Former Geneva Foundry

OFFSITE SURFACE SOIL SAMPLING - 2015

Environmental Restoration Program
Site # B00019
August 2016

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Note: Field work was conducted by NYSDEC staff (James Craft, Engineering Geologist and Scott Williams, Engineering Technician) during July-December 2015. Mr. Craft performed the XRF analyses and Mr. Williams provided GIS support/maps and historical research. Data summaries, interpretations, and report writing were the responsibility of Mr. Craft.

SUMMARY

The Geneva Foundry operated on Jackson Street in the City of Geneva for more than a century (1868-1988). To melt iron and cast iron objects, the foundry burned coal and later, coke (processed coal) mixed in layers with iron (unrefined and scrap) and flux. Air emissions of ash particles from the foundry stack settled on residential and commercial neighborhoods in the vicinity of the foundry. The "fly ash" particles contain variable concentrations of metals, of which lead and arsenic are the contaminants of concern. The main source of lead was contaminated scrap (e.g., leaded-gas residues on engine blocks and lead-paint on scrap iron) and the natural arsenic content of coal/coke was released during combustion.

This report presents data and interpretations from offsite surface soil samples collected and analyzed in 2015. As described in the 2015 revised Supplemental Remedial Investigation/Alternatives Analysis Report, previous sampling (mainly 1999 and 2005) documented apparent offsite foundry impacts of lead and arsenic. However, interpretations of the extent of foundry impacts and background levels were confounded by multiple potential sources of lead and low sampling density. To overcome these difficulties and the highly-variable contaminant distributions at yard-scale or less, the sampling strategy included several transects from un-impacted areas toward the former foundry (to help define the area of concern) and multiple samples per property (seven, on average, in the area of concern) to increase the probability of locating isolated areas of contamination.

Surface soil samples from over 700 offsite locations (residential yards, parks, churches, and street right-of-ways) were analyzed using a combination of field instrument (x-ray fluorescence analyzers; XRF) and laboratory analyses. The data show a complex distribution of elevated lead and arsenic in surface soils extending roughly 1000 feet in all directions from the foundry with farther impacts (~ 1300 feet to the east) in the dominant downwind direction. In general, lead concentrations are higher and more prevalent in yards closest to the foundry and decrease with distance with localized exceptions caused by coal-ash fill and/or apparent lead paint deposits. Lead (symbol = **Pb)** concentrations for the laboratory dataset (a subset of samples selected based elevated XRF screening) ranged from 48 to 6380 parts per million (ppm) with a mean of 460 ppm. Arsenic (symbol = **As**) ranged from 4 to 228 ppm with a mean of 18 ppm. The residential soil cleanup objectives (SCOs) for Pb = 400 ppm and As = 16 ppm per NYSDEC Part 375.6.6 Given mean concentrations slightly above SCOs, slightly more than half of the Pb and As lab datasets are above SCOs.

As noted, many yards show variable contaminant concentrations (with a combination of samples both above and below SCOs). This variability increases with distance from the foundry and likely results from a combination of factors such as variations in foundry scrap and operations, wind direction and speed, additional ash input from other historical foundries, and redistribution of ash and soil over a timeframe of many decades. Ash particles may be redistributed laterally by wind, runoff, and activity (especially on bare soil or impervious surfaces) and vertically by biological (disturbed/churned by humans, dogs, rodents, worms, grubs, ants, etc.) and chemical/physical (dissolution/infiltration) processes. Approximately 25% of the properties sampled showed "enrichment" in lead (elevated Pb/As ratios; ~ > 40) which was observed and/or interpreted as coal-ash fill from former residential furnaces or lead paint residues. In many of these cases, the relative proportion of any foundry impacts is unclear / indeterminable especially at the perimeter of the known area of concern. Coupled with incomplete access (about 50% of canvassed property owners allowed access), complete definition of the problem was hampered in places but sampling efforts to date have largely defined the extent of Geneva Foundry impacts on offsite properties.

General Precautions: Lead is a very versatile metal (readily smelted, melted, casted, and alloyed, malleable, very dense) that has been mined, smelted, and used for millennia. Uses such as plumbing, liquid storage/serving containers, and wine preservative date back to Roman times along with reports of lead poisoning. Early in the twentieth century, commercial and industrial applications like paint and gasoline additives greatly expanded the use of lead which greatly expanded the potential for exposure to this neurotoxin (the developing brains of infants/children are most susceptible as is the tendency to be exposed).

Potential lead exposures include:

- lead paint on older housing (pre-1978) and nearby soil;
- leaded gasoline exhaust residues near busy streets;
- lead from foundry emissions (and lead smelters have contaminated widespread areas); and
- coal-ash fill in backyards (highly variable concentrations - some low Pb/some high Pb– high lead levels in some ash is likely due to co-combustion of waste paper w/lead inks in residential furnaces).

Any urban area, therefore, may have areas of lead (and/or other) contamination. General rules of thumb include:

- Abate any interior or exterior lead paint hazard.
- Keep dirt out of the house (use mats and/or remove shoes and wipe pet paws).
- Keep yards grassy/well-vegetated and plantings mulched (avoid exposure to bare ground).
- Wash hands with soap and water after gardening or any time before eating.
- Avoid gardening in areas of obvious fill (chunks of coal, cinders, glass, brick, etc.) and use raised beds where possible (healthy gardening tips: (http://www.health.ny.gov/publications/1301/).

The tracking/transfer of contaminated soil to inside homes is perhaps less recognized than more direct/obvious potential exposures such as the ingestion of contaminated soil or lead paint. Even if the “dirt” is quickly swept or vacuumed, the finest (and most respirable) dust particles may be continuously re-circulated by inefficient vacuum filters and sweeping. This exposure scenario (as well as direct contact/ingestion) can be mitigated or eliminated by the steps noted above.

Geneva's Industrial Past - (Multiple Foundries - 1812-1988)

Geneva has an interesting manufacturing history that included a number of foundries in a relatively small area of the City. Some operated for over a century; the first, Burrall Company started manufacturing farm implements in 1812 and in 1846 produced the first cast-iron pipe which replaced wooden water lines in Geneva (Osburn, 2015). With the construction of the Seneca-Cayuga branch of the Erie Canal in the 1820s and the first railroads in the 1840s, transport of coal, iron, and goods was facilitated and the industry blossomed. By the 1860s, three foundries operated in close proximity including the Catchpole (later Geneva) Foundry and the New York Central Iron Works. Cast-iron stoves and boilers were major products along with farm implements/machinery and steam engines. As demand and factories expanded, a trained workforce and knowledgeable entrepreneurs fostered competition and innovation. By the late 19th century, as many as six foundries were located near or along the NY Central Railroad (Geneva Historical Society, 2014). The Geneva Foundry survived the longest (1868-1988) but others, such as the much larger NY Central Iron Works at Exchange and Lewis Streets, operated nearby for many decades (Osburn, 2015) and a manufactured gas plant operated a block to the east on Wadsworth Street (which produced coke as a by-product).

Lead & Arsenic - Origin, Occurrence, and Fate

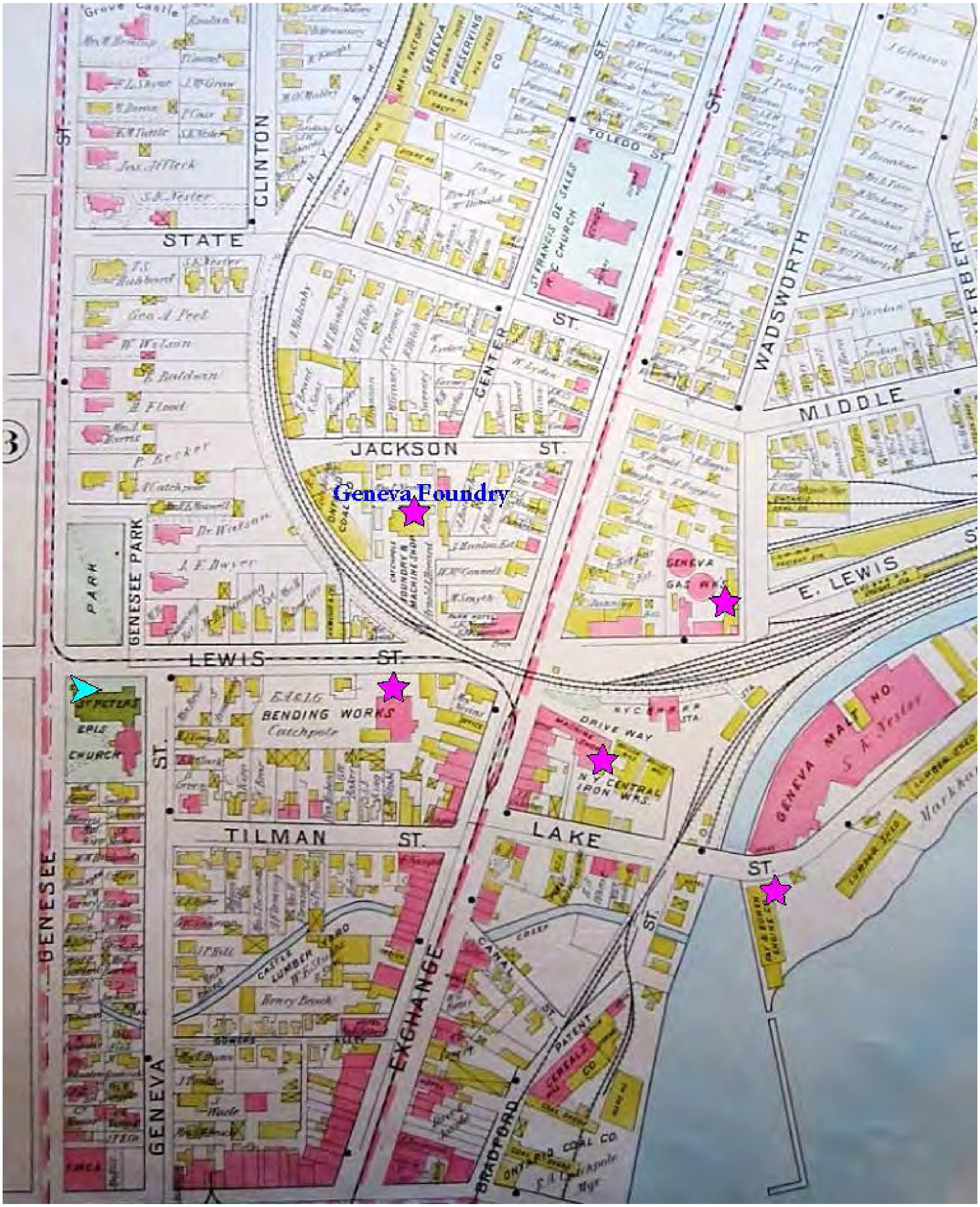
Lead (Pb) and Arsenic (As) are naturally-occurring elements which are present in soils at natural background concentrations of about 50 parts per million (ppm) and 5 ppm, respectively. Urban background levels can be somewhat higher due to human activity, ranging roughly from 50-250 ppm for Pb and 5-10 ppm for As. The NYS residential Soil Cleanup Objectives (SCOs) for Pb = 400 ppm and As = 16 ppm per NYCRR Part 375.6. Many urban areas are plagued by elevated lead levels due to the former use of lead paint on housing (banned 1978; EPA https://www.epa.gov/lead/learn-about-lead#found) and leaded gas (use curtailed in late 1980s; Filipelli et al., 2005). Most metals persist indefinitely in soils with varying degrees of solubility/dissolution.

Coal & Foundry Furnaces

Coal and the ability to move it by rail fueled the Industrial Revolution in which foundries played a key role. Coal, and later, more commonly, coke (processed coal; heated in air-tight chambers to remove impurities) provides the heat source for foundry cupola furnaces. Coal is a sedimentary rock composed mostly of diverse organic carbon compounds (fossilized plant material). It also contains roughly 10% inorganic minerals such as clays, quartz, and pyrite (iron sulfide); most of the arsenic content is associated with pyrite (substituting for some of the sulfur content; USGS, 2005). The U.S. Geological Survey (2009) estimated that 75 of the 90 naturally-occurring elements may be present in coal (mostly at trace levels) which vary with coal age (e.g., typically lower metal content in younger coal/lignite deposits) and location. In Appalachian coal deposits, arsenic ranges from about 10 to 70 ppm; bituminous coal from western Pennsylvania averages ~ 30 ppm As (with a similar ppm range for Pb).

The 1904 map of Geneva (New Century Map of Ontario County - *Geneva Free Library*) below shows several coal yards and two separate rail connections to Pennsylvania coal. The Fall Brook RR along the west shore of Seneca Lake connected to the western PA bituminous (~ 30 ppm As) coalfields and the Lehigh Valley RR connected to the eastern PA anthracite (~ 10 ppm As) coal belt. Bituminous coal likely found much greater use in coke production and foundries whereas anthracite (metamorphic coal) was popular ("cleaner"; easier to handle) in residential furnaces. Therefore, coal used by Geneva industries likely contained roughly 30 ppm of As and hence was enriched (~ 6x) in As relative to natural As background of about 5 ppm (and the combustion process significantly enriches the As content of fly ash as discussed further below). On the other hand, lead levels in coal are less than soil background; the excess lead in the vicinity of the Geneva Foundry is attributable mostly to contaminated foundry feedstock.

Figure 1 – 1904 Map of Geneva (Purple Stars = fly ash emission points and include a much larger foundry at the time, NY Central Iron Works. Other foundries (off the map) include Herendeen Foundry, Phillips & Clarke Stove, and Andes Stove works).



Sources of Lead

As major iron recyclers, foundries use large amounts of scrap iron. Motor vehicles (especially engine blocks) are a desirable source of dense scrap although unrefined ("pig") iron direct from iron ore smelters was the major feedstock in the 19th century. As motor vehicles proliferated early in the 20th century, so did the supply and transport of vehicle scrap. Coincidentally, the Geneva Foundry changed owners and expanded in the 1920s as Pb-paint and Pb-gasoline came into common use. As described by Filipelli et al. (2005):

> "By far the largest use of Pb has occurred in the industrial era, where two new applications of Pb were found in the twentieth century: Pb-based paints and tetraethyl/methyl Pb-additives to gasoline. Lead-based paints, which contain up to 15% Pb, are extremely durable and flexible, and their use expanded dramatically during the 1920s (Fig. 1). The production and use of Pb for gasoline additives was spurred by the need to control the explosion of gasoline in cylinders of internal combustion engines. Thomas Midgely, an engineer for General Motors and DuPont, perfected the formulation of Pb additives in the 1920s, but the peak in Pb use for this application follows the trend in automobile use in America, with a peak closer to 1970 (Fig. 1). Midgely (ironically, also the inventor of Freon®, the chlorofluorocarbon chemical implicated in stratospheric ozone loss) first developed an effective anti-knock additive using plant biomass–produced alcohol, but as this additive could be produced by any farmer and was not patentable, he was told to continue searching, eventually finding that adding ~2% Pb oxides to gasoline works well. An early warning sign went up when scores of workers were severely poisoned in the 1920s by Pb toxicity in plants producing tetraethyl Pb additives, although a multi-pronged industrial cover-up limited public awareness of this situation (Markowitz and Rosner, 2002)."

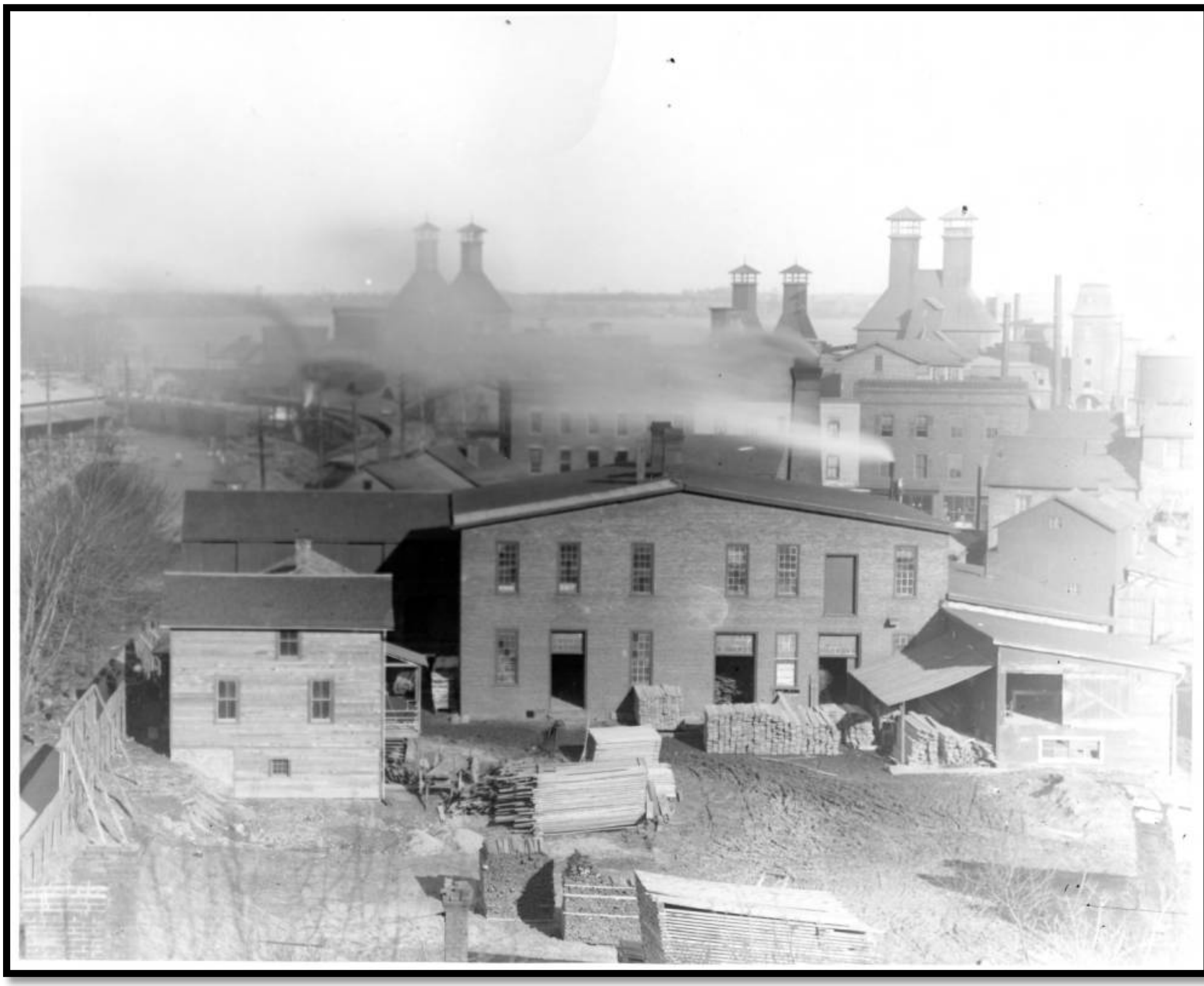
With the advent of leaded gasoline, lead-coated/-permeated engine blocks, heads, and valves and lead-painted scrap became very common. At Geneva Foundry, the use of scrap engine blocks and attendant issues of lead-contaminated scrubber sludge were documented by the former owner (Brennan, 1985; App. A). When lead-tainted scrap is melted in foundry cupolas with alternating layers of coal/coke (containing arsenic), lead and arsenic may vaporize (elemental boiling points = ~ 600-700 C; varies with compound/mineral type) and then condense on or be incorporated into fly ash particles which are released through the stack and settle over surrounding areas.

Short cupola stacks with little or no air pollution controls historically for many foundry operations produced copious amounts of fly ash particles with moderate dispersion and fairly localized deposition. Geneva Foundry had a short exterior stack (~10-15 feet above roofline) with no pollution controls until an inadequate and problem-plagued venturi scrubber was installed in 1970. Dispersion modeling of the Geneva Foundry cupola stack using data from a 1976 air permit and a 1973 stack test (App. D), shows maximum downwind concentrations at 75 meters (250 ft.). Residential properties are within 200 feet of the stack. Modeled concentrations diminish to about 1/3 maximum at 300 meters and about 1/4 of maximum at 400-500 meters and tail off with distance.

Conversely, the tall stacks of coal-fired power plants and metal ore smelters were designed to disperse/spread emissions over a wide area but with unfortunate consequences. For example, coal-related mercury and acid-rain emissions have impacted entire ecosystems (e.g., the Adirondacks) and metal smelter impacts can extend many miles (e.g., the Omaha lead smelter contaminated over 15,000 yards and the impacts from the Tacoma arsenic smelter extend over 20 miles).

With variable winds and weather over time (120 years of operation in this case), surface soils in all directions may become contaminated from air-borne particles containing variable concentrations of lead and arsenic. Dominant wind directions are generally from the west-southwest and foundry impacts appear to extend farther to the east. However, even the least frequent wind directions (generally from the east and often storm-related and hence stronger on average) may approach or exceed 10% frequency or a duration of about 12 years over the life of the foundry. In addition, multiple coal-burning emission points (as shown on Fig. 1; three other historic foundries are off the map) could have had an additive effect in the past especially where these lined up in certain wind directions. For example, a east/southeast wind, of say 10% frequency could have transported the emissions of 3 or more sources and have a similar or greater impact as a 30% prevailing wind carrying emissions from one large point source. And similarly, a south wind could produce a wide plume from several sources (see Fig. 2 below).

Figure 2. Pre-Wright Brothers Aerial Photo (circa 1880s) - View of Geneva looking east from the spire of St. Peter's Church (SE corner of Lewis & Genesee Sts.; blue arrow on Fig. 1 shows the photo vantage point).



<u>Evidence of Lead in Geneva Foundry Emissions:</u>

- A 1984 analysis of venturi scrubber sludge from the foundry detected 1200 ppm Pb and foundry casting sand showed 3500 ppm Pb.

- A 1995 analysis of an interior dust sample at the venturi cyclone showed 635 ppm Pb while other interior samples were an order of magnitude lower.

- A local pastor conveyed that he observed over time that emissions from the Foundry had darkened/stained his church (reddish Medina Sandstone), a grimy gray. Most of the grime had been removed ("pointed") but a XRF scan of four gray-stained areas and four normal/red areas showed Pb and As were detected at a factor of 3-4 higher in the stained gray areas.

- Use of scrap engine blocks/lead issues were confirmed by the owner (Brennan, 1985; App. B); melting of engine blocks containing leaded-gas deposits produces lead in foundry emissions.

- Lead (and arsenic) contamination is documented at other foundries nationwide (see App. A).

<u>Direct Evidence of Offsite Migration of Geneva Foundry Emissions:</u>

- The NYSDEC Division of Air file shows several neighbor complaints and opacity violations for particulates. Newspaper articles also document complaints of neighbors.

- Four local residents conveyed that they had observed ash/soot or smoke/fumes:
    - An elderly lady on Lewis St. noted that particulates used to "rain" on her Mom's freshly-hung laundry which had to be re-washed and re-hung when the wind changed;
    - An elderly gentleman on Exchange St. noted that his eyes would burn when foundry smoke plumes migrated through his neighborhood;
    - A couple on Clinton St. noted that flames would arc out of the foundry stack at night and ash would settle on surfaces like vehicles; and
    - the pastor's observations of smoke-grime on his Genesee St. church are noted above.

- Historical photos of smoke plumes. Geneva Foundry is shown on the report cover whereas the sources of the chimneys/smoke plumes in other photos below (Figs. 2 & 3) are obscure. However, general industrial activity is obvious and most of the smoke plumes are likely from foundries.

Figure 3 - Historical Geneva Photos - undated but likely pre-1900 (*www.**newyork**heritage.org/*):

Estimates of Pb Releases from the Geneva Foundry

Using data from a 1976 air emission permit (App. C), an EPA emission factor of 0.1 – 1.1 pounds of Pb/ton of product (USEPA - AP-42; 1995/2003), and daily operation of 4 to 12 hours, estimates of annual lead releases range from 1000 to 25000 pounds. With a production rate of 9 tons/hour (noted in the 1976 permit), the foundry ranks as a large production facility (USEPA, 1998).

Estimates of Lead & Arsenic "Enrichment" needed to Exceed SCOs

Coal used in Geneva contained an estimated 30 ppm of arsenic and lead. Considering soil cleanup objectives (SCOs) for Pb = 400 ppm and As = 16 ppm (www.dec.ny.gov/docs/remediation_hudson_pdf/part375.pdf) and a soil background Pb level of 50-100 ppm, Pb "enrichment" of > 4X - 8X would be needed to exceed its SCO. For As, a background level of 5-10 ppm would need a > 1.5X - 3X enrichment to exceed its SCO of 16 ppm. Therefore, coal impact alone appears much less likely to exceed SCOs for Pb than for As. Further, coal combustion processes enrich the metal content in coal fly ash and in particular, arsenic concentrations (see below).

Estimates of Soil Arsenic Concentrations from Fly Ash Input

Coal fly ash is typically "enriched" in metals during combustion of the organic content (loss of ~ 80-90% of its volume) in coal. Studies of coal and ash from coal-fired power plants show arsenic enrichments of two to ten times (related to its volatility and combustion processes). As noted by Zielinski et al. (2007), "Compared to other trace elements in fly ash, arsenic shows particularly strong enrichment (5-10X) in the finest (< 10 um diameter) size fractions of high surface area". USEPA (1995) reported that 90% of a typical cupola foundry's uncontrolled emissions are < 10 um diameter. Foundry cupola furnaces using coke fuel are less efficient (frequent episodes of incomplete combustion) than coal-fired power plants but the basic combustion processes and fly ash formation are analogous. One consequence of very fine fly-ash particulates is the likelihood of re-mobilization.

EPRI (2010) in its comprehensive review of metal concentrations in fly ash and soils, reported fly ash arsenic ranges as: 8 - 1385 ppm (min./max.); 22 – 261 ppm (10%-90%); and a 70 ppm mean. EPRI noted that arsenic in fly ash is one of the few elements that consistently exceeds both background and health-based screening levels.

Given an estimated 30 ppm of arsenic in coal used in Geneva, a reasonable estimate of fly ash enrichment of arsenic would be in the range of 50 - 300 ppm As. Considering a natural soil with 10 ppm As and a 5% and 10% addition of fly ash (50-300 ppm As) by volume, the following are hypothetical arsenic concentrations (if homogenized; sampling results could be affected by vertical stratification, post-depositional disturbance, and the sampling technique):

5% Fly Ash Input:

Soil	Ash	Mixture
(.95 x 10 ppm) +	(.05 x 50 ppm) =	[9.5 + 2.5 ppm] = 12 ppm As
(.95 x 10 ppm) +	(.05 x 100 ppm) =	[9.5 + 5 ppm] = 14.5 ppm As
(.95 x 10 ppm) +	(.05 x 200 ppm) =	[9.5 + 10 ppm] = 19.5 ppm As
(.95 x 10 ppm) +	(.05 x 300 ppm) =	[9.5 + 15 ppm] = 24.5 ppm As

10% Fly Ash Input:

Soil	Ash	Mixture
(.90 x 10 ppm) +	(.10 x 50 ppm) =	[9 + 5 ppm] = 14 ppm As
(.90 x 10 ppm) +	(.10 x 100 ppm) =	[9 + 10 ppm] = 19 ppm As
(.90 x 10 ppm) +	(.10 x 200 ppm) =	[9 + 20 ppm] = 29 ppm As
(.90 x 10 ppm) +	(.10 x 300 ppm) =	[9 + 30 ppm] = 39 ppm As

2015 Offsite Surface Soil Investigation Results

Previous interpretations of the extent of foundry impacts and background levels have been confounded by multiple potential sources of lead and low sampling density. To overcome these difficulties and the highly-variable contaminant distributions at yard-scale or less, the sampling strategy included several transects (Fig.4) from un-impacted areas toward the former foundry to help define the area of concern (AOC) and multiple samples per property (seven, on average, in the AOC) to increase the probability of locating isolated areas of contamination (See detailed sampling strategy/plan in Appendix B).

Sampling Summary:

- XRF screening helped to define the AOC and to focus lab analyses to samples of greater concern.
- XRF data showed 0.98 correlation to lab data for lead (Fig. 9; very reliable).
- ~ 100 yards sampled and lab-tested (~ 50% of access requests granted).
- ~ 10% of properties < SCOs (but highly-variable distribution).
- Sampling with depth shows the upper 6”-8” soil to be contaminated; consistent with air deposition of ash and vertical redistribution by chemical (e.g., dissolution/sorption) and physical/biological processes (e.g., runoff, cracks/burrows, worms, ants, rodents, dogs, humans).
- Contaminant distributions are highly variable, even within a single backyard, due to variations in foundry feedstock/operations, wind/weather, chaotic ash fallout/redistribution, and changes in land 8surfaces over time.
- Some historical contaminant contributions from other foundries and industries nearby appears certain in places (mainly arsenic from coke/coal combustion).
- Overall, about 25% of the yard impacts are interpreted as primarily localized impacts which include coal-ash fill from home furnaces and lead-based paint.
- In aggregate, offsite surface soil sampling data to date show a complex distribution of lead and arsenic over a multi-block Area of Concern.

Surface soil samples from over 700 offsite locations (residential yards, parks, churches, and street right-of-ways) were analyzed using a combination of field instrument (x-ray fluorescence analyzers = XRF) and laboratory analyses. The data show a complex distribution of elevated lead and arsenic in surface soils extending roughly 1000 feet in all directions from the foundry with farther impacts (~ 1300 feet to the east) in the dominant downwind direction. In general, lead concentrations are higher and more prevalent in yards closest to the foundry and decrease with distance with localized exceptions caused by coal-ash fill and/or apparent lead paint deposits.

Pb/As ratios (Fig. 8) - Lead/arsenic ratios proved useful to indicate locations with possible excess lead input and hence help define the extent of foundry impacts vs. other problems. Pb/As ratios of roughly < 40 are considered “normal” foundry ash deposition (based on spatial distributions, data ranges, observed fill, and ash contents (e.g., a lab analysis of Geneva Foundry scrubber sludge = 1200 ppm Pb and an expected range of 50-300 ppm for As in coal fly ash noted above). And Pb/As > 40 indicate possible additional lead input as confirmed in places where coal ash fill was observed. Conversely, very low Pb/As (or high As/Pb) ratios may indicate locations with excess coal ash input (e.g., general coal combustion or foundry inputs without much lead scrap such as pre-1920s operations). A general area of elevated arsenic (> 60 ppm including the highest As value of 228 ppm; As/Pb ratio => 0.15) was observed at Genesee Park and surrounding properties.

XRF Analyses

Over 200 locations (ROWs, parks, yards, churches, etc.) were scanned in place (EPA method 6200 was followed). Elevated levels (double-digit As and a few triple-digit ppm As and triple digit ppm Pb) were consistently observed as the center City (east of Genesee St.) was approached. A low detection limit for arsenic with a XOS-XRF (https://xos.com/products/hd-rocksand/) was key in establishing a general Geneva background of single-digit ppm As (insitu field readings with the XOS analyzer proved reliable). And as noted above and shown in Figure 9, XRF data (using an Innov-X analyzer: https://innovx.ca/) showed excellent (0.98) correlation to laboratory data for lead. These XRF data and techniques were shown to be accurate and precise (collection in Zip-lock bags and air-drying for 2 weeks eliminates potential negative bias commonly introduced by moisture).

ROW Transects - Figure 8 shows XRF data from a west-east transect which sampled ROWs along West Washington St. (southernmost yellow line on Fig. 4) starting at the City's western edge (Reed St.) to South Main St. to Genesee St. (samples 1-12). To avoid disturbed/new soil, samples were biased to bases of large trees and include two insitu samples at the Washington St. Cemetery (very low As & Pb detected along Washington and High Streets provided the natural/urban background of As = 5 ppm; Pb = 50 ppm). The remaining samples are in Genesee Park and yard samples in the vicinity of Genesee Park Place about 300 feet from the Foundry. The early data (1-12; urban background > ¼ mile from foundry) do not correlate or track well spatially whereas the later elevated data, in particular, the lead (blue) and arsenic (red), tend to track in concert. Gallium (enriched, like As in coal ash) and zinc also track well. Such correlation over a range of concentrations indicates common sources/inputs.

Church Exterior Walls - A local pastor conveyed that he observed over time that emissions from the Foundry had stained his church a grimy gray color (St Peter's Episcopal Church at Genesee & Lewis Streets, a magnificent structure constructed in the 1860s of reddish Medina sandstone). Most of the grime had been removed but patches remain. XOS-XRF scans of four grayish areas and four adjacent normal/red areas detected Pb and As at a factor of 3-4 higher (but below SCOs) in the gray-stained areas (other than silicon and iron, components of the iron-rich red sandstone, little else was detected). These data corroborate the pastor's observations and help to confirm airborne deposition of Pb and As from the foundry to surrounding areas.

Church Foundations - Two other churches showed elevated lead and arsenic near the foundations. Given stone or brick construction, lead paint issues appear minimal. A possible explanation is that the large structures deflected/diminished the flow of wind causing some settling of ash particles. Also, sandblasting or weathering/spalling of any foundry grime on the structures' walls over the decades may have focused contamination along the foundations.

Figure 4.   Right-of-Way Transects (in Yellow; Blue triangles = sample points < 400 ppm Pb; RED > 400 ppm)

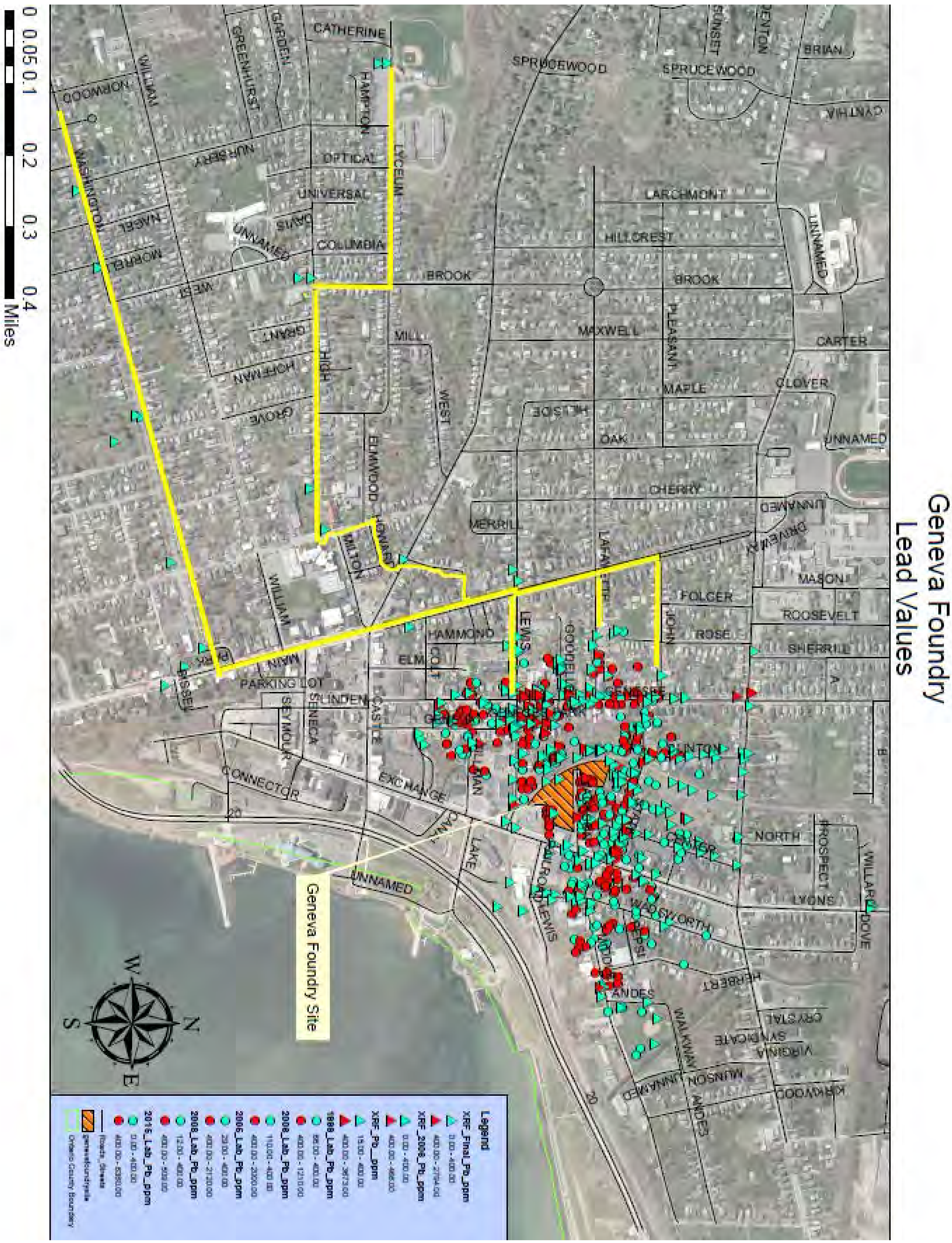


Figure 5 – Distribution of Lead in Surface Soils (RED = > 400 ppm; BLUE < 400 ppm)

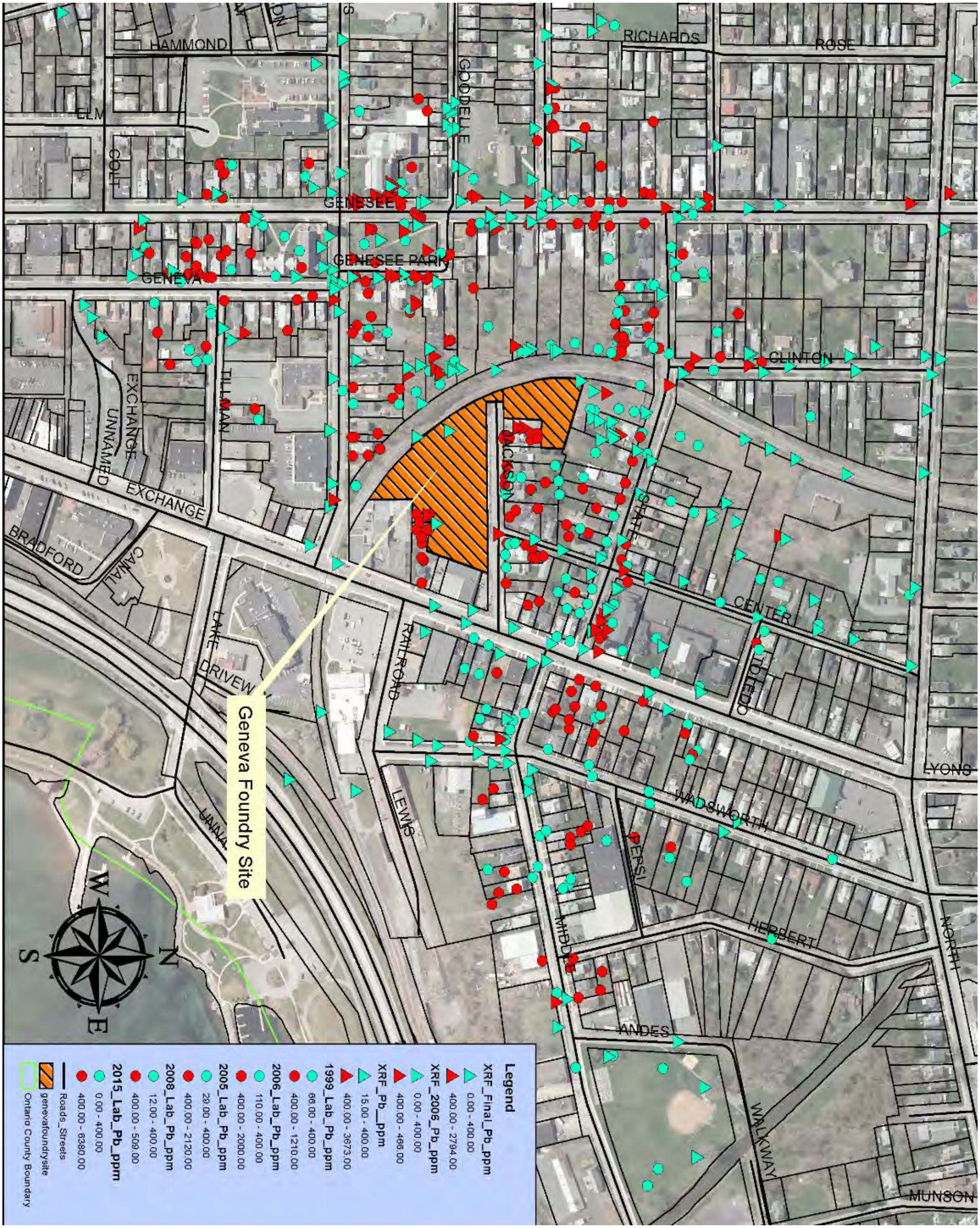
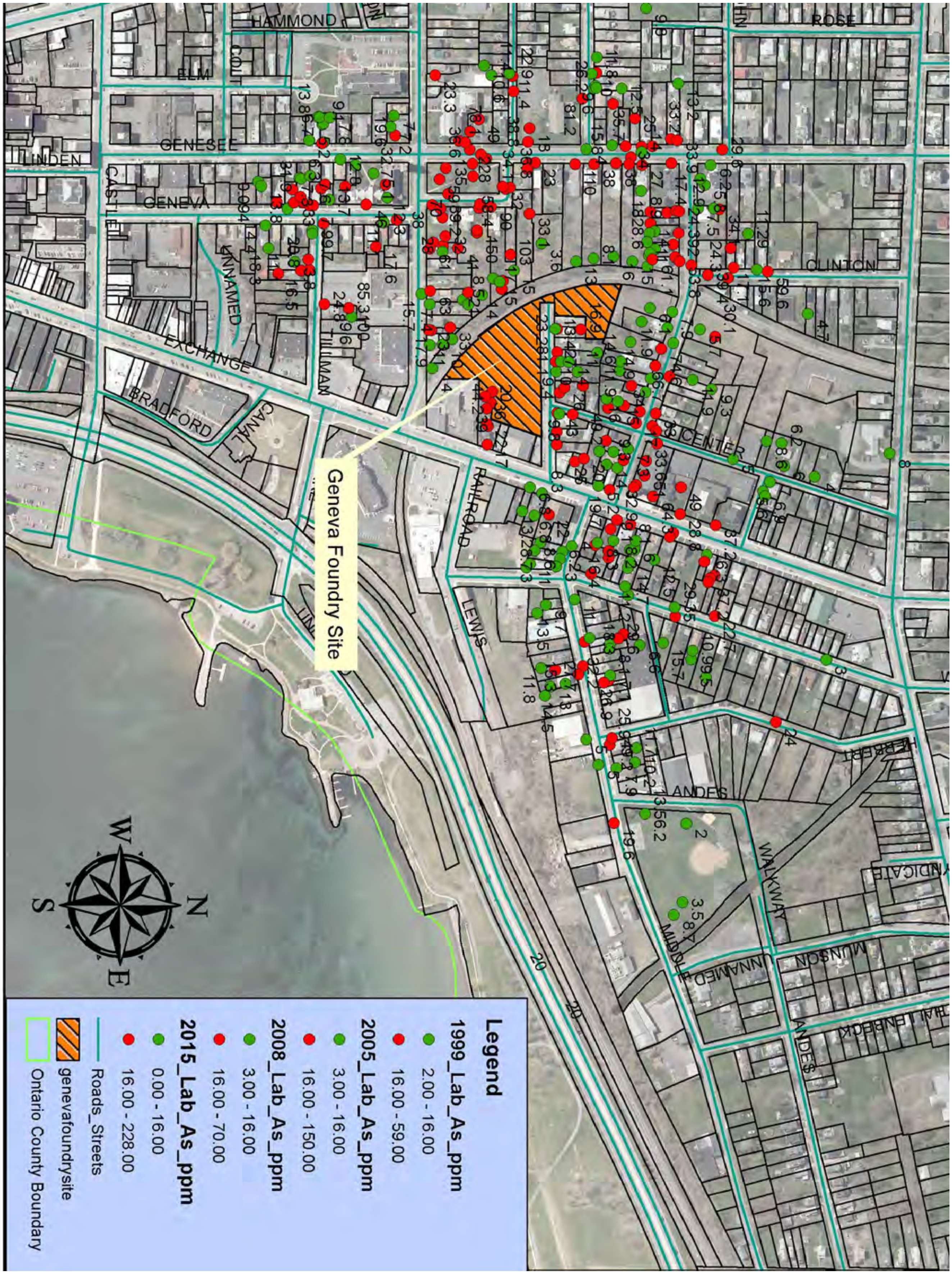


Figure 6 – Distribution of Arsenic in Surface Soils (RED = > 16 ppm; GREEN < 16 ppm)



As shown below in Table 1 and Figures 7 & 8, lead concentrations for the laboratory dataset (a subset of samples selected based elevated XRF screening) ranged from 48 to 6380 parts per million (ppm) with a mean of 460 ppm. Arsenic ranged from 4 to 228 ppm with a mean of 18 ppm. The residential soil cleanup objectives (SCOs) for Pb = 400 ppm and As = 16 ppm per NYSDEC Part 375.6.6 Given mean concentrations slightly above SCOs, slightly more than half of the Pb and As lab datasets are above SCOs.

Table 1 – Laboratory Data Summary

Metal	**Residential SCOs (mg/kg)**	**Total Lab Samples**	**Range & Mean (mg/kg)**	**# Samples with SCO Exceedences**
Arsenic	16	309	4 – 228 (Mean = 18)	180 (58%)
Lead	400	345	48 – 6380 (Mean = 435)	193 (56%)

Figure 7 – Scatterplot of Lab Data - (Color boundaries = SCOs; 16 ppm for arsenic & 400 ppm for lead)

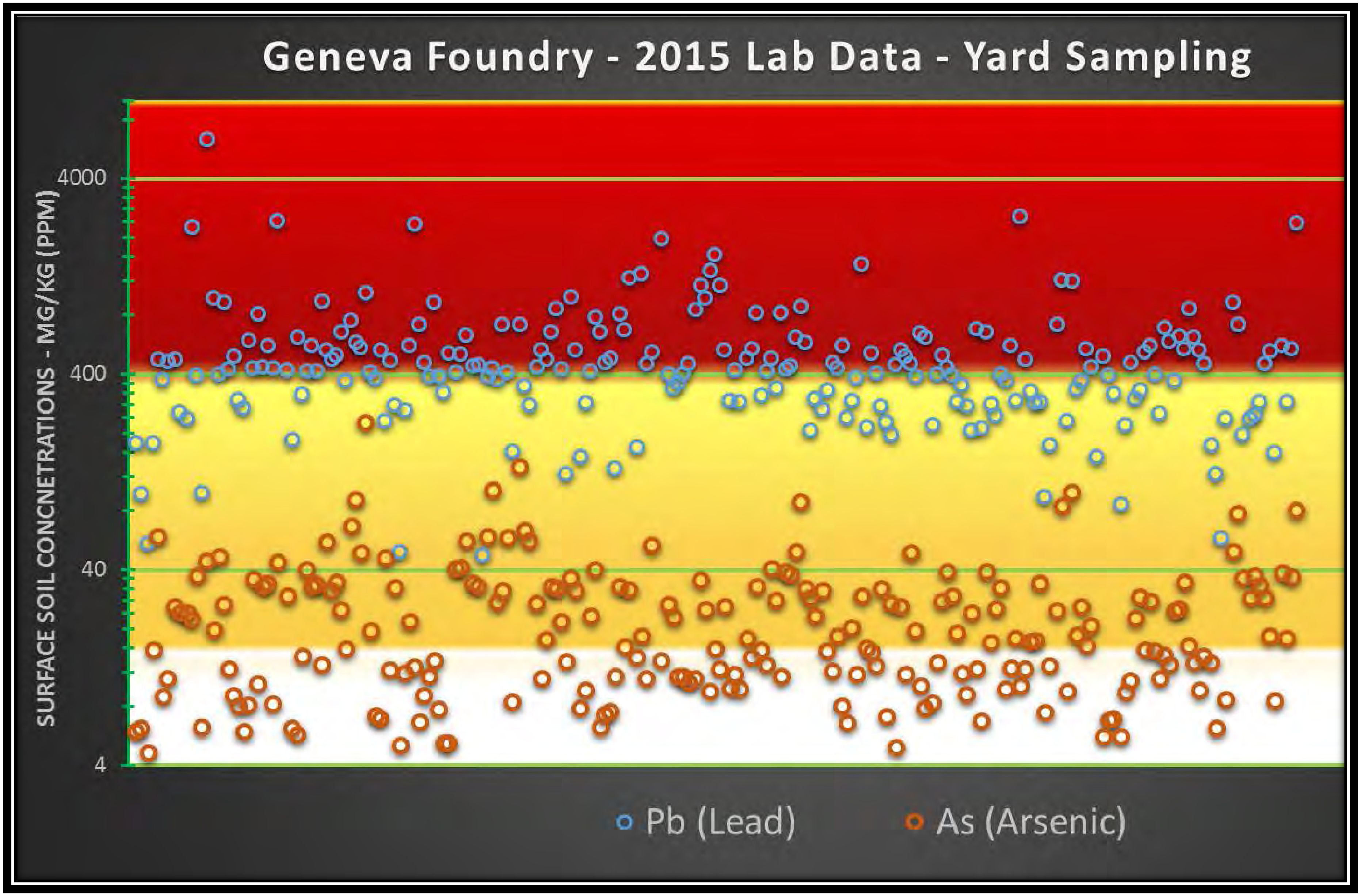


Figure 8

Geneva Foundry
Surface Soils - Lead/Arsenic Ratio

Figure 8 – 3-D Histogram of lead lab data (~ 25% of data range from 400-500 ppm ; ~50 % of the data range from 300-600 ppm)

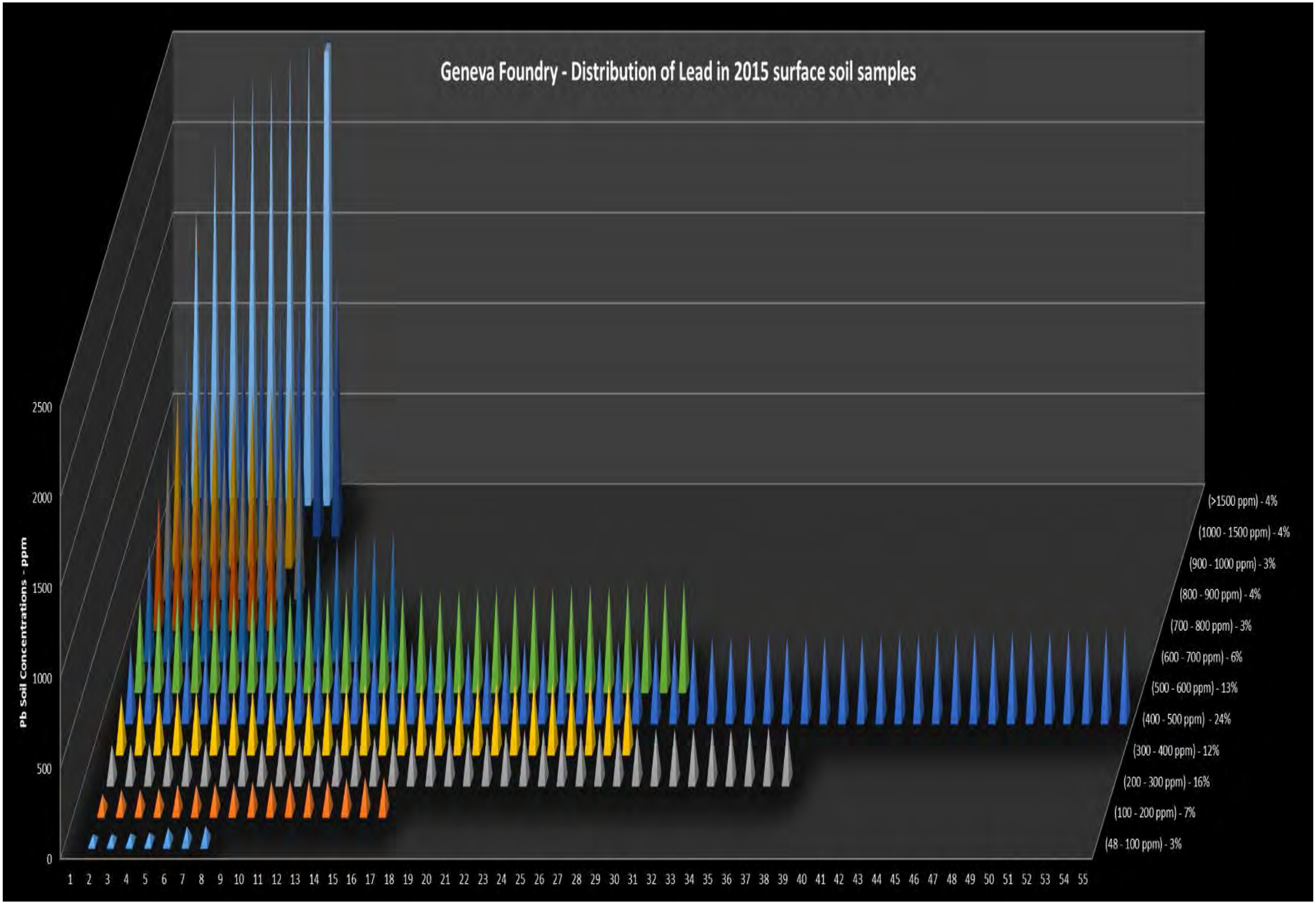


Figure 9 – Correlation of Lab and XRF Lead analyses (split samples/air-dried; moisture introduces some negative bias in XRF analyses).

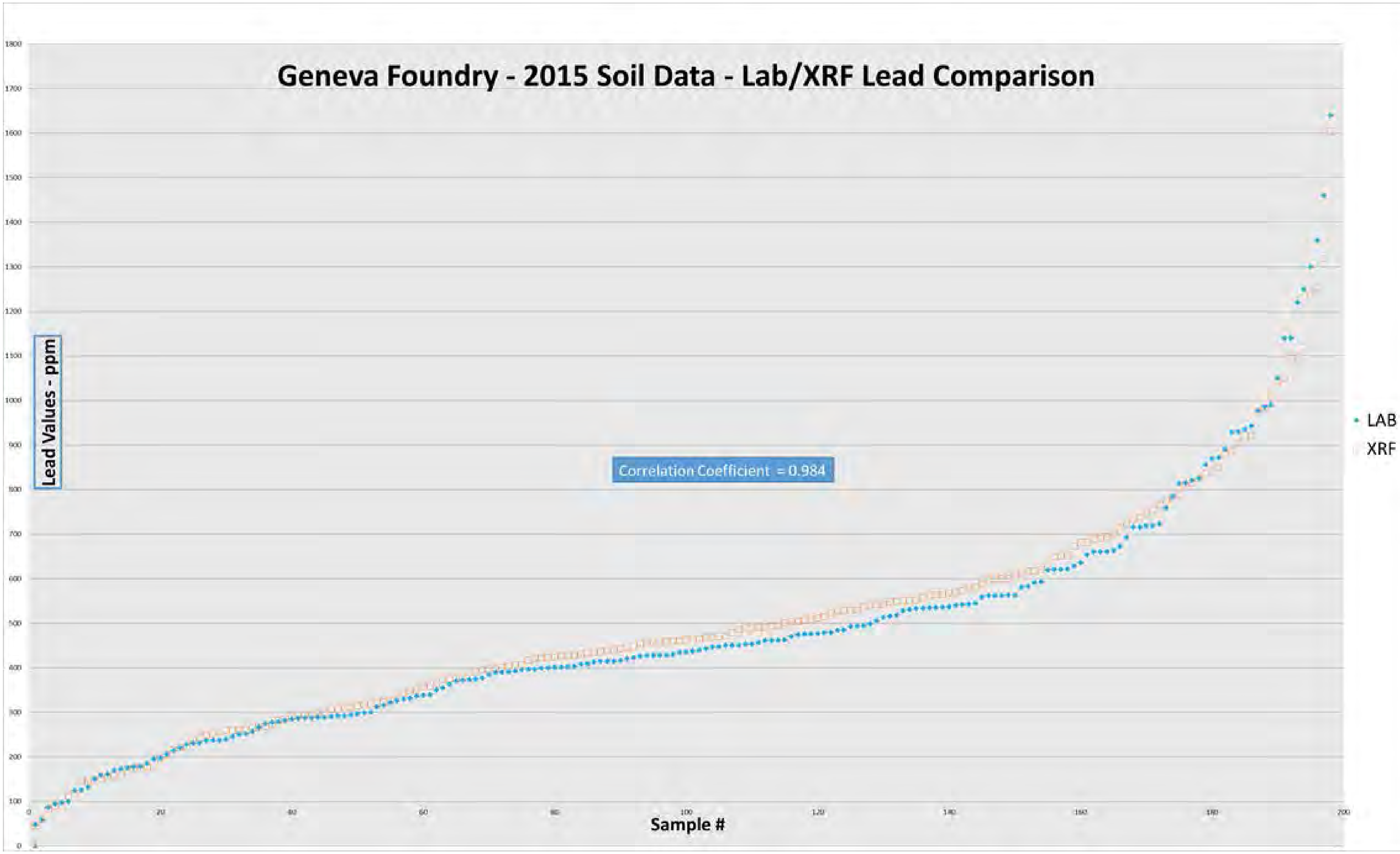
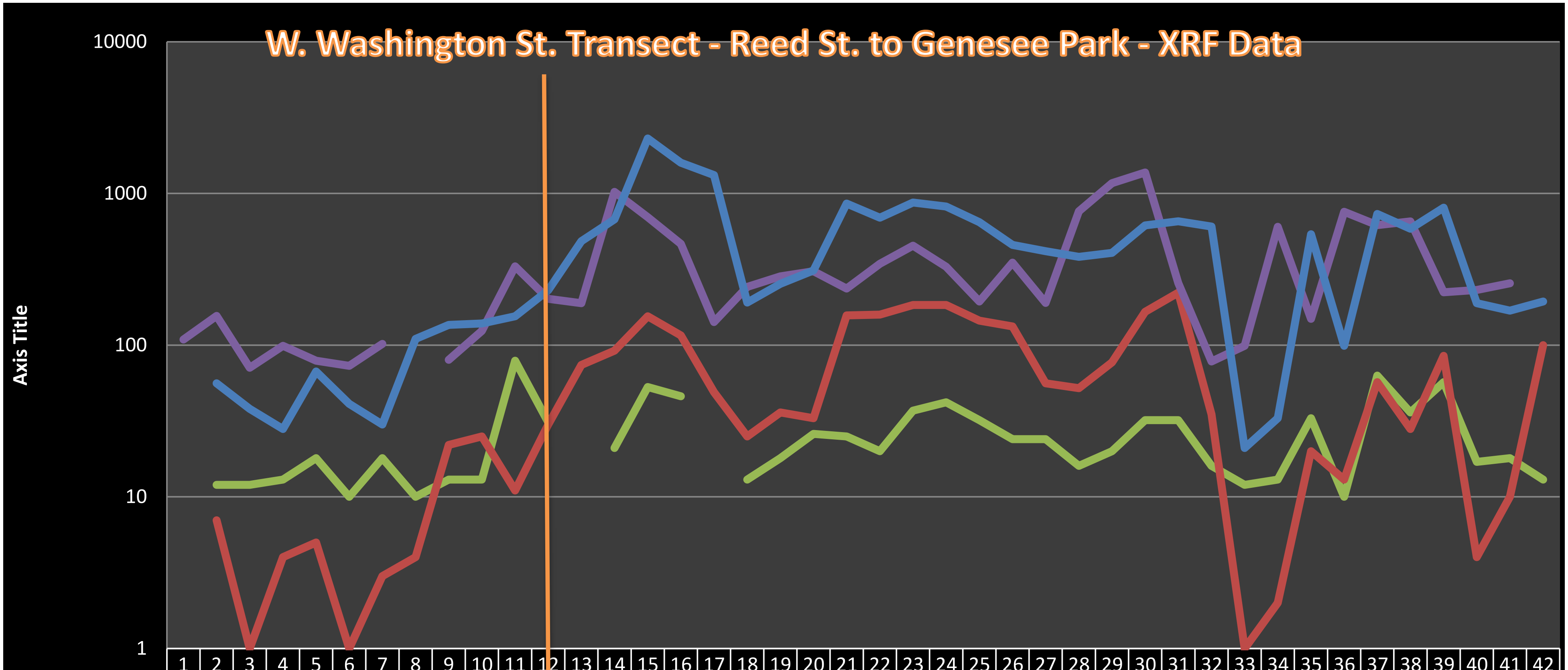


Figure 10 - ROW samples along West Washington Street to Genesee Park Place

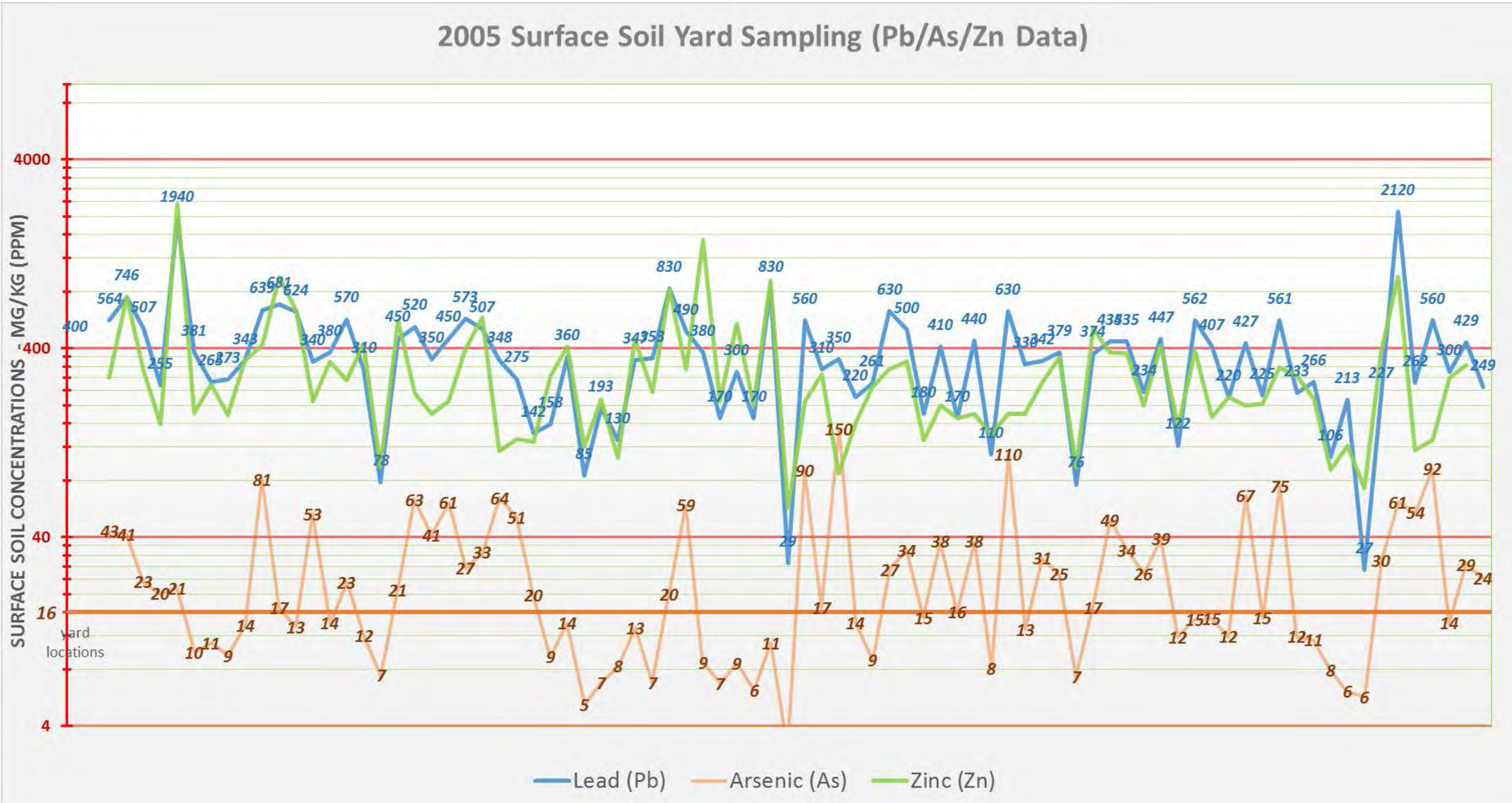
Data points #1 - #12 are ROW samples from the City's western edge (Reed St.) to South Main St. to Genesee St. The remaining samples are park and yard samples in the vicinity of Genesee Park Place about 300 feet from the Foundry. Note the dissonance in the early data (1-12; urban background > ¼ mile from foundry) and the close correlation of later data in particular, the lead (blue) and arsenic (red) data. Gallium (enriched, like As, in coal ash) and zinc also track well. Such correlation of elevated levels suggests a common man-made source of these elements.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Ga		12	12	13	18	10	18	10	13	13	79	31		21	53	46		13	18	26	25
As (ppm)		7	1	4	5	1	3	4	22	25	11	30	74	92	155	116	49	25	36	33	157
Zn	109	156	71	99	79	73	102		80	124	331	202	189	102	698	465	142	242	284	307	236
Pb (ppm)		56	38	28	67	41	30	110	136	139	155	230	485	675	230	159	132	191	254	311	858

	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Ga	20	37	42	32	24	24	16	20	32	32	16	12	13	33	10	63	36	57	17	18	13
As (ppm)	159	184	184	145	133	56	52	77	166	222	35	1	2	20	13	57	28	85	4	10	100
Zn	344	453	329	194	350	190	764	116	137	257	78	99	603	149	758	619	654	223	231	256	
Pb (ppm)	692	872	820	647	458	416	382	406	616	656	605	21	33	538	99	733	586	806	189	169	194

Figure 11 – Graph of Lead, Arsenic, Zinc 2005 data (yards along Jackson, State, and Genesee Streets). Lead and Zinc track well; arsenic less consistently but correlates in large part. One location is interpreted as lead paint (1940 ppm Pb; peak on the left) based on the high Pb level, other much lower Pb values nearby, and the corresponding very low As level. Some zinc releases from the foundry would be expected (e.g., depending on scrap, especially galvanized scrap) and paint commonly contains zinc.



Interpretations:

The overall data distribution shows relatively high values of lead and arsenic prevalent in yards close to the Foundry such as along Jackson St. and on Exchange St. (directly adjacent to the east of the Foundry) with generally lower levels some distance from the Foundry. However, many yards show variable contaminant concentrations (with a combination of samples both above and below SCOs). This variability increases with distance from the foundry and likely results from a combination of factors such as variations in foundry scrap and operations, wind direction and speed, additional ash input from other historical foundries, and redistribution of ash and soil over a timeframe of many decades.

Where high Pb levels were noted near the outer edge of the AOC, (roughly 1000 feet from the foundry on Geneva St., Middle St., and Lafayette St.), local coal-ash fill was often observed. It was interpreted as coal bottom-ash from home furnaces due to high Pb/probable waste paper/Pb inks although in some cases, the coal ash-fill showed low Pb, presumably combustion of wastepaper varied. In other cases, very high lead levels (>1000 ppm) were generally interpreted as leaded paint residues.

Conversely, unusually low Pb levels near the foundry are indicative of disturbed or replaced soil. Examples include the ROWs along Lewis and Exchange Streets (Pb < 100 ppm; a tan inorganic sand) or the wooded area just west of the RR tracks and the foundry. The woods show widespread evidence of thick coal-ash deposits (> 1-foot of dark soil, cinders, coal chunks) and numerous XRF analyses show levels of < 200 ppm lead. Low lead levels, large volumes, and some distance from homes suggest that these fill deposits are coal bottom-ash of commercial/industrial origin (this area also shows evidence of fill scarps and rubble to the west). Residential furnaces may or may not have routinely burned wastepaper with lead inks which likely produces variable lead concentrations. Volatile metals in coal, such as Pb and As, largely vaporize and preferentially condense/accumulate on finer particles during the combustion process and hence, are primarily released as components of fly ash (rather than bottom ash).

<u>Churches</u> – The presence of large church properties in one general area (four churches along Genesee St. from Lewis St. north to Lafayette St.) and St. Francis deSales church on Exchange Street aids interpretation since many samples could be systematically spaced/collected and the large lawns have been consistently maintained over a long timeframe (unlike small residential lawns with varied maintenance, uses, multiple owners and possible lead paint issues). The following is a brief summary of these sampling data and interpretations.

St. Peter's Episcopal Church (149 Genesee St.) – Most samples were at background levels (the pastor conveyed that the topsoil had been replaced some years ago). However, as noted above, the pastor also conveyed that he observed over time that emissions from the Foundry had stained his church, from a reddish Medina sandstone to a grimy gray. Most of the grime had been removed but XOS-XRF scans of four grayish areas and four adjacent normal/red areas detected Pb and As at a factor of 3-4 higher (but below SCOs) in the gray-stained areas. Such observations and data help to confirm airborne deposition of Pb and As from the foundry to surrounding areas.

Faith Community Church (90 Lewis St.) – Variable contamination (both above and below SCOs) but the shrubs/plantings near the building foundation on the north front area were quite elevated and sediment beneath the downspout was very elevated. Deposition of ash and runoff from the large roof which flowed to a gutter/downspout could explain elevated metals in sediment near the discharge point (here and at other properties) and foundry ash plumes impinging on a large structure could have caused focused ash deposition and any wall deposition of foundry emissions could weather/spall with time and accumulate along the foundation.

Genesee Park – Adjoining the two churches above and Genesee Park Place, this park showed variable contamination with several elevated samples, in particular, elevated arsenic. This general area showed arsenic levels > 60 ppm, in places, and included the highest As value of 228 ppm found during this study. A possible explanation is the additive effects of other foundries and emission points. Figures 1 and 2 show several coal-burning emission points (including the large NY Central Iron Works) which align in certain directions. East/southeast winds, for example, could have transported the emissions of three or more coal-burning (As-rich) sources toward the vicinity of Genesee Park. And while such winds are of generally low frequency (~ 10-20%), the additive effects of several sources may exceed the impact of one source dispersed by more frequent (~ 30+%) prevailing winds.

St. Michael's Orthodox Church (98 Genesee St.) – Variable contamination; most below SCOs but foundry impacts are evident in places and a very elevated lead sample in the northwest is likely fill/paint.

Church of God's Revealed Truths (5 Genesee Park) - All lawn samples were elevated and indicative of foundry impacts.

St. Francis deSales Church (130 Exchange St.) – Some elevated lead samples along State Street (mostly in the ROW and along the foundation) and elevated arsenic was present in the lawn along Exchange Street. As noted for Faith Community Church, foundry ash plumes interrupted by large buildings could reduce wind speed and cause localized ash deposition and any wall foundry deposits may weather/spall with time.

<u>Interpretation of Heterogeneity</u> -Very chaotic/uneven contaminant distributions in surface soils can result from the effects of highly-variable:

- foundry feedstock (relatively "clean" to highly contaminated scrap);
- foundry cupola/stack conditions (startup, temperature, turbulence, etc.);
- coal sources/trace metal content;
- atmospheric conditions (wind speed and direction, precipitation, etc.);
- near-surface air turbulence (complex air flow; increased deposition with air speed reductions near buildings, trees, and the ground);
- depositional surfaces (lawns, bare ground, snow, pavement, roofs, etc.);
- wind re-suspension of ash (dust-like) particles over time (especially during dry summer conditions);
- runoff (rain, melting snow may transport/re-distribute particles);
- dissolution (increased potential with acidic rain) and infiltration into the subsurface; and
- subsequent soil disturbances (e.g., humans, dogs, rodents, and/or insects such as worms, ants, grubs, etc.) may redistribute/spread particles vertically in places (diluting concentrations) over time.

And the soil sampling process, however carefully planned and implemented, invariably introduces some variability. In this case, ash particle fallout may produce millimeter-scale differences in a vertical soil profile which is difficult to capture consistently (e.g., sampling 0"-2" below the root zone can vary since the turf root zone and the soil that clings to roots varies at each location). Hence, the spatial distribution of airborne and deposited contaminants can be expected to be very complex and heterogeneous. Contamination in general is typically quite heterogeneous but the potential processes affecting the generation, transport, deposition, and fate of tiny ash particles are diverse and unpredictable.

Approximately 25% of the properties sampled showed "enrichment" in lead (elevated Pb/As ratios; ~ > 40; see Fig. 8) which was directly observed or interpreted as coal-ash fill from former residential furnaces or as lead paint residues. In many of these cases, the relative proportion of any foundry impacts is unclear / indeterminable especially at the perimeter of the known area of concern. Coupled with incomplete access (about 50% of canvassed property owners allowed access), complete definition of the problem was hampered in places but sampling efforts to date have largely defined the extent of Geneva Foundry impacts on offsite properties.

Conclusion

In sum, extensive coal/coke combustion to melt and cast iron was concentrated in a relatively small area of Geneva for more than a century. This long-term industrial activity likely explains most of the elevated levels of lead and arsenic in surface soils surrounding the Geneva Foundry. Lead contamination appears more directly related to Geneva Foundry given the timing of plentiful contaminated (leaded gas/leaded paint) scrap starting in the 1920s onward (as some other local foundries foundered and closed). Arsenic appears more widespread than lead in places and may reflect the coal fly-ash emissions of several foundries and other industrial/commercial activity.

References

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Osburn, Karen (2015) - "Way Back When in Ontario County" - Finger Lakes Times http://www.fltimes.com/lifestyle/way-back-when-in-ontario-county-iron-foundries-thrived-in/article_604f67cc-e9d8-11e4-affa-b3fa59cc815a.html

USEPA – Lead Paint https://www.epa.gov/lead/learn-about-lead#found

USEPA (1995) - AP-42 SECTION - 12.10 IRON FOUNDRIES (Processes & Emission Factors)

USGS (2002) - Characterization and Modes of Occurrence of Elements in Feed Coal and Fly Ash—An Integrated Approach Characterization and Modes of Occurrence of Elements in Feed Coal and Fly Ash—An Integrated Approach

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USGS (2009) http://pubs.usgs.gov/pp/1625f/downloads/Front.pdf

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Zielinski et al. (2007) - Mode of occurrence of arsenic in feed coal and its derivative fly ash, Black Warrior Basin, Alabama Article (PDF Available) in Fuel 86(4):560-572

APPENDICES

APPENDIX A – EXAMPLES of OTHER FOUNDRIES with LEAD & ARSENIC CONTAMINATION

ATSDR - PUBLIC HEALTH ASSESSMENT
RUSTON FOUNDRY
ALEXANDRIA, RAPIDES PARISH, LOUISIANA
http://www.atsdr.cdc.gov/HAC/pha/pha.asp?docid=732&pg=1#conc

ATSDR - PUBLIC HEALTH ASSESSMENT
NORFOLK NAVAL SHIPYARD
PORTSMOUTH, VIRGINIA
http://www.atsdr.cdc.gov/hac/pha/pha.asp?docid=502&pg=2

ATSDR - PALESTINE FOUNDRY INVESTIGATION
PALESTINE, ANDERSON COUNTY, TEXAS
EPA FACILITY ID: TXN000605670
https://www.dshs.texas.gov/epitox/consults/palestine_hc.pdf

"The arsenic concentrations in all 83 surface soil (0-1 inches) samples collected ranged from 2.0 milligrams per kilogram (mg/kg) to 82.8 mg/kg with an average concentration of 32.4 mg/kg…The lead concentrations in all 83 surface soil (0–1 inches) samples and the subset of 71 residential yard and playground samples ranged from 11.2 milligrams lead per kilogram soil (mg/kg) to 1,170 mg/kg…"

Note: Searches of other databases (NPL, etc.) show many other examples.

:

GENEVA FOUNDRY CORPORATION

ENVIRONMENTAL IMPACT

OF

ELECTRIC FURNACES

INSTALLATION

Geneva Foundry Corporation has melted iron at the same location on Jackson St. for over 125 years, utilizing a cupola to accomplish the task. This is basically a large cylinder lined with refractory which is fueled by coke, a treated coal. In 1970, as environmental awareness grew, the Geneva Foundry became the second foundry in the state to install a Venturi scrubber, a pollution control device designed to control pollutants from the cupola. Unfortunately, the device was inadequately designed and has caused numerous headaches to foundry officials, neighbors, and DEC offials. In addition, the scrubber produces a sludge which is contaminated with lead, causing further concern in regard to land pollution. Currently, the firm must send this sludge to a secure landfill in Michigan for proper disposal.

In response to these environmental concerns, the firm's management have decided to replace the cupola/scrubber melting facility with two coreless electric induction melting furnaces. The advantages to this move are substantial:

-Air pollution to the outside is completely eliminated. no - just reduced significantly

-The sludge is completely eliminated.

-The lead is no longer a problem, as scrap source is changed to a non-lead scrap. (bushlings or plate scrap instead of motor blocks).

Additionally, the move allows the firm to save money by using a less expensive source of power-nighttime electricity. By operating the melting and pouring operation at night, the firm can take advantage of the fact that there is no demand charge, less cost per kilowatt hour, and qualify for an incentive rate of .01/kwh off for power attributed to new load from the NYSEG. This idea has been "borrowed" from a foundry located in a residential section of Erie, PA., which was faced with the same decision two years ago. No noise pollution to my knowledge has been reported as a problem, but we are all ready designing features into the charging bucket and air vents to insure a quiet operation. We are also simultaneously applying for inexpensive power from the New York Power Authority so that the change to nighttime melting may be unnecessary. We will not know if we qualify for this power for some time, so we are proceeding on the assumption that we will have to melt and pour at night.

The new equipment can be installed while the old equipment is still operating, as we are locating the new equipment in a new location. Once the furnaces are operational, the old equipment will most likely be "mothballed", rather than removed. (No asbestos is present). However, we plan to remove the stacks from the roof to streamline the looks of the plant. We may be painting the building and replacing the windows in the spring if conditions permit.

In regard to notifying the public, we plan to hold a press conference announcing the changes in the near future, and I plan to go around to each of the neighbors personally to inform them of the changes. We intend to address the noise issue as it occurs, and will be as cooperative as possible if problems do turn up.

APPENDIX C – Dispersion Modeling - 1976 Stack Test

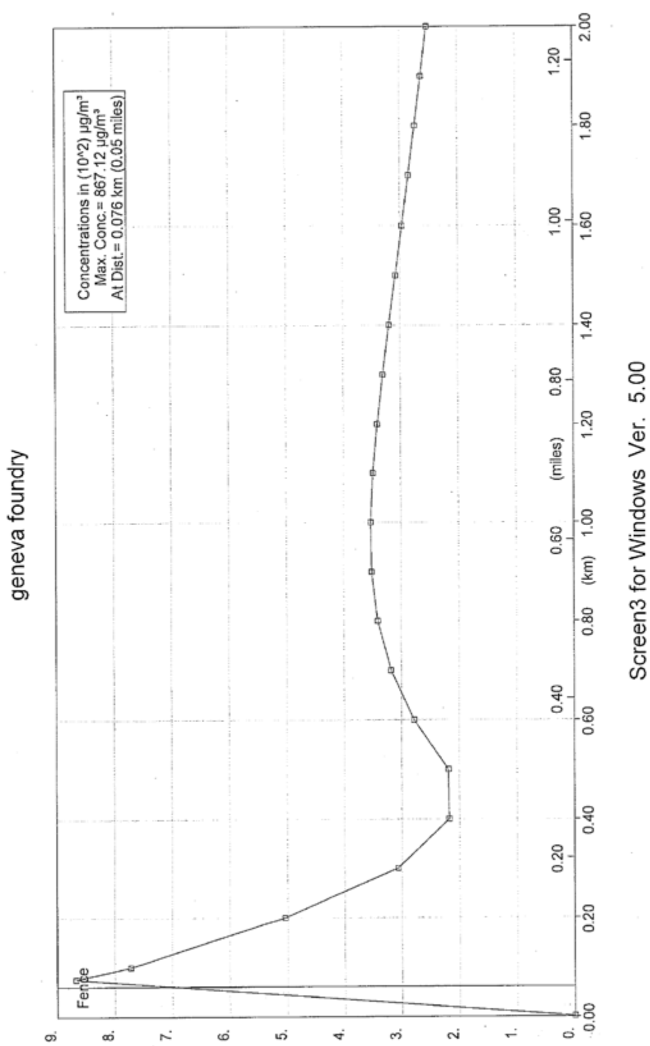
Memo to Geneva Foundry File
1/11/08
J. Craft

Re: Modeling Dispersion of Emissions from the Geneva Foundry Cupola (gray iron smelting/coke fuel)
Using SCREEN 3 (USEPA air dispersion screening model from Division of Air) and data from a 1976 air permit and a 1973 stack test (attached), maximum downwind concentrations were estimated at 75 meters (250 ft.) from the stack. Residential properties are within 200 feet from the stack (200 feet is marked as FENCE on output graph). As the attached output graph shows, concentrations diminish to about 1/3 maximum at 300 meters, a minimum (1/4 maximum) at 400-500 meters, rise somewhat, and then tail off gradually with distance. Note that the exact stack configuration is unknown but attached photos show about 10-15 feet of the 50 foot x 4 foot stack above the roof line. The model is very sensitive to stack stickups greater than 15 feet and show widespread dispersion above this value (obviously a taller stack would have dispersed the emissions over a wider area with perhaps less deposition near the foundry).

NOTE: SCREEN3 is a single source Gaussian plume model which provides maximum ground-level concentrations for point, area, flare, and volume sources, as well as concentrations in the cavity zone, and concentrations due to inversion break-up and shoreline fumigation.
http://www.epa.gov/scram001/dispersion_screening.htm
NOTE 2: These results correspond closely with manual calculations by S. Shearer of NYSDOH.

01/11/08 14:32:12
*** SCREEN3 MODEL RUN ***
*** VERSION DATED 96043 ***
geneva foundry
SIMPLE TERRAIN INPUTS:
SOURCE TYPE = POINT
EMISSION RATE (G/S) = 19.9080
STACK HEIGHT (M) = 15.2400
STK INSIDE DIAM (M) = 1.2192
STK EXIT VELOCITY (M/S)= 56.3880
STK GAS EXIT TEMP (K) = 327.5944
AMBIENT AIR TEMP (K) = 293.1500
RECEPTOR HEIGHT (M) = 0.0000
URBAN/RURAL OPTION = URBAN
BUILDING HEIGHT (M) = 10.6680
MIN HORIZ BLDG DIM (M) = 60.9600
MAX HORIZ BLDG DIM (M) = 91.4400
THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.
BUOY. FLUX = 21.605 M**4/S**3; MOM. FLUX = 1057.345 M**4/S**2.
*** FULL METEOROLOGY ***
****
*** SCREEN AUTOMATED DISTANCES ***
****
*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***
DIST CONC U10M USTK MIX HT PLUME SIGMA SIGMA
(M) (UG/M**3) STAB (M/S) (M/S) (M) HT (M) Y (M) Z (M) DWASH

------- ---------- ---- ----- ----- ------ ------ ------ ------ -----
1. 0.000 1 1.0 1.1 320.0 216.79 8.08 8.07 NO
100. 772.5 3 8.0 8.7 2560.0 25.00 21.57 20.00 SS
200. 504.2 4 8.0 8.9 2560.0 27.84 30.79 27.20 SS
300. 306.4 4 8.0 8.9 2560.0 28.06 45.36 40.23 SS
400. 217.6 4 4.0 4.4 1280.0 63.55 61.00 54.69 NO
500. 218.8 6 1.5 1.7 10000.0 72.78 52.83 34.42 NO
600. 278.0 6 1.0 1.1 10000.0 81.11 62.19 39.58 NO
700. 317.9 6 1.0 1.1 10000.0 81.11 70.61 43.40 NO
800. 340.9 6 1.0 1.1 10000.0 81.11 78.87 47.07 NO
900. 351.2 6 1.0 1.1 10000.0 81.11 86.95 50.60 NO
1000. 352.7 6 1.0 1.1 10000.0 81.11 94.85 53.98 NO
1100. 348.5 6 1.0 1.1 10000.0 81.11 102.57 57.24 NO
1200. 340.7 6 1.0 1.1 10000.0 81.11 110.12 60.38 NO
1300. 330.7 6 1.0 1.1 10000.0 81.11 117.51 63.41 NO
1400. 319.6 6 1.0 1.1 10000.0 81.11 124.73 66.34 NO
1500. 308.0 6 1.0 1.1 10000.0 81.11 131.79 69.17 NO
1600. 296.4 6 1.0 1.1 10000.0 81.11 138.72 71.92 NO
1700. 284.9 6 1.0 1.1 10000.0 81.11 145.50 74.59 NO
1800. 273.8 6 1.0 1.1 10000.0 81.11 152.14 77.19 NO
1900. 263.1 6 1.0 1.1 10000.0 81.11 158.66 79.72 NO
2000. 253.0 6 1.0 1.1 10000.0 81.11 165.05 82.18 NO
2100. 243.3 6 1.0 1.1 10000.0 81.11 171.33 84.59 NO
2200. 234.2 6 1.0 1.1 10000.0 81.11 177.50 86.94 NO
2300. 225.6 6 1.0 1.1 10000.0 81.11 183.55 89.23 NO
2400. 217.4 6 1.0 1.1 10000.0 81.11 189.51 91.48 NO
2500. 209.8 6 1.0 1.1 10000.0 81.11 195.36 93.68 NO
2600. 202.5 6 1.0 1.1 10000.0 81.11 201.12 95.83 NO
2700. 195.7 6 1.0 1.1 10000.0 81.11 206.79 97.94 NO
2800. 189.2 6 1.0 1.1 10000.0 81.11 212.37 100.02 NO
2900. 183.1 6 1.0 1.1 10000.0 81.11 217.87 102.05 NO
3000. 177.4 6 1.0 1.1 10000.0 81.11 223.28 104.05 NO
MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 1. M:
76. 867.1 3 10.0 10.9 3200.0 21.36 16.69 15.40 SS
DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB
****
*** REGULATORY (Default) ***
PERFORMING CAVITY CALCULATIONS
WITH ORIGINAL SCREEN CAVITY MODEL
(BRODE, 1988)
****


geneva foundry
Concentrations in (10^2) µg/m³
Max. Conc.= 867.12 µg/m³
At Dist.= 0.076 km (0.05 miles)
Fence
(km)
(miles)
Screen3 for Windows Ver. 5.00

OP LOCATION FACILITY EMISSION POINT
2 I 3 2 0 5 0 0 0 0 4 7 0 0 1 A

NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

COPIES: WHITE - ORIGINAL; GREEN - CENTRAL OFFICE; YELLOW - APPLICANT; PINK - OIH; CARDBOARD - REGIONAL OFFICE

PROCESS, EXHAUST OR VENTILATION SYSTEM

APPLICATION FOR ENVIRONMENTAL ANALYSIS RATING AND PERMIT TO CONSTRUCT OR CERTIFICATE TO OPERATE

PLEASE PRINT OR TYPE XX

SECTION A

1. NAME OF OWNER/FIRM: Geneva Foundry Corporation
2. NUMBER AND STREET ADDRESS: 23 Jackson St.
3. CITY - TOWN - VILLAGE: Geneva — 4. STATE: N.Y. — 5. ZIP: 14456
6. OWNER CLASSIFICATION: A. COMMERCIAL ☐ B. INDUSTRIAL ☒ C. UTILITY ☐ D. FEDERAL ☐ E. STATE ☐ F. MUNICIPAL ☐ G. EDUC. INST. ☐ H. HOSPITAL ☐ I. RESIDENTIAL ☐ J. OTHER ☐
7. NAME & TITLE OF OWNERS REPRESENTATIVE: Robert D. Brennan Sr. V.P. (signature) — 8. TELEPHONE: 315 789-7400
9. NAME OF AUTHORIZED AGENT:
10. TELEPHONE:
11. NUMBER AND STREET ADDRESS:
12. CITY - TOWN - VILLAGE: — 13. STATE: — 14. ZIP:
15. NAME OF P.E. OR ARCHITECT PREPARING PLANS: — 16. NYS P.E. OR ARCH'T LIC. NO. — 17. TELEPHONE
18. SIGNATURE OF REPRESENTATIVE OR AUTHORIZED AGENT:
19. FACILITY NAME (IF DIFFERENT FROM OWNER/FIRM): Geneva Foundry Corporation
20. FACILITY LOCATION (NUMBER AND STREET ADDRESS): 23 Jackson St.
21. CITY - TOWN - VILLAGE: Geneva — 22. COUNTY: Ontario
23. BLDG. NAME OR NUMBER: Foundry — 24. FLOOR NAME OR NUMBER: Main
25. DATE APPLICATION COMPLETED: 1/20/76 — 26. EXPECTED DATE OF OPERATION: Present
27. PERMIT TO CONSTRUCT: A. ☐ NEW SOURCE B. ☐ MODIFICATION
28. CERTIFICATE TO OPERATE: A. ☐ NEW SOURCE B. ☐ MODIFICATION C. ☒ EXISTING SOURCE

FOR AGENCY USE ONLY

29. LOCATION CODE	30. FACILITY ID. NO.	31. U.T.M.(E)	32. U.T.M.(N)	33. SIC NUMBER	34. DATE APPL. RECEIVED	35. DATE APPL. REVIEWED	36. REVIEWED BY:
320500	0047	3378	7487	3321	1/12/76	1/22/76	Levy

PERMIT TO CONSTRUCT

37. DATE ISSUED: / / — 38. EXPIRATION DATE: / / — 39. SIGNATURE OF APPROVAL:

40. CONDITIONS:
1. DEVIATION FROM APPROVED APPLICATION SHALL VOID THIS PERMIT
2. THIS IS NOT A CERTIFICATE TO OPERATE
3. TESTS AND/OR ADDITIONAL AIR POLLUTION CONTROL EQUIPMENT MAY BE REQUIRED PRIOR TO THE ISSUANCE OF A CERTIFICATE TO OPERATE
4. STACK TEST REQUIRED YES ☐ NO ☐

RECOMMENDATION OF C.O. APPROVAL

41. DATE ISSUED: 1/29/76 — 42. EXPIRATION DATE: 11/19/76 — 43. SIGNATURE OF APPROVAL: Stanley Hulyer 1/29/76 (Date)

44.
1. ☒ INSPECTED BY Levy (Name)
2. ☐ DOES NOT REQUIRE INSPECTION
3. ☐ INSPECTION DISCLOSED DIFFERENCES AS BUILT VS PERMIT, CHANGES AS INDICATED ON FORM
4. ☐ I RECOMMEND ISSUANCE OF A PROVISIONAL CERTIFICATE TO OPERATE PENDING THE APPROVAL OF STACK TESTS
5. ☒ I RECOMMEND ISSUANCE OF A CERTIFICATE TO OPERATE THE SOURCE AS BUILT
6. ☒ HAVE EPISODE ACTION PLANS BEEN ACCEPTED FOR THIS SOURCE — EXEMPT ☐ YES ☒ NO ☐
7. ☐ APPLICATION FOR C.O. DENIED

UPON COMPLETION OF CONSTRUCTION, SIGN THE STATEMENT LISTED BELOW AND FORWARD TO THE APPROPRIATE FIELD REPRESENTATIVE

THE PROCESS, EXHAUST OR VENTILATING SYSTEM HAS BEEN CONSTRUCTED AND WILL BE OPERATED IN ACCORDANCE WITH STATED SPECIFICATIONS AND IN CONFORMANCE WITH ALL PROVISIONS OF EXISTING REGULATIONS

SIGNATURE OF AUTHORIZED REPRESENTATIVE OR AGENT: Charles L. Caswell — DATE:

SECTION B

45. EMISSION POINT ID.	46. GROUND ELEV. (FT)	47. HT. ABOVE STRUCTURES (FT)	48. STACK HT (FT)	49. INSIDE DIAM. (IN.)	50. EXIT TEMP (°F)	51. EXIT VELOCITY (FT/SEC)	52. EXIT FLOW RATE (SCFM)	53. DRAFT TYPE (N F I)	54. WIND DIRECTION	55. RECEPTOR DISTANCE (FT)	56. DRAWING NUMBERS OF PLANS SUBMITTED
0001A	460	50	25	47	130	15.38 184.9	11454	F	W	180	

SECTION C

57. DESCRIBE PROCESS OR UNIT: Foundry Cupola Exhaust System - Wet Scrubber + CUPOLA

58. TOTAL NUMBER OF SIMILAR PROCESSES OR UNITS: 1

SECTION D

CONTROL TYPE	MANUFACTURER'S NAME AND MODEL NUMBER	FUEL TYPE	FLOW RATE (SCFM)	TEMP (°F)	PRESSURE DROP (IN. H_2O)	HORSE POWER	CONTAM'T CONTROL'D	EFFICIENCY (%)	HOW DET.	DISP. METH.	INITIAL COST ($)	OPER. COST ($)	DATE INSTALLED	USEFUL LIFE
13	Air Pollution Industries		13700	150	30	250	075	95.7	2	1	plus $90,000	plus 25,000	1/71	15yr.
01	Chicago Blower, 5600PA 3S1		13700	150		250							/	

SECTION E

CALCULATIONS IN DETERMINING INPUT OR PRODUCTION RATE, EMISSION RATE POTENTIAL AND ACTUAL EMISSIONS:

Avg. Flow Rate = 11454 CFM

Avg. T° = 130° F

Actual Emission 13.03 lb/Hr.

Avg. Process Wgt. = 18567 lb./Hr.

Avg. Allowable at 18567 = 16.55

Figures taken from Stack test Report

Test Performed 5/30/73 - 6/1/73

ERP = 9.284 Ton/hr × 17 lb/Ton

ERP = 157.83 lb/hr

SECTION F

CONTAMINANT NAME	%	CODE	INPUT OR PRODUCTION	UNITS	ERP (LBS/HR)	HRS/DAY	DAYS/YR	PROPOSED RATING	ACTUAL EMISSIONS	UNITS	ACTUAL EMISSIONS (LBS/HR)	AGENCY USE ONLY: ENV. RATING	ALLOWABLE EMISSIONS	UNITS
~~Mostly~~ Coke Fly Ash		075	18567	1	157.83	4	239	B			13.03	B	16.55	1

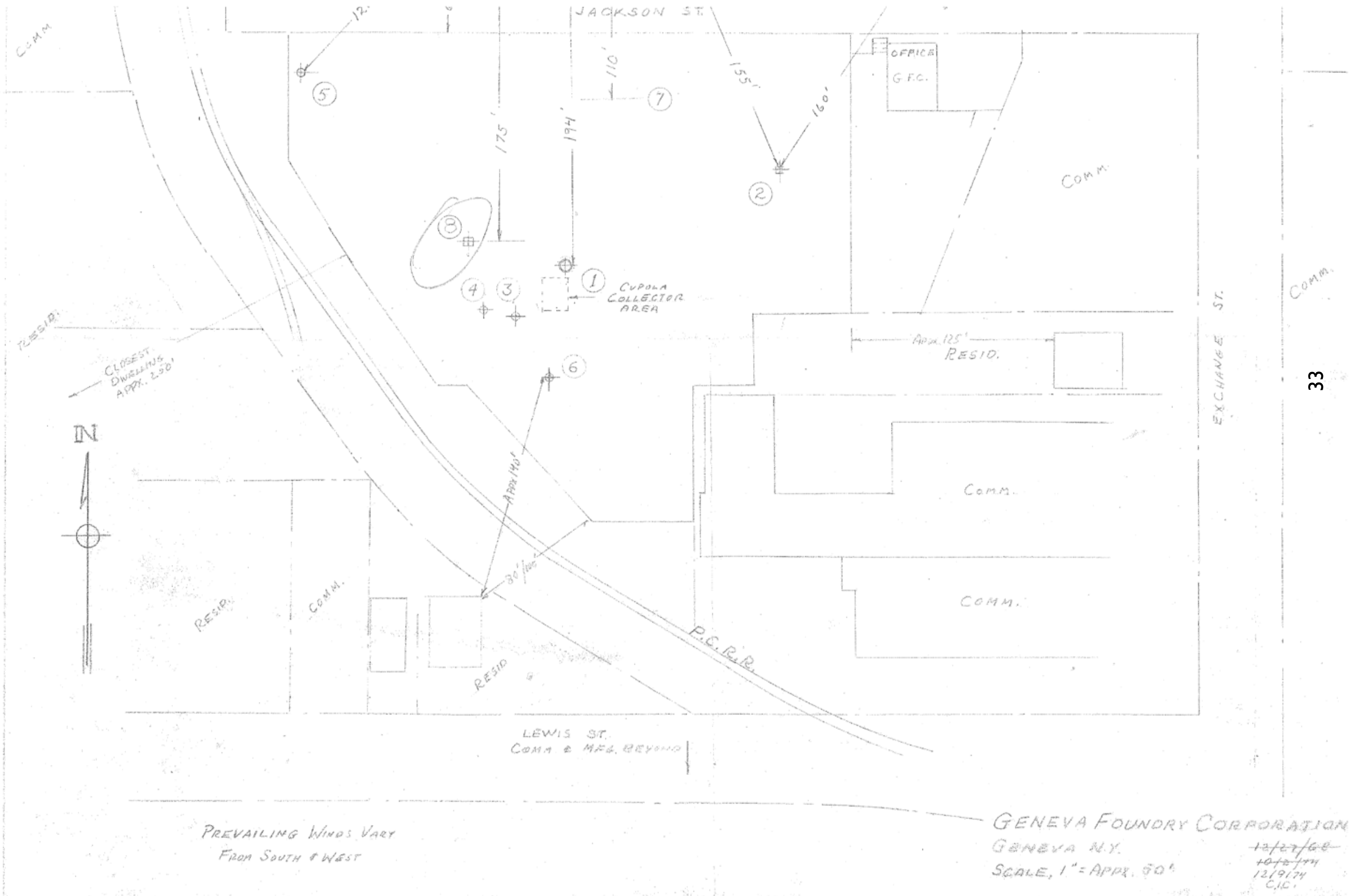
SECTION G

SOLID FUEL TYPE	LBS/HR	%S	OIL TYPE	GPH	%S	GAS TYPE	CFH	BTU/CF	CONTROL EQUIPMENT TYPE	NUMBER	CONTROL EQUIPMENT TYPE	NUMBER	CONTROL EQUIPMENT TYPE	NUMBER	PROCESS CODE	APPLICABLE CODE(S)
									13	1	01	1				212

NOTES 1. Plans must be submitted in triplicate with this application.
2. Any person knowingly making any false statement or false report in connection with this application shall be liable for penalties as prescribed by law

AIR 100I (7/73)

OP LOCATION FACILITY EMISSION POINT
2 I 3 2 0 5 0 0 0 0 4 7 0 0 1 A


JACKSON ST.
EXCHANGE ST.
LEWIS ST.
COMM & MFG. BEYOND
P.C.R.R.
CUPOLA COLLECTOR AREA
OFFICE
G.F.C.
CLOSEST DWELLING, APPX. 250'
APPX 140'
APPX 125'
RESID.
COMM.
175'
194'
110'
155'
160'
N
PREVAILING WINDS VARY FROM SOUTH & WEST
GENEVA FOUNDRY CORPORATION
GENEVA N.Y.
SCALE, 1" = APPX. 50'
~~12/27/68~~
~~10/18/74~~
12/9/74
C.I.C.

APPENDIX D

Offsite Soil Sampling Strategy/Plan

Former Geneva Foundry (site #B00019) – 43 Jackson St. – Geneva, NY

(Undated [1960s?] aerial photograph of the **Geneva Foundry** (view to the NW)

Purpose: Determine the nature and extent of impacts to surface soils from foundry air emissions

Data Trends: The overall data distribution shows that relatively high values of lead are prevalent in yards close to the Foundry such as along Jackson St. and at 234 Exchange St. (directly adjacent to the east of the Foundry). As one moves away from the Foundry, concentrations generally decrease with exceptions noted along Genesee St. (elevated levels in small front yards [410-630 ppm] vs. lower levels [110-350] in large backyards; possibly disturbed/fill). The distribution of elevated arsenic generally correlates with lead; zinc closely tracks lead levels. Previous sampling showed other metals such as cadmium and mercury were not contaminants of concern.

Data Interpretations: Past air emissions from Foundry appear to have impacted proximal yards and that the higher levels in the small front yards on Genesee St. may reflect some input from lead paint. Deeper sampling onsite and in some yards showed that lead levels decrease significantly below 2"-4" (double-digit ppm of lead appears to be natural background) which indicates surficial deposition of lead. Previous sampling did not include drip line or areas adjacent to homes therefore, lead paint should not be a significant issue (except where re-distributed such as by mowing). Lead from vehicle exhaust does not appear significant in the street ROW sampling so that leaves foundry emissions as the only reasonable explanation for most of the elevated lead levels. Historic fill is a possibility is a few cases where debris (glass, coal ash/cinders) was noted in a couple of gardens but overall, soil cores showed normal topsoil in the yards which were cored.

Data Needs: Determine extent of foundry impacts with a sampling plan that is scientifically-defensible, reasonable, and implementable.

Sampling Strategy: Representative soil sampling for heterogeneously-distributed contaminants is a very difficult task. The initial rounds at this site used a point sample in the front yard and one in the back yard which located some of the more severely contaminated yards but could not rule out others (as shown below, if 50% of a yard is randomly contaminated, one sample has a 50% chance of finding it; if 10% contaminated, a 10% chance and so on). Using probability theory and cumulative binominal distributions discussed further below, it appears probable that 7 discrete samples/yard can find most of the contamination.

Area of Concern - Several ROW transects from un-impacted areas toward the former foundry will be sampled with XRF to determine where apparent foundry impacts diminish. Washington St., High St., Clinton St., and Center St. will be attempted. Once an apparent AOC edge/zone is identified, un-sampled properties within it will be canvassed for permission to perform detailed sampling.

Yard Sampling Procedures

- Each property (“decision unit”) will be field tested using the DEC (Innov-x) XRF at 7 locations (2 in the front yard - 5 in the backyard for average-sized properties, i.e., 2500-7500 sq.ft. ; additional locations will be added to larger parcels in roughly 50’x50’increments).
- Assuming rectangular lots with small front yards, front yards will be divided into thirds with 2 samples located at the mid-points. Backyards will be divided into quadrants with sampling locations at the center of each quadrants and at the intersection of the quadrants (center of the yard). Locations will be flagged, geo-refed w/GPS, and measured/taped to a landmark.
- Exceptions to the above grid include play areas or areas of bare soil such as gardens (samples will be biased toward these areas).
- At each sampling location, a 3”-4” diameter of turf/vegetation will be cut and peeled back to beneath the normal root zone with a clean stainless-steel trowel.
- The bare, exposed soil will be tamped flat and an insitu XRF reading will be taken (~ 1 minute) and recorded.
- A soil sample (roughly 4 oz.) will be collected from 0” – 2” below exposed ground surface and placed in labeled Zip-lock bags or directly into lab containers and the turf will be replaced. The sample will be visually described and photographed. The trowel will be wiped, washed, and rinsed between locations.
- At the center backyard location (or at a location which shows evidence of fill); a deeper sample will be collected from 6” bgs.

- Initially, all locations from several properties will be collected in Zip-lock bags and the insitu/field XRF readings will be confirmed under controlled indoor conditions with various moisture contents (moisture tends to dampen/bias field XRF readings low).
- Once field and controlled XRF readings are shown to be comparable and verified with standards, two to four locations with the highest insitu XRF readings at each property will be sampled and placed directly in lab containers.
- A blind field duplicate sample will be collected at a frequency of one in every ten soil samples. An MS/MSD sample will be submitted at a frequency of one in 20 soil samples.
- Samples will be analyzed for lead and arsenic by EPA method 6010C with metal digestion and percent solids.

Grab vs. Composite Soil Sampling

An alternative to point/grab sampling is composite sampling, such as, Incremental Sampling Methodology (http://www.itrcweb.org/ism-1/Executive_Summary.html provides a rigorous scientific basis for thorough composite sampling for defined areas (decision units) such as yards). However, the minimal number of discrete samples (n=30) and replicates to be composited for a decision unit/yard may be too intensive considering the number of yards (and EPA has a similar procedure: http://www.epa.gov/OUST/cat/ssg496.pdf). Also, any contaminant distribution of < 50% would be masked by compositing where if say 30% of the yard was contaminated, compositing would show a mean concentration below levels of concern.

Optimal Number of Grab Samples

It appears then that point samples are preferred but how many per yard? If we conduct a binomial probability experiment with a range of possible concentration distributions (in a yard of say 1% to 90% of the area is contaminated > a SCO), an optimal range of trials/samples may be evident.

A binomial experiment has the following characteristics:

- The experiment involves repeated trials (sample points).
- Each trial has only two possible outcomes - a success ("heads" or > SCO) or a failure ("tails" or < SCO).
- The probability that a particular outcome will occur on any given trial is constant.
- All of the trials in the experiment are independent.

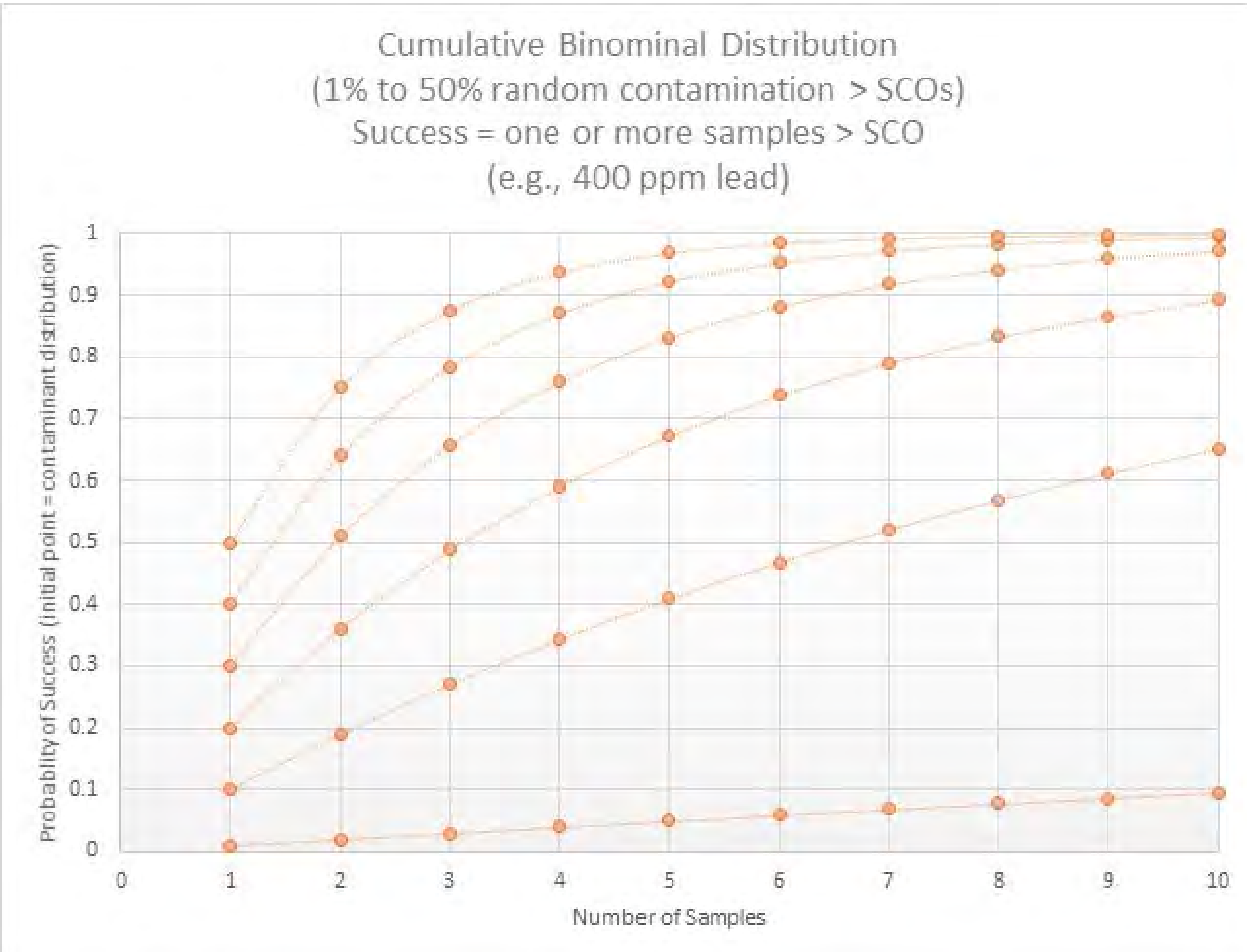
A binomial distribution is a probability distribution. It refers to the probabilities associated with the number of successes in a binomial experiment. Consider the classic case of flipping a coin where the probability is known (0.50 or 50%) and "heads" = success. Of course, one flip (trial) has a 50% chance of heads; more trials (from the graph and table below) show a 87.5% chance of one success in 3 trials and a 97% chance in 5 trials. Or the chance of drawing a certain suit (13 cards/suit/52 cards) from a well-shuffled deck of cards = 25%; with 4 trials, the chance = 66% (if the cards are returned to the deck; odds must remain constant in this case).

Spatially, an example might be a 10 x 10 grid with % contamination (> SCO) represented by random squares in the grid (10 "black" squares = 10% contamination; throw a dart blindfolded for each trial).

Excel 2013 provides a convenient way to run the experiment and display results (cumulative binominal distributions) as shown in the attached and below (earlier versions of Excel did not include the cumulative range of "successes": BINOM.DIST.RANGE (A, B, C, D); one had to add up probabilities of success for each trial). And http://stattrek.com/online-calculator/binomial.aspx provides a nice single-value calculator and statistics background.

A yard with 1% contamination is of course very difficult to find (and likely not of concern) but 10% – 50% contamination also present "probable" difficulties. The probability of one sample (the old standby) finding contamination depends on contaminant distribution (in the graph below, sample #1 = contamination distribution/probability). The graph shows that 7 samples/yard would just exceed 50% probability for a yard with 10% contamination and exceed 70% probability for 20%-50% contaminated yards.

Figure 1



Considering the multi-sample data available for Geneva (Table 1 below), a rough probability distribution can be calculated for each of 6 yards (2 yards can't miss = 100%, 2 yards = 63%, 1 = 38%, and 1 = 13%). Using the Figure 1 above, seven samples could theoretically capture contamination at a > 50% probability for each of these examples. Of course, the difficulties lie with lower % probabilities which perhaps are less of a concern.

Table 1
Geneva Foundry Site

Summary of 2006 Residential Soil Sampling Results
Laboratory Analyses for Lead (Pb) mg/Kg, or parts per million (ppm)

Sample Number	***2006 Results Lead (Pb)***	***2005 Results***	***Comments[1]***
16 Jackson-3	340	1,940/381	860 - average
16 Jackson-4	370		
16 Jackson-5	1,400		3 samples < 400 ppm
16 Jackson-6	970		5 samples > 400 ppm
16 Jackson-7	660		Prob. Dist. > 400 = 0.625 (63%)
16 Jackson-8	820		
30 Jackson-3	720	265/273	470 - average
30 Jackson-4	330		
30 Jackson-5	990		5 samples < 400 ppm
30 Jackson-6	550		3 samples > 400 ppm
30 Jackson-7	250		Prob. Dist. > 400 = 0.375 (38%)
30 Jackson-8	380		
40 Jackson-3	470	681/624	Previous result: 471
40 Jackson-4	790		650 - average
40 Jackson-5	730		
40 Jackson-6	620		All samples > 400 ppm
40 Jackson-7	630		Prob. Dist. > 400 ~ 1.0 (~100%)
40 Jackson-8	840		
47 State-3	360	233/266	257 – average
47 State-4	420		
47 State-5	110		7 samples < 400 ppm
47 State-6	140		1 sample > 400 ppm
47 State-7	320		Prob. Dist. > 400 = 0.125 (13%)
47 State-8	210		
67 State-3	420	2,120/262	650 – average
67 State-4	300		
67 State-5	630		3 samples < 400 ppm
67 State-6	710		5 samples > 400 ppm
67 State-7	290		Prob. Dist. > 400 = 0.625 (63%)
67 State-8	470		
234 Exchange-3	1,300	830/490	Previous results: 667-1,210
234 Exchange-4	2,000		978 – average
234 Exchange-5	760		
234 Exchange-6	880		All samples > 400 ppm
234 Exchange-7	640		Prob. Dist. > 400 ~ 1.0 (~100%)
234 Exchange-8	1,000		

Table 2 – Hypothetical Sampling Trials (chance of "success" in finding contamination) with Cumulative Binominal Distributions - Hypothetical sampling (1 to 10 samples) of randomly-distributed surface-soil contamination (1% to 90% > 400 ppm Pb) in using Excel 2013 function - BINOM.DIST.RANGE (A, B, C, D))

Sample #	Lead > 400ppm	1 = Success	Sample #	Column1	Prob. of Success
1	0.01	1	1		0.01
2	0.01	1	2		0.0199
3	0.01	1	3		0.029701
4	0.01	1	4		0.03940399
5	0.01	1	5		0.04900995
6	0.01	1	6		0.05851985
7	0.01	1	7		0.06793465
8	0.01	1	8		0.07725531
9	0.01	1	9		0.08648275
10	0.01	1	10		0.09561792
1	0.1	1	1		0.1
2	0.1	1	2		0.19
3	0.1	1	3		0.271
4	0.1	1	4		0.3439
5	0.1	1	5		0.40951
6	0.1	1	6		0.468559
7	0.1	1	7		0.5217031
8	0.1	1	8		0.56953279
9	0.1	1	9		0.61257951
10	0.1	1	10		0.65132156
1	0.2	1	1		0.2
2	0.2	1	2		0.36
3	0.2	1	3		0.488
4	0.2	1	4		0.5904
5	0.2	1	5		0.67232
6	0.2	1	6		0.737856
7	0.2	1	7		0.7902848
8	0.2	1	8		0.83222784
9	0.2	1	9	-	0.86578227

10	0.2	1	10		0.89262582
1	0.3	1	1		0.3
2	0.3	1	2		0.51
3	0.3	1	3		0.657
4	0.3	1	4		0.7599
5	0.3	1	5		0.83193
6	0.3	1	6		0.882351
7	0.3	1	7		0.9176457
8	0.3	1	8		0.94235199
9	0.3	1	9		0.95964639
10	0.3	1	10		0.97175248
1	0.4	1	1		0.4
2	0.4	1	2		0.64
3	0.4	1	3		0.784
4	0.4	1	4		0.8704
5	0.4	1	5		0.92224
6	0.4	1	6		0.953344
7	0.4	1	7		0.9720064
8	0.4	1	8		0.98320384
9	0.4	1	9		0.9899223
10	0.4	1	10		0.99395338
1	0.5	1	1		0.5
2	0.5	1	2		0.75
3	0.5	1	3		0.875
4	0.5	1	4		0.9375
5	0.5	1	5		0.96875
6	0.5	1	6		0.984375
7	0.5	1	7		0.9921875
8	0.5	1	8		0.99609375
9	0.5	1	9		0.99804688
10	0.5	1	10		0.99902344
1	0.6	1	1		0.6
2	0.6	1	2		0.84
3	0.6	1	3		0.936
4	0.6	1	4		0.9744
5	0.6	1	5		0.98976
6	0.6	1	6		0.995904
7	0.6	1	7		0.9983616
8	0.6	1	8		0.99934464
9	0.6	1	9		0.99973786

10	0.6	1	10		0.99989514
1	0.7	1	1		0.7
2	0.7	1	2		0.91
3	0.7	1	3		0.973
4	0.7	1	4		0.9919
5	0.7	1	5		0.99757
6	0.7	1	6		0.999271
7	0.7	1	7		0.9997813
8	0.7	1	8		0.99993439
9	0.7	1	9		0.99998032
10	0.7	1	10		0.9999941
1	0.8	1	1		0.8
2	0.8	1	2		0.96
3	0.8	1	3		0.992
4	0.8	1	4		0.9984
5	0.8	1	5		0.99968
6	0.8	1	6		0.999936
7	0.8	1	7		0.9999872
8	0.8	1	8		0.99999744
9	0.8	1	9		0.99999949
10	0.8	1	10		0.9999999
1	0.9	1	1		0.9
2	0.9	1	2		0.99
3	0.9	1	3		0.999
4	0.9	1	4		0.9999
5	0.9	1	5		0.99999
6	0.9	1	6		0.999999
7	0.9	1	7		0.9999999
8	0.9	1	8		0.99999999
9	0.9	1	9		1
10	0.9	1	10		1

History - Geneva has an interesting manufacturing history that included an unusual number of foundries and stove/boiler manufacturers in a small area. Many operated for over a century starting in the 1830s. With the arrival of railroads in the 1840s, transport of coal and iron was facilitated and the industry blossomed. Geneva Foundry survived the longest (1860-1988) but others operated nearby (e.g., NY Central Iron Works, Catchpole Bending Works) and a MGP operated a block to the east. All and all, coal/coke combustion was concentrated in a small area for more than a century which may explain the elevated levels of arsenic (more widespread than lead) and lead contamination appears more directly related to Geneva Foundry.

“In the mid-1800s, Geneva claimed the most foundries in western New York State. The metal industry accounted for almost 70% of the city’s jobs in the 1950s and remained strong until the 1970s. Today, Geneva has only one major metal fabrication company.”

Alfred Catchpole established a machine shop in Geneva in 1860. After serving in the Civil War, he resumed his work and focused on steam heating. He invented the “Florida” boiler in 1884, so named to conjure up images of warmth. William Brennan, Sr. purchased the Catchpole Boiler, Foundry, and Machine Company in 1921 and began the ***Geneva Foundry Corporation***. The Foundry did not make retail products but did castings for other companies. Locally, they made parts for American Can and Shuron Optical; out-of-town clients included the Carrier Corporation, General Electric, and Delco. As noted by Mr. Brennan in the late 1980s, the Geneva Foundry (GF) melted iron at same location for over 125 years utilizing a cupola (a large cylinder lined with refractory and fueled by coke (processed coal). In 1970, GF became the second foundry in the state to install a venturi scrubber but due to inadequate design, numerous operational problems arose. In addition, the sludge contained hazardous levels of lead. Therefore, GF decided to replace the cupola/scrubber with two coreless electric induction melting furnaces at considerable cost in 1985 but business declined and GF was closed in 1988.

Another major foundry was the ***New York Central Iron Works***, established in 1851 at Lewis and Exchange Sts. It produced steam engines and boilers, but also made “Reapers and Mowers…Clod Crushers, Field Rollers…Cultivators and PLOWS AND PLOW POINTS of old and new patterns.”

Small foundries, such as Thomas Burrall’s, produced parlor and cook stoves in Geneva. The first major stove manufacturer was the ***Phillips & Clark Stove Company***; they moved here from Troy in 1885. In 1897, ***Summit Stove and Foundry*** was established near Phillips & Clark. In the early 1920s, Phillips & Clark changed their name to ***Andes Stove Company***, after the name of one model of stove. The company assumed control of Summit around the same time and shifted production to furnaces and enamel cooking ranges. Parlor stoves evolved through the 1800s, becoming more efficient and ornate. Reliable steam heating became available in the 1850s, but it was expensive to install and was considered complicated and unsafe. For these reasons, parlor stoves remained popular for many years.

Edward Herendeen shifted from producing farm implements to boilers, particularly the Furman boiler, invented by fellow Genevan Frederick Furman in 1885. ***Herendeen Manufacturing*** became part of the ***U.S Radiator Corporation*** in 1910; Geneva’s role was to continue making boilers. Established in 1880 by James R. Vance, the ***Vance Boiler Works*** began in a shop across from the New York Central Railroad Depot. Vance, a Scottish immigrant, had worked as a boiler maker and a foreman at the New York Central Iron Works. Vance Boiler Works moved to the north side of town around 1902, and back downtown (near the present Lyons National Bank) in 1914.

<u>Potential Sources of Metals (Lead and Arsenic) in Foundry Emissions:</u>

Lead emissions from the foundry are directly inferred from analyses from the foundry’s air pollution control devices. As noted above, a venturi scrubber was installed in 1970 (i.e., air scrubber dust and sludge from the Foundry which was sent to the Ontario County Landfill until 1984). It was discovered that the dust was EP toxic for lead (25 ppm; total lead = 1200 ppm; foundry sand total lead = 3500 ppm) and hence hazardous waste and the landfill was then listed in the Registry. Also, interior data collected in 1995 show 635 ppm of lead in dust at the air pollution cyclone while other interior samples were an order of magnitude lower.

Lead in the foundry’s air emissions likely dates back to the use of painted (lead-based) metal scrap as part of its feedstock. Additional lead input came in the 1920s with the addition of tetraethyl lead to gasoline. Scrapped engine blocks were internally coated with lead (e.g., valves/cylinders) and car bodies were painted with lead-based paint. Depending on the feedstock, melting of scrap iron in the cupola furnace released variable amounts of lead and the combustion of coke fuel (derived from coal which naturally contains arsenic, lead and other metals) released arsenic and other metals. Both vapors/fumes and particulates (w/coatings and condensates) of lead and arsenic were released via a short furnace stack (~ 25 feet) into the atmosphere. Variable winds, trees, and structures led to highly chaotic depositional patterns which were subsequently disturbed by yard maintenance and mixing of soil (e.g., worms, squirrels, humans). Most of the metal mass likely settled out near the foundry and dispersion modeling of the stack configuration showed maximum deposition within 300 feet. Long-time neighbors conveyed that stack flames were visible at night and a pastor noted that his church's exterior (at Lewis and Genesee Sts.) was coated/darkened by foundry emissions (which XRF testing corroborated).

Other Possible Sources of Lead and Arsenic:

Historic leaded house paint/chips and leaded gas vehicle emissions, of course, complicate interpretation. Data collected to date attempted to avoid possible lead paint chips/flakes and impact from vehicle emissions was not evident. Similar historical industries were quite numerous in Geneva and another foundry, NY Central Iron Works, was located just south of GF. Early local sources for coke were likely the manufactured gas plants (#835015) formerly located about a block to the E/SE and the Border City MGP located about one mile east but any separate effects of historic air emissions for arsenic from these plants are not clear. Coal burning in general may have left an arsenic imprint on older neighborhoods where coal furnaces (residential and commercial) were common (along with possible local/backyard ash disposal as noted in a few yards).

APPENDIX E

Analytical Data Package (on CD)