Environmental Assessment of Proposed Tracer Particle and Gas Releases
Chemical and Bio-Defense Testbed (CBT) Program
Urban Threat Dispersion (UTD) Program

Prepared for the Department of Homeland Security
Science and Technology Directorate

August 17, 2021

Version 5

EXECUTIVE SUMMARY

The United States (U.S.) Department of Homeland Security (DHS) Science and Technology Directorate (S&T), in partnership with the Metropolitan Transportation Authority (MTA) and other stakeholders in New York City (NYC), is proposing to conduct testing events to improve resiliency of urban areas and transportation systems against chemical or biological terrorist attacks (Proposed Action).

This Environmental Assessment (EA) documents the analysis of any potential effects on the environment resulting from the Proposed Action. This EA is being coordinated with stakeholders and the public for information and comment, in accordance with *the National Environmental Policy Act (NEPA) of 1969* as outlined in 40 CFR Parts 1500-1508 and DHS Directive 023-01, Rev. 01 and DHS Instruction Manual 023-01-001-01, Rev.01, implementing NEPA. Recent changes to the Council on Environmental Quality (CEQ) regulations implementing NEPA (40 CFR Parts 1500-1508) became effective on September 14, 2020. As stated in 40 CFR Part 1506.13, the new regulatory changes apply to any NEPA process begun after September 14, 2020. This EA commenced after that date; therefore, this EA conforms to the new CEQ NEPA implementing regulations.

The Proposed Action would take place between September 2021 and May 2022 and involves the release of particle and gas tracer materials directed into the open-air space in several pre-determined locations within NYC. The Proposed Action would include the release of low concentrations of safe particle and gas tracer materials as part of two programs - the Urban Threat Dispersion (UTD) program and the Chemical and Bio-defense Testbed (CBT) program. The Proposed Action and the No Action Alternatives are considered in this EA.

The UTD program is a follow-on to the Underground Transportation Restoration [UTR] project/test event, conducted in 2016, in which safe particle and gas tracers were released in the MTA NYC Transit (NYCT) subway system. In this study, the dispersion of materials through the system was studied. The results of the UTR project helped first responders and critical stakeholders better understand how biological particles would disseminate after a potential release. The UTR test event also raised several additional questions, including the relationship between tracer materials released in the subway and the aboveground urban environment. These follow-on questions are the focus of the proposed upcoming UTD test. Additionally, further evaluation of the propagation of tracer materials to transit and outdoor sites in the greater NYC metro area, and Northeastern Seaboard is of interest.

The goal of the CBT program is to increase resilience against potential chemical or biological agent attacks by testing and evaluating detection technologies and mitigation (or response) strategies to reduce agent propagation in several locations within the NYC subway system. In order to evaluate the performance of both sensor technologies and response strategies, DHS S&T proposes to disseminate safe simulant or tracer materials that mimic key properties of biological and chemical agents of concern. Performance data would be gathered regarding the

performance of newly installed sensors (e.g., maintenance costs, frequency of false alarms, and probability and time to detect a potential threat) after the testing events.

In order to understand how tracer dispersion and sensor performance are affected by train car and passenger movement much of the testing must be conducted during operational hours. As such, the public may be present during testing. The proposed testing schedules for UTD and CBT are as follows:

UTD: Particle and gas tracer releases would occur within a defined two-week timeframe between September and December 2021. There would be five separate testing days scheduled within this two-week timeframe. NYC Stakeholders were recently updated on the UTD program in May 2021 and have initially concurred with October 17-30, 2021 as the desired release window.

CBT: Particle and gas tracer releases would occur on a rolling basis between September 2021 and May 2022, with the specific schedule dependent on the pace of technology installation. Testing would occur up to 10 days per month, with a maximum of four test events per day.

Several particle (P) and gas (G) test options may be used in the Proposed Action to meet the scientific objectives of both the CBT and UTD programs, these safe tracer materials are being considered in this EA. Table 1. summarizes proposed usage of the safe tracer materials across the two programs.

Table 1. Safe Tracer Materials Being Considered for Use in CBT and UTD

Test Option	Description	Planned use in CBT	Planned use in UTD
P1	DNATrax-OB	No	Yes
P2	DNATrax-Silica	No	Yes
P3	Safe Tunable Alginate Microparticles (STAMP) with cargoes	Yes	Yes
P4	DNA-Silica liquid mixture	Yes	No
P5	Visolite	Yes	No
G1	Sulfur hexafluoride (SF_6)	Yes	Yes
G2	SF_6 and Perfluorocarbon tracers (PFTs)	Yes	Yes

Five particle options (P1-P5) are considered within this EA. The proposed particles would meet various purposes and needs of the CBT and UTD projects, while the sixth represents the No Action Alternative.

- Option P1 (DNATrax-OB), P2 (DNATrax-Silica), P3 (STAMP), and P4 (DNA-Silica) represent similar options of an aerosol release using DNA oligonucleotides. The oligonucleotides enable specific and sensitive measurement of particle spread in the environment, and detection by some biosensor technologies.

- Options P1 and P2 contain DNATrax, which is a maltodextrin-based particle. DNATrax was developed for food labeling purposes and has been classified by the U.S. Food & Drug Administration (FDA) as Generally Recognized as Safe (GRAS). Option P2 uses amorphous silica as a carrier to enable production of larger particles. Options P1 and P2 are proposed for use solely in UTD.

- Option P3 uses alginate, a safe polysaccharide isolated from algae as the particle carrier. The resulting particles are not water-soluble, enabling improved investigation of environmental persistence, and can be functionalized to enable detection by different sensors. Option P3 is proposed for use in both CBT and UTD.

- Option P4 contains many of the same components as Option P1-P3 but is released as a liquid mixture that rapidly evaporates to form droplet nuclei. Option P4 is proposed for use in CBT and is included in this analysis due to its ease of production compared to the other safe tracer materials.

- Option P5 (Visolite) is a commercially-available fluorescent powder commonly used in HVAC testing. Option P4 is proposed for use in CBT, and would partially meet program needs (enabling testing of mitigation/response strategies and some, but not all, sensor technologies).

- Option P1, P2, and P4 have all been safely used in prior tracer tests[1,2].

Options P1-P5 would be aerosolized in particle sizes that are respirable. As a result, existing airborne exposure limits were considered regarding the usage of all safe tracer materials discussed here. The Occupational Safety and Health Administration (OSHA) has developed eight-hour time-weighted average Permissible Exposure Limits and the American Conference of Governmental Industrial Hygienists (ACGIH) has established 8-hour Threshold Limit Values for workers in occupational settings for a range of materials. The U.S. Environmental Protection Agency (EPA) has also established limits for specific criteria pollutants known as the National Ambient Air Quality Standards (NAAQS) to protect public health, including the health of sensitive immune-compromised populations. Based on safe particulate composition and very low concentrations, there would be no anticipated adverse effects to the public from any of the tracer materials being released since the materials are safe at the testing levels being proposed. No appreciable risk to passengers, residents of NYC or the greater regional area, tourists, transit workers, or field test personnel would occur. The Proposed Action is shown to be well within all established exposure limits and guidelines set by OSHA, ACGIH, and the EPA.

Two gas test options (G1-G2) are considered. The gas tracer materials would be released in very low concentrations (ppt or lower).

- Option G1 consists of releasing sulfur hexafluoride (SF_6) gas. SF_6 is a perfluorocarbon and is not known to cause adverse health effects, even at high concentrations.

- Option G2 consists of SF_6 gas and up to six additional perfluorocarbon tracers (PFT): perfluorodimethylcyclobutane (PDCB), perfluoromethylcyclohexane (PMCH), metaperfluorodimethylcyclohexane (mPDCH), perfluoromethylcyclopentane (PMCP), perfluoro-iso-propylcyclohexane (i-PPCH), and/or perfluorotrimthylcyclohexane (PTCH).

Due to the safety of the proposed test materials and the relatively small quantity of materials to be released (<10 g for the aerosol options, and <500 g for the gas options), and the temporary nature of the Proposed Action, no effects are anticipated on noise, hazardous materials, water resources, vegetation, or land use and infrastructure. Negligible effects are anticipated on biological resources, cultural resources and historic properties, environmental justice communities, and air quality. A beneficial impact on public health and safety is anticipated as the results of the Proposed Action would significantly improve public safety and increase resiliency in the face of a potential biological or chemical agent attack. It is worth noting that UTD and CBT test events would not occur simultaneously, so there are no anticipated synergistic effects. Based on this analysis, there would be no significant effects due to implementation of the Proposed Action. There would be no significant effects due to the incremental effects of the Proposed Action in consideration of other past, present, or reasonably foreseeable actions within the affected area.

The No Action Alternative would not involve the release of any particle or gas tracer materials. It would not enable testing of gas sensor technologies in CBT and would not enable collection of highly specific real-time concentration data in UTD, which is difficult to achieve with particulates alone. The No Action Alternative would not meet the need or purpose of the Proposed Action.

DHS S&T will post this EA with an email address for the public to comment over a 30-day period following publication. Public input submitted will be discussed and considered with respect to conclusions of the EA. During testing, signs would be posted near the tracer release locations for public awareness and would provide instructions for accessing more detailed information. A public relations campaign will occur in New York and New Jersey based on input from the New York Police Department (NYPD), MTA, and Port Authority of New York and New Jersey (PANYNJ).

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LIST OF ACRONYMS

AAC – Acceptable Air Concentration
ACGIH – American Conference of Governmental Industrial Hygienists
AEGL - Acute Exposure Guideline Level
ANL – Argonne National Laboratory
ARPA - Archaeological Resources Protection Act
BGEPA - Bald and Golden Eagle Protection Act
BGM – Below Ground Model
CAS – Chemical Abstracts Service
CBT – Chemical and Bio-Defense Testbed
CEQ – Council on Environmental Quality
CERCLA - Comprehensible Environmental Response, Compensation, and Liability Act
CFR – Code of Federal Regulations
COPD – Chronic Bronchitis/Chronic Obstructive Pulmonary Disease
COVID-19 – Coronavirus Disease 2019
CT – Census Tract
dB - decibel
DFU – Dry Filter Unit
DHS S&T – Department of Homeland Security Science & Technology
DNA – Deoxyribonucleic Acid
DNATrax – DNA Tagged Reagents for Aerosol Experiments
EA – Environmental Assessment
EC_0 – No-Effect Concentration
EC_{50} – 50% of Maximal Effect Observed
EJSCREEN – Environmental Justice Screening Tool
EPA – Environmental Protection Agency
ESA – Endangered Species Act
ETAD – Ecological & Toxicological Association of Dyes & Organic Pigments Manufacturers
FDA – Food & Drug Administration
GRAS – Generally Recognized As Safe
GWP – Greenhouse Warming Potential
HVAC – Heating, Ventilation & Air Conditioning
iPPCH - Perfluoro-iso-propylcyclohexane
LLNL – Lawrence Livermore National Laboratory
MBTA – Migratory Bird Treaty Act
MIT LL – Massachusetts Institute of Technology Lincoln Laboratory
MMAD – Mass Median Aerodynamic Diameter
mPDCH - Metaperfluorodimethylcyclohexane
MTA – Metropolitan Transportation Authority
NAAQS – National Ambient Air Quality Standards
NAGPRA - Native American Graves Protection and Repatriation Act
NEPA – National Environmental Policy Act

NHPA – National Historic Preservation Act
NRHP – National Register of Historic Places
NYC – New York City
NYCCAS – New York City Community Air Survey
NYCT – New York City Transit
NYDEC – New York City Department of Environmental Conservation
NYPD – New York Police Department
NYSHPO – New York State Historic Preservation Office
OB – Optical Brightener
OSHA – Occupational Safety and Health Administration
PDCB - Perfluorodimethylcyclobutane
PEL – Permissible Exposure Limit
PFT – Perfluorocarbon Tracer
PM_{10} – Particulate Matter under 10 microns
PM_{5} – Particulate Matter under 5 microns
$PM_{2.5}$ – Particulate Matter under 2.5 microns
PMCH – Perfluoromethylcyclohexane
PMCP - Perfluoromethylcyclopentane
PNOS – Particle Not Otherwise Specified
PPL – Particles Per Liter of Air
PSU – Portable Sampling Unit
PTCH - Perfluorotrimthylcyclohexane
RCRA – Resource Conservation and Recovery Act
SAS – Synthetic Amorphous Silica
SDS – Safety Data Sheet
SF6 – Sulfur hexafluoride
SPCC – Spill, Prevention, Control, and Countermeasures
S-SAFE – Subway Surface Air Flow Exchange
STAMP – Safe Tunable Alginate MicroParticles
TLV – Threshold Limit Value
TWA – Time Weighted Average
U.S. – United States
USFWS – U.S. Fish and Wildlife Service
UTD – Urban Threat Dispersion
UTR – Underground Transportation Restoration
UV-LIF – Ultraviolet Laser Induced Fluorescence
WMATA – Washington Metropolitan Area Transit Authority

Section 1. Purpose and Need of the Proposed Action

A strategic objective of the United States (U.S.) Department of Homeland Security (DHS) is to prevent, disrupt, detect, and recover from biological attacks[3]. Protecting and remediating critical infrastructure from the effects of biological weapons is a key element to achieving this goal. Early warning detection systems, rapid response strategies, and post-attack remediation strategies are constantly being examined for urban areas to minimize casualties and economic impact. Dispersion models of both the subway systems and aboveground urban canyons have been created to help in these endeavors and are critically important for homeland defense.

The DHS Science and Technology Directorate (S&T), in support of these goals, is proposing two efforts occurring in NYC between September 2021 and May 2022. The first effort, the Chemical and Bio-Defense Testbed (CBT) program seeks to evaluate detection technologies for chemical and biological agents and mitigation strategies to reduce agent spread. Specific program objectives include creating an enduring testbed in the NYC subway system to vet current and emerging chemical and biological agent sensing technologies as well as response strategies to mitigate the spread of contamination, and to gather realistic performance, operations and maintenance, and cost data.

As one component of the CBT program, DHS S&T proposes to evaluate sensor technology and mitigation action effectiveness by conducting open-air releases of safe tracer materials that mimic key properties of biological and chemical agents of concern. Safe particle and gas materials would be disseminated in several subway stations where sensing and mitigation technologies have been installed, and the effectiveness of these technologies in detecting and reducing the concentrations of the dispersed materials would be evaluated. Measurements would also be collected during testing to characterize the background environment (for example, temperature, humidity, background particle and gas constituents, etc). Testing would be ongoing between September 2021 and May 2022, dependent on the pace of technology installation. Upper limits to testing frequency are provided below in Section 2.1.2.

The Urban Threat Dispersion (UTD) program seeks to provide quantitative evidence that is needed to validate, refine, and integrate urban dispersion models to ensure their accuracy. Several tracer studies dating back to the 1960s have been conducted, but many of these efforts focused on dispersion of gases and liquid aerosols[1]. These types of measurements lack information on reaerosolization, train car mechanical filtration, and fomite transport (i.e., attachment and subsequent resuspension of particulate materials on passengers and their personal effects). Solid particulate measurements that did exist lacked the spatial and temporal resolution desired for model validation. A 2016 effort, called Underground Transportation Restoration (UTR), in which temporal air and surface measurements of gas and particle tracer dispersion were collected throughout Manhattan, represented a significant increase in our understanding of particulate dispersion. However, UTR focused primarily on tracer dispersion within the Metropolitan Transportation Authority New York City Transit (MTA NYCT) subway system and was generally limited to sites in Manhattan. The proposed testing action evaluated in this EA would build upon the earlier 2016 UTR test to better understand the coupling of dispersion between the subway and aboveground environment and the broader geographic

extent of dispersion to the outer boroughs. Small quantities of safe particle and gas tracers that can be quantitatively and sensitively tracked in the environment would be released from up to six aboveground or subway locations in NYC. Five test events are proposed to occur over an approximately two-week window between September – December 2021. Recent engagements with NYC Stakeholders including NYPD, PANYNJ, MTA, Long Island Rail Road (LIRR), New Jersey Transit (NJT), Metro-North, Amtrak, NYC Department of Health, and New Jersey Department of Health have initially concurred with October 17-30, 2021 as the desired test window.

It should be noted that the ongoing COVID-19 pandemic has altered many fundamental aspects of daily life in NYC and across the globe. Among these changes are reduced train frequency, reduced ridership and commuter population, reduced numbers of people moving throughout the city, and increased frequency of cleaning in the transit systems and generally throughout the city. These changes would be expected to impact the data collected during this Proposed Action and could impact its interpretation and applicability. Impacts due to COVID-19 are being closely monitored and discussed with key stakeholders, although as vaccines become available, it is anticipated that ridership and pattern of life will approach a “new normal.” A COVID-19 protocol may be put in place for test personnel based on conversations with NYC stakeholders and CDC guidance at the time of the UTD and CBT test events. This protocol would address concerns such as mask usage and periodic COVID-19 testing for test personnel. Any change in test timing due to COVID-19 conditions would be subject to approval from relevant stakeholders and agencies, would result in an edited publication of the EA, and would be clearly communicated to the public.

Section 2. Proposed Action and Alternatives

This section discusses the Proposed Action as well as the No Action Alternative. The Proposed Action includes several testing options, which are presented below. The analysis of the alternatives is in accordance with the National Environmental Policy Act (NEPA) of 1969 as outlined in 40 CFR (Code of Federal Regulations) Parts 1500-1508 and DHS Directive 023-01, Rev. 01 and DHS Instruction Manual 023-01-001-01, Rev.01, implementing NEPA. Recent changes to the Council on Environmental Quality (CEQ) regulations implementing NEPA (40 CFR Parts 1500-1508) became effective on September 14, 2020.

2.1 Tracer Testing Location and Particle and Gas Tracers (Proposed Action)

The Proposed Action would require both a location to perform testing as well as the use of gas and/or particle tracers to safely mimic dispersion of biological and/or chemical threat agents. A range of particle and gas tracer test options is being considered to fully meet the purposes and need of the Proposed Action. The Proposed Action includes these two components and is further discussed below.

2.1.1 Testing Locations

The proposed locations for tracer releases have been coordinated with stakeholders in NYC based on their priorities and program needs.

The optimum condition for executing a bio-terror attack would be during rush hour, when a large number of commuters are in the transit system, trains are running at peak number and speed, and population density in downtown areas is highest. Because the movements of trains and people are important drivers of particle dispersion, airflow, and sensor performance, the most accurate reflection of material transport would involve testing during near-peak operational hours. Therefore, release of particle and gas test options are generally proposed during revenue hours (i.e., during normal operations while passengers are present within stations). In some cases, efforts would be made to conduct testing during off-peak or non-operational hours if possible (primarily applicable to CBT activities). Cones and security tape would be used to secure a 10-foot area around the release point. Field test personnel (including MTA and NYPD personnel) would control access to the immediate area.

2.1.1.1 Chemical and Bio-defense Testbed (CBT)

Releases of the particle and gas test options would occur from platforms in either the Times Square or Grand Central stations in NYC. These platforms are the sites of current and future planned technology installations for the CBT program. Sensor placement and installation is occurring in coordination with the MTA. Initial tracer testing is anticipated to begin at Grand Central station and expand to Times Square station later as technology installations proceed. In order to evaluate the effectiveness of sensor architectures for different release scenarios, release events are proposed to be conducted from different locations on the station platforms over the course of testing. The planned test schedule and proposed amounts of particle and gas materials released per release event are discussed in the next few sections.

The Grand Central and Times Square stations were identified as sites for CBT program performance because of their strategic importance. Both stations are located in midtown

Manhattan. Grand Central station is the second most frequently used station in the MTA NYCT subway system, with over 155,000 riders on an average weekday (numbers based on pre-COVID-19 ridership data). The Times Square station is the most frequently used station in the MTA NYCT subway system with over 203,000 riders on an average weekday. The Grand Central 456 platform is connected by a long passageway to the Grand Central Shuttle platform. The S line is a 0.5-mile track connecting Grand Central station to Times Square station. The S line receives over 100,000 riders on an average weekday and, unlike the rest of the system under normal operating conditions, shuts down at night between midnight and 6:00 a.m.

The Shuttle tunnel connecting Times Square to Grand Central station offers an excellent opportunity to evaluate the effectiveness of mitigation or response technologies as part of the Proposed Action. Technologies designed to reduce (or mitigate) tracer dispersion can be installed in the tunnel, tracer releases can be conducted at one of the stations, and the effectiveness of these mitigation measures in limiting tracer dispersion to the neighboring station can be evaluated.

2.1.1.2 Urban Threat Dispersion (UTD)

Proposed particulate and gas tracer release locations for the UTD test were identified based on discussions with stakeholders regarding key goals of the Proposed Action, to address uncertainty due to wind direction during the test, and to enable comparison of results with those of past dispersion tests. Based on these criteria, subway platforms at Times Square and Union Square station, indoor and outdoor locations near the Oculus Transit Hub as well as aboveground locations at Times Square and Union Square Park were identified. Each of these locations have potential strategic impact (i.e., multiple subway lines converge, high passenger and pedestrian traffic, significant cultural and economic importance, etc.). Depending on the wind direction on any given day and to ensure that particle and gas tracer materials disperse towards areas equipped with measurement equipment, tracer releases would occur from a subset of the proposed sites on each day (two subway/indoor and two aboveground locations on each day). Specific locations are subject to revision based on discussions with stakeholders. Measurement equipment would be broadly distributed through the greater NYC metro area (see Figure 2 for more details).

2.1.2 Timing and Release Amounts

2.1.2.1 Chemical and Bio-defense Testbed (CBT)

Testing would be conducted between the period of September 2021 and May 2022. Up to 10 days of testing may occur each month, with no more than four tests per day. Testing may occur on consecutive days. Each test event would be expected to last for 3-4 hours. Release and measurement equipment would be deployed, and a 30-minute period of background measurements would be collected. Each test event would involve the release of one particle material and/or one gas material over the course of less than 10 minutes. The tracer release would occur, and then measurements would be collected from CBT sensors and environmental monitoring devices for a period of 2-3 hours, depending on whether multiple subway platforms are involved. CBT testing would not occur during the planned UTD test window; CBT sensors would be leveraged to provide information about the UTD releases during this time.

Release amounts would be determined based on sensor limits of detection, distance of sensor from the chosen release site, and the approximate volume of the release area. Efforts would be made to use the smallest quantities necessary. Maximum anticipated release amounts are shown for each test option in Table 2. Test options P1 and P2 are not proposed for use in CBT. Based on these release amounts, and assuming a maximum of four releases per day, the maximum release amounts over a 24-hour period are also shown.

Table 2. Likely Maximum Parameters for CBT Particle and Gas Release Amounts

Test Option	Release Format	Amount per Release (g)	Max Release Amount over 24 hours (g)
P3: STAMP	Liquid or powder	1	4
P4: DNA-Silica liquid mixture	Liquid	5	20
P5: Visolite	Powder	10	40
G1: SF_6	NA	500	2000
G2: PFTs	NA	500	2000

2.1.2.2 Urban Threat Dispersion (UTD)

A “release event” involves simultaneous particle and gas tracer releases from two of the subway platform/indoor selected locations and the two of the selected aboveground locations. Release locations would be identified ahead of each test day based on meteorological conditions (i.e. wind speed and direction). A total of five release events are proposed over a two-week period. The long test-window is designed to address weather-related risks since test events cannot be conducted in the rain. Tracer releases would last for 10 – 20 minutes. Each release event would be separated by a minimum of 5 hours, with no more than 3 release events in a 24-hour period. Table 3 is an example of what the release schedule would look like. Test options P4 and P5 are not proposed for use in UTD.

The particle and tracer dissemination method would be short dry bursts every 30 – 60 seconds for 10 – 20 minutes. The maximum amount of particle tracer material released at a particular location over fifteen minutes, 8 hours, and 24 hours is 20, 40, and 60 grams, respectively (Table 3). The particulate release amount has been chosen because it provides enough tracer material for sampling measurements to take place at sites a significant distance away from the release location but should not create a visible plume or substantially add to the visible background (see Section 3.6.2).

Gas tracers would be released simultaneously with the particle tracers. Releases would be continuous during the 10 - 20-minute particle release period. The release rates and amounts are listed in Table 4.

Table 3. Tentative UTD Release Schedule (Subject to Revision)

Release Event #	Location 1*							Location 2*					
	Subway Platform 1				Nearby Aboveground Site			Subway Platform			Nearby Aboveground Site		
	PFT #1	DNATrax-OB (P1)	DNATrax-Silica (P2)	STAMP (P3)	PFT #2	DNATrax-OB (P1)	DNATrax-Silica (P2)	PFT #3	DNATrax-OB (P1)	DNATrax-Silica (P2)	PFT #4	DNATrax-OB (P1)	DNATrax-Silica (P2)
1	0.5 kg	10 g	-	10 g	0.5 kg	10 g	-	0.5 kg	10 g	10 g	0.5 kg	10 g	10 g
2	0.5 kg	10 g	10 g	-	0.5 kg	10 g	10 g	0.5 kg	10 g	-	0.5 kg	10 g	-
3	0.5 kg	10 g	-	10 g	0.5 kg	10 g	-	0.5 kg	10 g	10 g	0.5 kg	10 g	10 g
4	0.5 kg	10 g	10 g	-	0.5 kg	10 g	10 g	0.5 kg	10 g	-	0.5 kg	10 g	-
5	0.5 kg	10 g	-	10 g	0.5 kg	10 g	-	0.5 kg	10 g	10 g	0.5 kg	10 g	10 g

** Specific release locations would be selected based on predicted wind conditions 12-24 hours ahead of a release event. Each release location would include both a subway platform and a nearby aboveground location (selected from the following three options: Times Square Station/Times Square Aboveground; Union Square Station/Union Square Park; Inside and outside Oculus Transportation Hub).*

Table 4. Proposed UTD Tracer Gas Release Amounts and Release Rates

Gas	CAS	Mass Released (kg) (10-min)*	Mass Released (kg) (8-hr)	Mass Released (kg) (24-hr)	Release Rate per Event (g/min)
Sulfur Hexafluoride (SF_6)	2551-62-4	1.0	2.0	3.0	50 - 100
PDCB	28677-00-1	0.5	1.0	1.5	25 - 50
PMCH	355-02-2	0.5	1.0	1.5	25 - 50
mPDCH	335-27-3	0.5	1.0	1.5	25 - 50
PMCP	1805-22-7	0.5	1.0	1.5	25 – 50
iPPCH**	423-02-9	0.5	1.0	1.5	25 – 50
PTCH**	374-76-5	0.5	1.0	1.5	25 – 50

**A gas release event would occur over a 10 – 20 minute period and would coincide with the release of the particulate tracer. The upper bound is set at 2 gas release events per business day and 3 gas release events over 24-hours. One PFT gas would be released from each particulate release location.*

*** The primary release events would rely on PDCB, PMCH, mPDCH, and PMCP. The iPPCH and PTCH tracers would be used for additional small scale tracer testing at sites within the Oculus Transit Hub.*

2.1.3 Release Devices and Measurement Equipment

Two mechanisms would be used to release particle tracer materials in short bursts for UTD and CBT: a device called an “eductor” as well as a filter cassette (Figure 1). In the case of the eductor, particulate tracer material is stored in a plastic tube that fits into the bottom of the eductor. Compressed air would be passed over a small opening in the top of the tube which aerosolizes the particulates. Alternatively, particulate tracer material would be loaded into a plastic cassette on top of a support filter. Compressed air is then passed through the filter resulting in dispersion of the tracer material. Pictures of both dispersion mechanisms are shown in Figure 1. The particle tracer material would be weighed and pre-filled into the eductor plastic tube or filter cassette in a laboratory. The filled containers would be placed in a shatter resistant, leak-proof sealed secondary container for transport to the test site. Additionally, for CBT, a nebulizer may be used to release liquid formulations of STAMP (P3) or DNA-Silica liquid mixtures (P4). A nebulizer is a small device that turns a liquid into a fine aerosolized mist.

For release of the gas tracer, test options that are liquid at room temperature (such as the PFTs, Option G2), would be released by evaporation via metering onto a low-temperature hot plate/blower dissemination device as shown in Figure 1. Gas tracers which are gaseous at room temperature (such as SF_6, Option G1) would be released from a low-pressure cylinder through a flow meter to monitor its release rate or pre-filled mylar bags (not shown).

None of the release devices are particularly large but many do require electrical power. Release locations would be identified that do not interfere with pedestrian traffic and would be approved with MTA NYCT beforehand.

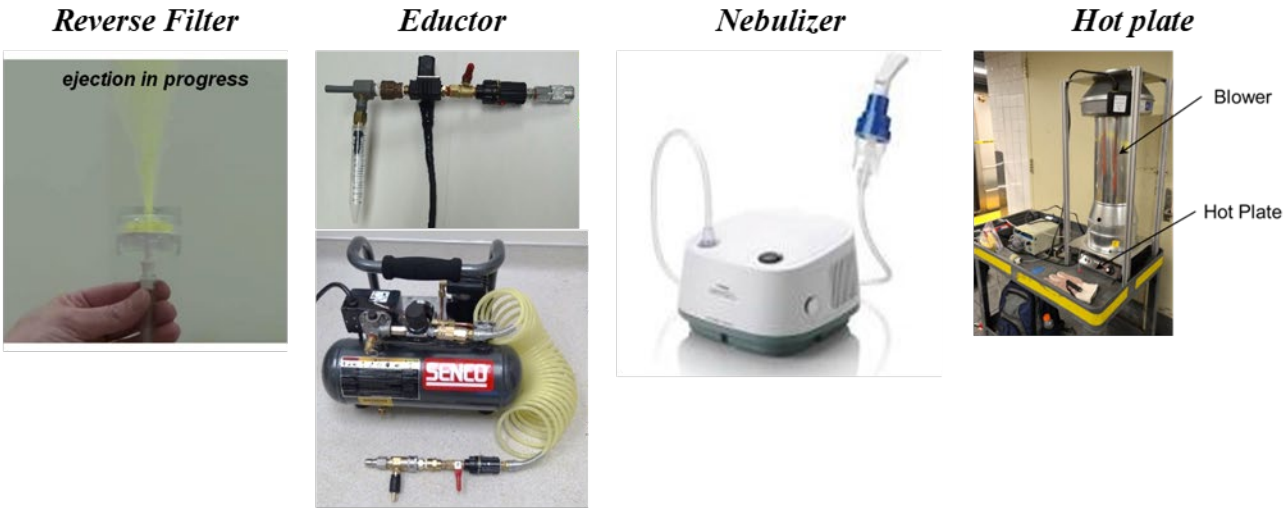

Figure 1. Possible tracer release devices. The reverse filter aerosol generator or eductor would be used for powder tracer like Options P1, P2, and P3. A nebulizer might be used for liquid suspensions of P3 and P4. PFTs (G2) would be released using a hot plate dissemination device.

For both CBT and UTD, a variety of portable measurement devices would be installed during the testing periods to collect measurements of tracer dispersion following releases. In the case of CBT, measurement equipment would be installed on the Times Square and Grand Central platforms in close vicinity to the CBT sensors being evaluated. This additional measurement equipment would only be in place for the duration of the tracer releases and would be removed once testing is completed. Locations would be identified where equipment can be secured and would not impede pedestrian movement. Photographs of locations would be supplied to MTA NYCT for approval ahead of the testing. For UTD, measurement equipment would be located throughout the greater NYC metro area (Figure 2). Equipment would be temporarily located within subway stations, near station entrances and vents, and at aboveground sites (including within/near critical infrastructure) during the several-week period encompassing testing. Locations have been identified where power is available. In all cases, measurement devices can be locked in place using a chain, and pedestrian traffic would remain unimpeded. Units would be put into position before testing begins and removed after testing concludes. No permanent physical changes would take place to stations or outdoor locations from the use of measurement equipment.

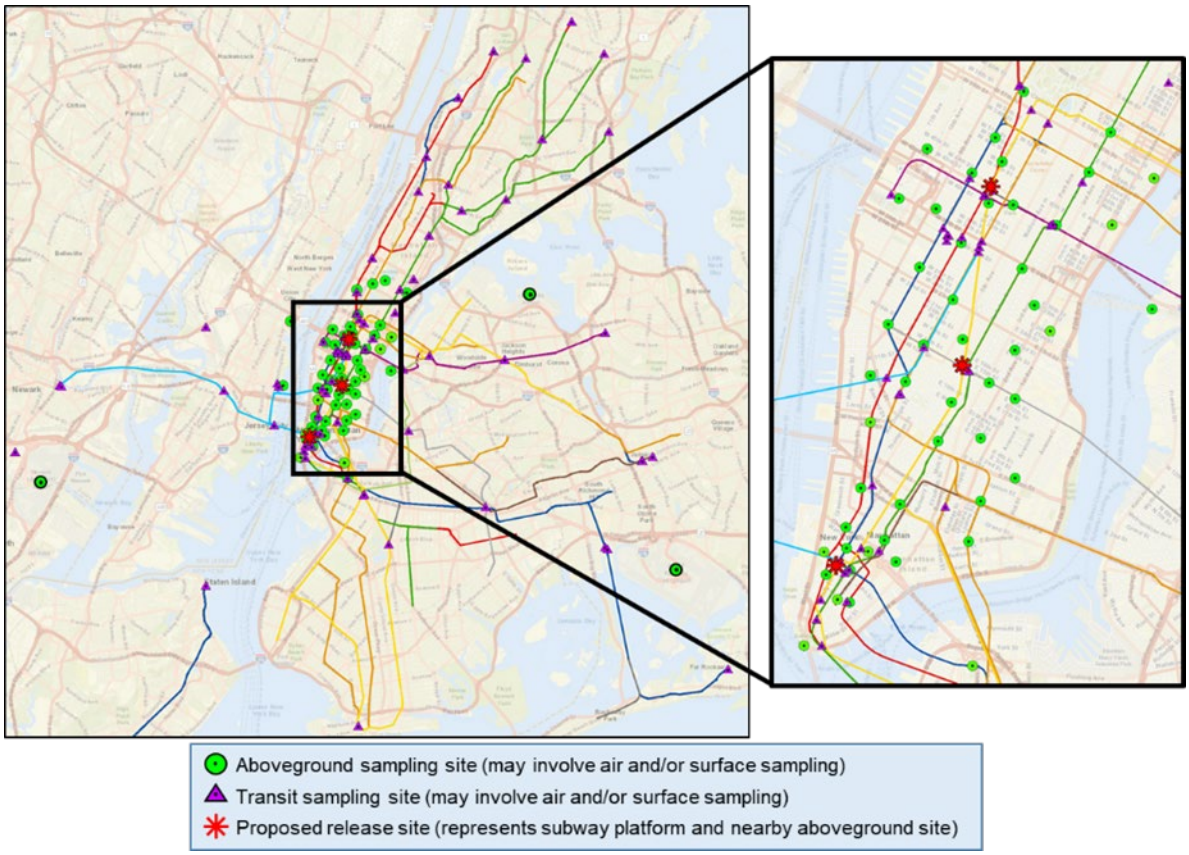

Figure 2: Map of release and sampling locations during dispersion measurements (some listed sites may be excluded). Red stars indicate potential tracer release locations and each represent both a subway platform site and a nearby co-located aboveground site.

Mobile equipment and samplers would be used to collect particle measurements. Images of all equipment is provided in Figure 3. Portable Sampling Units (PSUs) weigh 113 pounds (lbs), are approximately 5’ × 25” × 16” (H×W×D) in size and require electrical power (110 Volts). Approximately 40-60 devices are planned for use across both CBT and UTD programs. Dry Filter Units (DFUs) weigh 42 lb, are approximately 15” × 13” × 13” in size and require electrical power (110 Volts). Approximately 60 devices are planned for use across both CBT and UTD programs. The DFUs may be outfitted with a custom modification to enable automated sequential collection of samples. The E-SEQ-FRM is a commercially-available sequential sampling unit, weighs 45 lb, are approximately 30” × 25” × 24” in size, and requires electrical power. Up to three devices are planned for use.

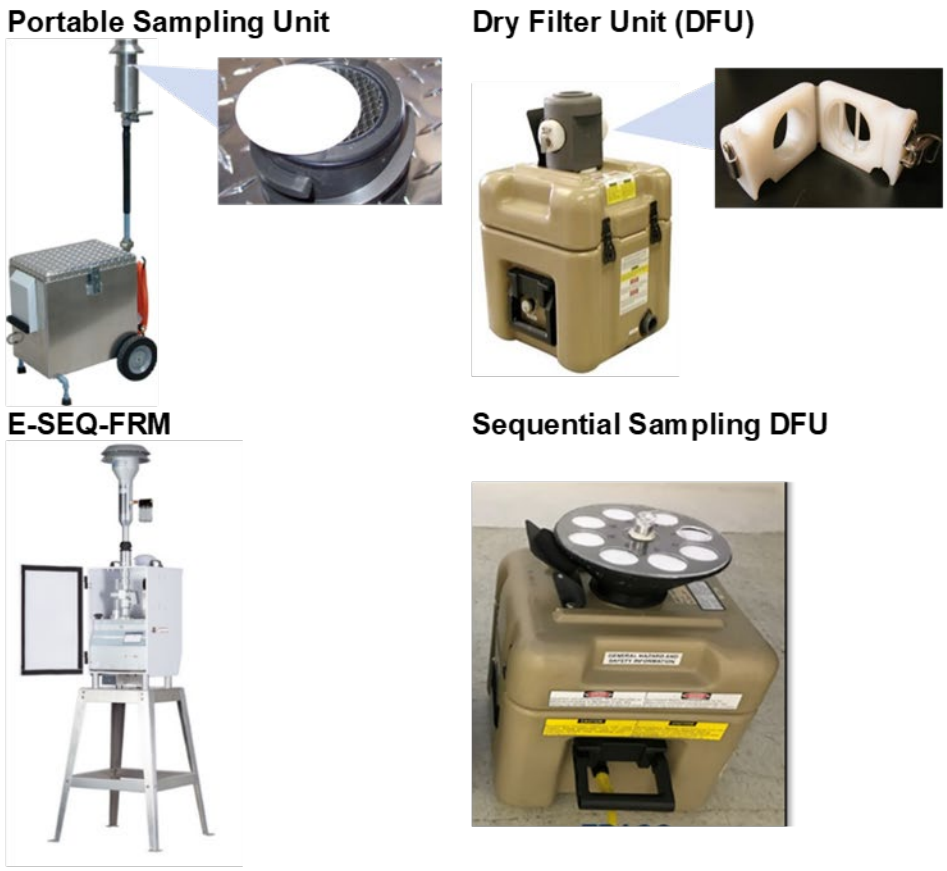

Figure 3. Photographs of particle tracer measurement equipment. A Portable Sampling Unit (PSU) is shown on the top left. A standard Dry Filter Unit (DFU) is shown on the top right. Inserts show the filter housings in both cases. A commercial sequential sampling unit, the E-SEQ-FRM, is shown on the bottom left. A custom DFU modified to collect sequential filter samples is shown on the bottom right.

Other equipment, including up to 25 portable particle counters and 10 cascade impactors may be placed near the release sites for real-time particle counts. Particle counters and cascade impactors would be locked in place and plugged into outlets for power. Aluminum coupons and collection wafers would be placed on the ground at 25 – 50 locations both in the subway and at aboveground sites. Equipment would be put in position the day of testing and removed at the end of each day of testing. No physical changes would take place to station or outdoor locations where materials are located.

Mobile equipment would be used to collect gas samples. Images of all equipment is provided in Figure 4. Approximately 100-150 gas samplers would be temporarily located at measurement locations during testing. In the case of UTD, the gas samplers can be locked in place using a chain (and may be mounted onto fences or lightpoles) and pedestrian traffic would remain unimpeded. No permanent physical changes would take place to stations or outdoor locations from the use of gas bag samplers. The majority of gas samples would be collected from the air

using gas bag or sorption tube samplers (Brookhaven Atmospheric Transport Samplers, BATS II, Figure 4). The gas bag samplers are custom made portable devices that weigh approximately 15 lbs, are 16” × 10” × 12” in size, and are battery powered. The sorption tube samplers are custom made portable devices that weigh approximately 20.5 lbs, are 16” × 8” × 12.6” in size, and are battery powered. The LESS-I devices are also small sequential sorption tube sampling devices and would be used primarily for CBT.

In addition, approximately 10 portable gas sensors would be placed in stations near the release for real-time gas concentration measurements. Gas sensors would be locked in place and plugged into outlets for power. Units would be put into position the day of testing and removed at the end of each day of testing. No physical changes would take place to station or outdoor locations where gas sensors are located.

Figure 4. Photographs of gas tracer measurement equipment. The Brookhaven Atmospheric Transport Samplers (BATS II) are shown on the left, and a gas bag sampler is shown in the center, and a LESS-I sequential sorption tube sampler is shown on the right.

2.1.4 Particle Tracer Test Options

Six particle tracer test options (P1-P6) are being considered to complete the Proposed Action. A combination of test options P1-P5 would be needed to meet the objectives and need of the Proposed Action.

There are regulations in place regarding occupational exposure to respirable material over an 8-hour work day (i.e., set by OSHA and other international occupational safety organizations), environmental air pollution (i.e., set by the EPA), minimum concentrations resulting in observed health impacts (i.e., set by the ACGIH), and ingestion (i.e., set by the Food and Drug Administration [FDA]). These guidelines and regulatory limits were assessed for comparison purposes in order to contextualize the relative safety and risk of using these materials in the described amounts. More details are provided in Section 3.4 of this EA.

2.1.4.1 DNATrax-OB (P1)

The first particle test option (P1) is to aerosolize DNA oligonucleotides (oligos) encapsulated in maltodextrin particles (referred to as "DNATrax") and tagged with an Optical Brightener (OB). DNATrax (i.e., DNA oligos encapsulated inside maltodextrin) was developed by Lawrence Livermore National Laboratory (LLNL) for food labeling and has been classified by the FDA as Generally Recognized As Safe (GRAS). DNATrax-OB was previously used as a particulate tracer in the MTA NYCT subway system during revenue hours as part of the 2016 UTR program with no reported adverse effects (see Section 3.4 of this EA).

The primary component, maltodextrin, is already used in food and drink products including beer, protein shakes, and sweeteners such as Splenda. The optical brightener, Fluorescent Brightener 220, is used in several consumer products such as laundry detergent and paper production. The DNA oligo sequences, although selected from natural sources, are very short (<200 base-pairs in length) do not produce proteins and are considered to be safe (See Appendix A). In addition, DNA is already ubiquitous in the environment and is produced by all living matter. P1 would enable direct comparison of the results of the Proposed Action with results from the 2016 UTR test.

2.1.4.2 DNATrax-Silica (P2)

The second particulate test option (P2) is to aerosolize P1 attached to amorphous silica particles (without optical brightener added). Particulate P2 would be referred to as DNATrax-Silica. DNATrax-Silica was previously used as a particle tracer in the MTA NYCT subway system during revenue hours as part of the 2016 UTR program with no reported adverse effects (see Section 3.4 of this EA). Amorphous silica, the primary component in P2, is used as an anti-caking agent and a carrier for liquid active ingredients in human and animal nutrition. P2 would enable direct comparison of the results of the Proposed Action with results from the 2016 UTR test.

2.1.4.3 STAMP (P3)

The third particle test option (P3) is to aerosolize DNA oligos encapsulated in calcium alginate particles. P3 is referred to as STAMP (Safe Tunable Alginate Microparticle). STAMP was developed by Massachusetts Institute of Technology Lincoln Laboratory (MIT LL) for use as an advanced particle simulant in tracer studies. An SDS for STAMP is provided in Appendix A. The surface of the STAMP particles can be functionalized in order to modify particle properties to better mimic biological agents of concern, or to enable detection of the particles by diverse sensor technologies. For the Proposed Action, STAMP particles may by functionalized with fluorescent dyes such as CFDye-amines or a protein such an antibody. In this case, the antibody recognizes a mouse protein. Based on the small quantities being used, none of these components present a significant risk to human health.

Sodium alginate, the primary precursor of test option P3, is a polysaccharide isolated from brown algae that is used as a thickening agent in the food industry (e.g., in ice cream and jellies), as a wound dressing, as an inactive ingredient in pharmaceutical products, and as an impression-making material for prosthetics or in dentistry[4]. Sodium alginate forms a hydrogel in the presence

of calcium, so STAMP particles do not dissolve in water (although they are biodegradable)[4]. This property of the STAMP particles enhances the ability to track and measure their persistence in the environment over time, an important goal of this development effort and test.

The primary goal of P3 is to enable simultaneous challenge of different sensor technologies in the CBT program (for example, fluorescence-based sensors, antigen-based sensors, and DNA-based sensors). This enables end-to-end evaluation of sensor architectures, which is critical to achieve the goals of the CBT program. Use of P3 is also planned during UTD testing in a more limited scope, with the goal being to evaluate the properties and effectiveness of STAMP relative to the better-characterized test options P1 and P2 and to better understand particle persistence in the environment.

2.1.4.4 DNA-Silica Liquid Mixture (P4)

The DNA-Silica liquid mixture consists of many of the same components present in test options P1-P3, but involves aerosolization of these components as a liquid mixture using a nebulizer. P4 would consist of amorphous silica, short non-coding DNA oligonucleotides, fluorescent dyes such as CFdye-amines or Fluorescent Brightener 220, salt, glycerol, and the same antibody discussed for P3. A key difference in P4 compared to P1-P3 is that the different components are not physically coupled to one another, with no defined geometry between the components. Rapid evaporation of the aerosolized liquid results in production of dry droplet nuclei that contain the different components. P4 accomplishes many of the same testing objectives for the Proposed Action as P3, but is less preferred since the components are not physically coupled. P4 is being considered in this EA to provide flexibility due to its relative ease of production and scalability.

2.1.4.5 Visolite (P5)

Visolite is a polydisperse, commercially-available fluorescent powder commonly used as an air tracer in leak tests. The powder consists primarily of calcium carbonate with an associated propriety fluorescent resin. Because of the fluorescent resin, Visolite can be detected specifically and in real-time in the background environment using UV-laser induced fluorescence (UV-LIF). Since some of the sensor technologies being evaluated in CBT are UV-LIF sensors, Visolite would enable testing of a subset of sensors under evaluation, thereby meeting only some of the purpose and need of the Proposed Action. Visolite could also be used to evaluate the effectiveness of mitigation/response strategies that rely on filtration or removal of particulates from the air. Use of P5 in combination with Options P1-P4 would be required to meet the full scope of the Proposed Action.

2.1.5 Gas Tracer Test Options

Three gas tracer test options (G1-G3) are being considered to complete the Proposed Action. G2 meets the purpose and need of the Proposed Action.

2.1.5.1 Sulfur Hexafluoride (G1)

The first gas test option (G1) is to use sulfur hexafluoride alone. Sulfur Hexafluoride (SF_6) is a biologically inert, colorless, odorless gas. It has been widely used as an airflow tracer for several decades in indoor and outdoor studies alike, including subway releases in Washington, DC (2007, 2008)[5] and Boston, MA (2009, 2010, and 2012)[6] as well as aboveground releases in mid-town Manhattan during UDP (2005)[7].

Because of its stability and high dielectric constant, SF_6 is primarily used as an insulating gas by the electric power industry. Due to its use in electric substations, urban areas in the U.S. have considerable fugitive emission sources. An unfortunate consequence of the fugitive emissions is that elevated background levels of SF_6 may compromise the tracer measurements. The value of using SF_6 as a tracer is that its infrared signature permits detection in real time using portable infrared gas analyzers. Even in the presence of significant background levels, the real-time measurement capability would be invaluable for monitoring the concentration levels in stations near the release point during the tests and for obtaining high time-resolution data.

2.1.5.2 Perfluorocarbon Tracers (G2)

The second gas test option (G2) is to use up to six PFTs in addition to SF_6. Four PFTs (PDCB, PMCH, mPDCH, and PMCP) would be used for the bulk of the testing, while iPPCH and PTCH may be used for additional smaller-scale testing. All PFTs are inert, odorless, and colorless. They are fully fluorinated (saturated with fluorine), and are extremely stable, chemically and physically. One result of their extreme stability is that they have few commercial uses and therefore their background concentration in the atmosphere is extremely low[8]. This permits very small amounts of the tracers to be detected. Because of this low background, PFTs have been used as airflow tracers for decades[9], including subway studies in Washington, DC, Boston, MA, and NYC.

2.2 No Action Alternative

Under the No Action Alternative the proposed testing of bio- and chemical detection and mitigation/response technology and measurements of tracer dispersion would not happen. The No Action Alternative would not help to increase the resilience of urban areas and transportation networks against chemical and biological threats and thus does not meet the purpose and need of the Proposed Action. The No Action Alternative is carried forward for analysis in this EA to provide a comparison of baseline conditions to the Proposed Action, as required by the CEQ NEPA implementing regulations.

Section 3. Affected Environment and Environmental Consequences

This chapter describes the existing environment for resource areas that may be affected by the Proposed Action and the No Action Alternative, and the potential environmental consequences associated with these alternatives. Resource areas analyzed include soil resources; water resources; biological resources; hazardous waste and materials; cultural and historic resources; air quality; noise; human health and safety; socioeconomics; environmental justice; and land use and infrastructure.

The affected environment summarizes the current physical, biological, social, and economic environments of the area within and surrounding the Proposed Action. For each resource area, the bounds of the area for analysis that could be impacted by the Proposed Action and No Action Alternative are broadly defined, and the elements or components of the resource area that may be potentially affected are described. For many of the resource areas potentially affected by the alternatives, the area of analysis is confined to the test area.

The analysis of environmental consequences for each resource area begins by explaining the methodology used to characterize potential impacts, including any assumptions made. The impacts analysis considers how the condition of a resource area would change as a result of implementing each of the alternatives and describes the types of impacts that would occur (e.g., direct, indirect, beneficial, adverse). The EA analysis also considers environmental trends and other past, present, and reasonably foreseeable activities relevant to the Proposed Action area. The terms “impacts” and “effects” are used interchangeably in this chapter.

3.1 Test Site Overview

Particle and gas test options P1-P5 and G1-G2 would be disseminated in open-air releases in several locations in the MTA NYCT subway system and several aboveground locations in Manhattan. Because a key goal of the Proposed Action is to evaluate sensor and mitigation/response technology performance under realistic operational conditions with train and passenger movement, the public would be present for some of the testing.

3.2 Geology, Soils, Topography and Geological Hazards

Geological resources consist of the surface and subsurface materials that make up the Earth’s crust. Within a land area, these resources are described with the study of geology, soils, and topography. In the U.S., geologists separate geologically similar areas into physiographic provinces. Provinces are grouped based on similarities between landforms’ physical features and processes, and their relation to geologic structures, terrain, sediment, history, and rock types. Information about an area’s physical features and processes can identify important aspects of the land’s structural integrity, capacity for construction, and potential for geologic hazards. The prevalence of geologic hazards is based on the forces that act on geological resources. These hazards pose a threat to human safety and the built environment; examples include erosion, earthquakes, landslides, and sinkholes.

NYC is located on the eastern Atlantic coast, at the mouth of the Hudson River. It is made of five boroughs separated by various waterways. Brooklyn and Queens occupy the western portion of Long Island, while Staten Island and Manhattan are completely on their own land mass. Bronx, to the north, remains attached to the New York State mainland. The geological history of NYC is long and includes several formations, most notably those of bedrock and remnants of glacial activity. The soil as described by the Natural Resource Conservation Service is primarily a fine-loamy, mixed, active mesic Glossic Hapludalfs. The topography of New York City is very diverse but has been substantially altered through construction activity. Several fault lines reside under NYC and sedimentation and erosion are present.

The test options P1-P5 and G1-G2 would have no impact on these resources as activities would occur in an already-existing transit location and urban area with no potential to disturb existing topography or geology. Therefore, there would be no significant effects to topography or geology as a result of the Proposed Action. Under the No Action Alternative, the proposed testing would not occur. Therefore, there would be no changes to these resources and no significant effects under the No Action Alternative.

3.3 Land Use and Planning

Land use refers to classifications that indicate the types of human activity occurring on a parcel of land. A predominant factor affecting land use is compliance with local zoning ordinances. Other relevant factors include existing land use and the types of land use on adjacent properties. Land use changes occur regularly throughout the U.S. and have potential negative impacts to the human environment depending on its classification change and scope. In some cases, land use may have positive impacts to the human environment, such as habitat restoration or reclaiming previously contaminated lands for development. Utilities and infrastructure are crucial components of the human environment.

This section describes the potable water supply, sanitary sewer and wastewater treatment, stormwater management, electricity and natural gas supply, waste management, and fencing and security features at the site.

NYC is an urban environment comprised of residential, commercial, and industrial land use classifications with recreational areas such as parks and playgrounds located throughout. The area has been heavy impacted by construction activities and maintains an infrastructure to support more than 8 million people. As the Proposed Project is utilizing existing transportation infrastructure, a change of land use is not expected. The Proposed Action would occur during operational hours and the public may be present, but would not impact public transportation access or use. While testing may require the use of an electrical outlet, there would be no appreciable increase on the city's electric system or capacity. Use of potable water, sanity sewer and wastewater infrastructure, natural gas, waste management, or additional security would not be required. Therefore, there would be no significant effects to land use or infrastructure overall under the Proposed Action.

Under the No Action Alternative, the proposed testing would not occur. Therefore, there would be no changes to these resources. There would be no significant effects under the No Action Alternative.

3.4 Public Health and Safety

Public health and safety are largely a matter of adherence to regulatory requirements outlined by the OSHA and local police, fire, and medical services. The OSHA standards specify the amount and type of safety training and education required for industrial workers, the use of protective equipment and clothing, engineering controls, and maximum permissible exposure limits to contaminants, with respect to workplace stressors like air, noise, and spilled pollutants (29 C.F.R. Part 1910). In order to adhere to OSHA regulations, employers typically have internal processes and procedures in place to protect the safety of employees, contractors, and the public. Employers must review potentially hazardous workplace conditions; monitor exposure to workplace chemical, physical, and biological agents, and ergonomic stressors; and recommend and evaluate controls to ensure exposure to personnel is eliminated or adequately controlled. Additionally, employers are responsible for ensuring a medical surveillance program is in place to perform occupational health physicals for those workers subject to the use of respiratory protection, engaged in work that involves hazardous waste, asbestos, lead, or other activities requiring medical monitoring.

This section discusses the evaluation for all human health and safety effects related to the Proposed Action. The public would be exposed to very low concentrations of particulate and gas associated with the test options. Exposures may include inhalation, ingestion, and dermal contact. Additional contact may occur following testing due to the potential for re-aerosolization of the particulate material due to air movement within the subway station. The population during rush hours is expected to be largely comprised of healthy working adults, but young, aged or immune-deficient or immune-compromised riders are also expected to be present during testing (perhaps at higher frequencies than usual due to the ongoing COVID-19 pandemic). A discussion of the anticipated maximum concentration of tracer exposure will first be discussed. The individual environmental consequences of each individual gas and particulate will then be discussed. Impacts to the overall public human health and safety from the Proposed Action would be less than significant.

Both particulate test options P1 and P2 were previously released in the MTA NYCT subway system during revenue hours in 2016 as part of the UTR program. Release amounts were similar to those proposed for use in the upcoming Proposed Action. MTA NYCT records absenteeism information for their Rapid Transit Operations (RTO) which include those who work on or near trains as they operate in the system. Figure 5 shows absenteeism data from January 1, 2016 to Octoberober 1, 2016, a period which includes the 2016 UTR tracer releases. The vertical dashed lines indicate the week of tracer testing. There were no significant increases in the total amount of RTO absenteeism the week of tracer testing (or in the following weeks after). There were also no reported health complaints from MTA NYCT employees during this period. This anecdotal data suggests that release of DNATrax-OB, DNATrax-Silica, or PFTs (P1 and P2 and gas test option G2) did not have negative health impacts on workers in the transit system.

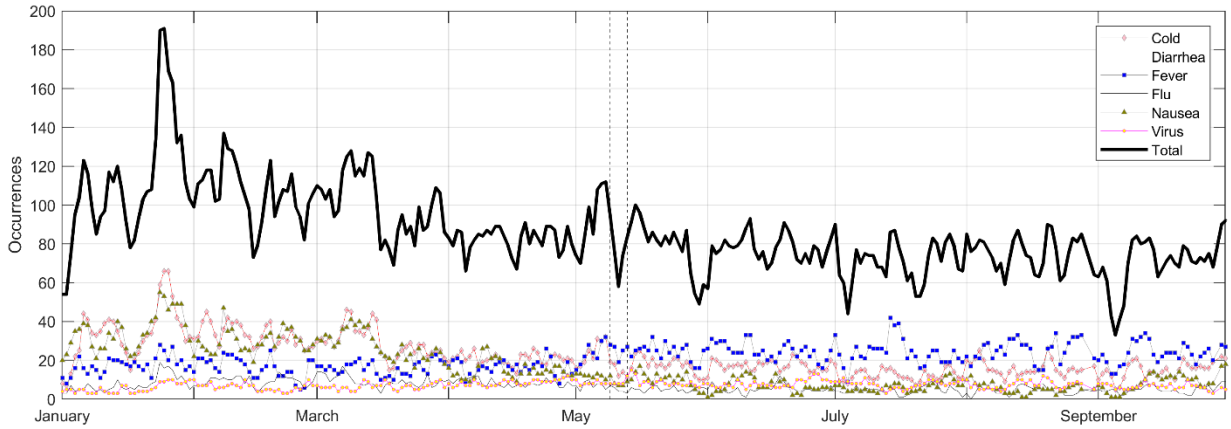

Figure 5. Total occurrences of Rapid Transit Operations worker absences due to individual categories (i.e., cold, diarrhea, fever, flu, nausea, and virus). Vertical dashed lines have been provided to indicate the first and last days of the UTR tracer test in May 2016. The tracers released included DNATrax-OB and DNATrax-Silica-OB (P1 and P2) as well as the PFT gas tracers PDCB, PMCH, and mPDCH (G2).

A particle tracer very similar to P4 was released in transit vehicles while test personnel were present as part of the 2021 Viral Phenomenology program[2]. There were no reports of adverse effects during this test event.

3.4.1 Particulate Test Options (P1-P5)

The evaluation of public health and safety consequences of each individual gas and particle test option is discussed below.

Based on the maximum release amounts described in Section 2 for UTD, the maximum amount of particle tracer material released (either within a station or aboveground) over fifteen minutes, 8 hours, and 24 hours is 20, 40, and 60 grams, respectively. Maximum release amounts for the CBT effort over these same durations are expected to be lower, even given the possibility of four releases per day (Table 2). The majority of released material would be in the respirable particle range of 1 – 10 µm. For all particulate test options, a 10 foot radius controlled zone would be established around the release site using construction cones and security tape. The release sites would be manned by test personnel, but no access for the general public would be permitted within this zone while the release occurs. The material would be directed into the airspace to be rapidly mixed, minimizing exposure of any one individual to tracer materials.

Table 5 presents measurements from previous similar test efforts as well as computer modeling results using the ANL Below Ground Model (BGM) in order to predict the particle concentrations near the release site. Several OSHA and ACGIH exposure limits are also provided for reference. Measurements from previous releases and modeling results updated for the current Proposed Action indicate particle concentrations that are 1 – 2 orders of magnitude lower than the established permissible exposure limits (for an 8-hour average exposure).

Table 5. Estimated Mass Concentrations from Computer Modeling and Measured Mass Concentrations from Subway Particulate Measurements

Particle	Release Size	Release Location	Details	15-min PM10*	1-hr PM10	3-hr PM10	8-hr PM10
B. subtilis mix ¥	18.7 g (burst)	Boston subway	Non-revenue (no train)	1.25	0.39	0.13	0.05
B. subtilis mix ¥	42 g (burst)	Boston subway	Non-revenue (1 train arrival)	0.64	0.24	0.08	0.03
Silica mix ¥	146 g (16 g/min)	NYC subway	Non-revenue (1 train arrival)	0.20	0.19	0.06	0.02
Silica mix ¥	65 g (7.2 g/min)	Boston subway	Non-operational (no train)	0.62	0.28	0.12	0.04
Silica mix ¥	55 g (5 g/min)	Boston subway	Non-operational (no train)	0.65	0.24	0.10	0.04
Urea/OB ¥	30 g (1.5 g/min)	Boston subway	Revenue hours	0.70	0.44	0.20	0.08
Pure OB ¥	30 g (1.5 g/min)	Boston subway	Revenue hours	0.70	0.44	0.20	0.08
PSL microspheres ¥	1 g (0.05 g/min)	Boston subway	Revenue hours	0.07	0.035	0.012	0.0045
DNA-Tagged Carrier (Option P1) ¥	20 g (1 g/min)	NYC GC 456 Platform	Revenue hours	0.154	0.04	0.013	0.005
DNA-Tagged Carrier (Option P1) ¥	20 g (1 g/min)	NYC Times Sq 123 Platform	Revenue hours	0.677	0.22	0.07	0.03
DNA-Tagged Carrier (Option P1) ¥	20 g (1 g/min)	NYC Penn St 123 Platform	Revenue hours	0.544	0.14	0.05	0.02
DNA-Tagged Carrier**	20 g (1 g/min)	Times Sq (123 platform)	Revenue hours	0.320	0.11	0.035	0.027
DNA-Tagged Carrier**	20 g (1 g/min)	Times Sq (outdoors)	Revenue hours	0.100	0.03	0.011	0.008
DNA-Tagged Carrier**	20 g (1 g/min)	Union Sq (456 platform)	Revenue hours	0.320	0.11	0.035	0.027
DNA-Tagged Carrier**	20 g (1 g/min)	Union Sq (outdoors)	Revenue hours	0.100	0.03	0.011	0.008
DNA-Tagged Carrier**	20 g (1 g/min)	WTC (Oculus Trans. Hub)	Revenue hours	0.450	0.15	0.049	0.037
DNA-Tagged Carrier**	20 g (1 g/min)	WTC (outdoors)	Revenue hours	0.100	0.03	0.011	0.008

¥ Measurements from previous tracer tests
*** Below Ground Model results*
** Reported as the mass concentration (mg/m^3)*
The following regulatory limits are provided for comparison: OSHA Nuisance Dust PEL = 5 mg/m^3; ACGIH Nuisance Dust TLV = 3 mg/m^3; OSHA Amorphous Silica PEL = 0.8 mg/m^3

3.4.1.1 DNATrax-OB (P1)

Test Option P1 is to aerosolize DNA oligonucleotides (oligos) encapsulated in maltodextrin particles (referred to as "DNATrax") and tagged with an Optical Brightener (OB). DNATrax was developed by Lawrence Livermore National Laboratory (LLNL) for food labeling and has been classified by the FDA as Generally Recognized As Safe (GRAS). DNATrax is listed as a nuisance dust on its SDS (provided in Appendix A). The DNA oligos enable sensitive and specific detection and quantification of the particles in the environment using molecular biology techniques. The Optical Brightener has been added to make tracer discrimination easier for real-time biological trigger sensors utilizing fluorescence techniques. Safety information for DNATrax-OB components is summarized below. DNATrax, and specifically DNATrax-OB, has been used for tracer testing in public spaces, including the MTA NYCT subway system, previously with no recorded negative health impacts (Figure 5).

Maltodextrin (CAS # 9050-36-6) is a polysaccharide produced from starch that is often used as a food additive and has FDA Generally Recognized as Safe (GRAS) approval for ingestion. The maltodextrin SDS lists the OSHA PEL as 5 mg/m^3 (respirable fraction)[10]. Maltodextrin is characterized as a nuisance dust and is not known to have adverse effects on the lungs[10].

The incorporated DNA sequences originate from harmless bacteria that live near hot springs. The DNA sequences are inert, non-living, and have been verified as dissimilar from other known biological sequences. Environmental DNA is already ubiquitous in byproducts (e.g., skin, hair, urine) from all organisms; therefore there is no additional impact or burden placed on the environment from use of the material.

Several toxicology studies have been performed on Fluorescent Brightener 220 (CAS # 16470-24-9) and related optical brighteners [11,12]. These materials are generally not irritating to skin and eyes. Toxicity studies of this brightener and a related compound in rats and other mammals observed no fatalities or signs of toxicity via ingestion at a range of doses [13,14,15]. Several inhalation toxicity studies have also been conducted in rats using closely related Fluorescent Brighteners. No mortality was observed, although temporary reductions in overall health were observed at the highest attainable concentrations [16,17]. Animals appeared healthy during the 14 days following exposure and had normal weight gains. Finally, a review of toxicity studies for three optical brighteners, including CI Fluorescent Brightener 220, carried out by the German Institute for Consumer Health Protection and Veterinary Medicine[18] also concluded that they pose no risk to consumers.

The DNATrax-OB particles would have a mass median aerodynamic diameter (MMAD) between 1 – 10 µm, which is considered respirable. The DNATrax-OB particles (including the primary component maltodextrin) are not listed explicitly by OSHA; therefore, it is assumed classified as "Particulates Not Otherwise Regulated." At a minimum, it would be required to remain under the designated 8-hour PEL of 5 mg/m^3. The ACGIH recently established a Threshold Limit Value of 3 mg/m^3 for respirable particles. The ACGIH designation applies only to particles that do not dissolve in water (maltodextrin readily dissolves in water), but to be conservative, the lower

ACGIH mass concentration is in full compliance. As shown in Table 5, the maximum concentrations encountered after particle releases are significantly lower than the established limits by OSHA and ACGIH for particles not otherwise regulated. Option P1, consisting of maltodextrin, CI Fluorescent Brightener 220 and the DNA oligos is not anticipated to present a significant risk to human health and safety.

3.4.1.2 DNATrax-Silica (P2)

The second particulate test option (P2) is to aerosolize P1 attached to amorphous silica particles (but without addition of optical brightener). Particulate P2 will be referred to as DNATrax-Silica. Safety information for DNATrax-Silica is summarized below. P2 has been used for tracer testing in public spaces, including the MTA NYCT subway system, previously with no recorded negative health impacts (Figure 5).

Amorphous silica, (CAS # 007631869) the primary component in P2, is used as an anti-caking agent (e.g., dried eggs), filler for the rubber industry, and a carrier for liquid active ingredients in human and animal nutrition. Amorphous silica is found naturally in dust from microscopic marine plant fossil skeletons (i.e., diatomaceous earth). One of the major problems with assessing the health effects from amorphous silica is contamination from crystalline silica[19]. Crystalline silica can cause several negative human health effects such as silicosis, tuberculosis, chronic bronchitis/chronic obstructive pulmonary disease (COPD) and lung cancer. However, all amorphous silica that is proposed for use would be synthetically manufactured, avoiding contamination with crystalline silica. No silicosis has been found in the epidemiological studies involving workers with long-term exposure to intentionally manufactured Synthetic Amorphous Silica (SAS)[19]. In addition, long-term animal inhalation experiments exposed to high concentrations of amorphous silica (> 10 mg/m^3) showed no obvious pathology[19]. No adverse changes were observed in Wistar rats exposed to three different types of respirable SAS particles[20].

A variety of products containing silica are considered safe. Silica gels are considered GRAS when used as anti-foaming agents[21]. Silicon dioxides are considered GRAS as substances migrating from paper and paperboard products used in food packaging[22]. In 2018, the FDA updated silicon dioxide as a food additive permitted for direct addition to food for human consumption[23].

As discussed above, maltodextrin is a polysaccharide produced from starch that is often used as a food additive and has FDA Generally Recognized as Safe (GRAS) approval for ingestion. The maltodextrin SDS (provided in Appendix A) lists the OSHA PEL as 5 mg/m^3 (respirable fraction)[10]. Maltodextrin is characterized as a nuisance dust and is not known to have adverse effects on the lungs[10].

The incorporated DNA sequences originate from a harmless bacteria that are found near hot springs. The DNA sequences are inert, non-living, and verified as dissimilar from other known biological sequences. Environmental DNA is already ubiquitous in byproducts (e.g., skin, hair,

urine) from all organisms; therefore, there is no additional impact or burden placed on the environment from use of the material.

Amorphous silica is regulated by OSHA and would be required to remain under the designated 8-hour respirable PEL of 0.8 mg/m^3. Amorphous silica is not listed by the ACGIH; therefore, it is assumed designated as “particles not otherwise specified (PNOS)” and would need to remain under the established Threshold Limit Value (TLV) of 3 mg/m^3 for respirable particles. As shown in Table 5, the maximum concentrations encountered after particle releases would be well below the established limits by OSHA and ACGIH. Amorphous silica and the DNA oligos are not anticipated to present a significant risk to human health and safety.

3.4.1.3 STAMP (P3)

The third particulate test option (P3) is to aerosolize DNA oligos encapsulated in calcium alginate particles (referred to as STAMP). The STAMP particles may also be functionalized with fluorescent dyes (such as CFDye-amines) and/or a protein such as an antibody. The fluorescent dyes are being used to allow detection of the particles by fluorescence-based biosensors, while the antibody may be used to enable detection by a different class of sensor technology that may be included in the CBT testing.

STAMP was developed by MIT LL for use as an advanced particle simulant in tracer studies. This particle has not been used in previous tracer tests and is proposed for use in a more limited scope relative to P1 and P2. Maximum amounts of STAMP to be released during UTD testing from a particular location over twenty minutes, 8 hours and 24 hours are 10, 20, and 30 grams, respectively. Maximum amounts are expected to be less than this for CBT (Table 2). Safety information for STAMP is summarized below, and an SDS is provided in Appendix A.

The precursor for STAMP particles is sodium alginate, which is a polysaccharide isolated from brown algae (SDS provided in Appendix A). Sodium alginate is a particularly useful material because it forms a gel under mild conditions in the presence of calcium, independent of temperature. As a result, it is a common additive to food products as a thickener and emulsion stabilizer. Alginate is also used in pharmaceutical applications because of its ability to encapsulate and increase the stability of cargoes[4]. Both calcium alginate and sodium alginate (CAS # 9005-35-0 and 9005-38-3, respectively) are classified as GRAS by the FDA for oral administration in a variety of food products [24,25]. A number of studies have concluded that there are no adverse toxicological effects from oral administration of alginates [26,27,28].

Alginate also has excellent biocompatibility, especially in the case of highly purified preparations. Studies evaluating the impact of alginate injections or implants in mammals show little to no evidence of inflammatory responses, especially when highly purified preparations are used[29,30]. Highly purified, food-grade alginate is commercially available and is being used for STAMP production. Because gelation of STAMP particles is achieved using calcium, the particles are expected to dissolve in the presence of molecules that bind to calcium, many of which are present in the body[29.] Because of its biocompatibility, alginate is used in a variety of biomedical and pharmaceutical applications. Alginate-encapsulation of drugs and therapeutics can increase

the stability of these compounds in the body, and chemical modification of the alginate can be used to modify gel stability and regulate the timing of drug release[30,31]. Of note, alginate itself does not inherently interact with mammalian cells, and mammalian cells do not have specific receptors for alginate. Modification of the alginate with specific functional groups is required to enable efficient interaction of particles with human cells[29].

The ability to modify the properties of alginate particles to confer new properties is also a key advantage of STAMP as a particle tracer, since it enables functionalization of the particles to enable detection by different sensor modalities. As mentioned above, in addition to encapsulating non-coding DNA oligonucleotides, the STAMP particles may be modified with fluorescent dyes (such as CFDye-amines) and/or a protein such as an antibody. The safety of non-coding DNA sequences in particle air tracers was discussed above for P1 and P2. As was the case for P1 and P2, the DNA sequences included in STAMP (P3) do not encode a functional product. In this case, the DNA sequences are randomly generated and screened to ensure that they are inert and dissimilar from other DNA sequences in publicly available databases such as Genbank. The fluorescent tags chosen for inclusion (CFdye-amines or related functionalized CFdyes) are considered safe and are commonly used in fluorescent labeling studies. The antibody selected for use is commercially available, recognizes a mouse protein, and is produced in goats. The antibody would be coupled to the STAMP particles via a biotin-streptavidin connection. Highly purified biotinylated versions of the antibody are commercially-available.

The STAMP particles would have a mass median aerodynamic diameter (MMAD) between 1 – 10 µm, which is considered respirable. None of the components of STAMP are listed explicitly by OSHA or by ACGIH, and would therefore be required to remain under the requirements for "Particulates not Otherwise Regulated" (an 8-hour TWA PEL of 5 mg/m^3 for OSHA and a TLV of 3 mg/m^3 for ACGIH). The SDS also mentions an aspiration hazard due to the potential for sodium alginate crosslinking following respiration. This hazard is alleviated for the STAMP particles since the alginate is already in a crosslinked form. In any case, at the release amounts proposed in Table 3, the maximum concentration of STAMP encountered after a release would be well below the most conservative exposure of 3 mg/m^3 set by ACGIH.

3.4.1.4 DNA-Silica Liquid Mixture (P4)

Test option P4 contains many of the same constituents as discussed above, including amorphous silica, short non-coding DNA oligonucleotides, fluorescent dyes such as CFdye-amine or Fluorescent Brightener 220, salt, glycerol, and the same antibody discussed for P3. As discussed above, planned maximum amounts would remain well below OSHA limits for amorphous silica and ACGIH limits for PNOS. Salt and glycerol may be added to Option P4 in order to tune the size of evaporated droplet nuclei after release. Both salt and glycerol are common ingredients in many food products and have received a GRAS rating from the FDA.

3.4.1.5 Visolite (P5)

There are no major health concerns related to open air releases of Visolite (P5). Visolite is commonly used for HVAC testing and leak testing and is commercially available. The primary

constituents of Visolite include calcium carbonate (0-100% by weight), magnesium carbonate (1-5% by weight), amorphous silica (0.1-5% by weight), and a proprietary copolymer resin (10-30% by weight). According to the ACGIH, Visolite is characterized as a Particle Not Otherwise Specified with a 3 mg/m^3 8-hour TWA threshold limit value (TLV). OSHA has specific 8-hour TWA limits for one of the minor components of Visolite (magnesium carbonate), with a PEL of 15 mg/m^3. As shown in Table 5, maximum release amounts would be well below these limits.

3.4.2 Gas Test Options (G1-G2)

As stated earlier, the maximum amount of gas to be released from a particular location over ten minutes, 8 hours, and 24 hours are 1, 2, and 3 kilograms, respectively for SF_6, and 0.5, 1.0, and 1.5 kilograms for the PFTs (Table 4). Based on the concentrations observed during previous tracer release tests (for example, during subway testing in Boston AND during the S-SAFE test in NYC)[1], the expected concentrations in NYC for the proposed upcoming tracer test would be well within the established limits.

Table 6 provides gas concentrations measured near the release points during the 2016 UTR test. The PFTs shown in Table 6 are not always exactly the same as those considered in this EA but provide a useful indicator of the likely maximum PFT concentrations immediately at the release point. Results have been adjusted based on the release amounts proposed in Table 4.

The Acceptable Air Concentration (AAC) for PFTs are indicated as appropriate. Measured tracer concentrations were generally well below the established limits in all cases. Average PFT concentrations at aboveground release points would be expected to be significantly lower than those reported for subway platforms due to more rapid dilution in the surrounding environment.

Table 6. Observed Gas Tracer Concentrations during UTR Study (MTA NYCT)

Tracer Gas	Average ppmv (15-min)	Average ppmv (30-min)	Average ppmv (8-hr*)
PMCH	3.1	2.1	0.01
PDCB	1.9	1.3	Not measured
mPMCH	1.8	1.1	Not measured
AAC Limit	*9.0*	*Not applicable*	*3.0*

**Based on 3-hour exposure measurements*

3.4.2.1 Sulfur hexafluoride (G1)

Gas test option G1 involves the release of SF_6 alone (CAS # 2551-62-4). The OSHA PEL and the ACGIH TLV for SF_6 are 1,000 ppm for an 8-hour TWA. These limits were established to prevent oxygen displacement (i.e., to prevent asphyxia) rather than because of chemical toxicity. It is evident from Table 6 that the maximum concentrations likely to be encountered in this study

are far below the established limits. In addition, SF_6 has been released in subways in Washington, DC, and Boston, MA, many times without adverse effects.

SF_6 is a potent greenhouse gas in comparison to carbon dioxide. See discussion below.

3.4.2.2 Perfluorocarbon tracers (G2)

The second gas test option (G2) is to use up to six PFTs in addition to SF_6. Four PFTs (PDCB, PMCH, mPDCH, and PMCP) would be used for the bulk of the testing, while iPPCH and PTCH may be used for additional smaller-scale testing. The CAS numbers for all gas tracers are provided in Table 4. All PFTs are inert, odorless, and colorless, are extremely chemically stable, and have been used as airflow tracers for decades [9]. Their background concentration in the atmosphere is extremely low [32]. This permits very small amounts of the tracers to be detected. Being extremely stable chemically also makes perfluorocarbon compounds biologically inert and therefore suitable for a wide range of medical applications such as blood extenders or blood substitutes[33], wound healing[34], eye surgery[35,36], equipment sterilization, imaging[37], liquid breathing[38,39,40,41], and organ storage.

Both SF_6 and the PFTs are potent greenhouse gases compared to carbon dioxide. However, the relative contributions to global warming are small compared to the primary anthropogenic sources: carbon dioxide, methane, and nitrogen oxide due to the very low amount of SF_6 and PFTs in the atmosphere[42]. The relative contribution to global warming potential from the tracer gases described in this document is often measured in terms of Greenhouse Warming Potential (GWP). This is defined as the time-integrated radiative forcing of a tracer substance relative to the same mass of reference gas (usually taken as CO_2)[43]. The GWP of SF_6 is 23,600 [9]. The GWP of the particular PFTs proposed for this study are not published, but can be conservatively estimated as 10,000 based on the acceptance range of GWP for PFTs as 1,000 – 10,000[44]. Using these GWPs for the tracers, the upper bound is estimated at 268 MTCDE (Metric Tons Carbon Dioxide Equivalent). The release mechanisms (metered cylinder or metered evaporation, Figure 1) enable accurate quantification and control of release amounts.

The amount of PFTs that would be released in this study (PFTs: 10 kg) is a minuscule fraction of the industrial emissions of these gases. Assuming the maximum release amounts considered in Table 3 the tracers have a GWP of only 0.0005% (1 out of 200,000) of the total PFTs and SF_6 released in the U.S. in 2008 and only 0.008% of the GWP from fugitive SF_6 emissions in NYC in 2008 alone [9].

Because perfluorocarbons are not known to cause adverse health effects, even at high concentrations, no OSHA PEL, ACGIH TLV, or Acute Exposure Guideline Level (AEGL) have been established. For S-SAFE, a 15-min Acceptable Air Concentration (AAC) limit of 9 ppm and an 8-hr limit of 3 ppm were established[45] for the PFTs. These thresholds were based on the known toxicity profile of cyclohexane, which is an industrial solvent, not an inert perfluorocarbon compound. Nevertheless, based on the maximum observed concentrations near the PFT release locations in prior Boston, MA, and NYC subway tests, the concentrations near the PFT

release locations in this study should be below the 15-min AAC limit, and 1-2 orders of magnitude lower than the AAC 8-hr limit [1].

3.5 Socioeconomics

The analysis of socioeconomic impacts identifies those aspects of the social and economic environment that are sensitive to changes and that may be affected by activities associated with the Proposed Action. Socioeconomic factors describe the local demographics, income characteristics, and employment of the region of influence.

3.5.1 Executive Order 12898, Environmental Justice

The EPA defines environmental justice with a goal of "fair treatment" to identify potential disproportionately high and adverse impacts to minority communities and low-income communities and identify alternatives to address any adverse impacts as defined in EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*. For purposes of assessing environmental justice under NEPA, the CEQ defines a minority population as one in which the percentage of minorities exceeds 50 percent or is substantially higher than the percentage of minorities in the general population or other appropriate unit of geographic analysis (CEQ, 1997). A low-income population is defined as a Census tract (CT) with a median household income lower than the poverty threshold. A CT usually covers a contiguous area, and its boundaries usually follow visible and identifiable features (e.g., road, river). CTs were designed to be relatively homogeneous units with respect to population characteristics, economic status, and living condition.

According to the U.S. Census Bureau, the estimated population of NYC in 2014 was 8.1 million people. Based on data from 2014, land usage is a mixture of single- and multi-family residential use (39%), open space/recreation (27%), transportation/utility (8%), commercial (7%), industrial (4%), and other (15%)[46]. There are 1,585,873 people living in Manhattan, 48% non-Hispanic White, 25.4% Hispanic, 12.9% non-Hispanic black, 11.2% non-Hispanic Asian, and 0.1% non-Hispanic American Indian[47]. The average New Yorkers is female (52%) and between the ages of 19-64 (61%). The majority (68%) of people in NYC rent their homes, with the median household income being $60,762 and 19% of the population living in poverty.

Areas in and around NYC do contain areas with potential environmental indicators according to the EPA's Environmental Justice Screening Tool EJSCREEN. These indicators are not necessarily surprising for a dense urban area and include diesel exposure, cancer risk, respiratory hazard, traffic proximity, lead paint exposure, superfund proximity, hazardous waste proximity, and wastewater discharge indicators. Importantly, many of these areas are distributed throughout the city and would not be expected to be disproportionately affected by any of the activities in the Proposed Action.

With respect to health effects from particulate tracers, the small quantity of material proposed for release in the Proposed Action would result in upper bound concentrations (i.e., next to release site) that are well under the established limits by OSHA and ACGIH (See Section 3.4). In general, however, testing in the greater NYC area means testing in an environment that is

extremely diverse in terms of land use and demographics. Of note, the results of this test have the potential to positively impact and increase the safety of all public transit riders. While environmental justice communities may be present or reside within the proposed project area, no disproportionately high or adverse impacts on low-income populations or minority populations are anticipated from the Options P1-P5 and G1-G2. Therefore, there would be no significant effects to environmental justice communities under the Proposed Action.

Under the No Action Alternative, the proposed testing would not occur. Therefore, there would be no changes to the existing socioeconomic environment or any disproportionate high and adverse impacts on environmental justice communities. There would be no significant effects under the No Action Alternative.

3.6 Air Quality

This section describes the ambient NYC outdoor, mass transit bus, and subway air quality. The Proposed Action is anticipated to have little to no additional impact on air quality, which is already characterized by high particulate concentrations. Therefore, impacts to air quality from the Proposed Action would be less than significant. A brief summary is provided below, with more details provided in two prior EAs[1,2].

Under the No Action Alternative, the proposed testing would not occur. Therefore, there would be no effect on air quality. There would be no significant effects under the No Action Alternative.

3.6.1 NYC Metropolitan Outdoor Air Quality

Outdoor air quality in NYC has historically been poor and the city estimates that 6 percent of the city's annual deaths are attributable to air pollution[48]. The Clean Air Act, last amended in 1990, required the EPA to develop National Ambient Air Quality Standards (NAAQS) for particulate matter with a diameter below 10 μm (PM_{10}) and 2.5 μm ($PM_{2.5}$). NAAQS define primary standards, which protect the health of "sensitive" populations such as asthmatics, children, and the elderly. In addition, NAAQS define secondary standards which protect against decreased visibility and damage to animals, crops, vegetation, and buildings. The NYC Community Air Survey (NYCCAS) reported annual average $PM_{2.5}$ concentrations for 2016 that range from 4.5 – 16.8 $\mu g/m^3$ depending on the measurement location, with the highest concentrations recorded in Manhattan. These 2016 levels represent an average 28 percent decline in $PM_{2.5}$ levels compared to 2009, but still remain above the primary and secondary NAAQS standards[49]. Outdoor PM_{10} levels in NYC have remained steady for the same time period, averaging 60 $\mu g/m^3$ for 2005 – 2011[50] and are well below NAAQS standards. NYC continues to work towards reducing particulate emissions and meeting national standards.

3.6.2 Subway Indoor Air Quality

This section describes the characteristic background particulate matter found in air/surface samples in several transit environments. It should be emphasized that passenger entrances, ventilation shafts, and tunnels allow for a large exchange of air with the outside environment.

Airborne particulate mass concentrations have been previously measured at several subway systems around the world. Airborne particulate mass concentrations were almost always significantly higher inside subway stations than ambient air outside of the stations[51,52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70]; generally by at least a factor of four. Significant mass concentration variations were measured between different subway systems, and between stations[71], seasons[53,57,72,73], and time of day[73,70] for the same city. Real-time background particle concentration data gathered as a part of the 2016 UTR study indicated high background levels of particles in the Grand Central (>100,000 ppl for particles 0.52 – 2.13 μm diameter) and Times Square (>50,000 ppl for particles 0.52 – 2.13 μm diameter) stations in NYC[74].

The elevated mass concentration values in the subway are thought to be influenced by passenger activity, floor cleaning, station depth, date of construction, ventilation rate, proportion of frictional to regenerative braking, train frequency, wheel type (rubber vs. steel), and the presence or absence of platform-edge doors and/or air-conditioning in subway cars and stations[59,63]. Analysis has been conducted on collected particulate samples to determine the constituent materials. Iron oxides (e.g., Fe_3O_4, Fe_2O_3) make up the majority of subway particulate mass (e.g., 64 – 71 percent in London subway [54]). Airborne iron is primarily attributed to wear debris from the subway car wheel-rail interface and braking (contributed 15 percent total mass [75]).

Other metals found in elevated percentages to the outdoors were chromium (present in steel), manganese (present in steel), copper (present in current collector shoes rubbing against conductor rail), zinc (vehicular traffic), and barium (present in some brakes [51]). Steel, manganese and chromium were found to be more than 100 times higher in the NYC subway system than outdoors [61]. Carbon-rich particles are generally found, attributed to carbon inclusion in steel, oils, and human debris (e.g., clothes fibers, hair, skin) [62,55,51]. Other non-metals found were silica quartz (e.g., 7.2 percent in Washington, DC), attributed to concrete (i.e., construction, degradation) [62], and chlorides [55,64,73] attributed to the use of road salts for de-icing. Fluorescent particles have been reported at <1 percent of total particle counts [64].

A 2015 NYC subway system sampling campaign examined the types of microorganisms found within stations[76]. The findings suggest a rich and diverse background of microorganisms in the subway environment. Hundreds of organisms classified as bacterial, viral, archaeal, and eukaryotic taxa were found in the subway; however, most organisms were considered harmless. There were several *Bacillus* species found within the subways, with the most abundant being *B. cereus* (some strains of which can cause foodborne illness).

3.7 Noise

Noise can be transmitted or continuous, steady or impulsive, and can involve any number of sources and frequencies. It can be easily identifiable or generally nondescript. Although human response to noise varies, measurements can be calculated with instruments that record instantaneous sound levels in decibels (dB). The dB is a logarithmic unit that expresses the ratio of a sound pressure level to a standard reference level. A-weighted decibels (dBA) characterize

sound levels that can be sensed by the human ear. “A-weighted” denotes the adjustment of the frequency range to what the average human ear can sense when experiencing an audible event. The threshold of audibility is generally within the range of 10 to 25 dBA for normal hearing. The threshold of pain normally occurs in the region of 135 dBA (USEPA, 1981).

Existing noise within NYC results from ongoing construction activities, vehicular traffic, and air traffic. None of the equipment or personnel due to implementation of the Proposed Action would generate loud noises that would increase existing noise levels. Noise due to equipment would not exceed 82 dBA at any test site and would be well-below this level for any release site not requiring generator power. Therefore, the Proposed Action would result in no significant impact to the existing noise environment.

Under the No Action Alternative, the proposed testing would not occur. Therefore, there would be no effect on the existing noise environment. There would be no significant effects under the No Action Alternative.

3.8 Hydrology and Water Resources

Hydrology is the study of how water naturally distributes and circulates. Water resources consist of the use and quality of both groundwater and surface water, floodplains, and wetlands. Water quality refers to the chemical and physical composition of water, usually in respect to its suitability for a particular purpose, such as drinking.

NYC is located within the 02030201 and 02030202 hydrological unit codes and contains many jurisdictional waters and wetlands subject to the Clean Water Act. Areas determined to be floodplains and coastal zone exist within NYC, especially along waterfront and coastal areas. According to the New York Department of Environmental Conservation (NYDEC), the Long Island Aquifers under the city are among the most productive aquifers in the U.S. Additionally, NYC drinking water supply system is the largest unfiltered water supply in the United States. It provides approximately 1.2 billion gallons of high-quality drinking water to nearly one-half the population of New York State every day.

Test options P1-P5 and G1-G2 would have no impact on these resources as activities would occur in an already existing transit location and urban area; therefore, there would be no significant impacts associated with the Proposed Action. Under the No Action Alternative, the proposed testing would not occur. Therefore, there would be no changes to these resources and no significant effects under the No Action Alternative.

3.9 Biological Resources

3.9.1 Threatened or Endangered Species

Biological resources at the proposed Project Site may include vegetation, wildlife, and special status species. The Migratory Bird Treaty Act of 1918 (MBTA) (16 U.S.C. § 703 *et seq.*) protects migratory birds. Other laws that protect terrestrial and avian special status species include the Endangered Species Act of 1973 (ESA) (16 U.S.C. § 1531 *et seq.*), the Bald and Golden Eagle

Protection Act of 1940 (BGEPA) (16 U.S.C. § 668 *et seq*.) and species protected by the State of New York. Together, these resources form the ecological character of a given site.

Four threatened and endangered species (piping plover, red knot, roseate tern, and seabeach amaranth) reside within the county but are all coastal species, and are not anticipated to be present in the subway system or in midtown Manhattan close to the planned release locations, as the appropriate habitat does not exist in these areas. Any tracer materials that disseminate to appropriate habitats would be expected to be at vanishingly low concentrations. Therefore, there would be no effect on threatened and endangered species from the proposed testing and consultation with the USFWS is not required. There would be no significant effects to threatened or endangered species under the No Action Alternative.

3.9.2 Vegetation, Wildlife, and Aquatic Resources

Other urban wildlife including birds, coyotes, deer, rodents, fish, reptiles, and amphibians are present in NYC. While urban wildlife and their habitat may be present in the proposed project area, no effect is anticipated on wildlife, given the relatively low quantities and non-toxicity of the materials.

New York is home to many animal and plant species and their habitat. The potential for exposure of terrestrial wildlife to the particulate materials was evaluated due to movement of the material with the air vented from the station, or due to aboveground releases.

DNATrax-OB (P1) would not impact the surrounding environment. The primary component, maltodextrin, is already used extensively in several food and drink products commonly found in Manhattan. The DNA oligos are safe and are comprised of the same four nucleotides as all other DNA (uniqueness comes from differences in sequence)[77]. The specific sequences being used do not code for functional products and would be made to look distinctly different from known pathogens that are searched for within the DHS BioWatch air sampling program. The fluorescent brightener used with DNATrax (i.e., fluorescent brightener 220) is used in several commercial products found commonly in Manhattan (paper, clothing). It has been tested extensively on animals and has presented little to no risk. The OB is soluble in water and is removed by >75% to >95% through adsorption from sewage with direct photolysis a second elimination process (half-life for the OB on surface water is 3.9 – 5.2 hours)[78]. OB acute toxicity levels are known for fish (*Brachydanio rerio*; 96 h-LC_0 > 1,000 mg/L), daphnia (*Daphnia magna*; 48 h-EC_0 ≥ 113 mg/L), and algae (*Scenedesmus subspicatus*; 96 h-EC_{50} > 1,000 mg/L). There would be less than 100 g of OB released over the duration of all proposed tests. Toxicity levels for daphnia (the lowest toxicity level) would only be exceeded if the entire OB supply were deposited in a water reservoir containing 601.8 liters (~ 4 bathtubs of water).

DNATrax-Silica (P2) would not impact the surrounding environment. The primary component, amorphous silica, is found naturally in marine plant fossil skeletons and is already used extensively in several products commonly found in Manhattan such as toothpaste, anti-caking agents (e.g., dried eggs) and carriers for liquid active ingredients in human and animal nutrition.

STAMP (P3) would not impact the surrounding environment. The primary component, alginate, is found in algae and used as a thickening agent in the food industry (e.g., in ice cream and jellies), as a wound dressing, as an ingredient in pharmaceutical products, and as an impression-making material for prosthetics or in dentistry. Extensive toxicity studies have been conducted on different salt forms of alginate in a variety of different animal and human models, resulting in an Acceptable Daily Intake (ADI) designation of "Not Specified," which is reserved for very low toxicity materials[79]. While particles are not readily soluble in water, they are biodegradable and dissolve in the presence of molecules that remove the calcium ions from the alginate matrix and are expected to break down in the environment over time.

The components of P4 (DNA-Silica liquid mixture) have already been discussed above and are not expected to have an impact on wildlife. Visolite (P5) would also not affect the surrounding environment. The major constituents of Visolite are inorganic salts. Ecotoxicity studies conducted using rainbow trout, water fleas, and green algae did not observe any effects of these constituents at the highest dosages tested[80].

Likewise, release of both SF_6 (G1) and PFTs (G2) in the amounts detailed earlier would have no discernable impacts on wildlife due to the low concentrations that would be observed and the absence of toxic effects from the gas tracers. With respect to the gas test options, SF_6 is currently present at appreciable levels within the NYC environment from electric power substations. The proposed perfluorocarbons are not known to cause adverse health effects, even at high concentrations as discussed earlier.

Based on the discussion above, there would be no significant effects to wildlife or special-status species under the Proposed Action. Test Options P1-P5 and G1-G2 would similarly have no effect on vegetation or special plant species as testing would occur in an existing transit location in an urban area. Under the No Action Alternative, the proposed testing would not occur. Therefore, there would be no changes to these resources and no significant effects under the No Action Alternative.

3.9.3 Areas with Special Designation

According to the U.S. Fish and Wildlife Service's (USFWS) Information for Planning and Consultation, there is no critical habitat in the proposed project area. Therefore, there would be no impact and no significant effects to areas with special designation from implementation of the Proposed Action. Under the No Action Alternative, the proposed testing would not occur. Therefore, there would be no changes to these resources and no significant effects under the No Action Alternative.

3.10 Cultural Resources

3.10.1 Historic Properties

This section describes the current setting for cultural resources and evaluates the potential effects to cultural resources as a result of the Proposed Action. Cultural resources, while not defined in statute or regulation, are generally inclusive of historic properties as defined by the National Historic Preservation Act of 1966 (NHPA) (54 U.S.C. § 300101 *et seq*.) cultural items as defined by the Native American Graves Protection and Repatriation Act of 1990 (NAGPRA) (25 U.S.C. § 3001 *et seq*.); archaeological resources as defined by the Archaeological Resources Protection Act of 1979 (ARPA) (16 U.S.C. § 470aa *et seq*.); sacred sites as defined by Executive Order 13007, *Indian Sacred Sites*; and collections and associated records as defined by 36 C.F.R. Part 79.

Cultural resources are associated with human use of an area. They may include archaeological sites, historic properties, or locations of ethnographic interest associated with past and present use of an area. A cultural resource can be physical remains, intangible traditional use areas, or an entire landscape encompassing past cultures or present, modern-day cultures. Physical remains of cultural resources are usually referred to as archaeological sites or historic properties. Cultural resources of significance to Native American tribes can include archaeological resources, structures, prominent topographic features, vegetation, animal species, and minerals that Native Americans consider essential for the preservation of traditional culture. Cultural resources that are listed in or eligible for listing in the National Register of Historic Places (NRHP) are known as historic properties.

Almost 7,000 National Register of Historic Places (NRHP) listed properties and 116 National Historic Landmarks as reported by the National Park Service and one World Heritage Site as designated by the United Nations Educational, Scientific and Cultural Organization are present within NYC. Additionally, the NYC vicinity and surrounding area has been inhabited by Native Americans for thousands of years and many sites remain which may have cultural significance.

Consideration was given to the potential effects of the Proposed Action on any known cultural resources or historic properties. Many of the stations in the NYC subway system are listed on the NRHP. Of the specific stations mentioned previously, the Times Square subway station and Union Square subway station are both listed in the NRHP. The Grand Central subway station is not listed, although the aboveground terminal is listed. On August 6, DHS S&T presented this finding in a consultation letter to the New York State Historic Preservation Office (SHPO) consistent with Section 106 of the National Historic Preservation Act and 36 CFR Part 800. On August 12, 2021, the New York SHPO issued written concurrence. A copy of the correspondence is provided in Appendix B and C, respectively. For the reasons discussed below, the Proposed Action would have no effect on these historical locations.

There would be no ground disturbing activities or need to permanently affix equipment to any structures or walls within subway stations. The placement and use of testing equipment would not result in visual or audible impacts given the temporary nature of the activity. The tracer

materials used for testing would also have no direct or indirect effect to any contributing features of any historic properties. As such, the Options P1-P5 and G1-G2 would have no effect on historic properties. Therefore, there would be no significant effects to historic properties under these Options.

Under the No Action Alternative, the proposed testing would not occur. Therefore, there would be no effects on existing cultural resources or historic properties and there would be no significant effects under the No Action Alternative.

3.11 Hazardous Materials and Wastes

Hazardous materials and wastes are physically hazardous and include combustible and flammable substances, compressed gases, and oxidizers. Health hazards are associated with materials that cause acute or chronic reactions, including toxic agents, carcinogens, and irritants. In addition to being a threat to humans, the improper release or storage of hazardous materials, hazardous wastes, and petroleum products can threaten the health and well-being of wildlife species, habitats, soil and land use, and water resources.

For this analysis, the terms hazardous waste, hazardous materials and toxic substances include those substances defined as hazardous by the Comprehensible Environmental Response, Compensation, and Liability Act (CERCLA) (i.e., superfund), Resource Conservation and Recovery Act (RCRA), and the Spill, Prevention, Control and Countermeasures (SPCC) Rule under the Clean Water Act. In general, they include substances that, because of their quantity, concentration, or physical, chemical or toxic characteristics, may present a danger to public health or welfare or the environment when released into the environment. Regulated substances include the storage, transportation, handling, and use of hazardous materials, as well as the generation, storage, transportation, handling, and disposal of hazardous wastes. The purpose of CERCLA, often referred to as Superfund, is to clean up contaminated sites so that public health and welfare are not compromised. RCRA provides for “cradle to grave” regulation of hazardous wastes. An SPCC Plan can be developed, if required, to outline the methods and procedures established to minimize the potential for spills and discharges into waterways from the facility.

NYC is home to sites subject to CERCLA and RCRA and contains many areas where hazardous materials and waste are present. Equipment used to generate releases and collect samples during the Proposed Action would be properly stored before and during use before being returned to the laboratory where they would be cleaned and evaluated for reuse. All sampling waste generated during sample collection (e.g., gloves, filters) would be disposed of according to regulations. Release amounts are so small that no large amount of visible residual material is anticipated to be present after test events. Test sites would be cleaned to remove any visible residual material, if present. Real-time measurement equipment would enable confirmation that aerosol levels have returned to baseline following each test. None of the materials brought to the stations are RCRA regulated hazardous waste.

Test Options P1-P5 and G1-G2 would have no impact on these resources as activities would occur in an existing transit location and urban area. As a result, there would be no significant

effects from the Proposed Action due to hazardous materials and waste. Under the No Action Alternative, the proposed testing would not occur. Therefore, there would be no effects on these resources and no significant effects under the No Action Alternative.

3.12 Impacts from Past, Present, and Reasonably Foreseeable Actions

This section analyzes the impact to the human environment which results from the incremental impact of the Proposed Action Alternative and No Action Alternative when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions. These impacts can result from individually minor, but collectively significant, actions taking place over a period of time.

There are numerous projects occurring in NYC that may require environmental analysis and public input. Past, ongoing and reasonably foreseeable actions in the area would be primarily associated with the maintenance of supporting infrastructure such as roadways and utility systems as well as residential housing and commercial districts. It is assumed these actions, in addition to a myriad of others including scientific research, development, testing, and evaluation, would continue in the future. Unless within the DHS S&T mission and determined to be a major federal action, DHS S&T has no ability to prevent future non-federal foreseeable actions due to its limited statutory authority for projects that would occur regardless of the Proposed Action.

The impact on the environment which would result from the incremental impact of the Proposed Action, when added to other past, present, and reasonably foreseeable future actions have been considered. Resource areas analyzed include soil resources; water resources; biological resources; hazardous waste and materials; cultural and historic resources; air quality; noise; human health and safety; socioeconomics and environmental justice; and land use and infrastructure. Due to the selection of preferred test materials, the relatively limited quantity of materials to be released, and temporary nature of the Proposed Action, no effects are anticipated on noise, water resources (surface water, ground water, floodplains, wetlands), geology, soils or topography, vegetation, air quality, biological resources, cultural resources and historic properties, socioeconomic; and environmental justice communities; therefore no significant effects would occur. Land use and the infrastructure would not be significantly affected as the proposed testing would not alter any existing land use designations and test sites would not be accessible to the public. By aiding in evaluation and testing of chemical and biological defense technologies, the Proposed Action would have a beneficial impact on human health and safety. The Proposed Action Alternative would result in no significant effects when considered with other recent past, ongoing, or reasonably foreseeable future actions in the project area.

Under the No Action Alternative, the Proposed Action would not occur; therefore; there would be no significant impacts of the No Action Alternative in combination with other past, present or reasonably foreseeable actions in the proposed project area.

Section 4. Conclusions and Identification of the Proposed Action

As a result of the information presented within the EA, DHS S&T has determined there would be no significant impacts on the environment or human health, nor would there be any significant additive effects. The Proposed Action (Testing Location, Particle Options P1-P5, and Gas Options G1-G2) would enable realistic simulant/tracer dispersion and highly sensitive and specific measurements. The Proposed Action would allow for an evaluation of the effectiveness of different measures at reducing tracer levels in the air. Selection was based on the ease of material production, safety, and prior experience with similar materials. The No Action Alternative would not help to validate current particulate models and therefore does not meet the purpose and need of the Proposed Action.

Section 5. Persons and Agencies Contacted

New York State Historic Preservation Office
Peebles Island Resource Center
PO Box 189
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Section 6. List of Preparers

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The Honorable Charles E. Schumer
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The Honorable Gary Peters
Chairman, Homeland Security and Governmental Affairs Committee,
Ranking Member
Washington, DC 20510

The Honorable Rob Portman
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U.S. House of Representatives

The Honorable Bennie G. Thompson
Chairman
Committee on Homeland Security
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The Honorable John Katko
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The Honorable Lee Zeldin
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The Honorable Thomas Suozzi
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The Honorable Gregory W. Meeks
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The Honorable Grace Meng
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The Honorable Nydia M. Velázquez
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The Honorable Hakeem Jeffries
United States House of Representatives
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The Honorable Yvette D. Clarke
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The Honorable Jerrold Nadler
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The Honorable Alexandria Ocasio-Cortez
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The Honorable Adriano Espaillat
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The Honorable Ritchie Torres
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The Honorable Jamaal Bowman
United States House of Representatives
Washington, D.C. 20515

Appendix A: Safety Data Sheets

SAFETY DATA SHEET

Issuing Date 18-Sep-2014 **Revision Date** 18-Sep-2014 **Revision Number** 0

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND THE COMPANY/UNDERTAKING

GHS product identifier

Product Name **DNA Tagged Reagents for Aerosol Experiments**

Other means of identification

Synonyms DNATrax

Recommended use of the chemical and restrictions on use

Recommended Use No information available

Uses advised against No information available

Supplier's details

Supplier Address
Lawrence Livermore National Laboratory
7000 East Ave.
Livermore, CA 94550
TEL: 925-422-1100

Emergency telephone number

Emergency Telephone Number 925-422-1100

2. HAZARDS IDENTIFICATION

Classification

This chemical is not considered hazardous according to the OSHA Hazard Communication Standard 2012 (29 CFR 1910.1200).

GHS Label elements, including precautionary statements

Emergency Overview

The product contains no substances which at their given concentration are considered to be hazardous to health

Appearance White **Physical State** Solid/Powder. **Odor** Slightly sweet

Precautionary Statements

Prevention
- None

General Advice
- None

Storage
• None

Disposal
• None

Hazard Not Otherwise Classified (HNOC)

Not applicable

Other information
Dust contact with the eyes can lead to mechanical irritation.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Synonyms DNATrax

Chemical Name	CAS-No	Weight %
Maltodextrin	9050-36-6	99.9999
Non-Biological DNA	-	0.0001

4. FIRST AID MEASURES

Description of necessary first-aid measures

Eye Contact Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

Skin Contact Wash skin with soap and water. If skin irritation or rash occurs: Get medical advice/attention.

Inhalation IF INHALED: If breathing is difficult, remove to fresh air and keep at rest in a position comfortable for breathing. Get medical attention.

Ingestion Clean mouth with water and afterwards drink plenty of water. Do NOT induce vomiting. Get medical attention.

Most important symptoms/effects, acute and delayed

Most Important Symptoms/Effects None known

Indication of immediate medical attention and special treatment needed, if necessary

Notes to Physician Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Suitable Extinguishing Media
Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Unsuitable Extinguishing Media No information available.

Specific Hazards Arising from the Chemical
No information available.

Explosion Data
Sensitivity to Mechanical Impact None.
Sensitivity to Static Discharge None.

Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal Precautions	Ensure adequate ventilation. Avoid contact with eyes. Refer to Section 8 for personal protective equipment.

Environmental Precautions

Environmental Precautions	No special environmental precautions required. See Section 12 for additional Ecological Information.

Methods and materials for containment and cleaning up

Methods for Containment	Take up mechanically and collect in suitable container for disposal.
Methods for Cleaning Up	Clean contaminated surface thoroughly.

7. HANDLING AND STORAGE

Precautions for safe handling

Handling	Handle in accordance with good industrial hygiene and safety practice. Avoid contact with eyes.

Conditions for safe storage, including any incompatibilities

Storage	Keep containers tightly closed in a dry, cool and well-ventilated place.
Incompatible Products	Oxidizing agents.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Control parameters

Exposure Guidelines	This product does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies. Exposure limits to follow are those for nuisance particulates: ACGIH TLV TWA: 10 mg/m^3 of total dust OSHA PEL TWA: 15 mg/m^3 of total dust

Appropriate engineering controls

Engineering Measures	Showers Eyewash stations Ventilation systems

Individual protection measures, such as personal protective equipment

Eye/Face Protection	None required under normal usage. Risk of contact, wear: Safety glasses with side-shields.
Skin and Body Protection	None required under normal usage. Risk of contact: Protective gloves. Lightweight protective clothing.
Respiratory Protection	None required under normal usage. If exposure limits are exceeded or irritation is experienced, NIOSH/MSHA approved respiratory protection should be worn. Respiratory protection must be provided in accordance with current local regulations
Hygiene Measures	Handle in accordance with good industrial hygiene and safety practice.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical State	Solid/Powder	**Appearance**	White
Odor	Slightly sweet	**Odor Threshold**	No information available

Property	Values	Remarks/ - Method
pH	Not applicable	None known
Melting Point/Range	No data available	None known
Boiling Point/Boiling Range	Not applicable	None known
Flash Point	Not applicable.	None known
Evaporation rate	No data available	None known
Flammability (solid, gas)	No data available	None known
Flammability Limits in Air		
upper flammability limit	No data available	
lower flammability limit	No data available	
Vapor Pressure	No data available	None known
Vapor Density	No data available	None known
Specific Gravity	Not applicable	None known
Water Solubility	Soluble in cold and hot water	None known
Solubility in other solvents	No data available	None known
Partition coefficient: n-octanol/water	Not applicable	None known
Autoignition Temperature	No data available	None known
Decomposition Temperature	No data available	None known
Viscosity	Not applicable	None known
Flammable Properties	Not flammable	
Explosive Properties	No data available	
Oxidizing Properties	No data available	

Other information

VOC Content (%)	Not applicable.

10. STABILITY AND REACTIVITY

Reactivity

Not reactive under normal conditions.

Chemical stability

Stable under recommended storage conditions.

Possibility of hazardous reactions

None under normal processing.

Hazardous Polymerization

Hazardous polymerization does not occur.

Conditions to avoid

Ignitions sources - heat, sparks and open flames.

Incompatible materials

Oxidizing agents.

Hazardous decomposition products

None known.

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

Product Information

Inhalation	Inhalation of dust in high concentration may cause irritation of respiratory system.
Eye Contact	Dust contact with the eyes can lead to mechanical irritation.
Skin Contact	No known hazard in contact with skin.
Ingestion	Low order of toxicity based on components. No known hazard by swallowing. May cause gastrointestinal discomfort if consumed in large amounts.

Symptoms related to the physical, chemical and toxicological characteristics

Symptoms None known

Delayed and immediate effects and also chronic effects from short and long term exposure

Sensitization	No information available.
Mutagenic Effects	No information available.
Carcinogenicity	Contains no ingredients above reportable quantities listed as a carcinogen.
Reproductive Toxicity	No information available.
STOT - single exposure	No information available.
STOT - repeated exposure	No information available.
Aspiration Hazard	No information available.

Numerical measures of toxicity - Product

LD50 Oral >5000 mg/kg; (ATE)

12. ECOLOGICAL INFORMATION

Ecotoxicity

Contains no substances known to be hazardous to the environment or not degradable in waste water treatment plants.

Persistence and Degradability No information available.

Bioaccumulation No information available.

Other Adverse Effects

No information available.

13. DISPOSAL CONSIDERATIONS

Waste Disposal Methods This material, as supplied, is not a hazardous waste according to Federal regulations (40 CFR 261). This material could become a hazardous waste if it is mixed with or otherwise comes in contact with a hazardous waste, if chemical additions are made to this material, or if the material is processed or otherwise altered. Consult 40 CFR 261 to determine whether the altered material is a hazardous waste. Consult the appropriate state, regional, or local regulations for additional requirements.

Contaminated Packaging Do not re-use empty containers.

14. TRANSPORT INFORMATION

DOT Not regulated

IATA Not regulated.

IMDG/IMO	Not regulated.

15. REGULATORY INFORMATION

International Inventories

TSCA	Exempt
DSL	Exempt

Legend

TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

U.S. Federal Regulations

Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372.

SARA 311/312 Hazard Categories

Acute Health Hazard	No
Chronic Health Hazard	No
Fire Hazard	No
Sudden Release of Pressure Hazard	No
Reactive Hazard	No

Clean Water Act

This product does not contain any substances regulated as pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42).

CERCLA

This material, as supplied, does not contain any substances regulated as hazardous substances under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302) or the Superfund Amendments and Reauthorization Act (SARA) (40 CFR 355). There may be specific reporting requirements at the local, regional, or state level pertaining to releases of this material.

U.S. State Regulations

California Proposition 65

This product does not contain any Proposition 65 chemicals.

U.S. State Right-to-Know Regulations

This product does not contain any substances regulated by state right-to-know regulations.

U.S. EPA Label Information

EPA Pesticide Registration Number Not applicable

16. OTHER INFORMATION

NFPA	**Health Hazard** 1	**Flammability** 0	**Instability** 0	**Physical and Chemical Hazards** -
HMIS	**Health Hazard** 1	**Flammability** 0	**Physical Hazard** 0	**Personal Protection** X

Prepared By	Product Stewardship 23 British American Blvd. Latham, NY 12110 1-800-572-6501
Issuing Date	18-Sep-2014
Revision Date	18-Sep-2014
Revision Note	Initial Release.

General Disclaimer

The information provided on this SDS is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other material or in any process, unless specified in the text.

End of Safety Data Sheet

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Food and Drug Administration
College Park, MD 20740-3835

August 25, 2014

Anthony Zografos
DNA Trek
3997 Lyman Road
Oakland, CA 94602

via email: azografos@dnatrek.com

Re: Your Inquiry on DNATrax, ID system using small DNA sequences

Dear Mr. Zografos:

In response to your inquiry, dated July 14, 2014, about the regulatory status of DNATrax, our thinking on the status of DNATrax may be somewhat different from yours; however, the overall conclusion would be that the use of DNA in this fashion would meet GRAS (generally recognized as safe) criteria. Our understanding is that DNATrax utilizes small defined DNA segments of around 100 bases (you specifically mention the thermophilic bacterium Thermatoga maritima as one source of DNA in your submission) as identifiers that could be applied to fruit and vegetables to encode information that would identify the companies involved in the processing and distribution of the commodities.

In its Statement of Policy: Food Derived From New Plant Varieties (57 FR 22984, May 29, 1992), the agency stated the following:

> With respect to transferred genetic material (nucleic acids), generally FDA does not anticipate that transferred genetic material would itself be subject to food additive regulation. Nucleic acids are present in the cells of every living organism, including every plant and animal used for food by humans or animals, and do not raise a safety concern as a component of food. In regulatory terms, such material is presumed to be GRAS. Although the guidance provided in section VII. calls for a good understanding of the identity of the genetic material being transferred through genetic modification techniques, FDA does not expect that there will be any serious question about the GRAS status of transferred genetic material.

Consequently, based on its ubiquity in food, FDA concluded that nucleic acids themselves do not raise safety concerns. While this use of nucleic acids would be distinct from the use of genetic material in plant cells or other food cells, the inherent rationale would still apply. Moreover, the small size of the nucleic acids involved would not ordinarily be expected to remain intact after digestion or be biologically active.

Further, the carriers you describe would ordinarily also be considered GRAS, in fact, some have been affirmed as GRAS by the agency in years past (In Title 21 of the Code of Federal Regulations, maltodextrin is affirmed GRAS in section 184.1444, salt is mentioned in section 182.1(a) as a substance the Commissioner regards as safe for its intended use). Starches, while not specified in the regulations as direct food ingredients have a long history of use in foods and would meet history of common use in food criteria as discussed in the report of the Select Committee on GRAS Substances on uses of starches in packaging materials in 1979.

Based on these criteria, we conclude that the DNA and carriers and other substances used in DNATrax would be safely used as a tracer/identifier as described in the description dated June 12, 2014.

Sincerely yours,

Robert I. Merker -S

Digitally signed by Robert I. Merker -S
DN: c=US, o=U.S. Government, ou=HHS, ou=FDA, ou=People, 0.9.2342.19200300.100.1.1=1300070407, cn=Robert I. Merker -S
Date: 2014.08.25 08:16:00 -04'00'

Robert I. Merker, Ph.D.
Supervisory Consumer Safety Officer
Division of Biotechnology
and GRAS Notice Review
Office of Food Additive Safety
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SAFETY DATA SHEET
MANUGEL® GHB

SDS # : 8131058626-B
Revision date: 2015-05-29
Format: NA
Version 6.04

1. PRODUCT AND COMPANY IDENTIFICATION

Product Identifier

Product Name MANUGEL® GHB

Other means of identification

Product Code(s) 8131058626-B

Synonyms Sodium alginate: Algin (INCI name), alginic acid, sodium salt

Recommended use of the chemical and restrictions on use

Recommended Use: Foodstuff application

Restrictions on Use: See section 16 for more information

Manufacturer Address

FMC Corporation
1735 Market Street
Philadelphia, PA 19103
(215) 299-6000 (General Information)
msdsinfo@fmc.com (E-Mail General Information)

Emergency telephone number

For leak, fire, spill, or accident emergencies, call:
(800) 424-9300 (CHEMTREC - U.S.A. & Canada)
(703) 527-3887 (CHEMTREC - all other countries)

(207) 594-3200 (FMC Plant - Rockland, ME)
(303) 595-9048 (Medical - U.S. - Call Collect)

2. HAZARDS IDENTIFICATION

Classification

OSHA Regulatory Status

This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200)

GHS Label elements, including precautionary statements

EMERGENCY OVERVIEW

Warning

Physical Hazards
MAY FORM COMBUSTIBLE DUST CONCENTRATIONS IN AIR

Hazards not otherwise classified (HNOC)
Aspiration or inhalation of this product could cause chemical pneumonitis. Excessive inhalation of dust can mechanically impede respiration. Due to the hygroscopic properties of the gums, they can form a paste or gel in the airway.

Other Information
No information available.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical name	CAS-No	Weight %
Sodium alginate	9005-38-3	100

* The exact percentage composition has been withheld as a trade secret.

Synonyms are provided in Section 1.

4. FIRST AID MEASURES

Eye Contact — Flush eyes with water as a precaution. Get medical attention if eye irritation develops or persists.

Skin Contact — Wash with water and soap as a precaution.

Inhalation — Remove person to fresh air. If breathing is difficult or if discomfort occurs and persists, obtain medical attention.

Ingestion — Never give anything by mouth to an unconscious person. Drink plenty of water. Get medical attention if symptoms occur.

Most important symptoms and effects, both acute and delayed — Difficulty breathing. Cough.

Indication of immediate medical attention and special treatment needed, if necessary — Aspiration or inhalation of this product could cause chemical pneumonitis. Treatment is symptomatic and supportive.

5. FIRE-FIGHTING MEASURES

Suitable Extinguishing Media — Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

Unsuitable extinguishing media — None known.

Specific Hazards Arising from the Chemical — Avoid dust formation Fine dust dispersed in air, in sufficient concentrations, and in the presence of an ignition source is a potential dust explosion hazard.

Explosion data
Sensitivity to Mechanical Impact — Not sensitive.

Sensitivity to Static Discharge	Static electricity might be sufficient to ignite dust clouds. Possibility of ignition will depend on the minimum ignition energy (MIE) and the type of operations undertaken with the material. MIE values are not provided in this SDS.
Protective equipment and precautions for firefighters	As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions	Avoid dispersal of dust in the air (i.e., cleaning dust surfaces with compressed air.). Avoid breathing dust. Powder may become slippery when wet. For personal protection see section 8.
Other	For further clean-up instructions, call FMC Emergency Hotline number listed in Section 1 "Product and Company Identification" above.
Environmental Precautions	See Section 12 for additional Ecological Information.
Methods for Containment	Dust deposits should not be allowed to accumulate on surfaces, as these may form an explosive mixture if they are released into the atmosphere in sufficient concentration.
Methods for cleaning up	Sweep, vacuum or shovel into suitable containers for disposal. Nonsparking tools should be used. Washdown water is not recommended. Powder may become slippery when wet.

7. HANDLING AND STORAGE

Handling	Handle in accordance with good industrial hygiene and safety practice. Minimize dust generation and accumulation. Routine housekeeping should be instituted to ensure that dusts do not accumulate on surfaces. Dry powdered material can build static electricity when subjected to the friction of transfer and mixing operations. Provide adequate precautions, such as electrical grounding and bonding, or inert atmosphere. Ensure adequate ventilation. In case of insufficient ventilation, wear suitable respiratory equipment if release of airborne dust is expected.
Storage	Store at less than 20 °C, in tightly closed containers. Keep out of direct sunlight. Store in dry environment away from heat and sources of ignition, i.e., steam pipes, radiant heaters, hot air vents or welding sparks. Do not store with strong smelling materials.
Incompatible products	Oxidizing agents. Strong acids.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

This product, as supplied, does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies

Appropriate engineering controls

Engineering measures	It is recommended that all dust control equipment such as local exhaust ventilation and material transport systems involved in the handling of this product contain explosion relief vents or an explosion suppression or an oxygen-deficient environment. Use only appropriately classified electrical equipment and powered industrial trucks.

Individual protection measures, such as personal protective equipment

Eye/Face Protection	Safety glasses.
Skin and Body Protection	Minimize skin contamination by following good industrial hygiene practices. Use gloves if extended exposure is anticipated.
Hand Protection	Protective gloves

Respiratory Protection	If exposure limits are exceeded or irritation is experienced, NIOSH/MSHA approved respiratory protection should be worn. Positive-pressure supplied air respirators may be required for high airborne contaminant concentrations. Respiratory protection must be provided in accordance with current local regulations.
Hygiene measures	Handle in accordance with good industrial hygiene and safety practice.
General information	Protective engineering solutions should be implemented and in use. These recommendations apply to the product as supplied. If the product is used in mixtures, contact an appropriate protective equipment supplier or industrial hygienist for more information.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Appearance	Dry powder, Free flowing powder
Physical State	Solid
Color	White to yellowish-brown
Odor	No information available
Odor threshold	No information available
pH	~ Neutral , solution (1 %)
Melting point/freezing point	Not applicable
Boiling Point/Range	No information available
Flash point	Not applicable
Evaporation Rate	No information available
Flammability (solid, gas)	No information available
Flammability Limit in Air	
Upper flammability limit:	No information available
Lower flammability limit:	No information available
Vapor pressure	No information available
Vapor density	No information available
Density	No information available
Specific gravity	No information available
Water solubility	Soluble in water
Solubility in other solvents	No information available
Partition coefficient	No information available
Autoignition temperature	No information available
Decomposition temperature	No information available
Viscosity, kinematic	No information available
Viscosity, dynamic	No information available
Explosive properties	No information available
Oxidizing properties	No information available
Molecular weight	No information available
Bulk density	No information available
K_{st}	>0 bar m/s

10. STABILITY AND REACTIVITY

Reactivity	Not applicable
Chemical Stability	Stable under recommended storage conditions.
Possibility of Hazardous Reactions	None under normal processing.
Hazardous polymerization	Hazardous polymerization does not occur.
Conditions to avoid	Dust formation. Excessive heat. Humid air. Sparks.
Incompatible materials	Oxidizing agents. Strong acids.
Hazardous Decomposition Products	Burning produces obnoxious and toxic fumes: Carbon oxides (COx).

11. TOXICOLOGICAL INFORMATION

Product Information

Sensitization Not expected to be sensitizing based on the components.

Component Information

Chemical name	LD50 Oral	LD50 Dermal	LC50 Inhalation
Sodium alginate (9005-38-3)	>5 g/kg (Rat)	> 2,000 mg/kg (rabbit)	4.72 mg/l (1 h) (rat)

* No mortality was observed at the maximum attainable concentration.

Information on toxicological effects

Symptoms No information available.

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Chronic toxicity Product does not present a chronic toxicity hazard based on known or supplied information.
Mutagenicity No known mutagenic or teratogenic effects.
Carcinogenicity Contains no ingredient listed as a carcinogen.
Reproductive toxicity This product does not contain any known or suspected reproductive hazards.
STOT - single exposure None known.
STOT - repeated exposure None noted in chronic animal studies.
Aspiration hazard Aspiration may cause chemical pneumonitis. Excessive inhalation of dust can mechanically impede respiration.

12. ECOLOGICAL INFORMATION

Ecotoxicity

The environmental impact of this product has not been fully investigated.

Persistence and degradability Expected to biodegrade, based on component information.

Bioaccumulation Bioaccumulation is unlikely.

Mobility No information available.

Other Adverse Effects None known.

13. DISPOSAL CONSIDERATIONS

Waste disposal methods This material, as supplied, is not a hazardous waste according to Federal regulations (40 CFR 261). This material could become a hazardous waste if it is mixed with or otherwise comes in contact with a hazardous waste, if chemical additions are made to this material, or if the material is processed or otherwise altered. Consult 40 CFR 261 to determine whether the altered material is a hazardous waste. Consult the appropriate state, regional, or local regulations for additional requirements.

Contaminated Packaging Dispose of in accordance with federal, state and local regulations.

14. TRANSPORT INFORMATION

DOT NOT REGULATED

TDG NOT REGULATED

15. REGULATORY INFORMATION

U.S. Federal Regulations

SARA 313
Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372

SARA 311/312 Hazard Categories

Acute health hazard	No
Chronic health hazard	No
Fire hazard	No
Sudden release of pressure hazard	No
Reactive Hazard	No

Clean Water Act
This product does not contain any substances regulated as pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42)

CERCLA
This material, as supplied, does not contain any substances regulated as hazardous substances under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302) or the Superfund Amendments and Reauthorization Act (SARA) (40 CFR 355). There may be specific reporting requirements at the local, regional, or state level pertaining to releases of this material

US State Regulations

California Proposition 65
This product does not contain any Proposition 65 chemicals.

U.S. State Right-to-Know Regulations

This product does not contain any substances regulated by state right-to-know regulations

International Inventories

A food, food additive, drug, cosmetic, or device, when manufactured, processed or distributed in commerce for use as a food, food additive, drug, cosmetic, or device is not subject to the notification requirements of 40 CFR 720.

Component	TSCA (United States)	DSL (Canada)	EINECS/ELINCS (Europe)	ENCS (Japan)	China (IECSC)	KECL (Korea)	PICCS (Philippines)	AICS (Australia)
Sodium alginate 9005-38-3 (100)	X	X		X	X	X	X	X

Mexico - Grade Minimum risk, Grade 0

16. OTHER INFORMATION

NFPA	**Health Hazards** 0	**Flammability** 1	**Instability** 0	**Special Hazards** -
HMIS	**Health Hazards** 0	**Flammability** 1	**Physical hazard** 0	**Personal Protection** X

**Indicates a chronic health hazard.*

Revision date: 2015-05-29
Revision note Format Change

Disclaimer

Refer to NFPA 654, *Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids* , for safe handling. FMC Corporation believes that the information and recommendations contained herein (including data and statements) are accurate as of the date hereof. NO WARRANTY OF FITNESS FOR ANY PARTICULAR PURPOSE, WARRANTY OF MERCHANTABILITY OR ANY OTHER WARRANTY, EXPRESSED OR IMPLIED, IS MADE CONCERNING THE INFORMATION PROVIDED HEREIN. The information provided herein relates only to the specified product designated and may not be applicable where such product is used in combination with any other materials or in any process. Further, since the conditions and methods of use are beyond the control of FMC Corporation, FMC corporation expressly disclaims any and all liability as to any results obtained or arising from any use of the products or reliance on such information.

Prepared By:

FMC Product Stewardship

FMC Logo - Trademark of FMC Corporation

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Product Suitability

The information contained in this document (as well as any advice or assistance) is provided by FMC only as a courtesy and is intended to be general in nature. Any uses suggested by FMC are presented only to assist our customers in exploring possible applications. FMC makes no warranty, express or implied, as to its accuracy or completeness, or the results to be obtained from such information, advice or assistance. Each customer is solely responsible for determining whether the FMC products are suitable for such customer's intended use, and for obtaining any necessary governmental registrations and approvals for such customer's production, marketing, sale, use and/or transportation of finished goods using or incorporating the FMC products.

End of Safety Data Sheet

LINCOLN LABORATORY
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

SAFETY DATA SHEET

Section 1: Identification

Product Identifier
Product Name: Safe Tunable Alginate Microparticles (STAMP)

Other means of identification
Chemical Name/Synonyms: calcium alginate, alginate hydrogel, synthesized biosimulant particles

Recommended use of the chemical and restrictions on use
Recommended Use: Biosimulant for conducting quantitative aerosol phenomenology tests, particle transport studies, training exercises, sensor evaluation, etc.

Manufacturer Contact Information
Company: MIT Lincoln Laboratory
244 Wood Street, Group 47
Lexington, MA 02421
(781) 981-5500

Emergency Telephone Number
(781) 981-5500

Section 2: Hazard(s) Identification

Hazard Classification: Not a hazardous substance or mixture

GHS Label elements, including precautionary statements: Not a hazardous substance or mixture

Other information: As with any particles composed of organic material, dispersed powders in air, present in high-enough concentrations, near a source of ignition, and in a confined area, could pose a dust explosion hazard.

Section 3: Composition/ Information on Ingredients

Chemical Name	Synonym	CAS#	Weight %
Calcium alginate	Alginic Acid Calcium Salt	9005-35-0	>99.999
Deoxyribonucleic acid	DNA, oligonucleotides	-	<0.001

No components need to be disclosed according to the applicable regulations.

Section 4: First-Aid Measures

Description of necessary first-aid measures

Eye contact:	Flush eyes thoroughly with water as a precaution. Seek medical attention if eye irritation develops or persists.
Skin contact:	Wash skin with soap and water as a precaution. If skin irritation or rash occurs seek medical advice/attention.
Inhalation:	Remove to fresh air in event of excessive inhalation of bulk material. If breathing is difficult or discomfort occurs and persists, seek medical attention.

Swallowing:	Rinse mouth with water as a precaution. Never give anything by mouth to an unconscious person. Seek medical attention if symptoms occur.
Most important symptoms & effects, acute and delayed:	No data available.
Indications of immediate medical attention and special treatment needed, if necessary:	No data available.

Section 5: Fire-Fighting Measures

Suitable extinguishing agents: Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide

Unsuitable extinguishing agents: None known

Special hazards arising from the chemical: Fine dust dispersed in air, if present in high-enough concentrations in a confined area and near an ignition source, could pose a potential dust explosion hazard.

Special protective equipment for firefighters: As in any fire, wear self-contained breathing apparatus and full protective gear.

Section 6: Accidental Release Measures

Personal precautions: Ensure adequate ventilation. Avoid breathing vapors, mist or gas. For personal protection see section 8.
Measures for environmental protection: No special environmental precautions required.
Measures for cleaning/collecting: Wet wipe or mop. Keep in suitable, closed containers for disposal.

Section 7: Handling and Storage

Handling: Ensure adequate exhaust ventilation and avoid sources of ignition at places where dust is formed.
Storage: Keep container tightly closed in a dry and well-ventilated place, away from sources of ignition.

Section 8: Exposure Controls/Personal Protection

Chemical Name	OSHA PEL (8 hour TWA)	OSHA STEL/ceiling	NIOSH REL (8 hour TWA)	ACGIH TLV (8 hour TWA)
Calcium alginate as a Particulate Not Otherwise Regulated (PNOR)	15 mg/m^3 (total dust), 5 mg/m^3 (respirable fraction)	None	10 mg/m^3 (total dust)	10 mg/^{m3} (total dust)

General protective and hygienic measures: Follow good industrial hygiene and safety practices.
Breathing equipment: Respiratory protection is not required. Where protection from nuisance levels of dusts as desired, use type N95 or P95 disposable respirator (NIOSH approved).
Protection of hands: Wear protective gloves. Wash hands after use.
Eye protection: Wear safety glasses.
Control of environmental exposure: No special environmental precautions required.

Section 9: Physical and Chemical Properties

Form: Powder, off-white in color

Odor: No data available
Odor threshold: No data available
pH: No data available
Melting point/melting range: No data available
Boiling point/boiling range: No data available
Flash point: Not applicable
Evaporation rate: No data available
Flammability: No data available
Upper/lower flammability or explosive limits: No data available
Auto ignition temperature: No data available
Danger of explosion: No data available
Vapor pressure: No data available
Vapor density: No data available
Relative density: No data available
Solubility in/Miscibility with water: Not soluble in water

Section 10: Stability and Reactivity

Reactivity: Not applicable
Chemical stability: Stable under recommended storage conditions.
Conditions to avoid: High dust concentrations. Sparks.
Incompatible materials: Strong oxidizing agents.
Hazardous decomposition products: formed under fire conditions – Carbon oxides.
Other decomposition products – No data available.

Section 11: Toxicological Information

Acute toxicity: No data available
Potential routes of exposure/potential health effects
Skin: No data available
Eye: No data available
Inhalation: No data available
Ingestion: No data available
Carcinogenic effects: No component of this product presents at levels greater than or equal to 0.1% is identified as probable, possible, confirmed, or regulated human carcinogen by IARC or OSHA.
Mutagenic effects: No data available
Reproductive toxicity: No data available
Sensitization: No data available
Target organs: No data available

Section 12: Ecological Information (non-mandatory)

Ecotoxicity: No data available
Mobility: No data available
Biodegradation: No data available
Bioaccumulation: No data available

Section 13: Disposal Considerations (non-mandatory)

This material, as supplied, does not meet the definition of a hazardous waste according to Federal regulations (40 CFR 261). Dispose of in accordance with federal, state and local regulations. Dispose of contaminated packaging as unused product.

Section 14: Transport Information (non-mandatory)

DOT regulations: Not regulated

Air transport IATA-DGR: Not regulated

Section 15: Regulatory Information (non-mandatory)

US Federal Regulations

SARA Section 302 (reportable chemicals): No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA Section 313 (specific toxic chemical listings): This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

Clean Air Act, Section 112 Hazardous Air Pollutants (HAPs): This product does not contain any substances regulated as a HAP pursuant to Section 112 of the Clean Air Act.

Clean Water Act: This product does not contain any substances regulated as pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42).

Toxic Substances Control Act: This material is provided for Research and Development purposes only under 40 CFR Section 720.36.

Section 16: Other Information

NFPA	Health Hazard 0	Flammability 1	Instability 0	Special Hazard -
HMIS	Health Hazard 0	Flammability 1	Physical Hazard 0	PPE X

SDS date of preparation/update: 10/10/2019

Disclaimer: The information contained in this document (as well as any advice or assistance) is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. MIT Lincoln Laboratory and staff shall not be held liable for any damage resulting from handling or from contact with the above product.

LINCOLN LABORATORY
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

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Appendix B: Regulatory Communications

U.S. Department of Homeland Security
Washington, D.C. 20528

Homeland Security

New York State Historic Preservation Office
Peebles Island Resource Center
P.O. Box 189
Waterford, NY 12188-0189

Reference: Environmental Assessment of Proposed Tracer Particle and Gas Releases / Chemical and Bio-Defense Testbed (CBT) Program /Urban Threat Dispersion (UTD) Program, U.S Department of Homeland Security, Science and Technology Directorate (DHS S&T)

Dear New York State Historic Preservation Officer:

Pursuant to Section 106 of the National Historic Preservation Act and its implementing regulations 36 Code of Federal Regulations (C.F.R.) Part 800, DHS S&T is transmitting this letter to initiate consultation and identify historic properties for the above referenced Undertaking.

The Undertaking will take place between September 2021 and May 2022 and involve the release of safe particle and inert gas tracer materials directed into the open-air space in several pre-determined locations within NYC that include Times Square, the World Trade Center complex, Union Square and Grand Central Station. In addition, particle and gas tracer releases measurements will be taken at over 130 locations across the five New York City boroughs, at the three area airports, and transit hubs in northern New Jersey.

Description of Undertaking:
The Proposed Action will include the release of low concentrations of safe particle and gas tracer materials as part of two programs - the Urban Threat Dispersion (UTD) program and the Chemical and Bio-defense Testbed (CBT) program. The goal of these tests is to deliver actionable information to inform emergency preparedness planning for a wide-area bioterrorism event. The particulate and gas materials planned for release will help to refine and verify subway and outdoor airflow and dispersion models that were previously developed by Argonne and Los Alamos National Laboratories, respectively. The planned testing will lead to enhanced accuracy and sensitivity of the current models and optimize placement of existing biodefense sensors. Additionally, the DHS BioWatch Program will leverage this unique opportunity to test performance of its BD21 candidate sensor technologies.

The UTD program is a follow-on to the Underground Transportation Restoration [UTR] project/test event, conducted in 2016, in which safe particle and gas tracers were released in the MTA NYC Transit (NYCT) subway system. In this study, the dispersion of materials through the system was studied. The results of the UTR project helped first responders and critical stakeholders better understand how biological particles would disseminate after a potential

release. The UTR test event also raised several additional questions, including the relationship between tracer materials released in the subway and the aboveground urban environment. These follow-on questions are the focus of the proposed upcoming UTD test. Additionally, further evaluation of the propagation of tracer materials to transit and outdoor sites in the greater NYC metro area, and Northeastern Seaboard is of interest.

The goal of the CBT program is to increase resilience against potential chemical or biological agent attacks by testing and evaluating detection technologies and mitigation strategies in several locations within the NYC subway system. In order to evaluate the performance of both sensor and mitigation technologies, DHS S&T proposes to disseminate safe simulant or tracer materials that mimic key properties of biological and chemical agents of concern. Performance data will be gathered regarding the performance of newly installed sensors (e.g., maintenance costs, frequency of false alarms, and probability and time to detect a potential threat) after the testing events.

Identification of Historic Properties:
Almost 7,000 National Register of Historic Places listed properties and 116 National Historic Landmarks as reported by the National Park Service and one World Heritage Site as designated by the United Nations Educational, Scientific and Cultural Organization are present within the city. Additionally, the NYC vicinity and surrounding area has been inhabited by Native Americans for thousands of years and many sites remain which may have cultural significance.

Assessment of Effects:
Consideration was given to the impact of the tests on any cultural resources or historic properties. Many of the stations in the NYC subway system are listed on the National Register of Historic Places (NRHP). There would be no ground disturbing activities or need to permanently affix equipment to any structures or walls within subway stations. As such, the placement and use of testing equipment would not result in visual or audible impacts given the temporary nature of the activity.

The tracer materials used for testing would also have no direct or indirect effect to any contributing features of any historic properties. As such, the proposed action would have no adverse effect on historic properties. Therefore, there would be no significant effects to historic properties.

Finding of Adverse Effect to Historic Properties:
DHS S&T has determined that the Proposed Action would not require ground disturbing activities or modifications to existing structures or surrounding environments. Therefore, pursuant to 36 C.F.R. 800.5(d)(2), DHS S&T has determined that there are No Adverse Effects to Historic Properties due to the proposed undertaking and is requesting further consultation with your office, pursuant to 36 C.F.R. 800.6, to resolve these effects. In accordance with Section 106 of the National Historic Preservation Act, DHS S&T has also notified State Historic Preservation Officers of its determination.

Your prompt attention to the request is greatly appreciated. If DHS S&T has not received a response from your office within 30 days of your receipt of this determination letter, DHS S&T

will consider its responsibilities under Section 106 to have been fulfilled. Written correspondence may be submitted to me by mail to the following address:

Science and Technology Directorate
245 Murray Lane MS 0202
Washington, DC 20528
Attn: Donald Bansleben

We look forward to continuing the Section 106 consultation process with you. If you require additional information or have any questions or concerns, please feel free to contact Donald Bansleben by telephone at (202) 254-6146 or by email at donald.bansleben@hq.dhs.gov.

Sincerely,

Donald A. Bansleben

Donald A. Bansleben, Ph.D.
Program Manager, Office of Mission Capability and Support
Science and Technology Directorate
Department of Homeland Security

From: New York State Parks CRIS Application
To: Bansleben, Donald
Subject: SHPO Initial Consultation Submission Received
Date: Friday, August 6, 2021 11:05:34 AM

CAUTION: This email originated from outside of DHS. DO NOT click links or open attachments unless you recognize and/or trust the sender. Contact your component SOC with questions or concerns.

This message is a notification from the New York State Historic Preservation Office (SHPO) through its Cultural Resource Information System (CRIS). Initial submission NGXWV5P2MLAB has been received for the following project: Proposed Tracer Particle and Gas Releases: Chemical and Bio-Defense Testbed (CBT) Program and Urban Threat Dispersion (UTD) Program, U.S Department of Homeland Security, Science and Technology Directorate (DHS S&T).

No action on your part is required at this time. You will receive an email notification when the submission is accepted as a new project record or if more information is necessary to process the submission.

If you have any questions about CRIS, please contact CRIS Help at CRISHelp@parks.ny.gov. For any other questions, please call 518-237-8643.

Sincerely,

New York State Historic Preservation Office
Peebles Island State Park, P.O. Box 189, Waterford, NY 12188-0189
518-237-8643 | https://parks.ny.gov/shpo
CRIS: https://cris.parks.ny.gov

Are you registered to vote? Register to vote online today. Moved recently? Update your information with the NYS Board of Elections. Not sure if you're registered to vote? Search your voter registration status.

You are receiving this email as part of an online service administered by New York State Parks, Recreation and Historic Preservation's Division for Historic Preservation, also known as the New York State Historic Preservation Office (SHPO). The Cultural Resource Information System (CRIS) is an advanced Geographic Information System application that provides access to New York State's vast historic and cultural resource databases and digitized paper records. In addition, CRIS serves as an interactive portal for agencies, municipalities and the public who use or require consultation with our agency on historic preservation programs or issues.

Our email to you is in direct response to material that was submitted to our office regarding a project for which you were identified as a contact. Such projects include actions that are reviewable by our agency under the National Historic Preservation

Act of 1966 (Section 106), the New York State Historic Preservation Act (Section 14.09 NYSPRHPL), or the State Environmental Quality Review Act (SEQRA).

If you did not enter this project directly into CRIS, you are receiving this notification as SHPO or another project contact has entered it in our system. You will receive future correspondence for this project via email.

If you are a registered CRIS user and the creator of this submission, you may edit the submission through the **My Submissions** tab on your Home dashboard. Otherwise, you may view or edit this submission in CRIS as follows:

1. Click or browse to CRIS: https://cris.parks.ny.gov

2. At the CRIS Legal Disclaimer, click **I Agree** to proceed.

3. Click **Proceed as Guest** or log in with an NY.gov ID account.

4. In the top navigation bar, click **Submit**.

5. On the Submit page, click the Consultation tile. Paste the submission Token (NGXWV5P2MLAB) in the text box and click the Continue button.

6. The CRIS Submit application will open in a new browser tab. **NOTE:** If you edit this submission, please make sure you click **Submit to SHPO** to ensure that SHPO receives the revised submission.

Appendix C: Public Involvement Documentation and Comments

NEW YORK STATE OF OPPORTUNITY. | Parks, Recreation, and Historic Preservation

ANDREW M. CUOMO
Governor

ERIK KULLESEID
Commissioner

August 12, 2021

Donald Bansleben
Program Manager
Department of Homeland Security, Science and Technology Directorate
245 Murray Lane MS 0202
Washington, DC 20528

Re: DHS
Proposed Tracer Particle and Gas Releases: Chemical and Bio-Defense Testbed (CBT) Program and Urban Threat Dispersion (UTD) Program, U.S Department of Homeland Security, Science and Technology Directorate (DHS S&T)
21PR05292

Dear Donald Bansleben:

Thank you for requesting the comments of the State Historic Preservation Office (SHPO). We have reviewed the project in accordance with Section 106 of the National Historic Preservation Act of 1966. These comments are those of the SHPO and relate only to Historic/Cultural resources. They do not include potential environmental impacts to New York State Parkland that may be involved in or near your project. Such impacts must be considered as part of the environmental review of the project pursuant to the National Environmental Policy Act and/or the State Environmental Quality Review Act (New York Environmental Conservation Law Article 8).

Based upon this review, it is the opinion of the New York SHPO that no historic properties, including archaeological and/or historic resources, will be affected by this undertaking.

If further correspondence is required regarding this project, please be sure to refer to the OPRHP Project Review (PR) number noted above.

Sincerely,

Roger Daniel Mackay

R. Daniel Mackay

Deputy State Historic Preservation Officer
Division for Historic Preservation

References

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