Diagnostic Tools to Evaluate Impacts of Trace Organic Compounds on Aquatic Populations and Communities

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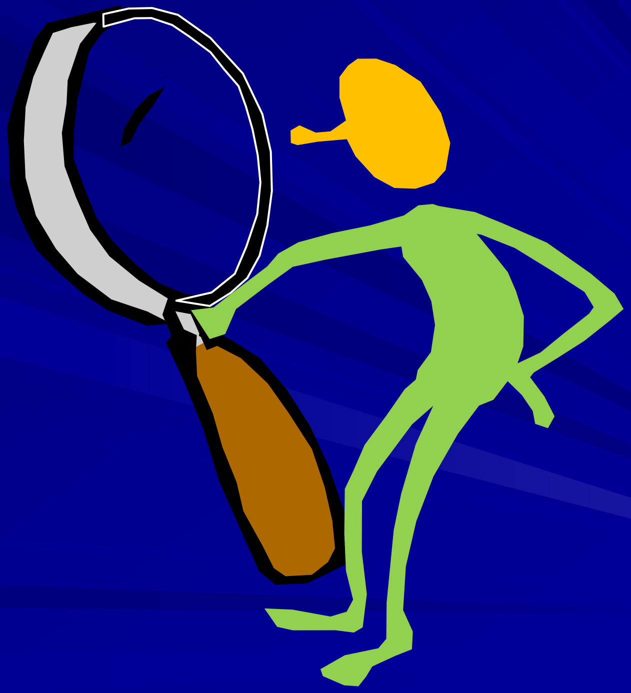
Research Objectives

- Develop and apply a procedure to prioritize TOrCs
- Develop and test diagnostic tools to identify whether TOrCs are a cause of biological impairment
- Develop a relational database of TOrC exposure data; temporarily residing at:
  http://werf2.tetratech-ffx.com/
- Develop a Collaboration Plan for fostering partnerships among stakeholders in Phase 2

Project Focus

- Organic contaminants of emerging concern
- Surface water only
- Ecological integrity, not human health
- Wastewater-influenced sites
- Effects on aquatic populations and communities

Which TOrCs should I monitor?



TOrC Prioritization Approach

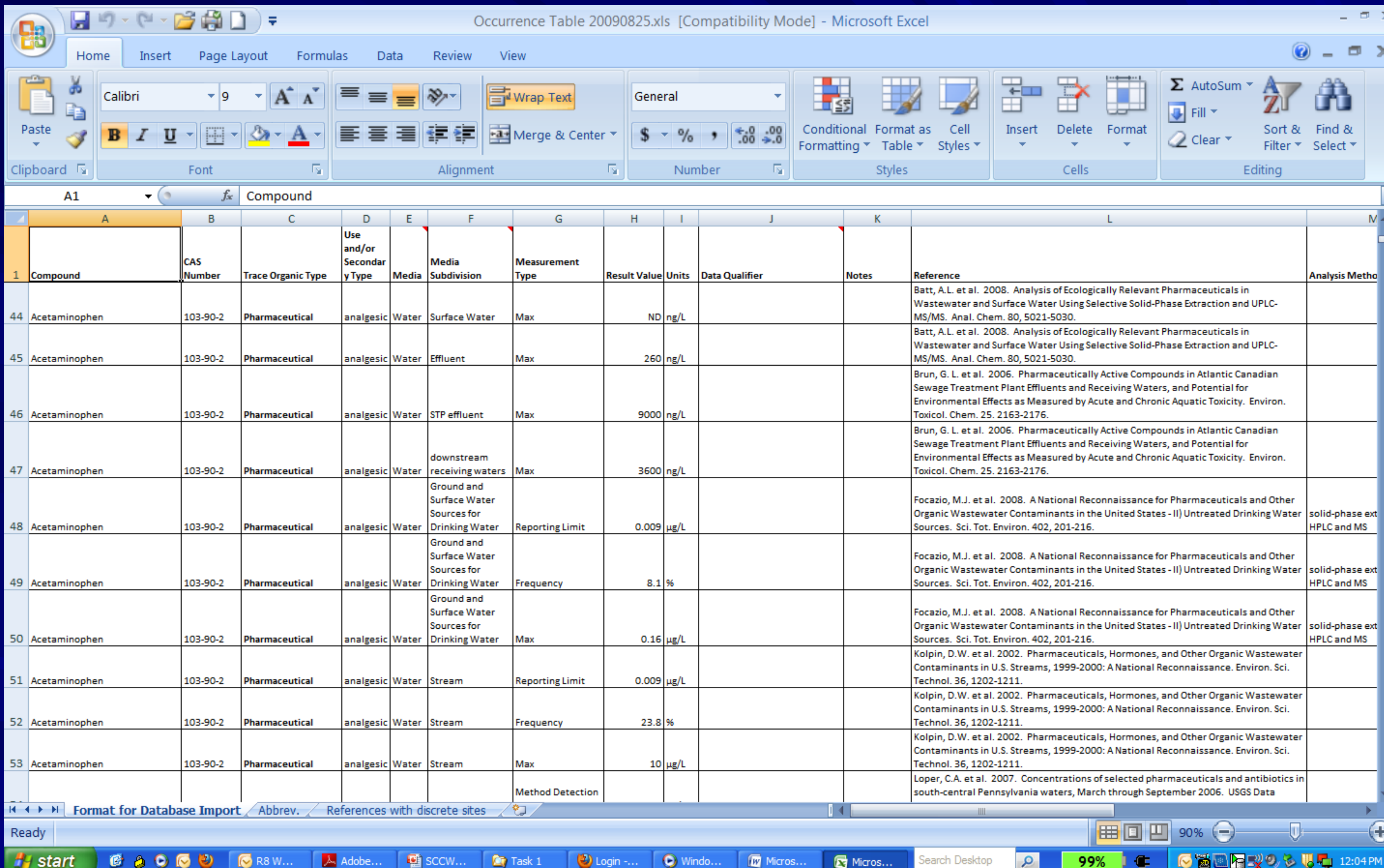
Compiled:

- TOrC occurrence data
- TOrC fate information (ECOSAR, PBT Profiler)
- Predicted toxicity and endocrine activity thresholds (ECOSAR, PBT Profiler, EU, FDA)

Occurrence Data

- Over 100 studies examined; 70 studies used
- Information from > 700 sites
- Over 500 TOrCs, including 48 high risk, high production volume TOrCs with no occurrence information
- Over 30 monitoring organizations represented
- Included as supplemental information

Occurrence Database: Results and Sources



Row	Compound	CAS Number	Trace Organic Type	Use and/or Secondary Type	Media	Media Subdivision	Measurement Type	Result Value	Units	Data Qualifier	Notes	Reference	Analysis Metho
44	Acetaminophen	103-90-2	Pharmaceutical	analgesic	Water	Surface Water	Max	ND	ng/L			Batt, A.L. et al. 2008. Analysis of Ecologically Relevant Pharmaceuticals in Wastewater and Surface Water Using Selective Solid-Phase Extraction and UPLC-MS/MS. Anal. Chem. 80, 5021-5030.	
45	Acetaminophen	103-90-2	Pharmaceutical	analgesic	Water	Effluent	Max	260	ng/L			Batt, A.L. et al. 2008. Analysis of Ecologically Relevant Pharmaceuticals in Wastewater and Surface Water Using Selective Solid-Phase Extraction and UPLC-MS/MS. Anal. Chem. 80, 5021-5030.	
46	Acetaminophen	103-90-2	Pharmaceutical	analgesic	Water	STP effluent	Max	9000	ng/L			Brun, G. L. et al. 2006. Pharmaceutically Active Compounds in Atlantic Canadian Sewage Treatment Plant Effluents and Receiving Waters, and Potential for Environmental Effects as Measured by Acute and Chronic Aquatic Toxicity. Environ. Toxicol. Chem. 25. 2163-2176.	
47	Acetaminophen	103-90-2	Pharmaceutical	analgesic	Water	downstream receiving waters	Max	3600	ng/L			Brun, G. L. et al. 2006. Pharmaceutically Active Compounds in Atlantic Canadian Sewage Treatment Plant Effluents and Receiving Waters, and Potential for Environmental Effects as Measured by Acute and Chronic Aquatic Toxicity. Environ. Toxicol. Chem. 25. 2163-2176.	
48	Acetaminophen	103-90-2	Pharmaceutical	analgesic	Water	Ground and Surface Water Sources for Drinking Water	Reporting Limit	0.009	µg/L			Focazio, M.J. et al. 2008. A National Reconnaissance for Pharmaceuticals and Other Organic Wastewater Contaminants in the United States - II) Untreated Drinking Water Sources. Sci. Tot. Environ. 402, 201-216.	solid-phase ext HPLC and MS
49	Acetaminophen	103-90-2	Pharmaceutical	analgesic	Water	Ground and Surface Water Sources for Drinking Water	Frequency	8.1	%			Focazio, M.J. et al. 2008. A National Reconnaissance for Pharmaceuticals and Other Organic Wastewater Contaminants in the United States - II) Untreated Drinking Water Sources. Sci. Tot. Environ. 402, 201-216.	solid-phase ext HPLC and MS
50	Acetaminophen	103-90-2	Pharmaceutical	analgesic	Water	Ground and Surface Water Sources for Drinking Water	Max	0.16	µg/L			Focazio, M.J. et al. 2008. A National Reconnaissance for Pharmaceuticals and Other Organic Wastewater Contaminants in the United States - II) Untreated Drinking Water Sources. Sci. Tot. Environ. 402, 201-216.	solid-phase ext HPLC and MS
51	Acetaminophen	103-90-2	Pharmaceutical	analgesic	Water	Stream	Reporting Limit	0.009	µg/L			Kolpin, D.W. et al. 2002. Pharmaceuticals, Hormones, and Other Organic Wastewater Contaminants in U.S. Streams, 1999-2000: A National Reconnaissance. Environ. Sci. Technol. 36, 1202-1211.	
52	Acetaminophen	103-90-2	Pharmaceutical	analgesic	Water	Stream	Frequency	23.8	%			Kolpin, D.W. et al. 2002. Pharmaceuticals, Hormones, and Other Organic Wastewater Contaminants in U.S. Streams, 1999-2000: A National Reconnaissance. Environ. Sci. Technol. 36, 1202-1211.	
53	Acetaminophen	103-90-2	Pharmaceutical	analgesic	Water	Stream	Max	10	µg/L			Kolpin, D.W. et al. 2002. Pharmaceuticals, Hormones, and Other Organic Wastewater Contaminants in U.S. Streams, 1999-2000: A National Reconnaissance. Environ. Sci. Technol. 36, 1202-1211.	
							Method Detection					Loper, C.A. et al. 2007. Concentrations of selected pharmaceuticals and antibiotics in south-central Pennsylvania waters, March through September 2006. USGS Data	

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Occurrence Database: Fate and Effects

TOrc and Fate 20098025.xls [Compatibility Mode] - Microsoft Excel

	Compound	CAS Number	Endocrine disrupting compound?	Toxicity (mg/L) (PBT Profiler)	ChV Value Fish (mg/L) (ECOSAR)	ChV Value Daphnid (mg/L) (ECOSAR)	ChV Value Algae (mg/L) (ECOSAR)	Miniumum Toxicity Value	Half-life, water (d) (PBT Profiler)	Half-life, soil (d) (PBT Profiler)	Half-life, sediment (d) (PBT Profiler)	Half-life (PBT Pr
2	Desisopropylatrazine	1007-28-9		0.75	67.779	28.995	34.39	0.75	60	120	540	
3	Minocycline	10118-90-8		0.4	1560.59	469.606	352.427	0.4	180	360	1600	
4	Fenuron	101-42-8		54	89.621	36.311	40.125	36.311	15	30	140	
5	Simetryn	1014-70-6		3.4	3.224	2.338	5.51	2.338	60	120	540	
6	3,4-Dichlorophenyl isocyanate	102-36-3		Not Estimated	0.38	0.374	1.343	0.374	38	75	340	
7	Glyburide	10238-21-8		0.18	0.148	0.203	1.094	0.148	180	360	1600	
8	Heptachlor epoxide	1024-57-3	Yes	Not Estimated	0.08	0.117	0.682	0.08	180	360	1600	
9	Bis(2-ethylhexyl)adipate	103-23-1	Yes	Not Estimated	0.000157	0.000624	0.013	0.000157	8.7	17	78	
10	Acetaminophen	103-90-2		1.1	229.872	78.864	70.194	1.1	15	30	140	
11	4-n-nonylphenol	104-40-5	Yes	0.004	0.01	0.018	0.147	0.004	15	30	140	
12	Tamoxifen	10540-29-1		Not Estimated	0.006	0.013	0.127	0.006	60	120	540	
13	Clinafloxacin	105956-97-6										
14	Risperidone	106266-06-2			1.593	1.441	4.523	1.441				
15	4-methylphenol	106-44-5		0.12	8.901	4.902	8.077	0.12	15	30	140	
16	1,4-Dichlorobenzene	106-46-7		1.1	0.703	0.622	1.842	0.622	38	75	340	
17	4-nonylphenol diethoxycarboxylate	106807-78-7	Yes	Not Estimated	0.257	0.375	2.799	0.257	15	30	140	
18	Glyphosate	1071-83-6		Not Estimated	5.17E+05	51610.602	9218.471	9218.471	15	30	140	
19	Toluene	108-88-3		3	2.567	1.833	3.643	1.833	15	30	140	
20	Phenol	108-95-2		0.19	19.947	9.423	12.715	0.19	15	30	140	
21	Pebulate	1114-71-2		0.94	0.404	0.407	1.473	0.404	15	30	140	
22	Metformin hydrochloride	1115-70-4		130000	88340.5	11245.115	2755.598	2755.598	15	30	140	
23	1-ethylnaphthalene	1127-76-0		0.18	0.114	0.127	0.574	0.114	15	30	140	
24	Erythromycin	114-07-8		17	6.647	5.238	13.753	5.238	180	360	1600	
25	Propoxur	114-26-1		15	39.404	18.975	26.25	15	38	75	340	
26	Endosulfan	115-29-7	Yes	Not Estimated	0.808	0.815	2.947	0.808	180	360	1600	
27	Triphenyl phosphate	115-86-6		Not Estimated	0.145	0.186	0.925	0.145	38	75	340	
28	Tri(2-chloroethyl)phosphate	115-96-8		Not Estimated	62.942	29.543	39.534	29.543	60	120	540	
29	10-hydroxy-amitriptyline	1159-82-6										
30	Aldicarb	116-06-3	Yes	65	77.268	32.844	38.632	32.844	38	75	340	
31	Bis(2-ethylhexyl)phthalate	117-81-7		Not Estimated	0.000461	0.00155	0.027	0.000461	15	30	140	
32	Di-N-octyl phthalate	117-84-0	Yes	Not Estimated	0.000172	0.000679	0.015	0.000172	15	30	140	
33	Hexachlorobenzene	118-74-1		0.012	0.015	0.023	0.192	0.012	180	360	1600	
34	Methyl salicylate	119-36-8		0.098	3.364	2.52	5.351	0.098	15	30	140	
35	Dichlobenil	1194-65-6		3.1	3.241	2.427	5.27	2.427	38	75	340	
36	Benzophenone	119-61-9	Yes	1.7	1.45	1.207	3.182	1.207	15	30	140	

Combined

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Occurrence Database: Prioritized TOrCs and MOAs

Compound	CAS Number	Trace Organic Type	Approach(es) Considered High Priority	Most Sensitive Species (ECOSAR)	Known EDC	Mode of Action or Class of Compound
Acetyl cedrene	32388-55-9	Deodorizer/Fragrance	2, 3	Fish	Unknown	
Acetyl-hexamethyl-tetrahydro-napthalene (AHTN)	1506-02-1	Deodorizer/Fragrance	3	Daphnid	Yes	
Celestolide (ADBI)	13171-00-1	Deodorizer/Fragrance	2, 3	Fish	Unknown	
Galaxolide	1222-05-5	Deodorizer/Fragrance	1, 2, 3	Fish	Unknown	
Musk ketone	81-14-1	Deodorizer/Fragrance	1, 2, 3	Fish	Yes	
Musk xylene	81-15-2	Deodorizer/Fragrance	2, 3	Fish	Unknown	
OTNE	54464-57-2	Deodorizer/Fragrance	2, 3	Fish	Unknown	
Phantolide (AHMI)	15323-35-0	Deodorizer/Fragrance	3	Fish	Unknown	
Tonalide	21145-77-7	Deodorizer/Fragrance	1, 2, 3	Fish	Unknown	
Traseolide (ATII)	68140-48-7	Deodorizer/Fragrance	2, 3	Fish	Unknown	
1,1'- 1,2-ethanediylbis(oxy) bis 2,4,6-tribromo-Benzene	37853-59-1	Flame Retardant	3	Fish	Unknown	
1,4:7,10-Dimethanodibenzo a,e cyclooctene, 1,2,3,4,7,8,9,10,13,13,14,14-dodecachloro-1,4,4a,5,6,6a,7,10,10a,11,12,12a-	13560-89-9	Flame Retardant	3	Fish	Unknown	
1H-Isoindole-1,3(2H)-dione, 2,2'-(1,2-ethanediyl)bis 4,5,6,7-tetrabromo-	32588-76-4	Flame Retardant	3	Fish	Unknown	
Hexabromocyclododecane	3194-55-6	Flame Retardant	1, 2, 3	Daphnid	Yes	Endocrine disruptor (thyroid)
PBDE-209	1163-19-5	Flame Retardant	1, 2, 3	Fish	Yes	Endocrine disruptor (thyroid)
1,1'-Biphenyl, bis(1-methylethyl)-	69009-90-1	Industrial Chemical	3	Fish	Unknown	
1,1'-ethylidenebis 3,4-dimethyl-Benzene	1742-14-9	Industrial Chemical	3	Fish	Unknown	

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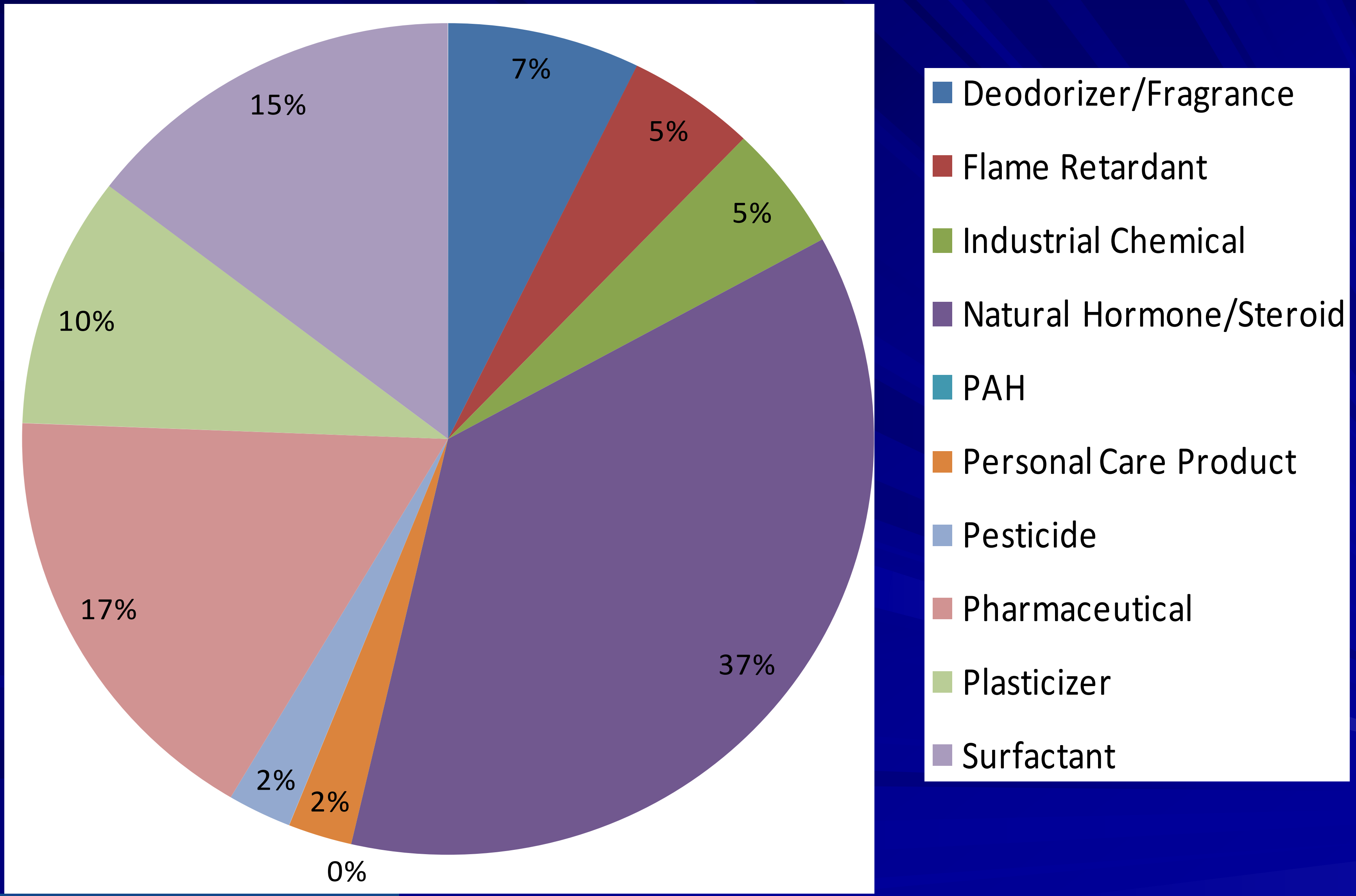
Prioritized TOrCs Based on:

1) Maximum observed concentration vs. conservative effect thresholds (Risk-based)
2) Risk-based + persistence and bioaccumulation potential scores (Risk + PB)
3) Persistence, Bioaccumulation, Toxicity – not occurrence-based (PBT)

Risk-based Approach

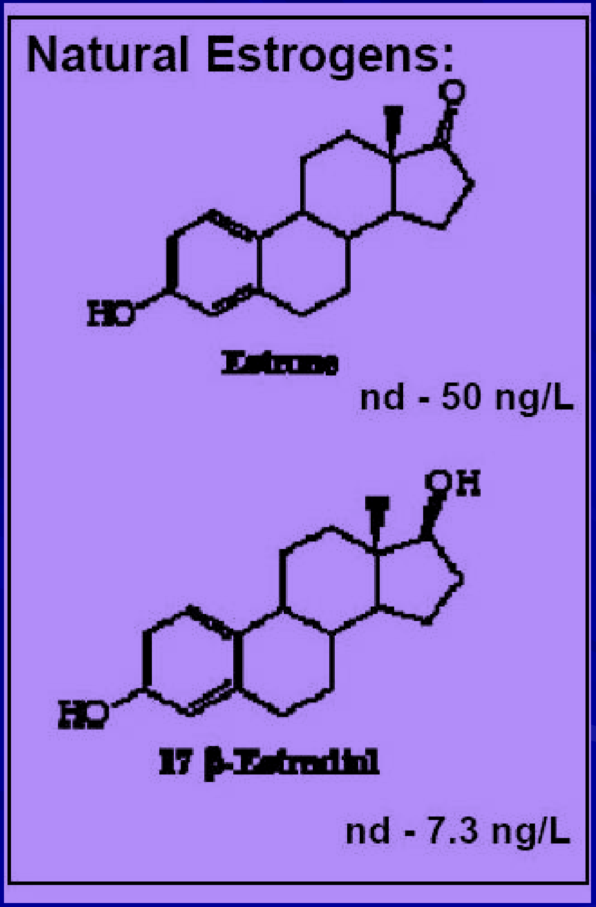


Risk-based Approach

- Relatively few pharmaceuticals ranked as high priority as compared to the number monitored
  - Exceptions are synthetic steroids and hormones

Risk-based Approach

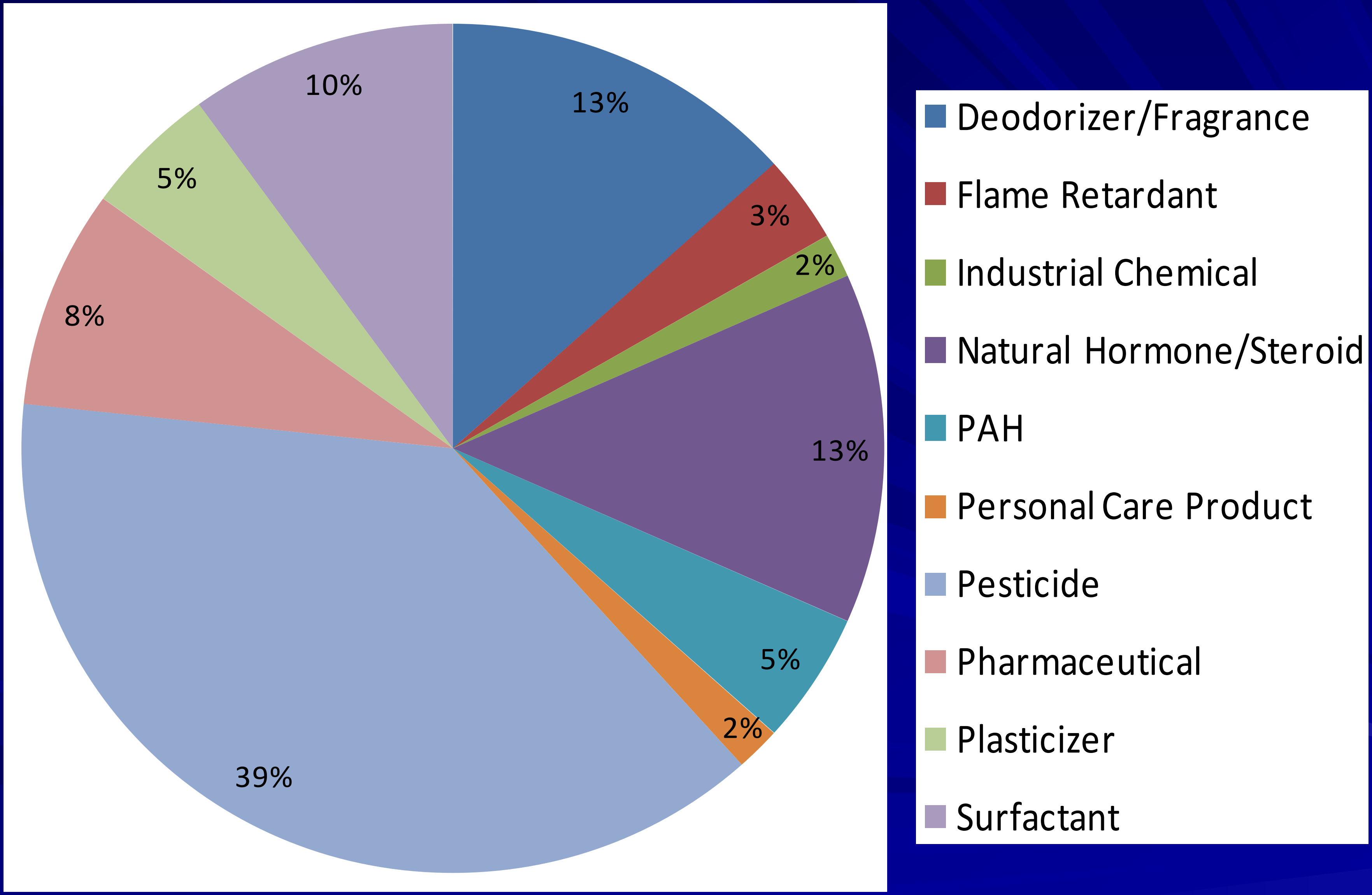
- Most sensitive endpoint is predicted chronic toxicity rather than estrogenic activity for most high priority TOrCs
  - Exceptions are the few hormones



Risk-based Approach

- Shortest TOrC list of all 3 approaches (41)
- Hormones, steroids, pharmaceuticals, and surfactants comprise most of the high priority TOrCs
- Wastewater discharges could be a major source of these TOrCs
- Most pharmaceuticals monitored may not present a risk to aquatic life.
- **HOWEVER**, many unknowns in terms of estrogenic and other endocrine activity effects of many of these chemicals

Risk + PB Approach



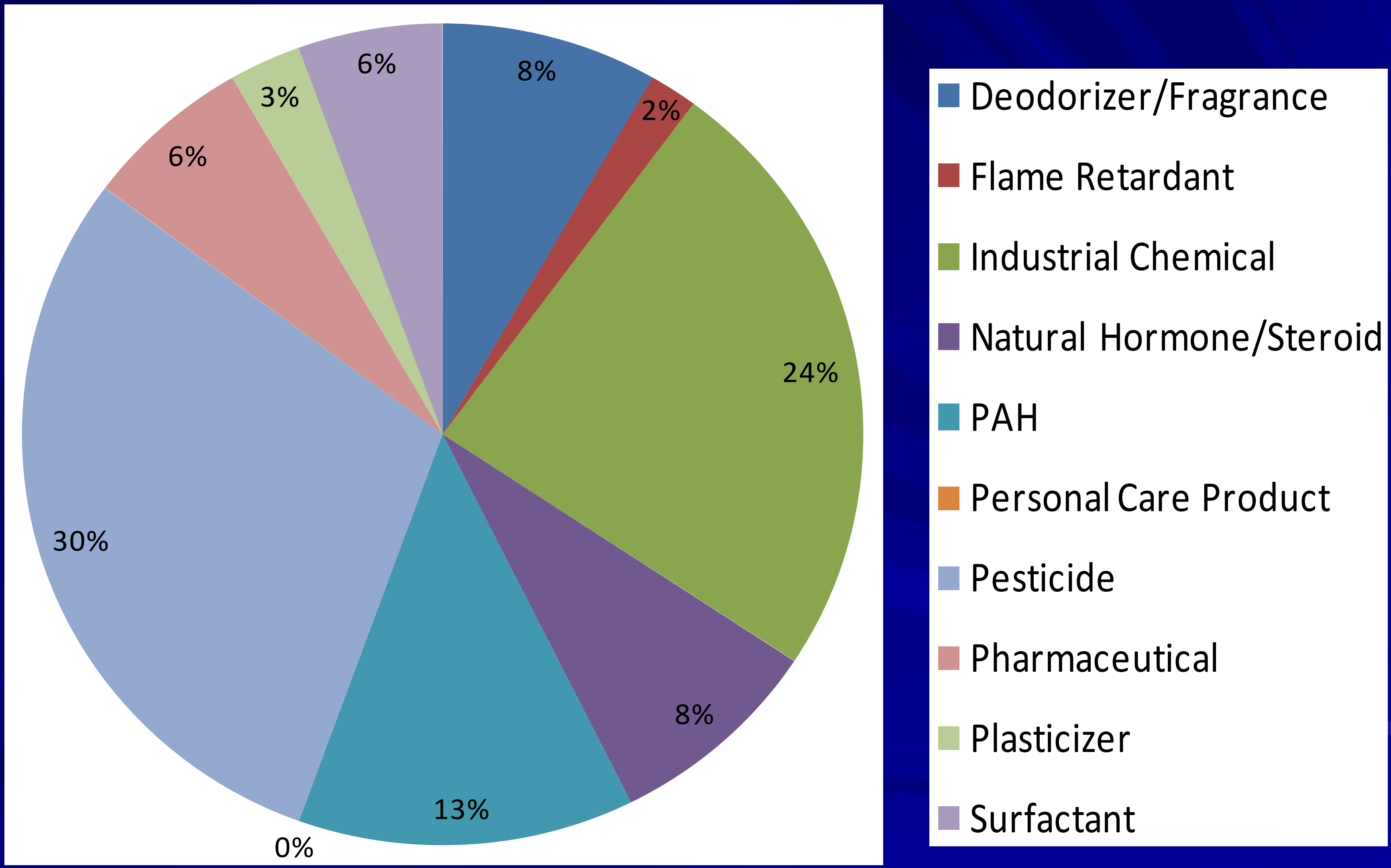
Risk + PB Approach

- Hormones, steroids, pharmaceuticals, and surfactants still important

- Half of the TOrCs are persistent or bioaccumulative chemicals: pesticides and fragrances.

- Wastewater discharges may or may not be a major source of some of these TOrCs

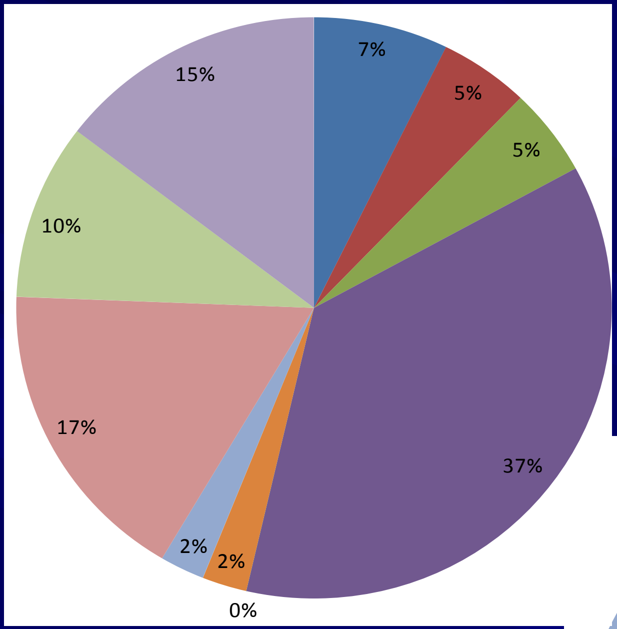
PBT Approach



PBT Approach

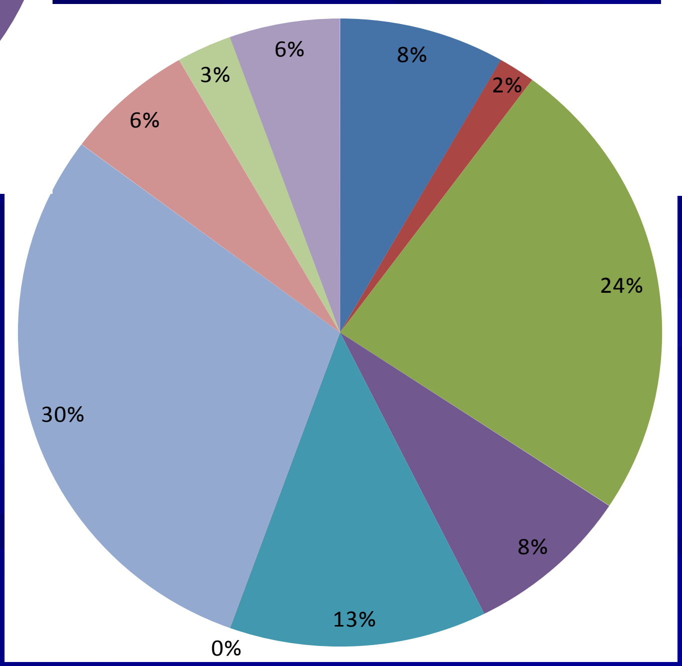
- Most are pesticides, PAHs, and industrial chemicals
- Wastewater discharges may not be a major source of these TOrCs
- This is the longest list of high priority TOrCs (108).

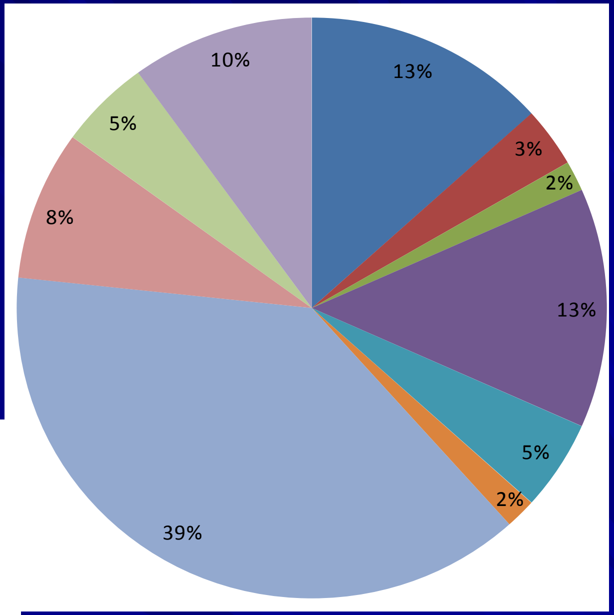
Summary of Prioritizations



Risk-based

Risk + PB





PBT

High Priority TOrCs Using All Approaches

- 17α-ethynylestradiol
- 4-n-nonylphenol
- 4-Nonylphenol
- Bis(2-ethylhexyl)adipate
- Bis(2-ethylhexyl)phthalate
- Campesterol
- Cholesterol
- Coprostanol
- Desmosterol
- Di-N-octyl phthalate
- Epicoprostanol
- Galaxolide
- Mestranol
- Musk ketone
- para-nonylphenol
- PBDE-209
- Pentachlorophenol
- Stigmastanol
- Stigmasterol
- Tamoxifen
- Tonalide
- β-sitosterol
- Hexabromocyclododecane

Some Common TOrCs May Be Low Risk

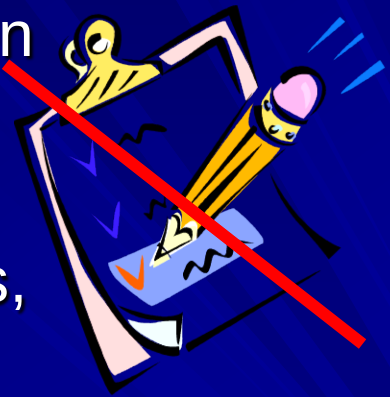
- Caffeine is almost always measured but was low risk using all 3 approaches
- But some TOrCs that are low risk may be useful surrogates for co-occurring high risk TOrCs that are more difficult to measure
- Not enough information to determine which TOrCs tend to co-occur in wastewater discharges but WERF research and other programs in progress.

Uncertainties

- Occurrence data should be treated with some caution because:
  - Many questions regarding analytical methods, quantification of TOrCs
  - Not a complete compilation of all data collected in the U.S.
- Toxicity values could be underestimates for those chemicals which have limited structural activity-toxicity relationships available.

TOrC Lists Should Serve as a Tool!

- Lists of high priority TOrCs should **not** be taken as monitoring requirements or chemicals for regulation
- High priority TOrCs might vary with site factors, treatment available, etc.
- Prioritization approaches should help utilities and others organize and manage screening of TOrCs.
- A chemical by chemical approach may be okay for prioritizing TOrCs, but need to consider the cumulative risk of TOrCs at a site.



SCREENING SITES FOR TOrC RISK

Screening Approach

Influent factors:
population size and age distribution; types of inputs (e.g., hospital contribution)

Treatment factors:
Type of treatment; treatment performance; effluent consistency; frequency of upsets

TOrCs predicted to pose risk to aquatic life?

Site observations:
fish intersex frequency; tissue hormone concentrations; TOrC data; population/community impairment

Site factors:
barriers to organism movement; refugia present; sensitive species; pH, temp; effluent dilution

What types of wastewater-influenced sites are most at risk from TOrCs?

Hypotheses

- Sites with WWTP influent high in hormones, steroids, plasticizers, and surfactants are higher risk
- WWTPs with lower nutrient removal rates are higher risk sites
- Sites having less effluent dilution are at higher risk
- Sites having more barriers to organism movement and emigration are at higher risk

Categorization of Site Risk Potential

WWTP Effluent TOrC Scenario	TOrCs in the Effluent Exceed Conservative Thresholds?	Population/Community Impact Observed?	Risk Potential
A	Yes	Unknown	Possible
B	Unknown	Yes	Possible
C	Unknown	Unknown	Unknown
D	No	No	Low

Note: If TOrCs exceed thresholds and the site is impacted, screening is unnecessary – diagnostics are needed

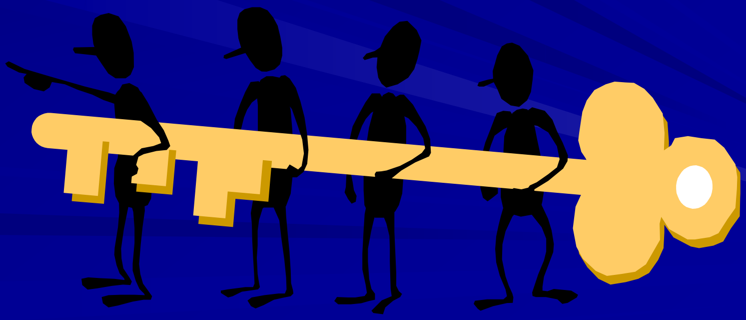
Site Risk Levels for TOrCs

Site Risk classification	WWTP Facility	Receiving Waterbody
LEVEL I (Lowest)	Low risk	Low risk
LEVEL II	Low risk	High risk
LEVEL III	High risk	Low risk
LEVEL IV (Highest)	High risk	High risk

Boulder Creek, before upgrade:
Scenario A, Level IV

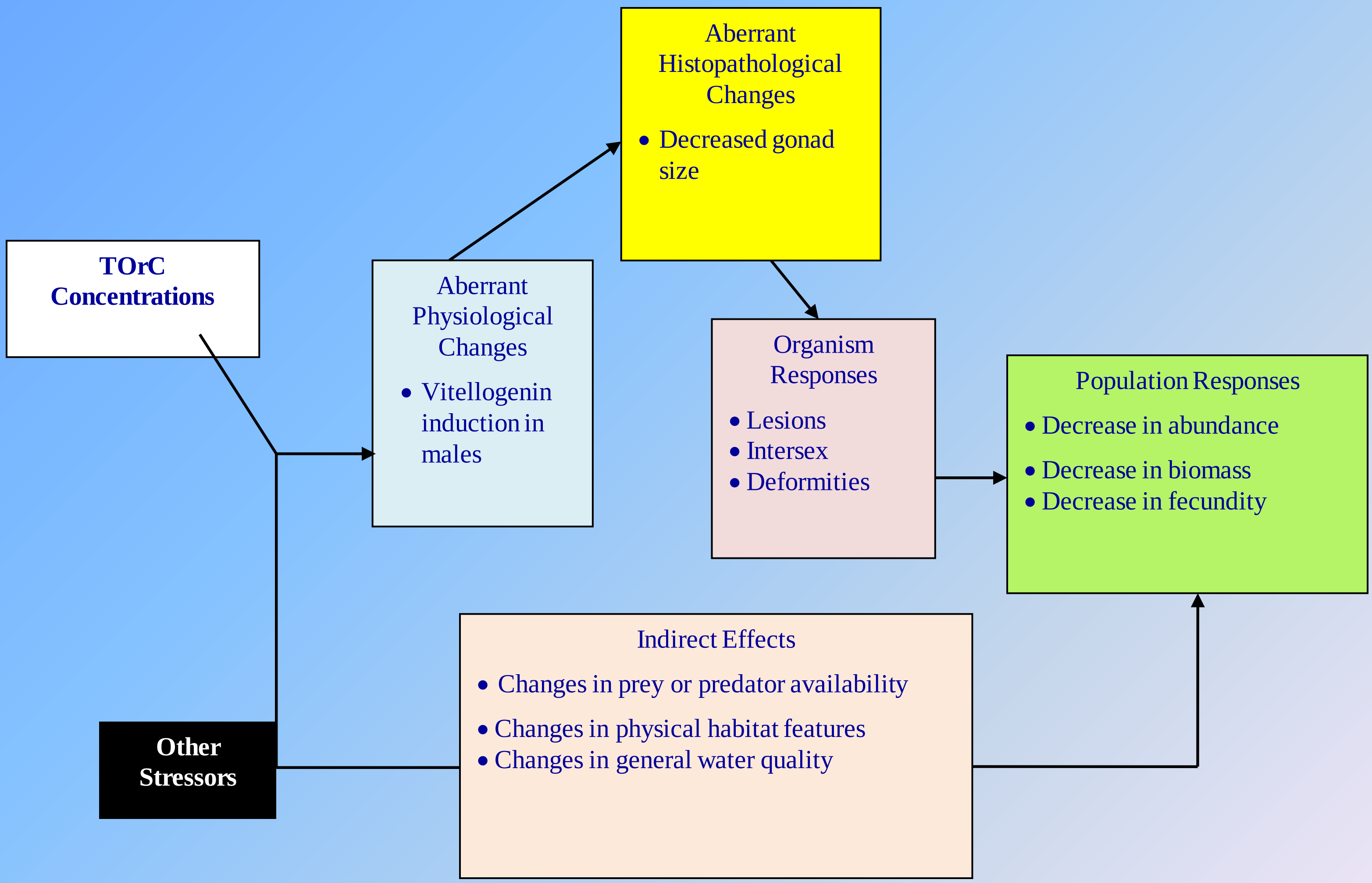
	Factor	Value	Risk
WWTP Input Characteristics	Industry/hospital-related influents	>5%	High
WWTP Treatment Characteristics	Level of treatment	Trickling filters, chlorination/ dechlorination.	Medium - High
Receiving waterbody	Effluent dilution (low flow)	Effluent dominates flow (perhaps >70% of the time)	High
	Waterbody openness/barriers	Some diversions for irrigation and dams could prevent fish movement	High
	Presence of other potential sources of TOrCs	Urban runoff, agriculture, historic pollution from mining	High

DIAGNOSING RISKS DUE TO TOrCS



Do effluent TOrCs pose a risk to aquatic populations and communities?

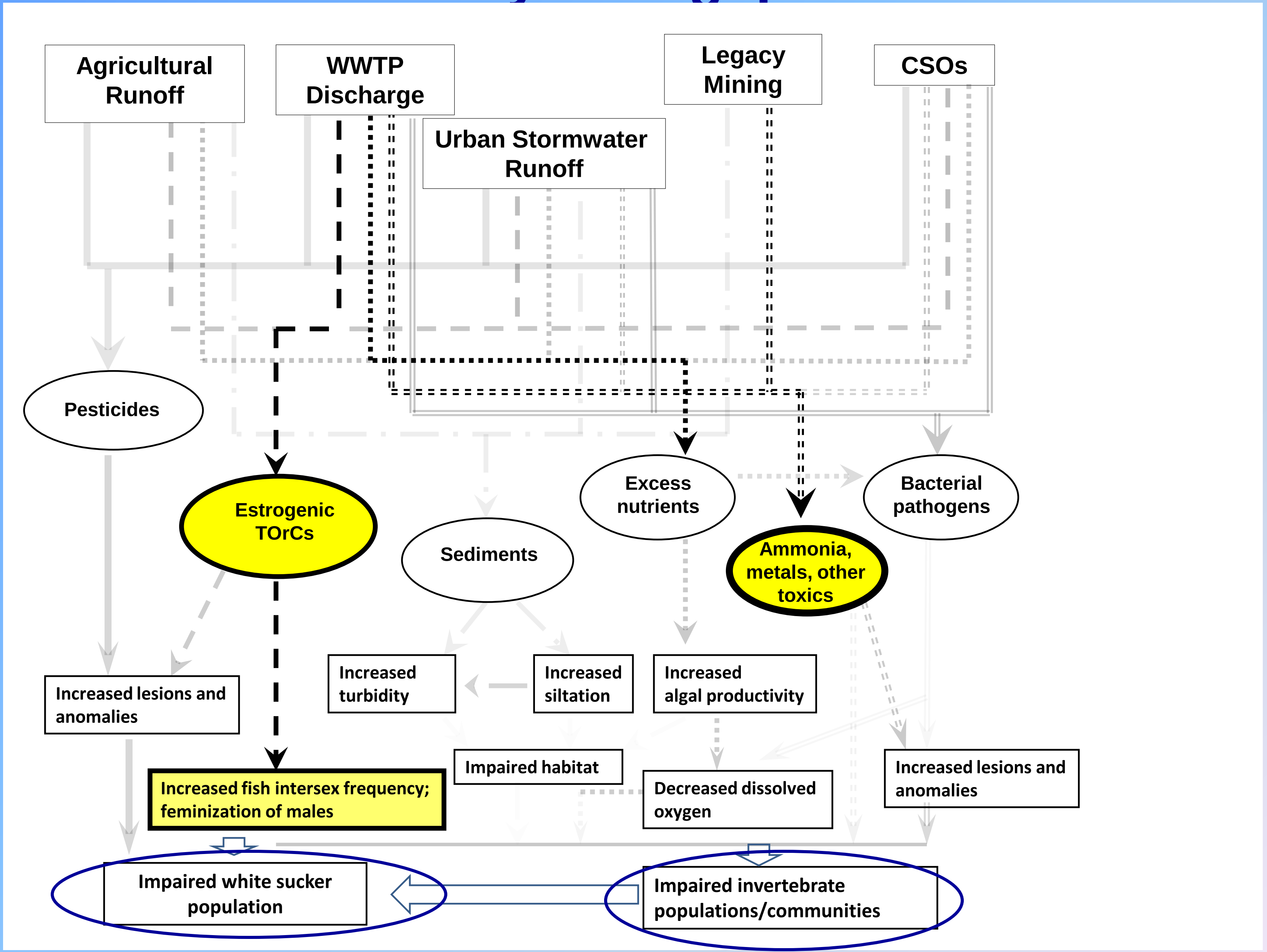
Need to link exposure and effects at different levels of biological organization



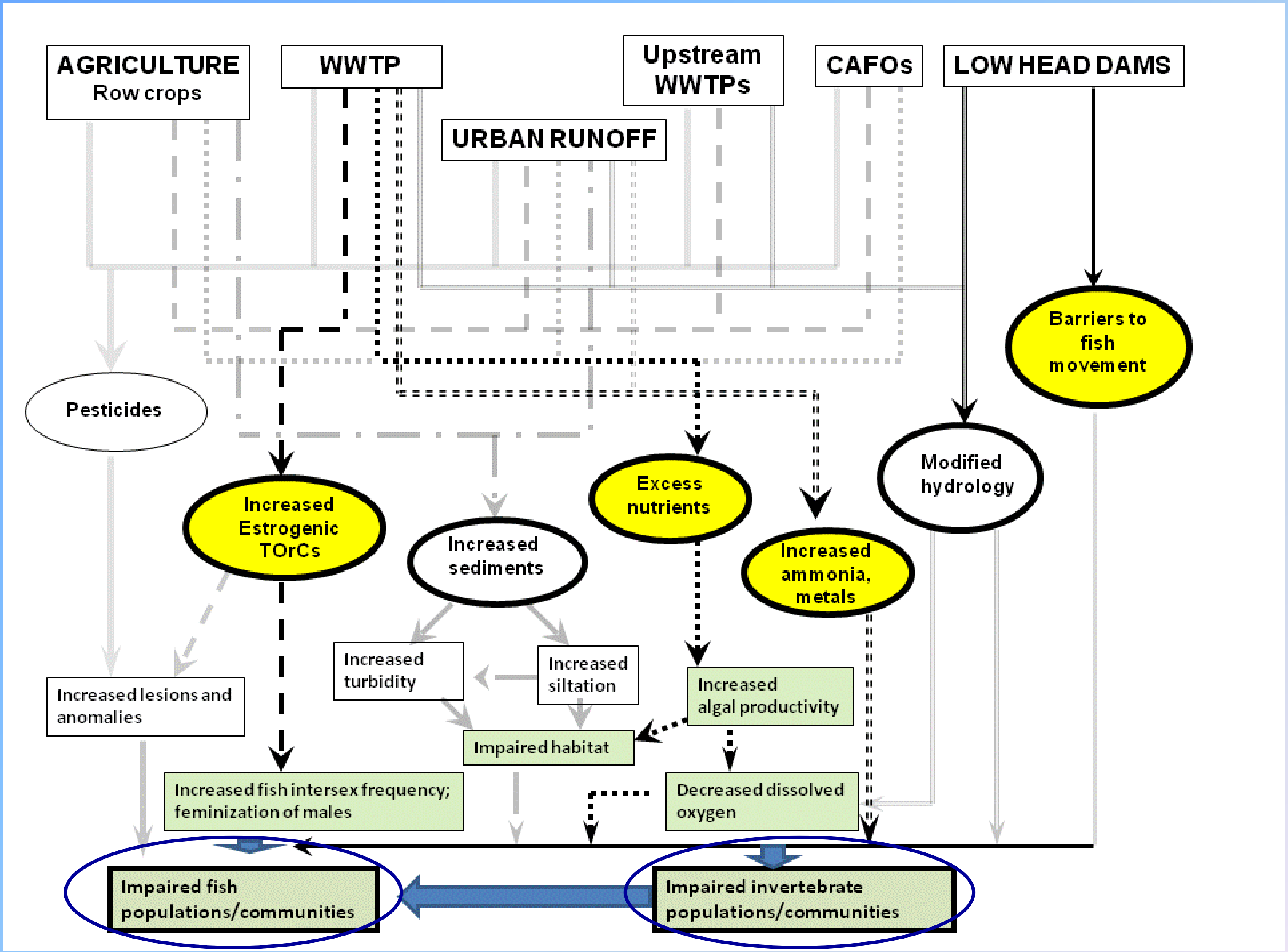
Evaluated 7 Case Studies

Site (WWTP)	Location	Percent Effluent	Potential Stressors in Addition to WWTP TOrCs	Biological Impairment?	TOrC Data?	Scenario Type	Risk Level
SCB	CA	<1	Legacy pesticides and PCBs; normal ocean temperature variation	Not Known	Water, Fish, Effluent, Sediment	A	I or III, depending on WWTP
Guelph	ON	40	Channelization; low-head dams; agricultural runoff	Not known	Water, Fish, Effluent	A	II
Kitchener	ON	10 - 15	Urban runoff; low-head dams; agricultural runoff; CAFOs	Yes, fish	Water, Fish, Effluent	A	IV
Ravenna	OH	>90	Urban runoff; septic systems	Yes – fish, macroinvertebrates	Predicted	B	IV
Mansfield	OH	>80	Urban runoff; legacy industrial contaminants; industrial discharges; agricultural runoff	Yes – fish, macroinvertebrates; but upstream impaired too	Predicted	B	III
Taylor Run	PA	85	Urban runoff, stormwater	Yes – periphyton, macroinvertebrates	Fish Tissue	A	III
Boulder	CO	>70	Urban runoff; legacy mining pollutants; agricultural runoff	Not Known	Water, Fish, Effluent	A	Pre-upgrade= IV Post upgrade = II

Many data gaps:



More levels of biological organization examined; Better diagnostics



Exposure And Effects Information At Multiple Biological Levels Is Critical

Site	Suborganism	Organism	Population	Community
SCB, CA.	Vtg. in male turbot; TOrCs and legacy CECs in livers; cortisol and thyroid hormones in blood	Ova-testis; intersex rate	Gender ratio; relative abundance	ND
Guelph, ON.	TOrC analyses in water; Vtg., hormone, enzymes in fish exposed in situ	14-d in situ fish studies	Wild fish population studies	Macroinvertebrate and fish bioassessments
Kitchener, ON.	TOrC analyses in water; Vtg., hormone, enzymes in fish exposed in situ	Intersex rate	Darter population studies	Macroinvertebrate and fish bioassessments
Ravenna, OH.	ND (predicted TOrC risk)	ND	ND	Macroinvertebrate and fish bioassessments
Mansfield, OH.	ND (predicted TOrC risk)	ND	ND	Macroinvertebrate and fish bioassessments
Taylor Run, PA.	TOrCs observed in fish tissue	ND	ND	Algal, macroinvertebrate, and fish bioassessments
Boulder Creek, CO.	Vtg. in male white suckers	Intersex in white suckers	Skewed sex ratio in white suckers	ND

Recommendations

- At first, evaluate those TOrCs that are known to occur and are high priority from a tox or EDC perspective – tailor the list of TOrCs to your site/region
- Screening of sites should include wastewater input, treatment, and waterbody factors, as well as site data
- Diagnosing effects of TOrCs requires exposure and effects data at multiple levels

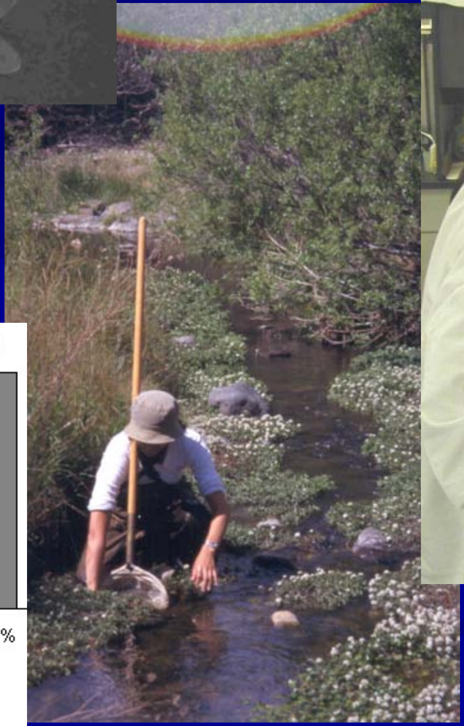
Recommendations

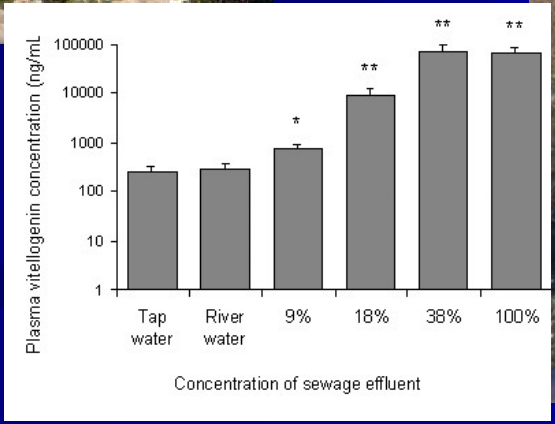
- Suborganismal indicators may be more useful in documenting exposure than measurements of a partial list of TOrCs monitored infrequently
- Exposure information without population-level effects information is of limited use in understanding:
  - TOrC effects
  - Types of sites or populations most at risk
  - Levels of TOrCs that may pose a risk
- Large waterbodies present formidable challenges in diagnosing effects of TOrCs on biota. Efforts may best be focused on effluent-dominated systems, to further test and refine the screening framework.

Recommendations

- EPA's CADDIS or Environment Canada's EEM are useful for organizing and evaluating lines of evidence. For most sites, available data are unlikely to be sufficient for diagnosing effects specifically due to TOrCs.
  - Both approaches provide scientifically defensible procedures for eliminating non-TOrC stressors
- Typical aquatic bioassessments generally do not measure indicators of TOrC exposure or effects. They are most useful with other tools to diagnose whether TOrCs are affecting biota.

What Should Phase 2 Look Like?





Phase 2 Should:

- Address critical data/information gaps in the form of testable hypotheses
- Provide useful guidance or tools in the

Testable hypotheses organized according to 3 basic questions:

1. *Under what conditions do waterbody factors or WWTP factors drive aquatic ecological risks of TOrCs?*

2. *In what types of sites are "high" TOrC concentrations associated with observed biological effects?*

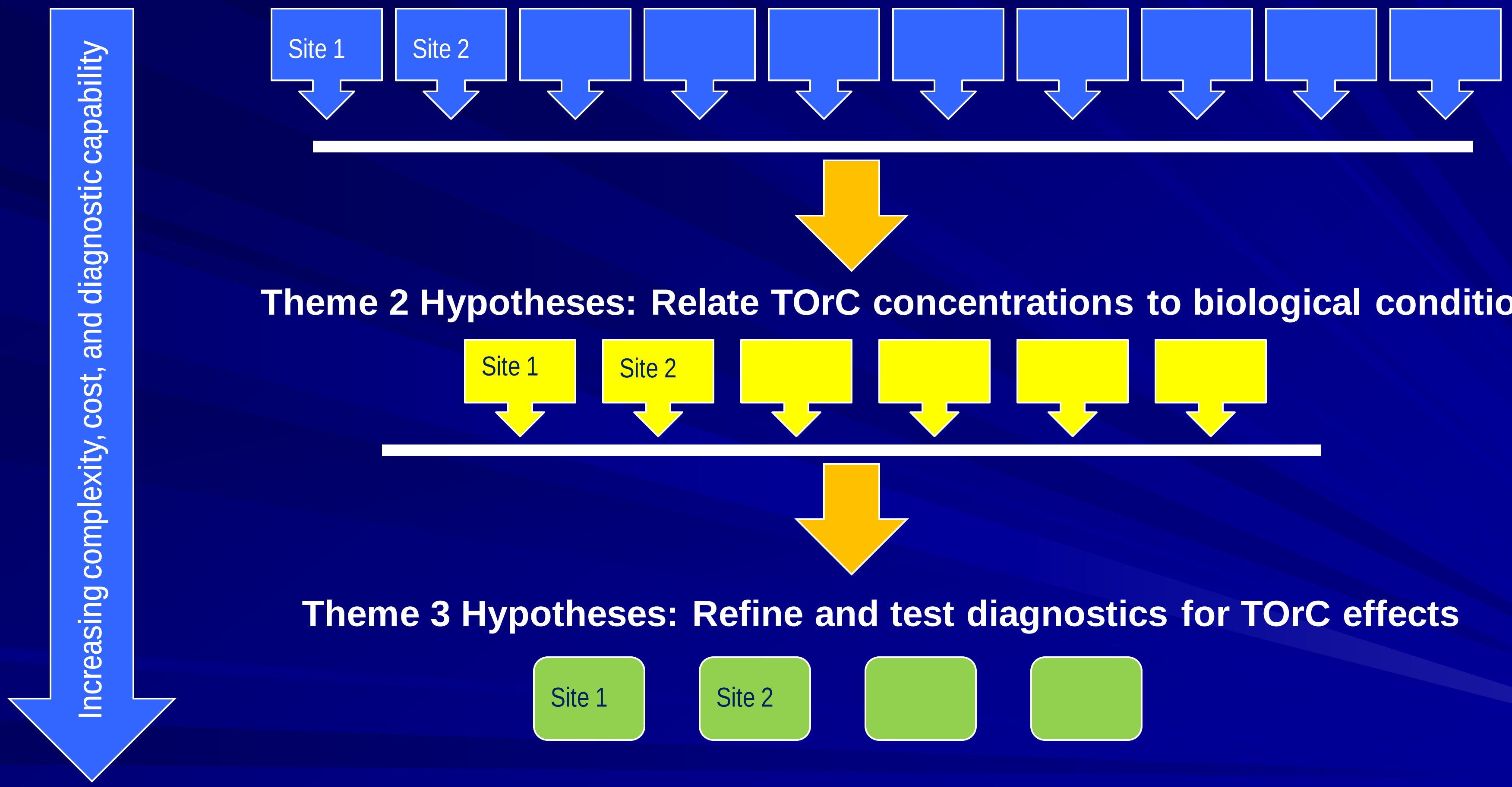
3. *Can a retrospective, stressor-identification approach partition the effects of TOrCs from other stressors or will the approach be a process of elimination where TOrCs are the most likely remaining cause of effects?*

Products, Time Frame, Complexity

- Theme 1: refines the site screening process: deliver a useful screening tool within first year; may involve many sites; least complex technically
- Theme 2: identify relationships between TOrCs and biological integrity using subset of sites from Theme 1; provide tangible tools within 2 years to further refine screening and help diagnostics; intermediate complexity
- Theme 3: test diagnostic approaches using subset of sites from Theme 2; provide a useful diagnostic approach and tools within 3 years to assess if TOrCs cause or could cause effects; highly complex

Potential Phase 2 Design

Theme 1 Hypotheses: Refine Site Screening Process



Coordination and Collaboration are Key

- California CEC prioritization and CEC monitoring efforts fit in well with Phase 2 goals
- Need participation from utilities as well as researchers and various monitoring organizations
- Multifaceted expertise is needed to make the linkages
  - TOrC concentration data in various matrices
  - Suborganismal endpoints: biomarkers, vtg, etc
  - Individual organismal endpoints: sex identification, growth, etc
  - Population/community endpoints: species fecundity, abundance, diversity, etc.

WEB-BASED DATABASE

TETRA TECH

Search Interface

- Geospatial Based
- Search Studies, Compounds, Locations, Date and other qualifiers
- Includes full Export in Excel
- Results in Summary Format or Export to Excel
- Allows for batch import

TETRA TECH

Search Interface

CASNumber	Compound	MeasurementType	MediaType	OriginalResultValue	OriginalResultValueUnitType	ResultValue	ResultValueUnitType
95-50-1	1,2-dichlorobenzene	Actual	Tissue	0	ug/kg	0	ug/kg

complex world | CLEAR SOLUTIONS™

Upload / Data Entry Interface

- Batch or Form Upload
- Review/approval process
- Includes geo-tagging of data based on county/zip/stream etc.
- Includes reference manager for administrators

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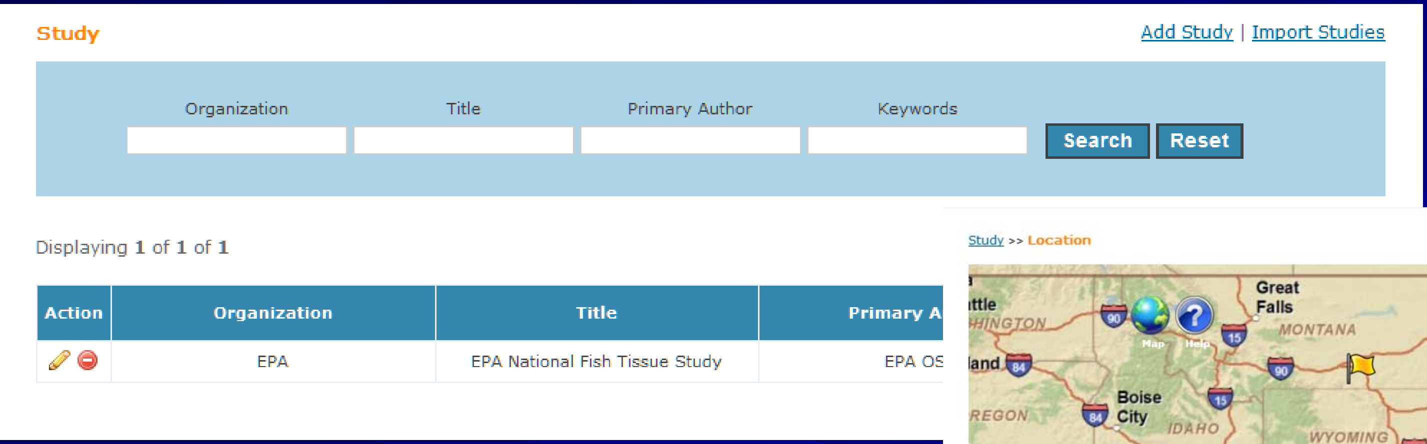
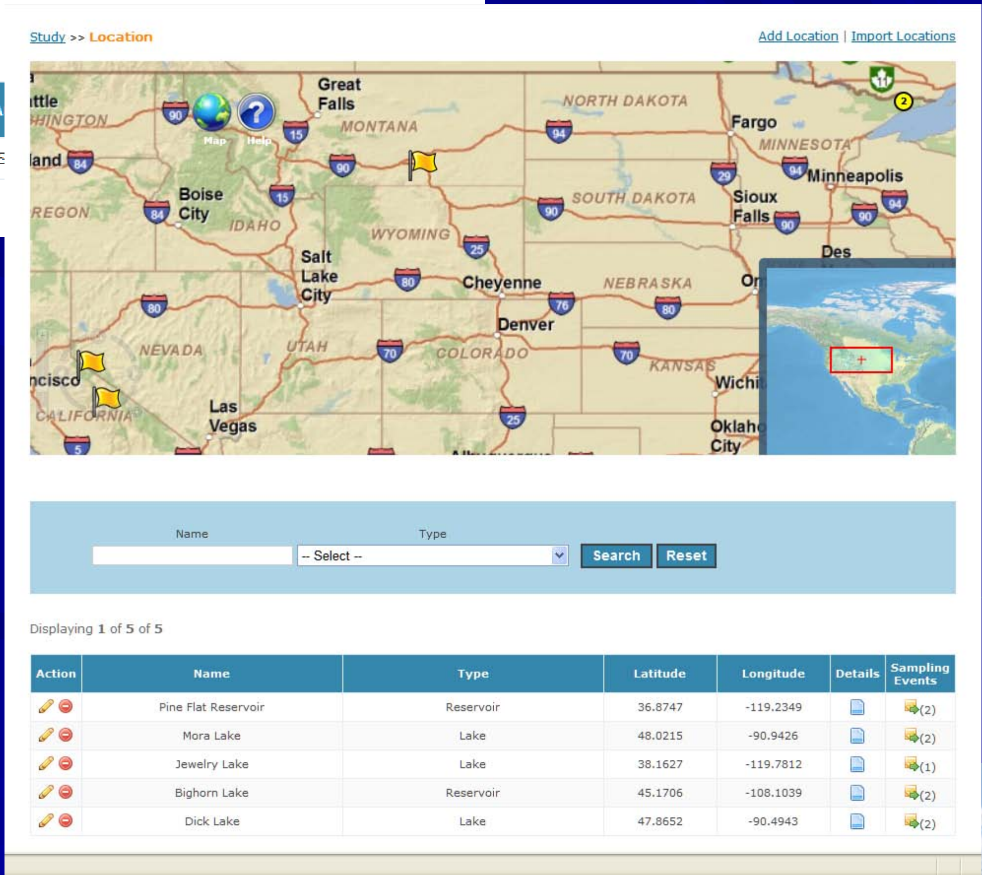
Upload / Data Entry Interface





TETRA TECH

Upload / Data Entry Interface

Study >> Location >> **Sampling Event**

Add SamplingEvent | Import SamplingEvents

Start Date | End Date | Sample Type: -- Select -- | Search | Reset

Displaying **1** of **2** of **2**

Action	Start Date	End Date	Sample Type	Details	Results
	5/23/2001		Composite Fish Tissue Predator		(47)
	5/23/2001				

Study >> Location >> Sampling Event >> **Result**

Add Result | Import Results

Compound | Media Type: -- Select -- | Measurement Type: -- Select -- | Search | Reset

Displaying **1** of **10** of **47**

Action	Compound	Media Type	Measurement Type	Converted Result	Original Result	Details
	1,2-dichlorobenzene	Tissue	Actual	0 ug/kg	0 ug/kg	
	1,3-dichlorobenzene	Water	Actual	0 ug/kg	0 ug/kg	
	1,4-Dichlorobenzene	Tissue	Actual	0 ug/kg	0 ug/kg	
	4-Nonylphenol	Tissue	Actual	0 ug/kg	0 ug/kg	
	Acenaphthene	Tissue	Actual	0 ug/kg	0 ug/kg	
	Acenaphthylene	Tissue	Actual	0 ug/kg	0 ug/kg	
	Anthracene	Tissue	Actual	0 ug/kg	0 ug/kg	
	Biphenyl	Tissue	Actual	0 ug/kg	0 ug/kg	
	Carbazole	Tissue	Actual	0 ug/kg	0 ug/kg	
	Chrysene	Tissue	Actual	0 ug/kg	0 ug/kg	