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Science and Technology

**Environmental Assessment of Proposed Tracer Particle and Biological
Releases for the Hazards of Dynamic Outdoor Release (HODOR)
Project**

**Prepared for Department of Homeland Security Science and
Technology Directorate**

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Executive Summary

This Environmental Assessment (EA) documents the analysis of the potential effects of a proposal by the Department of Homeland Security (DHS) Science & Technology Directorate (S&T) to conduct tests during January/February 2018 and then again during June/July, 2018 involving the release of low concentrations of particles at two buildings within the Chilocco Indian Agricultural School (Chilocco campus) in Newkirk, Kay County, OK. The S&T program is entitled the Hazards of Dynamic Outdoor Releases (HODOR). No construction, permanent land disturbance, or land use changes would occur with implementation of the Proposed Action or the Alternatives.

The HODOR program supports DHS's strategic goals to detect and recover from biological attacks and inform and support biodefense planning, response, and restoration, particularly in consequence/risk assessment modeling of the indoor hazards posed by outdoor aerosols. Characterizing the impact of biological weapons on infrastructure is a key element to achieving this goal. One indicator of a building's ability to withstand the effects of a biological weapon is the building protection factor (BPF). The BPF is the degree to which a building's occupants are protected from biological materials as compared to a person located outside the building. Dispersion models have been created to help in these endeavors and are actively used by agencies within DHS for both pre- and post-attack planning. Pre-attack planning includes identifying strategies for response in the event of a biological attack. Post-attack planning includes determining the source location for attribution, identifying exposed people, and aiding the remediation effort (e.g., mapping, decontamination). While the dispersion models are critically important for homeland defense, the lack of quantitative evidence and understanding of the BPF is a significant gap. Selection of specific buildings that are representative of U.S. construction for homes and apartments was conducted to support this effort. This EA is being conducted in accordance with the National Environmental Policy Act (NEPA) in 40 CFR 1500-1508, and DHS Directive 023-01, *Implementation of the National Environmental Policy Act*. In support of these tests, aerosol biologists from Sandia National Laboratory, aerosol engineers from the National Biodefense Analysis and Countermeasures Center (NBACC), scientists from the OSU-University Multispectral Laboratories (UML), and other supporting state and federal agencies have partnered for the proposed testing. The assembled team has conducted a thorough review of available literature to assess the potential for environmental hazards associated with the proposed program. Specifically, an analysis of alternatives was conducted to select appropriate buildings for testing, best inert materials, and optimal biological material for release to successfully meet program objectives.

Buildings to be used for testing were selected based on the DHS-desired characteristics, as well as the ability to release materials at a distance from these buildings that minimize environmental impact and public exposure.

Action alternatives were considered for testing location and testing materials. A total of five abandoned residential and apartment buildings within the Chilocco campus were evaluated

against two main criteria: conformance to typical US building standards; and potential testing obstructions (e.g. vegetation, proximity to other buildings).

Residential Building Alternative 1 (Building 53) and Residential Building Alternative 2 (Building 56) both contain numerous vegetation and building obstructions and would require major renovations to meet current typical building standards. Residential Building Alternative 3 (Building 58) has the fewest number of potentially obscuring structures and required minor renovations.

Apartment Building Alternative 1 (Building 10) did not realistically represent current apartment building design or utilize standard heating, ventilation, and air conditioning (HVAC) systems. Apartment Building Alternative 2 (Building 60), more realistically simulated a typical apartment structure with multiple HVAC systems, thus allowing more accurate testing conditions. The No Action Building Alternative would result in no real-world testing scenario, and would not meet the stated purpose and need.

The use of inert particulate materials provides extremely valuable information toward the overall objectives of the HODOR program. Inert materials will be used to monitor gross particle movement around and into each building, in real time, using relatively simple and straightforward sensors. The data collected with inert particle materials will be used to optimize sensor placement for subsequent biological particulate releases. Two different inert particulates were selected to be employed for use in gross characterization of particle penetration into buildings. Alternative Inert Particle 1 would utilize titanium dioxide (TiO₂), a white odorless powder that is chemically insoluble in water, nonreactive, nonflammable, and nonhazardous. This material is not regulated or defined as a toxic or hazardous material.

Alternative Inert Particle 2 is a 90:10% mixture of urea powder with CL Fluorescent Brightener 220. Urea serves an important role in the metabolism of nitrogen-containing compounds by animals and is the main nitrogen-containing substance in the urine of mammals. CL Fluorescent Brightener 220 is a finishing reagent in textiles, and up to 2% by weight in laundry detergents.

Both aerosol particulates would be released and detected by sensors located outside and inside the preferred buildings. At the concentrations resulting from the proposed releases, all materials are considered nontoxic and nonhazardous. The No Action Alternative would result in no release of aerosol particulates. This alternative would result in possible missed biological sensors detections, reducing the likelihood of program success. In addition, it would increase the number of barcoded biological material releases and would require additional labor to decontaminate each site between releases. These factors would increase both programmatic cost and time and is not a preferred alternative.

To understand the true detection capabilities of the biological sensor, challenge tests with a material must be performed. Since a portion of the technologies rely on the detection of genetic or proteinaceous materials to positively identify a particular threat agent, the simulant must be of biological origin. Three alternatives were considered in order to evaluate tradeoffs

in test procedures, which would either partially meet the needs of DHS S&T; additionally there is a no action alternative, which would involve no particulate releases.

Alternative Biological Particulate 1 would employ the use of *Bacillus thuringiensis* subsp *kurstaki* (Btk) barcoded spores, which are the preferred biological material to be employed for sensitive characterization of building penetration. Native Btk, sold under the commercial name of Dipel, is used extensively as a bioinsecticide and is not considered a hazard by the U.S. Environmental Protection Agency (EPA) when handled appropriately. The barcoded variant provides much more specific detection and identification from background than the native organism, as it contains a genetic barcode that does not affect any physiological function or phenotypic expression of the organism. It will be dispersed in a similar manner to that of native Btk when used as an insecticide. However, release will be at much lower concentrations than typical insecticidal application rates. The use of the barcoded Btk has been approved for use in this program by the State of Oklahoma's Department of Agriculture, Food, & Forestry.

Alternative Biological Particulate 2 would utilize native Btk, without barcoding. Native Btk is an approved biopesticide under the commercial name of Dipel. This alternative would require much more time and labor to execute. Alternative Biological Particulate 3 would employ a tagged, inert, fluorescent particle known as DNATrax. The safety of DNATrax particles cannot be assumed, therefore, its use presented unknown risks not conducive to testing objectives. The release of all three biological particulate alternatives would result in slow application rates and low concentrations. No Action Biological Particulate Alternative would still allow the primary objectives of the tests to be met through use of inert particles only, but would require larger quantities of inert powder to overcome the natural background of particulates internal and external to the building. In order to simulate real world data that more closely matches, releases of an actual biological nature is needed.

The Chilocco campus and surrounding land is under the ownership of the Council of Confederated Chilocco Tribes (CCCT) which include the Kaw Nation, the Otoe-Missouria Tribe, the Pawnee Nation, the Ponca Nation, and the Tonkawa Tribe. The campus is abandoned, thus reducing the risk of potential human health and safety risks posed by the presence of sensitive populations. S&T and UML have been in communication with the Bureau of Indian Affairs and CCCT and have determined that the implementation of the preferred alternatives has no adverse impact on resources, human health or the environment.

The direct, indirect, and cumulative environmental effects caused by the potential exposure of terrestrial wildlife, vegetation, water resources, and air quality by movement of the material by any of the alternatives would not have an adverse effect. This is due to both selection of the test materials and limited quantity that will be used. The Chilocco campus is listed on the National Register of Historic Places. Consultation with the appropriate Tribal Historic Preservation Officers has been initiated, and no adverse effect is anticipated.

This EA details the approach and reasoning the team would employ to minimize environmental impacts. As can be seen in the body of this document, the buildings to be used, their location, the release locations and the amounts and types of materials to be used all serve to

minimize impact to the surrounding environment. S&T has determined that the proposed testing would have no potential for significant impact on the human environment and that an environmental impact statement is not needed.

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List of Acronyms

ATCC – American Type Culture Collection
BIA – Bureau of Indian Affairs
BP1 – Biological Particulate 1, barcoded *Bacillus thuringiensis* subsp *kurstaki*
BP2 – Biological Particulate 2, native *Bacillus thuringiensis* subsp *kurstaki*
BP3 – Biological Particulate 3, DNATrax sugar particles
BP4 – Biological Particulate 4, no action
BPF – Building Protection Factor
Btk – *Bacillus thuringiensis* subsp *kurstaki*
BTRA – Biological Threat Risk Assessment
CAA – Clean Air Act
CERCLA - Comprehensive Environmental Response, Compensation and Liability Act
CH₄ – Methane
CO – Carbon Monoxide
CO₂ – Carbon Dioxide
CONTAM – Contaminate Model
DFU – Dry Filter Unit
DHS – United States Department of Homeland Security
DHS S&T – United States Department of Homeland Security Science and Technology Directorate
DNA – Deoxyribonucleic Acid
DoD – Department of Defense
EA – Environmental Assessment
ECBC – Edgewood Chemical Biological Center
eDNA – Environmental Deoxyribonucleic Acid
EIS – Environmental Impact Statement
EPA – United States Environmental Protection Agency
EPCRA - Consolidated List of Chemicals Subject to Emergency Planning and Community Right-To-Know Act
FDA – Food & Drug Administration
FMS – Facility Monitoring Software
GHG – Green House Gas
GRAS – Generally Recognized As Safe
HAP – Hazardous Air Pollutant
HODOR – Hazards of Dynamic Outdoor Releases
HPAC – Hazard Predication and Assessment Capability
HVAC – Heating, Ventilation, and Air Conditioning
HVAS – High Volume Air Sampler

IBAC – Instantaneous Bioaerosol Analyzer and Collector
KS – Kansas
LIF – Light Induced Fluorescence
LLNL – Lawrence Livermore National Laboratory
MMAD – Mass Median Aerodynamic Diameter
MSDS – Materials Safety Data Sheet
N₂O – Nitrous Oxide
NAAQs – National Ambient Air Quality Standards
NBACC – National Biodefense Analysis and Countermeasures Center
NEPA – National Environmental Policy Act
NHPA – National Historic Preservation Act
NO₂ – Nitrogen Dioxide
O₃ – Ozone
OB – Optical Brightener
OK – Oklahoma
OSHA – Occupational Safety and Health Administration
P1 – Particulate 1, Titanium Dioxide
P2 – Particulate 2, Urea Powder with CI Fluorescent Brightener 220
P3 – Particulate 3, no action
Pb – Lead
PC – Polycarbonate
PEL – Permissible Exposure Limits
PPE – Personal Protective Equipment
PM – Particulate Matter
qPCR – Quantitative Polymerase Chain Reaction
RCRA – Resource Conservation and Recovery Act
RDT&E – Research, Development, Testing, and Evaluation
RH – Relative Humidity
RTP – Real Time Particle Counter
SDS – Safety Data Sheet
SEIS – Supplemental Environmental Impact Statement
SO₂ – Sulfur Dioxide
THPO – Tribal Historic Preservation Officer
TiO₂ – Titanium dioxide
UML – OSU-University Multispectral Laboratories, L.L.C.
UV – Ultraviolet

1 Purpose and Need

A strategic goal of the U.S. Department of Homeland Security (DHS) is to prevent, detect, protect, and recover from biological attacks.¹ Characterizing the impact of biological weapons on infrastructure is a key element to achieving this goal. Dispersion models have been created to help in these endeavors and are actively used by agencies within DHS for both pre- and post-attack planning. Pre-attack planning includes identifying strategies for response in the event of a biological attack. Post-attack planning includes determining the source location for attribution, identifying exposed people, and aiding the remediation effort (e.g., mapping, decontamination). Predictive models such as the Contaminant Model (CONTAM), Hazard Predication and Assessment Capability (HPAC), and post-attack remediation strategies (e.g., mapping contamination) have been created to support this mission. CONTAM was designed to estimate dispersion of material in a multizone indoor location. The code utilizes a well-mixed zone approach with highly detailed building layouts to include individual room pressures, air flows, surface leakage, and other methods of material interaction. HPAC was designed as a counter proliferation, counterforce tool to predict dispersion of material in the atmosphere. It has algorithms to assist in the calculation of both source terms and consequences. The dispersion method utilizes a random-walk of tracer “particles.” These models use the building protection factor (BPF). The BPF is the degree to which a building’s occupants are protected from biological materials as compared to a person located outside the building. While the dispersion models are critically important for homeland defense, the lack of quantitative evidence and understanding of the BPF is a significant gap.

The DHS Science and Technology Directorate (S&T) proposes to test the penetration of a biological simulant into two buildings, to inform and support biodefense planning, response, and restoration, particularly in consequence/risk assessment modeling of the indoor hazards posed by outdoor aerosols. Testing would occur at the Chilocco Indian School in Newkirk, Kay County, OK.

Relevant previous tests are illustrated in Table 1; many of the previous efforts have focused on gases and liquid aerosols in subway systems. Without meaningful validation under applicable conditions, the actual measure of protection that current dispersion models provide is academic rather than demonstrated. The proposed testing action will determine the degree to which particles enter different types of buildings under different conditions. This will provide experimental data with which to enhance current and new modeling efforts.

The purpose of this Environmental Assessment (EA) is to evaluate whether significant impacts to the environment may occur from the proposed dispersion testing at the Chilocco Campus. DHS S&T proposes to test the penetration of inert particulates as well as a biological simulant into buildings and houses, to inform and support biodefense planning, response, and restoration, particularly in consequence/risk assessment modeling of the indoor hazards posed by outdoor aerosols. Selection of specific buildings that are representative of U.S. construction for homes and apartments was conducted to support this effort. This EA is being conducted in

accordance with the National Environmental Policy Act (NEPA) in 40 CFR 1500-1508, and DHS Directive 023-01, *Implementation of the National Environmental Policy Act*.

Testing will be conducted through the release of (2) different inert powders as well as barcoded spores and are meant to simulate the behavior of harmful biological materials as they move from the outdoors into buildings. The inert powders are 1) titanium dioxide (TiO₂) and 2) urea powder mixed with 10% CI Fluorescent Brightener 220 optical brightener. Both types of powders allow for the gross mapping of particle penetration into the different building types. TiO₂ is a chemically inert powder commonly used in paints, food, cosmetics, and insecticides. Urea is the main chemical found in human and mammalian urine and is used throughout the world as a fertilizer. Optical brighter is a chemical whitener added to toothpastes and laundry detergents to increase fluorescence. For this study the optical brighter is added to the urea, to increase particle visibility for detection, at a weight percent of $\leq 10\%$.

Barcoded *Bacillus thuringiensis* subspecies kurstaki (Btk) spores will be used for the biological material in these tests. These spores resemble and acts like deadly pathogens, but they are safe, found in nature, and are used in organic gardening practices. Use of a live biological material realistically represents the kind of material that might be used in a bioterrorist event and allows sensitive identification methods to be employed. Detection of Btk will be performed using polymerase chain reaction (PCR) methods which identify the spore based on their nucleic acid (DNA) or genetic fingerprint. In this approach, samples are collected on filters and taken into a molecular biology laboratory where the DNA is extracted and analyzed using PCR instrumentation. This approach is the same as what would be used for detection of *Bacillus anthracis* if released in a terrorist attack. It is much more sensitive than the detection methods for the powders (TiO₂ and urea) which are based on particle size and fluorescence properties. PCR also differentiates the spore using specific barcodes, from naturally occurring background material such as pollens, which the LIF-based (optical brightener) detection cannot. Use of the biological material is a key attribute that fulfills the purpose of the proposed dispersion tests.

Table 1 . Representative list of particulate and spore material phenomenology measurements (not all-inclusive).

Year	Agency/Program	Sponsor	Material	Location	EA
1966	US Army	US Army	<i>B. atrophaeus</i> (Bg)	New York Subway	Unknown
2006	MetroGuard Testing	*MTA/NYCT	Urea, Polystyrene	MTA/NYCT	Unknown
2007-2008	Argonne National Lab, Brookhaven National Lab	MTA/NYCT	Urea	DC/WMATA	Unknown
2008	Los Alamos National Lab	DoD	<i>B. thuringiensis</i> subsp <i>kurstaki</i> (Btk)	Fairfax County, VA	Unknown
2009	Lawrence Livermore National Lab, Los Alamos National Lab	Pentagon Force Protection Agency	<i>B. amyloliquifaciens</i>	Pentagon	None completed
2011	US Army	Defense Threat Reduction Agency	Barcoded <i>B. thuringiensis</i>	Aberdeen Proving Ground	Unknown
2016	DHS/EPA	MTA	DNATrax/sulfur hexafluoride (SF ₆) gas	New York Subway	Environmental Assessment of Proposed NYC Subway Tracer Particle and Gas Releases for the Underground Transport Restoration (UTR) Project

* MTA NYCT- Metropolitan Transportation Authority New York City Transit, DC WMATA- District of Columbia Washington Metropolitan Area Transit Authority

2 Test Alternatives to Meet the Need

This section includes a description of the testing activity, methodology of buildings selection, and parameters for the selection of chemical and biological test simulants. The analysis of alternatives was conducted in accordance with the National Environmental Policy Act (NEPA) as outlined in 40 CFR Parts 1500-1508 and DHS's implementing regulation Directive 023-01, Rev 01, *Implementing the National Environmental Policy Act*.

2.1 Test Description

In the event of an outdoor biological agent attack, it is currently unknown the extent to which hazardous material will penetrate buildings and homes in the vicinity of such attack. Current models use a Building Protection Factor (BPF) to describe the permeability of a building to particulates in an outdoor biological attack. The BPF is defined as the reduction in dose received by a typical building occupant compared to a person located outside the building. An unprotected building will typically have a BPF of slightly above 1.² In the DHS Bioterrorism Risk Assessment (BTRA), BPF values assigned are from 0-1 as a fraction, with 1 being most the most protective, but little to no experimental data exists to support these values. This project would further advance preparedness by providing improved estimates of the boundaries and levels of contamination in homes and buildings following an outdoor aerosol release of a biological agent under varied conditions. UML will release materials upwind of select buildings and experimentally determine the amount of material that penetrates the buildings. The data collected would facilitate modeling efforts that support response and recovery decisions and actions by local, state, tribal, and federal emergency managers.

The release activities would take place at the abandoned Chilocco campus in rural Oklahoma (Figure 1) during January/February 2018 and then again during June/July, 2018. This site is closed to the general public under an exclusive use agreement between the site's tribal owners, the Council of Confederated Chilocco Tribes (CCCT) and the OSU-University Multispectral Laboratories L.L.C. (UML). UML is a nonprofit 501c3 research laboratory, owned by Oklahoma State University, which supports various federal agencies for sensor testing and training. The CCCT consists of 165 acres surrounded by 5,000 acres of tribal owned land. The nearest residential home is located more than 0.6-mile (1km) north of the closest potential release area. The nearest public buildings are a casino and a gas station located 1.4 mile (2.3km) south east of the closest release area. This testing activity proposes two different release areas on the campus located near a vacant residential home (building 58) and an apartment complex (building 60). These two buildings required renovations to support the subject testing and, at this time, the renovations have been completed. One of the proposed buildings (building 58) to be used was repaired by UML in (June/July 2017) to meet typical building standards. Repairs included window replacement, roof repair, and installation of new electrical and HVAC services. Repair of this structure was accomplished through consultation process with the CCCT Tribal Historic Preservation Officers (THPOs) pursuant to 36 CFR Part 800, *-Protection of Historic Properties*, section 101(d)(2).

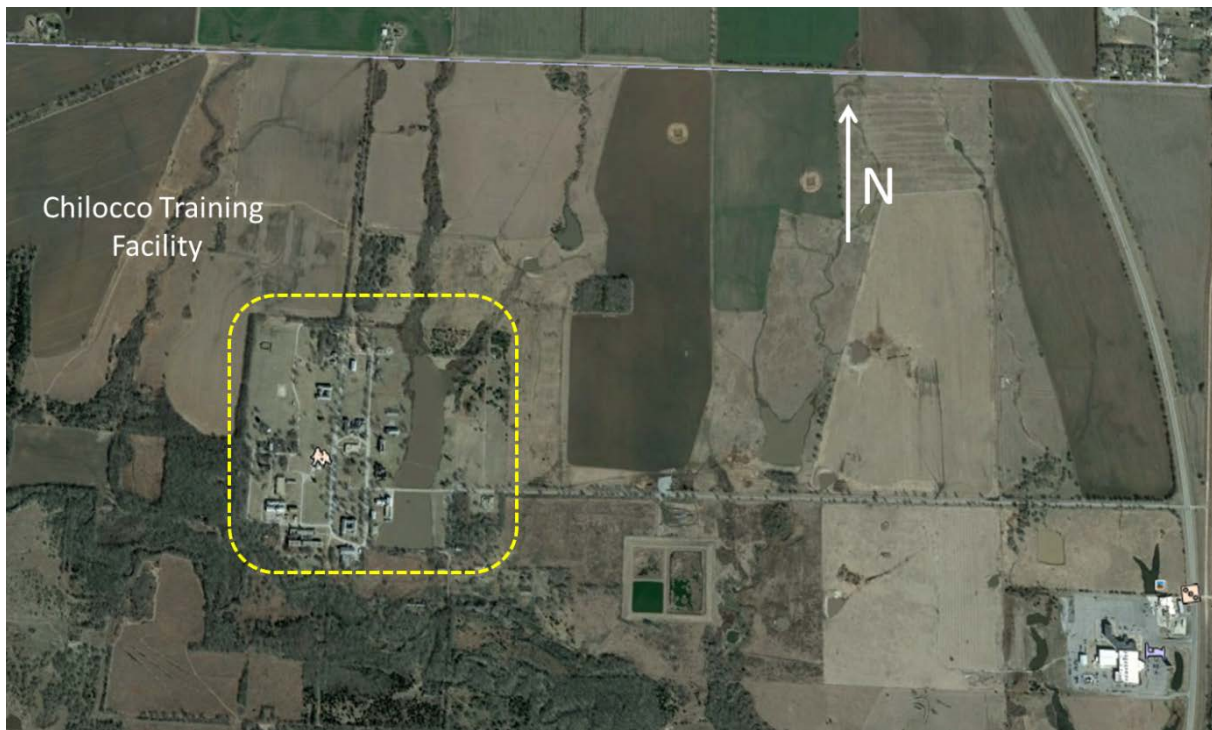


Figure 1. Google image of the Chilocco Indian School and surrounding land.

Particulate release at the site is designed to mimic that of an actual biological release and will be bound by the following conditions. These release conditions were developed to ensure that the aerosol cloud generated, with both inert and biological simulants, would provide a measurable signature that would then rapidly decrease below the Occupational Safety and Health Administration (OSHA) permissible exposure limits (PEL) values before reaching the property boundary, thereby these releases would pose no risk to public and minimal risk to the surrounding environment. These conditions include:

1. Access to site will be restricted to UML, Government staff, and contractors supporting this study.
2. The majority of personnel participating in the study will be positioned outside and upwind of the release zone (south side of campus).
3. Personnel conducting the release will be outfitted in personal protective equipment (PPE) such as Tyvek suits, masks and gloves.
4. Any personnel required to be in areas potentially above the OSHA PEL shall be provided respirators.
5. The release position will be maximized in distance from the nearest pond and any aquatic life.
6. Each release will be performed under fair weather conditions such as clear skies with no precipitation forecasted.

7. Wind direction will be from the south traveling north between the speeds of 2 to 12 mph.
8. The total particulate matter disseminated will be limited to 600 grams or less over a 10-minute period per release event.
9. Releases will only take place when there are no people conducting agricultural activities in the fields north of campus.

Given the boundaries above, the following imagery depicts two positions that would be ideal aerosol release points, Figure 2 and Figure 3. Each of the buildings in this photograph is unoccupied and not accessible to the public. Position A is located approximately 30 meters south of building 58, a single story three-bedroom residential home. Position B is located within 30 meters (98 feet) of building 60, a two-floor apartment complex. Both structures are more than 100 meters (328 feet) from the property fence line, and more than 175 meters (574 feet) from the nearest body of standing fresh water with aquatic life. Wind speeds during each release must be constant and traveling from south to north with average wind speeds from 2 to 12 mph.



Figure 2. Google Earth image of release Position “A” approximately 20 to 40 meters due south of residential house denoted as building 58. This building south side is approximately 135 meters from the north fence line and 240 meters from the nearest pond.



Figure 3. Google Earth image of release Position “B” approximately 20 to 40 meters due south of the small apartment complex denoted as building 60. This building south side is approximately 150 meters from the north fence line and 175 meters from the nearest pond.

The release material, in all cases, will be particulates with mean aerodynamic particle size of 5 μm (microns, or micrometers) and range of 4-7 μm . Particulate matter will be released as dry or wet aerosols at release Positions A and B. Wet aerosol dissemination will be performed using purified water that will rapidly evaporate upon dispersal. Dispersion rates during a release will maximize up to 60 grams of particulate matter per minute over a 10-minute time period, for a total dispersion up to 600 grams (1.3 lbs). Airborne particulate matter is governed by the EPA under the Clean Air Act National Ambient Air Quality Standards (NAAQS) (40 CFR part 50). The Clean Air Act identifies two types of national ambient air quality standards. *Primary standards* provide public health protection, including protecting the health of "sensitive" populations such as asthmatics, children, and the elderly. *Secondary standards* provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. The mean diameter of the particulates being released fall in the range of 2.5 - 10 micrometers (μm) in diameter, so releases fall under PM10 category. PM10 defines the regulatory limit as a release concentration of 0.150 mg/m^3 over a 24-hour period. Based on duration of the release event that only occurs for 10 minutes, and the relative size of the plume that will be generated, this test is below the limit for a 24-hour period. Each release event will be separated by a time period (hours to days) to allow the particle background in the air surrounding the building to decay to pre-release levels. A total of three biological release events are proposed over a one to two-week period for each building. Table 2 is an example of the proposed maximum release quantities and scheduling of releases for each building. The release events identified in the table will performed in high humidity season (summer months between July and August) and in low humidity season (winter months between December and February).

Table 2. Tentative quantities and release schedule for each building type* (subject to revision).

Release Event	Day	Detector Suite	Grams of TiO ₂	Grams of Bt	Grams of Urea with 10% Brightener	Sampling Window	Simulant Release Window
1	Mon	RTP	600	0	600	TBD	TBD
2	Tues	RTP	600	0	600	TBD	TBD
3	Wed	RTP	600	0	600	TBD	TBD
4	Mon +1 week	DFU/IBAC/HVAS	0	600	0	TBD	TBD
5	Tues + 1 week	DFU/IBAC/HVAS	0	600	0	TBD	TBD
6	Wed + 1 week	DFU/IBAC/HVAS	0	600	0	TBD	TBD

Note that testing may be conducted on the weekend or in subsequent weeks if one or more of the weekday tests was postponed due to suboptimal weather conditions

TBD- to be determined through modeling of current weather conditions

Detector Suite: RTP, real time particle counter; DFU, dry filter unit collector for qPCR; IBAC, instantaneous bioaerosol analyzer and collector; HVAS, high volume air sampler

This effort involves pre-characterization of building particulate permeability using inert particles, followed by biological particulate release. These inert and biological materials are nontoxic to both the public and environment at the concentrations being released. While the biological modified material offers the greatest sensitivity and added advantages of being able to track movement and migration of particulates to the surrounding infrastructure over time, use of inert materials for particulate releases offers significant cost and time benefits as opposed to conducting all of the testing with biological modified material. Once released, commercial sensors and collection equipment will be used to measure the particulates outside and inside the buildings of interest. The majority of these sensors weigh 1 to 10 lbs, and are mounted on camera tripods. These sensors include portable real time particle counters (RTPs), dry filter cassettes, (DFUs), personnel cascade impactors, biological impactors, high volume aerosol samplers (HVAS), and real time fluorescent particle counters, Instantaneous Bioaerosol Analyzer and Collector (IBAC) units.

Table 3. Instruments to be employed in data capture during and post release

Instrument	Data	Flow Rate	Particle Size Range (µm)
High volume air sampler (HVAS)	Off Line	100 L/min	Range: 1-20
RTP (TSI) AeroTrak	Real Time	2.83 L/min	Range: 0.3-25 2 Bins: 0.3/0.5 4 Bins: 0.3/0.5/1/5
IBAC (DHS)	Real Time	3.8 L/min	0.7 and above
Marple Impactor	Off Line	2 L/min	21.3 and above, 14.8, 9.8, 6.0, 3.5, 1.55, 0.93, 0.52 and final PVC filters
Dry filter/ cassette filter units	Off Line	2 L/min	Gross particulate collection on polycarbonate filters

2.2 Site Selection

DHS chose UML to be the performer on this project based on their experience, capabilities and facilities. UML has a unique infrastructure that includes an abandoned town (Chilocco Campus: with over 30 buildings) and access to a multistory (eight floor) abandoned high rise complex. This one of a kind infrastructure will be augmented by UML's subject matter expertise in areas of microbiology, aerosol and chemical detection, as well as by experienced program managers that have participated in, or led similar test campaigns, for other government agencies.

The buildings on the Chilocco campus used in this program include characteristics that are representative of residential and apartment buildings within the United States. Additional characteristics desired for test buildings include:

- minimal proximity to the public,
- unoccupied from daily use,
- have release positions in the predominant wind direction,
- no obstructions within 20 meters of the building,
- centrally located to campus to ensure plume dissipation below PEL prior to migration off campus,
- maximize distance from nearby pond and any aquatic life,
- the ability to environmentally sample the building over a course of hours to weeks, to months, with limited human movement traffic at or around the structure.

For HODOR testing, two buildings on the Chilocco campus were selected: one representative of a house; and one representative of an apartment building.

2.2.1 Building Alternatives

Three residential structures at the Chilocco campus were considered for use in the HODOR testing and are presented in Figure 4. The buildings are located in the north end of campus as highlighted in Figure 4A. Potential obstructions around each building can be seen in Figure 4B. All of these single family homes would require repairs prior to testing to bring each up to typical US building codes and standards. Building repairs included replacement of doors, windows, repair of roofs, and internal HVAC system. None of these buildings are inhabited.



Figure 4. Satellite images of the Chilocco campus denoting the (A) area where these potential homes are located. Image (B) provides a high magnification of the location of each home and surrounding structures that may impact testing.

2.2.1.1 Residential Building Alternative 1 - Building 53

Building 53 is located on the northernmost edge of the Chilocco campus. It is surrounded by a thicket of trees and scrub brush. While the building is of reasonable construction, having been repaired within the last 5 years, its location was determined to be unacceptable for testing. This building is surrounded by obstructions that include nearby buildings, trees, and scrub brush on three out of four sides. Although the structure is the furthest away from the nearby pond, it is within 30 meters of the property line. Release of material from the immediate south could result in the possibility of the plume movement beyond the property line, denoted as the fence line in Figure 4B, with concentrations above PEL limits.

2.2.1.2 Residential Building Alternative 2 - Building 56

Building 56 is a single family home located south of Building 53. It is 100 meters from the property fence line, and more than 250 meters from the nearby pond. It is in a state of extreme disrepair, and would require extensive renovation. This building was also surrounded by obstructions that include nearby buildings, trees, and scrub brush on four out of four sides. For these reasons it was not selected.

2.2.1.3 Residential Building Alternative 3 - Building 58

Building 58 is the southernmost residential building on the north end of campus. This house meets all the preferred criteria, has few obstructions and is located closest to the center of campus. The site is more than 100 meters from the property fence line, reducing the risk of plume movement, and is approximately 200 meters from the nearest surface water. The building required minimal repairs to comply with typical U.S. building standards. Repairs were

conducted by UML through consultation with the CCCT THPOs in compliance with the business lease agreement. Building 58 is the residential building preferred alternative for HODOR testing.

2.2.2 Building Selection - Apartment Building Alternatives

Two different apartment buildings on the Chilocco campus were proposed to support HODOR testing. Both buildings are centrally located on campus more than 150 meters from the campus's property line. They are unoccupied and were renovated by UML within the last decade to meet typical U.S. building standards.



Figure 5. Satellite images of the Chilocco Campus highlighting the location of apartment buildings (A) building 60 and (B) building 10.

2.2.2.1 Apartment Building Alternative 1 - Building 10

Building 10 is located on the southern end of campus. In 2011, the building underwent interior refurbishment to simulate single dorm rooms, and included the use of a building-wide heating, ventilation, and air condition (HVAC) system. This is not a reasonable representation of an

apartment building, which typically utilizes multiple HVAC systems to service rooms. Building 10 is also surrounded by larger buildings on three sides that would limit the dispersion to a smaller area. This building is also within 30 meters of surface water.

2.2.2.2 Apartment Building Alternative 2 - Building 60

Building 60 is located at the northern end of the Chilocco campus directly across from Building 58. This building has eight, one bedroom apartments, each with approximately 600 ft² of floor space. Each apartment has more than six windows and its own centralized HVAC unit. This building is centrally located more than 150 meters from the north fence line and 175 meters from the pond. There are limited obstructions on three out of four sides of the building, with the south side being unobstructed to support better dissemination. As such, Building 60 is the chosen preferred alternative as an apartment building for HODOR testing.

2.2.2.3 No Action Building Site Alternative

Under the No Action Site Alternative, S&T would be unable to meet its stated purpose and need to conduct outdoor release testing to characterize the BPF of residential and apartment buildings for protecting the public. The data collected from the test event will assist in national security/emergency preparedness by enabling refinement and improving the fidelity of dispersion models; therefore, the no action alternative is not preferred.

2.3 Inert Particulate Tracer Alternatives

The use of inert particulate materials provides extremely valuable information toward the overall objectives of the HODOR program. Two different kinds of inert materials (P1 and P2) will be used to monitor gross particle movement around and into each building, in real time, using relatively simple and straightforward sensors. These sensors use a small embedded air pump and enclosed optical sensor to sample air for determining the number, size, and fluorescence properties of airborne particulates. The data collected with inert particle materials will be used to optimize sensor placement for subsequent biological particulate releases. This will minimize the number of types and amount of barcoded biological material released into the environment. The details about sensor setup and analyses are beyond the scope of this document, but are identified in Table 3. For inert releases, decontamination of each building would not be required because these materials are nontoxic and not regulated. Of the 600 grams of particulates released, only a small fraction will deposit on the building surface, ~20%, while only a sub-fraction, < 1%, will penetrate into the building. At these levels the release materials will be similar to nuisance dusts and season pollens.

2.3.1 Inert Particulate Alternative P1 – Preferred Alternative 1

The first preferred inert particulate alternative (P1) for aerosolization is titanium dioxide (TiO₂). The titanium dioxide (TiO₂) proposed for this study is identified by Chemical Abstract Service (CAS) registry number 13463-67-7. It is a white odorless powder that is chemically insoluble in water, nonreactive, nonflammable, and nonhazardous. This material is not regulated or defined

as a toxic or hazardous material. Its use is ubiquitous throughout the world in paints, coatings, sunscreens, cosmetics, and the food industry. Possible routes of entry into the body are through ingestion or inhalation, and it is defined as a nuisance particulate with accumulation in lungs. The National Institute for Occupational Safety and Health (NIOSH) and OSHA defined the PEL of respirable TiO_2 as 15 mg/m^3 for an 8 hour time weighted average (TWA). Immediately Dangerous to Life or Health (IDLH) for titanium dioxide is defined as $5,000 \text{ mg/m}^3$ based on being 500 times the OSHA PEL of 10 mg/m^3 promulgated in 1989. The current IDLH value is based on the 1989 PEL value of 10 mg/m^3 , and not the 2017 PEL value of 15 mg/m^3 per <https://www.cdc.gov/niosh/idlh/13463677.html>. OSHA Health Code and Health Effects categorize TiO_2 particulates as HE19, which is defined as “Generally Low Risk Health Effects-Nuisance particulates, vapors or gases”. Titanium dioxide is not listed under the United States Environmental Protection Agency (EPA) Consolidated List of Chemicals Subject to Emergency Planning and Community Right-To-Know Act (EPCRA), Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), or Section 112(r) of the Clean Air Act.

2.3.2 Inert Particulate Alternative P2 – Preferred Alternative 2

The second preferred inert particle alternative (P2) is urea powder homogeneously mixed with 10% weight of CI Fluorescent Brightener 220. This powder was used in a previous Department of Energy Study. Supplementary information from this study that documents its toxicology is summarized here.³ Urea serves an important role in the metabolism of nitrogen-containing compounds by animals and is the main nitrogen-containing substance in the urine of mammals. The average adult excretes 20 grams of urea per day, the proposed release would equate to releasing the urine from 27 adults (~1 lb) into a 1.5 acre area.³ More than 90% of world industrial production of urea is destined for use as nitrogen fertilizer at application rates of 10 lbs per acre. As an additive, urea is found in gum, wine, and cosmetic powders of weight percent up to 10%. Urea powder, CAS 57-13-6, is a colorless, odorless solid, highly soluble in water, and practically non-toxic (LD_{50} is 15 g/kg for rats). OSHA has defined the PEL for respirable dusts of urea as 5 mg/m^3 .^{3,4} OSHA Health Code and Health Effects categorize urea particulates as HE15, which is defined as “Moderate Irritation to Nose, Throat, and Skin”. When released into the air it is expected to have a half-life of less than one day. It is also important to note that any inhaled urea particles will dissolve and be rapidly removed by the body’s natural processing of urea.⁵

Optical brighter, such as CI Fluorescent Brightener 220, CAS 16470-24-9, is a finishing reagent in textiles, and up to 2% by weight in laundry detergents. Because it absorbs ultraviolet light and emits visible light, it makes clothing and paper appear brighter and whiter. The report of the Ecological and Toxicological Association of Dyes and Organic Pigments Manufacturers (ETAD), submitted to the U.S. EPA High Production Volume (HPV) Chemicals Challenge Program, and accepted by the EPA, summarizes the results of published toxicology studies on CI Fluorescent Brightener 220 and related optical brighteners. According to the studies summarized in the report, these materials are generally not irritating to skin and eyes; toxicity studies in male and female Wistar rats showed that oral doses up to $15,000 \text{ mg per kg body weight}$ (the highest level tested) resulted in no fatalities. Toxicity studies of a related brightener (CI Fluorescent

Brightener 263, CAS No. 67786-25-8) reported no deaths and no signs of toxicity in male and female Wistar rats, male NMRI mice, female New Zealand white rabbits, and female beagle dogs orally administered 2500, 1000, 1000 and 500 mg/kg (respectively). In inhalation toxicity studies, Wistar rats were exposed for 4 hours to 163, 375, 1,225 and 1,895 mg/m³ of CI Fluorescent Brightener 28/113 (CAS No. 4404-43-7) (the latter being the maximum attainable concentration). No mortalities occurred in any group. At doses of 1,225 and 1,895 mg/m³, a transient reduction of the general condition of the rats was observed for 4-6 hours. No further clinical symptoms were seen and at the end of the 14 day observation period no findings were noted in pathological examinations. In a similar study, rats exposed to 2,900 mg/m³ of CAS No. 13863-31-5 for 4 hours did not result in mortality of any of the 10 animals tested. Animals appeared healthy during the 14 days following exposure and had normal weight gains. Once released the material will hydrolyze and then accumulate into soils and undergo hydrolysis and photolysis. The decomposition products of both are not fully known. If released into water they are toxic to fresh water aquatic species at concentrations greater than 100mg/liter.³ For this effort, we will be performing 12 release events consisting of 540 grams of urea mixed with 60 grams of CI Fluorescent Brightener 220. These 12 iterations are based on three releases, for each of the two buildings, for both summer and winter seasons and equates to a total of 720 kg of CI Fluorescent Brightener 220. If this full amount of 720 kg were released directly into the nearest fresh water pond all at once and not decompose, the estimated concentration would be less than 0.1 mg/liter, which is 1,000 times lower than the concentration toxic to aquatic life.

2.3.3 No Action Inert Particulate Alternative P3

The no action inert particulate alternative (P3) would eliminate conducting *in-situ* particulate releases at the building test sites. If the no action alternative is taken, optimizing placement of biological sensors will not be possible and it will reduce the likelihood of program success due to missed detections. In addition, it would increase the number of barcoded biological material releases and would require additional labor to decontaminate each from each site between releases. These factors would increase both programmatic cost and time and is not a preferred alternative.

2.4 Biological Particulate Tracer Alternatives

In conducting testing of this nature, it is important to attempt to replicate, as closely as possible, what would happen in the event of a biological attack. Ideally, testing may be conducted using nonpathogenic, safe, but still live, biological materials, or simulants. A number of simulants are available. One is *Bacillus thuringiensis*. It forms dormant structures called spores. These spores a specific size and shape, and, as described in a preceding section, very specific methods exist to detect and identify these organisms. For these tests, the challenge comes in differentiating the released biological organism from other naturally occurring organisms, pollens, molds or those used in agricultural applications (biopesticides). Barcoded spores from Btk offer a simple method for genetically distinguishing the harmless released organism from background.

2.4.1 Biological Particulate Alternative BP1 – Preferred Alternative

The preferred biological particulate alternative is a barcoded *Bacillus thuringiensis* subsp *kurstaki* (Btk). Specifically, the unmodified Btk is American Type Culture Collection (ATCC) strain 33679, the HD-1 strain (serotype 3a3b), that is registered with the EPA as an approved biopesticide under the commercial name of Dipel. Btk has been registered for use as an insecticide since 1971, and has undergone reregistration in 1998 and is currently being reviewed as part of periodic reevaluation of registered products to assess risk as science, policies, and practices change. All registered products continue to meet the statutory standard of no unreasonable adverse effects, when employed as approved, to human health (including occupational and non-occupational exposures) or the environment (environmental fate and non-target organism).⁶ The U.S. Department of Agriculture/U.S. Forest Service gypsy moth suppression program use of Btk, along with other agrichemicals and biological controls, was evaluated for environmental, health, and safety concerns in a 1995 Environmental Impact Statement (EIS), and again in a 2009 supplemental EIS (SEIS). In this document, more than one million pounds per year of Btk spores were applied annually over an average of 343,000 acres in the USA for the control of the gypsy moth from 1995 to 2002.⁷ From 2003 to 2006, an additional 200,000 plus acres per year have been treated.⁸ The 2009 SEIS updated the 1995 EIS prepared for the Human Health and Ecological Risk Assessment for Btk in aerial applications for gypsy moth suppression. Typical agricultural application of Btk under the trade name of Dipel is on the order of 8 lbs of dried material per acre.⁹

Edgewood Chemical Biological Center (ECBC) designed and introduced a series of 46-bp sequences into specific places on the Btk genome to create special “barcoded” spores. The sequences were introduced into regions between genes, chosen to minimize the potential of disrupting any protein-coding genes or regulatory sequences which could affect the phenotype (what it looks like) or physiology (what it does) of the organism. The 46-bp sequence constitutes a “barcode” which creates a unique identifier that is paired with a chromosome. The design allows for the use of a tailor-made quantitative Polymerase Chain Reaction (qPCR) assays for specific spore detection and differentiation. The barcode does not do anything, other than being present as a unique DNA identifier. The 46 bp region is stably integrated into the chromosome of the host bacteria. There are no new secretions, products or altered growth characteristics in organisms harboring these barcodes.¹⁰ Barcoded Btk spores, as described here, have been approved by the State of Oklahoma Department of Agriculture, Food, & Forestry for a Biotechnology Use Permit (OK-2017-0001) for use in all aspects of the HODOR testing program. Particulate Alternative BP1 is the preferred alternative because of its characteristics that make it a simulant to mimic a biological agent along with the unique barcode identifier.

2.4.2 Biological Particulate Alternative BP2

Another biological particulate alternative (BP2) is the native Btk organism (ATCC strain 33679), without the addition of DNA barcodes. This has the advantage of still being a biological spore that closely matches a real world biological release. However, without the DNA barcode, each

release must be followed by a thorough decontamination of the inside and outside of the building. This is to remove excess spores so that there is no background level of spores that would contaminate the detectors or collection filters and cause inaccurate results in subsequent releases. Decontamination entails a thorough bleaching of all inside surfaces where spores could collect. After the bleach treatment, all surfaces would have to completely dry so that future releases do not adhere to wet surfaces. Bleaching of the soil is impractical, and creates additional issues with toxicity to local flora and fauna. This means that each release would require much more time and labor to execute, therefore, Particulate Alternative BP2 is not preferred.

2.4.3 Biological Particulate Alternative BP3

The third biological particulate alternative (BP3) is a tagged, inert, fluorescent particle known as DNATrax. Because biological particles are naturally fluorescent, in some cases, other particles that fluoresce can be used as their substitutes. DNATrax is a sugar based biological simulant that is composed of maltodextrin encapsulated non-biological DNA oligonucleotides (~100 base pairs). DNATrax, originally developed as a biological simulant for aerosol testing, has since been developed for food labeling and has been classified by the FDA as Generally Recognized As Safe (GRAS). The primary component, maltodextrin, is used in several commercially available food products such as sweetening agents (e.g., Splenda®) and protein shakes. The DNA oligonucleotide sequences, selected from natural sequences, do not produce proteins and are considered to be safe. DNATrax particles are fluorescent particles that have a mass median aerodynamic diameter (MMAD) of 1 – 10 µm, which is considered respirable. The DNATrax-particles (including the primary component maltodextrin) are not listed explicitly by OSHA; assumption of its safety cannot be assumed. The use of this alternative would be less comparable to an actual biological attack, as well as being cost prohibitive. This is not the preferred alternative.

2.4.4 No Action Biological Particulate Alternative BP4

While the No-Action Biological particulate (BP4) would still allow the primary objectives of the tests to be met through use of inert particles only, it is not recommended. Use of the inert particles requires larger quantities of inert powder in order to overcome the natural background of particulates internal and external to the building. In order to simulate real world data that more closely matches a biological release, releases of an actual biological nature, with far fewer particulates need to be executed.

3 Affected Environment

Several US building locations were considered to host the measurements. The three main criteria in selecting a venue for this study were as follows:

- A variety of building scales with known characteristics of interest.
- Buildings that are representative of those found in the U.S.

- A system in which research studies on the modeling of airflows, particle transport dynamics, and assessments of normal background conditions can be carried out.

The house and apartment building test beds are located at the abandoned Chilocco Indian School, Newkirk, OK. Testing is addressed under the Bureau of Indian Affairs (BIA) approved business lease agreement. The planned program was briefed to the OK Secretary of Agriculture, the OK Secretary of Science and Technology, and members of their staffs. The OK Department of Environmental Quality declined to participate in the meeting after reviewing the briefing and stated to the Secretary of Agriculture that they did not believe the program fit into their area of oversight. Following the meeting with the OK Secretaries, an OK Biotechnology permit was applied for and approved for the release of barcoded spores in accordance with the HODOR program.

3.1 Chilocco Overview

The proposed project location is the Chilocco Indian Agricultural School, which is located adjacent to the intersection of U.S. Highway 77 and EOO18 Road, approximately 7 miles north of the town of Newkirk, OK and approximately 6 miles south of Arkansas City, KS. UML is a non-profit research laboratory supporting national security programs for various state and federal agencies to include the Department of Homeland Security, Oklahoma Army National Guard, and the Department of Defense. To support these testing and training programs, UML has entered into a lease agreement with its land holders, the Council of Confederate Chilocco Tribes (CCCT), to use the Chilocco Indian Agriculture School Campus. The CCCT was established on August 2, 2000 under the Chilocco Treaty with the Kaw Nation, the Otoe-Missouria Tribe, the Pawnee Nation, the Ponca Nation, and the Tonkawa Tribe. These five Native American Governments work jointly to oversee and manage the campus which was once the Chilocco Indian Agriculture School. The school was active from 1884 through 1980, with construction of various buildings over its 100 year time period. Although building materials vary from stone to wood to metal, for the most part each is united by a common use of limestone. Individual buildings have been altered over time, primarily reflecting the continued use of the school until its closing. Upon closing, this large infrastructure was open to deterioration from natural elements. In 2006, the campus was listed on the National Register of Historic Places.



Figure 6. Aerial photograph of the Chilocco Campus.

3.2 Air Quality

The Clean Air Act (CAA) of 1970 requires that states adopt ambient air quality standards. The CAA (42 USC 7401 et seq.) establishes ambient air quality standards, permit requirements for both stationary and mobile sources, and standards for acid deposition and stratospheric ozone (O₃) protection. The standards have been established to protect the public from potentially harmful amounts of pollutants. Under the CAA, the EPA establishes primary and secondary air quality standards. Primary air quality standards protect public health, including the health of “sensitive populations, such as people with asthma, children, and other adults.” Secondary air quality standards protect public welfare by promoting ecosystem health, and preventing decreased visibility and damage to crops and structures. EPA has set National Ambient Air Quality Standards (NAAQS) for the following six criteria pollutants: O₃, particulate matter (PM₁₀, PM_{2.5}), nitrogen dioxide (NO₂), carbon monoxide (CO), sulfur dioxide (SO₂), and lead (Pb). Greenhouse gases (GHG), water vapor, carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O) are also regulated and have been linked to global climate change.

According to the EPA, no counties in Oklahoma are classified as nonattainment areas for criteria pollutants. These counties, due to their rural nature, maintain good air quality and visibility throughout the year. This includes Kay County, where the subject test buildings are located¹¹.

3.2.1 Potential Impacts to Air Quality

Based on the existing air quality of Kay County, typical air levels and types of emissions from the proposed testing would not produce significant increases in criteria pollutants, GHGs, or hazardous air pollutants (HAPs). The proposed testing will not contribute to emissions occurring within the region. The proposed testing is not expected to impact attainment status based on any of the primary and secondary NAAQS for criteria pollutants or other regulated air emissions. Contribution of the proposal to incremental increases of unregulated GHG emissions is expected to be negligible¹¹. The releases of particulate materials and biological simulants are relatively small in scale and will fall under PM₁₀ guidelines. The proposed testing would not impact air quality due to the use of non-toxic materials that are not regulated through the Oklahoma Department of Environmental Quality or the EPA. No significant adverse impacts to air quality resources are anticipated.

3.3 Water Resources

3.3.1 Potential Impacts to Surface Water

The project area is located approximately 470 feet north of Chilocco Creek in Kay County. Chilocco Creek continues downstream to the east where it joins the Arkansas River approximately 13 miles east/southeast from the Chilocco campus. Chilocco Creek is a perennial stream located in Kay County, Oklahoma. Chilocco Creek resides within the Kaw Lake watershed. This watershed consists of approximately 610,412 acres. Chilocco Creek is approximately 16.31 miles in length and is listed by the Oklahoma Department of Environmental Quality as Impaired. Causes of impairment for Chilocco Creek are: *Enterococcus*

bacteria, Escherichia coli (E. coli), and turbidity. A large fresh water pond is located on the 0.1 miles to the east from the release site. Due to the limited amounts of nonhazardous and/or nonregulated materials to be used and the distance from this pond, testing would not impact aquatic life, hence is of no impact.

3.3.2 Potential Impacts to Floodplains

“The Flood Insurance Rate Maps (FIRM) were reviewed for the project area at the Federal Emergency Management Agency (FEMA) website. Four (4) permanent structures are within a regulated Zone A floodplain. (See Appendix G - Floodplain and Wetland Plat) These structures, however, were constructed prior to floodplain concerns.”¹¹

No structures that exist in the floodplain are intended for use in the proposed testing, therefore, no impact to floodplains is anticipated.

3.3.3 Potential Impacts to Wetlands and U.S. Waters

Under Executive Order 11990, each agency shall provide leadership and shall act to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities for conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating and licensing activities. The U.S. Fish and Wildlife Service National Wetland Inventory maps were consulted for the project area. The method used in this Environmental Assessment to determine if an area is a wetland has been described in Section D of the US Army Corps of Engineers Wetlands Delineation Manual. Generally, to be classified as a wetland an area being observed must satisfy three criteria: hydrophytic vegetation, hydric soils, and wetland hydrology¹¹”.

One emergent, scrub-shrub wetland, one surface water (pond described in previous section) and one ephemeral stream (Chilocco Creek) are located within 0.1 mile of the proposed project area; however, no impact is anticipated from testing activities. Because jurisdictional wetlands or other waters of the U.S. are located not within the HODOR testing area; therefore a Section 404, Clean Water Act permit is not required.

3.4 Vegetation

The materials disseminated may settle on vegetation. The Chilocco testing area is described below.

“The project area is situated in the Prairie Tableland Level IV ecoregion, within the Central Great Plains region. The project area is located in a cleared and landscaped area adjacent to sparsely wooded areas utilized for livestock grazing. However, the primary vegetation of the Central Great Plains can still be represented in areas left untouched by the development of cultivated fields. Species consistent with riparian corridors such as pecan (Carya illinoensis), hickory (Carya texan a) and American elm (Ulmus Americana) can still be found along with associated forbs and grasses.”¹¹

Vegetation in the testing activity area is consistent with that of heavily disturbed areas in which constant mowing and vegetation control occurs. At the release levels identified, inert materials such as TiO₂ and urea will not harm this vegetation. TiO₂ is chemically inert and will wash off of vegetation surfaces to entrain into the soil at concentrations below reportable limits for the EPA. The amount of urea being released is below the manufacture application rate as a fertilizer and will provide a source of nitrogen for vegetation growth. There is no indication that optical brighter released at the levels defined would be hazardous to plant life. Btk will have no impact on the vegetation as the genetically unmodified variant, Dipel, is dispersed in higher quantities as an insecticide on agricultural crops and vegetation.

3.5 Conclusions

The testing activities have been bounded in order to mitigate any possible effects of the proposed particulate releases. Table 4 identifies the total amount of each simulant that will be released during this study. There will be up to three releases of each material at each Position, A or B, one time during the summer and once timer during the winter. In all cases, release amounts and downwind exposure amounts of the inert particles (TiO₂ and the urea-CI Fluorescent Brightener 220 mixture) and the barcoded spores are lower than PEL (TiO₂), recommended application rates (urea, barcoded spores), and estimated toxicities (CI Fluorescent Brightener 220) to the test environment as detailed in sections 2.3.1, 2.3.2, 2.4.1 and 2.3.2, respectively. It is therefore concluded that the potential for environmental impact to the proposed tests with the proposed materials is minimal.

Table 4. Total Amount of material released.

Simulant Material Description	Position A House Releases	Position B Apartment Releases	Weight per release (grams)	Test Events Two iterations (Summer/Winter)	Cumulative Amount Total amount during course of Program
TiO ₂	3	3	600	2	10.8 kg
*Urea with	3	3	540	2	9.7 kg
*CI FB 220			60	2	1.1 kg
Btk (barcoded Spores)	3	3	600	2	10.8 kg

* Urea and CI Fluorescent Brightener 220 are released as a mixture using a weight percent of 90:10

4 Environmental Consequences of Implementing the Alternative Actions

This section will discuss all human health and safety effects related to the release of particulates and biologicals during the planned testing.

4.1 Human Health and Safety Effects

Personnel contact with particulates and biological alternatives is expected to occur and includes potential for inhalation, ingestion, and dermal contact. Additional potential for contact may occur following testing from possible re-aerosolization of the particulate material due to air movement within buildings. A discussion of the anticipated upper bounds of test material

exposure will first be discussed. The environmental consequences of the selected individual particulate and biological alternative will then be discussed within their individual health related studies and the planned population exposure.

4.1.1 Human Health and Safety Effects from Particulate Releases

As stated earlier, the maximum amount of particulate material released over ten minutes is limited to less than 600 grams (dry weight) released as either powders or liquid aerosols per release. The release material will be particulates with mean aerodynamic particle size of 5 microns and range of 4-7 microns. Dispersion rates during a release will maximize up to 60 grams per minute over a 10 minute time period, for a total dispersion up to 600 grams (1.3 lbs). The material released will not impact the particulate matter for the area as governed by the EPA under the Clean Air Act National Ambient Air Quality Standards (NAAQS) for Particulate Matter (40 CFR part 50). The Clean Air Act identifies two types of national ambient air quality standards. Primary standards provide public health protection, including protecting the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. Based on the mean diameter of the particulates being released ranging from 2.5 to 10 micrometers (μm) in diameter, these releases falls under PM10 category. PM10 defines the regulatory limit for ambient air concentration of 0.150 mg/m^3 over a 24 hour period. Each release is currently planned as a transient event which will be completed within 10 minutes.

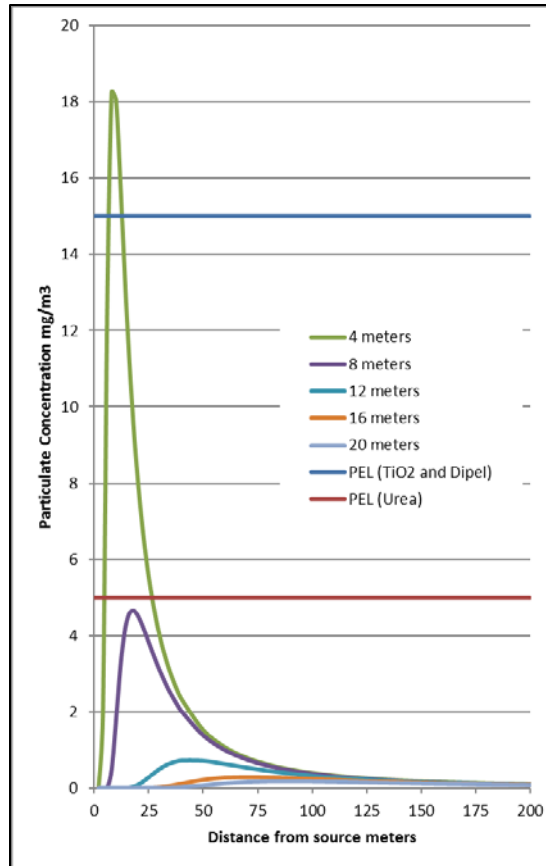


Figure 7. Concentration of particulates as a function of distance from the source and height from the ground.

The releases will be conducted under bounded meteorological conditions to maximize the movement of materials toward the structures of interest. HPAC modeling recommends that the release be conducted in the evening for optimal weather conditions, further limiting the presence of personnel to those conducting tests. All personnel involved in testing will remain upwind of the release and out of PEL concentrations. As stated above, the EPA has set a health-based national ambient air quality standard for daily outdoor PM₁₀ content at 0.150 mg/m³.

A Gaussian plume model was used to approximate the concentration of the particulate matter emanating from point source disseminator at Position A or B (as described in Section 2.1). The model assumes negligible diffusion in one direction of travel as the wind is blowing continuously from south to north while particulate matter is dispersed at a rate of 1 g/second or 60 grams per minute.

Using Gaussian plume modeling, the concentration of particulates released from a point source at a rate of 1 gram/second was calculated assuming near neutral atmospheric stability, Figure 7. As previously stated for TiO₂, urea with OB, and Btk (commercial variant, Dipel) the PEL was established by OSHA to be between 5 (Urea) to 15 mg/m³ (TiO₂ and Dipel). Figure 7 is a plot of the particulate matter concentration generated by a disseminator six feet from the ground at a

wind speed of 2 mph at various heights above ground with increasing distances from the source. At the source the IDLH value of 5,000 mg/m³ is never reached and the plume decays to below the PEL value of 15 mg/m³ within 16 meters at a 2-meter stack height for TiO₂ and Dipel and 28 meters for the urea (PEL value of 5 mg/m³). As distance from the release point increases the plume concentration continues to decay. At the property fence line, the particulate concentration has decayed to less than 0.2 mg/m³ which equates to 4% of the OSHA PEL value for urea and 1.3% of the OSHA PEL value for TiO₂ and Dipel. At the nearest dwelling, 1 km north of the release site, the concentration is estimated to be 0.004 mg/m³, or less than 0.1% of the OSHA PEL value for each of the particulates. This value is a worst-case concentration because it assumes that the plume particulates will move unobstructed in a straight line, without the structure being in the way and without gravimetric settling. The OSHA PEL value is based on an 8-hour work day, yet the dissemination is occurring for only 10 minutes. Based on these values, the generated plume does not pose significant health risk for the public outside of the Chilocco property. Participants supporting these test events that are within 30 meters and downwind of the release point will be provided respiratory protection. Outside of a 20-meter boundary exposure to the 10 minute release is below PEL and respiratory protection is optional.

The plot in Figure 7 was constructed using the highest dissemination rate of 60 grams of particulates per minute (1 g/sec) and a wind speed of 2 mph. Disseminating at lower rates will simply decrease the concentration of material being released at all distances and vertical heights. The wind speed will affect the resultant plume. Once again, the plot in Figure 7 represents the highest concentration expected. Any increases in wind speed will dilute the plume concentration of particulates. Table 4 demonstrates how the concentration decreases as a function of increasing wind speed.

Table 5. The concentration of particulates (mg/m³) in terms of increasing distance as a function of wind speed at dispersions rates of 60 grams/minute.

Distance from disseminator (meters)	Wind Speed 2 mph	Wind Speed 7 mph	Wind Speed 12 mph
10	39.1 mg/m ³	11.2 mg/m ³	6.52 mg/m ³
20	9.78 mg/m ³	2.80 mg/m ³	1.63 mg/m ³
150	0.174 mg/m ³	0.0497 mg/m ³	0.0290 mg/m ³
1000	0.0039 mg/m ³	0.0011 mg/m ³	0.0007 mg/m ³

4.1.1.1 Human Health and Safety Effects from Particulate Alternative P1

Particulate Alternative 1 is TiO₂. As referenced in Section 2.1.1, TiO₂ is ubiquitous in the modernized world, with uses in areas such as paints and coatings, sunscreens, cosmetics, and the food industry many orders of magnitude less than regulated amounts. As illustrated in Section 4.1.1, the human health and safety effects outside of the immediate test area are anticipated to be negligible based on low volume releases of materials and modeled concentrations well below the IDLH and PEL limits.

4.1.1.2 Human Health and Safety Effects from Particulate Alternative P2

Particulate Alternative 2 is the urea powder with 10% weight of optical brightener. As referenced in Section 2.1.2, urea is a common fertilizer while the optical brightener is a fluorescent whitening agent commonly used in printing inks, coatings, plastics, synthetic fibers, and many other types of products. Optical brightener has been FDA approved for use in many adhesives (21 CFR §175.105, 21 CFR §175.125), and in all polymer types (21 CFR §178.3297). The Materials Safety Data Sheet (MSDS) for optical brightener is provided in Appendix B. As illustrated in Section 4.1.1, the human health and safety effects outside of the immediate test area are anticipated to be negligible based on low volume releases of materials and modeled concentrations well below the IDLH and PEL limits.

4.1.2 Human Health and Safety Effects from Biological Particulate Material Alternative BP1

Biological Particulate Alternative BP1 employs barcoded Btk spores. The health and safety effects of this alternative have been deemed not presently a risk to human health and safety as evidenced by the recent issuing of a Biotechnology Permit from the Oklahoma State Department of Agriculture, Food, & Forestry for the amount of material to be released during the proposed HODOR testing. A copy of this permit and its corresponding application is attached in Appendix B. Handling and release of barcoded spores will be conducted by skilled technical personnel wearing appropriate personal protective equipment such as gloves, masks and laboratory coats. As illustrated in Section 4.1.1, the human health and safety effects outside of the immediate test area are anticipated to be negligible based on low volume releases of materials and modeled concentrations as there are no PEL limits for Btk.

4.2 *Environmental Effects on Wildlife*

An existing Environmental Site Assessment (ESA) was conducted as an environmental assessment (EA) by the BIA. It addresses the Migratory Bird Treaty Act of 1918 and other relevant statutes and regulations. This document details the entire Chilocco campus with a finding of no impact for various types of training and testing.¹¹

The release of test materials as described above are expected to have little to no impact on wildlife. This is illustrated by the few species that inhabit the testing area as well as fact that the concentrations of materials release are below those which will cause harm. In Kay County, migratory waterfowl such as ducks, herons, shorebirds, and geese are known to frequent areas around rivers, streams, ponds, wetlands and lakes. Additionally, wildlife attracted to these areas include beaver and otters. Upland game birds such as wild turkey, bobwhite quail, and dove species are plentiful and can be found in agricultural and prairie lands. Birds such as bald eagle, northern harrier, red-tailed hawk, red-bellied woodpecker, carolina chickadee, tufted titmice, and numerous warblers and sparrows also are common. Mammals include white-tailed deer, bobcats, coyotes, fox, rabbit, raccoon, squirrels, skunks and opossums.

Table 6. Endangered, Threatened and Sensitive Species.¹¹

Species	Status	Environmental Baseline for Potential Habitat	Potential Habitat Presence / Species Potential for Occurrence within the Project Area	Species Analysis Required	Determination of Effect
Interior Least Tern (<i>Sterna antillarum athalassos</i>)	Endangered (Federal)	Interior least tern inhabits barren to sparsely vegetated sandbars along rivers, sand and gravel pits, or lake and reservoir shorelines. The premier nestling sites are salt flats, broad sandbars, and barren shores along wide, shallow rivers.	No potential habitat present. No potential for occurrence within the project boundaries.	No further analysis will be required for this species	"No Effect"
Whooping Crane (<i>Grus americana</i>)	Endangered (federal)	Whooping crane habitat is in dense emergent vegetation (sedge, bulrush) in shallow ponds, freshwater marshes, wet prairies, or along lake margins, within large expanses of undisturbed wilderness. During migration between November and March, Whooping Cranes, are sighted in Texas along rivers in grain fields, or in shallow wetlands.	No potential habitat present. No potential for occurrence within the project boundaries.	No further analysis will be required for this species	"No Effect"
Red Knot (<i>Calidris canutus rufa</i>)	Proposed Threatened (Federal)	Red Knot breeds in the high Arctic on dry upland tundra including weathered sandstone ridges, upland areas with scattered willows and poppy, moist marshy slopes and flats in foothills, well drained slopes hummocked with <i>Dryas</i> spp. And upland glacial gravel close to streams or ponds. Outside of the breeding season the species is strictly coastal frequently tidal mudflats or sandflats, sandy beaches of sheltered coasts, rocky shelves, bays, lagoons and harbors, occasionally also oceanic beaches and saltmarshes.	No potential habitat present. No potential for occurrence within the project boundaries.	No further analysis will be required for this species	"No Effect"

Piping Plover (<i>Charadrius melodus</i>)	Threatened (Federal)	Piping plovers breed on sandy beaches along the Atlantic Coast, the Great Lakes and on river sandbars and islands, barren shorelines and inland lakes, and alkali wetlands in the northern Great Plains of Canada and the United States. Wintering primarily along Gulf Coast beaches from Florida to Mexico, along the Atlantic Coast from North Carolina to Florida, and on the Caribbean islands. Piping Plovers often roost on beaches huddled down in the sand, or behind driftwood or clumps of seaweed and other debris. They also roost among debris in wash-over passes created by hurricanes and storms on barrier islands and peninsulas.	No potential habitat present. No potential for occurrence within the project boundaries.	No further analysis will be required for this species	"No Effect"
Texas Horned Lizard (<i>Phrynosoma cornutum</i>)	Tracked by ONHI	Texas Horned Lizard habitat is found in flat, open desert and grasslands with little to no cover. They can be found in arid and semiarid habitats in open areas with sparse plant cover. Because horned lizards dig for hibernation, nesting and insulation purposes, they commonly are found in loose sand or loamy soils.	No potential habitat present. No potential for occurrence within the project boundaries.	No further analysis will be required for this species	"No Effect"
Alligator Snapping Turtle (<i>Macrochelys femminckii</i>)	Tracked by ONHI	Alligator Snapping Turtle live in freshwater areas. They generally live in deep waters of large rivers, canals, lakes and swamps. There should be no negative impacts from surface disturbance to this species since no favorable habitat exists at this site for the Alligator Snapping Turtles.	No potential habitat present. No potential for occurrence within the project boundaries.	No further analysis will be required for this species	"No Effect"
Arkansas River Shiner (<i>Notropis girardi</i>)	Threatened (Federal)	Arkansas River shiner generally occupies the main channel so wide, shallow, sandy –bottomed rivers of larger streams of AR basin. Adults are uncommon in quiet pools or backwaters, and almost never occur in tributaries having deep water and bottoms of mud or stone.	No potential habitat present. No potential for occurrence within the project boundaries.	No further analysis will be required for this species	"No Effect"
Shovelnose Sturgeon (<i>Scaphirhynchus platyrhynchus</i>)	Tracked by ONHI	Deep channels and embayments of large turbid rivers; often over sand mixed gravel or mud in areas with strong current.	No potential habitat present. No potential for occurrence within the project boundaries.	No further analysis will be required for this species	"No Impact"

Bald Eagle (<i>Haliaeetus leucocephalus</i>)	Delisted (Federal)	Bald Eagle is generally found near open bodies of water, near lakes and reservoirs roosting in tall conifer and deciduous trees and cliffs along shorelines.	No potential habitat present. No potential for occurrence within the project boundaries.	No further analysis will be required for this species	"No Impact
Woodchuck (<i>Marmota monax</i>)	Tracked by ONHI	Woodchucks live in open habitats (meadows, pastures, old fields, orchards) that often border areas, which may be used for hibernation. Woodchucks emerge from hibernation in winter for early spring, depending on location. The earliest emergence occurs in the southern part of the range.	Potential habitat present. Low potential for occurrence within the project boundaries.	No further analysis will be required for this species	"No Impact
Prairie Mole Cricket (<i>Gryllotalpa major</i>)	Tracked by ONHI	Prairie Mole Cricket inhabits relicts of tall grass prairie. They are usually found only in high quality, relatively unmodified habitat like The Nature Conservancy's Tallgrass Prairie preserve in north central Oklahoma.	No potential habitat present. No potential for occurrence within the project boundaries.	No further analysis will be required for this species	"No Impact

Table 7. Migratory Birds.¹¹

Species	Status	Environmental Baseline for Potential Habitat	Potential Habitat Presence/Species Potential for Occurrence within the Project Area	Species Analysis Required
Little Blue Heron (<i>Egretta caerulea</i>)	Birds of Conservation Concern	Found in marshes, ponds, lakes, meadows, mudflats, lagoons, streams, and other bodies of calm shallow water. Nest in trees and shrubs approximately 4 meters above the ground. Will forage on grassland insects when marshes and swamps are dry.	Potential habitat present. Potential for occurrence within the project boundaries.	"may impact individuals but not likely to cause a trend to Federal listing or a loss of viability."
Loggerhead Shrike (<i>Lanius ludovicianus</i>)	Birds of Conservation Concern	Found in open country with scattered trees and shrubs, Cropland/hedgerow, Desert, Grassland/herbaceous, Old field, Savanna, Shrubland/chaparral. For nesting it prefers shortgrass prairies; often perching on poles, wire or fencepost. Suitable hunting perches are an important part of the habitat.	Potential habitat present. Potential for occurrence within the project boundaries.	"may impact individuals but not likely to cause a trend to Federal listing or a loss of viability"
Red-headed Woodpecker (<i>Melanerpes erythrocephalus</i>)	Birds of Conservation Concern	Suburban/orchard, open woodlands, especially with beech or oak, open situations with scattered trees, parks, cultivated areas and gardens. Nest in holes excavated 2 to 25 meters above ground in live or dead trees, utility pole, or fencepost. Will use existing holes where available.	Potential habitat present. Potential for occurrence within the project boundaries.	"may impact individuals but not likely to cause a trend to Federal listing or a loss of viability"
Scissor-tailed Flycatcher (<i>Tyrannus forficatus</i>)	Birds of Conservation Concern	Inhabits open country with scattered trees and shrubs for perching and nesting. Nest principally in isolated trees or shrubs, but also in tree or shrub copses. Inhabits savannas, pastures, croplands, second-growth scrub, forest edges, and developed areas. Hunts from a perch; darts out and captures insects as they fly by rarely hops from branch to branch or hovers near trees to forage.	Potential habitat present. Potential for occurrence within the project boundaries.	"may impact individuals but not likely to cause a trend to Federal listing or a loss of viability"
Swainson's Hawk (<i>Bufo swainsoni</i>)	Birds of Conservation Concern	Savanna, open pine-oak woodland and cultivated lands (e.g. alfalfa and other hay crops, and certain grain and row croplands) with scattered trees. Tolerates extensive cultivation in nesting area, though vineyards, orchards, rice, corn, and cotton are not suitable foraging habitat. Nests often are within one mile of riparian zone. Repeat nester.	Potential habitat present. Potential for occurrence within the project boundaries.	"may impact individuals but not likely to cause a trend to Federal listing or a loss of viability"

Mississippi Kite (<i>Ictinia mississippiensis</i>)	Birds of Conservation Concern	Tall forest, open woodland, prairie, semiarid rangeland, shelterbelts, wooded areas bordering lakes and streams in more open regions, scrubby oaks and mesquite, and lowland/floodplain forests. Requires open areas near nesting sites for foraging.	Potential habitat present. Potential for occurrence within the project boundaries.	"may impact individuals but not likely to cause a trend to Federal listing or a loss of viability"
Bell's Vireo (<i>Vireo bellii</i>)	Birds of Conservation Concern	The types of habitat used vary widely among the four subspecies. Dense brush willow thickets, mesquite, streamside thickets, and scrub oak, in arid regions often near water, also adjoin uplands. Nest in shrub or low tree usually averaging about one meter above ground, usually in horizontal or down sloping twig fork, typically near edge of thicket.	No potential habitat present. No potential for occurrence within the project boundaries.	"no impact"

No surface disturbance will occur due to the proposed action. The proposed action would not result in change to plant and animal species composition. No significant adverse impacts to wildlife are anticipated, and any adverse impacts that result from the proposed action will be incidental.

Previous analysis has shown that of the relevant animal species of concern, endangered and threatened species present in Kay County, OK there is no expected habitat specifically in the Chilocco testing area.¹¹ A variety of migratory birds are present at Chilocco. The HODOR program and testing is not likely to impact populations of these species. Testing activities do not require machinery or ground disturbance and will not disturb suitable bird habitats. The inert powders released both at the site and downwind have a reduced potential for impact, as discussed in the preceding section. Since the testing area does not impede habitat favored by the Golden or Bald Eagle, and the potential flight of one of these birds over the test area is not likely due to distance away from known habitats. Based on the characteristics of the affected wildlife and availability of similar habitats nearby, and the decreased potential of significantly impacting wildlife, the HODOR program would have no effect to wildlife, migratory birds, or any specially listed species.¹¹

4.3 Environmental Compliance

Equipment used to generate releases and collect samples will be returned to the laboratory, cleaned, and evaluated for reuse. All sampling waste generated during sample collection (e.g., gloves, filters) will be disposed of properly. None of the equipment or personnel will generate loud noises that will disturb the environment. None of the materials used will generate Resource Conservation and Recovery Act (RCRA) regulated hazardous waste. The wastes generated will not significantly differ between any of the alternatives. Assuming that 100% of the aerosolized particulate material would deposit in a triangular geometry prior to exiting campus, these materials would be below the release limits for each. As a fertilizer urea application rates vary up to 8 lbs per acre per application. For these tests will be releasing ~ 1lb of urea. As a bioinsecticide, the commercial variant of Btk (Dipel) is typically applied to farm lands in a range between 1 to 2 kg, up to 2,000 grams, per acre per application in frequencies of every 10 to 14 days. Each test using Btk/Dipel will be limited to 600 grams, or 30% of the manufacture guidance. It is expected that only a small fraction (< 1%) of the particulates released will penetrate into the test buildings. Using a building protection factor of 0.99, this would equate to 6 grams of the released material evenly dispersed throughout the building as a dust. At this level it would not be harmful or require any special decontamination procedures. The majority of particulates will be collected in the filters once the HVAC system(s) is turned on.

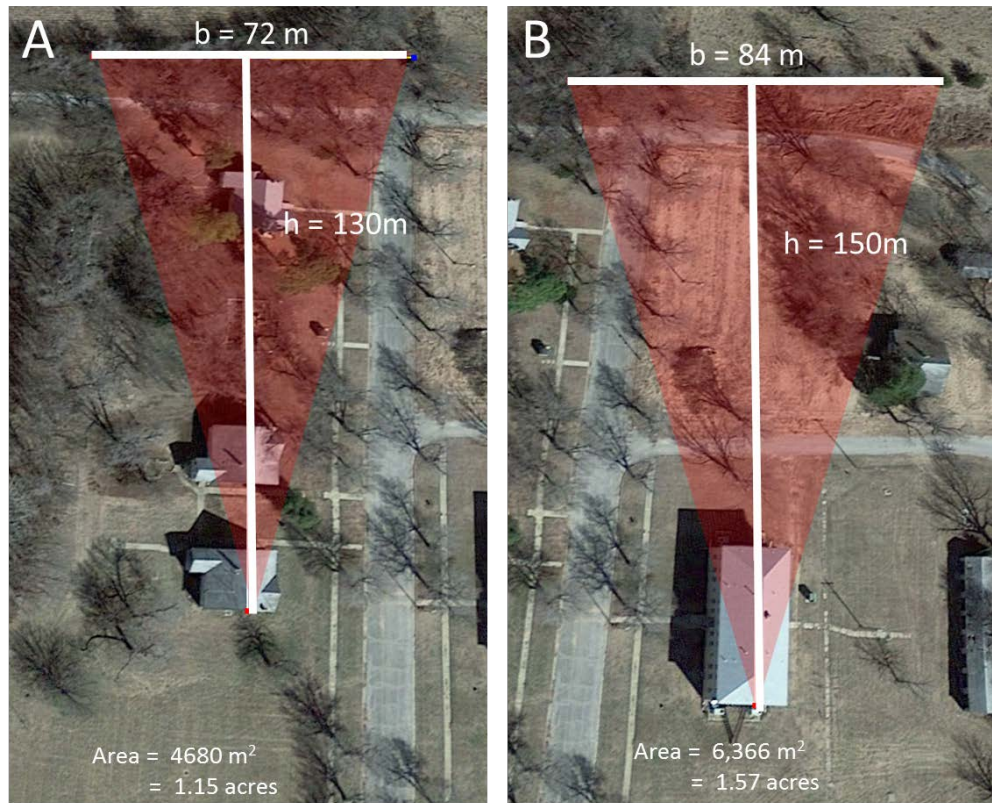


Figure 8. The relative acreage affected by the release of particulates at release positions A and B assuming that the material settles from the air stream prior to exiting campus.

4.4 Historic Properties

Pursuant to Section 106 of the National Historic Preservation Act of 1966 and the implementing regulations in 36 C.F.R. Part 800, consideration was given to the impact of the tests on any historic properties. The Chilocco Indian Agriculture School was listed on the National Register of Historic Places (NRHP) in 2006, under criteria A (significant events) and C (architecture) for significance in education, Native American history, politics/government, and architecture. The school was used from 1884 to 1980, and began as a non-reservation boarding school, designated by the U.S. Congress and implemented by the Bureau of Indian Affairs (BIA).

To support the HODOR testing, the residential home, building 58, required repairs. Consistent with a previously executed lease agreement and pursuant to 36 C.F.R. 800.2(c)2, UML consulted with the Tribal Historical Preservation Officers (THPOs) of the CCCT, which is comprised of the Kaw Nation, Otoe-Missouria Tribe of Indians, Pawnee Nation of Oklahoma, the Ponca Tribe of Oklahoma, and the BIA. Although a member of the CCCT, the Tonkawa Tribe does not currently have a federally recognized THPO. The scope of this request included repairs to roofing, windows, doors, electrical, and HVAC. After the four THPOs reviewed this request, UML hosted them for consultation that included a walkthrough of the building to discuss any additional requirements. The THPOs concurred that the requested repairs to Building 58 would have “No

Adverse Effect” to any contributing factors of the NRHP listed site and provided authorization to perform these repairs through consultation letters, in accordance with 36 CFR 800.4(d) (1).

For the HODOR program, the temporary deployment and placement of test equipment for this project would have no adverse effect to the NRHP listed property as the equipment is portable and requires no permanent physical changes to the two buildings or surrounding environment. Further, the inert powder to be utilized would not significantly impact the physical characteristics of the listed properties. A letter seeking concurrence on S&T’s no adverse effect determination for the HODOR project was sent to the CCCT in July 2017, and is provided in Appendix A.

4.5 Environmental Justice

Executive Order 12898 directs federal agencies to consider environmental justice in connection with their programs and activities. It requires federal agencies to " ... *analyze the environmental effect, including human health, economic and social effects of federal actions, including effects on minority communities and low-income communities, when such analysis is required by the National Environmental Policy Act of 1969 (NEPA)*... " Furthermore, it states that " ... *each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies or activities on minority populations and low-income populations...*"Memorandum accompanying E.O. 12898, February 4, 1994.

In order to advance environmental justice, BIA and other federal agencies should pursue fair treatment and meaningful involvement of minority and low-income populations. Fair treatment means such groups should not bear a disproportionately high share of negative environmental consequences from federal programs, policies, decisions or operations. Meaningful involvement means federal officials actively promote opportunities for public participation and federal decisions can be materially affected by participating groups and individuals.

In accordance with Executive Order 12898, analysis of the environmental effects must include effects on minority communities and low-income communities, when such analysis is required by the National Environmental Policy Act of 1969, 42 U.S.C. section 4321 et seq. Data was compiled and analyzed as provided below using the EPA’s EJSCREEN: Environmental Justice Screening and Mapping Tool which provides data from aggregated and updated sources as cited.

The testing site is located close to the Kansas border, near the town of Newkirk, in Kay County, Oklahoma. According to July 1, 2016 U.S. Census data estimates,¹² approximately 2,230 people live in the city of Newkirk, 44,943 people reside in the mostly rural Kay county, while 323M live in the State.

- Approximately 24% of residents in Newkirk live below the federal poverty threshold compared to 19% in Kay County and 14% in the State;
- Minority populations account for 16% of the population in Newkirk, compared to 20% in Kay County and 23% in the State;
- Approximately 86% of Newkirk residents have a high school degree or higher, compared to 87% in both Kay County and the State; and
- In Newkirk, approximately 18% of residents were under the age of 18, and 18% are over the age of 65, compared to 18% and 25% respectively in Kay County and, 23% and 15% in the State.

UML has an existing Environmental and Cultural Resources Review with the BIA and CCCT. In that existing EA and CRR, types of activities such as the proposed testing are identified as supplemented by information in this EA. The THPOs for each of the CCCT tribes and the BIA have all expressed support of the testing and associated activities (See Appendix A, and the extensively referenced EA). Per interactions between DHS, UML, the CCCT and the BIA, no mitigation measures have been identified as a requirement to carry out any of the possible alternatives because there is no evidence that any low income or minority populations would receive a higher exposure to the particulate matter than any other group. No residences or commercial activities are present or impacted within a 1 km, or 0.6 mile, radius of proposed test locations on the Chilocco campus. Therefore, selection of any of these alternatives would not disproportionate impact minority or low-income communities.

There is no reason to suspect that the testing activity would have direct disproportionate impacts on any minority since several contractors will be used in the continued rehabilitation of the Chilocco campus. Furthermore, the CCCT would directly benefit from the structural improvements to lease buildings on campus.

Based on the foregoing information, the analysis of environmental effects including human health, as well as economic and social effects on minority communities and low-income communities, it is concluded that there are no disproportionate impacts.

5 Cumulative Impacts

The proposed HODOR testing involves low concentrations of biopesticidal spores as approved by permit issued by the OK Department of Agriculture. Review identified that because the spores are insecticidal, they may slightly reduce local grasshopper infestations, but there is no expected cumulative impact from their release on nearby agricultural activities. Even in combination with new work, which is not currently foreseen anticipated, on this same scale, there would be no cumulative impact. Further analysis on potential for cumulative impacts is provided below.

The testing is limited to that described in this document. Review of planned activities by DHS and others at the site identified that further use or testing using the planned test materials is not foreseen either by DHS or other entities. While listed and regulated species are located

regionally, they and associated habitats were not identified in the developed or adjacent agricultural areas in the vicinity of the project and therefore no potential cumulative impacts were identified. Migratory bird species of concern are known to frequent ponds, rivers and streams (Section 4.2). However, based on limited test material quantities and the absence of any recurring testing foreseen, no adverse cumulative effects are anticipated for these species for the water bodies at or adjacent the project.

Review of contributions to potential cumulative effects of the testing when combined with any similar insecticides that may be applied in nearby agricultural locations did not identify significant adverse cumulative effects. This is because of the limitations on test material quantities used under the approved permit and by the test plan limits. Furthermore, there is absence of any further testing foreseen with the same or similar materials in the future.

6 Conclusions of the Proposed Testing

The proposed HODOR testing is similar to other activities that have occurred at the Chilocco campus. Further, no adverse impacts to the human environment have been identified or reported during similar S&T aerosol testing in urban, densely-populated subway systems (Table 1). As a function of this particular limited test activity, no cumulative effects are anticipated at this time. The alternatives considered for building structures led to straightforward conclusions that Building 58 and Building 60 at Chilocco as representative home and apartment complex, respectively, were most appropriate for HODOR testing. There are two preferred particulates (P1 and P2) and one preferred biological particulate (BP1) to be used in the testing. An aerosol release of P1 and/or P2 (TiO₂ and/or urea with optical brightener) will result in low hazard, time efficient, and cost-effective initial characterization of penetration factors as well as refinement of sensor placement for the biological particulate release. Release of barcoded spores (BP1) will provide highly sensitive and specific measurement of building penetration factors by these biological materials. Implementation of the no particulate alternatives will not help to validate current particulate models and therefore will not meet the needs of this development effort and testing. It is therefore concluded that the testing activity minimizes environmental impact through selection of test buildings, bounding of releases and use of minimal amounts of materials. This assessment has determined that the proposed testing would not have a significant impact on the human environment and that an environmental impact statement is not needed. No future outdoor testing is foreseen, therefore minimizing any potential for cumulative effects. Further, through the course of this testing activity, the direct, indirect, and cumulative environmental effects caused by the potential exposure of terrestrial wildlife, vegetation, water resources, and air quality by movement of the material by any of the alternatives would not have an adverse effect.

7 Persons and Agencies Contacted

Mr. James Reese
Secretary of Agriculture
State of Oklahoma

Ms. Teena Gunter
General Counsel
Oklahoma Department of Agriculture, Food, & Forestry

Mr. Bryan Painter
Director of Administration & Communications
Oklahoma Department of Agriculture, Food, & Forestry

Mr. Kenny Naylor
Director of Consumer Protection Services
Oklahoma Department of Agriculture, Food, & Forestry

Mr. Jeremy Seiger
Director of Agricultural Environmental Management Services
Oklahoma Department of Agriculture, Food, & Forestry

Dr. Stephen McKeever
Secretary of Science and Technology
State of Oklahoma
Regents Professor of Physics and MOST Chair of Experimental Physics, Oklahoma State University

Mr. Jeremy Lovekamp
Acting Superintendent
DOI - Bureau of Indian Affairs
Pawnee Agency
Pawnee, OK 74058

Mr. Jon Shotton
Chairman
Council of Confederated Chilocco Tribes
Otoe Missouria Tribe
Red Rock, OK 74651

Dr. Lloyd Hough
Program Manager
Chemical and Biological Defense Division

Department of Homeland Security

Dr. Christine Tomlinson

SETA Support to Dr. Hough

Chemical and Biological Defense Division

Department of Homeland Security

Appendix A: Supporting Documentation

The proposed project location is the Chilocco Indian Agricultural School, located adjacent to the intersection of U.S. Highway 77 and EOO18 Road, approximately 7 miles north of the town of Newkirk, OK. In 2006, this campus was nominated for registration under requirements set forth in 36 CFR Part 60 of the National Historic Preservation Act of 1966, National Parks Service under the United States Department of the Interior. The OSU-University Multispectral Laboratories L.L.C. (UML) is a non-profit research organization that has an exclusive business service lease agreement with its land holders, the Council of Confederate Chilocco Tribes (CCCT) to use the Chilocco Indian Agriculture School Campus. The CCCT was established on August 2, 2000 under the Chilocco Treaty with the Kaw Nation, the Otoe-Missouria Tribe, the Pawnee Nation, the Ponca Nation, and the Tonkawa Tribe. These five Native American Governments work jointly to oversee and manage the Indian Reserve which was once the Chilocco Indian Agriculture School. The lease agreement between UML and the CCCT consists of three separate documents, the Business Service Lease Agreement, Cultural Resources Review and Evaluation of Potential Effects, and Environmental Assessment. UML's ability to perform both indoor and outdoor sensor testing using various simulant materials, which are described in the HODOR program, are identified within the scope of all of these documents. Building repair or refurbishment is included under the lease agreement as leasehold improvements. Due to the historic significance of the campus, the CCCT tribal owners have passed a resolution designating that each member's federally recognized Tribal Historic Preservation Officers will deal with all matters of historic preservation. According to the established process, any repairs, such as leasehold improvements, are requested by UML, in writing, to the CCCT Chairman and designated THPOs for consultation.

For this program, the residential home (Building 58) required repair of windows, doors, roof, HVAC and electrical. A request was submitted by UML to the CCCT Chairman and THPOs on January 30, 2017. At the date of this request, the Tonkawa did not have a federally recognized THPO, but all other members did. The UML Laboratory Director, Dr. Cris Lewis, met with the recognized THPOs at Chilocco to walk through the building to discuss its repair and identify any tribal requirements to ensure compliance with Section 106 of the National Historic Preservation Act of 1966 and implementing regulations at 36 C.F.R. Part 800. Each of the THPOs provided verbal and written consultation letters stating that the repairs and leasehold improvements has *no potential for adverse effect* of the culture or historic property. These letters are offered below.



To: Chairman John Shotton
John Michael Knife Chief, THPO
Crystal Douglas, THPO
Elsie Whitehorn, THPO
Halona Clawson, THPO
Council of Confederated Chilocco Tribes

From: Cris Lewis
Laboratory Director
OSU-University Multispectral Laboratories

Date: 30 January 2016

Subject: Request Approval for Refurbishment of Teacher Housing

Sir/Madam,

UML would like to submit the following request for refurbishing the residential houses on the north side of the Chilocco Campus; buildings 56, 58, 59, and 158. Refurbishment would include repairing the roof, replacing all shingles, repair of broken windows, external siding, doors, and installation of electrical and heating/cooling systems. At this time we do not anticipate installing water or sewer. Each house would be brought back up to standard building codes. Currently, funding is available for two of the requested four structures, with the plan to renovate the two most structurally sound. Any of the remaining funds would support repair of the roofs on the requested structures. For this reason, our request encompasses all four structures. Depending on the funds available, UML will work and notify the CCCT Tribal Historic Preservation Officers (THPOs) on which buildings are used.

UML would like to submit this request for consideration and consultation with the CCCT's THPOs.

Cris
Lewis

Digitally signed by Cris Lewis
DN: cn=Cris Lewis, o=OSU-
University Multispectral
Laboratories, ou=UML,
email=clewis@okstate-uml.org,
c=US
Date: 2017.02.02 09:11:57 -0600

Respectfully,
Cris Lewis
Laboratory Director
OSU-University Multispectral Laboratories, LLC





Ponca Tribe of Oklahoma

"Rich In Culture and Tradition"

"Equal Opportunity Employer and Provider"

February 2, 2017

OSU-University Multispectral Laboratories, LLC
Chris Lewis
Laboratory Director
500 W.S. Ave
Ponca City, OK 74601

SUBJECT: Concurrence Letter for Refurbishment of Teacher Housing

Dear Chris,

The Ponca Tribe of Oklahoma Tribal Historic Preservation Office has reviewed all available information regarding the above-mentioned project and concurs that proposed project should not adversely affect any sacred sites, traditional cultural properties or any other historic property of interest to the Ponca Tribe of Oklahoma. Consultation with the Ponca Tribe of Oklahoma is required by Section 106 of the National Historic Preservation Act of 1966 (NHPA), and 36 CFR Part 800.

However, in the event of any inadvertent discovery of any American Indian remains, funerary objects, or objects of cultural patrimony, please contact the Ponca Tribe of Oklahoma immediately.

This information is provided to assist you in complying with 36 CFR Part 800 for Section 106 Consultation procedures. Thank you for the opportunity to review this project and provide comments. If you have any questions, please do not hesitate to contact me at halona.clawson@ponca.com.

Myto,

A handwritten signature in black ink that reads "Halona Cabe".

Halona Cabe



OTOE-MISSOURIA TRIBE OF INDIANS

8151 HIGHWAY 177
RED ROCK, OK 74651-0348

February 15, 2017

OSU-University Multispectral Laboratories, LLC
Attn: Chris Lewis
500 W.S. Ave
Ponca City, OK 74601

SUBJECT: Concurrence Letter for Refurbishment of Teacher Housing

Dear Mr. Chris Lewis:

Pursuant to Section 106 of the National Historic Preservation Act of 1966 (NHPA), and 36 C.F.R. Part 800, the Otoe-Missouria Tribal Historic Preservation Office has received and reviewed all available information in regard to the above-mentioned project.

The Otoe-Missouria Tribal Historic Preservation Office concurs that this proposed project will not adversely affect any sacred sites, traditional cultural properties or any other historic property of interest to the Otoe-Missouria Tribe. However, in the event of any inadvertent discovery of any American Indian remains, funerary objects, or objects of cultural patrimony, please contact the Otoe-Missouria Tribe immediately.

Thank you for the opportunity to review this project and provide comments. Should you have further questions or concerns, please do not hesitate to contact me.

Thank you,

A handwritten signature in cursive script that reads "Elsie Whitehorn".

Elsie Whitehorn
Tribal Historic Preservation Officer
Otoe-Missouria Tribe
580-723-4466 ext 202
ewhitehorn@omtribe.org



KAW NATION

Drawer 50
Kaw City, OK 74641
(580) 269-2552 phone
(866) 404-5297 toll free
www.kawnation.com

June 7, 2017

OSU-University Multispectral Laboratories, LLC
Cris Lewis
Laboratory Director
500W.S. Ave
Ponca City, Oklahoma 74601

RE: Concurrence Letter for Refurbishment of Teacher House

Cris Lewis,

The Kaw Nation Tribal Historic Preservation Office has reviewed all available information regarding the above-mentioned project and concurs that proposed project should not adversely affect any sacred sites, traditional cultural properties or any other historic properties of interest to the Kaw Nation. Through the National Historic Preservation Act of 1966 (NEPA), and 36 CFR Part 800 Consultation with the Kaw Nation is required by section 106.

With the information that was provided by your organization the Kaw Nation has no objections at this time. Therefore, in accordance with 36 CFR 800.4(d) (1), you may proceed with your project. However, in the event of any inadvertent discovery of any American Indian remains, Funerary objects or objects of cultural patrimony must be immediately reported to us under both the NHPA and NAGPRA regulations.

This information is provided to in order to assist in the compliance of 36CFR Part 800 under Section 106 in accordance as government to government consultation procedures. This letter will stand as compliance. Should you have Questions, please do not hesitate to contact Crystal Douglas at (580)-269-2552 ex 235 crystal_douglas@kawnation.com. Thank you for your time and Consideration. This letter is being sent as formal consent to strengthen correspondence of compliance in February 2017.

Sincerely,

Crystal Douglas
THPO Kaw Nation

Cris Lewis,

The Pawnee Nation Office of Historic Preservation has received the information and materials requested for our Section 106 Review and Consultation.

As you may know, consultation with the Pawnee Nation is required by Section 106 of the National Historic Preservation Act of 1966 (NHPA), and 36 CFR Part 800.

Given the information provided, you are hereby notified that the proposal project location should have no effect on historic properties in the direct area of potential effects and no adverse effects to historic properties in the visual APE to affect any known Archaeological, Historical, or Sacred Pawnee sites. Therefore, in accordance with 36 CFR 800.4(d) (1), you may proceed with your proposed project. However, please be advised that undiscovered properties may be encountered and must be immediately reported to us under both the NHPA and NAGPRA regulations.

This information is provided to assist you in complying with 36 CFR Part 800 for Section 106 Consultation procedures. Please retain this correspondence to show compliance. Should you have questions, please do not hesitate to contact me at mknifechief@pawneenation.org. Thank you for your time and consideration.

Sincerely,

John Micheal Knife Chief
Tribal Historic Preservation Officer
Cultural Resources Division
Pawnee Nation of Oklahoma
P.O. Box 470
657 Harrison Street
Pawnee, OK 74058
Phone: 918.762.2180 or 918.762.3227
Fax: 918.762.3662
mknifechief@pawneenation.org

Appendix B: Supporting Data and Materials Safety Data Sheets

The following are provided as separate attachments.

Particulate alternative P1: TiO₂ MSDS

Particulate alternative P1: Title 252. Oklahoma Department of Environmental Quality Air Chapter 100. Air pollution control

Particulate alternative P2: Urea powder, CAS 57-13-6 and CI Fluorescent Optical Brightener 220, CAS 16470-24-9 MSDSes

Biological Particulate BP1: Btk MSDS

Biological Particulate BP1: Btk Compliance Letter from UML

Biological Particulate BP1: Btk OK Department of Agriculture application and granted Biotechnology Permit

Citations

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- ¹ DHS S&T Directorate Strategic Plan 2011, <https://www.dhs.gov/xlibrary/assets/st-directorate-strategic-plan-2011.pdf>
- ² https://www.ll.mit.edu/publications/journal/pdf/vol17_no1/17_1_7Cousins.pdf
- ³ Supporting Documentation for NEPA Compliance of August 2010 Boston Tracer Tests Project Name: Homeland Security Systems Studies – Subway Component: Field Work
- ⁴ http://www.martrexinc.com/msds/MSDS_Urea.pdf
- ⁵ Enna, S. and L. Schanker (1972). Absorption of Saccharides and Urea from the Rat Lung. *American Journal of Physiology*, vol. 222, pp. 409-414
- ⁶ <https://archive.epa.gov/pesticides/reregistration/web/pdf/0247.pdf>
- ⁷ http://na.fs.fed.us/pubs/misc/seis/gm_inviron_impact_statemnt_draft.pdf
- ⁸ <http://na.fs.fed.us/fhp/gm>
- ⁹ <https://gmoanswers.com/ask/what-application-rate-equivalence-field-bt-corn-vs-field-organic-corn-spraying-bt-insecticide>
- ¹⁰ Emmanuel, PA et al., 2012. Detection and Tracking of a Novel Genetically Tagged Biological Simulant in the Environment. *Appl. Environ. Microbiol.* 78:8281.
- ¹¹ Final Environmental Assessment Plan for the Chilocco Indian Agricultural School Campus Business Lease prepared by Reagan Smith Energy Associates, 2015.
- ¹² <https://www.census.gov/quickfacts/fact/table/kaycountyoklahoma/PST045216>, <https://www.census.gov/prod/cen2010/cph-2-38.pdf> and https://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml?src=bkmk