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Tetra Tech Inc.

**lis mmi calculation tool: a user guide**

A logo with blue and green colors

Description automatically generatedA logo of a company

Description automatically generatedThis is a logo for the engineering firm Tetra Tech. It consists of a blue rectangle with rounded edges containing a blue uppercase T and a blue lowercase t in block font on a white background. To the right, the words "Tetra Tech" appear in block font as well.

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**Project Background**

The Connecticut Long Island Sound (CTLIS) Macroinvertebrate Multimetric Index (MMI) is a scientifically robust tool developed to assess the ecological condition of embayment sites in Long Island Sound using benthic macroinvertebrate communities. Developed by Tetra Tech in collaboration with the Connecticut Department of Energy and Environmental Protection (CT DEEP), the MMI integrates biological, chemical, and physical data collected from over 200 sites between 2010 and 2021.

The index is grounded in a disturbance gradient derived from sediment and water quality, land use, and macroinvertebrate trait data. From over 500 candidate metrics, six were selected for the final index model, capturing key ecological responses such as pollution tolerance, bioturbation potential, and the presence of sensitive or tolerant taxa. The index demonstrated high performance, with discrimination efficiencies exceeding 89% in both calibration and validation datasets.

This tool fully automates the CTLIS MMI calculation process. Users simply provide macroinvertebrate count data and sample metadata - no additional processing or formatting is required. The tool automatically joins trait information, calculates all relevant metrics and index scores, and generates a formatted, informative report. This streamlined workflow ensures that users can focus on interpreting results rather than managing data, making the tool ideal for regulatory assessments, long-term monitoring, and public communication.

# Getting Started

To use this tool, simply follow these four steps:

1. **Install RStudio**  
   Instructions are provided on Page 2.
2. **Download the Tool from GitHub**  
   Visit the GitHub repository and follow the download steps outlined on Page 3.
3. **Prepare Your Input Data**  
   Format your macroinvertebrate count data as described on Page 4.
4. **Run the Tool**  
   Launch the R Markdown script and follow the execution steps on Page 5.

Each of these steps is explained in detail in the following sections.

# Installing RStudio

**Step 1: Install R**

1. Go to the official R Project website: <https://cran.r-project.org>
2. Click on the link for your operating system (Windows, macOS, or Linux)
3. Download the latest version of R and follow the installation instructions

**Step 2: Install RStudio**

1. Visit the RStudio download page: <https://posit.co/download/rstudio-desktop/>
2. Download the installer for your operating system
3. Run the installer and follow the prompts

**Note:** R must be installed before RStudio, or RStudio will not function properly

# Downloading the Tool from GitHub

To access the CTLIS MMI calculation tool, follow these steps:

1. **Visit the GitHub Repository**  
   Go to the official GitHub page for the tool:

<https://github.com/ismarbiberovic/LIS-Macroinvertebrate-MMI>

1. **Download the Repository**
   * On the GitHub page, click the green “Code” button.
   * Select “Download ZIP” from the dropdown menu.
   * Save the ZIP file to your computer and extract its contents to a folder

# Prepare Your Input Data

Before running the CTLIS MMI tool, you’ll need to prepare an input file that contains your macroinvertebrate count data. These must follow specific formatting rules to ensure the tool runs correctly. You will add Information about your input file to the designated Excel form called “Tool Input Form”, including input file name and its respective column names.

**Macroinvertebrate Count Data**

This file should contain:

* One row per taxon per sample
* Columns that have:
  + A unique identifier for each sample
  + Taxonomic names
  + Number of individuals observed (i.e., taxa count)
* Format must be .csv or .xlsx
* Note that you do not have to remove any columns not used by the tool from this file; the tool will do that on its own

**3. Formatting Tips**

* Ensure format is exactly what the tool expects, long format for taxa counts
* Avoid blank rows or merged cells
* Use consistent taxonomic names without periods, parentheses, or underscores
* Place your input file in the `User Input Data` folder

**4. Example File**

An example input template is provided in the GitHub repository (see the file called Example\_data.csv). You can use this as a starting point to format your own data. Please know that data in this file are completely fictional.

# Running the Tool

Once your input form is ready, follow these steps to run the LIS MMI tool using RStudio:

1. Launch RStudio file called “LIS MMI Calculator.Rmd” if you haven’t already
2. Go to the top menu and click: Session 🡪 Set Working Directory 🡪 To Source File Location. This ensures that R uses the folder where your current script is saved as the working directory, making it easier to read and write files relative to your script.
3. Click the “Knit” button at the top of the RStudio window
4. The tool will:
   1. Read your input data through the Excel form
   2. Join trait information
   3. Calculate metrics and MMI scores
   4. Generate a report and relevant data
      1. The report is saved in the same folder as the R Markdown script
      2. Output data is automatically stored in the Output Files folder, which is created by the script - you do not need to create this folder manually

Scenarios in which the tool will not work properly:

* Information in the form does not match what is in the sample/input file
* The name of the form has been changed
* A sheet was added to the form, or cells were moved/deleted in the form
* The R Markdown code has been altered

**The final .docx report will be saved in the same folder as the script. All output files will be saved in the `Output Files` folder.**

# Contact and Support

If you need assistance while using the CTLIS MMI tool, please reach out to the appropriate contact:

* **Trait Table Updates & Technical Support**  
  *Katie O’Brien-Clayton, CT DEEP*  
  📧 <Katie.OBrien-Clayton@ct.gov>
* **MMI Methodology & Report Details**  
  *Ismar Biberovic, Tetra Tech*  
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