USAID GLOBAL HEALTH SUPPLY CHAIN PROGRAM

Procurement and Supply Management

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| Dispatch Optimizer User Guide  June 2024 |

The USAID Global Health Supply Chain Program-Procurement and Supply Management (GHSC-PSM) project is funded under USAID Contract No. AID-OAA-I-15-0004.  GHSC-PSM connects technical solutions and proven commercial processes to promote efficient and cost-effective health supply chains worldwide. Our goal is to ensure uninterrupted supplies of health commodities to save lives and create a healthier future for all. The project purchases and delivers health commodities, offers comprehensive technical assistance to strengthen national supply chain systems, and provides global supply chain leadership.

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Overview of Dispatch Optimizer

In health supply chains, transportation planning is just one step in a complex set of logistics processes that ensure essential health commodities get from warehouses to the public health facilities which order them. In planning outbound transportation, supply chain professionals must determine the sequencing and grouping of destinations into dispatches, as well as the vehicle type to use for each delivery. This planning must be coordinated with a set of warehouse activities such as order validation, pick wave assignment, picking, packing, staging and loading. In the absence of planning tools, users have to make these decisions based on historical experience and intuition. The Dispatch Optimizer provides a way for users to make data-driven decisions about dispatches from the warehouse.

Users load a list of orders into the tool, follow the guided user experience, and then solve for the optimal set of dispatches and review the results. The suggested dispatch groupings and sequences, along with truck assignments, can then inform warehouse picking and packing activities and the ordering of appropriate delivery vehicles to facilitate delivery of health commodities to the hubs and service delivery points.

The Dispatch Optimizer helps users determine:

• How to group facilities into dispatches?

• How to sequence those facilities within the dispatch?

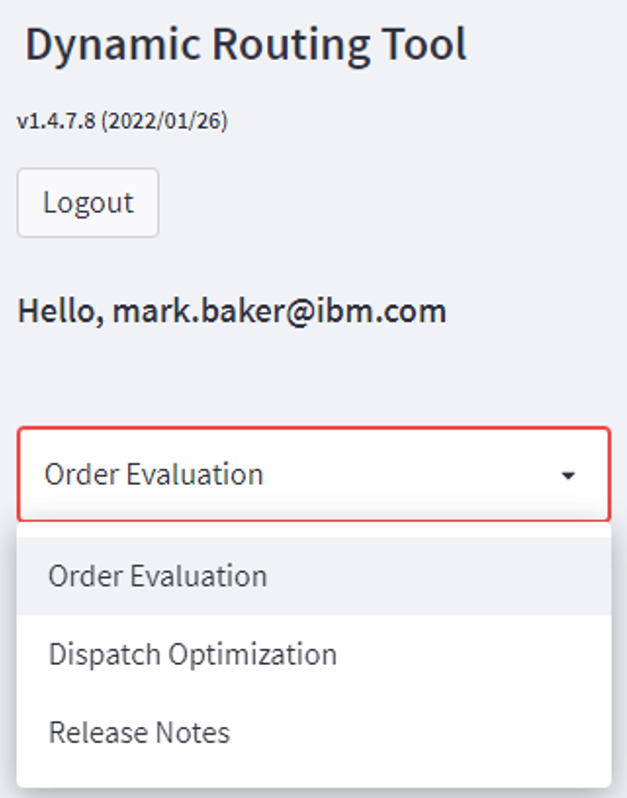
• What vehicle to use for each dispatch?

Overall Workflow

The tool takes users through the following workflow via an interactive web application.

1. User Logs in.
2. User uploads a list of orders on the Order Evaluation page.
3. User makes selections about which sets of facilities to include and downloads the “Order Evaluation Tool.”
4. User uploads validated Order Evaluation File.
5. User refines the data to specify which trucks should be used.
6. User solves the optimization problem.
7. User reviews results.

Depending on the context, some of these steps may be skipped. A configuration file contains parameters which will determine which features will be active.

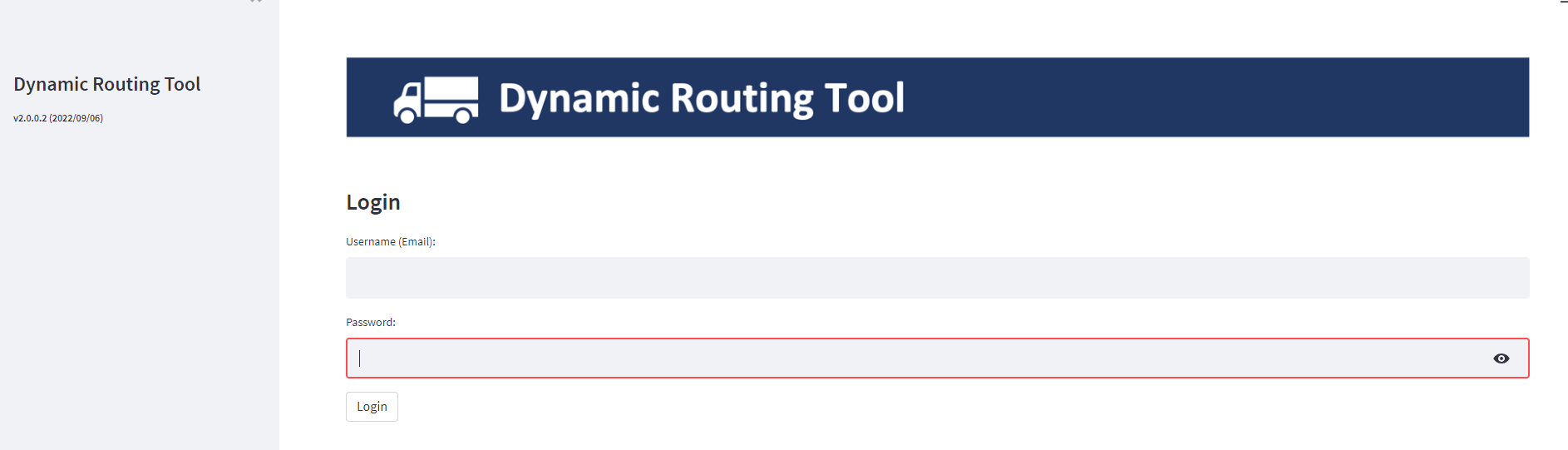


*Figure 1: Left-side navigation menu*

Tool Log-in

When user first visits the web app URL, they should enter their username and password. The valid usernames and passwords are defined on the credentials file. **The default is any email address for username and Password1 for admin view or Password2 for the user view.**

You can set up any credentials and user groups you’d like by modifying the following parts of the code: app\_login.py (def check\_credentials function), credentials.toml, credentials.ini (if you want to encrypt).



*Figure 2: Log-in Screen*

Order Evaluation

After logging in, the user will be shown the Order Evaluation screen. On this screen, the user will upload a set of orders. This will trigger the tool to look up the relevant order details, such as the destination facility and the estimated volume of each order.

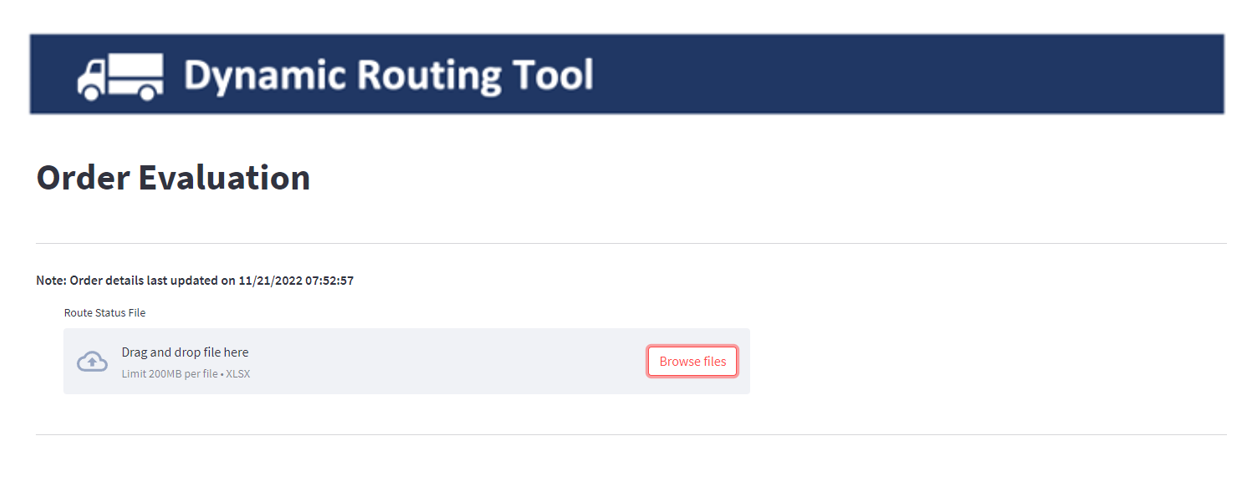
Note that this feature was developed specifically to work with outputs from Zambia’s WMS system. However, the pipeline can be adjusted to work with your files, or you can skip this step and manually populate the Order Evaluation template. The files necessary on the back end for this step to work are the following:

* COUNTRY DRO ORDER DETAILS (updated in the back end)
* COUNTRY ALL Facility Mapping (updated in the back end)

The input file you will load into the app is: COUNTRY Order List Upload – the Order IDs must match those available in the Order Details file in order to properly run. *Route* can be any descriptor or categorization that user find helpful (e.g., District or Province name).

The output of this process will be matching the format of the COUNTRY Order Evaluation Template.

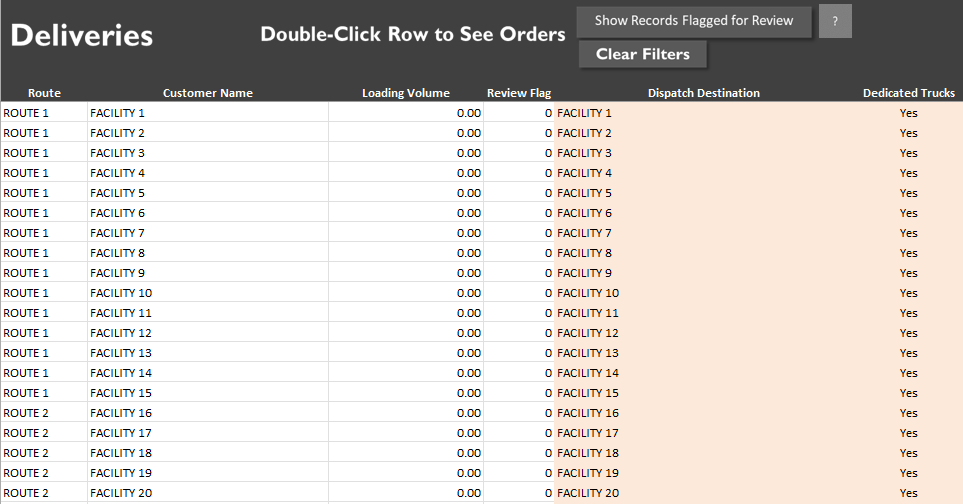
After uploading the list of orders, the user will be presented with a graph summarizing the estimated volume, by destination. The user clicks the download button to download the Order Evaluation Tool, which is a standalone Excel document.



*Figure 3: Order Evaluation Screen*

After opening the Excel tool, users will be presented with a list of deliveries. The user can double-click a delivery record to see the underlying orders. The user can double-click an order record to see the underlying order lines. On the order line page, users can adjust the volume to address data errors or other factors. On the delivery screen, the user can change the destination of a delivery (E.g., if delivery needs to be sent to a District Health Office rather than the facility itself). In certain configurations of the tool, users can specify that a certain facility needs to be visited by a “dedicated truck” rather than as part of a multidrop route.

Note that this file contains many hidden columns and is a protected sheet. Go to Review > Unprotect Sheet and then you can Unhide the hidden columns.

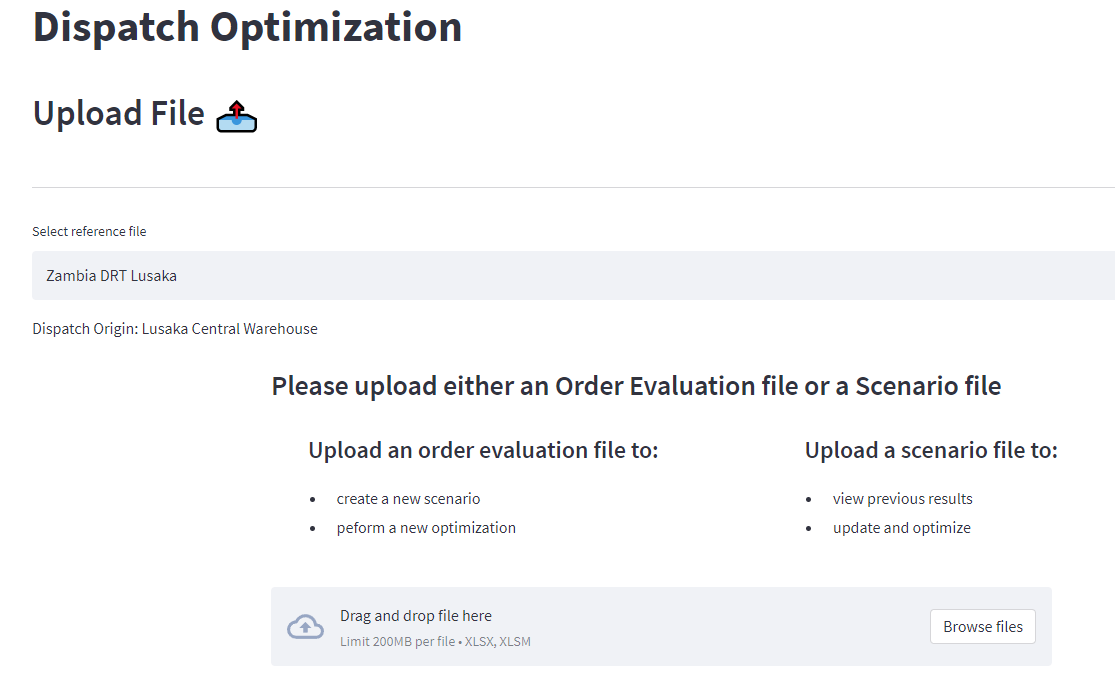


*Figure 4: Order Evaluation Screen*

Once the user is satisfied that this data reflects the actual dispatch needs, the user should save the Excel document to their local machine and return to the web app.

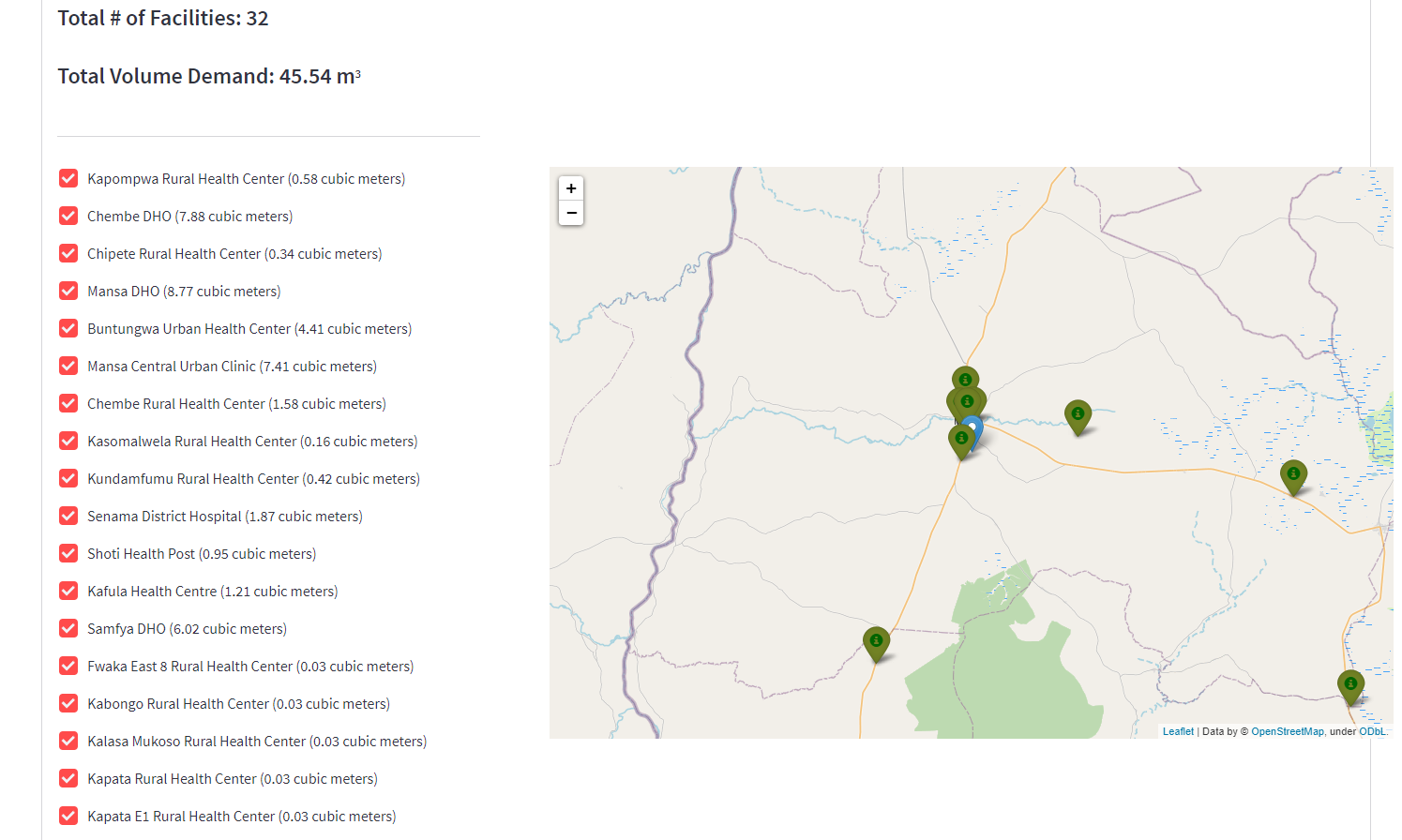
Upload File

After uploading the Order Evaluation file on this page, the user will be presented with a list of facilities and their associated volumes. The facilities will be plotted on a map. An error will appear if you try to load orders for a facility not contained in the COUNTRY DRT WAREHOUSE file. You can move forward without addressing this error, but those facilities will not be included in the optimization. It is important that the DRT facilities match the COUNTRY ALL Facility Mapping file in both ID and Name.



*Figure 5: Upload File for Dispatch Optimization*

On this screen, the user can de-select a facility if they do not wish to include it in the optimization. When the user is satisfied with the list of scenarios, they should click “Initialize Scenario,” which creates and saves a new scenario which will be tracked through the subsequent process.

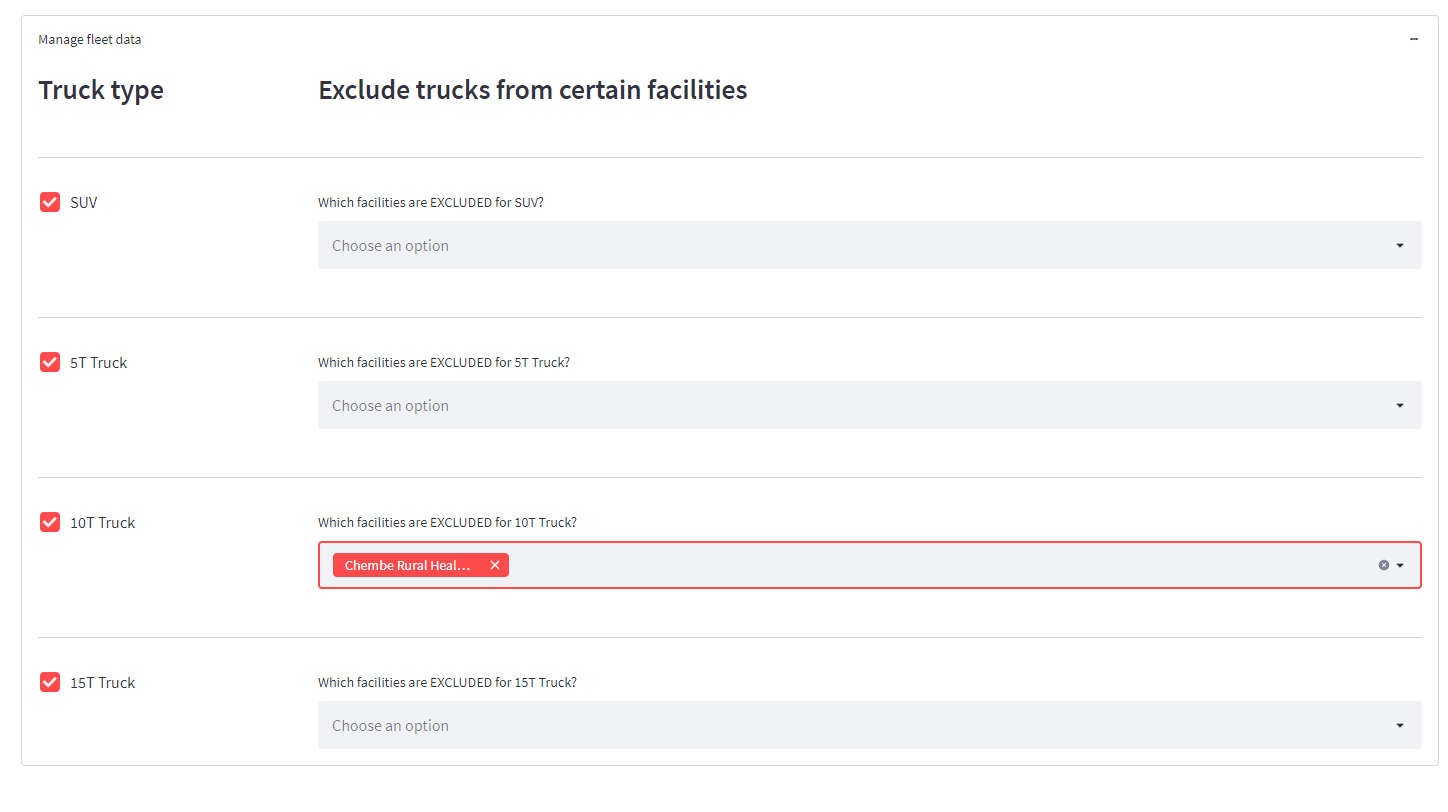


*Figure 6: Review facility list, locations and volumes before initializing*

Refine Data

The Refine Data screen gives the user a chance to refine the rules by which the routes are optimized. In the latest version of the tool, this mostly focuses on vehicle usage. The user has two mechanisms via which to define which vehicles can be used to make deliveries. First, a given vehicle type can be broadly allowed or disallowed by using the check box. Alternatively, the user can use the dropdowns to exclude specific vehicles from delivering to specific facilities.

Note: The model can also be configured to exclude certain facility/vehicle combinations by default.

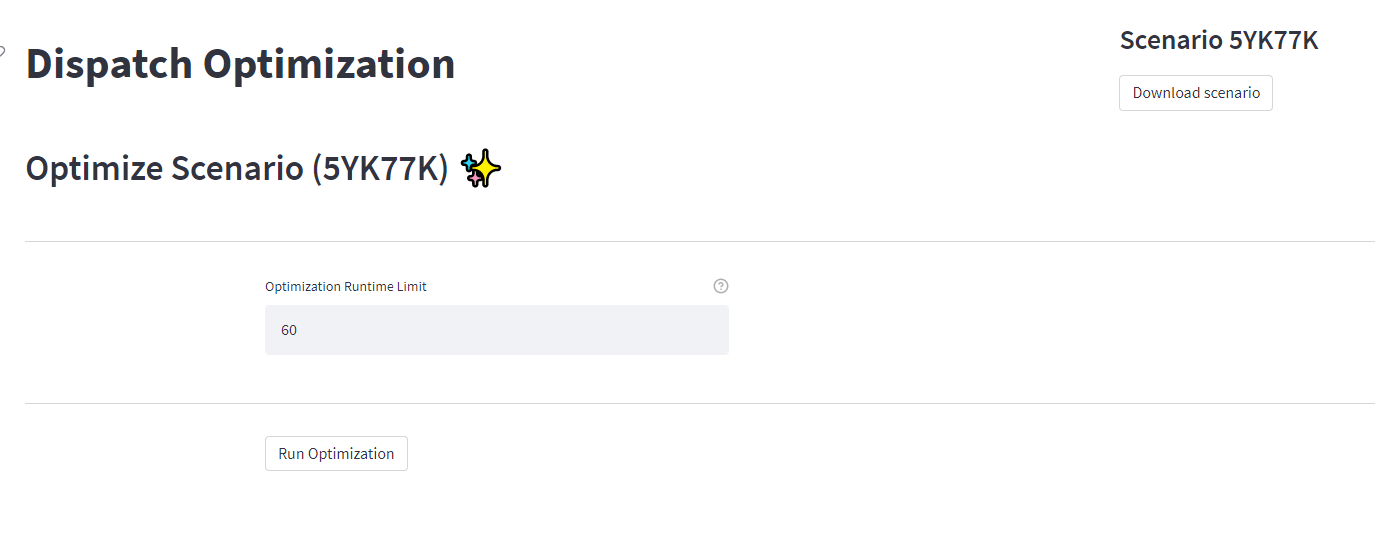


*Figure 7: Refine data by defining ineligible facility/vehicle combinations*

Solve Optimization

On the Solve Optimization page, the user clicks to initiate the processing and solving of the optimization model. It is recommended to set the Optimization Runtime Limit to 60 seconds or more, to allow the model enough time to search for an optimal solution. If you have a large number of facilities, you may need to increase this value to allow a more precise solution to be found.

Depending on what features you turned on in the country\_confg.toml file you may see more options than are shown in the image below that can be changed in the user interface. Otherwise, these features can be turned on and off using the Parameters tab in the DRT file. Use Predetermined Routes can only be set on this screen.

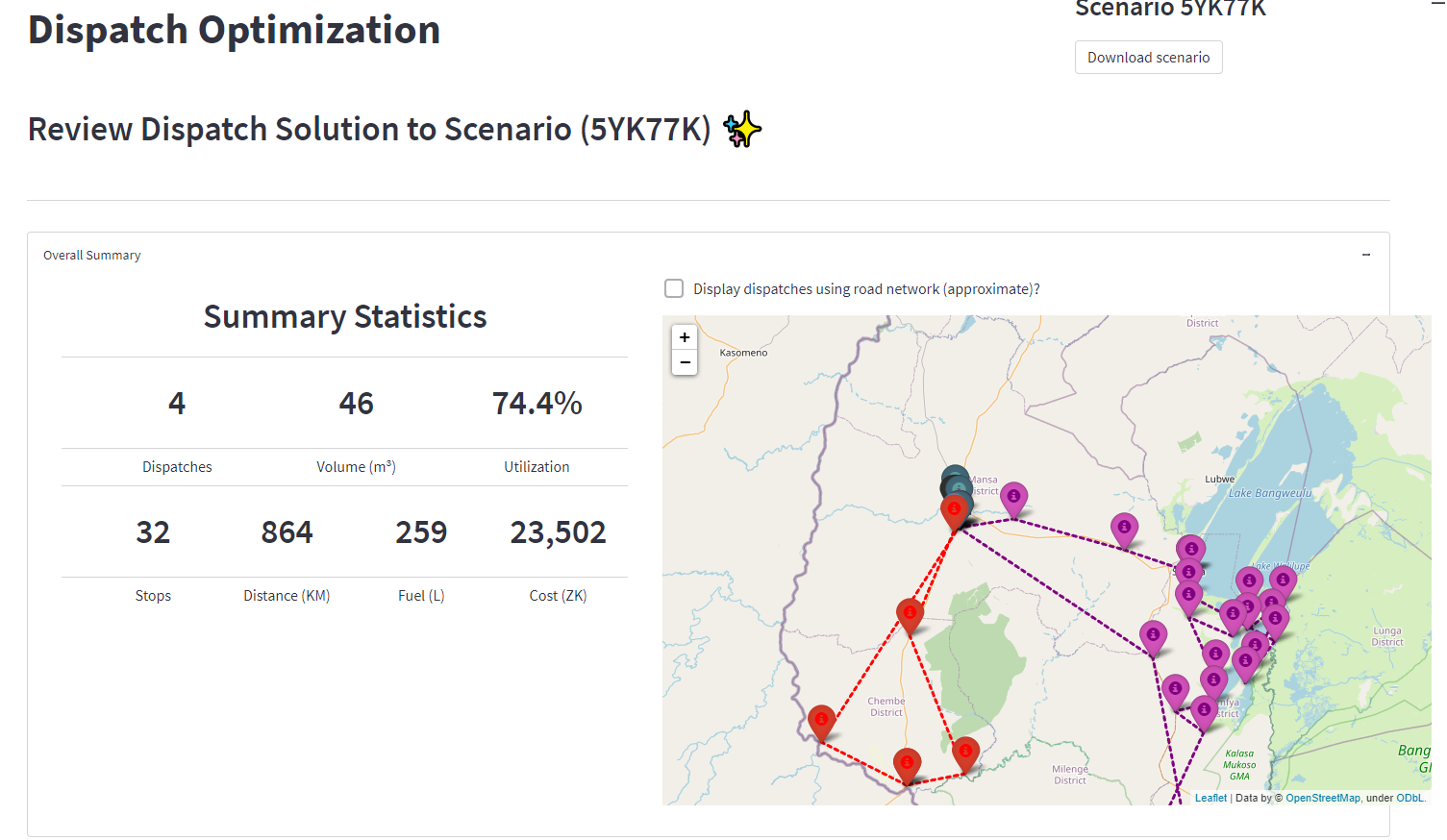


*Figure 8: Solve Optimization screen*

Review Results

The Review Results screen contains a summary at the top and detailed, dispatch by dispatch details below. The maps show straight lines but they represent the road network distances you loaded into the DRT file.

On the top left, the outputs will be summarized in terms of distance, number of dispatches, percent of overall truck utilization (i.e., of all the vehicles being used, what percentage of available capacity is being utilized).



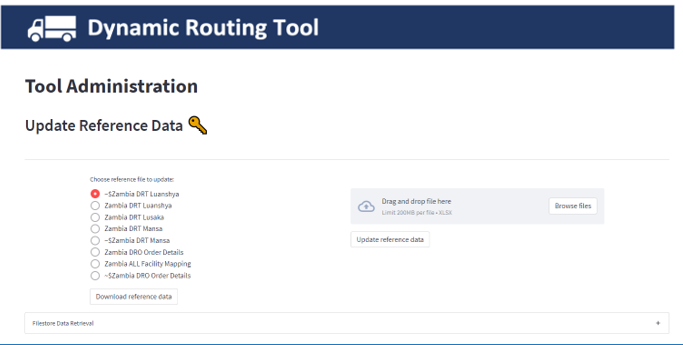
*Figure 9: Review Results Screen*

Data Administrator View

The credentials.ini file defines two different log-in types—user and admin. If the tool is access using the admin password, an additional screen will be available: Tool Administration.

On this page, the admin can follow the simple interface to update any of the reference data by uploading new versions of any table. This could be used to update order details, transportation costs and more.

If you are working on the application locally, you can also refresh data by updating the file in the data folder and restarting the application.



*Figure 10: Data Administrator View*

Working with Scenarios

When the user first uploads the Order Evaluation file and commences the Dispatch Optimization workflow, a scenario is initialized. This scenario persists through the workflow and can be downloaded from the Review Results page so that the underlying data, parameters and solution can be shared or revisited in the future. On the Order Evaluation page, the user has the option of uploading a scenario file instead of an Order Evaluation file, which will load the tool with the same parameters that were set previously. The downloaded scenario file can also be archived to provide an auditable and re-solvable snapshot of the data and parameters that were fed into the optimization model.

Data Model

The zip folder associated with this user guide contains templates for the files below, indicating the specific fields that are required.

In the labels below, “Country” is a generic placeholder for the relevant country in which the tool is being implemented. “Warehouse” is also a placeholder for a specific warehouse name, as there may be multiple warehouses which use the tool.

The files may have instructions in them. You may need to delete these tabs before loading the files in the app.

**COUNTRY ALL Facility Mapping**

This file is used by the tool to determine which facility maps to which warehouse. This is used during the Order Evaluation step in order to determine which volume should flow via which hub.

**COUNTRY ORDER LIST UPLOAD**

This is the input file for the Order Evaluation step of the application. It requires a list of Order IDs matching those in the COUNTRY DRO ORDER DETAILS file and an associated “Route” which can be any useful tag like what region it’s in or what day it will be ready for dispatch. These routes can be used with the “Use Predetermined Route” feature of the application if you want to create dispatches only within the same “Route” grouping.

**COUNTRY DRO ORDER DETAILS**

This table contains all of the order lines which are available for optimization. For each order line, it specifies the customer facility, the item SKU and name, and the associated quantities, weights, and volumes. This table is referenced when the user uploads a list of order numbers during the Order Evaluation step.

The cubic volumes provided for each item that will be evaluated for last mile distribution should be relatively accurate. The estimates here will scale up for each item that is used and consumed. For items where the exact volumetrics are not known, an estimate will suffice in particular for small and infrequently procured items and can be updated at a later time when the volume is better known. In most case 20% of commodities make up 80% or more of the cubic volume of deliveries, therefore focus on the high frequency and bulky commodities, will give reasonable estimate.

**COUNTRY DRO ORDER EVALUATION TEMPLATE**

This is a template which will be automatically populated by the tool. The user will download and interact with the completed template as part of the Order Evaluation steps. However, if you do not wish to use the Order Evaluation portion of the app, this template can also be populated manually.

**COUNTRY DRT WAREHOUSE**

If a country has multiple warehouses which will be using the Dispatch Optimizer, there should be a separate file for each warehouse.

* **Facility:** Defines the set of facilities which can receive deliveries. The GPS coordinates is needed in this sheet.
* **Distance:** Matrix defining distances between every combination of facilities. Indexed in same sequence as main facility table.
  + A Distance Matrix for all facilities in the Facilities sheet. This will need to generated using existing matrix or built via tools like [Open Route Service](https://openrouteservice.org/). In particular, Open Route Services Matrix API calls enable users to get the distance from one location to all other locations quickly. These calls can then be stacked to populate the full distance matrix.
  + If a site does not generate distance values, then, review the GPS coordinate and ensure it is correct and reachable by road. If the GPS is correct and the facility is known to be reachable by vehicle, then, one option is to move the GPS point for routing purposes to be on nearest road and then add the distance that the GPS point was moved
* **Time (optional):** Matrix defining travel time between every combination of facilities. Indexed in same sequence as main facility table.
* **Fleet:** List of vehicle types and attributes, including average speed and capacity.
* **Fleet Exclusions:** List of facility/vehicle combinations which should be considered ineligible by default.

*Cubage, Facility Group, Distance Adj, and Parameters can be left unpopulated when executing the main dispatch optimization functionality of tool.*