



Australian Government
Department of the Environment



SavBAT 2.1 User Manual

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1 ABOUT SAVBAT 2.1

SavBAT 2.1 automates geospatial and other calculations required to estimate greenhouse gas abatement for a project in accordance with the *Carbon Credits (Carbon Farming Initiative—Emissions Abatement through Savanna Fire Management) Methodology Determination 2015* (the method).

The Department of the Environment and a team of independent assessors quality assured SavBAT 2.1 and found it to be a true and correct translation of the method.

SavBAT 2.1 builds on previous versions of SavBAT, allowing users to:

- diagnose issues with user-created vegetation fuel type maps;
- upload a project boundary and create a project vegetation fuel type dataset from a Government-supplied vegetation fuel type base map²; and
- estimate abatement potential for a hypothetical future year. This is referred to as a 'hypothetical abatement forecast'.

SavBAT 2.1 builds on SavBAT 2.0 by calculating adjusted net annual abatement and improving the hypothetical abatement forecast calculation outputs. SavBAT 2.0 was released with the exposure draft of the method.

SavBAT 1.0, an earlier version of SavBAT, is only applicable to projects in the high rainfall zone that are registered with the earlier savanna fire management method: *Carbon Credits (Carbon Farming Initiative) (Reduction of Greenhouse Gas Emissions through Early Dry Season Savanna Burning—1.1) Methodology Determination 2013*.

SavBAT 2.1 supports projects in both the savanna low rainfall zone and high rainfall zone³. The method treats the two rainfall zones separately, but combines the abatement estimates from each. SavBAT 2.1 is able to calculate forecasts and reports from a single map with land in both the high rainfall zone and the low rainfall zone.

Broadly, the method approaches for the two rainfall zones differ in the following ways:

- High rainfall zone: four unique eligible vegetation fuel types, the baseline period is 10 years.
- Low rainfall zone: five unique eligible vegetation fuel types, the baseline period is 15 years.

With the exception of the length of the baseline period, the calculation processes are the same for both rainfall zones.

SavBAT 2.1 calculates the abatement using the same logic and reference table values as SavBAT 2.0, including the same geospatial processes and calculations.

² Note: the vegetation fuel type base map is not certified as meeting the requirements of the method and cannot be submitted in an offsets report to the Clean Energy Regulator. The base map functionality is provided to assist proponents with estimates of abatement potential.

³ The rainfall zones are defined by a map that is downloadable from: <http://www.environment.gov.au/climate-change/emissions-reduction-fund/methods/savanna-burning>.

To undertake the geospatial operations, SavBAT 2.1 retrieves monthly fire maps that are developed and maintained on the North Australia Fire Information (NAFI) website: www.firenorth.org.au. The data accessed from this site is compliant with the method's requirements for monthly and seasonal fire maps.

GeoTIFF files that upload successfully in previous versions of SavBAT are also correctly attributed and formatted for upload into SavBAT 2.1.

1.1 Browser support

SavBAT 2.1 is designed for a minimum support screen resolution of 1024 x 768 and for use with recent versions of the major browsers: Internet Explorer, Chrome, Mozilla Firefox and Safari.

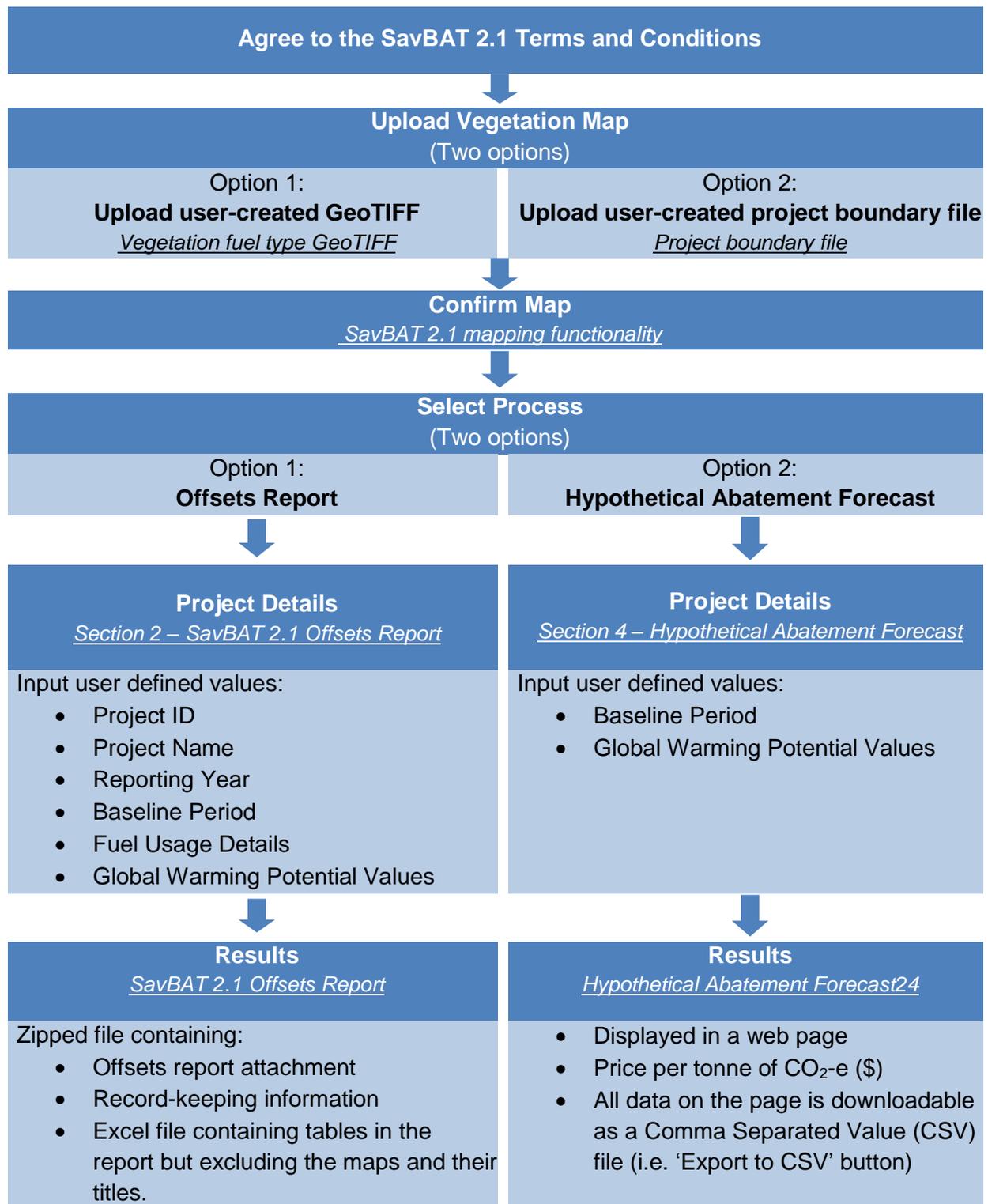
1.2 Step-by-step use of SavBAT 2.1

SavBAT 2.1 is a simple web interface which consists of six web pages that sequentially step users through the entering of required data in order to generate either an offsets report or hypothetical abatement estimate to view online or download. SavBAT 2.1 does not require any user login. Users visit the website anonymously, entering and uploading their data and receiving their output. No data is held by the website. As SavBAT 2.1 does not persistently store any of the user's data, if the user leaves the web site or loses internet connectivity, they lose any data they have entered or uploaded and must start the process again.

Users are responsible for their own document and records management.

The generation of offsets reports is the primary purpose of SavBAT 2.1 and is detailed in [Section 2](#). Information on the generation of a hypothetical abatement forecast is in [Section 4](#).

1.2.1 Flowchart of steps for using SavBAT 2.1



1.3 SavBAT 2.1 errors and problem solving

Appendix B describes all SavBAT 2.1 error messages and procedures for addressing the errors.

2 SAVBAT 2.1 OFFSETS REPORT

The zipped portable document format (.pdf) reports produced by SavBAT 2.1 do not contain all of the content that project proponents are required to provide as part of their offsets submission to the Clean Energy Regulator or to keep as their records. The exact content of the outputs is detailed in [Results – SavBAT 2.1 Offsets Report](#), which also lists the additional data required to meet reporting and record-keeping requirements.

SavBAT 2.1:

- ✓ Verifies that the area uploaded into SavBAT 2.1 is wholly contained within the high and low rainfall zones, as required by the method;
- ✓ Calculates the years since last burnt (YSLB) values for each pixel in an area uploaded into SavBAT 2.1;
- ✓ Calculates the fire scar area (A) in the EDS and the LDS periods for each vegetation fuel type class;
- ✓ Accepts pre-prepared data for fuel use;
- ✓ Accepts user-defined global warming potential values;
- ✓ Calculates net annual and adjusted net annual abatement required for offsets reporting and record keeping; and
- ✓ Creates many of the maps that contribute to offsets reporting and record keeping.

SavBAT 2.1 **does not**:

- ✗ Provide mapping functionality that permits the user to create the vegetation fuel type map required by the method;
- ✗ Assess whether the vegetation fuels type map used by SavBAT 2.1 has been validated in accordance with the method;
- ✗ Link to the National Greenhouse and Energy Reporting (NGER) legislation for Fuel Usage and Global Warming Potential information (users should access [NGER legislation](#) independently for this information);
- ✗ Sum project parts where a project uploaded to SavBAT 2.1 has more than one part;
- ✗ Permit the use of seasonal fire maps that are not sourced from NAFI;
- ✗ Allow for baselines that start before the year 1992 in the low rainfall zone and 1995 in the high rainfall zone (these early baselines are only potentially valid for transitioning projects, early baselines are not permitted for projects under the current method);
- ✗ Require (or allow) users to create accounts or log in;
- ✗ Provide a permanent document management or record management system for the files created by users; or
- ✗ Output spatial datasets used in the calculation along with their associated metadata. These datasets are available for free download, pre-prepared and zipped, from the NAFI website (www.firenorth.org.au > More Tools > SavBAT data > Download SavBAT Data).

2.1 Before you start: Data required from the user

A savanna fire management project may be declared with one or more project areas. Division of the project may occur due to aggregation, transitioning, partial reporting and / or separating manual calculations for low and high rainfall zones, or for business objectives or other purposes. The method describes the calculations in terms of each project area, so a project with more than one project area will have to undertake calculations separately for each area.

SavBAT 2.1 can perform calculations on a project area that includes land within the high rainfall zone and land within the low rainfall zone from a single map. However SavBAT 2.1 cannot calculate a project area that has parts with different end years for the baseline period. Where this occurs, the user must, externally from SavBAT 2.1, separate the project area into two or more areas so that each area has only one end year. The user then uploads and processes each vegetation fuel type dataset, along with the associated fuel use, separately. Running SavBAT 2.1 multiple times for a single project area, once for each area dataset, will give users multiple reports which will need to be manually combined by the project proponent in any offsets reports submitted to the Clean Energy Regulator.

2.1.1 Spatial Data

The project or potential project spatial data for input in SavBAT 2.1 can be one of the following two options:

Option A - User-created raster format vegetation fuel type map:

To submit an offsets report to the Clean Energy Regulator this map must be validated in accordance with the method. This single dataset is termed the vegetation fuel type GeoTIFF.

SavBAT 2.1 does not assess whether the uploaded vegetation fuel type GeoTIFF has been validated in accordance with the method. Map validation occurs independently of SavBAT 2.1.

Option B - A project boundary file:

SavBAT 2.1 creates a vegetation fuel type dataset from the vegetation fuel type base map. This vegetation fuel type base map covers the entirety of the high and low rainfall zones, is not certified as meeting the requirements of the method, and cannot be submitted in an offsets report to the Clean Energy Regulator. Use of the base map is only for hypothetical abatement forecasts (see [page 19](#)).

2.1.1.1 Vegetation fuel type GeoTIFF

Users that opt for a vegetation fuel type GeoTIFF must, externally from SavBAT 2.1, prepare a raster format vegetation fuel type map in a supported file format, projection and with correct data attribution, as defined in the table below.

Image Format	8-bit palette GeoTIFF
Georeferencing information	Embedded in GeoTIFF tags
Image File Extension	.TIF or .TIFF
Projection	GDA_1994_Albers (EPSG:3577)
Upload Format	Single TIF file (no ancillary files required or allowed)
Grid Size (Resolution)	250 m x 250 m
Pixel values high rainfall zone	<p>Pixels must have the following values depicting the relevant vegetation fuel type:</p> <p>0: Pixel is within the project area but contains an ineligible vegetation fuel type</p> <p>1: hOFM (Open Forest Mixed)</p> <p>2: hWMi (Woodland Mixed)</p> <p>3: hWHu (Woodland Hummock)</p> <p>4: hSHH (Shrubland Hummock)</p> <p>255: NODATA (i.e. pixel is outside the project area)</p>
Pixel values low rainfall zone	<p>Pixels must have the following values depicting the relevant vegetation fuel type:</p> <p>0: Pixel is within the project area but contains an ineligible vegetation fuel type</p> <p>11: IWHu (Woodland with Hummock grass)</p> <p>12: IWMi (Woodland with Mixed grass)</p> <p>13: IWTu (Woodland with Tussock grass)</p> <p>14: IOWM (Open Woodland, with Mixed grass)</p> <p>15: ISHH (Shrubland (Heath) with Hummock grass)</p> <p>255: NODATA (i.e. pixel is outside the project area)</p>

Appendix A describes the ESRI ArcGIS procedures for producing vegetation fuel type data in the format required for SavBAT 2.1. As described earlier, a project may span the two rainfall zones, in which case each section of the user's vegetation raster must only have the correct pixel values for that rainfall zone. Data showing the boundary of each zone is available from the Department's website, and this data is formatted for GIS software.

The user must direct SavBAT 2.1 to where the desired dataset is stored on their personal device using the 'Select File' button. Upload of data stored from the internet (e.g. cloud storage) is not supported.

Notes on vegetation fuel type GeoTIFFs:

1. The method's [Explanatory Statement](#) (see 'Division 2' within) provides guidance on creating a vegetation fuel type GeoTIFF.
2. GeoTIFF files that upload successfully to SavBAT 1 and SavBAT 2 (i.e. existing high rainfall zone savanna projects) can also be uploaded into SavBAT 2.1.
 - Use SavBAT 2.1 if the project is registered under the [Carbon Credits \(Emissions Abatement through Savanna Fire Management\) Methodology Determination 2015](#).
 - Use SavBAT 1 if the project is registered under the [Carbon Farming \(Reduction of Greenhouse Gas Emissions through Early Dry Season Savanna Burning-1.1\) Methodology Determination 2013](#).

2.1.2 Project ID and Project Name

Both of these fields require input. The Project ID will be validated by SavBAT 2.1 as one or more numerical characters with no spaces. The Project Name field accepts alphabetical and numerical characters, and there are no restrictions on the number of characters or spaces.

2.1.3 Reporting Year

This field requires input. It is the user's responsibility to select the appropriate reporting year in accordance with the method, and any transitional project arrangements that may apply. SavBAT 2.1 only allows valid combinations of reporting and baseline years.

2.1.4 Baseline Period

It is the user's responsibility to select the appropriate reporting year in accordance with the method, and to consider any transitional project arrangements that may apply.

Baseline durations will change according to project location in high rainfall and/or low rainfall zones. The baseline period is 10 years in the high rainfall zone and 15 years in the low rainfall zone. Periods must be in whole calendar years, corresponding to the requirements of the method and the fire maps provided by NAFI.

The user must nominate the years for the baseline period. SavBAT 2.1 identifies whether the user's uploaded spatial data occupies the high and / or low rainfall zones, and presents appropriate baseline periods in the drop down option on the Project Details page. Where the uploaded spatial data for the project covers both rainfall zones, the baselines for the two zones will end in a synchronised way so that the high rainfall zone baseline years will be the last 10 year period of the 15 year baseline for the low rainfall zone (e.g. for a baseline option of 1996-2010, the high rainfall zone baseline years will be 2001-2010 and the low rainfall zone baseline years will be 1996-2010). If the project has two or more areas where the last year of the baseline period differ, then the user must (externally from SavBAT 2.1) separate the project area into two or more vegetation fuel type datasets, along with the associated fuel use from the area contained within each dataset.

With projects or project parts that are not transitioning, the method requires that the baseline must finish in the year prior to project commencement. Thus, not all available baseline years in SavBAT 2.1 will be consistent with the requirements of the method. It is the user's responsibility to select the appropriate baseline. The last year of the baseline period must be the same across all files and zones for spatial data uploaded into SavBAT 2.1.

2.1.5 Uncertainty Buffer

This field is required. If this is the first reporting year, users must enter zero (0) for the project area under the method (e.g. a new project or an existing CFI project transitioning to the ERF method). If this is not the first reporting year for the project area under this method, users must enter the uncertainty buffer figure from the previous year's reporting (i.e. from a SavBAT 2.1 Offsets Report, or from manual uncertainty buffer calculations made from a SavBAT 2.0 Offsets Report).

2.1.6 Fossil Fuel Emissions

Fossil fuel use may have zero, one or more rows, with a row for each fuel type used in undertaking the project during the reporting period. The relevant legislation is the *National Greenhouse and Energy Reporting (NGER) Measurement Determination*. NGER legislation does not define 'fossil' fuels types, only fuel types. However, the method extends the ordinary meaning of the term where a fossil fuel is a fuel that is sourced from fossil hydrocarbon deposits, but may also include biofuels and blends from these two sources.

The fossil fuel type (i.e. NGER fuel type) should match that which is specified in Schedule 1 of the *NGER Measurement Determination* in force at the end of the reporting period. This extends to the energy content factors and emission factors used to calculate the emissions from fuel use. All versions of the *NGER Measurement Determination* can be accessed at: <http://www.comlaw.gov.au/Series/F2008L02309>.

If a fossil fuel usage row is entered (i.e. if any field in a row has data entered), all three fields of the row must be completed. It is recommended that the user records the fuel item number and the name of the fuel combusted, e.g. "56 Kerosene for use as fuel in an aircraft".

The user must, externally from SavBAT 2.1, calculate the emissions from fuel use in accordance with the requirements of the *NGER Measurement Determination*.

Volume Used and Emissions from fossil fuel use will be validated by SavBAT 2.1 as positive numbers.

2.1.7 Global Warming Potential Values

These fields are required. Global Warming Potential (GWP) values for methane (CH₄) and nitrous oxide (N₂O) are specified in Schedule 1 of the *National Greenhouse and Energy Reporting (NGER) Reporting Regulations* in force at the end of the reporting period. All versions of the *NGER Reporting Regulations* can be accessed at <https://www.comlaw.gov.au/Series/F2008L02230>. At the time this user manual version was published, the GWP values were:

- CH₄—25
- N₂O—298

Users must manually enter the appropriate GWP which will be validated as positive numbers by SavBAT 2.1.

2.2 Getting started: Using SavBAT 2.1

SavBAT 2.1 pages are set up for ease of navigation, with buttons at the base of each page that allow users to navigate backwards and forwards at any point before the calculation has been initiated. The user must have uploaded a valid file or populated required cells with valid data to progress through the pages using the 'Next' or 'Calculate' buttons. Note that when using SavBAT 2.1, the user should navigate using the buttons provided at the bottom of each page. Do not use the browser's 'Back' or 'Forward' buttons to navigate.

SavBAT 2.1 assists users through drop down menus for standard values where they occur. Cells or drop down menus can be selected either by tabbing or selecting the cell using the cursor. Cells are colour coded or shaded to help users:

- White: Cell requires value but user has not yet tabbed through or clicked on the cell.
- Green: Data passes validation. Note that this does not mean that the data is correct for the user's project area uploaded into SavBAT 2.1.
- Red: User has input invalid data or selected a cell without populating the cell.

Until all required cells have been populated with valid data, the 'Next' or 'Calculate' button will be disabled. See below for standard features in the Offsets Report 'Project Details' page.

The screenshot shows the 'Project Details' page of the SavBAT 2.1 interface. At the top, a navigation bar contains six steps: 1. Welcome, 2. Upload Map, 3. Confirm Map, 4. Select Process, 5. Project Details (active), and 6. Results. Below the navigation bar, the page title is 'Enter Offsets report details'. A note states 'All fields(*) are required'. The form includes several input fields: 'Project ID*' (red), 'Project Name*' (green), 'Reporting Year*' (dropdown menu showing 2014), and 'Select baseline period*' (dropdown menu showing 2004 - 2013). Below these is a text input for 'Uncertainty buffer for the preceding year*' (green) with a note: 'Enter zero (0) if this is the first reporting year for the project area under the methodology (e.g. a new project or an existing CFI project transitioning to the ERF)'. The 'Fossil Fuel Emissions' section contains a table with columns 'Fuel Type*', 'Vol. Used (t)*', and 'Usage Emission (tonnes CO2-e)*'. The first row shows '56 Kerosene for use as fuel in an a' (green), with red cells for 'Vol. Used' and 'Usage Emission'. A second row is partially visible with a red cell for 'Fuel Type'. An 'Add fuel' button is next to the table. The 'Global Warming Potential Values' section has a table with columns 'Gas' and 'GWP Value'. The first row shows 'CH4*' (green) with a value of '24'. The second row shows 'N2O*' (white) with an empty cell. At the bottom, there are '< Back' and 'Calculate >' buttons. Annotations with callouts explain: 'red: fails validation' (pointing to Project ID), 'green: passes' (pointing to Project Name), 'dropdown menu' (pointing to Reporting Year), 'links to NGER and user manual pages' (pointing to a URL), 'adds new fuel row' (pointing to Add fuel), 'red: cell requires data, has been clicked' (pointing to Usage Emission), 'deletes row' (pointing to a delete icon), 'white: cell requires data, hasn't been clicked' (pointing to N2O*), and 'calculate button disabled: invalid or unpopulated cells in form' (pointing to the Calculate button).

2.2.1 SavBAT 2.1 mapping functionality

SavBAT 2.1 has a simple map page which displays the uploaded (or clipped) vegetation data to the user, highlighting errors such as invalid pixel values (i.e. invalid vegetation fuel types) or pixels extending beyond their valid rainfall zone. It also allows the user to confirm that the numerical indexing within the input layer matches the SavBAT 2.1 specifications (e.g. the pixels that should be attributed as 2 are not attributed as 4).

A user who imports a vegetation fuel type GeoTIFF or uploads a project boundary file that conforms to the supported format will be presented with a non-editable image of the vegetation fuel type GeoTIFF. The image will have pan and zoom functionality and display the following:

- Spatial data file name;
- All the eligible vegetation fuel type pixels in the spatial data and colour codes for these pixels with a colour that is unique to each eligible vegetation type (the user can turn the vegetation fuel type layer on and off to assist with error diagnosis. This layer is named the Vegetation raster);
- Key to the codes on the page, Grid North, and a scale;
- Pixels colour coded as red where vegetation pixels are attributed incorrectly or where a vegetation pixel is attributed as an eligible vegetation fuel type but falls partly or wholly outside of the relevant rainfall zone;
- When the cursor is positioned over any pixel and the left mouse button clicked, the attribution data for that pixel will be shown, allowing the user to diagnose vegetation fuel type GeoTIFF errors and confirm that the attribution for non-error pixels is correct;
- The latitude and longitude, Albers easting and northing, of the cursor position on the map;
- A location map (MiniMap) showing the relative position of the screen area to the coastline and the rainfall boundaries. The user can hide or unhide the MiniMap;
- A line of the coastline (this is named the Base Layer) and both rainfall boundaries, including buffered boundaries. The user can turn the rainfall boundaries on and off to assist with error diagnosis, but cannot do this for the Base Layer.
 - Note: each rainfall zone has a buffer of one pixel (250 m). This buffer accounts for the fact that when clipping the correctly geo-referenced vegetation fuel type GeoTIFF with the polygon rainfall boundary border, pixels are likely to still overlap the polygon by up to one pixel width, depending on the software employed by the user and the options selected to do the clip. What may not be obvious with raster datasets is that they are never treated as a grid of square polygons but are always processed as a grid of points. Depending on the GIS software being used, the points are effectively assumed to be at the centre or at one of the corners of the pixel square that users see. This is one of the reasons that such processes will never be precisely reproducible between platforms. Due to the nature of polygons, the use of this buffer does not bias the estimate because the area of additional land beyond the boundary that is included is, on average, equal to the area of land omitted where the activity is permitted and carried out. This means that on average, the area of land considered will closely conform to the unbuffered rainfall boundary. Where the two rainfall zones meet, there is a 500 m zone where pixels may be legitimately attributed as high or low rainfall vegetation fuels types.

1. Welcome 2. Upload Map 3. Confirm Map 4. Select Process 5. Project Details 6. Results

Vegetation Map
Vegtype_nodata255_8.tif

Legend

- 0 Ineligible vegetation fuel type
- 1 hOFM Open Forest Mixed
- 2 hWMI (Woodland Mixed)
- 3 hWHu (Woodland Hummock)
- 4 hSHH (Shrubland Hummock)
- 11 IWHu (Woodland with Hummock grass)
- 12 IWMI (Woodland with Mixed grass)
- 13 IWTu (Woodland with Tussock grass)
- 14 IOWM (Open Woodland, with Mixed grass)
- 15 SHH (Shrubland (Heath) with Hummock grass)
- Invalid Pixels

Pixel Value : 1

< Back Next >

next button disabled because of invalid pixels

1. Welcome 2. Upload Map 3. Confirm Map 4. Select Process 5. Project Details 6. Results

Vegetation Map
Vegtype_nodata255_8.tif

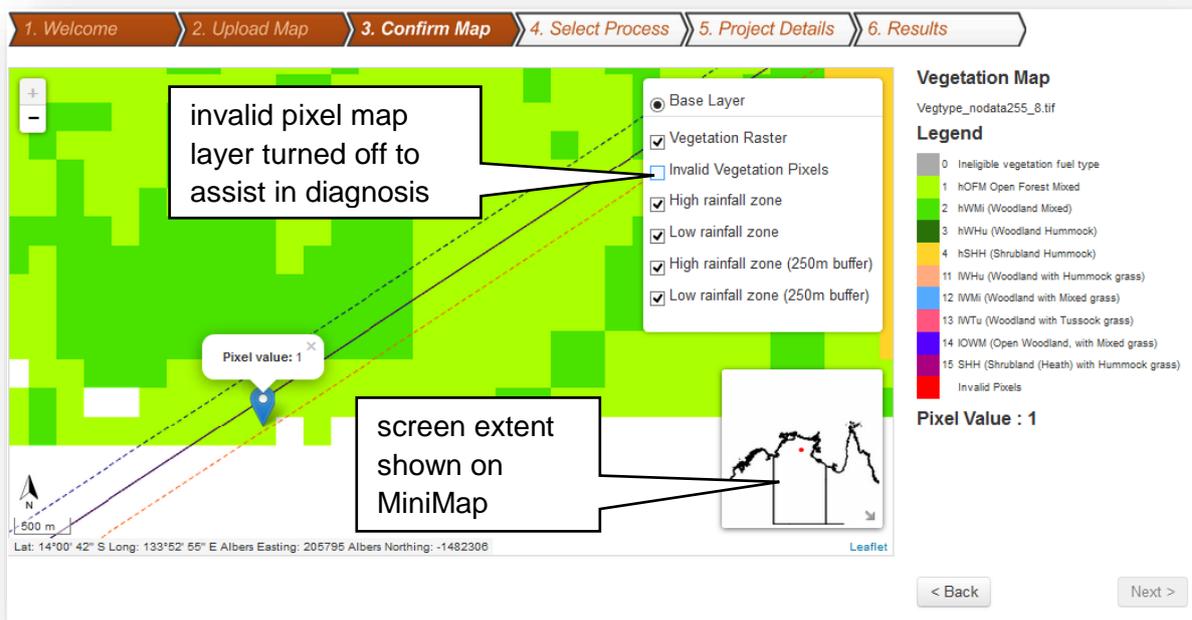
Legend

- 0 Ineligible vegetation fuel type
- 1 hOFM Open Forest Mixed
- 2 hWMI (Woodland Mixed)
- 3 hWHu (Woodland Hummock)
- 4 hSHH (Shrubland Hummock)
- 11 IWHu (Woodland with Hummock grass)
- 12 IWMI (Woodland with Mixed grass)
- 13 IWTu (Woodland with Tussock grass)
- 14 IOWM (Open Woodland, with Mixed grass)
- 15 SHH (Shrubland (Heath) with Hummock grass)
- Invalid Pixels

Pixel Value : 1

< Back Next >

Where there are many invalid pixels, it may assist diagnosis to turn off the invalid vegetation pixel layer as below.



The user will be prompted to confirm that the vegetation fuel type map is correct (by pressing the 'Next' button) before proceeding if the following criteria are met:

- all vegetation fuel type pixels are attributed correctly (for vegetation fuel type GeoTIFF upload only);
- all eligible vegetation fuel type pixels are located wholly within the relevant rainfall zone (for vegetation fuel type GeoTIFF upload only).

If these criteria are not met, then SavBAT 2.1 will not be able to complete calculations until spatial data is correctly attributed and the 'Next' button will be disabled.

2.3 Results – SavBAT 2.1 offsets report

For the offsets report option, SavBAT 2.1 produces two separate PDF reports and an Excel file which are zipped in a folder for download by the user.

The three file outputs are:

- Offsets report attachment:
Attachment1_Calculations_And_Maps_For_Project_Offset_Report.pdf
- Record-keeping information:
Calculations_And_Maps_For_Project_Record_Keeping.pdf
- Excel file:
Calculations_And_Maps_For_Project_Record_Keeping.xlsx

Note that where an area uploaded into SavBAT 2.1 spans low and high rainfall zones, the results will be integrated within these reports.

The reports and files produced by SavBAT 2.1 do not contain all of the content that project proponents need to provide as part of their offsets report submission to the Clean Energy

Regulator or keep as their records. The SavBAT 2.1 Offsets Report attachment contains the necessary maps and calculation result for net annual abatement and the project proponent will need to manually create their offsets report.

2.3.1 Record keeping - Information included in Excel file

The report tables are also provided in an Excel format file based on the Project Record Keeping report (since it contains the superset of tables), including all tables in that report but excluding the maps and their titles. The tables are presented on separate spreadsheet pages for each year of the baseline, the reporting year and the abatement results. The file does not include any formulae.

3 AUDITING OF A SAVBAT 2.1 OFFSETS REPORT

Audit reports, prepared by a registered category two or three greenhouse and energy auditor, provide reasonable assurance that the user's project complies with the Eligible Offsets Project declaration, method and relevant legislative requirements for the reporting period. Information assessed by an auditor can include the location and area of the project, evidence to support legal right to undertake the project, monitoring data, the details of abatement calculations and record keeping.

The method allows project proponents to undertake some required geospatial and other calculations either manually, or by using SavBAT 2.1. Use of SavBAT 2.1 simplifies the reporting and record-keeping requirements but it is not mandatory.

Information on auditing is available on the Clean Energy Regulator website: www.cleanenergyregulator.gov.au.

The auditor may wish to confirm the authenticity of SavBAT 2.1 and the calculations submitted by a project as described in the following section.

3.1 SavBAT 2.1 testing and auditing

The Department of the Environment has undertaken quality assurance testing of SavBAT 2.1 and found it is a true and correct translation of the method.

To support auditing of the web site and its calculations, a single MD5 checksum value (e.g. 176DADE867B804D645FF979EA01F2F0D4) will be computed for the two key files used to compute the emissions outputs, the uploaded raster vegetation fuel type dataset and SavBAT 2.1 code that calculates the emissions (and all interim values).

This will be done as follows:

1. Each time the process is run by a user, an MD5 checksum value will be computed for SavBAT 2.1 code and a separate MD5 checksum will be computed for the user's vegetation fuel type dataset as uploaded.
2. These two hexadecimal values will be added to produce the final hexadecimal checksum value.
3. The checksum value will be included in the output reports.

This allows an audit of the output to be undertaken at any time, by recomputing the file checksums, adding them and comparing the result to the value included in the report. SavBAT 2.1 automatically adds the two component values.

4 HYPOTHETICAL ABATEMENT FORECAST

SavBAT 2.1 can estimate abatement potential for a hypothetical future year. This is referred to as a 'hypothetical abatement forecast'.

This hypothetical abatement forecast uses the same processes and calculations as the SavBAT 2.1 offsets report. However, it does not account for fuel use, and makes assumptions that may result in estimates of potential abatement which are materially different from the abatement which is ultimately realized.

4.1 Differences between a forecast and what is ultimately realised

Any hypothetical abatement forecast will almost certainly be different from what abatement is ultimately realised due to:

- the use of a vegetation fuels type dataset that is not validated in accordance with the method; and/or
- the use of data to inform the calculation processes for the hypothetical abatement forecast differing from that data used for the SavBAT 2.1 offsets report estimates.

The causes of these potential differences are explained in the next two sections.

4.1.1 *Differences due to use of a non-validated vegetation fuels type dataset*

The use of a non-validated vegetation fuels type dataset will result in differences between the hypothetical abatement forecast and what abatement is ultimately realised. This occurs when the user chooses to upload:

- a project boundary (in this case, SavBAT 2.1 creates a vegetation fuel type dataset from the vegetation fuel type base map); or
- a user-created GeoTIFF that has not been validated in accordance with the method.

In both instances the completeness or accuracy of this map for any uploaded project boundary is unknown.

4.1.2 *Differences due to data used to inform the calculation processes*

Hypothetical abatement forecast calculations in SavBAT 2.1 are informed by geospatial analysis when appropriate data are available (i.e. past data) and/or assumptions about the probabilities of vegetation fuel types burning in each fire season. SavBAT 2.1 offsets report calculations are informed only by geospatial analysis resulting in differences between the hypothetical abatement forecast and what abatement is ultimately realised. How these processes are used in the hypothetical abatement forecast calculations is described below.

Data used to inform calculation	Calculation type and the use of data derived using geospatial or probability processes	
	SavBAT 2.1 offsets report for reporting year	Hypothetical abatement estimate for future year
Area burnt by fire season and vegetation fuel type (ha) Table 12:	<p>Geospatial: Uses the seasonal fire map and overlays this with the vegetation fuel type map to derive actual area burnt in the reporting year.</p> <p>Probability: Geospatial data is available to populate this table so probability based inputs are not required or used.</p>	<p>Geospatial: Geospatial data is not available to populate this table so probability based inputs are used.</p> <p>Probability: Does not use historical fire map data. Instead, the percentage burnt each fire season is equally applied across each vegetation fuel type in the area uploaded into SavBAT 2.1. For example, if a project has two vegetation fuel types: A: 200 ha; and B: 450 ha, then for the “cell” in the estimation table with 10% burnt EDS and 20% burnt LDS we would assume for the EDS, 20 ha of A was burnt and 45 ha of B, and for the LDS, 40 ha of A and 90 ha of B.</p>
Area burnt by YSLB (ha) SavBAT 2.1 Table 14:	<p>Geospatial: Uses the YSLB data for the previous year and overlays this data with:</p> <ul style="list-style-type: none"> • vegetation fuels type map, and • seasonality map for the reporting year. <p>For example, for 2013 the calculation must use the 2012 YSLB data. This is because fuel load in the area burnt in 2013 is a product of previous year’s fire activity, not the current year. The area burnt in 2013 data is used to compile the YSLB data for 2013 and this data is then be used for 2014 calculations.</p> <p>Probability: Geospatial data is available to populate this table so probability based inputs are not required or used.</p>	<p>Geospatial: uses the most recent year of YSLB data and overlays this with the vegetation fuels type map to derive a table of YSBL by vegetation fuel type.</p> <p>Probability: Because it cannot be known which season each vegetation fuel type will burn in the future, the percentage burnt for each fire season is applied equally across each vegetation fuel type in the area uploaded into SavBAT 2.1. Compared with the SavBAT 2.1 offsets report process described to the left, this process:</p> <ul style="list-style-type: none"> • uses the most recent year of YSLB data available and overlays this data with the vegetation fuels type map, then; • multiplies the resulting area by the percentage burnt for the EDS and LDS for the “cell” of the estimation results currently being calculated

The below example demonstrates the limitations of the hypothetical abatement forecast.

Hypothetical example: A high rainfall project has two vegetation fuel types: hSHH and hOFM, with areas of 100,000 and 10,000 ha respectively.

In February 2016 the project proponent uses SavBAT 2.1 to investigate abatement scenarios for the coming fire season. SavBAT 2.1 overlays the project vegetation fuel type map with the available 2015 YSLB data to create Table i below. SavBAT 2.1 then assigns area burnt by YSLB as per each combination of EDS and LDS percent area burnt from the results matrix. Table ii below gives a scenario from a results matrix where 10% of the area is burnt in the EDS and 20% in the LDS. Table iii demonstrates how Table i and ii are combined for this scenario. Using this approach SavBAT 2.1 creates an equivalent of Table iii for each of the 66 combinations of EDS and LDS percent area burnt in the results matrix and uses this table to calculate potential abatement for each scenario (i.e. combination of EDS and LDS percentage area burnt).

The following year (2017), the proponent creates a SavBAT 2.1 offsets report for 2016. SavBAT 2.1 uses the same 2015 YSLB data as in the previous year's estimate; however the seasonal fire maps for 2015 have now been produced. SavBAT 2.1 overlays the 2015 YSLB data with the vegetation fuel type map and the fire season map and determines the area burnt by YSLB (Table iv below). In this hypothetical example, 33,000 ha burnt as it did in the hypothetical abatement forecast example, with 11,000 ha in the EDS and 22,000 ha in the LDS. However, the fire activity was proportionally higher in the hOFM than assumed in the earlier SavBAT 2.1 estimate. Thus, even though the total area burnt in each season was the same, the abatement calculation in the report will differ from the earlier hypothetical abatement forecast because information is now available on where the activity has occurred and the associated vegetation fuel type influences emissions calculations.

Table i: Vegetation fuel type map overlaid by most recent YSLB data								
(Used for abatement estimate)								
Season	Vegetation fuel type	YSLB						Total
		1	2	3	4	5	>5	
Unknown	hSHH	20,000	30,000	20,000	10,000	10,000	10,000	100,000
	hOFM	1,000	2,000	3,000	500	500	3,000	10,000
Total		21,000	32,000	23,000	10,500	10,500	13,000	110,000

Table ii: % area burnt in each season for a hypothetical cell in the abatement estimate	
(Used for abatement estimate)	
EDS	10%
LDS	20%

Table iii: % area burnt assigned to each season for a hypothetical cell in the abatement								
(Used for abatement estimate)								
Season	Vegetation fuel type	YSLB						Total
		1	2	3	4	5	>5	
EDS	hSHH	2,000	3,000	2,000	1,000	1,000	1,000	10,000
	hOFM	100	200	300	50	50	300	1,000
LDS	hSHH	4,000	6,000	4,000	2,000	2,000	2,000	20,000
	hOFM	200	400	600	100	100	600	2,000
Total		6,300	9,600	6,900	3,150	3,150	3,900	33,000

Table iv: Area burnt by YSLB (i.e. Table 14 from SavBAT 2 report)								
(Used for abatement estimate)								
Season	Vegetation fuel type	YSLB						Total
		1	2	3	4	5	>5	
EDS	hSHH	1,200	1,800	1,200	600	600	600	6,000
	hOFM	500	1,000	1,500	250	250	1,500	5,000
LDS	hSHH	2,400	3,600	2,400	1,200	1,200	1,200	12,000
	hOFM	1,000	2,000	3,000	500	500	3,000	10,000
Total		5,100	8,400	8,100	2,550	2,550	6,300	33,000

4.2 Data for a hypothetical abatement forecast

Hypothetical abatement forecasts use much of the same functionality as offsets reports. An overview of the processes is given in Section 1.2, page 6. The common functionality for both processes is described in Section 2.2, page 13.

Some data required to use SavBAT 2.1 is common to both the SavBAT 2.1 offsets report and the hypothetical abatement forecast and some data is unique to each function. The data common to both the SavBAT 2.1 offsets report and hypothetical abatement forecasts are:

- spatial data (see [Section 2.1.1](#), page 9);
- Global Warming Potentials for methane and nitrous oxide (see [Section 2.1.7](#), page 12); and
- baseline periods (see [Section 2.1.4](#), page **Error! Bookmark not defined.**1).

Data that is unique to the hypothetical abatement forecast is the users estimated price per tonne of CO₂-e. The use of this functionality is optional.

4.2.1 Project boundary file

Users choosing to use a project boundary file must, externally from SavBAT 2.1, prepare a project boundary file in a supported format, projection and structure, as defined in the table below.

File Formats	Three options: <ul style="list-style-type: none">• zipped shapefile (ZIP: containing at least SHP, DBF, SHX and PRJ files)• KML• KMZ
Projection	<ul style="list-style-type: none">• shapefile in GDA94 Geographics or GDA_1994_Albers• KML/KMZ only support WGS84 Geographics
Allowed Features	Must contain one or more polygons, each of which may be multi-part polygons. No attributes required or used (but these may be present)

The user must direct SavBAT 2.1 to where the desired dataset is stored on their personal device using the 'Select File' button. Upload of data stored from the internet is not supported.

4.3 Creating a hypothetical abatement forecast

Once the user has progressed to the project details page and entered all required data, the 'Calculate' button will become active. The output from the hypothetical abatement forecast calculation is an onscreen display of estimated emissions reductions in both tonnes of CO₂-e and also in dollars (based on a user entered price per tonne of CO₂-e). In addition to the screen display of this data, a downloadable CSV version of this data is available. This is a simple CSV format file containing the data displayed on the screen and will not contain any formulae or functionality.

Guidance on how to interpret the results is given in *Results –* , page 244.

Abatement Estimation produced on 30/10/2014 09:50:49 using base vegetation map clipped by project boundary rainfall_both_gda94.zip

Display: Tonnes of CO₂-e Gross Value Price per tonne: \$ Export to CSV

% of project area burnt in Early Dry Season

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
0%	26,126.87	22,264.29	18,401.71	14,539.13	10,676.55	6,813.97	2,951.39	-1,011.19	-4,773.77	-8,636.35	-12,498.93
10%	19,886.44	16,023.86	12,161.29	8,298.71	4,436.13	573.55	-3,289.03	-7,125.51	-11,014.19	-14,876.77	
20%	13,646.02	9,783.44	5,920.86	2,058.28	-1,803.10	-5,666.88	-9,529.46	-13,374.44	-17,254.62		
30%	7,405.59	3,543.01	-319.57	-4,182.15	-8,027.13	-11,907.30	-15,769.88	-19,632.46			
40%	1,165.17	-2,697.41	-6,559.99	-10,422.57	-14,258.15	-18,147.73	-22,010.31				
50%	-5,075.26	-8,937.84	-12,800.42	-16,663.00	-20,468.58	-24,388.16					
60%	-11,315.68	-15,178.26	-19,040.84	-22,903.42	-26,709.00						
70%	-17,556.11	-21,418.69	-25,281.27	-29,143.85							
80%	-23,796.53	-27,659.11	-31,521.69								
90%	-30,036.96	-33,899.54									
100%	-36,277.39										

Warning: This estimate does not account for fuel load and makes assumptions about fire intensity. The result in estimates of potential abatement which are materially different from what is ultimately realised. More information is available in the user manual.

Estimation Data Details

Vegetation Fuel Type by Area (Ha) for Project Region

Rainfall Zone	Vegetation Class	Area (Ha)
High	hOFM	200.00
High	hWMI	41,762.50
High	hWHu	0.00
High	hSHH	3,275.00
Low	lWHu	0.00
Low	lWMI	0.00
Low	lWTu	210,031.25
Low	lOWM	0.00
Low	lSHH	6.25

Global Warming Potential Values

Gas	GWP Value
CH ₄	21
N ₂ O	310

Start of the LDS for project region

Year	LDS Start Date
1999	1 August
2000	1 August
2001	1 August
2002	1 August
2003	1 August
2004	1 August
2005	1 August
2006	1 August
2007	1 August
2008	1 August
2009	1 August
2010	1 August
2011	1 August
2012	1 August
2013	1 August
Hypothetical	1 August

Exports all data on the page at present to a CSV file

Price per tonne is editable if user selects the gross value option

Display shows information about the abatement estimate

Cells display abatement in tonnes of CO₂-e or gross value depending on the display option chosen by the user

The initial view of the calculation results is tonnes of CO₂-e for scenarios of percentage of the area uploaded into SavBAT 2.1 burnt in the EDS and LDS in 10% increments. The ‘% of project area burnt’ by fire season is the fire scar area as a percentage of the area uploaded into SavBAT 2.1, not the fire scar area multiplied by patchiness as a percentage of the area uploaded into SavBAT 2.1.

The right side of the page displays information about the area uploaded into SavBAT 2.1 and the information used to inform the hypothetical abatement forecast. This information and the results in tonnes of CO₂-e are static and do not change. If the user wishes to change any of the information about the area uploaded into SavBAT 2.1 or the hypothetical abatement forecast, other than the price per tonne, they will need to run another simulation.

As well as the tonnes of CO₂-e, the user can, by pressing the button ‘Gross Value’, activate functionality where they can populate the price per tonne cell with a value of interest to them. The display then shows the dollar value for the estimated abatement when multiplied by this value. Adding or changing the value in this field dynamically updates the data displayed in the table cells.

4.3.1 Printing the hypothetical abatement forecast

SavBAT 2.1 does not have a print function. Users can save/print the hypothetical abatement forecast by using the print screen function on their computer/keyboard. The user may need to resize the screen view so that all results and information are visible. Users with Microsoft Windows operating systems can also use the 'Snipping Tool' program in the Accessories program list to take screen shots. Alternatively users can export the results to a CSV file and format the output to their own requirements.

4.3.2 Export to CSV functionality

In addition to the screen display of this data, the 'Export to CSV' button can be used to download a comma separated values (.csv) file containing the data displayed on the page at the time the button is pressed (i.e. either estimated emissions in tonnes of CO₂-e or dollars). The CSV output does not contain any formulae or functionality. Saving both the tonnes of CO₂-e and gross value requires exporting twice. If the user wishes to explore the effect of different prices for the same hypothetical abatement forecast, then the gross value results can be exported multiple times for the same abatement calculation.

4.4 Results – Hypothetical abatement forecast

Interpreting the results from a hypothetical abatement forecast involves:

1. Understanding the baseline fire characteristics.
2. Analysing the hypothetical abatement forecast result.
3. Assessing the projects' target fire regime.

4.4.1 Understanding the baseline fire characteristics

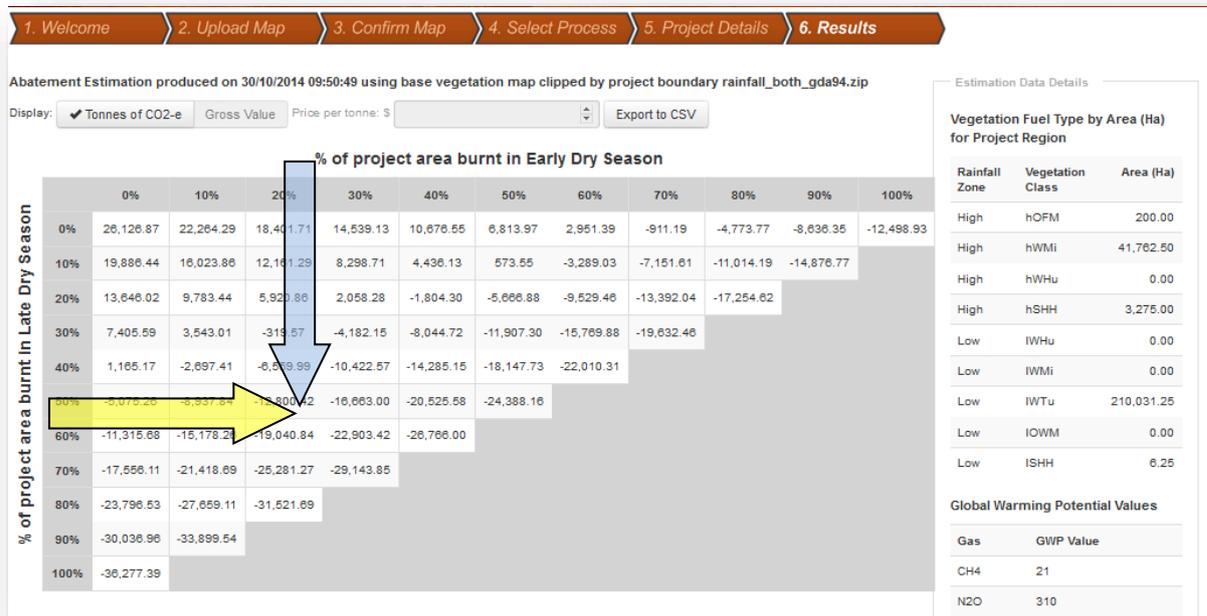
Determine the project's fire characteristics in the baseline, primarily percentage area burnt in EDS and LDS. By developing an understanding of these characteristics and applying their knowledge of the project area, the user can begin to understand not only what the average characteristics are, but also how variable fire has been during the baseline. This knowledge could then be drawn upon when considering the risks imposed by natural variability on any target(s) a project may choose to set.

To explore the baseline fire characteristics the user would:

- i. Run a SavBAT 2.1 offsets report for the project where the baseline years match those of interest.
- ii. Use the CSV outputs from the SavBAT 2.1 offsets report:
 - a. for each year of the project calculate the average % area burnt for all vegetation fuels types in EDS and LDS from Table 11 such as in the hypothetical example below;
 - b. examine the annual variability in these user calculated values.

4.4.2 Analyse the hypothetical abatement forecast result

Using the knowledge about the baseline trace the average LDS % burnt (yellow arrow) to where it meets the average EDS % burnt (blue arrow). Users make their own extrapolations regarding abatement for areas burnt between the 10% increments.



4.4.3 Assess the projects' target fire regime

Assess the abatement impact of the projects target EDS and LDS % area burnt by tracing the target LDS % burnt to where it meets the target EDS % burnt, on the first two tabs of the hypothetical abatement forecast Results page. The layout allows the user to assess the impact of adverse outcomes such as where break-even is when the user meets the LDS target but where the LDS exceeds the target (use the gross value function and the price per tonne cell with a value of interest).

5 CONTACT US

If you have any problems setting up or using SavBAT 2.1, or for more information, please contact the Darwin Centre for Bushfire Research by emailing either Peter.Jacklyn@cdu.edu.au or Andrew.Edwards@cdu.edu.au.

To contact the Australian Government for any reason regarding SavBAT 2.1, please contact the Department of the Environment by emailing emissions-reduction@environment.gov.au or calling 1800 852 974.

6 ACKNOWLEDGEMENTS

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SavBAT 2.1 builds on the success of SavBAT. Development and hosting of SavBAT 2.1 is funded by the Department of the Environment, and made possible by the following organisations:

- The North Australian Fire Information service (NAFI) - allows SavBAT 2.1 to access necessary map data;
- The Indigenous Land Corporation and Latitude Forest Services - assisted with the design and development of the procedure for preparing project data on vegetation fuel types for input to SavBAT 2.1 (*Attachment A*);
- Darwin Centre for Bushfire Research (DCBR) at Charles Darwin University - contributed to the development and testing of SavBAT 2.1 and this manual;
- Auricht projects, Charles Darwin University and Darwin Herbarium - created the base map of vegetation fuel types;
- The Clean Energy Regulator - for advice on auditing;
- Spatial Vision - designed and developed the web tool.

APPENDIX A - PROCEDURE FOR GENERATING PROJECT VEGETATION FUEL TYPE DATA FOR INPUT TO SAVBAT 2.1 FROM VALIDATED PROJECT VEGETATION FUEL TYPE MAPPING

This appendix describes how to produce project vegetation fuel type data in the required format for input to SavBAT 2.1. All other formats will be rejected by SavBAT 2.1. The definition of the required format is as follows:

Image Format	8-bit palette GeoTIFF
Georeferencing information	Embedded in GeoTIFF tags
Image File Extension	.TIF or .TIFF
Projection	GDA_1994_Albers (EPSG:3577)
Upload Format	Single TIF file (no ancillary files required or allowed)
Grid Size (Resolution)	250 m x 250 m
Pixel values high rainfall zone	<p>Pixels must have the following values depicting the relevant vegetation fuel type:</p> <p>0: Pixel is within the project area but contains an ineligible vegetation fuel type</p> <p>1: hOFM (Open Forest Mixed)</p> <p>2: hWMi (Woodland Mixed)</p> <p>3: hWHu (Woodland Hummock)</p> <p>4: hSHH (Shrubland Hummock)</p> <p>255: NODATA (i.e. pixel is outside the project area)</p>
Pixel values low rainfall zone	<p>Pixels must have the following values depicting the relevant vegetation fuel type:</p> <p>0: Pixel is within the project area but contains an ineligible vegetation fuel type</p> <p>11: IWHu (Woodland with Hummock grass)</p> <p>12: IWMi (Woodland with Mixed grass)</p> <p>13: IWTu (Woodland with Tussock grass)</p> <p>14: IOWM (Open Woodland, with Mixed grass)</p> <p>15: ISHH (Shrubland (Heath) with Hummock grass)</p> <p>255: NODATA (i.e. pixel is outside the project area)</p>

For the operation of eligible projects, the method requires that a map of vegetation fuel type must:

- a) Be in raster format with a maximum pixel size of 250 m x 250 m.
- b) Assign a vegetation fuel type to each pixel that represents a part of the project area, according to the vegetation fuel type specified in Schedule 1. (The high and low rainfall zones have vegetation fuels types unique to each zone and SavBAT 2.1 checks that each zone is correctly attributed).
- c) Be based on mapping products of topographical and landscape features such as landform, substrate, slope, elevation, projected foliage cover, persistent greenness, or a satellite-derived vegetation index.
- d) Be validated in accordance with section 3.4 using validation data collected not more than three years before project commencement.

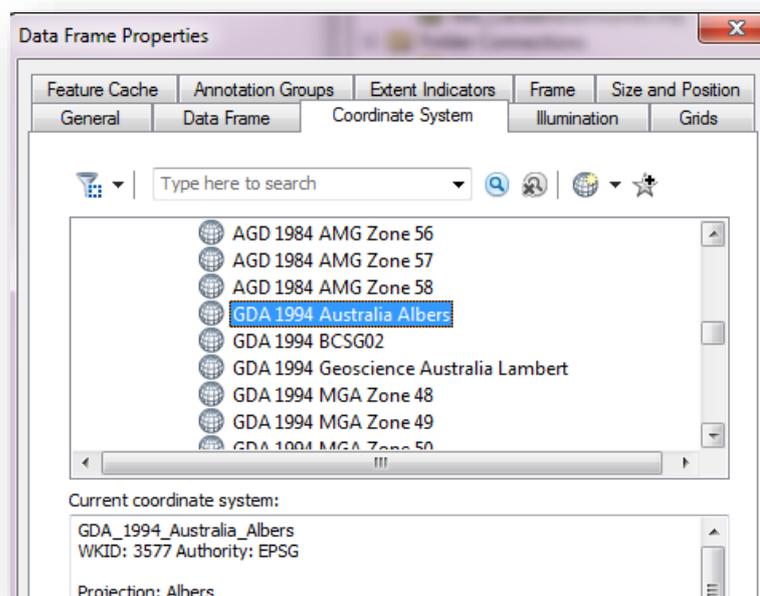
The procedure described here assumes:

- Vegetation fuel type map data have been created or derived by the user and saved as a shapefile;
- The vegetation fuel type data has been clipped to the project boundary and the relevant rainfall zone boundary(s);
- For the production of a SavBAT 2.1 offsets report attachment to be submitted to the Clean Energy Regulator as part of the projects offsets report, the vegetation fuel type map has been created and validated according to the method;
- ESRI ArcGIS Desktop is being used as the GIS application. As part of ArcGIS Desktop, ArcMap is used for data manipulation whereas ArcGIS Explorer can be used for viewing vegetation fuel type layers.

Users can employ other GIS applications if they wish, however the steps below will not apply. Freeware GIS applications include QGIS (<http://www.qgis.org/en/site/>) and MapWindow (<http://www.mapwindow.org/>) – these can also be used to view vegetation fuel type layers. Some data manipulation in GIS freeware is available; however this usually requires the user to download relevant add-ons.

Steps

1. Open a new ArcGIS for Desktop session using the ArcMap program. Do not have any layers open/added.
2. Open Data Frame Properties (see image below) and ensure the data frame is in a GDA_1994_Albers (ESPG:3577) projection, as defined in the table below.

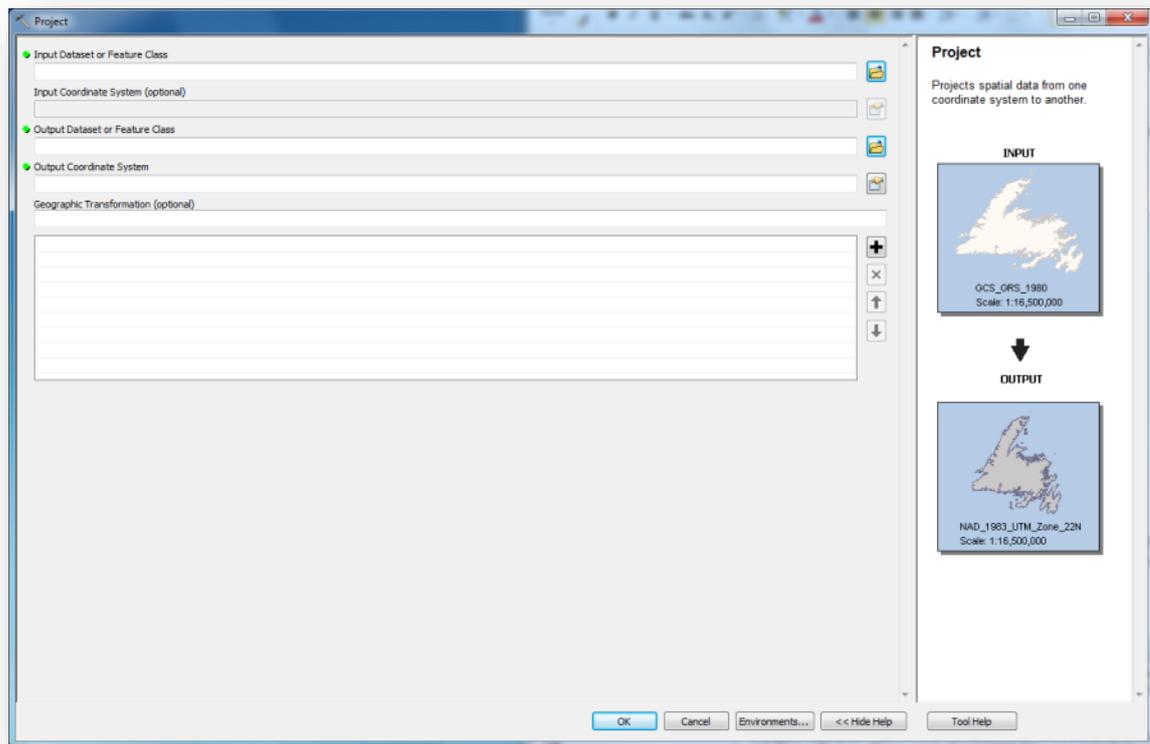


PROJCS["GDA94 / Australian Albers"]

- Geographic Coordinate System: "GCS_GDA_1994" or "GDA94"
 - DATUM["Geocentric Datum of Australia 1994"
 - SPHEROID["GRS 1980", 6378137.0, 298.257222101,
 - AUTHORITY["EPSG", "7019"]],
 - TOWGS84[0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0],
 - AUTHORITY["EPSG", "6283"]],
 - PRIMEM["Greenwich", 0.0,
 - AUTHORITY["EPSG", "8901"]],
 - UNIT["degree", 0.017453292519943295],
 - AXIS["Geodetic longitude", EAST],
 - AXIS["Geodetic latitude", NORTH],
 - AUTHORITY["EPSG", "4283"]],
- PROJECTION["Albers Equal Area",
 - AUTHORITY["EPSG", "9822"]],
- PARAMETER["central_meridian", 132.0],
- PARAMETER["latitude_of_origin", 0.0],
- PARAMETER["standard_parallel_1", -18.0],
- PARAMETER["false_easting", 0.0],
- PARAMETER["false_northing", 0.0],
- PARAMETER["standard_parallel_2", -36.0],
- UNIT["metre", 1.0],
- AXIS["Easting", EAST],
- AXIS["Northing", NORTH],
- AUTHORITY["EPSG", "3577"]]

3. Add the vegetation fuel type shapefile to the data frame.
4. Check the mapping extent and edit or clip, using the Clip function under Raster Processing:
 - a) Clip using the project boundary
 - b) Clip using the appropriate rainfall region boundary (high rainfall or low rainfall zones) if the user's project is on the coast or adjacent to the boundary between rainfall zones.
 - c) If the user's project area crosses the boundary between the two rainfall zones, it is suggested that the user does not merge the maps in shapefile format, but later in the process when they are both in raster format (see step 6).

5. Check the properties of the file, ensuring the data is in GDA_1994_Albers (ESPG:3577) (in ArcMap: GDA 1994 Australia Albers). If not, re-project the file using the Project tool.

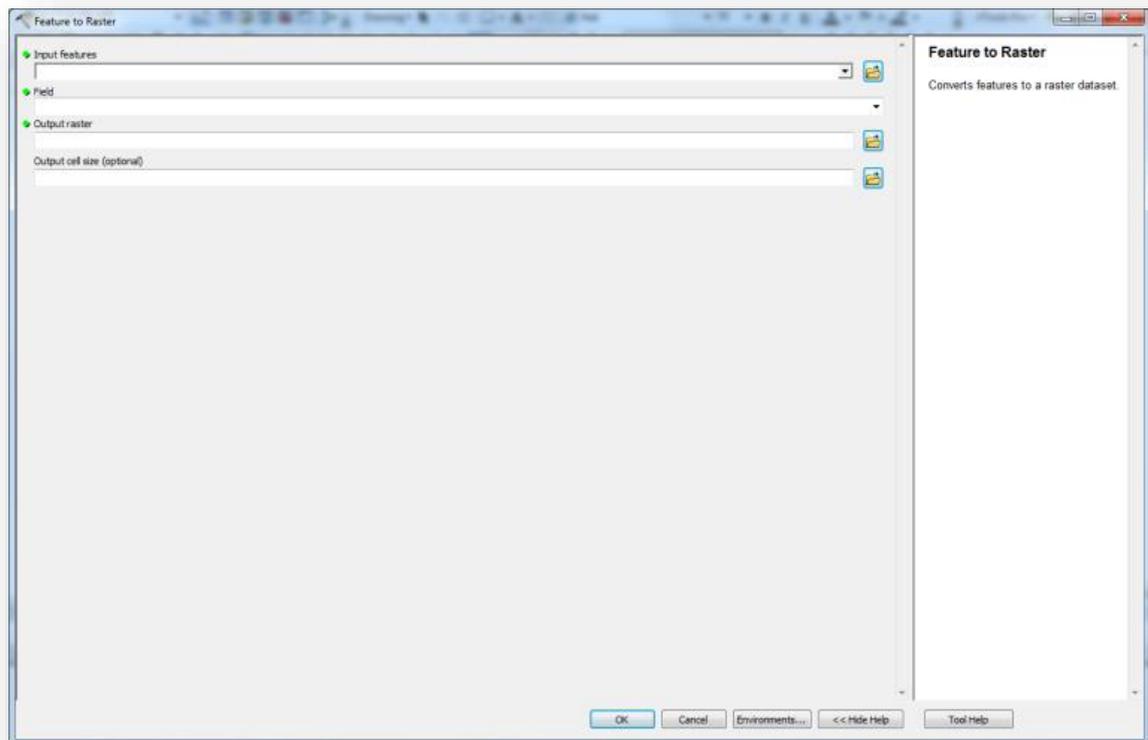


6. Classify the vegetation fuel type data according to the SavBAT 2.1 vegetation fuel type pixel values.
 - a) Add an integer field (e.g. 'SavBAT2.1_Fuel_Type') to the shapefile attribute table and use the Field Calculator (right mouse click on heading of the new field) to attribute the new field with values 0, 1, 2, 3, 4, 11, 12, 13, 14, 15.

To avoid common errors ensure that before conversion:

- Only values 0, 1, 2, 3, 4, are used in the high rainfall zone;
- Only values 0, 11, 12, 13, 14, 15 are used in the low rainfall zone;
- Ineligible vegetation types in the project area are set to zero (not to 255, 256 or any other value prior to conversion);
- The vegetation fuel type data is clipped to the project boundary;
- The vegetation fuel type data is clipped to the rainfall map(s). Note: SavBAT 2.1 has buffered the rainfall region boundaries by one pixel [250 m] to allow for the raster representation of vector mapping; however, if a pixel extends over the buffered rainfall zone boundary it will be rejected by SavBAT 2.1. It is therefore worthwhile zooming in to the project boundary, overlaying the buffered rainfall zone boundaries, and checking the mapping extent).

7. Convert the feature dataset to a raster using the Feature to Raster tool:



- a) 'Field' must be the new integer field (e.g. 'SavBAT2.1_Fuel_Type').
- b) Output Raster: specify the file extension .tif and include this extension in the file name.
- c) Cell size is 250.0.
 - SavBAT 2.1 requires a 250 m resolution. Grid size can be changed using the Resample tool under Raster Processing.
 - Note: adding the '.0' to '250' (i.e. '250.0') helps minimise problems that may occur during this conversion process.
 - If the user is having a problem with the pixel size, they may find it helpful to install the open source GDAL utility program. The user can use the GDALINFO command to check and correct rasters.
8. After the Feature to Raster conversion process is complete, add the raster layer to the data frame (if it is not set to do so automatically).
9. Double click on the raster dataset. Under Properties > symbology - classify as 'Unique Values'
 - a) If asked 'do you want to create unique values?' > yes
 - b) Check the raster values are the correct integer values, i.e. 0,1,2....15 only.

In the Raster Information, the NoData Value will most likely be blank, it doesn't matter if it is or not. The user will have to undertake a further conversion of the file to make the NoData values = 255, see step 9.
 - c) Check the Raster Information: Properties > Source > Raster Information
 - Number of bands : 1

- Cellsize (x,y): 250, 250.
 - if incorrect: the user used a default value or typed in the wrong value in the feature to raster conversion.
- Format: TIFF
 - if incorrect: the user forgot to put .tif on the end of the output file name.
- Pixel Type: unsigned integer
 - if the pixel Type is incorrect: then the user has either used the wrong field in the feature to raster conversion or has calculated a wrong value in the 'SavBAT2.1_Fuel_Type' field.
- Pixel Depth: 8 Bit
 - if the pixel depth is incorrect: then the user has either used the wrong field in the feature to raster conversion or has calculated a wrong value in the 'SavBAT2.1_Fuel_Type' field.

If any of the above are incorrect, delete the file, make the change(s) suggested above, and recreate the raster layer.

10. There are two methods to create the final raster; if one method doesn't work then try the other:

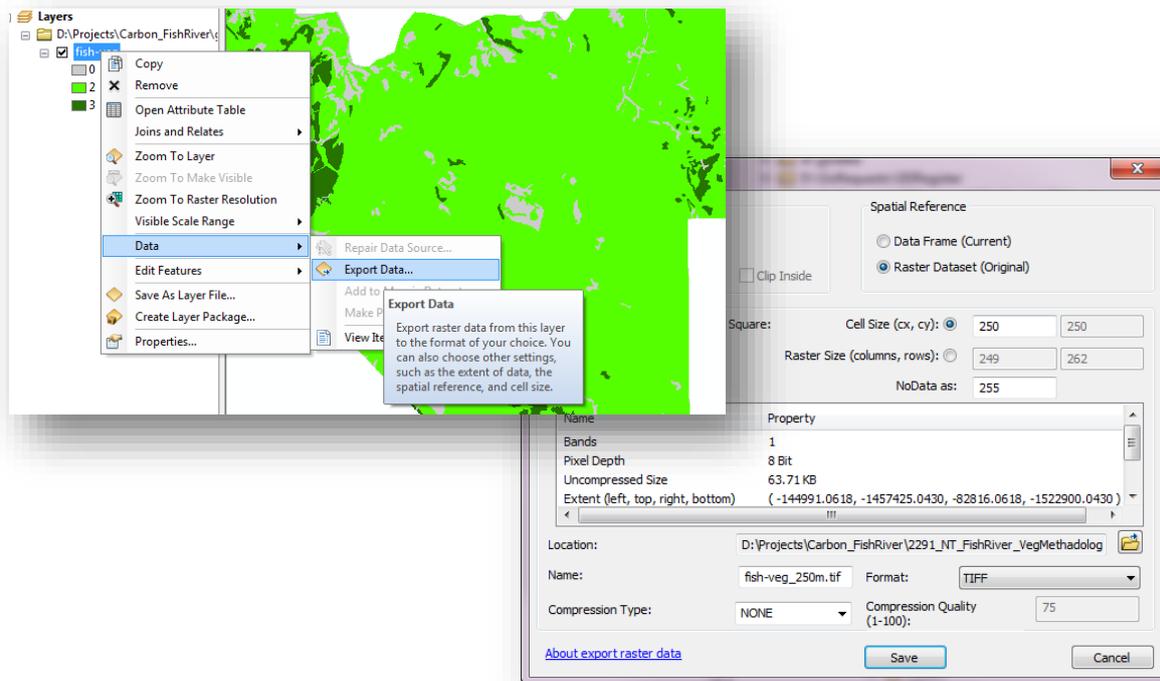
a) Use Copy Raster tool:

- Data management tools > Raster > Raster Dataset > Copy Raster
- add '.tif' extension
- define 'no data' = 255
- Pixel type = 8 bit unsigned

b) Right click on the raster: Data > Export Data

- Cell Size: 250 and 250
- NoData as: 255
- Format: TIFF

The user can use LZW compression if they wish.



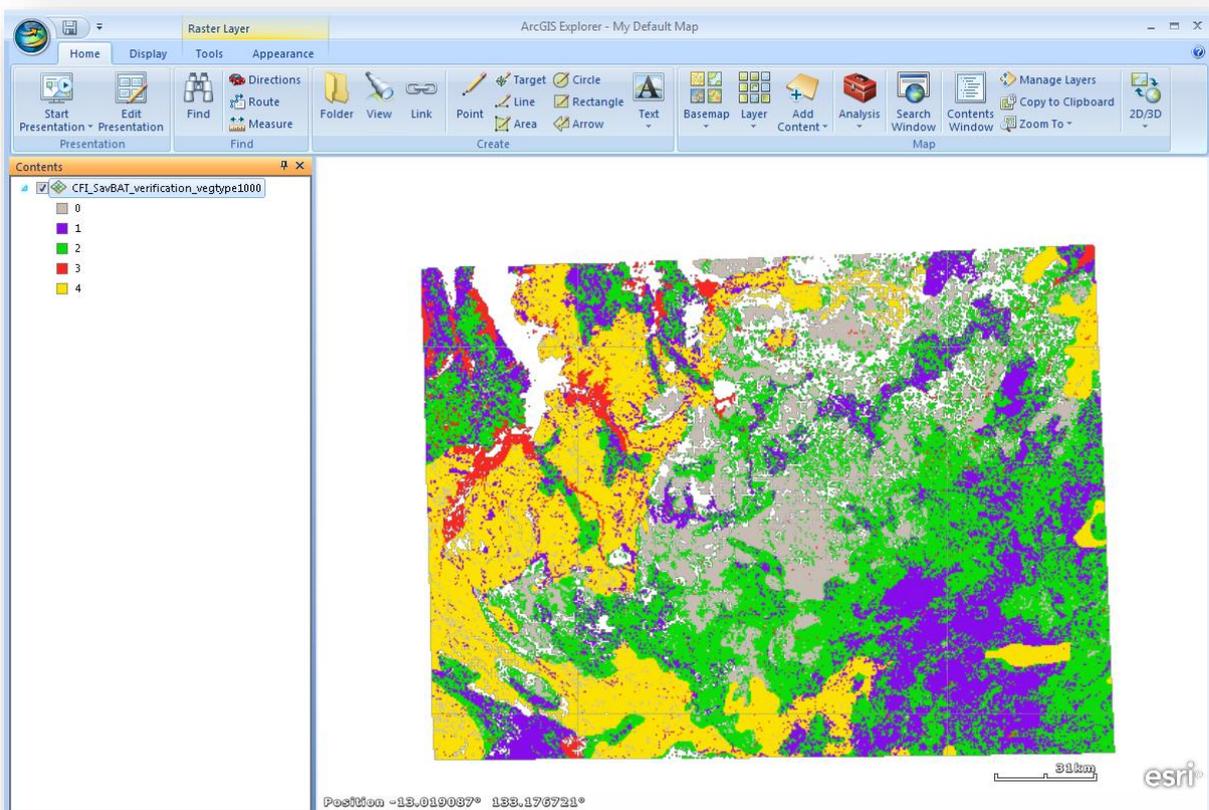
11. Check the properties and values of the file as per the Verification section below.
12. Save the vegetation fuel type GeoTIFF in a folder for use as input in SavBAT 2.1.
13. Save a copy of the vegetation fuel type GeoTIFF and raw map for archiving purposes in accordance with the method.
14. It is recommended the user does backup for all related data on a separate IT network or some other off-site storage facility.

Verification

The points below are not required to make data ready for use in SavBAT 2.1, but can help in confirming the format and features of existing *.tif vegetation layers, and making some fixes to existing data.

If the user wishes to view and verify an existing *.tif vegetation fuel type layer, they should use a GIS application to do so, such as ArcMap as used in the steps above, or ArcGIS Explorer, as included in the ESRI ArcGIS platform. Freeware and other GIS software will also work provided the user has an understanding of the software functionality and tools. The examples below use both ArcGIS Explorer and ArcMap to work through the viewing and verification process. The verification process can be used, for example, to check for correct vegetation fuel type attribution across the area uploaded into SavBAT 2.1, and more generally to confirm that the vegetation fuel type layer has been created correctly for use in SavBAT 2.1.

1. In ArcGIS Explorer, display the vegetation fuel type layer by using the Add Content > Raster Data options. Find the vegetation fuel type layer in the directory box that appears and select and open. The visual representation of the layer will appear in the data frame on the right, and the contents panel on the left will show the pixel values that correspond to the raster layer. These pixel values reflect the vegetation type, dependent on rainfall area, as detailed in the first table of Appendix A.



If displaying the vegetation layer in ArcMap, choose the Add Data option and navigate to the layer saved in the directory, then open. The screen display will be very similar to the ArcGIS Explorer display. Use the information button option to click on and find out more information about individual pixels, or refer to the left hand panel for pixel values and associated colours.

2. To verify the coordinate system and projection, and that it complies with SavBAT 2.1 requirements (GDA_1994_Albers), open layer properties in ArcGIS Explorer by right-clicking the vegetation layer title in the left hand contents panel. Under the Source Data tab it will list data type (raster) and the coordinate system. If this coordinate system is different to GDA_1994_Albers, please use ArcMap/another GIS with data manipulation functionality to re-project the layer (see step 5 above). Check the properties after re-projection to ensure the process has worked.
3. If needing to reclassify numerical pixel values of the vegetation layer to those required by SavBAT (see first table of Appendix A for pixel values and corresponding vegetation types), use the Reclassify or Reclass by Table tools in ArcMap, under Spatial Analyst.

APPENDIX B – SAVBAT ERRORS AND PROBLEM-SOLVING

There are three issue types in the below table, these are:

- **Error Message:** SavBAT provides an error message to help the user resolve the issue.
- **Error:** A SavBAT 2.1 function is not available because the user has not entered required data or entered invalid data.
- **Information Message:** Not an error, for information only.

SavBAT 2.1	Issue	Solution
Any	Error Message: <i>“Unable to connect to server, please check your internet connection.”</i>	This is due to a loss of internet connection – check your networking connection, networking settings, the cables to your modem, etc.
Welcome	Error: ‘I agree and next’ button not functioning	This could occur if the SavBAT 2.1 website does not load fully and correctly and could be caused by poor network connectivity. It could also be caused by using an unsupported browser type or version (see page 6 for information about supported browsers). If you believe the problem may have been network related, once your network is working correctly, press the browser refresh button to try reloading the SavBAT 2.1 website.
Upload map	Error: ‘Next’ button not functioning	No valid spatial file has been uploaded by the user – upload a valid spatial file.
Upload map	Error Message: <i>“Error - SavBAT will not be able to complete calculations until the vegetation pixels are attributed correctly or all eligible vegetation pixels are located wholly within the relevant rainfall zone. This must be completed by modifying the Veg GeoTIFF externally to SavBAT”</i>	The uploaded GeoTIFF file is not attributed correctly or some eligible vegetation pixels are outside the relevant rainfall zone. Externally to SavBAT 2.1, modify the file to comply with the requirements in Vegetation fuel type GeoTIFF , page 10 and upload it again.
Upload map	Error Message: <i>“Dataset is completely outside the rainfall region.”</i>	The uploaded GeoTIFF or boundary file is correctly attributed but entirely out of the rainfall regions. Externally to SavBAT 2.1, modify the file to comply with the requirements in Vegetation fuel type GeoTIFF , page 10.
Upload map	Error Message: <i>“The uploaded file is not valid, please try again”</i>	The uploaded GeoTIFF or boundary file is not in the supported format, projection and structure. Externally to SavBAT 2.1, modify the file to comply with the requirements in Vegetation fuel type GeoTIFF , page 10 or Project boundary file , page 22.
Upload map	Error Message: <i>“Projection must be <xxx>”</i>	The uploaded GeoTIFF file is not in the supported projection (where <xxx> would be replaced by words within this list: <i>EPSG:3577,GDA, 94, Albers</i>). Externally to SavBAT2.1, modify the file to comply with the requirements in Vegetation fuel type GeoTIFF , page 10.
Upload map	Error Message: <i>“Grid size (m) must be 250 x 250”</i>	The uploaded GeoTIFF file is not set to the required grid size. Externally to SavBAT 2.1, modify the file to comply with the requirements in Vegetation fuel type GeoTIFF , page 10. More help is available in Appendix A .

SavBAT 2.1	Issue	Solution
Upload map	Error Message: <i>"Image Format must be a single band GeoTIFF"</i>	The uploaded GeoTIFF file is not in the required format. Externally to SavBAT 2.1, modify the file to comply with the requirements in Vegetation fuel type GeoTIFF , page 10. More help is available in Appendix A .
Upload map	Error Message: <i>"Image data type cannot be <xxx>. It must be a 8-bit palette GeoTIFF"</i>	The uploaded GeoTIFF file is not in the required format (where <xxx> is replaced with the image type SavBAT 2.1 determined). Externally to SavBAT 2.1 modify the file to comply with the requirements in Vegetation fuel type GeoTIFF , page 10. More help is available in Appendix A .
Upload map	Error Message: <i>"Image data type cannot be 1 bit. It must be a 8-bit palette GeoTIFF"</i>	The uploaded GeoTIFF file is not in the required format. Externally to SavBAT 2.1 modify the file to comply with the requirements in Vegetation fuel type GeoTIFF , page 10. More help is available in Appendix A , page 27.
Upload map	Error Message: <i>"Fail to get GeoTransform Metadata"</i>	The uploaded GeoTIFF or project boundary file may be in the supported format, projection and/or structure; however when SavBAT 2.1 tries to set the GIS dataset metadata (which defines its projection) an unspecified error occurs in SavBAT 2.1. This is unlikely to occur – try the process again and if the problem persists, refer to the Contact Us section of this manual (page 27).
Upload Map	Error Message: <i>"Unexpected Error: Upload failure reason unknown. Please select the file and try again."</i>	The upload of the GeoTIFF or project boundary file fails for unknown reason(s). Check the map file to ensure it conforms to spatial data requirements, and, for project boundary files, that the file does not contain duplicate polygons.
Upload map	Error Message: <i>"The uploaded shapefile has no projection file."</i>	The uploaded project boundary ZIP file folder contains the SHP, SHX and DBF files but no PRJ file. Externally to SavBAT 2.1, modify the file to comply with the requirements in Project boundary file , page 22.
Upload map	Error Message: <i>"The uploaded zip file does not contain a valid shapefile."</i>	The uploaded project boundary ZIP file is not in the supported format, projection and structure. Externally to SavBAT 2.1, modify the file to comply with the requirements in Project boundary file , page 22.
Confirm map	Error: 'Next' button not functioning	This will generally indicate that the uploaded GeoTIFF or map boundary files were not valid. There are numerous possible reasons for this - see error message on the Confirm Map page for reason.
Confirm Map	Error Message: <i>"Invalid pixel value is found. Value must be in list <xxx>"</i>	For uploaded GeoTIFF, pixels are attributed incorrectly (where <xxx> would be the list of valid pixel values for the rainfall region(s) covered by the dataset e.g. 0, 1, 2, 3, 4, 255). These invalid pixels are colour-coded in red on the Confirm Map page. Use the SavBAT 2.1 mapping functionality to identify the invalid pixel and externally to SavBAT 2.1 modify the file to comply with the requirements in Vegetation fuel type GeoTIFF , page 10.
Confirm Map	Information Message: <i>"All pixels in the vegetation raster are valid. The raster is entirely within the Low rainfall region."</i>	Not an error, information only.

SavBAT 2.1	Issue	Solution
Confirm Map	Information Message: <i>"All pixels in the vegetation raster are valid. The raster is entirely within the High rainfall region."</i>	Not an error, information only.
Confirm Map	Information Message: <i>"All pixels in the vegetation raster are valid. The raster is located in both rainfall regions."</i>	Not an error, information only.
Confirm Map	Error Message: <i>"<xxx> high rainfall vegetation pixels are incorrectly located outside the high rainfall region."</i>	For uploaded GeoTIFF, pixels are attributed correctly but one or more pixels attributed as uniquely high rainfall (i.e. 1, 2, 3, 4) are located outside of the high rainfall zone (where <xxx> is replaced by the number of pixels in error). These misplaced pixels are colour-coded in red on the Confirm Map page. Use the SavBAT 2.1 mapping functionality to identify the invalid pixel and, externally to SavBAT 2.1, modify the file to comply with the requirements in Vegetation fuel type GeoTIFF , page 10.
Confirm Map	Error Message: <i>"<xxx> low rainfall vegetation pixels are incorrectly located outside the low rainfall region"</i>	For uploaded GeoTIFF, pixels are attributed correctly but one or more pixels attributed as uniquely low rainfall (i.e. 11, 12, 13, 14, 15) are located outside of the high rainfall zone (where <xxx> is replaced by the number of pixels in error). These misplaced pixels are colour coded in red on the Confirm Map page. Use the SavBAT 2.1 mapping functionality to identify the invalid pixel and externally to SavBAT 2.1 modify the file to comply with the requirements in Vegetation fuel type GeoTIFF , page 10.
Select process	Error: 'Next' button not functioning	This is because you have not selected the desired Output type – Offset report or Hypothetical abatement forecast
Project details	Error: 'Calculate' button not functioning	All required fields have not been populated or have been populated incorrectly – See Before you start: Data required from the user , page 9 or Data for a hypothetical abatement forecast , page 22.
Project Details	Error Message: <i>"Unable to complete request, possibly caused by intermediate proxy server timeout."</i>	The intermediate proxy server (i.e. your internet settings) do not allow for a long enough calculation time between when the message is sent to SavBAT 2.1 and the results of the calculations are sent back to you from SavBAT2.1. Change the server timeout settings to five or more minutes for report/estimate calculations.
Project Details	Error Message: <i>"Unexpected Error: INTERNAL SERVER ERROR."</i>	An unexpected error with the SavBAT 2.1 server. Try the process again.