

Identifying Point and Nonpoint Sources of Nutrients

Colorado DPA Guide for Developing 208 Plans

Overview

This guide is designed for Designated Planning Agencies (DPAs) that want to include a discussion about nutrient sources of and management strategies in their 208 plan. The [Comprehensive, optimal, and Effective Abatement of Nutrients \(CLEAN\) Center](#) developed the [Nutrient Decision Support System \(NDSS\)](#) to help watershed managers assess the sources of nutrients (total nitrogen and total phosphorus) affecting water quality and find practical methods to reduce nutrient levels in waterbodies. Currently, the CLEAN NDSS provides management options for:

- Wastewater Treatment Facilities (WWTFs)
- Agricultural Management Operations

Available Resources

Colorado State University (CSU), in collaboration with state and federal agencies, developed resources to assist in statewide planning and decision making. Access the tools and additional resources developed by CSU using the weblinks below:

- CLEAN NDSS Resources: <https://erams.com/catena/tools/nutrient-control/>
 - Technical documentation, webtool access, video tutorials, overview information
 - How-to video: <https://youtu.be/lcg0Lc2c6dg>
- Additional DPA Resources: <https://erams.com/catena/tools/colorado-collaborative/co-dpa-resources/>

QUICK START GUIDE

The [CLEAN NDSS](#) helps evaluate the sources and contributions of nutrient pollution, and assess the effectiveness of various best management practices (BMPs) and control measures in reducing nutrient loads. Deciding which feature(s) to use will depend on how the information will be incorporated into 208 plan development. The following information can be provided by the CLEAN NDSS:

- [Identify point \(WWTF\) and nonpoint \(agriculture\) sources of nutrients](#)
- [Quantify nutrient sources](#)
- [Evaluate the magnitude and relative contributions over time](#)
- [Identify effective control measures and BMPs to address nutrient sources](#)

Procedure

1. [Login to eRAMS account](#)
2. [Define Area of Interest](#)

3. [Identify Nutrient Sources](#)
4. [Quantify Nutrient Contributions](#)
5. [Evaluate BMPs and Control Measures](#)

Detailed step-by-step instructions and data source information can be found in the CLEAN NDSS technical user guide available here: <https://erams.com/catena/tools/nutrient-control/>

Step 1 – Login to eRAMS and Set-up CLEAN Project

<https://www.youtube.com/watch?v=lcg0Lc2c6dg&t=85s>

The CLEAN NDSS requires a free user account to begin using the tool (<https://erams.com/account/>).

Detailed instructions to register an account and begin creating projects are available here:

<https://erams.com/catena/getting-started/>. Once logged in, follow the workflow below to set up a new project and get started.

Set-up CLEAN Project

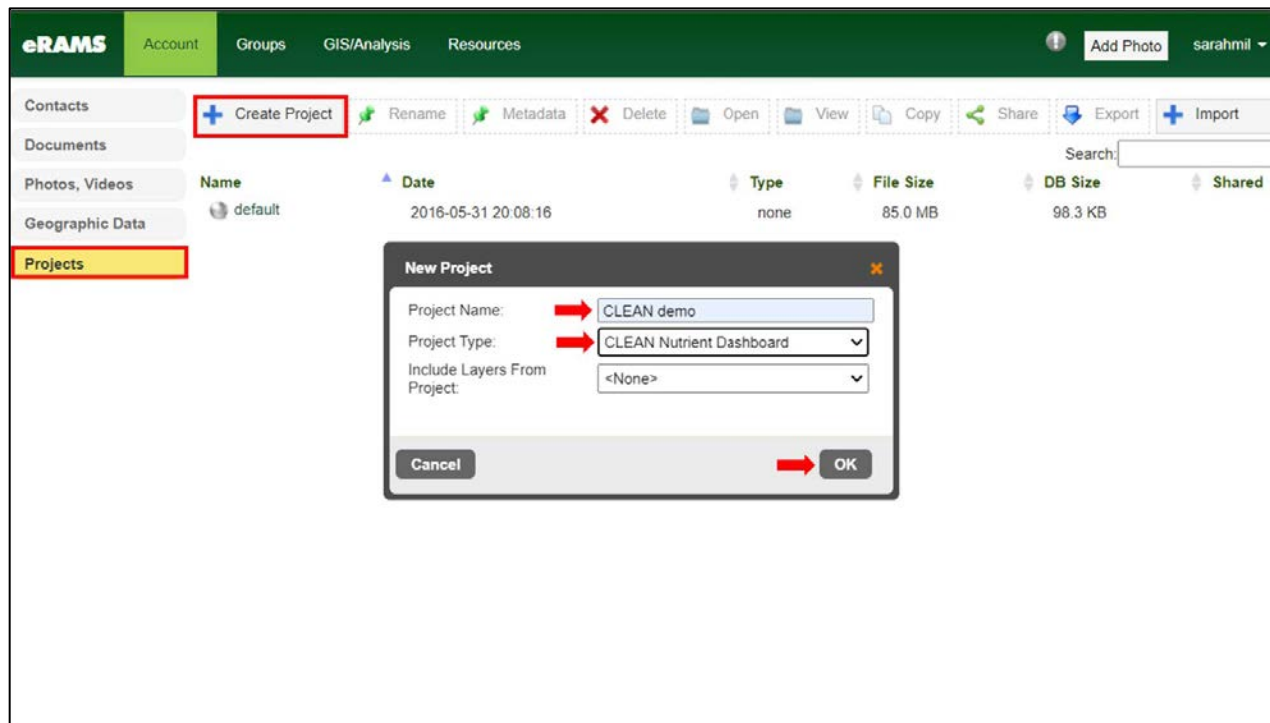


Figure 1 Registered user process for creating a CLEAN NDSS project in eRAMS

1. Login to your eRAMS account here: <https://erams.com/account/>
2. Select the “Projects” tab from the left panel (Figure 1)
3. Select “Create Project” from the top toolbar
4. Enter a Project Name
 - Alternatively, select a project from the list to access previous projects
5. Select “CLEAN Nutrient Dashboard” from the Project Type drop-down
 - Optional: Select layers from previously saved projects under the “Include Layers from Project” drop-down
6. Click “OK”

7. Locate the name of the project you have created in the project list, click the link
 - The link will redirect you to the CLEAN interface, where you can conduct analyses and save work to your eRAMS account.

Step 2 – Define Area of Interest

<https://www.youtube.com/watch?v=lcg0Lc2c6dg&t=135s>

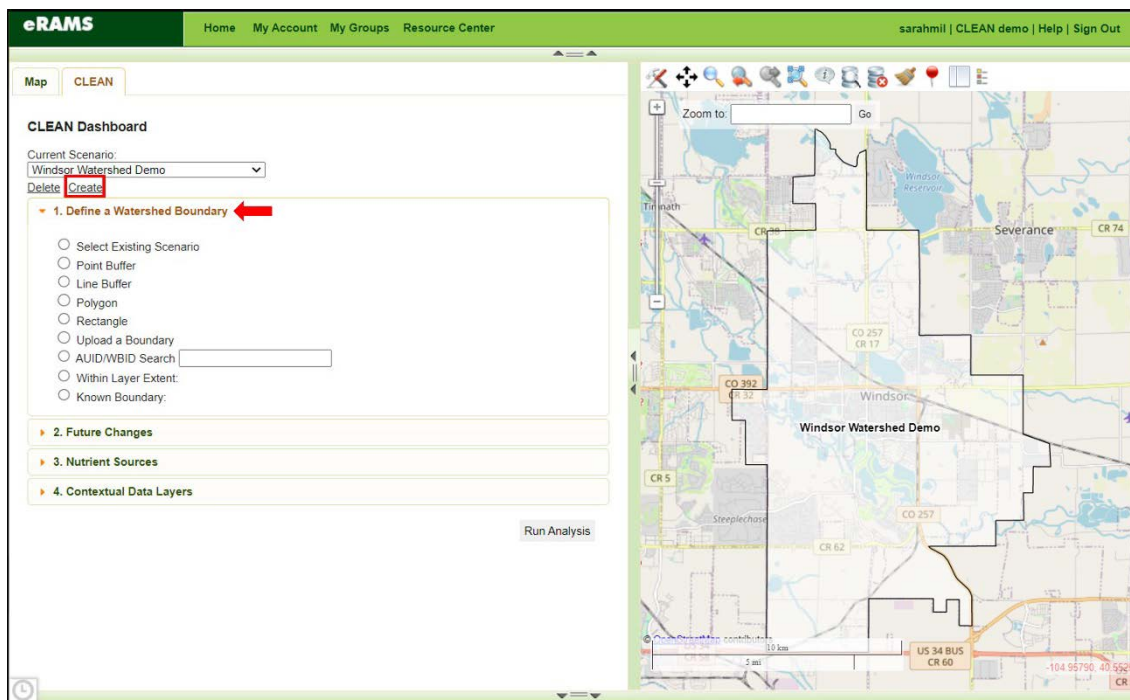


Figure 2 Define area of interest

Once you are logged into eRAMS and have set up a CLEAN project ([Step 1](#)), begin by defining your region of interest or watershed boundary by selecting from the available options:

- Existing Scenarios: If this method is chosen, you will be prompted to select an option from the list of previously developed scenarios.
 - This tool allows users to develop and analyze multiple scenarios to compare the results of different management strategies and BMPs. More information about scenario development is provided in [Step 4](#).
- Draw boundary: Point, line, polygon, or rectangle can be drawn on the map
- Known boundary: Select from states, counties, cities, HUC 8, 10 or 12
- Upload boundary: If this method is chosen, you will be prompted to select a user-supplied geospatial layer (i.e., shapefile).
 - All files associated with a shapefile can be zipped into a ZIP archive (*.zip) then uploaded, or multiple files can be uploaded.
- Stream Segments: In Colorado stream segments are tracked by waterbody identification numbers (WBID) or segment portion (AUD). If the ID is known the corresponding boundary region of that segment will be selected by the tool.

and associated reductions in nutrient loads. Future facility configurations for many facilities often includes the addition of a treatment process to improve water quality, particularly nutrient loads.

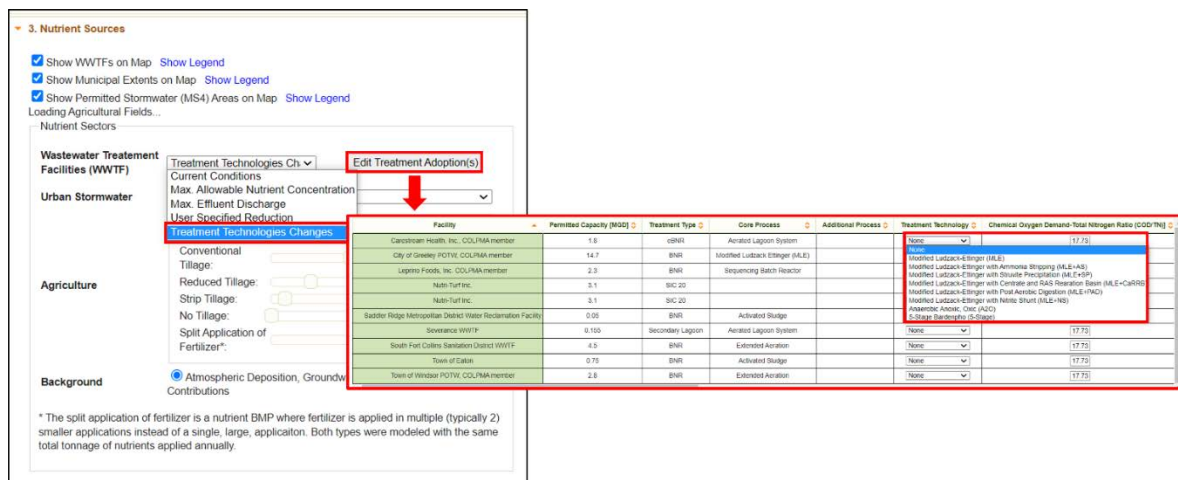


Figure 4 Add WWTF treatment technology

The CLEAN NDSS allows users to select options from the dropdown list (Figure 4) to evaluate future scenarios for:

- **Current Conditions:** observed effluent concentration and discharge of nutrients (i.e., current effluent load of nutrients)
- **Max. Allowable Nutrient Concentration:** A what-if scenario where all facilities are assumed to discharge according to the final phase of Colorado Regulation 31's nutrient regulations (concentration) at their current/observed discharge (flow)
- **Max. Effluent Discharge:** A what-if scenario where all facilities are assumed to discharge according to the final phase of Colorado Regulation 31's nutrient regulations (concentration) and the maximum discharge (flow) associated with their permit
- **User Specified Reduction:** A what-if scenario where all facility current conditions are multiplied by a user-specified reduction factor (0-100%).
 - This could be useful in examining future environmental conditions based on average reductions in loads. For example, what would loads in this watershed be like if all facilities reduce their loads by 10%?
 - This could be useful in examining the impacts of future regulations and the average reduction necessary across a region to achieve those levels which can be combined outside the NDSS with treatment technology implementation costs for a feasibility or impact assessment.
- **Treatment Technology Changes:** A what-if scenario where each facility's current conditions are further reduced by the addition of a treatment technology aimed at load reduction results based on regionalized calibration of treatment effectiveness in Colorado. Treatment technologies for each facility can be modified using the edit feature as described in Figure 3.

Urban Stormwater

The urban stormwater section of the CLEAN NDSS is undergoing extensive redevelopment and enhancement leveraging the Community-enable Lifecycle Analysis of Stormwater Costs (CLASIC) tool.

To more holistically assess stormwater runoff contributions to nutrient loads and broader water quality impacts, please refer to the DPA guide developed specifically for Stormwater BMPs available here: <https://erams.com/catena/tools/colorado-collaborative/co-dpa-resources/>

Agriculture

To consider scenarios for agricultural sources of nutrients in your area you will need to provide the following input information:

- Proportion (%) of flood and sprinkler/drip irrigation
 - Default data is based on Colorado Decision Support System (CDSS) data for irrigated agricultural fields
- Proportion of area (%) using conventional, reduced, strip or no crop rotation
 - Default data is based on CSU survey of irrigated agricultural users
- Split application of fertilizer – the practice of applying fertilizer in multiple times (typically twice) instead of a single event
 - Default data is based on CSU survey of irrigated agricultural users

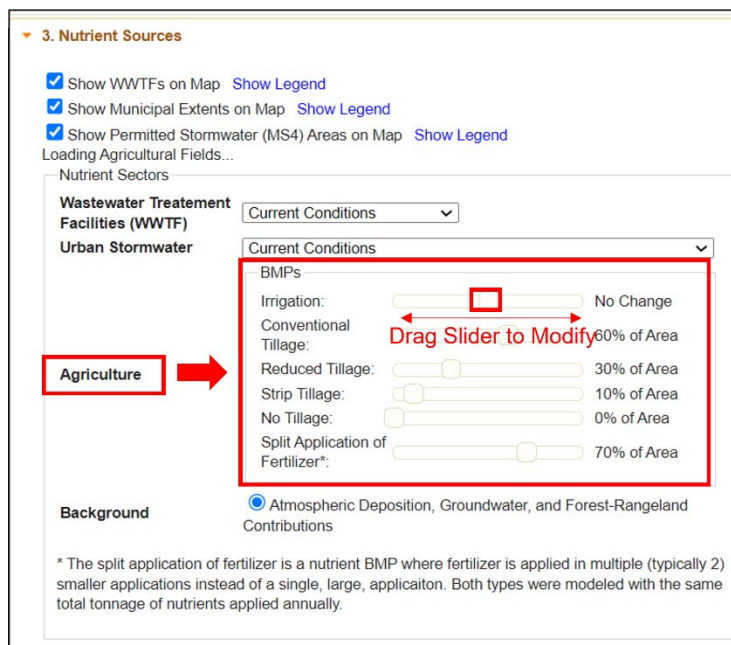


Figure 5 Agriculture inputs to CLEAN NDSS

The agricultural sources can be modified by moving the slider within each specific criteria or remain at default values (Figure 5).

Other Nutrient Sources

Users can review other potential sources of nutrients within watersheds including atmospheric deposition, groundwater, and forest-rangeland contributions.

Step 4 – Evaluate Nutrient Contributions

<https://www.youtube.com/watch?v=lcg0Lc2c6dg&t=794s>

Once the user has specified the necessary inputs the next step is to run the analysis by scrolling down to the bottom of the dashboard as needed and clicking the “Run Analysis” button (Figure 6).

Develop Scenarios

This process can be repeated to develop multiple scenarios and explore the impacts of different management strategies by modifying the inputs and comparing the results.

To develop a new scenario (Figure 5):

1. Select “Create” from the top of the CLEAN Dashboard located under the current scenario drop down list
2. Repeat [Step 2](#) to define the area and [Step 3](#) to modify inputs
3. Select scenarios to include in the analysis by clicking the boxes next to the scenario name in the drop-down menu at the top of the dashboard
4. Scroll down to select “Run Analysis” button from the bottom of the left dashboard.

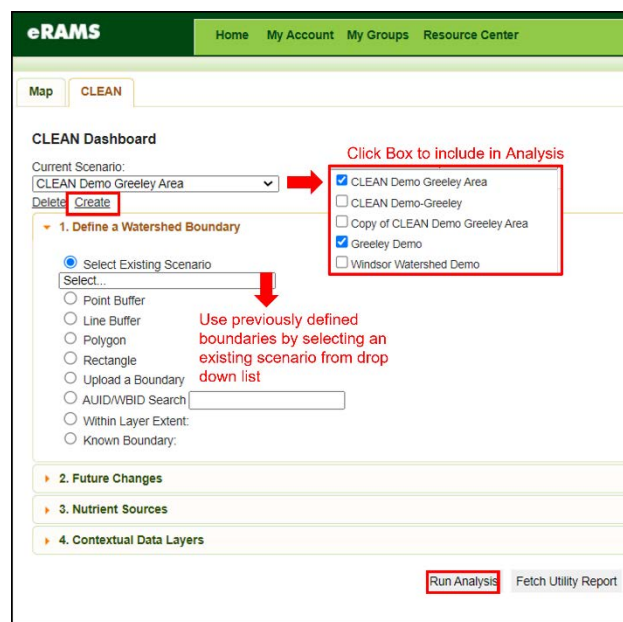


Figure 6 Develop new scenario and run analysis

Result Summary

The CLEAN NDSS will summarize nutrient sources (total nitrogen, total phosphorus) into an interactive bar chart that compares the selected scenarios. All images (png, jpeg, svg) and data can be downloaded (pdf, csv, xls) by clicking the stacked lines in the upper corner of the plotted area (Figures 7-8).

The tool will also produce an interactive pie chart that displays the nutrient breakdown by source type. Clicking any section of the pie chart will provide additional details for the source (Figure 8).

Analyzing the contributions of nutrient loads from identified sources enhances your understanding of how water quality is affected by both nonpoint and point sources in your area. This valuable information

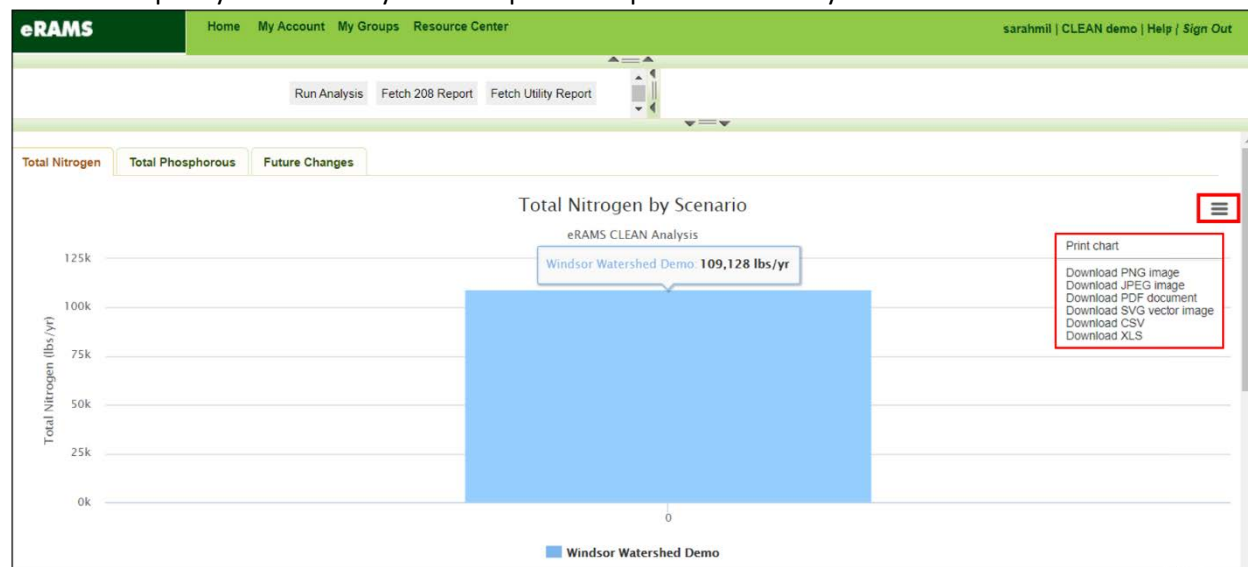


Figure 7 Example of CLEAN NDSS analysis and results

assists planning and management agencies in making well-informed decisions regarding strategies for improvement. It also aids in setting goals and targets for each sector, taking into account projected nutrient contributions and their impact on water quality. Further information on waterbody impairment status and water quality conditions are provided in the DPA guide for Watershed Data and Summary Information developed using the WRAP tool, available here: <https://erams.com/catena/tools/colorado-collaborative/co-dpa-resources/>



Figure 8 Pie chart summary and interactive figures

Climate, Population and Land Use Changes (Optional)
<https://www.youtube.com/watch?v=lcg0Lc2c6dg&t=243s>

The CLEAN NDSS provides options for users to explore impacts due to changing future conditions, such as climate, population growth and land uses. The tool also provides default values for current conditions to be used as a baseline scenario upon which to evaluate future impacts. DPAs are strongly encouraged to watch the [full video tutorial](#) which provides detailed information and step-by-step instructions to perform this optional procedure.

Current Conditions

This feature is used to understand current conditions and develop baseline information for existing predetermined climate, population, and land use data. Default parameters are automatically populated when “Current Projections” is selected.

Future Projections

Here users can customize population and land-use changes to better understand future impacts to nutrient loads. This feature allows users to define sub-areas in their boundary experiencing population

change, new growth, and development or merging of nearby communities (e.g., new subdivisions, consolidation of utility areas, etc.).

To customize future population and land use inputs (Figure 9):

1. Select “Custom Future Projections” to open the input table
2. Use the “Add Additional Development Areas” options to delineate the sub-area undergoing future growth
3. Modify population and/or land use data as needed
 - a. Default is based on historic U.S. Census population conditions and future conditions estimated from the Colorado State Demographer’s county growth projections
4. Click “Save” to apply the changes

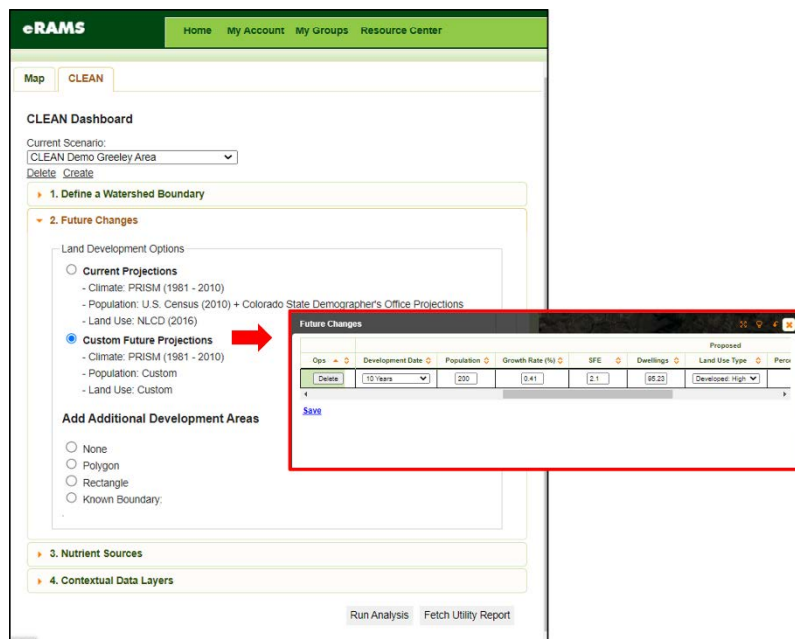


Figure 9 Future conditions interface

Climate: Currently the climate data cannot be modified, only historic/observed climate data is available. CSU is working to update this

feature to include climate scenarios aligned with the Colorado Water Plan future growth scenarios. This feature is expected to be available sometime in early 2024.

Population: DPAs should consult with appropriate local organizations and municipalities to obtain the most updated projections. Many city-level planning and development offices maintain their own growth projections based on their local knowledge and permits for ongoing or future planned development. These projections can be used to improve the accuracy of population estimates in your area.

Land Use: Customizing land use type and percent impervious area will result in changes to nutrient loadings from the agricultural, stormwater and wastewater sectors.

Detailed instructions on how to customize future development scenarios can be found on **page 11** of the CLEAN NDSS technical user manual.

Step 5 – Evaluate Best Management Practices (BMPs) and Control Measures

The CLEAN NDSS can evaluate nutrient load impacts when implementing different treatment technologies and BMP scenarios. The tool contains information about several common treatment technologies and BMPs used in WWTFs and agricultural operations.

Scenarios can be generated by the user to evaluate the impacts of different BMPs, or combinations of BMPs. Follow the process described in [Step 4](#) to create new scenarios for analysis. A few examples are provided below to describe how a user might approach this for both wastewater treatment and agricultural sectors.

Scenario 1: WWTF Treatment Technologies – Additional Treatment Processes

<https://youtu.be/lcg0Lc2c6dg?t=601>

A scenario can be developed to assess the addition of a treatment process to an existing facility. For example, Facility A, already an enhanced Biological Nutrient Removal (eBNR) facility may be considering additional treatment for nutrient conditions and trying to examine whether they should go with something like struvite precipitation. The NDSS provides a regional-calibrated estimate of further nutrient reductions from the implementation of this technology at the point of discharge and its associated change in watershed load allocations across all sectors.

Scenario 2: WWTF Combination to Single Discharge Permit

<https://www.youtube.com/watch?v=lcg0Lc2c6dg&t=919s>

A more complex scenario could be developed where a DPA could consider impacts of two WWTFs combining into a single discharge permit. This could be accomplished by using the ‘User Specified Reduction’ strategy in the NDSS and specifying a 100% reduction for the facility to be closed and a negative reduction (i.e., increase) at the facility to be expanded.

This scenario changes the spatial distribution of nutrient loads in a watershed and across geo-political boundaries to help DPAs gain insights into regional nutrient benefits (reductions) from this action. Further, this scenario could be applied to multiple regions of interest and the overall change to nutrient loads could be examined by:

- Watershed above Facility 1
- Watershed above Facility 2
- Downstream watershed containing both Facility 1 and 2, various political boundaries such as the county
- DPA boundary level benefit of merging Facility 1 and 2, and others (i.e., most political boundaries do not align with environmental boundaries like watersheds).

Then the overall impact on the region by this facility consolidation could be considered and evaluated. With additional resources, this can be further enhanced with other available with cost data (not provided by NDSS) to assess implementation costs required to achieve that change (i.e., cost to expand 1 facility and incremental cost-benefit for that facility to process more effluent). Using this feature, a DPA could identify numerous nearby facilities and assess potential cost-benefit comparisons for multiple scenarios of regionalized consolidation and can be used to help inform decision making at the state, regional, and facility levels.



Scenario 3: Agricultural BMPs

<https://youtu.be/lcg0Lc2c6dg?t=699>

If a DPA were interested in assessing the potential cost-share benefits to support irrigated agriculture and associated water quality improvements, they could use the NDSS to analyze that topic.

For example, the NDSS allows assessment of current irrigated conditions of agriculture in a watershed and comparison against other scenarios. Therefore, DPAs could develop multiple scenarios for their region which incrementally increase the proportion of sprinkler irrigated (higher irrigation efficiencies) agricultural acres compared to flood irrigation (lower irrigation efficiency) acreage and the associated water quality impacts/benefits from adoption of these. Those benefits can be compared against the required cost to develop the infrastructure for those sprinkler systems and assess NPS pollution benefit versus required cost to guide future planning and decision making.

Additional eRAMS Map Features & Layers

<https://youtu.be/9KggAOLVodQ>

Detailed information about all eRAMS map features, processes, tools and data can be accessed here:

<https://erams.com/catena/gis/quick-start/>

Base Map

Users can specify desired base, public, user, or project layers for analysis. To do so, with the CLEAN interface open, click the “Map” tab on the left dashboard

1. Select the desired drop-down menu to modify the map:
 - Base layers: None, Google, Bing, or USGS National Map
 - Public layers: U.S. Census, U.S. Geo Data, U.S. Hydro Data, U.S. EPA Water, Land Use Land Cover
 - User layers: spatial layers, tables (see below)
 - Project layers: option to import from previous analysis when you set up a new CLEAN project

Upload Layers

Users can upload files (Figure 10) and add their own information under the “Map” tab:

- (i) Project Layers – Registered user access, these files correspond to the current project and will be available to any project members (i.e., used within a project). Check out the [eRAMS Grouping capabilities](#) for more information about sharing projects.
- (ii) User Layers – Registered user access, these files are associated with your user account and can be accessed from any project (i.e., used across projects)

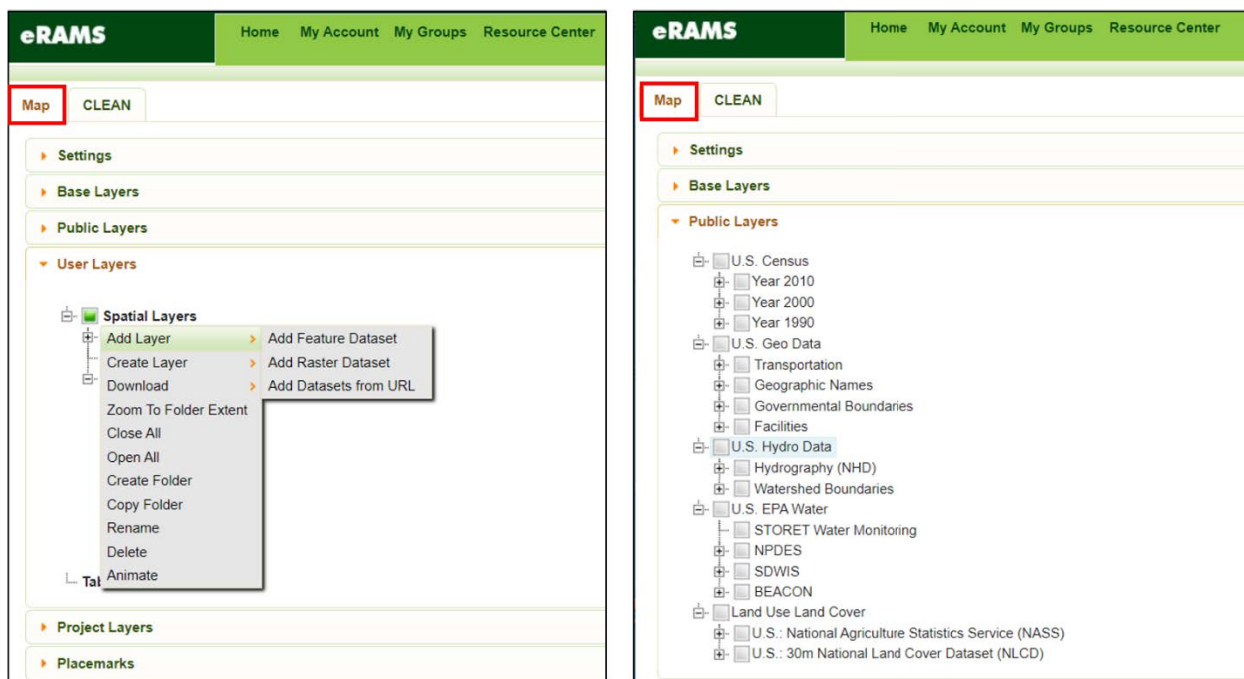


Figure 10 Public and user layer options available in eRAMS