

# **Draft Recommendations from the Science Advisory Panel for Constituents of Emerging Concern (CECs) in Recycled Water**

**Paul Anderson, Nancy Denslow, Jörg E. Drewes (Chair),  
Adam Olivieri, Dan Schlenk, Shane Snyder**

**Public Meeting  
May 21, 2010**

# CALIFORNIA RECYCLED WATER POLICY

- Draft report to be submitted in response to Policy, sec 10b
- (2) “Panel shall review the scientific literature....and submit a report describing the *current state of knowledge regarding the risks of emerging constituents* to public health and the environment”
- (3) “Each report should include *recommendations* that the State should take to improve our understanding of emerging constituents....and to protect public health and the environment”

# STATE RECYCLED WATER POLICY

- What are the appropriate constituents to be monitored, including analytical methods and MDLs?
- What is the known toxicological information for the above constituents?
- Would the above lists change based on level of treatment and use? If so, how?
- What are possible indicators that represent a suite of CECs?
- What levels of CECs should trigger enhanced monitoring of CECs in recycled water, groundwater and/or surface waters?

# COMMENT PERIOD FOR THE DRAFT REPORT

- Task initiated in Oct 2009
- Released to public on 4/16/10
- “*Monitoring Strategies for Chemicals of Emerging Concern in Recycled Water*” (draft for public comment)
  - 9 Chapters
  - 13 Appendices
  - 99 References
  - 180 pages
- Comments requested by 5/15/10

# COMMENTS RECEIVED

Detailed comments from 30 entities/individuals

- posted on [www.sccwrp.org](http://www.sccwrp.org)
- Constructive comments
- General agreement on proposed framework
- Panel reviewed all comments and considered various modifications to the final report

# NATURE OF COMMENTS

## Major crossover topic areas for comments:

- The nature of monitoring program should be information gathering rather than regulatory compliance
- Prioritization framework has been applied inconsistently
  - Chemical by chemical vs. bioanalytical approach
  - Number of recommended compounds is far too low
  - Surrogates and performance indicators are missing
- Derivation and selection of monitoring trigger levels (MTLs) are unclear
- Details provided for monitoring are insufficient
  - Are bioanalytical methods being part of the suggested initial monitoring program?
  - What should be measured where, by whom, how often?
  - Need better defined analytical methods (QA/QC)
- Relevance of ecological concerns
- Antibiotic resistance
- Panel did not answer all charge questions

# Purpose of Monitoring Program

**COMMENT:** The nature of monitoring program should be information gathering rather than regulatory compliance

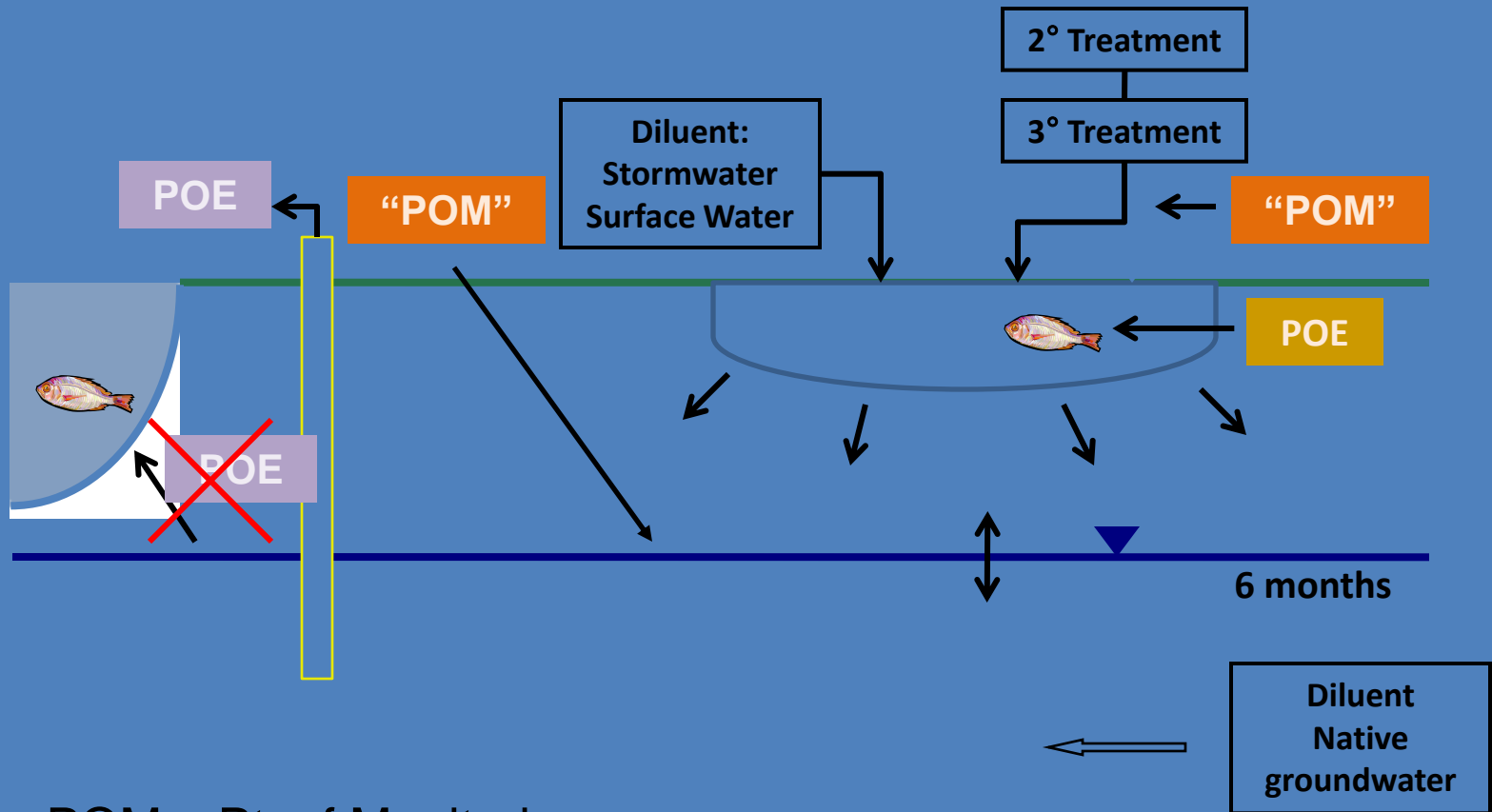
**PANEL RESPONSE:** We agree!

**RESOLUTION:**

- The Panel will revise language in the report that would suggest monitoring is meeting regulatory compliance

# Surface Spreading Operation

Recycled Water Contribution < 50%

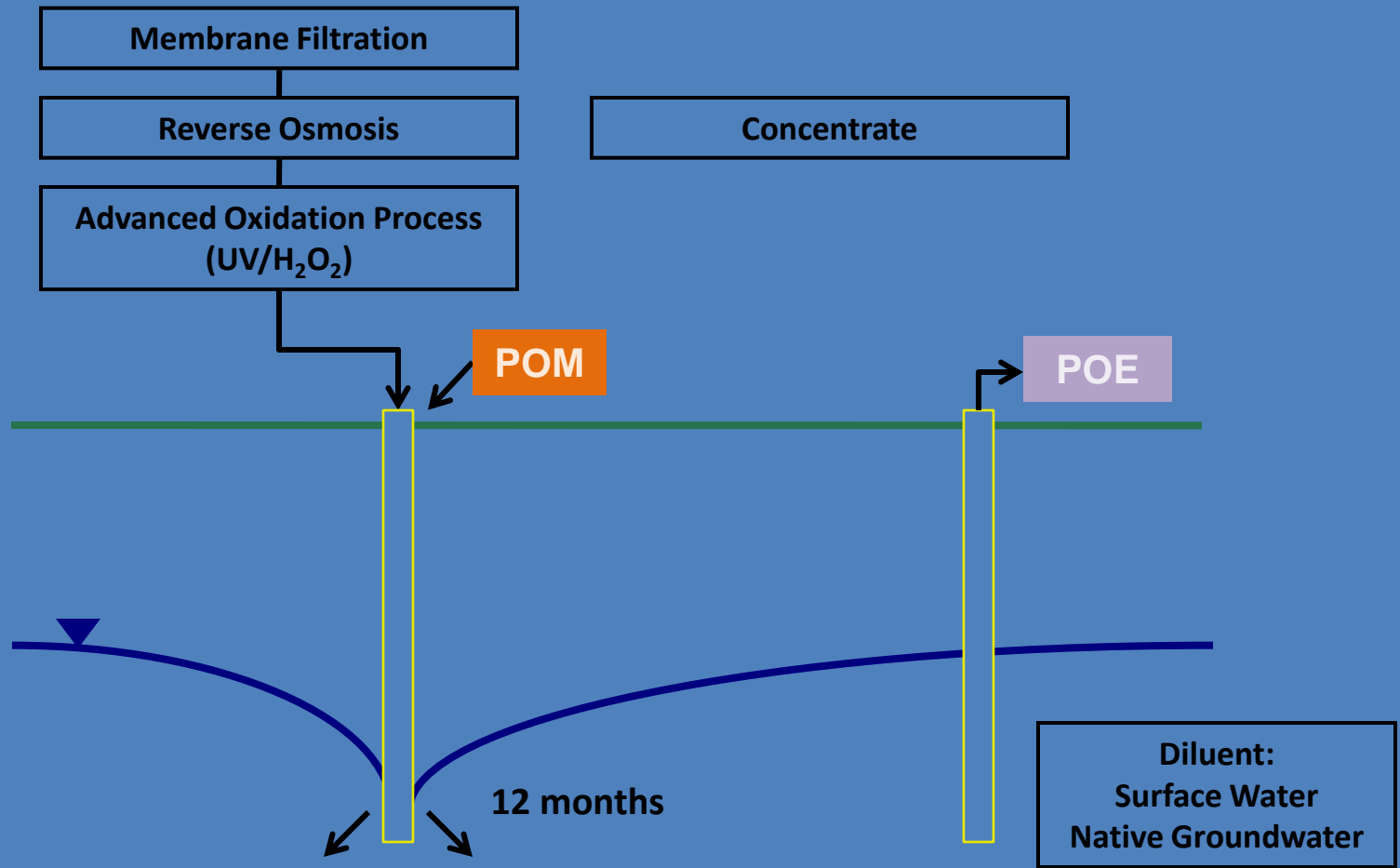


POM – Pt. of Monitoring

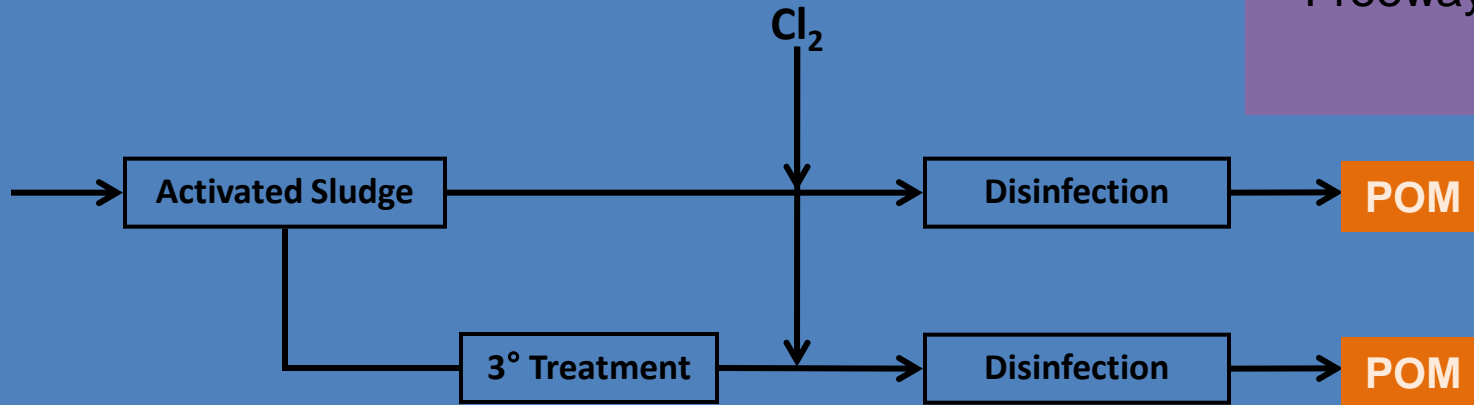


# Subsurface Injection Operation

Recycled Water Contribution > 50%



# Urban Landscape Irrigation (Title 22)



POE Restricted access:  
Landscape  
Freeway/golf course

**POE**  
terrestrial

POE Unrestricted  
access:

1. Residential
2. Golf course
3. Urban landscape

# FRAMEWORK & APPLICATION

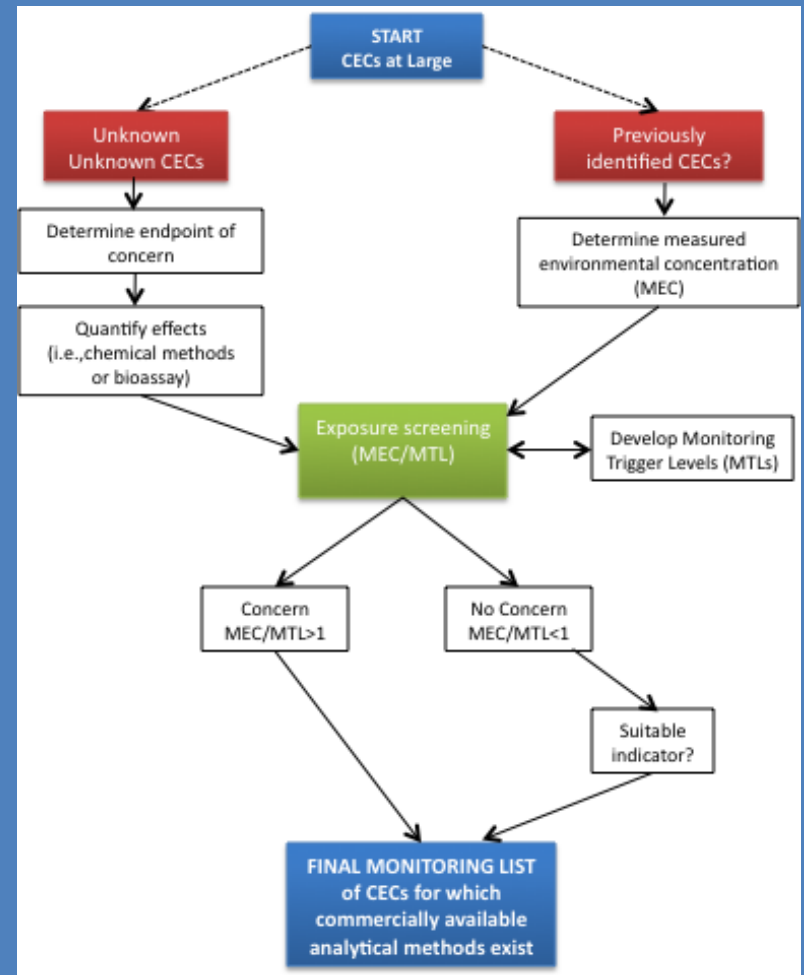
**COMMENT:** Proposed framework and basic approach were sound, understandable and transparent

**PANEL RESPONSE:** We agree!

- Thank you very much!

**RESOLUTION:**

- General framework will remain unchanged



# FRAMEWORK & APPLICATION

**COMMENT:** Prioritization framework has been applied inconsistently

- Chemical by chemical vs. bioanalytical approach
- Number of recommended compounds is far too low
- Surrogates and performance indicators are missing

**PANEL RESPONSE:** We agree!

## **RESOLUTION:**

- Panel will emphasize the proposed three-pronged approach to prioritize CECs for inclusion into a monitoring program (MECs, PECs, bioanalytical screening tools)
- Performance indicators and surrogates are provided
- “CECs at large” database has been expanded to include chemicals with Cal notification levels

# FRAMEWORK & APPLICATION

**COMMENT:** Prioritization framework has been applied inconsistently

- Surrogates and performance indicators are missing

**RESOLUTION:**

- Performance indicators and surrogates are provided

- Example:

*Surface Spreading*

Monitoring Level	Good Removal (>90%)	Intermediate Removal		Poor Removal (<25%)
		(90 < x < 50%)	(50 < x < 25%)	
Piloting/start-up	ΔAmmonia			
	ΔNitrate			
	ΔDOC			
	Fluorescence			
	BDOC			
	ΔGemfibrozil			ΔPrimidone
	ΔDEET			
	ΔIopromide			
	ΔMeprobamate			
Full-scale operation/ compliance monitoring:	ΔAmmonia			
	ΔUVA			
	ΔTOC			

*Direct Injection (RO)*

Monitoring Level	Good Removal (>90%)	Intermediate Removal		Poor Removal (<25%)
		(90 < x < 50%)	(50 < x < 25%)	
Piloting/start-up:	ΔConductivity			
	ΔTOC			
	ΔBoron			
	ΔCaffeine		ΔNDMA	
	ΔDEET			
	ΔMeprobamate		ΔChloroform	
	ΔAcetaminophen			
Compliance monitoring	ΔConductivity			
	ΔBoron			

# FRAMEWORK & APPLICATION

## Example: RO treatment

	Surrogate Parameters	Indicator Compounds
<b>Validation Monitoring: Piloting or/and Commissioning</b>		
Step 1	Define and verify operational boundary conditions for each unit process comprising the overall treatment train after operating the system assuring steady-state conditions. Do operational boundary conditions meet design criteria within an acceptable range? If yes, proceed to step 2. If not, determine cause for deviation.	<u>Baseline Monitoring:</u> Conduct occurrence study to confirm presence of viable indicator compounds in the feedwater of each unit process
Step 2	Quantify surrogate, e.g., conductivity rejection of overall system. Is conductivity rejection within previously observed range and does it meet performance specification of manufacturer? If yes, proceed to step 3 If not, determine cause for deviation, for example by quantifying conductivity rejection of individual pressure vessels	Identify 5-10 suitable indicator compounds for spiking study (challenge test) at pilot-scale
Step 3	<u>Validation Monitoring:</u> Quantify removal differential of viable surrogate parameter $\Delta X_i = (X_{i,in} - X_{i,out}) / X_{i,in}$	<u>Validation Monitoring:</u> Conduct spiking study with select indicator compounds (5-10) to determine the removal differentials under pre-determined operating conditions: $\Delta Y_i = (Y_{i,in} - Y_{i,out}) / Y_{i,in}$
Step 4	Select viable surrogate and operational parameters for each unit process	Select 3-6 indicator compounds from categories classified as "Good removal"
<b>Compliance Monitoring: Full-scale Operation</b>		
Step 5	Confirm operational boundary conditions of full-scale train and removal differential $\Delta X_i$ for selected surrogate and operational parameters	
Step 6	<u>Operational Monitoring:</u> Monitor differential $\Delta X_i$ of select surrogate and operational parameters for each unit process or/and the overall treatment train on a regular basis (daily, weekly)	<u>Verification Monitoring:</u> Monitor differential $\Delta Y_i$ of selected indicator compounds for each unit process or/and the overall treatment train regularly, but less frequently (semi-annually, annually).
Drewes et al. (2010, Wat. Sci. Techn.)		

# FRAMEWORK & APPLICATION

Reuse Practice	CEC Class	Indicator		CEC Class	Indicator		Surrogate	
		Tox relevance	MRL <sub>practical</sub>		Performance	MRL		Method
<b>Groundwater recharge</b>			ng/L			ng/L		
<b>SAT</b>	Steroid hormone	17b-estradiol	1	Pharma	$\Delta$ gemfibrozil	10	$\Delta$ ammonia	SM
	Antimicrobial	Triclosan	50	Personal care	$\Delta$ DEET	10	$\Delta$ nitrate	SM
	Stimulant	Caffeine	50	Pharma	$\Delta$ iopromide	50	$\Delta$ DOC	SM
	DBP	NDMA	2	Food additive	$\Delta$ sucrolose	100	$\Delta$ UVA	SM
<b>Direct Injection</b>	Steroid hormone	17b-estradiol	1	Personal care	$\Delta$ DEET	10	$\Delta$ conductivity	SM
	Antimicrobial	Triclosan	50	Food additive	$\Delta$ sucrolose	100	$\Delta$ TOC	SM
	Stimulant	Caffeine	50					
	DBP	NDMA	2					
<b>Landscape Irrigation</b>		none			none		Turbidity	SM
							Cl2 residual	SM
							Total coliform	SM

# Chemical-specific vs. broad screening approach

**COMMENT:** Chemical-specific evaluation is impractical

- The Panel should have relied more on bioanalytical screening

**PANEL RESPONSE:** We agree that bioanalytical screening is promising but it is not ready for prime time. Chemical specific approach gets us answers now.

- Lots of effort on developing bioanalytical high throughput tools
  - OECD
  - USEPA-EDSP Tier 1
  - NTP-NIEHS/EPA --Tox 21
  - Implementation 3-10 years away
    - Most likely to be used for Exposure Assessment (EEQ)
    - Wait for Feds to evaluate effect (2013)
  - Chemical-specific approach is slow, but proven

**RESOLUTION:** Report will be revised to clarify Panel's view that bioanalytical screening will ultimately replace chemical specific approach (tox. relevant indicator CECs)



# Expanding the chemical universe

**COMMENT:** CA “Notification” compounds are not necessarily monitored comprehensively and should be screened for recycled water applications (CDPH)

- CECs previously identified for voluntary monitoring were left out of universe

**PANEL RESPONSE:** We agree.

**RESOLUTION:** Re-screen those for which MEC/MTL data readily available. Consider future data collection for those where data are scarce

# DERIVATION AND APPLICATION OF MTLs

**COMMENT:** The Panel does not follow its recommended MTL derivation process.

- The panel recommends a process from Snyder et al. (2010) to derive screening level ADIs
- The panel then selects MTLs from other sources.

**PANEL RESPONSE:** MTL selection process is conservative, health protective, transparent and suitable for initial prioritization of CECs for monitoring.

**RESOLUTION:** Report will be revised to clarify that the initial MTLs are appropriate for use in a CEC monitoring program

# DERIVATION AND APPLICATION OF MTLs

**COMMENT:** Inappropriate assumptions about toxicity were used for caffeine and triclosan

- The assumptions about toxicity of caffeine and triclosan overestimate the potential toxicity of these CECs

**PANEL RESPONSE:** Process used by the Panel to select initial MTLs used the most conservative values in the literature

**RESOLUTION:** Discussion will be added to the Final Report pointing out the conservative nature of the caffeine and triclosan MTLs.

# DERIVATION AND APPLICATION OF MTLs

**COMMENT:** The report contradicts itself as to whether the MTLs are examples or can be used in a monitoring program.

- Refers to MTLs as just “examples.”
- Indicates MTLs are to be used in a “CEC monitoring program.”

**PANEL RESPONSE:** These are not examples, they are our recommendations.

- However, these are initial recommendations
- Panel strongly recommends revisiting MTLs periodically
- Exceeding MTLs does not necessarily indicate a health risk is present.

**RESOLUTION:** Final Report will be revised to refer to the MTLs as “initial MTLs” and to clarify that MTLs should be reviewed and updated every three to five years.

# ANALYTICAL METHODS, MDLs AND QA/QC

**COMMENT:** Methods to be applied and approach for QA/QC was not defined

**PANEL RESPONSE:** Panel agrees that robust methodologies and QA/QC are critical to a successful program

- Blanks (laboratory and field), matrix spikes, reproducibility, etc. are vital
- The panel suggests performance based methodologies vs. prescriptive methods
- However, for trace CEC monitoring, the panel recommends use of isotope dilution and tandem mass spectrometry whenever possible
- The panel suggests MRLs 10x lower than MTL (or nearest analytically feasible) for toxicological indicators
- The panel suggests lowest practical MRL for performance indicators (taking into account potential for blank contamination)
- Discussion on methodologies and QA/QC are provided in Chapter 7 and Appendix M (*Prerequisites for Monitoring CECs in Recycled Water*)

**RESOLUTION:** Report will be expanded to include suggested MRLs

# LEVEL OF CONSERVATISM

**COMMENT:** Clarify derivation of safety factors

**PANEL RESPONSE:** We agree

**Resolution:** The Panel will revise report and provide additional clarifications how safety factors were derived

- Reported MECs for combined secondary/tertiary effluent; no credit for advanced treatment (40-800x)
- 90<sup>th</sup> percentile MECs for combined secondary/tertiary effluent (10x)
- MEC based on MDL where data are ND (10x)
- No credit for dilution after application (2x)
- Chemical toxicity utilized safety factors of from 100 to 10,000x
- Total range of safety factors: 5-8 orders of magnitude

# LEVEL OF CONSERVATISM

**COMMENT:** Incidental ingestion for landscape irrigation is too conservative

**PANEL RESPONSE:** The Panel agrees.

**RESOLUTION:** Final Report will be revised.

- Landscape irrigation exposure based on high volume will be modified to 20 mL/person, day (WRF-04-011, 2007)
- Thus, no CEC was identified to meet a MEC/MTL ratio  $>1$  for Landscape Irrigation

# INTERPRETATION OF MONITORING DATA

**COMMENT:** Panel gave prescriptive actions associated with multiple threshold benchmarks that can be understood as regulatory criteria

**PANEL RESPONSE:** We agree.

- Panel responded with multiple tiering interpretive concept that allows for flexible and adaptive management when faced with threshold exceedances/non detects
- Panel considers tiering levels and recommended potential actions that managers could consider; actual tiering levels and responses are to be flushed out between regulators and purveyors

**RESOLUTION:** Panel will modify the existing recommended tiering structure and management options, and will make clear that these are recommended options, and not clear cut regulatory responses.



# POTENTIAL FOR ECOLOGICAL IMPACTS

**COMMENT:** The Panel did not consider relevant ecological exposure and impacts due to CECs in recycled water.

**PANEL RESPONSE:** The Panel disagrees. We considered multiple exposure scenarios for the 3 reuse practices

- Little to no connectivity to surface and/or marine waters
- Incidental runoff was not a concern for the 3 reuse practices
- Surface water discharge will be addressed by Ecosystem Panel

**RESOLUTION:** No change to report; the concurrent CEC SAP for ecosystems will address ambient impacts.

# ANTIBIOTIC RESISTANCE

**COMMENT:** Panel did not include antibiotics in their report or assess the *risk associated with pathogens and genes that carry antibiotic resistance*.

## PANEL RESPONSE:

- We agree that antibiotics are important CECs and they were among the chemicals considered
- The issue of antibiotic resistance was considered to be outside of the charge to the panel. The issue is broader than the specific reuse projects considered by the panel and these processes do not contribute more to the problem of antibiotic resistance

## RESOLUTION:

- The Final Report will clearly state that antibiotic resistance is outside of the charge of the panel. The panel recommends that this problem be considered by a federal panel (e.g. CDC).

# SCHEDULE

- **Meeting #1: September 2009**
  - Background presentations & perspectives of interested parties
- **Meetings #2 & #3: Jan, Feb 2010**
  - Address charge questions
- **Draft report released 4/16/10**
- **Meeting #4: May 20-21**
  - Written comments requested by May 15
  - Public comments session on May 21, 9a-noon
- **Final report will be submitted June 25, 2010**
- **SWB hearing to adopt recommendations Nov 2010**

# Prioritization Scheme for CECs

