



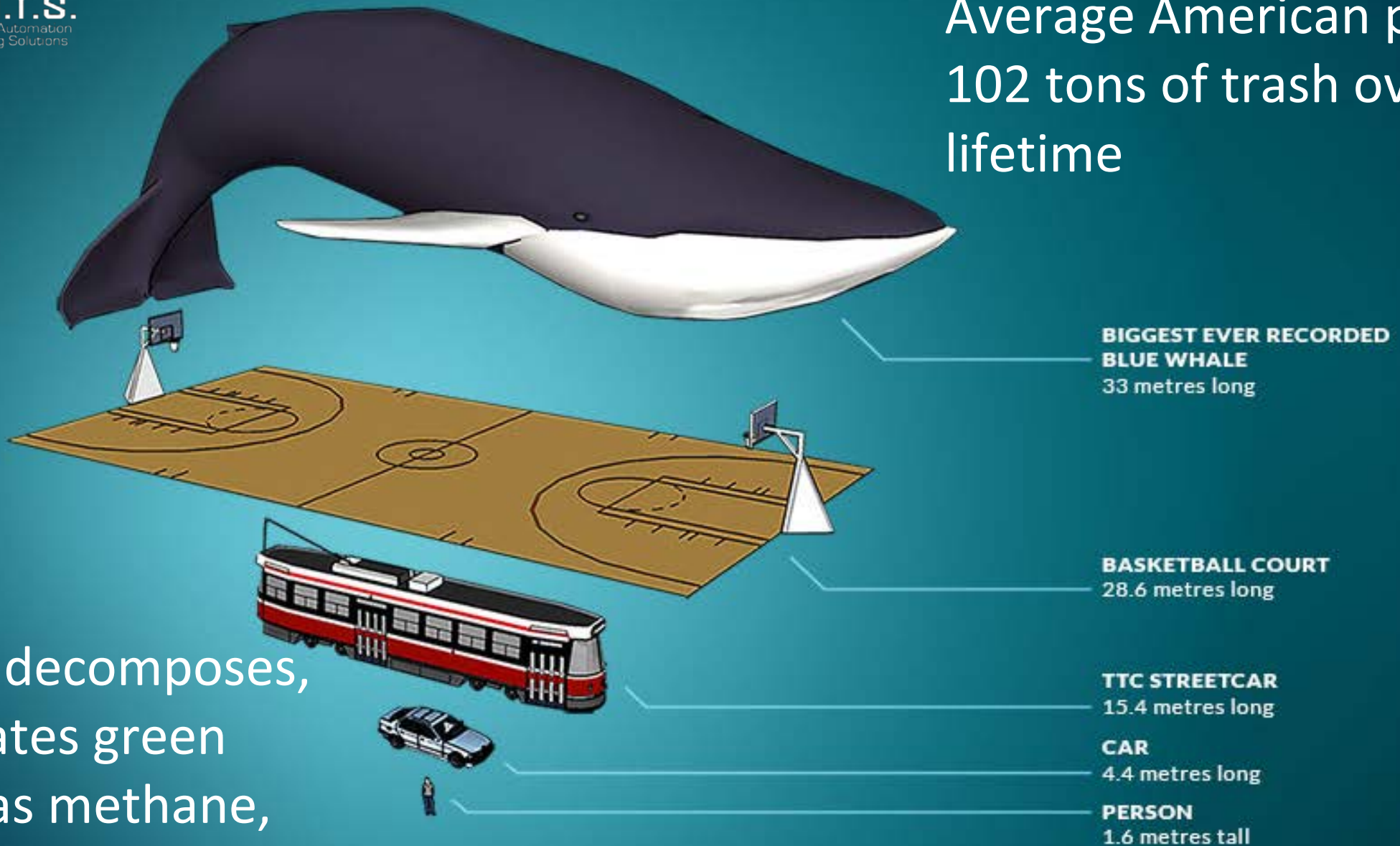
Environmental Monitoring System with Human Autonomy Teaming Technologies

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The U.S. is the number one
generator of trash in the world

Average American produces
102 tons of trash over their
lifetime



As trash decomposes,
it generates green
house gas methane,
contributing to
climate change

To Address This Directly ...

“We need enhanced environmental monitoring to deliver real time actionable data to find leaks and validate abatement projects.”

Dr. Eugene Tseng, Environmental engineer and attorney

Sunshine Canyon landfill case study: NASA has benchmarked a 60% reduction of methane flux with monitoring and odor mitigation measures

1/2016



5/2017

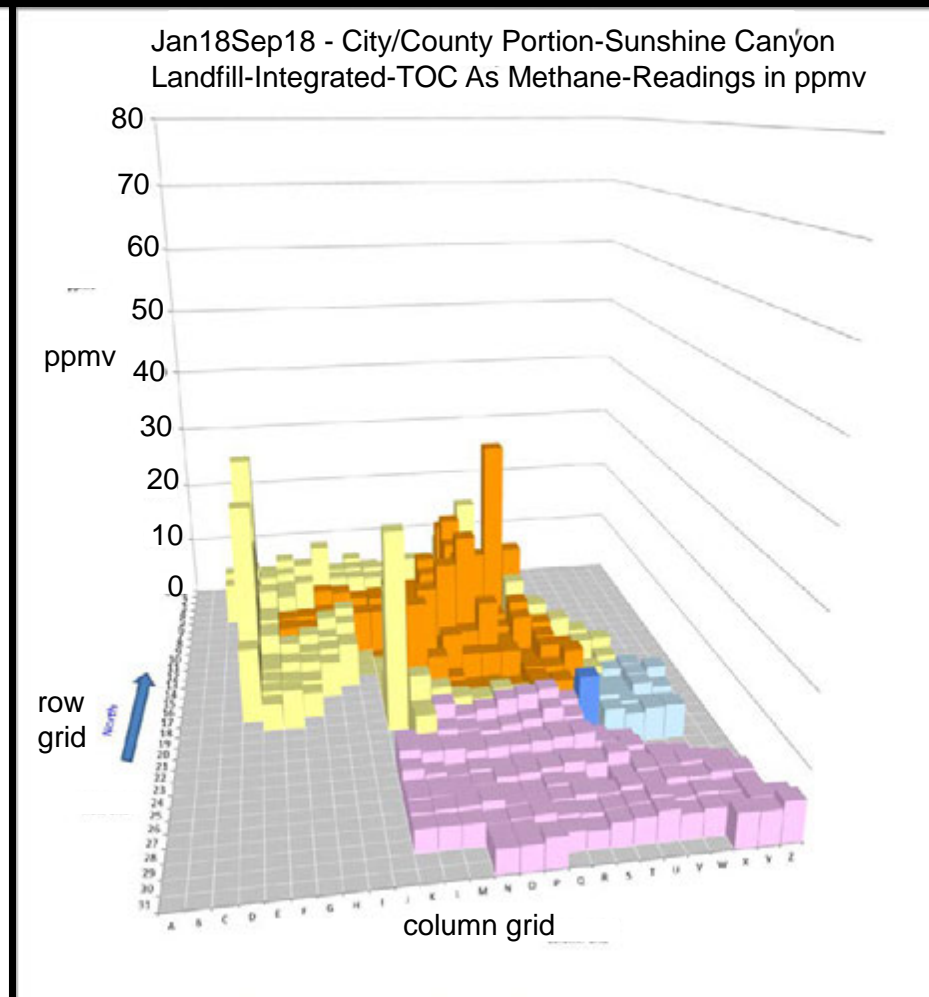
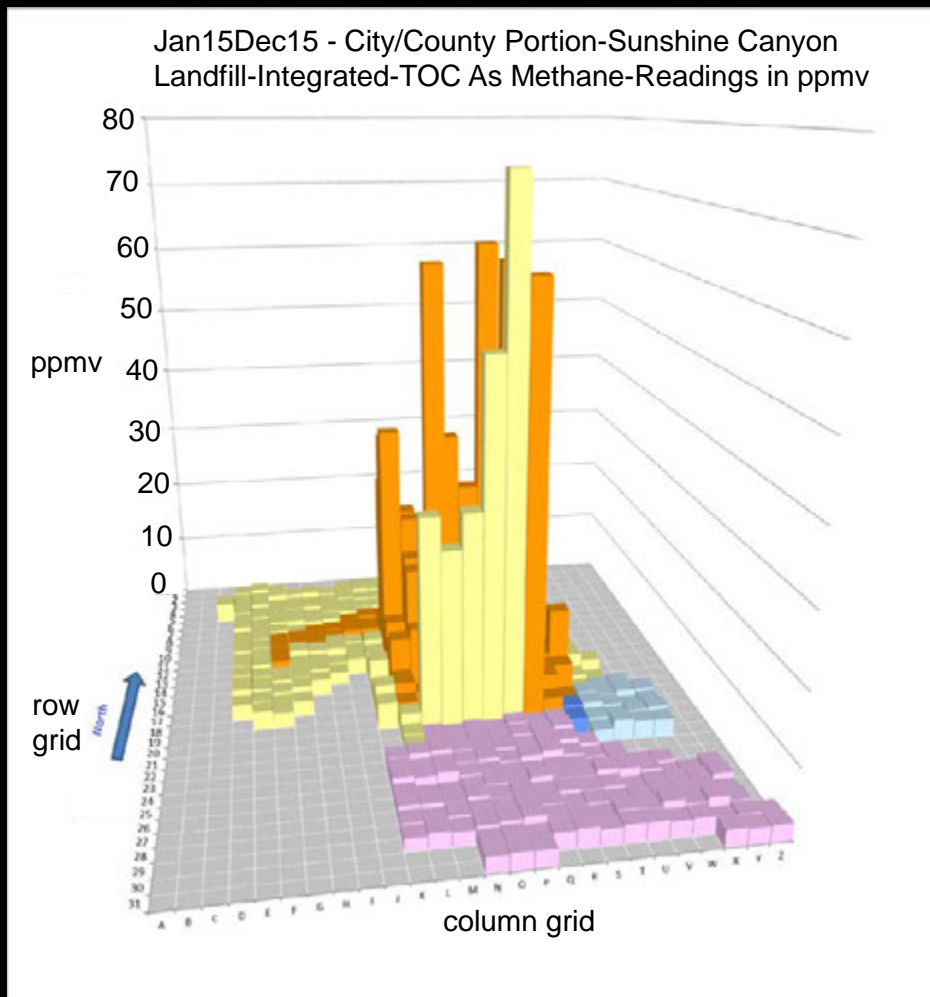


2/2019



SCAQMD Rule 1150.1 Surface Emissions Monitoring (Year 2015 vs 2018)

Compare Overall Grid Emission Levels Before / After Implementation of Mitigation Measures



Note: Methane level is only a proxy for odor.

Graphs are from Sunshine Canyon Landfill Board of Directors' Meetings

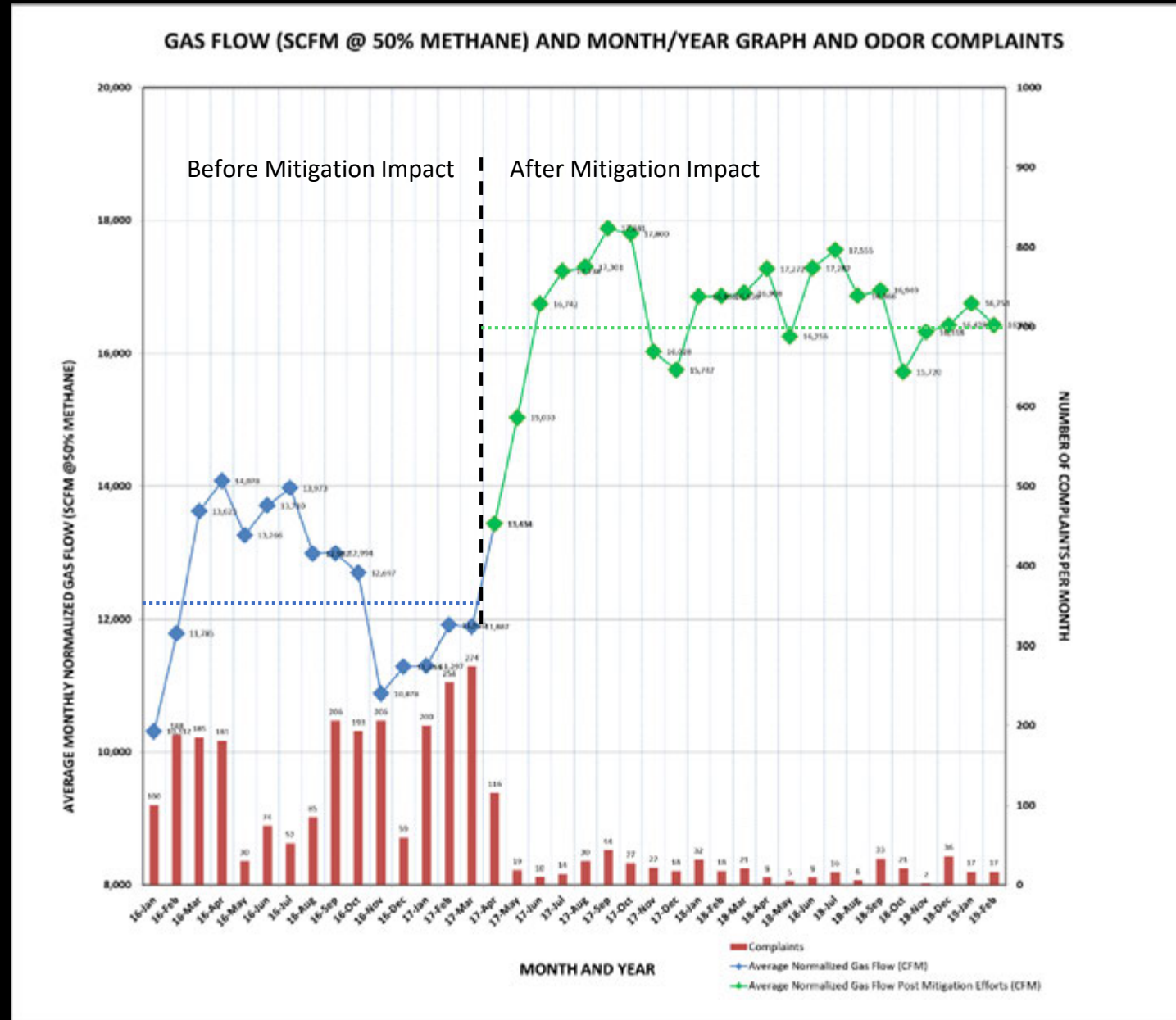
Gas Flow and Odor Complaints

Holistic systems engineering mitigation

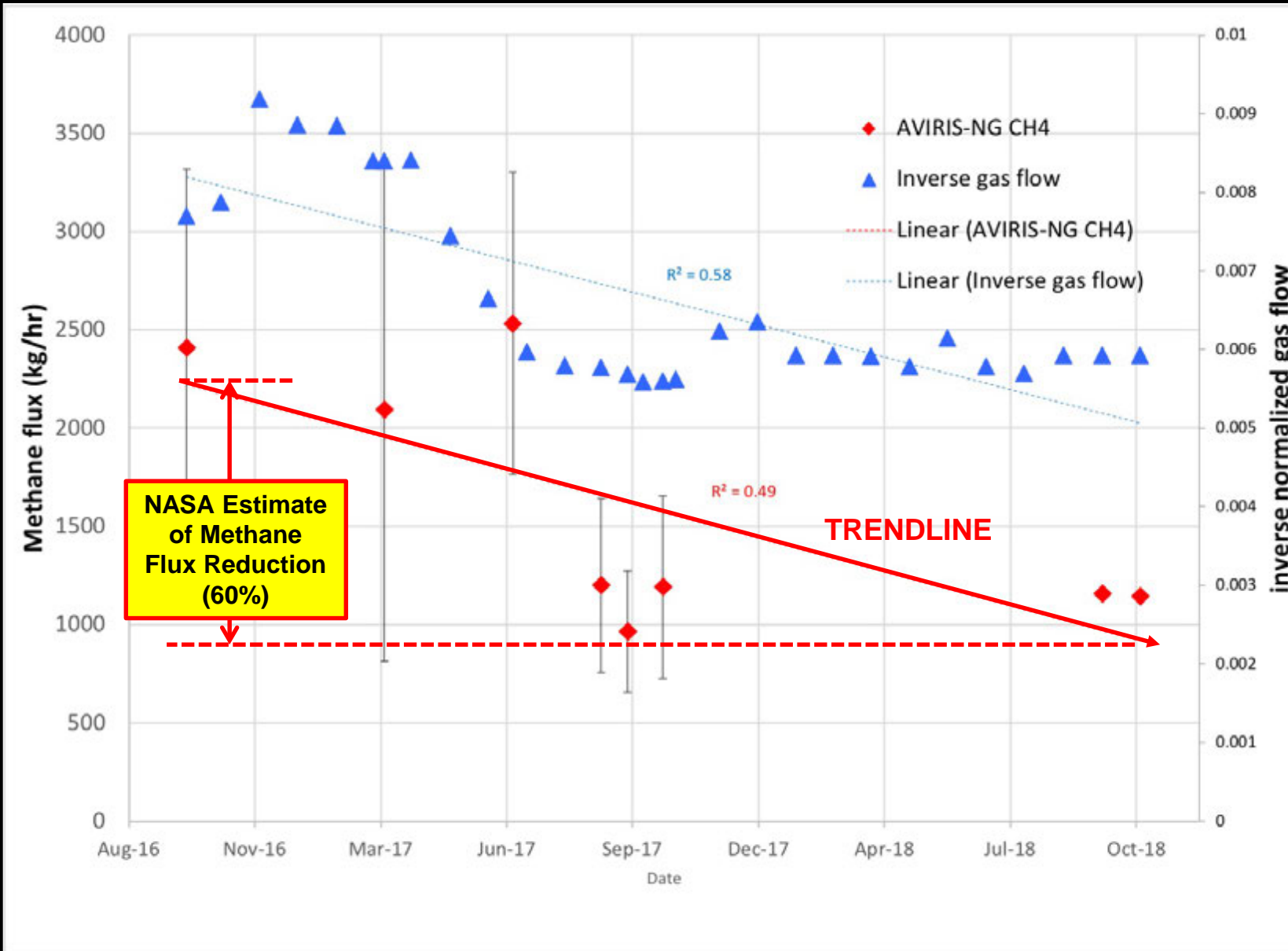
- Provide enhancement to intermediate landfill cover to reduce surface emissions (PosiShell and ClosureTurf)
- Improve operations by materials removal prior to disposal
- Increase in collection volume by 62%

NASA/JPL remote sensing

- Identify methane “hotspots” and estimate methane “flux”
- Provide independent conclusion that LFG collection system has significantly improved



Methane Flux (NASA)



State of the Art

Current practice
outdated

Advanced
sensors hand-
held and walked
quarterly

Leaks
undetected for
days/months

Drone and big
data: Real-time
actionable info



Visual marking of potential
leaks and hand charting
locations for repair

The Solution: Consoar™



24/7 data collection 4x faster than humans

- Network of ground and air drones (up to 500 ft)
- Effective in inaccessible locations
- AQMD approved odor sensors

Drones managed by a single operator using HAT technology developed for NASA

Data encrypted in transit and at rest powered by Amazon Web Services

Data presented to enable real-time decisions and operational changes



Tablets/Phones for Field Inspector



PREV

SPECIFY

NEXT

CH4 readings between

0

and

499

ppm

LOGOUT

Layers:

Select All/None

- Grid
- Wells
- Pipes
- Buildings
- Repairs
- Layer 6
- Layer 7
- etc.

Map Satellite



MAIN MENU

Example Heat Map

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Layers:

Select All/None

- Grid
- Wells
- Pipes
- Buildings
- Repairs
- Layer 6
- Layer 7
- etc.



Worse Count	# of Grids
8	7
7	13
6	50
5	40
4	18
3	2

HATS Technology and Unique Capabilities

Built on a suite of innovative technologies

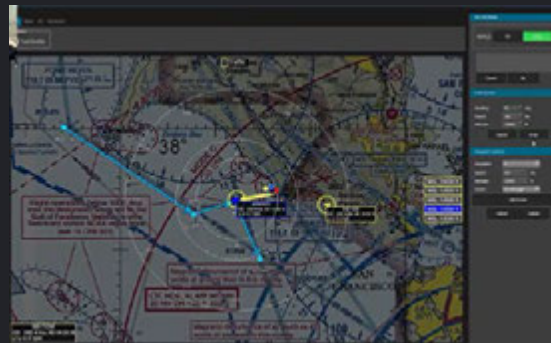
R-HATS, multiple commercial planes management



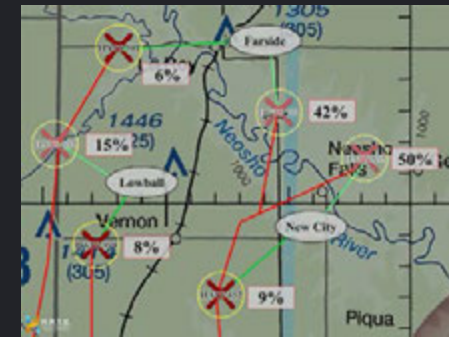
HATIS, risks visualization for multiple drones operation



J-HATT, control station for large aerial drones.



M-HATT, managing large # drones with 1 operator



AMAZON WEB SERVICES

Scale for handling data from many unmanned vehicles and communicate with diverse platforms.

Unique capabilities

- High ratio of vehicles to operator
- Higher actionable information quality/quantity at a much lower cost
- Multidisciplinary approach results trust and acceptance
- AWS cloud computing scaling and data analytics

Call to Action



It's possible to significantly reduce landfill emissions at an affordable cost.

Join HATS' ongoing effort on building enhanced environmental monitoring system

- Utilize real time data to help optimize landfill operations
- Provide actionable data to reduce overall emissions of landfill gas to positively impact Climate Change

HATS is looking for partnership

- Enforcement agencies and regulatory organizations
- Landfill test sites with different characteristics: active, full scale, operations

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Thank You



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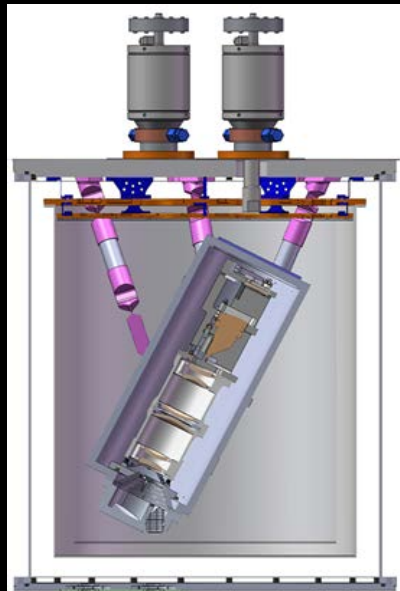
Backup Slides



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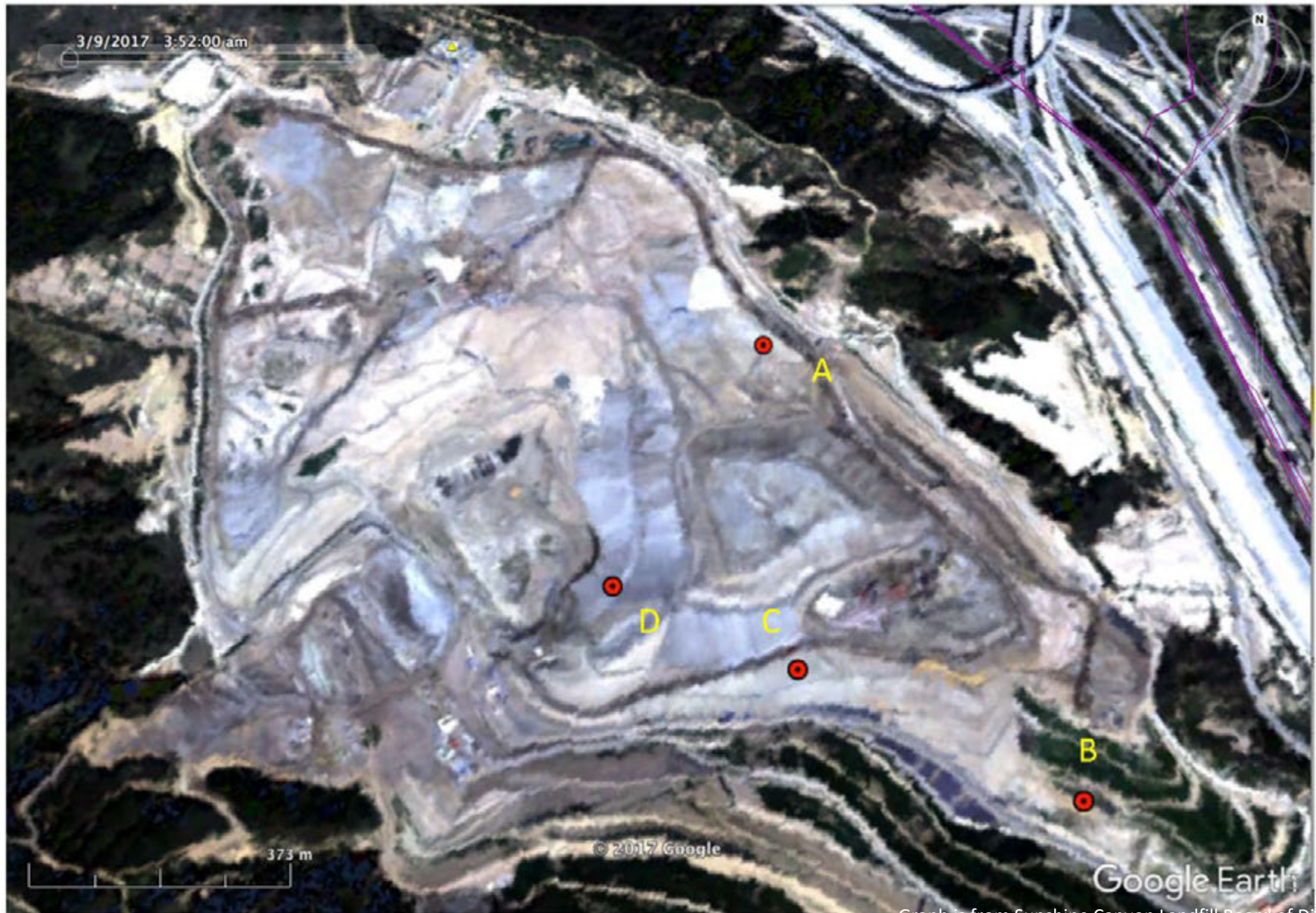
Collaboration with NASA /JPL / CalTech

The Hyperspectral Thermal Emission Spectrometer (HyTES) is an airborne imaging spectrometer with 256 spectral channels between 7.5 and 12 micrometers in the thermal infrared part of the electromagnetic spectrum and 512 pixels cross-track.

A screenshot of the HyTES website. The header includes the NASA logo and the text "Jet Propulsion Laboratory California Institute of Technology". The main heading is "HyTES Hyperspectral Thermal Emission Spectrometer". Below this, there is a section titled "Order" with a map showing the instrument's field of view. The map displays a landscape with a river and mountains, and several blue arrows indicating the instrument's scanning path. Below the map, there are several buttons: "Order Additional Data", "View Data", "Download", and "Clear All". At the bottom, there is a table with columns for "Instrument", "Location", "Date/Time", "Image Source", "File Format Source", "Available Data", and "Download".

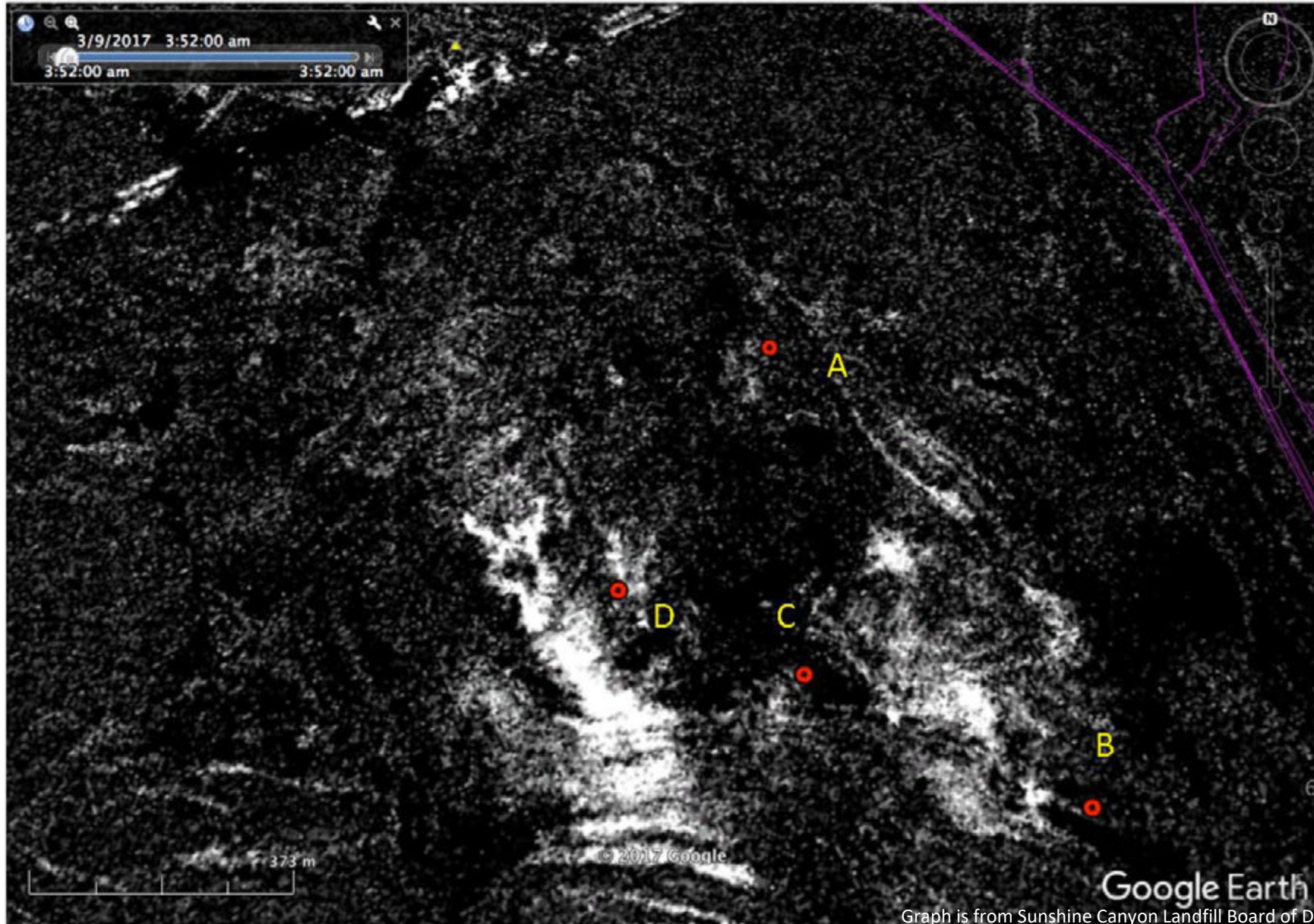
Instrument	Location	Date/Time	Image Source	File Format Source	Available Data	Download
HyTES V1.0			CH1, TIR, NH, DCC, SDC, LDR	TIF, PDF, MP3, SDC, NH, ImageDownload	HyTES V1.0 Data	Download

Sunshine Cyn visible 2017-03-09



Graphic from Sunshine Canyon Landfill Board of Directors Meeting

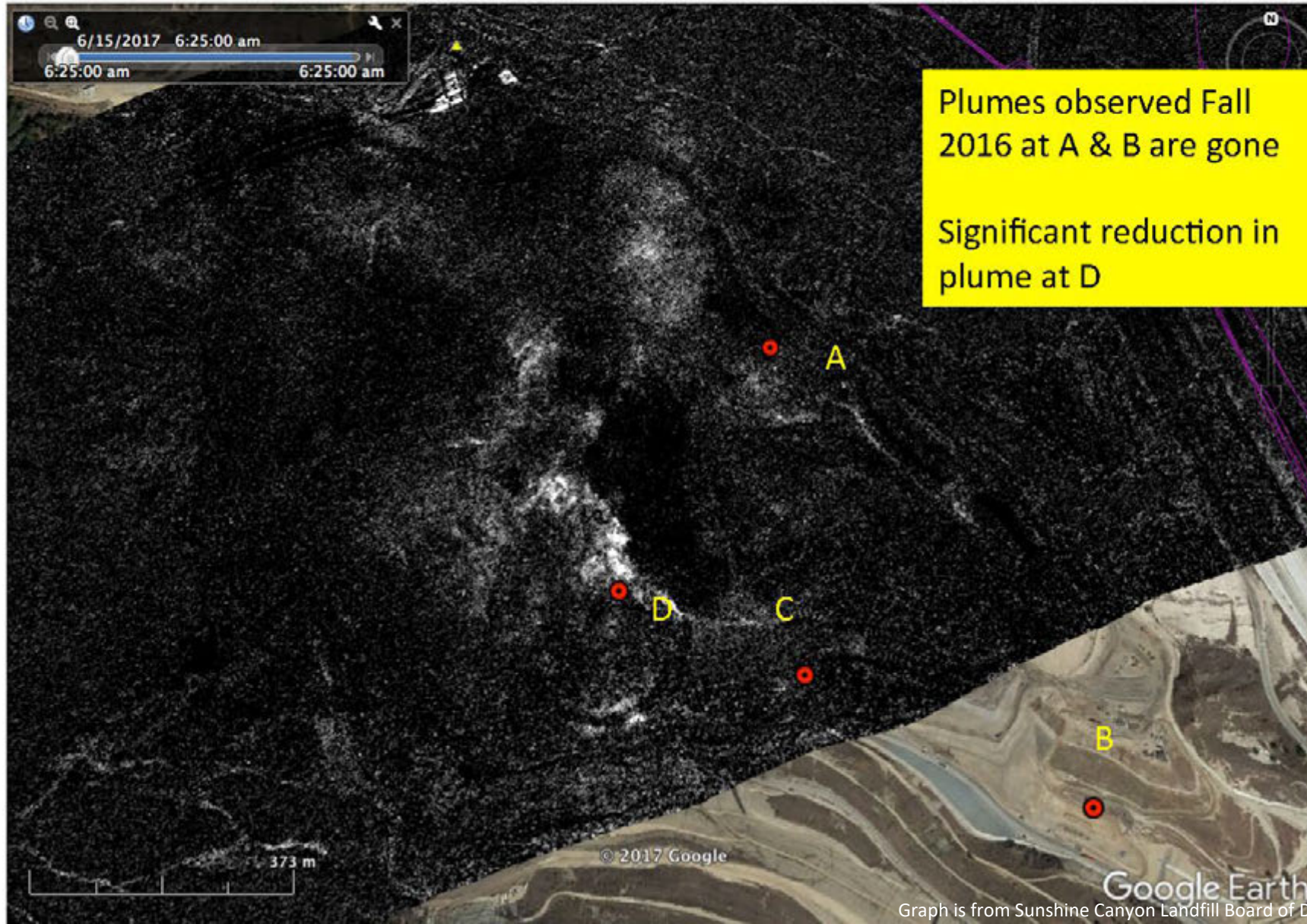
Sunshine Cyn methane 2017-03-09



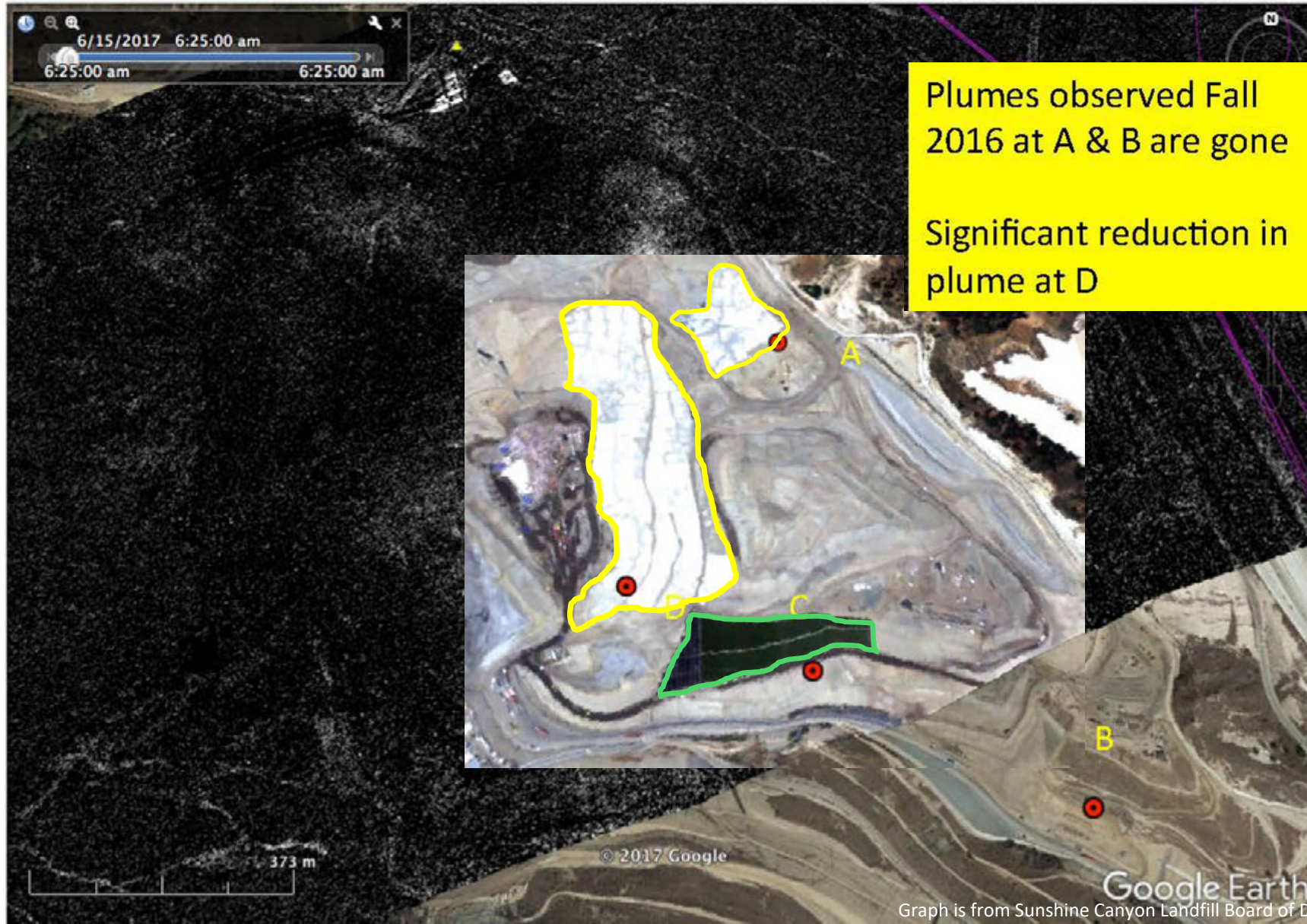
Sunshine Cyn visible 2017-06-15



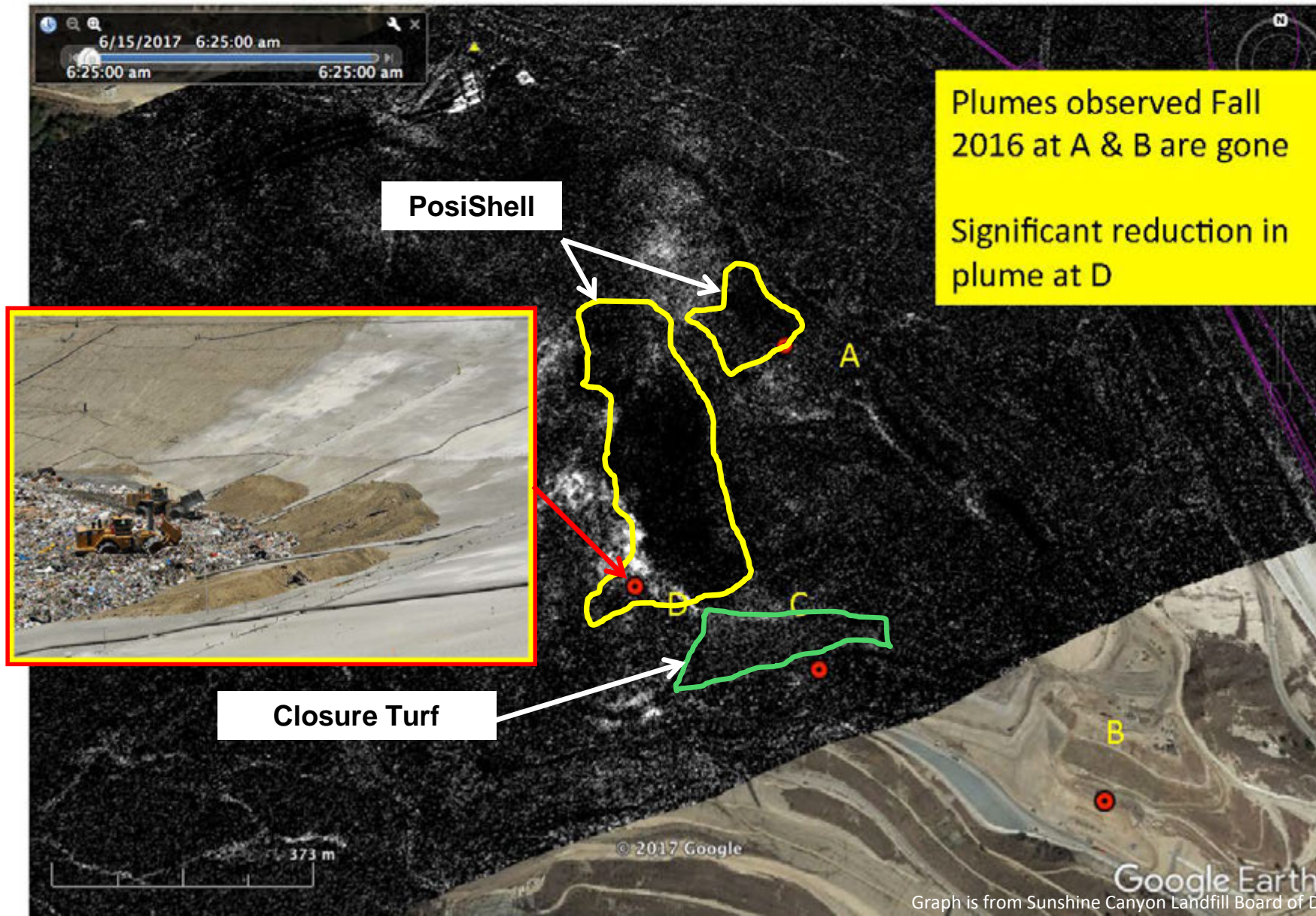
Sunshine Cyn methane 2017-06-15



Sunshine Cyn methane 2017-06-15



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Sunshine Cyn methane 2017-06-15

