METRO
GRIMM'S FUEL COMPANY COMPOSTING ASSESSMENT & RECOMMENDATIONS

GREEN MOUNTAIN TECHNOLOGIES, INC. TEAM [GMT]:

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PRESENTATION OUTLINE

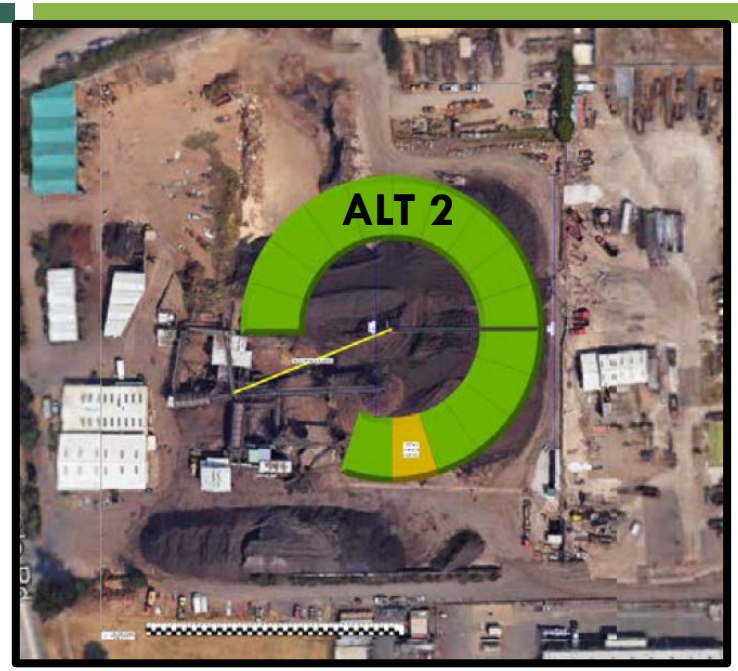
1. Findings Overview
2. Intro To Technology Alternatives
3. Compost Science… Briefly
4. Current Conditions Observed
   - Site Conditions
   - Feedstocks
   - Regulatory Status
   - Pile Emissions Monitoring
   - Community Experience Of Odor
6. Odor Monitoring / Dispersion Modeling
7. Technology Alternatives Development
8. Recommendations
   - Technology Options
   - Regulatory Tools
   - Permit Recommendations
   - Land Use Consistency
   - Other Suggestions
9. Conclusions

OVERVIEW

- Grimm's Fuel has been a local recycling and landscape material supplier for over 40 years and their services are needed by the community
- Odors from the Large Static Pile composting system are excessive and impact nearby residences
- Forced aeration compost technology would dramatically reduce odor impacts
- Land use and regulatory codes could be better coordinated to facilitate rapid remediation efforts

RECOMMENDATION OVERVIEW

1. We believe Grimm's current composting odors make a unnecessary impact to the local residents, and should be reduced significantly
2. We recommend the primary composting technology be changed to a forced aeration system to assure aerobic decomposition
3. GMT recommends any of 4 alternatives for Grimm's Fuel composting methods. Any one of which provide a viable solution to the odor problem. Each with differing costs and advantages

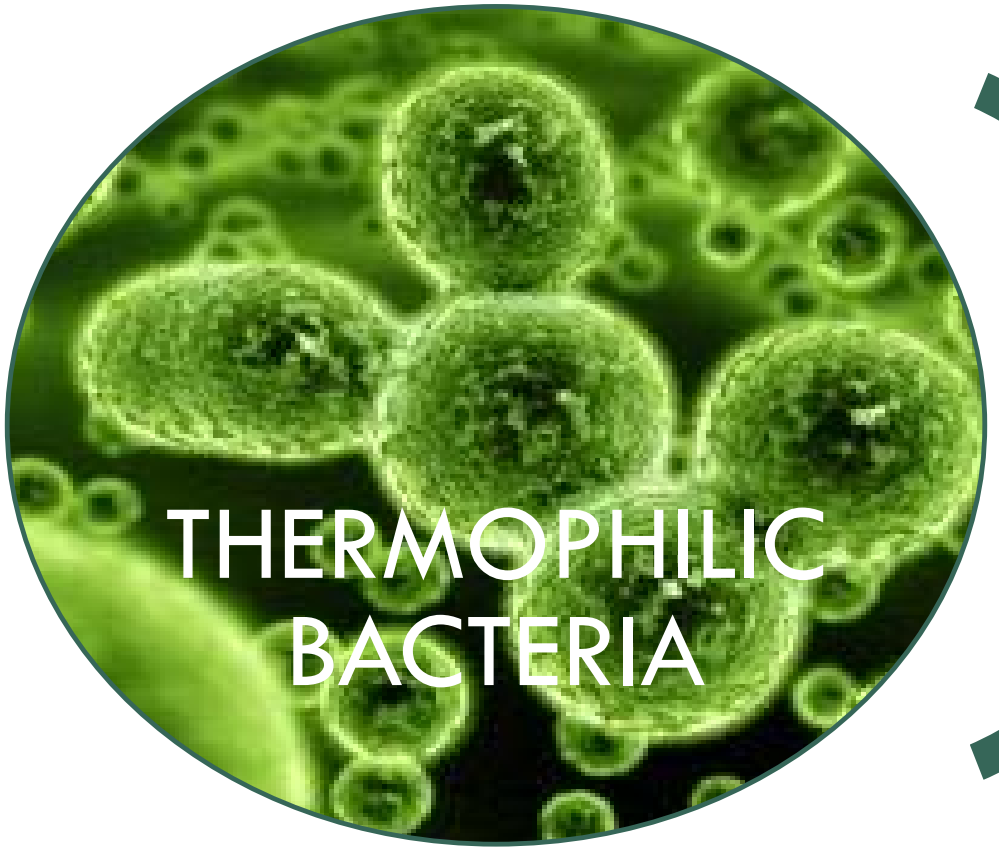


ALL SOLUTIONS:

- FULLY AEROBIC
- < 14' TALL PILES
- BIOCOVERS / BIOFILTERS
- NO DISTURBANCE IN 1ST 20-DAYS
- FASTER THROUGHPUT
- LESS VOLUME ON SITE

COMPOST SCIENCE

"Its All About The Bugs…"



MIX Green waste
[**Carbon & Nitrogen** = FOOD]

Add **Water**

O_2

Ensure **<u>Oxygen</u>**

AEROBIC

COMPOST SCIENCE

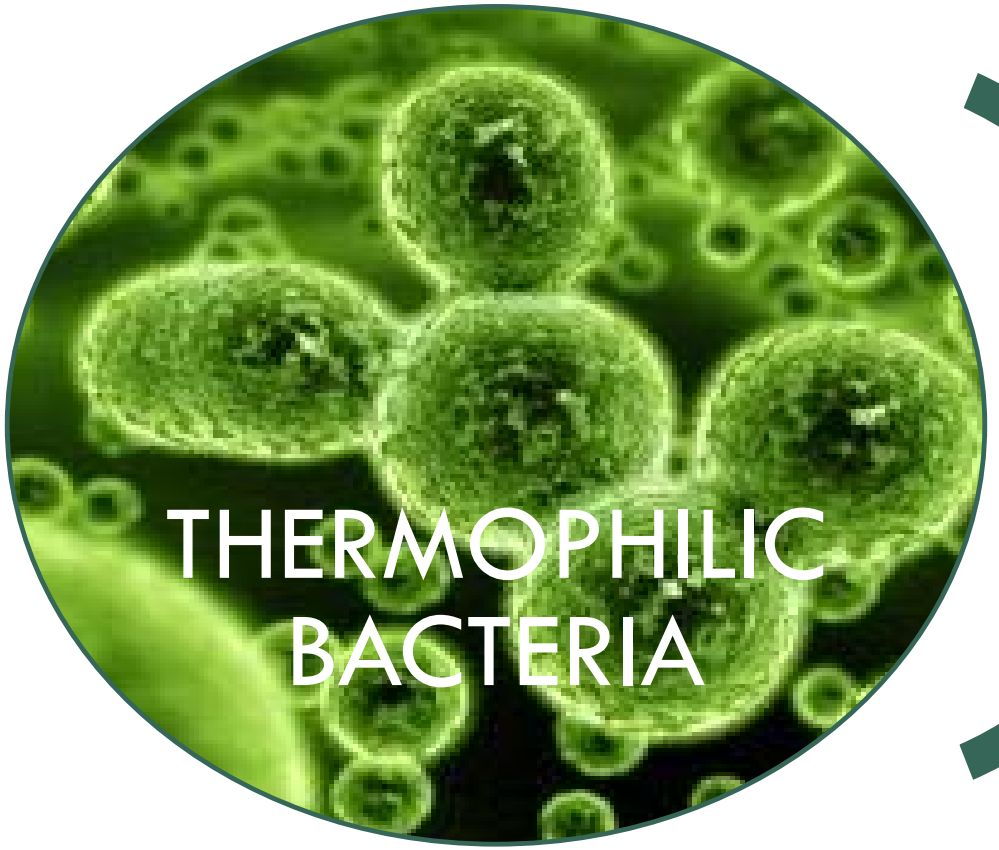
HEAT

CO2

WATER

Humus-based
COMPOST

COMPOST SCIENCE



MIX Green waste
[Carbon & Nitrogen = FOOD]

Add Water

~~WITHOUT OXYGEN~~
~~= "ANAEROBIC"~~

COMPOST DEFINITION / COMPOST SCIENCE

~HEAT

CO_2 + Methane, Mercaptans, Ammonia, reduced sulfur = **ODORS**

WATER, ACIDS

-Not-ready-for-prime-time soil amendment
-May have very low pH
-Less degraded in same amount of time
-May still have pathogens
-Can provide nutrients to soil
-Should be AEROBICALLY cured to produce a finished product

"digestate"

CURRENT CONDITIONS OVERVIEW

- Grimm's current composting process is a Large Static Pile which is mostly anaerobic, and is evidently overtaxed for the volumes received
- Odor exceedances for the neighboring residences occur during calm weather both before and after turning activities
- Regulatory tools are vague and do not provide assurance to neighbors or Grimm's that change can occur productively for both parties.
- This Metro process is intended to provide a map of what is possible so a route can be charted by all parties concerned to improve the odors and the operations for now and the future.

OVERVIEW OF GRIMM'S CURRENT PROCESS

Large Receiving area


Processing Equipment
Dependable, Well-built & Maintained


Good Blend

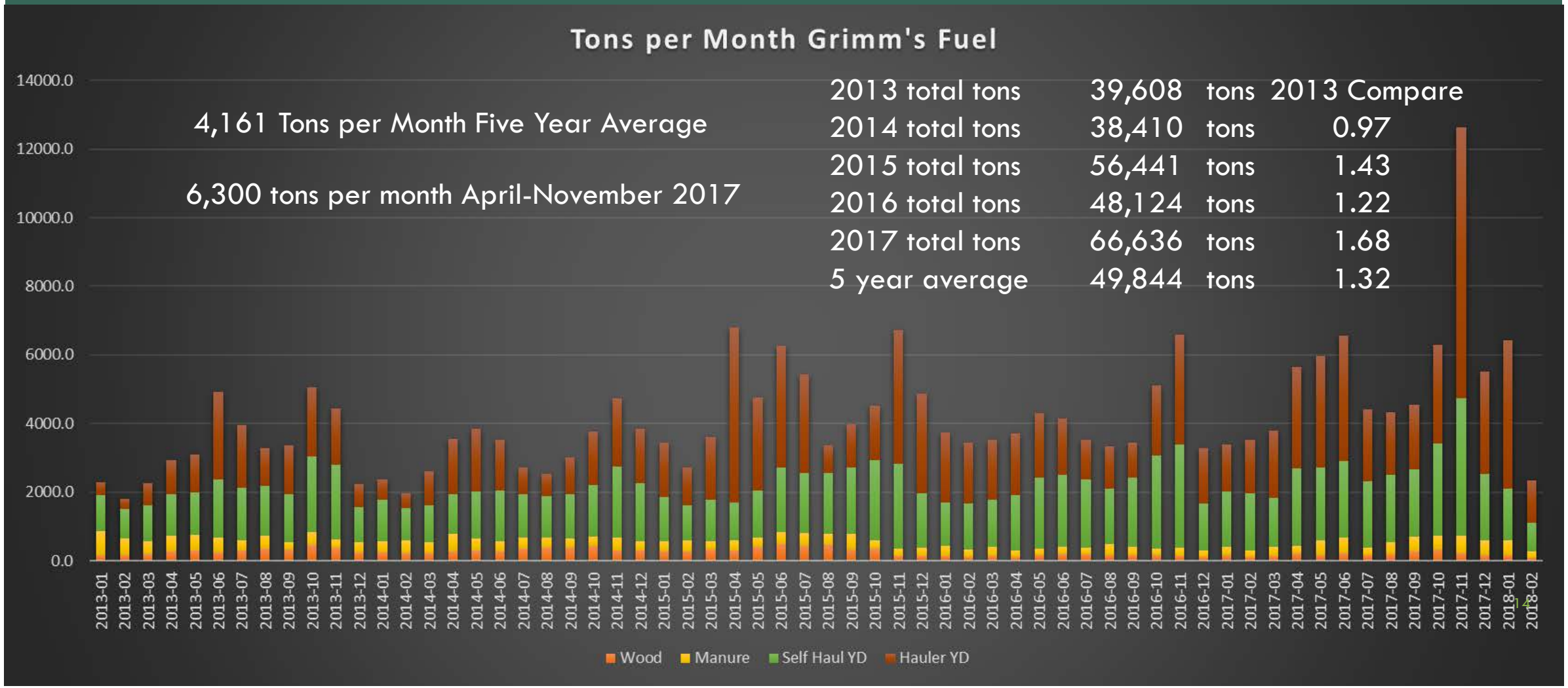

Efficient mobile equipment


Smelly, Inefficient Composting System

CURRENT CONDITIONS OBSERVED GRIMM'S SITE

FEEDSTOCK TYPES & VOLUMES

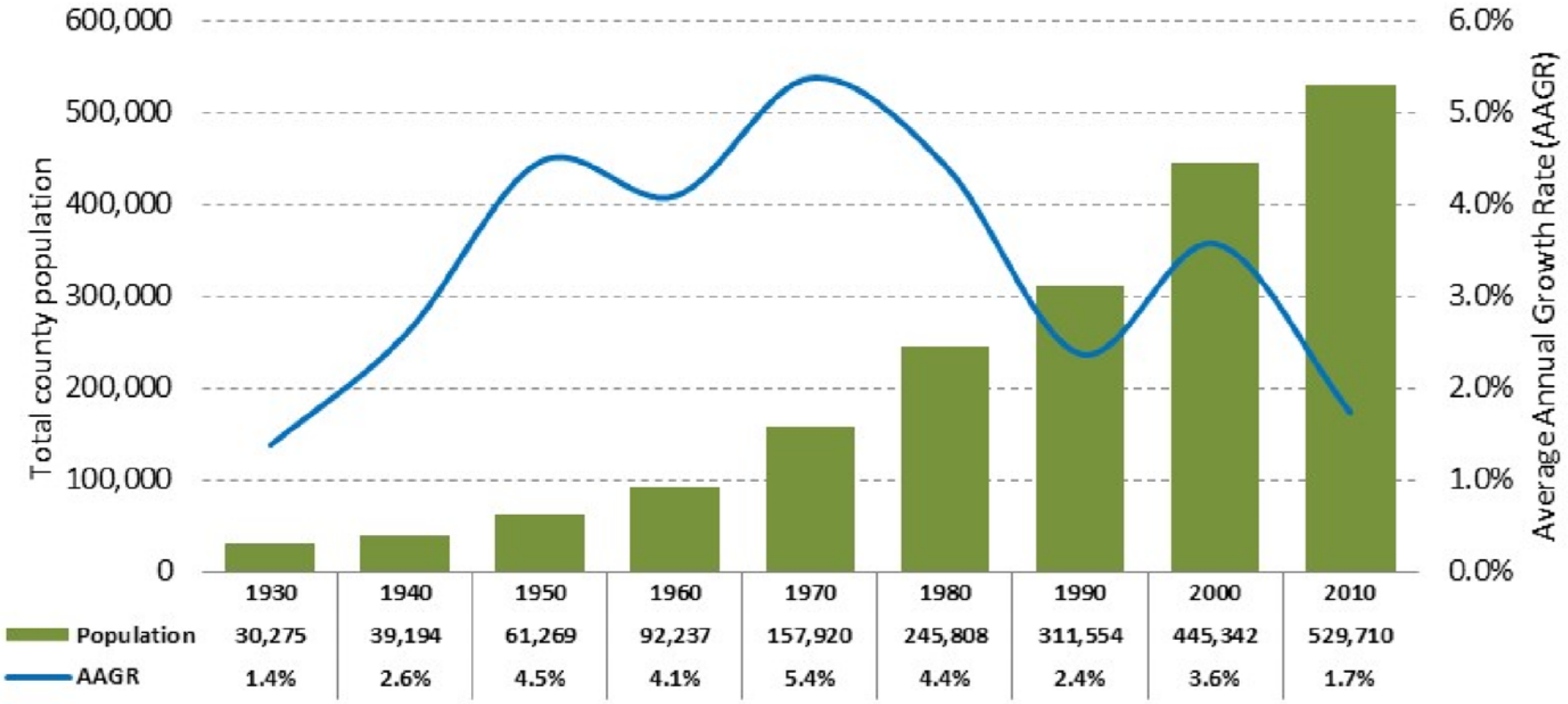
FEEDSTOCK VOLUMES & TYPES



Demographic and Economic Trends

Portland State UNIVERSITY

Washington County—Total Population by Ten-year Intervals (1930-2010)

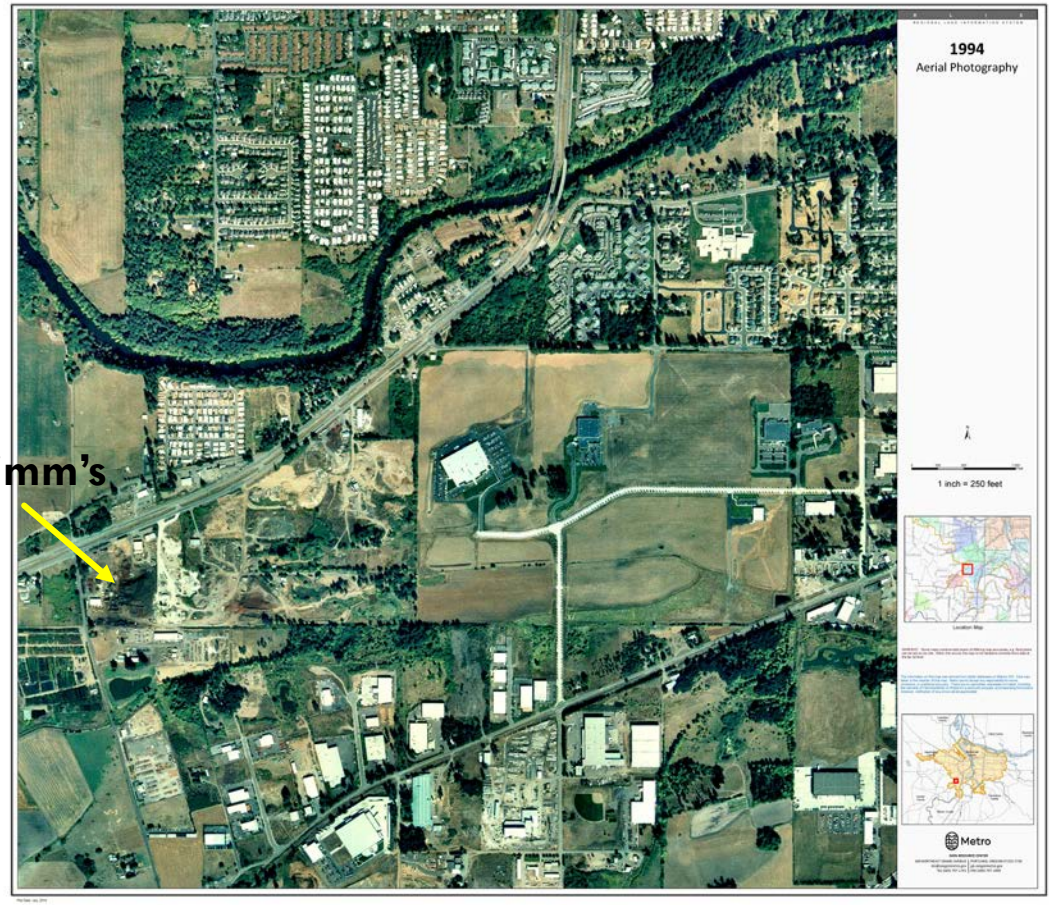


	1930	1940	1950	1960	1970	1980	1990	2000	2010
Population	30,275	39,194	61,269	92,237	157,920	245,808	311,554	445,342	529,710
AAGR	1.4%	2.6%	4.5%	4.1%	5.4%	4.4%	2.4%	3.6%	1.7%

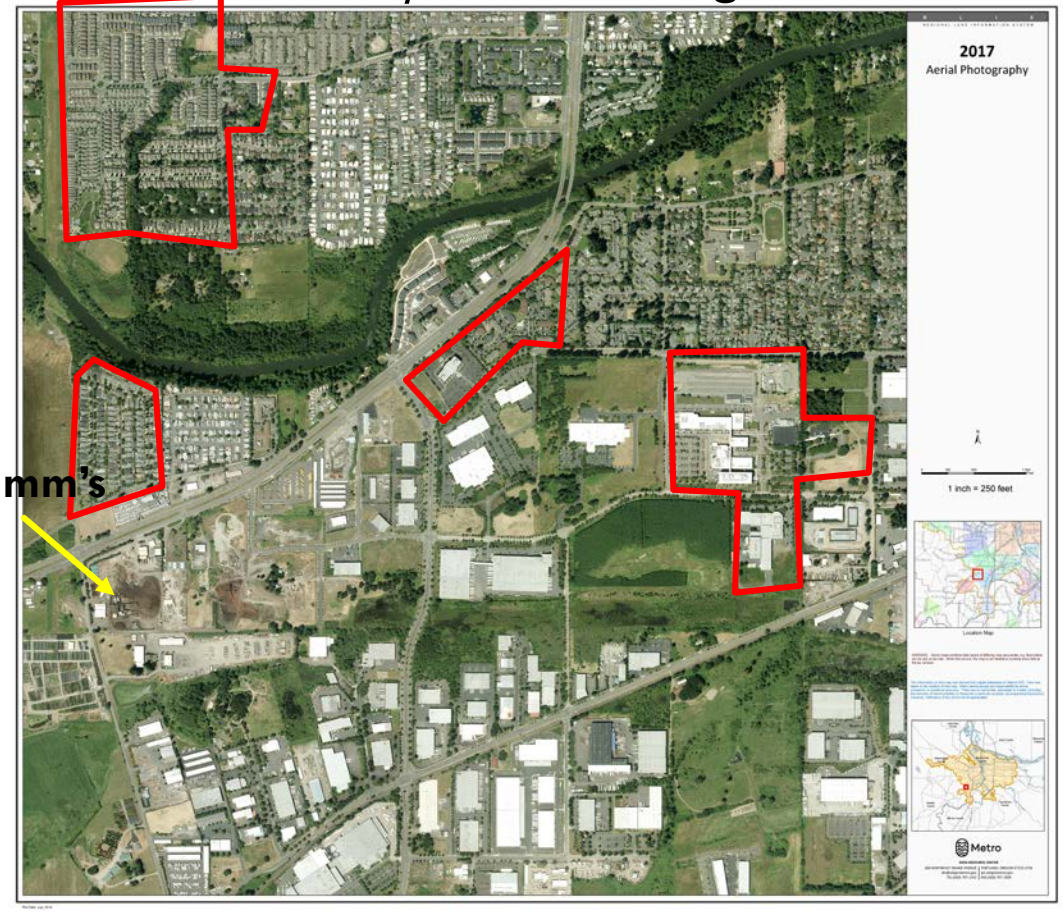
Sources: U.S. Census Bureau, 1930 to 2010 Censuses. Calculated by Population Research Center (PRC).
Note 1: Average annual growth rate is used for simplicity. In actuality the rate is an annualized rate calculated with this formula: [LN(Year1/Year2)/10]
Note 2: The 2000 total population does not reflect Count Question Resolution (CQR) revisions made by the U.S. Census Bureau. Revised total population numbers are used for the "County and Incorporated City Population" table.

SITE / COMMUNITY EVOLUTION

1994 AERIAL



2017 AERIAL w/ a few changed areas outlined

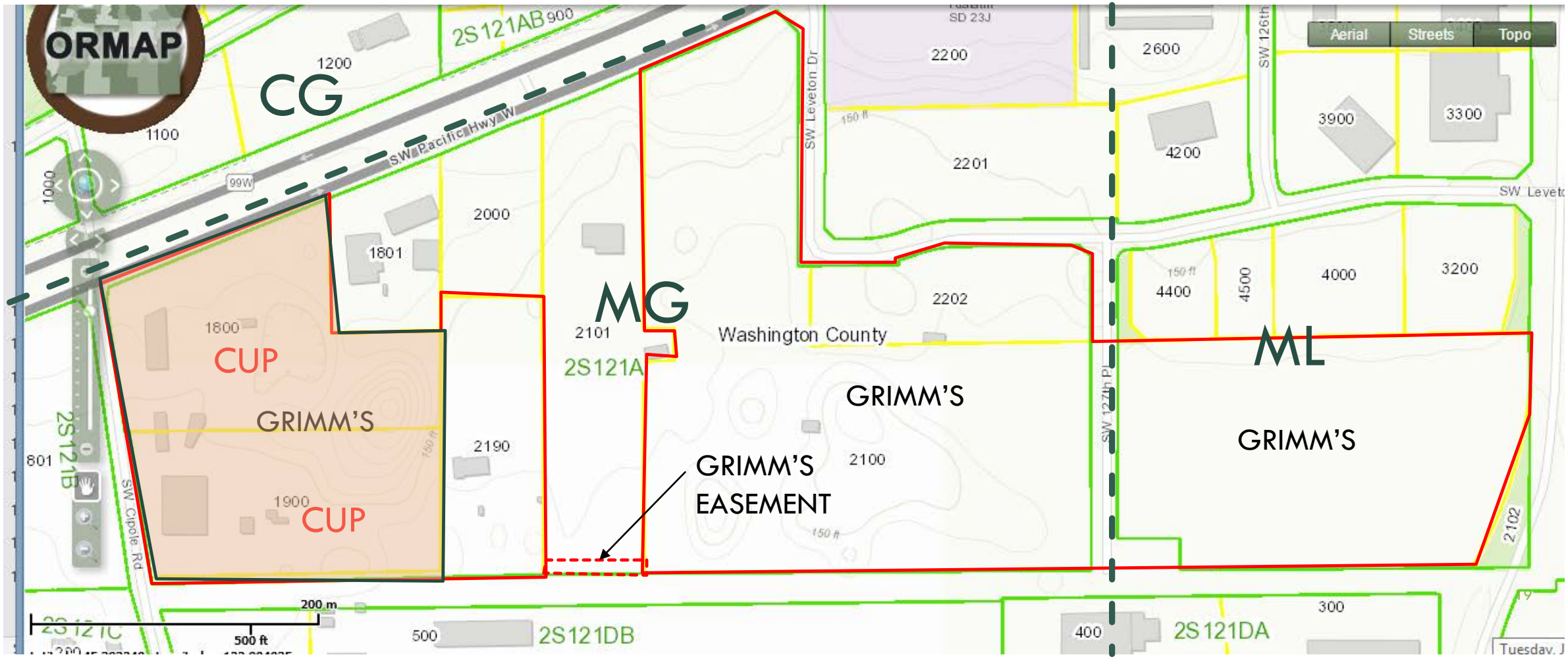


CURRENT GRIMM"S OPERATION

REGULATORY STATUS – PRIMARY REGULATORY LEVELS FOR GRIMM'S COMPOST FACILITY

- STATE – **OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY (DEQ)** REGULATIONS & PERMIT AND OPERATIONS PLAN
- TRI-COUNTY REGIONAL- **METRO** REQUIREMENTS & LICENSE AND OPERATIONS PLAN
- CITY – **TUALATIN** LAND USE ZONING AND REQUIREMENTS & CONDITIONAL USE PERMIT
- **TUALATIN VALLEY FIRE & RESCUE** – OREGON FIRE CODE, RESPONSE & ENFORCEMENT… INCLUDING DEVELOPING & FOLLOWING AN EMERGENCY PLAN

REGULATORY STATUS



PILE EMISSIONS FINDINGS

Location	LEL (methane) % -Anaerobic-	Ammonia ppm -Ind Anaerobic-	Carbon Monoxide ppm -Anaerobic-	Oxygen % -Ind Aerobic-
Surface - averages	24 (1.2)	0.1	40	11.9
Subsurface (2' deep) - averages	54 (2.7)	0.03	128	3.9

Emissions were measured on 3 Different Occasions:
Before, During, and After February's Pile Turning
And at 2 Different Depths: Surface & 2' Below Surface

Found: Methane, ammonia, and carbon monoxide were higher In Subsurface readings than in Surface readings

- Oxygen Extremely Low In Subsurface

PILE EMISSIONS FINDINGS

- Subsurface (@ 2’ deep): **Anaerobic**
- Surface 1’-2’ Thick “Rind”: **Of Aerobic Conditions**
- Aerobic layer is partially treating emissions from subsurface

ODOR EXPERIENCES – COMPLAINT RECORD

Table 4.1-1

	Total # of Complaints	# Days referenced by Complaints	Highest # of Complaints in a month / month	# Months with >20 complaints	Turnings
2013	74	38	26/October	1 - October	~Apr, Sept
2014	33	20	9/May	0	May, Oct
2015	7	7	2/September	0	Apr, Oct
2016	109	67	27/September	2 – Sept, Oct	Jan, Jun, Oct
2017	162	92	32/October	4 – Apr, Sept, Oct, Nov	Apr, Sept
Feb 2018	92	22	91/February	-	Feb

NEIGHBORS' EXPERIENCES

SURVEY LOCATIONS

ODOR SURVEY PARTICIPANT LOCATIONS

1 CASE Pony Ridge	6 North – King City random	11 BUSINESS – SouthE – Suburban Door
2 CASE Angel Haven	7 North – King City complainant	12 BUSINESS – South – Sonic Audio
3 CASE Hazelbrook	8 BUSINESS – West – T.V. Wildlife Refuge	13 BUSINESS – NorthE – G.H.McCulloch
4 Hazelbrook - Random	9 2.85 mi SW – Sherwood – random	G GRIMM'S COMPOST FACILITY
5 NorthE – Tigard 1x complainant	10 ESE – Lafky Park – random	

2.8 miles

NEIGHBORS' EXPERIENCES – SURVEY DATA RESULTS

Table 4.2 – 1 Participant / Location Characteristics

Participant Descripns	# Participants	Avg Dist to Grimm's Pile	Avg Impacts
CASE	3	0.5 mi	High 4.7
All Complainants	5	1.1 mi	High 3.6
Non-complainant Residences	4	1.8 mi	Low 1.0
All Non-complainants	8	1.2 mi	Low 1.0
Businesses	4	0.5 mi	Low 1.0
Residences	9	Incl. Dupl. Participant: 1.4 mi	Medium 2.4
All	Range: 0.2 - 2.9 mi	Average: 1.1 mi	Medium 2.0

NEIGHBORS' EXPERIENCES – HIGHLY VARIED…

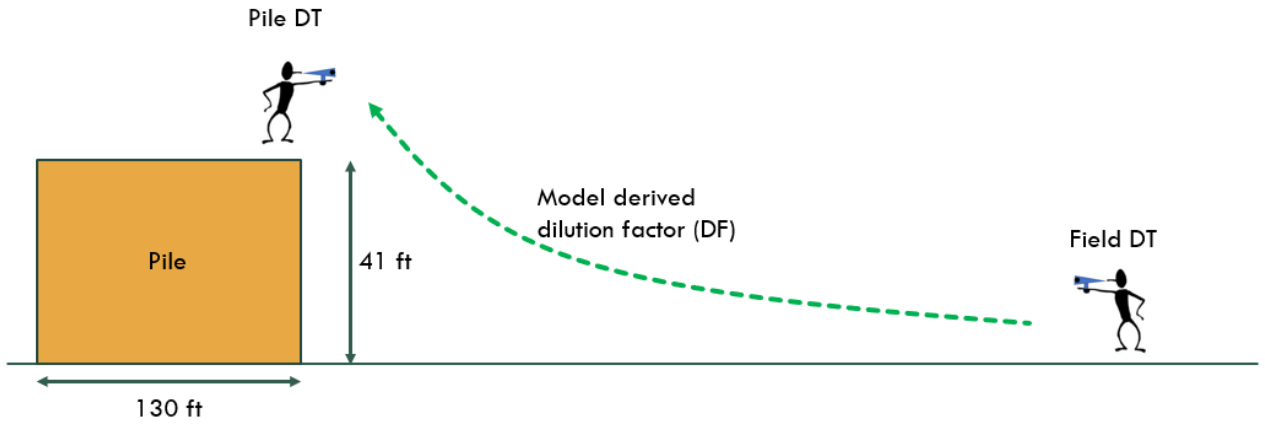
'EXPERIENCE' IS A QUALITATIVE CONCEPT: Cannot put a number to it

- Ranged from "NOT A PROBLEM" – Participant liked being close to the service Grimm's provides, doesn't mind the smell, "not like a dairy"
- To SERIOUSLY IMPACTING THEIR LIFE. Participant isolated themself due to embarrassment and sensitivity to family & friends. Another felt it permeated them; Soaked into their hair and "follows" them even out of the area.

ODOR DISPERSION MODELING

OVERVIEW OF MODELING PROCESS

1. **Dilution To Threshold [DT]** Odor Sampling In Neighborhood



2. Used dispersion model to calculate downwind dilution and to estimate odor at pile
3. Used Worst Case Pile DT to estimate impact to neighborhood

FIELD ODOR SAMPLING

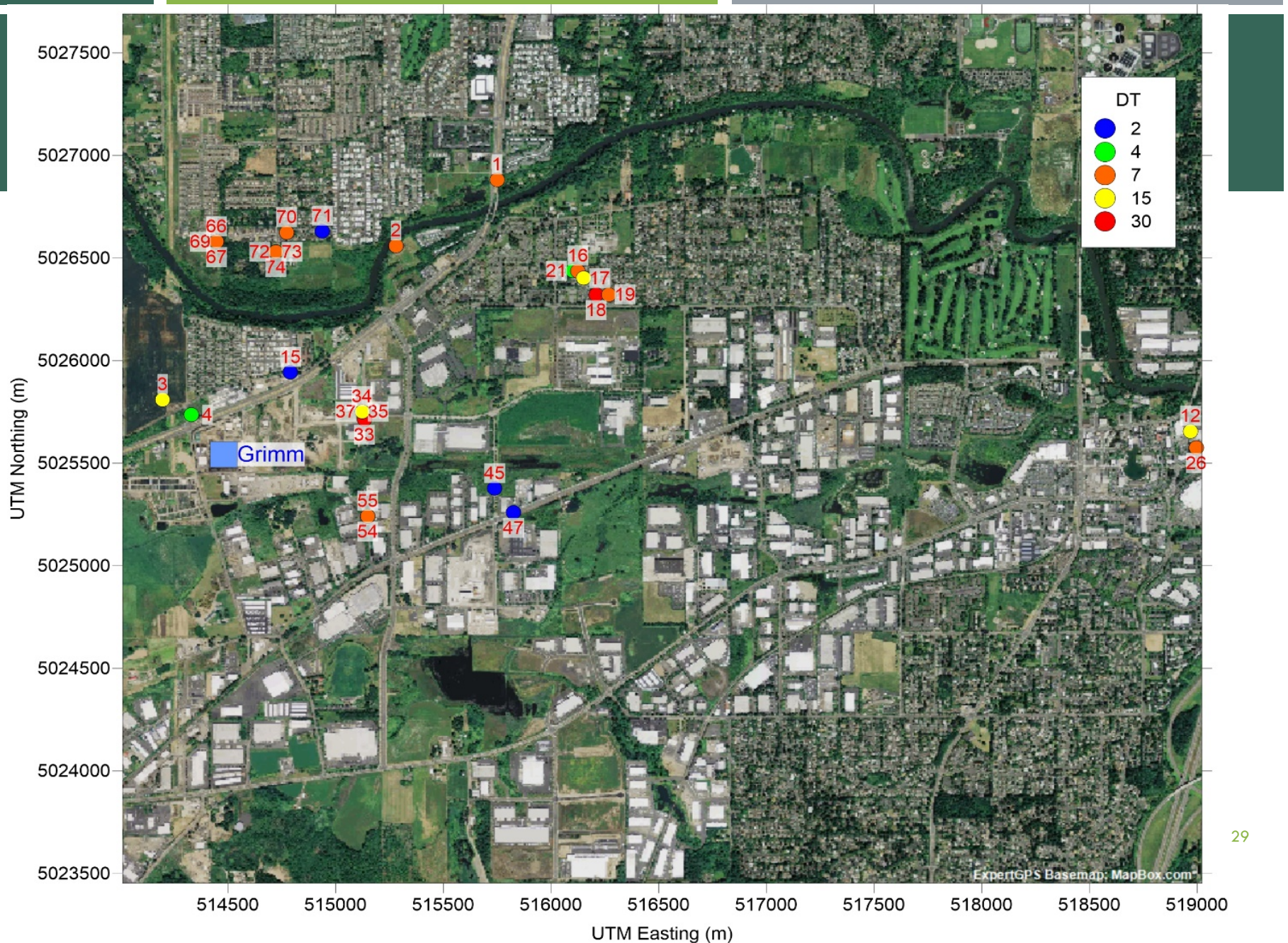
- Odor sampling was conduction using The Nasal Ranger® Field Olfactometer. A Nasal Ranger creates a calibrated series of discrete dilutions by mixing the odorous ambient air with odor-free (carbon) filtered air.

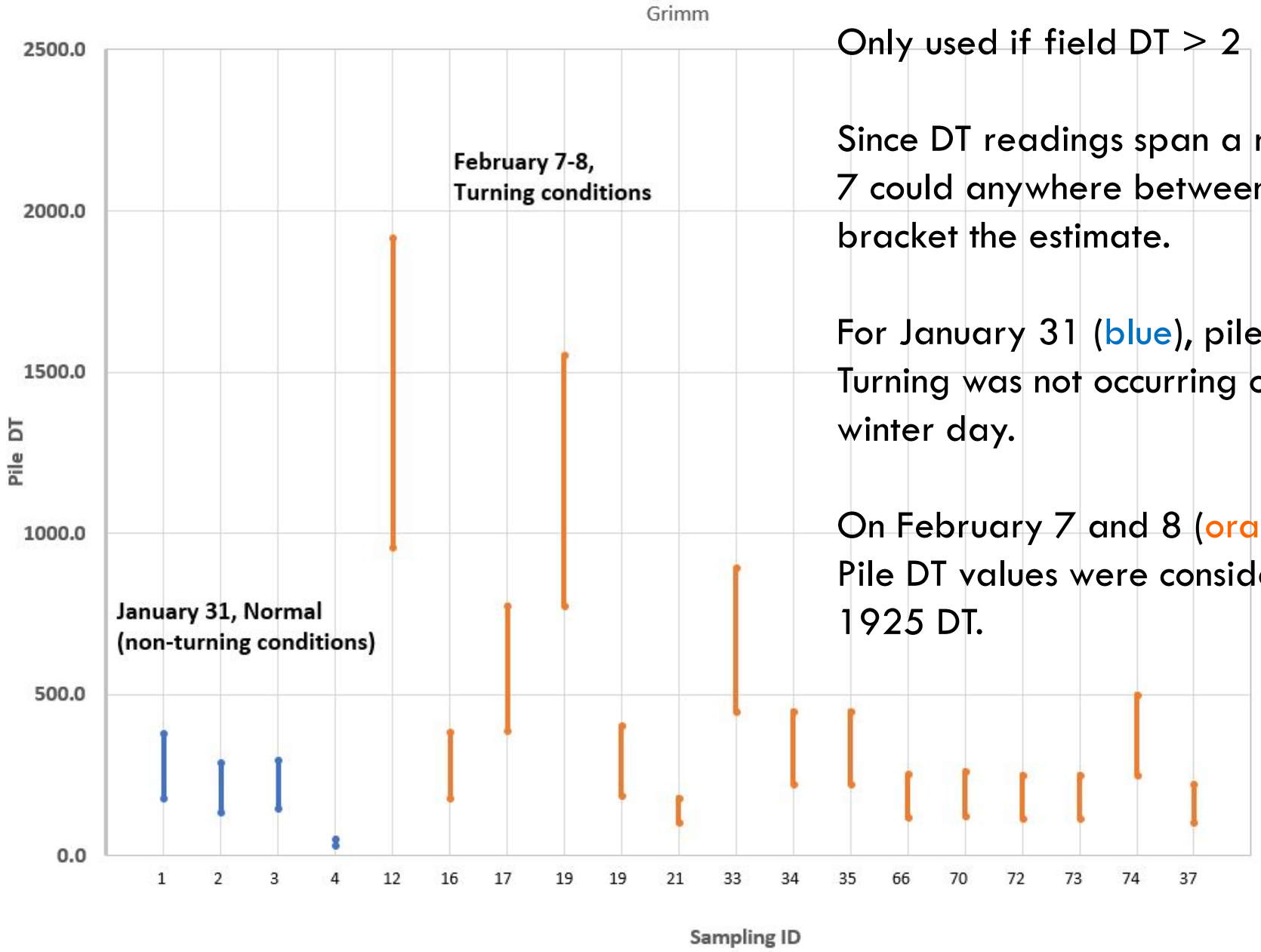
- Each discrete dilution level is a "Dilution-to-Threshold" (DT) ratio, which is a measure of the number of dilutions needed to make the odorous ambient air "non-detectable".
- The Nasal Ranger has 6 discrete dilution levels (2, 4, 7, 15, 30 and 60)
- A DT of 2 is just noticeable, while DT=7 can be considered nuisance, and a DT of 30 or more is objectionable.

FIELD ODOR SAMPLING

- Odor Sampling was conducted in the neighborhoods around Grimm's on 3 days:
  - January 31 (4 samples) < Not turning - Calm winds (< 1 mph)
  - February 7 (7 samples) < ACTIVE TURNING - Calm winds and inversion
  - February 8 (17 samples) < ACTIVE TURNING - Calm winds
- On all three of these days of sampling, winds were calm (less than 1 mph), as indicated by the weather station at the Grimm's site and at the Hillsboro Airport. Calm wind conditions occur about 20 percent of the time. During calm winds, plumes from the pile can slowly meander downwind and not disperse effectively, causing noticeable odor impacts. These conditions can lead to odor complaints well downwind of the facility.

FIELD ODOR SAMPLING





Only used if field DT > 2

Since DT readings span a range of possible values (e.g., a DT of 7 could anywhere between 7 to 15), the range was shown to bracket the estimate.

For January 31 (blue), pile DT values range from 19 to 400. Turning was not occurring on this day so it represents a "typical" winter day.

On February 7 and 8 (orange), active turning was occurring. Pile DT values were considerably higher, ranging from 62 to 1925 DT.

ODOR DISPERSION MODELING

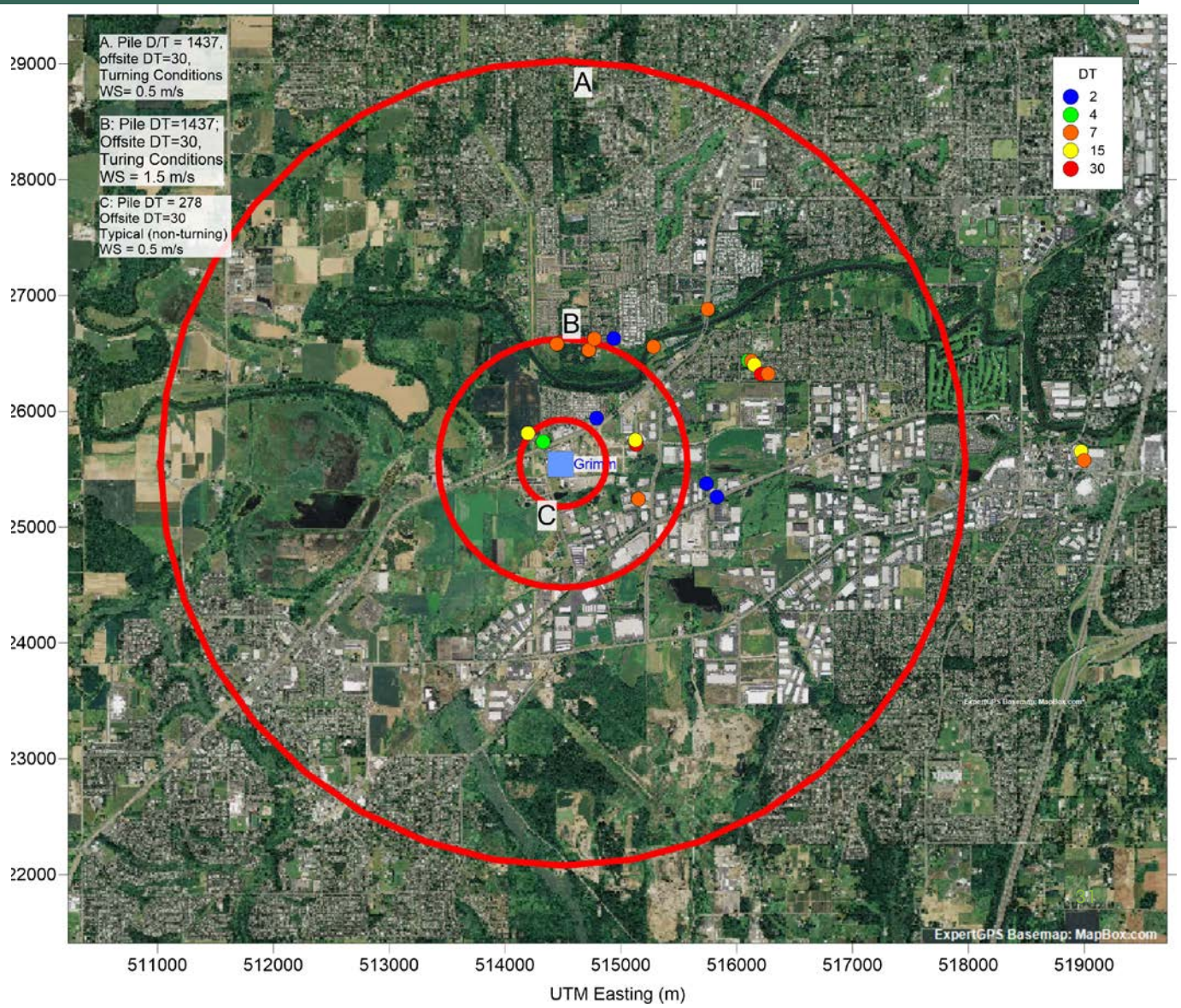
- Impacts defined by circles of DT =30.

  A: Turning activities under calm winds: impact out to 3.5 kilometers (2.2 miles)

  B: Turning activities under average winds: impacts out to 1.1 kilometers (0.68 miles)

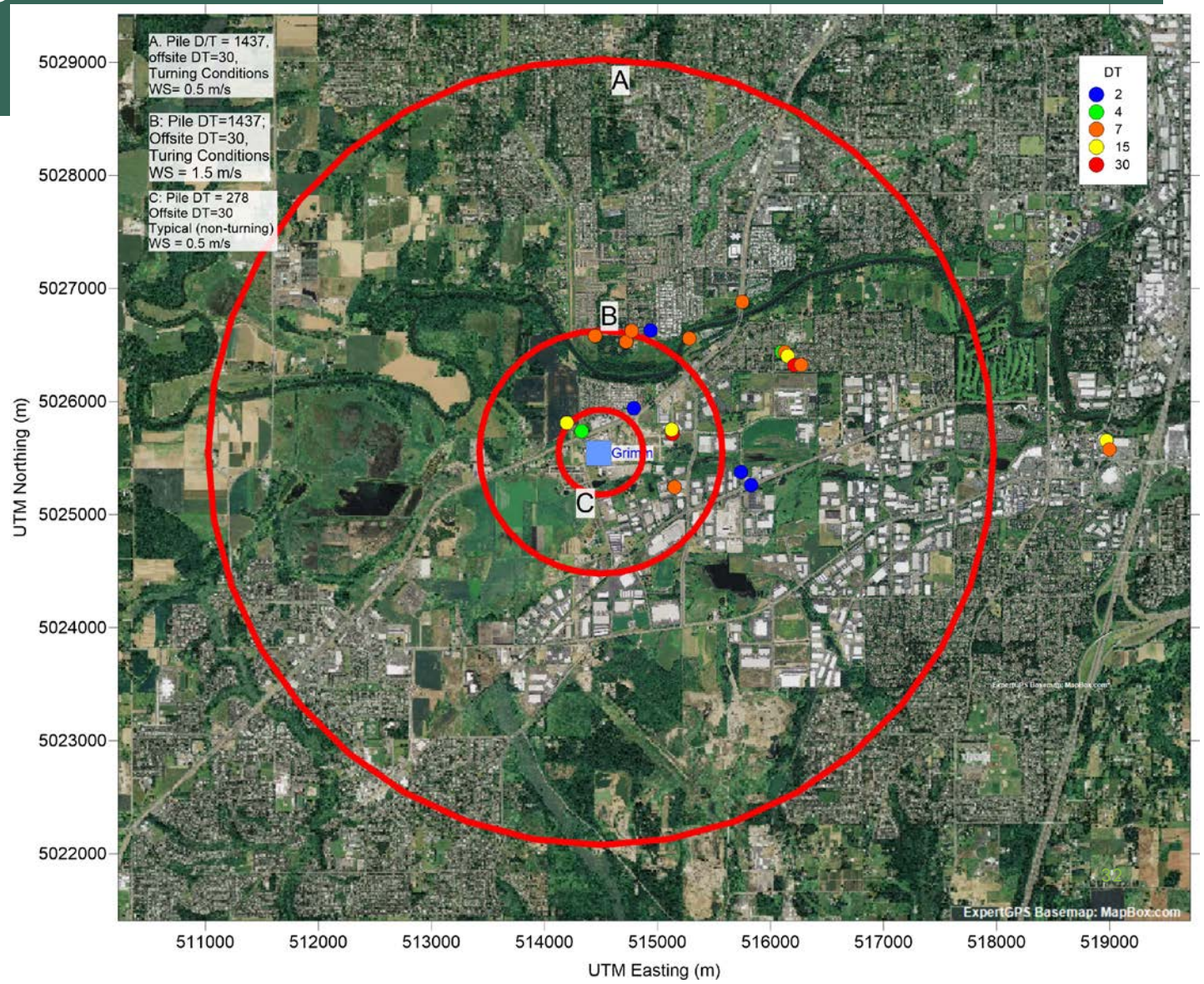
  C: Typical (non-turning) activities under calm wind conditions: impacts out to 375 meters (0.25 miles)

- These results indicate that the Grimm operations, as currently configured, are having a significant impact in the nearby community.



ODOR DISPERSION MODELING

- The nearest residential location is approximately 300 meters from the center of the pile. At this distance, the dilution factors are about 8.
  Thus, to keep the offsite DT under 10, the pile DT would need to be reduced by roughly a factor of 18, to a pile DT of 80 or less.



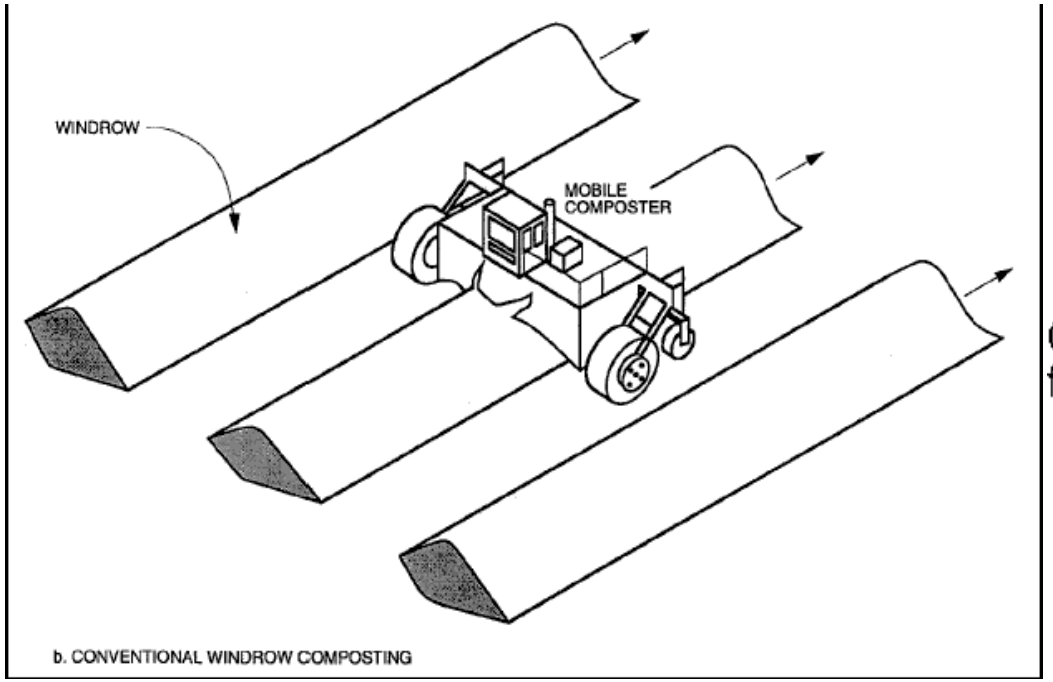
OVERVIEW OF PROPOSED TECHNOLOGY ALTERNATIVES

- Four Alternatives:
  1. Pipe On Grade – Rectangular Aerated Static Pile, Positive & Negative Aeration
  2. Pipe On Grade - Radial Aerated Static Pile, Positive Aeration
  3. Pipe Below Grade- Turned Aerated Pile - In-building, Positive And Negative Aeration
  4. Pipe Below Grade – Rectangular Aerated Static Pile, Positive And Negative Aeration

- All Alternatives Are Aerated Static Pile Technology As Opposed To Windrows
- All Alternatives Are Fully Aerobic
- All Alternatives Utilize Piles Less Than 14-feet High
- Three Alternatives Are Designed For No Disturbance For At Least 20-days
- All Alternatives Utilize Odor Control Technologies Including Biocovers And/Or Biofilters

AERATED STATIC PILE [ASP] VS WINDROW

Windrow Composting



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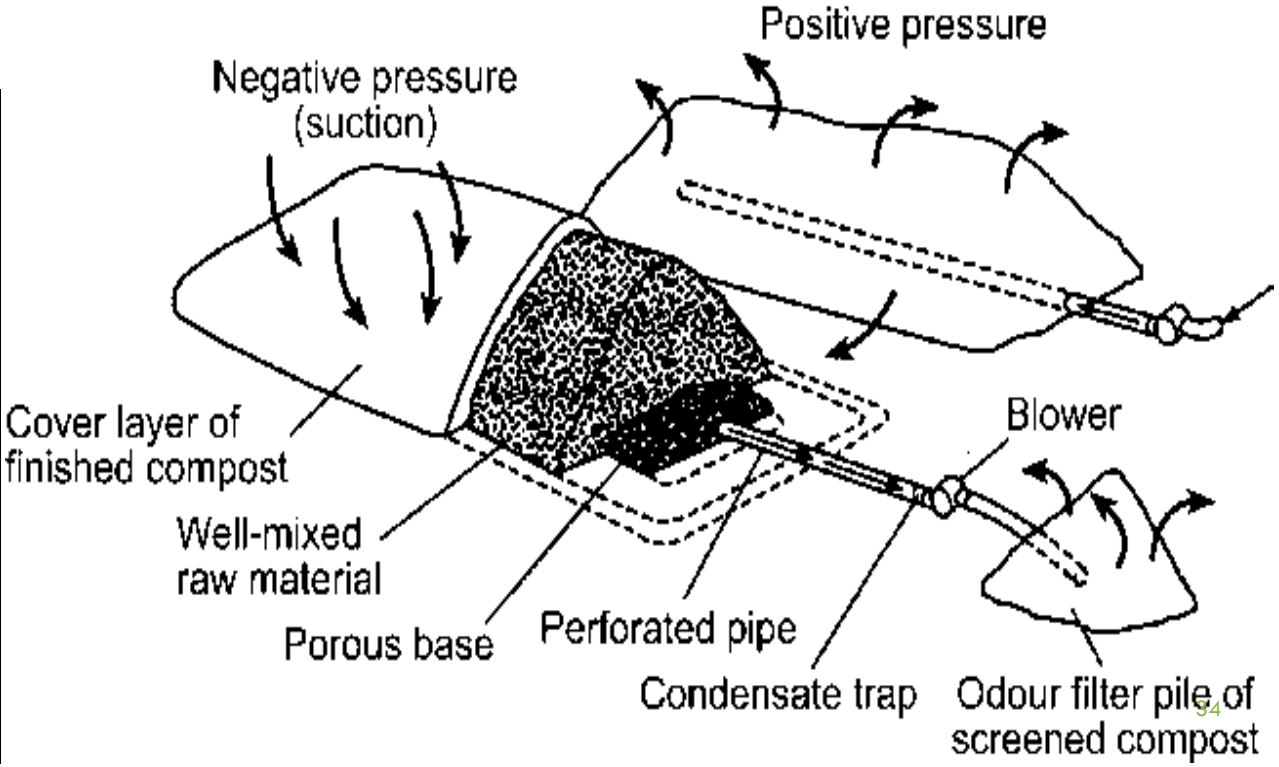
Aerated Static Pile Composting

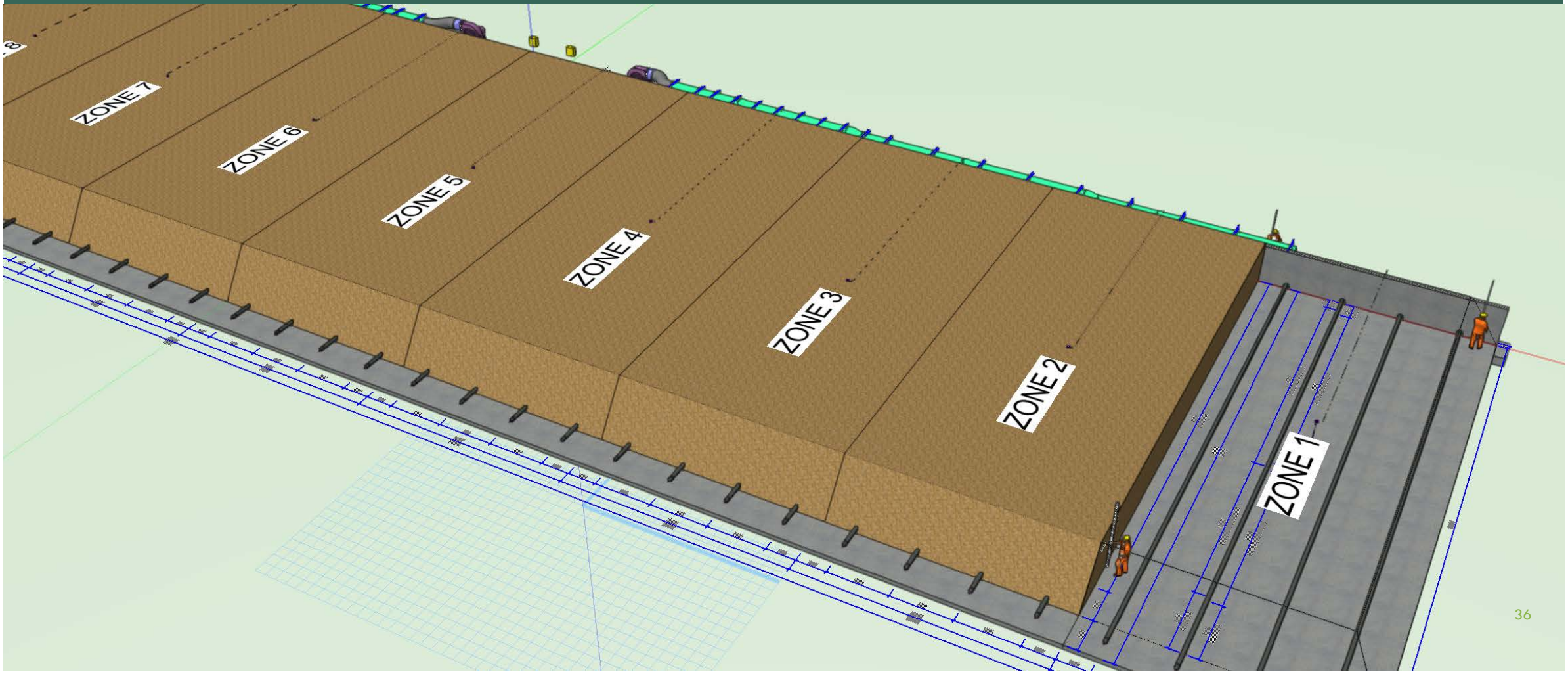


ALTERNATIVE 1 – TRADITIONAL AERATED STATIC PILE BAYS – POSITIVE AND NEGATIVE AERATION W/BIOFILTER

1203	m3/zone
1,574	yd3/zone
16	zones
25,176	cubic yards in place
10,946	tons in place
40	days in place
273.66	tons per day
99,885	tons per year

Grimm's Fuel Compost Alternative 1
Aerated Bays with external Biofilter and Biocover Positive and Negative Aeration Bays
Max throughput ~100,000 tons per year

ASP – PIPE ON GRADE

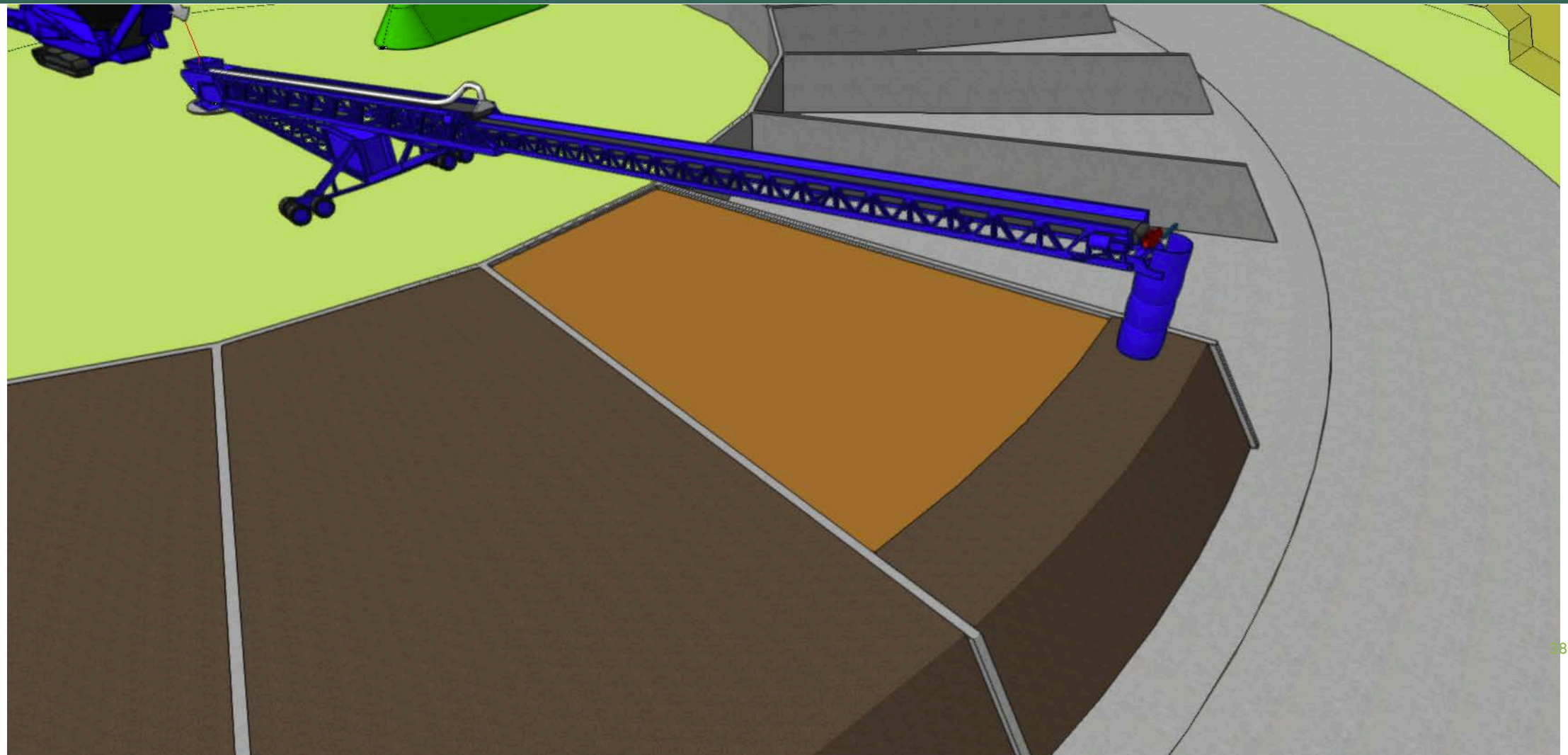


ALTERNATIVE 2 – INNOVATIVE RADIAL AERATED STATIC PILE – DOUGHNUT CONFIGURATION – POSITIVE AERATION

1253	m3/zone
1,639	yd3/zone at 12'deep
16	zones
26,223	cubic yards in place
11,401	tons in place
40	days in place
285.03	tons per day
104,036	Tons per year

Grimm's Fuel Compost Alternative 2
Extended Aerated Static Piles with Biocover Positive Aeration Capability
Automated zone filling system with Radial Telescoping Conveyor
Max throughput ~104,000 tons per year

RADIAL AERATED STATIC PILE FOR ALTERNATIVE 2



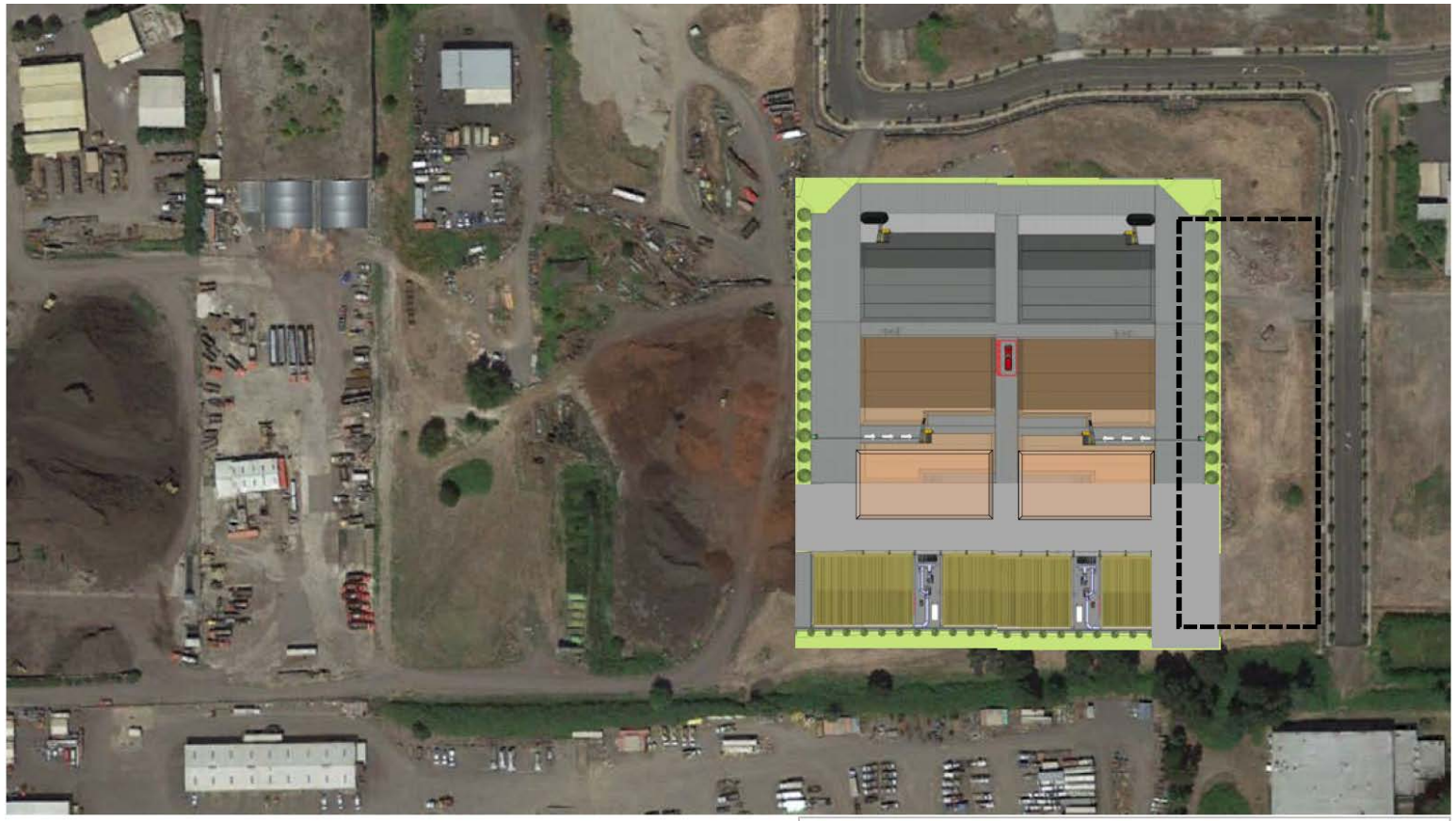
ALTERNATIVE 3 – STRUCTURE COVERED AERATED STATIC PILE SYSTEM – POSITIVE AND NEGATIVE AERATION WITH BIOFILTER

Total Building	560	275	$90.91	square foot costs
Inside Aerated floor	300	240	10	feet tall
Volume	26,667	cubic yards	21	days inside minimum
Compost in place	11,594	tons in place	1.5	peaking factor
Daily Production	368	TPD average	552	TPD peak
Avg. Inside Capacity	134,346	tons per year capacity	31.50	days avg. inside
Curing covered	180	180	12	feet tall
Curing Capacity	14400	cubic yards	26	days curing at peak volumes
Cost Estimate	$ 14,000,000		39	days curing at average production

Grimm's Fuel Compost Alternative 3
Fully Covered Aerated Static Pile in Structure with External Biofilter
Negative aeration on Building, Positive Aeration on Composting Piles
Compost Turners run every 6 to 8 days
Throughput ~134,000 tons per year

TURNED AERATED PILE – ENCLOSED ALTERNATIVE 3 – COMPOST FACTORY

ALTERNATIVE 4 – IN-GROUND AERATION AERATED STATIC PILE POSITIVE AND NEGATIVE AERATION W/ BIOFILTER-EXPANDABLE



	225	Aeration Pad width each section			
	430	Aeration pad length incl. biofilter			
	96,750	sq.ft.	$	30.00	cost per sq.ft.
	2.22	acres / section		2	Sections of aeration pad
$	5,805,000	2 concrete aeration pads & piping		120,000	Tons/year avg capacity
	62,200	sq.ft asphalt		47	Days in place
$	373,200	Asphalt		$6	cost per sq foot
	390	Pile length		350	Pile width
	53,083	YD^3 in place		10.5	feet high
	23,080	tons in place		491	tons per day peak capacity
	179,236	tons oer year peak capacity		2.3	cubic yards per ton shredded

Grimm's Fuel Compost Alternative 4

2 Phases shown 3 total possible on site
One or Two Turns on Aeation Pad
Flexible ASP Piles on Concrete Air Pad
Biofilter for Suction, Biocovers for Pressure
Turned after 20 days with loaders or turners
Negative Aeration with Biofilters first 20 days
Average Throughput - 120,000 Tons per year
Average Daily Throughput 328 Tons Per Day

ALTERNATIVE 4 EXAMPLE - CITY OF PHOENIX - OPERATED AS AN AERATED STATIC PILE, PUSH AND PULL AERATION BIOFILTERS AND BIOCOVERS

WE RECOMMEND:

Grimm's and/or Metro-DEQ **Remediate The Odors** As Goal And Bottom Line.

- Site Improvements Can Be Implemented Immediately

Within 3 Years:

- New Technology – Forced Aeration, Continuous Aeration, Fully Aerobic
- Metro Can Improve Its Regulatory Tools – Olfactometry & Permit Conditions
- Land Use Consistency Would Enable Better Composting Management
- Long Term Regulatory Assurance Would Enable Financing Of Improved Technology
- Improved Neighborhood Interaction Would Help All Parties.

OPERATIONAL SITE IMPROVEMENTS [IMPLEMENTED IMMEDIATELY]

- Control And Treat The Air Over The Screening and Grinding System
- Remove Relic Objects In / Near Piles To Reduce Spontaneous Combustion
- Utilize A minimum 12” Biocover of Wet Screened Overs on the Existing Pile
- Consider other ideas contained in the CA Mitigation Menu

WE RECOMMEND – FULLY AERATED TECHNOLOGY

ALTERNATIVE 4 –
IN-GROUND, POSITIVE AND NEGATIVE AERATION
BIOCOVERS AND BIOFILTER

- **PROS:**
  - HIGHEST PROCESS FLEXIBILITY,
  - LEAST IMPACT DURING TRANSITION,
  - EASIEST / HIGHEST FUTURE EXPANSION CAPACITY,
  - HIGH ODOR CONTROL,
  - HIGH PROCESS EFFICIENCY
- **CONS:**
  - REQUIRES STORMWATER MANAGEMENT DESIGN
  - REQUIRES LAND USE CONSISTENCY [CUP]
  - COST

WE RECOMMEND – IMPROVED REGULATORY TOOLS

Metro/DEQ Could Use Field Olfactometry For

- Use At Property Line To Monitor Emissions,
- Use With Additional Dispersion Modeling At Pile Surface, Or
- Use In Neighborhoods To Confirm Odors

WE RECOMMEND - PERMIT / LICENSE CONDITION OPTIONS

- Require Oxygen Monitoring – Minimum 10% At All Points In Active Piles
- Require Continuous, Forced Aeration
- Maximum Active And Curing Pile Height Of 14-feet
- Minimum Biocover Thickness Of 12-inches Over All Surfaces Of Active And Curing Piles
- No Disturbance Of Piles Within First 14-days Minimum
- Require PFRP Be Achieved At All Locations In Active Piles
- Temperature Monitoring Should Be Shown To Represent All Locations In Piles
- Require Compost Facility Operator Training
- Utilize CA Mitigation Strategy Menu To Inform Alternatives Depending Upon Issues (Reference In Section 9)

OTHER REGULATORY RECOMMENDATIONS

- We recommend that the Oregon Administrative Regulation (OAR 340-093-0030(23), (24), & (25) be changed to separate composting from anaerobic digestion. Defining "Compost" and "Composting" as **"aerobic"** could improve regulatory legitimacy of that important concept.
- We recommend the U.S. Compost Council (USCC) definition.

IMPROVED LAND USE CONSISTENCY

WE RECOMMEND - LONG TERM REGULATORY / FINANCIAL ASSURANCE

- Required regulatory elements such as permits and licenses that are needed to obtain financing could be lengthened to provide assurance for financing the needed updating of Grimm's compost technology.
- Encouragement of long term contracts, if under control of agencies, would also help with financing improvements.
- The community benefit of the compost infrastructure could be recognized and encouraged by assisting the financing of needed updating of Grimm's compost technology through grants or long term contracts.

WE RECOMMEND: TO IMPROVE NEIGHBORHOOD INTERACTION…

- We Suggest That Grimm's Engage The Community In Informal Educational Experiences During Construction Of The New Technology At Multiple & Regular Intervals To

  Give The Community An Opportunity To Learn: What Compost Is; How The New Technology Works; And To Develop Relationships With Grimm's And The Improved Facility.

CONCLUSIONS:
ALTERNATIVE EVALUATION PROCESS RESULTING IN RECOMMENDATIONS

METRO'S EVALUATION CRITERIA:

- Protects Human Health & Environment
- Good Value For People's Money
- Highest & Best Use Of Materials
- Adaptive / Responsive To Changing Needs
- Available To All Types Of Customers
- Compatible With Increasing Waste Reduction & Recycling
- Transparent For Site Operations & Odor Assessment Evaluation

CONCLUSIONS: ALTERNATIVE EVALUATION PROCESS

ALTERNATIVE 4 – IN-GROUND AERATION AERATED STATIC PILE POSITIVE AND NEGATIVE AERATION W/ BIOFILTER-EXPANDABLE

+ PROTECTS HUMAN HEALTH
+ PROTECTS ENVIRONMENT
+ GOOD VALUE FOR $$$
+ **HIGHLY EXPANDABLE / FLEXIBLE**
+ EFFICIENT OPERATION
+ CURRENT TECHNOLOGY

- STORMWATER DESIGN NEEDED
- CUP EXPANSION NEEDED

METRO

GRIMM'S FUEL COMPANY COMPOSTING ASSESSMENT & RECOMMENDATIONS

QUESTIONS???