Airborne
Spectral
Photometric
Environmental
Collection
Technology

ASPECT Air Quality Survey after Hurricane Ida
Baton Rouge, LA
September 3, 2021

ASPECT Mission Supporting:
Eric Delgado
On-Scene Coordinator
Delgado.Eric@epa.gov

Initial Mission Request
Brian Fontenot
Louisiana Department of Environmental Quality

ASPECT TEAM

Jill Taylor
Chemical/Photometric Lead
Taylor.Jillianne@EPA.gov
214-406-9896

Tony Honnellio
Radiological Lead (Detail)
Honnellio.Anthony@EPA.gov
617 947-4414

Ed Argenta
CBRN CMAD FOB Branch Chief
Argenta.Edward@EPA.gov
202-843-4511

90044854

Table of Contents

Acronyms and Abbreviations **3**
Background and Operational Overview **5**
General Mission Objectives ..... **6~~8~~**
Flight Conditions and Status ..... **6~~9~~**
Weather and Site Conditions ..... 6~~9~~
Data Results ..... **7~~10~~**
Flight Paths ..... 7~~10~~
Line Scanner Data Results ..... 9~~12~~
FTIR Data Results ..... 10~~13~~
Aerial Photography Results ..... 11~~16~~
Conclusion ..... **13~~20~~**
Appendix A: File Names of Data Collected During Flight ..... **16~~21~~**
Appendix B: ASPECT Systems ..... **18~~30~~**

Acronyms and Abbreviations

Alt	Altitude (in feet)
AGL	Above Ground Level
cm	centimeter
CST	Central Standard Time
DEM	Digital Elevation Model
Digital	Digital photography file from the Nikon D2X camera
ft	feet
FTIR	Fourier Transform Infrared Spectrometer
igm	Spectral data format based on grams format
IR	Infrared
IRLS	Infrared Line Scanner
jpg	JPEG image format
kts	knots
mph	miles per hour
m/s	meters per second
MSIC	Digital photography file from the Imperx mapping camera
MSL	Mean Sea Level Altitude (in feet)
ppm	parts per million
UTC	Universal Time Coordinated

Executive Summary

Hurricane Ida made landfall at 11:55 AM CDT Sunday, August 29 as a high-end category-4 hurricane, with maximum sustained winds of 150 mph. The storm moved ashore near Port Fourchon, Louisiana after a period of rapid intensification, tying for the fifth strongest landfalling continental US hurricane on record with Hurricane Laura of 2020, among three other hurricanes. Severe wind and large-scale flood damage have been reported to property and infrastructure in much of southeast Louisiana, including significant damage in New Orleans, Louisiana. In addition, Ida has caused widespread damage across the Mid-Atlantic and Northeast US.

On September 2nd, the State of Louisiana requested ESF-10 assistance through FEMA and Region 6 asked for the ASPECT plane to be deployed in support of the response to Hurricane Ida. The state wanted assistance monitoring facility emissions in the industrial area between Baton Rouge and New Orleans, where flaring is resulting in the visible emission of black smoke.

ASPECT was tasked to perform remote chemical sensing over target properties to screen for airborne chemicals and take high-resolution photos to provide situational awareness. Potential areas identified for monitoring included: East Baton Rouge, Ascension, Iberville, St. James, St. John, St. Charles, Jefferson, and Orleans. The system conducted one flight mission on September ~~2~~2, 2021 including air monitoring survey collections over the target area with favorable weather conditions for all passes. Although two black plumes were visible over one of the sites, no major emissions were detected with the FTIR.

A continuation of the overall Baton Rouge facility survey was conducted on September 3. Two data collection flights were conducted which bracketed a Presidential temporary flight restriction not allowing any flight activity. A total of 12 active data collection passes were made covering 8 facilities with no chemical plumes or compounds being detected. Other than flares and isolated steam plumes, little process activity was noted in the data.

ASPECT Air Quality Survey
Hurricane IDA
Baton Rouge, LA
September ~~3~~3, 2021

Background and Operational Overview

Hurricane Ida made landfall at 11:55 AM CDT Sunday, August 29 as a high-end category-4 hurricane, with maximum sustained winds of 150 mph. The storm moved ashore near Port Fourchon, Louisiana after a period of rapid intensification, tying for the fifth strongest landfalling continental US hurricane on record with Hurricane Laura of 2020, among three other hurricanes. Severe wind and large-scale flood damage have been reported to property and infrastructure in much of southeast Louisiana, including significant damage in New Orleans, Louisiana. In addition, Ida has caused widespread damage across the Mid-Atlantic and Northeast US.

On September 2, ASPECT was tasked to conduct a wide area air quality screening level assessment of areas populated with Risk Management Plan (RMP) sites and petrochemical facilities using the ASPECT system for detections of any airborne contaminants from ASPECT's 76 chemical detection library in the areas affected by Ida. The Region wanted to know if any detections were found, the location of the detection, and the concentration detected. Sites including Marathon Petroleum Company, Shell Norco Facility, and Phillips 66 pipeline site were surveyed. There were no chemical detections at the sites surveyed. Extremely slow satellite transmission speeds (possibly due to high bandwidth use by other first responders) resulted in long delays in data collection. Some chemical photos were pulled down during flight, with the majority needing to be pulled down with a more high-speed internet connection on the ground.

ASPECT was tasked with a continuation of the general Baton Rouge area survey and conducted two flights on September 3. Sites targeted for the September 3 survey are given in Table 1. Due to a Presidential Temporary Flight restriction, Flight 2 was cut short and was resumed later in the day as Flight 3.

Table 1. Sites Covered on September 3, 2021 Flights 3 and 4

ExxonMobil Baton Rouge Chemical Plant	30.484336	-91.169644
Formosa Plastics Corp Louisiana	30.501722	-91.185944
ExxonMobil Chemical Company - Baton Rouge Chemicals North Plant	30.50465	-91.173219
The Dow Chemical Company - Louisiana Operations	30.313927	-91.240586
Axiall LLC - Plaquemine Facility	30.267167	-91.184258
ExxonMobil Chemical Co - Baton Rouge Polyolefins Plant	30.56215	-91.20387
INEOS Oxide - A Division of INEOS Americas LLC	30.313889	-91.240278
Shintech Louisiana LLC - Shintech Plaquemine Plant	30.273611	-91.173333

General Mission Objectives

Once granted access to fly over the sites, the following general mission objectives were employed in conducting data collection with ASPECT:

1. To capture an overall, situational awareness of the incident using aerial photography with:
    - Oblique camera—photos taken by hand from the view/position of the co-pilot, and
    - MSIC photos—advanced camera mounted underneath the plane for a top-down view of the designated sites.
2. To qualitatively locate and characterize any the visible and non-visible components of a plume, as well as any areas on fire:
    - Using the Infrared Line Scanner (IRLS)
3. To screen for the presence and location of specific chemicals within ASPECT's automated chemical detection library:
    - Using the Fourier Transform Infrared (FTIR) Spectrometer

Flight Conditions and Status

Weather and Site Conditions

Prior to each flight, an updated status of the current and forecasted weather, site conditions and any potential flight obstacles including radio towers impacting safety is assessed by the crew. A summary of the ground weather conditions during the missions can be found in Tables 2 and 3.

Table 2. Ground Weather for Baton Rouge, LA, Flight 3
September 3, 2021

Time	1253	1353	1453	1553	1653
Wind direction	0 degrees	0 degrees N	0 degrees	0 degrees N	0 degrees N
Wind speed	1.3 m/s (3.0 mph)	2.2 m/s (5.0 mph)	0.0 m/s (0.0 mph)	2.7 m/s (6.0 mph)	3.1 m/s (7.0 mph)
Temperature	31.7 C	31.7 C	32.2 C	32.2 C	32.2 C
Relative humidity	59	61	60	58	56
Dew point	22.8 C	23.3 C	23.3 C	22.8 C	22.2 C
Pressure	1014.6 mb	1014.3 mb	1013.3 mb	1012.6 mb	1012.3 mb
Ceiling	Scattered 5000 Ft	Scattered 4000 Ft	Few 4200 Ft	Clear	Clear

Table 2. Ground Weather for Baton Rouge, LA, Flight 4
September 3, 2021

Time	1653	1753	1853	1953	2053
Wind direction	0 degrees N	22.5 degrees NNE	45 degrees NE	45 degrees NE	0 degrees N
Wind speed	3.1 m/s (7.0 mph)	2.2 m/s (5.0 mph)	2.7 m/s (6.0 mph)	1.3 m/s (3.0 mph)	0.4 m/s (1.0 mph)
Temperature	32.2 C	31.7 C	29.4 C	27.8 C	26.1 C
Relative humidity	56	59	68	74	88
Dew point	22.2 C	22.8 C	22.8 C	22.8 C	23.9 C
Pressure	1012.3 mb	1012.3 mb	1012.6 mb	1012.6 mb	1012.9 mb
Ceiling	Clear	Clear	Clear	Clear	Clear

Data Results

The following data is provided as a summary analysis. All data products are available for the Region to access on a shared FTP site. For a complete list of available products, see Appendix A. The data collected during these missions included a flight path summary, IRLS images, FTIR chemical identification and quantification, high resolution MSIC photos, and oblique photos.

Flight Paths

Wide, slow turns are required to be made in between runs to keep the instruments stable. The blue lines indicate the flight path while the green lines indicate the specific sections of the flight where chemical data was collected and processed. On Flight 3 the Allemania area was surveyed, and on Flight 4 the Baton Rouge area was surveyed. The flight paths are shown in Figures 1 and 2, respectively.

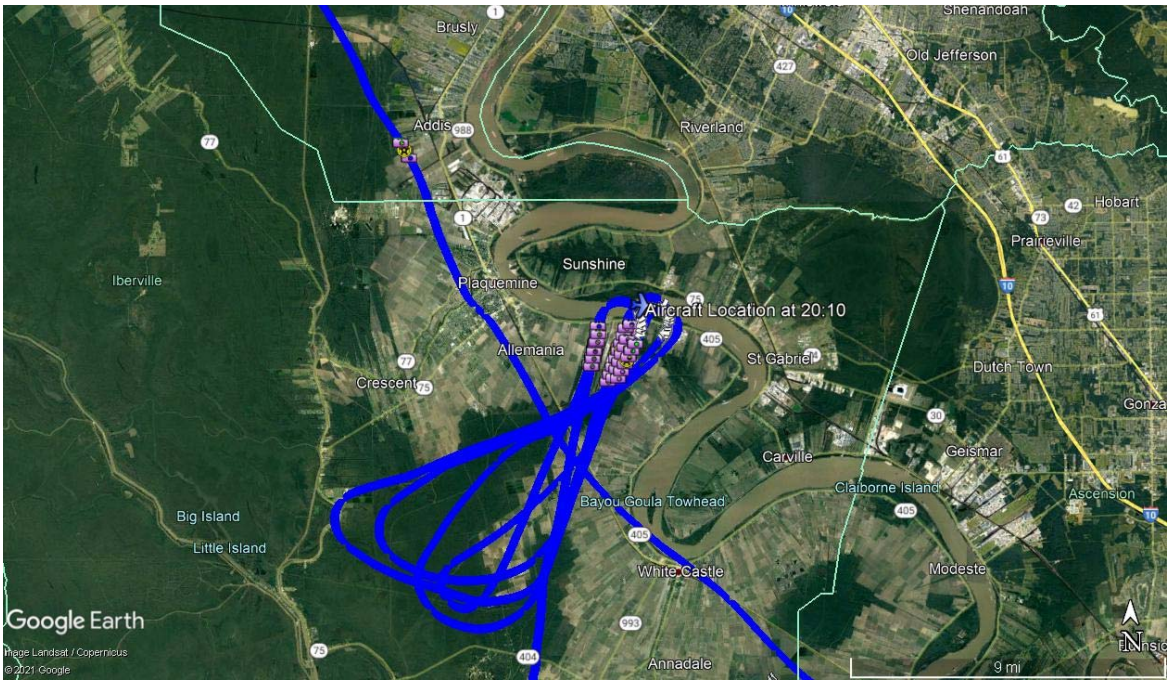

Figure 1. Data Collection Flight Path over the Baton Rouge Area Flight 3, September 3, 2021

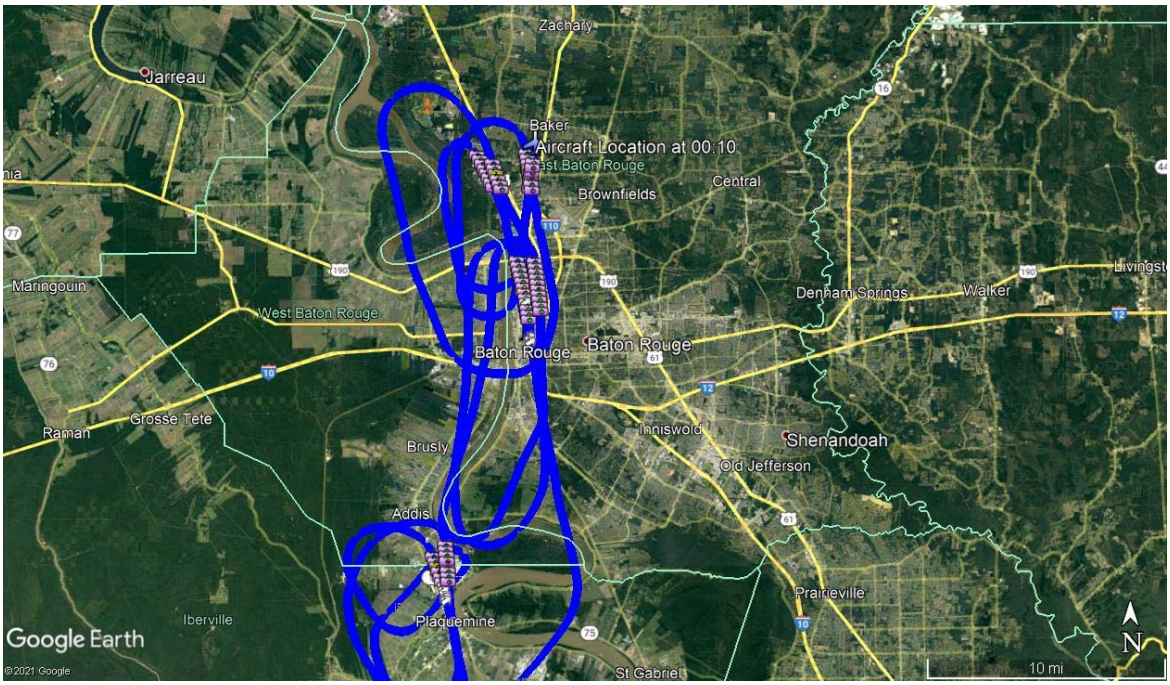

Figure 2. Data Collection Flight Path over the Baton Rouge Area Flight 4, September 3, 2021

Line Scanner Data Results

A total of 14 data collection runs (2 system checks and 12 data runs) were made over the Baton Rouge area and during each collection run an infrared line scanner image was generated. Figure 3 shows a 3-band infrared image collected over a facility collected as part of Flight 3. Minimum elevated thermal information is present in the image indicating little activity at the facility. Figure 4 shows a similar image collected on Flight 4 with flare signatures present on the northern portion of the facility. No chemical plumes can be observed being emitted from the facility.

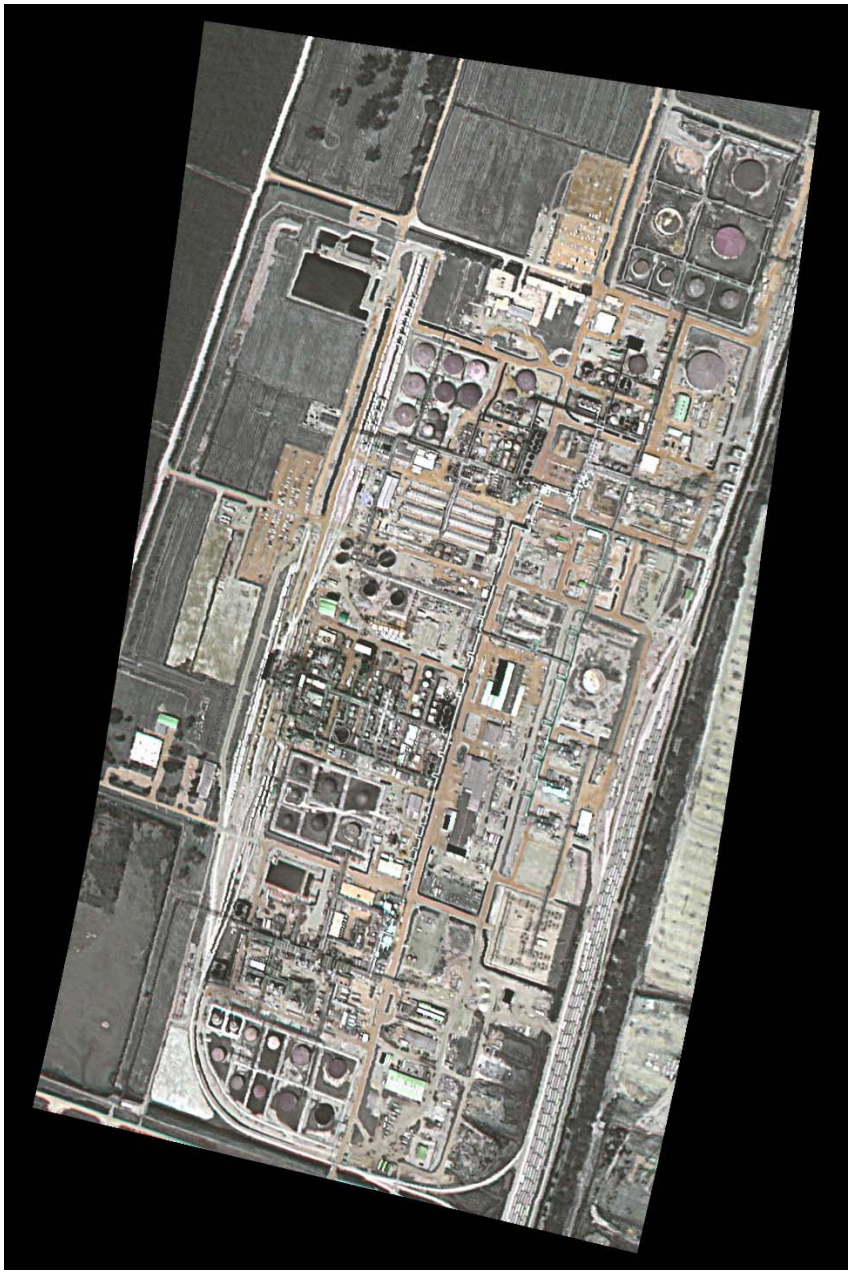

Figure 3. Three band IR image, Baton Rouge Area, Run 2, Flight 3, September 3, 2021

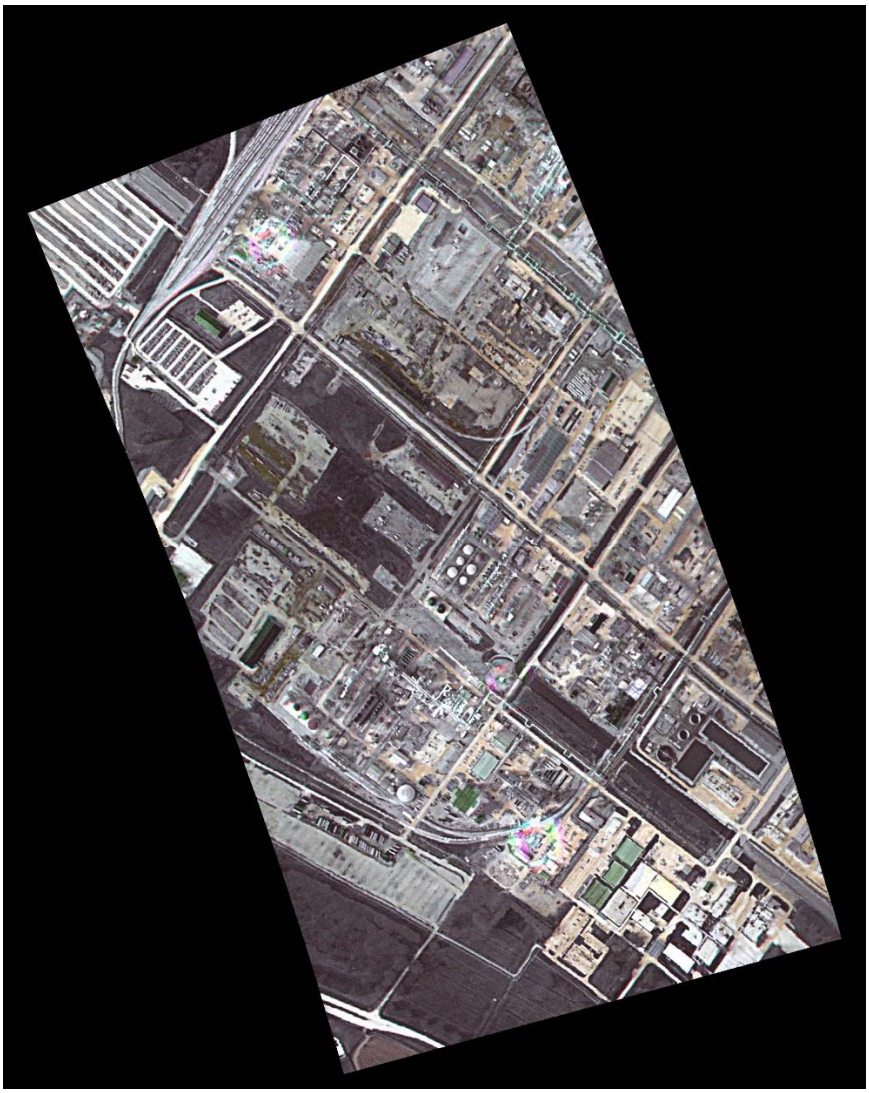

Figure 4. Three band IR image, Baton Rouge Area, Run 2, Flight 4, September 3, 2021

FTIR Data Results

FTIR spectral data at a resolution of 16 wavenumbers was collected for each run. ASPECT uses an automated detection algorithm to permit compounds to be automatically analyzed while the aircraft is in flight. Seventy-six chemical compounds are included in the airborne algorithm library (the list is provided in Appendix B, Table 1). In addition, collected data was also manually quality checked against a collection of published library spectra for each chemical detected.

ASTECT did not detect any programmed compounds (those found in Appendix C, Table 1) as part of the mission over the Baton Rouge areas on the two flights conducted on September 3. Details of the monitoring results can be found in Tables 3 and 4.

Table 3. Chemical Results Summary
Baton Rouge Collection Area, Flight 3

Pass	Date	Time (UTC)	Chemical	Max Concentration (ppm)
1	2021-09-03	18:40:38	ND	ND
2		19:28:07	ND	ND
3		19:37:29	ND	ND
4		19:47:36	ND	ND
5		19:58:57	ND	ND
6		20:09:07	ND	ND

Table 4. Chemical Results Summary
Baton Rouge Collection Area, Flight 4

Pass	Date	Time (UTC)	Chemical	Max Concentration (ppm)
1	2021-09-03	22:42:44	ND	ND
2		22:52:25	ND	ND
3		23:11:57	ND	ND
4		23:24:41	ND	ND
5		23:39:47	ND	ND
6		23:47:06	ND	ND
7		00:00:47	ND	ND
8		00:09:49	ND	ND

Aerial Photography Results

A full set of high-resolution aerial digital photography were collected as part of each data collection pass. Weather conditions over the Baton Rouge allowed high quality aerial images to be collected. Figure 4 shows an aerial image of part of the tank farm over the Exxon Chemical facility near Baton Rouge. It is noted that little water is present in the secondary containment structures. Figure 5 shows representative oblique image of the Westlake Plaquemine facility collected during Flight 3. Some activity is present at the facility as evident by the steam plume being released from a process unit.

Figure 5. MSIC photo taken over the Exxon Chemical Facility in Baton Rouge, LA on September 3, 2021

Figure 6. Oblique photo taken over the Shintech Plaquemine Facility as part of Flight 3, September 3, 2021

Conclusion

Two data collection flights were conducted on September 3, 2021 as part of the overall Baton Rouge collection area. A total of 12 active data collection passes were made covering 8 facilities with no chemical plumes or compounds being detected. Other than flares and isolated steam plumes, little process activity was noted in the data.

Appendix A: File Names of Data Collected During Flight

Baton Rouge Collection Areas, Flight 3, September 3, 2021

Run#	Time (UTC)	Altitude (MSL)	Velocity (knots)	MSIC Data Files	FTIR Data Files	IRLS Data Files
1	18:40:38	2877	119	20210903184044277.jpg 20210903184050635.jpg 20210903184057000.jpg	20210903_184041_A.igm	2021_09_03_18_40_43_R_01 TA=29.0;TB=49.2;Gain=3
2	19:28:07	2930	110	20210903192813180.jpg 20210903192819531.jpg 20210903192825896.jpg 20210903192832242.jpg 20210903192839510.jpg 20210903192845874.jpg	20210903_192810_A.igm	2021_09_03_19_28_12_R_02 TA=29.1;TB=49.3;Gain=3
3	19:37:29	2839	104	20210903193734248.jpg 20210903193741518.jpg 20210903193747867.jpg 20210903193754236.jpg 20210903193800578.jpg	20210903_193732_A.igm	2021_09_03_19_37_33_R_03 TA=29.2;TB=49.0;Gain=3
4	19:47:36	2899	109	20210903194742537.jpg 20210903194749801.jpg 20210903194756150.jpg 20210903194802499.jpg 20210903194808864.jpg 20210903194815213.jpg 20210903194821577.jpg 20210903194827921.jpg	20210903_194740_A.igm 20210903_194819_A.igm	2021_09_03_19_47_41_R_04 TA=29.4;TB=49.6;Gain=3
5	19:58:57	2861	107	20210903195903436.jpg 20210903195909802.jpg 20210903195916151.jpg 20210903195922510.jpg 20210903195928859.jpg 20210903195935223.jpg	20210903_195901_A.igm	2021_09_03_19_59_02_R_05 TA=28.8;TB=48.9;Gain=3
6	20:09:07	2890	110	20210903200913550.jpg 20210903200919899.jpg 20210903200926248.jpg 20210903200933507.jpg 20210903200939865.jpg 20210903200946223.jpg 20210903200952588.jpg 20210903200958938.jpg	20210903_200911_A.igm 20210903_200950_A.igm	2021_09_03_20_09_13_R_06 TA=28.7;TB=48.5;Gain=3

Baton Rouge Collection Areas, Flight 4, September 3, 2021

Run#	Time (UTC)	Altitude (MSL)	Velocity (knots)	MSIC Data Files	FTIR Data Files	IRLS Data Files
1	22:42:44	2812	104	20210903224250825.jpg 20210903224257175.jpg 20210903224303540.jpg 20210903224309890.jpg 20210903224316239.jpg 20210903224323508.jpg 20210903224329856.jpg 20210903224336220.jpg	20210903_224248_A.igm 20210903_224327_A.igm	2021_09_03_22_42_48_R_01 TA=30.0;TB=50.3;Gain=3
2	22:52:25	2876	109	20210903225230958.jpg 20210903225237307.jpg 20210903225244562.jpg 20210903225250927.jpg 20210903225257277.jpg 20210903225303629.jpg	20210903_225228_A.igm	2021_09_03_22_52_29_R_02 TA=25.5;TB=45.7;Gain=3
3	23:11:57	2883	110	20210903231203019.jpg 20210903231209368.jpg 20210903231215732.jpg	20210903_231200_A.igm 20210903_231240_A.igm	2021_09_03_23_12_01_R_03 TA=26.0;TB=46.0;Gain=3

				20210903231222987.jpg 20210903231229336.jpg 20210903231235701.jpg 20210903231242051.jpg 20210903231248416.jpg 20210903231254766.jpg 20210903231301115.jpg 20210903231307480.jpg 20210903231313830.jpg		
4	23:24:41	2893	110	20210903232447457.jpg 20210903232453806.jpg 20210903232501076.jpg 20210903232507426.jpg 20210903232513775.jpg 20210903232520141.jpg 20210903232526490.jpg 20210903232532839.jpg 20210903232539205.jpg 20210903232545554.jpg	20210903_232445_A.igm 20210903_232525_A.igm	2021_09_03_23_24_46_R_04 TA=25.5;TB=45.4;Gain=3
5	23:39:47	2903	105	20210903233953519.jpg 20210903233959869.jpg 20210903234006233.jpg 20210903234012583.jpg 20210903234018933.jpg 20210903234026203.jpg 20210903234032552.jpg 20210903234038917.jpg	20210903_233950_A.igm 20210903_234030_A.igm	2021_09_03_23_39_52_R_05 TA=24.8;TB=44.8;Gain=3
6	23:47:06	2896	112	20210903234712935.jpg 20210903234719285.jpg 20210903234725634.jpg 20210903234731999.jpg 20210903234738349.jpg 20210903234744698.jpg	20210903_234709_A.igm	2021_09_03_23_47_11_R_06 TA=22.8;TB=41.9;Gain=3
7	00:00:47	2885	106	20210904000052757.jpg 20210904000100011.jpg 20210904000106376.jpg 20210904000112723.jpg 20210904000119072.jpg 20210904000125438.jpg 20210904000131787.jpg 20210904000138147.jpg	20210904_000052_A.igm 20210904_000129_A.igm	2021_09_04_00_00_52_R_07 TA=21.7;TB=42.3;Gain=3
8	00:09:49	2915	106	20210904000955663.jpg 20210904001002027.jpg 20210904001008377.jpg 20210904001014727.jpg 20210904001021093.jpg 20210904001027442.jpg	20210904_000952_A.igm	2021_09_04_00_09_54_R_08 TA=20.9;TB=41.0;Gain=3

Appendix B: Priority Sites Provided by EPA Region 6 & Louisiana Department of Environmental Quality

~~Facility_Name~~Facility Name	Latitude	Longitude	Parish
Deltech LLC - Baton Rouge Facility	30.552892	-91.200536	East Baton Rouge
ExxonMobil Chemical Co - Baton Rouge Plastics Plant	30.551419	-91.175611	East Baton Rouge
ExxonMobil Baton Rouge Chemical Plant	30.484336	-91.169644	East Baton Rouge
Marathon Petroleum Co LP	30.068394	-90.596364	St. John the Baptist
Westlake Vinyls Co LP	30.209167	-91.017222	Ascension
Valero Refining - Meraux LLC - Meraux Refinery	29.930222	-89.944917	St. Bernard
Cornerstone Chemical Company	29.964722	-90.264722	Jefferson
Chalmette Refining LLC	29.937903	-89.969903	St. Bernard
ExxonMobil Chemical Company - Baton Rouge Chemicals North Plant	30.50465	-91.173219	East Baton Rouge
Equilon Enterprises LLC - Norco Refinery	29.995372	-90.410167	St. Charles
The Dow Chemical Company - Louisiana Operations	30.313927	-91.240586	Iberville
Rubicon LLC - Geismar Facility	30.20139	-91.01222	Ascension
BASF Corp - Geismar Site	30.18425	-91.002778	Ascension
Union Carbide Corp - St. Charles Plant	29.982289	-90.455622	St. Charles
Phillips 66 Co - Alliance Refinery	29.68406	-89.98145	Plaquemines
Axiall LLC - Plaquemine Facility	30.267167	-91.184258	Iberville
ExxonMobil Fuels & Lubricants Co - Baton Rouge Refinery	30.484392	-91.169444	East Baton Rouge
Equilon Enterprises LLC dba Shell Oil Products US - Convent Refinery	30.107684	-90.890796	St. James
Marathon Petroleum Company LP - Louisiana Refining Division - Garyville Refinery	30.061322	-90.593528	St. John the Baptist
BASF Corp - Zachary Site	29.547603	-90.523231	East Baton Rouge
Occidental Chemical Corporation - Geismar Facility	30.18819	-90.98188	Ascension
St Rose Refinery LLC - St Rose Refinery	29.950875	-90.328497	St. Charles
ExxonMobil Chemical Co - Baton Rouge Polyolefins Plant	30.56215	-91.20387	East Baton Rouge
Shell Chemical LP - Norco Chemical Plant West Site	30.004925	-90.422381	St. Charles
NOVA Chemicals Olefins LLC - Geismar Ethylene Plant	30.230619	-91.052884	Ascension
Roehm America LLC - MMA Plant	29.9575	-90.265833	Jefferson
Valero Refining - New Orleans LLC - St Charles Refinery	29.985781	-90.3955	St. Charles
Shell Chemical LP - Norco Chemical Plant - East Site	29.995556	-90.409722	St. Charles
BASF Corp - North Geismar Site	30.20594	-90.99195	Ascension
Stolthaven New Orleans, LLC - Braithwaite Facility	29.870919	-89.949339	Plaquemines
Shintech Louisiana LLC - Shintech Plaquemine Plant	30.273611	-91.173333	Iberville
Denka Performance Elastomer LLC	30.053928	-90.524792	St. John the Baptist

Formosa Plastics Corp Louisiana	30.501722	-91.185944	East Baton Rouge
DuPont Specialty Products USA LLC - Pontchartrain Site	30.05388	-90.52472	St. John the Baptist
Occidental Chemical Corp - Taft Plant	29.987222	-90.454722	St. Charles
Syngenta Crop Protection LLC - St Gabriel Plant	30.246728	-91.103508	Iberville
Mosaic Fertilizer LLC - Faustina Plant	30.083914	-90.91345	St. James
Mosaic Fertilizer LLC - Uncle Sam Plant	30.037222	-90.8275	St. James
LBC Baton Rouge LLC - Sunshine Terminal	30.294444	-91.148333	Iberville
Occidental Chemical Corporation - Convent Facility	30.055885	-90.830594	St. James
TOTAL Petrochemicals & Refining USA Inc - Carville Polystyrene Plant	30.229786	-91.073631	Iberville
Targa Midstream Services LLC	29.237034	-89.384977	Plaquemines
EnLink LIG Liquids LLC - Plaquemine Gas Processing Plant	30.236389	-91.241389	Iberville
EnLink LIG Liquids LLC - Gibson Gas Processing Plant	29.643056	-90.961944	Terrebonne
NuStar Logistics LP - St James Terminal	30.030065	-90.843463	St. James
Enterprise Gas Processing LLC - Norco Fractionation Plant	30.015411	-90.402958	St. Charles
Lone Star NGL Refinery Services LLC - Geismar Fractionation Plant	30.218889	-91.035833	Ascension
INEOS Oxide - A Division of INEOS Americas LLC	30.313889	-91.240278	Iberville
Discovery Producer Services LLC - Discovery Paradis Fractionation Plant	29.858889	-90.453333	St. Charles
Plains Marketing LP - St James Terminal	30.004341	-90.848449	St. James
Methanex USA Services LLC - Geismar Methanol Plant	30.206667	-91.020833	Ascension
Dyno Nobel LA Ammonia LLC - Ammonia Production Facility	29.964789	-90.264625	Jefferson
Kinder Morgan Liquids Terminals LLC - Geismar Methanol Terminal	30.205389	-91.023792	Ascension
South LA Methanol LP - St James Methanol Plant	30.039917	-90.863819	St. James
YCI Methanol Plant	29.97481	-90.86775	St. James
IGP Methanol LLC - Gulf Coast Methanol Complex	29.625453	-89.926611	Plaquemines
KMe St James Holdings LLC - Methanol Terminal	29.990919	-90.841239	St. James
Kemira Chemicals Inc	29.964722	-90.264722	Jefferson
PHILLIPS 66 PIPELINE LLC	29.923889	-90.482498	St. Charles
CF INDUSTRIES	30.08328	-90.957665	Ascension

Appendix C: ASPECT Systems

The US EPA ASPECT system collects airborne infrared (IR) images and chemical screening data from a safe distance over the site (about 3,000 ft AGL). The system consists of an airborne high-speed Fourier Transform Infra-Red (FTIR) spectrometer coupled with a wide-area IR Line Scanner (IRLS). The ASPECT IR systems can detect chemical compounds in both the 8-to-12-micron (800 to 1200 cm-1) and 3 to 5 micron (2000 to 3200 cm-1) regions. List of chemicals and detection limits are listed in Table 1. The 8 to 12 micron region is typically known as the atmospheric window region since the band is reasonably void of water and carbon dioxide influence. Spectrally, this region is used to detect carbon - non-carbon bonded compounds. The 3 to 5 micron region is also free of water and carbon dioxide but typically does not have sufficient energy for use. This band does show use in high-energy environments such as fires. The carbon - hydrogen stretch is very common in this region.

An Imperx mapping camera (29 mega pixels; mapping focal plane array) is concurrently operated as part of all chemical collections. These images are often digitally processed in lower resolution, so they can be transmitted via satellite communication. All imagery is geo-rectified using both aircraft attitude correction (pitch, yaw, and roll) and GPS positional information. Imagery can be processed while in flight or approximately 600 frames per hour can be processed once the data are downloaded from the aircraft. The high-resolution images (>20 MB each) are pulled from the ASPECT after the sortie and are available later.

All aerial photographic images collected by the ASPECT system are ortho-rectified and geospatially validated by the scientific reach back team. In general, this consists of conducting geo-registration using a USGS Digital Elevation Model (DEM) which promotes superior pixel computation and lessens topographic distortion. The image is check by the team (using a Google Earth base map) for proper location and rotation.

Airborne radiological measurements are conducted using three fully integrated multi-crystal sodium iodide (NaI) RSX4 gamma ray spectrometers. Each RSX4 spectrometer contains four 4”x2”x16” doped NaI crystals each having an independent photomultiplier/ spectrometer assembly. One RSX unit is configured with an additional upward NaI crystal utilized to provide real-time cosmic ray correction. Count and energy data from each crystal and pack is combined using a self-calibrating signal processor to generate a virtual detector output. All radiological spectrometer “packs” are further combined using a signal console controlled by the on-board central computer in the aircraft. Altitude correction data is provided by a radar altimeter with internal GPS systems within the packs serving as a backup. It should be noted that no radiological measurements were conducted on this mission.

Data is processed using automated algorithms onboard the aircraft with preliminary results being sent using a satellite system to the ASPECT scientific reach back team for QA/QC analysis. Upon landing, preliminary data results are examined and validated by the

scientific reach back team.

Table 1. ASPECT Automated Compounds

This table contains ASPECT's library of automated compounds.
Detection limits are for each chemical is found in parenthesis in units of parts per million (ppm)

Acetic Acid (2.0)	**Cumene (23.1)**	**Isoprene (6.5)**	**Phosphine (8.3)**
Acetone (5.6)	**Diborane (5.0)**	**Isopropanol (8.5)**	**Phosphorus Oxychloride (2.0)**
Acrolein (8.8)	**1,1-Dichloroethene (3.7)**	**Isopropyl Acetate (0.7)**	**Propyl Acetate (0.7)**
Acrylonitrile (12.5)	**Dichloromethane (6.0)**	**MAPP (3.7)**	**Propylene (3.7)**
Acrylic Acid (3.3)	**Dichlorodifluoromethane (0.7)**	**Methyl Acetate (1.0)**	**Propylene Oxide (6.8)**
Allyl Alcohol (5.3)	**1,1-Difluoroethane (0.8)**	**Methyl Acrylate (1.0)**	**Silicon Tetrafluoride (0.2)**
Ammonia (2.0)	**Difluoromethane (0.8)**	**Methyl Ethyl Ketone (7.5)**	**Sulfur Dioxide (15)**
Arsine (18.7)	**Ethanol (6.3)**	**Methanol (5.4)**	**Sulfur Hexafluoride (0.07)**
Bis-Chloroethyl Ether (1.7)	**Ethyl Acetate (0.8)**	**Methylbromide (60)**	**Sulfur Mustard (6.0)**
Boron Tribromide (0.2)	**Ethyl Acrylate (0.8)**	**Methylene Chloride (1.1)**	**Sulfuryl Fluoride (1.5)**
Boron Triflouride (5.6)	**Ethyl Formate (1.0)**	**Methyl Methacrylate (3.0)**	**Tetrachloroethylene (10)**
1,3-Butadiene (5.0)	**Ethylene (5.0)**	**MTEB (3.8)**	**1,1,1-Trichloroethane (1.9)**
1-Butene (12.0)	**Formic Acid (5.0)**	**Naphthalene (3.8)**	**Trichloroethylene (2.7)**
2-Butene (18.8)	**Freon 134a (0.8)**	**n-Butyl Acetate (3.8)**	**Trichloromethane (0.7)**
Carbon Tetrachloride (0.2)	**GA (Tabun) (0.7)**	**n-Butyl Alcohol (7.9)**	**Triethylamine (6.2)**
Carbonyl Fluoride (0.8)	**GB (Sarin) (0.5)**	**Nitric Acid (5.0)**	**Triethylphosphate (0.3)**
Carbon Tetraflouride (0.1)	**Germane (1.5)**	**Nitrogen Mustard (2.5)**	**Trimethylamine (9.3)**
Chlorodifluoromethane (0.6)	**Hexafluoroacetone (0.4)**	**Nitrogen Trifluoride (0.7)**	**Trimethyl Phosphite (0.4)**
Chloromethane (12)	**Isobutylene (15)**	**Phosgene (0.5)**	**Vinyl Acetate (0.6)**