State Water Resources Control Board
Science Advisory Panel on
Chemicals of Emerging Concern in Recycled Water

June 30, 2010, Final Panel Report
Communications Fact Sheet

This fact sheet was developed as an information piece for water, wastewater, and recycled water agencies in addressing potential questions from managers, staff, customers, and the media regarding the June 25, 2010 final report on monitoring of chemicals of emerging concern in recycled water. This fact sheet is an updated version of one dated April 19, 2010, describing the draft report.

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PANEL BACKGROUND

1. **Purpose of Panel**. The State Water Resources Control Board (SWRCB) – the regulatory agency responsible for setting statewide water quality policy – adopted a Recycled Water Policy[1] (Policy) in 2009 that:

   - Established State water recycling goals.
   - Clarified how Regional Water Quality Control Boards (RWQCBs) are to interpret and implement the State Antidegradation Policy (Resolution No. 68-16) for landscape irrigation and groundwater recharge water recycling projects.
   - Clarified the role of the California Department of Public Health (CDPH) with regard to establishing health-based requirements for landscape irrigation and groundwater recharge water recycling projects.
   - Included provisions to streamline the permitting of these types of projects, and incentives to facilitate the use of recycled water.

[1] State Water Resources Control Board, Resolution No. 2009-0011, Adoption of a Policy for Water Quality Control for Recycled Water (www.swrcb.ca.gov/water_issues/programs/water_recycling_policy/).

One provision in the Recycled Water Policy was how to address new classes of chemicals (such as pharmaceuticals, ingredients in personal care products, current use pesticides, and industrial chemicals), collectively referred to as "chemicals of emerging concern" or CECs,[2] that may be present in recycled water. The Policy authorized the formation of a "blue ribbon" advisory panel, convened by SWRCB in consultation with CDPH, to guide future actions relating to the monitoring of CECs for recycled water projects.

2. **Panel Scope.** A blue ribbon advisory panel – called the "Science Advisory Panel" (Panel) – was convened in May 2009. The SWRCB contracted with the Southern California Coastal Water Research Project (SCCWRP) to administer the Panel. More information on the Panel, including meeting presentations and reports, can be viewed online at www.sccwrp.org/view.php?id=574.

   In accordance with the Policy, the Panel is comprised of the following experts:

   - Human health toxicologist.
   - Environmental toxicologist.
   - Risk assessment/epidemiologist.
   - Biochemist.
   - Civil engineer (familiar with design and construction of recycled water treatment facilities).
   - Chemist (familiar with the design and operation of advanced laboratory methods for the detection of emerging constituents).

   The Panel was charged with addressing the following questions related to CECs in recycled water used for landscape irrigation and groundwater recharge:

   - What are the appropriate constituents to be monitored in recycled water, and what are the applicable monitoring methods and detection limits?
   - What toxicological information is available for these constituents?
   - Would the constituent list change based on level of treatment? If so, how?
   - What are the possible indicators (i.e., surrogates) that represent a suite of CECs?
   - What levels of CECs should trigger enhanced monitoring in recycled, ground, or surface waters?

   The Panel was explicitly charged with answering questions related to the use of recycled water in the terrestrial environment and its impacts on groundwater, with the primary focus on protection of human health. While addressing questions related to the discharge of treated wastewater effluent into the aquatic environment is an important task (and is being initially addressed by a separate panel of experts on marine ecosystems), the Panel determined at its first meeting that this was not an issue for recycled water used for urban landscape irrigation or groundwater recharge.

[2] The term "CECs" is also used to refer to "constituents of emerging concern."

The goal of the Panel is to provide regulators (including the CDPH, SWRCB, and RWQCBs) with recommended actions that the State of California should take to improve our understanding of CECs and, as appropriate, to protect public health and the environment. In particular, the Panel was charged with providing recommendations on monitoring CECs for projects that use recycled water for urban landscape irrigation, indirect potable reuse via surface spreading, and indirect potable reuse via subsurface injection.

3. **SWRCB Consideration of CEC Panel Recommendations.** The Policy states that "[w]ithin six months receipt of the panel's report the State Water Board, in coordination with CDPH, shall hold a public hearing to consider recommendations from staff and shall endorse the recommendations, as appropriate, after making any necessary modifications." The State Water Board staff intends to conduct a workshop during the summer to receive input on the Panel's recommendations, then formulate a recommended Policy amendment for consideration by the State Water Board in Fall 2010. The State Water Board's amendment to the Policy is expected to determine CEC monitoring requirements that would be imposed on landscape irrigation and groundwater recharge projects. Our perspective is that the Panelists are highly qualified experts and the Panel's recommendations are appropriate. We intend to strongly resist amendments to the Policy that deviate substantially from the recommendations, although some minor clarifications and refinements may be appropriate.

PANEL RECOMMENDATIONS

1. **Panel Report.** A draft panel report, titled "Monitoring Strategies for Chemicals of Emerging Concern (CECs) in Recycled Water," was released for public review on April 16, 2010. Joint comments on the draft report were submitted by WateReuse, NWRI, CASA, and ACWA.

   The Panel met on May 20-21, 2010, to address comments received on the draft report. The public portion of the meeting occurred from 9:00 am to noon on May 21, 2010, at SCCWRP's offices in Costa Mesa, and the Panel discussed its proposed responses with commenters. On June 25, 2010, the Panel released the final report.

2. **Summary of Panel Findings**.

   The Panel's report includes the following four products:

   - **Product #1: A conceptual framework for determining which CECs to monitor.** The Panel recommends particular chemicals be monitored based on the following criteria:
     - **Health-based Indicators**. Since thousands of chemicals potentially are present in recycled water and information about these chemicals is rapidly evolving, the Panel developed a transparent framework to guide the

prioritization of CECs for monitoring. The framework includes four steps for identifying health-based indicators:

1. Compiling occurrence data (a "measured environmental concentration" or MEC) in the source water used for a project.
2. Developing a "monitoring trigger level (MTL)" based on toxicological relevance.
3. Comparing occurrence with the trigger level (the ratio between MEC and MTL) - CECs with MEC/MTL greater than "1" are prioritized for monitoring).
4. Screening the priority CECs to ensure robust analytical methods are available.

This component of the framework is focused on CECs with occurrence data from recycled source water and toxicological information.

- **Performance-based Indicators** are included to characterize performance of individual unit processes. An indicator compound is an individual CEC that represents certain physicochemical and biodegradable characteristics of a family of trace organic constituents. The indicator compounds are relevant to fate and transport of broader classes of chemicals and provide a conservative assessment of removal during treatment.

- **Performance-based Surrogates**. A surrogate parameter is a quantifiable change of a bulk parameter such as TOC or ammonia that can measure the performance of individual unit processes (often in real-time) or operations in removing trace organic compounds and/or assuring disinfection. Surrogates and indicators are intended to evaluate for removal of CECs that are known to exist but can't be quantified.

- **Bioanalytical Screening** is recommended to characterize chemicals for which such information is presently unavailable (i.e., "unknown unknowns"). The Panel recommends further development of bioanalytical screening methods before screening can be reliably undertaken.

- **Product #2: Application of the framework to identify a list of chemicals that should be monitored presently.** Table 1 (at end of this document) summarizes the Panel's recommended monitoring compounds for each type of reuse project covered by the Policy. Table 1 should be preliminary pending clarification of a few ambiguities in the report.

- **Product #3: A sampling design and approach for interpreting results from CEC monitoring programs.** The Panel recommends a multi-phase approach for implementing recycled water CEC monitoring programs and interpreting the resulting data. These recommendations are also reflected in Table 1. The approach involves the use of multiple tiers to provide a flexible, adaptable

response to increase or decrease monitoring based on the initial results, thereby providing a cost-effective means for incremental information gathering. Should compounds be consistently present at high levels, additional evaluations or actions may be warranted. The Panel also recommends strict sampling and laboratory measurement quality assurance guidelines.

- **Product #4: Priorities for future improvements in monitoring and interpreting of CEC data.** The Panel considers science of CEC investigation to be in its early stages and recommends that the State undertake several activities that will greatly improve both monitoring and data interpretation for recycled water management. The Panel provides a number of such recommendations, including: 1) Develop and validate more and better analytical methods to measure CECs in recycled water; 2) Encourage development of bioanalytical screening techniques that allow better identification of the "unknown unknown" chemicals; and 3) Develop a process to predict likely environmental concentrations of CECs based on production, use and environmental fate, as a means for prioritizing chemicals on which to focus method development and toxicological investigation. These investigations should be conducted with guidance and review by a Science Advisory Panel.

  In addition to these research recommendations, the Panel recommends that the State develop a process to rapidly compile, summarize, and evaluate monitoring data as they become available. The Panel further recommends that the State establish an independent review panel that can provide periodic review of the proposed selection approach, reuse practices, and environmental concentrations of ongoing CEC monitoring efforts, particularly as data from the monitoring programs recommended here become available.

CECs – General Information

1. **Definition of CECs**. CECs (i.e., "chemicals of emerging concern" or "constituents of emerging concern") are typically the pharmaceuticals that people use to treat illnesses and the components of personal care products, like shampoos and detergents, which people use every day. These constituents get into wastewater and our water supply by flushing unused medications down the drain, dumping personal care products and household cleaning products down the drain, excreting unabsorbed medications into the sewer system, and improper commercial disposal methods. These constituents are not regulated in the potable water supply or in wastewater. However, these constituents are found at trace levels in many of our waters, including untreated surface water, drinking water, wastewater, and recycled water.

2. **CECs in Recycled Water.** CECs enter wastewater collection systems through human use and disposal. Conventional wastewater treatment partially removes CECs to very low levels or levels below detection (at nanograms per liter or less). Advanced engineered and natural treatments, such as those selected as appropriate for use in indirect potable reuse projects, remove CECs to levels below detection. As analytical

methods improve to allow the detection of even lower levels of contaminants (less than nanograms per liter), more compounds will be found. The ability to detect a compound does not necessarily translate to human health concerns.

3. **Water/Wastewater Agency Role**. Recycled water agencies are committed to producing high-quality recycled water through source control, treatment, monitoring, and research.

   Pollution prevention efforts, such as source control programs, and public outreach programs, diminish the amount of CECs entering wastewater collections systems (for instance, "No Drugs Down the Drain" at www.nodrugsdownthedrain.org). In addition, many CECs are removed or reduced in conventional wastewater treatment facilities.

   Recycled water agencies are also actively involved in increasing our understanding of CECs through research and monitoring. These agencies are collaborating with regulators on increasing our knowledge about the occurrence, fate, and potential impacts on human health associated with CECs in our water, including water supplies (e.g., groundwater and surface water), drinking water, wastewater, recycled water, and ocean water.

4. **Preventative Actions by the Public.** The general public can help reduce, but not completely eliminate, concentrations of CEC in our water by taking the following simple actions:

   - Never flush unused medications down the drain (alternative disposal options are listed at http://www.nodrugsdownthedrain.org/disposal.html).
   - Do not dump old cleaning products, pesticides, or automotive products down the drain. Rather, turn in potentially hazardous chemicals during local hazardous materials collections.
   - Use personal care products sparingly and according to the label recommendations.

   The Medical Waste Management Act (see http://www.cdph.ca.gov/certlic/medicalwaste/Pages/default.aspx) and other regulatory mandates help prevent the improper disposal of pharmaceuticals and other CECs by commercial, industrial, and institutional sites.

5. **Detection of CECs**. CECs are detected at very low (or trace) levels in water (for instance, detected concentrations of pharmaceutical CECs are millions of times less than a pharmaceutical dose). The ability to detect a compound does not necessarily translate to human health concerns.

   The ability to detect CECs at very low levels in water is a relatively new breakthrough in science. However, these methods are not standard methods (i.e.,

methods approved for regulatory purposes), but are currently being commercialized or are being used for research.

6. **Health Impacts.** Currently, no adverse human health impacts have been documented from exposure to the extremely low concentrations of pharmaceuticals or personal care products found in water supplies. Water and wastewater agencies are diligent in increasing our understanding of health impacts associated with CECs. Our understanding of the potential for public health impacts resulting from CECs in our recycled water is being expanded by the following work:

   - State and federal public health and environmental agencies are currently assessing the need for further research and other studies to determine whether CECs pose human health risks and, if so, what additional measures will need to be implemented.

   - Collaborative studies are currently being conducted by the water, wastewater, and water recycling community (including utilities, research organizations, and regulatory agencies) to increase our understanding of any possible impacts on public health and the environment.

TABLE 1. SUMMARY OF CEC PANEL RECOMMENDATIONS FOR MONITORING

Reuse Practice	Compound	Classification	Role	MRL ng/L	MTL ng/L	Monitoring Guidance	Response Guidance
Groundwater Recharge SAT	17b-estradiol	Steroid Hormone	Health-based Indicator[3]	1	9.0E-01	Tertiary recycled water & groundwater[4] Plant Start-up: Quaterly for 1st year Baseline Monitoring: Twice/year for 3 years One round Year 5 for CDPH Five –Year Report	<u>For CEC Indicators</u>: Confer with CDPH & RWQCB to develop a response plan (investigational only – not for compliance purposes) Goal < 5 times the ratio of MEC/MTL If 25% or less of samples during baseline monitoring > MEC/MTL = 0.1, CDPH/RWQCB should consider deleting monitoring requirement for the compound (review MTL before change made) If 1<MEC/MLT< 10: data check, continue to monitor, until 1 year and the MEC/MLT < 1 and preferably is consistently less than 5 times the ratio of MEC/MTL If 10<MEC/MLT< 100: data
	Triclosan	Antimicrobial	Health-based Indicator	50	350		
	Caffeine	Stimulant	Health-based Indicator	50	350		
	NDMA (N-nitrosodimethlyamine)	Disinfection byproduct	Health-based Indicator	2	1.0E+01		
	Δ Gemfibrozil	Pharmaceutical	Performance-based Indicator [5]	10	45000	Tertiary recycled water, monitoring well, downgradient potable well Plant Start-up: Quarterly for 1st year Baseline Monitoring: Twice/year for 3 years For surrogates use online devices where feasible One round Year 5 for CDPH Five	
	Δ DEET	Personal Care Product	Performance-based Indicator	10	2500		
	Δ Caffeine	Stimulant	Performance-based Indicator	50	350		
	Δ Iopromide	Pharmaceutical	Performance-based Indicator	50	7.5E+05		
	Δ Sucralose	Food Additive	Performance-based	100	N/A		

[3] Selection as a health-based indicator was based on the ratio of occurrence (MEC)/monitoring trigger level (MTL). To be conservative, the Panel used MEC data for secondary or tertiary recycled water and compared 90th percentile values to the MTLs. The MTLs were based on available toxicological information and selected in order of priority: CDPH derived benchmarks; U.S. EPA benchmarks; and lowest other available benchmark. If the MEC/MTL > 1, the compound was recommended for monitoring as a health-based indicators. The Panel's proposed MEC/MTL ratios should not be used to make predictions about risk.

[4] The Panel assumed tertiary effluent was used for groundwater recharge by surface spreading; the groundwater monitoring locations are to be determined on a case-by-case basis by CDPH (downgradient wells, monitoring wells representing the underlying groundwater and/or lysimeters).

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Reuse Practice	Compound	Classification	Role	MRL ng/L	MTL ng/L	Monitoring Guidance	Response Guidance
			Indicator			–Year Report	check, immediate re-sampling and analysis to confirm MEC, continue to monitor, until 1 year and the MEC/MLT< 1 and preferably is consistently less than 5 times the ratio of MEC/MTL If 100<MEC/MLT< 1000: all of the above plus enhance source identification program and monitor closer to the Point of Exposure If MEC/MTL>1000: all of the above plus immediately confer with the CDPH & RWQCBs to determine the required response action; confirm plant corrective actions through additional monitoring that indicates the CEC levels are below at least an MEC/MTL of 100
	Δ Ammonia	---	Performance-based Surrogate	SM[6]	---		
	Δ Nitrate	---	Performance-based Surrogate	SM	---		
	Δ Dissolved Organic Carbon (DOC)	---	Performance-based Surrogate	SM	---		
	Δ Ultraviolet Absorption (UVA)	---	Performance-based Surrogate	SM	---		
	1,2,3-Trichloropropane	Industrial chemical	Secondary Monitoring[7]	5	5.0E+00	Secondary/tertiary treated effluent representing the feed water quality to surface spreading Quarterly for 1 year	---
	Hydrazine	Industrial chemical	Secondary Monitoring	1	1.0E+01		
	Quinoline	Industrial chemical	Secondary Monitoring	1	1.0E+01		

[5] The intent of the performance-based indicators and surrogates is to quantify the removal differential.
[6] Standard Method (SM).
[7] U.S.EPA Candidate Contaminant List 3 CECs with MTLs of less than 500 ng/L and no MECs in recycled water in California.

TABLE 1. SUMMARY OF CEC PANEL RECOMMENDATIONS FOR MONITORING

Reuse Practice	Compound	Classification	Role	MRL ng/L	MTL ng/L	Monitoring Guidance	Response Guidance
Groundwater Recharge Direct Injection	17b-estradiol	Steroid Hormone	Health-based Indicator	1	9.0E-01	Advanced treated recycled water & groundwater[8] Plant Start-up: Quaterly for 1st year Baseline Monitoring: Twice/year for 3 years One round Year 5 for CDPH Five –Year Report	<u>For CEC Indicators</u>: Confer with CDPH & RWQCB to develop a response plan (investigational only – not for compliance purposes) Goal < 5 times the ratio of MEC/MTL If 25% or less of samples during baseline monitoring > MEC/MTL = 0.1, CDPH/RWQCB should consider deleting monitoring requirement for the compound (review MTL before change made) If 1<MEC/MLT< 10: data check, continue to monitor, until 1 year and the MEC/MLT < 1 and preferably is consistently less than 5 times the ratio of MEC/MTL If 10<MEC/MLT< 100: data check, immediate re-sampling and analysis to confirm MEC, continue to monitor, until 1 year and the MEC/MLT< 1 and
	Triclosan	Antimicrobial	Health-based Indicator	50	350		
	Caffeine	Stimulant	Health-based Indicator	50	350		
	NDMA (N-nitrosodimethlyamine)	Disinfection byproduct	Health-based Indicator	2	1.0E+01		
	Δ DEET	Personal Care Product	Performance-based Indicator	10	2500	Between secondary and membrane treatment processes; between membrane and advanced oxidation treatment; final recycled water prior to injection Plant Start-up: Quarterly for 1st year Baseline Monitoring: Twice/year for 3 years For surrogates use online devices where feasible One round Year 5 for CDPH Five –Year Report	
	Δ Sucralose	Food Additive	Performance-based Indicator	100	N/A		
	Δ NDMA	Disinfection byproduct	Health-based Indicator	2	1.0E+01		
	Δ Caffeine	Stimulant	Performance-based Indicator	50	350		
	Δ Conductivity		Performance-based Surrogate	SM	---		
	Δ DOC		Performance-based Surrogate	SM	---		

[8] The groundwater monitoring locations are to be determined on a case-by-case basis by CDPH (downgradient wells and monitoring wells representing the underlying groundwater).

TABLE 1. SUMMARY OF CEC PANEL RECOMMENDATIONS FOR MONITORING

Reuse Practice	Compound	Classification	Role	MRL ng/L	MTL ng/L	Monitoring Guidance	Response Guidance
							preferably is consistently less than 5 times the ratio of MEC/MTL If 100<MEC/MLT< 1000: all of the above plus enhance source identification program and monitor closer to the Point of Exposure If MEC/MTL>1000: all of the above plus immediately confer with the CDPH & RWQCBs to determine the required response action; confirm plant corrective actions through additional monitoring that indicates the CEC levels are below at least an MEC/MTL of 100
	1,2,3-Trichloropropane	Industrial chemical	Secondary Monitoring[9]	5	5.0E+00	Secondary/tertiary treated effluent representing the feed water quality to surface spreading Quarterly for 1 year	---
	Hydrazine	Industrial chemical	Secondary Monitoring	1	1.0E+01		
	Quinoline	Industrial chemical	Secondary Monitoring	1	1.0E+01		
Landscape Irrigation	None		Health-based Indicator	---	---	---	---
	None		Performance-based Indicator	---	---	---	---
	~~Turbidity~~	~~---~~	~~Title 22~~	~~SM~~	~~---~~	Per permit monitoring program	Per permit monitoring program

[9] U.S.EPA Candidate Contaminant List 3 CECs with MTLs of less than 500 ng/L and no MECs in recycled water in California.

TABLE 1. SUMMARY OF CEC PANEL RECOMMENDATIONS FOR MONITORING

Reuse Practice	Compound	Classification	Role	MRL ng/L	MTL ng/L	Monitoring Guidance	Response Guidance
			Surrogate				
	Cl2 Residual	---	Title 22 Surrogate	SM	---		
	Total Coliform	---	Title 22 Surrogate	SM	---		