Biosecurity COMMONS

Surveillance Design – Quick Start Guide

Last modified: 6 November 2024

Biosecurity COMMONS

Table of Contents

Biosecurity COMMONS

Surveillance Design

Pre-border measures and border control protocols constitute critical components in mitigating biosecurity risks, although complete threat elimination remains unattainable. In regions potentially exposed to biological threats, regulatory authorities implement comprehensive surveillance systems as their primary risk management framework. These systems are designed to facilitate early detection protocols, enabling authorities to identify and respond to potential outbreaks before they escalate to levels that could precipitate significant economic disruption, social instability, or environmental degradation.

Surveillance systems also serve a crucial verification function, establishing and maintaining documentation of disease-free status within specified regions. This verification mechanism is instrumental in both preserving existing trade relationships and facilitating the restoration of market access following biosecurity incidents. Furthermore, these systems generate critical data regarding ground-level response operations, including the delineation of outbreak, progression monitoring, and quantitative assessment of eradication initiatives.

Regardless of the objective, a fundamental challenge faced by surveillance practitioners is determining where to prioritise surveillance, and how much to allocate.

Biosecurity Commons provides a comprehensive Surveillance Design workflow that enables users to optimize their surveillance resource allocation through sophisticated analytical tools. This system can leverage geographic mapping capabilities, location-specific probability assessments, and actual occurrence data, while incorporating surveillance effectiveness metrics and operational constraints, including budgetary limitations and required detection confidence levels.

The workflow allows users to optimise surveillance allocation using different objectives including:

- **Minimising total costs** (that is surveillance resource costs plus likely incursion management costs, estimated with and without detection)
- **Maximising a total non-monetary benefit measure** (e.g. species richness)
- **Maximising a total saving** (or monetary benefit minus surveillance costs)
- **Maximising overall detection confidence or sensitivity** (that is the probability of detection if the invasive species is present)

For more details about the Surveillance Design please see the Surveillance Design workflow overview support article.

Linkages to other workflows

Outputs of Surveillance Design can be used directly as inputs in other workflows, such as:

- Informing **Proof of Freedom** by:
    - Using outputs of surveillance sensitivity based on different optimisation strategies to determine confidence or probabilities of absence given no detections occur
- Informing **Resource Allocation** for determining where surveillance effort (and confidence) will be greatest

Creating a Surveillance Design

Step 1. Create a new project

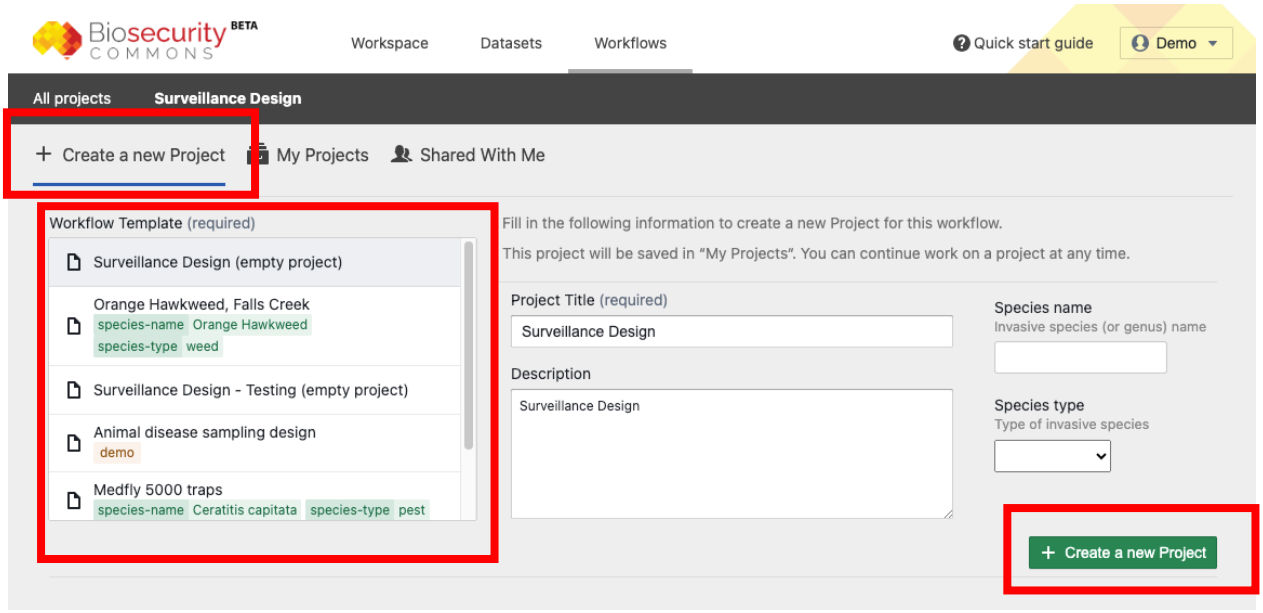
Select the Surveillance Design workflow and then select “Create a new Project” (see screenshot below).

When creating a new surveillance design project, users have the option to select an empty template, initially titled “Biosecurity Surveillance Design”, which can be renamed appropriately, or one of a range of prepopulated templates that have been constructed as examples of the workflow or based on previous case studies (e.g. “Orange Hawkweed, Falls Creek”).

The empty template is ideal for those wishing to create a brand-new surveillance design as it contains:

- The basic structure of the Surveillance Design workflow
- No preloaded datasets (except for the default region, albeit this can be easily changed)

By contrast, example templates provide users with the opportunity to see a completed demonstration of how surveillance designs can be produced, or if based on a real-world case study, how others have attempted to create a model.



Select a template and then give your project an appropriate title. Users can optionally provide additional descriptive details under the Description, Species name and Species type fields. These metadata are presently unused but will provide future flexibility in filtering and summarising projects.

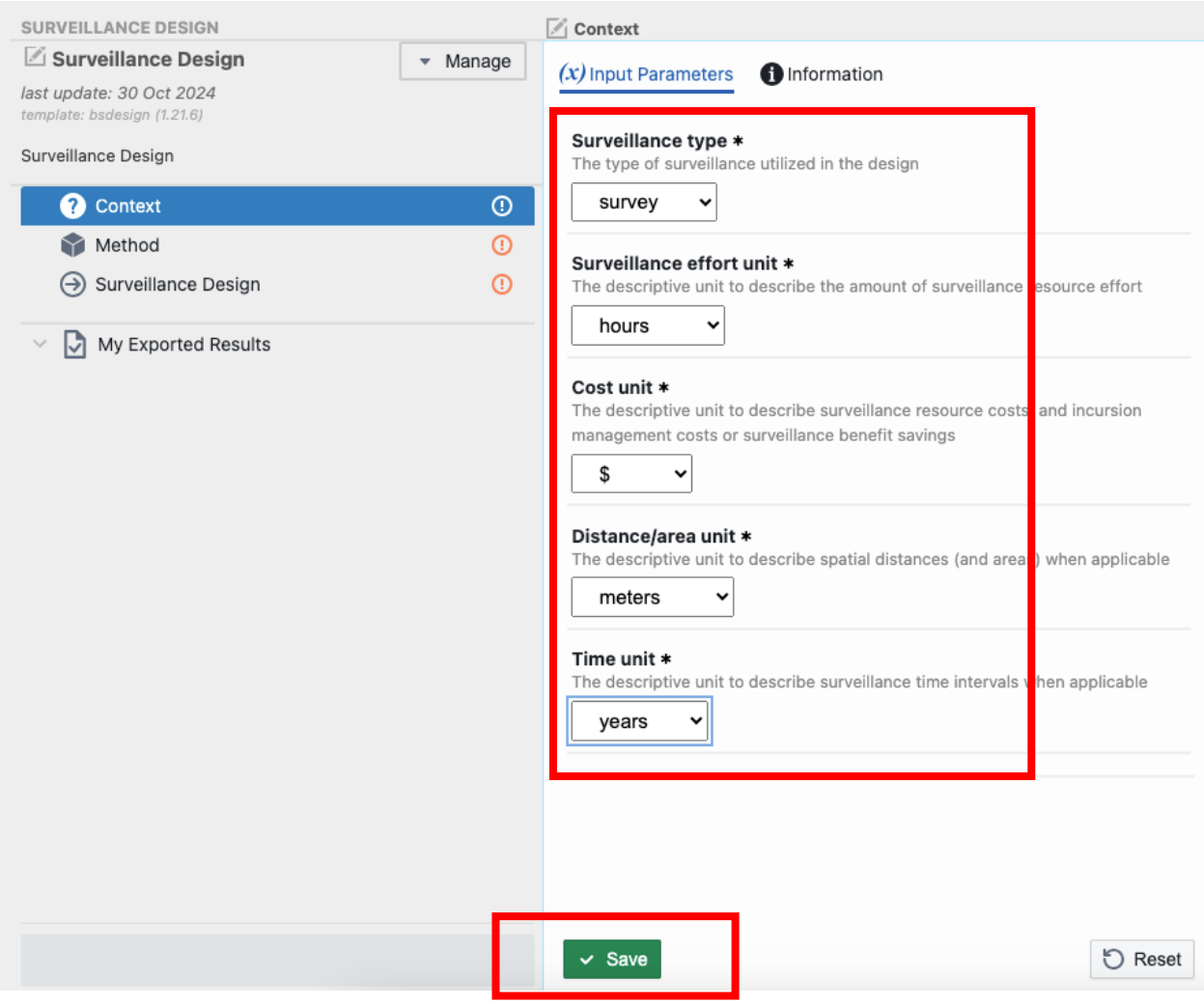
Once details have been provided, click the green “Create a new Project” button in the bottom right-hand corner to continue.

When you start a Surveillance Design workflow from an empty template you will be presented with the core elements of the Surveillance Design workflow on the left side of the screen – “Context”, “Method” and “Surveillance Design”. Orange exclamation points indicate steps that require attention and, as you progress through the project, these change to green ticks when complete.

Step 2. Specify your context

Select appropriate details of the context of your surveillance, including:

- **Surveillance type:** The type of surveillance utilized in the design (e.g. surveys, traps, samples)
- **Surveillance effort unit:** The unit to express quantities of surveillance (e.g. units, hours, traps, samples)
- **Cost unit:** The unit to describe surveillance, management, and/or benefit costs (e.g. $, hours)
- **Distance/area unit:** Unit for distances or areas where applicable (m or km)
- **Time unit:** Unit for time measures where applicable (years, months, weeks, days, etc.)

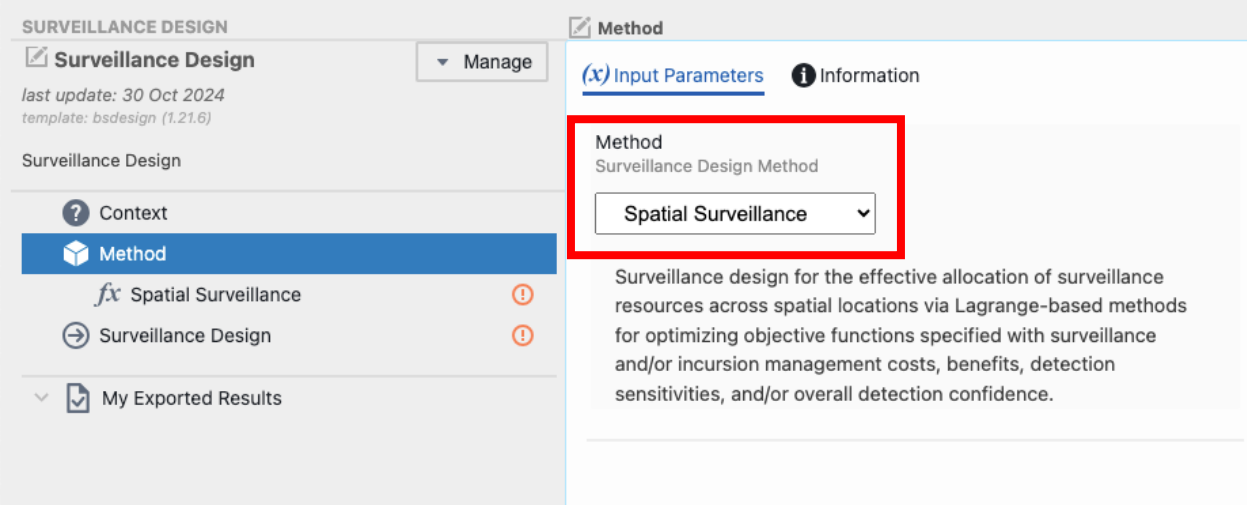


"Save" your selections when finished.

Step 3. Specify your method

Select your surveillance design method. Currently the following methods are available:

- **Spatial Surveillance**: For the effective allocation of surveillance resources across spatial locations
- **Sampling Surveillance**: For the effective allocation of surveillance sampling across one or more divisions (parts, locations, categories, etc.)



Other surveillance design methods are anticipated in future versions of the Biosecurity Commons platform.

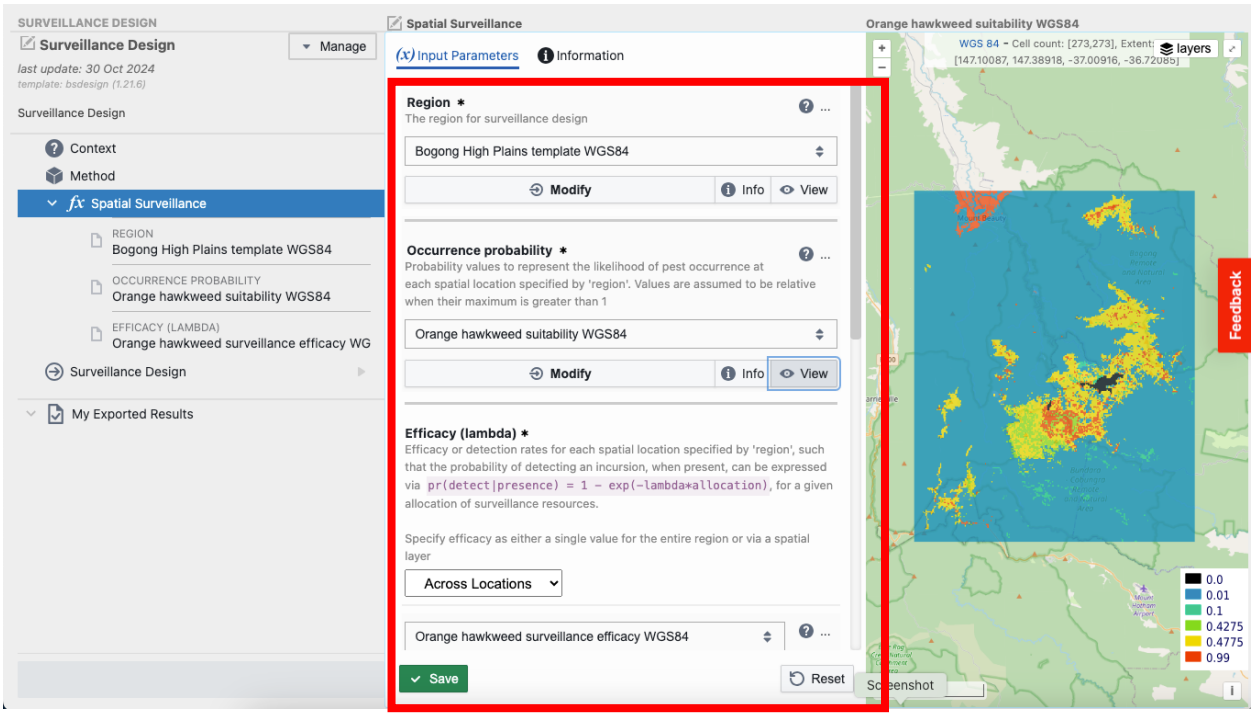
Depending on the surveillance type the user selects, different options will become available.

Biosecurity COMMONS

1. Spatial Surveillance

Selecting “Spatial Surveillance” will prompt users to specify the following:

- **Region** (*required*): Study spatial region for the design
- **Occurrence probability** *(required)*: Probability values to represent the likelihood of invasive species occurrence at each region spatial location
- **Efficacy** (lambda) *(required)*: Detection rate configuration parameter for each region spatial location, such that the detection probability when present is *1 - exp(-lambda*allocation)* for a given allocation of surveillance resources. May be single value or spatially distributed across locations.
- **Optimisation strategy** (*required*): For finding an effective surveillance allocation (options described above) selection:
    - Cost (minimum)
    - Benefit (maximum)
    - Saving (maximum)
    - Detection (maximum)
- **Allocated surveillance cost** (*optional*): Cost per unit of allocated surveillance
- **Fixed cost** (*optional*): Fixed additional cost applied to allocated locations (e.g. travel cost)
- **Constraint** *(required when optimisation strategy is benefit or detection)*: Available allocation budget or overall target confidence *(sensitivity)*. Results in dynamic inputs
    - Surveillance budget *(Required when budget constraint selected)*: Allocation budget value in appropriate units
    - Confidence (*Required when confidence constraint selected)*: Target overall detection confidence or sensitivity (e.g. 0.95)
- **Minimum Allocation** *(optional*): Minimum permissible allocation quantity (avoids infeasibly small allocations to locations)
- **Discrete Allocation** *(optional)*: Checkbox to indicate allocation should be whole numbers (e.g. traps, samples)

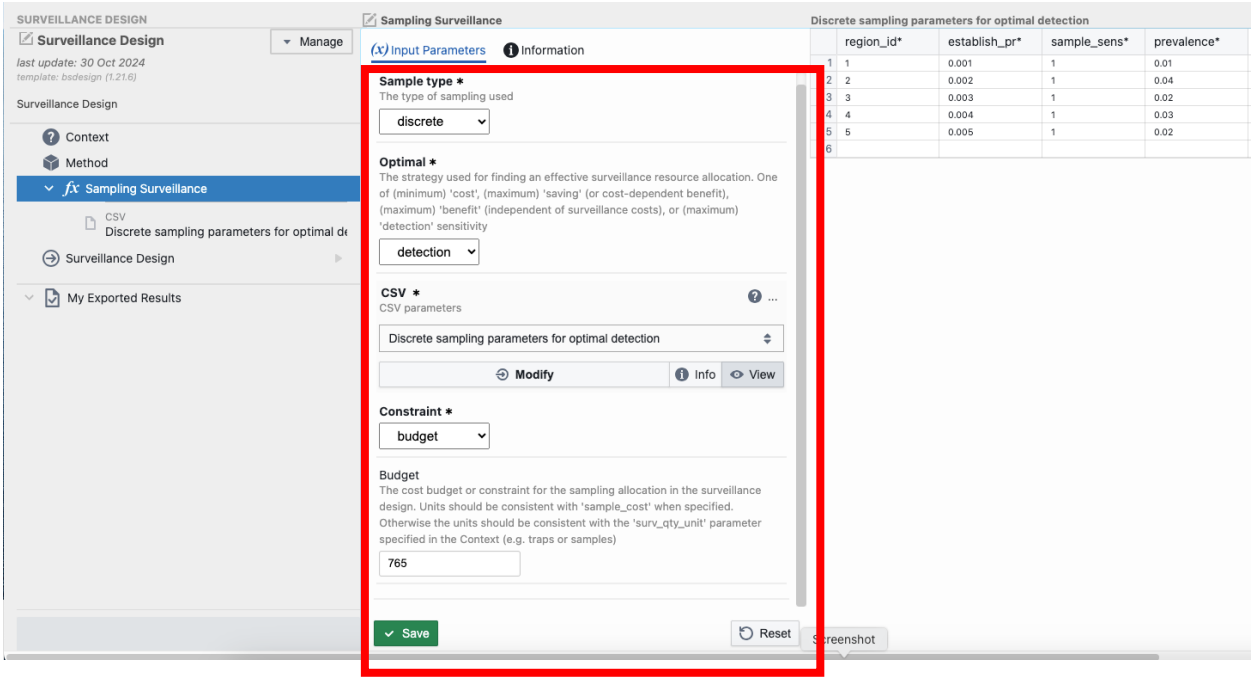


“Save” your selections when finished.

2. Sampling Surveillance

Selecting “Sampling Surveillance” will prompt users to specify the following:

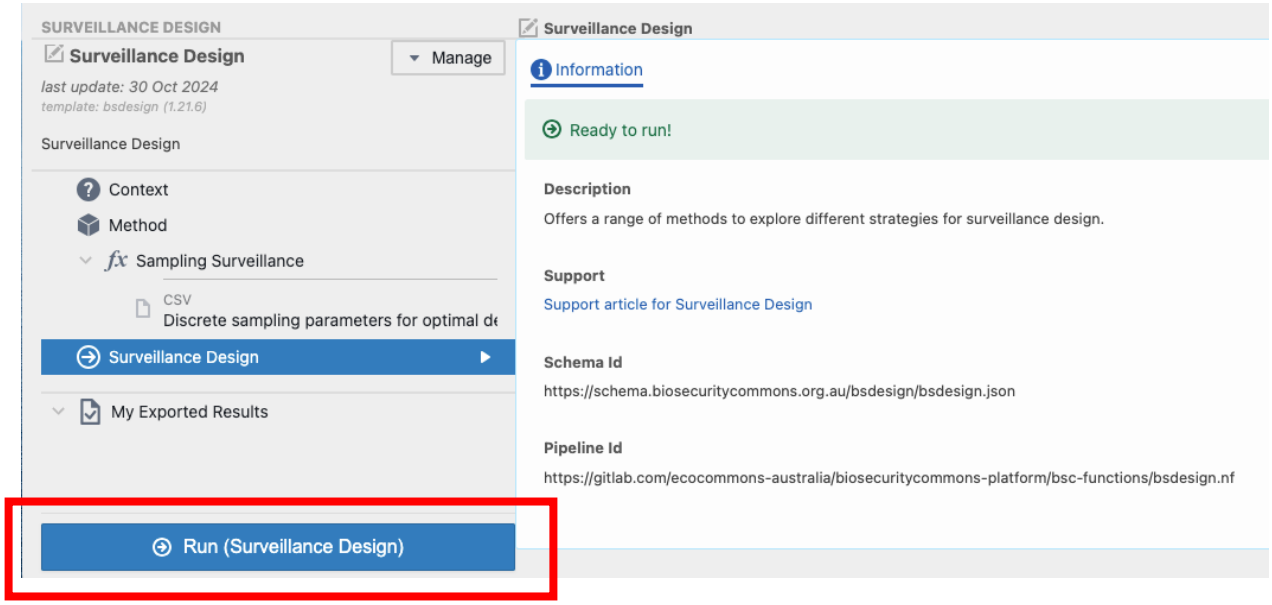
- **Sampling type** *(required)*: Discrete of continuous sampling design
- **Optimal** (*required*): For finding an effective surveillance allocation (options described above) selection
    - Cost (minimum)
    - Benefit (maximum)
    - Saving (maximum)
    - Detection (maximum)
- **CSV** *(required*): Table containing appropriate parameter columns (dependent on optimal selected)
    - Common columns
        - **region_id** *(required)*: Identifier for each division (part, location, category, etc.)
        - **establish_pr** *(required*): Establishment probability for each division
        - **prevalence** *(required*): Design prevalence for each division
        - **sample_sens** *(required*): Sample sensitivity (probability of detection when present) for each division
        - **fixed_cost** *(optional*): Fixed additional cost applied to each allocated division
        - **sample_cost** *(optional*): Cost per sample at each division
        - **total_indiv** *(optional*): Total individuals (e.g. trees, animals) that could be sampled at each division
    - Additional columns for optimal cost
        - **mgmt_cost_detected** *(required*): Estimated management cost for each division when incursion detected
        - **mgmt_cost_undetected** *(required*): Estimated management cost for each division when incursion undetected
    - Additional columns for optimal benefit
        - **benefit** *(required*): Non-monetary benefit measure for each division
    - Additional columns for optimal saving
        - **benefit** (*required*): Monetary benefit measure for each division
- **Constraint** *(required when optimisation strategy is benefit or detection*): Available allocation budget or overall target confidence (sensitivity). Results in dynamic inputs
    - Surveillance budget *(required when budget constraint selected)*: Allocation budget value in appropriate units
    - Confidence *(required when confidence constraint selected)*: Target overall detection confidence or sensitivity (e.g. 0.95)



“Save” your selections when finished.

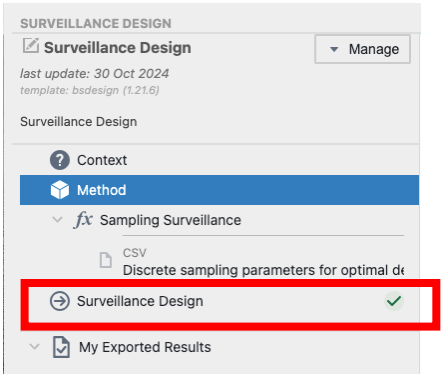
Step 4. Optimise your surveillance design

Once the Context and Method branches have been successfully configured you will be able to run your Surveillance Design, which will optimise the allocation of surveillance resources based on the objective function, surveillance efficacy and any constraints included under “Method”.



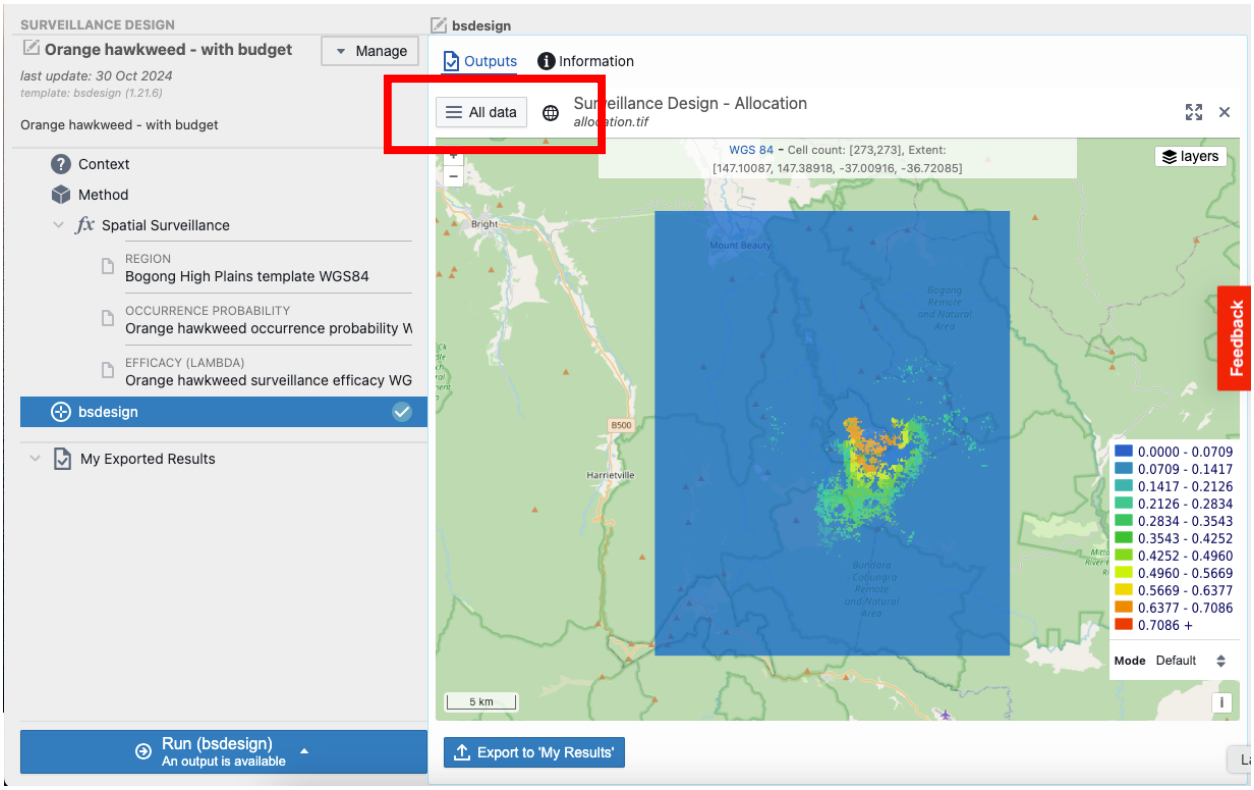
Click the blue ‘Run’ button in the bottom left to run your project. The output page will be updated as the job progresses from “Created”, “Submitted”, “Started” and “Success”.

Once it has finished, a green tick will appear next to Surveillance Design.



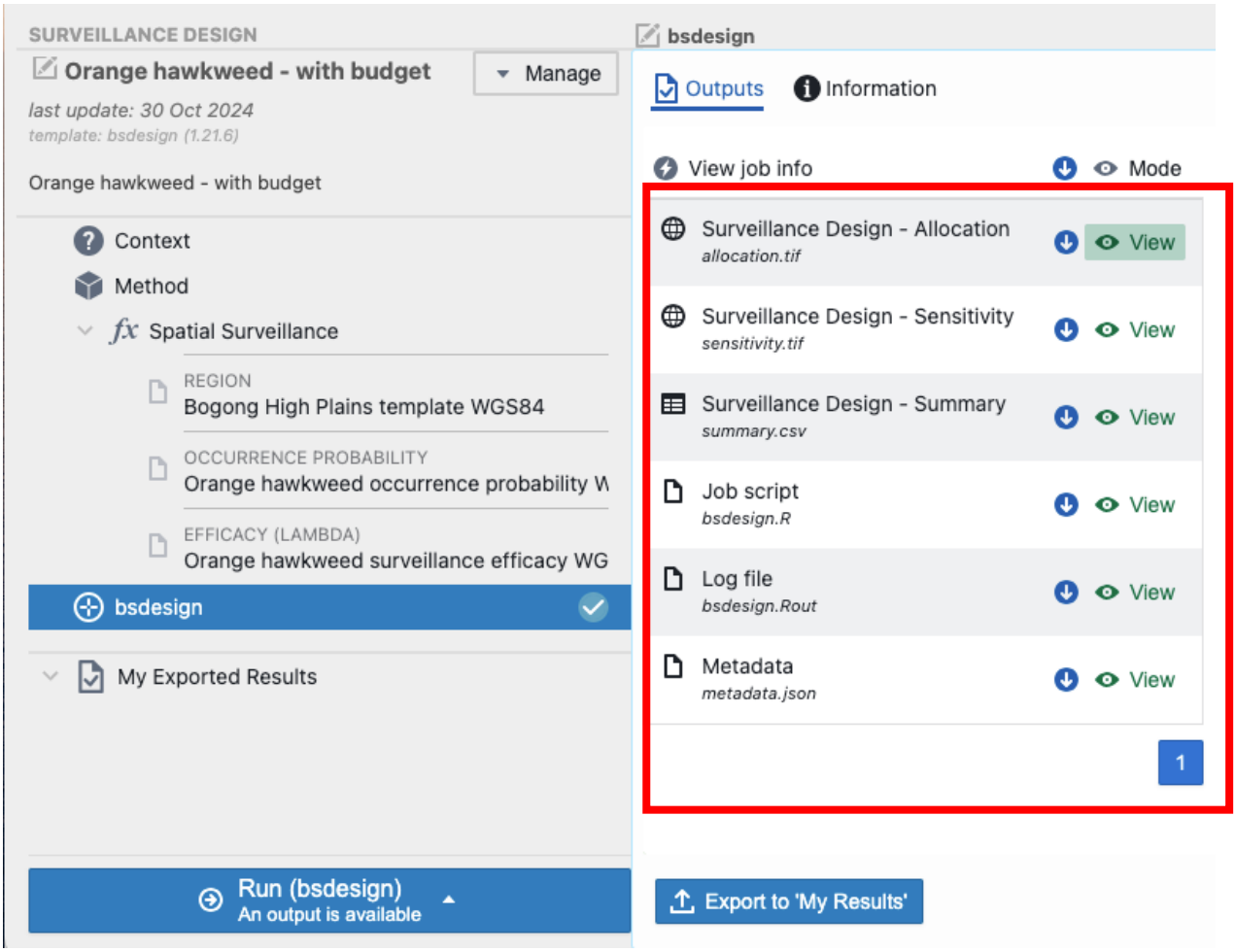
The model surveillance allocation output will automatically be displayed as a viewable allocation in the output pane.

For spatial surveillance designs the output will present a map of the spatial allocations.



Users can zoom in or out of regions of interest. Interactive maps also allow users to change the type of legend displayed.

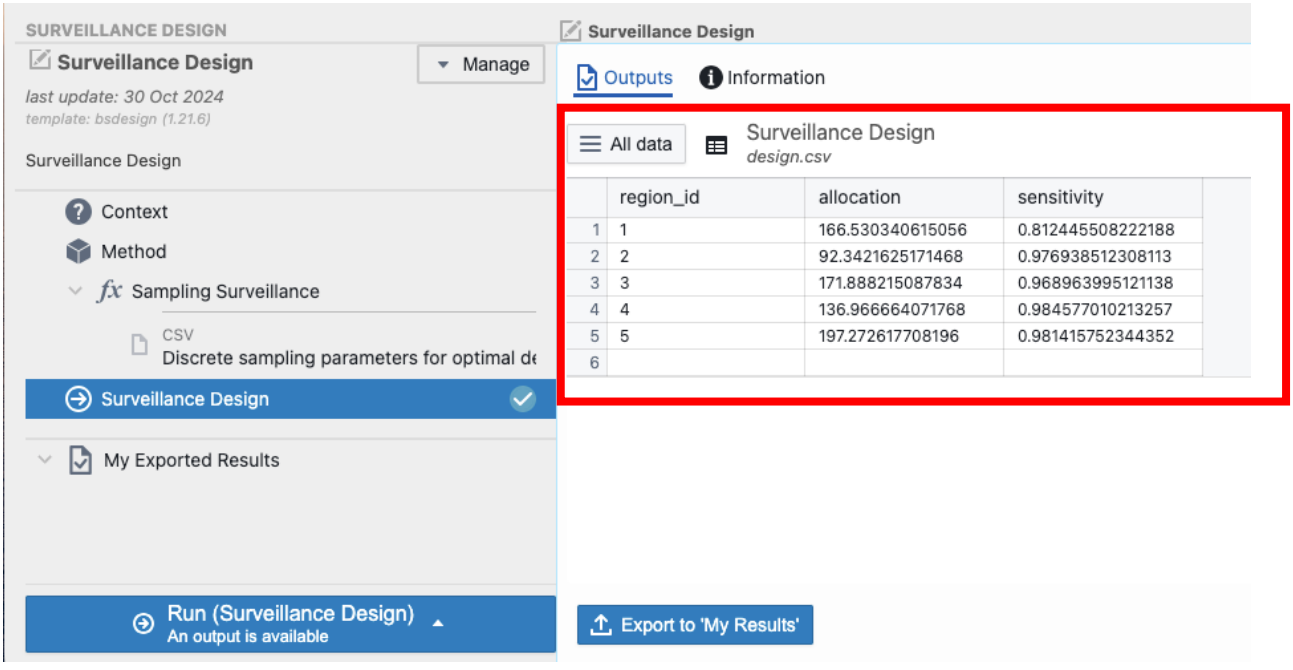
Clicking on the “All data” button allows users to view and download all the outputs.


SURVEILLANCE DESIGN
Orange hawkweed - with budget
Manage
last update: 30 Oct 2024
template: bsdesign (1.21.6)
Orange hawkweed - with budget
Context
Method
Spatial Surveillance
REGION
Bogong High Plains template WGS84
OCCURRENCE PROBABILITY
Orange hawkweed occurrence probability W
EFFICACY (LAMBDA)
Orange hawkweed surveillance efficacy WG
bsdesign
My Exported Results
Run (bsdesign)
An output is available
bsdesign
Outputs
Information
View job info
Mode
Surveillance Design - Allocation
allocation.tif
View
Surveillance Design - Sensitivity
sensitivity.tif
View
Surveillance Design - Summary
summary.csv
View
Job script
bsdesign.R
View
Log file
bsdesign.Rout
View
Metadata
metadata.json
View
1
Export to 'My Results'

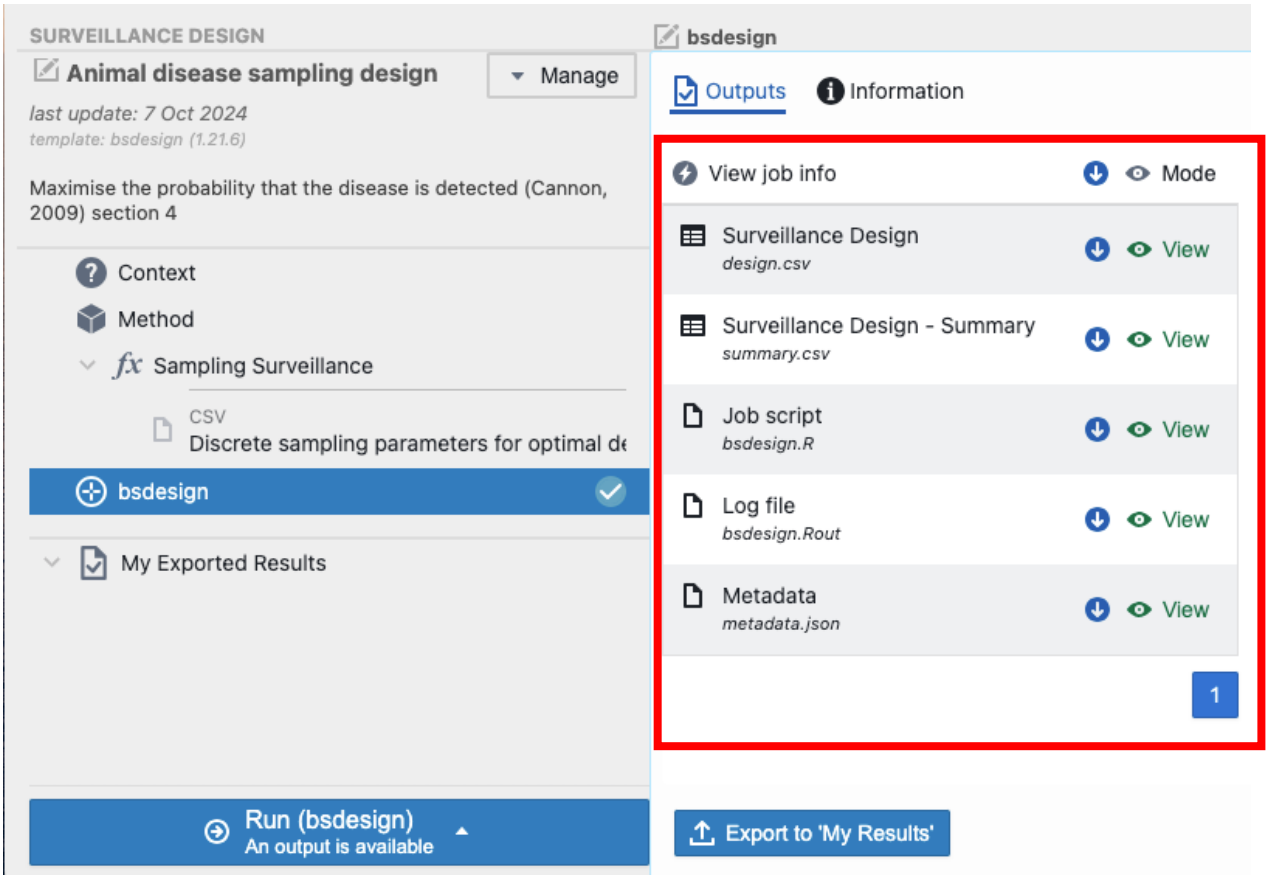
These spatial surveillance design outputs include:

- **Surveillance Design - Allocation** *(Spatial surveillance only)***:** A GeoTIFF containing the number of allocated units of surveillance across geographic space
- **Surveillance Design - Sensitivity** *(Spatial surveillance only)*: A GeoTIFF of probabilities of detection given surveillance allocation
- **Surveillance Design - Summary:** A .csv file containing summary information relevant to optimisation objective, such as columns describing the optimal amount of surveillance units, management costs, total costs and detection confidence across the study region
- **Job script:** A copy of the R script used to build the risk map
- **Log file**: A text file containing processes, messages, and other details associated with model runs
- **Metadata:** A .json file containing the metadata required to run the model on Biosecurity Commons
- **Input parameters** *(All models)***:** Input parameters required to run the Job Script

For sampling surveillance designs the output will present a table of the allocations for each division (parts, locations, categories, etc.) .



Clicking on the “All data” button allows users to view and download all the outputs.



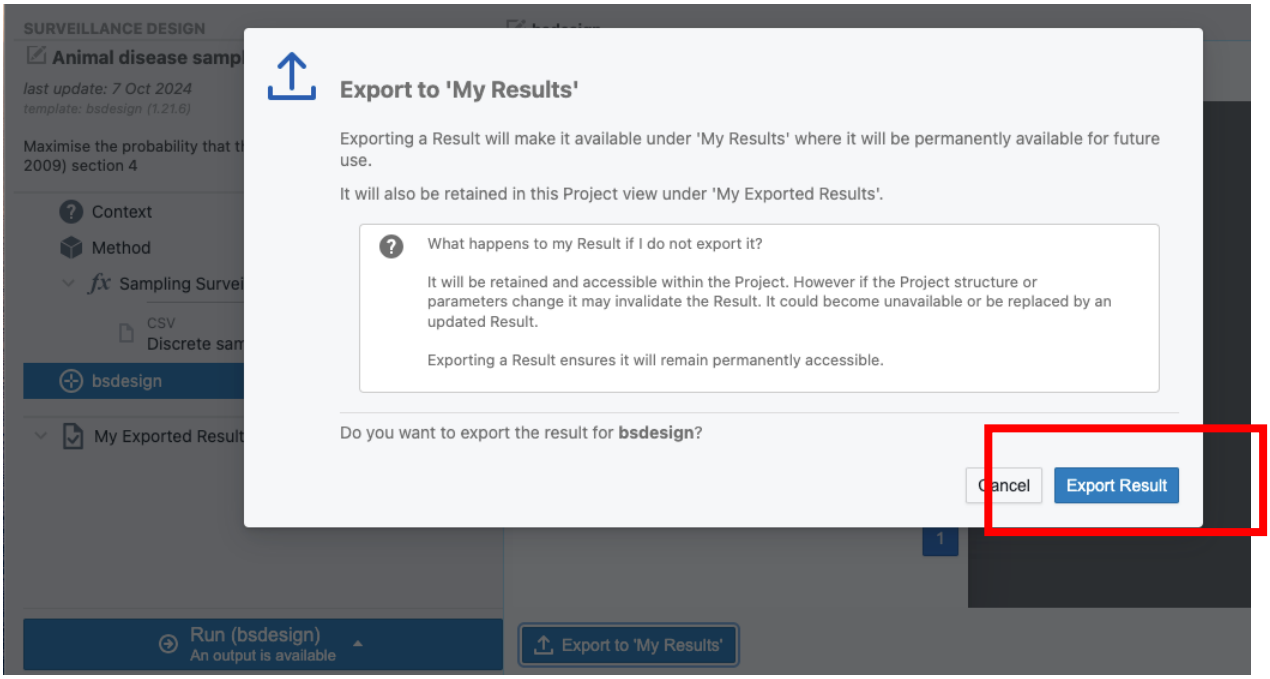
These sampling surveillance design outputs include:

- **Surveillance Design** *(Sampling surveillance only)*: A .csv containing the allocated effort per patch/location and its associated sensitivity
- **Surveillance Design - Summary:** A .csv file containing summary information relevant to optimisation objective, such as columns describing the optimal amount of surveillance units, management costs, total costs and detection confidence across the study region
- **Job script:** A copy of the R script used to build the risk map
- **Log file**: A text file containing processes, messages, and other details associated with model runs
- **Metadata:** A .json file containing the metadata required to run the model on Biosecurity Commons
- **Input parameters** *(All models)*: Input parameters required to run the Job Script

Step 5. Exporting outputs for use in other workflows

Users may wish to export outputs for use in other projects or other workflows.

To do this, view the output of interest, and select “Export to My Results” in the bottom left corner of the interactive map.



This output will now be discoverable in the user’s “My results” database, which in turn makes the layer available for use in other workflows.