5th Annual Standards Education Workshop

Standards-Based Enhanced Academic and Professional Training for Geoscientists

Angelo Lampousis, Ph.D.

5th Annual Standards Education Workshop
Thursday, November 2, 2017
Standards Coordination Office, Standards Services
National Institute of Standards and Technology

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The City College of New York

City College of New York – Identity

Albert Einstein
CCNY Lecture Series
1921 (first US visit)

- **8th nationally for diversity**
  Source: The Wall Street Journal/Times Higher Education 2018

- **One of the top 100 Best Regional Universities in the North**
- **Top Public School in the North**
  Source: U.S. News & World Report 2018

- **Student population representing 89.6% of the world's 193 sovereign states**

- **Major ethnic groups**

31.5%	Hispanics
27%	Asian Americans
27%	Whites
19.7%	African-Americans

Source: https://www.ccny.cuny.edu/news/wall-street-journal-ranks-ccny-8-nationally-diversity

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Project Partners

Jack Caravanos
Clinical Professor of
Environmental Public Health Sciences
NYU College of Global Public Health

https://publichealth.nyu.edu/faculty/jack-caravanos

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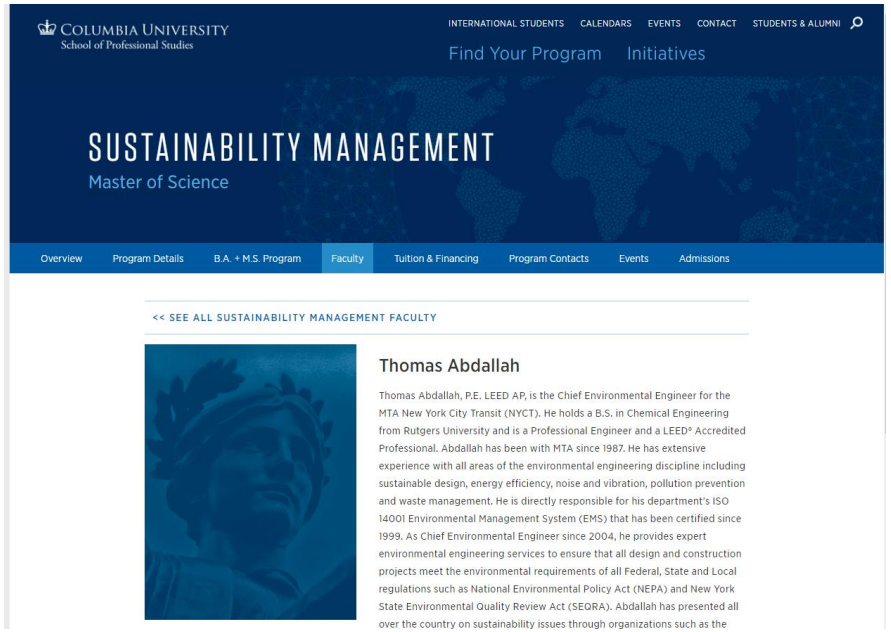
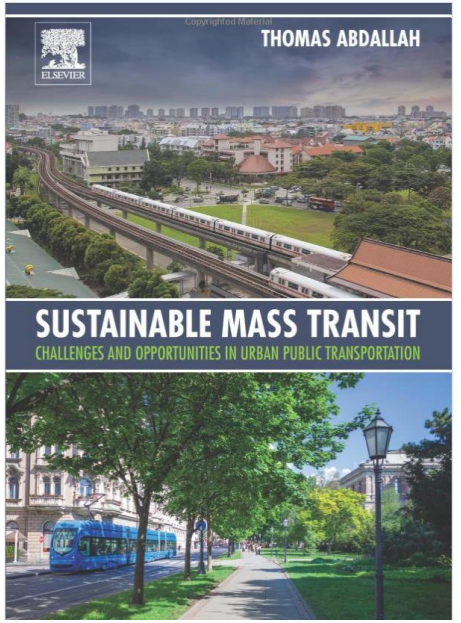
Thomas Abdallah, P.E., LEED AP
Deputy Vice President
Chief Environmental Engineer
MTA New York City Transit

Kate Aglitsky, LEED AP, EMS Director
MTA New York City Transit



http://sps.columbia.edu/sustainability-management/faculty/thomas-abdallah



https://www.elsevier.com/books/sustainable-mass-transit/abdallah/978-0-12-811299-1

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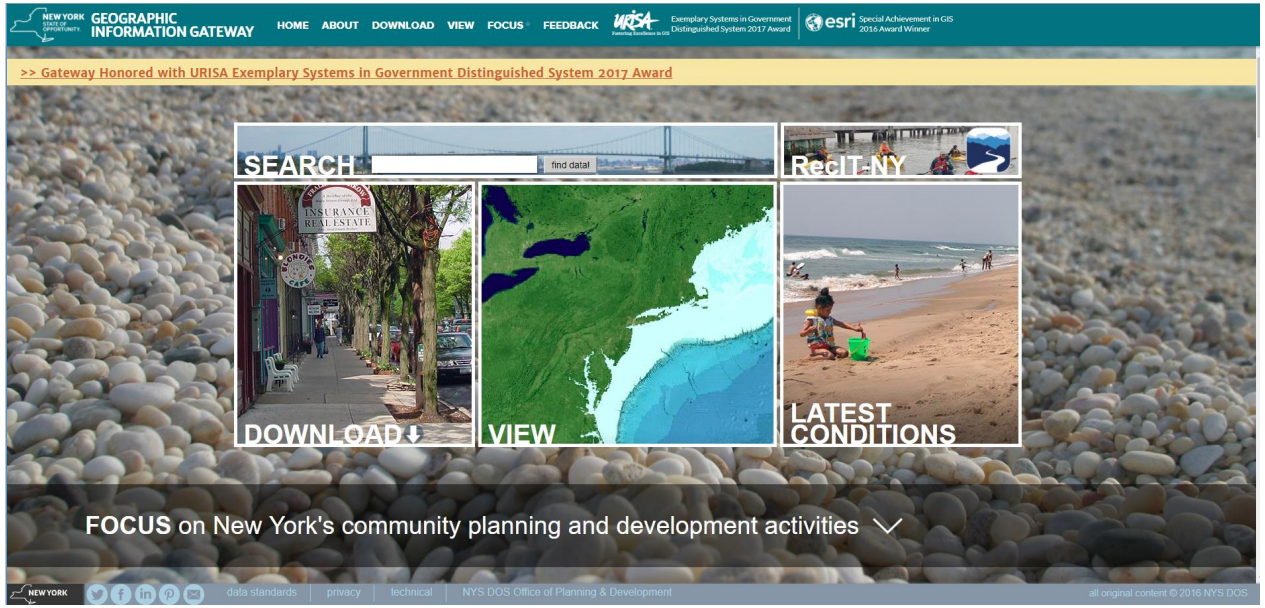


http://opdgig.dos.ny.gov/#/home

Jeffrey L. Herter

Coastal Resources Specialist III

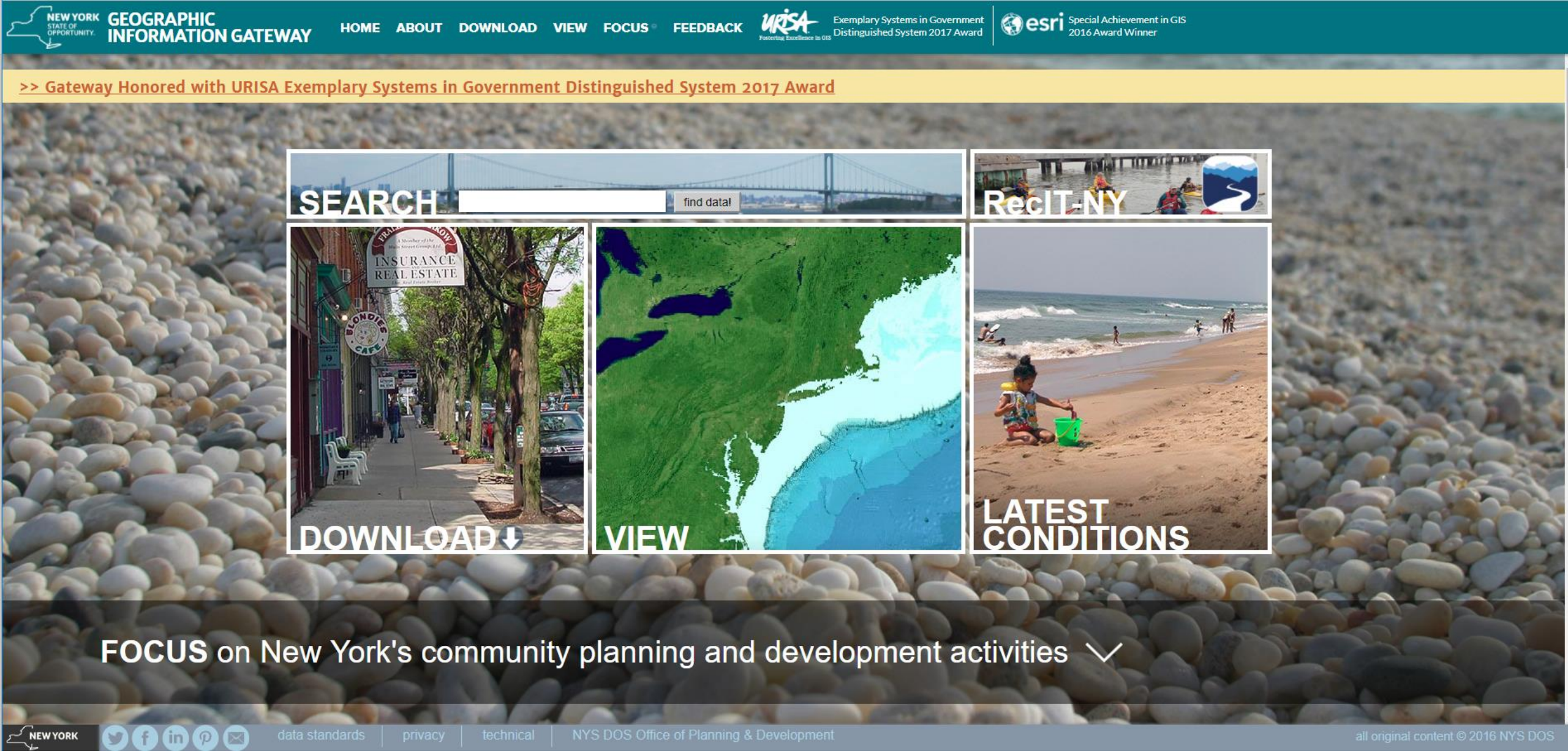
Geographic Information Gateway Project Manager

New York Department of State

Office of Planning, Development & Community Infrastructure

CUNY

The City College of New York



http://opdgig.dos.ny.gov/#/home

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Relevant CCNY major concentrations

Geology (also know as “Earth & Atmospheric Sciences” major)
Bachelor of Science (B.S.)

Environmental Earth Systems Science
Bachelor of Science (B.S.)

Earth System Science and Environmental Engineering
Bachelor of Engineering (B.E.)

http://ccny.smartcatalogiq.com/en/2017-2018/Undergraduate-Bulletin/Programs-of-Study

Relevant CCNY courses

- Phase I environmental site assessments EAS 33300
- Phase II environmental site assessments EAS 33400
- Global Environmental Hazards EAS 32800
- Introduction to Geographic Information Systems - EAS 33000
- Seminar on Science and Technology in NYC - MHC 20301
  Macaulay Honors College, CUNY

CUNY

The City College of New York

Relevant CCNY courses

- **Phase I environmental site assessments** EAS 33300
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  Macaulay Honors College, CUNY

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Standards-Based Curriculum at CCNY

existing / expanding
(based on NIST funding)

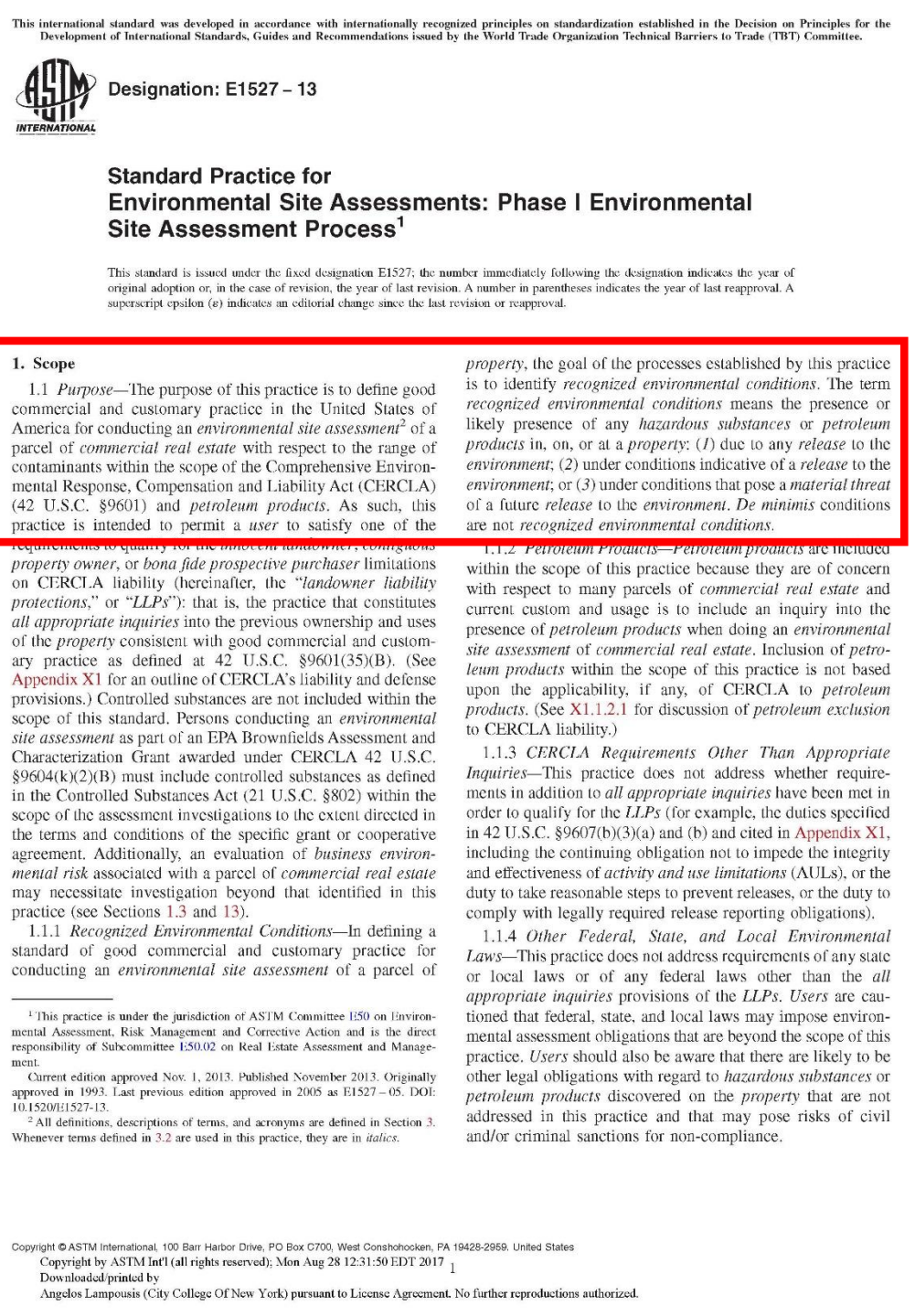
Phase I environmental site assessments [EAS 33300]

2017-2018 Undergraduate Bulletin Course Description

The purpose of this course is to introduce students to good commercial and customary practices in the US for conducting Phase I environmental site assessments (ESA) of commercial or residential properties with respect to hazardous substances and petroleum products. A Phase I ESA is the process for determining the presence of an existing release, a past release, or a material threat of a release of any hazardous substances or petroleum products into the ground, ground water, surface water of the property, or into structures on the property.

Credits: 3

Contact Hours: 3 hours per week.



This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

Designation: E1527 – 13

Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process[1]

This standard is issued under the fixed designation E1527; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 *Purpose*—The purpose of this practice is to define good commercial and customary practice in the United States of America for conducting an *environmental site assessment*[2] of a parcel of *commercial real estate* with respect to the range of contaminants within the scope of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (42 U.S.C. §9601) and *petroleum products*. As such, this practice is intended to permit a *user* to satisfy one of the requirements to qualify for the *innocent landowner*, *contiguous property owner*, or *bona fide prospective purchaser* limitations on CERCLA liability (hereinafter, the "*landowner liability protections*," or "*LLPs*"): that is, the practice that constitutes *all appropriate inquiries* into the previous ownership and uses of the *property* consistent with good commercial and customary practice as defined at 42 U.S.C. §9601(35)(B). (See Appendix X1 for an outline of CERCLA's liability and defense provisions.) Controlled substances are not included within the scope of this standard. Persons conducting an *environmental site assessment* as part of an EPA Brownfields Assessment and Characterization Grant awarded under CERCLA 42 U.S.C. §9604(k)(2)(B) must include controlled substances as defined in the Controlled Substances Act (21 U.S.C. §802) within the scope of the assessment investigations to the extent directed in the terms and conditions of the specific grant or cooperative agreement. Additionally, an evaluation of *business environmental risk* associated with a parcel of *commercial real estate* may necessitate investigation beyond that identified in this practice (see Sections 1.3 and 13).

1.1.1 *Recognized Environmental Conditions*—In defining a standard of good commercial and customary practice for conducting an *environmental site assessment* of a parcel of *property*, the goal of the processes established by this practice is to identify *recognized environmental conditions*. The term *recognized environmental conditions* means the presence or likely presence of any *hazardous substances* or *petroleum products* in, on, or at a *property*: (*1*) due to any *release* to the *environment*; (*2*) under conditions indicative of a *release* to the *environment*; or (*3*) under conditions that pose a *material threat* of a future *release* to the *environment*. *De minimis* conditions are not *recognized environmental conditions*.

1.1.2 *Petroleum Products*—*Petroleum products* are included within the scope of this practice because they are of concern with respect to many parcels of *commercial real estate* and current custom and usage is to include an inquiry into the presence of *petroleum products* when doing an *environmental site assessment* of *commercial real estate*. Inclusion of *petroleum products* within the scope of this practice is not based upon the applicability, if any, of CERCLA to *petroleum products*. (See X1.1.2.1 for discussion of *petroleum exclusion* to CERCLA liability.)

1.1.3 *CERCLA Requirements Other Than Appropriate Inquiries*—This practice does not address whether requirements in addition to *all appropriate inquiries* have been met in order to qualify for the *LLPs* (for example, the duties specified in 42 U.S.C. §9607(b)(3)(a) and (b) and cited in Appendix X1, including the continuing obligation not to impede the integrity and effectiveness of *activity and use limitations* (AULs), or the duty to take reasonable steps to prevent releases, or the duty to comply with legally required release reporting obligations).

1.1.4 *Other Federal, State, and Local Environmental Laws*—This practice does not address requirements of any state or local laws or of any federal laws other than the *all appropriate inquiries* provisions of the *LLPs*. *Users* are cautioned that federal, state, and local laws may impose environmental assessment obligations that are beyond the scope of this practice. *Users* should also be aware that there are likely to be other legal obligations with regard to *hazardous substances* or *petroleum products* discovered on the *property* that are not addressed in this practice and that may pose risks of civil and/or criminal sanctions for non-compliance.

[1] This practice is under the jurisdiction of ASTM Committee E50 on Environmental Assessment, Risk Management and Corrective Action and is the direct responsibility of Subcommittee E50.02 on Real Estate Assessment and Management.

Current edition approved Nov. 1, 2013. Published November 2013. Originally approved in 1993. Last previous edition approved in 2005 as E1527 – 05. DOI: 10.1520/E1527-13.

[2] All definitions, descriptions of terms, and acronyms are defined in Section 3. Whenever terms defined in 3.2 are used in this practice, they are in *italics*.

Standards-Based Curriculum at CCNY

existing / expanding (based on NIST funding)

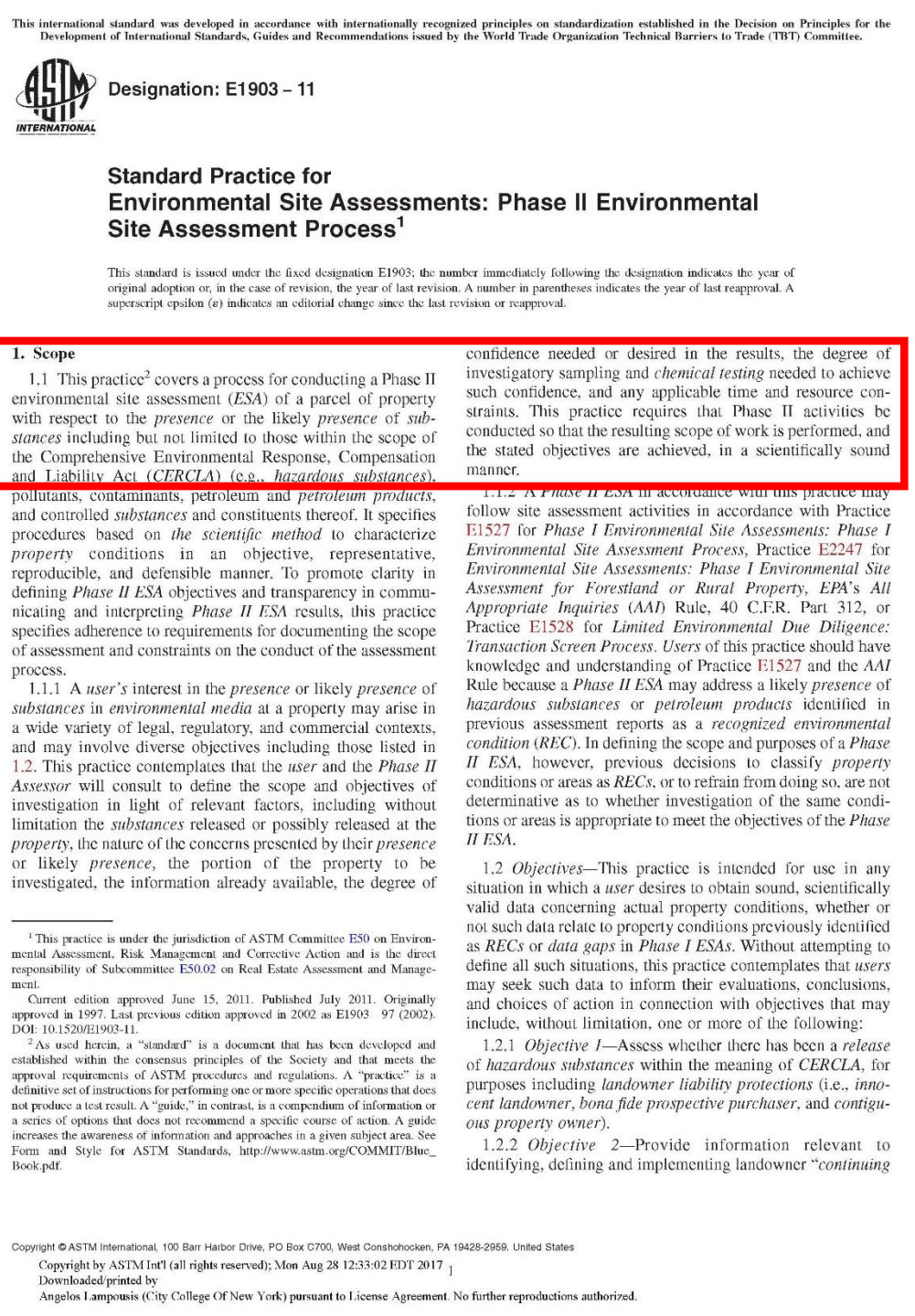
Phase II environmental site assessments EAS 33400

2017-2018 Undergraduate Bulletin Course Description

The purpose of this course is to introduce students to good commercial and customary practices in the United States of America for conducting Phase II environmental site assessments (ESA). A Phase II ESA is an evaluation process for confirming and quantifying the presence of hazardous substances or petroleum products in environmental media (i.e., soil, rock, groundwater, surface water, air, soil gas, sediment) throughout a contaminated site. A Phase II ESA typically includes a determination through field screening and chemical testing of the geological, hydrogeological, hydrological, and engineered aspects of the site that influence the presence of hazardous substances or petroleum products (e.g., migration pathways, exposure points) and the existence of receptors and mechanisms of exposure. Students are automatically enrolled in the 40-hour OSHA HAZWOPER (Hazardous Waste Operations and Emergency Response Standard) certification program which applies to employees who are engaged in clean-up operations that are conducted at uncontrolled hazardous waste sites.

Credits: 3

Contact Hours: 3 hours per week.



This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

Designation: E1903 – 11

Standard Practice for Environmental Site Assessments: Phase II Environmental Site Assessment Process[1]

This standard is issued under the fixed designation E1903; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice[2] covers a process for conducting a Phase II environmental site assessment (*ESA*) of a parcel of property with respect to the *presence* or the likely *presence* of *substances* including but not limited to those within the scope of the Comprehensive Environmental Response, Compensation and Liability Act (*CERCLA*) (e.g., *hazardous substances*), pollutants, contaminants, petroleum and *petroleum products*, and controlled *substances* and constituents thereof. It specifies procedures based on *the scientific method* to characterize *property* conditions in an objective, representative, reproducible, and defensible manner. To promote clarity in defining *Phase II ESA* objectives and transparency in communicating and interpreting *Phase II ESA* results, this practice specifies adherence to requirements for documenting the scope of assessment and constraints on the conduct of the assessment process.

1.1.1 A *user's* interest in the *presence* or likely *presence* of *substances* in *environmental media* at a property may arise in a wide variety of legal, regulatory, and commercial contexts, and may involve diverse objectives including those listed in 1.2. This practice contemplates that the *user* and the *Phase II Assessor* will consult to define the scope and objectives of investigation in light of relevant factors, including without limitation the *substances* released or possibly released at the *property*, the nature of the concerns presented by their *presence* or likely *presence*, the portion of the property to be investigated, the information already available, the degree of confidence needed or desired in the results, the degree of investigatory sampling and *chemical testing* needed to achieve such confidence, and any applicable time and resource constraints. This practice requires that Phase II activities be conducted so that the resulting scope of work is performed, and the stated objectives are achieved, in a scientifically sound manner.

1.1.2 A *Phase II ESA* in accordance with this practice may follow site assessment activities in accordance with Practice E1527 for *Phase I Environmental Site Assessments: Phase I Environmental Site Assessment Process*, Practice E2247 for *Environmental Site Assessments: Phase I Environmental Site Assessment for Forestland or Rural Property*, *EPA's All Appropriate Inquiries* (*AAI*) Rule, 40 C.F.R. Part 312, or Practice E1528 for *Limited Environmental Due Diligence: Transaction Screen Process*. *Users* of this practice should have knowledge and understanding of Practice E1527 and the *AAI* Rule because a *Phase II ESA* may address a likely *presence* of *hazardous substances* or *petroleum products* identified in previous assessment reports as a *recognized environmental condition* (*REC*). In defining the scope and purposes of a *Phase II ESA*, however, previous decisions to classify *property* conditions or areas as *RECs*, or to refrain from doing so, are not determinative as to whether investigation of the same conditions or areas is appropriate to meet the objectives of the *Phase II ESA*.

1.2 *Objectives*—This practice is intended for use in any situation in which a *user* desires to obtain sound, scientifically valid data concerning actual property conditions, whether or not such data relate to property conditions previously identified as *RECs* or *data gaps* in *Phase I ESAs*. Without attempting to define all such situations, this practice contemplates that *users* may seek such data to inform their evaluations, conclusions, and choices of action in connection with objectives that may include, without limitation, one or more of the following:

1.2.1 *Objective 1*—Assess whether there has been a *release* of *hazardous substances* within the meaning of *CERCLA*, for purposes including *landowner liability protections* (i.e., *innocent landowner*, *bona fide prospective purchaser*, and *contiguous property owner*).

1.2.2 *Objective 2*—Provide information relevant to identifying, defining and implementing landowner "*continuing*

[1] This practice is under the jurisdiction of ASTM Committee E50 on Environmental Assessment, Risk Management and Corrective Action and is the direct responsibility of Subcommittee E50.02 on Real Estate Assessment and Management.

Current edition approved June 15, 2011. Published July 2011. Originally approved in 1997. Last previous edition approved in 2002 as E1903 – 97 (2002). DOI: 10.1520/E1903-11.

[2] As used herein, a "standard" is a document that has been developed and established within the consensus principles of the Society and that meets the approval requirements of ASTM procedures and regulations. A "practice" is a definitive set of instructions for performing one or more specific operations that does not produce a test result. A "guide," in contrast, is a compendium of information or a series of options that does not recommend a specific course of action. A guide increases the awareness of information and approaches in a given subject area. See Form and Style for ASTM Standards, http://www.astm.org/COMMIT/Blue_Book.pdf.

Relevant CCNY courses

- Phase I environmental site assessments EAS 33300
- Phase II environmental site assessments EAS 33400
- **Global Environmental Hazards** EAS 32800
- **Introduction to Geographic Information Systems** - EAS 33000
- **Seminar on Science and Technology in NYC** - MHC 20301
  Macaulay Honors College, CUNY

CUNY

The City College of New York

Nine modules

- Power Point Presentations
- Reference materials library
- Short interviews recorded in video-podcast format
- Student handouts
- In-class activities
- Homework assignments
- Instructor guidance documents (*Instructors-only area*)
- Banks of test questions along with answers (*Instructors-only area*)

“Module” qualification

Educator’s comfort zone versus module adoptability

CU NY

Modules under development based on NIST funding

ISO 14001:2015

Environmental management systems

Metropolitan Transportation Authority

New York City Transit

Large-scale adaptation of international environmental management standards

CERTIFICATE

This is to certify that

MTA New York City Transit
Department of Capital Program Mangement
2 Broadway, 5TH Floor
New York, NY 10004
United States of America

has implemented and maintains an **Environmental Management System**.

Scope:
The Environmental Management System of The New York City Transit Authority (NYCTA) Department of Capital Program Management (CPM) for providing capital development, design, planning and construction management services to other departments within NYCTA in New York, New York, USA.

Through an audit, documented in a report, it was verified that the management system fulfills the requirements of the following standard:

ISO 14001 : 2004

Certificate registration no.	10000419 UM
Date of original certification	1999-03-17
Date of revision	2011-07-16
Date of certification	2011-07-16
Valid until	2014-07-15

UL DQS Inc.

Ganesh Rao
President

Accredited Body: UL DQS Inc., 1130 West Lake Cook Road, Suite 340, Buffalo Grove, IL 60089 USA

Modules under development based on NIST funding

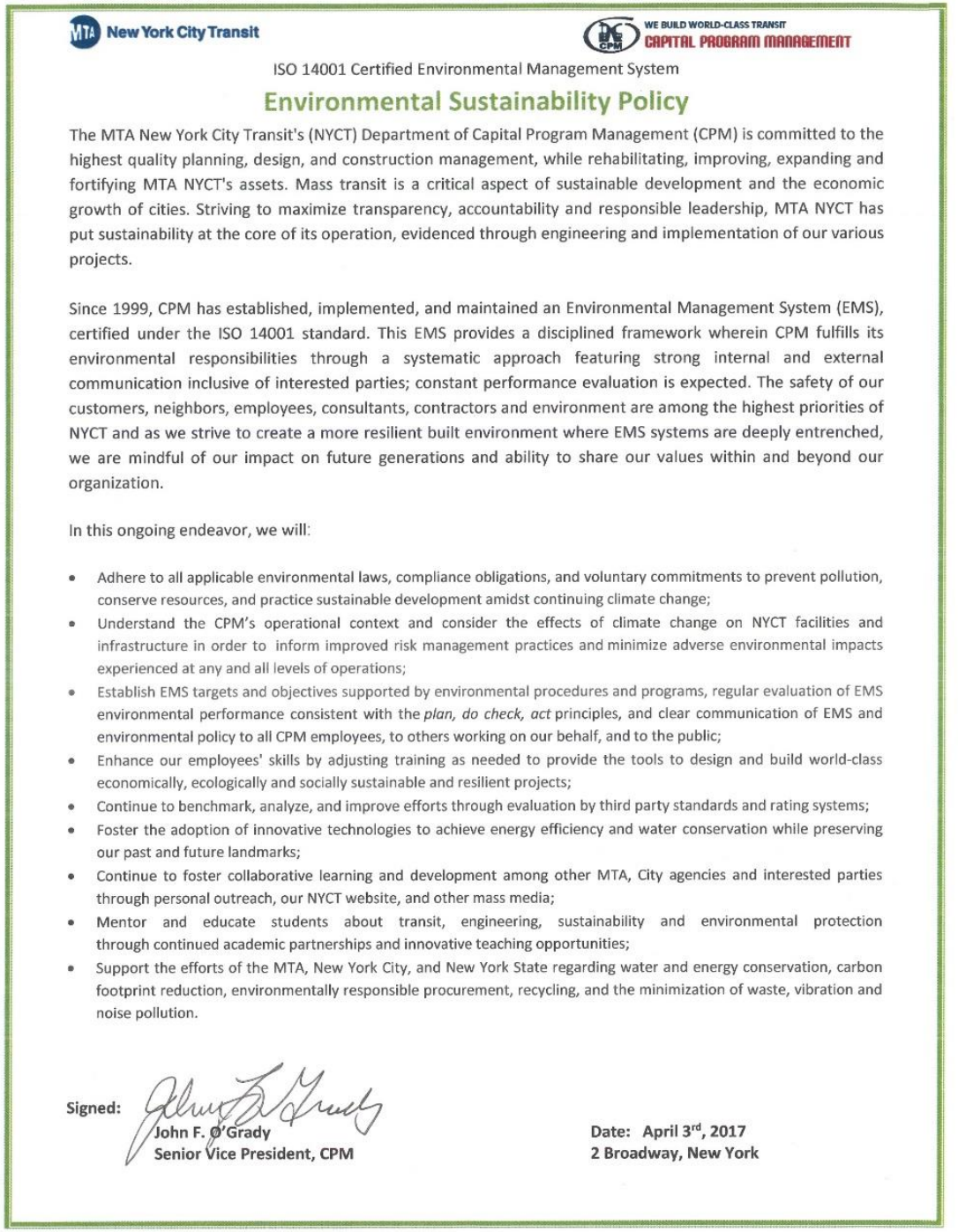
ISO 14001:2015

Environmental management systems

Metropolitan Transportation Authority

New York City Transit

Large-scale adaptation of international environmental management standards



New York City Transit

WE BUILD WORLD-CLASS TRANSIT
CAPITAL PROGRAM MANAGEMENT

ISO 14001 Certified Environmental Management System

Environmental Sustainability Policy

The MTA New York City Transit's (NYCT) Department of Capital Program Management (CPM) is committed to the highest quality planning, design, and construction management, while rehabilitating, improving, expanding and fortifying MTA NYCT's assets. Mass transit is a critical aspect of sustainable development and the economic growth of cities. Striving to maximize transparency, accountability and responsible leadership, MTA NYCT has put sustainability at the core of its operation, evidenced through engineering and implementation of our various projects.

Since 1999, CPM has established, implemented, and maintained an Environmental Management System (EMS), certified under the ISO 14001 standard. This EMS provides a disciplined framework wherein CPM fulfills its environmental responsibilities through a systematic approach featuring strong internal and external communication inclusive of interested parties; constant performance evaluation is expected. The safety of our customers, neighbors, employees, consultants, contractors and environment are among the highest priorities of NYCT and as we strive to create a more resilient built environment where EMS systems are deeply entrenched, we are mindful of our impact on future generations and ability to share our values within and beyond our organization.

In this ongoing endeavor, we will:

- Adhere to all applicable environmental laws, compliance obligations, and voluntary commitments to prevent pollution, conserve resources, and practice sustainable development amidst continuing climate change;
- Understand the CPM's operational context and consider the effects of climate change on NYCT facilities and infrastructure in order to inform improved risk management practices and minimize adverse environmental impacts experienced at any and all levels of operations;
- Establish EMS targets and objectives supported by environmental procedures and programs, regular evaluation of EMS environmental performance consistent with the *plan, do check, act* principles, and clear communication of EMS and environmental policy to all CPM employees, to others working on our behalf, and to the public;
- Enhance our employees' skills by adjusting training as needed to provide the tools to design and build world-class economically, ecologically and socially sustainable and resilient projects;
- Continue to benchmark, analyze, and improve efforts through evaluation by third party standards and rating systems;
- Foster the adoption of innovative technologies to achieve energy efficiency and water conservation while preserving our past and future landmarks;
- Continue to foster collaborative learning and development among other MTA, City agencies and interested parties through personal outreach, our NYCT website, and other mass media;
- Mentor and educate students about transit, engineering, sustainability and environmental protection through continued academic partnerships and innovative teaching opportunities;
- Support the efforts of the MTA, New York City, and New York State regarding water and energy conservation, carbon footprint reduction, environmentally responsible procurement, recycling, and the minimization of waste, vibration and noise pollution.

Signed: John F. O'Grady
Senior Vice President, CPM

Date: April 3rd, 2017
2 Broadway, New York

Modules under development based on NIST funding

Post hurricane Sandy resiliency efforts

The case of mold

- New York City's guidelines on assessment and remediation of fungi in indoor environments
- ASTM E3026-15 Visual Moisture Assessment (VMA) Standard Guide
- OSHA's A brief guide to mold in the workplace
- EPA's Mold remediation in schools and commercial buildings
- FEMA's Cleaning flooded buildings
- IICRC/ANSI S520 Standard for professional mold Remediation

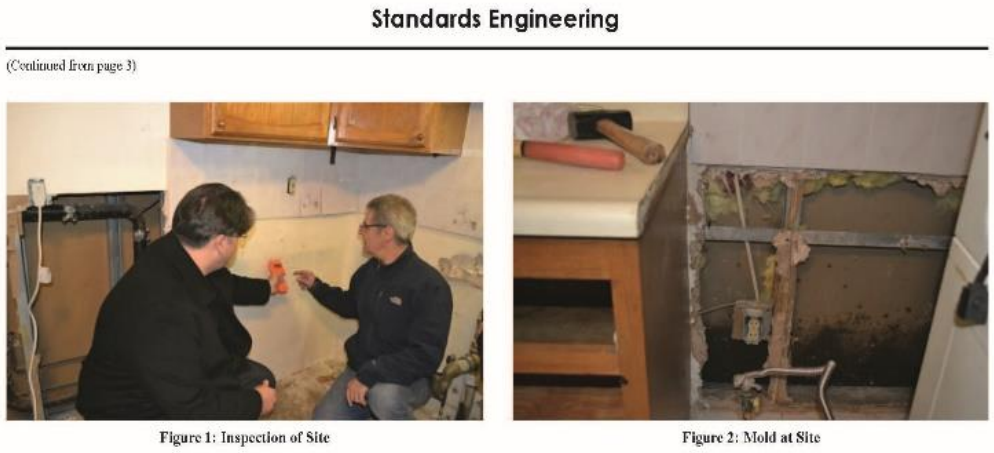


Figure 1: Inspection of Site

Figure 2: Mold at Site

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Modules under development based on NIST funding

OSHA safety standards from New York City to Bangladesh

Frances Perkins
U.S. Secretary of Labor
from 1933 to 1945

1911
New York City
Industry: Garment

2012
Bangladesh
Industry: Garment

CUNY

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Modules under development based on NIST funding

OSHA safety standards from New York City to Bangladesh (cont.)

"To assure safe and healthful working conditions for working men and women; by authorizing enforcement of the ***standards*** *developed under the Act; by assisting and encouraging the States in their efforts to assure safe and healthful working conditions; by providing for research, information, education, and training in the field of occupational safety and health; and for other purposes*."

President Richard Nixon signing the Occupational Safety and Health Act of 1970.
Courtesy of the Department of Labor

Modules under development based on NIST funding

http://www.bbc.com/news/world-latin-america-39649680

Building standards and global hazards: The case of Port-au-Prince, Haiti

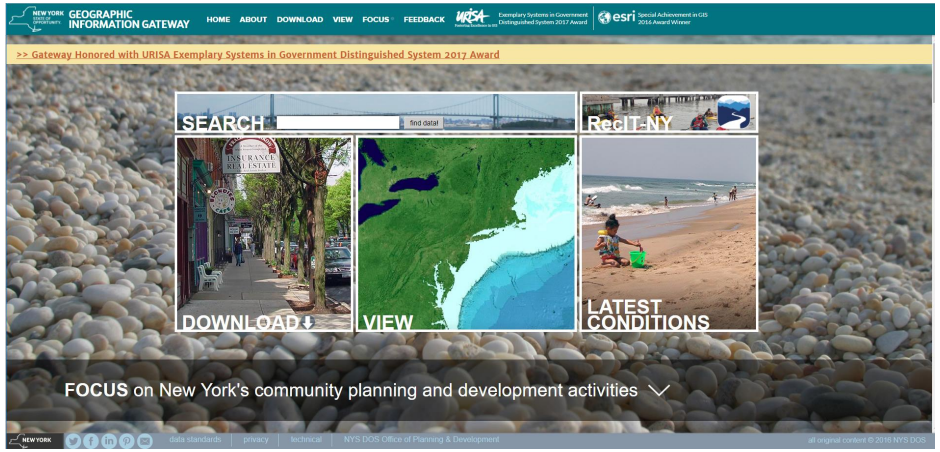
Modules under development based on NIST funding

Federal Geographic Data Committee (FGDC)

ISO 19115

Geographic Information metadata

The use of Geographic information metadata standards in the development of databases in support of resilient and sustainable growth



http://opdgig.dos.ny.gov/#/home

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Modules under development based on NIST funding

Mining standards in the US and internationally: The case of Latin American mining

- Mine Safety and Health Administration (MSHA)
  U.S. Department of Labor

- International Labour Organization (ILO)
  Indigenous and Tribal Peoples Convention of 1989 (No. 169)

Article 15: *The rights of the peoples concerned to the natural resources pertaining to their lands shall be specially safeguarded. These rights include the right of these peoples to participate in the use, management and conservation of these resources*.

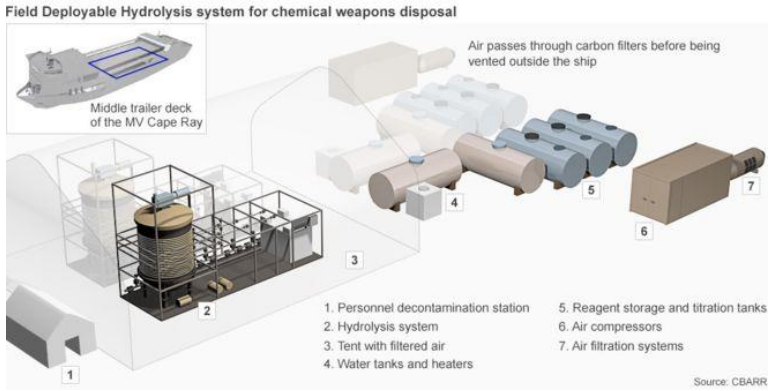
Utah's Bingham Canyon copper mine
Photo by Michael Collier

Artisanal Gold Mining

The Economist
Print edition | The Americas
Feb 6th 2016 | COCACHACRA, PERU

Modules under development based on NIST funding

Chemical and biological warfare agents: The case of Syria



BBC, 2 July 2014, Christine Jeavans
Destroying Syria's chemical weapons

United Nations Security Council Resolution 2118 (September 27, 2013) required Syria to assume responsibility for and follow a timeline for the destruction of its chemical weapons and its chemical weapon production facilities.

https://www.ecbc.army.mil/cbarr/

Modules under development based on NIST funding

Phase I / Phase II environmental site assessments

- ASTM E1527 Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process
- ASTM E1903 Standard Practice for Environmental Site Assessments: Phase II Environmental Site Assessment Process
- ASTM E2600 Standard Guide for Vapor Encroachment Screening on Property Involved in Real Estate Transactions
- ASTM E2790 Standard Guide for Identifying and Complying With Continuing Obligations

Preliminary Outcomes

Global Environmental Hazards EAS 32800

Typical class demographics

(*Spring 2017 data, as reported in SES Journal July/August 2017 Issue**)

- 94 undergraduate students
- 62 civil engineering majors
- 18 environmental earth systems science majors
- 3 geology majors
- 3 chemical engineering majors
- 1 biomedical science major
- 1 psychology major
- 6 undeclared

* Lampousis, Angelo, (2017), *The pursuit of relevance in standards-based curriculum development: The CCNY approach*, Standards Engineering Journal of the Society for Standards Professionals (SES), July/August 2017 Issue. [cover feature]

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Standards Engineering
The Journal of SES – The Society for Standards Professionals
Volume 69, No. 4 July/August 2017

On the Pursuit of Relevance in Standards-based Curriculum Development: The CCNY Approach

Angelo Lampousis, PhD

Looking for Environmental Issues from Hurricane Sandy

Haiti Earthquake Damage

Introduction

The Society for Standards Professionals (SES) has a significant history of documenting the use of standards in research and academia. For instance, during the 62nd Annual SES Conference in 2013 in Savannah, Georgia, the author participated in such a session highlighting examples of relationships between academic institutions, government, and standards developing organizations. In this article, we attempt to capture the current advances made from similar relationships specific to our home institution, the City College of New York (CCNY) of the City University of New York (CUNY.) These advances have become possible through a grant issued under the Standards Services Curricula Development Cooperative Agreement Program of the National Institute of Standards and Technology (NIST).

CCNY was one of five institutions receiving funding in 2016 from NIST out of forty-nine applicants. The purpose has been to develop teaching materials for integration into four courses encompassing topics such as environmental management standards, mold standards following hurricanes, environmental site assessments, the effects of international trade agreements on safety standards, building standards for mitigating the effects of earthquakes, mining standards, geographic information metadata standards, and standards for first responders regarding chemical and biological substances.

Of these four courses, two are offered in sequence on the topics of Phase I and Phase II environmental site assessments. The CCNY bulletin description on these two courses reads almost verbatim from ASTM E1527-13, *Standard Practice for Environmental Site Assessments. Phase I Environmental Site Assessment Process*, and ASTM E1903-11, *Standard Practice for Environmental Site Assessments: Phase II Environmental Site Assessment Process*, respectively. For instance, the Phase I course description starts as "The purpose of this course is to introduce students to good commercial and customary practices in the United States of America for conducting environmental site assessments of commercial or residential properties with respect to hazardous substances and petroleum products…" The Phase I course has been offered every fall semester since 2010, and the Phase II course has been offered every spring semester since 2011, both at the undergraduate and graduate levels. A third course entitled *Global Environmental Hazards* focuses on the study of important, naturally occurring, destructive phenomena, such as earthquakes, volcanic eruptions, landslides, and coastal flooding. Related topics include long-term causes and remediation of these problems, as well as a focus on consequences to urban environments. Finally, the fourth course is specific to CUNY's Macaulay Honors College students, who come together for a seminar course that they take over the course of their second year. This seminar course is called *Science and Technology in New York City*.

(Continued on page 3)

(Continued from page 1)

It is worth noting that the above-mentioned courses do not represent the only intended audience of the proposed nine modules funded by NIST. They represent more of an ecosystem of standards-related learning opportunities. In this context, the modules will be piloted and improved through multiple iterations. Ultimately, the plan is to communicate and share the results with the community of interested educators.

The CCNY approach

We consider the notion of *relevance* to be by far the most significant challenge in curriculum development efforts to date. In addition to a number of success stories, a quick review of curriculum development efforts in the STEM disciplines also reveals the level in which the literature is littered with unsuccessful or partially successful attempts to increase the students' understanding and appreciation of science, technology, engineering, and math. There is good reason for the great number of frequently unfulfilled curriculum development efforts in the STEM disciplines.

First, curriculum development is a painstakingly slow process. By the time the effort is complete market trends may have already shifted, effectively decreasing the relevance of the original idea. This is especially true for educational efforts that include elements of standards and standardization, which can have a particularly narrow focus in terms of the number of standards and associated industries that are being evaluated. Second, inevitably, a great number of proposed efforts, including those that may have been locally successful, rely heavily on the unique expertise of the principal investigators involved, making it almost impossible for other educational programs to readily replicate their model. Finally, the increased reliance of curriculum development efforts on web-based applications, although it ensures in the short term the widest possible visibility of the proposed models, makes the approach unsustainable in the long term. This is due to the high maintenance cost of the continuous optimization that is required for most, if not all, web-based applications in the ever changing environment of online platforms and personal devices.

In sharp contrast with the above, our approach has the following characteristics:

1. It takes into serious consideration the major challenge of the elusive *relevance* quality, as outlined above.
2. It strikes a balance between the ephemeral aspects of the proposed project and its long-term objectives, ensuring sustainability of the application of our model within our academic institution and beyond.
3. It shifts focus from a narrow number of standards to a wider collection, multiplying the relevance effect to larger communities. It is a conscious decision to step outside the "comfort" zone of our own expertize and assume more of a facilitator role, as opposed to dwelling on the singular role of an educator.
4. It invests significantly in achieving a finished product, in a way that will maximize the potential for replication of the model by other educational institutions. This finished product is described below in all its components for each proposed topic in the following section.

Methodology

The academic semester at CCNY follows the universal academic calendar that is shared among the twenty-four campuses of CUNY. Teaching time for a three-credit course is typically distributed over fourteen weekly meetings of 2.5 hours each, or twenty-eight meetings of 1.25 hours (i.e., two meetings per week.) Overall, the academic semester consists of fourteen weeks, excluding the final exams week and reading periods. NIST funds facilitated the development of teaching materials sufficient for nine weeks of teaching. Certain elements of these materials were already underway prior to the NIST grant, while others are now underway. Of the nine course topics outlined below, interested educators may adopt stand-alone topics or expand on a short sequence of topics as it best fits their needs. All of these resources will become available on line at no cost at the conclusion of the project through a dedicated website. The only area of the website that will be restricted through password protection will be the solution key to the test bank, since it should be accessible to educators only.

For each one of the proposed nine topics, we are developing the following components:

- Downloadable Power Point presentation.
- Training and reference materials library.
- Short interview recorded in video-podcast format featuring high-profile members of the standards community.
- Instructor guidance document consisting of instructions for preparation, detailed lesson plan, individual slide notes for the Power Point presentations, student handouts, and a collection of suggested in-class activities and homework assignments.
- A bank of forty test questions and answers for each topic, or 360 questions in all. These questions will be in a format suitable for machine scoring in large classes. Half of the questions will be in a multiple-choice format and half in a true-false format.

Curriculum development areas

We present below titles of the nine topics under development and we provide brief descriptions for each one.

1. Large-scale adaptation of international environmental management standards

   The Metropolitan Transportation Authority (MTA) of New York City Transit (NYCT) is the first public transportation company in North America certified to ISO 14001:2015, *Environmental management systems – Requirements with guidance for use*. In this topic, we present in detail what an environmental management system (EMS) is made up of, how to construct an EMS, and how to manage a successful EMS.

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Figure 1: Inspection of Site

Figure 2: Mold at Site

2. Post hurricane Sandy resiliency efforts: The case of mold

New York State recently joined an increasing number of states that regulate mold. In this topic we discuss the difference between the notions of "scientifically clean" and "customer clean" in the context of post hurricane Sandy resiliency efforts and as they relate to mold. (Hurricane Sandy developed in late October 2012, and impacted over sixteen states, including power outages for more than 8.5 million residences and 380,000 homes destroyed or damaged.) Figure 1 shows Dr. Angelo Lampousis (left) and Dr. Jack Caravanos inspecting a hurricane-impacted property of a CUNY colleague in Coney Island, Brooklyn, New York, on November 17, 2012, while Figure 2 shows the visible mold on the same site. New York City's guidelines on assessment and remediation of fungi in indoor environments, OSHA's *A brief guide to mold in the workplace*, EPA's *Mold remediation in schools and commercial buildings*, FEMA's *Cleaning flooded buildings*, as well as the IICRC/ANSI S520 *Standard for professional mold remediation* (third edition, 12/8/15) cite relevant standards that are candidate for inclusion in this module.

3/4. Phase I / Phase II environmental site assessments

In the next two topics we introduce students to good commercial and customary practices in the United States of America for conducting Phase I and Phase II environmental site assessments (ESA).

5. OSH A safety standards from New York City to Bangladesh

New York City is intertwined with the history of the Occupational Safety and Health Administration (OSHA). The story of US Secretary of Labor Frances Perkins, the first woman appointed to the US Cabinet, is emblematic of this relationship. Secretary Perkins famously witnessed the Triangle Shirtwaist Factory fire in 1911 in New York City. 100 years after the Triangle fire, a similar tragedy in Bangladesh killed twenty-six workers making clothes for US companies. We will explore the effect of international trade agreements between the US and low-income countries on worker safety standards worldwide.

6. Building standards and global hazards: The case of Port-au-Prince, Haiti

On January 12, 2010, the capital of Haiti, Port-au-Prince, was struck by a 7.0 magnitude earthquake, killing as many as 250,000 people. Across Port-au-Prince there were two buildings that remained largely unscathed after the earthquake: The US embassy and the tower headquarters of Digicel Haiti, a mobile telephone operator. These two buildings were designed to modern building standards. Through this incident we introduce the importance of building standards for earthquake-prone regions and beyond.

7. Mining standards in the US and internationally: The case of Latin American mining

The Observatory of Mining Conflicts in Latin America, a coalition of NGOs, recorded 215 disputes over the exploitation of natural resources in nineteen Latin American countries in 2014. Fourteen Latin American countries have signed the International Labour Organisation's Convention 169 on *Indigenous and Tribal Peoples* (1989), which requires governments to ensure that indigenous and tribal communities are consulted about projects that affect them. As the balance of power has shifted in favor of local populations, and the international community becomes increasingly aware of these issues, we will discuss mining and quarrying standards. Subtopics include exploration, drilling, construction of mines, mining operations, and processing of minerals.

8. The use of Geographic information metadata standards in the development of databases in support of resilient and sustainable growth

The Geographic Information Gateway (Gateway) is a state-of-the-art publicly available database under the Office of Planning and Development (OPD) of the New York Department of State (NYDOS). OPD is advancing progressive land use solutions, community development, and building standards and codes in support of New York communities. ISO 19115 on Geographic information metadata and Federal Geographic Data Committee (FGDC) metadata standards constitute the data acceptance standards for data included in the NYDOS OPD Gateway. We will introduce this topic with background information on Geographic Information Systems (GIS) and the methods of building geodatabases, and then we will explore the applications of the Gateway in building standards and codes that support the resilient and sustainable growth of New York communities.

9. Chemical and biological warfare agents: The case of Syria

In recent years there has been a significant effort invested in the development of counterterrorism standards to assist emergency first responders. One area of immediate interest is to facilitate advanced decontamination training related to chemical and biological agents. Chemical agents are chemical substances that are intended for use in terrorist activities and warfare. Biological agents likely to be used in terrorist activities include bacterial agents and viral agents. The mission of neutralizing on a US Navy vessel nearly 600 metric tons of chemical weapons originating from the Syrian regime will introduce this topic, which is related to the use of field deployable hydrolysis machines. Standards associated with the neutralization of and decontamination from chemical and biological warfare agents will be discussed in detail.

Current status and future steps

We are presently in the stage of field-testing the various curriculum components described above in real classroom environments. Student feedback is being actively collected. The final review of the material will be concluded at the end of the fall 2017 semester. Necessary changes and updates will be implemented during the last two months of the project.

Preliminary survey data for the first delivery of eight out of the nine proposed modules were realized during the spring 2017 academic semester. Over the course of 2.5 hours the eight modules were presented in fifteen-minute sections before a class of ninety-four undergraduate students enrolled in the Global Environmental Hazards course. Of these ninety-four students, sixty-two are majoring in civil engineering, eighteen in the environmental earth systems science program (i.e., an interdisciplinary program of the CCNY Division of Science and the CCNY Grove School of Engineering), three in geology, three in chemical engineering, one in biomedical science, one in psychology, and six have not yet declared a major. The survey was anonymous and recorded a total of eighty-four responses. Survey statistics on the question "Was any of the information presented in this module new to you?" are presented in Table 1. Overall, the survey results indicate that the majority of students had little to no prior exposure to those modules. Survey results also confirm some of the demographics described above. For instance, it comes as no surprise that a class of sixty-two civil engineering majors out of ninety-four undergraduate students has a little prior experience with building standards at 53.75 percent and a fair amount of prior experience with building standards at 32.5 percent (or a combined 86.25 percent.)

Civil engineering majors in great numbers in this particular class may also explain a solid 88.75 percent who found building standards as "very relevant" on the question "How relevant do you think this lecture is to authentic real-world activities?" (see Table 2). On the relevance question the preliminary results presented in Table 2 are very encouraging with all modules crossing the fifty percent mark and most of them actually scoring strong majorities among surveyed students for topics being "very relevant." It is also worth noting that these modules were not delivered by professional educators, but by four students supported under the NIST grant, two graduate students and two undergraduates, respectively.

Additional surveys were conducted in three other courses during the same semester, which are not presented in this report. The main conclusion in terms of progress in our standards-based curriculum efforts to date is that the CCNY approach has a significant probability of meeting the relevance criterion as described in the beginning. Ultimately, we envision the finished product to be attractive enough not only for students, but for the actual educators of students who may decide to adopt and incorporate some of the proposed modules into their respective curricula.

In closing, one may perhaps identify a common thread in most of the proposed modules in that they relate to an element of unwanted consequences when standards are absent or not followed. A student from those surveyed made the following comment on the module on building standards and earthquake hazards: "It was straight to the point of why the [Haiti] earthquake was infamous, [due to] poor building codes and little to no consideration of natural disasters. I like learning from past events to prevent a future negative outcome and informing others as well." This sentiment, echoed by other students as well, may be the key to unlocking the elusive relevance quality in standards-based curricula.

About the Author

Dr. Angelo Lampousis serves as a lecturer at the department of earth and atmospheric sciences at the City College of New York (CCNY) of the City University of New York. He specializes in curriculum development addressing the needs of diverse audiences ranging from construction and general industry entry-level workers to undergraduate and graduate students in the geosciences. He contributed to IEEE's *Practical Ideas from Professors* series of resources designed to help educators across the country and around the world discover ways to include standards and standardization themes into their course curricula. Dr. Lampousis is vice chair of the E50 training committee of ASTM International. He also serves on the Committee on Education of the American National Institute on Standards (ANSI). Most recently, he was the recipient of a $70,000 grant from the National Institute of Standards and Technology (NIST) to support standards-based enhanced professional training for geoscientists. He received his BS in agriculture from Aristotle University, Greece, and his MPhil in Earth and Environmental Sciences and PhD in agricultural geophysics from CUNY's Graduate School and University Center. He is also an OSHA-authorized trainer for both construction and general industry.

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	Never exposed	Little Experience	Fair Experience	A lot of experience	*Unanswered*
Building standards and earthquake hazards (Haiti case study)	8.75%	53.75%	32.5%	5%	0%
Mold standards and post hurricane Sandy resiliency efforts	25%	50%	23.75%	1.25%	0%
Phase I environmental site assessments standards	36.25%	50%	10%	3.75%	0%
Phase II environmental site assessments standards	43.75%	47.5%	8.75%	2.5%	0%
OSHA safety standards: NYC to Bangladesh	33.75%	47.5%	13.75%	5%	0%
Mining standards in the US and internationally: The case of Latin American mining	53.75%	38.75%	5%	1.25%	1.25%
Environmental management standards (NYC MTA case study)	61.25%	27.5%	10%	0%	1.25%
Geographic information metadata standards	58.75%	31.25%	8.75%	1.25%	0%

Table 1: Was any of the information presented in this module new to you?

	Not Relevant	Neutral	Very relevant	*Unanswered*
Building standards and earthquake hazards (Haiti case study)	1.25%	10%	88.75%	0%
Mold standards and post hurricane Sandy resiliency efforts	0%	20%	80%	0%
Phase I environmental site assessments standards	0%	21.25%	78.75%	0%
Phase II environmental site assessments standards	1.25%	16.25%	82.5%	0%
OSHA safety standards: NYC to Bangladesh	0%	30%	70%	0%
Mining standards in the US and internationally: The case of Latin American mining	0%	42.5%	56.25%	1.25%
Environmental management standards (NYC MTA case study)	0%	37.5%	62.5%	0%
Geographic information metadata standards	1.25%	40%	58.75%	0%

Table 2: How relevant do you think this lecture is to authentic real-world activities?

Track Level photo at South Ferry
(only the beginning)

South Ferry Street Level Entrance

“Module” qualification

Thank You

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