laboratory maintains documented procedures and appropriate facilities to avoid deterioration, contamination, or damage to the sample during storage, handling, preparation, and testing; any relevant instructions provided with the sample will be followed (SOREC005.XXX). Where items have to be stored

under specific environmental conditions, these conditions will be maintained, monitored and recorded where necessary.

a) Samples are stored according to the conditions specified by preservation protocols:

1) Samples which require thermal preservation shall be stored under refrigeration which is  $\pm 2^{\circ}\text{C}$  of the specified preservation temperature unless method specific criteria exist. For samples with a specified storage temperature of  $4^{\circ}\text{C}$ , storage at a temperature above the freezing point of water to  $6^{\circ}\text{C}$  shall be acceptable.

2) Samples, sample fractions, extracts, leachates and other sample preparation products are stored away from all standards, reagents, food and other potentially contaminating sources. Samples shall be stored in such a manner to prevent cross contamination.

## 11.5 Sample Disposal

The laboratory maintains a Hazardous Waste Management Plan which outlines procedures for the disposal of samples, digestates, leachates and extracts or other sample preparation products. Information is also included in section 16.0 of each analytical SOP.

## 11.6 Sample Subcontracting

a) FGL will advise the client of its intention to sub-contract any portion of the testing to another party.

b) When work is subcontracted, it is done so under chain of custody, and the proper records are included with the report package. When work is subcontracted to an outside laboratory a separate chain of custody is prepared.

c) When subcontracted work is reported by FGL a cover letter is supplied indicating the laboratory which performed the analysis. All original reports and chain of custodies resulting from the subcontracted work are provided to the client.

d) Subcontractors are reviewed for acceptability based on an evaluation of their Quality Manual and reporting format (SOP reference: S0QA050.XXX). On-site audits may be performed based on project specific requirements.

## 12.0 RECORDS

FGL maintains a record system to comply with all relevant regulations. The system can produce unequivocal, accurate records which document all laboratory activities. FGL retains on record all original observations, calculations and derived data, calibration records and a copy of the test report. This is primarily referenced from section 5.4.12 of "Quality Systems," National Environmental Laboratory Accreditation Conference, June 5, 2003.

### 12.1 Record Keeping System and Design

The record keeping system allows historical reconstruction of all laboratory activities that produced the resultant sample analytical data. This includes interlaboratory transfers of samples and/or extracts.

- a) The records include the identity of personnel involved in sampling, preparation, calibration or testing.
- b) The records include all information relating to the laboratory facilities equipment, analytical test methods, and related laboratory activities, such as sample receipt, sample preparation, or data verification.
- c) The record keeping system facilitates, the retrieval of all working files and archived records for inspection and verification purposes.
- d) All documentation entries are signed or initialed by responsible staff. The reason for the signature or initials is clearly indicated in the records such as "sampled by", "prepared by", or "reviewed by").
- e) All generated data except those that are generated by automated data collection systems, are recorded directly, promptly and legibly in permanent ink.
- f) Entries in records are not obliterated by methods such as erasures, overwritten files or markings. All corrections to record-keeping errors shall be made by one line marked through the error. The individual making the correction shall sign (or initial) and date the correction. These criteria also apply to electronically maintained records.

### 12.2 Hardcopy Records Management and Storage

- a) All records (including those pertaining to calibration and test equipment), certificates and reports are safely stored, held secure and in confidence to the client (SOP reference: S0QA215.XXX).
- b) All client records are held in strict confidence and will not be provided to any other party without consent of the client (SOP reference: S0ADM100.XXX).
- c) All records, including those specified in 12.4, are retained for a minimum of five years. All information necessary for the historical reconstruction of data is maintained by the laboratory. Records which are stored only on electronic media are supported by the hardware and software necessary for their retrieval.
- d) The laboratory has established a record management system for control of laboratory notebooks (SOP reference: S0QA020.XXX). Information which is part of a routine analysis is considered to be a record (such as run schedules). Controlled logbooks are typically used for quality assurance documentation such as daily balance, temperature, conductivity checks and instrument maintenance and personal analyst logbooks.
- e) Access to archived information is documented with an access log. These records are protected against fire, theft, loss, environmental deterioration, vermin and, in the case of electronic records, electronic or magnetic sources.

### 12.3 Electronic Records Management and Storage

Where computers or automated equipment are used for the capture, processing, manipulation, recording, reporting, storage or retrieval of test data, the laboratory ensures that:

- a) computer software is documented and adequate for use;
- b) computer and automated equipment are maintained to ensure proper functioning and provided with the environmental and operating conditions necessary to maintain the integrity of calibration and test data;
- c) Records that are stored or generated by computers or personal computers (PC's) have hard copy or write-protected backup copies.
- d) Records which are stored only on electronic media are supported by the hardware and software necessary for their retrieval.
- e) procedures are established for protecting the integrity of data; these procedures include data entry or capture, data storage, data transmission and data processing, maintenance of security of data includes the prevention of unauthorized access to, and the unauthorized amendment of, computer records.
- f) procedures are established for protecting existing data through backing up the appropriate electronic data storage areas (S0ADM010.XXX)

### 12.4 Sample Handling Records

A record of all procedures to which a sample is subjected while in the possession of the laboratory are maintained. These include records pertaining to:

- a) Sample preservation including appropriateness of sample container and compliance with holding time requirement;
- b) Sample identification, receipt, acceptance or rejection and log-in;
- c) Sample storage and tracking including shipping receipts, transmittal forms;
- d) Sample preparation including cleanup and separation protocols, ID codes, volumes, weights;
- e) Sample analysis including all original raw data, whether hard copy or electronic, for calibrations, samples and quality control measures, including analysts work sheets and data output records (chromatograms, strip charts, and other instrument response readout records); these records will include the following:
  - 1) Laboratory sample ID code;
  - 2) Date of analysis;
  - 3) Instrumentation identification and instrument operating conditions/parameters (or reference to such data);
  - 4) Analysis type;
  - 5) All manual calculations; and
  - 6) Analyst's or operator's initials

7) Reviewers initials

- f) Standard origin, receipt, preparation, and use;
- g) Equipment receipt, use, specification, operating conditions and preventative maintenance;
- h) Calibration criteria, frequency and acceptance criteria;
- i) Data and statistical calculations, review, confirmation, interpretation, assessment and reporting conventions;
- j) Method performance criteria including expected quality control requirements;
- k) Quality control protocols and assessment;
- l) Electronic data security, software documentation and verification, software and hardware audits, backups, and records of any changes to automated data entries;

### **12.5 Laboratory Support Activities**

In addition to documenting all the above-mentioned activities, the following shall be retained:

- a) Copies of final reports;
- b) Archived standard operating procedures;
- c) Correspondence relating to laboratory activities for a specific project;
- d) All corrective action reports, audits and audit responses;
- e) Proficiency test results and raw data; and
- f) Personnel qualifications, experience and training records;
- g) Initial and continuing demonstration of proficiency for each analyst; and
- h) A log of names, initials and signatures for all individuals who are responsible for signing or initialing any laboratory record.

### 13.0 LABORATORY REPORT FORMAT AND CONTENTS

This is primarily referenced from section 5.5.10 of “Quality Systems,” National Environmental Laboratory Accreditation Conference, June 5, 2003 .

The results of each test, or series of tests carried out by FGL are reported accurately, clearly, unambiguously and objectively. The results are provided in a test report and include all the information necessary for the interpretation of the test results and all information required by the method used. Some regulatory reporting requirements or formats such as the California drinking water Write-on format, may not require all items listed below, however, FGL will provide all the required information in the proper format to the client to meet the requirements of such regulatory reports.

a) Unless client or regulatory agencies require otherwise, each report to a client shall include at least the following information:

- 1) A title indicating analytical results;
- 2) FGL laboratory addresses, FGL location where the test was carried out, the laboratory certification number and phone number with name of contact person for questions;
- 3) Laboratory ID number linking the report information to all analytical, custody and field documentation. This includes identification on each page and total number of pages.
- 4) Name and address of client, and project name if applicable;
- 5) Description of the tested sample;
- 6) Date of receipt of sample, date and time of sample collection, date(s) of preparation and analysis performed. Time of preparation or analysis listed for samples which are 48 hours or less in holding time.
- 7) Identification of results derived from samples that did not meet NELAC acceptance requirements such as improper container, holding time or temperature.
- 8) Identification of the test method used;
- 9) If FGL performed the sampling, a reference to the method used;
- 10) Any deviations from the test method including data qualifiers and there meaning;
- 11) Testing results including supporting information such as reporting units or reporting on dry weight basis;
- 12) When appropriate, a statement of the estimated uncertainty of the test result;
- 13) A signature and title, or an equivalent electronic identification of the person(s) accepting responsibility for the content of the report, and date of issue;

- b) FGL provides many custom options for laboratory sample data and quality assurance reports. This ranges from sample data only to Full CLP analysis and deliverables. Please contact the laboratory if you have project specific requirements.
- c) Where the report package contains results of tests performed by sub-contractors, these results are clearly identified with a cover letter and the original full subcontractor report and supporting custody records.
- d) After issuing the report, it may be necessary to amend the original report. In this regard the appropriate sections of the report being amended will be indicated as such and cover letter indicating what was amended and the reason for amendment (SOP reference: SOADM015.XXX). If an electronic deliverable was provided the electronic deliverable will be amended, redelivered and the new electronic file name will be indicated on the amendment letter.
- e) FGL will notify clients promptly of any event such as the identification of defective measuring or test equipment that casts doubt on the validity of results given in any report package or amendment to a report package.
- f) Where clients require transmission of test results by telephone, fax or other electronic or electromagnetic means, staff will follow documented procedures that ensure confidentiality.

## 14.0 OUTSIDE SUPPORT SERVICES AND SUPPLIES

This is primarily referenced from section 5.4.5 and 5.4.6 of "Quality Systems," National Environmental Laboratory Accreditation Conference, June 5, 2003.

### 14.1 Subcontracted Analyses

FGL will subcontract all regulatory testing to NELAP accredited laboratories whenever possible. When this is not possible the analytical subcontractors used by FGL will be evaluated. The evaluation is performed by review of the Quality Assurance Plan and reports applicable to the test being subcontracted (SOP reference: S0QA050.XXX). On-Site audits of subcontractors are performed only if it is a project specific requirement. All subcontractor report packages will be clearly identified with a cover letter and the original full subcontractor report and supporting custody records.

If there are any indications that a subcontractor has knowingly supplied services of substandard quality, this information will be forwarded to all clients impacted.

### 14.2 Laboratory Supplies

a) Upon receipt of supplies FGL receiving/shipping personnel will verify the content of the supplies against the packing slip (SOP reference: S0SHP015.XXX). If the shipment is complete and the supplies received are in acceptable condition then they are provided to the department which placed the order and the approved packing slip is provided to accounting. If the shipment is incomplete or the supplies are unacceptable then the FGL department and the vendor are notified. Arrangements are then made with the vendor to complete the order or obtain supplies in acceptable condition. The accounting department maintains the packing slip records for all shipments.

b) Containers, chemicals and standards are dated upon receipt.

c) Wherever possible analytical reagent grade chemicals and NIST traceable standards are purchased. These supplies are considered acceptable for use by meeting the positive and negative quality control objectives of the analytical test being performed.

### 14.3 Laboratory Equipment

FGL will, wherever possible or relevant, ensure that purchased equipment is not used until it has been inspected, calibrated or otherwise verified as complying with any standard specifications relevant to the calibrations or tests concerned.

### 14.4 Laboratory Water Quality

The laboratories utilize type II water, as specified in Standard Methods for the Examination of Water and Wastewater, 18<sup>th</sup> Edition, section 1080A, for preparation of reagents and standards. For microbiological analyses the laboratory meets the specifications listed in section 9020B. A description of the water systems and related quality controls for each laboratory are listed below:

a) FGL Santa Paula obtains acceptable water quality through the use of a reverse osmosis (RO) system. A granular activated carbon bed is used prior to the RO to remove organics. A finishing bed of activated resin is used for final polishing.

b) FGL Stockton obtains acceptable water quality through the use of anion and cation deionization resin beds.

c) The water quality is verified by daily conductivity checks and daily/monthly/quarterly bacteriology related checks (SOP reference: S0QA170.XXX).

## 15.0 COMPLAINTS

This is primarily referenced from section 5.4.8 of “Quality Systems,” National Environmental Laboratory Accreditation Conference, June 5, 2005.

When a complaint, or other circumstance, raises doubt concerning FGL’s compliance with internal policies or procedures, or with external regulatory or client specified requirements, FGL will perform the following steps:

- a) Promptly review or audit those areas of activity and responsibility;
- b) Upon completion of the review, appropriate steps will be taken to correct the complaint and;
- c) Where relevant, the practices which led to the complaint will be corrected.
- d) Records of the complaint and subsequent actions will be maintained through the non-conformance/corrective action program (SOP reference: S0QA035.XXX).

## 16.0 REFERENCES

### 16.1 General Reference List

References for this plan include quality assurance, laboratory and field methods published by the U.S. Environmental Protection Agency (EPA) and other agencies mainly through the following sources:

- a) "Standard Methods for the Examination of Water and Wastewater," APHA, 20th Edition, 1998.
- b) "Methods for Chemical Analysis in Waters and Waste," (MCAWW) EPA-600/4-79-020
- c) "Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater," EPA Method Book, EPA 600/4-82-057, July 1982.
- d) "Methods for Evaluating Solid Waste," SW-846, 3rd edition (Electronic format only by ChemSoft, Inc.), and Proposed Revisions;
- e) "Prescribed Procedures for Measurement of Radioactivity in Drinking Water," EPA Method Book, EPA-600/4-80-032, August 1980.
- f) "Handbook for Sampling and Sample Preservation of Water and Wastewater," EPA Method Book, EPA-600/4-82-029, September 1982.
- g) "Eastern Environmental Radiation Facility Radiochemistry Procedures Manual," EPA Method Book, EPA 520/5-84-006, August 1984.
- h) "Environmental Measurements Laboratory Procedures," HASL-300, 28th Edition, February 1997 (online at <http://www.eml.doe.gov/publications/procman/>).
- i) "Quality Systems," National Environmental Laboratory Accreditation Conference, Revision 16, July 12, 2002.
- j) "Quality Systems for Analytical Services", Revision 1, U.S. Department of Energy, Office of Environmental Health, April 2004.

## 17.0 DEFINITIONS

Acceptance Criteria: specified limits placed on characteristics of an item, process, or service defined in requirement documents. (ASQC)

Accreditation: the process by which an agency or organization evaluates and recognizes a program of study or an institution as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory. In the context of the National Environmental Laboratory Accreditation Program (NELAP), this process is a voluntary one. (NELAC)

Accuracy: the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator. (Glossary of Quality Assurance Terms, QAMS, 8/31/92).

Analytical Detection Limit: the smallest amount of an analyte that can be distinguished in a sample by a given measurement procedure throughout a given (e.g., 0.95) confidence interval. (Applicable only to radiochemistry)

Analytical Reagent (AR) Grade: designation for the high purity of certain chemical reagents and solvents given the American Chemical Society. (Quality Systems)

Batch: environmental samples which are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A preparation batch is composed of one to 20 environmental samples of the same matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours. An analytical batch is composed of prepared environmental samples (extracts, digestates or concentrates) which are analyzed together as a group using the same calibration curve or factor. An analytical batch can include prepared samples originating from various environmental matrices and can exceed 20 samples. (Quality Systems)

Blank: a sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results. (ASQC, Definitions of Environmental Quality Assurance Terms, 1996)

Calibrate: to determine, by measurement or comparison with a standard, the correct value of each scale reading on a meter or other device, or the correct value for each setting of a control knob. The levels of the applied calibration standard should bracket the range of planned or expected sample measurements.

Calibration: the set of operations which establish, under specified conditions, the relationship between values indicated by a measuring instrument or measuring system, or values represented by a material measure, and the corresponding known values of a measurand. (VIM - 6.13)

Calibration Curve: the graphical relationship between the known values, such as concentrations, of a series of calibration standards and their analytical response.

Calibration Standard: a solution prepared from the primary dilution standard solution or stock standard solutions and the internal standards and surrogate analytes. The Calibration solutions are used to calibrate the instrument response with respect to analyte concentration. (Glossary of Quality Assurance Terms, QAMS, 8/31/92).

Certified Reference Material (CRM): a reference material one or more of whose property values are certified by a technically valid procedure, accompanied by or traceable to a certificate or other

documentation which is issued by a certifying body. (ISO Guide 30 - 2.2)

Chain of Custody: an unbroken trail of accountability that documents the physical security of samples, data and records.

Confirmation: verification of the presence of a component through the use of an analytical technique that differs from the original test method. These may include: Second column confirmation, Alternate wavelength, Derivatization, Mass spectral interpretation, Alternative detectors or Additional cleanup procedures.

Corrective Action: action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence. (ISO 8402)

Data Audit: a qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality (i.e., that they meet specified acceptance criteria.

Data Reduction: the process of transforming raw data by arithmetic or statistical calculations, standard curves, concentration factors, etc., and collation into a more useful form.

Detection Limit: the lowest concentration or amount of the target analyte that can be determined to be different from zero by a single measurement at a stated degree of confidence. See Method Detection Limit.

Document Control: the act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly and controlled to ensure use of the correct version at the location where the prescribed activity is performed. (ASQC, Definitions of Environmental Quality Assurance Terms, 1996)

Duplicate Analyses: the analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results from duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory.

Environmental Detection Limit (EDL): the smallest level at which a radionuclide in an environmental medium can be unambiguously distinguished for a given confidence interval using a particular combination of sampling and measurement procedures, sample size, analytical detection limit, and processing procedure. The EDL shall be specified for the 0.95 or greater confidence interval. The EDL shall be established initially and verified annually for each test method and sample matrix. (Radioanalysis Subcommittee)

Holding Times (Maximum Allowable Holding Times): the maximum times that samples may be held prior to analysis and still be considered valid. (40 CFR Part 136).

Initial Demonstration of Capability: procedure to establish the ability of the laboratory to generate acceptable accuracy and precision which is included in many of the EPA's analytical test methods. In general the procedure includes the addition of a specified concentration of each analyte (using a QC check sample) in each of four separate aliquots of laboratory pure water. These are carried through the entire analytical procedure and the percentage recovery and the standard deviation are determined and compared to specified limits. (40 CFR Part 136).

Internal Standard: a known amount of standard added to a test portion of a sample and carried through the entire measurement process as a reference for evaluating and controlling the precision and bias of the applied analytical test method.

Laboratory Control Sample (however named, such as laboratory fortified blank or spiked blank ): a sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes from a source independent of the calibration standards or a material containing known and verified amounts of analytes. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system. (NELAC ).

Laboratory Duplicate: Aliquots of a sample taken from the same container under laboratory conditions and processed and analyzed independently.

Limit of Detection (LOD): the lowest concentration level that can be determined by a single analysis and with a defined level of confidence to be statistically different from a blank. (Analytical Chemistry, 55, p.2217, December 1983, modified) See also Method Detection Limit.

Manager (however named): the individual designated as being responsible for the overall operation, all personnel, and the physical plant of the environmental laboratory. A supervisor may report to the manager. In some cases, the supervisor and the manager may be the same individual.

Matrix: The component or substrate which contains the analyte of interest. For purposes of batch determination, the following major matrix types are used at FGL:

Aqueous: Any aqueous sample excluded from the definition of a drinking water matrix or Saline/Estuarine source. Includes surface water, groundwater and effluents.

Water: Any aqueous sample that has been designated a potable or potential potable water source.

Liquid: Any organic liquid with <15% settleable solids.

Solids: Includes soils, sediments, sludges and other matrices with >15% settleable solids.

Matrix Spike (spiked sample, fortified sample): prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency. (Glossary of Quality Assurance Terms, QAMS, 8/31/92).

Matrix Spike Duplicate (spiked sample/fortified sample duplicate): a second replicate matrix spike is prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte. (Glossary of Quality Assurance Terms, QAMS, 8/31/92).

May: permitted, but not required (TRADE)

Method Blank: a sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples containing an analyte of interest through all steps of the analytical procedures. (NELAC ).

Method Detection Limit: the minimum concentration of a substance (an analyte) that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. (40 CFR Part 136 Appendix B).

Must: denotes a requirement that must be met. (Random House College Dictionary)

Negative Control: measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results.

NELAC: National Environmental Laboratory Accreditation Conference. A voluntary organization of state and federal environmental officials and interest groups purposed primarily to establish mutually acceptable standards for accrediting environmental laboratories. A subset of NELAP. (NELAC)

NELAP: the overall National Environmental Laboratory Accreditation Program of which NELAC is a

part. (NELAC)

**Performance Audit:** the routine comparison of independently obtained quantitative measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory.

**Positive Control:** measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects.

**Precision:** the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms. (NELAC).

**Preservation:** refrigeration and or reagents added at the time of sample collection to maintain the chemical and or biological integrity of the sample.

**Proficiency Test Sample (PT):** a sample, the composition of which is unknown to the analyst and is provided to test whether the analyst/laboratory can produce analytical results within specified acceptance criteria. (Glossary of Quality Assurance Terms, QAMS, 8/31/92).

**Proficiency Testing:** Determination of the laboratory calibration or testing performance by means of interlaboratory comparisons. (ISO/IEC Guide 2 - 12.6, amended)

**Proficiency Testing Program:** the aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results in comparison to peer laboratories and the collective demographics and results summary of all participating laboratories.

**Protocol:** a detailed written procedure for field and/or laboratory operation (e.g., sampling, analysis) which must be strictly followed.

**Pure Reagent Water:** shall be water in which no target analytes or interferences are present at a concentration which would impact the results when using a particular analytical test method.

**Quality Assurance:** an integrated system of activities involving planning, quality control, quality assessment, reporting and quality improvement to ensure that a product or service meets defined standards of quality with a stated level of confidence. (Glossary of Quality Assurance Terms, QAMS, 8/31/92).

**Quality Control:** the overall system of technical activities whose purpose is to measure and control the quality of a product or service so that it meets the needs of users. (Glossary of Quality Assurance Terms, QAMS, 8/31/92).

**Quality Manual:** A document stating the quality policy, quality system and quality practices of an organization. This may be also called a Quality Assurance Plan or a Quality Plan.

NOTE - The quality manual may call up other documentation relating to the laboratory's quality arrangements.

**Quality System:** a structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC. (ANSI/ASQC E-41994)

**Quantitation Limits:** the maximum or minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be quantified with the confidence level required by the data user.

Quantitation limit, for the purposes of NELAC, is defined as 3.18 times the MDL, by convention.

Range: the difference between the minimum and the maximum of a set of values.

Raw Data: any original factual information from a measurement activity or study recorded in a laboratory notebook, worksheets, records, memoranda, notes, or exact copies thereof that are necessary for the reconstruction and evaluation of the report of the activity or study. Raw data may include photography, microfilm or microfiche copies, computer printouts, magnetic media, including dictated observations, and recorded data from automated instruments. If exact copies of raw data have been prepared (e.g., tapes which have been transcribed verbatim, data and verified accurate by signature), the exact copy or exact transcript may be submitted.

Reagent Blank (method reagent blank): a sample consisting of reagent(s), without the target analyte or sample matrix, introduced into the analytical procedure at the appropriate point and carried through all subsequent steps to determine the contribution of the reagents and of the involved analytical steps. (Glossary of Quality Assurance Terms, QAMS, 8/31/92).

Reference Material: a material or substance one or more properties of which are sufficiently well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. (ISO Guide 30 - 2.1)

Reference Standard: a standard, generally of the highest metrological quality available at a given location, from which measurements made at that location are derived. (VIM - 6.08)

Requirement: a translation of the needs into a set of individual quantified or descriptive specifications for the characteristics of an entity in order to enable its realization and examination.

Selectivity: (Analytical chemistry) the capability of a test method or instrument to respond to a target substance or constituent in the presence of nontarget substances.

Sensitivity: the capability of a test method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest.

Shall: denotes a requirement that is mandatory whenever the criterion for conformance with the specification requires that there be no deviation. This does not prohibit the use of alternative approaches or methods for implementing the specification so long as the requirement is fulfilled. (*Style Manual for Preparation of Proposed American National Standards*, American National Standards Institute, eighth edition, March 1991).

Should: denotes a guideline or recommendation whenever noncompliance with the specification is permissible. (*Style Manual for Preparation of Proposed American National Standards*, American National Standards Institute, eighth edition, March 1991).

Standard Operating Procedures (SOPs): a written document which details the method of an operation, analysis or action whose techniques and procedures are thoroughly prescribed and which is accepted as the method for performing certain routine or repetitive tasks. (Glossary of Quality Assurance Terms, QAMS, 8/31/92).

Spike: a known mass of target analyte added to a blank sample or subsample; used to determine recovery efficiency or for other quality control purposes.

Standard Reference Material (SRM): a certified reference material produced by the U.S. National Institute of Standards and Technology and characterized for absolute content, independent of analytical test method.

Supervisor (however named): the individual(s) designated as being responsible for a particular area or category of scientific analysis. This responsibility includes direct day-to-day supervision of technical employees, supply and instrument adequacy and upkeep, quality assurance/quality control duties and ascertaining that technical employees have the required balance of education, training and experience to perform the required analyses.

Surrogate: a substance with properties that mimic the analyte of interest. It is unlikely to be found in environment samples and is added to them for quality control purposes. (Glossary of Quality Assurance Terms, QAMS, 8/31/92).

Test: a technical operation that consists of the determination of one or more characteristics or performance of a given product, material, equipment, organism, physical phenomenon, process or service according to a specified procedure.

NOTE - The result of a test is normally recorded in a document sometimes called a test report or a test certificate. (ISO/IEC Guide 2 - 12.1, amended)

Test Method: defined technical procedure for performing a test.

Control Chart: A chart in which the plotted quality control data is assessed via a tolerance level (e.g. +/- 10% of a mean) based on the precision level judged acceptable to meet overall quality/data use requirements instead of a statistical acceptance criteria (e.g. +/- 3 sigma).

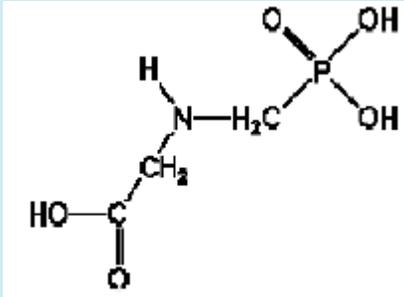
Traceability: the property of a result of a measurement whereby it can be related to appropriate standards, generally international or national standards, through an unbroken chain of comparisons. (VIM - 6.12)

Verification: confirmation by examination and provision of evidence that specified requirements have been met.

NOTE - In connection with the management of measuring equipment, verification provides a means for checking that the deviations between values indicated by a measuring instrument and corresponding known values of a measured quantity are consistently smaller than the maximum allowable error defined in a standard, regulation or specification peculiar to the management of the measuring equipment. The result of verification leads to a decision either to restore in service, to perform adjustments, or to repair, or to downgrade, or to declare obsolete. In all cases it is required that a written trace of the verification performed shall be kept on the measuring instrument's individual record.

Validation: the process of substantiating specified performance criteria.

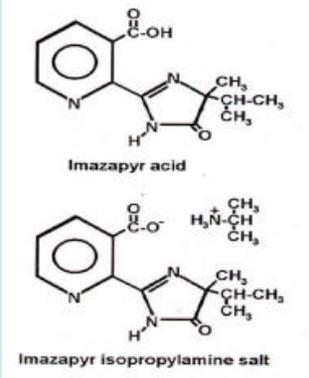
**Table A-1: Chemical description; degradation rates, products, and pathways; bioaccumulation ratings; and advantages and disadvantages of glyphosate herbicides for riparian use**

<b>Glyphosate</b>	
<b>Trade Name (Company)</b>	Aquamaster® (Monsanto Corporation)
<b>Registration No.</b>	524-343
<b>Formulation</b>	Aqueous solution of isopropylamine salt of glyphosate; technical formulation contains, 2,4-nitrosoglyphosate ("NNG") impurity; active ingredient: 53.8% glyphosate isopropylamine salt; equivalent to 48.0% glyphosate
<b>Chemical name</b>	IUPAC: N-(phosphonomethyl)glycine CAS: N-(phosphonomethyl)glycine
<b>Chemical formula</b>	
<b>Formula</b>	C <sub>3</sub> H <sub>8</sub> NO <sub>5</sub> P
<b>Herbicide family</b>	Organophosphorus
<b>Mode of Action</b>	Systemic, broad-spectrum (non-selective); amino acid synthesis inhibitor; inhibits 5-enolpyruvylshikimate-3-phosphate synthase, needed by plants to synthesize chorismate, an intermediate metabolic product in the synthesis of aromatic amino acids
<b>Molecular weight</b>	169.08 g/ mole glyphosate 228.22 g/mole glyphosate isopropylamine salt
<b>Specific gravity</b>	0.5
<b>Minimum drying time</b>	6 hours
<b>Highest proposed application rate</b>	1.5% solution; 3.75 qt/acre
<b>Rate of kill</b>	Relatively slow
<b>Volatility</b>	Extremely low vapor pressure, thus, negligible risk of movement

**Table A-1: Chemical description; degradation rates, products, and pathways; bioaccumulation ratings; and advantages and disadvantages of glyphosate herbicides for riparian use**

	through volatility
<b>Solubility</b>	Water: ~12,000 mg/L
<b>Soil organic carbon adsorption coefficient</b>	$K_{oc}=24,000$ Very high $K_{oc}$ indicates tight sorption to most soils, suspended solids, and sediments in the environment
<b>Octanol/water partition coefficient</b>	$K_{ow}=0.0003$
<b>Degradation pathways</b>	Primarily degraded by microbes and fungi in soil or water, under both aerobic and anaerobic conditions. Photodegradation in water and soil are not expected to contribute significantly to glyphosate degradation.
<b>Degradation products</b>	Aminomethylphosphonic acid (“AMPA”); further degraded to carbon dioxide and phosphate
<b>Half-life in benthic sediment</b>	$t_{1/2} = >3$ to 12 months
<b>Half-life in water</b>	$t_{1/2} = 7$ to 14 days
<b>Bioaccumulation</b>	BCF in fish after 10-14 day exposure period = 0.2 to 0.3 Low potential for bioaccumulation in aquatic animals; poorly absorbed when ingested by terrestrial mammals; any absorbed glyphosate is rapidly eliminated resulting in minimal tissue retention.
<b>Advantages for riparian use</b>	<ul style="list-style-type: none"> <li>- Low leaching potential due to strong sorption to soil/sediment particles</li> </ul>
<b>Disadvantages for riparian use</b>	<ul style="list-style-type: none"> <li>- Efficacy hindered by minimum drying time</li> <li>- Inactivated by adsorption to sediment particles</li> <li>- Application can be expensive</li> <li>- Requires use of non-ionic surfactants</li> </ul>

**Table A-1: Chemical description; degradation rates, products, and pathways; bioaccumulation ratings; and advantages and disadvantages of Imazapyr herbicides for riparian use**

	<b>Glyphosate</b>
<b>Trade Name (Company)</b>	Habitat® (BASF Company)
<b>Registration No.</b>	241-426
<b>Formulation</b>	Aqueous solution of isopropylamine salt of imazapyr plus acidifier; active ingredient: 28.7% imazapyr isopropylamine salt; equivalent to 22.6% imazapyr
<b>Trade name</b>	IUPAC: (RS)-2(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)nicotinic acid CAS: 2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-pyridinecarboxylic acid
<b>Chemical formula</b>	 <p>Imazapyr acid</p> <p>Imazapyr isopropylamine salt</p>
<b>Formula</b>	$C_{13}H_{15}N_3O_3$
<b>Herbicide family</b>	Imidazolinone
<b>Mode of Action</b>	Systemic, broad-spectrum (non-selective); Amino acid synthesis inhibitor, specifically, inhibits acetohydroxyacid synthase ("AHAS") aka acetolactase synthase ("ALS"), the first enzyme in the synthesis of branched-chain aliphatic amino acids (valine, leucine, and isoleucine) and as a result inhibits protein synthesis and cell growth
<b>Molecular weight</b>	261.28 g/ mole imazapyr 320.42 g/mole imazapyr isopropylamine salt

**Table A-1: Chemical description; degradation rates, products, and pathways; bioaccumulation ratings; and advantages and disadvantages of Imazapyr herbicides for riparian use**

<b>Specific gravity</b>	1.04-1.07
<b>Minimum drying time</b>	1 hours
<b>Highest proposed application rate</b>	1.5 lb a.e./acre
<b>Rate of kill</b>	Very slow
<b>Volatility</b>	Vapor pressure = $1.8 \times 10^{-11}$ mm Hg Henry's Law constant of $7.1 \times 10^{-17}$ atm m <sup>3</sup> /mole No volatilization from dry soil surfaces; low volatilization of imazapyr from water or moist soil surfaces.
<b>Solubility</b>	Water: 11,272 mg/L
<b>Soil organic carbon adsorption coefficient</b>	$K_{oc} = 8.81$ Very low $K_{oc}$ indicates low sorption potential
<b>Octanol/water partition coefficient</b>	$K_{ow} = 0.22, 1.3$
<b>Degradation pathways</b>	Slow anaerobic microbial degradation. No degradation under anaerobic conditions. Rapid photolysis in water.
<b>Degradation products</b>	Quinolinic acid
<b>Half-life in benthic sediment</b>	$t_{1/2} = <2$ to 7 days
<b>Half-life in water</b>	No detectable degradation due to hydrolysis up to 30 days, pH 5-7 Average $t_{1/2} = 1-4$ days (photolysis)
<b>Bioaccumulation</b>	BCF = 3; Low potential for bioaccumulation
<b>Advantages for riparian use</b>	<ul style="list-style-type: none"> <li>- Rapid photolysis in water</li> <li>- Shorter minimum drying time than glyphosate</li> <li>- No adsorption to particles</li> <li>- Application is more cost effective than application of glyphosate</li> <li>- Does not require use of non-ionic surfactants</li> </ul>
<b>Disadvantages for riparian use</b>	<ul style="list-style-type: none"> <li>- Increased adverse effects to non-target emerged vegetation due to higher efficacy on vascular plants</li> </ul>

Table A-2: Chemical Properties, environmental fate, general toxicity rating, and toxicity of adjuvants

Adjuvant (Manufacturer)	Ingredients	Chemical Properties	Degradation Pathways	General Toxicity Rating	Toxicity
<b>COMPETITOR® (WILBUR-ELLIS)</b>	98% Ethyl Oleate, Sorbitan Alkylpolyethoxylate Ester, Dialkyl Polyoxyethylene Glycol, 2% Constituents ineffective as spray adjuvant.	COMPETITOR is a Modified Vegetable Oil containing a non-ionic emulsifier system. Specific Gravity (H <sub>2</sub> O = 1): 0.9 ODOR: Fatty APPEARANCE: Amber Liquid		Caution	Acute Oral LD50 (rat): >5000 mg/kg, Eye Irritation: Minimally irritating to eyes, Inhalation LC50 (rat): not established, Acute Dermal LD50 (rabbit): >5000 mg/kg, Moderate Skin irritation
<b>Magnify® (Monterey AgResources)</b>	Aqueous solution, Alkyl polyglycoside, Ammonium sulfate and Ammonium nitrate 51.15%, constituents ineffective as spray adjuvant	-brown liquid with slight ammonia odor. -pH = 6.0		Caution	Daphnia: The 48-hour EC <sub>50</sub> and 95% confidence interval were reported as 7.7 mg/L and 6.3 – 13 mg/L, respectively. Rainbow Trout: The 96-hour LC <sub>50</sub> , and the 95% confidence interval were reported as > 100 mg/L, respectively.
<b>Mark-it Blue® (Monterey AgResources)</b>	Spray solution colorant, blue. Triphenylmethane blue dye, aqueous solution.	-completely soluble in water - pH = 7.0 - density = 8.84 lbs/gal	May liberate carbon monoxide, carbon dioxide or, if in contact with active metals, hydrogen gas	Caution, Non-toxic	Non-toxic

Table A-3: Glyphosate and Imazapyr herbicide mixture component concentrations and application rates for treatment of non-native Arundo

<b>Herbicide</b>	<b>Application Method</b>	<b>Spray Volume</b>	<b>Formulation</b>	<b>Active Ingredient</b>	<b>Surfactant</b>	<b>Colorant</b>
<b>Aquamaster® (Glyphosate)</b>	High volume handheld sprayer (backpack sprayer)	3.0 - 3.75 qt/acre	1.5% solution 2 oz/gal	1.6 – 2.0 qt/acre	1 oz/gal	3 oz/gal
<b>Habitat® (Imazapyr)</b>	High volume handheld sprayer (backpack sprayer)	2.0 – 3.0 qt/acre	1.5% solution 1.9 oz/gal	0.57 – 0.86 qt/acre	1 oz/gal	3 oz/gal