

Standard Operating Procedure (SOP) 2.1: Burn Severity Data Acquisition and QC, Version 1.0

Fire Monitoring Protocol for the Arctic Network *Fire Extent, Severity and Effects*

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The main Narrative for the Fire Monitoring Protocol for the Arctic Network: Fire Extent, Severity, and Effects is available from the NPS Inventory and Monitoring Network website (<https://www.nps.gov/im/arcn/protocols.htm>), the Natural Resource Reports website (<https://www.nps.gov/im/reports-nrr.htm>) and the Integrated Resource Management Applications (IRMA) Data Store (<https://irma.nps.gov/DataStore/Reference/Profile/2254884>).

SOP 2.1 - Burn Severity Data Acquisition and QC

Standard Operating Procedure #2.1

Version 1.0 (March 2020)

Revision History Log

Version No.	Revision Date	Author	Changes Made	Reason for Change

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Overview of MTBS Data Availability

The Monitoring Trends in Burn Severity (MTBS) website (<https://mtbs.gov/>) provides detailed information including the project overview, mapping methods, product descriptions, mapping status, and data access. Data release announcements are posted under “Latest MTBS Announcements” on the website home page. Burn severity data is generally updated twice a year approximately 2-3 years post-fire and includes fires greater than 1,000 acres for western states (500 acres or greater for eastern states) back to 1984. A burn severity data review should be completed **annually in April** to identify and acquire new datasets for NPS Alaska fires.

Download National MTBS Fire Occurrence and Burned Area Boundary Datasets

Download the National MTBS Fire Occurrence and Burned Area Boundaries Datasets from <https://mtbs.gov/direct-download> to review fires with available burn severity data. The National MTBS Fire Occurrence Dataset is a vector point shapefile derived from the centroid of the burned area in the Burned Area Boundaries Dataset. The National MTBS Burned Area Boundaries Dataset is a vector polygon shapefile of the extent of burned areas for all fires that have been mapped by MTBS since 1984. The attribute table from the fire occurrence data provides a valuable list of attribute fields for each fire including, but not limited to:

- Fire_ID (MTBS unique identifier), fire name and year
- Assessment Type (Initial, Extended or Initial SS)
- Pre- and post-fire Landsat scene IDs
- dNBR thresholds for each burn severity class (No Data, Increased Greenness, Low, Moderate, and High)

This information will be important during burn severity data analysis in SOP 2.3. Metadata is also provided with the National Fire Occurrence Dataset which lists each attribute field and the corresponding field definition.

To utilize the National MTBS Datasets:

1. Go to <https://mtbs.gov/direct-download>. On the *Fire Bundles Tab*, click on the red **Download** link next to Fire Occurrence Dataset (Figure 2.1.1).
2. **Save** the compressed file to O:\Monitoring\Vital Signs\Fire Extent and Severity\Data\BurnSeverity\01_MTBS_NationalData\[YEAR of download]
3. **Extract** the *.zip file to the folder. **Delete** the zip file after extraction.
4. Return to the MTBS Direct Download webpage and **repeat steps 1-3** to download and extract the National MTBS Burned Area Boundaries Dataset.

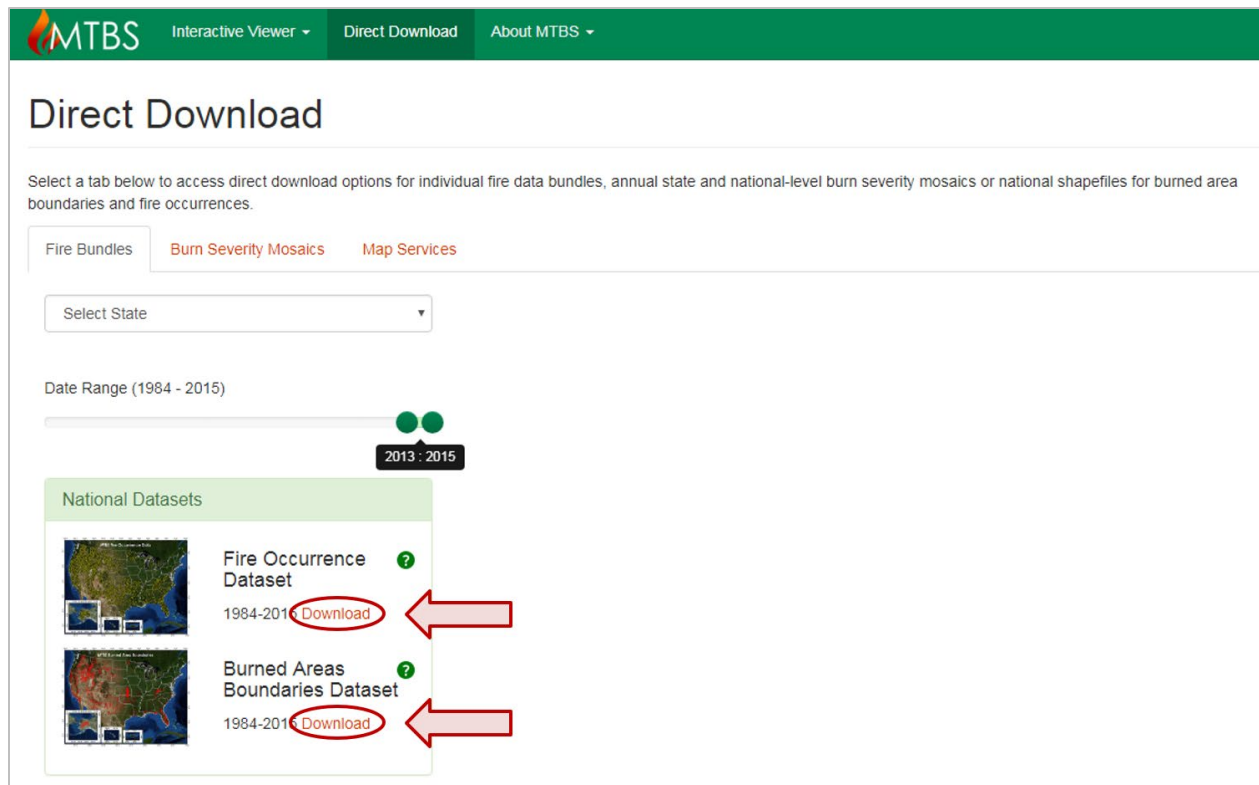


Figure 2.1.1. Download the Burned Area Boundaries Dataset and Fire Occurrence Dataset from the MTBS national geospatial data products webpage (<https://mtbs.gov/direct-download>).

Create a List of Fires Mapped by MTBS

Open a new ArcMap document. Add the *Alaska Unit Outline* layer from Theme Manager (Alaska Wildland Fire Themes → Fire Management → Alaska Unit Outline) and the two new datasets from MTBS (*mtbs_fod_pnts_DD.shp* AND *mtbs_perims_DD.shp*). Use the following steps to build a list of burn severity data that is available for NPS fires in Alaska:

1. To select the ARCN park unit outlines, uncheck the points and perimeters layers in the Table of Contents. Use the **Select by Rectangle** tool to highlight the 5 ARCN park units (Figure 2.1.2). Turn the points and perimeters layers back on.

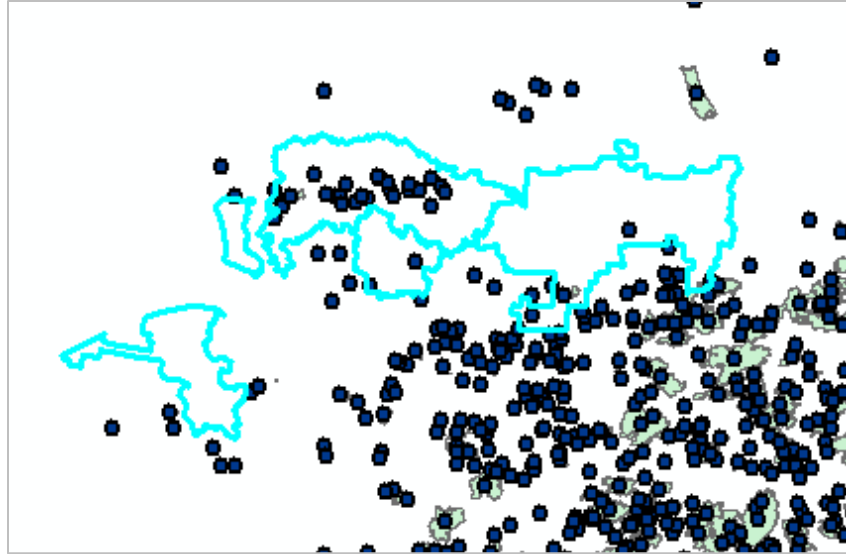


Figure 2.1.2. ARCEN park units are highlighted in bright blue. Fire occurrence and burned area data are also displayed in this ArcMap document.

2. Use the **Select by Location** tool to select perimeters that intersect with the selected ARCEN parks (Figure 2.1.3).
 - a. Selection Method: Select features from
 - b. Target Layers: mtbs_perims_DD
 - c. Source Layer: Alaska Unit Outline
 - d. Check the box for “Use selected features” (5 features selected)
 - e. Spatial Selection Method: Intersect the source feature layer. Click Apply.

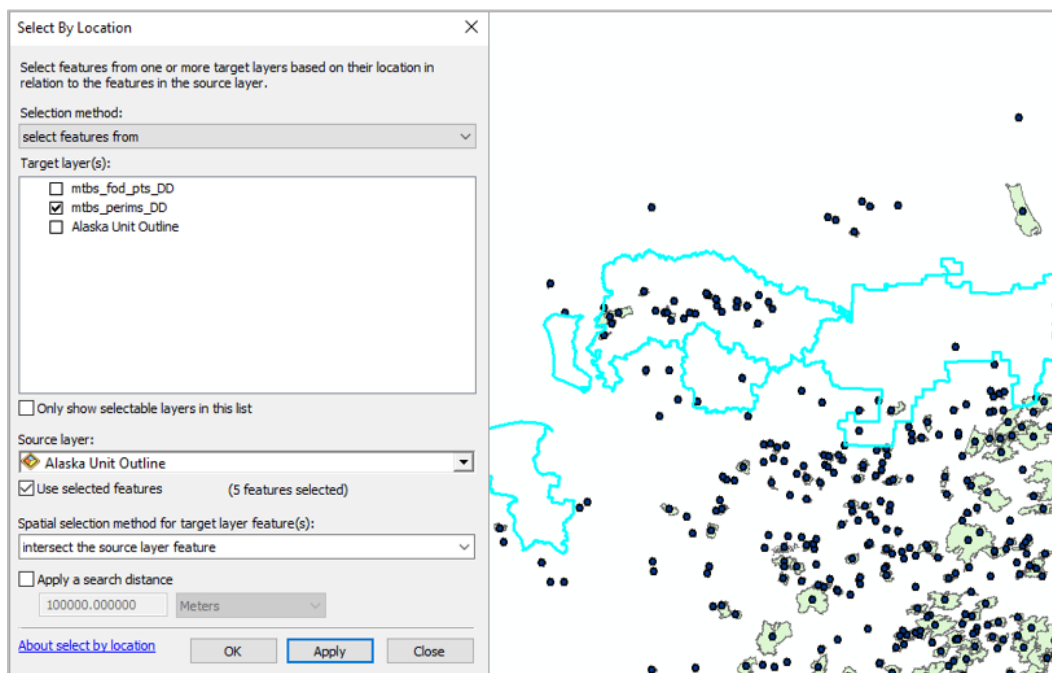


Figure 2.1.3. Select by Location tool set up for selecting all perimeters that intersect with the selected ARCN park units.

3. Use the **Select by Location** tool again to select the point features in *mtbs_fod_pts_DD* layer that intersect with the **selected** perimeters in the *mtbs_perims_DD* layer.
4. Open the attribute table for the *mtbs_fod_pts_DD* layer and view the **selected** records only.
5. Export the selected records as a text file.
 - a. Go to Table Options → Export
 - b. Export: Selected Records
 - c. Output Table: Name the file *MTBS_FOD_pts_[YEARMODY of Publication]_ARCN.txt*
 - i. **NOTE:** To find the publication date, go to O:\Monitoring\Vital Signs\Fire Extent and Severity\Data\BurnSeverity\01_MTBS NationalData\[YEAR of download] and open the *mtbs_fod_pts_DD.html* metadata file.
 - d. Save it as a text (*.txt) file and save it to: O:\Monitoring\Vital Signs\Fire Extent and Severity\Data\BurnSeverity\01_MTBS NationalData\[YEAR of download]

Update Access Database of Burn Severity Data

The Access database of all NPS Alaska burn severity data (*ARCN_BurnSeverity_Summary.accdb*) is updated using the text file that was just created. Additional fields have been added to track burn severity data downloading and processing.

The database has a table named *MTBS_Data_ARCN_fires*, which has a running list of all fires with MTBS burn severity maps in ARCN parks (Figure 2.1.4). The data originated from the MTBS Fire Occurrence Dataset that intersected the ARCN park boundaries and burned areas (as described above). The following fields were added to the data table:

- [Park_Code] – A text field for the 4 letter park code.
- [Data_Downloaded] – A yes/no field to indicate whether the MTBS data has been downloaded from the MTBS site and stored on the O drive. This field should be updated as data is downloaded.
- [FireStats_Completed] – A yes/no field to indicate if the zonal statistics have been calculated and appended to the tables described in SOP 2.2.
- [Severity_Desc_Table] – A yes/no field to indicate if the description dbf table (*_desc.dbf) for each fire has been appended to the table described in SOP 2.2.

The MTBS *FIRE_ID* field has been put in a **primary key** that cannot be duplicated. This prevents future table imports from overriding the existing data table and **only imports new fires** from the Fire Occurrence Dataset.

MTBS_Data_ARCN_fires								
FID	FIRE_ID	FIRENAME	Park_Code	Data_Downl	FireStats_Complete	Severity_Des	ASMNT_TYPE	
9972	AK6662215458420040721	NORUTAK HILLS 2	GAAR	☒	☐	☐	Extended	
1916	AK6679715533519860708	A309	GAAR	☒	☐	☐	Initial	
3748	AK6702115448519910701	BTT W 64	GAAR	☒	☐	☐	Initial	
4539	AK6702515974719940612	432258	KOVA	☒	☐	☐	Extended	
12690	AK6705515098220070708	MIDDLE FORK	GAAR	☒	☐	☒	Extended	
10252	AK6707615031720050530	CHAPMAN CREEK	GAAR	☒	☐	☐	Extended	
4911	AK6712115052019940608	BTT NE 26	GAAR	☒	☐	☐	Extended	
13506	AK6712615482820080627	REED RIVER	GAAR	☒	☐	☐	Extended	
777	AK6733915856620120607	NEKAKTE	KOVA	☒	☐	☐	Initial	
14924	AK6762116250420100703	ELI RIVER	NOAT	☒	☐	☒	Initial (SS)	
9056	AK6770115269620020720	DAWN CREEK	GAAR	☒	☐	☐	Extended	
9973	AK6775716231420040531	UVGOON CREEK	NOAT	☒	☐	☒	Initial	
2344	AK6780216366419870706	731015	CAKR	☒	☐	☐	Initial (SS)	
783	AK6781116236520120703	UVGOON CREEK 1	NOAT	☒	☒	☒	Initial	
7175	AK6782816239719990626	UVGOON CREEK 2	NOAT	☒	☐	☒	Extended	
789	AK6785016013320120706	UYON LAKES	NOAT	☒	☐	☒	Extended	
773	AK6788316073320120606	NOATAK GRAND CANYO	NOAT	☒	☐	☒	Initial	
10751	AK6789416031320050617	AKLUMMAYUAK	NOAT	☒	☒	☒	Extended	
10752	AK6790215823820050617	IMELYAK	NOAT	☒	☒	☒	Extended	
14915	AK6791116259720100701	EVAINGIKNUK	NOAT	☒	☐	☒	Initial (SS)	
1050	AK6793316087819840625	IAN N 55	NOAT	☒	☐	☒	Extended (SS)	

Figure 2.1.4. MTBS_Data_ARCN_fires table (in the burn severity access database) showing the four additional fields; Park_Code, Data_Downloaded, FireStats_Completed, and Severity_Desc_Table.

Update the MTBS_Data_ARCN_fires table (used to track the completed burn severity data) in the Access Database.

1. Open the Access Database (*ARCN_BurnSeverity_Summary.accdb*) located here:
O:\Monitoring\Vital Signs\Fire Extent and Severity\Data\BurnSeverity\05_Summary Data
2. Click on the **External Data** tab then click on **New Data Source > From File > Text File**.
 - a. Browse to the newly created text file with updates from MTBS new release data (e.g., *MTBS_FOD_pts_20160401_ARCN.txt*).
 - b. Select the middle radio button to **Append a copy of the records to the table:** *MTBS_Data_ARCN_fires*. Click **OK** (Figure 2.1.5).
 - c. Select the **Delimited** radio button and click **Next**.
 - d. Choose the **Comma** delimiter that separates fields and click on **First Row Contains Field Names**. Click **Next**.
 - e. Confirm the table to import to is correct and click **Finish**.
 - f. A Microsoft message will indicate how many rows were appended. The key violations will appear because there are duplicated *FIRE_ID* primary key (as these fires are already in the database). Click **Yes** to proceed.
3. Manually enter the 4 letter Park Code (in the Park_Code field) for each new record. (Use the *mtbs_fod_pts_DD* layer in ArcMap to determine the fire location and park code.)
4. Open the *MTBS_Data_ARCN_fires* table to identify which fires need to be downloaded (indicated by no checkmarks in the Data_Downloaded column).

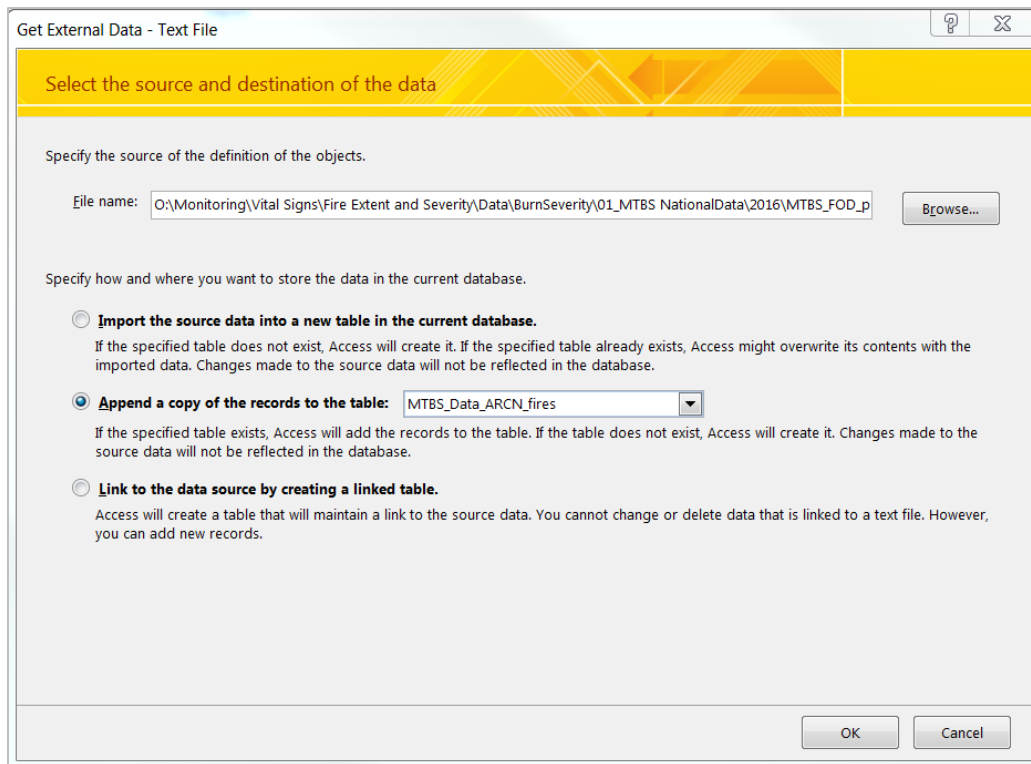


Figure 2.1.5. Append the MTBS_FOD_pts_[YEARMODY of release].txt file to the MTBS_Data_ARCN_fires table in the Access Database.

Download Individual Fire-Level MTBS Data

Individual fire-level burn severity datasets can be downloaded from MTBS via Direct Download (<https://mtbs.gov/direct-download>) or by using the Interactive Viewer for Alaska (<https://mtbs.gov/viewer/index.html?region=Alaska>). Instructions for using the Direct Download method are provided below.

Direct Download

Use the Direct Download method to query Alaska fires using a specific date range.

1. Open the MTBS Direct Download site (<https://mtbs.gov/direct-download>) (Figure 2.1.6).
2. Under the *Fire Bundles Tab*, select **Alaska** from the Select State drop down box.
3. Use the Data Range slider to select the desired date range (by year) (likely the most recent year available for download).
4. A new query table will be generated. **Sort** the table by Fire Name by clicking on the Fire Name column heading.
5. Check the box next to the fire name to select a fire for download. Select **ONE** fire at a time. **Do NOT** select multiple fires. **Note:** Reference the *MTBS_Data_ARCN_fires* table in the

ARCN Burn Severity Access database to determine which individual fires need to be downloaded.

6. Click the green **Download Files** button to download the MTBS data for the selected fires.

MTBS Interactive Viewer Direct Download About MTBS

Direct Download

Select a tab below to access direct download options for individual fire data bundles, annual state and national-level burn severity mosaics or national shapefiles for burned area boundaries and fire occurrences.

Fire Bundles **Burn Severity Mosaics** Map Services

Alaska

Date Range (1984 - 2015)

2015 - 2015

National Datasets

- Fire Occurrence Dataset 1984-2015 Download
- Burned Areas Boundaries Dataset 1984-2015 Download

☐	Fire Name	Acres	Year	Ignition Date	Fire Type	Fire ID
☐	BRIDGE	1116	2015	2015-06-26	Wildfire	AK6383315453320150626
☐	BRUNO CREEK	18618	2015	2015-06-22	Wildfire	AK6458115533720150622
☐	CAMP CREEK	11801	2015	2015-06-22	Wildfire	AK6429315747920150622
☐	CAN CREEK	51940	2015	2015-06-01	Wildfire	AK6108315491720150601
☒	CAPE ESPENBERY	1575	2015	2015-06-23	Wildfire	AK6653816379620150623
☐	CARD STREET	7367	2015	2015-06-15	Wildfire	AK6051015063620150615
☐	CARLSON LAKE	48197	2015	2015-06-25	Wildfire	AK6380915201720150625
☐	CHAHALIE LAKE	6437	2015	2015-06-24	Wildfire	AK6678614352520150624

Showing 1 to 171 of 171 rows 200 rows per page

Download 1 Files

Figure 2.1.6. Example search query (Alaska, 2015 fires) using the MTBS Direct Download tool (<https://mtbs.gov/direct-download>).

7. **Save** the zip file to O:\Monitoring\Vital Signs\Fire Extent and Severity\Data\BurnSeverity\[Park][YEAR][FireName].
8. **Extract** the DATA.ZIP file to the current location.
 - a. **Open** the [YEAR] folder that was extracted from the .zip file, then **open** the folder named *fire_level_tar_files*.
 - b. **Cut** the *.zip file from the *fire_level_tar_files* folder and **paste** it back to the [FireName] folder.
 - c. **Extract** the *.zip file.
9. **Delete** the following excess folders and compressed files from the [FireName] folder:
 - a. [YEAR] folder (that was extracted from the DATA.ZIP file)
 - b. [FIRE_ID].zip
 - c. DATA.ZIP

10. **Repeat** steps 5-9 until all needed individual fire MTBS data has been downloaded.

Fire-Level MTBS Data Products

There are three basic types of burn severity data products included in each fire-level data download:

- 1) *PDF Fire Map* – Displays the post-fire Landsat scene used for analysis, the classified dNBR burn severity map, and an acreage summary by burn severity class in a pdf file format (Figure 2.1.7).
- 2) *KMZ Fire Map* – Contains basic fire occurrence metadata along with multiple data layers (pre-fire Landsat image, post-fire Landsat image, classified fire severity image, and fire perimeter) packaged as a KMZ file format for use in Google Earth.
- 3) *GIS Data* – Zip file containing the full burn severity dataset with 10 individual files (Table 2.1.1) including metadata and tables, the fire perimeter, dNBR image files, Landsat scenes used for processing, and data masks.

Quality Control Checks on MTBS Data

Brief quality control checks should be made on all MTBS datasets. Complete the following steps to ensure the best quality data. “Red flag” any questionable items and confirm concerns with the MTBS program. Contact information can be found here: <https://mtbs.gov/contact>.

File Naming Conventions and File Formats

1. **Confirm** the zip file download for each fire contains 12 files (13-14 files only when applicable). Gap mask image files (*.tif) will only be included in the dataset when Landsat 7 scenes with the SLC (Scan Line Corrector) off were used to generate dNBR values. An additional landsat scene used for an initial assessment comparison will also be included **only** when an extended assessment scene was used for developing the burn severity map. See Table 2.1.1 for a complete list of file types and descriptions.
2. **Check** that all of the file names have a matching *Fire ID*. MTBS datasets follow a specific file naming convention. For example:
ak6781116236520120703_20100709_20120722_dnbr.tif
 - Black Font = Unique Fire ID
 - Purple Font = Fire start date
 - Green Font = Pre-fire Landsat image date
 - Red Font = Post-fire Landsat image date
 - Blue Font = Description of data product
 - Orange Font = File type extension

Table 2.1.1. List of products included in the MTBS GIS Dataset for each fire mapped.

File Name Example	Dataset Description
ak6813915798720100702_20090816_20110621.kmz	Google Earth map with pre and post fire images, perimeter, and thematic dNBR
ak6813915798720100702_20090816_20110621_burn_bndy.shp	Perimeter of detectable fire area derived from satellite imagery (ESRI shapefile)
ak6813915798720100702_20090816_20110621_dnbr.tif	dNBR used for burn severity analysis and mapping; subset to the fire area (Signed 16-bit GeoTIFF)
ak6813915798720100702_20090816_20110621_dnbr6.tif	Thematic dNBR; Derived by thresholding dNBR subset (8-bit GeoTIFF)
ak6813915798720100702_20090816_20110621_gapmask.tif	Landsat 7 gap mask when applicable ; subset to the fire area (pixel value 0 = masked area)
ak6813915798720100702_20090816_20110621_mask.shp	Mask for clouds, shadow, snow or anomalies intersecting fire area (ESRI shapefile)
AK6813915798720100702_20090816_20110621_metadata.txt	Metadata text file for complete product list
ak6813915798720100702_20090816_20110621_rdnbr.tif	Relative dNBR; subset to the fire area (Signed 16-bit GeoTIFF)
ak6813915798720100702_20090816_I5_refl.tif	Subset of Landsat scene used for pre-fire image (Bands 1-5, 7; Unsigned 8-bit GeoTIFF)
ak6813915798720100702_20100828_I5_refl.tif	Subset of Landsat scene used for initial post-fire image (Bands 1-5, 7; Unsigned 8-bit GeoTIFF). An additional Landsat scene for an extended assessment may also be included (when applicable.)
ak6813915798720100702_desc.dbf	Table containing key fire occurrence attributes
ak6813915798720100702_map.pdf	Fire map in pdf format
ak6813915798720100702_rep.dbf	Table containing statistical summary of burn severity by key GIS layers

Review Metadata and Data Attributes

1. Open the *_*metadata.txt* file in a text editor (e.g., Notepad) and review the *Fire and Landsat Information* sections (Figure 2.1.8). Check that the fire name and start date are correct. “Flag” any fires with a single scene assessment type.
2. Open the pdf Fire Map and review the *Acreage of Burn Severity* table (Figure 2.1.8). If the acreage reported in *High Severity* is 70% of the acreage or greater, flag this fire for further investigation. The same concept applies for *Non-Processing Area Mask* acreage. If 50% or more of the fire was not able to be mapped, the fire should not be included in burn severity data analysis. Acreage breakdown by burn severity class is also available in the *_*rep.dbf* file.

```

23 Fire Information
24 MTBS Fire ID: ak6369315014320130626
25 Fire Name (if known): TOKLAT RIVER EAST
26 Date of Fire: June 26, 2013
27 Type of Assessment: Extended
28 Acres within Fire Perimeter: 34216
29
30 Landsat Path and Row: 70/15
31 Pre-Fire Landsat Date/Scene ID: Landsat
   8 OLI; 2013-06-16 / 80710152013167
32 Post-Fire Landsat Date/Scene ID: Landsat
   8 OLI; 2014-07-30 / 80700152014211

```

Figure 2.1.8. Example metadata showing fire information and Landsat scene details.

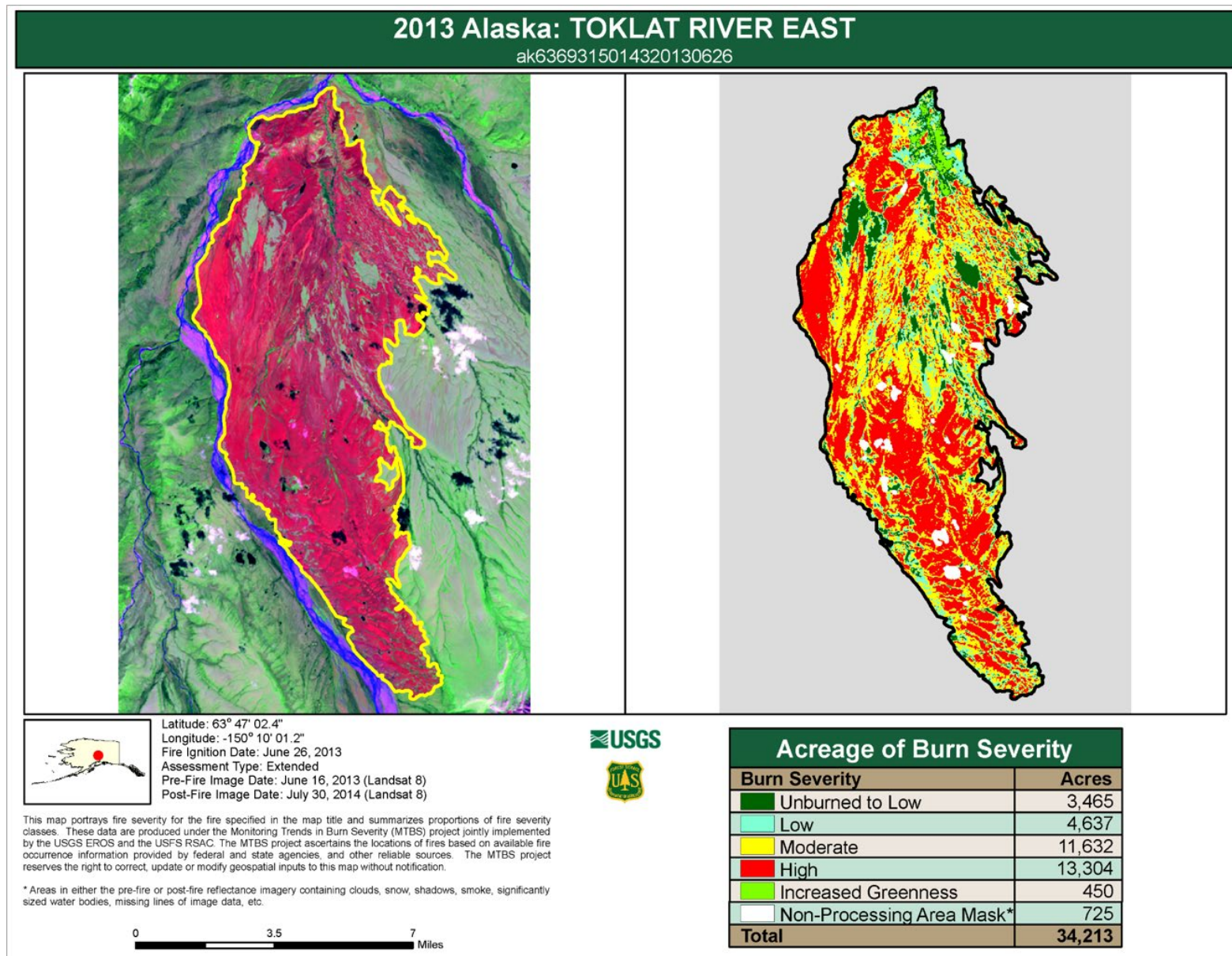


Figure 2.1.7. Example Fire Map (pdf) from MTBS program. This map displays the post-fire Landsat scene used for analysis, the classified dNBR burn severity map, and an acreage summary by burn severity classification.

3. **Review** the GIS data in ArcMap. Add a base layer (e.g., Alaska Unit Outline from Theme Manager) and then add the burn boundary, dnbr, dnbr6, and the pre-fire and post-fire Landsat reflectance layers for each fire. It may be easiest to review one fire at a time.
- a. Open the attribute table for the dnbr and dnbr6 (thematic display) layers.
 - i. The dNBR *Value* field should generally range from -1000 to 1000, give or take. The value range in the attribute table should match the High and Low values shown in the Table of Contents for that layer. “Flag” any fires if the range of values do not match.
 - ii. The dnbr6 layer attribute table should **only** have *Counts* in the *Value* rows 0-6. These values represent the burn severity classifications and match those shown on the pdf fire map (with the exception of 0; outside the perimeter). The burn severity classes and code values (0-6) are also described in the *_rep.dbf file. **Note:** The burn severity classification thresholds (dNBR values) can be found in the *_desc.dbf file. The thresholds are different for each fire.
 - b. Compare the pre and post-fire Landsat scenes for any visible errors in the fire perimeter. Areas that have burned within last 5 years can still show strong signatures on imagery (Figure 2.1.9). This may cause the fire extent to be over mapped.

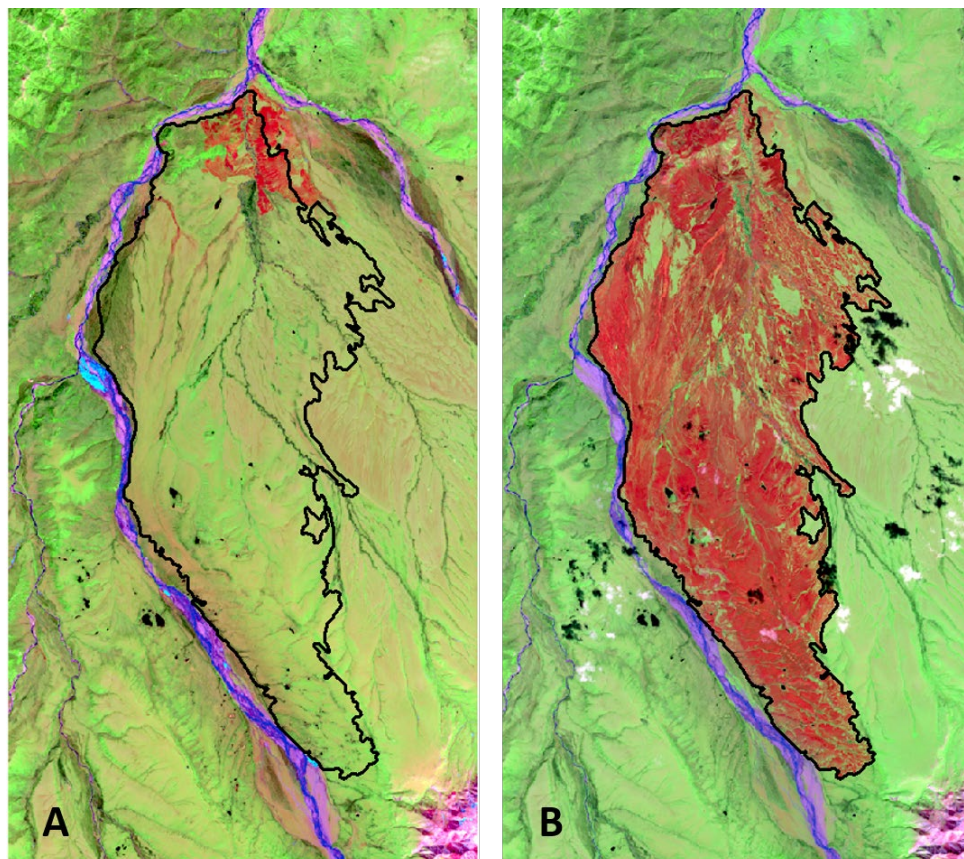


Figure 2.1.9. Example of a pre-fire Landsat image (A) compared to the post-fire Landsat image (B) with the fire perimeter displayed as a solid black line. Areas that have burned multiple times in close succession can cause

over mapping errors. Complete a visual inspection to ensure the fire extent is mapped correctly, as shown in this example.

- i. Go to the layer *Properties* for the pre-fire Landsat image (*_refl.tif) in ArcMap.
- ii. On the *Symbology* Tab, make sure the image is being displayed as a **RGB Composite**. Adjust the band combination for the Red, Green, and Blue channels to best visualize vegetation disturbance. The recommended band combination for Landsat 5-8 scenes is 6, 4, 3 (Figure 2.1.10). Be sure to *check* the box for **Display Background Value: (R, G, B)** set to 0, 0, 0 with no color when using Landsat 7 images with SLC off (May 2003 to present).

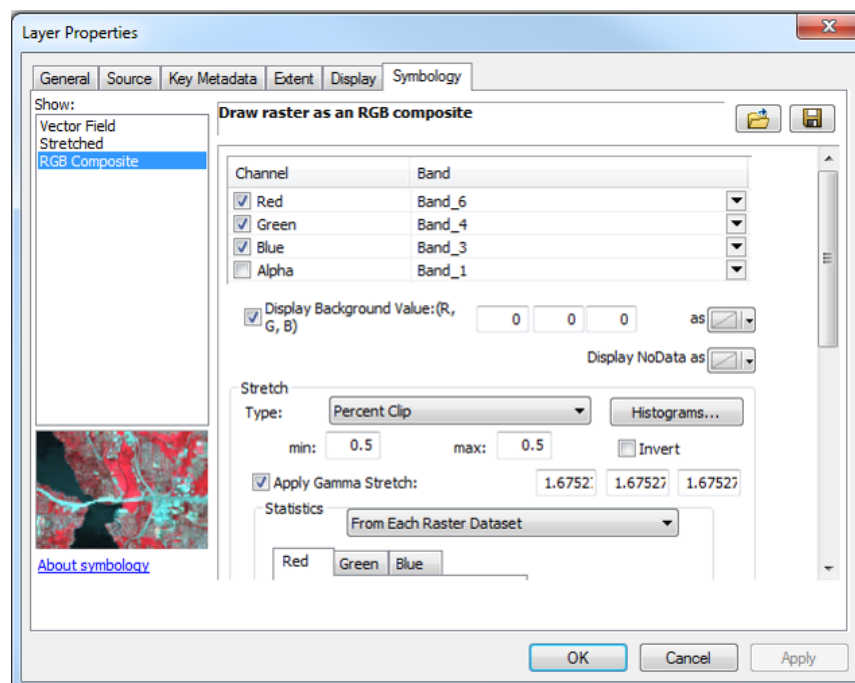


Figure 2.10. The recommended band combination for Landsat 5-8 images is 6, 4, 3. Vegetation disturbance from fire is displayed with a red signature against the green signature of unburned vegetation making new fire scars very visible.

- iii. Set the correct band combination on the post-fire Landsat image (*_refl.tif).
 - iv. Compare the two images for any perimeter mapping errors.
4. After reviewing the MTBS dataset, open the Burn Severity Access Database (*ARCN_BurnSeverity_Summary.accdb*). Check the **Data_Downloaded** check box to update the list of burn severity data that has been download (on the *MTBS_Data_ARCN_fires* table).