

## ATTACHMENT 1

### SCOPE OF WORK FOR TASKS ONE AND TWO

To be included upon final approval by the Parties.

#### **Task One: Selection of Chemicals of Interest for Further Evaluation**

##### **Description and Objective**

Lists of oil field production chemical additives are provided by the Permit Holders in monitoring reports submitted to the Central Valley Water Board. Task One is a preliminary hazard assessment of naturally occurring crude oil constituents (e.g. radionuclides, volatile organic compounds, semi-volatile organic compounds, metals and general minerals), and the chemical additives (collectively referred to as “chemicals of interest”). The objective of Task One evaluation will be to identify chemicals for further evaluation and identify chemicals for which inadequate data are available to make an initial hazard assessment. This initial assessment will be conducted using publically available scientific information to characterize and rank the chemicals of interest for further evaluation in the context of beneficial water reuse. The outcomes of Task One will be shared with the Food Safety Expert Panel.

##### **Suggested Approach**

Chemical additives used at various stages of oil production and naturally occurring crude oil constituents may be present in produced water. Chemicals that are toxic, teratogenic, carcinogenic, or are known to be endocrine disruptors, etc. to mammals, plants, or aquatic organisms, are environmentally persistent, or are bioaccumulative may be hazardous or present risk in the context of produced water beneficial reuse. Some chemicals may have available water screening criteria which can be used to identify the chemicals of interest for further evaluation.

The following can be used to determine whether these chemicals should be included on the list for evaluation:

- Oral toxicity information/data (with priority given to chronic mammalian toxicity data);
- Dermal toxicity information/data;
- Carcinogenicity information/data;
- Teratogenicity information/data;
- Environmental persistence/degradation information/data including soil half-life;
- Degradation byproducts of the chemicals and their associated toxicities, carcinogenicity, teratogenicity, endocrine disrupting potential, etc.;
- Plant uptake information/data;
- Amounts and frequency of use;
- Chemicals that are considered to be persistent, bioaccumulative, and toxic (as defined by the US Environmental Protection Agency [EPA] and others);
- Chemicals detected in any water quality analyses of irrigation water Chemicals with maximum measured irrigation water concentrations above available risk-based water screening levels (for example, EPA drinking water screening levels, California Public Health Goals);
- Mass of chemicals used in oil field;

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- Frequency of chemicals used in oil fields; and
- Chemicals for which the above information is not available;

It is recognized that there may be limited data for many of the chemicals of interest. Therefore, where appropriate and with sufficient justification, surrogate chemicals (for instance structurally similar chemicals with available data) can be identified and used where possible.

It is recommended that a scoring system be developed and applied in order to rank chemicals taking into consideration the range of parameters identified above. Based on the results of the scoring system, a 'cutoff' score shall be identified in order to identify additional chemicals of interest for further evaluation. As an example, the methodology used by EPA in identifying the Contaminant Candidate List (CCL) for the development of maximum contaminant levels (MCLs) under the Safe Drinking Water Act could serve as a model for this scope of work. In fact, much information can be gathered by what EPA has already accomplished with its broad CCL universe of potential drinking water contaminants.

Finally, the nature of the chemical shall also be factored into whether it should be included as a chemical of interest (for example, is it a petroleum-related compound already being addressed, an inert chemical or is the toxicity via inhalation exposures and not oral exposures).

### **Deliverables**

Identification and further evaluation shall focus on those chemicals that 1) may be at 'high' or detectable levels in irrigation water, 2) are chronically toxic to humans, and 3) may be taken into plants, in particular edible portions of the plant.

It is anticipated that the outcome of the selection of chemicals of interest will include the following:

- A comprehensive report of findings;
- A compilation of available quantitative and/or qualitative information on the chemical's physical and chemical properties relevant for fate and transport evaluation (e.g., KOW, bioconcentration, half-life in soil and water, Henry's constant, etc.);
- A detailed summary of knowledge gaps, including additives for which there are no known analytical methods; and
- A focused list of chemicals of interest.

### **Timetable**

Task One shall be completed **120 days** after the retention of the Consultants. The findings of Task One must be compiled in a report submitted to the Manager. It should be noted that the findings may be conveyed to the Permit Holders, the Food Safety Expert Panel, and may be presented to the general public during a meeting hosted by the Central Valley Water Board.

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## **Task Two: Literature Review for Produced Water Reuse in Agriculture**

### **Description and Objective**

The purpose of this task is to conduct a rigorous and thorough review of the available literature on produced water reuse in agriculture and the potential occurrence of chemical additives and petroleum-associated contaminants in food crops, in the context of current irrigation practices. The literature review will include an evaluation of known, naturally occurring constituents (e.g. heavy metals, aromatic hydrocarbons) and the chemicals of interest identified in Task One. The literature review shall focus on these chemicals of most interest and shall provide a comprehensive summary of the state of knowledge for the chemicals potentially present in irrigation water from produced water. This shall include a discussion of the strengths and limitations of the existing knowledge and a summary of the knowledge gaps that exist. The findings of Task Two will be shared with the Food Safety Expert Panel.

The literature review shall focus on the anthropogenic use of the identified chemicals of interest, especially as it may relate to the presence of the identified chemicals in water used to irrigate crops for human consumption.

### **Suggested Procedure**

The literature review shall include, at a minimum, the following components:

- A review of scientific literature and technical documents concerning the use of produced water in agricultural irrigation.
- A list of chemicals of potential concern likely in produced water used for irrigation
- Available compilation of information on occurrence of these chemicals in foodstuffs, including information on normal and low-risk levels in foods.
- A compilation of available chronic oral toxicity data for each of the chemicals of potential concern, focusing, where possible, on studies relevant to human health;
- A compilation of available quantitative and/or qualitative information on the chemical's persistence and degradation in the environment; and
- A compilation of available quantitative and/or qualitative information on chemical plant uptake properties, ideally for the specific food crops grown in the areas that receive irrigation water blended with oilfield produced water.

The literature review shall also include a review of other uses of the chemicals of interest, especially whether they are used during the drilling of water supply wells or maintenance of water systems. In addition, the literature review may include an evaluation of relevant epidemiological investigations, as appropriate.

Potential open sources of data include, but are not limited to the Environmental Protection Agency, Agency for Toxic Substances and Disease Registry (ATSDR), the US National Library of Medicine's TOXNET (including the Hazardous Substances Data Bank [HSDB]), and the European Chemicals Agency (ECHA). It is also important that the Consultants have a means of accessing the relevant research and technical publications from appropriate sources, including

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peer-reviewed journals. Use of citation management software that maintains a database of pdf copies of articles should be considered.

**Deliverables**

It is anticipated that the outcomes of Task Two will include the following:

- A comprehensive literature review report of findings;
- An annotated citation list;
- A summary of knowledge gaps; and
- A matrix table with available information, with a focus on factors necessary for the potential derivation of risk-based comparison levels of the chemicals of interest.

**Timetable**

Task Two shall be completed **120 days** following the retention of the Consultants. Findings of Task Two must be compiled in a report submitted to the Manager. It should be noted that findings of Task Two will be shared with the Permit Holders, the Food Safety Expert Panel, and will be presented at a meeting attended by the general public.

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## **ADDITIONAL SCOPE OF WORK FOR TASK THREE**

To be included upon final approval by the Parties.

### **Task Three: Food Crop Sampling and Analysis**

#### **Description and Objectives**

Oil field produced water (produced water) is known to contain traces of constituents from oil production processes, as documented by analytical results found in reports submitted to the Central Valley Water Board. These constituents are typically detected below primary maximum concentration levels (MCLs).

The objective of Task Three is to collect food crop samples, deliver samples to analytical laboratories, and prepare the results in reports. The reports will discuss if produced water constituents or chemicals of interest identified in Task One are present in the edible portions of food crops in significant concentrations that differ from food crops that are not irrigated with produced water (herein referred to as the objective of Task Three). The list of chemicals of interest may change as information becomes available about potential health risks and potential presence in produced water. The food crop samples collected shall be analyzed for the chemicals of interest listed in Task One (to the best of the Consultant's ability), and the produced water constituents listed in this sampling and analysis plan (SAP). It should be noted that reports and results of Task Three and the reports will be provided to the Food Safety Expert Panel.

#### **Suggested Procedure**

A third party sampling team with proficient experience will be chosen by the Consultants. In addition, Central Valley Water Board staff may attend sampling events, or split samples as necessary. The Consultants must notify the Manager two weeks before a sampling event takes place. The Consultants are to coordinate sampling and analytical activities with the Regional Board Scientific Advisor and provide opportunities for coordinated scientific sampling as practical with the Central Valley Water Board.

Before initiating sampling activities, sampling personnel will become familiar with an appropriate site specific health and safety plan and emergency response plan developed by the Consultants. It is the responsibility of the Consultants to ensure that personnel are familiar with the plan and follow it accordingly.

Sampling shall be conducted by a third-party independent sampler with proficient sampling experience. The Consultants and third-party sampler shall implement and be familiar with the techniques for project quality assurance and quality control (e.g. EPA SW-846).

#### **Recommended Sampling Techniques**

This section describes sampling methods and associated activities for collecting food crop

samples. A detailed sampling log of the sampling activities and materials will be maintained by a field technician.

Before sample collection, proper access permission from the landowner or leasees is required to enter any property. The Central Valley Water Board does not authorize the trespassing or collection of samples without consent. Landowners shall NOT be identified as part of any sampling event. Information regarding farmers, distributors, landowners, or leasees will not be shared with the general public.

The locality of each sample field shall be identified with an aerial photo. All records will be kept in a manner that does not identify property owners or leasees. Sampling locations, elevations, and sample type (Test or Control) will be recorded in a field logbook. Photo-documentation of sampling events should be taken and provided as part of the sampling record. Electronic copies of lab notes, photographs, and other field documentation should be maintained and provided to the Board as part of the sampling report.

Food crop samples will be collected from:

1. A minimum of three sampling locations for each crop type will be randomly selected from separate discrete fields known to be irrigated with produced water. Samples collected from these localities will be known as Test Samples.
2. A minimum of three sampling locations for each crop type will be randomly selected from separate discrete fields that are known to have never been irrigated with produced water. These samples will be known as Control Samples.

Samples shall not be labeled in a manner that identifies them as Test or Control to the contract analytical laboratories. This is to ensure that no bias is made during any stage of the analytical analysis.

Test and Control samples shall be collected away from potential source(s) of environmental contaminants such as agricultural chemicals, fuels, oils, grease, lubricants and combustion emissions and fumes. Potential sources of ambient contaminants include agricultural machinery, roadways, railroad tracks, residential and industrial areas, farm equipment, earth moving equipment, generators, and burn sites. Samples shall not be collected from areas or plants showing evidence of soot accumulation. No vehicles of any type shall be allowed to approach the sample location.

Test and Control samples shall not be collected from fields where agricultural chemicals have been recently (last 48 hours) sprayed. "Do Not Enter" postings must be obeyed at all times by the sample collectors.

Sample locations within the Test or Control fields shall generally be located in the interior area of the field or orchard. Sample fields can vary by shape and size and selection of the sample location should consider these factors along with consideration of avoiding potential

contamination sources as described above.

A single designated sample will be a composite of a single crop type taken from three different plants in the selected central sampling location. The composite sample shall be a balanced representation of food crops from all three plants. Samples shall be intact and whole with no obvious damage or decay. The selected samples shall be considered generally ripe and representative of commercial fruit that is available for the public consumer.

Sampling processes shall be conducted in a manner to minimize potential dust contamination and observe all reasonable dust control measures. No samples are to be pulled from the plant, but rather they must be cut from the branch. Samples will be placed inside approved pre-cleaned 32 oz. wide-mouth glass jars provided by the sampler or the certified analytical laboratory. All sample containers are to be closed and sealed with tamper proof material immediately after the desired sample volume has been placed in the container. All samples will be stored on ice in a thermally insulated shipping container (i.e., cooler) immediately after sample collection and until the samples reach the laboratory to ensure that the samples are maintained at 4°C +/- 2° C. Each sample within a shipping container will be listed on a chain of custody form for that container and container tamper seal noted.

If possible, extra samples of each crop type should be taken and labeled and stored. Collection and storage of extra samples should be coordinated with the Regional Board Scientific Advisor and the Regional Board. Extra samples may be collected to meet scientific objectives and to ensure that in the event that more samples are needed or samples become damaged, the work of Task Three can continue for the current crop season. Proper storage, handling, and holding times should be observed.

#### Quality Control

Field duplicate samples will be collected for quality control. One duplicate sample will be collected for 10% of the samples with a minimum of one duplicate per sample event. Each duplicate will be analyzed for the same parameters as its corresponding sample. Field duplicates will be collected from both Test and Control locations. Field duplicate samples will be submitted to the laboratory "blind" and will be assigned unique sample identification numbers so that they are not readily identifiable as duplicates by the laboratory.

To prevent potential cross contamination all equipment that comes into contact with samples (e.g. knives, samplers) will be thoroughly cleaned and decontaminated between each sampling event using best management practices.

#### Sample Transfer

Emphasis must be placed on careful documentation of sample collection and sample transfer. Samples will be hand-delivered to the laboratories within 24 hours of sample collection or shipped by 24-hour air courier (e.g., Federal Express) following all Department of Transportation (DOT) regulations. Sample custody shall be maintained by a "chain of custody record." The chain

of custody record will be completed by the individual collecting the sample. When transferring the possession of the samples, the individual relinquishing and receiving the samples will sign, date, and note the time on the chain of custody record.

The relinquishing individual will record specific shipping data on the original and duplicate chain of custody forms. If sent by mail, the package will be sent by registered mail with a return receipt requested. If sent by common carrier, a bill of lading will be retained as part of the permanent documentation. The relinquishing individual will retain a copy of the chain of custody record.

### Constituent Analysis

The analysis shall be completed by using an independent certified analytical laboratory (California State certified by ELAP or equivalent), when such analysis is available (see below). The chosen laboratory must have experience in analyzing food products. Samples will be sealed at the sampling locations and all chain of custody procedures will be followed.

Samples shall be labeled in a manner that does not identify to the analytical laboratory which samples are Test and which samples are Control. Samples should be peeled or shelled by the analytical laboratory or other appropriately controlled conditions (clean environment) so that only the edible portion of the food crop is analyzed. The analytical laboratory shall use best management practices to avoid cross contamination.

Samples shall be analyzed for all of the chemicals of interest (as defined by Task One) for which certified analysis are available. If there are chemicals of interest where there are no certified analytical methods for food crops (or a specific food crop) available, research laboratories or non-certified laboratories can be contracted for analysis as approved by the Regional Board Scientific Advisor and the Regional Board. In addition to being analyzed for chemicals of interest, samples must be analyzed for the following by the listed USEPA methods:

<b>Constituent</b>	<b>Method</b>	<b>Notes</b>
Volatile Organic Compounds (VOCs)	EPA8260B	
Semivolatile Organic Compounds (SVOCs)	EPA8270	
Metals	EPA6010B or EPA6020A	Includes Title 22 Metals
General Minerals	EPA300.0 or EPA9056	

This list is subject to periodic review by the Regional Board.

### SAP Deviations

As conditions may vary, it may become necessary to implement minor deviations from this SAP. Field personnel will notify the Manager when deviations from the SAP are necessary. Verbal approvals from the Manager, followed by written approvals, shall be obtained before implementing the deviations. Deviations from the SAP will be documented in the field logbook

and in the reports. It is the responsibility of the Consultant to keep a record of SAP deviations and approvals.

#### Data Compilation and Electronic Data Delivery

Once analytical results have been received from the laboratory, the Consultant will compile the data in an electronic format (Excel spreadsheet or equivalent) and distribute the data to the Regional Board Staff and Scientific Advisor together with electronic copies (e.g. PDF, JPG, etc.) of all field notes, analytical reports, photographs, and any other associated relevant materials.

#### Data Analysis and Sampling Reports

The Consultants will prepare reports describing sampling events and a discussion on results. In order to determine whether there is a significant difference between food crops grown with produced water and food crops grown without produced water. The reports will include a complete set of data using appropriate statistical analysis to determine if a difference occurs between the Test and Control samples. The Consultants shall document the reasons for using any statistical methods. Draft and final reports shall be submitted to the Central Valley Water Board.

The final report must include:

- The sampling logbook (original or copies);
- A general description of sampling activities;
- Sample location maps and/or aerial photos showing sample locations;
- Photos from sampling events;
- Laboratory reports including QA/QC data and chain of custody forms (original or copies);
- Tables showing analytical results and comparisons between Test and Control samples;
- A discussion of the statistical analysis and why a specific analysis was chosen;
- Results of any statistical analysis of the data;
- An interpretation and discussion of the results, as they relate to the objective of Task Three;
- A statement regarding future work if appropriate, as it relates to the objective of Task Three; and
- Any other pertinent information gathered by the Consultants germane to the work or objective of Task Three.

### **Deliverables**

After each sampling event, the Consultants shall submit the data and reports (as described above) to the Central Valley Water Board, addressed to the Manager. The Manager will share the reports with the Permit Holders and the Food Safety Expert Panel. Report findings may also be conveyed to the general public in a presentation given during a public meeting.

### **Task Dates**

Task Three shall be completed **300 days** after the retention of the Consultants. The chosen consultant shall provide a schedule for completing Task Three to the Manager within **90 days** of the retention of the Consultants. In the event that more time is needed to complete Task Three the Consultants must seek approval from the Manager.

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