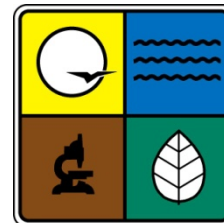
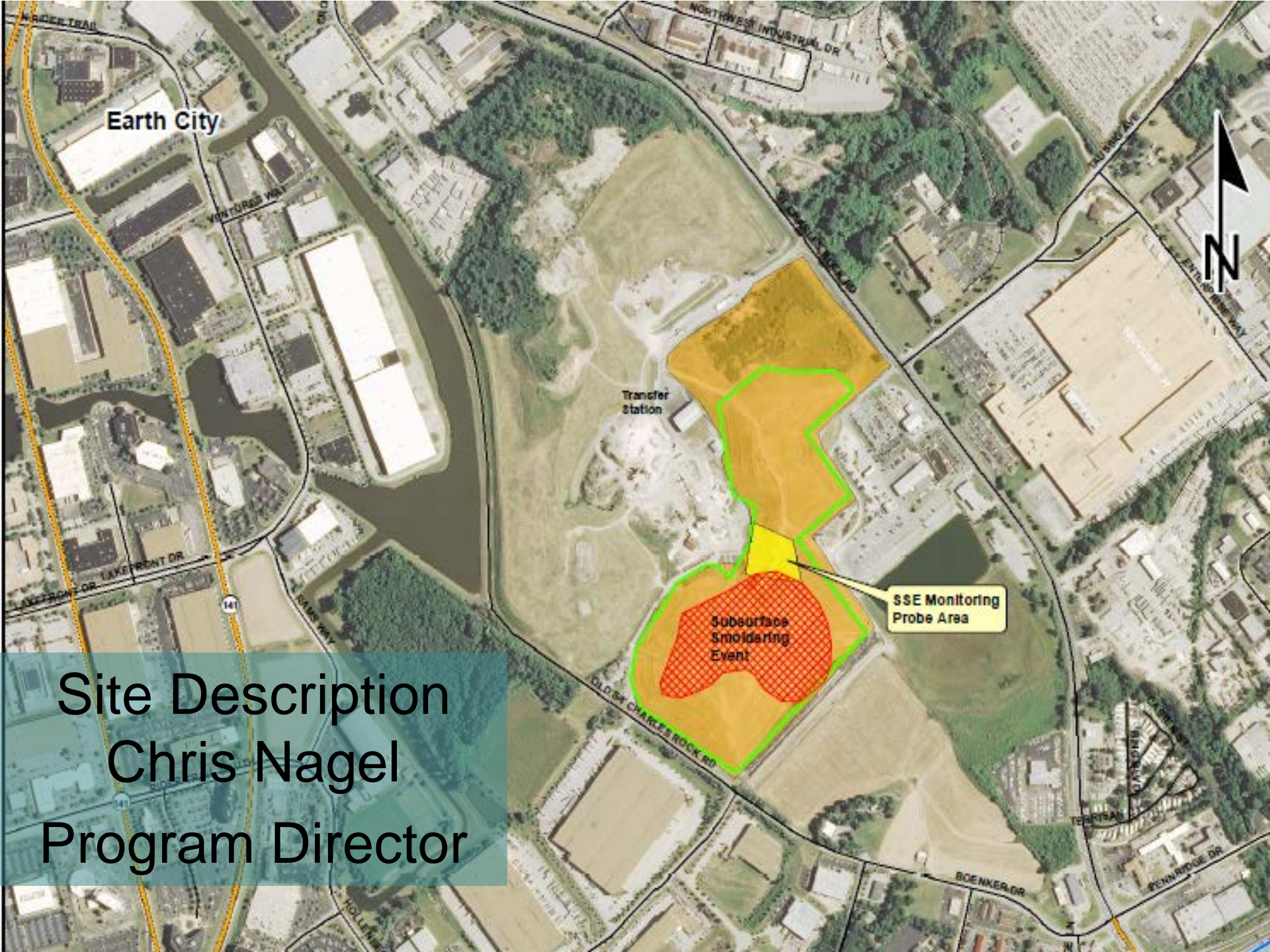


Bridgeton Sanitary Landfill

Division of Environmental Quality/
Solid Waste Management Program



MISSOURI
DEPARTMENT OF
NATURAL RESOURCES



Earth City

Transfer Station

SSE Monitoring Probe Area

Subsurface Smoldering Event

Site Description
Chris Nagel
Program Director

History of Subsurface Smolder



Reference Point

Main Settlement Bowl

01 25 2012

History of Subsurface Smolder



Reference Point

Main Settlement Bowl

04 09 2013

Remedial Action: Odor Mitigation
 Increase Capacity
 Gas Collection and
 Control System (GCCS)



Bridgeton Landfill's
Landfill Gas Processing Center

Missouri Department of
Natural Resources



Remedial Action: Odor Mitigation RCP Abandonment

Before



After



What does an RCP look like?



Removal of reinforced concrete pipe.

Remedial Action: Odor Mitigation Interim Capping System



Remedial Action: Odor Mitigation Leachate Management



On-site Treatment in Tanks

Is the liquid generated by Bridgeton Landfill a hazardous waste?

- Samples were analyzed to determine if they could be defined as hazardous waste.
- The samples analyzed did not meet the definition of hazardous waste.

Current Leachate Disposal: Facilities and Volumes

Gallons
Per Day

St. Louis MSD – Missouri River Plant	20,000
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St. Louis MSD – Bissell	100,000
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Multiple Facilities (Missouri, Iowa, Illinois)

Advanced Waste/Heritage/Valicor Facilities	<u>~200,000</u>
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Average Gallons Per Day	~320,000
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Oversight: Air Monitoring and Sampling



Air Sampling

- Laboratory analysis of data.
 - More detailed analysis.
 - Usually, 30 days to receipt of report.
 - Reviewed by DHSS.
- Weekly sampling events
 - Volatile organic compounds (VOCs), reduced sulfur compounds and aldehydes.
- Immediate, at any time
 - VOCs, reduced sulfur compounds and aldehydes
- Comprehensive, scheduled
 - 183 compounds.

Air Monitoring

- Sensors – real-time recording of data.
 - Reviewed by DHSS.
 - Data made available to DHSS daily during heavy construction.
 - Twice weekly after completion of heavy construction.
- Daily monitoring events
 - Hydrogen sulfide, benzene and odor level.
- Continuous monitoring: 24 hours/7days per week.
 - VOCs, hydrogen sulfide, carbon monoxide, sulfur dioxide, and gamma radiation.

Other Sampling:



- Storm Water: DNR staff conduct “as needed” sampling such as recent sampling of storm water runoff.
- Leachate: When a leachate line broke at the facility samples were collected by DNR staff and by Republic’s contractor for analysis.
- Sampling reports are posted on the website when results have been received and evaluated.



The logo of the Missouri Department of Health and Senior Services is a large, light gray watermark in the background. It features a circular design with the text "MISSOURI DEPARTMENT OF HEALTH AND SENIOR SERVICES" around the perimeter. In the center is a shield with a stylized "dhss" logo.

Missouri Department of Health and Senior Services

Jonathan Garoutte
Dennis Wambuguh
Keith Henke

Bureau of Environmental
Epidemiology

DHSS Efforts

- Assessing public health risks from exposure to hazardous substances in the environment.
 - Reviewing DNR data and reports on odors, chemicals and radiation.
 - Collecting data independently on radiation levels.
- Providing clear and accurate information about potential public health risks and recommendations for protective actions when appropriate.



Public Health and Odors

- Due to strong odors, individuals may experience undesirable, transient symptoms such as headache and nausea.
- Asthmatics and other sensitive individuals may be especially susceptible to strong odors.
- During periods of objectionable odor, sensitive individuals and persons with chronic respiratory diseases should limit time spent outdoors and seek medical advice for any acute symptoms.

Public Health and Odors

- DHSS has received several reports of health concerns due to strong odors, but monitoring of local hospital data has revealed no statistically significant increase in emergency department visits.
- Some of the chemicals detected have very low odor thresholds, although generally low toxicity.

Public Health and Chemical Exposure

- What are the chemicals of concern?
- How might people be exposed?
- How long might people be exposed?
- How much might they be exposed to?

Public Health and Chemical Exposure

- Data are screened against conservative public health comparison values for each chemical based on the type of potential exposure:
 - Acute, Intermediate and Chronic screening levels
- Primary concern during this phase is to assess for any acute (short-term) public health risks.
 - Acute may be defined as up to 14 days of exposure.
 - Some acute screening levels are available for exposures as short as a few hours or less.

Public Health and Chemical Exposure

- Factors affecting potential for public exposure:
 - What are the chemicals of concern?
 - How might people be exposed?
 - How long might people be exposed?
 - How much might they be exposed to?
- Based on the data provided by DNR throughout this event, DHSS has not observed chemicals at levels of public health concern for acute exposure.

Public Health and Radiation

- DNR has provided continuous monitoring of gamma radiation rates around the landfill. All of the readings have been exceedingly low from a public health standpoint and appear to be within normal background variations.
- On Feb. 2, DHSS collected several downwind air samples. Analysis by two labs found no alpha/beta radioactivity above normal background levels.
- DNR also completed a field screening for ambient gamma, and alpha/beta on dust swipes, on May 16.



Public Health and Radiation

- On June 4 and 11, DHSS collected several more air samples for analysis of alpha/beta. Samples were screened for alpha/beta radiation levels. Definitive lab analysis is forthcoming.
- On June 4, DHSS also collected data on real-time radon levels near the landfill. These showed low “background” levels of radon in ambient air.
- Additional sampling for alpha/beta and radon is planned.



DHSS Next Steps

- Continue review of monitoring data and sampling data. (*continue as received*)
- Provide info on radiological sampling as soon as available. (*anticipated July 2013*)
- Complete public health assessment of long-term chronic exposure concerns. (*planned Fall 2013*)

Missouri Attorney General

CHRIS KOSTER



JOE BINDBEUTEL
Attorney General's Office



- March 21, 2013 – Department of Natural Resources referred Bridgeton Landfill, LLC, and their parent company, Republic Services, Inc. to the Attorney General's Office for legal action.
- March 27, 2013 – Attorney General filed a lawsuit on Bridgeton Sanitary Landfill seeking to ensure Republic Services completes promised actions to address environmental, odor problems.
- May 13, 2013 – Attorney General enters into First Agreed Order with Bridgeton Landfill, LLC and Republic Services, Inc.



Bridgeton Landfill Agreement Highlights

- Republic committed to concrete pipe removal and to place an interim cap on the South Quarry:
 - To capture and control odors.
 - To minimize oxygen intrusion and to help suppress the smolder.
- Republic provided temporary housing assistance to residents near the landfill for the duration of the RCP work which resulted in increased odors.



Bridgeton Landfill Agreement Highlights

(Continued)

- Republic Services required to test leachate daily for hazardous characteristics and properly dispose of liquids.
- Republic Services commits to containment measures to prevent migration going beyond the neck to enter the North Quarry.
- Republic Services pays state costs for comprehensive air monitoring and sampling to occur daily, weekly.

Analysis Report Bridgeton Landfill Data

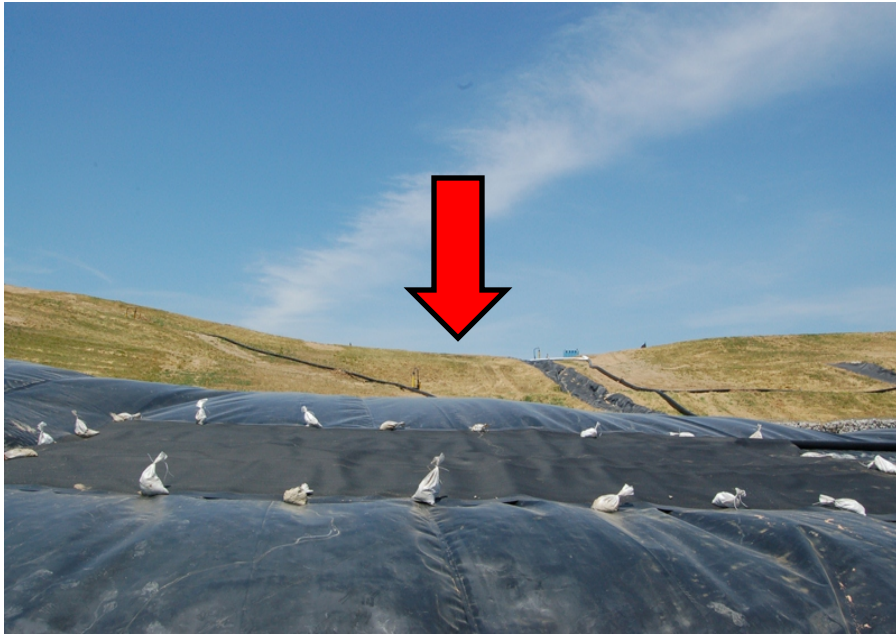
Todd Thalhamer, PE

Todd Thalhamer, P.E.



- Experience in waste management issues for Cal/EPA-CalRecycle. 21 years as an Environmental Engineer.
- Experience in firefighting including currently a volunteer Lieutenant for El Dorado Hills Fire, California 15 years as a Firefighter.
- Combined this experience to act as:
 - Consultant on over 40 waste fire projects in the US and Internationally.
 - Operations Chief at the San Bruno Pipeline Explosion Removal Project.
 - Incident Commander for the Longest Burning Tire Fire in the US.
- President of Hammer Consulting Service providing waste fire consulting and training services.

Site Background



Overview of area near the top of the southeast side slope that is exhibiting significant subsidence.

- Contracted with DNR on April 6, 2012 to evaluate this incident
- Site Visit 1: June 6, 2012
 - Current LGCS not capable to controlling odors
 - Two strong distinct odors and two areas of concern

[LGCS = landfill gas collection system]

Site Background



Settlement crack.

Provided 7 recommendations

1. Repair and cover all fissures in the areas around settlement.
2. Evaluate settlement daily, look for fissures.
3. Hydrate the soil cover to repair and prevent fissures.
4. Relocate the 2 power poles in the west bowl.
5. Implement incident command system and develop an incident action plan.

Site Background



Inflated flexible membrane liner.

Provided 7 recommendations
(Continued)

6. Collect air samples of the odor:

- i. Evaluate odors for toxic and/or hazardous gases;
- ii. Collect a minimum of 3 air samples in a summa canister from each odor location; and
- iii. Air sampling plan should be designed by an industrial hygienist.

7. Reduce oxygen to less than 1% in interior gas wells.

Site Background



Settlement cracks.

- Site Visit 2: August 22, 2012
 - Odor issues.
 - Still experiencing 2 distinct areas of subsidence
 - Temperatures in some wells over 200 °F
 - Smoldering event had expanded in all directions
 - Including movement north towards the North Quarry

General Findings



Damaged Gas Collection Well.

- The events continue to cause damage to the landfill's engineered environmental control systems.
- The events continue to impact the surrounding community from the release of landfill gases.

Reaction vs. Oxidation Event vs. Smoldering Fire



Smoldering Event at Candlestick State
Park, San Francisco, CA

There are only two types of fires (i.e., combustion) that are recognized in fire science: (1) flaming and (2) smoldering.

Facilities have used terms like ROSE, SOE, SSO, chemical reaction, pyrolysis, heating event to describe this event. I recommend the term “smoldering event.”

Bridgeton Landfill Incident

We have three events impacting the landfill

1.Heating Event [Temps >165 and $< 195^{\circ}\text{F}$]

2.Smoldering Event [CO over 1,000 ppm, $T>300^{\circ}\text{F}$]

3.Transitional Events [Residual, Pre-Combustion, Post-Combustion, LFGC influenced]

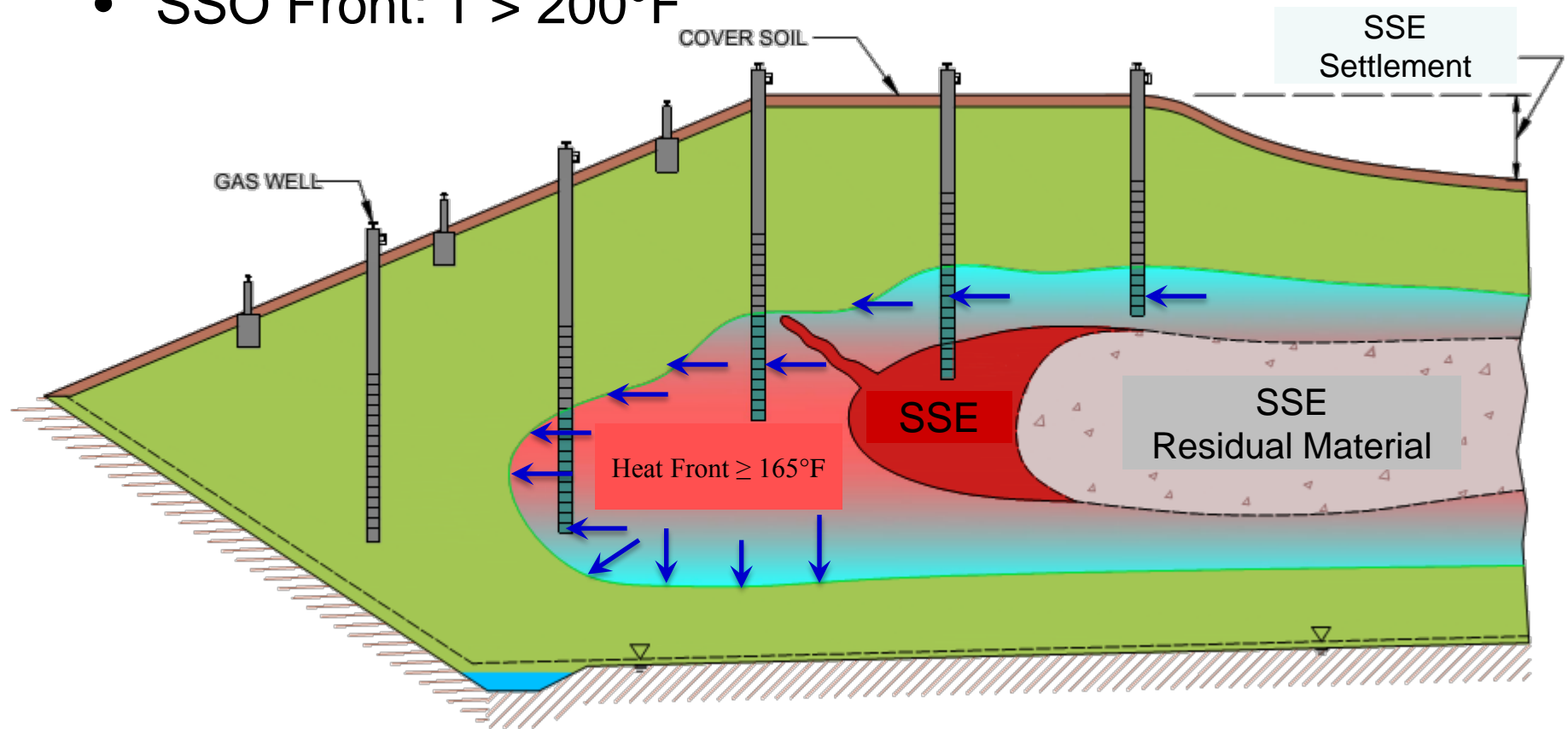
Typical Smoldering Events

$212/250^{\circ}\text{F}$ to 450°F + $>2\%$ O_2 + $>1,500$ ppm CO



Smoldering and Heating Events

- Heat Front: $T > 165^{\circ}\text{F}$
- SSO Front: $T > 200^{\circ}\text{F}$



How is the Data Collected?

- Gas Extraction Wells [GEW] Temp + CO
- Gas Interceptor Wells [GIW] Temp + CO
- Temperature Monitoring Probe [TMP] Temp only



Data Analysis

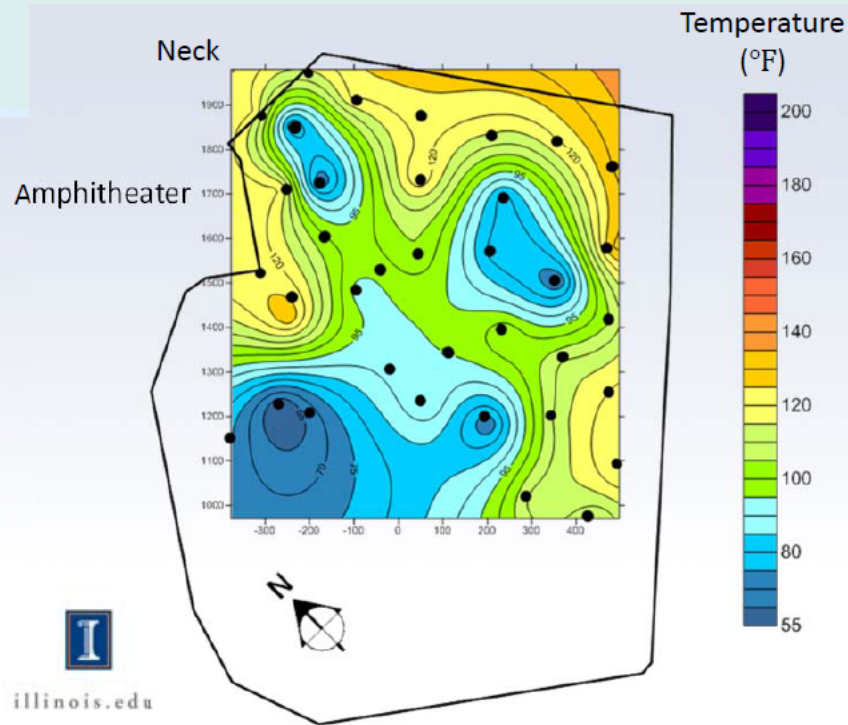
- Where are the events?
 - Where is the heating event?
 - Where is the smoldering event?
 - What is the current plan?
 - What is the contingency?

Findings

- Overall the landfill continues to experience a significant subsurface smoldering fire.
- The South Quarry (northern section) reaction's movement has changed from 2.8 to 3.0 feet per day to 1 to 2 feet per day.
Note: Rate not valid in the neck area due to the GIW system.
- The Heat Front has reached TMPs 1 to 4 in the neck (TMP-2).
- The Smoldering Event appears to be contained in the South Quarry in between the GIW system
 - Additional data (e.g., CO and temps) is needed to confirm this and then should be closely monitored.
 - I understand the department has requested this data from Republic Services.

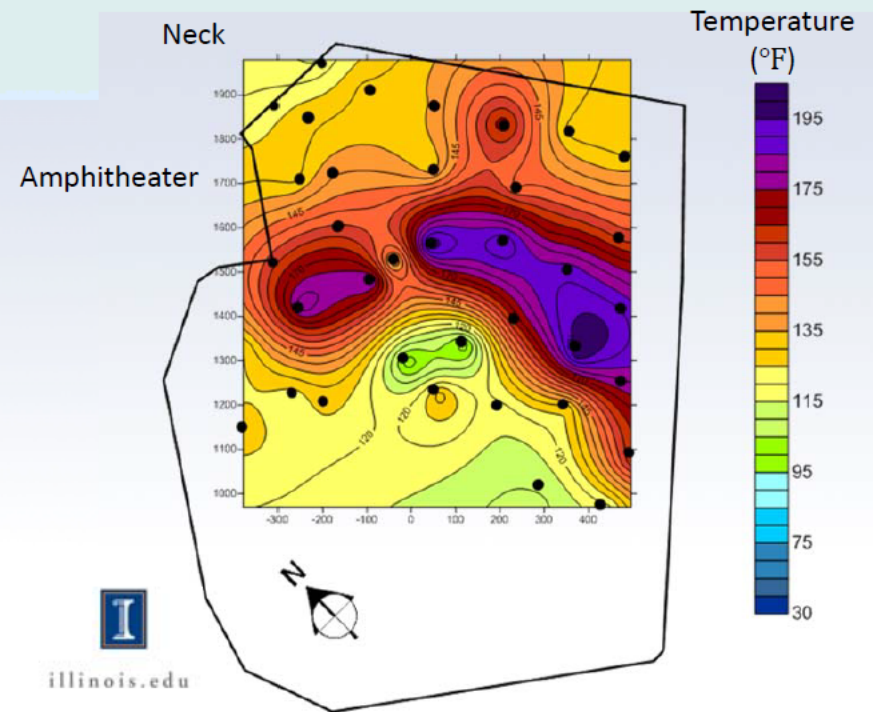
Status of South Quarry

September 2009



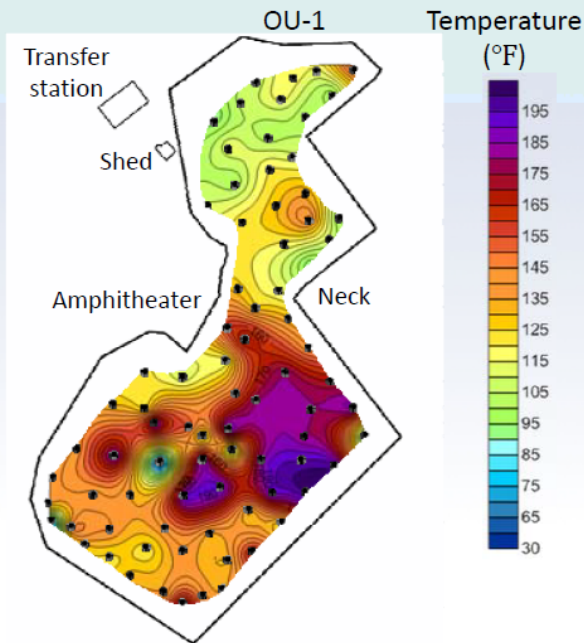
Status of South Quarry

March 2012



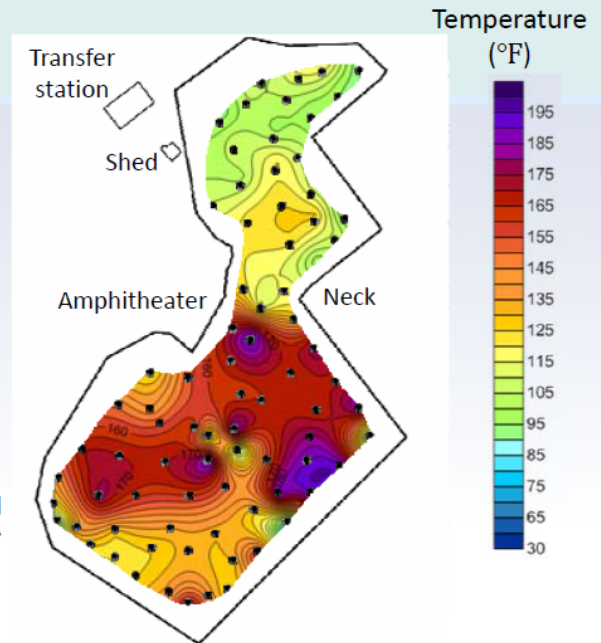
Location of Heat Front – North Quarry

January 2013

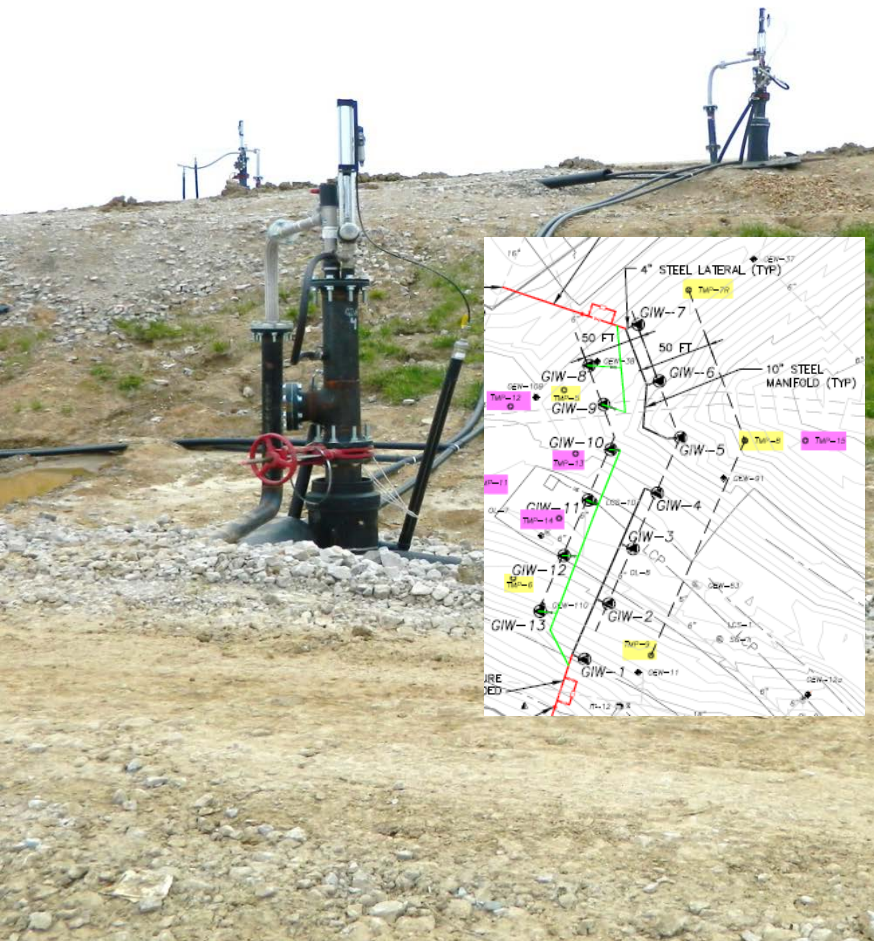


Location of Heat Front – North Quarry

April 2013

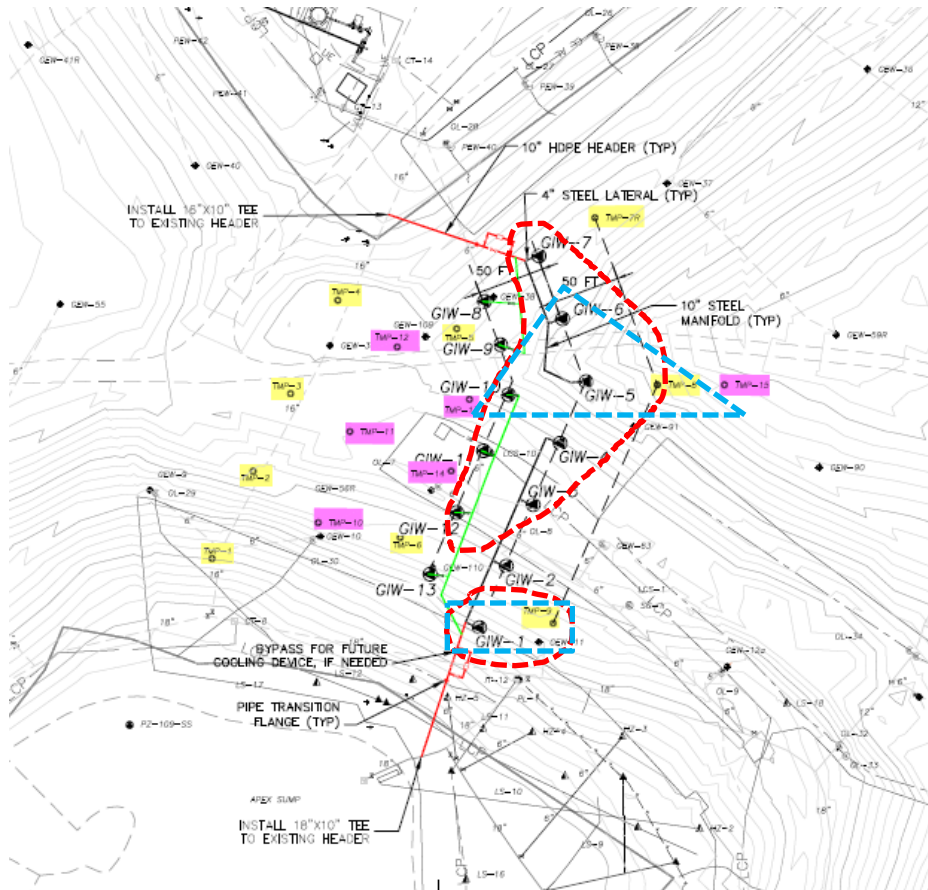


The Plan - Republic Services' Gas Interceptor Wells



- 2 rows (13) offset GIWs.
- Radius of influence of adjacent GIWs overlap and create a “vacuum curtain”.
- Collects heat and landfill gases and is intended to prevent spread of the SSE.
- The heat and gas are destructed in the GCCS.

Evaluation of Gas Interceptor Wells



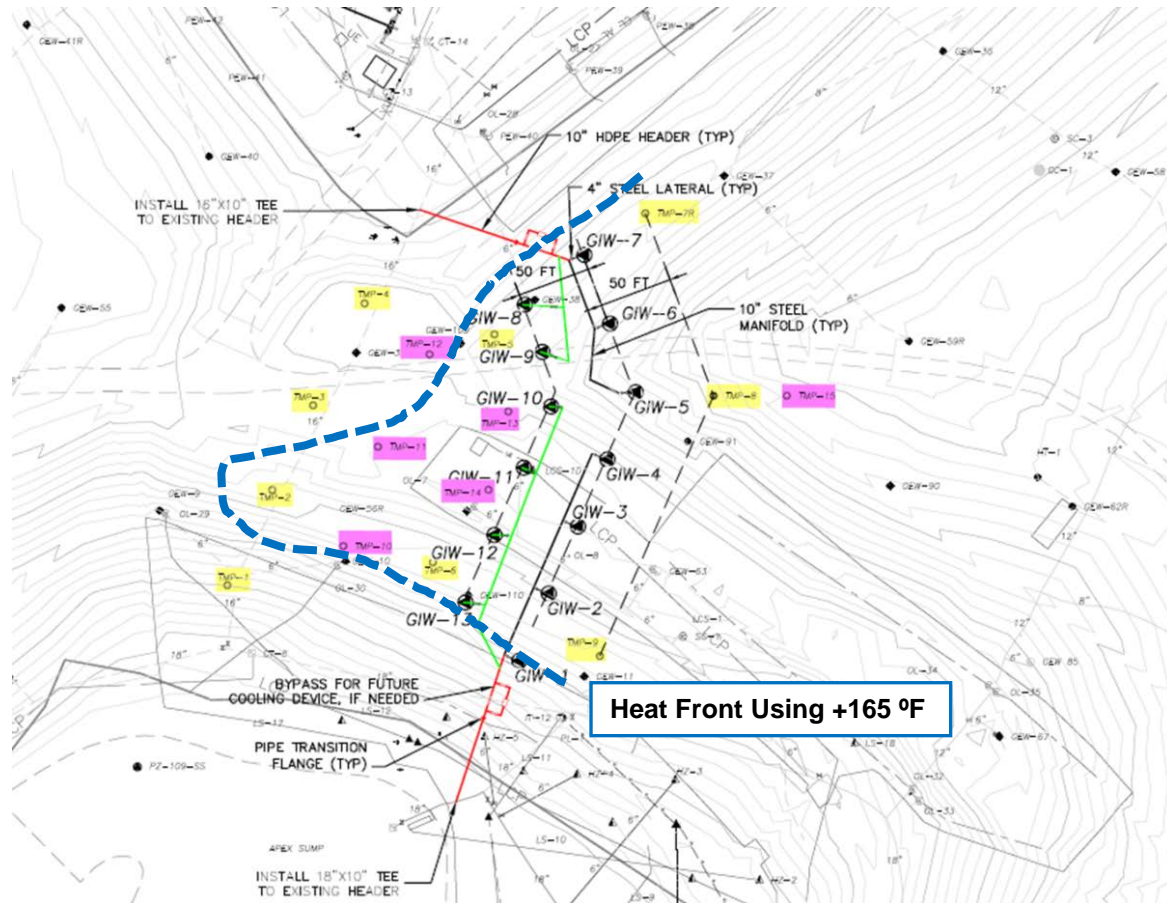
- Two Areas of concern in the “neck”
- Based on the TMP and GIW temperature readings
- Need CO data to refine issues

Date	Temperatures in Fahrenheit				
	GIW-1	GIW-4	GIW-5	GIW-6	GIW-10
6/6/2013	173	155	181	169	179
6/7/2013	176	152	176	173	180
6/8/2013	178	150	177	175	181

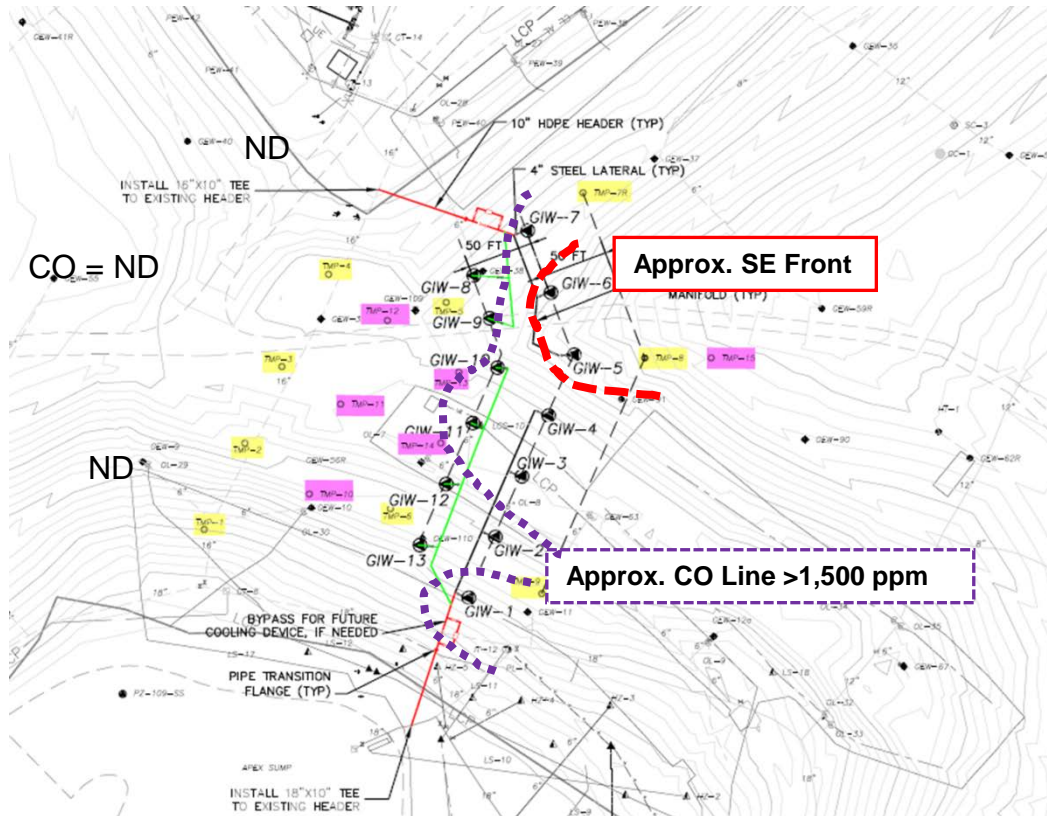
Date	Carbon Monoxide in ppm				
	GIW-1	GIW-4	GIW-5	GIW-6	GIW-10
6/7/2013	2,800	5,000	5,200	6,000	3,600

Date	CO in ppm	
	GIW-11	GIW-12
6/7/2013	1,400	1,600

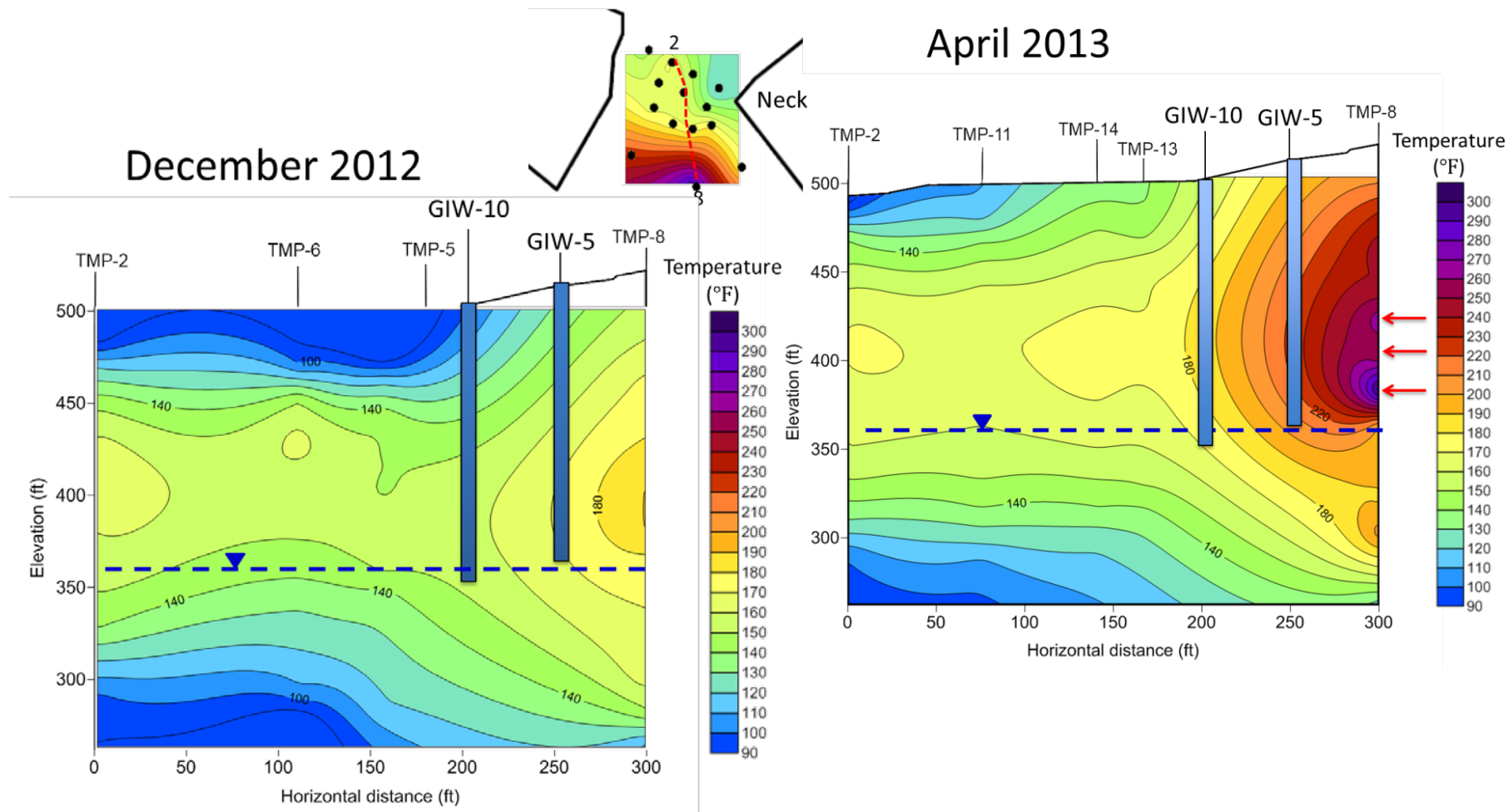
Estimating the Heat Front



Estimating the Smoldering Front

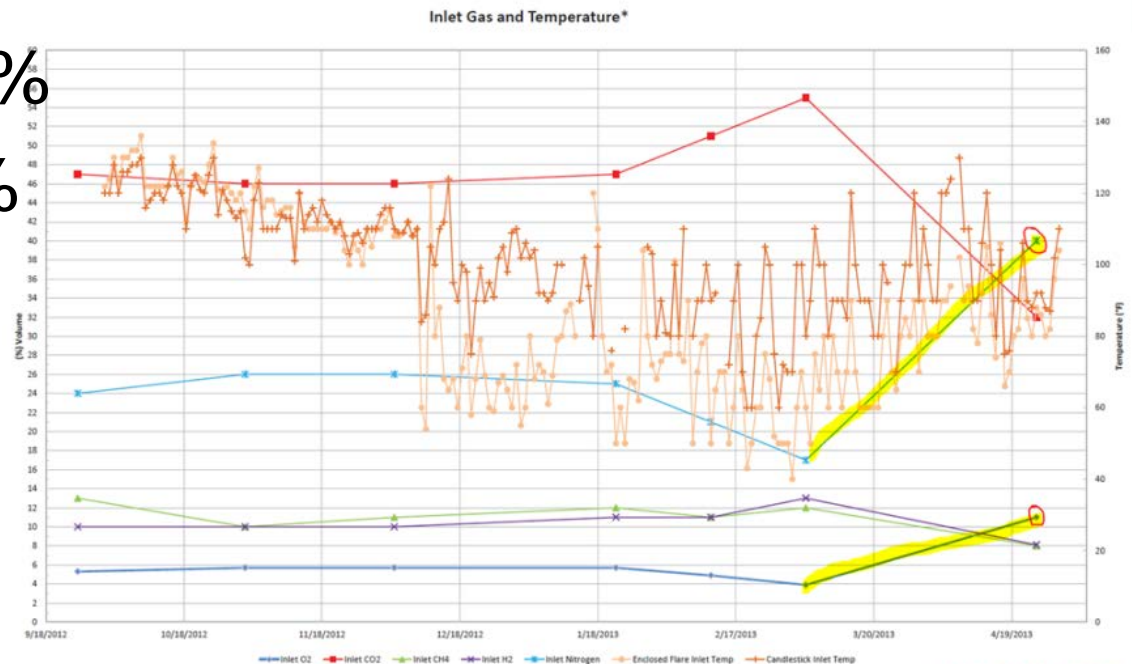


What does all this mean?



Other Concerns

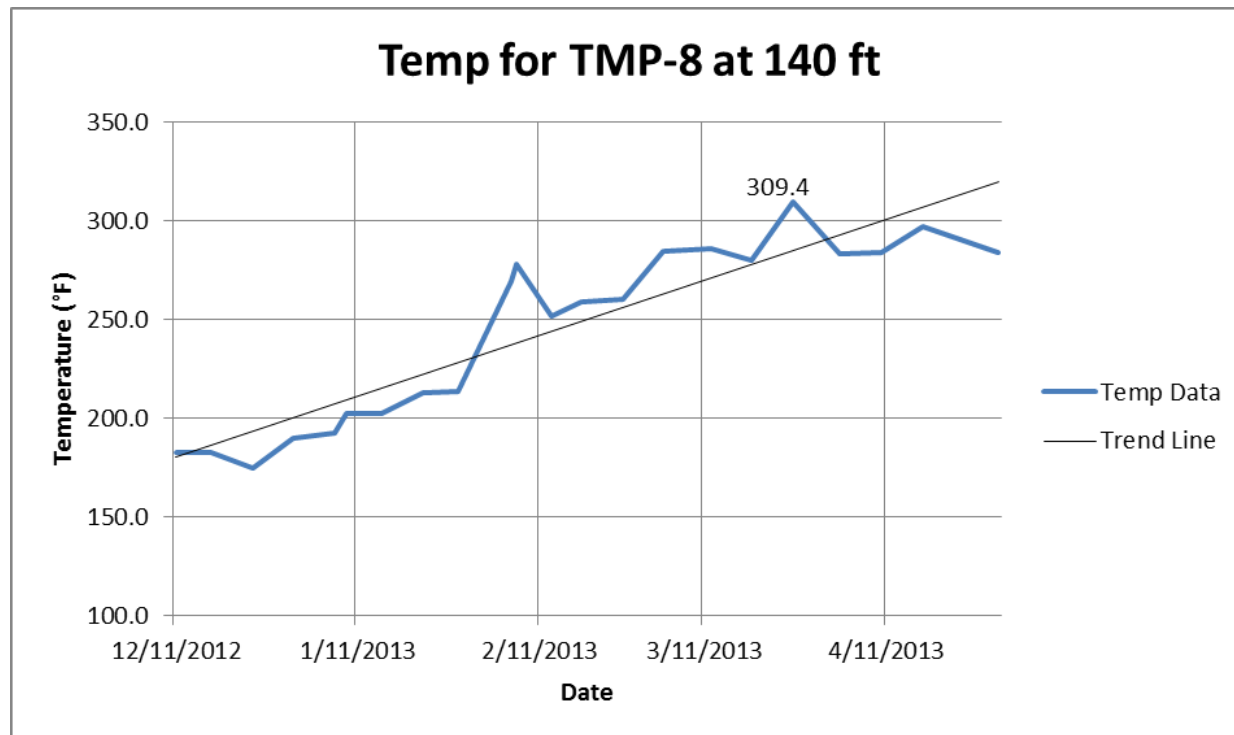
- LGCS is “overdrawing“ the system in April 2013
 - Nitrogen ~ 40%
 - Oxygen ~11%



*Gas data collected from Laboratory Reports. Temperature data collected from GEM 2000 field readings.

Other Concerns

- Overall Trends in the TMPs have positive slope or increasing temperatures.
- Short-term decrease in some TMPs



Incident Summary

- Heat front is impacting the northern most TMPs
- Smoldering event is estimated to be between the line of GIWs
- GIW system appears to be holding
 - GIW activated in April 2013
 - Limited CO data
 - Need to closely monitor
 - Additional GIW should be installed

North Quarry Contingency Plan

- Based on the plan
 - Operator shall establish a trigger for:
 - additional TMPs, interceptor wells, and capping of the North Quarry
 - Isolation break between North Quarry and OU-1
 - Operator shall provide a construction plan for the interceptor wells, cap and isolation break by set date.
 - Note there is no known physical barrier between the neck and North and South Quarries.

Proposed Sentry Criteria / Isolation Break

Indicator	Volume or/and Temperature	Isolation Break Required	Parameters
Carbon Monoxide (CO)			
CO levels in any gas extraction well or sentry monitoring well in the North Quarry.	>1,500 ppm	YES	CO result shall be repeatable and re-measured within 8 hours of receipt of the data. CO measurements shall be based on laboratory analysis and not field equipment. DNR and the fire authority shall be notified within 48 hours. Should any result exceed 1,500 ppm CO, the isolation break shall be constructed.
CO levels in two or more gas extraction wells and/or sentry monitoring well in the North Quarry.	>1,000 ppm	YES	Re-measure the initial CO result over 1,000 ppm within five days of receipt of the data. CO results greater than 1,000 ppm, but less than 1,500 ppm shall be re-measured 4 times for 4 weeks. DNR and the fire authority shall be notified within 5 days. Should all the retest exceed 1,000 ppm CO, the isolation break shall be constructed.
CO levels in any gas extraction well or sentry monitoring well in the North Quarry.	<1,000 ppm	No	No additional actions required. Continue monitoring per the First Agreed Order (Case No. 13SL-CC01088).
Temperature (°F)			
Any reportable temperature in a TMP at the sentry line ³ or in the North Quarry.	>200°F	YES	Temperature result shall be repeatable within 8 hours. DNR and the fire authority shall be notified within 48 hours. Should any temperature exceed 200°F in a TMP, the isolation break shall be constructed.
Any reportable temperature in a gas well located within the North Quarry.	>180°F	YES	Temperature result shall be repeatable within 8 hours. DNR and the fire authority shall be notified within 48 hours. Should any temperature exceed 180°F in a gas well, the isolation break shall be constructed.

Note: See next slide for the balance of the sentry criteria.

Proposed Sentry Criteria/Isolation Break

Indicator	Volume or/and Temperature	Isolation Break Required	Parameters
Combination of CO + °F			
Any reportable temperature in a TMP or gas well at or past the sentry line exceeding 195°F and any gas well in the North Quarry exceeding 1,500 ppm CO.	>195°F + >1,500 ppm	YES	Temperature result shall be repeatable within 8 hours. DNR and the fire authority shall be notified within 48 hours. Should any temperature exceed 195°F in a gas well in the North Quarry and CO is detected above 1,500 ppm at the sentry line or North Quarry, the isolation break shall be constructed.
Any reportable temperature in a TMP less than 195°F or gas well located within the North Quarry or sentry line with CO less than 1,000 ppm.	<195°F + <1,500 ppm	No	Temperature(s) shall be collected weekly. Continue monitoring per the First Agreed Order (Case No. 13SL-CC01088).
¹ These criteria are in addition to the First Agreed Order of Preliminary Injunction (Case No. 13SL-CC01088 between the State of Missouri and the Bridgeton Sanitary Landfill, LLC.			
² The temperature and CO levels for this matrix are for the establishment of a trigger value and not for the confirmation of a smoldering event.			
³ The sentry line for this matrix is currently defined as TMP-1 through TMP-4 on the Well Layout Plan by SCS Engineers, date 1/10/2013.			

Summary of Recommendations

- Add additional TMPs
- Agree on a set of trigger criteria
- Submit designs for the isolation break
- Reduce O₂ in the wells and in the system
- Start construction of a vertical barrier wall with CO₂ for control issues not suppression
- Do not allow the North Quarry to be used as a fire break
- Should the LF elect not to install the barrier wall, a third set of GIW should be installed within 45 days of this report.

Information Sharing



- Want to know when a particular department webpage is updated click on the “Red Envelope” located below the Program Links and Contacts on the right-hand side of the webpage.
- After providing e-mail address information, you will begin receiving e-mail notices of when that webpage is updated.

Missouri Department of
Natural Resources

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Steps Going Forward