N5HIELD™ - *Rapid, Accurate Ignition Detection System*

Powered by

N5 Sensors

Debra Deininger (CRO), ddeininger@n5sensors.com

N5 Sensors – Who We Are

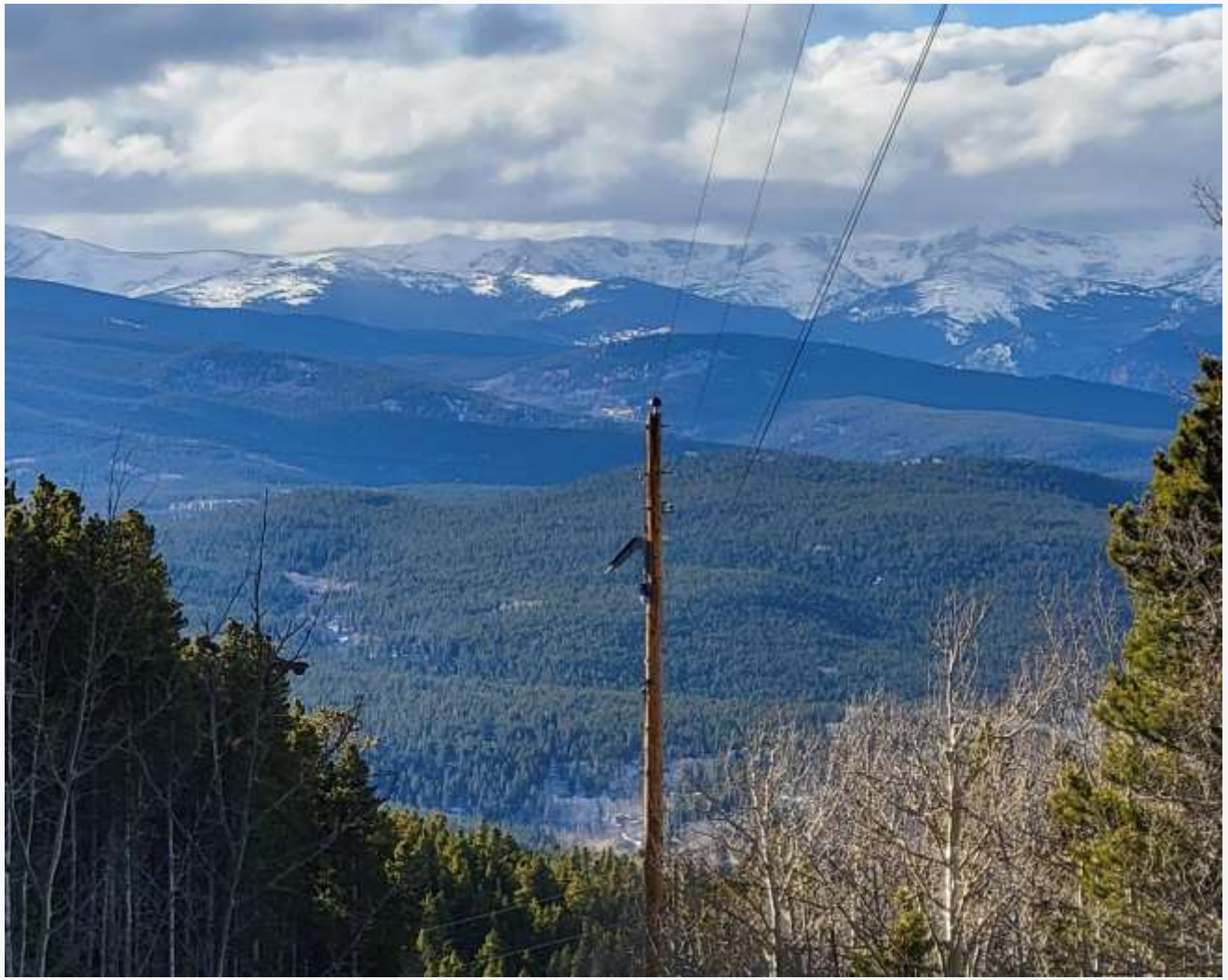
Company Snapshot

- Founded in 2012
- Univ. of Maryland Spin-Off
- Based in Rockville, Maryland
- 32 Team Members
- Offices in MD and CO

We Use Sensors, Data and AI, to Keep People, Communities, and Infrastructure Safe.

Agenda

- Typical Wildfire Detection Tools
- Ground-Based Wildfire Detection and Air Quality - Intro
- DHS S&T and USFA Deployment and Test Process
- How it Works: HW + AI
- Where it Fits & Current Deployments
- Lessons Learned and Next Steps



Wildfire (aka Bushfire) Detection

"911"

Most US Fires still reported by Citizens

Inaccurate?

Unpredictable?

Satellite

Monitoring Large Fires

GEO – Resolution?

LEO – Speed?

Camera + Ai

Smoke Colmns

24/7?

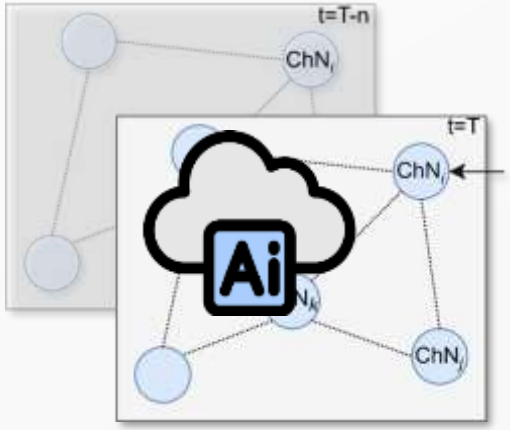
Accuracy?

Maintenance?

What Does it Do?

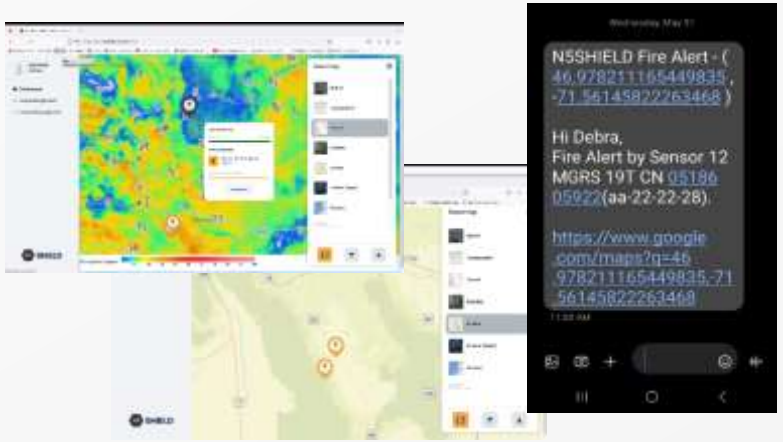
Multimodal Sensor Network

- ❑ Orthogonal Sensor Fusion
- ❑ Massive Environmental Data
- ❑ Minimal Infrastructure



Powerful Edge and Cloud Ai

- ❑ Fast Detection, Day/Night
- ❑ Low False Alarm Rate
- ❑ Network Based



Human-Centric Data and Alert Management

- ❑ 24/7 Text, Email Alert Notification
- ❑ AI+ Human Intelligence for Alert Processing
- ❑ API Based Real-time Data Access

N5 – Wildfire Product and DHS S&T Support

Lab Studies

4 Vendors
Prescribed Fire
CAL FIRE

2 Vendors
100 Sensos Each
US & Canada

N5 Only
245 Sensors
US & Canada

2020 2021 2022 2023 2024

Lab Studies

https://www.fireprotectionengineering-digital.com/fireprotectionengineering/q3_2022/MobilePagedReplica.action?pm=2&folio=48#pg50

- Initial atmospheric modeling estimates type & concentration of gases and particulate at remote distances from incipient wildfires
- Wildfire detection systems operate detect low levels of pollutants
- Fire protection engineers developed a laboratory-scale methodology for testing systems

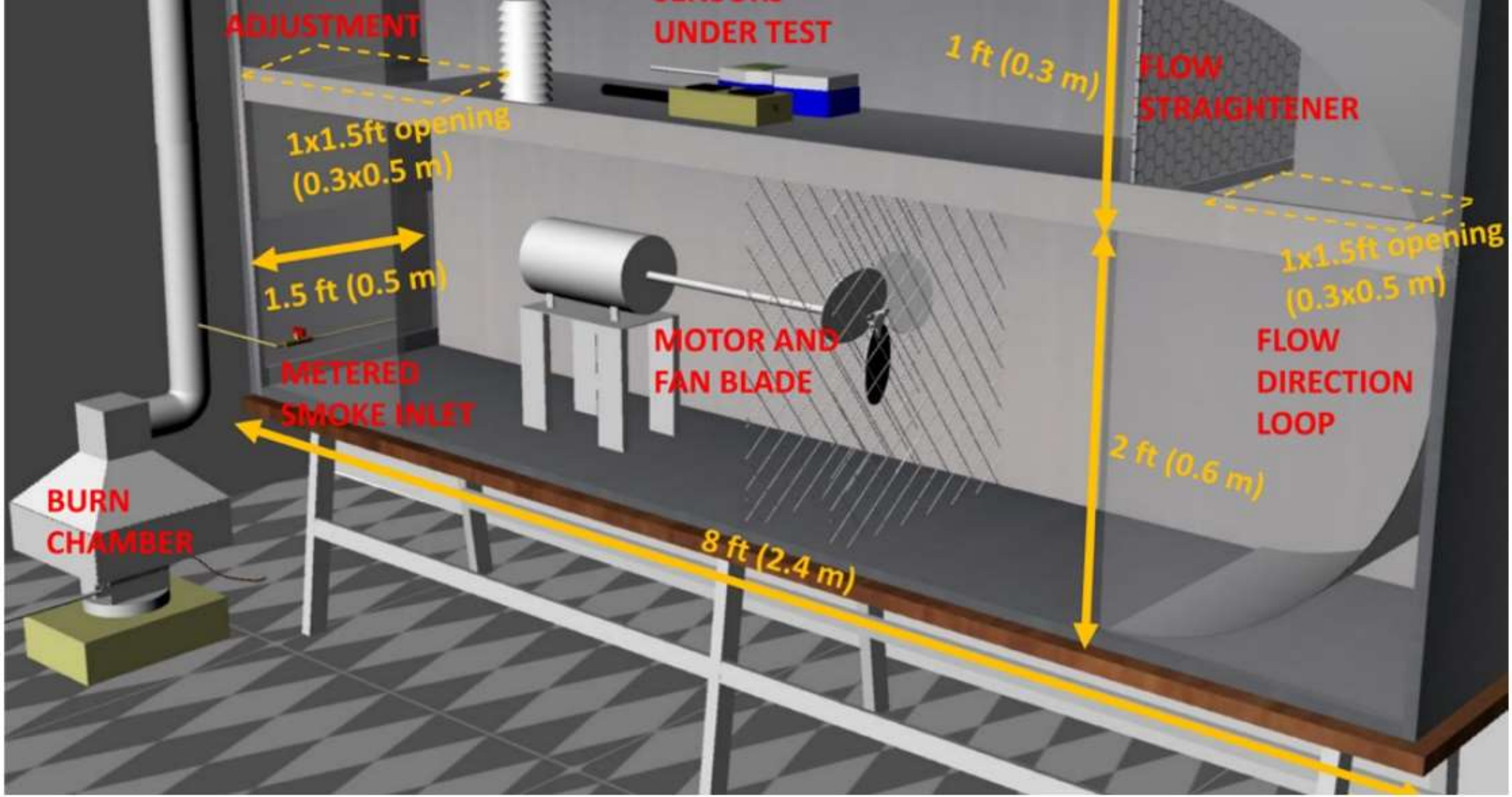


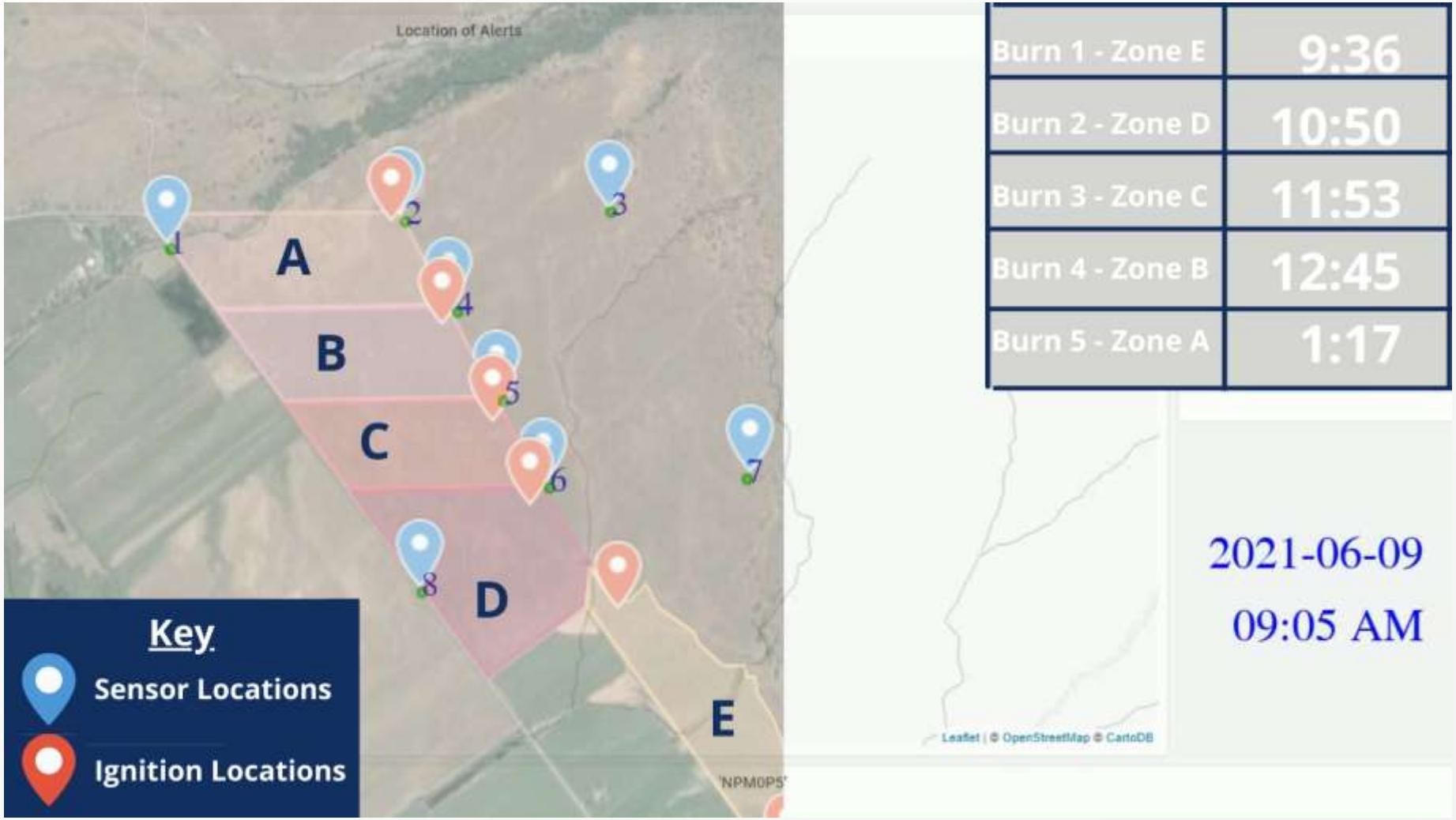
FIGURE 2. Laboratory EWWD Bench-Testing Apparatus

Prescribed Fire

- DHS + CAL FIRE pilot study
- Sensors placed around prescribed burns in the state of California.
- Two days & ten separate ignition events
- Measured by sensors located among the surrounding hills
- Additional testing throughout US & Canada

FIGURE 4. Grass Field Fire Used to Test Sensors in the Prescribed Burn Field Tests

California Training and Testing– June 9 2021



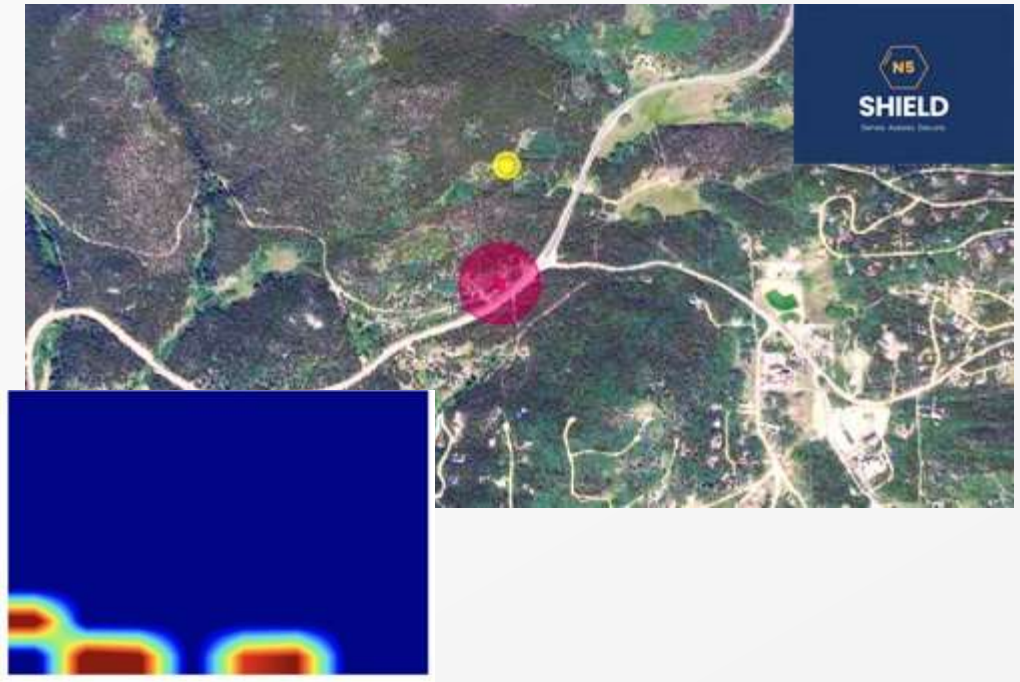
Burn 1 - Zone E	9:36
Burn 2 - Zone D	10:50
Burn 3 - Zone C	11:53
Burn 4 - Zone B	12:45
Burn 5 - Zone A	1:17

2021-06-09
09:05 AM

Colorado Training & Wildfire Detection Feb 2 2022

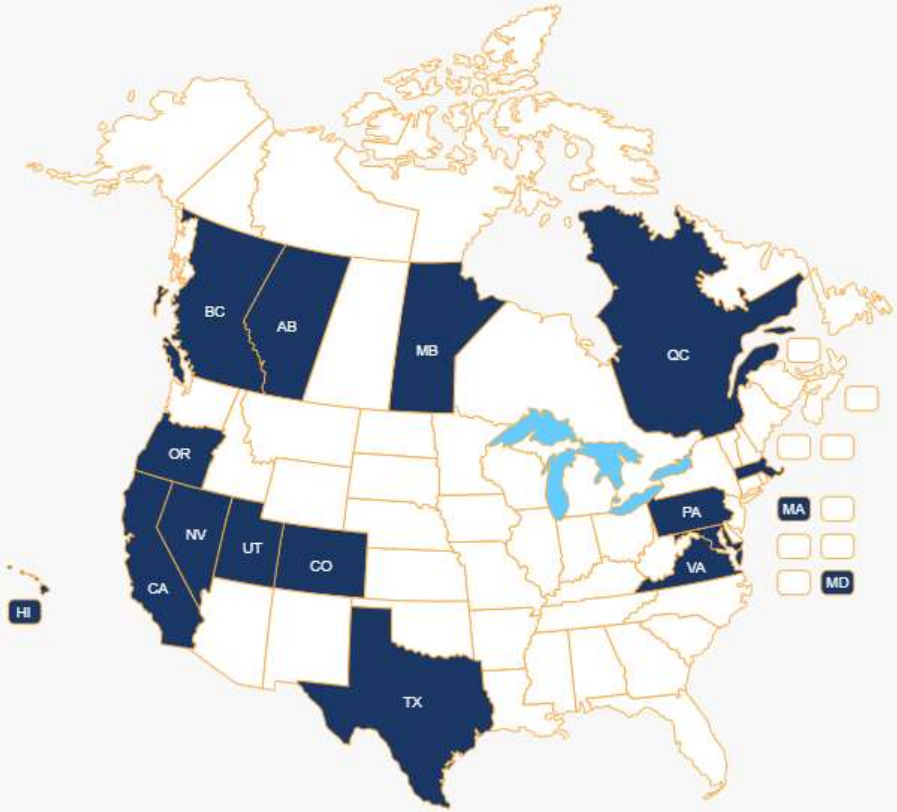
Flare up detected 36 minutes before 911 caller

10:00	12:00	14:00	16:00	18:00	19:30	20:06
Planned Fire Started		Fires Extinguished			Flare up detected	911 Caller



MSG:CAD:FYI: ;11000 HWY 119;7204092668 DIST: 11.15 ft;MM 11 HWY 119;FIRE MISC;PARTY WAS DRIVING BY
(Con't) 2 of 4
[02/02/22 20:06:28 SHARTVIGSON] SEEING A FIRE// RIGHT SIDE 119//SEES FLAMES// WEST SIDE OF HIGH WAY//CAN'T TELL WHAT IT IS BUT SEES
(Con't) 3 of 4
FLAMES//AT LEAST SEVERAL FEET WIDE//THERE WERE A FEW OF THEM [02/02/22 20:06:22 SHARTVIGSON] ;02/02/2022 20:04:32;D009;MISSOURI GULCH
(Con't) 4 of 4
RD;CREST VIEW DR;TL7;FD07;22001884;FIRE;BH(End)

2023



- 2 TB Data
- 1M+ acres protected
- 185 Fire Alerts
- 0.06% False Positives
- 1588 Air Quality Warnings

MAR 2024

Office of the Governor
GOVERNOR JOSH GREEN, M.D.
Ke Ke'ena O Ke Kia'āina

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Home » Latest Department News, Newsroom, Office of the Governor Press Releases » Office of the Governor – News Release – Dept. of Homeland Security Deploys Wildfire Sensors to Mitigate and Manage Fires in Hawai'i, Keep Communities Safe and Resilient

OFFICE OF THE GOVERNOR – NEWS RELEASE – DEPT. OF HOMELAND SECURITY DEPLOYS WILDFIRE SENSORS TO MITIGATE AND MANAGE FIRES IN HAWAIʻI, KEEP COMMUNITIES SAFE AND RESILIENT

Posted on Mar 8, 2024 in Latest Department News, Newsroom, Office of the Governor Press Releases

JOSH GREEN, M.D.

GOVERNOR
KE KIA'ĀINA

DEPARTMENT OF HOMELAND SECURITY DEPLOYS WILDFIRE SENSORS TO MITIGATE AND MANAGE FIRES IN HAWAI'I, KEE COMMUNITIES SAFE AND RESILIENT

Wildfire Sensor Technology Aims to Detect Fires and Save Lives

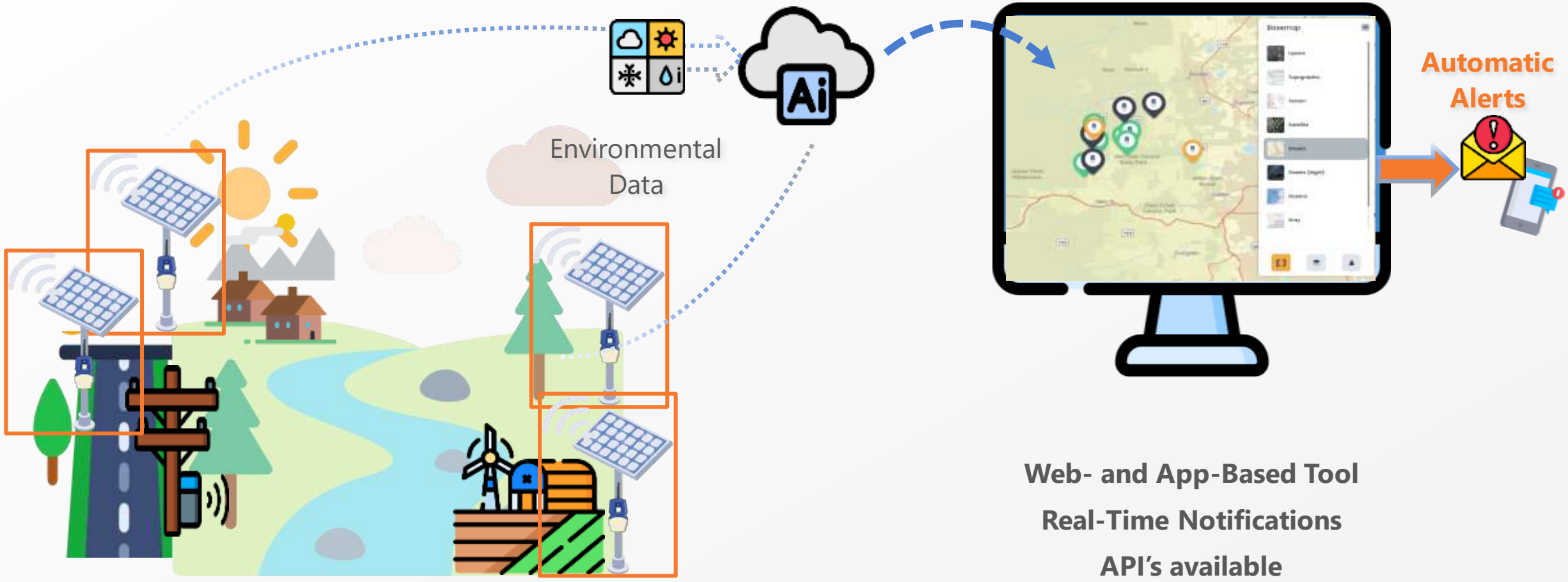
FOR IMMEDIATE RELEASE
March 8, 2024

WAILEA, MAUI, HAWAI'I – Governor Josh Green, M.D., Maui County Mayor Richard Bissen, and state of Hawai'i Department of Defense Adjutant General Kenneth Hara today joined the U.S. Department of Homeland Security (DHS) Science and Technology Directorate (S&T) and the U.S. Fire Administration (USFA) in announcing the planned deployment of 80 wildfire sensors and 16 wind sensors across Hawai'i. The initiative reflects the Homeland Security Department's continued commitment to support long-term recovery efforts following the unprecedented wildfires on Maui, while advancing innovative solutions for extreme weather

APRIL 2024

- Over 3 TB Data
- Over 250 Fire Alerts (total)
- New US Deployments
- New International Pilots: Australia, Portugal, South America

How Does it Work? - Hardware



Web- and App-Based Tool

Real-Time Notifications

API's available

Multimodal Sensors

Gas & Chemical Sensor + Particulate + Thermal IR

Data Transmission

Cloud uploads every 18 seconds

Communication

LTE / LoRa / Satellite

Ruggedized Construction

IP65

Power

Solar Panel / Rechargeable Battery

ChemNode™ Sensors

Sensor Type / Parameter	Specification
Particle Sensor Type	Laser Particulate Matter Sensor
Mass Concentration Size Range	1.0, 2.5, 4.0, 10 µm
Mass Concentration Range	0 to 1000 µg/m^3
Heat Sensor Type	Infrared Array Sensor
Heat Sensor Dimensional Area	8 x 8 (64 pixels)
Heat Sensor Range	-4°F to +212°F
Heat Sensor Viewing Angle	60°
Gas Sensor Array Type	Custom Semiconductor Photocatalytic Hybrid (SPH) Array Recognize patterns associated with gases produced by wildfires near and far. Wildfire smoke is a complex chemical mixture including NOx, O_3, and other species. Gas sensor array enables future detection of non-fire threats • Environmental Air Quality (NOx, O_3, SOx) • Explosion Hazards (Hydrogen, Oxygen, Volatiles) • Toxic and Corrosive Gases
Gas Sensor CO_2 Sensor Type	Photoacoustic
Environmental Sensor Type	Temperature, Humidity, Pressure

ChemNode™ + NEW Wind Sensor (prototype)

- Hyperlocal Wind
- Enhanced Data Accuracy
- Prototype launch Q2/24
- Bluetooth Enabled

- 3

Communications

LTE ChemNodes

LoRa ChemNodes

LTE Tower (Ex, ATT, Verizon, T-Mobile)

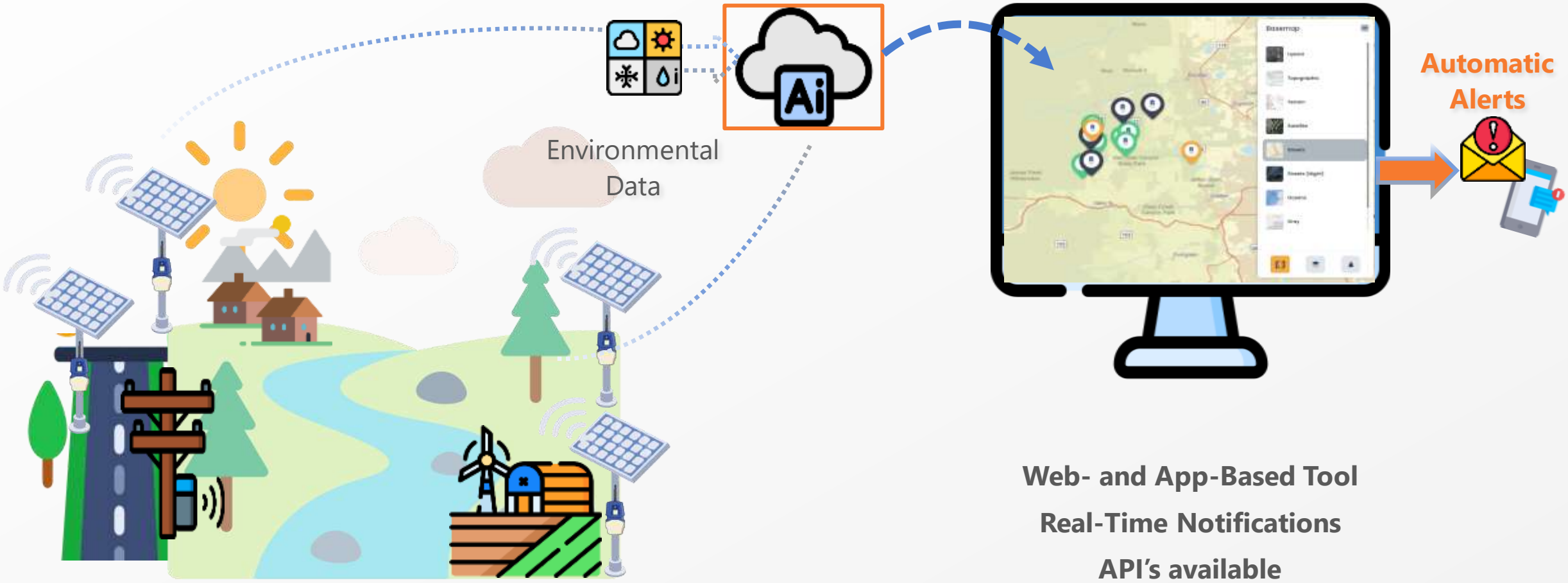
N5 LoRa Gateways

aws

Customer N5SHIELD Dashboard

+ APP and Texts

How Does it Work? Edge and Cloud Ai



Web- and App-Based Tool

Real-Time Notifications

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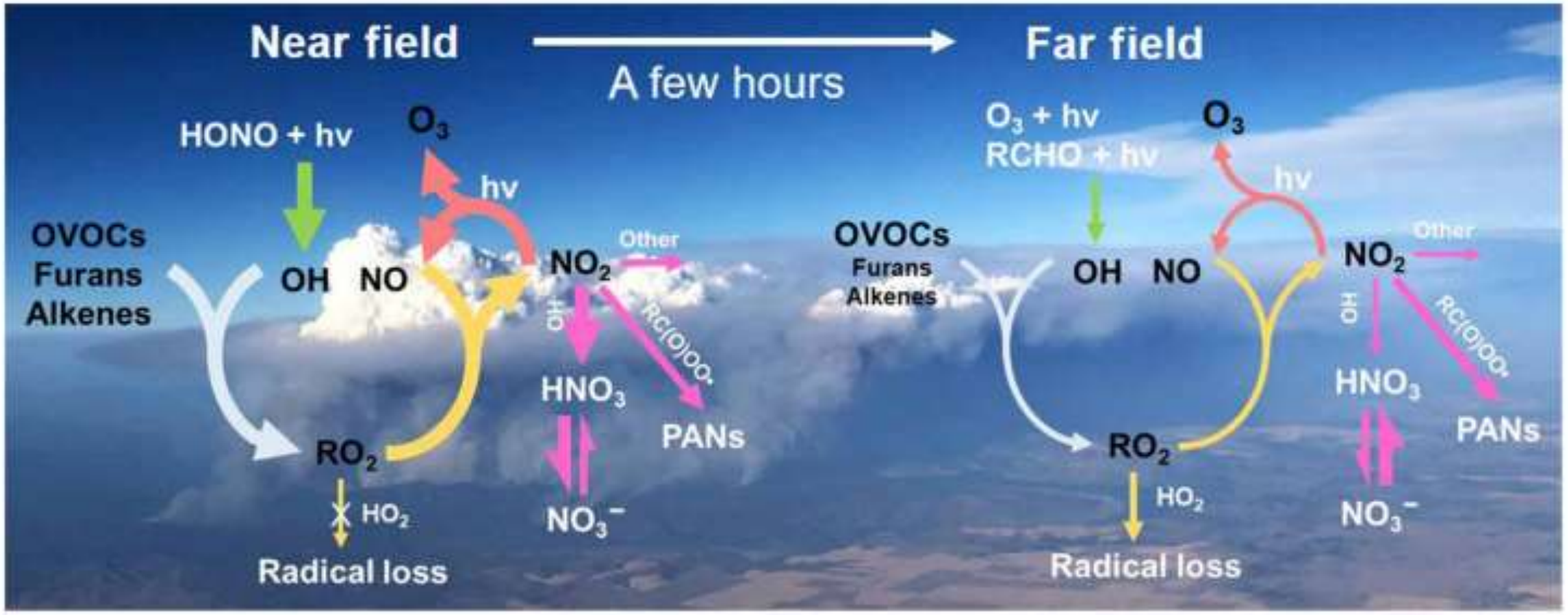
Smoke Chemistry

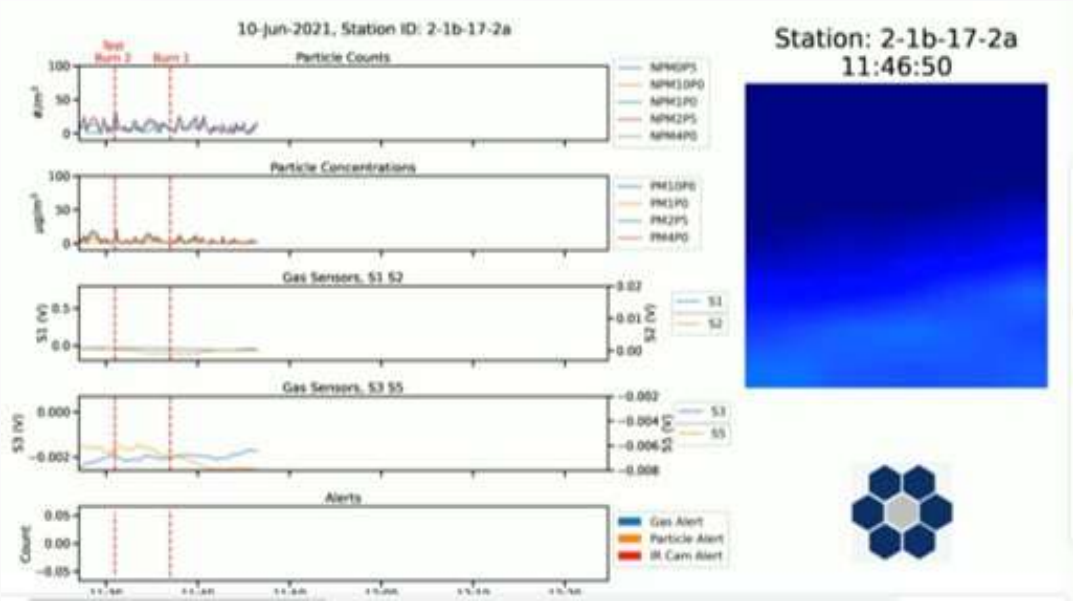


Gas, Chemical, Particulate Patterns Change with Distance

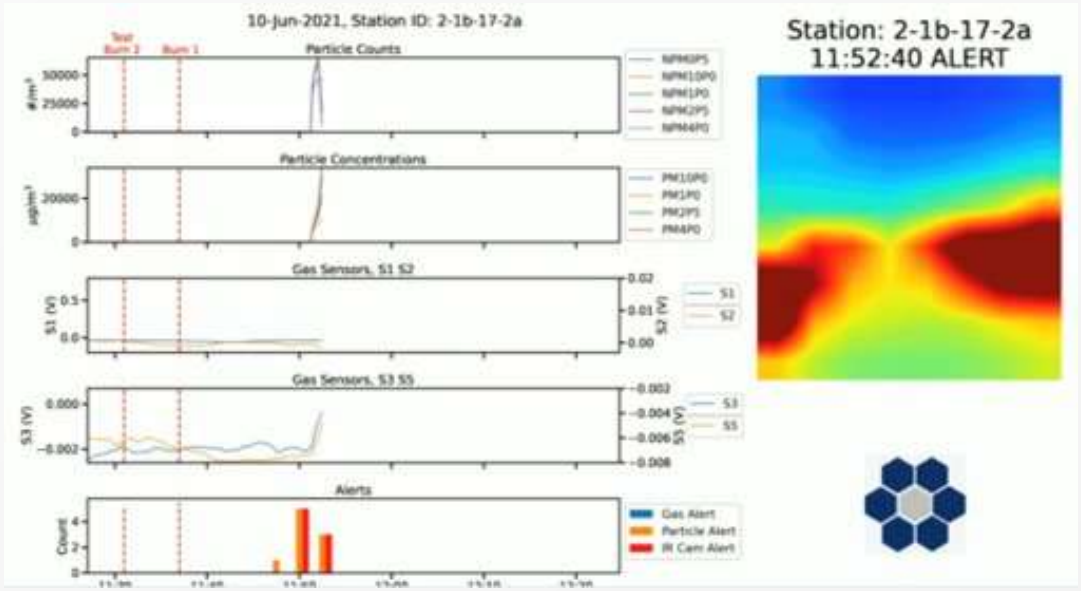
Additional information on wildfire smoke chemistry
Image taken from Xu et al., Sci. Adv. 7, eabl3648 (2021) 8 December 2021

Ground Based Sensors – Data Collection

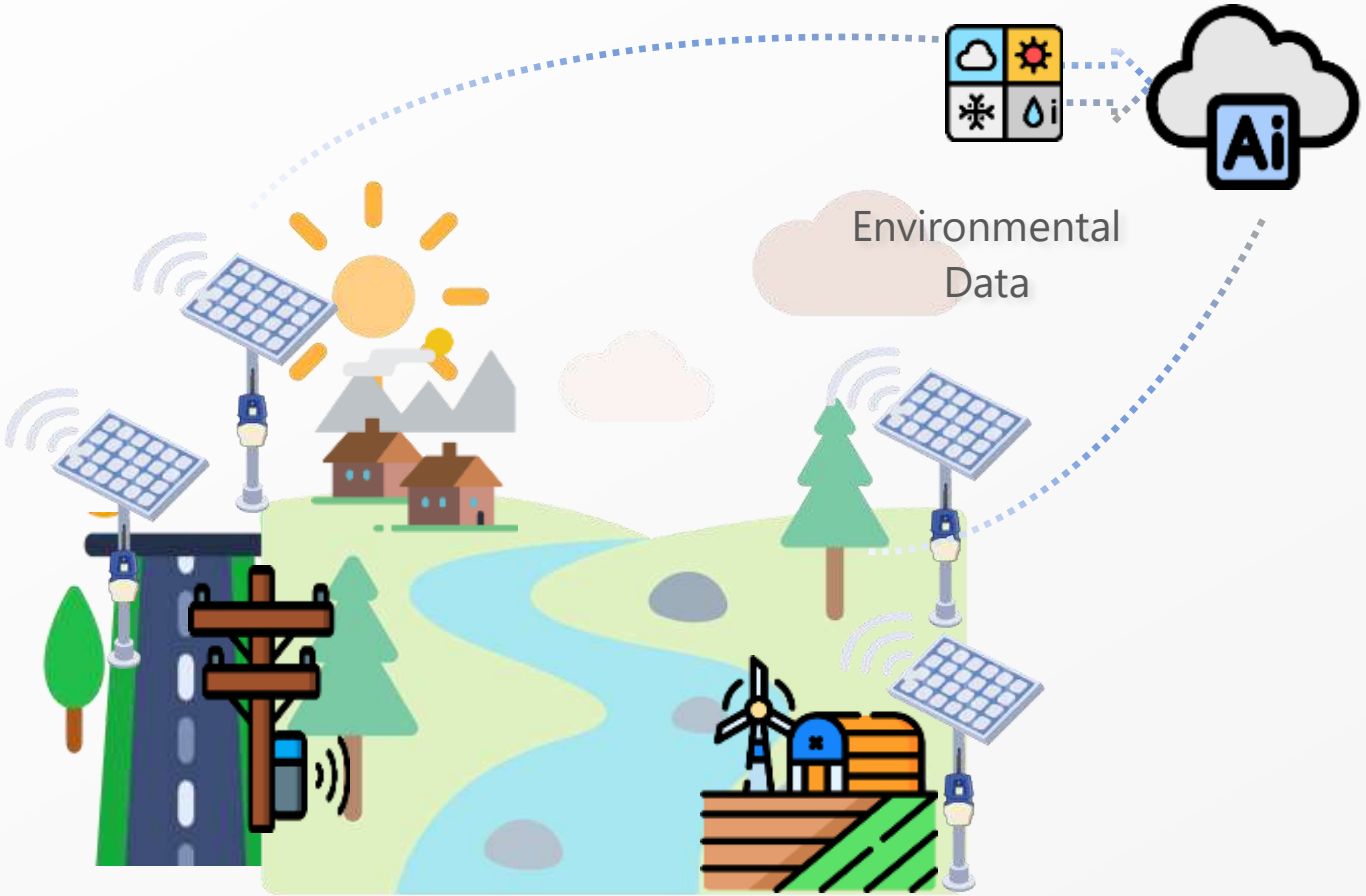
No Fire



FIRE



How Does it Work? Interface & Information

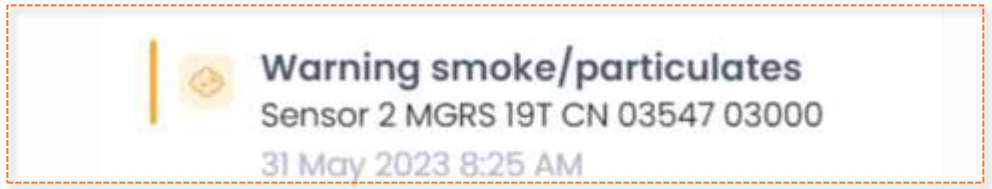


Web- and App-Based Tool

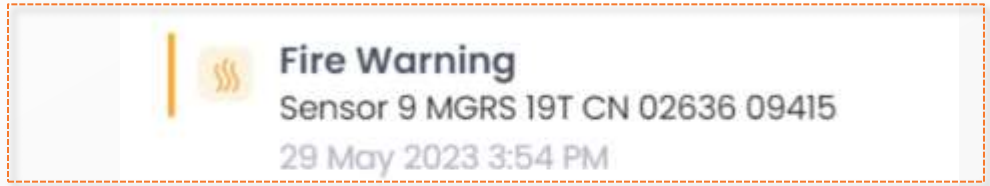
Real-Time Notifications

API's available

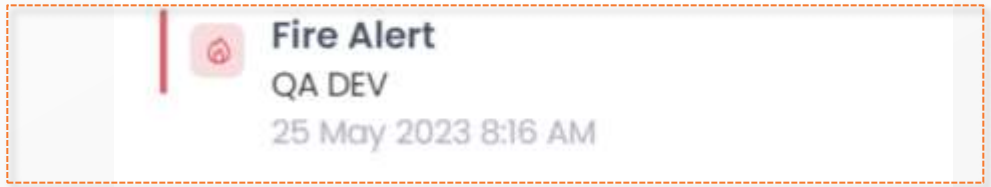
N5SHIELD™ Alert and Warning



Particulate Matter (1, 2.5, 4, and 10) micrometer is above a certain threshold indicating unhealthy air quality

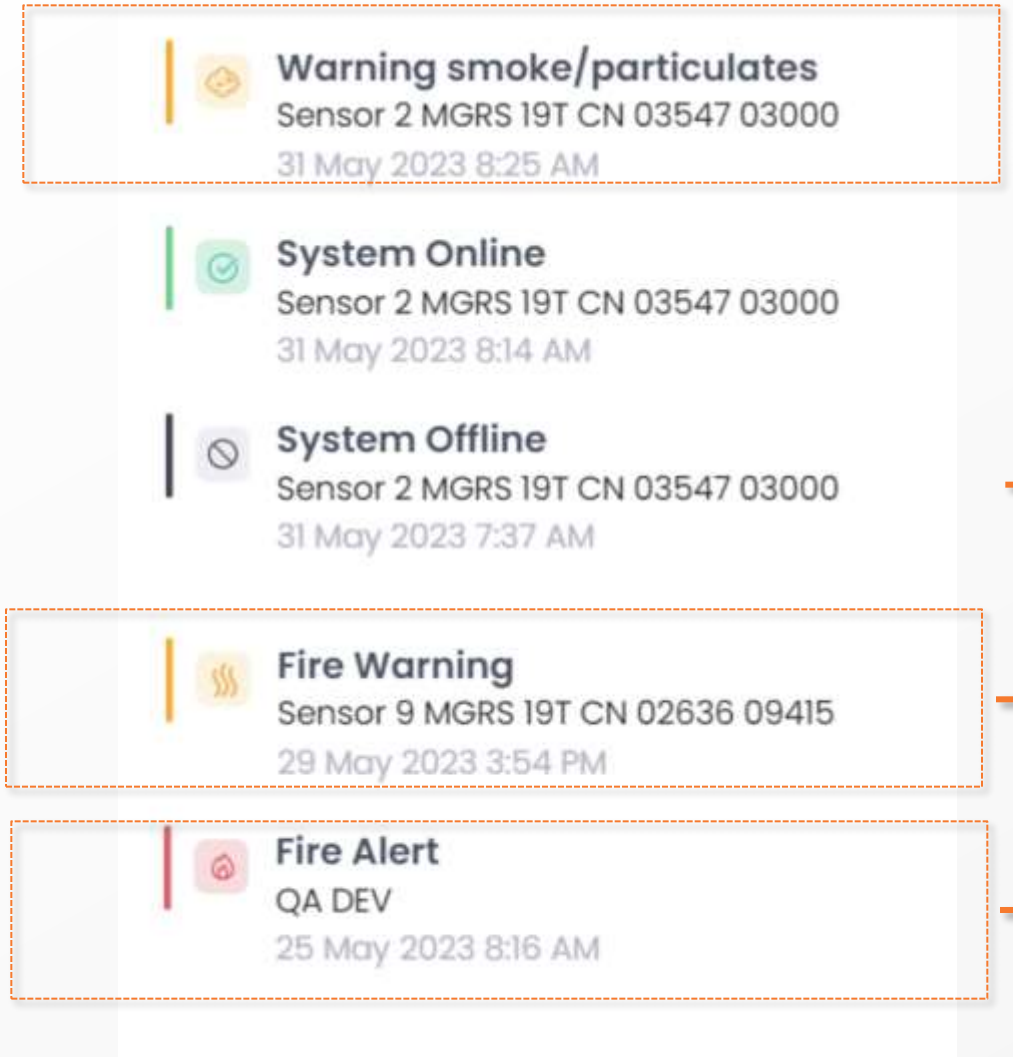


Potential Fire That Warrants Further Monitoring and / or Investigation. Fire Warning is only visible on the dashboard (No text/sms generated)



High Confidence Fire Alert, which issues a text/SMS message to registered numbers

N5SHIELD™ Alert and Warning



Particulate Matter (1, 2.5, 4, and 10) micrometer is above a certain threshold indicating unhealthy air quality

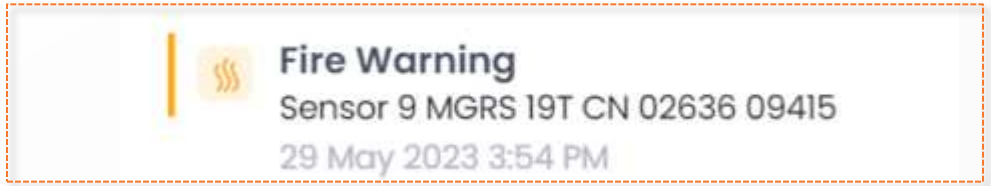
Indicating System Has Reestablished Connectivity

System is not connected

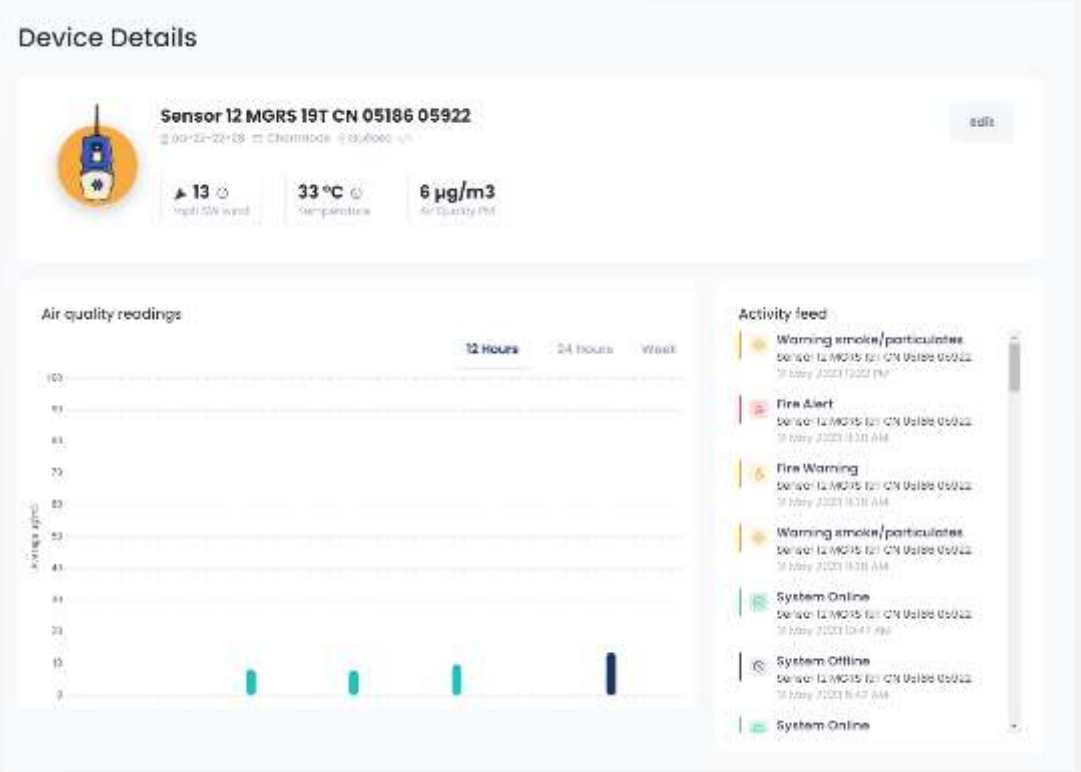
Potential Fire That Warrants Further Monitoring and / or Investigation. Fire Warning is only visible on the dashboard (No text/sms generated)

High Confidence Fire Alert, which issues a text/SMS message to registered numbers

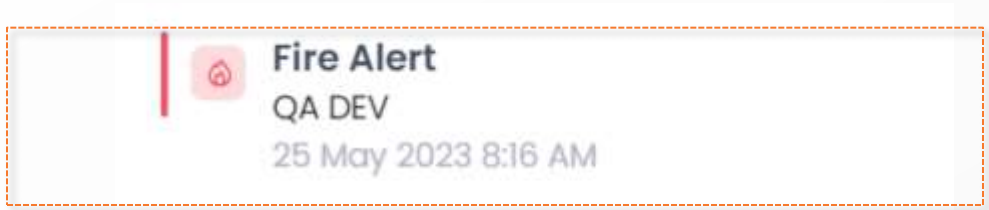
N5SHIELD™ Fire Warning



Potential Fire That Warrants Further Monitoring and / or Investigation. Fire Warning is only visible on the dashboard (No text/sms generated)



N5SHIELD™ Fire Alert



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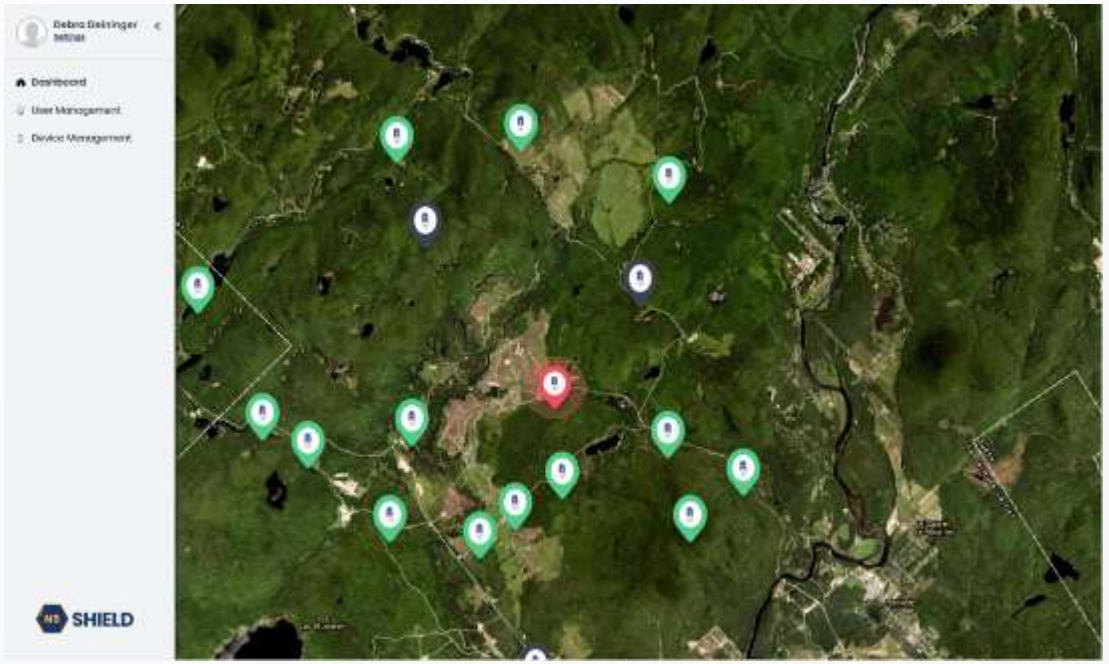
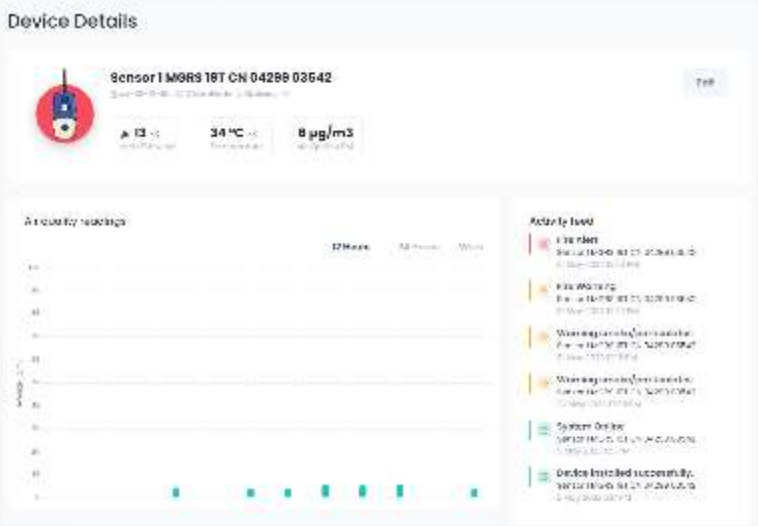
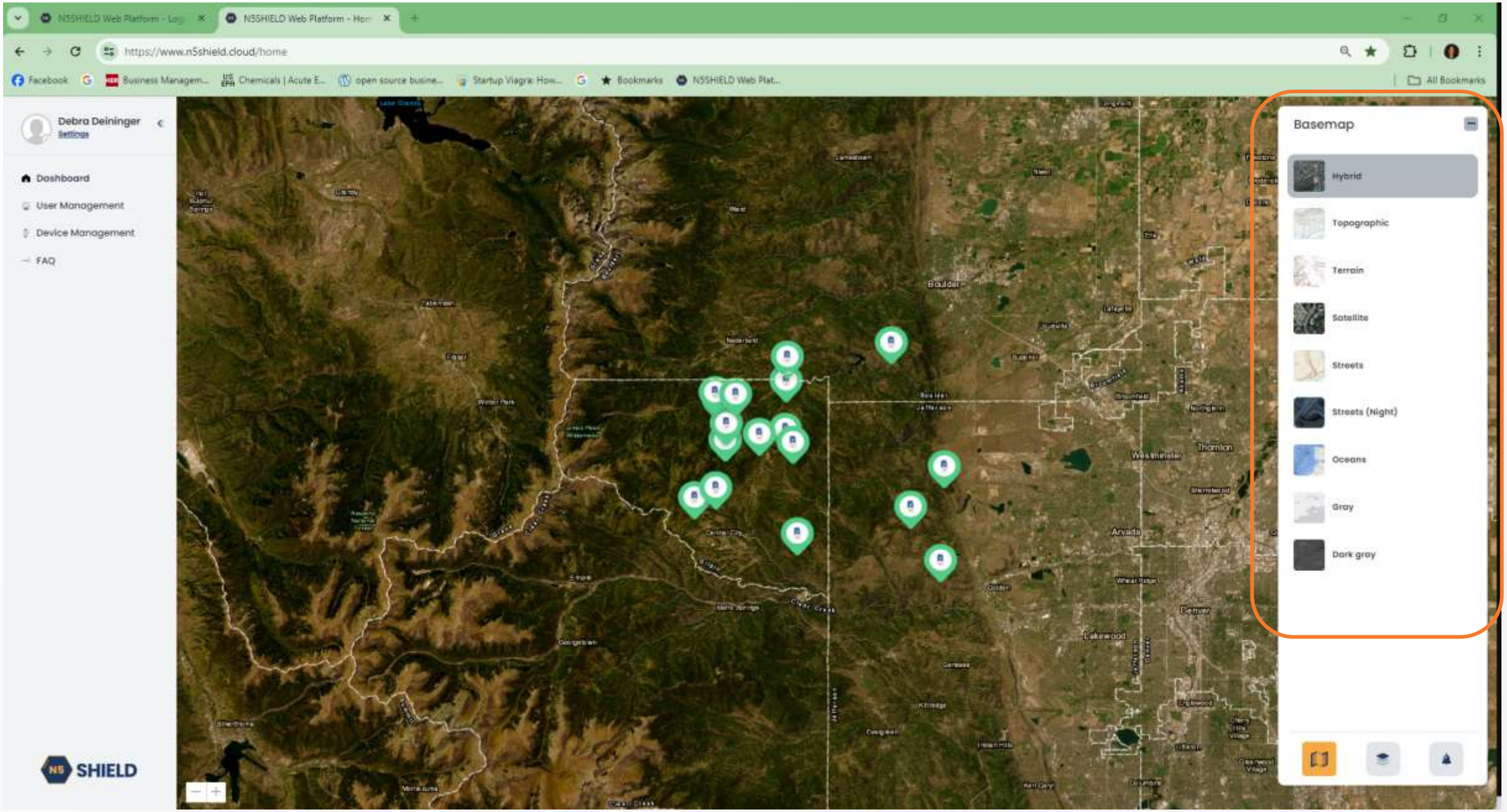
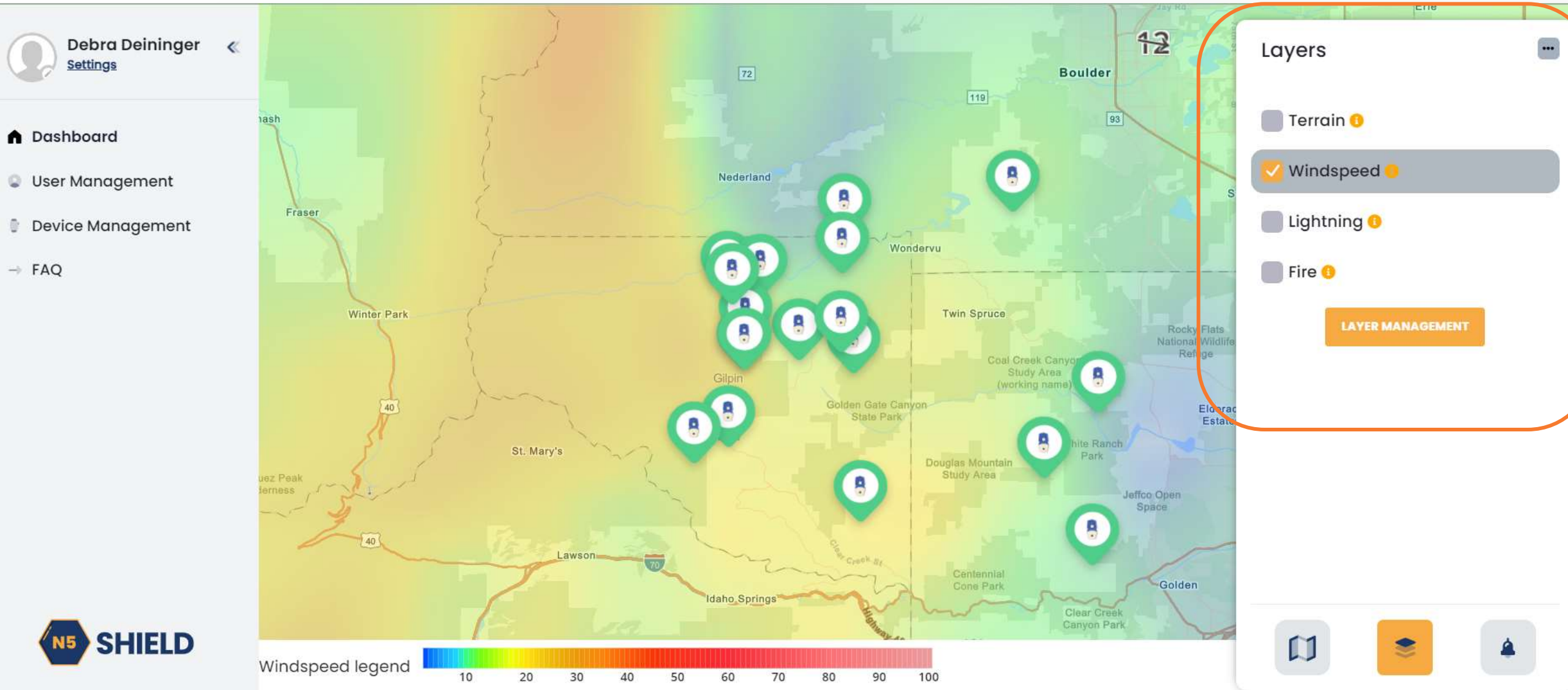





N5SHIELD Web Platform - Log
N5SHIELD Web Platform - Hon
https://www.n5shield.cloud/home
Facebook
Business Managem...
Chemicals | Acute E...
open source busine...
Startup Viagra: How...
Bookmarks
N5SHIELD Web Plat...
All Bookmarks
Debra Deininger
Settings
Dashboard
User Management
Device Management
FAQ
SHIELD
Basemap
Hybrid
Topographic
Terrain
Satellite
Streets
Streets (Night)
Oceans
Gray
Dark gray
Boulder
Arvada
Denver
Lakewood
Thornton
Westminster


Debra Deininger
Settings
Dashboard
User Management
Device Management
FAQ
N5 SHIELD
Boulder
Nederland
Fraser
Winter Park
Gilpin
Wondervu
Twin Spruce
St. Mary's
Golden Gate Canyon State Park
Coal Creek Canyon Study Area (working name)
Douglas Mountain Study Area
Jeffco Open Space
Centennial Cone Park
Golden
Clear Creek Canyon Park
Lawson
Idaho Springs
Windspeed legend
10 20 30 40 50 60 70 80 90 100
Layers
Terrain
Windspeed
Lightning
Fire
LAYER MANAGEMENT

Device Details

aa-22-17-46

aa-22-17-46 ChemNode Golden, Colorado

Edit

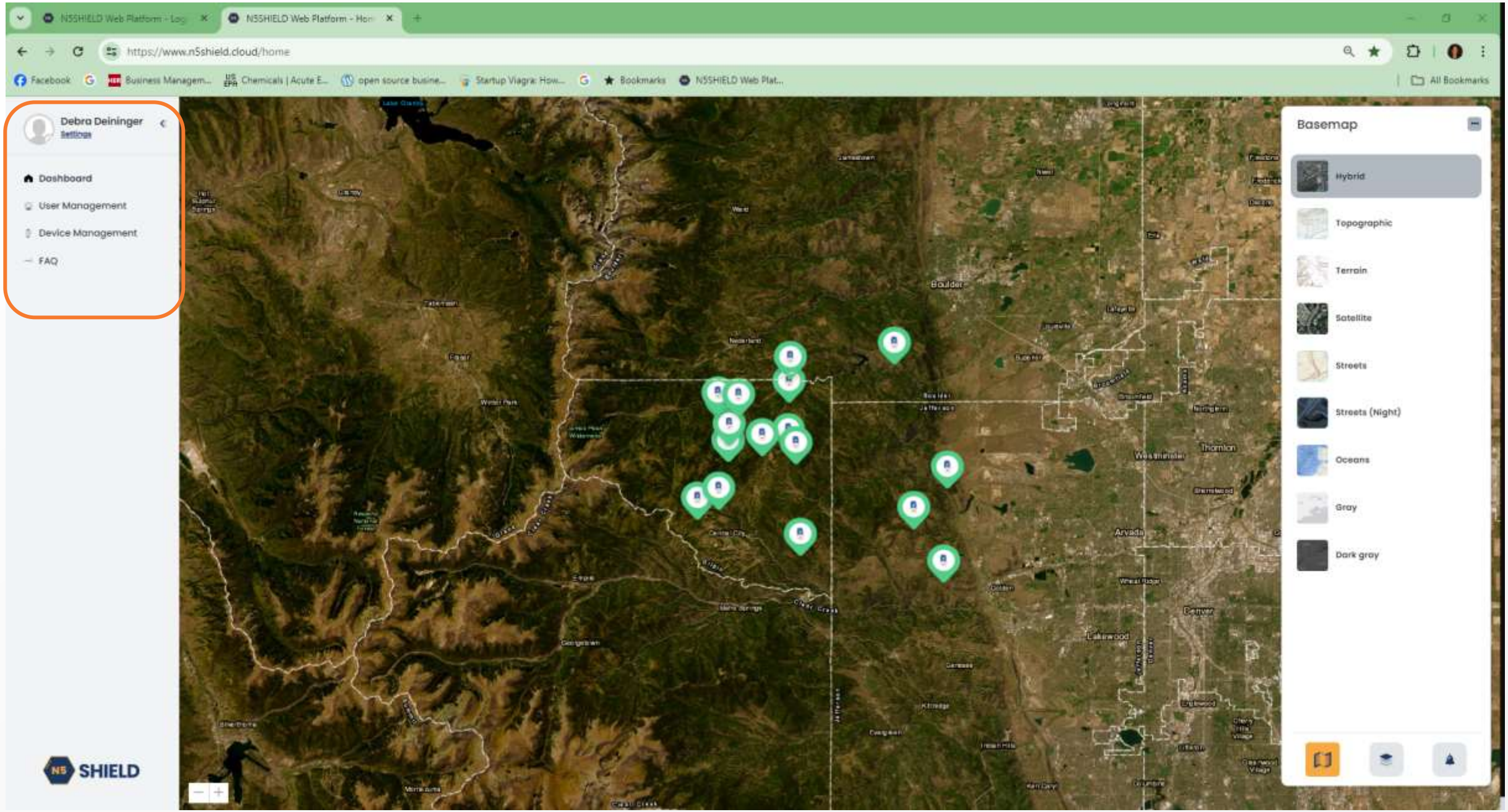
➤ 35	-2 °C	0 µg/m^3	71 %
kmph W wind	Temperature	Air Quality pm 1.0	Relative Humidity

Air quality readings

12 Hours | 24 Hours | Week

Activity feed

- **System Online**
  aa-22-17-46
  29 Oct 2023 8:47 AM
- **System Offline**
  aa-22-17-46
  29 Oct 2023 8:47 AM
- **System Online**
  aa-22-17-46
  1 Jul 2023 2:33 AM
- **System Offline**
  aa-22-17-46
  1 Jul 2023 2:27 AM
- **System Online**
  aa-22-17-46
  16 May 2023 1:35 AM


N5SHIELD Web Platform - Log
N5SHIELD Web Platform - Hom
https://www.n5shield.cloud/home
Facebook
Business Managem...
Chemicals | Acute E...
open source busine...
Startup Viagra: How...
Bookmarks
N5SHIELD Web Plat...
All Bookmarks
Debra Deininger
Settings
Dashboard
User Management
Device Management
FAQ
SHIELD
Basemap
Hybrid
Topographic
Terrain
Satellite
Streets
Streets (Night)
Oceans
Gray
Dark gray
Boulder
Arvada
Denver
Lakewood
Thornton
Westminster













Deployment Guidelines

- Site Review
  - Online review of potential locations for existing infrastructure and analysis of LTE coverage
  - Stakeholder inputs and risk mitigation plans
  - For remote areas with poor LTE coverage, onsite analysis of signal strength or LoRa deployment sites.
  - N5 usually loans HW to make measurements.
- Installation Support
  - ChemNodes are charged prior to shipment
  - App based installation
- Certain installations require specialized skill (e.g. utility infrastructure); most can be handled by user

Manitoba Canada Survey Report

N5 SHIELD

N5 Shield Coverage

Figure 1: Map indicating desired scan points with potential gateway, repeater and chemnode install locatio

Location Analysis

Figure 2: Map indicating the connection mesh for network propagation

The gateway and repeater network can be seen in Figure 2 above. Due t LTE, a proprietary N5 network mesh is created consisting of 2 gateway uplinks and

Connection Analysis

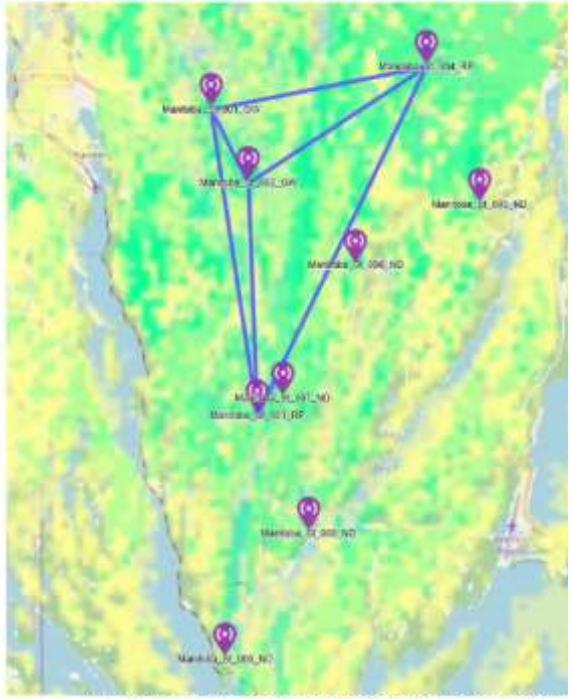


Figure 3: Simulation of the signal propagation for the 4 selected gateway and repeater sites

Map

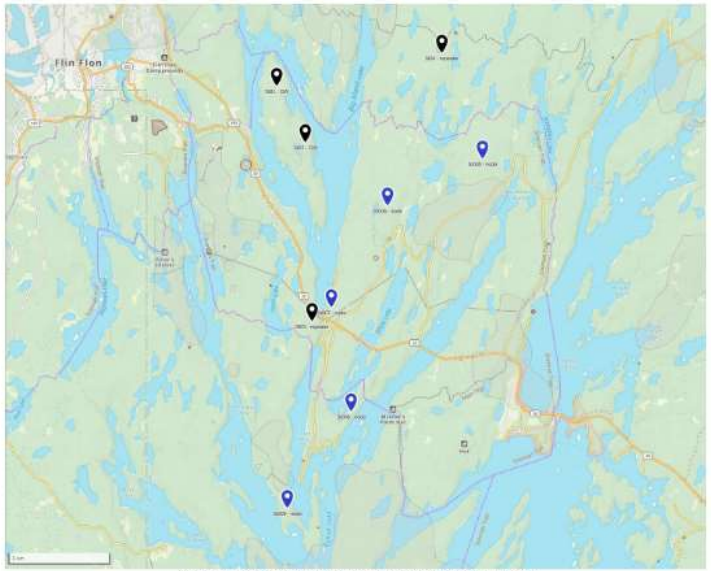


Figure 18: Map showing locations to scan and potentially install

The potential installation sites listed in Table 1 should be visited and assessed. Using an LTE scanner provided by N5, capture the LTE metrics at each location. After connection review, deployment may be adjusted before generating a full deployment report.

Lessons Learned and Next Steps

- We can detect early fire ignitions with the “Sense of Smell”
- Extending to new locations
- Optimizing deployment planning and guidelines
- Adding Additional training and test data
- Data Integrations
  - With cameras
  - With sprinklers
  - With NERIS (https://www.usfa.fema.gov/nfirs/neris/)

Contact Us

N5 Sensors

9605 Medical Center Drive, Suite #200
Rockville, MD 20850

877.451.FIRE (3473)

info@n5sensors.com