What is a BARC?

A Burned Area Reflectance Classification (BARC) is a satellite-derived map of postfire vegetation condition. The BARC has four classes: high, moderate, low, and unburned. This map product is used as an input to the burn severity map produced by the Burned Area Emergency Response (BAER) teams.
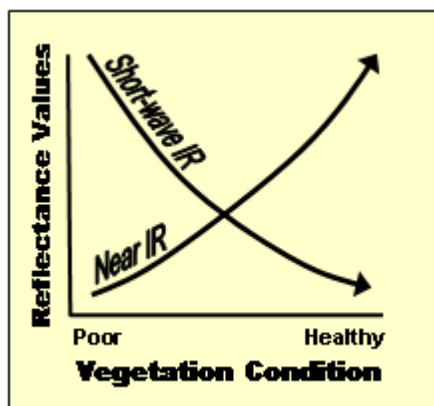

Important information about burn severity data provided in the BARC data bundle.

Starting in 2024, most BARC data bundles will include both the BARC data and a preliminary vegetation mortality classification derived from the same imagery. The vegetation mortality data is different from the analyst-interpreted BARC severity product delivered to the BAER team. It is created by applying the 7-class basal area loss model used in a typical RAVG assessment and is intended to be used by the BAER team to provide an initial estimate of vegetation mortality. It is also useful for communicating the difference between the soil burn severity data produced in the BAER assessment and the final vegetation burn severity produced through an official RAVG assessment or the burn severity produced by the MTBS program at later dates.

Note: Since the RAVG model is designed to be used in forested areas, care should be taken in interpreting vegetation burn severities in other vegetation types. A preliminary vegetation mortality product may not be provided if it is determined that the output is not applicable to the BARC mapping.

How are BARC maps generated?

BARC maps are made by comparing satellite near and shortwave infrared reflectance values. The logic behind the process is as follows:

- Near infrared light is largely reflected by healthy green vegetation. That means that near infrared bands will be very high in areas of healthy green vegetation and low in areas where there is little vegetation.
- Shortwave infrared light is largely reflected by rock and bare soil. That means that shortwave infrared band values will be very high in bare, rocky areas with little vegetation and low in areas of healthy green vegetation.
- Imagery collected over a forest in a pre-fire condition will have very high near infrared band values and very low shortwave infrared band values. Imagery collected over a forest after a fire will have very low near infrared band values and very high shortwave infrared band values.

It is the relationship between these two bands that BARC mapping attempts to exploit. The best way to do this is to measure the relationship between these bands prior to the fire and then again post fire. The areas where the relationship between the two bands has changed the most are most likely to be severely burned. The areas where that relationship has changed little are likely to be unburned or very lightly burned. To determine this relationship, analysts perform a band ratio between the shortwave and near infrared bands. The result is a classification of burned areas.

How should BARC data be used?

In the immediate aftermath of a wildfire, a Forest Service Burned Area Emergency Response (BAER) team is dispatched to the site to prepare an emergency rehabilitation and restoration plan. They do this by making an initial assessment of burn severity and to estimate the likely future downstream impacts due to flooding, landslides, and soil erosion. One of the first tasks for this team is the creation of a burn severity map that highlights the areas of high, moderate, and low burn severity. This map then serves as a key component in the subsequent flood modeling and Geographic Information System (GIS) analysis. The BARC data are meant to be used as a main input into the development of the final soil burn severity map.

What is the BARC256 and how do I use it?

In addition to delivering the 4-class BARC data to field teams, GTAC also provides field users a continuous 256-class version of the BARC. This is called the BARC256. This data set provides users the ability to adjust the break points between reflectance classes. Analysts at GTAC will color code the BARC256 image using the same classification scheme used for the BARC4 data, but the BARC256 will not be recoded into 4 classes. The breakpoints for the BARC256 will look something like this:

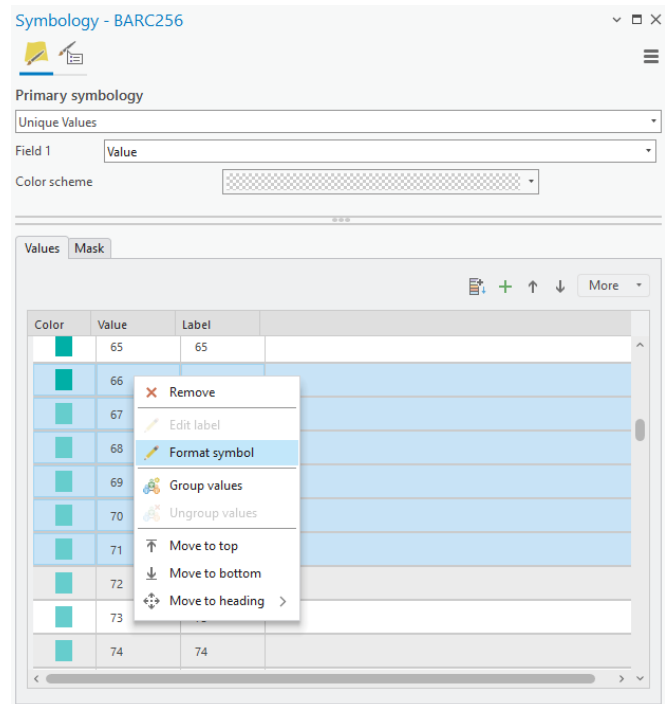| Color	Upper value	Label
■ (teal)	≤ 78.0	0 - 78
■ (light teal)	≤ 109.0	79 - 109
■ (yellow)	≤ 186.0	110 - 186
■ (red)	≤ 254.0	187 - 254

The color-coding on the BARC256 done by GTAC is meant to act as a starting point for field team members. Users can view the color scheme and adjust these break points as desired. This can easily be done in ArcGIS Pro.

The data will also typically be sent as a square or rectangular subset that covers land outside the fire perimeter. The clipped and masked product will also be provided based on the burn area boundary interpreted by the BARC analyst. If a separate fire perimeter is more appropriate for the BAER assessment, the rectangular subset BARC256 can easily be clipped to the fire perimeter of choice using the Extract by Mask geoprocessing tool using the Spatial Analyst extension in ArcGIS Pro.

Typical workflow using ArcGIS Pro:

- **Right-click** on the BARC256 image name in the Table of Contents.

- Click on **Symbology** in the pop out menu to open the symbology pane.

- In the symbology pane, change the **Primary symbology** from Colormap to **Unique Values**.

- Click on the color box and change colors where appropriate. For example, if you believe not enough "unburned" pixels are represented in the image, in the "Symbol" field, click on a few of the "low" colored boxes and change the color to the dark teal color similar to other "unburned" values. Observe how the BARC patterns change as you change the thresholds. You can change multiple values at one time by holding the **Shift** key while selecting a second value by clicking on the value column. With multiple values selected, right click on one of the selected color boxes and select **Format symbol** from the pop out menu (see graphic at right).

- After looking at your ancillary data and deciding more changes need to be made, continue with the same process as described above.

- If working from the non-clipped BARC256 data set, before reclassifying the BARC256 to a new four-class image, set your desired fire perimeter as the raster analysis **Mask** (Analysis | Environments | Mask). This will clip the BARC product to the perimeter any time you perform any analysis using Spatial Analyst. It is a good practice to also select the BARC256 raster as the **Snap Raster** (Analysis | Environments | Snap Raster) so that the pixels align between inputs and outputs.

- Users can recode the BARC256 into a four-class image using the new breakpoints (Spatial Analyst | Reclassify).

- After converting the BARC256 into a 4-class raster image, you can convert it to a vector shapefile (Conversion Tools | From Raster | Raster to Polygon). Note: Uncheck the **Simplify Polygons** option. This process makes some odd shapes and doesn't produce very good results.

- In the vector format, you can make local edits, such as in areas covered by clouds or smoke in the satellite imagery. This could by done by doing a union or intersect with shapefiles with known severity attributes, in essence, burning in the correct severity attribute to the vector BARC layer.

Who do I contact to get BARC maps?

The USDA Forest Service Geospatial Technology & Applications Center (GTAC) and the US Geological Survey Center for Earth Resources Observation and Science (EROS) both provide satellite imagery and BARC mapping services to BAER teams. GTAC is responsible for all wildland fires on Forest Service lands, while EROS is responsible for all Department of Interior lands. However, depending on workload, each office may assist the other for fires on lands not under their stewardship. BARC mappings can be requested directly from the BAER Imagery Support website using the RFMapp application:

https://burnseverity.cr.usgs.gov/rfmapp/baer

For questions regarding BARC data for fires on FS lands, contact Mark Nigrelli (801-975-3479; mark.nigrelli@usda.gov) or Robert Chastain (801-975-3761; robert.chastain@usda.gov). For fires on DOI lands, contact Kurtis Nelson (605-215-8266; knelson@usgs.gov).