GEORGIA
DEPARTMENT OF NATURAL RESOURCES

ENVIRONMENTAL PROTECTION DIVISION

Prescribed Fire Exceptional Event Demonstration for Exceedances of the 2024 Annual $PM_{2.5}$ NAAQS at Sandersville, GA in 2021-2023

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1. Introduction

The current annual and 24-hour $PM_{2.5}$ National Ambient Air Quality Standards (NAAQS) are 9.0 µg/m^3 and 35 µg/m^3, respectively. Federal Reference Method (FRM) monitors collect $PM_{2.5}$ samples for 24 hours on filters while Federal Equivalent Method (FEM) monitors measure hourly $PM_{2.5}$ concentrations continuously. An exceedance of the 2024 annual $PM_{2.5}$ NAAQS occurs when the measured 24-hour $PM_{2.5}$ concentration is greater than 9.0 µg/m^3.

At the Sandersville site (AQS ID: 13-303-0001), one FRM monitor collected data on a one in three-day schedule until August 2019, and an FEM monitor started collecting data in August 2019. The FEM monitor continued to collect data through 2023, and an additional collocated FEM monitor started collecting data in March 2023. The Washington County area is in attainment of the 2012 $PM_{2.5}$ NAAQS.

The Georgia Rules for Air Quality Control (391-3-1-.01(tt)) define open burning as any outdoor fire from which the products of combustion are emitted directly into the open air without passing through a stack, chimney, or duct. Such burning releases smoke, oxides of nitrogen, and other pollutants that may have a negative impact on Georgia's air quality. Georgia's Open Burning Rules (391-3-1-.02(5)) were created to improve air quality in Georgia. Prescribed fire is a type of fire that is subject to Georgia's Open Burning Rules. It is essential to maintain a sustainable and resilient wildland ecosystem, preserve endangered and threatened species, and prevent catastrophic wildfires. In 2006, the Georgia Department of Natural Resources (DNR) Environmental Protection Division (EPD), Georgia DNR Wildlife Resources Division (WRD), and Georgia Forestry Commission (GFC) signed a Memorandum of Understanding (MOU) to implement Georgia's Smoke Management Plan (SMP). In addition, GFC manages prescribed fires via its burn permitting system.

Despite the aforementioned coordinated efforts between DNR and GFC, exceedances of the 2024 annual $PM_{2.5}$ NAAQS occurred at the Sandersville $PM_{2.5}$ monitor in 2021-2023 that qualify for removal under the Exceptional Events Rule (EER). On December 20, 2024, Georgia Environmental Protection Division (EPD) submitted an Initial Notification for these events to the U.S. Environmental Protection Agency (EPA). The request indicated that 24-hour $PM_{2.5}$ concentrations on the sixty-three (63) days shown in Table 1 were impacted by smoke from Canadian wildfires (16 days) and prescribed fires (47 days) and requested review of the events under the case-by-case provision at 40 CFR 50.14(a)(1)(i)(F). This demonstration will focus on the 47 prescribed fire events, while a separate demonstration will focus on the 16 Canadian wildfire events. Table 2 shows the impact of exclusion of the data on the 2021-2023 design value (DV) for the Sandersville monitor.

Table 1. Exceedances of the 2024 annual $PM_{2.5}$ NAAQS occurred at the Sandersville $PM_{2.5}$ monitor (AQS ID: 13-303-0001) in 2021-2023 that qualify for removal under the EER.

#	Date	24-hour $PM_{2.5}$ ($\mu g/m^3$)	Tier	Cause of Exceedance
1	03/13/21	34.33	1	Prescribed fires
2	04/07/21	38.26	1	Prescribed fires
3	04/08/21	35.23	1	Prescribed fires
4	01/15/22	22.38	1	Prescribed fires
5	01/31/22	38.28	1	Prescribed fires
6	02/01/22	37.73	1	Prescribed fires
7	02/11/22	18.93	1	Prescribed fires
8	02/12/22	27.23	1	Prescribed fires
9	02/14/22	32.75	1	Prescribed fires
10	02/15/22	37.01	1	Prescribed fires
11	03/03/22	20.99	1	Prescribed fires
12	03/04/22	27.15	1	Prescribed fires
13	03/29/22	21.36	1	Prescribed fires
14	05/18/22	18.31	1	Prescribed fires
15	09/21/22	22.35	1	Prescribed fires
16	09/22/22	21.06	1	Prescribed fires
17	10/07/22	18.33	1	Prescribed fires
18	10/24/22	24.29	1	Prescribed fires
19	10/25/22	25.94	1	Prescribed fires
20	11/02/22	25.68	1	Prescribed fires
21	11/03/22	18.6	1	Prescribed fires
22	11/18/22	22.93	1	Prescribed fires
23	11/19/22	31.48	1	Prescribed fires
24	11/21/22	31.99	1	Prescribed fires
25	12/28/22	32.32	1	Prescribed fires
26	12/29/22	22.99	1	Prescribed fires
27	01/02/23	18.5	1	Prescribed fires
28	01/08/23	18.85	1	Prescribed fires
29	01/10/23	19.13	1	Prescribed fires
30	01/11/23	33.3	1	Prescribed fires
31	01/17/23	20.6	1	Prescribed fires
32	01/29/23	22.78	1	Prescribed fires
33	02/07/23	18.85	1	Prescribed fires
34	02/24/23	18.57	1	Prescribed fires
35	02/28/23	23.13	1	Prescribed fires
36	03/01/23	28.83	1	Prescribed fires
37	03/05/23	19.41	1	Prescribed fires
38	03/07/23	27.63	1	Prescribed fires
39	03/08/23	69.12	1	Prescribed fires
40	03/09/23	45.22	1	Prescribed fires
41	03/21/23	29.66	1	Prescribed fires
42	06/06/23	18.93	1	Canadian Wildfires

43	06/09/23	23.65	1	Canadian Wildfires
44	06/10/23	24.12	1	Canadian Wildfires
45	06/18/23	20.3	1	Canadian Wildfires
46	06/27/23	19.91	1	Canadian Wildfires
47	06/28/23	19.22	1	Canadian Wildfires
48	06/29/23	25.08	1	Canadian Wildfires
49	06/30/23	29.52	1	Canadian Wildfires
50	07/01/23	23.1	1	Canadian Wildfires
51	07/17/23	28.49	1	Canadian Wildfires
52	07/18/23	37.1	1	Canadian Wildfires
53	07/19/23	32.73	1	Canadian Wildfires
54	07/20/23	19.9	1	Canadian Wildfires
55	07/26/23	19.99	1	Canadian Wildfires
56	08/23/23	25.44	1	Canadian Wildfires
57	08/25/23	19.88	1	Canadian Wildfires
58	11/05/23	20.95	1	Prescribed fires
59	11/06/23	35.36	1	Prescribed fires
60	11/07/23	24.91	1	Prescribed fires
61	11/08/23	20.54	1	Prescribed fires
62	11/09/23	18.85	1	Prescribed fires
63	11/30/23	19.46	1	Prescribed fires

Table 2. Sandersville 2021-2023 DVs for the 2024 annual $PM_{2.5}$ NAAQS.

Monitoring Site (AQS ID)	2021-2023 DV without EPA Concurrence (µg/m^3)	2021-2023 DV with EPA Concurrence (µg/m^3)
Sandersville (13-303-0001)	10.0	9.0

The EPA has outlined requirements for demonstrations for prescribed fire events in the 2016 Exceptional Events Rule (EER) and has further clarified those requirements in a guidance document, *Exceptional Events Guidance: Prescribed Fire on Wildland that May Influence Ozone and Particulate Matter Concentrations* (issued in 2019, hereafter referred to as the Prescribed Fire Guidance). The Prescribed Fire Guidance also refers to a separate EPA-issued guidance document, *Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations* (issued in 2016, hereafter referred to as the Wildfire Ozone Guidance), for outlining certain requirements that apply to both prescribed fires and wildfires. This demonstration will describe how the prescribed fire events meet the requirements of the EER as described in regulation and both guidance documents, as applicable.

2. Narrative Conceptual Model

This section addresses the EER requirement at 40 CFR 50.14(c)(3)(iv)(A), which requires a narrative conceptual model that describes the event causing the exceedance and a discussion of how emissions from the event led to the exceedance at the affected monitor. In addition, this section includes a summary of how mitigation requirements in 40 CFR 51.930(a) were addressed.

The prescribed fires were conducted under the Georgia Smoke Management Plan (SMP). The Georgia SMP is considered a state-certified SMP for purposes of the EPA EER. The Georgia SMP, in combination with the Georgia EPD burn regulation, outlines the requirements for burn permits, burn registration and reporting, a burn authorization system, smoke management, resources, district resources, and inspection and enforcement.

The 47 prescribed fire exceptional events discussed in this document were due to silviculture burns that occurred on wildlands. According the 2016 Exceptional Events Rule (81 FR 68216), "Wildland" means an area in which human activity and development are essentially non-existent, except for roads, railroads, power lines, and similar transportation facilities.

For the 47 prescribed fire exceedance days listed in Table 1, National Oceanic and Atmospheric Administration (NOAA) Hazard Mapping System (HMS) smoke plumes and fire data, Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) trajectory modeling, and location of prescribed burns are used to clearly demonstrate that smoke from the prescribed fires conducted on the day of the exceedance and/or the day before the exceedances were transported to the Sandersville monitor causing the exceedances. In general, the prescribed fires responsible for the $PM_{2.5}$ exceedances were in close proximity (less than 100 km) and upwind of the monitor, which allowed calm surface winds to transport smoke plumes during the day and overnight to the monitor under a stable boundary layer. Section 3 of this document contains details to support this conceptual model.

As described in 40 CFR 51.930(a), states requesting to exclude data due to exceptional events must take appropriate and reasonable actions to protect public health from exceedances or violations of the NAAQS. These include providing for, at a minimum, prompt public notification whenever concentrations are expected to exceed a NAAQS, public education on actions individuals may take to reduce exposures to unhealthy air quality during events, and implementation of appropriate measures to protect public health from event-caused exceedances or violations of the NAAQS.

With respect to public notification and public education, the Georgia Forestry Commission (GFC) has a public website[1] with an interactive wildfire and burn permit map that contains the current Air Quality Index at all monitors in Georgia with the option to add the following layers: (1) burn restrictions, (2) daily burn permits, (3) $PM_{2.5}$, (4) NOAA HMS smoke plumes, (5) wind vectors, and (6) smoke forecast. The public can zoom in to see if smoke may impact their location. The Georgia EPD website[2] has a link to the GFC interactive burn permit map. Also, the Georgia EPD website has a link to EPA's AirNow Fire and Smoke Map[3], EPA's AirNow When Smoke is in the Air[4], EPA's AirNow Prepare for Fire Season[5], EPA's Smoke-Ready Toolbox for Wildfires[6], and Georgia DNR Wildlife Resource Division - Prescribed Fire

[1] https://georgiafc.firesponse.com/public/
[2] https://epd.georgia.gov/air-protection-branch/open-burning-rules-georgia
[3] https://fire.airnow.gov/
[4] https://www.airnow.gov/wildfires/when-smoke-is-in-the-air/
[5] https://www.airnow.gov/sites/default/files/2020-10/prepare-for-fire-season.pdf
[6] https://www.epa.gov/air-research/smoke-ready-toolbox-wildfires

Information[7]. These websites identify several protective measures that individuals should take to reduce smoke exposure as needed, including limiting outdoor activities, avoiding strenuous outdoor activity and remaining indoors, and considering temporarily relocating or closing all doors and windows on the day of prescribed fire activities. In addition, the Georgia EPD Ambient Air Monitoring Program website[8] provides the near real-time ambient air concentrations of multiple criteria pollutants (O_3, $PM_{2.5}$, SO_2, NO_2, and CO) across the state.

For larger fires or fires that may create a special interest from the public, additional notification is provided through the media. GFC maintains a media notification system where fires in excess of 1,000 acres are reported to the GFC Public Relations Department, which automatically issues a media alert for the affected area. GFC maintains a Memorandum of Understanding with the Georgia Department of Public Safety and the Georgia Department of Transportation whereby all prescribed fires of 100 acres or more are reported for smoke monitoring on Georgia highways. In addition, partners in the Georgia Prescribed Fire Council, such as USFS, Georgia Department of Natural Resources, the Nature Conservancy, Tall Timbers, and the Jones Center, also carry out public notifications for prescribed fire throughout the busy fire season. This includes press releases, social media content, and local contacts.

The conceptual model above shows that smoke from nearby prescribed fires needed to achieve land management objectives consistent with the requirements in the EER, led to exceedances of the 2024 annual $PM_{2.5}$ NAAQS on multiple days. Efforts to mitigate impacts of the prescribed fire emissions on public health included public notification and education, as well as smoke mitigation measures required by the SMP. This demonstration requests concurrence that the 47 exceedances of the 2024 annual $PM_{2.5}$ NAAQS measured at the Sandersville site caused by prescribed fires on the dates listed in Table 1 be excluded from regulatory decision making.

3. Clear Causal Relationship

This section addresses the EER requirements at 40 CFR 50.14(c)(3)(iv)(B) by showing that the event affected air quality in such a way that there exists a clear, causal relationship between the specific event and the monitored exceedance, and at 40 CFR 50.14(c)(3)(iv)(C) by providing analyses comparing the claimed event-influenced concentrations to concentrations at the same monitoring site at other times. The Prescribed Fire Guidance and Wildfire Ozone Guidance outline the expected components of a clear causal relationship portion of a demonstration. These include a comparison of the event-related concentration to historical concentrations, evidence that the emissions from the prescribed fire were transported to the monitor, and evidence that the prescribed fire emissions affected the monitor.

The historical data analysis section of this demonstration will focus on 2019-2023 $PM_{2.5}$ FEM data from the Sandersville monitor. Table 3 contains a comparison of prescribed fire exceptional event concentrations to historic 2019-2023 concentrations at the Sandersville $PM_{2.5}$ monitor (AQS ID: 13-303-0001). Generally, the exceptional event concentrations are at least double the 5-year annual average, quarterly average, and monthly average, and in some cases can be up to 7.6 times higher.

[7] https://georgiawildlife.com/prescribed-fire
[8] https://airgeorgia.org/

Table 3. Comparison of exceptional event concentrations to historic 2019-2023 concentrations at the Sandersville $PM_{2.5}$ monitor (AQS ID: 13-303-0001).

Exceptional Event Date	Exceptional Event (EE) Concentration ($\mu g/m^3$)	5-Year Annual Average ($\mu g/m^3$)	5-Year Quarterly Average ($\mu g/m^3$)	5-Year Monthly Average ($\mu g/m^3$)	Ratio EE to 5-Year Annual Average	Ratio EE to 5-Year Quarterly Average	Ratio EE to 5-Year Monthly Average
03/13/21	34.33	9.1	9.04	10.55	3.8	3.8	3.3
04/07/21	38.26	9.1	9.13	8.99	4.2	4.2	4.3
04/08/21	35.23	9.1	9.13	8.99	3.9	3.9	3.9
01/15/22	22.38	9.1	9.04	7.92	2.5	2.5	2.8
01/31/22	38.28	9.1	9.04	7.92	4.2	4.2	4.8
02/01/22	37.73	9.1	9.04	8.56	4.1	4.2	4.4
02/11/22	18.93	9.1	9.04	8.56	2.1	2.1	2.2
02/12/22	27.23	9.1	9.04	8.56	3.0	3.0	3.2
02/14/22	32.75	9.1	9.04	8.56	3.6	3.6	3.8
02/15/22	37.01	9.1	9.04	8.56	4.1	4.1	4.3
03/03/22	20.99	9.1	9.04	10.55	2.3	2.3	2.0
03/04/22	27.15	9.1	9.04	10.55	3.0	3.0	2.6
03/29/22	21.36	9.1	9.04	10.55	2.3	2.4	2.0
05/18/22	18.31	9.1	9.13	8.17	2.0	2.0	2.2
09/21/22	22.35	9.1	9.19	8.94	2.5	2.4	2.5
09/22/22	21.06	9.1	9.19	8.94	2.3	2.3	2.4
10/07/22	18.33	9.1	9.06	8.39	2.0	2.0	2.2
10/24/22	24.29	9.1	9.06	8.39	2.7	2.7	2.9
10/25/22	25.94	9.1	9.06	8.39	2.9	2.9	3.1
11/02/22	25.68	9.1	9.06	9.96	2.8	2.8	2.6
11/03/22	18.6	9.1	9.06	9.96	2.0	2.1	1.9
11/18/22	22.93	9.1	9.06	9.96	2.5	2.5	2.3
11/19/22	31.48	9.1	9.06	9.96	3.5	3.5	3.2
11/21/22	31.99	9.1	9.06	9.96	3.5	3.5	3.2
12/28/22	32.32	9.1	9.06	8.87	3.6	3.6	3.6
12/29/22	22.99	9.1	9.06	8.87	2.5	2.5	2.6
01/02/23	18.5	9.1	9.04	7.92	2.0	2.0	2.3
01/08/23	18.85	9.1	9.04	7.92	2.1	2.1	2.4
01/10/23	19.13	9.1	9.04	7.92	2.1	2.1	2.4
01/11/23	33.3	9.1	9.04	7.92	3.7	3.7	4.2
01/17/23	20.6	9.1	9.04	7.92	2.3	2.3	2.6
01/29/23	22.78	9.1	9.04	7.92	2.5	2.5	2.9
02/07/23	18.85	9.1	9.04	8.56	2.1	2.1	2.2
02/24/23	18.57	9.1	9.04	8.56	2.0	2.1	2.2
02/28/23	23.13	9.1	9.04	8.56	2.5	2.6	2.7
03/01/23	28.83	9.1	9.04	10.55	3.2	3.2	2.7
03/05/23	19.41	9.1	9.04	10.55	2.1	2.1	1.8
03/07/23	27.63	9.1	9.04	10.55	3.0	3.1	2.6
03/08/23	69.12	9.1	9.04	10.55	7.6	7.6	6.6

03/09/23	45.22	9.1	9.04	10.55	5.0	5.0	4.3
03/21/23	29.66	9.1	9.04	10.55	3.3	3.3	2.8
11/05/23	20.95	9.1	9.06	9.96	2.3	2.3	2.1
11/06/23	35.36	9.1	9.06	9.96	3.9	3.9	3.5
11/07/23	24.91	9.1	9.06	9.96	2.7	2.7	2.5
11/08/23	20.54	9.1	9.06	9.96	2.3	2.3	2.1
11/09/23	18.85	9.1	9.06	9.96	2.1	2.1	1.9
11/30/23	19.46	9.1	9.06	9.96	2.1	2.1	2.0

Figure 1 plots the 24-hour $PM_{2.5}$ concentrations for 2019-2023. The concentrations are generally below the Tier 3 value of 12.1 $\mu g/m^3$, except when smoke from wildfires and prescribed burns is present. All the selected exceptional events days are above the Tier 1 threshold of 18.15 $\mu g/m^3$. Most of the days selected were in 2022 and 2023 since 2021 will not be considered when EPA does the final designations based on 2022-2024 data.

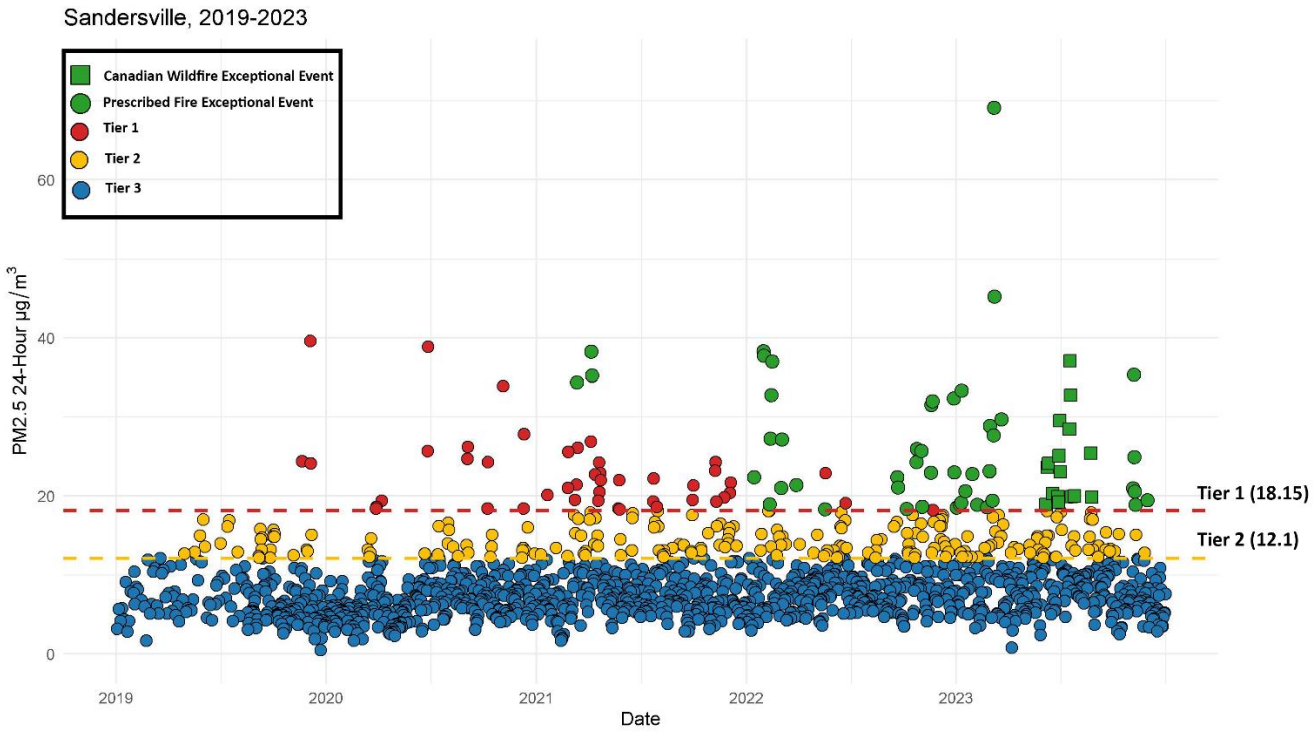

Figure 1. 24-hour $PM_{2.5}$ concentrations for 2019-2023 at the Sandersville monitor. Wildfire exceptional events are shown with green squares and prescribed fire exceptional events are shown with green circles.

Appendix A contains integrated maps for each exceedance day (map on the right) and the day before (map on the left). The maps include silviculture burn permits issued by the GFC, NOAA Hazard Mapping System (HMS) smoke plumes (light and dark grey shaded areas), and 24-hour $PM_{2.5}$ concentrations at the Sandersville $PM_{2.5}$ monitor and other nearby monitors. Both maps contain HYSPLIT back trajectories for all hourly measured $PM_{2.5}$ concentrations above 9.0 $\mu g/m^3$

on the exceedance day. Please note that the same HYSPLIT trajectories are shown on both maps. If fires that occurred on the exceedance day were responsible for the $PM_{2.5}$ exceedance, then the map on the right should be used to see the causal relationship. If fires that occurred on the day before the exceedance day were responsible for the $PM_{2.5}$ exceedance, then the map on the left should be used to see the causal relationship. Two versions of maps for each event are provided with trajectories released at 100-m or 500-m to show near-surface transport and potential influence from the surrounding terrain, respectively. The area around the Sandersville $PM_{2.5}$ monitor has a relatively flat terrain with geographic features having heights between 100-200 m above sea level[9]. Also, hourly $PM_{2.5}$ time series plots are shown for the day of the exceedance and the day before to demonstrate that fire emissions were transported to the Sandersville $PM_{2.5}$ monitor. Appendix B contains the GFC burn permit information (date, latitude, longitude, county, number of acres, and purpose of the burn) within a 100 km radius of the Sandersville $PM_{2.5}$ monitor for the day of the exceedance and the day before.

March 13, 2021

Many silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on March 13, 2021. The exceedance on this day was due to fires on the day before (March 12) being transported to the monitor in the early morning hours, and fires on the day of (March 13) being transported in the late evening hours. A total of 311 GFC permits covering 7,617.0 acres (85.8% from silviculture) were issued in a 100-km radius on March 12, 2021, and 378 GFC permits covering 6,718.3 acres (72.0% from silviculture) were issued in a 100-km radius on March 13, 2021. The NOAA HMS smoke plumes are present in the Sandersville area on both March 12 and 13.

April 7, 2021

Some silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on April 7, 2021. The exceedance on this day was due to fires on the day before (April 6) being transported to the monitor in the early morning hours, and fires on the day of (April 7) being transported in the mid-afternoon and late evening hours. A total of 144 GFC permits covering 2,845.0 acres (92.0% from silviculture) were issued in a 100-km radius on April 6, 2021, and 124 GFC permits covering 2,225.0 acres (84.4% from silviculture) were issued in a 100-km radius on April 7, 2021. The NOAA HMS smoke plumes are present in the Sandersville area on both April 6 and 7.

April 8, 2021

A few silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on April 8, 2021. The exceedance on this day was due to fires on the day before (April 7) being transported to the monitor in the early morning hours. A total of 124 GFC permits covering 2,225.0 acres (84.4% from silviculture) were issued in a 100-km radius on April 7, 2021. The NOAA HMS smoke plumes are present in the Sandersville area on April 7 and 8.

January 15, 2022

Many silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on January 15, 2022.

[9] https://ngmdb.usgs.gov/topoview/viewer/#13/33.1342/-82.7250

The exceedance on this day was due to fires on the day before (January 14) being transported to the monitor in the early morning hours and mid-afternoon, and fires on the day of (January 15) being transported in the late afternoon hours. The 100-m and 500-m trajectories differ as the 100-m set contains more tails coming from the east while the 500-m set includes tails from the southeast. However, both sets of trajectories still intersect with plumes from numerous fires on January 14. In addition, a couple of 500-m back-trajectories passed two large silviculture burn sites just beyond the 100-km buffer. Since these 500-m back-trajectories also passed multiple small silviculture burn sites, high hours PM2.5 concentrations on January 15, 2022, were likely caused by smoke plumes from these silviculture burns. A total of 117 GFC permits covering 2,558.6 acres (81.9% from silviculture) were issued in a 100-km radius on January 14, 2022, and 106 GFC permits covering 1,497.0 acres (71.0% from silviculture) were issued in a 100-km radius on January 15, 2022. The NOAA HMS smoke plumes are present in the Sandersville area on January 14.

January 31, 2022

Many silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on January 31, 2022. The exceedance on this day was due to fires on the day of (January 31) being transported in the evening hours. A total of 112 GFC permits covering 6,017.5 acres (73.0% from silviculture) were issued in a 100-km radius on January 31, 2022. The NOAA HMS smoke plumes are present in the Sandersville area on January 31.

February 1, 2022

Many silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on February 1, 2022. The exceedance on this day was due to fires on the day before (January 31) being transported to the monitor in the early morning hours. A total of 112 GFC permits covering 6,017.5 acres (73.0% from silviculture) were issued in a 100-km radius on January 31, 2022. The NOAA HMS smoke plumes are present in the Sandersville area on both January 31 and February 1.

February 11, 2022

Many silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on February 11, 2022. The exceedance on this day was due to fires on the day before (February 10) being transported to the monitor in the early morning hours, and fires on the day of (February 11) being transported in the late evening hours. A total of 132 GFC permits covering 5,577.2 acres (68.5% from silviculture) were issued in a 100-km radius on February 10, 2022, and 172 GFC permits covering 4,036.9 acres (80.4% from silviculture) were issued in a 100-km radius on February 11, 2022. The NOAA HMS smoke plumes are present in the Sandersville area on both February 10 and 11.

February 12, 2022

Many silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on February 12, 2022. The exceedance on this day was due to fires on the day before (February 11) being transported to the monitor in the early morning hours, and fires on the day of (February 12) being transported in the late evening hours. A total of 172 GFC permits covering 4,036.9 acres (80.4% from

silviculture) were issued in a 100-km radius on February 11, 2022, and 222 GFC permits covering 5,656.1 acres (76.7% from silviculture) were issued in a 100-km radius on February 12, 2022. The NOAA HMS smoke plumes are present in the Sandersville area on both February 11 and 12.

February 14, 2022

Many silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on February 14, 2022. The exceedance on this day was due to fires on the day of (February 14) being transported in the early afternoon, late afternoon, and late evening hours. A total of 106 GFC permits covering 3,950.0 acres (88.9% from silviculture) were issued in a 100-km radius on February 14, 2022. The NOAA HMS smoke plumes are present in the Sandersville area on February 14.

February 15, 2022

Many silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on February 15, 2022. The exceedance on this day was due to fires on the day before (February 14) being transported to the monitor in the early morning hours. A total of 106 GFC permits covering 3,950.0 acres (88.9% from silviculture) were issued in a 100-km radius on February 14, 2022. The NOAA HMS smoke plumes are present in the Sandersville area on both February 14 and 15.

March 3, 2022

Many silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on March 3, 2022. The exceedance on this day was due to fires on the day before (March 2) being transported to the monitor in the early morning hours, and fires on the day of (March 3) being transported in the late evening hours. A total of 162 GFC permits covering 6,791.2 acres (82.0% from silviculture) were issued in a 100-km radius on March 2, 2022, and 172 GFC permits covering 14,299.5 acres (93.9% from silviculture) were issued in a 100-km radius on March 3, 2022. The NOAA HMS smoke plumes are present in the Sandersville area on both March 2 and 3.

March 4, 2022

Many silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on March 4, 2022. The exceedance on this day was due to fires on the day before (March 3) being transported to the monitor in the early morning hours, and fires on the day of (March 4) being transported in the late evening hours. A total of 172 GFC permits covering 14,299.5 acres (93.9% from silviculture) were issued in a 100-km radius on March 3, 2022, and 119 GFC permits covering 5,120.5 acres (89.5% from silviculture) were issued in a 100-km radius on March 4, 2022. The NOAA HMS smoke plumes are present in the Sandersville area on both March 3 and 4.

March 29, 2022

Many silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on March 29, 2022. The exceedance on this day was due to fires on the day of (March 29) being transported in the early morning and early evening hours. A total of 89 GFC permits covering 2,948.7 acres (82.4% from

silviculture) were issued in a 100-km radius on March 29, 2022. The NOAA HMS smoke plumes are present in the Sandersville area on March 29.

May 18, 2022

A few silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on May 18, 2022. The exceedance on this day was due to fires on the day before (May 17) being transported to the monitor in the early morning hours, and fires on the day of (May 18) being transported in the late evening hours. A total of 34 GFC permits covering 375.1 acres (63.7% from silviculture) were issued in a 100-km radius on May 17, 2022, and 35 GFC permits covering 284.0 acres (29.6% from silviculture) were issued in a 100-km radius on May 18, 2022. The NOAA HMS smoke plumes are present in the Sandersville area on both May 17 and 18.

September 21, 2022

Some silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on September 21, 2022. The exceedance on this day was due to fires on the day of (September 21) being transported in the late afternoon and late evening hours. A total of 27 GFC permits covering 663.1 acres (92.9% from silviculture) were issued in a 100-km radius on September 21, 2022. The NOAA HMS smoke plumes are present in the Sandersville area on September 21.

September 22, 2022

Some silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on September 22, 2022. The exceedance on this day was due to fires on the day before (September 21) being transported to the monitor in the early morning hours, and fires on the day of (September 22) being transported in the mid-afternoon hours. A total of 27 GFC permits covering 663.1 acres (92.9% from silviculture) were issued in a 100-km radius on September 21, 2022, and 25 GFC permits covering 325.7 acres (76.5% from silviculture) were issued in a 100-km radius on September 22, 2022. The NOAA HMS smoke plumes are present in the Sandersville area on both September 21 and 22.

October 7, 2022

A few silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on October 7, 2022. The exceedance on this day was due to fires on the day before (October 6) being transported to the monitor in the early morning hours, and fires on the day of (October 7) being transported in the late afternoon hours. A couple of 100-m back-trajectories passed a silviculture burn site at the east of the monitoring site while some 500-m back-trajectories passed areas near two silviculture burn sites northeast of the monitoring site. A total of 31 GFC permits covering 412.2 acres (50.2% from silviculture) were issued in a 100-km radius on October 6, 2022, and 30 GFC permits covering 240.2 acres (28.5% from silviculture) were issued in a 100-km radius on October 7, 2022. The NOAA HMS smoke plumes are present in the Sandersville area on both October 6 and 7.

October 24, 2022

A few silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on October 24, 2022.

The exceedance on this day was due to fires on the day of (October 24) being transported in the late afternoon and late evening hours. A total of 46 GFC permits covering 1,035.1 acres (54.1% from silviculture) were issued in a 100-km radius on October 24, 2022. The NOAA HMS smoke plumes are present in the Sandersville area on October 24.

October 25, 2022

Some silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on October 25, 2022. The exceedance on this day was due to fires on the day before (October 24) being transported to the monitor in the early morning hours. The 100-m and 500-m trajectories differ as the 100-m set of trajectories come from the south and southeast and intersect with a large plume. The 500-m trajectories mostly come from the southwest but have some overlap with the 100-m set. This indicates that exceedances are attributable to the fire to the south. A total of 46 GFC permits covering 1,035.1 acres (54.1% from silviculture) were issued in a 100-km radius on October 24, 2022. The NOAA HMS smoke plumes are present in the Sandersville area on October 24 and 25.

November 2, 2022

A few silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on November 2, 2022. The exceedance on this day was due to fires on the day before (November 1) being transported to the monitor in the early morning hours, and fires on the day of (November 2) being transported in the early afternoon hours. The 100-m and 500-m sets of trajectories exhibit differences in their spatial distribution. However, smoke from prescribed fires either around or outside the state cover a large area around the site. In addition, one 100-m back-trajectory and one 500-m back-trajectory passed a close-by silviculture burn site east of the monitoring site. These two trajectories are associated with the highest hourly $PM_{2.5}$ concentration on the event day. A total of 51 GFC permits covering 762.7 acres (66.7% from silviculture) were issued in a 100-km radius on November 1, 2022, and 38 GFC permits covering 411.4 acres (48.0% from silviculture) were issued in a 100-km radius on November 2, 2022. The NOAA HMS smoke plumes are present in the Sandersville area on November 2.

November 3, 2022

Some silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on November 3, 2022. The exceedance on this day was due to fires on the day of (November 3) being transported in the mid-afternoon hours. A total of 51 GFC permits covering 833.2 acres (59.6% from silviculture) were issued in a 100-km radius on November 3, 2022. The NOAA HMS smoke plumes are present in the Sandersville area on November 3.

November 18, 2022

Some silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on November 18, 2022. The exceedance on this day was due to fires on the day of (November 18) being transported in the early afternoon and late evening hours. A total of 56 GFC permits covering 1,868.7 acres (90.2% from silviculture) were issued in a 100-km radius on November 18, 2022. The NOAA HMS smoke plumes are present in the Sandersville area on November 18.

November 19, 2022

A few silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on November 19, 2022. The exceedance on this day was due to fires on the day before (November 18) being transported to the monitor in the early morning hours. A total of 56 GFC permits covering 1,868.7 acres (90.2% from silviculture) were issued in a 100-km radius on November 18, 2022. The NOAA HMS smoke plumes are present in the Sandersville area on November 18.

November 21, 2022

Many silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on November 21, 2022. The exceedance on this day was due to fires on the day of (November 21) being transported in the late afternoon hours. The 500-m set of trajectories shows a wider spatial distribution than the 100-m set. However, both sets intersect with nearby fires to the northeast of the site, indicating exceedances on November 21 are the result of these fires. A total of 84 GFC permits covering 1,660.7 acres (65.8% from silviculture) were issued in a 100-km radius on November 21, 2022. The NOAA HMS smoke plumes are present in the Sandersville area on November 21.

December 28, 2022

Many silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on December 28, 2022. The exceedance on this day was due to fires on the day of (December 28) being transported in the mid-afternoon and early evening hours. A total of 119 GFC permits covering 2,188.4 acres (77.9% from silviculture) were issued in a 100-km radius on December 28, 2022. The NOAA HMS smoke plumes are present in the Sandersville area on December 28.

December 29, 2022

Many silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on December 29, 2022. The exceedance on this day was due to fires on the day before (December 28) being transported to the monitor in the early morning hours. A total of 119 GFC permits covering 2,188.4 acres (77.9% from silviculture) were issued in a 100-km radius on December 28, 2022. The NOAA HMS smoke plumes are present in the Sandersville area on both December 28 and 29.

January 2, 2023

Many silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on January 2, 2023. The exceedance on this day was due to fires on the day of (January 2) being transported in the late afternoon hours. A total of 70 GFC permits covering 376.1 acres (57.2% from silviculture) were issued in a 100-km radius on January 2, 2023.

January 8, 2023

Many silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on January 8, 2023. The exceedance on this day was due to fires on the day before (January 7) being transported to the monitor in the early morning hours. The 100-m set of trajectories has a larger spatial distribution

than the 500-m set. Both sets intersect with a large plume as well as small, nearby plumes, both to the south of the site. Exceedances are most likely caused by these plumes. A total of 110 GFC permits covering 1,697.2 acres (61.7% from silviculture) were issued in a 100-km radius on January 7, 2023. The NOAA HMS smoke plumes are present in the Sandersville area on January 7.

January 10, 2023

Many silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on January 10, 2023. The exceedance on this day was due to fires on the day before (January 9) being transported to the monitor in the early morning hours, and fires on the day of (January 10) being transported in the late evening hours. A total of 60 GFC permits covering 882.0 acres (59.4% from silviculture) were issued in a 100-km radius on January 9, 2023, and 105 GFC permits covering 2,183.7 acres (69.0% from silviculture) were issued in a 100-km radius on January 10, 2023. The NOAA HMS smoke plumes are present in the Sandersville area on both January 9 and 10.

January 11, 2023

Many silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on January 11, 2023. The exceedance on this day was due to fires on the day before (January 10) being transported to the monitor in the early morning hours, and fires on the day of (January 11) being transported in the late evening hours. A total of 105 GFC permits covering 2,183.7 acres (69.0% from silviculture) were issued in a 100-km radius on January 10, 2023, and 108 GFC permits covering 2,578.3 acres (81.7% from silviculture) were issued in a 100-km radius on January 11, 2023. The NOAA HMS smoke plumes are present in the Sandersville area on both January 10 and 11.

January 17, 2023

Many silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on January 17, 2023. The exceedance on this day was due to fires on the day before (January 16) being transported to the monitor in the early morning hours. A total of 122 GFC permits covering 2,319.6 acres (72.0% from silviculture) were issued in a 100-km radius on January 16, 2023. The NOAA HMS smoke plumes are present in the Sandersville area on January 16.

January 29, 2023

Many silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on January 29, 2023. The exceedance on this day was due to fires on the day before (January 28) being transported to the monitor in the early morning hours. The HMS shows fires (via AirNow, not plotted on Figures 32A and 32B) within 100 km and to the south of the site for both the event day and the day before. While 100-m and 500-m sets of trajectories have significantly different spatial distributions, smoke from these fires covered the area around the site on January 28, making these differences negligible. A total of 122 GFC permits covering 2,520.4 acres (76.4% from silviculture) were issued in a 100-km radius on January 28, 2023. The NOAA HMS smoke plumes are present in the Sandersville area on January 28. However, HMS smoke plumes on January 29 cannot be plotted as cloud cover was heavy across the state.

February 7, 2023

Many silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on February 7, 2023. The exceedance on this day was due to fires on the day before (February 6) being transported to the monitor in the early morning hours. A total of 102 GFC permits covering 3,351.1 acres (93.8% from silviculture) were issued in a 100-km radius on February 6, 2023. The NOAA HMS smoke plumes are present in the Sandersville area on February 6 and 7.

February 24, 2023

Many silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on February 24, 2023. The exceedance on this day was due to fires on the day of (February 24) being transported in the early evening hours. A total of 130 GFC permits covering 2,630.9 acres (74.7% from silviculture) were issued in a 100-km radius on February 24, 2023. The NOAA HMS smoke plumes are present in the Sandersville area on February 24.

February 28, 2023

Many silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on February 28, 2023. The exceedance on this day was due to fires on the day of (February 28) being transported in the mid-afternoon and late evening hours. A total of 138 GFC permits covering 6,040.5 acres (61.1% from silviculture) were issued in a 100-km radius on February 28, 2023. The NOAA HMS smoke plumes are present in the Sandersville area on February 28.

March 1, 2023

Many silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on March 1, 2023. The exceedance on this day was due to fires on the day before (February 28) being transported to the monitor in the early morning hours. A total of 138 GFC permits covering 6,040.5 acres (61.1% from silviculture) were issued in a 100-km radius on February 28, 2023. The NOAA HMS smoke plumes are present in the Sandersville area on February 28 and March 1.

March 5, 2023

Many silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on March 5, 2023. The exceedance on this day was due to fires on the day of (March 5) being transported in the early evening hours. The 100-m and 500-m sets of trajectories have different spatial distributions. However, the site was covered by smoke plumes on March 4 and 5. Both sets intersect with several plumes, making these spatial differences negligible. An exceptionally high $PM_{2.5}$ concentration in the night of the event day indicates that the event was primarily driven by smoke plumes from silviculture burn sites near the east of the monitoring site. A total of 94 GFC permits covering 4,094.5 acres (94.9% from silviculture) were issued in a 100-km radius on March 5, 2023. The NOAA HMS smoke plumes are present in the Sandersville area on March 5.

March 7, 2023

Many silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on March 7, 2023. The exceedance on this day was due to fires on the day before (March 6) being transported to the monitor in the early morning hours. A total of 146 GFC permits covering 5,940.1 acres (91.5% from silviculture) were issued in a 100-km radius on March 6, 2023. The NOAA HMS smoke plumes are present in the Sandersville area on both March 6 and 7.

March 8, 2023

Many silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on March 8, 2023. The exceedance on this day was due to fires on the day of (March 8) being transported in the mid-afternoon and evening hours. A total of 91 GFC permits covering 8,218.4 acres (93.3% from silviculture) were issued in a 100-km radius on March 8, 2023. The NOAA HMS smoke plumes are present in the Sandersville area on March 8.

March 9, 2023

Many silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on March 9, 2023. The exceedance on this day was due to fires on the day before (March 8) being transported to the monitor in the early morning hours. A total of 91 GFC permits covering 8,218.4 acres (93.3% from silviculture) were issued in a 100-km radius on March 8, 2023. The NOAA HMS smoke plumes are present in the Sandersville area on March 8 and 9.

March 21, 2023

Many silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on March 21, 2023. The exceedance on this day was due to fires on the day before (March 20) being transported to the monitor in the early morning hours, and fires on the day of (March 21) being transported in the early evening hours. The 100-m and 500-m sets of trajectories differ in their spatial distributions, but both intersect with numerous plumes both on the event day and the day before, especially those silviculture burn sites northeast of the monitoring site. A total of 105 GFC permits covering 6,355.6 acres (94.6% from silviculture) were issued in a 100-km radius on March 20, 2023, and 123 GFC permits covering 4,729.6 acres (94.7% from silviculture) were issued in a 100-km radius on March 21, 2023. The NOAA HMS smoke plumes are present in the Sandersville area on both March 20 and 21.

November 5, 2023

A few silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on November 5, 2023. The exceedance on this day was due to fires on the day before (November 4) being transported to the monitor in the early morning hours, and fires on the day of (November 5) being transported in the early afternoon and late evening hours. A total of 34 GFC permits covering 135.1 acres (69.4% from silviculture) were issued in a 100-km radius on November 4, 2023, and 11 GFC permits covering 37.3 acres (80.4% from silviculture) were issued in a 100-km radius on

November 5, 2023. The NOAA HMS smoke plumes are present in the Sandersville area on both November 4 and 5.

November 6, 2023

Some silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on November 6, 2023. The exceedance on this day was due to fires on the day before (November 5) being transported to the monitor in the early morning hours, and fires on the day of (November 6) being transported in the early evening hours. The 100-m and 500-m sets of trajectories differ in their spatial distributions. However, both sets intersect with plumes from several fires (additionally, the site was covered with smoke plumes on both the event day and the day before). A total of 11 GFC permits covering 37.3 acres (80.4% from silviculture) were issued in a 100-km radius on November 5, 2023, and 37 GFC permits covering 622.9 acres (76.3% from silviculture) were issued in a 100-km radius on November 6, 2023. The NOAA HMS smoke plumes are present in the Sandersville area on both November 5 and 6.

November 7, 2023

Many silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on November 7, 2023. The exceedance on this day was due to fires on the day before (November 6) being transported to the monitor in the early morning hours. The 100-m and 500-m sets of trajectories differ in their spatial distributions. However, the site was covered with smoke plumes on both the event day and the day before, making these differences negligible. A total of 37 GFC permits covering 622.9 acres (76.3% from silviculture) were issued in a 100-km radius on November 6, 2023. The NOAA HMS smoke plumes are present in the Sandersville area on both November 6 and 7.

November 8, 2023

Many silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on November 8, 2023. The exceedance on this day was due to fires on the day before (November 7) being transported to the monitor in the early morning hours. A total of 45 GFC permits covering 763.3 acres (78.2% from silviculture) were issued in a 100-km radius on November 7, 2023. The NOAA HMS smoke plumes are present in the Sandersville area on both November 7 and 8.

November 9, 2023

Many silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on November 9, 2023. The exceedance on this day was due to fires on the day of (November 9) being transported in the early afternoon hours. A total of 35 GFC permits covering 676.1 acres (83.2% from silviculture) were issued in a 100-km radius on November 9, 2023. The NOAA HMS smoke plumes are present in the Sandersville area on November 9.

November 30, 2023

Many silviculture fires were found in the path of the HYSPLIT back trajectories from the Sandersville monitor associated with high $PM_{2.5}$ concentrations measured on November 30, 2023. The exceedance on this day was due to fires on the day before (November 29) being transported to

the monitor in the early morning hours. The 100-m and 500-m set of trajectories differ in their spatial distribution. However, both sets intersect with plumes from numerous fires on November 30. A total of 70 GFC permits covering 1,581.8 acres (74.7% from silviculture) were issued in a 100-km radius on November 29, 2023. The NOAA HMS smoke plumes are present in the Sandersville area on November 29 and 30.

On the 47 "Prescribed Fires" dates listed in Table 1, prescribed fires generated smoke plumes resulting in elevated $PM_{2.5}$ concentrations at the Sandersville monitor. The monitored $PM_{2.5}$ concentrations were more than double the historical annual, quarterly, and monthly concentrations. In addition, the comparisons and analyses provided in Section 3 of this demonstration support our position that the prescribed fire events affected air quality in such a way that there exists a clear causal relationship between the specific events and the monitored $PM_{2.5}$ exceedances on the 47 "Prescribed Fires" dates listed in Table 1 that have been requested for exclusion, and thus satisfies the clear causal relationship criterion.

4. Human Activity Unlikely to Recur at a Particular Location

This section addresses the EER requirement at 40 CFR 50.14(c)(3)(iv)(E), which requires that the event was either a human activity that is unlikely to recur at a particular location or a natural event. The Prescribed Fire Guidance acknowledges that prescribed fires and their emissions are events caused by human activity and therefore must address the "human activity unlikely to recur at a particular location" criterion, and outlines how fire recurrence can be used to satisfy this criterion for a prescribed fire event. The demonstration must describe the actual frequency with which a burn was conducted and show that the prescribed fire was conducted consistent with either the natural fire return interval, or the prescribed fire frequency needed to establish, restore and/or maintain a sustainable and resilient wildland ecosystem. Since information was not available on the actual prescribed fire interval for specific tracts of land, Georgia EPD calculated an average fire interval for each county.

Based on the U.S. Forest Service Forest Inventory and Analysis (FIA) database, the primary stand types located within a 100 km radius of the Sandersville monitor are: (1) Longleaf/Slash at 458,326 acres (8.1% of the land mass), (2) Loblolly/Shortleaf at 2,521,091 acres (44.8% of the land mass), (3) Oak/Pine mix at 542,002 acres (9.6% of the land mass), and (4) Oak Hickory at 1,306,615 acres (23.2% of the land mass). These stand types typically burn anywhere from 1-3 years for Longleaf/Slash, 2-5 years for Loblolly/Shortleaf, 2-5 years for Oak/Pine mix, and 3-10 years for Oak Hickory. All prescribed fires in this demonstration were conducted consistently with the natural fire return interval, as further described below.

Guyette (2012)[10] developed historic (1650-1850 CE) mean fire intervals (MFI) estimates for the presence of fire in all or part of an average 1.2 km^2 area. Mapped Physical Chemistry Fire Frequency Model (PC2FM) estimates are based on temperature, precipitation, and the partial pressure of oxygen. Classification intervals are in 2-year classes (1-30 years), 5-year classes (31-50 years), 25-year classes (50-200 years), and a single class for intervals greater than 200 years. The natural fire return interval map for the continental U.S. is shown in Figure 2. A zoomed in map for the state of Georgia and the Sandersville area is shown in Figure 3.

[10] Guyette R.P., Stambaugh M.C., Dey D.C., Muzika R-M (2012), Predicting Fire Frequency with Chemistry and Climate, Ecosystems, 15:322-335, DOI 10.1007/s10021-011-9512-0.

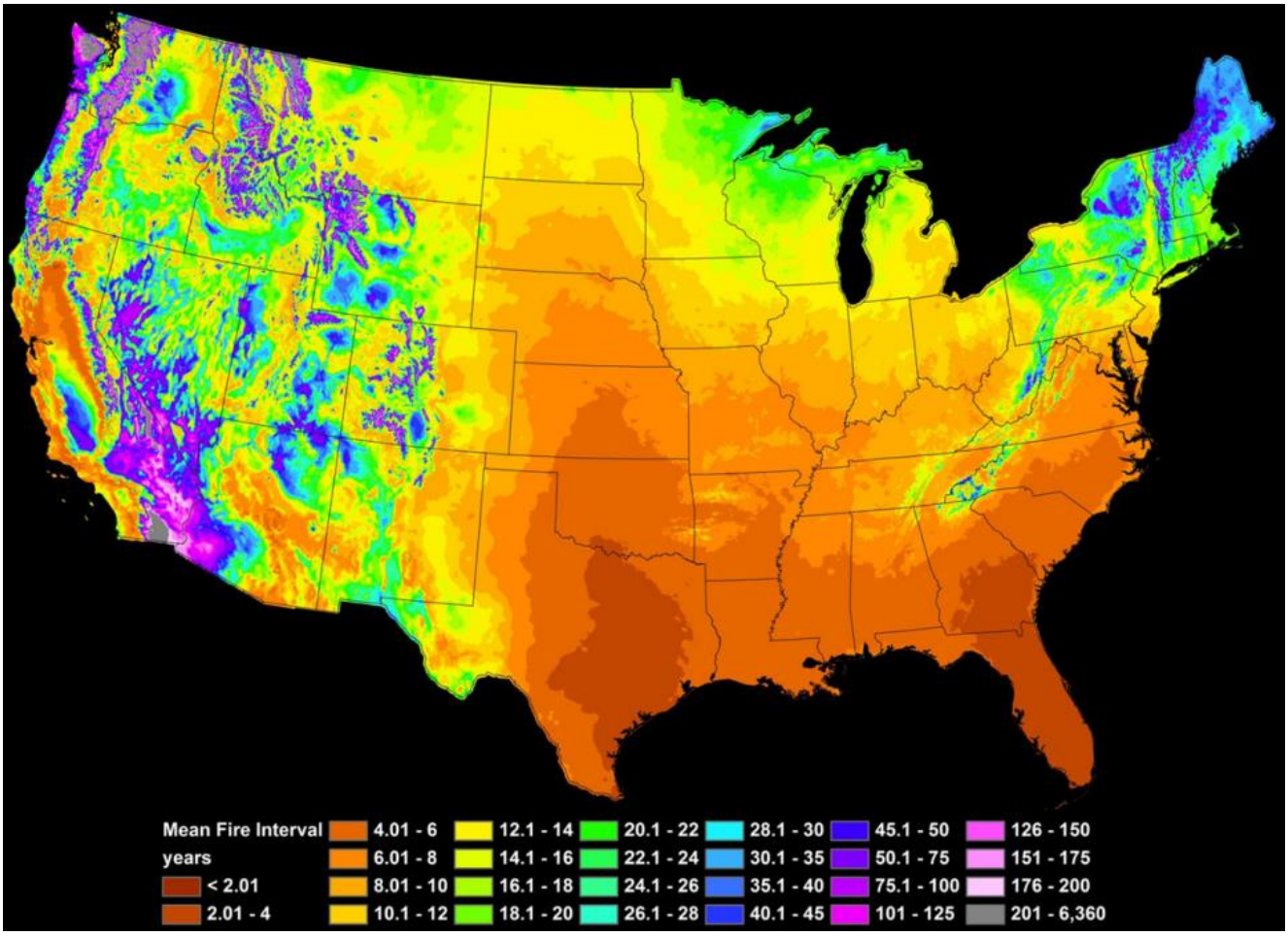

Figure 2. Natural fire return interval map for the continental U.S.

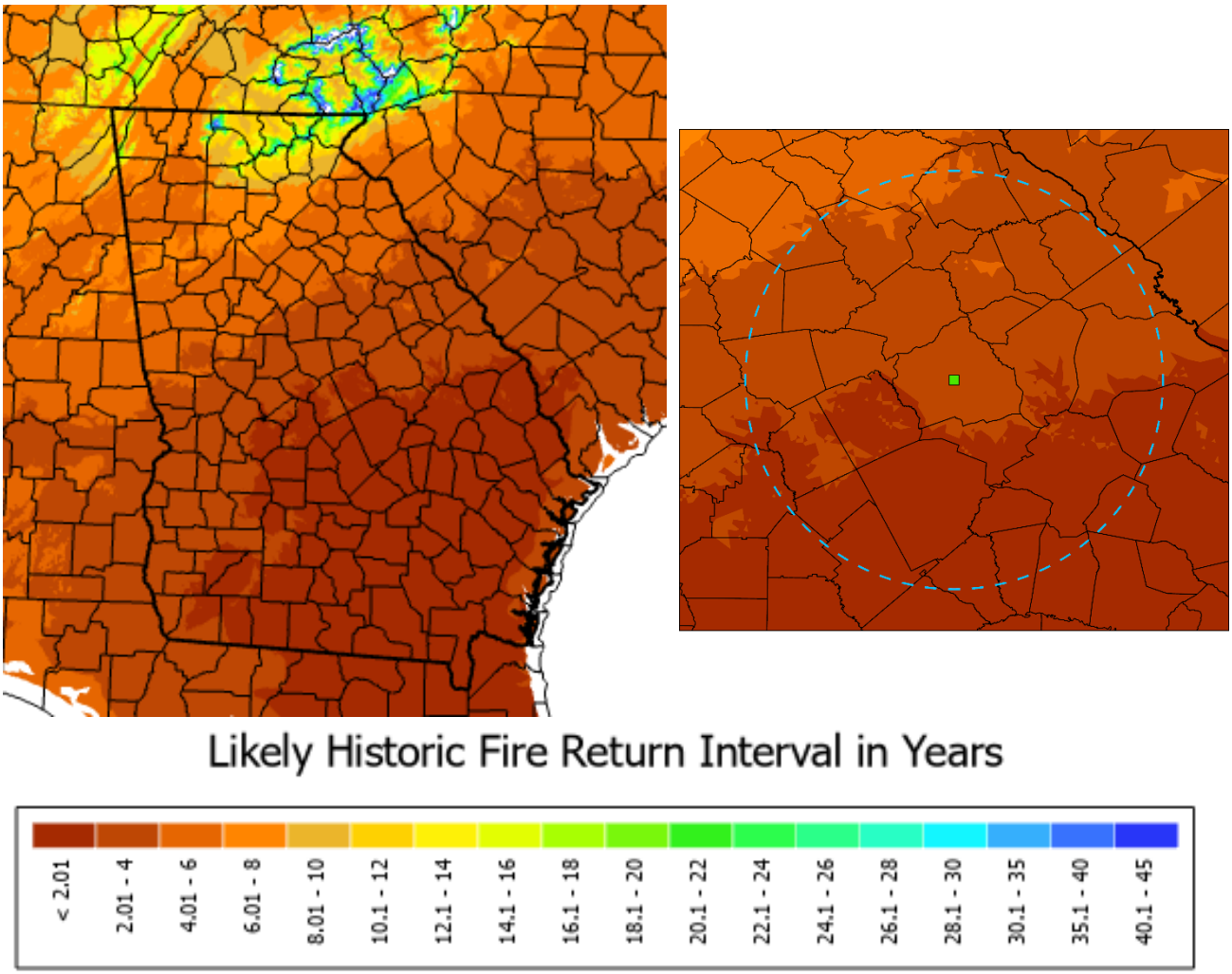

Figure 3. Natural fire return interval map for Georgia (left) and Sandersville (right). The Sandersville site is depicted with a green square, and the dashed line indicates a 100 km buffer around the Sandersville site.

The total burn acres available, annual average burn acres for FY2019-FY2024, and actual fire return interval (years) for all 38 counties within 100 km of the Sandersville monitor are provided in Table 4. The total burn acres available for each county was determined by multiplying the individual county area (acres) by the corresponding rural percentage (%) from the 2020 U.S. Census[11].

The annual burn acres for 2019-2023 were provided by GFC and the military bases. The actual fire return interval was calculated by dividing the total burn acres available by the annual average burn acres for 2019-2023. The overall actual fire return interval for the Sandersville area is 30.9 years, which is far greater than the 2-6 years historic fire return interval. The lowest actual fire return internal was 11.1 years in Jones County.

[11] https://www2.census.gov/geo/tiger/TIGER2023/UAC/tl_2023_us_uac20.zip

Table 4. Total burn acres available, annual average burn acres for FY2000-FY2024, and actual fire return interval (years).

County	Total Burn Acres Available	Annual Average Burn Acres for FY2000-FY2024	Actual Fire Return Interval (Years)
Baldwin	189,595.5	2,692.9	70.4
Bibb	122,878.6	974.3	126.1
Bleckley	162,347.8	5,543.7	29.3
Bulloch	501,693.7	10,876.1	46.1
Burke	634,716.4	25,150.8	25.2
Candler	189,144.4	8,049.5	23.5
Columbia	180,295.3	2,375.6	75.9
Dodge	376,950.0	10,417.6	36.2
Emanuel	519,595.9	20,375.8	25.5
Glascock	110,786.5	3,068.6	36.1
Greene	312,904.2	11,380.3	27.5
Hancock	367,382.5	7,268.3	50.5
Houston	217,172.8	4,784.3	45.4
Jasper	286,884.1	25,625.2	11.2
Jefferson	405,537.5	14,371.6	28.2
Jenkins	269,020.8	10,480.3	25.7
Johnson	233,752.0	7,087.3	33.0
Jones	298,594.5	26,943.9	11.1
Laurens	606,775.1	14,298.4	42.4
Lincoln	198,667.8	1,755.4	113.2
McDuffie	198,420.2	2,167.7	91.5
Montgomery	185,647.2	5,837.8	31.8
Morgan	269,342.1	6,250.7	43.1
Oglethorpe	341,766.7	10,504.7	32.5
Pulaski	190,586.5	6,068.1	31.4
Putnam	276,995.2	16,755.0	16.5
Richmond	167,269.7	14,254.3	11.7
Taliaferro	150,535.2	1,527.4	98.6
Tattnall	369,666.3	12,610.2	29.3
Telfair	335,938.5	11,260.9	29.8
Toombs	269,361.1	10,457.3	25.8
Treutlen	153,942.1	4,752.3	32.4
Twiggs	276,322.1	4,695.9	58.8
Warren	220,462.1	4,524.9	48.7
Washington	517,233.5	11,616.0	44.5
Wheeler	227,538.5	10,124.2	22.5
Wilkes	365,904.0	5,335.1	68.6
Wilkinson	345,085.4	5,521.7	62.5
TOTAL	**11,046,711.8**	**357,784.3**	**30.9**

The documentation provided in Section 4 of this submittal demonstrates that prescribed fire events in the Sandersville area satisfy the human activity unlikely to recur at a particular location criterion by describing the actual frequency with which burns are conducted and by showing how this burn frequency mimics the natural fire return interval. Specifically, the demonstration determined the actual burn frequency as being every 30.9 years, while the natural fire return interval for this area is 2-6 years.

5. Addressing the Not Reasonably Controllable or Preventable Criterion

This section addresses the EER requirement at 40 CFR 50.14(c)(3)(iv)(D) by demonstrating that each event was both not reasonably controllable and not reasonably preventable, as further described for prescribed fires in 40 CFR 50.14(b)(3). The "not reasonably controllable" prong is satisfied by showing that the prescribed fire was conducted under an adopted and implemented certified SMP, while the "not reasonably preventable" prong is satisfied by describing the benefits that would have been foregone if the fire were not conducted.

5.1 Not Reasonably Controllable

The Prescribed Fire Guidance states that the controllability prong of the not reasonably controllable or preventable criterion can be satisfied if (1) the prescribed fire was conducted under an adopted and implemented certified SMP, or (2) the prescribed fire was conducted with appropriate basic smoke management practices. If a demonstration intends to rely on a SMP to satisfy the not reasonably controllable prong, the SMP must be certified prior to the burn being conducted. The Sandersville prescribed fires were not reasonably controllable because they were conducted under Georgia's adopted and certified SMP which was being implemented at the time of the burn. A copy of the Georgia certified SMP is contained in Appendix C. A copy of EPA's SMP acknowledgement letter is contained in Appendix D.

The Georgia certified Smoke Management Plan includes five sections: (1) Authorization for Prescribed Burning, (2) Smoke Management, (3) Public Education and Awareness, (4) Surveillance and Enforcement, and (5) Smoke Management Plan Evaluation.

Authorization for Prescribed Burning

Prescribed burning is also regulated in Georgia under the *Georgia Forest Fire Protection Act* (Ga. Code Ann. 12-6-80 to 12-6-93). Burn permits are required from GFC for all prescribed fires except agricultural burning (which is notification only) and leaf pile burning. According to the *Georgia Forest Fire Protection Act*, all forest fire protection work is under the direction of GFC. The Act gives GFC the authority to go on any land for the purpose of preventing, controlling, or suppressing any uncontrolled fire. An aggressive State wildfire suppression policy has contributed substantially to protecting air quality in Georgia.

Prescribed burning helps achieve many desired resource objectives and can be used to minimize the emissions and adverse impacts of smoke on public health and the environment by reducing fuel loads that can lead to catastrophic wildfire. The *Georgia Air Quality Act* (Ga. Code Ann. 12-9-1 to 12-9-25) is designed to preserve, protect, and improve air quality, to control emissions in order to prevent the significant deterioration of air quality, and to attain and maintain national ambient air quality standards (NAAQS) set by the EPA. This Act authorizes the Georgia EPD

to issue rules regarding air quality, including the authorization to regulate prescribed burning when subject to the Federal Clean Air Act.

The *Georgia Forest Fire Protection Act* requires prescribed burn practitioners to obtain a permit from GFC before initiating a fire. The size, date, type of burn, county location, weather, air quality conditions, and other relevant information are used as criteria to determine if a permit shall be issued. Permits are issued by forest rangers and dispatchers that are trained in fire, weather, and smoke management. According to GFC procedures, all burn projects of one acre or more are screened to determine if air sheds or smoke-sensitive populations are threatened. Permits are issued or denied based on smoke management and fire danger. In order for permits to be issued, all the requirements of Georgia EPD's *Rules for Air Quality Control* (Georgia Rule 391-3-1-.02(5), "Open Burning") and GFC's guidelines must be met. Areas specified by Georgia EPD as especially susceptible to violations of air quality standards will be given special attention to avoid issuance of permits during measured or expected high air pollution periods. Such attention will include a regional review of the previous day and current day ambient concentrations for ozone and particulate matter in relation to NAAQS. Although agricultural burning does not require a permit, notification of GFC is required.

Smoke Management

The goal of smoke management is to reduce the exposure of Georgia's citizens to air pollution, impaired visibility, and nuisance caused by prescribed fire smoke. Use of the basic smoke management guidelines presented in this document will reduce the impact of smoke from prescribed fires on air quality and visibility. The basic principles of smoke management include identifying and mitigating impacts to smoke sensitive areas, minimizing emissions, selecting appropriate meteorological conditions to maximize smoke dispersion, properly evaluating weather conditions prior to burning, giving public notification, and monitoring air quality.

Public Education and Awareness

The Georgia Prescribed Fire Act tasks GFC to promote public education and awareness of prescribed fires. This does not preclude other agencies or organizations from promoting prescribed fire, and they are encouraged to do so. The Georgia Prescribed Fire Council and many other natural resource organizations are strong advocates of prescribed fire and include public education as part of their mission.

GFC delivers multiple prescribed burn manager trainings each year which typically reaches at least 200 candidates of which many become certified burners. Other public outreach is delivered through school programs, public events such as landowner field days, fair exhibits, expos, Prescribed Fire Awareness Week celebration, and learn-n-burns sessions which provide hands-on assistance and training to landowners who want to conduct prescribed burns.

Surveillance and Enforcement

GFC fire patrol aircraft advise local field offices of significant smoke intrusions discovered while on routine patrol flights. GFC rangers discuss smoke intrusions with individual prescribed

burn practitioners whenever problems occur. Suggestions to alter the scope of future projects are made. GFC retains the right to void certification of Georgia certified prescribed burners if certain stipulations are not adhered to which may include smoke intrusion into a smoke-sensitive areas if investigation reveals gross negligence for basic smoke management practices. All outdoor burning is subject to enforcement through local law enforcement officers, GFC investigators, and DNR. The enforcement authority is in the *Georgia Forest Fire Protection Act,* as well as EPD's authority to enforce Federal and State air quality regulations and laws.

Smoke Management Plan Evaluation

GFC and DNR will work closely with stakeholders to evaluate this plan, as needed. GFC will provide data on outdoor burning to stakeholders, and EPD will provide pertinent air quality monitoring data. The Georgia Prescribed Fire Council was formed to enable collaboration among prescribed burn practitioners and with other interested public and private organizations to address statewide natural resource goals, including air quality. DNR and GFC, in coordination with stakeholders, will evaluate the effectiveness of this SMP at Georgia Prescribed Fire Council Steering Committee meetings and revise it as necessary.

5.2 Not Reasonably Preventable

The Prescribed Fire Guidance states that a demonstration can satisfy the not reasonably preventable prong of the not reasonably controllable or preventable criterion by describing the benefits that would have been foregone if the fire were not conducted. The EER at 40 CFR 50.14(b)(3)(ii)(C) states that this demonstration may rely upon and reference a multi-year land or resource management plan for the area with a stated objective to establish, restore, and/or maintain a sustainable and resilient wildland ecosystem, and/or to preserve endangered or threatened species through a program of prescribed fire. The available land management documentation governing this prescribed fire shows that the fire was not reasonably preventable because of the benefits that would have been foregone if the fire had not been conducted.

The Georgia Assembly enacted the *Georgia Prescribed Burning Act* (Ga. Code Ann. 12-6-145 to 12-6-149) to authorize and promote the continued use of prescribed burning for community protection and for silvicultural, environmental, and wildlife purposes. Georgia's State Wildlife Action Plan (SWAP)[12] is a statewide strategy to conserve populations of native wildlife species and the natural habitats they need before these animals, plants, and places become rarer and more costly to conserve or restore. Georgia's SWAP lists 640 animal and plant species as high priorities for conservation. Species and habitats vary from golden-winged warblers, red-cockaded woodpeckers, and gopher tortoises to Georgia aster wildflowers and longleaf pine savannas. The SWAP uses the best available data to provide a comprehensive, adaptable assessment of conservation needs and the best ways to address them. The 150 conservation actions recommended focus efforts where they're most needed and most effective. These actions include prescribed burning. The latest version of Georgia's SWAP was revised in 2015 and approved by the U.S. Fish and Wildlife Service in September 2016.

[12] https://georgiawildlife.com/WildlifeActionPlan

The Biotics[13] rare species database was used to identify the top three rare, fire-dependent animal species[14] located within a 100-km radius of the Sandersville monitor. Based on the results of the query, the top three species are: (1) Eastern Indigo Snake (Drymarchon couperi), (2) Red-cockaded Woodpecker (Dryobates borealis), and (3) Gopher Tortoise (Gopherus polyphemus).

Without prescribed burning, the Sandersville area's tree stands and underbrush would continue to become increasingly dense and homogenous. The increased density of the forest leaves it vulnerable to wildfires, insect disturbance, and tree mortality. Increased homogeneity of the forest composition further limits desired wildfire habitat, and by extension wildlife species and biodiversity. If these prescribed fires had not been conducted, a variety of benefits would be foregone, including improved tree growth and conditions for hardwood species, increased biodiversity, fuel load reduction, and overall forest resiliency to disturbances such as pests, disease, and severe wildfire.

Based on the documentation provided in Section 5 of this submittal, the prescribed fire events satisfied the not reasonably controllable or preventable criterion. The events were not reasonably controllable because they were conducted under a certified and implemented Smoke Management Plan and were not reasonably preventable because of the benefits that would have been foregone if the fire were not conducted.

6. Public Comment

Georgia EPD held a 30-day public comment period starting on December 20, 2024, to receive public input regarding the Exceptional Event Demonstration. Notification of the public comment period was posted on the Georgia EPD website and emailed to interested stakeholders. Public comments received are included in Appendix G of this demonstration, along with Georgia EPD's responses to these comments in Appendix H.

7. Conclusions and Recommendations

This Exceptional Event demonstration has shown that the $PM_{2.5}$ monitor at Sandersville was impacted by smoke from prescribed fire, causing $PM_{2.5}$ concentrations that exceeded the 2024 annual $PM_{2.5}$ NAAQS of 9.0 $\mu g/m^3$ on the 47 "Prescribed Fires" dates listed in Table 1. The demonstration further shows that the prescribed fire events meet the EPA's definition of an Exceptional Event under the 2016 EER:

- Section 2. Narrative Conceptual Model includes a narrative conceptual model for the event, as required by 40 CFR 50.14(c)(3)(iv)(A).
- Section 3. Clear Causal Relationship includes a comparison to historical data, as required by 40 CFR 50.14(c)(3)(iv)(C), that shows the event concentration is very high compared to typical values measured at the site, and further demonstrates (through analysis of NOAA HMS smoke plumes, HYSPLIT trajectory modeling, and analysis of hourly $PM_{2.5}$ data) that emissions were transported to the monitor and caused the exceedance of the 2024 annual $PM_{2.5}$ NAAQS at the Sandersville monitor, showing a clear causal relationship between the event and exceedance as required by 40 CFR 50.14(c)(3)(iv)(B).

[13] https://www.natureserve.org/products/biotics-5
[14] https://www.georgiabiodiversity.org

- Section 4. Human Activity Unlikely to Recur at a Particular Location includes evidence that the prescribed fire event meets the EER definition of a human activity that is unlikely to recur at a particular location as required by 40 CFR 50.14(c)(3)(iv)(E), by establishing that the prescribed fire was conducted consistent with the natural fire return interval.
- Section 5. Not Reasonably Controllable or Preventable includes evidence that the prescribed fire meets the EER definitions of being not reasonably controllable as required by 40 CFR 50.14(c)(3)(iv)(D), by showing that the prescribed fire was conducted under the Georgia SMP (an adopted and implemented state-certified SMP), and describing the benefits that would have been foregone if the fire were not conducted as documented in the land management plans and prescribed fire documentation.
- Additional procedural requirements such as identifying regulatory significance with respect to 40 CFR 50.14(a)(1)(i), documenting public notification of the event as required by 40 CFR 50.14(c)(1)(i), and providing for a public comment period for this demonstration as required in 40 CFR 50.14(c)(3)(v) have also been addressed in Sections 1. Introduction, 2. Narrative Conceptual Model, and 6. Public Comment.

Therefore, Georgia EPD requests that the EPA review and concur that this demonstration shows that the 47 prescribed fire events in Table 1 meet the requirements of the EER, resulting in exclusion of the associated 47 daily $PM_{2.5}$ concentrations from regulatory decisions for the 2024 annual $PM_{2.5}$ NAAQS.

Appendices

A. Sandersville Integrated Plots for Exceptional Events by Date
B. Sandersville Exceptional Event Fires by Date
C. Georgia Memorandum of Understanding and Basic Smoke Management Plan
D. EPA's SMP Acknowledgment Letter
G. Public Comments
H. Georgia EPD's Response to Comments