

NYC Geothermal Exchange Systems

Pre-feasibility Analysis and Findings

November, 2023

NYC Mayor's Office of Climate & Environmental Justice

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Executive Summary

This report is intended to provide a status update on the district geothermal exchange system analysis for City buildings, as required per Local Law 2 of 2022. The report focuses on the identification of City-owned sites that are the most technically viable, will significantly reduce fossil fuel use, modernize buildings in need of repair, and benefit environmental justice communities through improving local air quality.

The Mayor's Office of Climate & Environmental Justice (MOCEJ), in coordination with the Department of Citywide Administrative Services (DCAS), contracted the National Renewable Energy Laboratory (NREL) for the analysis done to date.

In conjunction with NREL's analysis, MOCEJ and DCAS staff have identified five clusters to advance into the feasibility study phase: Bronx Community College, Queensborough Community College, Fort Totten, Hunts Point Market, and the St. George municipal buildings, which include the St. George Library Center. These sites are recommended based on the presence of a cluster of buildings that could be served by a district geothermal system at the demonstration phase, and in the case of Hunts Point, an additional heat source and sink (effluent from the Hunts Point Wastewater Resource Recovery Facility). The community college sites, and Fort Totten offer campuses of five or more buildings, and the St. George municipal buildings have a cluster of City-owned buildings in proximity to each other, with a standalone geothermal system already under consideration.

Priority sites will now be considered in a more thorough feasibility assessment to be completed by an engineering firm with experience in geothermal system analysis and design. The engineering firm will deliver reports detailing the feasibility of the system and qualitative/quantitative answers to all the required questions in the local law. MOCEJ and DCAS are in the process of procuring these assessments.

Local Law Requirements

Local Law 2 of 2022 requires a feasibility study to identify government locations for geothermal exchange systems connecting City buildings (NYC, 2022). The law directs the City to then select a maximum of 10 clusters, if any, that present the greatest potential benefit for a demonstration program.

The law requires reporting on or before March 1, 2023, and every two years thereafter until 2033. The report must contain an assessment of the demonstration program, discussion of performance and impacts of any geothermal exchange system created pursuant to this section and information on feedback regarding the provision of geothermal exchange service pursuant to this section.

The City is currently in the process of evaluating sites for feasibility and therefore cannot provide a performance evaluation of a geothermal system. This report, however, intends to provide transparency and demonstrate progress on the feasibility assessment of the district geothermal systems.

Analysis to Date

The preliminary analysis focused on identification of clusters of City-owned buildings that may be viable for a district system. NREL collected data from multiple City agencies and data sources, then cleaned and integrated the data to the best extent possible to conduct a geospatial analysis of City-owned properties within several hundred feet of each other to define a potential district system.

After dataset compilation, NREL, along with MOCEJ and DCAS, engaged with other City agencies to gauge interest and future capital needs to identify sites that could be a good fit for a geothermal exchange system.

Data Collection

Data collected and compiled from multiple sources to identify buildings that could be appropriate for a district system is briefly summarized here:

- DCAS maintains a database of City properties (DCAS, 2023). This dataset includes approximately 8,600 property records for campuses, individual buildings, and lots or parks.
- Local Law 84 of 2009 reporting data were used, where available, to associate buildings with their heating fuel types and energy consumption (Buildings, 2023).
- Local Law 87 of 2009 reporting data were used, where available, to associate buildings with their HVAC system types and system age (Buildings, Local Law 87 Frequently Asked Questions, 2023).

- NYC Department of Design and Construction (DDC) Geothermal Pre-Feasibility Screening Tool data were used to associate buildings with relevant geothermal characteristics, such as depth to bedrock or depth to ground water and availability of open space (DDC, n.d.).
- The Office of Management and Budget publishes the Asset Information Management System (AIMS) report each year (OMB, 2023). AIMS data were used, where possible, to supplement information regarding HVAC system types.

Building Cluster Development

The data collected were filtered and used to identify clusters of buildings that are close to one another geographically with the desired set of characteristics that give the highest potential for forming district geothermal systems. Building characteristics included, in part, building type, number of stories, square footage, and environmental justice community criteria.

Latitude and longitude data from individual buildings were used to collate buildings together into individual cluster sets. The maximum distance between each building was set to 400 ft., and at least two buildings were required to define building clusters.

Priority Attributes Used For Site Selection

Five clusters were selected for further investigation, as shown in Table 1 of the appendix. Sites were chosen after cluster analysis evaluation and through discussions with MOCEJ, DCAS, and staff at agencies that manage and operate properties.

The attributes below were considered for site selection:

- Open space: To drill geothermal boreholes without the additional complication of drilling underneath existing buildings, there must be an adequate amount of open space.
- Depth to bedrock: Bedrock deposits are either exposed at the land-surface level or located at variable underground depth. Evaluations of bedrock for geothermal deployment examines both bedrock land-surface elevation and overburden thickness. Land-surface elevation measures the height of bedrock deposits above or below sea level (USGS, 2023). Overburden thickness, or depth to bedrock, denotes the depth of subterranean bedrock deposits from a site's surface. Installation of geothermal boreholes in areas with high bedrock elevation levels may result in more expensive installations. Therefore, areas with greater depth to bedrock were prioritized.
- Use of fuel oil: Fuel oil #4 must be phased out in all NYC buildings by 2027, and in all City-owned buildings by 2025 in accordance with § 24-168 of the New York City Administrative Code. These buildings are prioritized as they are already in need of some HVAC upgrades to eliminate use of fuel oil #4. Fuel oil #2 was also prioritized as these

are often older systems and may need some HVAC upgrades to allow for upcoming biodiesel blending requirements.

- Capital improvements: Buildings expected to require capital improvements, especially for HVAC and energy efficiency renovations, yet are a few years out from project implementation, are ideal candidates for this demonstration effort. Consideration of sites with upcoming capital improvements is expected to allow sites to take advantage of required capital expenditures for HVAC system upgrades, which will improve the financial feasibility of the project.
- Proximity of buildings to each other: Higher load density can make network-connected, ground-heat exchanger coupled systems more cost-effective due to the lower length of distribution infrastructure required to serve a given amount of load.
- Load diversity: Building clusters with relatively spatially dense and diverse loads were prioritized. Such characteristics can not only make geothermal districts more cost-effective but also improve energy system performance. For example, a data center's waste heat can provide heat for an office building in the winter. With a properly configured loop, heat rejected by one building can be used by another that requires heat.
- Environmental justice impacts: Providing emissions reductions and investment in disadvantaged communities (DACs) is a priority.¹ Status of a location in or near a DAC is reflected in the discussion of each location chosen (NYSERDA, 2023).

Sites Selected for Further Analysis

Considering the attributes above, five high-priority sites were identified for further analysis.

The identification of sites within this report serves only as a preliminary recommendation for further review. Additional analysis and investigation, including site visits to review current conditions, is necessary to determine whether a site is feasible for a district geothermal system. The names and addresses of the buildings considered for initial study at each of the five sites selected can be found within Appendix Table 1.

¹ The Climate Leadership and Protection Act (CLCPA) defines DACs as “communities that bear the burdens of negative public health effects, environmental pollution, impacts of climate change, and possess certain socioeconomic criteria, or comprise high-concentrations of low-and-moderate income households.” Signed into state law in 2019, this nation-leading environmental act seeks to reduce New York’s greenhouse gas emissions 40 percent by 2030.

Bronx Community College

Bronx Community College campus, located in University Heights, consists of 33 buildings, a central quad and additional open space. While the entire college campus is not designated as a DAC, the campus administrative buildings are in a DAC and the surrounding neighborhood constitutes a DAC.

This site utilizes fuel oil #2 and has a high potential to reduce greenhouse gas emissions and emissions of other criteria pollutants, which will improve local air quality. Emissions reductions that result from system upgrades are expected to benefit not only the college but also residents of the surrounding DAC. Moreover, many of the campus buildings require significant HVAC upgrades.

Five of the 33 buildings are proposed for initial study. If a demonstration project is implemented at this site, the remaining buildings can be considered for potential expansion of the geothermal district. The next phase of feasibility assessment should consider whether the chosen subset is the appropriate set of buildings for an initial demonstration project. Future analysis must also consider that this western Bronx location has a very shallow depth to bedrock—approximately less than 50 ft. This shallow depth could complicate drilling for installation of a ground heat exchanger and increase drilling costs.

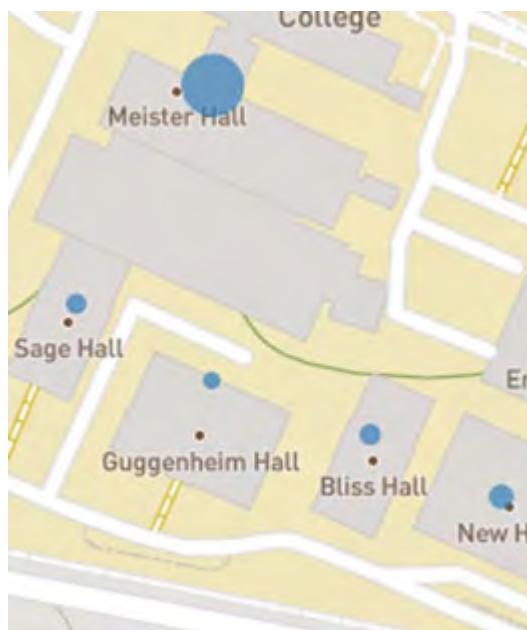


Figure 1. Cluster of buildings considered at Bronx Community College

Queensborough Community College

Queensborough Community College, located in Bayside, Queens, consists of 17 buildings.

Queensborough's campus is currently served by a district steam heating and chilled water system. It is possible some of this infrastructure could be re-purposed for a district geothermal system. Queensborough Community College relies on a mixture of natural gas and fuel oil #2. The load density in this location is high due to the proximity of the buildings, and renovations are expected in the near future.

A subset of 17 buildings have been proposed for initial study at the Queensborough Community College site. The remaining buildings can be considered for potential expansion of the geothermal district if a demonstration project is implemented at this location. The next phase of feasibility assessment should consider if this subset of buildings is the appropriate set for an initial demonstration project.

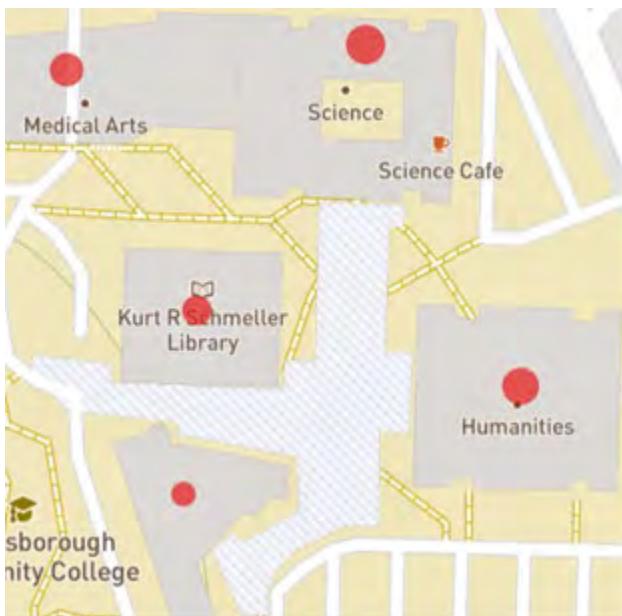


Figure 2. Cluster of buildings considered at Queensborough Community College

Fort Totten

Fort Totten has many small buildings owned by the New York City Department of Parks and Recreation (DPR), the New York Police Department (NYPD), and the Fire Department of New York (FDNY). Fort Totten is not within a DAC. However, the site has high fuel oil #2 usage, which results in high decarbonization and air pollution reduction potential. The buildings are also located close together, which increases the load density. Site buildings are aging and there are planned future renovations.

As part of this analysis, load density metrics were calculated for a hypothetical ground heat exchanger system serving a set of buildings currently conditioned by #2 fuel-oil burning equipment, shown with red dots in Figure 3. The City will likely consider a subset of this site for the district system, that may include, but not be limited to the sites identified in the figure below.

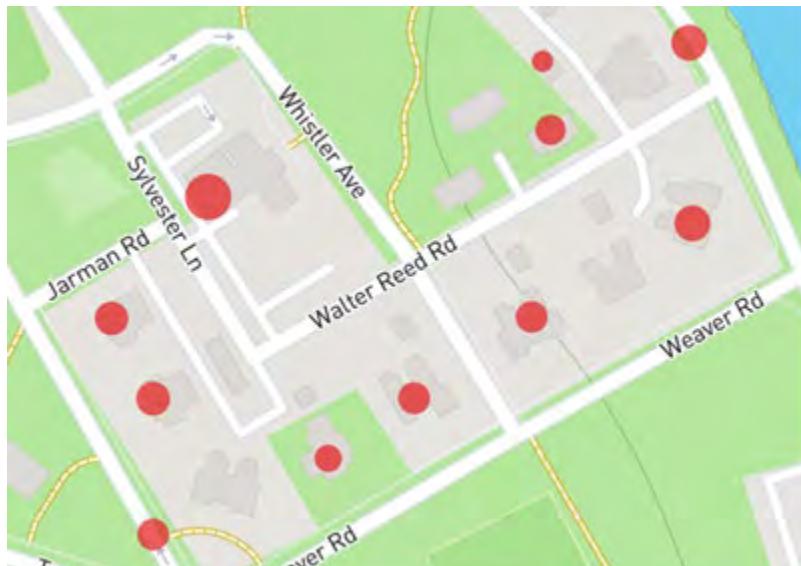


Figure 3. Cluster of buildings considered at Fort Totten

Hunt's Point Market

Hunt's Point is home to food distribution warehouses, cooperative markets with large refrigeration loads, and the New York City Economic Development Corporation's (EDC) Hunt's Point Market. This location has a high load density, which is typical of food distribution buildings. Nearby, the New York City Department of Environmental Protection (DEP) operates a wastewater resource recovery facility (WRRF), which rejects low-temperature heat through effluent that could be used as a heat source and sink for a district energy system. Given the geographic locations of both sites, the EDC Hunt's Point facility is considered in conjunction with the DEP WRRF.

EDC has conducted a prior analysis considering geothermal systems for Hunt's Point, which will hopefully provide a good starting point for analysis, as well as load profiles for the market. Contaminated soil, groundwater, and river sediment exist at various locations in and around the Hunt's Point site, which requires consideration as part of any future work. Additional analysis is also necessary to establish the load density of the WRRF and geographic feasibility of deploying a district geothermal system between locations. The potentially long distance between the DEP WRRF and Hunt's Point Market would necessitate more planning and coordination than other sites considered. As such, the complex nature of this site must be at the forefront of any future analyses.

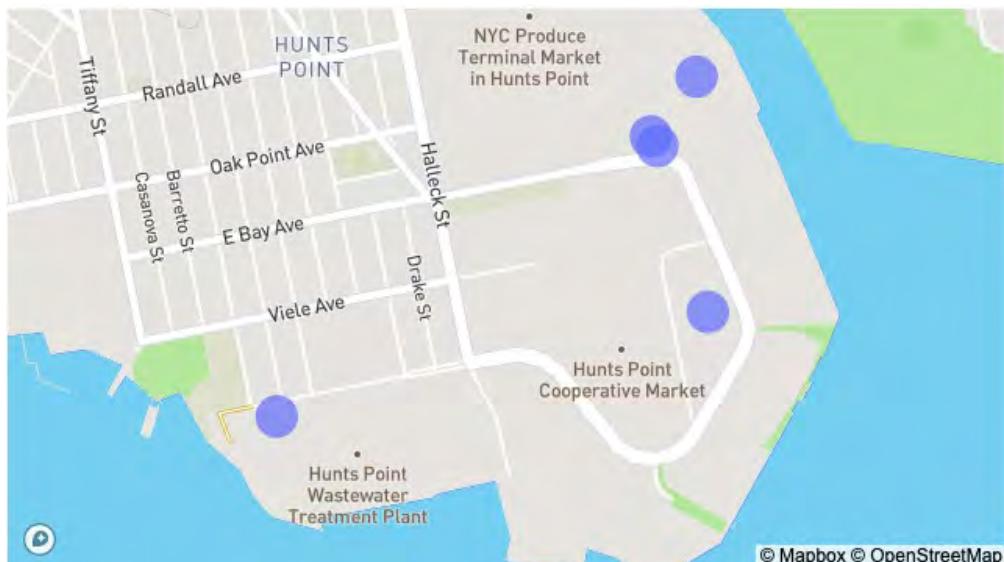


Figure 4: Hunts Point Cluster

St. George Municipal Buildings

There are several planned and currently ongoing renovations underway at several St. George site buildings. For instance, the St. George Library Center is considering a geothermal system to serve the single building. Staten Island Borough Hall, Richmond County Clerk, and Richmond County Surrogate's Court also have plans to move forward with a district condenser water system. The Richmond County Supreme Court is a recently constructed building that has hydronic heating. A potential geothermal district would tie into the scoped and existing systems.

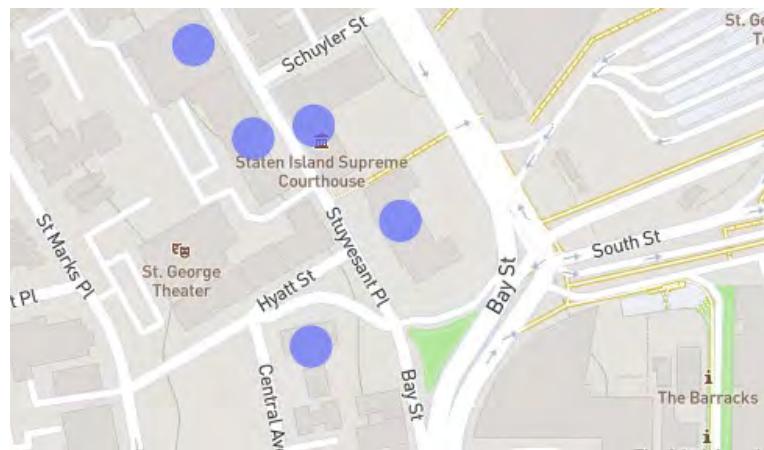


Figure 5: St. George Cluster

Next Steps

The City is now in the next phase of feasibility assessment which will conduct more thorough onsite assessments by an engineering firm with experience in geothermal systems analysis and design. The engineering firm will deliver reports detailing the feasibility of the system and qualitative/quantitative answers to all the required questions in the local law. MOCEJ and DCAS are in the process of procuring these assessments.

Appendix

Table 1. Clustered buildings

Building Name	Address
<i>Bronx Community College</i>	
Meister Hall	161 WEST 180TH ST
Sage Hall	175 WEST 180TH ST
Guggenheim Hall	155 WEST 180TH ST
Bliss Hall	145 WEST 180TH ST
New Hall	135 WEST 180TH ST
<i>Queensborough Community College</i>	
Medical Arts Building	222-01 56th Ave
Science Building	222-15 56th Ave
Humanities Building	222-25 56th Ave
Administration / Business Building	222-11 56th Ave
Kurt Schmeller Library	222-05 56th Ave
<i>Fort Totten</i>	
Building 405	405 WHISTLER AVE
Building 402	402 MURRAY AVE
Building 401	401 MURRAY AVE
Building 400	400 MURRAY AVE
Building 422	422 WEAVER AVE
Building 420	420 WEAVER AVE
Building 418	418 WEAVER AVE
Building 413	413 SHORE RD
Building 411	411 SHORE RD
Building 415	415 CLEAVER AVE
Building 430	430 WALTER REED RD
<i>Hunts Point</i>	
Hunts Point Produce Market	772 EDGEWATER RD
Hunts Point Fish Market	800 FOOD CENTER DR
Sultana/Citarella	600 FOOD CENTER DR
Hunts Point Cooperative Market	355 FOOD CENTER DR
Hunts Point Market – Fruit Auction Wholesale Bldg 1	240 FOOD CENTER DR
Hunts Point Market – Fruit Auction Wholesale Bldg 2	240 FOOD CENTER DR
Hunts Point Market – Fruit Auction Wholesale Bldg 3	240 FOOD CENTER DR

Krasdale	400 FOOD CENTER DR
Hunts Point WPCP Campus: DEP Site at Halleck St	1270 RYAWA AVE
<i>St. Georges</i>	
St. George Library Center	10 HYATT ST
Richmond County Supreme Court/Parking Garage	26 CENTRAL AVE
Staten Island Borough Hall	10 RICHMOND TER
Richmond County Surrogate Court	18 RICHMOND TER
Richmond County Clerk	130 STUYVESANT PLACE

References

Buildings, N. (2023). *Benchmarking and Energy Efficiency Rating*. Retrieved from <https://www.nyc.gov/site/buildings/codes/benchmarking.page#:~:text=The%20NYC%20Benchmarking%20Law%2C%20Local,through%20a%20process%20called%20benchmarking>

Buildings, N. (2023). *Local Law 87 Frequently Asked Questions*. Retrieved from <https://www.nyc.gov/site/buildings/codes/local-law-87-faq.page>

DCAS, N. (2023). *Real Estate Data Sets*. Retrieved from <https://www.nyc.gov/site/dcasa/real-estate-data-sets.page>

DDC, N. (n.d.). *Geothermal Pre-feasibility Tool*. Retrieved from <https://www.nyc.gov/assets/ddc/geothermal/geothermalTool.html>

NYC. (2022). *NYC Local Law 2 of 2022*. Retrieved from <https://nyc.legistar1.com/nyc/attachments/792c1ff4-9599-4edf-8007-f4b2800219a6.pdf>

NYSERDA. (2023). *Disadvantaged Communities Criteria*. Retrieved from <https://climate.ny.gov/resources/disadvantaged-communities-criteria/>

OMB, N. (2023). *Budget Publications Descriptions*. Retrieved from <https://www.nyc.gov/site/omb/publications/description-of-all-publications.page>

USGS. (2023). *Bedrock-Surface Elevation and Overburden Thickness Maps of the Five Boroughs, New York City, New York*. Retrieved from <https://pubs.usgs.gov/publication/dr1176/full>