Research Framework Applied

Examples from EDF and partner studies

Nichole Saunders
Senior Attorney
Energy Program

EDF
ENVIRONMENTAL DEFENSE FUND®
Finding the ways that work

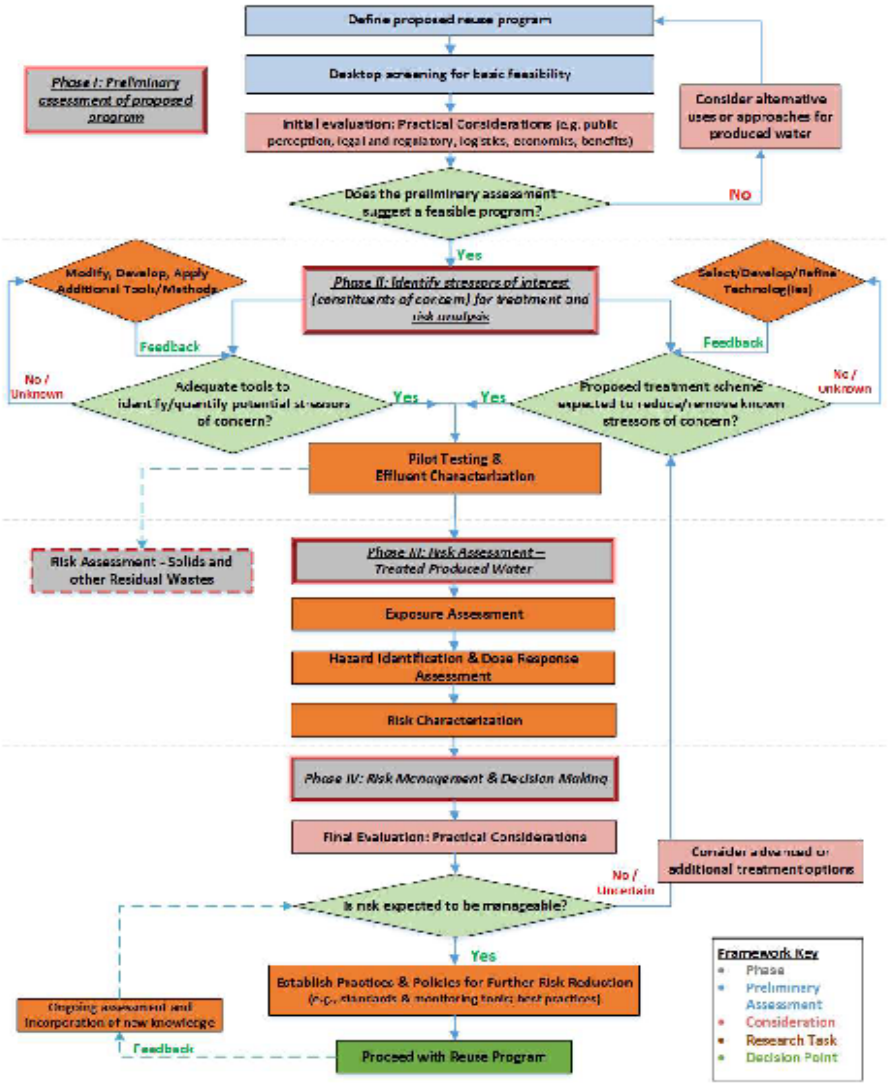
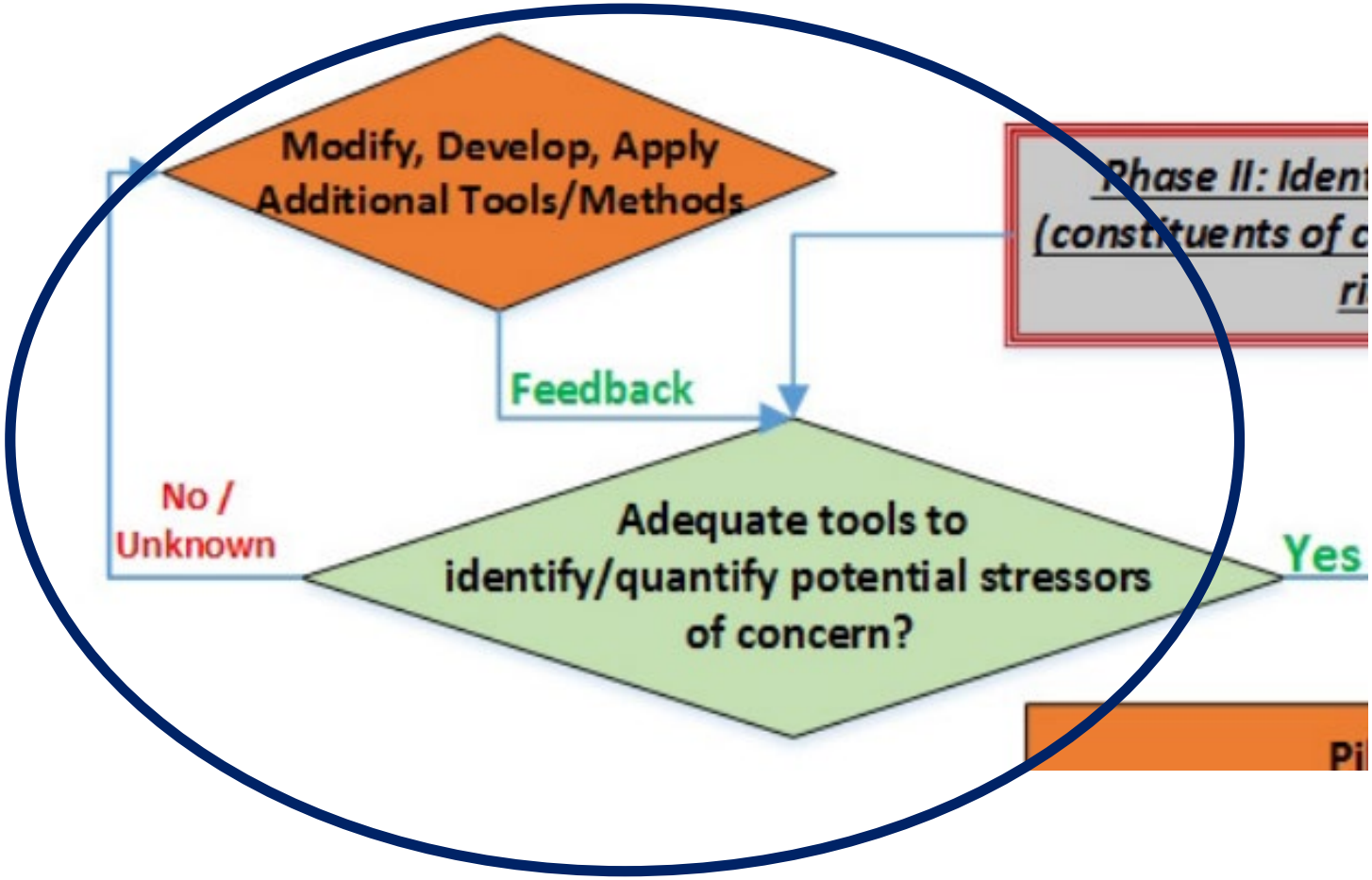


Figure 2-8: Framework for Research, Evaluation and Decision-Making

Research; testing/pilots; risk assessment

Risk management; standard development; regulation

Phase II: Identify stressors of interest (constituents of concern) for risk assessment



DOI: http://dx.doi.org/10.1016/j.teac.2017.07.002

Trends in Environmental Analytical Chemistry 15 (2017) 12–23

Contents lists available at ScienceDirect

Trends in Environmental Analytical Chemistry

journal homepage: www.elsevier.com/locate/treac

Emerging analytical methods for the characterization and quantification of organic contaminants in flowback and produced water

Karl Oetjen[a], Cloelle G.S. Giddings[b], Molly McLaughlin[c], Marika Nell[d], Jens Blotevogel[c], Damian E. Helbling[d], Dan Mueller[b], Christopher P. Higgins[a,*]

[a] Civil and Environmental Engineering, Colorado School Mines, Golden, CO 80401, USA
[b] Environmental Defense Fund, New York, NY 10010, USA
[c] Department of Civil and Environmental Engineering, Colorado State University, 1320 Campus Delivery, Fort Collins, CO 80523, USA
[d] School of Civil and Environmental Engineering, Cornell University, Ithaca, NY 14853, USA

- Complex matrix → many methods originally designed for surface and groundwater may not be suitable; proposes alternative potential solutions
- Unidentified organics → need targeted *and* non-targeted
- Large table of analytical tech and trends (also in GWPC, Appx 3-C)
- EPA-approved analytical methods available for about 25%

GEOSTANDARDS and GEOANALYTICAL RESEARCH

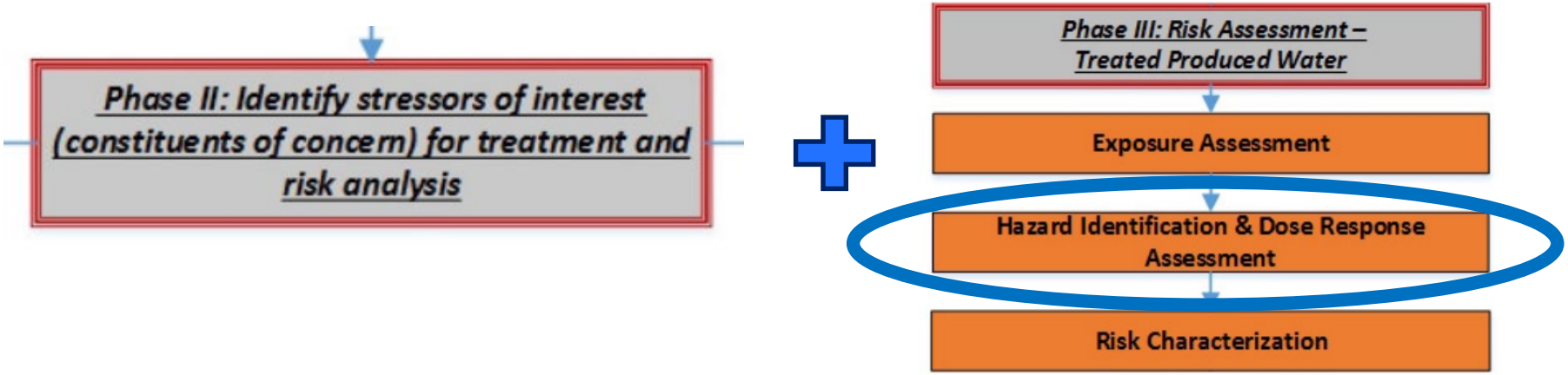
ORIGINAL ARTICLE

Direct Trace Element Determination in Oil and Gas Produced Waters with Inductively Coupled Plasma-Optical Emission Spectrometry: Advantages of High Salinity Tolerance

Aaron M. Jubb ✉, Mark A. Engle, Jessica M. Chenault, Madalyn S. Blondes, Cloelle G. Danforth, Colin Doolan, Tanya J. Gallegos, Dan Mueller, Jenna L. Shelton

First published:31 January 2020 | https://doi.org/10.1111/ggr.12316

- Measuring trace elements in high-salinity produced water is challenging, due to large dilution needed for standard methods (ICP-MS)
- Alternative methods (ICP-OES), though less sensitive (i.e. higher detection limit), can analyze brines with less dilution.
- This paper demonstrates that ICP-OES is often more successful at detecting (and quantifying) trace elements in produced water (TDS ranging from 17,000 to 370,000 mg/L)
- ICP-MS (used in standard methods) had non-detects for many elements identified in the same waters with ICP-OES



Environment International 134 (2020) 105280

Contents lists available at ScienceDirect

Environment International

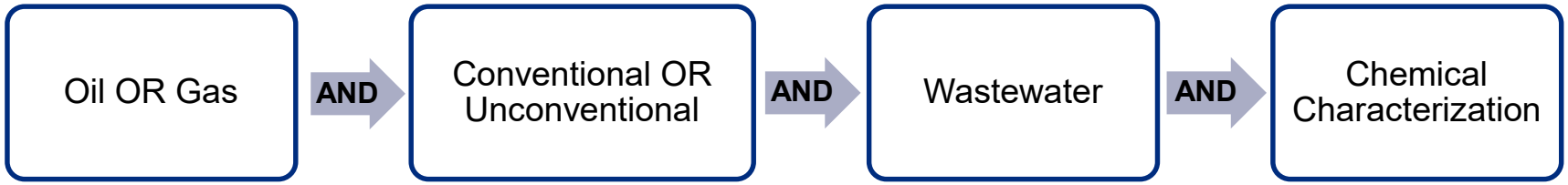
journal homepage: www.elsevier.com/locate/envint

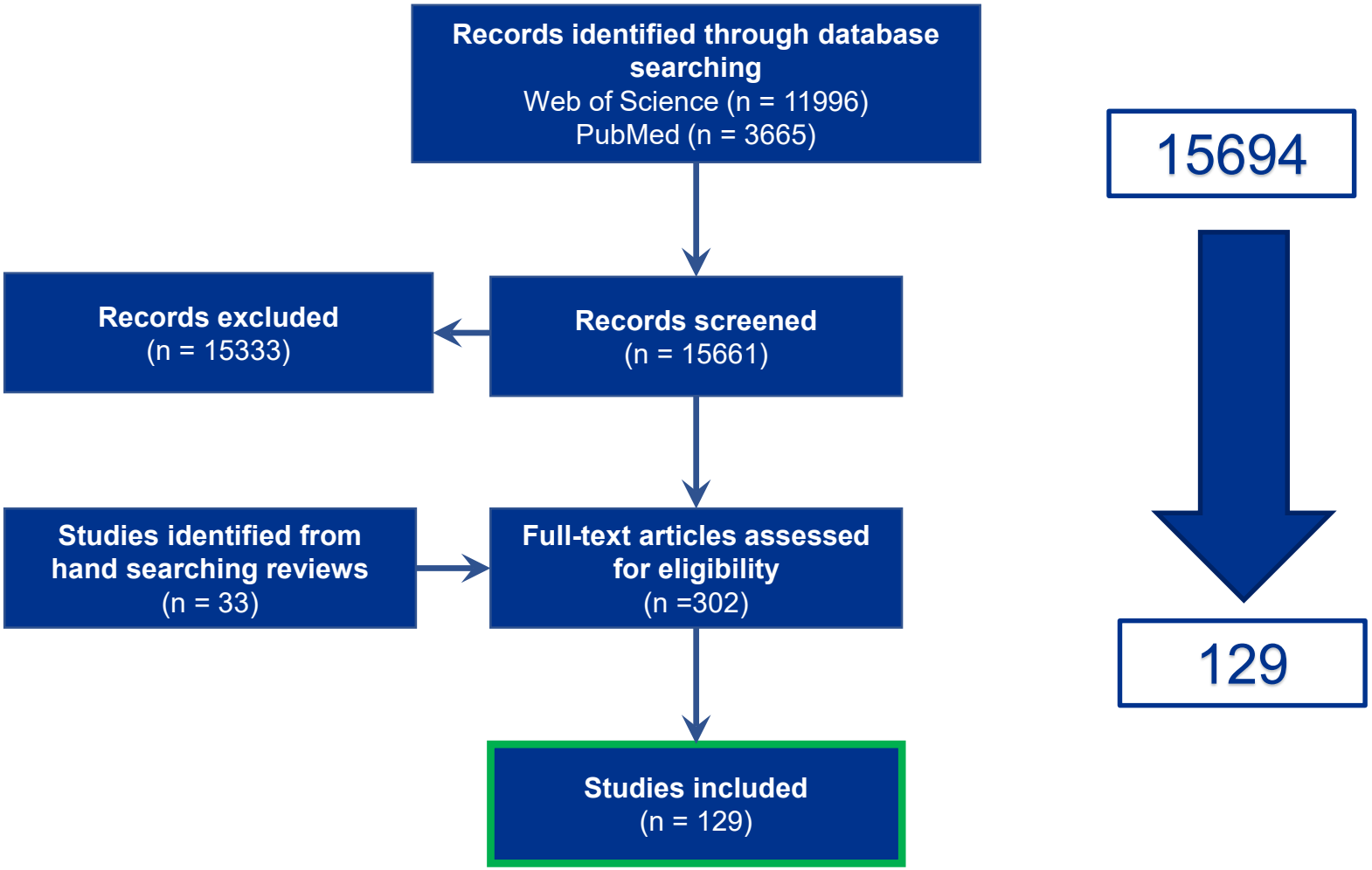
An integrative method for identification and prioritization of constituents of concern in produced water from onshore oil and gas extraction

Cloelle Danforth[a,*], Weihsueh A. Chiu[b], Ivan Rusyn[b], Kim Schultz[c], Ashley Bolden[c], Carol Kwiatkowski[c], Elena Craft[d,*]

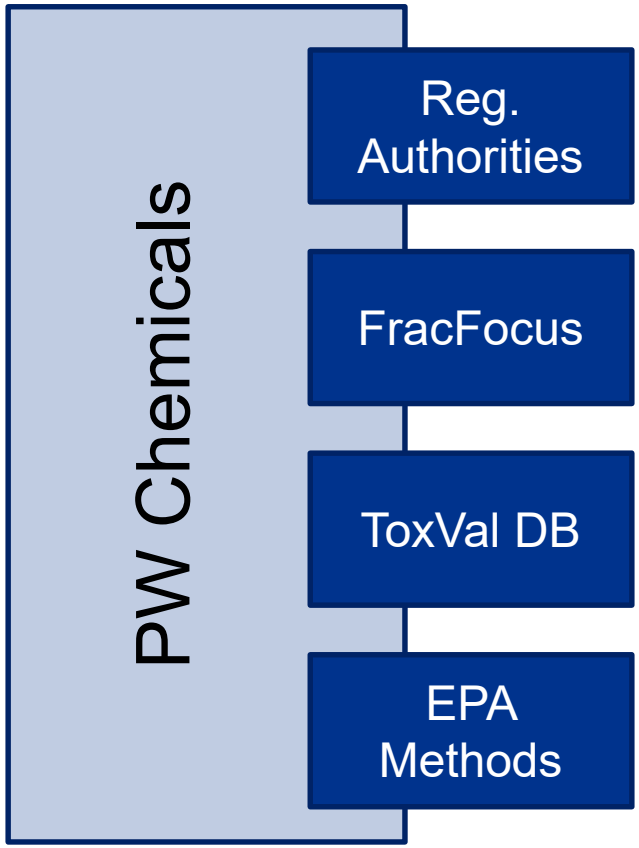
[a] Environmental Defense Fund, 2060 Broadway, Suite 300, Boulder, CO 80302, USA
[b] Department of Veterinary Integrative Biosciences, Texas A&M University, 4458 TAMU, College Station, TX 77843, USA
[c] The Endocrine Disruption Exchange, PO Box 54, Eckert, CO 81418, USA
[d] Environmental Defense Fund, 301 Congress Ave #1300, Austin, TX 78701, USA

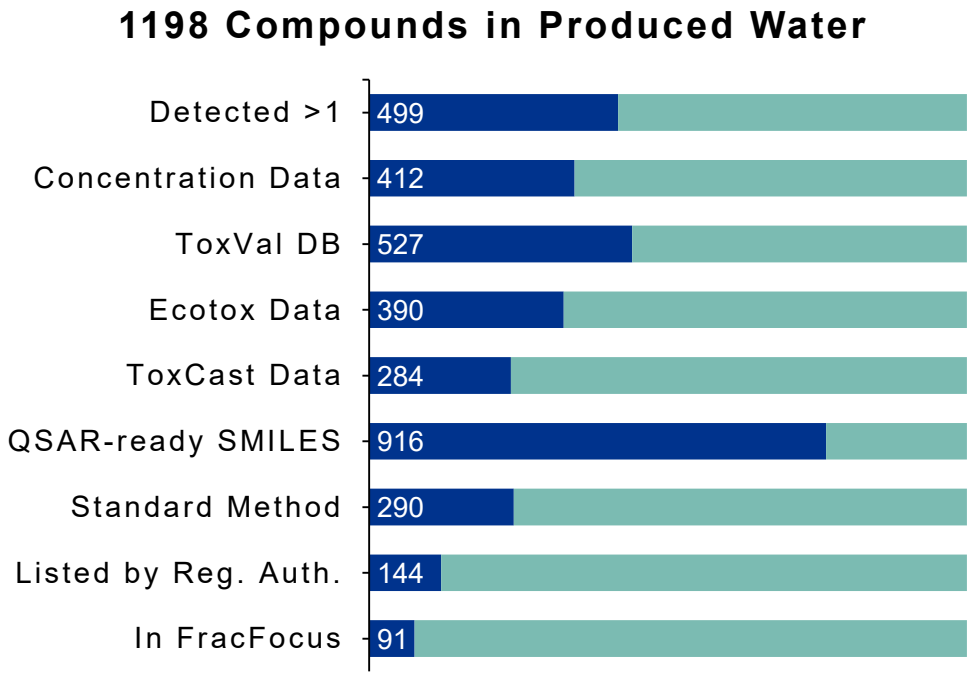
doi: https://doi.org/10.1016/j.envint.2019.105280


Oil OR Gas
AND
Conventional OR Unconventional
AND
Wastewater
AND
Chemical Characterization


Records identified through database searching
Web of Science (n = 11996)
PubMed (n = 3665)
Records excluded
(n = 15333)
Records screened
(n = 15661)
Studies identified from hand searching reviews
(n = 33)
Full-text articles assessed for eligibility
(n =302)
Studies included
(n = 129)
15694
129

X-walk to other databases

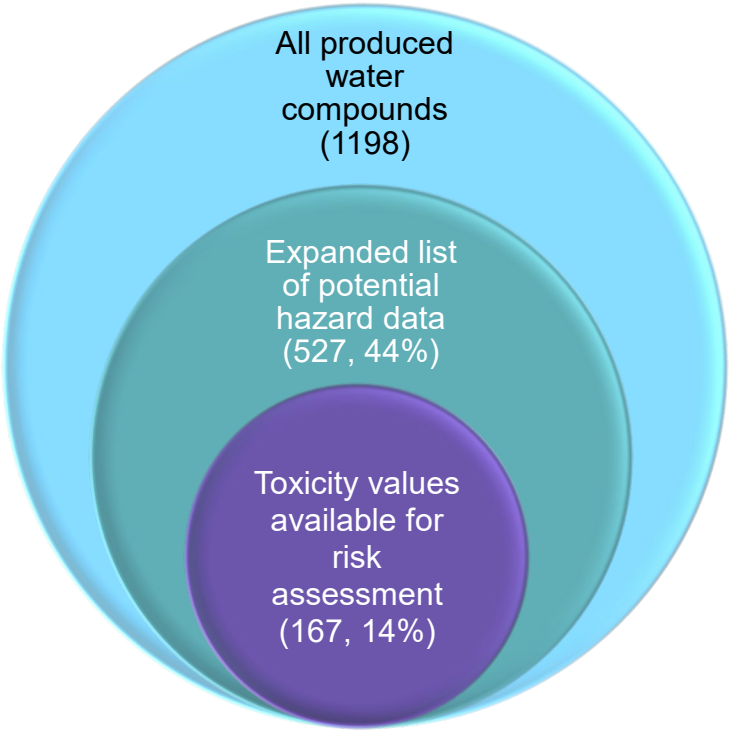




Standard Method: Hazardous Waste Test Methods/ SW-846, Title 40 of the Code of Federal Regulations Part 136 (40 CFR §136), National Environmental Methods Index (NEMI)

Listed by a regulatory authority (EPA DWS HA, RCRA, Priority Pollutant, TRI)

Toxicity data availability



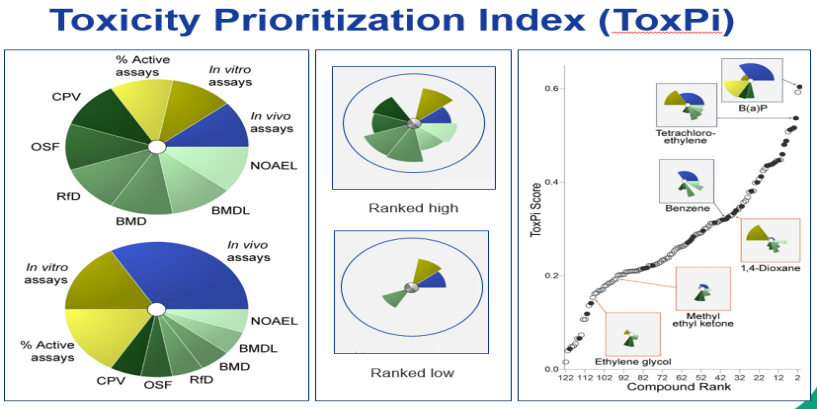
Expanded list (ToxVal DB): Number of Chemicals: 56314

As of August 2018 the ToxVal Database contains the following data: 772,721 toxicity values from 29 sources of data, 21,507 sub-sources, 4585 journals cited and 69,833 literature citations.

https://comptox.epa.gov/dashboard/chemical_lists/TOXVAL_V5

Quantitative toxicity values for risk assessment (per the OSWER Directive 9285.7–53 (U.S. EPA, 2003) and described by Wignall et al. 2018, doi: 0.1289/EHP2998):

- IRIS
- Office of Pesticide Programs
- Superfund Regional Screening Levels (CDC/ATSDR, PPRTV, HEAST)
- California EPA Office of Environmental Health Hazard Assessment



Next Phase

- Updating database (~50 new citations)
- Looking at exposure side of data
  - Physical/chemical data to understand how chemicals might be transported or move in the environment (water, soil, air, humans)
  - Different databases or models like EPA's CompTOX and EPI Suite
  - *only human
- Partners: CU Boulder, CO School of Mines

Toxicity Research Needs

Integrated Environmental Assessment and Management — Volume 15, Number 5—pp. 677–682

Received: 30 January 2019 | Returned for Revision: 22 February 2019 | Accepted: 15 April 2019

Brief Communication

Alternative Management of Oil and Gas Produced Water Requires More Research on Its Hazards and Risks

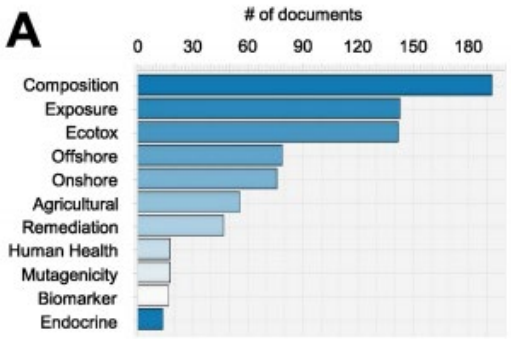
Cloelle Danforth,† Jennifer McPartland,‡ Jens Blotevogel,§ Nancy Coleman,|| Dennis Devlin,# Mandy Olsgard,†† Thomas Parkerton,‡‡ and Nichole Saunders§§*

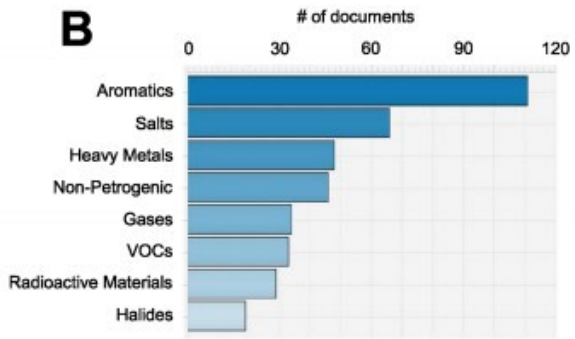
†Environmental Defense Fund, Boulder, Colorado, USA
‡Environmental Defense Fund, Washington, DC, USA
§Department of Civil and Environmental Engineering, Colorado State University, Fort Collins, Colorado, USA
||Environmental Consultants, Oklahoma City, Oklahoma, USA
#ExxonMobil Corporation, Irving, Texas, USA
††Department of Biological Sciences, University of Alberta, Edmonton, Alberta, Canada
‡‡ExxonMobil Biomedical Sciences, Inc, Spring, Texas, USA
§§Environmental Defense Fund, Austin, Texas, USA

Danforth et al, 2019 Conclusions

- Significant data gaps on produced water toxicity – research needed specifically on hazard and exposure
- Terrestrial tools are lacking (as compared to WET testing in the aquatic environment)
- Presents research frameworks to address gaps
- DOI: 10.1001/ieam.4160

Many more examples…

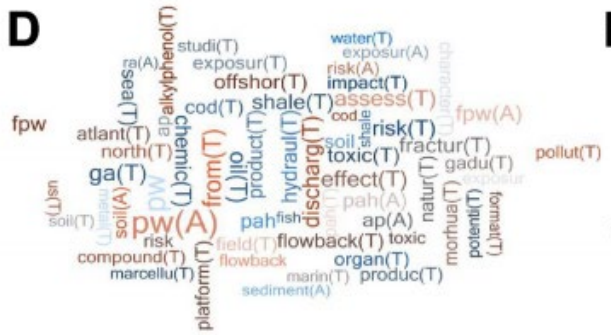


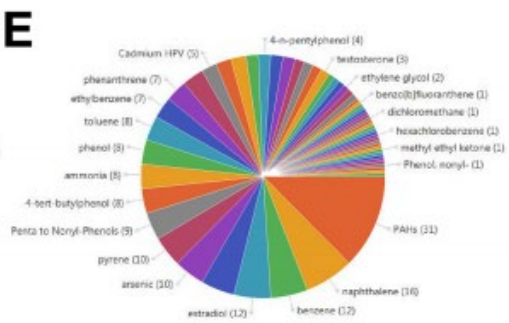


C

	Publication Year							
	1980-1984	1985-1989	1990-1994	1995-1999	2000-2004	2005-2009	2010-2014	2015-2018
Composition	0	1	4	12	19	50	44	63
Exposure	0	1	6	9	9	37	42	38
Ecotox	0	1	5	11	15	40	38	33
Offshore	0	1	2	9	11	19	21	16
Onshore	0	0	0	1	0	9	16	50
Agricultural	0	1	1	2	3	13	9	27
Remediation	0	0	0	1	1	10	11	24
Human Health	0	0	0	0	0	3	1	14
Mutagenicity	0	0	0	0	0	8	3	7
Biomarker	0	0	0	0	0	7	9	1
Endocrine	0	0	0	0	1	6	5	2

	Chemicals of Concern							
	Aromatics	Gases	Halides	Heavy Metals	Non-Petrogenics	Radioactive Materials	Salts	VOCs
Composition	109	22	10	36	32	23	50	29
Exposure	63	6	9	16	22	7	32	9
Ecotox	68	11	7	27	20	12	13	14
Offshore	38	5	0	13	10	8	7	6
Onshore	22	16	11	15	20	10	24	12
Agricultural	15	12	8	10	9	7	25	6
Remediation	13	8	7	6	7	3	15	3
Human Health	8	3	1	4	3	4	3	4
Mutagenicity	6	2	3	3	3	3	4	3
Biomarker	14	0	0	1	3	1	0	0
Endocrine	12	0	0	0	2	0	1	0





Check out literature review in Module 3!