Arizona's Use of R for TMDL Automation

June 22, 2023

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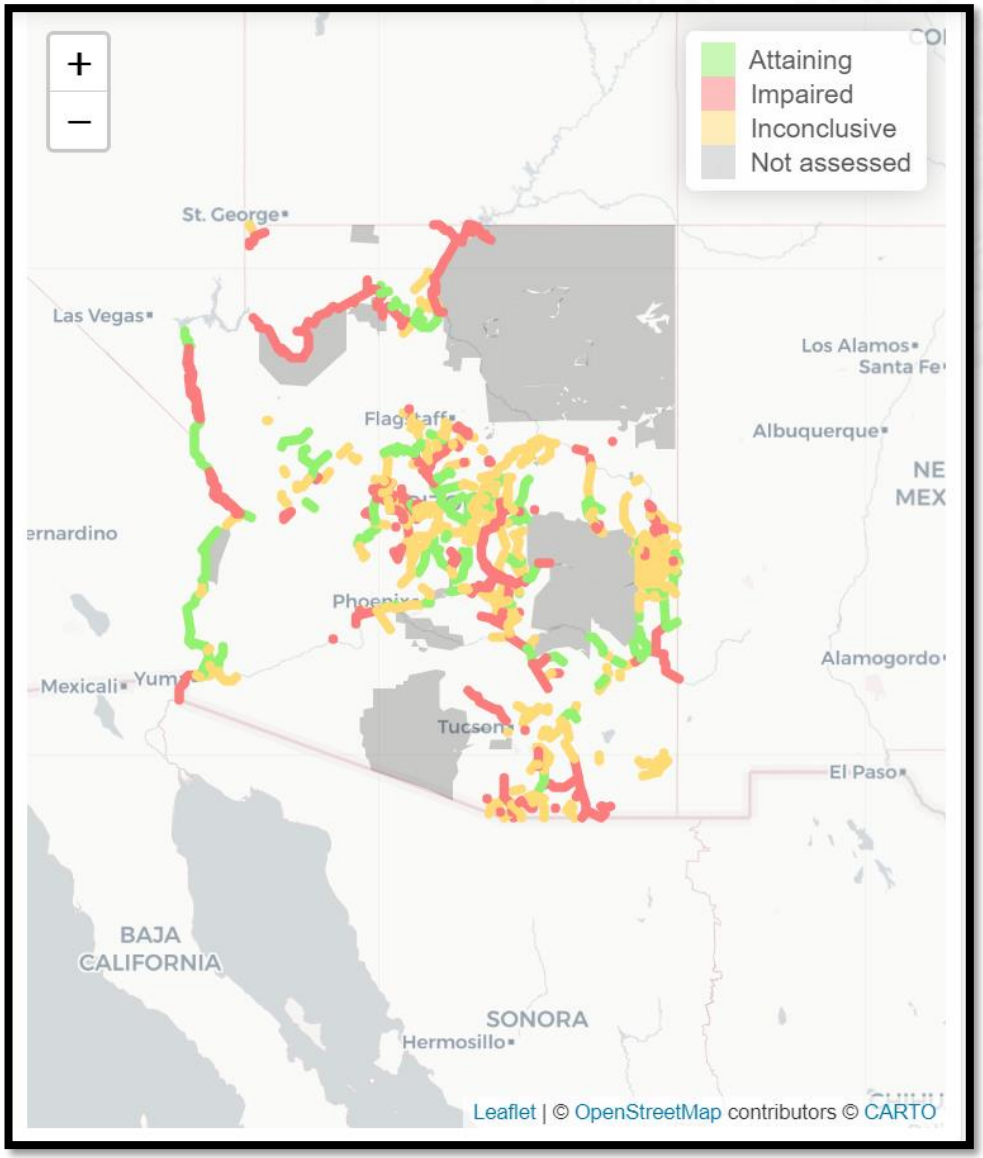
Environmental Program Manager

ADEQ Arizona Department of Environmental Quality

Arizona's Current Parameter Impairment Status

- 289 Impaired Parameters
- 137 of those Parameters Have a TMDL
- **152** Impaired parameters don't have a TMDL

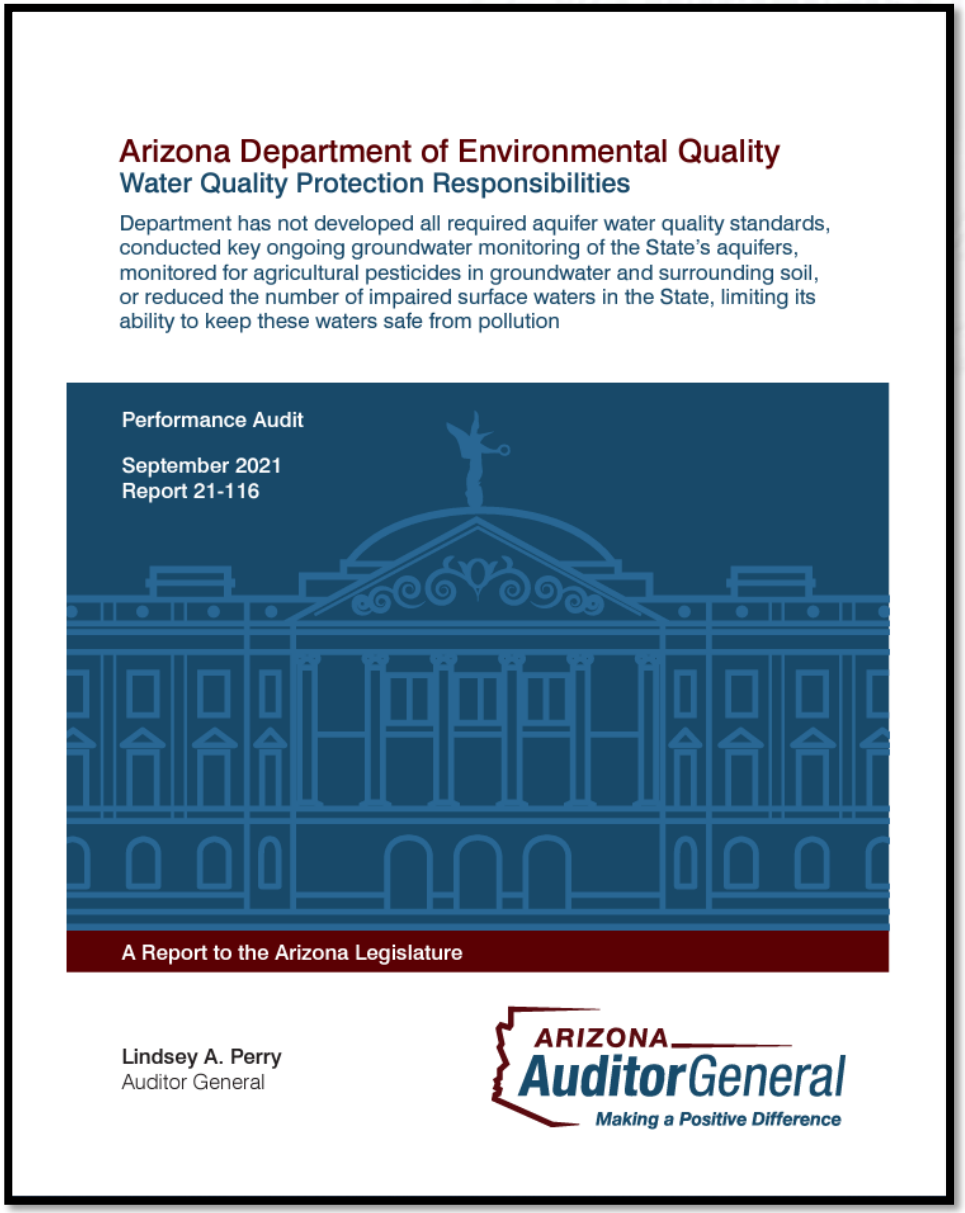


Auditor General Report Findings

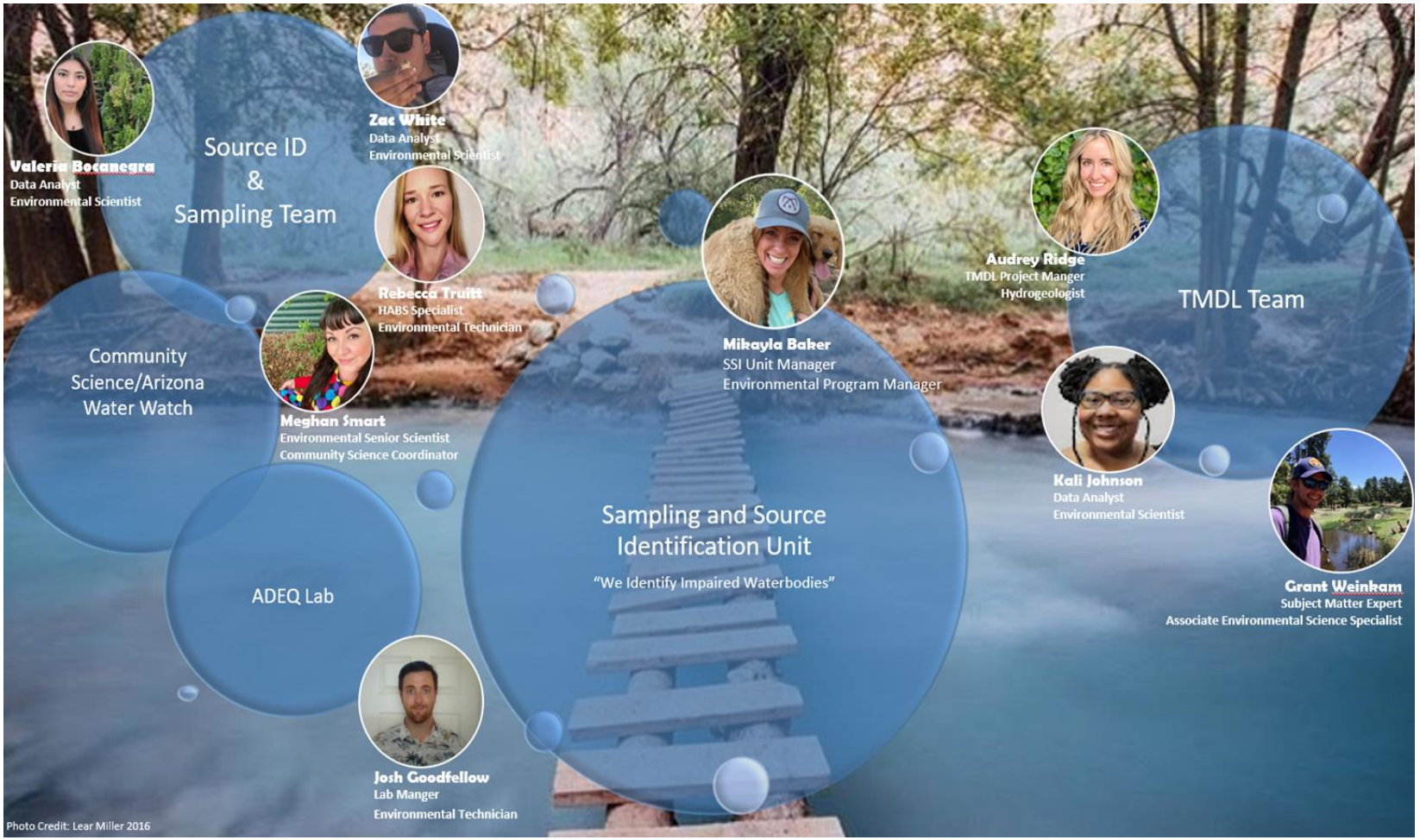
Department has not developed some TMDLs

Department has not tracked due dates

Department has not reviewed existing TMDLs to identify needed changes



The Team!


Source ID
&
Sampling Team
Valeria Bocanegra
Data Analyst
Environmental Scientist
Zac White
Data Analyst
Environmental Scientist
Rebecca Truitt
HABS Specialist
Environmental Technician
Meghan Smart
Environmental Senior Scientist
Community Science Coordinator
Community
Science/Arizona
Water Watch
ADEQ Lab
Josh Goodfellow
Lab Manger
Environmental Technician
Sampling and Source
Identification Unit
"We Identify Impaired Waterbodies"
Mikayla Baker
SSI Unit Manager
Environmental Program Manager
Audrey Ridge
TMDL Project Manger
Hydrogeologist
TMDL Team
Kali Johnson
Data Analyst
Environmental Scientist
Grant Weinkam
Subject Matter Expert
Associate Environmental Science Specialist
Photo Credit: Lear Miller 2016

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Environmental Scientist

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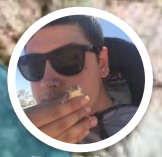

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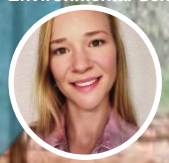

Rebecca Truitt
HABS Specialist
Environmental Technician

Mikayla Baker
SSI Unit Manager
Environmental Program Manager

Audrey Ridge
TMDL Project Manger
Hydrogeologist

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Community
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Meghan Smart
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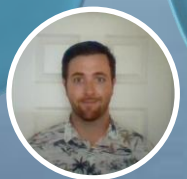
Sampling and Source Identification Unit

"We Identify Impaired Waterbodies"

ADEQ Lab

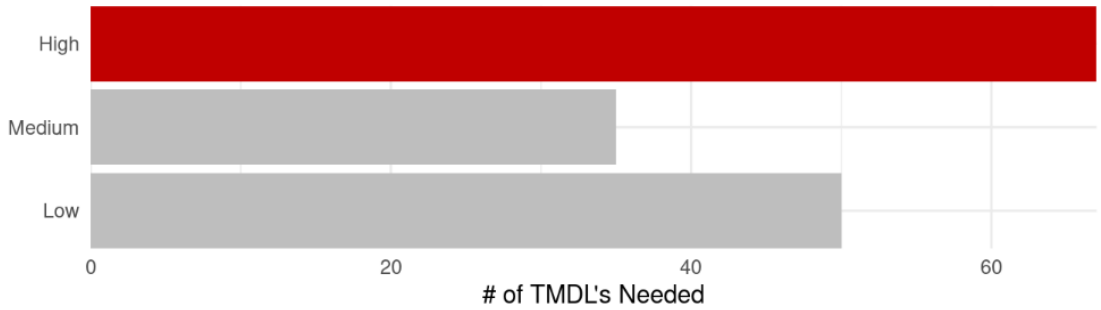


Josh Goodfellow
Lab Manger
Environmental Technician

Photo Credit: Lear Miller 2016

Where Do We Start?

- There are **67** impairments out of 152 that are **high priority** based on Arizona Administrative Code R18-11-606



TMDL Prioritization Tool

Arizona's TMDL Priority Application

Developed by: Jason Jones

Overview | Metrics & Sources | Assign Weights | Index

Welcome!

This application helps users assign priorities for Total Maximum Daily Loads (TMDLs) in Arizona. TMDLs are basically a pollution budget for impaired waters so a waterbody can meet standards. Waterbody and parameter combinations will be used in this application because this is what has been traditionally reported to EPA for the impaired waters list. For example, Three R Canyon, which has a waterbody ID (WBID) of 15050301-558B is impaired for nickle and selenium.

How this Application Works

This interactive document was created using an R markdown document with shiny. R is a free opensource software platform for data science. R markdown generates the document and shiny makes it interactive. The user does not need to know anything about R but it is important to know that the code and logic behind this application is fully transparent and can be reproduced by anyone with the appropriate permissions (see the Sources tab).

Code was written that gathers the data needed for the metrics that make up the TMDL priority index (Figure 1). This application does not run that code directly as there are database, google spreadsheet and network permissions that are needed. A file is produced when the code is run that is used by this application. Code for the app is located at `J:\WQD\Surface Water Section\TMDL\TMDL Prioritization`.

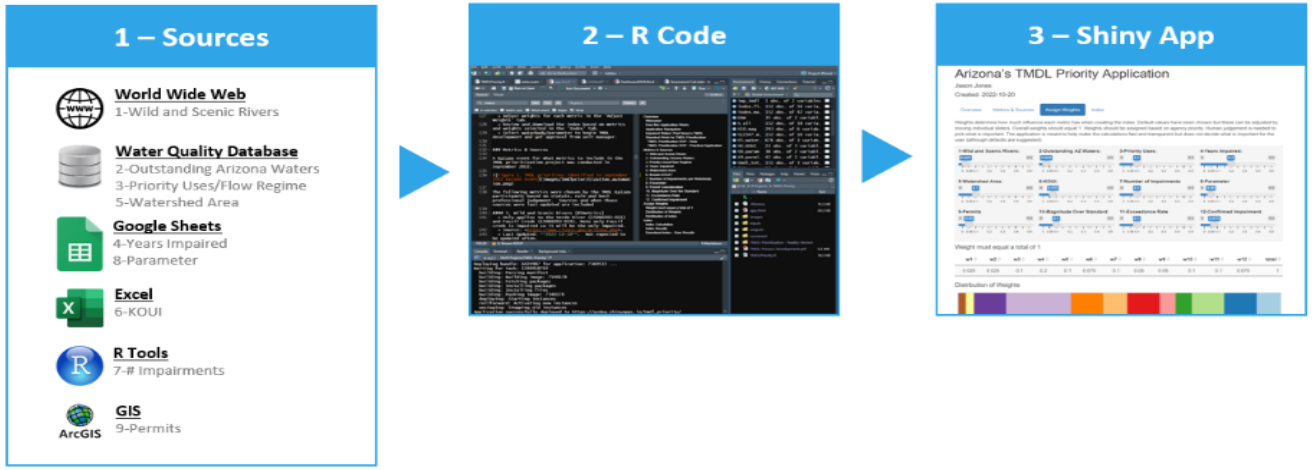


Figure 1. Application architecture

https://azdeq.shinyapps.io/tmdl_priority/

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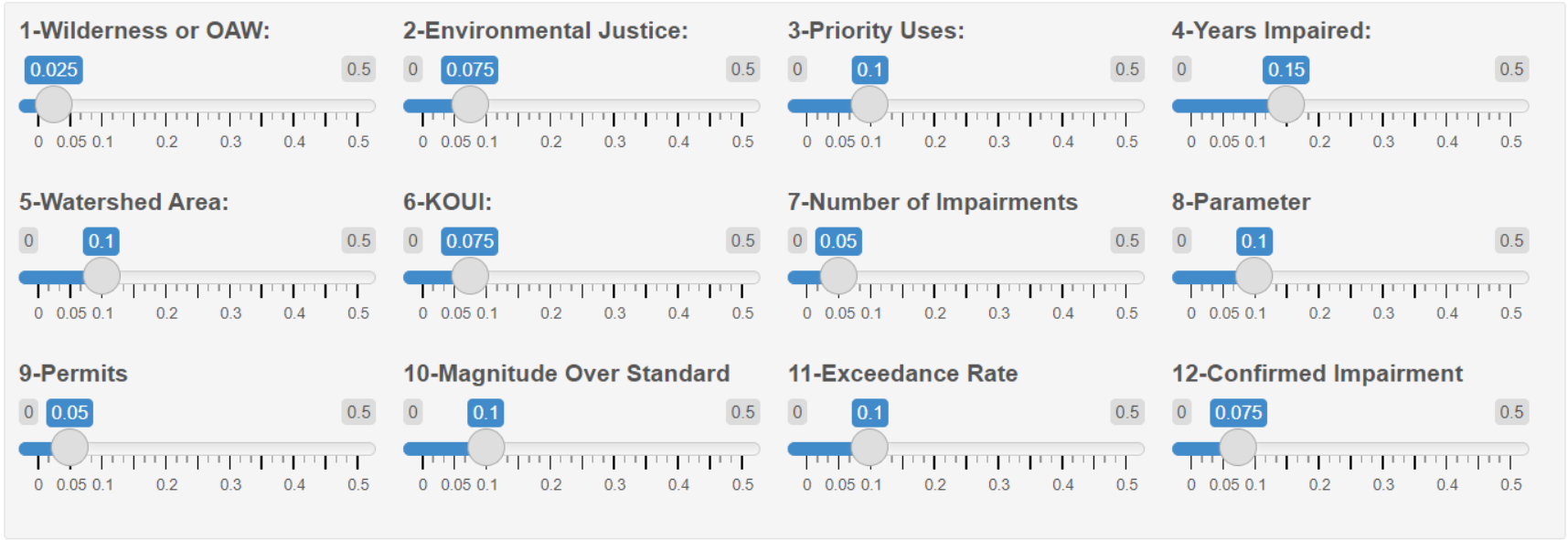
Overview | Metrics & Sources | **Assign Weights** | Index

Weights determine how much influence each metric has when creating the index. Default values have been chosen but these can be adjusted by moving individual sliders. Overall weights should equal 1. Weights should be assigned based on agency priority. Human judgement is needed to pick what is important. The application is meant to help make the calculations fast and transparent but does not decide what is important for the user (although defaults are suggested).



Weight must equal a total of 1

TMDL Prioritization Tool

$$Metric_1 = \frac{x_1 - min(x)}{max(x) - min(x)} wt_x$$

$$Index = \sum_{i=1}^{n} Metric_i$$

Index Results

See the Download Index - Raw Results to see the math behind how the index was calculated.

Show 10 entries Search:

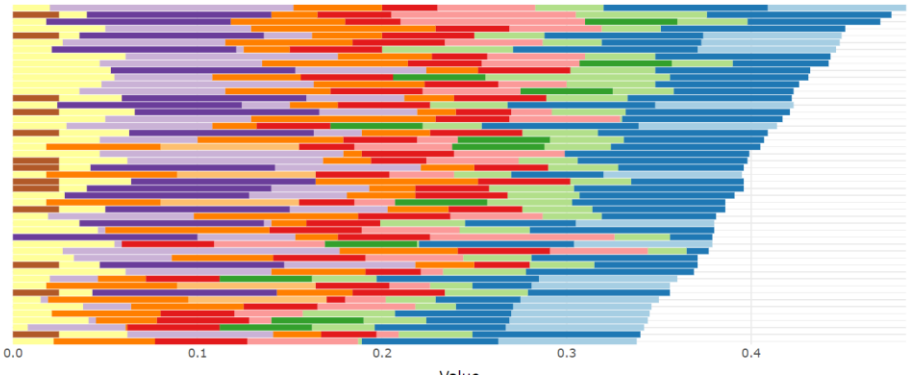
WBID	WaterbodyName	CharacteristicName	TMDLPriorityRule	Index
All	All	All	All	All
15050100-012B	MINERAL CREEK (MIN)	COPPER	High	1
15060103-004	SALT RIVER	ARSENIC	High	0.97
15070102-034B	BIG BUG CREEK	ARSENIC	Medium	0.95
15060202-016	OAK CREEK	ESCHERICHIA COLI	High	0.89
15060106B-0410	CORTEZ PARK LAKE	PH	High	0.89
15060103-006	SALT RIVER	ESCHERICHIA COLI	Low	0.88
15080301-090A	MULE GULCH	COPPER	High	0.88
15050100-014A	QUEEN CREEK	COPPER	High	0.86
15050301-011	NOGALES WASH	COPPER	High	0.86
15040004-003	SAN FRANCISCO RIVER	ESCHERICHIA COLI	High	0.83

Showing 1 to 10 of 152 entries Previous 1 2 3 4 5 … 16 Next

Index Breakdown

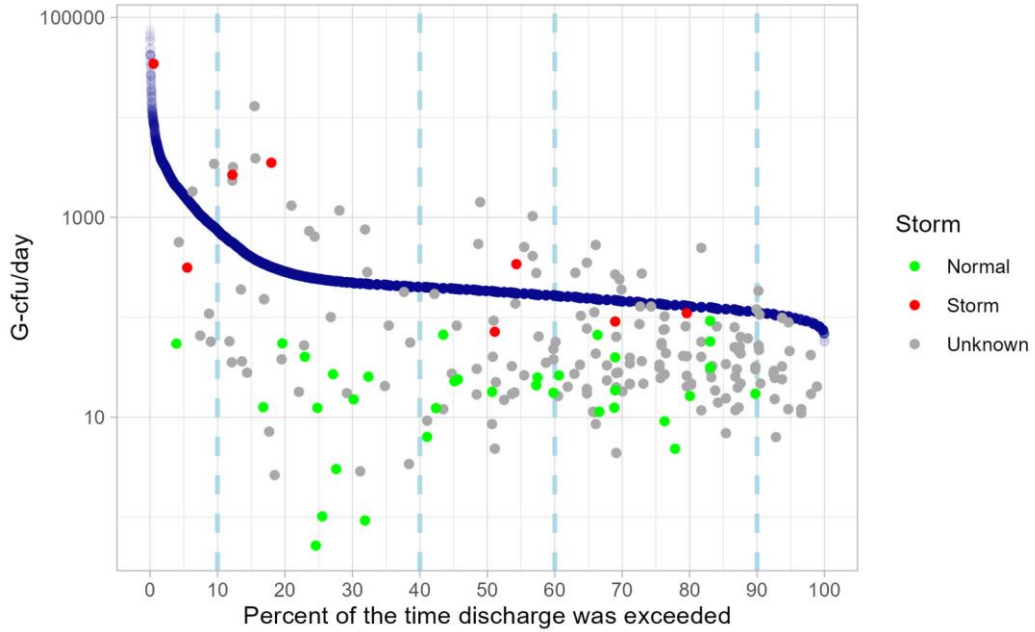
This staked bar chart shows how each metric contributes to the overall index score. Hover over the bars to see the waterbody, category, raw value and the metric value. See the 'Metrics & Sources' tab for additional information on each metric such as units.

Select How Many Waters You Would Like to Explore



Load Duration Curves for E. Coli

Inputs:
Gage for flow = 09504500
Start Date = 1970-01-01
End Date = 2022-12-31
CharacteristicName = Escherichia coli
MonitoringLocations for data = multiple monitoring locations from water quality portal



Questions?

TMDL

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R Code

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