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Environmental Protection Agency

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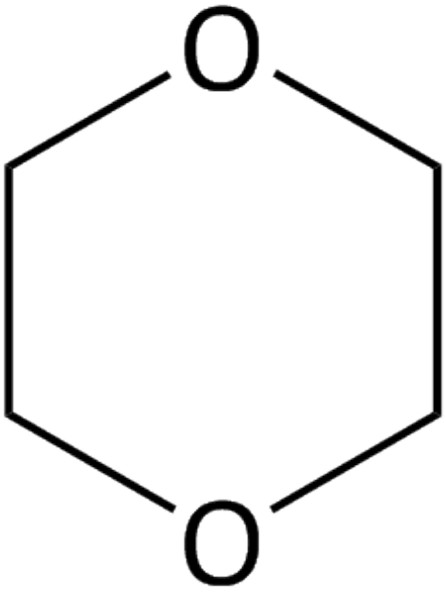
Office of Chemical Safety and
Pollution Prevention

Data Quality Evaluation Information for General Population, Consumer, and Environmental Exposure for 1,4-Dioxane (1,4-D)

Systematic Review Support Document for the Supplement to the Risk Evaluation

CASRN: 123-91-1



November 2024

This supplemental file contains information regarding the data quality evaluation results for data sources that were considered PECO-relevant for the *Supplement to the Risk Evaluation for 1,4-Dioxane*. EPA conducted data quality evaluation and extraction based on author-reported descriptions and results; additional analyses (e.g., statistical analyses) potentially conducted by EPA are not contained in this supplemental file. EPA performs data quality evaluation as a part of the TSCA systematic review process described in the *Draft Systematic Review Protocol Supporting TSCA Risk Evaluations for Chemical Substances*. The systematic review steps are further described in Appendix C of the *Supplement to the Risk Evaluation for 1,4-Dioxane*.

Additionally, the overall quality determination (OQD) for each reference represents the data as a whole for each evidence stream, not for individual scenarios described within a study. No OQD is determined for each reference, as a whole, if it contains data from more than one evidence stream. For example, a study that has data for monitoring and experimental would have one OQD for monitoring and one for experimental, each representative of distinct evidence streams. The OQD for monitoring would apply to all media monitored. Acronyms and abbreviations used within this supplemental file are defined in the table at the end of this file.

Table of Contents

Study Citation:	Romero, J., Ventura, F., Caixach, J., Romero, J., Gode, L. X., Ninerola, J. M. (1998). Identification of 1,3-dioxanes and 1,3-dioxolanes as malodorous compounds at trace levels in river water, groundwater, and tap water. Environmental Science & Technology 32(2):206-216.
HERO ID:	194342

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling methodology is discussed in detail. Sampling locations for the river and groundwater are reported in Figure 2. The exact location of Factory A was not disclosed. Sampling material, storage and preservation are also reported. Sampling duration and frequency was also reported.
	Metric 2:	Analytical Methodology	High	Analytical methodology is discussed in detail and the study analyzed 1,4-dioxane via GC/MS of CLSA extracts. The limit of detection is reported in Table 5 for wastewater (100 ug/L). Groundwater samples were collected, but CLSA was not adequate for determining 1,4-dioxane at low ppb levels and had a recovery of <1%.
	Metric 3:	Biomarker Selection	N/A	The study tested for 1,4-dioxane in environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The samples were collected in Barcelona and Girona, Spain.
	Metric 5:	Currency	Low	Wastewater samples were collected from November 1993 to June 1996, but Table 4 only displays samples collected from January 1994 to July 1995.
	Metric 6:	Spatial and Temporal Variability	Medium	Sample replicates are not reported for wastewater and 35 samples were collected for wastewater.
	Metric 7:	Exposure Scenario	High	Samples were collected across the Tordera river to evaluate the sources of odor complaints. Factory A was identified as the source of the odors and monitored, and 1,4-dioxane was detected in its wastewater. The river is the source of water supply for 140,000 -500,000 inhabitants, as well as for industries and agricultural areas.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data is not reported. Summary statistics (mean, maximum, minimum, and detection frequency) are reported in Table 4.
	Metric 9:	Quality Assurance	Medium	The study applied and documented QA/QC measures; however, one or more pieces of QA/QC information is not described. Missing information is unlikely to have a substantial impact on results. The study reports a range of QC measurements including recoveries and matrix effects. Reported data was corrected for recovery efficiency. The recovery efficiency values of 1,4-dioxane in wastewater samples were no reported. Baseline samples were not reported.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Variability reported in terms of range and percentage per range (table 5). Limitation regarding the instrument sensitivity reported.

Overall Quality Determination Medium

Study Citation:	Abe, A. (1999). Distribution of 1,4-dioxane in relation to possible sources in the water environment. Science of the Total Environment 227(1):41-47.
HERO ID:	194346

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sampling methodology for 1,4-dioxane surface and groundwater as well as effluents from chemical plants and activated sludge inflow and treated river basin sewerage and apartment house treatment effluent samples in Kanagawa Prefecture, Japan described in terms of sampling equipment, procedures, storage containers, and study site characteristics. Duration of sample storage prior to analysis lacking.
	Metric 2:	Analytical Methodology	Medium	Detection limits reported. Analytical methodology detailed in terms of extraction and analytical instrumentation. Some details, such as instrument calibration, not detailed.
	Metric 3:	Biomarker Selection	N/A	Sampling for chemical of interest within environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples collected in Kanagawa Prefecture, Japan.
	Metric 5:	Currency	Low	Sampling conducted 1995-1998.
	Metric 6:	Spatial and Temporal Variability	Medium	Text notes n=38 samples from 17 sites in 7 rivers with 9 from coastal sea areas, and a total of n=65 groundwater samples obtained. Sampling performed once or twice annually for surface water (some replicate sampling). Sampling of chemical plants obtained during two separate runs for two plants.
	Metric 7:	Exposure Scenario	Medium	No exposure controls. Text notes, “At specific points at seven sites in three rivers and 20 wells, sampling was performed once or twice annually” and “Effluents from two combined collection treatments of apartment houses, three river basin sewerage systems, and chemical plants were also collected”. Source of exposure not detailed.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Tables 2 shows the raw data, the range, and median of the concentrations for river water and groundwater sampling. Text page 5 provides secondary consumer product data.
	Metric 9:	Quality Assurance	Low	Quality assurance not discussed and no baseline or control sampling other than influent versus effluent results. Recoveries not reported.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Variability of results reported within statistical summary measures for surface and groundwater samples, but not chemical plant or river basin sewerage results. Sites sampled throughout location of Kanagawa. Potential study limitations not detailed.

Overall Quality Determination — Medium

Study Citation:	Zygmunt, B. (1998). Distillation preconcentration and clean-up of aqueous samples for direct aqueous injection-gas chromatographic determination of volatile polar organic pollutants. Fresenius' Journal of Analytical Chemistry JOURNAL OF ANALYTICAL CHEMISTRY(1):86-89.
HERO ID:	1010122

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Critically Deficient	The specific sampling methodology is not discussed in the paper. The only description available was that "sample was taken from the trunk sewer at the site where the waste water is discharged from the factory waste water treatment plant to a river."
	Metric 2:	Analytical Methodology	High	Extraction, analytical methods, instrument (GC), calibration, detection limits detailed.
	Metric 3:	Biomarker Selection	N/A	This metric is not applicable (n/a) if the study is testing for the parent chemical in an environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	Critically Deficient	Geographic location is not reported, discussed, or referenced.
	Metric 5:	Currency	Low	Timing of sample collection for monitoring data is not reported. Study published in 1998.
	Metric 6:	Spatial and Temporal Variability	Critically Deficient	Only 1 sample was reported to be collected (page 4, section 3.4).
	Metric 7:	Exposure Scenario	Medium	The sample was reported to be from trunk sewer at the site where the wastewater was discharged (environmental media) from a pharmaceutical factory. However, details about the population exposed is missing.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	The sample result was reported as a single result.
	Metric 9:	Quality Assurance	Low	Recoveries are <70% (table 1). Other QC measures not reported.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Variability and uncertainty were not discussed.

Overall Quality Determination — Uninformative

Study Citation:	Ramírez, N., Marcé, R. M., Borrull, F. (2011). Determination of volatile organic compounds in industrial wastewater plant air emissions by multi-sorbent adsorption and thermal desorption-gas chromatography-mass spectrometry. International Journal of Environmental Analytical Chemistry 91(10):911-928.
HERO ID:	1061745

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sampling methodology is discussed in the study and is generally appropriate. Sampling site (Tarragona industrial complex), procedure, equipment (Tenax TA tube with air sampling pump SKC Eighty Four USA), and calibration were described, though sampling storage was not mentioned.
	Metric 2:	Analytical Methodology	High	Analytical method is clearly described, yet extraction method was not mentioned. Method detection and quantification limit was reported as a range.
	Metric 3:	Biomarker Selection	N/A	Study chemical is in an environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were taken from an industrial WWTP located in the South Industrial Complex of the Tarragona area, Spain.
	Metric 5:	Currency	Medium	The samples were collected in November 2008.
	Metric 6:	Spatial and Temporal Variability	Medium	Sixteen samples were taken in the industrial WWTP. It's not mentioned whether replicate samples were taken.
	Metric 7:	Exposure Scenario	Medium	Site 2 data discussed the exposure scenario of wastewater - post-treatment tank.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Summary statistics were reported: average, max, and min values were reported in Table 4.
	Metric 9:	Quality Assurance	High	The study applied quality assurance/quality control measures and all pertinent quality assurance information is provided in the study.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	The study did not have description of the limitations of the study though such lack of description was not likely to substantially impact the results.

Overall Quality Determination Medium

Study Citation:	Kim, C. G., Seo, H. J., Lee, B. R. (2006). Decomposition of 1,4-dioxane by advanced oxidation and biochemical process. Journal of Environmental Science and Health, Part A: Toxic/Hazardous Substances & Environmental Engineering 41(4):599-611.
HERO ID:	1725816

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sampling methodology is briefly discussed and is missing information. The sample matrix was characterized and described. Details such as sample storage/duration and sampling equipment and procedure are not provided.
	Metric 2:	Analytical Methodology	Low	The analytical methodology is clear and appropriate, and the study analyzed 1,4-dioxane via GCMS. The limit of detection is not reported. Recoveries and calibration are not reported.
	Metric 3:	Biomarker Selection	N/A	The study tested for 1,4-dioxane in environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Wastewater was sampled from two textile companies in Gumi, Gyungsanbukdo, Korea.
	Metric 5:	Currency	Low	The sample collection date is not reported, but the paper was published in 2006.
	Metric 6:	Spatial and Temporal Variability	Critically Deficient	The sample size is not reported and replicate sampling was not discussed.
	Metric 7:	Exposure Scenario	Low	Study tested for optimal decomposition conditions for 1,4-dioxane degradation in synthetic as well as actual wastewater samples from two polyester textile plants in South Korea. The source of 1,4-dioxane described only as from industrial textile operations. The exposure scenario is not well characterized and no exposure controls were reported.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Low	Raw data is not reported. Concentration data from the actual textile plant wastewater from two different plants reported in Table 1 (point value and range). Sample size and frequency of detection are not reported.
	Metric 9:	Quality Assurance	Low	QA/QC measures are not discussed and issues were not identified. Baseline, pre-exposure, and control sampling are not reported.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Variability of results reported only as range for Table 1 results. Key uncertainties, limitations, and data gaps are not discussed.

Overall Quality Determination — Uninformative

Study Citation: Even-Ezra, I., Mizrahi, A., Gerrity, D., Snyder, S., Salveson, A., Lahav, O. (2009). Application of a novel plasma-based advanced oxidation process for efficient and cost-effective destruction of refractory organics in tertiary effluents and contaminated groundwater. Desalination and Water Treatment 11(1-3):236-244.

HERO ID: 1739517

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Critically Deficient	Sampling methodology for the contaminated groundwater concentration result reported in Table 1 (which is Table 2 effluent result as well) not discussed or referenced.
	Metric 2:	Analytical Methodology	Critically Deficient	Analytical methodology not discussed for 1,4-dioxane within contaminated groundwater.
	Metric 3:	Biomarker Selection	N/A	Sampling for chemical of interest within environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples collected in California.
	Metric 5:	Currency	Medium	Sampling dates not reported, publication date 2009.
	Metric 6:	Spatial and Temporal Variability	Critically Deficient	Number of samples not reported for groundwater in Table 1.
	Metric 7:	Exposure Scenario	Low	Sampling site described only as “contaminated” in California.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Low	Unclear statistical summary measure (raw or average) for reported result in Table 1 and Table 2 influent as number of samples specified. No other statistical summary measures reported.
	Metric 9:	Quality Assurance	Low	Quality assurance not discussed and no baseline or control sampling. Recoveries not reported.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Variability of results not reported within statistical summary measures. Potential study limitations not detailed.

Overall Quality Determination Uninformative

Study Citation:	Lee, I. S., Sim, W. J., Kim, C. W., Chang, Y. S., Oh, J. E. (2011). Characteristic occurrence patterns of micropollutants and their removal efficiencies in industrial wastewater treatment plants. Journal of Environmental Monitoring 13(2):391-397.
HERO ID:	1787908

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sampling methodology for 1,4-dioxane samples of industrial wastewater treatment effluent described in terms of sampling equipment, sample storage and study site characteristics. Details on procedures and sample storage duration prior to analysis lacking.
	Metric 2:	Analytical Methodology	High	Detection limits reported in supplemental materials. Analytical methodology detailed in terms of extraction, analytical instrumentation, calibration, recoveries. Analyses described as conducted according to modified U.S. EPA methods.
	Metric 3:	Biomarker Selection	N/A	Sampling for chemical of interest within environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples collected in Daegu, Jinju, Haman and Yangsan City, South Korea.
	Metric 5:	Currency	Medium	Sampling conducted December of 2005.
	Metric 6:	Spatial and Temporal Variability	Low	28 total samples taken across nine wastewater treatment plants (WWTPs) as reported in table 2. However, only one sample taken for each plant at effluent. No replicate samples taken. Sampling conducted only in December of 2005 across nine WWTPs.
	Metric 7:	Exposure Scenario	High	Industrial WWTP grab sampling conducted at WWTP influent and effluent, as well as inlet and outlets of each treatment steps. Input sources of each plant described in table 1.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Tables 2 and S1 provide effluent sampling results. Number of samples not directly reported but may be inferred from table 2 (28 samples). Frequency of detection noted (text page 4) as 100% for 1,4-dioxane.
	Metric 9:	Quality Assurance	Medium	Quality assurance discussed within supplemental material with description of method blanks and recoveries. Recoveries ranged from 50-120%. Lack of baseline, pre-exposure or control sampling.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Variability of results not reported within statistical summary measures as results reported as single values, but characterized through different locations sampled. Potential study limitations not discussed.
Overall Quality Determination			**Medium**	

Study Citation:	Stepien, D. K., Püttmann, W. (2013). Simultaneous determination of six hydrophilic ethers at trace levels using coconut charcoal adsorbent and gas chromatography/mass spectrometry. Analytical and Bioanalytical Chemistry 405(5):1743-1751.
HERO ID:	2228940

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling methodology for 1,4-dioxane samples of surface water from rivers and a canal described in terms of sampling equipment, procedures, sample storage, sample storage duration prior to analysis and study site characteristics and locations.
	Metric 2:	Analytical Methodology	High	Detection limits and limits of quantification reported in Table 5. Analytical methodology detailed in terms of extraction, analytical instrumentation, calibration, recoveries. Extraction procedure described as conducted according to modified U.S. EPA methods.
	Metric 3:	Biomarker Selection	N/A	Sampling for chemical of interest within environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples collected in Wesel Datleln Canal and Lippe, Rhein, Main, Schwarzbach, Rur and Oder rivers in Germany.
	Metric 5:	Currency	Medium	Sampling conducted October, 2011 and February, 2012.
	Metric 6:	Spatial and Temporal Variability	Medium	Total number of samples reported as n=27 with n=24 conducted in 2011 and n=4 in 2012. Replicate samples taken within some rivers, as noted in Table 2. Sampling conducted only in October, 2011 and February, 2012. 3 sites (Lippe, Schwarzbach, and Rur) have single sample.
	Metric 7:	Exposure Scenario	Medium	Surface water sampling conducted within several rivers and a canal in Germany. However, exposure receptor and sources and not well characterized.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Table 6 provides surface water sampling results within each river/canal. Number of samples reported within Table 6 as n=27. Raw data not reported overall, however a single sample was obtained from three rivers, the Rur, Schwarzbach and Lippe rivers (with single concentration result in Table 6). Results reported as medians with minimum and maximum concentration summary statistics. Frequency of detection noted (text page 8) as 100% for 1,4-dioxane.
	Metric 9:	Quality Assurance	Medium	Quality assurance discussed within text with description of method blanks and recoveries. Recoveries >70%. Lack of baseline, pre-exposure or control sampling.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Variability of results reported within statistical summary measures (minimum, maximum) for some rivers, but not all. Variation also characterized by different locations sampled. Potential study limitations not discussed.

Overall Quality Determination — Medium

Study Citation:	Stepien, D. K., Diehl, P., Helm, J., Thoms, A., Püttmann, W. (2014). Fate of 1,4-dioxane in the aquatic environment: From sewage to drinking water. Water Research 48(Elsevier):406-419.
HERO ID:	2545899

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Low	Sampling methods are discussed and generally appear scientifically sound. Sample preservation and storage was reported in section 2.3. Sample location, equipment and duration were reported for the samples collected from the wastewater treatment plant and surface waters. However, sample equipment was not reported for the samples collected from drinking water treatment facilities, the authors only reported that it "was performed by an external company". This missing information is unlikely to have a substantial impact on results. Sampling methodology for groundwater samples is not reported
	Metric 2:	Analytical Methodology	Medium	Analytical methods are discussed and generally appear scientifically sound. Sample extraction and instrumentation are reported. A US EPA method (2008) is cited and some recoveries are reported. However, recoveries and limits are only reported for the surface water samples and not the wastewater or drinking samples.
	Metric 3:	Biomarker Selection	N/A	This metric does not apply as the parent compound was measured in environmental media
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Location of surface water and drinking water samples are reported. However, location of wastewater treatment plants are not reported.
	Metric 5:	Currency	Medium	Samples were collected in 2012-2013.
	Metric 6:	Spatial and Temporal Variability	Medium	Sample size varies by media, but likely captures variability of environmental contamination in each scenario of interest. At each wastewater treatment plant, 7 samples were collected. At each of the three rivers measured there were 19, 49, and 15 samples collected. Samples at the drinking water facilities were collected at different locations (raw water, wells, and drinking water) and sample numbers ranged from 1-9.
	Metric 7:	Exposure Scenario	High	The data closely represent a relevant exposure scenario. The aim of this paper was to measure the occurrence of 1,4-dioxane in the water cycle. The authors measured 1,4-dioxane at multiple points in several wastewater and drinking water treatment plants and along three rivers.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Summary statistics are reported, but raw data are not reported and the summary statistics cannot be reproduced.
	Metric 9:	Quality Assurance	High	The study applied and documented quality control measures. Method blanks, controls, and surrogates were used with recoveries ranging from 70-130%.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	The authors discuss temporal and spatial variability in dioxane distributions, but a the discussion of uncertainties and limitations is absent.

Overall Quality Determination Medium

Study Citation: Han, T. H., Han, J. S., So, M. H., Seo, J. W., Ahn, C. M., Min, D. H., Yoo, Y. S., Cha, D. K., Kim, C. G. (2012). The removal of 1,4-dioxane from polyester manufacturing process wastewater using an up-flow Biological Aerated Filter (UBAF) packed with tire chips. Journal of Environmental Science and Health, Part A: Toxic/Hazardous Substances & Environmental Engineering 47(1):117-129.

HERO ID: 2567781

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Critically Deficient	Sampling methodology for 1,4-dioxane samples of treated wastewater effluent described only in terms of site characteristics. Details regarding sampling equipment, procedures, sample storage conditions and sample storage duration prior to analysis lacking.
	Metric 2:	Analytical Methodology	Low	Detection limits are not reported. Analytical methodology detailed in terms of extraction and analytical instrumentation while data regarding calibration, recoveries are lacking.
	Metric 3:	Biomarker Selection	N/A	The study tested for 1,4-dioxane in environmental media (wastewater).
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Effluent wastewater samples collected in the Gumi Industrial Complex, South Korea
	Metric 5:	Currency	Low	The sample collection date is not reported, but the paper was published in 2012.
	Metric 6:	Spatial and Temporal Variability	Critically Deficient	The sampling size was not reported and replicate sampling was not reported.
	Metric 7:	Exposure Scenario	Medium	In this study, a lab-scale up-flow biological aerated filter (UBAF) packed with tire chips was investigated for the treatment of 1,4-dioxane and fed with treated wastewater anaerobically treated effluent from a polyester manufacturing facility. The source of 1,4-dioxane was described as polyester manufacturing process. NOTE 1 of 2: Text was confusing as text describes anaerobic effluent as discharging into wastewater treatment, but abstract also notes this as treated effluent, “”The UBAF was fed with effluent, containing an average of 31 mg/L of 1,4-dioxane, discharged from an anaerobic treatment unit at H Co. in the Gumi Industrial Complex, South Korea”. NOTE 2 of 2: Text page 3 notes wastewater discharged into Nakdong River, which is also a source of drinking water.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Low	Table 1 provides anaerobically treated wastewater effluent (used as influent for the study bio-reactor) sampling results as means and standard deviations. Table 4 wastewater effluent from bio-reactor reported as means only. Number of samples not reported. Raw data not reported. Frequency of detection not reported.
	Metric 9:	Quality Assurance	Low	QA/QC measures are not discussed and issues were not identified. Recoveries, baseline, pre-exposure, and control sampling are not reported.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Variability of results reported within statistical summary measures (standard deviation) for Table 1 results, but not Table 4. Key uncertainties, limitations, and data gaps are not discussed.

Overall Quality Determination Uninformative

Study Citation:	Lee, K. C., Beak, H. J., Choo, K. H. (2015). Membrane photoreactor treatment of 1,4-dioxane-containing textile wastewater effluent: Performance, modeling, and fouling control. Water Research 86(Elsevier):58-65.
HERO ID:	3021437

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Critically Deficient	No sampling methodology is provided. The only information provided is the wastewater samples used for this study were taken from the effluent stream of a textile manufacturing factory in Korea.
	Metric 2:	Analytical Methodology	Low	Analytical instrument reported. LOD and other details such as calibration and recoveries not reported.
	Metric 3:	Biomarker Selection	N/A	Study is testing for the parent chemical in an environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Korea.
	Metric 5:	Currency	Low	Sampling date not reported. Publication date is 2015.
	Metric 6:	Spatial and Temporal Variability	Critically Deficient	No sample size is provided. From table 1, it seems like 1 sample was taken from the feed (effluent) and product.
	Metric 7:	Exposure Scenario	Low	”The wastewater samples used for this study were taken from the effluent stream of a textile manufacturing factory in Korea”. The exposure route is not well characterized but the scenario is of interest for the chemical.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	High	The concentration is provided in Table 1. No summary statistics can be provided with only 1 sample taken.
	Metric 9:	Quality Assurance	Low	QA/QC measures are not discussed and no issues were not identified by the study. Recoveries not reported.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	The characterization of variability and limitations are absent.

Overall Quality Determination — Uninformative

Study Citation:	Carrera, G., Vegué, L., Boleda, M. R., Ventura, F. (2017). Simultaneous determination of the potential carcinogen 1,4-dioxane and malodorous alkyl-1,3-dioxanes and alkyl-1,3-dioxolanes in environmental waters by solid-phase extraction and gas chromatography tandem mass spectrometry. Journal of Chromatography A 1487(Elsevier):13-Jan.
HERO ID:	3537746

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	The sampling methodology is clear and appropriate, and includes details such as equipment and sample storage. Sample storage duration is not provided.
	Metric 2:	Analytical Methodology	Low	The analytical methodology and extraction, SPE (based on EPA method 522) and GC-MS, are well described. MQL is provided for surface water. Method detection and quantification limits for 1,4-dioxane in wastewater could not be determined due to the presence of 1,4-dioxane in the matrix analyzed.
	Metric 3:	Biomarker Selection	N/A	Study is testing for parent chemical in an environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Spain.
	Metric 5:	Currency	High	Samples were collected from October to November 2015.
	Metric 6:	Spatial and Temporal Variability	Medium	70 total samples were collected, as few as 6 collected for a location. Replicates are not reported.
	Metric 7:	Exposure Scenario	Medium	The exposure scenario is not well characterized. The study is testing for the presence of the chemical in groundwater and wastewater from WTTP, but it is not clear what the exposure route is.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data is not reported. Summary statistics (means, standard deviations, minimum and maximum concentrations) are provided in Table 7.
	Metric 9:	Quality Assurance	Medium	Quality control measures such as the use of a standard solution, recoveries, and control samples are discussed. QA/QC issues were not identified. Some recoveries are below 70%.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Standard deviations are provided in Table 7. Uncertainty was discussed in the results section. Limitations are not reported.
Overall Quality Determination			**Medium**	

Study Citation:	Gedalanga, P. B., Pornwongthong, P., Mora, R., Chiang, S. Y., Baldwin, B., Ogles, D., Mahendra, S. (2014). Identification of biomarker genes to predict biodegradation of 1,4-dioxane. Applied and Environmental Microbiology 80(10):3209-3218.
HERO ID:	3537910

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Critically Deficient	The sampling methodology is extremely brief: "Activated sludge samples were collected from an industrial wastewater treatment plant with dioxane concentrations ranging between 50 and 100 mg/liter".
	Metric 2:	Analytical Methodology	Critically Deficient	The analytical methodology is not described on how they found the initial dioxane concentrations of the samples.
	Metric 3:	Biomarker Selection	N/A	Study is testing for the parent chemical in an environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in the US.
	Metric 5:	Currency	Low	Publication date is 2014. No sample collection date is provided.
	Metric 6:	Spatial and Temporal Variability	Critically Deficient	No sample size is provided.
	Metric 7:	Exposure Scenario	Low	The exposure scenario is not well characterized. The study was testing 1,4-dioxane in an industrial wastewater treatment plant.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Low	Raw data is not provided. The range of concentrations is given in the text. In figure 3, there is a concentration of this chemical shown at time 0.
	Metric 9:	Quality Assurance	Low	QA/QC measures are not discussed and issues were not identified.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Uncertainty and data gaps related to the sludge samples is not discussed. The only variability information provided is the range.

Overall Quality Determination — Uninformative

Study Citation:	Gurung, A., Hassan, S. H., Oh, S. E. (2011). Assessing acute toxicity of effluent from a textile industry and nearby river waters using sulfur-oxidizing bacteria in continuous mode. Environmental Technology 32(13-14):1597-1604.
HERO ID:	3537930

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Low	Sampling equipment and methods were not reported, with the exception that samples were transported in a polyethylene container on ice and immediately stored at 4°C prior to conducting the experiments.
	Metric 2:	Analytical Methodology	Low	Samples were analyzed by gas chromatography fitted with a mass spectrometer (GC-MS) (Agilent 7890A, Agilent Technology, USA). No information on extraction, operating conditions or calibration was provided. A limit of detection was not provided.
	Metric 3:	Biomarker Selection	N/A	Analysis of TSCA chemical in wastewater and river water.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected at a textile plant in Korea.
	Metric 5:	Currency	Low	Date of samples not provided, but presumed to be prior to 2010 based on publication date.
	Metric 6:	Spatial and Temporal Variability	Critically Deficient	Number of samples not explicitly reported. It is known that river samples were collected upstream and downstream of the plant. These concentrations were reported as ND. The effluent sample was reported as 273 +/- 15.2 ug/L, but the type of value was not reported. It is unknown if it is average of multiple samples collected, or duplicate analysis of the same sample. The study reports that the experiment was conducted in duplicate, but that information was provided under the statistical analysis section and does not shed light on the number of samples collected. The timing of the samples was not reported, however, there does not appear to be seasonal or multi-year samples.
	Metric 7:	Exposure Scenario	Medium	Samples were collected from the textile plant effluent and both and up and downstream of the textile plant. The upstream site is primarily influenced by non-point agricultural runoff (without industrial effluent) and the downstream site is impacted by effluent from an industrial complex and wastewater treatment plants. This type of information is highly relevant, however, since the intent of the study was to assess the use of bioassays to monitor and manage effluents, little else is known about the exposure scenario. No microclimate data was reported (exact location, time, climate).
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Low	There is no raw data and stats reported are not clear. Table 1 with the results does not indicate if the values are means or single samples. A +/- value was reported for the effluent, but was not described.
	Metric 9:	Quality Assurance	Critically Deficient	There was no discussion of QA/QC practices (blanks, recoveries, etc.) and the field and lab protocols were not discussed to assume the use of QA/QC.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	There was no discussion on uncertainty, variability, or limitations in the measurements.

Overall Quality Determination — Uninformative

Study Citation:	Han, J. S., So, M. H., Kim, C. G. (2009). Optimization of biological wastewater treatment conditions for 1,4-dioxane decomposition in polyester manufacturing processes. Water Science and Technology 59(5):995-1002.
HERO ID:	3537968

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sampling methodology for 1,4-dioxane samples industrial wastewater effluent described in terms of sampling equipment, procedures, sample storage and study site characteristics. Details on sample storage duration prior to analysis lacking.
	Metric 2:	Analytical Methodology	Low	Detection limit not reported. Analytical methodology detailed in terms of extraction and analytical instrumentation. Details on recoveries, calibration and detection limit lacking.
	Metric 3:	Biomarker Selection	N/A	Sampling for chemical of interest within environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples collected in polyester/nylon manufacturing sites in the Republic of Korea.
	Metric 5:	Currency	Medium	Sampling conducted 2007.
	Metric 6:	Spatial and Temporal Variability	Low	Total number of samples not reported, however text notes three factory sites sampled. Replicate sampling not conducted for wastewater. Fig 2a reports a total 4 effluent samples from the 3 sites.
	Metric 7:	Exposure Scenario	Medium	This study examined the effectiveness in 14-dioxane removal from wastewater using activated sludge as a biological treatment within three industrial polyester and nylon manufacturing facilities in the Republic of Korea. Source of 1,4-dioxane exposure noted as industrial processes.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Low	Figure 2a provides wastewater treatment effluent concentration data (also text page 5). Number of samples not reported, however sampling conducted at three industrial sites, with site T sampled twice for a total of 4 samples. Results reported as single values with no indication of summary statistics. Frequency of detection not noted.
	Metric 9:	Quality Assurance	Low	Quality assurance not discussed within text with no description of method blanks and recoveries. Lack of baseline, pre-exposure or control sampling.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Variability of results not reported within statistical summary measures. Potential study limitations not discussed.

Overall Quality Determination Low

Study Citation:	Isaka, K., Udagawa, M., Sei, K., Ike, M. (2016). Pilot test of biological removal of 1,4-dioxane from a chemical factory wastewater by gel carrier entrapping Afipia sp. strain D1. Journal of Hazardous Materials 304:251-258.
HERO ID:	3537988

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Critically Deficient	The study described the wastewater was from a chemical factory, but specific sampling methodology was not provided, including equipment, procedure, and storage.
	Metric 2:	Analytical Methodology	Low	Analytical methodology is discussed: concentration of 1,4D in samples were determined by solid phase extraction-gas chromatography-mass spectrometry. The study LOQ, LOD, detection limits, and/or reporting limits not reported.
	Metric 3:	Biomarker Selection	N/A	Chemical was measured in an environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The study took samples from a chemical factory in Japan.
	Metric 5:	Currency	Low	No sampling date is provided, but a publication date (2016) is available.
	Metric 6:	Spatial and Temporal Variability	Critically Deficient	Sample size is not reported, and cannot be inferred. The average, min, and max are reported, indicating more than one sample.
	Metric 7:	Exposure Scenario	Medium	The samples were relevant exposure route from influent and effluent samples of the wastewater from the chemical factory to study a chemical removal method.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data are not reported. Average, minimum, and maximum values were reported.
	Metric 9:	Quality Assurance	Low	Quality assurance/quality control techniques and results were not directly discussed but can be inferred from the study protocols.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Description about the variability and limitation regarding the data is missing.

Overall Quality Determination — Uninformative

Study Citation:	Li, M., Mathieu, J., Yang, Y., Fiorenza, S., Deng, Y., He, Z., Zhou, J., Alvarez, P. J. (2013). Widespread distribution of soluble di-iron monooxygenase (SDIMO) genes in Arctic groundwater impacted by 1,4-dioxane. Environmental Science & Technology 47(17):9950-9958.
HERO ID:	3538108

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sampling methodology is not indicated from an authoritative source but is clear. Sampling equipment, storage, site characteristics are described, though some other information like calibration or sample duration were lacking.
	Metric 2:	Analytical Methodology	High	There were 2 ways that the authors analyzed the chemicals. One method was conducted according to EPA method 8260 followed by GC/MS. The second method was conducted by a novel method using frozen microextraction followed by GC/MS. The authors provide MDLs for both methods (Table 2).
	Metric 3:	Biomarker Selection	N/A	Chemical was tested in an environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The site was reported to be on the north slope of Alaska, and that it was an oil and gas industrial facility surrounded by Arctic tundra and was impacted by chlorinated solvents spills.
	Metric 5:	Currency	Medium	Samples were collected in August 2010.
	Metric 6:	Spatial and Temporal Variability	Low	4 monitoring wells were sampled.
	Metric 7:	Exposure Scenario	Medium	The data likely represent the relevant exposure scenario.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	The 4 sampling data were reported as single point data. No variance was reported.
	Metric 9:	Quality Assurance	Low	Quality assurance/quality control techniques and results were not directly discussed; no recoveries were reported.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	The study did not describe the uncertainties and limitations associated with the data/media.
Overall Quality Determination			**Medium**	

Study Citation:	Li, M., Van Orden, E. T., Devries, D. J., Xiong, Z., Hinchee, R., Alvarez, P. J. (2015). Bench-scale biodegradation tests to assess natural attenuation potential of 1,4-dioxane at three sites in California. Biodegradation 26(1):39-50.
HERO ID:	3538109

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Soil core and groundwater samples were collected from three sites in California. Groundwater samples were collected using a sterile disposable bailers and preserved at 4C, soil samples were obtained during well installation or as well bottom sediment during groundwater sample collection.
	Metric 2:	Analytical Methodology	Medium	Detection limit reported as approximately 1ug/L. Samples were analyzed by a GC/MS-SIM, but no information regarding accuracy and precision were reported.
	Metric 3:	Biomarker Selection	N/A	Not applicable because parent 1,4-dioxane was measured in groundwater and soil samples.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	California
	Metric 5:	Currency	Medium	Samples were collected in June 2012.
	Metric 6:	Spatial and Temporal Variability	Low	Sample size is not explicitly reported but can be estimated. Plumes at three industrial sites were sampled., with two to nine sampling sites around each plume. It is assumed that there is only one groundwater or soil core sample per sampling site, although different layers were sampled. The water and soil samples from each well were used to make triplicate microcosms per sampling site.
	Metric 7:	Exposure Scenario	Low	There are 3 different impacted industrials sites at unknown locations in CA: Site 1 was impacted by 1,1,1-TCA and 1,1-dichloroethene, this site is characterized by a significant decrease in 1,4-dioxane concentrations over last few decades. Site 2 was exposed to dioxane from an up-gradient unknown source and contained a small dioxane plume. Site 3 reported an unknown source for an aquifer contained a 0.2 mile-long-plume. While we know that the sites were impacted, the study did not describe information about the type of industry or the release itself. Additionally, while the samples of groundwater and soil core are considered real world, the analysis was conducted on the liquid samples in the microcosms.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data is not reported. Table 1 reports data per site as average and SD for groundwater samples.
	Metric 9:	Quality Assurance	Low	Recoveries are not reported as well as key QA/QC parameters.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	A ”plus minus” value was provided for the initial dioxane concentration, but was not clearly defined. It is presumed to be a a measure of variability for the triplicate microcosm samples. The study doesn’t report limitations regarding the monitoring portion of the study.

Overall Quality Determination Medium

Study Citation:	Simonich, S. M., Sun, P., Casteel, K., Dyer, S., Wernery, D., Garber, K., Carr, G., Federle, T. (2013). Probabilistic analysis of risks to US drinking water intakes from 1,4-dioxane in domestic wastewater treatment plant effluents. Integrated Environmental Assessment and Management 9(4):554-559.
HERO ID:	3539074

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	The sampling methodology is detailed and appears scientifically sound. The sampling equipment, locations, sampling storage conditions, and sample duration are reported.
	Metric 2:	Analytical Methodology	High	Analytical methods are detailed and scientifically sound. Sample extraction method, analytical instrumentation, instrument calibration, limits, and recoveries are reported.
	Metric 3:	Biomarker Selection	N/A	This metric is not applicable because the parent chemical (1,4-diocane) was analyzed in environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Texas, Oklahoma, Kansas, California, Oregon, Illinois, Indiana, Ohio, Kentucky, New Jersey, New York, Pennsylvania, Georgia, Tennessee.
	Metric 5:	Currency	Medium	Samples were collected in 2010.
	Metric 6:	Spatial and Temporal Variability	High	Samples were collected from 40 different municipal wastewater treatment plants. Duplicate samples were collected.
	Metric 7:	Exposure Scenario	High	The data closely represent relevant/realistic exposure scenarios. The aim of the paper was to measure dioxane concentrations in wastewater effluent from plants receiving domestic wastewater in the US. The paper sampled 40 municipal plants from various regions around the country and considered seasonal variation when sampling.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Summary statistics are reported in the main text, but raw data is not available in the main text or the supplemental document and summary statistics cannot be reproduced.
	Metric 9:	Quality Assurance	High	The study applied quality control measures and reports the results in the main text. Travel blanks and recoveries were measured. No dioxane was reported in the travel blanks, "indicating no contamination occurred during field sampling". Recoveries ranged from 80-90%.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	High	Variability and limitations is discussed throughout several paragraphs at the end of the paper. Variability is accounted for different locations sampled. Potential sources of limitations discussed include if grab samples are representative in nature of the effluent overall and if seasonal or diurnal changes have been reported in wastewater. The authors use citations from other papers in the field to support their assertions about these potential sources of variability.
Overall Quality Determination			**High**	

Study Citation:	Sun, M., Lopez-Velandia, C., Knappe, D. R. (2016). Determination of 1,4-Dioxane in the Cape Fear River Watershed by Heated Purge-and-Trap Preconcentration and Gas Chromatography-Mass Spectrometry. Environmental Science & Technology 50(5):2246-2254.
HERO ID:	3539133

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling methodology is detailed and appears scientifically sound. Sampling equipment, sampling duration, and storage conditions are reported. Sample storage followed EPA method 522.
	Metric 2:	Analytical Methodology	High	Analytical methods and extraction are detailed and scientifically sound. The method developed in this paper was verified against EPA methods 8270 and 522. The pre-concentration step (in lieu of an extraction), instrumentation, instrument calibration, limits, and recoveries were all reported.
	Metric 3:	Biomarker Selection	N/A	This metric is not applicable because the parent chemical (1,4-diocane) was analyzed in environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in the Cape Fear River watershed.
	Metric 5:	Currency	High	Samples were collected from Oct 2014 to July 2015
	Metric 6:	Spatial and Temporal Variability	High	A total of 64 samples were collected. Duplicate samples were taken at sites selected at random to check method reproducibility.
	Metric 7:	Exposure Scenario	High	The data closely represent relevant exposure scenario. The aim of this study was to measure 1,4-dioxane in the CFR watershed and assess the contribution of WWTPs. To meet this aim, samples were collected "to bracket 8 WWTP discharge points" along the watershed. This sampling scheme likely captures the relevant exposure scenario well. WWTP discharge samples were also collected in two communities located in the CFR watershed.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Box plots are provided in Figure 4 for each site. Raw data is not provided.
	Metric 9:	Quality Assurance	Medium	Raw data are reported in table S4, but they are only identified by sample number and not linked to any sampling location, which will make replicating and interpreting the summary statistics difficult.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	The study characterizes variability in the media studied, by time and location, but has a limited discussion of uncertainties, limitations, and data gaps.

Overall Quality Determination High

Study Citation:	Barndok, H., Hermosilla, D., Han, C., Dionysiou, D. D., Negro, C., Blanco, A. (2016). Degradation of 1,4-dioxane from industrial wastewater by solar photocatalysis using immobilized NF-TiO2 composite with monodisperse TiO2 nanoparticles. Applied Catalysis B: Environmental 180:44-52.
HERO ID:	3578754

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Critically Deficient	Sampling methodology for 1,4-dioxane samples of treated wastewater effluent described only in terms of site characteristics and supplied by chemical factory. Details regarding sampling equipment, procedures, sample storage and sample storage duration prior to analysis lacking.
	Metric 2:	Analytical Methodology	Low	Detection limits not reported. Analytical methodology detailed in terms of extraction and analytical instrumentation while data regarding calibration, recoveries lacking.
	Metric 3:	Biomarker Selection	N/A	Sampling for chemical of interest within environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	Critically Deficient	Samples described only as industrial wastewater post-treatment effluent supplied by a chemical factory.
	Metric 5:	Currency	Low	Sampling dates not reported. Publication date is 2016.
	Metric 6:	Spatial and Temporal Variability	Critically Deficient	Total number of samples not reported. Information regarding replicate sampling not detailed.
	Metric 7:	Exposure Scenario	Low	In this study, the effect of various wastewater matrices on the removal of 1,4-dioxane was studied and a treatment of an industrial wastewater contaminated with 1,4-dioxane was carried out. Source of 1,4-dioxane described only as from chemical factory.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Low	Table 1 provides treated wastewater effluent sampling results only in terms of a concentration range. Number of samples not reported. Raw data not reported. Frequency of detection not reported.
	Metric 9:	Quality Assurance	Low	Quality assurance not discussed. Lack of baseline, pre-exposure or control sampling.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Variability of results reported within statistical summary measures (range) for Table 1 results. Potential study limitations not discussed.

Overall Quality Determination — Uninformative

Study Citation:	Pozzi, R., Bocchini, P., Pinelli, F., Galletti, G. C. (2006). Rapid analysis of tile industry gaseous emissions by ion mobility spectrometry and comparison with solid phase micro-extraction/gas chromatography/mass spectrometry. Journal of Environmental Monitoring 8(12):1219-1226.
HERO ID:	3579234

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Critically Deficient	Sampling methodology for 1,4-dioxane samples of ambient air industrial ceramic tile kiln emissions described only in terms of site characteristics and limited information on procedures. Details regarding sampling equipment, sample storage and sample storage duration prior to analysis lacking.
	Metric 2:	Analytical Methodology	Low	Detection limits not reported. Analytical methodology detailed in terms of extraction, calibration and analytical instrumentation while data regarding recoveries lacking. The paper compared IMS and GC/MS analysis techniques of VOCs.
	Metric 3:	Biomarker Selection	N/A	Sampling for chemical of interest within environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Sampling conducted within residential areas where industrial kilns were operated within the areas of Sassudo in Modena, Italy.
	Metric 5:	Currency	Low	Sampling dates not reported. Publication date 2006.
	Metric 6:	Spatial and Temporal Variability	Critically Deficient	Total number of samples not reported. Information regarding replicate sampling not detailed.
	Metric 7:	Exposure Scenario	Medium	In this study, results from ambient air industrial ceramic tile kiln emissions sampling utilizing a rapid method for the analysis of gaseous emissions, based on ion mobility spectrometry (IMS) as a means for on-site monitoring of volatile organic compounds (VOCs) was compared with emissions sampling results analyzed utilizing gas chromatography/mass spectrometry.Source of 1,4-dioxane described only as from industrial ceramic tile kiln operations.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Low	Table 2 provides ambient air industrial kiln emissions (mg/m^3) sampling results only in terms of a single value. Number of samples not reported. Raw data not reported (Table S1 reports data from non-relevant, non-real world pilot kiln emissions). Frequency of detection not reported.
	Metric 9:	Quality Assurance	Low	Quality assurance not discussed. Lack of baseline, pre-exposure or control sampling.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Variability of results not reported for Table 2 results. Potential study limitations in terms of analytical techniques discussed.

Overall Quality Determination — Uninformative

Study Citation:	Priddle, M. W., Lesage, S., Jackson, R. E. (1992). Analysis of oxygenated solvents in groundwater by dynamic thermal stripping-GC-MSD. International Journal of Environmental Analytical Chemistry 49(3):117-123.
HERO ID:	3579242

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling methodology for 1,4-dioxane samples of landfill groundwater described in terms of sampling equipment, study site characteristics and storage conditions.
	Metric 2:	Analytical Methodology	Medium	Limit of quantification reported in text page 5. Analytical methodology detailed in terms of extraction, analytical instrumentation with lack of information regarding calibration and recoveries.
	Metric 3:	Biomarker Selection	N/A	Sampling for chemical of interest within environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples collected in groundwater at the Gloucester landfill near Ottowa, Canada.
	Metric 5:	Currency	Low	Sampling conducted September, 1989.
	Metric 6:	Spatial and Temporal Variability	Medium	Total number of samples reported as n=33. Replicate samples described as taken (text page 6). Sampling conducted only September of 1989.
	Metric 7:	Exposure Scenario	Medium	This study proposed a 1,4-dioxane analytic method which provided a lower detection limit than what was standard at the time and was utilized to define a 1,4-dioxane groundwater plume from a former solvent and medical disposal site at the Gloucester landfill near Ottowa, Canada. Additional details about the landfill site is described elsewhere, which may contain information about the population affected.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Low	Figures 3 and 4 note concentrations. Number of samples noted as n=33. Raw data not reported, "the contours in plan view are based upon the maximum concentration in each multilever sampler." Results reported as single concentrations with no variability summary statistics. Frequency of detection not noted.
	Metric 9:	Quality Assurance	Low	Quality assurance not discussed. Lack of baseline, pre-exposure or control sampling, but can be implied based on the article's protocols.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Variability of results not reported within statistical summary measures of data. Potential study limitations not discussed.

Overall Quality Determination Medium

Study Citation:	Isaacson, C., Mohr, T. K. G., Field, J. A. (2006). Quantitative determination of 1,4-dioxane and tetrahydrofuran in groundwater by solid phase extraction GC/MS/MS. Environmental Science & Technology 40(23):7305-7311.
HERO ID:	3579567

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Low	This article reads as a method paper (i.e. they are using an experimental technique to sample for 1,4-dioxane) and does not really include traditional sampling techniques. The duration of sample storage is also lacking.
	Metric 2:	Analytical Methodology	High	The extraction, instrument, calibration curves, recoveries, and analytical methodology are clear and appropriate, and the LOQ of 0.31 micrograms per liter is provided.
	Metric 3:	Biomarker Selection	N/A	Study is testing for the parent chemical in an environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	Critically Deficient	No location given for the industrial site from which samples were collected. This article reads as a method paper (i.e. they are using an experimental technique to sample for 1,4-dioxane). The paper does not really document the location and doesn't really include traditional sampling techniques.
	Metric 5:	Currency	Low	Publication date is 2006. No sample collection date is provided.
	Metric 6:	Spatial and Temporal Variability	Medium	57 samples obtained from 57 wells. No duplicates (one time sampling campaign).
	Metric 7:	Exposure Scenario	Medium	The exposure scenario is not well characterized. The study is testing for dioxane in groundwater, but the exposure route is not described. It is mentioned that the samples were collected from a former industrial site.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Mean and SE for each well are provided in Table 2; however, no raw data is provided.
	Metric 9:	Quality Assurance	Medium	QA/QC measures are discussed in detail and the use of blanks is reported. No QA/QC issues were identified. High recoveries reported (>70%).
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	SE are provided in Table 2 for variability. No limitations are reported.

Overall Quality Determination — Uninformative

Study Citation:	Lee, K. C., Choo, K. H. (2013). Hybridization of TiO2 photocatalysis with coagulation and flocculation for 1,4-dioxane removal in drinking water treatment. Chemical Engineering Journal 231:227-235.
HERO ID:	3580139

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Critically Deficient	No sampling methodology reported, only the location of the samples.
	Metric 2:	Analytical Methodology	Low	Extraction, analytical methodology and instrument reported. Detection limit, calibration and recoveries are not reported.
	Metric 3:	Biomarker Selection	N/A	Study is testing for the parent chemical in an environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Korea.
	Metric 5:	Currency	Low	Sampling date not reported. Publication date is 2013.
	Metric 6:	Spatial and Temporal Variability	Critically Deficient	No sample size is provided.
	Metric 7:	Exposure Scenario	Low	The exposure scenario is 1,4-dioxane in surface water in Korea. The exposure route is not well characterized, including source and population affected.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	High	Value of ND is provided in Table 1.
	Metric 9:	Quality Assurance	Low	QA/QC measures were not discussed and issues were not reported, but can be inferred from the paper's procedures.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	The characterization of variability and limitations are absent.

Overall Quality Determination — Uninformative

Study Citation:	Lee, W., Park, S. H., Kim, J., Jung, J. Y. (2015). Occurrence and removal of hazardous chemicals and toxic metals in 27 industrial wastewater treatment plants in Korea. Desalination and Water Treatment 54(4-5):1141-1149.
HERO ID:	3580141

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Low	Sampling methodology is briefly discussed and is missing information. The study site was characterized. Details such as sample storage conditions, sampling equipment and procedure, and matrix characteristics are not provided, but staff members at each WWTP collected samples and immediately delivered to the laboratory for analysis. Given the use of trained WWTP staff and the partial support for the research from three grants, inferred acceptable methods were used.
	Metric 2:	Analytical Methodology	Medium	According to the authors, the analytical procedure was conducted in an "authorized laboratories according to the Korea Standard Methods for the Examination of Water and Wastewater, which is on the basis of Standard Methods." Liquid liquid extraction gas chromatography/mass spectrometry was applied for analysis. Detection limit was reported as 0.001 mg/L.
	Metric 3:	Biomarker Selection	N/A	Chemical was measured in an environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Location is in Korea.
	Metric 5:	Currency	Medium	Samples were collected between July through September 2012.
	Metric 6:	Spatial and Temporal Variability	Medium	There are 27 WWTPs that were sampled, and the sampling campaign was conducted 3 times at each WWTP (once each month). Table 4 reports a sample size of 81 for each pollutant. Replicate sampling was not reported.
	Metric 7:	Exposure Scenario	Medium	The study reported that the exposure route is wastewater and the study analyzed for 1,4-dioxane in both influents and effluents. Exposure controls or background samples were not represented.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data are not reported, and therefore summary statistics cannot be reproduced. Summary statistics are reported in Table 4 (minimum, 25th percentile, median, 75th percentile, and maximum).
	Metric 9:	Quality Assurance	Low	QA/QC measures are not discussed and issues were not identified. Recoveries, baseline, pre-exposure, and control sampling are not reported.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	The study reported the interquartile ranges that reflect the variability of the data. Key uncertainties, limitations, and data gaps are not discussed.

Overall Quality Determination Medium

Study Citation:	Pugazhendi, A., Banu, J. R., Dhavamani, J., Yeom, I. T. (2015). Biodegradation of 1,4-dioxane by Rhodanobacter AYS5 and the role of additional substrates. Annals of Microbiology 65(4):2201-2208.
HERO ID:	3672270

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Critically Deficient	No sampling methodology provided.
	Metric 2:	Analytical Methodology	Low	Extraction and analytical methods and instrument reported. Detection limit, recoveries, and calibration not reported.
	Metric 3:	Biomarker Selection	N/A	Study is testing for the parent chemical in an environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	Critically Deficient	No sample location given.
	Metric 5:	Currency	Low	Publication date is 2015. No sample collection date provided.
	Metric 6:	Spatial and Temporal Variability	Critically Deficient	No sample size provided. Possibly single sample collected based on reported concentration.
	Metric 7:	Exposure Scenario	Low	The exposure scenario is 1,4-dioxane in wastewater. The route of exposure and source are unclear.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	High	The concentration is provided in the methods section.
	Metric 9:	Quality Assurance	Low	QA/QC measures are not discussed and issues are not identified.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	The characterization of variability is absent. Limitations are not reported.

Overall Quality Determination Uninformative

Study Citation: Kawata, K., Ibaraki, T., Tanabe, A., Yagoh, H., Shinoda, A., Suzuki, H., Yasuhara, A. (2001). Gas chromatographic-mass spectrometric determination of hydrophilic compounds in environmental water by solid-phase extraction with activated carbon fiber felt. Journal of Chromatography A 911(1):75-83.

HERO ID: 3798945

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Critically Deficient	The sampling methodology for collection of river water samples is not provided.
	Metric 2:	Analytical Methodology	High	Extraction, analytical methods, instrument, recoveries, calibration curves, and detection limits reported.
	Metric 3:	Biomarker Selection	N/A	Study is testing for the parent chemical in an environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected from rivers in Japan.
	Metric 5:	Currency	Low	Samples were collected in June 2000.
	Metric 6:	Spatial and Temporal Variability	Low	1 sample collected from each of the 4 rivers (pg 8 of pdf).
	Metric 7:	Exposure Scenario	Low	The exposure scenario is 1,4-dioxane in river water. The route of exposure and source are not well characterized, but this is a scenario of interest for the chemical.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Concentrations are provided in the text of page 8. It is unclear if these are raw data or are average concentrations.
	Metric 9:	Quality Assurance	Low	QA/QC measures are not discussed and issues were not identified.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	The characterization of variability and limitations are absent.

Overall Quality Determination — Uninformative

Study Citation:	Yamamoto, N., Saito, Y., Inoue, D., Sei, K., Ike, M. (2018). Characterization of newly isolated Pseudonocardia sp. N23 with high 1,4-dioxane-degrading ability. Journal of Bioscience and Bioengineering 125(5):552-558.
HERO ID:	4356768

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Critically Deficient	No sampling methodology provided for this sample. Only location reported.
	Metric 2:	Analytical Methodology	Low	Only analytical instrument described for the sample taken. Detection limits not reported.
	Metric 3:	Biomarker Selection	N/A	Study is testing for the parent chemical in an environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Sample was collected in Japan.
	Metric 5:	Currency	Low	Publication date is 2017.
	Metric 6:	Spatial and Temporal Variability	Critically Deficient	Single sample described in methods on page 2.
	Metric 7:	Exposure Scenario	Low	Sample was from groundwater, no other information given about exposure scenario.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	High	Single raw data sample is provided in methods section on page 2. No summary statistics can be produced for single sample.
	Metric 9:	Quality Assurance	Low	No QA/QC measures or issues are discussed but can inferred from the study's protocols.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	The characterization of variability and limitations are absent.

Overall Quality Determination Uninformative

Study Citation: Mahmoud, M., Elreedy, A., Pascal, P.,eu, Sophie, L.,eR, Tawfik, A. (2017). Hythane (H-2 and CH4) production from unsaturated polyester resin wastewater contaminated by 1,4-dioxane and heavy metals via up-flow anaerobic self-separation gases reactor. Energy Conversion and Management 152:342-353.

HERO ID: 4432805

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Low	The sampling methodology is very brief and missing details such as sample size, sampling procedure, sample storage. etc.
	Metric 2:	Analytical Methodology	Critically Deficient	No analytical methodology is provided for the samples in Table 1.
	Metric 3:	Biomarker Selection	N/A	Study is testing for the parent chemical in an environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Egypt.
	Metric 5:	Currency	Low	Publication date is 2017, but sampling date was not provided.
	Metric 6:	Spatial and Temporal Variability	Critically Deficient	No sample size is provided.
	Metric 7:	Exposure Scenario	Low	The exposure scenario is not well characterized. The study is measuring 1,4-dioxane in wastewater, but the exposure route is unclear. An inference can be drawn that the wastewater that was the source of the real-world samples was not intended to be treated once it reaches the sewer system, but that is also uncertain.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	The mean and standard deviation are provided in Table 1. Raw data are not provided.
	Metric 9:	Quality Assurance	Low	QA/QC measures are not reported and issues are not discussed. The use of blanks or controls is not reported.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Some information is provided about variability from the standard deviation. Neither uncertainty nor data gaps related to the monitored data were discussed.

Overall Quality Determination Uninformative

Study Citation:	Blotevogel, J., Pijls, C., Scheffer, B., de Waele, J. P., Lee, A., van Poecke, R., van Belzen, N., Staal, W. (2019). Pilot-scale electrochemical treatment of a 1,4-dioxane source zone. Ground Water Monitoring and Remediation 39(1):36-42.
HERO ID:	5078859

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Critically Deficient	No sampling methodology described for the pilot test.
	Metric 2:	Analytical Methodology	Critically Deficient	No analytical methodology described for the pilot test.
	Metric 3:	Biomarker Selection	N/A	Study is testing for the parent chemical in an environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	Critically Deficient	Location of groundwater samples is not reported.
	Metric 5:	Currency	Low	Sampling date not reported. Publication date is 2019.
	Metric 6:	Spatial and Temporal Variability	Critically Deficient	No sample size is reported for the pilot test.
	Metric 7:	Exposure Scenario	Low	The exposure scenario is not well characterized. The study is testing for 1,4-dioxane in groundwater, but the route of exposure is unclear.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	The range of concentrations is reported in methods section "Groundwater Influent Characterization". Raw data is not provided.
	Metric 9:	Quality Assurance	Low	QA/QC measures are not discussed and issues were not reported. Controls and recoveries not reported.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	The characterization of variability is absent. No measures of variance or limitations are provided.

Overall Quality Determination — Uninformative

Study Citation:	Karges, U., Ott, D., De Boer, S., Püttmann, W. (2020). 1,4-Dioxane contamination of German drinking water obtained by managed aquifer recharge systems: Distribution and main influencing factors. Science of the Total Environment 711:134783.
HERO ID:	6392878

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling methodology for 1,4-dioxane samples of finished drinking water and surface water described in terms of sampling equipment, procedures, sample storage and duration of storage prior to analysis and study site characteristics.
	Metric 2:	Analytical Methodology	High	Detection limits reported. Analytical methodology detailed in terms of extraction, analytical instrumentation, calibration, recoveries and limits of quantification.
	Metric 3:	Biomarker Selection	N/A	Sampling for chemical of interest within environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples collected in various municipalities of Germany including Berlin, Saxony, North Rhine-Westphalia, Rhineland-Palatinate, Hesse, Baden-Wurttemberg and Bavaria.
	Metric 5:	Currency	High	Sampling conducted April, 2015 through February of 2016.
	Metric 6:	Spatial and Temporal Variability	Medium	Total number of samples reported as n=125 (Table 1) with the number of samples ranging from 1-27 from each region. Duplicate samples taken in some areas. Sampling conducted April 2015 through February 2016 across a wide variety of German regions (Figure 2).
	Metric 7:	Exposure Scenario	Medium	Blank field and method sampling conducted. Finished drinking water samples along with corresponding source surface water samples across multiple regions and municipalities in Germany.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Figures 4, 6 and 7 and Figures S1-S3 report concentration data by region and districts with Tables S2 and S3 providing raw data by location. Figures report concentration results as means with standard errors. Number of samples reported in Table 1. Frequency of detection not detailed.
	Metric 9:	Quality Assurance	Medium	Quality assurance discussed within methods description and text description of field and method blanks and recoveries. Lack of baseline, pre-exposure sampling.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Variability of results reported within statistical summary measures of standard deviations within figures. Potential study limitations not directly discussed, however reasons for variation in concentrations discussed.

Overall Quality Determination Medium

Study Citation:	Matsushita, T., Sugita, W., Ishikawa, T., Shi, G., Nishizawa, S., Matsui, Y., Shirasaki, N. (2019). Prediction of 1,4-dioxane decomposition during VUV treatment by model simulation taking into account effects of coexisting inorganic ions. Water Research 164:114918.
HERO ID:	6575251

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sampling methodology for 1,4-dioxane in samples of groundwater described only briefly in terms of sampling procedures and study site characteristics (raw groundwater inputs to full-scale drinking water treatment plants) and storage conditions. Details regarding sampling equipment and duration of storage prior to analysis lacking.
	Metric 2:	Analytical Methodology	Low	Detection limits not reported. Analytical methodology detailed only in terms of analytical instrumentation with details on instrument calibration, recoveries and extraction lacking.
	Metric 3:	Biomarker Selection	N/A	Sampling for chemical of interest within environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples collected from raw inputs to drinking water treatment plants in Tachikawa, Japan.
	Metric 5:	Currency	Low	Sampling dates not reported. Publication date 2019.
	Metric 6:	Spatial and Temporal Variability	Low	Total number of groundwater samples reported as n=3. No replicate sampling, and dates of sampling not reported.
	Metric 7:	Exposure Scenario	Medium	Groundwater collected from raw water inputs to drinking water treatment plants in Tachikawa, Japan. However, source and population affected not reported.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Low	Table 1 presents concentration results for groundwater samples (surface and tap water samples were spiked) in terms of a single concentration with no statistical variability summary measures. Number of samples reported in Table 1. Frequency of detection not detailed.
	Metric 9:	Quality Assurance	Low	Quality assurance not discussed. Lack of baseline, pre-exposure sampling and use of field and/or laboratory blanks, recoveries not detailed.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Variability of results not reported within statistical summary measures within Table 1. Potential study limitations not discussed.

Overall Quality Determination Low

Study Citation:	Battaglin, W., Duncker, J., Terrio, P., Bradley, P., Barber, L., DeCicco, L. (2020). Evaluating the potential role of bioactive chemicals on the distribution of invasive Asian carp upstream and downstream from river mile 278 in the Illinois waterway. Science of the Total Environment 735(Elsevier):139458.
HERO ID:	6838249

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sites are described in the study and were stored on ice and shipped on ice to the appropriate laboratory within 24 h of collection. More description of the study sites, sample collection methods, and stream flow conditions at the time of sample collection is provided in Duncker and Terrio (2017).
	Metric 2:	Analytical Methodology	Low	Extraction, analytical methodology and calibration is clear and appropriate and samples were analyzed by USGS labs; however, no LOD and recoveries are provided for 1,4-dioxane.
	Metric 3:	Biomarker Selection	N/A	Study is testing for the parent chemical in an environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in the Illinois River, US.
	Metric 5:	Currency	High	Samples were collected from May to October 2015.
	Metric 6:	Spatial and Temporal Variability	Medium	28 samples were analyzed, with samples taken at different locations of the river. No replicates are reported.
	Metric 7:	Exposure Scenario	Medium	The exposure scenario is 1,4 dioxane in surface waters of the Illinois River, which could affect the fish in the river. This is a scenario of interest for the chemical. Source of exposure is briefly described, but exact source not detailed.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Number of detections and maximum concentration are provided in Table S1. Raw data is not provided.
	Metric 9:	Quality Assurance	High	Quality control measures are described and the use of field blanks is reported. No QA/QC issues were identified.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	The characterization of variability is absent and no measures of variance are provided. Limitations not reported.

Overall Quality Determination Medium

Study Citation:	Lee, K. H., Wie, Y., Jahng, D., Yeom, I. (2020). Effects of Additional Carbon Sources in the Biodegradation of 1,4-Dioxane by a Mixed Culture. Water 12(6):1718.
HERO ID:	6839421

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sampling methodology is briefly discussed. The sample matrix was characterized and described. Details such as sample storage/duration and sampling equipment and procedure are not provided.
	Metric 2:	Analytical Methodology	Low	The analytical methodology is clear and appropriate, and the study analyzed 1,4-dioxane via GC/MS of LLE extracts. Recoveries and the limit of detection are not reported.
	Metric 3:	Biomarker Selection	N/A	The study tested for 1,4-dioxane in environmental media (wastewater).
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The samples were collected in Korea.
	Metric 5:	Currency	Low	The sample collection date is not reported, but the paper was published in 2020.
	Metric 6:	Spatial and Temporal Variability	Critically Deficient	Sample size is not reported for Table 1.
	Metric 7:	Exposure Scenario	Low	The exposure scenario is not well characterized. The study is testing for 1,4-dioxane in wastewater from a textile wastewater treatment plant. The exposure route is not described.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Low	Raw data is not reported. One summary statistic (a range) is reported in Table 1.
	Metric 9:	Quality Assurance	Low	QA/QC measures are not discussed and issues were not identified.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	The characterization of variability is absent. No measures of variance were reported. Uncertainty is not discussed.

Overall Quality Determination — Uninformative

Study Citation:	Simazaki, D., Asami, M., Nishimura, T., Kunikane, S., Aizawa, T., Magara, Y. (2006). Occurrence of 1,4-dioxane and MTBE in drinking water sources in Japan. Water Supply 6(2):47-53.
HERO ID:	6839456

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling materials, procedure, time, storage and transport is reported.
	Metric 2:	Analytical Methodology	Medium	Analytical methodology and time of analysis is well described. Analytical conditions reported in table 2. Determination limits were reported. Some information missing such as calibration.
	Metric 3:	Biomarker Selection	N/A	This metric is not applicable because the study is testing for the parent chemical (1,4-dioxane) in water.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Japan (nationwide)
	Metric 5:	Currency	Low	Samples were collected between 2001 to 2002.
	Metric 6:	Spatial and Temporal Variability	Medium	The survey was nationwide and a high number of plants were sampled (n=91) in 2001, resulting in sampling at 80 sites using surface water and 11 sites using groundwater. Additional samples were collected in 2001 from 29 plants with high 1,4-dioxane or VOC levels. It appears only 1 sample was collected per site (no replicates).
	Metric 7:	Exposure Scenario	Medium	1,4 -dioxane levels in raw water at 91 drinking water treatment plants in Japan. Samples were collected prior to a revision of the drinking water standard (lowered to 50 ug/L). Parameters such as air temperature, water temperature, pH, color, turbidity and potassium permanganate consumption were measured at collection but not reported. It is also unclear what the source of contamination is.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Low	Table 4 reports detection frequency and average concentration for surface and groundwater, but is missing further summary statistics and raw data. Table 5, however, reports raw data for 9 of the sampling points with the co-occurrence of 1,4-dioxane and MTBE. Figure 3 reports the results of the 29 samples in 2002, but only in terms of number of samples per concentration level.
	Metric 9:	Quality Assurance	Low	The study followed a published analytical procedure, implying the use of QA/QC There is no discussion of QA/QC procedures or recovery values.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	There is no statistical measurement of variability, and key limitations are not reported. There is variability in the areas sampled throughout Japan.

Overall Quality Determination Medium

Study Citation:	Yamada, H., Ikeda, M., Suzuki, K., Konishi, S., Oikawa, T. (2010). Implementation of water safety plan efforts to improvement of source water quality in Tokyo waterworks. Water Practice and Technology 5(3):wpt2010050.
HERO ID:	6839458

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Low	The study reports results from a monitoring program conducted by Tokyo Waterworks, but sampling methodology not reported. Sampling was conducted by a government institution, therefore the score is low.
	Metric 2:	Analytical Methodology	Critically Deficient	Detection limit was reported in the text, but analytical methodology was not reported.
	Metric 3:	Biomarker Selection	N/A	Not applicable because 1,4 dioxane in surface water.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Japan
	Metric 5:	Currency	Medium	Samples were collected in 2008.
	Metric 6:	Spatial and Temporal Variability	Critically Deficient	The study does not report sample size.
	Metric 7:	Exposure Scenario	Medium	The paper identified a company that was the source of the contamination upstream of the drinking water plant, but only limited details provided. The type of company, amount of release, etc. was not reported.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Low	Data reported in Figure 2 could be raw data or average concentrations. There is no summary of statistics.
	Metric 9:	Quality Assurance	Low	The study doesn't report analytical methodology or sampling procedures, there is no information regarding QA/QC procedures, but does report the accreditation of the laboratory by ISO/IEC 17025.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	A measurement of variability is not reported, as well as key limitations for the monitoring data.

Overall Quality Determination — Uninformative

Study Citation:	Nahar, S., Zhang, J., Nakamura, S. (2011). Influence of biogeochemical qualities of Shizuoka water on the degradation of PVC shower hose. Journal of Environmental Protection 2(2):204-212.
HERO ID:	6841317

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Low	Sampling methodology was not thoroughly discussed and the paper lacked information such as sampling equipment, storage conditions and duration, and sampling procedures. The study was conducted by the University of Toyama and financially supported by a grant-in-aid for Scientific Research (No. 19310007) from the Ministry of Education, Science, Sports and Culture of Japan, thus assumed that acceptable methods were used.
	Metric 2:	Analytical Methodology	Low	The analytical methodology is GC-MS, which is only briefly described. No LOD or LOQ is provided.
	Metric 3:	Biomarker Selection	N/A	Study is testing for the parent chemical in an environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected from 11 cities in Japan.
	Metric 5:	Currency	Medium	Samples were collected in March 2010.
	Metric 6:	Spatial and Temporal Variability	Medium	34 samples from 11 cities were collected. No replicates are reported.
	Metric 7:	Exposure Scenario	Medium	Tap, river, spring, and pond water were collected from 11 cities in a paper-industrial area in the eastern Shizuoka. The potential contamination source (pulp and paper mills) is discussed, but the paper does not adequately separate the data by water type. However, it does make clear that the highest concentration is in the Uzui River, and the data show that a number of water samples exceeded the 50 mg/L limit for 1,4-dioxane in Japan.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Low	Raw data are not provided, although a distribution of 1,4 dioxane in the region sampled is provided in Figure 5a. Data are presented in Section 3.5 in the text as a range of average levels. The data are not broken out by water body type (i.e., tap versus surface water), but it is clear the maximum detection was in river water. No standard deviation is provided.
	Metric 9:	Quality Assurance	Low	QA/QC measures are not reported and issues were not identified. The use of blanks or controls is not reported. The study was conducted by the University of Toyama and financially supported by a grant-in-aid for Scientific Research (No. 19310007) from the Ministry of Education, Science, Sports and Culture of Japan; thus, assumed that some QA/QC measures were included.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Some information about variability was included, such as the range of average detections. In addition, a distribution of 1,4 dioxane in the region sampled is provided in Figure 5a. The standard deviation is not presented. The main unknowns discussed in the paper do not relate to the concentrations measured, but instead relate to characteristics of the water and the impacts on shower hoses that have hardened and becoming brittle in the region. Study limitations are not discussed.

Overall Quality Determination Low

Study Citation:	Osama, R., Awad, H. M., Ibrahim, M. G., Tawfik, A. (2020). Mechanistic and economic assessment of polyester wastewater treatment via baffled duckweed pond. Journal of Water Process Engineering 35:101179.
HERO ID:	6848385

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Low	Sampling methodology is only briefly discussed, therefore, most sampling information is missing such as sampling equipment and procedure, sample storage conditions/duration, and study site characteristics. Retarded polyester wastewater was collected daily.
	Metric 2:	Analytical Methodology	Low	Analytical methodology is only briefly discussed and most information is missing such as sample extraction, calibration of the instrument, and recovery samples. Additionally, no LOD or LOQ is reported. The study analyzed 1,4-dioxane via GC/MS.
	Metric 3:	Biomarker Selection	N/A	The study tested for 1,4-dioxane in environmental media (wastewater).
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Al Arab, Egypt.
	Metric 5:	Currency	High	Samples were collected in 2018.
	Metric 6:	Spatial and Temporal Variability	Critically Deficient	Sample size is not reported.
	Metric 7:	Exposure Scenario	Low	The wastewater effluent sample was collected from a polyester plant of New Borg Al-Arab city. Information on manufacturing processes at the facility were not provided. Additionally, it is uncertain if pre-treatment of wastewater occurred at the facility prior to sample collection. As the sample was collected for a pilot scale experiment on wastewater treatment, it is likely that the sample represents wastewater that is not intended to be released to the environment prior to treatment. The effluent samples from the pilot scale experiment are not considered "real world."
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Low	Raw data are not reported. A concentration range and average value are reported in the text on page 2. Figure 1 reports 1,4 dioxane concentration in influent before treatment. Figure 2 reports initial concentration data with SD.
	Metric 9:	Quality Assurance	Low	QA/QC techniques and results were not directly discussed.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	The characterization of variability is limited; a measure of variance is reported in Figure 2. Key uncertainties, limitations, and data gaps are not discussed.

Overall Quality Determination — Uninformative

Study Citation:	Harley, K. G., Calderon, L., Nolan, J. E. S., Maddalena, R., Russell, M., Roman, K., Mayo-Burgos, S., Cabrera, J., Morga, N., Bradman, A. (2021). Changes in Latina women's exposure to cleaning chemicals associated with switching from conventional to "green" household cleaning products: The LUCIR intervention study. Environmental Health Perspectives 129(9):97001.
HERO ID:	9551210

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling methodology is discussed and is generally appropriate (i.e., scientifically sound) for the chemical and media of interest. Sampling was conducted with personal air monitoring and conditioning of the sampling tubes, flow rates, sampling time, storage and transport is described. Sampling storage duration is not reported.
	Metric 2:	Analytical Methodology	High	The analytical method used was not a publicly available method from a trusted or authoritative source, but the methodology is clear and appropriate. MDL is reported in the supplemental material. The analytical method is described in detail including analytical conditions.
	Metric 3:	Biomarker Selection	N/A	The study tested for the parent chemical in environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Salinas, California.
	Metric 5:	Currency	High	The collection of personal air monitoring samples occurred from June through August 2019.
	Metric 6:	Spatial and Temporal Variability	Medium	The collection of replicate samples is not reported. Fifty samples were collected for each preintervention visit and postintervention visit, but only 49 samples were analyzed for each visit due to one sorbent tube being damaged in the field.
	Metric 7:	Exposure Scenario	Medium	Personal air monitoring samples were collected in residences (kitchen and bathroom) of Latina women during the use of "regular" cleaning (pre-intervention samples) and during the use of "green" cleaning products (post-intervention) and 1,4-dioxane was measured. Questionnaire data was collected by "youth researchers" on behavior patterns (cleaning frequency, etc.) of the participants. The use of exposure controls (pre-exposure and background samples) and the microclimate (e.g. temperature inside the residence) are not reported.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data are not reported. Summary statistics are reported (detection frequency, geometric mean, geometric mean standard deviation, max, and percentiles) in the main file and the SI.
	Metric 9:	Quality Assurance	Low	QA/QC techniques discussed briefly such as practices to avoid cross contamination and normalizing the response for each analyte to the internal standard response. However, the use of recoveries and baseline samples are not reported.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	High	Variability is reported in terms of GSD and percentiles. Limitations are discussed such as the small sample size and the short sampling time.

Overall Quality Determination High

Study Citation:	Cordone, L., Carlson, C., Plaehn, W., Shangraw, T., Wilmoth, D. (2016). Case study and retrospective: Aerobic fixed film biological treatment process for 1,4-dioxane at the Lowry landfill superfund site. Remediation Journal 27(1):159-172.
HERO ID:	9551483

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Critically Deficient	The study reported the construction of a groundwater /leachate extraction trench, but there is no information on the sampling technique to obtain the data for the pilot treatment.
	Metric 2:	Analytical Methodology	Critically Deficient	The study doesn't report any analytical methodology or reference a method.
	Metric 3:	Biomarker Selection	N/A	1,4-dioxane in groundwater and leachate
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Denver, Colorado, USA
	Metric 5:	Currency	Low	The study reports a feed of water to the reactors in 2003, for the full scale reactor the data is reported from 2004-2005.
	Metric 6:	Spatial and Temporal Variability	Critically Deficient	The number of samples or times the sample was analyzed is not reported.
	Metric 7:	Exposure Scenario	High	1,4 dioxane groundwater/leachate discharged at a landfill site. The site is a Superfund site.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Low	The study reports some average concentrations and data presented in exhibits 6 and 10. Could be raw data or averages and needs to be digitalized.
	Metric 9:	Quality Assurance	Critically Deficient	There is no information on any analytical or sampling procedure that can provide information of the QA/QC.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	There are no variability, uncertainties, and limitations reported.

Overall Quality Determination — Uninformative

Study Citation:	Shi, G., Nishizawa, S., Matsushita, T., Kato, Y., Kozumi, T., Matsui, Y., Shirasaki, N. (2021). Computational fluid dynamics-based modeling and optimization of flow rate and radiant exitance for 1,4-dioxane degradation in a vacuum ultraviolet photoreactor. Water Research 197:117086.
HERO ID:	9564057

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Low	Sampling methodology is only briefly discussed, therefore, most sampling information is missing such as sampling equipment and procedure, sample storage duration, and study site characteristics. Groundwater was collected from the raw water input of a treatment plant and stored a 4 °C.
	Metric 2:	Analytical Methodology	Low	Analytical methodology is only briefly discussed and most information is missing such as sample extraction, calibration of the instrument, and recovery samples. Additionally, no LOD is reported. The study analyzed 1,4-dioxane via GC-MS. Details on the method parameters are reported on page 5.
	Metric 3:	Biomarker Selection	N/A	The study tested for 1,4-dioxane in environmental media (groundwater).
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Tachikawa, Japan.
	Metric 5:	Currency	Low	The sample collection date is not reported. The study was published in 2021.
	Metric 6:	Spatial and Temporal Variability	Critically Deficient	There is no information reported about the number of samples; the SI reports a concentration that can be related to a single sample.
	Metric 7:	Exposure Scenario	Medium	A groundwater sample was collected from the raw water input to a full-scale drinking water treatment plant in Tachikawa, Japan, and 1,4-dioxane was measured. The use of exposure controls (pre-exposure and background samples) and the microenvironment are not described.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Low	Raw data and summary statistics are not reported. A single concentration is reported in Table S1.
	Metric 9:	Quality Assurance	Low	QA/QC techniques and results were not directly discussed.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	The characterization of variability is absent and no measure of variance is reported. Key uncertainties, limitations, and data gaps are not discussed.

Overall Quality Determination — Uninformative

Study Citation:	Osama, R., Awad, H. M., Zha, S., Meng, F., Tawfik, A. (2021). Greenhouse gases emissions from duckweed pond system treating polyester resin wastewater containing 1,4-dioxane and heavy metals. Ecotoxicology and Environmental Safety 207(Elsevier):111253.
HERO ID:	9564851

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Low	Sampling methodology is briefly discussed and some sampling information is missing such as sampling equipment, sample storage conditions/duration and study site characteristics. Samples were daily collected from a chemical facility and grab samples from the influent were collected twice per week for physico-chemical analysis.
	Metric 2:	Analytical Methodology	Low	Analytical methodology is only briefly discussed and most information is missing such as sample extraction, calibration of the instrument, and recovery samples. Additionally, no LOD or LOQ is reported. The study analyzed 1,4-dioxane via GC-MS.
	Metric 3:	Biomarker Selection	N/A	The study tested for 1,4-dioxane in environmental media (wastewater).
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Al Arab, Alexandria, Egypt.
	Metric 5:	Currency	Low	The sample collection date is not reported. The study was published in 2021.
	Metric 6:	Spatial and Temporal Variability	Medium	The collection of replicates is not reported. Eighty-four samples were collected.
	Metric 7:	Exposure Scenario	Medium	1,4-dioxane is measured in industrial wastewater from Borg Al-Arab industrial city, Alexandria, Egypt. Samples were collected as part of a study that investigated a wastewater treatment technique. The use of exposure controls (pre-exposure and background samples) and the microenvironment are not described. Physico-chemical properties of the water are reported.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data are not reported. Summary statistics (min, max, average, and standard deviation) are reported in Table 1a.
	Metric 9:	Quality Assurance	Low	QA/QC techniques and results were not directly discussed.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	The characterization of variability is limited; standard deviation is reported in Table 1a. Key uncertainties, limitations, and data gaps are not discussed.

Overall Quality Determination Low

Study Citation:	Lee, C. S., Asato, C., Wang, M., Mao, X., Gobler, C. J., Venkatesan, A. K. (2021). Removal of 1,4-dioxane during on-site wastewater treatment using nitrogen removing biofilters. Science of the Total Environment 771:144806.
HERO ID:	9565258

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling protocols, materials, preservation, storage and transport are described in section 2.2. The sampling methodology is clear, appropriate and similar to widely accepted protocols for the chemical and media of interest.
	Metric 2:	Analytical Methodology	High	Samples were analyzed according to publicly available analytical methods that are scientifically sound and widely accepted (US EPA Method 522.A). All pertinent sampling information is provided such as LODs, extraction methods, analytical instrumentation.
	Metric 3:	Biomarker Selection	N/A	Not applicable; the study is testing for 1,4-dioxane in wastewater and tap water.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples collected in Long Island, NY, USA.
	Metric 5:	Currency	High	Samples were collected from November 2018 to February 2020. Timing of sample collection for monitoring data is consistent with current expected exposures.
	Metric 6:	Spatial and Temporal Variability	Medium	The study collected tap water samples (n=23), septic tank effluent (n=37), and the final treated effluent (n=34), however, no sample replicates were used.
	Metric 7:	Exposure Scenario	High	Presence of 1,4 dioxane in groundwater from onsite-wastewater treatment systems and tap water in Long Island, NY, USA. The study reports a control site (site 4).
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	The data is reported in the text with main statistics including mean, standard deviation, min and max. Table 1 also reports data. However, supplementary or raw data are not reported, and therefore summary statistics cannot be reproduced.
	Metric 9:	Quality Assurance	Low	Key QA/QC parameters are not reported or discussed in the study, but the use of QA and QC techniques is expected due to the use of an standard procedure and the analytical method used.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	High	Variability reported as standard deviation for wastewater, some limitations reported in the results and discussion section.

Overall Quality Determination High

Study Citation: Caron-Beaudoin, E., Whyte, K. P., Bouchard, M. F., Chevrier, J., Haddad, S., Copes, R., Frohlich, K. L., Dokkie, D., Juul, S., Bouchard, M., Verner, M. A. (2022). Volatile organic compounds (VOCs) in indoor air and tap water samples in residences of pregnant women living in an area of unconventional natural gas operations: Findings from the EXPERIVA study. Science of the Total Environment 805:150242.

HERO ID: 9567272

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling methodology is discussed and appears scientifically sound. Sampling location, duration, transport and storage are reported in the study.
	Metric 2:	Analytical Methodology	High	Analytical methods are detailed and scientifically sound. Air and water samples were analyzed according to identified EPA methods. Detection/reporting limits are provided in the SI.
	Metric 3:	Biomarker Selection	N/A	This metric is not applicable because the parent chemical (1,4-diocane) was analyzed in environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Peace River Valley, British Columbia, Canada.
	Metric 5:	Currency	High	Samples were collected in 2019.
	Metric 6:	Spatial and Temporal Variability	Medium	There were 85 samples. Replicates of water samples were collected and analyzed. There were no replicates for the air samples, which were the only ones for which 1,4-D was analyzed.
	Metric 7:	Exposure Scenario	High	The data closely represent relevant/realistic exposure scenarios. The population studied was pregnant women. Possible sources of exposure were inventoried for each participant, including proximity to unconventional gas wells. While there were no exposure controls, the country-wide data to which the study participants'' results were compared (CHMS) provide a point of reference. Detailed microclimate information are missing, but we know samples were collected in a single season, from May to September.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data are not provided. Summary statistics are provided, but are missing some parameters, such as mean and SD.
	Metric 9:	Quality Assurance	Low	QA/QC techniques were discussed, such as lab blank samples, spiked sample and spiked duplicate sample, as well as continuous calibration verification standard samples. However, the use of recoveries and baseline samples were not reported.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	The discussions of uncertainty, variability, and study limitations are limited. One source of uncertainty is acknowledged - the inability to link detections to fracking activities. A limitation mentioned is the small number of participants (and in the water samples, the low number of detections). While standard measures of variability such as standard deviation or even range are not provided, the study provides median concentrations of the population by 6 different characteristics (indigenous or not, attached garage or not, etc.) in Table 4.

Overall Quality Determination High

Study Citation:	Li, F., Deng, D., Zeng, L., Abrams, S., Li, M. (2021). Sequential anaerobic and aerobic bioaugmentation for commingled groundwater contamination of trichloroethene and 1,4-dioxane. Science of the Total Environment 774:145118.
HERO ID:	9569574

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Groundwater was collected according to NJDEP Low Flow Purging and Sampling Guidance.
	Metric 2:	Analytical Methodology	Medium	Information regarding the extraction, analytical methods, and QA/QC techniques including the method detection limit are reported in the SI, but it is not clear if this method is for the analysis of the groundwater sample.
	Metric 3:	Biomarker Selection	N/A	Not applicable since the study analyzed the parent chemical (1,4-dioxane) in environmental media (groundwater).
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Sample collected in New Jersey, U.S.
	Metric 5:	Currency	High	The groundwater sample was collected in 2017.
	Metric 6:	Spatial and Temporal Variability	Critically Deficient	Sample size is unclear and not reported. Readers could assume that at least one groundwater sample was collected, with no replicates, as mentioned in the text. However, sampling methodology is not clear. Additionally, although the text referenced Table S1 as having 1,4D concentrations, Table S1 does not list 1,4D concentrations in groundwater.
	Metric 7:	Exposure Scenario	High	Groundwater from a site collected in central New Jersey, the site was historically impacted by TCE contamination and was operated by a gas company. The study also collected field data including pH, specific conductivity, dissolved oxygen and a range of VOC reported in table S1
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Low	Since there is only one sample, there is no summary of statistics.
	Metric 9:	Quality Assurance	Low	Recoveries as well as other QA/QC parameters are not reported. The main QA/QC parameters are implied through the study's use of standard field and laboratory protocols.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	The variability of data from the contamination plume is not reported , nor does it discuss any uncertainties or limitations associated with that sample and the analytical method used, which is not specified.

Overall Quality Determination Uninformative

Study Citation:	Karges, U., de Boer, S., Vogel, A. L., Püttmann, W. (2022). Implementation of initial emission mitigation measures for 1,4-dioxane in Germany: Are they taking effect?. Science of the Total Environment 806(Part 4):150701.
HERO ID:	9610324

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling methodology, materials , storage, location and transportation are reported in section 2.1
	Metric 2:	Analytical Methodology	High	LOQ reported for both drinking water and surface water. Analytical methodology is well described. Drinking water and surface water were analyzed per US EPA Method 522.
	Metric 3:	Biomarker Selection	N/A	Not applicable, 1,4-dioxane was analyzed in drinking and surface water
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples collected in seven regions in Germany.
	Metric 5:	Currency	High	Samples collected in summer 2017 and 2018 and autumn 2018.
	Metric 6:	Spatial and Temporal Variability	Medium	No sample replicates were collected. Samples were collected in multiple seasons (summer and autumn) and multiple years 2017 and 2018). Overall, the study collected 44 drinking water, 86 surface water and 18 waste water treatment plant discharge samples.
	Metric 7:	Exposure Scenario	High	The study measured 1,4-dioxane in surface water and drinking water in 2017/2018 to investigate the effectiveness of mitigation measures implemented after 2015/2016. Mitigation measures included integration of AOP units, shutdown or alteration of production processes. Samples were only collected in areas where 1,4-dioxane was previously detected or were in relation to suspected point sources.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data reported, summary of statistics reported in Figure 2 for drinking water, but not for surface water and waste water treatment plants effluents.
	Metric 9:	Quality Assurance	Low	Recovery values are not reported, key QA/QC are assumed due to the use of a standard procedure US EPA method 522.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Variability reported as 25th-75th percentiles. Some limitations reported in the conclusion.

Overall Quality Determination High

Study Citation:	Osama, R., Ibrahim, M. G., Elreedy, A., Fujii, M. (2020). Long-term assessment of 1,4-dioxane uptake via duckweed with emphasis on operational parameters. Materials Science Forum 1008:121-127.
HERO ID:	9642623

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Critically Deficient	Uninformative. Sampling methodology for 1,4-dioxane samples of industrial wastewater described only in terms of brief study site characteristics. Information regarding sampling equipment, procedures, sample storage and duration of sample storage prior to analyses lacking.
	Metric 2:	Analytical Methodology	Critically Deficient	Uninformative. Analytical methodology not detailed. Information regarding detection limits, extraction, analytic instrumentation, calibration and recoveries lacking.
	Metric 3:	Biomarker Selection	N/A	N/A. Sampling for chemical of interest within environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples collected in Borg Al-Arab city, Alexandria, Egypt.
	Metric 5:	Currency	Low	Sampling dates not reported. Publication date 2020.
	Metric 6:	Spatial and Temporal Variability	Critically Deficient	Uninformative. Total number of samples, whether replicate sampling was conducted, and timing/dates of sampling not reported.
	Metric 7:	Exposure Scenario	Medium	Sampling of industrial wastewater from a chemical facility polyester plant in Egypt.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Table 1 reports industrial wastewater 1,4-dioxane concentrations in terms of mean, standard deviation, minimum and maximum statistical summary measures. Raw data not reported. Number of samples and frequency of detection data lacking.
	Metric 9:	Quality Assurance	Low	Quality assurance not discussed. Lack of baseline, pre-exposure sampling.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Variability of results reported within statistical summary measures of standard deviations and range within Table 1. Potential study limitations not discussed.

Overall Quality Determination — Uninformative

Study Citation: Li, M., Mathieu, J., Liu, Y., Van Orden, E. T., Yang, Y.,u, Fiorenza, S., Alvarez, P. J. J. (2014). The Abundance of Tetrahydrofuran/Dioxane Monooxygenase Genes (thmA/dxmA) and 1,4-Dioxane Degradation Activity Are Significantly Correlated at Various Impacted Aquifers. Environmental Science & Technology Letters 1(1):122-127.

HERO ID: 3545051

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Critically Deficient	The sampling methodology is not discussed, only the locations of the samples are reported.
	Metric 2:	Analytical Methodology	Low	Limited analytical methodology is provided (only instrument); no LOD or LOQ is provided for sampling of 1,4D. Only MDLs for other data within the study are given.
	Metric 3:	Biomarker Selection	N/A	Study is testing for the parent chemical in an environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected from CA, TX, and AK in the US.
	Metric 5:	Currency	Low	Publication date is 2014. No sample collection date is provided.
	Metric 6:	Spatial and Temporal Variability	Low	As few as 2 samples were collected per location. Triplicates were used for some but not all of the samples.
	Metric 7:	Exposure Scenario	Low	The exposure scenario is not well characterized. The study is testing for dioxane in groundwater, but it is not clear what the exposure route or the source is.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Means and standard deviations are found in Table S3 for initial 1,4D concentrations. No raw data is provided.
	Metric 9:	Quality Assurance	Low	QA/QC measures are briefly discussed through the use of control samples. No QA/QC issues were identified.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Variability characterized through standard deviations provided in Table S3. No limitations reported on sampling or monitoring of 1,4D from the sites.

Overall Quality Determination Unacceptable

Study Citation: Carrera, G., Vegué, L., Ventura, F., Hernández-Valencia, A., Devesa, R., Boleda, M. R. (2019). Dioxanes and dioxolanes in source waters: Occurrence, odor thresholds and behavior through upgraded conventional and advanced processes in a drinking water treatment plant. Water Research 156(Elsevier):404-413.

HERO ID: 5078959

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Low	Little information provided for sampling methods, only sites reported in supplementary material.
	Metric 2:	Analytical Methodology	Medium	Extraction and analytical procedure, calibration, and instrument were described in details in the supplementary materials. MQL were reported for each scenario. Recoveries are missing.
	Metric 3:	Biomarker Selection	N/A	Parent chemical is in an environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Llobregat River in Sant Joan Despí, Spain
	Metric 5:	Currency	High	The study reported that sampling took place in 2015 (surface water) & 2018 (finished drinking water).
	Metric 6:	Spatial and Temporal Variability	High	Table 2 reported 27, 137, 82, 89 samples for the periods of sampling.
	Metric 7:	Exposure Scenario	Medium	The data closely represent relevant exposure scenario. Samples were taken from different points of a waste water treatment plant. However, it is unknown what the exposure source is.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Average, standard deviation, and max were reported for table 2. Table 3 reports concentrations at different sampling times in 2015 (no summary statistics). Table S5 reports average and SD of groundwater from the groundwater intake, collected from 2015-2017.
	Metric 9:	Quality Assurance	Low	Quality assurance/quality control techniques and results were not directly discussed, but can be implied through the use of standard field and laboratory protocols. Recoveries are not reported.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	The study has limited discussion of key uncertainties, limitations, and data gaps. Variability accounted for in times sampled and different areas.

Overall Quality Determination Medium

Study Citation:	Karges, U., Becker, J., Püttmann, W. (2018). 1,4-Dioxane pollution at contaminated groundwater sites in western Germany and its distribution within a TCE plume. Science of the Total Environment 619-620(Elsevier):712-720.
HERO ID:	4167557

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sampling methodology for 1,4-dioxane groundwater well sampling detailed in terms of sampling equipment, procedures and study site characteristics. Sample storage conditions and duration of sample storage prior to analysis lacking.
	Metric 2:	Analytical Methodology	High	Analytical methodology described in terms of extraction, analytical instrumentation, limit of quantification, instrument calibration and recovery range (80-120%). Analysis conducted according to slightly modified US EPA method 522 for analysis of drinking water, with additional references for method in Stepien and Puttmann (2013) and Stepien (2014).
	Metric 3:	Biomarker Selection	N/A	Sampling for chemical of interest within environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples collected from polluted groundwater well sites in Western Germany.
	Metric 5:	Currency	Medium	Sampling conducted October – November, 2014.
	Metric 6:	Spatial and Temporal Variability	Medium	Total number of samples reported as n=44 (Table 5). Repeated sampling within some groundwater sampling wells with samples taken at multiple depths in some wells. Number of samples for each site ranged from 1-23. No replicates detailed. Sampling conducted across a variety of areas, from urban industrial to rural. Figure 2 details depth distribution of 1,4-Dioxane below ground levels. Sampling conducted only between October – November, 2014 for main study.
	Metric 7:	Exposure Scenario	High	Exposure sources for 1,4-dioxane described in detail in text as spanning a variety of settings from urban industrial to rural and further detailed in Table 2 and Figure 1 (Five sites were known to be contaminated with VCH, two sites were polluted by leachate from landfills, and one site was polluted by the discharge from a detergent manufacturing plant). Sampling described as conducted in close proximity to drinking water suppliers. Control sampling conducted in close proximity to sampling.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Results reported in Table 5 as min and max, number of samples for each of 8 sampling sites, and Table 6 for each sample depth with a single concentration. Text page 8 notes 1,4-dioxane was detected at each site. Sampling sites described in detail. Raw data not reported.
	Metric 9:	Quality Assurance	High	Quality assurance discussed within methods description of field and analytic blanks, recoveries of 80-120%, and quality verification within analytic methods. Sampling conducted according to slightly modified standard EPA methodologies.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Variability of results reported within statistical summary measures of ranges within Table 5. Potential study limitations not presented.

Overall Quality Determination High

Study Citation:	Saraji, M., Shirvani, N. (2017). Determination of residual 1,4-dioxane in surfactants and cleaning agents using headspace single-drop microextraction followed by gas chromatography-flame ionization detection. International Journal of Cosmetic Science 39(1):36-41.
HERO ID:	3538324

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology and Conditions	Medium	For the real world samples, limited information is given on the brands tested. Different temperature ranges were tested. Missing information such as sample storage conditions.
	Metric 2:	Analytical Methodology	High	Extraction and analytical methods are reported, and the authors performed in depth method validation tests to ensure validity. The authors also describe how they derived the LOD for the study.
	Metric 3:	Biomarker Selection	N/A	Biomarkers do not apply to this type of study.
Domain 2: Representative				
	Metric 4:	Testing Scenario	Low	There is limited information on the amount of chemical used, use of exposure control and range of conditions or microenvironments tested. The source is from shampoos, hand washing and dish washing liquids.
	Metric 5:	Sample Size and Variability	Low	The study uses 1 dish washing soap sample which is a consumer product. Additionally no replicate tests were conducted for this product.
	Metric 6:	Temporality	High	Study was published in 2016.
Domain 3: Accessibility/Clarity				
	Metric 7:	Reporting of Results	High	The single sample of the concentration in dish washing liquid is reported. Since it is single concentration no summary statistics can be produced.
	Metric 8:	Quality Assurance	Low	There was no mention of QA/QC checks in this paper; however, considering the detailed method validation it can be implied that the authors used standard scientific protocols during their test.
Domain 4: Variability and Uncertainty				
	Metric 9:	Variability and Uncertainty	Medium	The characterization of variability and uncertainty is only briefly discussed in the introduction. The characterization is related to the testing methods used in this experiment.

Overall Quality Determination Medium

Study Citation:	Makino, R., Kawasaki, H., Kishimoto, A., Gamo, M., Nakanishi, J. (2006). Estimating health risk from exposure to 1,4-dioxane in Japan. Environmental Sciences 13(1):43-58.
HERO ID:	3660508

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology and Conditions	Medium	Sampling method information is limited to how/where products were obtained. Other information about sampling is missing, such as sample storage conditions/duration and volume of liquid sampled. Since for product concentration studies, omitting these details is common, it is not likely to have a substantial impact on results.
	Metric 2:	Analytical Methodology	Medium	Analytical instrumental (GC/MS) and extraction method were identified, but instrument calibration and recoveries were not mentioned. The determination limit varied for each sample and is reported in table 1, for samples with no detectable 1,4-D. An outside lab was used, but no publicly-available standard method was identified. Methods seemed scientifically sound; missing analytical information is unlikely to substantially impact results.
	Metric 3:	Biomarker Selection	N/A	No biomarkers are selected.
Domain 2: Representative				
	Metric 4:	Testing Scenario	Medium	The testing scenario involved a dilution and analysis of samples of different products. Limited information on testing conditions was provided, due to the use of an outside lab, but that is common for product concentration studies. One product type, detergent for bath, was inferred to be a cleaning product from the word detergent, not soap; lack of certainty on that point affects the application of the data on one of several product types to exposure scenarios.
	Metric 5:	Sample Size and Variability	Low	The sample size is not discussed, but there appears to be one concentration per product, with each category having 2-4 products sampled. No replicates were identified.
	Metric 6:	Temporality	Low	The samples for the product concentrations were collected in 2003.
Domain 3: Accessibility/Clarity				
	Metric 7:	Reporting of Results	High	The concentration in each product was reported, as well as a general total range in the text. Summary stats can be calculated from these data points.
	Metric 8:	Quality Assurance	Low	QA/QC was not directly discussed in the paper, but the use of standard field and laboratory protocols suggests some QA/QC measures were included.
Domain 4: Variability and Uncertainty				
	Metric 9:	Variability and Uncertainty	Low	Sections 5.2 discuss uncertainty related to why findings related to consumer product concentrations from this study might have been different from findings from a prior study, but that is not an uncertainty about the products sampled in this study. Further, there is no discussion of limitations or gaps related to the measured concentrations. There is no measure of variability reported.

Overall Quality Determination Low

Study Citation:	Potter, P. M., Al-Abed, S. R., Hasan, F., Lomnicki, S. M. (2021). Influence of polymer additives on gas-phase emissions from 3D printer filaments. Chemosphere 279:130543.
HERO ID:	9415402

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology and Conditions	High	Sampling methodology is discussed in detail with conditions and equipment and appears scientifically sound, including manufacture, conditions, and calibration curves.
	Metric 2:	Analytical Methodology	Low	Analytical methodology is described in detail, including GC equipment, references, and conditions. Limits not reported.
	Metric 3:	Biomarker Selection	N/A	Biomarker not used.
Domain 2: Representative				
	Metric 4:	Testing Scenario	Medium	Experiment conducted under two sets of conditions, pyrolitic and oxidative, with the pyrolytic described as more likely to represent real 3d printing. 3D printer filaments were purchased from the manufacturers. Some information not reported, such as exposure controls.
	Metric 5:	Sample Size and Variability	Low	One sample collected for each experiment type (pyr/ox) for six 3D filaments; 1,4D only identified for one filament type (PLA-CNT).
	Metric 6:	Temporality	High	Study conducted in 2021.
Domain 3: Accessibility/Clarity				
	Metric 7:	Reporting of Results	High	Emissions data are displayed graphically in main document, and raw data points are provided in supplemental file. Only one sample collected for each experiment type so summary statistics cannot be produced.
	Metric 8:	Quality Assurance	Medium	QA/QC issues identified and discussed in reference standards and methodologies. Mention of EPA review and quality assurance approval. Some information missing such as recoveries.
Domain 4: Variability and Uncertainty				
	Metric 9:	Variability and Uncertainty	Medium	Data do not seem highly uncertain, but the authors discuss that the variance identified in the detected compounds in various filaments indicate a need for more standardized sample collection methods for these types of studies. The study tests 6 different types of filaments.

Overall Quality Determination — Medium

Study Citation:	Sack, T. M., Steele, D. H., Hammerstrom, K., Remmers, J. (1992). A survey of household products for volatile organic compounds. Atmospheric Environment 26(6):1063-1070.
HERO ID:	28339

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology and Conditions	Medium	The article specifically references the past EPA studies and methodologies used in collecting samples. The actual sampling details are limited, and the sources are from the 1980's. This paper follows a previous study done to determine the presences of 6 chlorinated solvents, and after that study further chemical analytes were tested.
	Metric 2:	Analytical Methodology	High	The U.S. EPA Method 624 "Purgeables" was used as a guideline for the analytical methods. Gas chromatography and mass spectrometry (GC/MS) were used. The reporting limit was 0.1%.
	Metric 3:	Biomarker Selection	N/A	Biomarkers do not apply to the type of experiment performed.
Domain 2: Representative				
	Metric 4:	Testing Scenario	Low	Only one set of testing conditions was used to measure the amount of 1,4 Dioxane in the samples. No information on testing conditions are given otherwise, but as a product concentration the test is relevant to all consumers.
	Metric 5:	Sample Size and Variability	Medium	The two product categories in which 1,4-dioxane was identified were adhesives and household cleaners/polishes. In the Adhesive related products category, three sub categories had 65, 2 and 9 products sampled. The household cleaners/polishes category had 15 sub categories with 1-16 samples each. There is no mention of replicate samples being analyzed.
	Metric 6:	Temporality	Low	The study was published in 1992 and builds on a study conducted in 1987.
Domain 3: Accessibility/Clarity				
	Metric 7:	Reporting of Results	Medium	No raw data are presented in the paper; average concentrations are reported for different product categories. There do not seem to be any inconsistencies between the text and the data in tables.
	Metric 8:	Quality Assurance	Low	Recovery for 1,4-dioxane was 46%; the solubility of 1,4-dioxane in water was given as the likely the reason for the issue, however, it is mentioned that the values were not corrected for recovery. Other QA/QC measures were mentioned, such as blind audit samples and repeated analysis of calibration solutions.
Domain 4: Variability and Uncertainty				
	Metric 9:	Variability and Uncertainty	High	Variability is discussed throughout the article, including potential contributing factors. Multiple products were tested, and why specific analytes were found more often in certain categories was also discussed. The limitations of analyzing certain chemicals after the initial measurements were also discussed.

Overall Quality Determination Medium

Study Citation:	NCDWR, (2021). Cape Fear River Basin 1,4-dioxane study.
HERO ID:	10365582

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	The 1,4-Dioxane and Bromide Monitoring Plan describes the sampling methodology: grab samples collected near-surface (i.e., 0.1-meter depth). Only the samples that reported elevated UCMR3 results were analyzed for 1,4-dioxane. The more info tab reported that samples were collected since November 2017 at 148 surface water locations and 12 of the 17 river basins in NC. Missing information such as equipment and storage conditions.
	Metric 2:	Analytical Methodology	High	"Samples are analyzed by the DWR Water Sciences Section Laboratory, Organic Chemistry Branch, using EPA method 624.1 for surface water, with a practical quantitation limit (PQL, the lowest concentration that can be reliably measured) of 1.0 µg/L (microgram per liter, equivalent to one part per billion)"
Domain 2: Representative				
	Metric 3:	Geographic Area	High	The file 1,4-dioxane Station List (2018-2020) reports station number, location name, basin, classification and water body type.
	Metric 4:	Temporal	High	Data reported from 2018-2021
	Metric 5:	Exposure Scenario	High	The microenvironment can be identified in the surface water classification reported in the file 1,4-dioxane Station List (2018-2020) and described in https://deq.nc.gov/about/divisions/water-resources/water-planning/classification-standards/classifications#DWRPrimaryClassification
Domain 3: Accessibility/Clarity				
	Metric 6:	Availability of Database and Supporting Documents	High	State maintained database with metadata present and supporting documentation.
	Metric 7:	Reporting Results	Medium	The database is well organized by year reports and understandable. Individual points reported but summary statistics is missing.
Domain 4: Variability and Uncertainty				
	Metric 8:	Variability and Uncertainty	High	Uncertainty reported as data qualifiers, the codes can be found at: https://deq.nc.gov/about/divisions/water-resources/water-sciences/chemistry-laboratory/quality-assurance. Variability not applicable

Overall Quality Determination High

Study Citation:	CA Water Board, (2022). EDT library and water quality analyses data and download page.
HERO ID:	10365609

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	The sampling methodology is reported in the individual Consumer Confidence Report by water system. For example, for the San Gabriel Valley water system, the document mentions that all water samples were collected by state-certified employees of the water company or independent engineering firms.
	Metric 2:	Analytical Methodology	High	The California Water Board recommends on their 1,4-dioxane website the use of EPA method 522 to analyze for presence of 1,4-dioxane in drinking water source. Column AA reports the analytical method as EPA 522 and EPA 8270c. For the sites that the methods is reported as null, it is possible to see the method used in the CA Drinking Water Watch database.
Domain 2: Representative				
	Metric 3:	Geographic Area	High	All samples in California. Water system name reported in Column C and County in Column F.
	Metric 4:	Temporal	High	Data from 2015-2022.
	Metric 5:	Exposure Scenario	Medium	The microenvironment can be identified in the water system classification, sampling point, facility type and status, and population served. Potential sources of exposure are not described. Sampling point name provides information on the media (effluent, well, etc.), but does not clearly identify if the samples are raw or treated water.
Domain 3: Accessibility/Clarity				
	Metric 6:	Availability of Database and Supporting Documents	Medium	State maintained data base with metadata present and supporting documentation available.
	Metric 7:	Reporting Results	High	The database is organized and understandable.
Domain 4: Variability and Uncertainty				
	Metric 8:	Variability and Uncertainty	Low	Variabilities and key uncertainties are not discussed. Other than ”less than detection limit” field, there are no data qualifier fields.

Overall Quality Determination High

Study Citation:	NY DOH, (2022). 1,4–Dioxane concentrations received by the New York State Department of Health as of May 11, 2022.
HERO ID:	10365665

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	No information is provided on sampling methodology in the spreadsheet of raw data or associated annual drinking water reports. However, sampling must be conducted in accordance with state regulations (which include a requirement for every PWS that has 15 or more service connections and serves 25 or more people to submit to the state a sampling plan for its approval) and the National Primary Drinking Water Standards. As such, it is assumed that the samples were collected using widely accepted methods. Applicable regulations may be found at https://regs.health.ny.gov/volume-title-10/content/subpart-5-1-public-water-supplies.
	Metric 2:	Analytical Methodology	Medium	The methods used are not reported in the spreadsheet, but the spreadsheet provides the name of the laboratory in column N and detection limit in column AB. A search of some (but not all) of the laboratories mentioned in the spreadsheet show the use of EPA methods for the analysis of 1,4-dioxane. Additionally, information on the NY government website (https://www.health.ny.gov/regulations/nycrr/title_10/part_5/docs/appendix_5c.pdf) specifically indicates that all samples shall be analyzed using approved methods as recognized by U.S. EPA and/or the New York State Environmental Laboratory Approval Program (ELAP). For 1,4D, the analyte code is 2049. A user guide is provided at: http://www.opssys.com/InstantKB/attachments/SDWIS-SA-GUIDE-80.pdf.
Domain 2: Representative				
	Metric 3:	Geographic Area	High	All sites are in New York State. The Public Water Supply name facility name are reported in columns B and D.
	Metric 4:	Temporal	High	Data collected from 2008 to 2022.
	Metric 5:	Exposure Scenario	High	The raw data spreadsheet provides a brief description of the sample point (WTP finished water, well, etc.). The associated annual drinking water reports provide a description of the population served, the treatment methods at the facility, and the possible sources of contamination. The data overall represent the exposure of 1,4-dioxane concentrations of drinking water for the population of New York State.
Domain 3: Accessibility/Clarity				
	Metric 6:	Availability of Database and Supporting Documents	Medium	The database source is New York State. The database itself is not publicly accessible, but the data is publicly available upon request. Additionally, some data appears to be available on a site- by-site basis in pdf format (see https://water.ny.gov/doh2/applinks/waterqual/#/waterSystem). While there is no database documentation available on-line, the column headers and abbreviations do appear to use standard SDWIS State naming conventions and database structure.
	Metric 7:	Reporting Results	Medium	The database is well organized, however the lack of a data dictionary or user guide makes it difficult to accurately interpret some of the data columns and qualifiers. User guide provided at: http://www.opssys.com/InstantKB/attachments/SDWIS-SA-GUIDE-80.pdf.
Domain 4: Variability and Uncertainty				
	Metric 8:	Variability and Uncertainty	Medium	Uncertainty reported as data quality code in column AA. The code ”A” was used, meaning accepted, according to the user guide at http://www.opssys.com/InstantKB/attachments/SDWIS-SA-GUIDE-80.pdf.

Overall Quality Determination High

Study Citation:	Commonwealth of Massachusetts, (2018). Energy & Environmental Affairs Data Portal: Search for drinking water.
HERO ID:	10365667

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Low	Sampling methodology was not reported in the Excel file or the website.
	Metric 2:	Analytical Methodology	High	Column P reports the analytical method for each site. Methods included EPA 522, EPA 8260B, EPA 8270B, and EPA 8270D. The lab detection limit was provided for most, but not all samples.
Domain 2: Representative				
	Metric 3:	Geographic Area	High	All data is from the Commonwealth of Massachusetts. PWS Name is reported in Column B and Town is reported in Column C.
	Metric 4:	Temporal	High	Data collected from 2007 to 2022.
	Metric 5:	Exposure Scenario	High	The data represent drinking water exposure for the general population in Massachusetts. The class of the PWS is reported in column D. Classes represented in the dataset are Community (COM) or Non-Transient Non-Community (NTNC), as defined in the companion FAQ document. Column O reports the type of water (raw or finished). Information regarding sources of 1,4-dioxane is missing.
Domain 3: Accessibility/Clarity				
	Metric 6:	Availability of Database and Supporting Documents	Medium	The data is publicly accessible through an on-line state portal. There is no database documentation is available on-line, such as a data dictionary, but a FAQ sheet provides limited information. The data portal disclaimer states that "the data contained in this public data portal has been retrieved through the agency's pre-existing data systems and/or existing hard copy documentation that have been converted into a data format. Although reasonable efforts have been made to make this data useful to the public, the data presented through this portal has not been fully verified for accuracy and/or completeness, and the agency assumes no obligation to either maintain or update any of the data contained on this website. This portal does not include all of the agency's regulatory data, and therefore should not be relied upon to determine overall compliance. Users of this data portal should not rely upon the information presented to determine the applicability of any individual legal requirements and/or remedies which may be available."
	Metric 7:	Reporting Results	Medium	The raw output is well organized. While there is no data dictionary, it is understandable. There is no summary of statistics in the data source.
Domain 4: Variability and Uncertainty				
	Metric 8:	Variability and Uncertainty	High	Uncertainty is reported as data qualifiers in column J. Lab reported detection limit in column R.

Overall Quality Determination High

Study Citation:	City of Greensboro, (2022). 1,4-dioxane sampling results: Greensboro, NC (as of July 25, 2022).
HERO ID:	10365698

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	According to the SOC Year 1 report, EPA Method 624.1 (40 CFR Part 136 wastewater method) was used for all aqueous 1,4-dioxane samples. EPA Method 8270C SIM (Solid Waste Method) was used for the following sites: aeration tank, dewatered sludge cake, incinerator scrubber/centrate, and domestic septage.
	Metric 2:	Analytical Methodology	High	According to the SOC Year 1 report, EPA Method 624.1 (40 CFR Part 136 wastewater method) was used for all aqueous 1,4-dioxane samples. EPA Method 8270C SIM (Solid Waste Method) was used for the following sites: aeration tank, dewatered sludge cake, incinerator scrubber/centrate, and domestic septage. The City used two commercial laboratories certified by NCDEQ to conduct 1,4-dioxane analyses: Meritech Inc. and Pace Laboratories. Both labs were used for 1,4-dioxane eDMR split analyses and both were used in the initial 2015 study.
Domain 2: Representative				
	Metric 3:	Geographic Area	High	Samples were collected near Greensboro, NC.
	Metric 4:	Temporal	High	Samples were collected between 2019 and 2022.
	Metric 5:	Exposure Scenario	High	Samples were collected to investigate concentrations of 1,4-dioxane in the T. Z. Osborne Water Reclamation Facility ("TZO") effluent discharge and downstream drinking water supplies.
Domain 3: Accessibility/Clarity				
	Metric 6:	Availability of Database and Supporting Documents	High	The data is adequately supported by companion documents.
	Metric 7:	Reporting Results	High	For Year 1, the SOC report provides a summary of the data with number of samples, range, and average. Raw data is in the appendix. The data prior to Year 1 and the Year 2 data (in progress) is only reported as point values.
Domain 4: Variability and Uncertainty				
	Metric 8:	Variability and Uncertainty	Medium	Variability was investigated with regular sampling for over a year. The Year One Report provides a range, but no other measure of variability. To reduce analytical uncertainty, some samples were split and sent to multiple labs for analysis. No limits or gaps were discussed.

Overall Quality Determination High

Study Citation:	NWQMC, (2022). Water quality portal: 1,4-Dioxane.
HERO ID:	10368680

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sampling methodology information is provided in columns AF to AJ, including the sampling method code and the equipment used. No information was provided on transportation or storage conditions. Note that for approximately 10% of the samples the sampling methodology was reported as "UNKNOWN".
	Metric 2:	Analytical Methodology	Medium	37 different analytical method codes are reported in column BO and BS. 994 point values do not have an analytical method and 183 point values were reported as "historical data". Description of the methods reported in column BQ and detection limit in column BY. About 42% of the samples are missing a detection limit, but the standard methods used might have minimum LODs. While there is heterogeneity in the information provided, the confidence rating of high is based on the samples with the most complete data.
Domain 2: Representative				
	Metric 3:	Geographic Area	High	Column X reports the location identifier code. The information of each code can be found at https://waterdata.usgs.gov/nwis/si
	Metric 4:	Temporal	High	Data reported from 1977 to 2022. The date is reported in column G
	Metric 5:	Exposure Scenario	Medium	The media is reported in column E and F and the microenvironment as location and time reported in columns G and H. There is no information regarding the population and source of 1,4-dioxane.
Domain 3: Accessibility/Clarity				
	Metric 6:	Availability of Database and Supporting Documents	Medium	The database is widely accepted and a user guide is available which describes all of the data fields.
	Metric 7:	Reporting Results	Medium	The database does not report summary of statistics, only point values. While the data are well organized, since the data originates from numerous different entities (states) and monitoring programs, some data may be difficult to interpret due to the lack of populated data fields or discrepancies between columns.
Domain 4: Variability and Uncertainty				
	Metric 8:	Variability and Uncertainty	High	Uncertainty is characterized by the inclusion of data qualifier columns, however, qualifier codes are only reported for 684 point values. Column AS reports the results status identifier that indicates the acceptability of the result with respect to QA/QC criteria.
Overall Quality Determination			**High**	

Study Citation:	U.S. EPA, (2017). Unregulated Contaminant Monitoring Rule (UCMR 3) (2013-2015) data: 1,4-dioxane.
HERO ID:	10410586

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Widely accepted sampling methodology by EPA , EPA 522. Column U characterizes the monitoring requirement as AM: Assessment monitoring
	Metric 2:	Analytical Methodology	High	Data was analyzed with EPA method 522
Domain 2: Representative				
	Metric 3:	Geographic Area	High	Geographical areas reported by region and state in columns v and w
	Metric 4:	Temporal	High	UCMR3 reports data from 2013-2015
	Metric 5:	Exposure Scenario	High	Microenvironment reported in columns L and G. Size of the Public Water System: ”Size category of the PWS for UCMR, based on retail population as of December 31, 2010: S ($\leq$ 10,000), L ($>$ 10,000)”, and facility water type: Source of water at the facility: ”SW (surface water), GW (groundwater), GU (groundwater under the direct influence of surface water), MX (Any combination of: SW, GW and GU)”.
Domain 3: Accessibility/Clarity				
	Metric 6:	Availability of Database and Supporting Documents	High	EPA database is widely accepted and accessible
	Metric 7:	Reporting Results	High	Results are reported as point data (raw output) and data summary (page 11) including number of samples, MRL, detection frequency, and number of PWS and samples below and above the reference concentration
Domain 4: Variability and Uncertainty				
	Metric 8:	Variability and Uncertainty	Low	Variability, uncertainty and key data gaps are not reported. RL or LOD not reported.

Overall Quality Determination High

Study Citation:	NCDWR, (2017). 1,4-dioxane monitoring in the Cape Fear River Basin of North Carolina: An ongoing screening, source identification, and abatement verification study.
HERO ID:	10501014

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Widely accepted sampling methodology, "Sampling was conducted according to methods described in North Carolina's Ambient Monitoring System (AMS) Quality Assurance Project Plan (QAPP) (NCDENR, 2014, Section B.2 and Appendices 7 and 8) and instructions provided by the contract laboratory for 1,4-dioxane sample collection and preservation"
	Metric 2:	Analytical Methodology	High	Widely accepted analytical methodology, for year one method SW-846 8270 SIM (selected ion monitoring) and for year two method SW-846 8260B
Domain 2: Representative				
	Metric 3:	Geographic Area	High	Samples were collected in the Cape Fear River basin, North Carolina, USA. Appendix A reports coordinates for each sampling station.
	Metric 4:	Temporal	High	Samples were collected from October 2014 - October 2016
	Metric 5:	Exposure Scenario	High	The water from the Cape Fear River basin serves as source of drinking water to many counties in North Carolina."According to UCMR3 data, this basin also exhibits some of the highest measured concentrations of 1,4-dioxane in finished drinking water in NC and the U.S".
Domain 3: Accessibility/Clarity				
	Metric 6:	Availability of Database and Supporting Documents	Medium	State database may be not widely accepted, the document includes supporting documentation and QA/QC protocols.
	Metric 7:	Reporting Results	Medium	The database reports summary of statistics including min, max, median and mean.
Domain 4: Variability and Uncertainty				
	Metric 8:	Variability and Uncertainty	Medium	Variability reported as min and max per station per year and different locations studied. Uncertainty and limitations are not reported or discussed.

Overall Quality Determination High

Study Citation:	NCDWR, (2019). North Carolina DWR 1,4-Dioxane Study: Data collected from Publicly Owned Treatment Works (POTWs) having pretreatment programs and Industrial Dischargers that directly discharge to the Cape Fear River Basin, 2019.
HERO ID:	11414335

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	The DWR letters established that grab samples were required to avoid cross-contamination and ensure consistency.
	Metric 2:	Analytical Methodology	High	The industrial discharge and pretreatment letters required that 1,4-dioxane was analyzed in a certified laboratory that used the EPA method 624.1.
Domain 2: Representative				
	Metric 3:	Geographic Area	High	The geographic locations are documented per each site.
	Metric 4:	Temporal	High	Samples were collected monthly for three consecutive months starting in July 2019 for the publicly owned treatment works (POTWs) and in October 2019 for the industry.
	Metric 5:	Exposure Scenario	High	The database report results of 1,4 dioxane for 28 municipalities with pretreatment programs and 20 industrial discharges within the Cape Fear River Basin.
Domain 3: Accessibility/Clarity				
	Metric 6:	Availability of Database and Supporting Documents	Medium	The database is state maintained. Metadata is present and data fields are clear and defined.
	Metric 7:	Reporting Results	High	The database reports results per site and sampling month, the data is well organized.
Domain 4: Variability and Uncertainty				
	Metric 8:	Variability and Uncertainty	Low	The database does not report summary of statistics and therefore there is not variability reported. The database reports data qualifiers and supporting information.

Overall Quality Determination High

Study Citation:	PWC, (2021). The facts about 1,4-Dioxane: Monthly 1,4-dioxane results, P.O. Hoffer Water Treatment Facility.
HERO ID:	10365696

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Low	The sampling methodology was not reported. The companion data source only indicates that samples were collected monthly at the point of entry
	Metric 2:	Analytical Methodology	Low	The analytical methodology was not reported in data source or companion source
Domain 2: Representative				
	Metric 3:	Geographic Area	High	Samples collected at the Hoffer water treatment facility in Fayetteville NC
	Metric 4:	Temporal	High	Samples collected from 2014 to 2021
	Metric 5:	Exposure Scenario	High	the companion source (Annual Water Quality Report) indicates that 1,4-dioxane has been detected in the Cape Fear basin from untreated industrial discharges, as a result, there is a monthly investigation of 1,4-dioxane in the point of entry of the water treatment facility. The Hoffer facility serves the Fayetteville population
Domain 3: Accessibility/Clarity				
	Metric 6:	Availability of Database and Supporting Documents	Low	The database may not be widely known and only reports monthly concentrations
	Metric 7:	Reporting Results	Low	The database only reports point data and not summary of statistics
Domain 4: Variability and Uncertainty				
	Metric 8:	Variability and Uncertainty	Low	Variability, key uncertainties, limitations, and data gaps are not discussed

Overall Quality Determination Low

Study Citation:	Fisher, J., Mahle, D., Bankston, L., Greene, R., Gearhart, J. (1997). Lactational transfer of volatile chemicals in breast milk. American Industrial Hygiene Association Journal 58(6):425-431.
HERO ID:	194390

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	High	The reference provided equations for rates of change including in the amount of chemical and in the amount of chemical ingested by nursing infant, adapted from Ramsey and Andersen 1984.
	Metric 2:	Model Evaluation	Medium	This reference discussed a physiological based pharmacokinetic (PBPK) model developed from several other models; some level of evaluation was likely performed, but specifics were not detailed.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Low	The study was published in 1997.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	Low	Development of this model was based on various PBPK models (Shelley et al 1998, Hoover et al 1991, Schreiber 1993, Byczkowski and Fisher 1995); at least one article is not publicly available.
	Metric 5:	Model Inputs and Defaults	High	Key model inputs are identified, referenced and described (see Tables I, II, III).
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Medium	There was limited discussion of variability about samples, uncertainty on toxicology of chemical in infants, and data gaps. The standard deviation was provided for various partition coefficients.

Overall Quality Determination Medium

Study Citation:	Valcke, M., Nong, A., Krishnan, K. (2012). Modeling the Human Kinetic Adjustment Factor for Inhaled Volatile Organic Chemicals: Whole Population Approach versus Distinct Subpopulation Approach. Journal of Toxicology 2012:404329.
HERO ID:	1260919

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	High	The authors used mathematical models to estimate inhalation exposures that were derived from peer-reviewed sources (citations given). The authors combined metrics from many different studies to develop the simulations for each sub-population and entire populations. The human kinetic adjustment factors were simple calculations applied to the results (these are also cited).
	Metric 2:	Model Evaluation	High	The authors used mathematical models to estimate inhalation exposures that were derived from peer-reviewed sources (citations given).
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	The paper was received in 2011 and published in 2012.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	High	The models used in the study were derived from other sources, cited in the report, including a World Health Organization publication and one cited to a peer-reviewed journal that appears to be publicly-available. These and other supporting references were not obtained, but would likely contain model guidance and documentation.
	Metric 5:	Model Inputs and Defaults	High	The authors clearly described the inputs they used that were derived from other studies for the exposure estimates.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	High	The authors' approaches incorporated the variability seen in the general population. The authors mention uncertainties in the results as they compare to other studies and suggest why there might be differences. The uncertainties are minimal. The authors used Monte Carlo software to simulate the blood concentrations of 1,4-Dioxane in individuals of different sub-populations based on computed input and demographics of the Canadian population. They then simulated scenarios of distinct sub-groups and entire populations with the results to form the data sets for the comparisons.

Overall Quality Determination High

Study Citation:	Simonich, S. M., Sun, P., Casteel, K., Dyer, S., Wernery, D., Garber, K., Carr, G., Federle, T. (2013). Probabilistic analysis of risks to US drinking water intakes from 1,4-dioxane in domestic wastewater treatment plant effluents. Integrated Environmental Assessment and Management 9(4):554-559.
HERO ID:	3539074

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	Medium	The authors did not provide an example of the model. They briefly described the elements used in the model to estimate concentrations and provided the dilution factors in a table.
	Metric 2:	Model Evaluation	Low	The authors developed the probabilistic model, and they did not describe whether it was evaluated and reviewed or the extent to which the model results correlated with real data.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	The modeled scenario uses monitoring data collected in 2010.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	Low	The authors developed the model for the study. The authors did not indicate that there was documentation available for the model.
	Metric 5:	Model Inputs and Defaults	Medium	The authors provided detailed information about some of the inputs to the model, including the distribution of 1,4-D concentrations measured in 40 WWTP effluents. The authors ran a Monte Carlo simulation, but specific calculations were not reported. The authors mentioned possible data quality issues with the effluent sampling and suggested the extent to which these issues affected the results.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Medium	The authors characterized the variability of the data in the report. The authors asserted that there were few sources that had 1,4-dioxane concentrations to compare to the WWTP sample test results, and the results of the comparisons suggested that the results were similar in similar settings. The authors collected effluent samples from 40 WWTPs around the country only once, which contributes to uncertainty related to the representativeness of the data. The author applied the concentrations of 1,4-dioxane detected to 1,323 drinking water intakes; the patterns of spatial distribution of the two data sets loosely matched each other.

Overall Quality Determination Low

Study Citation:	Makino, R., Kawasaki, H., Kishimoto, A., Gamo, M., Nakanishi, J. (2006). Estimating health risk from exposure to 1,4-dioxane in Japan. Environmental Sciences 13(1):43-58.
HERO ID:	3660508

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	High	Key mathematical equations to calculate inhalation and dermal exposure to 1,4-Dioxane from dishwashing liquid and to calculate 1,4-Dioxane concentrations in the air around two plants are provided in the data source. Equations are described in detail and correctness can be assessed.
	Metric 2:	Model Evaluation	Medium	The model to determine inhalation and dermal exposure to 1,4-Dioxane from dishwashing liquid was based on the National Industrial Chemicals Notification and Assessment Scheme (NICNAS). The article is in a peer-reviewed journal and the model was developed by the Australian government. METI-LIS, a local atmospheric dispersion model, was used to estimate 1,4-Dioxane concentrations in the air and the model was developed by Japan's Ministry of Economy, Trade, and Industry.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Low	The derived concentration measurements of 1,4-Dioxane from dishwashing liquid was from a sample collected in 2003. AMeDAS data for 2001 and PRTR survey results from 2001 were used as the inputs for the METI-LIS model.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	High	There is sufficient documentation in the data source to understand the inhalation and dermal exposure model. The authors rely on publicly available model and data set to develop the geospatial model results, and one assumes that the dispersion model had been built to accommodate the meteorological data.
	Metric 5:	Model Inputs and Defaults	High	Key model inputs and defaults are identified, referenced and clearly described for all modeled scenarios.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	High	The study characterizes variability in the population/media studied; e.g., the study included a statistical summary of data derived from one of the models that was run 10,000 times and a discussion of some model inputs being derived from long-term meteorological data. The authors briefly suggest possible reasons for variability in their results. Key uncertainties, limitations, and data gaps are identified.

Overall Quality Determination High

Table 70: Glossary of Select Terms for Data Extraction Tables

Term	Definition
1,4-D	1,4-Dioxane
3D	3-Dimensional
AK	Alaska
AMeDAS	Automated Meteorological Data Acquisition System
AOP	Aspect oriented programming
CA	California
DOH	Department of health
EDT	Electronic data transfer
EPA	Environmental Protection Agency
FAQ	Frequently asked question
GC	Gas chromatography
GSD	Geometric standard deviation
IEC	International Electrotechnical Commission
IMS	Ion mobility spectrometry
ISO	International Organization for Standardization
LLE	Liquid-liquid extraction
LOD	Limit of detection
LOQ	Limit of quantification
MDL	Method detection limit
METI-LIS	Ministry of Economy Trade and Industry Low-rise Industrial Source
mg/m^3	Milligrams per cubic meter
MRL	Method reporting limit
MS	Mass spectrometry
N	Number of samples
N/A	Not applicable
NC	North Carolina
NCDWR	North Carolina Department of Water Resources
ND	Not detected
NICNAS	National Industrial Chemicals Notification and Assessment Scheme
NJDEP	New Jersey Department of Environmental Protection
NWQMC	National Water Quality Monitoring Council
NY	New York
PBPK	Physiologically based pharmacokinetic
OQD	Overall quality determination
Ppb	Parts per billion
PRTR	Pollutant Release and Transfer Register
PVC	Polyvinyl chloride
PWC	Public works commission
PWS	Public water system

Continued on next page . . .

Table 70 . . . continued from previous page

Term	Definition
QA/QC	Quality assurance/quality control
SD	Standard deviation
SDWIS	Safe Drinking Water Information System
SE	Standard error
SI	Supplemental information
SIM	Selected ion monitoring
SPE	Solid phase extraction
TCE	Trichloroethylene
TX	Texas
μg/L	Micrograms per liter
UBAF	Up-Flow biological aerated filter
UCMR	Unregulated Contaminant Monitoring Rule
US or USA	United States of America
VOC	Volatile organic compound
WTP	Water treatment plant
WWTP	Wastewater treatment plant