

Lessons learned from 20 years' remedial work amongst derelict gasworks, gasworks dumps, coke ovens & other coal-tar sites

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ABSTRACT: By far the greatest body of remedial concerns involving derelict manufactured gas plants and other coal tar sites are the human exposure and environmental degradation risks attendant to inadequately characterized sites. These “Lessons Learned” examples present a variety of ways in which poorly-characterized, “remediated” sites may represent substantial and unacceptable, remaining public health and environmental risks. Lessons Learned here identify concerns related to the need to: Understand plant operational history, and thus, the points of origin of likely types of toxic residuals and wastes; identify the process movement of solid, viscous and liquid toxics on and around the plant; discover and address the likely fate of each identified type of residual or waste; discover points or areas of discharge of plant wastes; determine the geologic nature of the subsurface of the gas yard and of its surroundings; consider potential geological anomalies that may represent pathways for sequestration or migration of plant residuals and wastes, and; suspect that historically “vacant” portions of the gas yard, or nearby surroundings almost always indicate the presence of the plant dump.

1 INTRODUCTION

Most manufactured gas plants operated on a 24/7 basis, on account of the constant demand for their product and because most of their gas manufacturing processes required that the ceramic retorts or fire-brick-lined ovens be continually operated so as to avoid destructive fracturing from the necessary heating and cooling cycles related to “destructive distillation.” As a result of this continuous operation the gasworks produced a never-ending stream of residuals and wastes, and these wastes mounted in volumetric magnitude, by the day.

2 REASONABLE CONCERN FOR ACCURATE PLANT DESCRIPTION

It stands to reason that an FMGP (*Former Manufactured Gas Plant*), in order to receive an accurate site remediation, but be accurately declared by the RP (*Responsible Party*) as to its capacities to generate artificial gas, and thereby also to generate the residuals and wastes which today may represent threats to public health and to the environment. This is a serious worldwide matter of concern, for the following reasons:

1. Environmental regulation, in place worldwide, has not been given the legal ability to compel the RP to release its own historic archival plant technical and operational documents and drawings;
2. Regulators, therefore, do not have access to the very documentation that would tend to define the nature, quantities, timing, and site location of the very toxic substances that represent real threats.

3. RPs need only to declare that their own historic archival plant-site data has been “destroyed.” The author does not know of a single instance in which a North American regulatory agency has attempted to or has been successful in compelling an RP to open its archives for document discovery relevant to accurate site and waste characterization of FMGP sites.

3 SOME IMMUTABLE FEATURES OF GASWORKS OPERATIONS

Gasworks were inherently dangerous places; they produced a product, as well as residuals and wastes that the industry knew to possess dangerous characteristics and properties. As a result, gasworks had a consistency in certain aspects of layout and design features. Recognition of this consistency is essential to accurate site and waste characterization, and failure to recognize the features of this consistency will lead to flaws in whatever remedial actions, alternatives and technologies are selected and put forth in the record of decision that commonly is employed in cleanup of uncontrolled hazardous waste sites. In fact, these flaws can be considered to represent “fatal flaws” in the scheme of remediation, and the flaws themselves generally will outstrip the assumed “risks” that commonly are brought forth as elements of consideration for selection of remediation. The author has prepared Table 1 as an enumeration of the logical considerations in planning and conduct of site and waste characterization for FMGPs.

4 TYPICAL CRITICAL SITE CHARACTERIZATION QUESTIONS NEEDING RESOLUTION

Gasworks universally were designed to fit into the available gasyard space and to be so designed as to through-put gas-generating feedstocks and, in the process, to accommodate the introduction and management of the waters generated by the processes as well as the greater volumes of clear, cool water required to process and treat (clarification for removal of tar and purification for removal of residual tar and all manner of other impurities, to include sulfur, cyanide (when produced), CO₂). Typically critical questions need to be raised and answered as part of the RP disclosure and of the regulatory agency response. Table 2 presents a selection of lessons-learned questions requiring resolution.

5 TYPICAL CRITICAL SITE WASTE DECLARATION QUESTIONS NEEDING RESOLUTION

It stands to reason that an FMGP Remedial Action Plan requires full disclosure of key issues relating to the nature of gas-manufacturing wastes that constitute much of the source of the environmental threats to be mitigated or removed by remediation reflecting a proper concern for human health and environmental protection. A lessons-learned selection of typical critical site waste questions makes up Table 3.

An example herewith is offered that represents an extension of concern for the off-site dumping of box wastes. At the once major Bay Shore FMGP, engineering geologists of the New York Department of Environmental Conservation (assigned environmental remediation agency), even in consideration of known nearby, off-plant gasworks dumping, have not yet discovered quantities of box wastes to equal what normally would correspond to rough computations developed from known plant production figures.

5.1 *Case of the long-standing legal aversion to gas-house dumping in New York State*

New York state has consistently led the nation in the historic recognition and legal aversion to the dumping and other open discharge of gas-house wastes to the environment. We cite

Table 1. Predictable critical features of gasworks layout & design.

Consideration	Usual nature	Seen as a flaw
Plant bounds	Show the legal bounds of the titled property known as the <i>gasyard</i>	All other parcels owned by the gasworks company or its officers, within several historic blocks should also be declared, as those are prime candidates for off-plant gasworks dump sites related to the plant
Plant process flow	Up-gradient to down-gradient	Wastes are generated and accumulate up-gradient to down-gradient
Water-intensive	Gas required cooling and clarification prior to purification	Once-through clear, cold water, becomes contaminated, up to down-gradient
Gas-manufacturing process effluent	“Gas Liquor” becomes progressively more contaminated	Degree of contamination was visible; a factor of its colour; visible > 2500 ppm TPAH
Plant operational drainage system	Flows from up-gradient edge to down-gradient edge	Fluent effluents tend to flow toward discharge at or along the down-gradient edge of the gas yard
Clarification components	Operated to remove particles of tar	Tars captured in sumps of clarification components
Purifiers	Removed sulfur and other remaining impurities	Resulting “box wastes” had the concentrated purifier impurities
Plant tars (PAH hot spots & transported contaminants)	MSS signatures vary diagnostically by major process	Characterization should incorporate this useful feature in evaluating source and transport implications
Tar sludge	Heavy PAHS and accumulated geologic “dirt” from coal feedstock	Sludge was unburnable and unsalable; generally dumped
Empty spaces within site maps	Spaces that are devoid of historic map, plot, or aerial image evidence of occupation by plant components; almost always indicates the location of the primary plant dump	If not properly sampled, the entire remediation becomes subject to unacceptable risk of contaminant release from undetected “hot spots”

herewith only a small example of this historic recognition. The reader, however, should be aware that, generally speaking, provisions of public law have not represented an outstanding historic deterrent to such dumping.

For example, as early as 1884, the laws of New York State were amended at Sec. 25, with a statute entitled “An act for the preservation of moose, wild deer, bird, fish, and other game” to provide that “no person, association, company or corporation shall throw or deposit, or permit to be thrown or deposited, any dyestuff, coal tar, refuse from gas houses, sawdust, lime, or other deleterious substance, or cause the same to run or flow into or upon any of the rivers, lakes, ponds, streams, or any of the bays or inlets adjoining the Atlantic Ocean, within the limit of this State” (1918, US PHS Bull. no. 87, Montgomery & Phelps, p. 109).

Table 2. Critical site characterization questions needing resolution.

Consideration	Basic information needs	Seen as a flaw
Matching site history with declared site layout	Location of all gas-manufacturing components necessary to matching site history	Any missing component becomes a potential “hot spot” source-and-release agent in post-remediation time
Subsurface tar vessels	Tar Wells and Cisterns used to receive and gravity separate tar oils; used to receive gravity flow of tars captured in the Hydraulic Main or at Seal Boxes, or as gas liquors at points requiring sequestration	These tars, tar oils, and tar bearing (solution and suspension) required storage-management; now often hot spots for continued release, as interfacing with passing groundwater
Gas holder below-ground water-seal tanks (<i>Basins</i> and <i>Pits</i>)	Generally constructed before 1910; universally leaked tar light oils and gas liquors, through flaws in tank masonry	Identify and investigate all such tanks; many contain toxic debris from pre-1985 gasworks demolition; then often cleared to but one foot below existing grade.
Tar extractors	Variable locations based on general plant design features	Collected tar from tar mists in raw gas; collected tars, light oils and gas liquors
Clarification component sumps	Condensers, washers, scrubbers and their combinations	Long-term use and inherent leaks, spills and discharges lead to soil contamination and sources of further contamination of passing perched or ground water
Tar separators (underground, at cwg > c. 1895)	Locations and construction design; most were sources of leakage of light oils and gas liquors	Should be sought for all CWG plants, all of which should be considered as having generated unsalable tar-water emulsions
Purifier “boxes”	Last point of gas processing; removal of remaining impurities, inadvertent capture of remaining gas liquors	Generally an area of highly-saturated PAH-contaminated soil, particularly around box fluid drains; usually discharged directly to the ground.
Site fringes	Screening for presence of dumped debris, especially spent retort, generator or coke oven ceramic fragments	Off-cast fragments create a grossly-porous dump mass into which off-spec. tars and tar-water emulsions were discharged.

Notes: TPAH (Total Polycyclical Aromatic Hydrocarbon);

CWG (Carburetted Water Gas);

Gas Liquor (Here meant to incorporate coal-gas ammoniacal liquor, as well as the effluent of all other gas-manufacturing processes.

5.2 *Known gasworks dumps of the greater New City Area*

Gasworks dumps have largely been ignored in definition, with RPs generally writing them off as “fill” and seldom suffering questioning by regulatory authorities. In most instances, a quick look at corresponding boring logs should remove any doubt as to origin and the high probability for hot spots of toxic gas works residuals and wastes. Table 4 is an interim

Table 3. Critical site waste questions needing reasonable resolution.

Consideration	Usual nature	Seen as a characterization flaw
Plant sewer(s)	Generally cut-cover brick masonry <1900	When not reported, nor investigated; often the location of outward leakage of gas liquors discharged from the gas plant
Types and quantities of residuals & wastes generated	Quantities can be reasonably computed from plant capacity characteristics	Do the known residuals and waste quantities approximate those of the discernable plant historic capacity?
Reported quantities; both residuals & generated	Post 1900; public utility regulatory commissions required annual reports of quantities	Once used to compute income from saleable residuals; now used to judge quantities dumped around site
Gas yard waste bodies	Fringes and lower-gradient end of the site	Is the existence of such wastes reported?
Unexplored portions of the gas yard	Usually the primary plant dumping ground	If not reported; entire site remediation becomes compromised
Origin of each plant hot spot	Can be resolved with reference to declared nature of full-disclosure plant layout	
Terminology utilized in consultants' site reports	Of particular concern is the use of the term <i>fill</i> , even in direct association with gasworks debris, residuals and tar wastes	As a result, many sites have been and continue to be reported having gas yard ground termed <i>fill</i> , when indeed, the ground can be seen to have been a <i>dump</i>

summary of the gasworks dumps of greater New York City (the five Boroughs, including Staten Island and Long Island).

6 TYPICAL PLANT HISTORIC DOCUMENTATION NEEDS

It stands to reason that an FMGP Remedial Action Plan requires full disclosure of key issues relating to the nature of gas-manufacturing wastes that constitute much of the source of the environmental threats to be mitigated or removed by remediation reflecting a proper concern for human health and environmental protection. Discovery and use of these documents provides the regulatory agency with a firm basis for peer-review in the public interest. Commonly an RP selection of such documents is made available to the RP consultant, but withheld from the Agency. A lessons-learned selection of typical critical site waste questions makes up Table 5.

7 CRITICAL SITE DOCUMENTATION ISSUES

Remediation of coal-tar sites is a demanding public responsibility. The public is served appropriately only when there is full disclosure of the historic site and waste conditions under which public health and the environment are revealed. There is no end to potential damage when the RP is allowed to replace less-than-diligent data requirements with assumptions, and

Table 4. Known gasworks dumps of the greater new city area.

Created	Location	Conditions or circumstances of dumping
1824-c. 1900	New York City east river shoreline	General industrial dumping, to depths of more than 10–20 ft, produced a westward migration of the shoreline of as much as 3 to 5 city blocks; no current knowledge of specific gasworks dump areas or hotspots within this dumped ground.
1870–1960	Rockaway Park FMGP LILCO	Purifier box wastes dumped on land adjacent to the former gasworks; generally dumped on the shoreline.
1880	Northern Gas Light Co., Borough of The Bronx	1880: “The Inspectors recommend that the Northern Gas-Light Company be required to abandon the dry-lime process and adopt the iron process in its stead; they be required to provide suitable wells for the ammonia water and to prevent the overflow of the tar wells running into the river, and that the surface waters of the works be carried into a drain well, closed by gates, which shall be only raised at high tide, thus enabling matters hitherto deposited to be carried off.” (<i>NY Times</i> , 07 Dec, 1880)
1888–1973	Bay Shore, Long Island	Persistent rumours about the existence of two off-plant gashouse dumps, said to be located adjacent to the formal gasworks property bounds.
1899	U.S. Code Title 33 Sec. 441	“The placing, discharging, or depositing, by any process or in any manner, of refuse, dirt, ashes, cinders, mud, sand, dredgings, sludge, acid, or any other matter of any kind, other than that flowing from streets, sewers, and passing there from in a liquid state, in the tidal waters of the harbour of New York, or its adjacent or tributary waters, or in those of Long Island Sound, within the limits prescribed by the supervisor of the harbour, is hereby strictly forbidden.”
1903–1960	Astoria Gasworks, Astoria Northern Queens	From 1901: Purchase of vast acreage of swamp and tidal lands by the Consolidated Edison Co., in execution of “Chief” Bradley’s long-term plan to remove all of its gas manufacturing activities from Manhattan. (Author’s notes: This plan was achieved by construction of the Astoria and Hunts Point gas plants, between 1906 and 1924. After the Consolidated Gas Co. vacated the Manhattan plants, the many former gasworks were sold and redeveloped into residential and commercial sites, without remedial action; thus placing the public into concentrated potential exposure over subsurface toxics; Peter Cooper and Stuyvesant Town Villages are the most publicly dangerous of those sites). 1901: “Chief Engineer Bradley of The Consolidated Gas Co. has completed plans for the new plant, which include 4 new holders with a capacity of 12,000,000 cu. ft. of gas each, and 10 retort houses, as well as a number of out buildings. The cost of the plant will be several million dollars.” (<i>The Engineering Record</i> , 16 Mar 1900). 1895–1906: Massive dumping of all manner of utility-industry waste, behind new bulkheads, to raise the land for construction of what had been planned to be the world’s largest central gas plant. 1906–1960: Routine dumping of gashouse residuals and wastes on the general property.

(Continued)

Table 4. (Continued)

Post-1924	Hunts point FMGP consolidated gas co. (Con Edison)	Large blanket dump of purifier box wastes; those of which are related to coal-carbonization yielding a distinct bluish colour to ground captured in aerial images.
Post-WWII	Brentwood, long island	Post-WW II: Dumping of purifier box wastes as the sub-grade for pushing American Boulevard across the previous gap represented by a swamp. 2008: Remediated by Admin. Order on Consent NYS DEC/LILCO
Sep, 1947	Con Edison, at Public Place, Brooklyn, NY	ConED begins the trend of gifting derelict gasworks property, and likely associated off-plant former gasworks dumps to municipalities and cities, for use as dedicated parklands, with covenant not to redevelop the sites (author's comment) "City of NY awarded Final Decree" relative to acquiring title to the (former ConED real property required for the THREE PUBLIC PARKS, within the block bounded by Washington Street, Jackson Street, Adams Street and Fulton Street, the PUBLIC PLACE, within the block bounded by Adams Street, Johnson Street, Jay Street and Willoughby Street, and PEARL STREET, from Willoughby Street to the public Place, in the Borough of Brooklyn, City of New York." (Supreme Court of Kings County)
1954–1975	Town of Syosset Town Landfill	"Long Island Lighting and its successor, KeySpan Corp., used the (Syosset Town) landfill from 1954 to 1975, when it was closed by the Nassau County Department of Health."
c. 2009	Babylon Gasworks; Off-Site	2009: Informant reports that a "hot spot" of dumped gasworks residuals and wastes was discovered and removed under DEC direction, on the opposite of the Long Island RR ROW, but in up-gradient G-W direction.

Table 5. Critical site documentation questions needing attention.

Consideration	Usual nature	Seen as a flaw
Historic chronology of site operation	Year-by-year listing of date of establishment; must be compiled from relevant records; as there is no uniform source of such documentation.	Not to have such a record may invite ignorance of important site events, including modifications to gas-making and treatment techniques and site contaminant-release events such as floods, explosions and fire.
Plant production quantities, by, the year	Computations can then be made of relative quantities of expected source contaminants. After initiation of State utility control, production and sales records for tars generally included.	Production plots once were a U.S. standard remediation feature; now often neglected for submittal by RPs and seldom demanded by regulators. Some plant-specific Annual Reports actually show evidence of non-sales or non-plant use for tars (= dumping practice).

(Continued)

Table 5. (Continued)

Consideration	Usual nature	Seen as a flaw
Plant modifications, including rebuilds	Most gasworks either received major modifications or were closed and replaced by replacement plants.	Undisclosed plant activities or events may represent either or both increased generation, leakage, spillage, discharge or dumping of toxic substances.
Public-source plant records	<ul style="list-style-type: none"> • Brown's Directory of North American Gas Companies • Newspaper Articles • Gas Journals 	When available and not employed, gives an indication of lack of competence in site documentation.

damage-onto-damage when RP-favourable risk assumptions are made upon that layer of disregarded uncertainty. In all cases, the items presented in Table 5 should be made first and highest in priority for discovery and disclosure.

8 SUMMARY

Remediation of coal-tar sites is a demanding public responsibility. Whenever sources of accurate plant-specific information are not made available for review and comment by the designated public oversight agency, the RP is doing an injustice to the public, who must bear the risks associated with non-discovery or non-disclosure of relevant site information. The author is not qualified to address the legal aspects of thwarting the intent of public law, but the potential implications should be clear to the reader.