COMPENDIUM OF ENVIRONMENTAL FIELDWORK TECHNOLOGIES

Requested by:

American Association of State Highway
and Transportation Officials (AASHTO)

Standing Committee on the Environment

Prepared by:

The Louis Berger Group, Inc.
412 Mount Kemble Ave
Morristown, NJ 07962

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I. Introduction

There are many reasons for the development and use of new technologies for field data collection as part of the analysis of existing conditions, impacts and potential mitigation measures associated with the various technical disciplines covered under the umbrella of National Environmental Policy Act (NEPA) compliance. Federal regulations drive the requirements for many field methods, while some are more specific at the state and local level. The need for data and analyses that can be readily shared between discipline experts, environmental consultants, resource agencies and state departments of transportation (DOTs) is evident, as is the demand for technology that can streamline the process by transmitting accurate data quickly and precisely from the field to the office for immediate analysis and sharing. It is understandable then that methods vary from state to state and from consultant to consultant, and that DOTs could benefit from the sharing of these methods in a compendium report, synthesizing actual literature published on the topics for each discipline, as well as personal experiences and opinions on the currently-used methods.

Environmental managers, both at state DOTs and at consulting firms assisting the DOTs in conducting the field studies, need to understand the latest fieldwork technologies, processes and tools that are currently available to them, including those that are not actually being used by them at the present time. An important aspect to consider regarding the fieldwork technologies that are currently being used in various states is the level of efficiency that those technologies and techniques offer. Different types of field sampling technologies, processes and tools are available and are utilized throughout the country, with some states favoring certain ones, either because they have been proven to be most efficient and/or effective, or perhaps because they are not aware of others that are more efficient and/or effective. While some of the technologies used are considered to be state-of-the-art, others are simplified approaches that DOTs have developed to address everyday needs.

The objective of this research is to develop and maintain an ongoing compendium of environmental fieldwork technologies that can be easily shared with state DOTs to enable time-and-cost savings. A compendium of this type does not currently exist, so this is designed to be valuable as a reference tool for DOT environmental staff and their consultants to use, and to perhaps consider alternative technologies that they are not currently using, but which have been successfully applied in other states. An understanding of the applicable situations or conditions for using various technologies is also an important element of the overall objective. Specifically, the intent of this research is to cover fieldwork methods related to *Cultural Resources, Ecology, Water Permitting* and *Noise Analysis*.

For purposes of this research, “environmental fieldwork technologies” are interpreted rather broadly to encompass not just true technologies used in the course of field data collection, but also processes, practices and other tools that can have an impact on how much fieldwork is actually required, how long the fieldwork would take or how the fieldwork would be undertaken. The focus of the research is on those environmental fieldwork technologies, primarily related to NEPA-related projects, which are considered to be “state of the art.” Additionally, this research

focuses on those state DOTs that perceive themselves to be at the forefront of using environmental fieldwork technologies and practices considered to be state-of-the-art, and by so doing, may provide greater awareness of those technologies and practices for other state DOTs to consider in their own field data collection programs.

II. Methodology

This research consisted of three basic elements. The first task included the development and implementation of an online survey of all state DOTs to determine the technologies and practices being used by each, and to identify suitable candidate DOTs to participate in a follow-up interview process. This task also included a review of those DOT websites that identified themselves as a leader in each of the four disciplines (i.e., *Cultural Resources*, *Ecology*, *Water Permitting* and *Noise Analysis*) by responding as such in the online survey. The second task involved a more detailed interview process with those state DOTs that identified themselves as leaders in fieldwork technologies and practices for each of the four disciplines. The final task involved a limited survey of consultants working with some of the DOT leaders in order gain any additional perspective. The methodologies used for performing these three tasks are presented below.

Online Survey and Website Review

A survey was conducted using an online survey tool hosted by *Survey Gizmo*. Initial survey questions were prepared and submitted to the NCHRP Panel for review and comment prior to publication of the survey. Upon receipt of Panel comments, further refinement of the specific questions was implemented prior to actually sending the survey form to the state DOTs.

The survey was initially distributed to each state DOT Environmental Director (including District of Columbia and Puerto Rico) via email on October 7, 2008. The names of the Directors were identified from the list of "voting members" on AASHTO SCOE's website. The original deadline for completion of the survey was identified as October 24, 2008.

The email sent to each state DOT Environmental Director explained the purpose of the survey, provided a link to the actual survey and requested that the Director forward the email on to the technical specialist for each of the subject disciplines at his/her state DOT. The four disciplines of interest for this research include *Cultural Resources*, *Ecology*, *Water Permitting*, and *Noise Analysis*, with a separate survey element designed for each discipline. Upon forwarding of the email by the Director to his/her own designated technical specialist for each discipline, it was the intent that the technical specialist would then serve as the actual survey respondent. In this manner, the survey respondent was asked to identify which state and technical discipline he/she represents on the first page before entering the survey. Each survey had between 12 and 18 questions, including requests for contact information and a question that asked whether or not the specialist thought his/her state should be considered for further surveying. Copies of the four discipline survey forms are provided in the Appendices to this report (Appendix A.1 for *Cultural*

Resources, Appendix B.1 for *Ecology*, Appendix C.1 for *Water Permitting*, and Appendix D.1 for *Noise Analysis*).

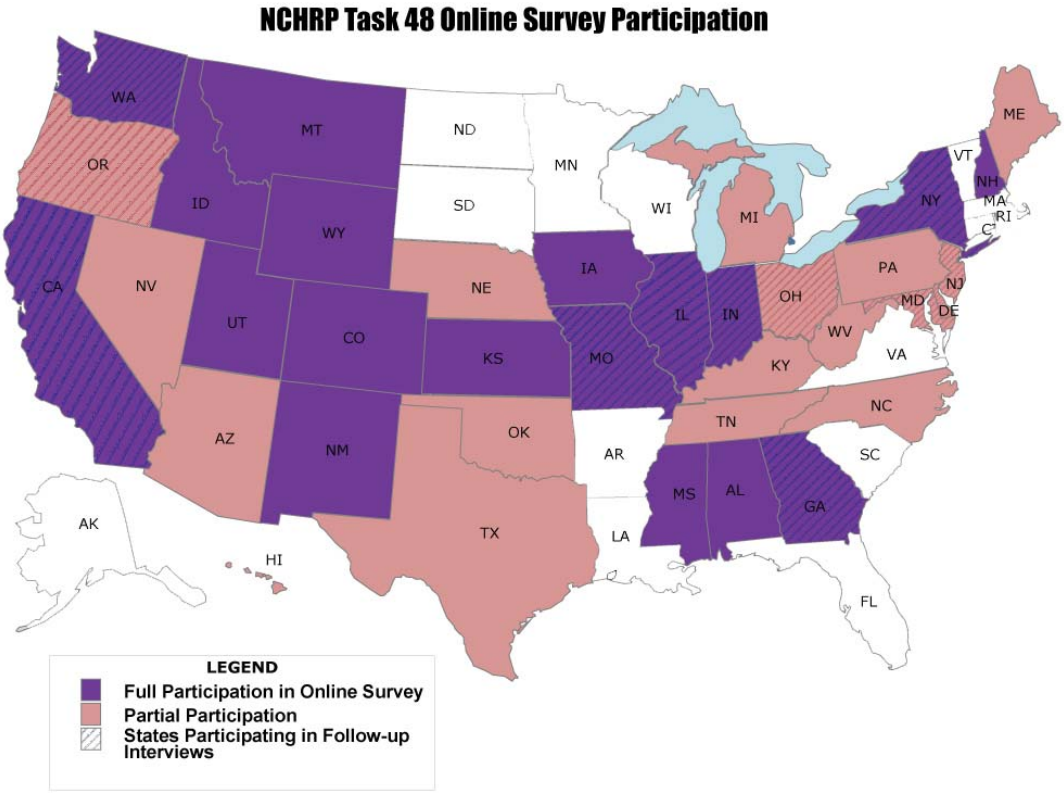
By the original deadline date of October 24, 2008, a total of 56 completed surveys representing all four technical disciplines were received from 19 states. At that time, an additional 44 surveys were in some state of completion but had not officially been submitted (considered "partial") and a total of 27 surveys were "abandoned," meaning that the survey site was visited but not utilized. An update was sent to NCHRP with this information, and a request was made to extend the deadline in order to increase the overall survey sample size. Following the first set of completed surveys, five states had indicated their willingness to participate in a follow-up survey in *Cultural Resources*, as well as two states each for *Ecology*, *Water Permitting* and *Noise Analysis*. In some cases, the same state DOT had indicated its willingness to participate in more than one technical discipline follow-up survey.

Upon review of these results, the NCHRP Panel agreed that the deadline should be extended so as to achieve maximum participation by the states. The deadline for survey completion was extended to November 7, 2008 and a second email was sent on October 24 to those states that had not yet fully participated (as determined by the data gathering feature on *Survey Gizmo*), informing them of the deadline extension and once again requesting their participation. Texas DOT was also invited to participate during this second round, as they had inadvertently been excluded from the first round of invitations. Following this two-week extension, a total of 92 survey responses had been received; of these, there were 23 responses in the category of *Cultural Resources*, 25 in *Ecology*, 20 in *Water Permitting* and 24 in *Noise Analysis*.

The completed sample results were conveyed to NCHRP along with a request that the survey be extended yet again in one final effort to further enhance the overall completed sample size. This extension was approved and another email was sent out on November 21 informing the DOTs that had not fully participated that the survey was extended until December 5. At that time, contact information for Hawaii DOT was obtained from NCHRP and a survey request was sent to them as well. Although the survey extension officially ended on December 5, the survey and survey tool were not fully closed until December 16 in order to allow the survey results to be tabulated and processed for use in the interim report. If additional surveys had been received during this additional period following official close of the extension date, they would have been accepted, although none were received.

The final survey extension yielded the participation of 38 states, with full participation in all four disciplines from 19 states. The *Cultural Resources* survey yielded a final total of 31 responses, *Ecology* yielded 30 responses, *Water Permitting* yielded 25 responses, and *Noise Analysis* yielded 32 responses. In combination, the final total of 118 responses received represented 57 percent of the total universe of 208 potential respondents (i.e., 4 disciplines for each of the 50 states, District of Columbia and Puerto Rico). The map on the next page identifies the status of survey participation by each state, including those with full participation (i.e., completion of all four discipline surveys) and those with partial participation (i.e., completion of one to three discipline surveys).

The map also indicates the number of states that had indicated interest in participating in one or more follow-up interviews as part of the next task. The stated intent of the follow-up interviews was to focus on those DOTs that consider themselves to be at the forefront of using state-of-the-art environmental fieldwork technologies. In this regard, the following states indicated their interest in participating in a follow-up interview:



- *Cultural Resources* (9 states): California, Delaware, Georgia, Illinois, Indiana, Missouri, New York, Oregon, and Washington;
- *Ecology* (4 states): California, Maryland, Ohio, and Washington;
- *Water Permitting* (3 states): California, New York, and Washington; and
- *Noise Analysis* (4 states): California, New Jersey, New York, and Washington.

Given their interest in participating in the next round of interviews and, in most cases, their perception of themselves as leaders in environmental fieldwork technologies, the above-listed state DOTs were then requested to participate in the next round of research. Prior to the initiation of the interviews, a visit was made to each of these DOT's websites in order to gather background and preliminary information on some of their practices in the indicated discipline.

This information was also used to help develop some of the questions presented in the Task 2 State DOT interviews. Information regarding these website reviews is presented in the Appendices at the end of this report (Appendix A.4 for *Cultural Resources*, Appendix B.4 for *Ecology*, Appendix C.4 for *Water Permitting*, and Appendix D.4 for *Noise Analysis*).

State DOT Interviews

After reviewing the results of the online survey and conducting the review of select state DOT websites, the follow-up interview questions were developed and presented to the NCHRP Panel for their review and approval. The interview participants were identified through one of the questions on the initial online survey, which asked the survey taker to identify a contact at the state DOT (if other than themselves) who would be available and suitable for participation in the telephone interview. In two-thirds of the cases, this person identified was the same person who completed the online survey, while the other one-third of the specialists interviewed were not the same person who completed the online survey. All interview participants were sent a copy of the original online survey responses in addition to the questions that would be discussed prior to scheduling a phone interview. Copies of the interview questions for the four technical disciplines are provided in the Appendices to this report (Appendix A.2 for *Cultural Resources*, Appendix B.2 for *Ecology*, Appendix C.2 for *Water Permitting*, and Appendix D.2 for *Noise Analysis*).

It should be noted that some of the same states identifying themselves as being at the cutting edge of technology in their respective fields were those that volunteered to participate in several discipline interviews, which limits the geographic distribution and variety of states to be involved in the interviews. Whether or not all of the states that volunteered are in fact at the cutting edge of technology, or whether or not it could be argued that other states are also at the cutting edge of technology, the fact remains that these states are the ones that perceive themselves in this manner and were willing to participate in further interviews. Therefore, it was not the intent to identify and select other states that could potentially qualify as "cutting edge" states based on their survey responses, or to attempt to further solicit other states to participate in a follow-up interview; in fact, one of the intentions of the initial survey was to narrow down the field for suitable and interested states, thereby allowing the states to decide for themselves if they should or want to be involved in the next steps of the research.

For three of the four technical disciplines (*Cultural Resources*, *Ecology* and *Water Permitting*), the number of state DOTs that actually participated in the follow-up interviews was slightly lower than the number originally indicating interest in such participation during the online survey. In two cases, the state DOT was unavailable or non-responsive during the actual interview phase, while in the third case, the state DOT did participate in the interview but the information was incomplete or unclear. The final list of state DOTs that participated in the follow-up interviews were:

- *Cultural Resources* (8 states): California, Delaware, Georgia, Illinois, Indiana, Missouri, Oregon, and Washington;
- *Ecology* (3 states): California, Maryland, and Ohio;

- *Water Permitting* (2 states): New York and Washington; and
- *Noise Analysis* (4 states): California, New Jersey, New York, and Washington.

At least one technical expert supported the research interviewer during each of the interviews in order to be sure that the appropriate follow-up questions were asked of the state DOT in each of the disciplines. Prior to the results of the interviews being included in this report, the state DOTs were given the opportunity to review and make edits on their individual write-ups. More than half of the DOTs took advantage of this opportunity and offered minor comments for clarification.

It should be noted that in some interviews, the DOT discipline specialist volunteered particular brand names of technological products that are commonly used by their staff or by their consultants. These brand names have been mentioned in this regard, as appropriate, although it is not the intent of this report to promote specific brands over others; it is the intent, however, to identify the information as presented by the DOT discipline specialists with regard to those products with which they have had success and which they generally use.

Consultant Survey

The third phase of research was to conduct follow-up surveys with select consultants of some of the state DOTs that were interviewed during the previous task. A questionnaire was developed in order to further explore fieldwork technologies and methods from the consultant's perspective in an effort to solicit additional information that may be useful to other DOTs across the country. Where possible, the questions were tailored to be specific to that state's practices, based on the initial online survey responses and the results of the follow-up state DOT interviews. Copies of the consultant questionnaires for the four technical disciplines are provided in the Appendices to this report (Appendix A.3 for *Cultural Resources*, Appendix B.3 for *Ecology*, Appendix C.3 for *Water Permitting*, and Appendix D.3 for *Noise Analysis*).

During this phase, a total of no more than ten consultants between the four discipline areas were proposed to be surveyed based on the results of the previous state DOT interviews. Those disciplines in which it was believed that no further value could be obtained by surveying consultants were superseded by those disciplines where it was believed that the best value could be obtained to supplement the state DOT interviews.

It was decided that in the interest of time, it would be appropriate to allow the consultants to complete the surveys electronically, allowing for telephone contact if necessary for clarification. Four consultants were surveyed in the field of *Cultural Resources* and two consultants for *Ecology*. It was originally expected that two consultants would be interviewed for water permitting; however, of the two state DOTs interviewed in this field, only one of them provided a consultant contact for follow up and that consultant did in fact participate in the survey. Two consultants were sent surveys in the field of *Noise Analysis*, however only one responded within the allotted time.

III. Cultural Resources- Results

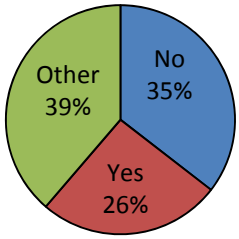
A total of 31 states completed the *Cultural Resources* element of the survey, including: Alabama, Arizona, California, Colorado, Connecticut, Delaware, Washington D.C., Georgia, Hawaii, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Maryland, Mississippi, Missouri, Montana, New Hampshire, New Mexico, New York, North Carolina, Ohio, Oregon, Pennsylvania, Tennessee, Utah, Washington, West Virginia, and Wyoming. The tabulated responses for each of the questions included in the *Cultural Resources* survey are presented below. The original online survey can be found in Appendix A.1 of this report. Although 31 states took the survey, not all of these states necessarily answered every question presented to them. Therefore, the total number of answers may vary, and the percentages of responses presented for each question are based only on those states that did respond to that particular question.

Following the online survey, a total of eight state DOTs (California, Delaware, Georgia, Illinois, Indiana, Missouri, New York, Oregon and Washington) were interviewed in greater detail about each specific topic related to *Cultural Resources*. In addition, consultants familiar with performing cultural resources fieldwork for four of these states were surveyed as well. The original interview questions for the state DOTs and the survey questions for the consultants can be found in Appendix A.2 and A.3 of this report. The results of a website review of the state DOTs interviewed in greater detail are presented in Appendix A.4.

These three sets of responses (i.e., online survey, follow-up interviews with "cutting edge" state DOTs, and consultant surveys) are presented below for each of the major technologies and/or practices that can influence the amount of fieldwork required, the amount of time required for conducting fieldwork, and/or how the field data are collected.

1. Topic: The use of GPS in architectural and archaeological studies

Online survey results:

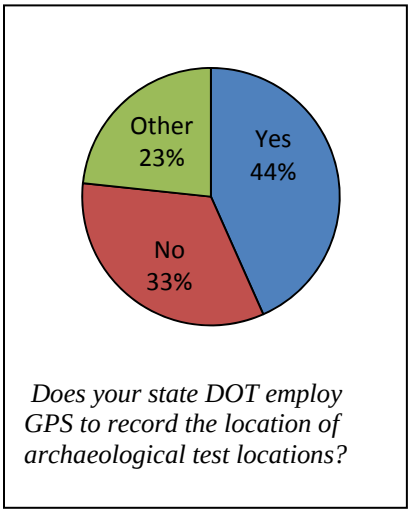


Does your state DOT require that GPS be used to record the location of historic architectural resources?

According to the results of the online survey, as presented in the following charts, the use of GPS is more common in the recordation of archaeological resources than in the recordation of historic architectural resources. According to some responses on this topic, street addresses are still generally used for architectural resources as well as aerial photos and existing information.

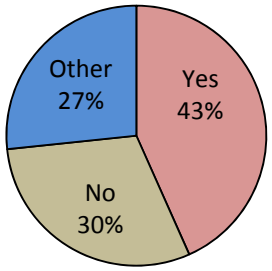
Eight states responded affirmatively to the question asking whether their state DOT requires GPS to be used to record the location of historic architectural resources, while eleven responded in the negative. Twelve states chose to answer the question with a "sometimes" response using the open-

ended response option[1]. While the open-ended responses varied, some explained that aerial photos and existing GIS maps are used to record locations. Others answered that they have used GPS on a case by case basis, such as in recording the location of district boundaries and historic bridges.



Does your state DOT employ GPS to record the location of archaeological test locations?

When asked the question regarding whether GPS is used to record the location of archaeological test locations, thirteen states responded that yes, GPS is used to record the location of archaeological test locations and ten states said that it is not. Seven states chose to answer the question with a "sometimes" response using the open-ended response option[2]. The open-ended responses varied but most indicated that GPS is being used by consultants to record archaeological test locations, although it is not required.



Does your state DOT employ GPS for recordation of location and descriptions of archaeological deposits, features, and/or landscape elements?

[1] Two states responded that GPS is required if later verification of the location/address of the property could be difficult or if the area is rural.
One state responded that GPS is used to record the location of district boundaries and historic bridges in the historic bridge inventory.
One state noted that they do not yet require the use of GPS, but are working towards full use of it.
One state responded that they had started using it, but that "the field data input mechanism is not friendly".
One state explained that UTM coordinates are recorded but that information can be obtained with the use of GIS and other mapping programs.
One state responded that this is something for the SHPO to decide.
One state responded that the use of GPS varies by district and staff performing the work.
One state responded that they do not require the use of GPS but that consultants are using it.
One state explained that GPS is rarely used since there are excellent aerial photos and GIS maps available.
One state responded that while they do record everything in UTM from either hand units or mapping software, they do not always use GPS.
One state responded that they are working on a new process with the SHPO to do GPS mapping.

[2] One state indicated that they have started requiring its use, but it is not yet well implemented.
One state explained that GPS is used to record the location of "select positive shovel test positions that yield diagnostic cultural material and/or evidence of intact deposits or features".
Two states responded that their consultants that do their archaeological work do use GPS, and one noted that their in-house staff uses it as well and that they were considering making it a requirement.
One state noted only that this is for the SHPO to decide.
One state explained that it is not a requirement, but GPS (either handheld, total station or Trimbles) are used for almost all field investigations, and that they use survey quality equipment on more detailed site specific investigations as well as having access to professional surveyors when needed.
One state responded that while they do record everything in UTM from either hand units or mapping software, they do not always use GPS.

When asked if GPS is used in the recordation of location and descriptions of archaeological deposits, features and/or landscape elements, thirteen states responded affirmatively to this question, and nine responded in the negative. Eight states chose to answer the question with a "sometimes" response using the open-ended response option. The open-ended responses were similar to previous responses, one state noted that they are just beginning to use GPS, two states noted that it is not required but that consultants use it (one of these states said they are considering making it a requirement), and one state responded that this is for the SHPO to decide. One state responded that "isolated features and site deposits are recorded with GPS; features that are part of larger sites are not individually recorded with GPS but are with a total station". One state explains "most archaeological features and deposits would be mapped in by a Total Station on the site, but everything is tied into the geo-referenced site grid and mapped boundaries". One state responded that archaeological deposits and landscape elements are typically recorded using some level of GPS and that site-specific features may be recorded using GPS or are "located with manual tapes from shot in locations". One state responded that they use GPS for this purpose if it is part of an approved mitigation plan.

State DOT interview results:

GPS for architectural resources

(CA) Caltrans does not require the use of GPS for historic architectural resources. The main reason for this is because not enough staff is trained in its use, and therefore they do not require its use by consultants. The California SHPO does not require GIS data for Section 106 consultation submittals; instead, they require just enough information to show the locations of historic properties, so that drives Caltrans' level of effort. GIS is being used more frequently as more staff becomes aware of its usefulness. More built-environment properties are being entered into Caltrans' Cultural Resources GIS database. Caltrans feels that as the number of entries in the database grows, staff will see the benefit.

(DE) Delaware Department of Transportation (DelDOT) does not require the use of GPS for historic architectural resources. They generally use the parcel information and actual address for the documentation of the structure. However, about 50% of the time, DelDOT's consultants use GPS for architectural resources, and DelDOT leaves it up to the consultants' discretion. The use of GPS depends on whether the structure is in a rural or urban environment. DelDOT would like consultants to use it in a rural context (farmsteads). In this regard, consultants are using handheld GeoTrimbles. It should be noted that 100% of DelDOT's historic architectural fieldwork is performed by consultants.

(GA) In the case of Georgia Department of Transportation's (GDOT) study of historic architectural resources, GPS is used for boundary delineations when aerial photos are not available, but it is not required by the Georgia SHPO. Basic location information is recorded for historic resources and added to the Natural, Archaeological, and Historic Resources Geographical Information System (NAHRGIS), the state database. Mapping and aerial photography is such that the use of GPS is not that pertinent and the study of historic architectural structures does not require that kind of accuracy. GDOT does not foresee it

becoming a requirement. Approximately 60% of their work is done by consultants and the remaining 40% is done in-house.

(IL) Illinois Department of Transportation (IDOT) does not utilize or require GPS for the study of historic architectural resources. Instead, plat maps are used. IDOT is divided into nine zones and, although they have many highly trained staff, at this time there is no one particular person assigned to structures. The SHPO and a private consultant have been assisting with the effort in historic architectural resources.

(IN) The use of GPS is not required in Indiana for historic architectural resources. The reason is because most in-house projects have small Areas of Potential Effect (APEs). Consultants use GPS on a case-by-case basis, although its use is optional. The Indiana Department of Transportation (INDOT) uses the ArcMap GIS program to produce their graphics for reports. At this time, training people in using GPS would not be cost-effective.

(MO) The use of GPS has not been required in Missouri because of the availability of extremely detailed aerial photos for use in the study of architectural resources. Additionally, highway plans are registered to a geographic coordinate system. Sometimes GPS is used in a situation such as the discovery of smaller structures outside of the right-of-way where the focus is narrow. For this type of situation, GPS might be used and backed-up with aerials. The primary benefits of using GPS to record historic structures might be in the very early stages of a NEPA study because it allows precision of location.

(OR) Currently, the Oregon Department of Transportation's (ODOT) historic built environment staff does not use GPS and the SHPO has only recently begun developing a GIS for historic structures.

(WA) GPS is not used for historical architectural resources in Washington State because the projects are usually on a grid and, therefore, street addresses can be used.

GPS for archaeological test locations, deposits, features and/or landscape elements

(CA) Typically, Caltrans asks for sub-meter accuracy when using GPS to record archaeological test locations. The number of site excavations that have used GPS is difficult to ascertain since Caltrans is decentralized and consultants perform most of the field studies. There is no universal standard to always use GPS in recording properties because so many different consultants perform work for Caltrans. Consultants are contracted directly through Caltrans and also through local assistance contracts. Caltrans recently upgraded to new hand-held devices with sub-meter accuracy. Those staffers who know how to use the technology are getting a lot out of it and training other staff on how to use it. Advantages are that it is easier to map features that are more spread out. A disadvantage is that one loses the artistry in hand-drawn maps, but the time savings makes up for this.

There are no specific requirements for the use of GPS in the recordation of locations and descriptions of archaeological deposits, features and/or landscape elements in California. GPS is

used on field surveys and it is used increasingly as staff and consultants become more technologically savvy. It is used more for surveys than excavations because some consultants do not have machines that have sub-meter accuracy required for excavations. Handheld units are used on surveys because of portability.

Caltrans has not established uniform metadata standards for GPS. Rather, the Bureau of Land Management (BLM) has published standards that cultural resources staff have adopted because they must use that standard on BLM land so it is easy to apply it across the board.

(DE) In Delaware, GPS is being used by consultants to record archaeological site and test locations. As of 2006, GPS has been used 100% of the time. DelDOT finds it useful in situations where there are multiple occupations in an urban setting. Sometimes consultants use Total Station instead, but only a small percentage of the time. Total station is also occasionally used to record archaeological features. Prior to 2006, pedestrian surveys were conducted in plowed fields using a grid design. GPS is not usually used for features or landscape elements. Delaware has detailed maps with updated yearly aerials. An advantage of using GPS is in streamlining shovel test artifact concentrations which can provide a summary earlier than waiting for a report. It is a cost-effective technique that makes it quick and easy to record information and put it in a map. A disadvantage of using GPS is that without having detailed analysis to back it up, it can be difficult to make planning decisions, as the SHPO often wants a full report and artifacts to be catalogued. GPS can expedite decision making, but sometimes that means a decision will be made before all of the information is available.

(GA) When using GPS for recording archaeological test locations, the in-house equipment at GDOT allows for sub-meter accuracy. GDOT has a full geophysical program as well. The use of GPS is not required but it is encouraged, including for use by consultants. It is especially used for cultural resources work at wetland mitigation sites where sometimes there are large tracts of more than 1000 acres. Some consultants have used GPS to record the location of each shovel test unit on these large survey tracts. GPS is routinely used to record the location of all geophysical survey grids surveyed by GDOT. GPS is also used to record archaeological site boundaries. The site boundaries can then be converted from an ArcMap shape file to a DGN file (design) and sent to design engineers. This information can be used by the design engineers, in the case of an eligible site or potentially eligible site, to make design changes that would avoid or minimize harm to the archaeological sites. Another common application for GPS is that they can load the project DGN files, USGS quadrangle maps, and aerial photos onto their GPS unit before entering the field. The GPS can then be used to keep the project on alignment while in the field. This is especially useful on "new location" projects.

Most commonly, a Total Station is used to record the location and descriptions of archaeological deposits, features and/or landscape elements. When testing for National Register eligibility, Total Station will be used. 3D imagery via the Leica ScanStation 2 has been used to map out Phase III archaeological site mitigation projects.

Disadvantages of using GPS are that it adds time in collecting data and there are limitations of accuracy in heavy canopies. GDOT could foresee the potential for a future GPS requirement in order to save on costs especially for the larger mitigation projects.

(IL) IDOT does use GPS to record archaeological test locations, and likes to see accuracy up to one foot. All IDOT projects utilize GPS in this regard. One of the disadvantages of using GPS is the amount of time involved. Primarily handheld GPS units are used by IDOT's consultant, which does 100% of the field work in Illinois through an intergovernmental agreement with the University of Illinois. GPS is not generally used to record the location and descriptions of archaeological deposits, features and/or landscape elements. Instead, boundaries are recorded and then a Total Station is used to record the rest of the site.

(IN) A potential reason for INDOT to have not required the use of GPS for recording locations and descriptions of archaeological deposits, features and/or landscape elements is that they feel that the handheld GPS is not always as accurate as they would like it to be. Indiana SHPO does not require it. What is used instead is Total Station, which is considered to be more accurate. GPS is used in situations where there is a high potential for archaeological sites; however, most projects do not result in identification of a National Register site. Additionally, it is a lot of work to upload the data and get it ready for the field. Only one person is trained to do this at INDOT and it is not always feasible. Therefore, INDOT does not foresee the use of GPS being required.

(MO) Total Station, Magellans and backpacks are all used in the recordation of archaeological test locations, deposits, features and/or landscape elements in Missouri. Professional highway surveyors are also available. However, the level of accuracy varies by type of equipment from a few meters (backpacks) to centimeters (Trimbles). The Missouri Department of Transportation (MoDOT) finds that surveys are the most accurate. This can be a disadvantage of GPS in that the cheaper models lack precision and there can be compatibility issues. The issue of what type of accuracy is required usually depends on the project. Survey precision is required for intrastate projects whereas aerial precision is required for landscape type situations. MoDOT hires consultants to do some of the big corridor studies, but their goal is to do all Phase I and II studies in-house, as well as some of the Phase IIIs. All MoDOT staff is centralized.

(OR) The use of GPS is required through archaeology consultant contracts and has been part of contracts for at least 4 years. The use of research-grade GPS units to record archaeological test locations and descriptions of archaeological deposits, features and/or landscape elements is required by ODOT[3]. There are difficulties using research-grade units, such as in heavy tree cover, so ODOT relies on recreational-grade units as well. Research-grade units collect more precise data, which also ties in better with preliminary design plans, as opposed to recreational-grade units.

ODOT worked collaboratively with the SHPO and its GIS division to develop geodatabases to that would meet SHPO's approval and allow for a seamless transfer of data. ODOT's GIS division is funding a position at SHPO to help improve the SHPO's GIS archaeological database.

[3] Approximately 85% of the work done in Oregon is performed by consultants.

(WA) The use of GPS to record archaeological test locations and features is more frequent in the eastern part of the state where there is less tree cover and only one WSDOT archaeologist. Throughout the rest of the state, the use of GPS is performed by consultants[4]. WSDOT has used Trimbles on a project to do some mapping in the urban area of Seattle but found that the degree of error was too significant to use the data. Trimbles has difficulty recording in forest cover and most of western Washington State is forested, so it may be used for site location but not to map site boundaries. Handheld GPS is usually used across the board by WSDOT staff, while consultants have total station and backpack. Sub-meter accuracy is required for archaeology. There is a cost savings when using GPS compared to mapping with total station, and this influences the use of GPS. Its use is not required in a statement of work, but if consultants have the technology, then it is accepted.

Consultant surveys:

GPS for architectural resources

(DE) DelDOT's consultant does not use GPS for the recordation of historic architectural resources. The consultant noted that they do not see a reason to use GPS units when one can consult Google Earth or Acme Mapper online program which provides aerials and real world coordinates.

(IL) The IDOT cultural resources consultant does not deal with historic architectural resources since IDOT hires separate consultants for architectural resources.

(IN) The cultural resources consultant that was surveyed does not perform historic architectural surveys for INDOT and was therefore unable to respond on the topic of using GPS for historic architectural resources.

(OR) The ODOT consultant is rarely involved with architectural resources, and indicated that ODOT generally uses their own in-house personnel for architecture, while the consultant focuses on archaeological resources.

GPS for archaeological test locations, deposits, features and/or landscape elements

(DE) There is no level of accuracy that is required when DelDOT's consultant uses GPS for archaeological test location, but they use sub-meter. GPS is used 100% of the time on DelDOT projects by the consultant although it is not required by DelDOT. One of the advantages of using GPS for recordation of archaeological test locations is that data are easily imported as layers for GIS manipulation. Primarily, DelDOT's consultant uses handheld GPS units. The consultant would propose to use GPS even if it were not employed by the State because they find it to be labor efficient and time and cost effective from client and consultant perspectives. Outside of

[4] In Washington, approximately 70% of the work is performed by consultants and 30% is performed in-house.

recordation, when equipped with uploaded project mapping, GPS units inform archaeologists the limits of the APE (i.e., they indicate whether one is inside or outside of the project APE).

DelDOT's consultant also uses GPS in the recordation of location and descriptions of archaeological deposits, features, and/or landscape elements in mapping artifact concentrations discovered via pedestrian survey and for providing richer geophysical contexts. GPS is used 100% of the time in this context. An advantage to using GPS for this purpose is that data can be manipulated for mapping in GIS; the consultant sees no drawbacks to using GPS. Handheld units are used by the consultant. DelDOT's consultant always uses predictive modeling because it drives the field methods.

(IL) The level of accuracy required when using GPS to record archaeological test locations depends on the situation. For Phase 1 surveys, they do not require sub-meter levels of accuracy, but for testing the consultant requires decimeter accuracy. In some situations, an Electronic Total Station is used rather than GPS. This is tied into benchmarks provided by IDOT engineers. GPS has been utilized by the consultant in the recordation of archaeological test locations in approximately 95% of IDOT projects. A disadvantage of GPS is the lack of precision as opposed to using a Total Station for large complex site testing. The primary advantage of using GPS is time savings. The consultant uses several different models of handheld units, each with differing levels of accuracy. Different situations require different levels of accuracy. In combination with a Total Station, the consultant has found the use of GPS to be a highly effective and accurate method for recording spatial locational data.

The consultant utilizes GPS to record all archaeological site locations. They also use GPS to provide known points of reference for use with a Total Station except in those cases where established reference points are already available. It is used on approximately 95% of IDOT projects by the consultant. An advantage of using GPS for this purpose is that it provides accurate spatial locations.

Predictive modeling is not used by IDOT's consultant. They feel that predictive models are not always good predictors of where buried resources are found, such as in most floodplains and alluvial/colluvial fans. The consultant feels that they cannot use predictive modeling to assume that people of the past necessarily excluded certain localities or regions. There have been numerous borrow pit projects and upland highways/pipelines that have brought to light the potential of environments that were overlooked because they were not associated with water and therefore, potential historic settlements. The consultant would always prefer to see actual on-the-ground surveys conducted before making any predictive judgments about the nature or extent of cultural resources in any areas of this state.

(IN) INDOT's consultant does use GPS to record the location of survey areas, artifacts, and positive shovel tests on all Phase I projects. Sometimes GPS is used in Phase IIs and IIIs in conjunction with a Total Station. GPS has been utilized approximately 90% of the time. The consultant feels that while GPS is not flawless, they have found it to be a quick and effective method of recording. However, a field map on an aerial map is still maintained to alleviate errors if they do occur in the GPS data.

The consultant uses a simple handheld GPS (non-submeter accuracy) to record survey areas and artifact concentrations. They use a Trimble GeoXT with submeter accuracy to record unit locations. Oftentimes the GPS data is used in conjunction with a Total Station to lay out grids and record unit locations. The consultant uses GPS in most situations even though it is not required by INDOT, because it is easy to use and typically provides better results than sketch maps.

The INDOT consultant uses predictive modeling for archaeological site locations. The consultant is able to include cultural resource management and research projects together to produce predictive models for several regions in Indiana. Data is not always available to produce predictive models, but when it is used it has been very successful in the till plain regions of Indiana.

(OR) ODOT's consultant generally uses GPS on all projects and, in some cases, will also use Total Station mapping to tie directly into established datum points. GPS is used in the recordation of archaeological test locations in 100% of the projects the consultant does for ODOT. An advantage to using GPS is that depending on the equipment used, it is generally quick and easy to use. The primary GPS tool used by the consultant is the "recreation" grade handheld GPS unit. They also have a Trimble "resource" grade GPS capable of sub-meter accuracy, but has found that it is costly in personnel time, and is a far less user-friendly field navigation tool. They use it when circumstances require sub-meter accuracy, but it is not the primary equipment of choice.

The consultant would use or propose to use GPS in the recordation of archaeological test locations even if ODOT did not employ or require such use because of the ease of use; in addition, the Oregon SHPO requires UTM site coordinates, so GPS is the easiest way to capture the information they require. ODOT is trying to establish a sub-meter standard for data recording, but is presently not required for archaeological resources.

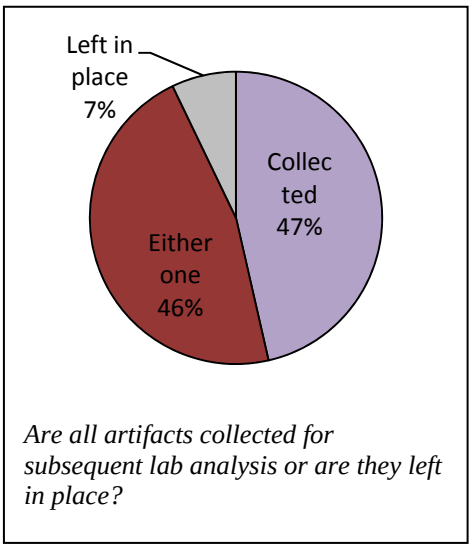
Typically, for survey (pedestrian or exploratory) the consultant records transects and probe locations with a handheld GPS. Initial site field maps are made using GPS. Anytime the consultant does formal evaluation/data recovery work at a site, they map with a Total Station. This applies to 100% of their projects.

The consultant has been involved in a series of predictive model programs; this has been the production of a series of resource maps to be used by maintenance crews, whose activities do not undergo the same review that new construction projects do. These produced a set of high, medium, and low probability areas along highway corridors throughout the state, and can be used to guide activities in the absence of formal project review. For example, if landslide debris blocks a highway that must be cleared immediately, maintenance crews can consult the model maps and know that debris cannot be dumped in a high probability area. This is not meant to substitute for project review, but provides a level of informed guidance when normal review is not possible.

2. Topic: The handling of artifacts.

Online survey results:

Thirteen states responded that artifacts are collected for analysis, two states responded that they are left in place and fifteen states responded that they may be either left in place or collected. Of those states responding that either method is used, two did not offer further explanation while thirteen offered additional detail in their responses. One of the states explained that only diagnostic artifacts are collected, while another state said that artifacts are collected and culled in the lab except for modern refuse. One state stated that at this time, prehistoric artifacts are collected, but generally only a sample of historic artifacts are collected, or sometimes none, because there is a repository in their state that is currently accepting historic collections. Another state responded that collection depends on the size of artifacts; large industrial sized artifacts may be recorded and left in the field due to curation space and conservation costs. By law, artifacts excavated out of the ground must be collected and therefore, they abide by that law and practice. On rare occasions, such as a Phase III data recovery project in a quarry site, they may adopt a discard policy in the field that has been agreed upon by the DOT and SHPO. In another state, they are left in place unless they will be impacted by project actions. In one state, artifacts are collected if warranted by Phase III. One state responded that there was no collection on surveys, and that curation was required for excavations. One state explained that collection was done on a case-by-case basis, that they (and the SHPO) allow historical architectural artifacts to be sampled, and that if there is an inordinate amount of redundant historic artifacts (i.e., whiteware), those artifacts may be sampled as well as long as the principal investigator is qualified as a historic archaeologist. All prehistoric artifacts are collected. Another response indicated that artifacts are collected on right-of-way that they own, but on easements that cross another agency's land, they follow that agency's procedures. One state responded that surface artifacts are typically collected; however, subsurface artifacts are generally left in place in order to minimize disturbing them. Another state explained that artifact collection is very site/project specific, depending on landowner (public v. private) and regulatory framework. Often, artifacts are left in the field in site identification phases and collected during testing phases. Artifacts are always collected during data recovery. One state noted that typically, during a Phase II pedestrian survey, only a sample of artifacts (mostly diagnostics) are collected. During Phase III & IV investigations, all artifacts are collected, analyzed, and curated. One state responded that artifact collection depends upon the circumstances of the project.



Are all artifacts collected for subsequent lab analysis or are they left in place?

State DOT interview results:

(CA) Artifacts are never collected during surveys because California has a problem of curation space. Additionally, the Bureau of Land Management (BLM) statewide survey permit prohibits collecting artifacts on BLM lands. Therefore, the only time artifacts would be collected would be for an exceptional find, such as a yew bow found in the desert a few years ago.

(DE) In Delaware, all artifacts are collected and culled in the lab. An advantage of this is that they have a nice full suite of artifacts to draw upon. The disadvantage is that both DelDOT and the SHPO are running out of room to store the artifacts. Currently, the SHPO rents a warehouse for storage; DelDOT stores artifacts as well, but they are in a "curation crisis".

(GA) Usually artifacts are collected, but sometimes in-field analysis is done because of the high cost of curation (especially for small sites that are not eligible for the National Register). GDOT encourages their consultants to do the same. This applies to prehistoric and historic artifacts. In-field analysis is used for isolated finds as well. GDOT uses the University of West Georgia for curation.

(IL) Artifacts are not always collected on projects in Illinois. When a historic site is covered with a low density of archaeological material, generally a sample is taken. The same applies to quarry sites, where a sample will be taken, weighed and recorded. Prehistoric artifacts are generally collected unless they are very common and abundant like fire-cracked rock (shell equivalent) which would be taken to the lab, sorted, weighed and tossed. If something rare was found, such as a fluted point, they would dig and screen the entire site. However, most sites are old farmsteads and are not particularly deep. Space is a problem for all states in storing artifacts, including Illinois. IDOT feels that it is not necessary to have a standard methodology with regards to collecting or leaving artifacts in place; this should be determined on a case-by-case basis.

(IN) During a Phase IA investigation, large historic or lithic scatters are not 100% collected. All prehistoric artifacts are recovered and sampled from archaeological deposits in the plow-zone layer. It is up to the principal investigator, in consultation with the SHPO, as to what percentage of artifacts are collected. For Phase I surveys, INDOT does not recover 100% of all fire-cracked rock, shell, or coal slag (burnt coal). For Phases II and III, they do not collect all of the artifacts when there is redundancy. Artifacts are weighed in the field but not always collected. Disadvantages to collection are lack of curation space, time and money. For most projects, they only need to be able to collect enough information to make an eligibility determination.

(MO) In Missouri, all diagnostic artifacts are collected unless the density is overwhelming or there is a particularly large surface scatter.

(OR) ODOT generally requires the collection of artifacts. Private property owners may retain most artifacts uncovered during excavations; however, the University of Oregon is the primary collection facility. The collection facility and museum at the University of Oregon has recently expanded in part due to Transportation funding. Some of Oregon's nine federally recognized

Tribes request artifacts be reburied immediately after they are photographed and/or mapped, through intergovernmental agreements.

(WA) In Washington State, artifacts typically are not collected during the discovery/site delineation phase but are collected during significance testing and data recovery phases of investigation. WSDOT is not always able to curate all artifacts, due to limitations of space at available curation facilities. Generic items (bricks, brick fragments, nails, shingles, plain bottle glass shards, multiple items of the same manufacturer and dates of manufacture) usually are systematically catalogued and described, but discarded prior to a collection being curated. One advantage to collecting artifacts is for the research potential that they provide. A disadvantage is collecting generic artifacts that have limited or no scientific value and the curation costs that result.

Consultant survey results:

(DE) According to DelDOT's consultant, artifacts are always collected rather than leaving them in place. This applies to both prehistoric and historic artifacts. Collecting artifacts can be labor intensive; however, artifact collection and removal to a lab for further analysis allows for more data to be collected, which facilitates better compliance end "products".

(IL) According to IDOT's consultant, artifacts are always collected in Illinois. Some items such as non-utilized limestone, rough rock or brick, glass etc. are discarded after analysis or recordation of number and weights. The consultant acquires landowner permission to remove artifacts from the field. If the landowner refuses permission, they do not do the survey, but instead wait until the land is bought by IDOT. This applies to both prehistoric and historic artifacts. The biggest advantage of collecting artifacts for the consultant is that we can establish curated materials for future research.

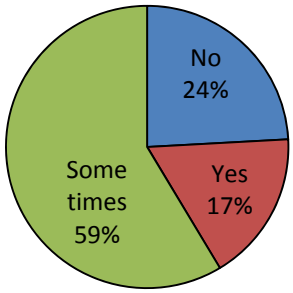
(IN) The INDOT consultant surveyed always collects artifacts unless it is a historic dump. Prehistoric artifacts are always collected while historic dumps are sometimes sampled. Hazardous materials such as asbestos or battery carbons are not collected. One advantage to artifact collection is that when artifacts are collected, they can be examined in a laboratory setting where they are clean and there is access to a microscope or other equipment. This allows for multiple opportunities to examine the artifacts if necessary. The only advantage to non-collection is not having to curate the material.

(OR) According to the ODOT consultant, artifacts are left in place during pedestrian surveys; artifacts encountered in exploratory probes, or during formal site testing are collected (archaeological work, even exploratory probing, requires an archaeological permit activity in Oregon; artifact collection is done for all excavation projects requiring a permit). This applies to both prehistoric and historic artifacts. In the consultant's opinion, if artifacts are encountered on a surface that will remain undisturbed, there's no compelling reason to collect them; if artifacts are removed during the course of excavation, responsibility should be assumed for the artifact.

3. Topic: The use of Geomorphology/Geoarchaeology

Online survey results:

The survey asked the question whether the State DOT requires geomorphology/geoarchaeology prior to conducting archaeological surveys in order to identify the resource potential of the project area. Five states responded "yes" and seven states responded "no". Seventeen states responded "sometimes" and offered additional detail in their responses. Six of the states that responded "sometimes" clarified that geomorphology/ geoarchaeology is used on a case-by-case basis depending on the environment and the scale of the project using the professional judgment of the DOT staff. The other states that responded "sometimes" gave more specific circumstances,[5] but in general it appears that its use varies depending on the environment.



Does your state DOT require Geomorphology / Geoarchaeology prior to conducting archaeological surveys (particularly at stream crossings) in order to identify the archaeological resource potential of the project area before deciding to do detailed archaeological testing?

State DOT interview results:

(CA) Geomorphology and/or geoarchaeology are not always used prior to conducting archaeological surveys, but their use is increasing. Their use depends on the vertical Area of Potential Effect (APE). For instance, when deep excavations are required, such as for bridge abutments, Caltrans researches the potential for buried sites. Caltrans or its consultants will conduct archival research, remote sensing, soil cores, and some backhoe trenching, depending on sensitivity and potential for effects.

(DE) Geomorphology and/or geoarchaeology are not always used prior to conducting archaeological surveys. Their use depends on the geological nature of the environment,

[5] One state responded: In areas where sites may be deeply buried.
One state responded: In coordination with SHPO office this sometimes occurs.
One state responded: It depends on the potential for effect (vertical APE), but it's recommended for most projects.
One state responded: It depends upon the depth of the Holocene age sediments at the crossing. The major problem in our state is Aeolian deposits.
One state responded: It is recommended that it be done prior to initiating a deep testing strategy.
One state responded: Our state DOT contracted (using TE funding) geomorphological/geoarchaeological studies in each of our 6 Districts. Additional geomorphological/geoarchaeological testing is only required on projects that were found to have a moderate to high potential for buried soil horizons.
One state responded: Required for fishponds, which are pre-western contact and post contact aquaculture facilities.
One state responded: This type of investigation is not generally done before surveys are conducted, but may be done at any time before construction, depending on the type of project and the geomorphological context.
One state responded: Usually such "deep testing" is also required by SHPO guidelines.
One state responded: We are relying on geoarchaeology/geomorphology more and more, although are not yet requiring it during survey.
One state responded: When I decide it's necessary in consultation with SHPO.

surveying and level of effort. If the site is a good intact context with potential or a highly active geological area with fluvial (river) deposits, then such approach may be used. If it is an urban environment that has been previously disturbed, then the use of Geomorphology/Geoarchaeology is probably not a good use of time and money. Whether or not to use geomorphology/geoarchaeology is decided on a case-by-case basis and is a coordinated decision with the SHPO. Approximately 50-75% of the time it is used, but DelDOT does not expect it to be proposed by consultants unless necessary.

(GA) Geomorphology/Geoarchaeology has not been used often, but in the past 2 or 3 years it has been used on test projects such as at a site that is conducive to site burial. However, it is not done prior to conducting archaeological surveys. The decision of whether or not to use it has more to do with vertical APE. If a possible find is so deep it might not be disturbed, then geomorphology is not necessary. Geomorphology is also used for testing and mitigation projects. At the shovel testing phase, it comes in handy if it ends up going to mitigation. It results in better research designs and it is helpful to have the data available when developing mitigation.

GDOT is more apt to utilize geomorphology at the Phase II (NRHP evaluation) level in floodplain environments due to the likelihood of encountering deeply stratified alluvial deposits. They have found that by doing a geomorphological study at the Phase II stage, this can improve the quality of the Phase III (mitigation) fieldwork and also helps warrant against unanticipated finds, i.e. deeply buried archaeological deposits not detected in previous investigations.

(IL) In Illinois, geomorphology or geoarchaeology is not always used prior to conducting archaeological surveys; however, it is left to the consultant to determine when its use is appropriate. It is used in the floodplain 99% of the time and sometimes in urban settings. It is not used in flatland or at eroded sites. The advantage to using geomorphology/geoarchaeology is that it gives a better feel for what is going on and eliminates surprises. To put it in perspective – the cost of having a contractor excavate trenches is higher for one day than having a geomorphologist on site for a whole week.

(IN) Geomorphology and/or geoarchaeology is not always considered prior to conducting archaeological surveys. However, there may be situations where a geo-specialist might assist the archaeologist on a Phase II; for example, if it is necessary to know what the landform is, a specialist might be brought in to interpret the site. Augering or coring might be done to determine the potential of sites. The use of this is case specific. INDOT does not require geomorphological studies for river/stream settings, and does not see an advantage to the use of geomorphology in the early stages, although it can help focus the survey. However, they do find it to be advantageous to have a specialist assisting in Phase II or III.

(MO) Whether or not geomorphology/geoarchaeology is used in Missouri depends on the setting and nature of the project. It may be used in river valleys or in uplands with old Loess deposits. MoDOT is most concerned with preservation and the context of the deposits. The technique is used commonly on some projects such as old metal truss bridges across the Missouri River that are often replaced. The use of geomorphology/geoarchaeology has increased over the past few

years on Phase IIIs or larger Phase Is despite the fact that MoDOT does not have a formally trained geomorphologist on board. The use of geomorphology/geoarchaeology is helpful in looking for buried deposits when deciding where to put trenches and was especially useful on the I-70 project.

(OR) Geomorphology/geoarchaeology is used and recommended, but not required in Oregon. It has been applied to projects when there is potential for substantial geomorphology/ geoarchaeology because of deeply buried stratigraphy and meandering rivers. However, geomorphology/geoarchaeology background research is generally conducted project-to-project, to provide basic geomorphological information for technical reports. Three firms in Oregon have geoarchaeologists. SHPO has recommended the use of geomorphology/geoarchaeology and has issued specific guidelines on fieldwork. This technology provides an advantage in dealing with deep deposits, understanding site formation processes, and providing valuable insights.

(WA) WSDOT relies heavily (approximately 90% of projects) on structural geology and geomorphology in research design, and requires detailed reporting of geological data and exposed stratigraphic layering within shovel probes and other excavation units. Washington has a pretty consistent soil development profile with a glacial sediment as a base layer. WSDOT requires reliable and detailed reporting to assure that they are not sampling fill and that native sediments, when encountered, are being sampled appropriately. Geomorphology/ geoarchaeology is not used on surface surveys in the eastern part of the state where ground visibility is high enough to identify potential sites at the surface.

Consultant survey results:

(DE) When the interviewed consultant works for DelDOT, geomorphology/geoarchaeology is considered prior to conducting archaeological surveys and DelDOT decides on its use. It has been utilized on approximately 90% of archaeological surveys. Advantages to employing its use at the early stages of analysis is that assessing the potential for deeply buried resources informs archaeologists of the depth of testing to identify sites (Phase I). The consultant feels that DelDOT or SHPO should decide when to use geomorphology/geoarchaeology. However, if DelDOT did not employ its use, the consultant might propose its use in alluvial settings because of the need to estimate depth of Phase I testing.

(IL) IDOT uses a geomorphology/geoarchaeology consultant on all major projects, especially those in floodplain environments where buried resource potential is high e.g., floodplains of major rivers, colluvial/alluvial fans. An advantage of using Geomorphology/ Geoarchaeology at the early stages is that it can be a tremendous aid in predicting buried surfaces or geomorphic features such as inner-channel ridges, with or without artifacts. Although IDOT does not specifically require this work, they commonly expect the consultant to use whatever means they have in identifying buried resources or landscapes.

(IN) On a basic level, the geomorphology is assessed for all (100%) of the projects that the consultant does for INDOT. In the records review, the geology and soils of the project area are

always examined. This information is confirmed or refuted in the field. For Phase Ic, II and III, investigations, geomorphology is more formally utilized. An understanding and interpretation of site formation processes is a must for these levels of investigation.

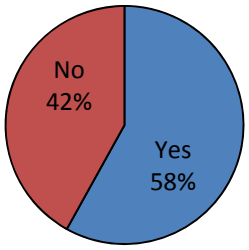
An advantage to geomorphology is that examining the geomorphology of an area at a basic level can give one an idea of what to expect in the field. One can formulate what the potential of cultural deposits is and what types of deposits could occur. Geomorphology/geoarchaeology is a useful tool. One has a better picture and can formulate better ideas and theories through its use.

The consultant believes that perhaps one of the reasons INDOT has not required the use of geomorphology/geoarchaeology is because they do not have anyone on the cultural resources staff that has geomorphic experience.

(OR) Part of the consultant's pre-field research always involves consideration of available soil mapping and landform position. Geomorphology/Geoarchaeology is used prior to conducting archaeological surveys on nearly 100% of DOT projects by the consultant. An advantage of using it is that it is important to assess potential for burial materials, and landform position relative to know site distributions.

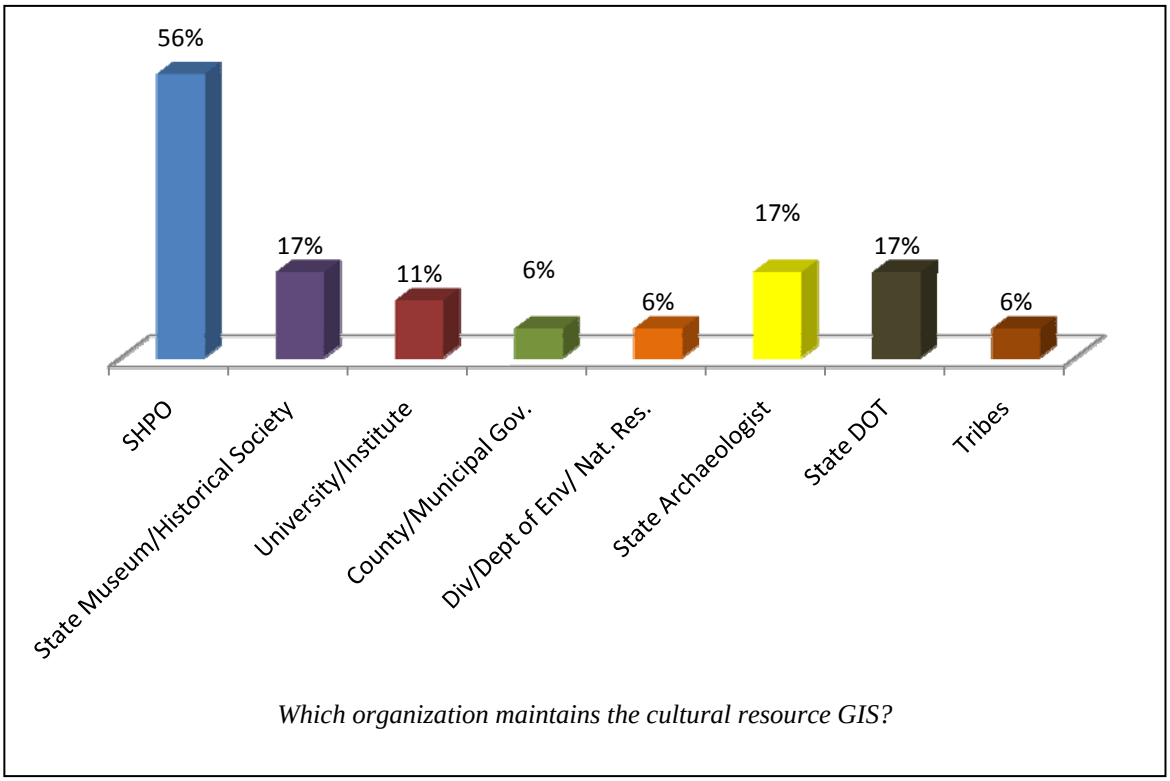
4. Topic: Statewide GIS database

Online survey results:



Is there a cultural resource database covering your entire state that is integrated into a GIS program (i.e., cultural resource data layers) which is available to your state DOT and its consultants from some centralized source within the state?

The state DOTs were asked whether there is a cultural resource database covering the entire state that is integrated into a GIS program (i.e., cultural resource data layers) which is available to the state DOT and its consultants from some centralized source within the state? Eighteen states responded "yes" and thirteen states responded "no" to this question. Of the states that responded affirmatively, they were asked which organization maintains the cultural resource GIS database. The respondents chose from a list of several possible answers and, in some cases, indicated more than one entity was responsible for maintaining the GIS database. Ten states indicated that it is the SHPO that maintains the GIS. Three states said that it was the state museum/state historical society. Two states chose university/institute as their response. One state chose county/municipal government. One state chose Division/Department of Environmental or Natural Resources. Three states indicated that maintenance of the program is the responsibility of the DOT. One state indicated the involvement of the tribes. Three states indicated that the state archaeologist maintains this program.



Which organization maintains the cultural resource GIS?

DOT interview results:

(CA) California has a series of district-based Transportation Enhancement Activities (TEA) funded databases consisting of Access tables and ArcView formatted GIS data, as well as vector/raster data. These TEA databases have known sites, built environment properties, links to PDF reports and site records, aerial photos, USGS topographical quadrangles, and historic maps as raster data. As more districts obtain the TEA databases and more staff are trained on the system, the use of GIS is increasing. It helps improve accuracy of information used in planning and allows quicker responses to queries from project management or maintenance.

Caltrans is currently in the process of developing a statewide Enterprise Cultural Resources database that includes GIS data. It is expected that having the database will make things more efficient in that consultants who work in different areas of the state would have more uniformity in requirements and records searches would be quicker and more accurate.

(DE) Delaware SHPO has a GIS system that has just come online and is still working out a few issues and it only has National Register listed properties. It has a public domain and private domain but only National Historic Landmarks data are available to the public. The availability of a centralized data source of GIS information would allow for a more efficient and streamlined desk review process which would save DelDOT time and money.

(GA) Georgia's centralized database known as NARHGIS is a statewide planning tool that has been active for 10 years now. It includes restricted use of point data for all archaeological sites and previously recorded historic structures. Archaeologists must be qualified to have access. Every archaeological site in the state is recorded in the database. Georgia is moving towards shape file rather than point data which will be Phase II of the NARHGIS project. Currently, users can download the historic architectural survey forms; they are moving towards electronic submission for both history and archaeology. There is a small fee for consultants to use the database on a project-by-project subscription, in lieu of a SHPO fee. An advantage of this planning tool is that it provides access to a lot of data and resources, thereby resulting in cost savings. A disadvantage is the fee required for consultants.

(IL) IDOT's centralized data system is in the process of being upgraded. Reports and photos are available online and meet the Illinois Historic Preservation Agency standards. Users of the system must apply for access. Both archaeology and structures are available, dating back to 1985. The University of Illinois helped to get all data in the system and is in the process of updating data prior to 1985.

(IN) Indiana does not have a cultural resource database covering the entire state; however, the staff archaeologists at INDOT have started to gather information to create a GIS database or predictive model of prehistoric sites in Indiana. INDOT already has a lot of parameters created in GIS and there are layers already available. This project began with a huge records review, with a focus on site location and using the Minnesota Archaeological Predictive Model as an example. The database will most likely be maintained by INDOT's Cultural Resources Section unless the SHPO wants to take it over.

INDOT feels that the availability of such a database would make cultural resource assessments more efficient by making it possible to define areas of high, moderate and low potential. Any archaeologist could look for the potential in their project area. It is noted that GIS would focus efforts in investigation, and it could be a useful tool in highway development and selection of alternatives. Types of data that INDOT would like to have available include prehistoric sites, and eventually, known historic sites and above-ground resources for historic structures. Each county has a review of structures over 50 years old put on a map, but right now it is only available in hard copy.

(MO) Missouri has a long recorded history and has a centralized database housed at the SHPO's office for the past 5 years, which is maintained by the Department of Natural Resources (DNR). All counties have been entered in the database and MoDOT is in the process of verifying all data. The database includes archaeology only and there is a database for properties listed on the National Register. Reports are included in the database as well. Architectural history is not yet uniform enough to include in the database. Professional archaeologists must sign a memorandum of understanding with the SHPO for access to the database where they must agree to share information as well as access it. Archaeologists that have access to the database include those working for agencies, consultants and Universities.

(OR) The Oregon SHPO maintains a GIS database for tracking known archaeological sites. It includes shape files that have data from past surveys and the database can only be accessed at SHPO. Currently, ODOT is expanding the database and developing their own database for tracking minor transportation projects as per a Programmatic Agreement (PA) with FHWA. ODOT has recently completed a GIS shape file for all minor transportation projects completed under the PA.

(WA) Washington State has a GIS database that is maintained by the Department of Archaeology and Historic Preservation (DAHP). It includes archaeological sites and known ethnographic site locations and has all site inventory forms in an electronic database in PDF form. There is also a historic property inventory form database. All hard copy surveys and property forms completed during a project are supplied to DAHP on a CD so that they can be uploaded into the system, and technical reports are uploaded to the database as they come in. Technical reports dating back to the 1980s have been uploaded as well. The database provides multiple GIS layers for archaeology and ethnographic site locations, area surveys, linear surveys, National Register districts and landscapes. Built historic properties, such as houses and bridges, are not on a GIS layer but are tracked by township and range and are available at DAHP (the SHPO office). Consultants do not have direct remote access to the GIS database and they have to go to the DAHP office for access. DAHP presently is in the process of creating remote access opportunity to qualified individuals and entities. An advantage of this database is that immediate access allows projects to be regularly screened for changes in project design and to see if wetland mitigation sites and construction staging areas are available, as well to see if they have been previously surveyed. This cuts down on time in the field, and helps to ensure that known, significant cultural resources sites will not be impacted.

Consultant survey results:

(DE) DelDOT's consultant is unaware of any intention by DelDOT to develop a GIS database for archaeological sites and structures. The consultant would like to see a cultural resources database utilized by DelDOT as a way to bring them to the forefront of cutting edge technology.

(IL) IDOT's consultant has access to various types of data, access to which they gain primarily through other governmental agencies and/or intuitions. This data is used in all aspects of planning and site analysis as relevant to each project. One potential disadvantage is that it can be somewhat wasteful to the DOT when data is available from other agencies/intuitions.

(IN) Indiana does not have a GIS database. The consultant surveyed was not aware of any intention to develop one but feels that if one were to be developed it would help to bring Indiana to the forefront of cutting edge technology as many states do possess them.

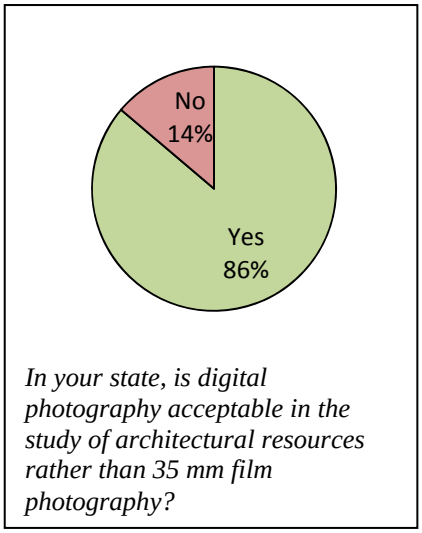
(OR) Since ODOT does not have a GIS database, the consultant mainly accesses the Oregon state GIS clearinghouse and gets individual Shapefile information from ODOT; the consultant then uses this data for mapping and updating site locations. There are great advantages for ODOT, SHPO, and the museum to have access to comparable GIS base data; however, they all

currently maintain their own data (shape) files, so this is where discrepancies have the potential to arise.

5. Topic: The use of digital photography in architectural resources.

Online survey results:

When asked whether the state was using digital photography in the study of architectural resources rather than 35 mm film photography, twenty-five states said "yes", while four states said "no".



In your state, is digital photography acceptable in the study of architectural resources rather than 35 mm film photography?

State DOT interview results:

(CA) California SHPO accepts digital format in evaluation documents, and this allows Caltrans or its consultants to insert the digital pictures into printed reports. The use of 35mm film is rare; however, 35 mm photos are still required for HABS/HAER given the issues with ensuring that digital photographs are archived in such a way that they are accessible for future use. There are no standards on photography set by the SHPO in California.

(DE) DelDOT uses digital photography for the study of architectural resources rather than 35mm film photography. An advantage of digital photography is that it saves time and money. A disadvantage is when digital photography is used in the lab for highly detailed artifacts and microscopic views, and museum quality cannot be achieved. There are no standards set by the Delaware SHPO for digital photography.

(GA) Digital photography is used by GDOT and 35 mm is not used anymore. Concerns over the curation or stability of print images lead to the move away from 35mm film. Disadvantage is the viability of digital photographs and the formats.

(IL) In Illinois, the SHPO has approved the use of digital photography for almost everything except HABS work. When 35mm film is used, it can be difficult to find people to deal with the processing of film. IDOT is in the process of working with the SHPO on moving over to digital photography for everything.

(IN) Indiana uses digital photography as opposed to 35mm film in the study of architectural resources. The only issues with using digital photography are that they are running out of server space and assume that at some point, digital photography will also be obsolete. Indiana does not prepare HABS/HAER documentation, so this is not an issue for recording historic structures.

(MO) Missouri uses digital photography for surveying architectural resources. State level criteria are met for HABS/HAER bridge documentation and they are getting ready to transfer

over to digital for this as well. However, if a significant resource is involved, large format film will be used. MoDOT has access to a full service professional lab.

(OR) Digital photography is used for the study of architectural resources. HABS/HAER requires Large Format (LF) film recordation, but this is becoming more problematic as materials and experience for this type of work becomes more scarce. However, HABS/HAER issues are not as prevalent as they once were, since representatives of the most significant resources and types have been recorded. Future LF recordation would be limited to highly significant structures or underrepresented styles or resources.

(WA) The use of 35mm film has been phased out of use at WSDOT. One of the disadvantages to using digital photography is trying to find the resources to log the photos and, as a result, there are many project-related digital photos that are backlogged and await formal logging and quality organization.

Consultant survey results:

(DE) DelDOT's consultant does not find any disadvantages to the use of digital photography for the study of architectural resources and does not use 35 mm film for any projects they are involved in for DelDOT.

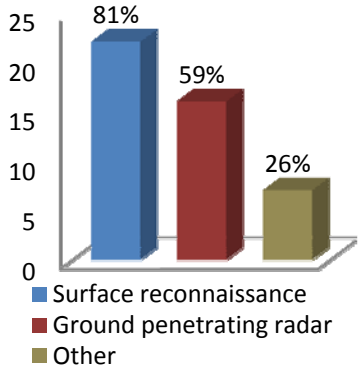
(IN) The INDOT consultant surveyed does not perform historic architectural surveys, but when photography is required for an INDOT project, they use digital medium.

(IL & OR) Consultants from Illinois and Oregon responded that digital photography is used exclusively.

6. Topic: The use of non-invasive techniques.

Online survey results:

The states were asked to select which types of non-invasive techniques they use prior to excavation. Many states identified multiple types of non-invasive techniques that are used. Twenty-two states chose surface reconnaissance as the technique used while sixteen states chose ground penetrating radar. Seven states mentioned other methodologies; of these, five states identified the use of geophysical techniques such as magnetometry, soil resistivity, gradiometry and/or metal detection, while two states identified historic/map research and/or GIS.



Does your state DOT advocate, require, or recommend any non-invasive techniques to be used prior to excavation?

State DOT interview results:

(CA) Non-invasive techniques are not required to be used prior to excavations, but some are used on a case-by-case basis as determined by the Caltrans project archaeologist. Ground penetrating radar is being used more frequently, but is still only used on a small fraction of projects. Given the widely varied geomorphology of California and types of archaeological properties present, Caltrans is still in the process of determining the most effective remote sensing tools to use in a given situation. Metal detection is used on many jobs, particularly historic-era sites.

(DE) DelDOT does not require the use of non-invasive techniques to be used prior to excavations. However, sometimes they do use metal detecting. The most common non-invasive technique used is background research. This is possible because Delaware has extensive amounts of historical literature available. Whether or not they use non-invasive techniques depends on the size of the project because it is not usually cost feasible. It is most likely to be used on larger projects or burial/cemetery delineation. Surface reconnaissance is usually conducted by foot, in the case of a plowed field. A disadvantage to the use of non-invasive techniques is that some are very expensive. Also a drawback is the reliability factor; since anyone can learn how to use ground penetrating radar, it is preferable that someone who really knows what he/she is doing, such as a geophysicist, actually uses the equipment. Sometimes the consultant wants to use it and it is inappropriate or geologically impossible. A geophysicist would not make that mistake. DelDOT usually requests resumes if it is proposed by the consultant to be sure they are getting a well trained individual to use the technique being proposed.

(GA) GDOT owns a full suite of geophysical instruments (gradiometer, ground penetrating radar, and resistivity) that are used in advance of archaeological fieldwork to determine areas of potential. After the initial identification, GDOT will go out and do the geophysical work to help guide the testing as much as possible. They try to do this on mitigation as well. Non-invasive techniques are also used in high probability areas associated with Phase I work. GDOT has found the use of non-invasive techniques to be helpful in avoidance alternatives and measures to minimize harm. It also assists in coordination efforts with Native Americans on many projects, such as the Etowah Mounds. However, GDOT has found that its effectiveness is limited in heavy vegetation, and the ability to record different soil aspects is limited by water table or heavy clay sediments. The geophysical work done in-house by GDOT is about 90%. On larger mitigation projects where they use consultants, GDOT will often provide consultants with their own reports to save on time and costs. The fact that GDOT owns all of their own equipment is a huge cost savings for them and they consider it an investment that pays for itself. The use of geophysical techniques, particularly at the Phase II stage, has directly aided in the NRHP eligibility assessments of many archaeological sites by locating subsurface features that were then investigated as part of the testing strategy.

(IL) Various non-invasive techniques are used in Illinois such as ground penetrating radar, surface reconnaissance, magnetometry, soil resistivity and gradiometry and are used on approximately 10% of projects in Illinois. A combination of these is usually used on sites where, for example, the site may be fairly large but funds only allow for excavating a part of it; non-

invasive techniques can be used to determine what else is on the site. These techniques are also used in situations that are likely to involve a cemetery or, as is common in Illinois, a family plot by a farmstead. IDOT has found that using a combination of these techniques works best. Samples collected are subject to the PIMA technique (portable infrared mineral analyzer) at the University of Illinois lab, which allows for the determination of the origin of the composition materials.

(IN) Non-invasive techniques are not required to be used by INDOT. Typically, the archaeologist will elect to use techniques to focus the investigation. Surface reconnaissance is used for most Phase IA investigations that have good ground visibility. If moving a cemetery or unmarked grave, the project will usually undergo geophysical surveys involving magnetometers or ground penetrating radar, depending on the consultants' experience and familiarity with the project. INDOT stresses that the use of such techniques may not be appropriate in every situation, which is why it is important to have a good amount of knowledge on the techniques so that they are most appropriately applied.

(MO) MoDOT owns their own ground penetrating radar (GPR) system. It is not used on every project, but is primarily applied in urban areas for parking lots, sidewalks, and streets. In rural environments, it is used to look for burials, graves and smaller family type cemeteries. MoDOT has three staff members that are trained in GPR. GPR is used approximately once or twice a month. The GPR is useful for other departments in MoDOT as well, such as in Engineering for detecting voids in bridge approaches. It can also be used to look for and avoid septic tanks around homes. MoDOT has found the GPR to be a very valuable piece of equipment that has paid for itself.

(OR) The use of ground penetrating radar (GPR) is not a requirement, but it is recommended. GPR is most often used if there are concerns about burials. Depending on the project, GPR is used about 10% of the time.

(WA) Non-invasive techniques are used in Washington State but are not required. WSDOT used ground-penetrating radar (GPR) on a known Native American cemetery island in the Lake Washington area and during the Columbia River Crossing Project that traversed Fort Vancouver and adjacent areas known to have burials. Soil resistivity has also been used. The advantage is that when dealing with native burial grounds, tribes give favorable responses and agree with this approach. GPR is also used as a geomorphology technique as a way of identifying areas that could have burials and identifying particular anomalies that could be burials. Using this technique has allowed advancements in the study where they might otherwise have had resistance because of tribal concerns. Using GPR, WSDOT will map the distribution of anomalies and do a systematic investigation of the anomalies. A disadvantage of using non-invasive techniques is that there can be a pushback from project management; such techniques can be interpreted as "fancy science" and thus practical or perceived as not being worth the money due to unfamiliarity or scientific naiveté.

Consultant survey results:

(DE) DelDOT's consultant uses surface reconnaissance as a non-invasive technique in plowed fields. This technique is employed approximately 90% of the time in Delaware. The consultant finds surface reconnaissance to be a productive avenue for identifying sites and feels that DelDOT should consider the entire suite of non-invasive techniques and potentially employ them as "suites" to help identify sites or at least "test them out" to evaluate which ones work best in the context of Delaware.

(IL) IDOT's consultant has used various non-invasive techniques such as magnetometry, soil resistivity, metal detection and pedestrian survey. They have used magnetometry to predict subsurface density or distribution of subsurface structures, both historic and prehistoric. The consultant typically uses these specialized techniques on bigger projects where major excavations need to be conducted. They are not generally used for subsurface non-invasive techniques in normal surveys. The consultant has found that they are generally not very helpful in complex site environments where there is a lot of superpositioning or deep middens. The consultant feels that it would not be appropriate to use non-invasive techniques in urban areas where buried utilities or pipes are present.

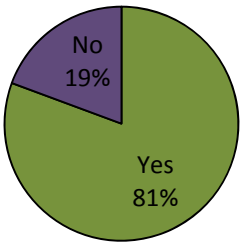
(IN) The consultant has used magnetometry because it was the equipment that was available at the time. It would have been appropriate to use soil resistivity as well. These techniques have only been used on approximately 5% of INDOT projects.

The consultant is in favor of geophysical techniques because it can save time and labor. However, they are not in favor of it being required as just an additional step to testing or excavation. They feel it should be able to reduce the amount of hand excavation if a geophysical survey is used. Of course the techniques do not identify all cultural deposits, but traditional sampling methods utilizing backhoe stripping can be used. They have also found that in deeply stratified deposits or complex geomorphic settings, the techniques are not very useful.

(OR) ODOTs consultant has used magnetometry/gradiometry and ground penetrating radar (GPR). The consultant owns its own GPR equipment. The actual application of these techniques is relatively rare (i.e., once or twice a year on average). The advantage of using these techniques is that when they work as hoped, they save much in the long run, but the disadvantage is that when they don't it becomes an expensive gamble.

There should be two conditions to consider when deciding whether to use non-invasive techniques; whether there is a reasonable expectation that features detectable with non-invasive strategies are present, and whether there is a geological context that is conducive to appropriate use of the equipment.

7. Topic: Programmatic Agreements



Does your state DOT have any Programmatic Agreements (general or project specific) in place with the SHPO to streamline the cultural resources process for DOT projects?

Online survey results:

Twenty-five states indicated that they do have programmatic agreements in place, while six indicated that they do not.

State DOT interview results:

(CA) Caltrans has a Programmatic Agreement (PA) that has been in place since 2004 to streamline the Section 106 process of the National Historic Preservation Act. They feel that it has been very effective in streamlining the 106 consultation process and they do not think any improvements are warranted at this time. As for data collection, the only streamlining is that Caltrans has been delegated responsibility for determining level of effort, so they do not have to consult with SHPO on 36 CFR 800.4(a). They also have a PA for seismic bridge projects, but those are less frequent nowadays.

(DE) DelDOT's programmatic agreement with the SHPO has expired, but they are working on a new one. The new programmatic agreement will be providing DelDOT more responsibility while at the same time still requiring quarterly reporting. It will also solidify what is considered a Minor project and elaborate on tribal consultation and curation issues. DelDOT is looking at Pennsylvania State DOT as an example.

(GA) GDOT has several Memorandums of Understanding (MOUs) with the SHPO and FHWA with regards to minor projects, such as signage, repaving and improvements to existing roadways. These are projects that GDOT has determined, in consultation with SHPO and FHWA, to have "no potential to cause effect". This agreement is updated annually and new projects are considered for addition to the list. This agreement is currently undergoing its fourth update. GDOT is currently working on an electronic document transfer agreement which is expected to result in cost savings.

(IL) IDOT has a programmatic agreement which allows the environmental coordinator to review and sign off on small projects in-house, which saves time. They have a bridge memorandum of understanding with the Advisory Council on Historic Preservation which streamlines that process as well. IDOT also has a programmatic agreement for habitation sites which includes tribal consultation. The programmatic agreements usually have a 5-year life span, at which time they are reviewed and revised as necessary. IDOT would like to see a nationwide bridge programmatic agreement put into place by FHWA since most states have bridge programmatic agreements, and certain types of bridges included in these agreements are standard.

(IN) INDOT has a minor projects programmatic agreement with FHWA, the Advisory Council on Historic Preservation and the Indiana SHPO, which was signed in 2008. The same agencies also have a programmatic agreement on historic bridge replacement projects which was signed in

2006. The bridge programmatic agreement is currently undergoing a program where all bridges in the state are being inventoried and will not be completely in place until the end of the year. INDOT feels that the programmatic agreement for minor projects has been effective in streamlining the Section 106 review process. This programmatic agreement is also being updated to include a new category of projects to be included.

(MO) MoDOT has a programmatic agreement Section 106 for minor highway projects involving new right-of-way less than 25' wide and extending less than 1,000 feet. MoDOT can review and determine if there is a need to do a Phase I. The original programmatic agreement has been in place for five years and a second one has just been put in place.

MoDOT also has a bridge programmatic agreement that locks into the results of the state bridge survey. The original programmatic agreement includes bridges from the 1950s-60s and they are looking at following up with the next group of bridges.

(OR) ODOT established a PA with FHWA and SHPO for Minor Transportation Projects (specific CEs) in 2001. The PA streamlines reporting requirements and is currently under revision. ODOT is collaborating with FHWA and SHPO to include other types of activities, such as geotechnical borings.

(WA) Washington State has a Statewide Programmatic Agreement with FHWA and SHPO which identifies kinds of WSDOT projects and project activities that can be exempted from Section 106 review.

The Urban Corridors Office within WSDOT has a corridor-level agreement that deals with design-build projects (WSDOT normally does about 30% design on design-build projects). This programmatic agreement works well because there are frequent changes in construction footprint as well as an accelerated time schedule, with less than a month between design and construction. This programmatic agreement requires DAHP to review and concur with determination of site eligibility and project effects within 10 days. For design modifications, it allows for post-review investigations and discoveries. Corridor level surveys are performed to identify deep fill, at-grade, and cut-below-grade areas that can be translated to construction contractors as restricted or unrestricted areas, thereby allowing the design-builder to choose unrestricted areas for staging or other situations which would normally require review.

Consultant survey results:

(DE) DelDOT's consultant is unaware of any specific programmatic agreements that DelDOT and the SHPO are currently developing to streamline the cultural resources data collection process for DOT projects. They do not believe that such agreement could have any impact on their role or responsibilities as consultant to DelDOT and they do not believe that such agreement could have an impact on the level of work that they typically conduct for DelDOT.

(IL) IDOT's consultant has programmatic memorandum of agreements for all major projects, such as airports, long highway corridors, and multi-site impact projects, regardless of area. They

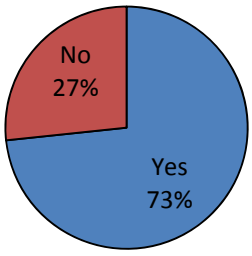
feel that these agreements have made them more aware of consulting agents other than IDOT. The level of work is not affected as a result of these agreements. The process could be made more efficient by streamlining the steps for creating an agreement, thereby decreasing the instance of construction delays.

(IN) The INDOT consultant has only dealt with the Minor Project Programmatic Agreement on a few occasions and the programmatic agreement has not decreased their level of work.

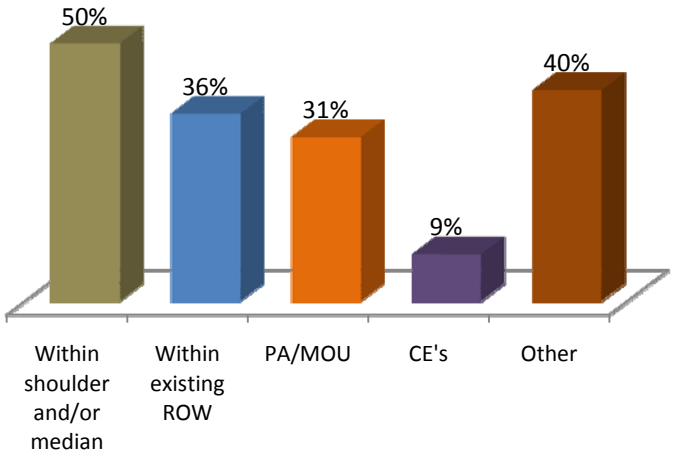
(OR) The ODOT consultant did not respond to the survey question on programmatic agreements.

8. Topic: Exempting projects from full archaeological investigation.

Online survey results:



Are there specific types of projects or project settings that are generally exempt from full archaeological investigation (e.g., shovel tests, test units, etc.) in your state?



What types of projects are generally exempt?

Twenty-two states indicated that there are specific types of projects within their state that are generally exempt from full archaeological investigation, while eight states indicated that there are not specific types of projects that are generally exempt. The 22 states indicating that specific types of projects are generally exempt were then asked what types of projects are generally exempt. Eleven states responded that projects located entirely within the shoulder and/or median were exempt from full investigation while eight states indicated that projects entirely within the existing right-of-way were exempt. Seven states responded that there were programmatic agreements or MOUs in place with the SHPO that addressed this issue and exempted projects where there is no potential for cultural resources or where the ground has been previously disturbed by construction activity. Two states responded that Categorical Exclusions were exempt. Nine states identified other circumstances for exempt projects[6].

[6] Two states mentioned that areas that are known to have been previously disturbed would be exempt.

State DOT interview results:

(CA) In California, some projects are exempted from full archaeological investigation. Under the Section 106 PA, Caltrans cultural resources staff reviews a project to determine whether it is "screenable". If it meets a pre-defined list of project types, the Cultural Resources staff can screen the project. Screening may involve anything from drawing on personal knowledge, accessing GIS-based information, Native American consultation, field reviews, and/or full records searches. If the project area is sensitive, it is not screened but Section 106 compliance must be conducted.

(DE) Not many projects in Delaware are generally exempted from full archaeological investigation. Some exceptions may be made in consultation with the SHPO concerning repaving or striping projects but there are not many situations where an exemption applies. DelDOT is working on a programmatic agreement to this effect.

(GA) Projects that are exempted from full archaeological investigation in Georgia are those listed in the "no potential to cause effect" MOU. NARHGIS will be used for these projects. Many maintenance projects are being done recently whereby the current economy is taken into consideration; such projects are generally exempt.

(IL) In Illinois, projects entirely within the existing right-of-way and those located entirely within the shoulder/median are exempted from full archaeological investigation, provided that the area within the right-of-way has previously been torn up. Although not currently included in the exempt projects list, the inclusion of milling and new surface projects might also be helpful in streamlining the cultural resources process.

(IN) Minor projects are exempt from full archaeological investigation as per the minor projects programmatic agreement. This includes situations in which the project area is disturbed, such as in an urban environment, where an archaeological records check may be more appropriate and field work is not recommended. This programmatic agreement for minor projects saves time and money and is effective in streamlining the cultural resources data collection process. However, other situations that INDOT feels would be appropriate to exempt from full archaeological investigation are those where INDOT disposes materials such as asphalt into gravel pits or abandoned quarries; as there is generally no archaeological potential in these locations since the landscape has already been so disturbed.

One state explained that projects that are defined as unlikely to affect historic resources and projects that are scoped in the field by archaeologists as not likely to impact historic resources would be exempt.
Three states explained that certain projects that involve little disturbance would be exempt such as bridge redecking, signage, resurfacing, or other minor highway improvements.
One state explained that overlays are exempt; since these are generally state funded and there is no state legislation requiring consultation with SHPO.
One state noted that steep terrain would be exempt (except for quarry sites).
One state listed the following projects as exempt: projects in disturbed ROW, non-bifurcated medians (interstate), additional ROW that has been severely disturbed, slope areas over 10% except for possible caves/rock shelters.

(MO) As agreed upon in the programmatic agreement, certain types of projects are exempt from full archaeological investigation. MoDOT is focusing on transportation system preservation rather than new alignments so this agreement works well. MoDOT feels that in order to streamline the process for cultural resources, it might also be helpful to exempt hazardous waste locations from full archaeological investigation.

(OR) As designated in the programmatic agreement for CEs, shovel tests are not required on projects that do not have subsurface disturbance; exceptions are if a project crosses a river or creek. The programmatic agreement has been successful in streamlining the process so far. ODOT is working with the SHPO to include other types of projects in the agreement such as geotechnical borings in the roadway.

(WA) As per the Programmatic Agreement of 2000, and amended in 2006, projects within the known vertical and horizontal limits of previous disturbance are exempt from archaeological investigation. In the case of projects involving no change in original footprint, such as repairs and replacements of existing facilities, project engineers can exempt such projects, but usually call cultural resources specialists for verification. Projects with no new ground disturbance can usually be exempted and there is also a "misfit list" of projects that can also be exempted and are posted quarterly. After being posted, the SHPO and the tribes have opportunity to review these projects before construction begins. Approved projects and exemptions are listed on the website. WSDOT has found this process to be an appropriate and useful means of streamlining the cultural resources data collection process.

Consultant survey results:

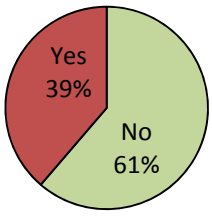
(DE) DelDOT's consultant is not aware of any specific reasons why DelDOT does not exempt certain projects or situations from full archaeological investigation and does not feel that such exemptions would be appropriate or useful as a means of streamlining the cultural resources data collection process because it would not be consistent with the National Historic Preservation Act.

(IL, IN, OR) The consultants for IDOT, INDOT and ODOT are not involved with exempt projects in their states.

9. Topic: The forefront of cutting edge technology

Online survey results:

Of the states that completed the online survey, twelve states consider themselves to be at the forefront of cutting edge technology, while nineteen did not. Of the twelve states that said "yes" to this question, nine were willing to be surveyed further with regards to their *Cultural Resources* fieldwork practices.



Do you consider your state DOT to be at the forefront of cutting edge technology and/or procedure used to collect, identify and record cultural resources data?

State DOT interview results:

(CA) In addition to the use of GPS, California uses thematic studies to streamline evaluation and introduce some standardization in data collection methods specific to historical archaeology at a statewide level. Thematic studies are designed to address a specific research topic or a specific type of cultural resource (e.g., covered bridges, certain architectural style unique to a master designer, or even an archaeological site type, such as agricultural/farming properties, mining sites, and water conveyance systems). For archaeological sites, a thematic study would standardize the recordation of archaeological material for determination of National Register eligibility under Criterion D (from the National Park Service standards). Use of thematic studies improves consultants' work by streamlining the amount of project-specific work that needs to be done and ensuring consistency in the approach. Caltrans has conducted statewide bridge and tunnels inventories under this thematic approach. Caltrans has published historical archaeology thematic studies for agricultural properties and mining properties.

The sheer size of Caltrans' program makes it unique and they feel that is what has helped bring them to the forefront of cutting edge technology in cultural resources fieldwork. Most important from a technology perspective is the TEA database that they are converting to an Enterprise system. Additionally, Caltrans has an excellent relationship with the SHPO and has even had staff work "rotations" in the project review unit. Much of the cultural resources investigation work paid for by Caltrans has resulted in significant advancements in understanding the history and prehistory of the state.

(DE) DelDOT is nearing completion of its online report database where every one of its cultural resource reports will be available online and free to the public in a searchable format. Full reports date back to 1952. FHWA has supported this project along with the FAA. Public feedback has been positive, mostly in the form of academic feedback and firms using it as a research tool. DelDOT suggests that other states consider a similar database in order to bring them to the forefront of cutting edge technology.

Methodologically, DelDOT feels that there is a fairly level playing field among state DOTs that have on-staff archaeologists. The most helpful suggestion they can offer to other states is having a good cultural resources management website (via the state DOT) where they can make information and regulations available online. This saves consultants time and money, especially when the consultants are from out of state, and it cuts down on traveling and cost of mailing large documents.

(GA) GDOT believes that their use of 3-D mapping with Leica ScanStation 2 for their Phase III Mitigation projects puts them at the forefront of cutting edge technology in cultural resources fieldwork.

GDOT suggests that states invest in geophysical equipment if they can because it pays for itself, especially the Ground Penetrating Radar (GPR). Additionally, every state should have a GIS database when possible, because it provides more information on the front end, especially for designers and planners.

(IL) One of the most helpful technologies that IDOT feels has brought them to the forefront of cutting edge technology is the use of the SharePoint site to coordinate with tribes and FHWA. The 22 tribes that have land claims in Illinois met in the fall of 2008 and announced that they want to be involved in more IDOT projects. Previously IDOT was sending out between 1300 and 1500 information packets a year to the tribes in order to coordinate with them on projects that might be in areas of tribal concern. IDOT has now constructed a SharePoint site to share this information with the tribes. It includes a map of the project area and a two-square mile zone around the project area showing the areas of high probability in that zone which may include mounds and/or graves. Tribes pre-selected the areas that they were concerned about and only projects in those areas are shown. The advantage to this database and site is that it saves in travel costs and saves paper. It has been very helpful in getting data out to the tribes faster and allows them to be more active in the process. The site has resulted in tremendous time savings to IDOT. The University of Illinois puts the data on the SharePoint site and when this is complete, an email gets generated and is sent to the tribes. IDOT has received positive feedback from most of the tribes; however, some of the tribes are concerned with the accessibility of the new technology. This program is still in a trial period.

(IN) One example of a cutting edge procedure used by INDOT is a recently drafted management plan related to linear resources, brick roads, and canals, and how to determine their eligibility. INDOT feels that their use of GIS in producing high quality maps is something that has brought them to the forefront of cutting edge technology. They feel that GIS is a tool that should be utilized by all DOTs and that they should all develop central databases. Their bridge program is also something they feel has brought them to the forefront, and they expect it to be a national model when it is done.

To bring other states to the forefront, INDOT recommends that they not hesitate to "think outside the box" and try something new. Keeping a good relationship with the SHPO is also very important.

(MO) MoDOT feels that having a GPR in-house has helped bring them to the forefront of cutting edge technology. It saves them money because they do not have to hire outside for the use of this equipment. There is a learning curve associated with the equipment though. GIS has also been very useful and in the future they would like to be able to develop a data layer where natural biological/social/cultural layers can be merged. If this can be accomplished, MoDOT believes it will have unlimited potential in archaeological site prediction.

(OR) ODOT attributes much of its presence at the forefront of cutting edge technology to its success in working with the tribes. Partnering with those that care about resources guides the fieldwork because collaboration is encouraged. ODOT has agreements in place with tribes for assistance in fieldwork and monitoring during construction. Additionally, ODOT arranged a field school component to a data recovery project and an educational component to train tribal members in archaeological fieldwork methods. Tribes have their own cultural resource components and ODOT has set up intergovernmental agreements to use tribes as consultants. ODOT has started an in-house archaeological fieldwork program to assist maintenance and local agencies. This will save money and time for the agency and local partners.

(WA) A cutting edge technology used by WSDOT is Rotasonic Coring (i.e., continuous solid cores acquired within casings by high-frequency vibration that produce high-resolution, undisplaced or disintegrated stratigraphic profiles). In urban areas where APEs are entirely paved, solid coring is used to identify subsurface stratigraphy relationships in an attempt to identify the archaeological potential of deeply buried sites. A typical core is 6 inches in diameter and cut into 2.5-foot lengths and sent to a lab where the consultant identifies layers and depth of interfaces, and also screens the layers to attempt recovery of artifacts. Also used are Geoprobes, which are a solid, 2-inch diameter core acquired within a Lexan liner that can be used to identify stratigraphic relationships and soil characteristics of subsurface layers in urbanized areas. This has been found to be expensive for archaeological site identification and development of stratigraphic relationships, but essential for completion of these objectives. This technology is especially useful in Seattle where the land has been re-graded during historic periods, and where there was a lot of tideflat reclamation and development due to laws that stated productive use would lead to private property ownership.

WSDOT feels that the use of GPR, particularly in tandem with imaging software and the use of sonic coring to look for deeply buried archaeological potential, has brought them to the forefront of cutting-edge technology in cultural resources fieldwork. They are also hoping to acquire geophysics remote-sensing equipment in the near future.

Consultant survey results:

(DE) The consultant for DelDOT feels that the use of GPS, ground penetrating radar and the availability of reports online are all technologies which have helped to bring Delaware to the forefront of cutting edge technology.

(IL) Depending on each particular project/site, consultants for Illinois have used various remote sensing techniques (Resistivity, Magnetometry, aerial photographic analysis and LIDAR) and feel that these technologies have helped to bring Illinois to the forefront of cutting edge technology.

(IN) INDOT's consultant feels that INDOT's selection of consultants has helped to bring them to the forefront of cutting edge technology.

(OR) ODOT's consultant feels that one of the things that has helped bring ODOT to the forefront of cutting edge technology is that ODOT has historically worked closely with the University of Oregon's Museum of Natural & Cultural History. Over the years, ODOT has taken advantage of open dialogue regarding field strategies with museum personnel, who maintain strong links throughout a vibrant university and scientific community with access to geographers, geologists, anthropologists, and other specialists.

IV. Ecology- Results

A total of 30 state DOTs completed the *Ecology* element of the online survey, including: Alabama, Arizona, California, Colorado, Connecticut, Georgia, Idaho, Illinois, Indiana, Iowa, Kansas, Maine, Maryland, Michigan, Mississippi, Missouri, Montana, New Hampshire, New Jersey, New Mexico, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, Tennessee, Texas, Utah, Washington, and Wyoming. The tabulated responses for each of the questions included in the *Ecology* survey are presented below. The original online survey can be found in Appendix B.1 of this report. Although 30 states took the survey, not all of these states necessarily answered every question presented to them. Therefore, the total number of answers may vary, and the percentages of responses presented for each question are based only on those states that did respond to that particular question.

Most of the questions presented below were answered with a simple "yes" or "no" response. However, for three of the questions, multiple response answers were permitted and because of that, the number of responses provided exceeds the number of states responding to the question.

Following the online survey, a total of three state DOTs (California, Maryland and Ohio) were interviewed in greater detail about each specific topic related to *Ecology*. In addition, consultants familiar with performing ecological fieldwork for two of these "cutting edge" states (California and Ohio) were surveyed as well. The original interview questions for the state DOTs and the survey questions for the consultants can be found in Appendix B.2 and B.3 of this report. The results of a website review of the state DOTs interviewed in greater detail are presented in Appendix B.4.

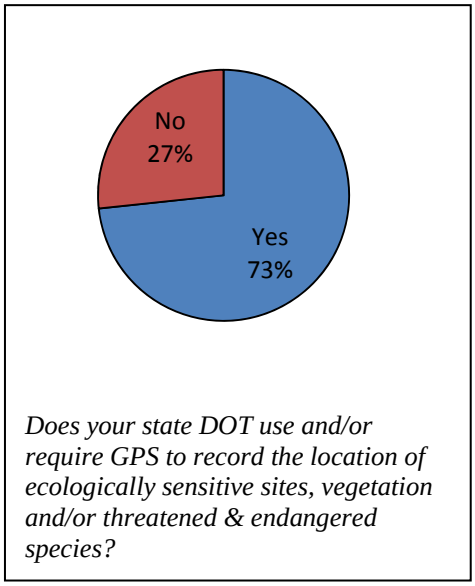
These three sets of responses (i.e., online survey, follow-up interviews with "cutting edge" state DOTs, and consultant surveys) are presented below for each of the major technologies and/or practices that can influence the amount of fieldwork required, the amount of time required for conducting fieldwork, and/or how the field data are collected.

1. **Topic: The use of GPS for data collection and recordation of ecologically sensitive sites, vegetation, wildlife, and/or threatened and endangered species**

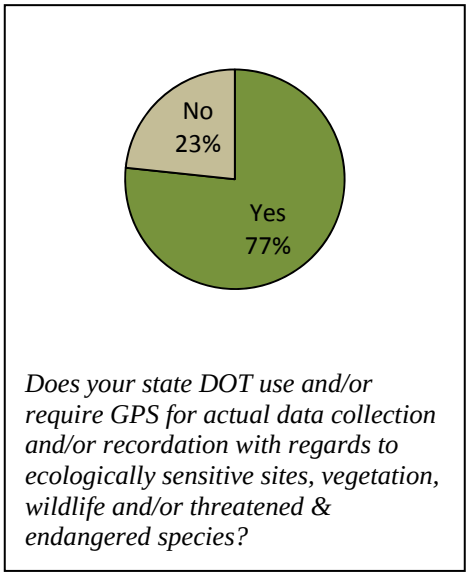
   Online survey results:

In response to the question of whether the state DOT uses and/or requires GPS to record the location of ecologically sensitive sites, vegetation and/or threatened & endangered species, twenty-two states replied that they do, while eight said that they do not.

When asked whether the state DOT uses and/or requires GPS be used for actual data collection and/or recordation with regards to ecologically sensitive sites, vegetation, wildlife and/or threatened & endangered species, twenty-three states replied "yes" while seven states said "no".



Does your state DOT use and/or require GPS to record the location of ecologically sensitive sites, vegetation and/or threatened & endangered species?



Does your state DOT use and/or require GPS for actual data collection and/or recordation with regards to ecologically sensitive sites, vegetation, wildlife and/or threatened & endangered species?

State DOT interview results:

(CA) When using GPS in California, several factors are taken into consideration by Caltrans ecologists when determining whether or not its use is cost effective. If assessing larger areas where the absolute amount, volume or location is less critical, Caltrans feels that digitizing is most cost-effective, such as when doing a general count of endangered species habitat and the presence of the species essential components is all that needs to be verified. What they look at in terms of whether or not to use GPS is whether the increased accuracy results in better impact analysis and understanding. For example, if there is a longitudinal encroachment as opposed to a perpendicular encroachment, the amount of effect can be more accurately described.

For indirect impacts, Caltrans will use GIS data to estimate the number of vernal pools and their density. If there are going to be direct impacts where small distances matter, then detailed survey data is critical and they would call for engineering grade data by survey crews. GPS use is required in locations where there are discreet elements in the field that can be documented; however, it is less frequently used in a situation like oak woodlands where the habitat varies in density and the use of remote sensing tools would be more appropriate. Although Caltrans is using Trimbles for fieldwork among their 13 district offices/ field offices, they do not mandate that all offices be on the exact same system; however, they are constantly upgrading to bring everyone up to a minimum standard. In California, between 5-15% of the work is done by consultants and those contracts typically include GPS as a requirement.

(MD) Maryland State Highway Administration (SHA) consultants use GPS to record boundaries of protected habitat areas (i.e., wetlands, threatened and endangered species habitat) that are transferred to design plans to avoid and minimize impacts. A backpack type GPS is traditionally used; however, handheld units are also being utilized as well as total station. While it is the preferred method, sometimes GPS is not as accurate in the summer when there is dense tree cover so it may not be used if not practicable.

GPS data on delineated wetlands are currently in report format; however the SHA is working on sharing information with others via internet databases. In addition, GPS is used for wetland delineation and the siting of Best Management Practices (BMPs). When surveying areas that are located outside of the right-of-way, the data can be shared with others.

Maryland SHA finds the use of GPS to be a cost savings both initially and for the future. The more GPS is used, the less work will be needed in the future and there will be less redundancy because the data can be reused. Regulatory agencies currently accept GPS unless the project is controversial and will require a more traditional survey to be done.

(OH) Ohio Department of Transportation (ODOT) uses GPS to record data on the location of streams, wetlands, threatened and endangered plants and Indiana bat habitat, unless there are topographical issues that may affect the accuracy of the equipment.

ODOT has found the use of GPS to be a benefit in terms of overall time and cost savings because in the past they would have professional surveyors out doing the work and flagging wetlands. Now they can do it themselves with GPS. State regulatory agencies accept use of GPS with the sub-meter accuracy that is achieved by the ODOT's equipment. GPS is generally not used when elevation is an issue because the units they have are not adequate for elevation data. For stream profiles, a survey level and rod are used, but ODOT primarily uses a handheld Trimble GPS unit.

Approximately 50% of Ohio projects are done in-house and usually consist of smaller projects as per an existing programmatic agreement. Approximately 90% of these in-house projects involve bridge/culvert replacement alignments. Major new alignments, such as at a CE level, are done by consultants.

Consultant survey results:

(CA) According to one of Caltrans' consultants, GPS data are routinely collected to identify highway stream crossings during fish passage evaluation surveys. GPS is utilized for data collection on about 10% of Caltrans' projects. The consultant finds it to be a benefit in terms of overall time and cost savings because the alternative is using maps to identify coordinates of survey sites, a process which is more time consuming. The primary GPS tools used in this regard is the handheld unit. The consultant would recommend its use even if Caltrans did not employ or require such use because they depend upon it to accurately locate sites and integrate site specific information with other data using GIS.

(OH) According to one of ODOT's consultants, for the past 20 years, the consultant has been using GPS for data collection on ODOT projects to establish the centerline and right-of-way limits of proposed highway corridors and study area boundaries, the location of wetland delineation sampling points, stream sampling locations, delineated wetland/upland boundaries and the locations of threatened and endangered species, including the locations of potential roost trees for the federally endangered Indiana Bat (*Myotis sodalis*). In general, GPS is used for data collection and recordation of ecologically sensitive sites, vegetation, wildlife and/or threatened and endangered species on over 50% of ODOT projects.

The ODOT consultant finds the use of GPS to be a benefit in terms of overall time and cost savings. Prior to using GPS, field biologists had to use a tape measure and compass to locate wetland delineation sampling transects, soil and vegetation sampling points and wetland/upland boundaries. This took a lot of time. Using GPS saves a tremendous amount of time and thus money. The consultant also had to rely on survey crews to stake study area boundaries and the center lines of proposed roads, which also took more time and added to project costs. Using a handheld GPS unit, they are able to upload the study area boundaries and then go into the field to locate the study area without a survey crew. This eliminates the need to coordinate with another field crew, thus saving time and reducing project costs. They can also enter the mapped field data into the unit and then make the necessary corrections and plot the data and generate figures a lot more quickly than before. This also saves time and reduces project costs. The consultant would recommend the use of GPS even if it was not required due to the time savings that can be realized when using the equipment. Currently there are no situations in which the consultant does not use GPS for data collection of ecologically sensitive sites, vegetation, wildlife and/or threatened and endangered species.

ODOT's consultant uses handheld GPS units that are accurate to within one meter for most wetland delineation studies and ecological surveys. They use total station when checking elevations in a wetland mitigation site.

2. Topic: Statewide GIS database

Online survey results:

	Wetlands	T & E	Flood plains	Soils	Land Use	Other
Yes	4	12	1	2	4	5
No	3	3	2	3	2	6

Are there IT/GIS technologies available to your state DOT and its consultants from some centralized source within the state?

The states were asked to indicate which types of data were available to them from a centralized GIS source within the state. The number in the chart indicates how many states chose each data type.

State DOT Interview results:

(CA) California does not have a Department-specific GIS dataset available from a centralized source within the state, but all types of data are available to some degree. Wetland data is available at the state level, but soil data varies regionally depending on the level of coverage. Hydrology is uniform statewide. Since there is not a statewide data set for environmental data, it is difficult to use such data sets on individual projects because their details vary and sometimes the data are not detailed enough for use on projects. General datasets from a variety of external sources provide a generalized background for studies.

Caltrans works with the California Department of Fish and Game to utilize the GIS information that is currently available, such as the information regarding fish passage (salmon) or endangered species locations. They are also working on having Fish and Game as the repository for natural resource data which will be available to consultants and to the public, with appropriate filtering of sensitive location information on threatened and endangered species. The intent is to have a detailed right-of-way inventory as part of a four-pronged environmental management system that Caltrans is currently working on. Inventory will be the third step in the system. The goal is to have a central repository that allows people to quickly store and retrieve data regardless of their location. An advantage to this would be consistency and greater precision in the work. For instance, for a project with multiple alternatives, such a repository would allow for a thorough analysis in a short period in time and allow them to adjust quickly to changes in the alternatives; it is an iterative process, and when there are changes in design it allows them to compare alternatives as they go forward.

A centralized database would also allow for the translation of information back and forth between systems. For example; biologists could transfer wetland boundaries to project engineers who can see impacts as they design. This kind of transfer of information eliminates questions of how things are calculated. A perceived disadvantage to databases is that people can overestimate the accuracy or value of the results such as in the case of wetlands, where a wetland boundary is, in reality, more of a region or zone and not as simple as the line that is depicted by GIS. Another potential disadvantage is that the cost and time involved in training and data collection can be high if not focused. It takes a certain amount of training to really get the most out of the tools.

(MD) Maryland's iMap is the GIS database for state reporting and sharing purposes and will include wetland delineation/mitigation sites and critical area boundaries/mitigation sites. Mitigation sites have been georeferenced, but delineated wetland boundary surveys have not yet been georeferenced for iMap; this information is in the development phase. The data has been collected for years and SHA is getting ready to pilot this effort.

The data that is available on iMap is updated frequently and is used during planning, designing and permitting. Information is available on centralized mitigation sites, which is fact checked with Maryland Department of the Environment to be sure that the data is accurate and consistent. Mitigation site data has been collected since the late 1980s. Data on stream mitigation is also available as well as all BMPs in Maryland in the form of digital data tracked by watershed, county and state routes. A sensitive species project review GIS layer is also available, but each project has its own coordination on this issue to ensure that the most current information is being used. Land use has some information too, but the associated county is usually contacted to obtain the latest information. The 100-year floodplains are mapped and are on the GIS database, as is forest cover. Having the latest information is an advantage; iMap gets all of the data together and promotes sharing information between departments, and allows for more frequent updates.

SHA is always working to improve the availability of ecology data. A new addition is the Large Animal Recovery System (LARS) (i.e., bear and deer roadkill) which helps identify potential locations for placement of wildlife passage corridors and fencing along roads. This type of information has been funded by auto insurance companies in other states.

(OH) Ohio Department of Natural Resources (DNR) has a GIS clearinghouse including National Wetlands Inventory (NWI), Ohio-mapped wetlands (Ohio wetland inventory), threatened and endangered species habitat, Natural Resources Conservation Service (NRCS) soils, land use, roads, topography and floodplains. ODOT incorporates other sources into their GIS and has a database called *Sharedrive* which is accessed by their district staff. ODOT has used GIS for more than 5 years; however, it has seen the most usage in the past 2 to 3 years. The GIS data is utilized during a "red flag summary" of potential projects during the planning phase of a project. It is also used in the creation of maps and figures. Data for bald eagles and Indiana Bat habitat is constantly being updated.

An advantage to having a centralized GIS data source is being able to search for information to use in planning studies such as for making maps; a search and query is a very helpful tool in planning and the analysis of data. Consultants do not have access to ODOT GIS files, but information is available from the DNR and the Ohio Geographically Referenced Information Program (OGRIP). Information on threatened and endangered species is not available through the database due to its sensitive nature, and consultants must contact the agencies directly for this information.

Consultant survey results:

(CA) The types of GIS data that are currently available to Caltrans' consultant include locations of bridges, highway location and attributes, district boundaries, Endangered Species Act information, land ownership, stream and hydrologic units and biological resources at location. However, most of the data is not available from Caltrans, but is instead available from other government agencies. There is not a true centralized source. So far, the required data have been available from publically accessible sources. Some sources have a variety of related information, such as California Department of Fish and Game and California Environmental Resources Evaluation System (CERES).

(OH) The following GIS data are available to ODOT's consultant from a centralized source within the state:

- Soils from the NRCS (Federal)
- Ohio Wetlands inventory
- National Wetlands Inventory Data
- Endangered species data
- Land use/land cover data set from Ohio Department of Natural Resources (ODNR)
- Floodplain Boundaries
- County aerials

- County Light Detection and Ranging (LiDAR)
- USGS Topographic quadrangles from Ohio Geographically Referenced Information Program (OGRIP)

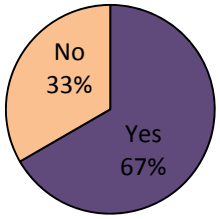
The data is downloaded from the ODNR website and the OGRIP websites, and soils data is retrieved from the NRCS soils data mart web site. The data is then stored on the consultant's servers for future uses. They use the data in ArcGIS ArcView 9.3
OGRIP has not finished its OSIP (Ohio Statewide Imagery Program) of aerial and LiDAR due to budget issues but is planning to eventually finish.

Having the GIS data on state operated sites makes it easier to locate the data. If the state sites did not exist, the data could still most likely be found, but it would be time consuming and the data would be scattered between Universities and nonprofit organizations and private for-profit websites.

3. Topic: Wetland Mitigation Banks

Online survey results:

Twenty states responded that they do actively utilize wetland banking in order to expedite the mitigation process and/or reduce the level of fieldwork required for mitigation. Ten states responded that they do not.



Does your state actively utilize wetland banking in order to expedite the mitigation process and/or reduce the level of fieldwork required for mitigation?

State DOT interview results:

(CA) Caltrans utilizes wetland mitigation banks throughout the state, usually on smaller projects where relative overhead of the cost of developing something else would be prohibitive. According to Caltrans, one of the advantages of banking is knowing that (if commercial or pre-approved) agencies have already agreed upon the values of the service area, uncertainty can be eliminated. It also provides for a fairly clean transaction in that the bank retains the long-term responsibility. A third advantage is that banking provides a de-facto valuation in terms of cost of credits in that it sets the real value of the resource. Disadvantages to banking include lack of availability; sometimes banks can preclude permittee-based mitigation and a bank will put down options on all the good land in the area. Another disadvantage is that there can be an increased review time for developing a bank and there can be a high level of competition. This can limit the choices available in type and location of mitigation. Sometimes cost and obligation of fulfilling regulatory requirements ends up winning out over what is best for the environment. While banking can reduce the fieldwork required for mitigation, it does not reduce fieldwork required for the rest of the project since there still needs to be analysis done to be sure the impacts are sufficiently understood and whether that particular mitigation is a good match.

(MD) Maryland SHA does not currently use wetland mitigation banks, since at this time none currently exist in Maryland. SHA will consider the use of bank sites on a case by case basis. Current policy is to mitigate using Maryland SHA-owned sites for over 5,000 square feet of impact, otherwise in-lieu fee is used.

SHA is working on developing its own banking system, which is currently referred to as "advanced mitigation". SHA is working on a new banking instrument to replace the one that was previously signed in 1994 by all interagency review teams.. Maryland SHA is currently receiving interest from bankers looking to come into the state. It is not practicable to use a bank if the cost to pay into a site is more expensive than to build a site; on the other hand, banking is feasible when there are limited impacts to a small site and funds can be paid into the state's in-lieu fee program. The use of wetland banking could effectively reduce the level of fieldwork required and associated costs for mitigation once it is implemented. It could be both an environmentally and economically preferable choice for most projects as far as SHA is concerned.

(OH) ODOT uses banking in wetland mitigation and finds that the advantages are that it is more convenient than building and monitoring their own site. It is especially cost-effective to use banks when the project in question involves only a small amount of mitigation. Other than the frequent lack of availability, ODOT does not see any disadvantage to using banks. Conversely, ODOT feels that in addition to expediting the mitigation process, wetland banking also effectively reduces the level of fieldwork required and associated costs for mitigation.

ODOT has their own "pooled mitigation areas" that are separate from the Mitigation Bank Review Team (MBRT) process. They are associated with a project that has a 404/401 permit, although they are not as large as traditional banks, ODOT builds them bigger than they need to be to serve as "extra credit" and then they go through public review through the permitting process. They are only used for ODOT projects and the credits cannot be sold. Regulatory agencies allow "pooled mitigation areas" based on monitoring. Original 401/404 permits establish total number of credits generated by the mitigation, amount of credits used by the permitted activity and amount of remaining credits.

Consultant survey results:

(CA) The consultant for Caltrans had no response to this question.

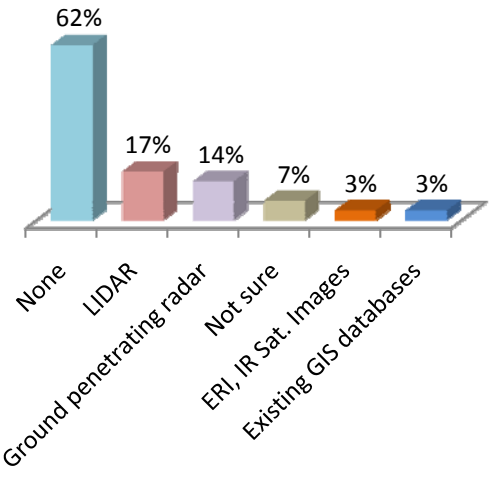
(OH) ODOT's consultant noted that ODOT has been able to mitigate for wetland stream impacts by using pooled mitigation credits that were generated by ODOT projects elsewhere in the state, but the consultant was unaware of instances where ODOT had gone to a formally approved, independent mitigation bank for the purchase of credits.

The most common situation in which wetland mitigation banks are used are for very small impacts (<0.5 acre) to isolated, Category 1 wetlands and very small impacts (less than 0.5 acre) to federally regulated Category 1 and Category 2 non-isolated wetlands resulting from private development projects. From the consultant's perspective, clients in the private sector may derive

limited benefit from using wetland mitigation banks, particularly with respect to the time it takes to obtain an individual Section 404 or Nationwide Permit from the regulatory agency. The consultant feels that there may be some reluctance on the part of the Corps with regards to the use of approved wetland mitigation banks, even for relatively minor wetland impacts. In their experience, there are a number of project-specific examples in which permit applicants have been forced to continue to search for an "acceptable" wetland mitigation project, despite the fact that an approved wetland mitigation bank has been shown to be readily available. This reluctance to allow mitigation to occur at an approved wetland bank results in delays in the waterways permitting process. Once permission to use a wetland mitigation bank is granted however, clients derive some benefit because they are not burdened with having to carry out annual wetland mitigation monitoring activities.

The other issue is that currently there are not enough approved wetland mitigation banks in Ohio to serve all of the projects that may be available at any given time. This is in part due to the extensive length of time that it takes (sometimes several years) for the Ohio Mitigation Bank Review Team (comprised of representatives from the U.S. Army Corps of Engineers, Ohio EPA, Ohio Department of Natural Resources) to review and approve of a wetland mitigation bank.

Having an approved wetland mitigation bank in the area doesn't always expedite the waterways permitting or mitigation process. If use of the bank is approved by the agency however, it does effectively reduce the level of fieldwork required and associated costs for mitigation. This results in less work for the consultant; however, the consultant encourages the use of approved wetland mitigation banks in order to save their clients the cost of designing, constructing and monitoring their own wetland mitigation sites.



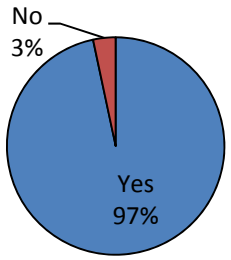
Does your state DOT use and/or require the use of remote sensing tools in order to facilitate and/or streamline required field studies?

4. Topic: Field Equipment

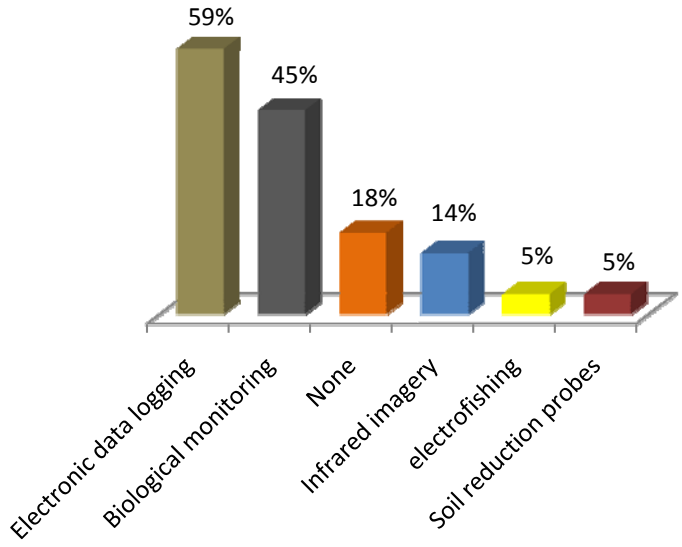
Online survey results:

The survey asked states whether they use or require the use of remote sensing tools in order to facilitate and/or streamline required field studies. Eighteen states responded that no remote sensing tools were used. Five states responded that LIDAR is used and four states chose ground penetrating radar. Four states chose the "other" category, with one state identifying the use of electrical resistivity imaging (ERI) and IR satellite images and one state indicating that existing GIS databases are used. The remaining two states choosing the "other" category were unsure if these technologies are used.

Additionally, the states were asked whether digital photography was being used by the state to aid in field work. Because of the overwhelming majority of "yes" responses from 29 states, and only one "no" response, it was decided that this question did not require any follow up in the individual DOT interviews or with the consultants.



Is digital photography used and/or required to be used by your state DOT to aid in field work?



Does your state DOT use any new or state-of-the-art monitoring techniques for hydrologic monitoring of stream and wetland mitigation sites?

The state DOTs were asked whether they use any new or state-of the art monitoring techniques for hydrologic monitoring of stream and wetland mitigation sites. Thirteen states chose electronic data logging as the technique used. Ten states chose biological monitoring. Three states responded that infrared cameras and imagery are used. One state said that electro fishing is used and one state listed soil reduction probes. Three states said that no state-of-the-art techniques are used and one said that the question was not applicable to their situation.

State DOT interview results:

(CA) Caltrans utilizes remote sensing tools in the field such as ground penetrating radar, which is used to avoid disturbing areas of potential enhancement. Technologies like this are used on a limited basis for California projects. Multi-spectral imaging is used as a cooperative technique with Fish and Game (F&G) to determine vegetation cover types. The biggest advantage for using these types of technology for an ecological-analysis would be in a situation involving, for instance, a vernal pool area where it is hard to get detailed surveys with a GPS and using high resolution would make more sense.

Although state-of-the-art monitoring techniques are not used to conduct hydrologic monitoring of streams or wetland mitigation sites, Caltrans tries to do thorough monitoring that leads to the best management decisions on the site. They are trying to do surveys that allow for better decision-making in site management. For example, a Caltrans biologist developed a way to find

Fairy Shrimp cysts in the soil of vernal pools out of season, a survey method which is also now used by the Fish and Wildlife Service in California.

(MD) Remote sensing tools such as Light Detection and Ranging (LIDAR) or ground penetrating radar are used by Maryland SHA, but they are not used for ecological based investigations in planning and environmental design. The concern is that the cost of these technologies might be exorbitant compared to other technologies, especially for small-scale projects. Remote sensing tools might be convenient to use for work with underground storage tanks and for cultural resources, but they generally have not been applied to ecological resources. Depending on the level of accuracy, such tools might be able to facilitate and/or streamline ecological field studies resulting in time and cost savings, but there is not enough knowledge of the technology at this time.

Maryland SHA uses several state-of-the-art monitoring techniques for conducting hydrologic monitoring of streams or wetland mitigation sites. Soil Reduction Probes (iris tubes) are used for identifying redox (anaerobic conditions) to determine if a site is a wetland. Electronic Data Loggers are used for stream monitoring, depth and velocity range of flows. Groundwater monitoring (daily, weekly, and monthly) is conducted at proposed and constructed mitigation sites, and surface, stream and ground water monitoring has been conducted at bog turtle sites in Hampstead, Maryland. Biological Monitoring is used for pre- and post-construction mitigation, fish surveys (electro-shocking), plankton monitoring and hydro-monitoring for range of flow. Advantages to using these technologies is that they save time and money to collect greater amounts of data. For example, piezometers can take measurements 24 hours a day and it costs less than paying an analyst to be in the field.

(OH) ODOT does not utilize remote sensing tools in the field. They feel that LIDAR does not give good elevation data. ODOT needs 0.5-foot contours on their plans, so in order to use LIDAR, the technology would need to be better. ODOT does not see the use for ground penetrating radar in ecological field work. Aerial photos are used for wetland boundaries.

ODOT utilizes several state-of-the-art monitoring techniques for conducting hydrologic monitoring of streams or wetland mitigation sites. Ohio Environmental Protection Agency (EPA) has developed indices for water quality and wetland monitoring, which ODOT is required to use. Electronic data forms are used for habitat/wetland delineation forms. ODOT has just started using Tablet PCs in the field which have been shown to result in time savings rather than having to re-write forms. However, there is a learning curve associated with proper usage of the PCs.

Consultant survey results:

(CA) The Caltrans consultant typically uses Google Earth to view sites as aerial photos. According to the consultant representative, their work with Caltrans has not included need for remote sensing tools. The consultant has not had a need for the data resulting from state-of-the-art hydrologic monitoring techniques in their work for Caltrans.

(OH) According to the ODOT consultant, remote sensing tools are not used or required by ODOT. The consultant does not prefer to use these tools, due to the requirement of field verification, and does not feel that they would facilitate and/or streamline required field studies on ODOT projects. Also, the U.S. Army Corps of Engineers wetland delineation procedures do not allow one to substitute remote sensing for field delineation techniques.

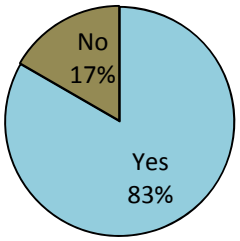
The consultant used hydrologic monitoring at the Detwiler Marsh Wetland Mitigation Site to determine the seasonal hydroperiod of the existing wetland prior to design of a wetland enhancement plan, and then continued to monitor the site's hydrology after the enhancement plan was constructed in order to ensure that hydrologic performance criteria had been met. Post-construction monitoring involved the use of a continuous data logger to monitor the water levels in the marsh on a continuous basis.

ODOT's consultant would use or propose to use state-of-the-art hydrologic monitoring if they thought it would save time and money on the project. The consultant feels that the use of data loggers is advantageous to both ODOT and the consultant because of their accuracy and ability to collect a tremendous amount of data with minimal effort on the part of the consultant.

5. Topic: Programmatic Agreements and Streamlining

Online survey results:

The state DOTs were asked if they had any programmatic agreements, either general or project specific, in place with federal or state regulatory or review agencies to streamline the ecological process for DOT projects. Twenty-five states responded "yes" and five said "no".



Does your state have any programmatic agreements (general or project specific) in place with federal or state regulatory/review agencies to streamline the ecological processes for DOT projects?

State DOT interview results:

(CA) Rather than programmatic agreements, Caltrans has what they consider to be agreements on methodologies and data sharing, such as the agreement they have with California Fish and Game on fish passage. They try to build data collection into agreements. There is a data sharing agreement in the works with the U.S. Forest Service for wetlands monitoring. Caltrans feels that agreements like this are effective in streamlining the data collection processes. However, these agreements would be even more effective if they could establish standards for equipment and protocols for monitoring that can be used in projects, as is done for hydrology. The collection of real-time data would also be helpful, for example in the case of bird migration.

(MD) Maryland has a NEPA/404 streamlined process, which involves concurrence points and regular coordination with Department of Natural Resources (DNR), Maryland Department of the Environment (MDE), the U.S. Army Corps of Engineers (ACOE), the U.S. Environmental Protection Agency (EPA), the U.S. Fish and Wildlife Service (FWS), among others. It requires

concurrence/comment from all agency representatives at three main key decision points (purpose and need, alternatives retained for detailed study and preferred alternative/conceptual mitigation plan) in the planning process. The streamlined process is aimed at getting agencies engaged "early and often" providing opportunities to lay out concerns and document them while moving forward as a team.

The Maryland State Programmatic General Permit (MSPGP) authorized the state to make permitting decisions for the Corps. The State program General Waterway construction permit, which is for minor or small-scale construction projects that impact wetlands or waterways but are considered to have small impacts, involves a more expedited review process. Maryland SHA feels that these programs/agreements do help to effectively streamline the data collection process. Currently, Maryland SHA is working on a programmatic agreement for streamlining stimulus projects that are expected to have a relatively low environmental impact.

Maryland SHA would like to see projects such as paint striping, milling, and the installation of sensors in roadways programmatically excluded because they result in virtually no impact off of the road surface. Although the more projects that are included in these agreements, the more the process would be streamlined, they don't want to jeopardize other agency processes. However, agencies are overburdened and anything that can lessen the workload would benefit everyone. Allowing SHA to use georeferenced data rather than field verify everything would also streamline the process. For example, in dealing with floodplain impact permits, an analyst must visit the site; this is an example of where GIS should be allowed. It would be helpful if they were allowed more flexibility and were allowed to identify areas where there are truly resources at issue. It works best to follow the intent of the regulations and focus on areas where resources are being impacted and for activities off the roadway.

Maryland's NEPA/404 streamlining process is currently undergoing revisions to one of the concurrency points (i.e., SHA preferred alternative and concept mitigation). Revisions include possibly renaming the concurrence point or breaking it up into two parts. This is because Maryland does not want a detailed mitigation plan too early and feels that the mitigation plan should be developed closer to when project construction occurs.

(OH) ODOT has an ecological Memorandum of Agreement (MOA) between the FWS and Ohio DNR for smaller projects regarding nationwide 404 permits. There is also an agreement in place with the Ohio EPA which bundles bridge and culvert replacements and allows for an accelerated turn-around time for reviews of less than 30 days. However, if a project involves an individual permit, then it still must go through the regular full ecological coordination. Ohio has coastal consistency MOAs for Lake Erie; if a project meets nationwide permit criteria, than it automatically has coastal consistency. ODOT and the FWS have a streamlined biological assessment and biological opinion process under the Endangered Species Act with regards to the Indiana Bat. Under the formal program there are two tiers of coordination for impact to habitat of the bat.

ODOT is working on a regional general permit that will be transportation-specific, and which will allow that pre-construction notification (PCN) for temporary impacts not be required for

smaller projects. ODOT is constantly working with agencies on improving their streamlining agreements. ODOT feels that the agencies are good at working to make modifications to make sure all issues are addressed.

Consultant survey results:

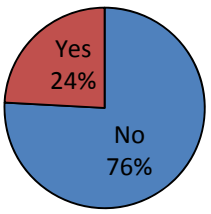
(CA) Caltrans' consultant's experience with programmatic agreements is currently ongoing. The target is streamlining permits; however, it is too early to tell if the process will achieve that goal.

(OH) ODOT's guidelines for MOA determination and field review still requires that data be collected regarding the presence and quality of stream, wetland and ecological resources in the project area. As such, the MOA does not streamline the data collection process. The MOAs do, however, streamline the agency coordination process.

6. Cutting Edge Technologies and/or Procedures and advice from the states.

Online survey results:

Out of the twenty-nine states that answered this question, seven states considered themselves to be at the forefront of cutting edge technology, while twenty-two did not. Of the seven states that said "yes" to this question, four were willing to be surveyed further with regards to their *Ecology* fieldwork practices; however, only three DOTs were actually available at the time of the follow-up interviews.



Do you consider your state DOT to be at the forefront of cutting edge technology and/or procedure used to collect, identify and record ecological data?

State DOT interview results:

(CA) Caltrans is headed toward the integration of both measured information (GPS data, long term monitoring) and predicted information (modeling) and is at the point now where the technology is such that field data can be integrated into unified systems. For example, if a certain resource was being monitored by several different entities at different locations, and everyone was using the same equipment, then all the field data could be combined. The modeling information and predictive nature of integrating field data is evolving. Caltrans has been working in cooperation with California Fish and Game and the U.S. Fish and Wildlife Service on several pilot study areas involving advanced mitigation and projecting the needs for future wetland mitigation. Now it is just a matter of figuring out where the issues are in terms of policy.

(MD) Maryland SHA tries to stay on the cutting edge from a monitoring and design standpoint. They are employing new techniques in fish passage and stream restoration techniques. For example, engineer log jams (ELJ) were used in the Intercounty Connector project and similarly on the Woodrow Wilson Bridge replacement, to create riffle grade control as opposed to step pools. According to the SHA, ELJ had previously been used only in the western states and in Alaska.

SHA has a "going green" committee that is looking at things like the reuse of asphalt, with a focus on reducing purchased materials. SHA also focuses on stewardship and going above and beyond what is required by permits and compliance by doing environmental restoration projects including streams restoration, tree plantings and wetland restoration. They have also experimented with LED lighting in streets, solar powered traffic lights, renewable energy, and retrofitting old stormwater sites.

Maryland's Green Infrastructure Assessment is a GIS data tool developed by the Maryland Department of Natural Resources that prioritizes and ranks ecosystems in the state for planning purposes. The tool is used early in the planning process to understand the critical resources in the project study area. Then it's used again during alternatives development to aid in avoiding or minimizing critical habitats/resources. In addition, the GIS-based tool makes it easy to locate gaps in the network of green hubs and corridors, which are ideal locations for mitigation sites. The US 301 Corridor Transportation Study in Charles County is the Project Planning Project pilot for using this tool. Furthermore, the project is a pilot for the Green Highways Partnership, a new progressive approach to transportation projects that strives to incorporate environmental streamlining and stewardship into all phases of projects through integrated planning, regulatory flexibility and market based rewards. This new approach has gained the support of Federal agencies and state agencies including the Maryland Department of Natural Resources.

In order to move to the forefront of cutting edge technology, Maryland recommends being proactive and staying current with trends and working with agencies rather than against. It is important to invest in its people and their ideas and new technologies, as well as to adapting to changes that are going on all around. Educating everyone, including maintenance and construction crews, will bring everyone up to speed on the requirements of permitting and stewardship.

(OH) The use of personal digital assistants (PDAs) and electronic data forms are examples of cutting edge technology being used by ODOT. Their staff is also trained and qualified to do Indiana bat mist net surveys. ODOT is always purchasing and updating their GIS and GPS equipment to stay at the forefront of cutting edge technology. If Caltrans were to offer advice to other states on getting to the forefront of cutting edge technology, it would be to take it step-by-step and to try to stay consistent within one's own state. Don't get distracted by the range of solutions. It is good to experiment but not a good idea to waste time on unproven technology.

Consultant survey results:

(CA) The consultant for Caltrans feels that it is likely that the advanced environmental review and compliance approach using electronic templates, on-line and live training, etc. place Caltrans at the forefront of cutting edge technology. Training, coordination, standardized approach to most activities and a continued pursuit of improvement are necessary for a state to possess in order to be at the forefront of cutting edge technology.

Caltrans' consultant feels that their role is to assist in providing support and unique expertise as needed to develop tools and training to use tools that support communication, coordination, streamlined response to environmental review and compliance needs.

(OH) ODOT's consultant feels that ODOT's use of GPS and GIS are probably the primary technologies that have put ODOT into the forefront of cutting edge technology when it comes to the completion of environmental studies. ODOT has spent a tremendous amount of time and effort over the years developing their Project Development Process, waterways permitting process, ecological survey process and so on. The consultant would recommend that any state that who has not yet developed these procedures review what ODOT has done.

They believe that a good consultant will provide ODOT, or any client, with recommendations regarding new technologies or procedures that have been proven to work in a cost-effective manner on other projects.

V. Water Permitting- Results

A total of 25 states participated in the *Water Permitting* element of the survey, including: Alabama, California, Colorado, Connecticut, Georgia, Hawaii, Idaho, Illinois, Indiana, Iowa, Kansas, Mississippi, Missouri, Montana, Nevada, New Hampshire, New Jersey, New Mexico, New York, Oklahoma, Tennessee, Texas, Utah, Washington and Wyoming. The tabulated responses for each of the questions included in the *Water Permitting* survey are presented below. The original online survey can be found in Appendix C.1 of this report. Although 25 states took the survey, not all of these states necessarily answered every question presented to them. Therefore, the total number of answers may vary, and the percentages of responses presented for each question are based only on those states that did respond to that particular question.

Most of the questions presented below were answered with a simple "yes" or "no" response. However, for some of the questions multiple response answers were permitted and in those cases, the number of responses provided may exceed the number of states responding to the question.

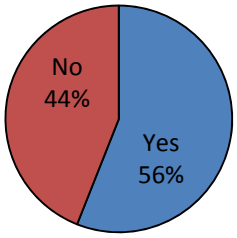
Following the online survey, a total of two state DOTs (New York and Washington) were interviewed in greater detail about each specific topic related to *Water Permitting*. In addition, consultants familiar with performing water permitting fieldwork for one of these states was surveyed as well. The original interview questions for the state DOTs and the survey questions for the consultants can be found in Appendix C.2 and C.3 of this report. The results of a website review of the state DOTs interviewed in greater detail are presented in Appendix C.4.

These three sets of responses (i.e., online survey, follow-up interviews with "cutting edge" state DOTs, and consultant surveys) are presented below for each of the major technologies and/or practices that can influence the amount of fieldwork required, the amount of time required for conducting fieldwork, and/or how the field data are collected.

1. Topic: *GPS/GIS Field Technologies Related to Stormwater Management Facility Inventory and Retrofit Prioritization*:

Online survey results:

The states were asked whether they use and/or require GPS to collect and record locational and attribute information for stormwater features such as drainage outlets. In response to this question, fourteen of the states said "yes" and eleven of the states said "no".



Does your state DOT use and/or require the use of GPS to collect and record locational and attribute information for stormwater features such as drainage outlets?

State DOT interview results:

(NY) In New York State Department of Transportation's (NYSDO) stormwater operations, GPS has been used for field location of various assets, including stormwater management practices and stormwater outfalls. These coordinates can be directly downloaded into existing databases. NYSDOT has implemented an outfall mapping GIS database, which has been useful for downloading coordinates and other attributes into the database. For capturing this data, handhelds have been used and desired accuracies (sub-meter) have been achieved. Post-processing in the office is required. Typically, NYSDOT uses the Trimble GeoXT 2005 series GPS handheld units. Sometimes they use Garmin GPS handheld units. According to NYSDOT, as there typically is not a lot of data to manage, these handheld units are sufficient. ArcView GIS software is also typically used. Although these handheld units may have the ability to download directly to GIS software in the field, NYSDOT tries to minimize the number of people doing post-processing of data for the sake of consistency, and typically delegates this duty to one person in the office. NYSDOT feels that these GPS & GIS technologies have saved time & money.

(WA) Washington State Department of Transportation (WSDOT) has been collecting some stormwater features over the last 3 years as part of their Roadside Feature Inventory Program. When stormwater features are part of the safety clear-zone, they are mapped using GPS by field crews. On and off over the past 12 years, they have had teams mapping stormwater outfalls using GPS as part of their retrofit prioritization process. Currently, WSDOT is initiating a GPS and GIS mapping effort that specifically targets collecting and verifying complete stormwater management system features such as detention ponds, pipes, culverts, ditches, catch basins, and various drainage inlets.

WSDOT feels that the use of GPS for their outfall retrofit prioritization process has been effective in streamlining the data collection and recordation process in some ways, but needs work in certain areas. They have identified outfalls in many priority areas, but the field and data entry methods were not always adequate nor followed adequately to ensure that the GPS location was meaningful. The stormwater features mapped as part of the safety inventory support the new, full stormwater system inventory because they provide some baseline of what is out there and where to look for it.

All of WSDOT's various efforts at outfall and inlet mapping are implemented as GIS data sets. WSDOT has used the GIS data on outfalls for retrofit to help communicate during program planning and scoping where outfalls exist and get a sense of their retrofit priority. This information has been used to prioritize and fund stormwater retrofit projects in compliance with their stormwater permit.

WSDOT primarily uses handheld resource grade GPS technology for outfall and stormwater system mapping. This technology meets the needs of project planning and scoping, environmental regulatory compliance, and maintenance operations with minimal set-up and traffic disruptions. The safety inventory crews are moving toward survey grade GPS technology

to improve the potential direct use of their data in preliminary engineering. Currently, WSDOT is using Trimble GeoXT and sometimes GeoXH GPS units.

WSDOT uses their GIS data library to screen state highways for key conditions such as traffic volumes and proximity to sensitive streams, fish-bearing streams, and drinking water sources to help prioritize outfall retrofit field investigation locations. As their complete stormwater management system inventory develops, they will be using the GIS-based database to plan and report stormwater related maintenance activities more effectively.

Consultant survey results:

(WA) WSDOT's consultant has used GPS to obtain mapping coordinates for monitoring stations associated with WSDOT's NPDES monitoring program. This process is typically performed following the installation of monitoring equipment at each station. For BMP monitoring, coordinates are collected at both the inlet and outlet stations. Mapping coordinates for each station are documented on standardized field forms.

The consultant feels that GPS provides a simple and cost effective means of documenting station locations. The consultant's field personnel have all received training on how to use GPS in the course of their day-to-day field work. Documenting station locations through some other means would likely be less accurate, though in some cases more practical. For example, the consultant frequently uses mile markers to give approximate locations of monitoring stations. This method provides the end user with location information that can be used to conveniently find the approximate location on a map or in the field without the use of a GPS unit.

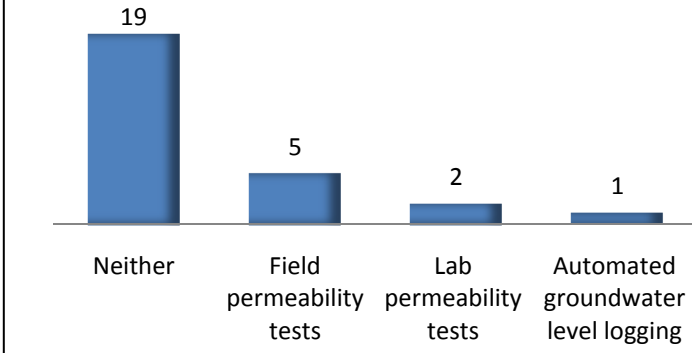
WSDOT's consultant primarily uses handheld GPS units that are manufactured by Trimble. In general, this tool is preferred for use by the consultant's field personnel due to their portability and ease of use.

The consultant would like to see an integrated GIS/database system implemented in Washington. An inlet identification or outfall mapping GIS database would be useful during the project planning phase to identify appropriate BMPs for monitoring. Specifically, this database could be queried to identify BMPs that are more suitable for monitoring based on their location and associated number of inlets and/or outlets. After screening BMPs in this manner, site reconnaissance could be performed to determine which specific facilities should be monitored based on other logistical consideration (e.g., safety, access, etc.).

WSDOT's SRWeb program (http://www.srview.wsdot.wa.gov) is a very effective tool for determining the roadside environment for any given mile marker on state roads. WSDOT's consultant uses this tool frequently.

2. Topic: Field Permeability Testing

Online survey results:



During project planning does your state DOT use any of the following to collect site data at proposed stormwater facility locations of receiving waters?

The states were asked if during project planning, they use field permeability tests or lab permeability tests to evaluate soil permeability rate, automated groundwater level logging to evaluate groundwater depth, or neither. In response, five states responded that they perform field permeability tests to evaluate soil permeability rate. Two states responded that they perform lab permeability tests to evaluate soil permeability rate. One state responded that automated groundwater level logging is performed to evaluate groundwater depth. It should be noted that a couple of states indicated that more than one procedure is used. Nineteen states responded that they do not use any of these methods to evaluate soil permeability rate or groundwater depth.

State DOT interview results:

(NY) In NYSDOT's stormwater operations, field permeability tests are rarely used. Although NYSDOT implements a standard procedure for these tests, NYSDOT indicated that there is no regulatory requirement mandating that a specific procedure be implemented. NYSDOT also does not use lab permeability testing.

NYSDOT indicated that there is no specific reason why automated groundwater level logging is not used and/or is being considered for use. However, they do acknowledge that data loggers would be useful in locations where access is particularly difficult, or if manpower was severely limited.

(WA) WSDOT usually does not perform field permeability tests, though on occasion, they may do a slug test (a common field hydraulic conductivity test) using their test holes, and for more complex dewatering situations, a full pump test. Typically they determine the saturated hydraulic conductivity of a soil (Ksat) using an equation based on grain size and percent fines. WSDOT also performs rigid wall permeameter testing in their laboratory. As of yet, the results of the equation have not been compared with the lab tests to determine whether there is good agreement between the two. However, the grain size correlations they use were developed from research conducted at the University of Washington based on lab permeability studies. That research is referenced in the infiltration section of the WSDOT Highway Runoff manual.

With regards to automated groundwater level logging, a lot of WSDOT's stormwater treatment facility groundwater monitoring is done manually (a site visit with a water level indicator). In the past few years, however, they have been receiving more and more requests to install data logging equipment at these sites. WSDOT's "logger of choice" is the LevelTroll 300 from In-Situ, Inc., Fort Collins, Colorado. These units are voltage output pressure transducers with an onboard datalogger that is installed "downhole" in the piezometer. If there are a lot of piezometers in close proximity (a few hundred-foot radius), WSDOT generally elects to install Vibrating Wire type pressure transducers in the wells and wire them to a central datalogger. Their "logger of choice" in this instance would be a "CR" series data logger from Campbell Scientific, Inc., Logan, Utah. They also use these loggers anytime a variety of sensors are used and/or telemetry is employed. Two reasons for electing to use data logging equipment are: 1) the need to collect near continuous or daily data; and 2) travel distance to the site for manual readings.

Consultant survey results:

(WA) The consultant for WSDOT has found that of the field permeability test methods available to them, the Washington State Department of Ecology (2005) Pilot Infiltration Test (PIT) is the most reliable predictor of infiltration rates for a proposed stormwater infiltration facility
The consultant's research has generally shown there is a relatively poor correlation between field and laboratory test results and has published literature on the issue.

The consultant states that they have not performed studies on a wide enough range of soil types to be able to assess whether there is a relative predictability of approximate soil permeability values for various soil types on subsequent projects or whether there is a significant variability in test results for similar site conditions.

WSDOT's consultant has used automated level logging instrumentation to monitor water levels in both stormwater facilities and receiving waters as a consultant to WSDOT. In general, this monitoring has been performed in connection with surface waters as opposed to groundwater.

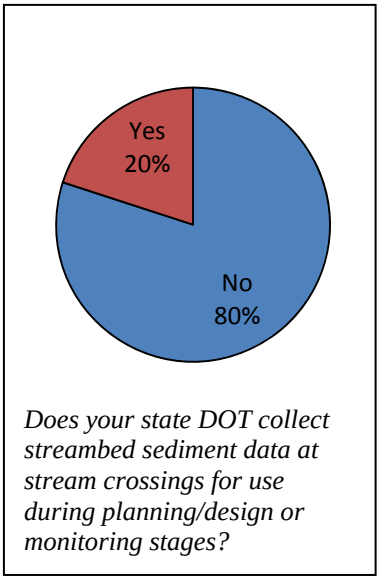
The consultant typically uses integrated data loggers and pressure transducers that are manufactured by In-Situ Inc. in these applications (e.g., Level Troll 500 or 700). Alternatively, they will use a stand-alone data logger that is manufactured by Campbell Scientific (CR1000) in combination with a stand-alone pressure transducer that is manufactured by Instrument Northwest (e.g., PS9805 or SDI-12).

In general, continuous logging is always performed due to monitoring requirements that are specified in WSDOT's NPDES permit. If the objective of the project is to monitor flow or groundwater fluctuation, then continuous logging instruments are a necessity.

3. Topic: Streambed Sediment Analyses

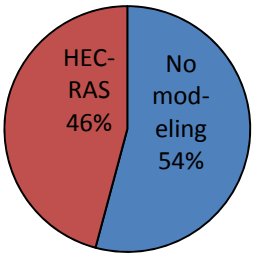
Online survey results:

The survey asked states whether they collect streambed sediment data at stream crossings for use during planning, design or monitoring. Twenty states said "no" and five said "yes".



Does your state DOT collect streambed sediment data at stream crossings for use during planning/design or monitoring stages?

The states were asked if they employ specific sediment transport models such as HEC-RAS, that dictate specific field data collection needs. Thirteen states said that no sediment transport modeling is performed and no associated field data is collected. Eleven states said that HEC-RAS is typically used. No states indicated the use of any other specialized sediment transport models.



Do you employ specific sediment transport models such as HEC-RAS that dictate specific field data collection needs?

State DOT interview results:

(NY) NYSDOT does not collect quantitative streambed sediment data for permitting purposes; however, a qualitative description based on observation of the streambed is routinely incorporated into permit applications. In instances where stream restoration is necessary to satisfy compensatory mitigation requirements, pebble counts are conducted to estimate the size distribution of particles in the restored/reference reaches. According to NYSDOT, there have been no problems in the past regarding their level of sediment analysis for water permitting.

Likewise, NYSDOT does not employ streambed sediment sampling for sediment transport analyses or scour evaluations. An estimate of the average particle size is obtained from visual site inspection and from any available boring reports. They compensate for this uncertainty by using low (conservative) size estimates. According to NYSDOT, this has not caused issues in the past.

It is recognized that NYSDOT would benefit from greater data precision in regard to sediment transport/scour analyses and consideration has been given to collecting streambed sediment data in the future. If this were to occur, sieve analysis would be the preferred method.

(WA) WSDOT indicated in the online survey that they do collect streambed sediment data at stream crossings for use during planning or monitoring stages. No follow-up was necessary in this regard.

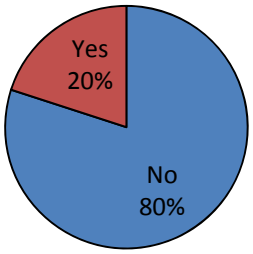
Consultant survey results:

(WA) The consultant has collected streambed sediment data for scour and sediment transport analyses. This work has typically been performed in the context of bank stabilization projects. In general, geotech boring and associated sediment gradation analyses have provided the most useful data. Also, simpler pebble counts by their field staff have been utilized for some projects.

4. Topic: Stormwater Quality Monitoring

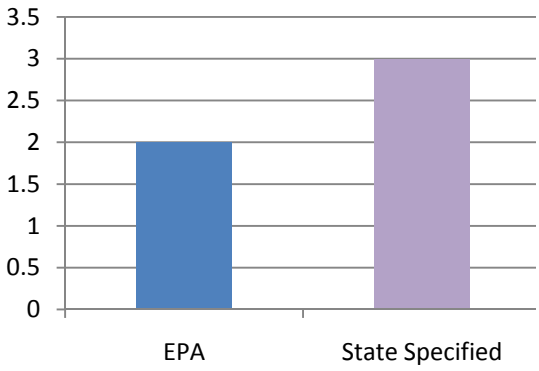
Online survey results:

The states were asked whether or not they require effluent stormwater quality monitoring from construction sites or operation facilities to evaluate the efficiency of BMPs. Twenty states responded "no" and five said "yes". Those states that responded "yes" were then prompted to answer the two questions that follow, with regards to standard methods and what the effluent is sampled for.



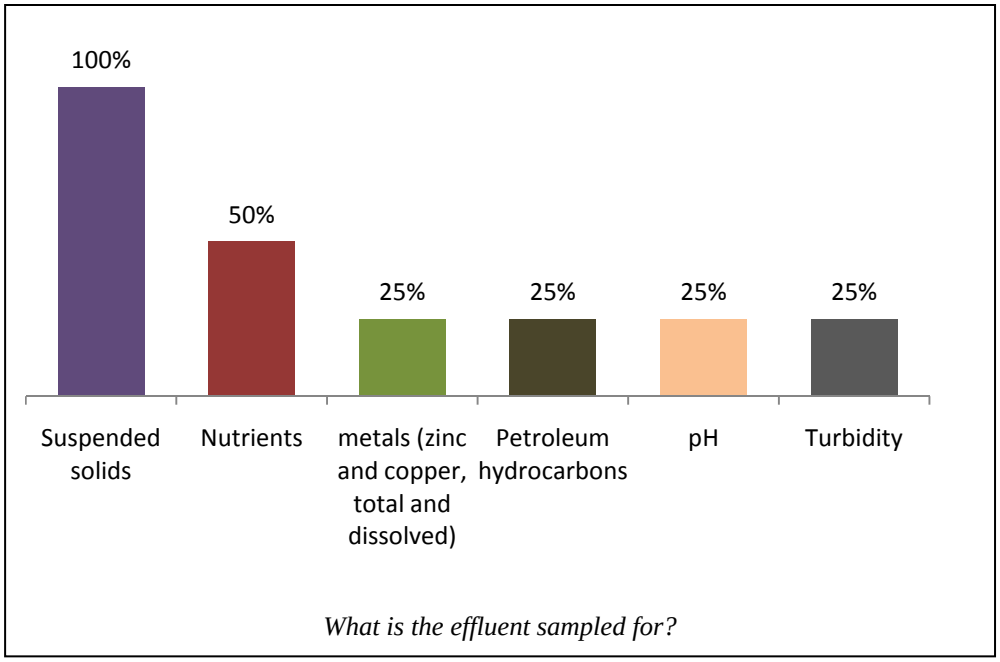
Does your state DOT require effluent stormwater quality monitoring from construction sites and/or operational facilities to evaluate the efficiency of BMPs?

In the first follow-up question, those five states which responded affirmatively to the previous question regarding effluent stormwater quality monitoring, were asked what standard methods were used for sampling and analysis. A total of four states responded to this question. The EPA method was selected by two of these states and State-specified methods were selected by three states. None of the other methods of sampling and analysis, including ASTM, AWWA, and APHA methods, were chosen by any of the states.



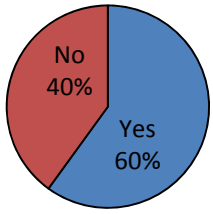
Are any of the following standard methods used for sampling and analysis?

States that responded "yes" to the question regarding whether or not they require effluent stormwater quality monitoring from construction sites or operation facilities to evaluate the efficiency of BMPs, were asked what the effluent is sampled for. A total of four states responded to this question. Among these four states, "suspended solids" was selected in all four cases, "nutrients" was selected twice, and the following choices were all selected once: metals, petroleum hydrocarbons, pH and turbidity. The choices that were available but were not selected by any state were chlorides and pathogens.



What is the effluent sampled for?

All of the state DOTs were asked if they implement regular preventative maintenance of stormwater management/treatment devices (stormwater inlets, detention or bioretention basins, conveyance systems, hydrodynamic/vortex separators, etc.) to optimize performance. In response, fifteen states responded "yes" and ten states responded "no".



Does your state DOT implement regular preventative maintenance of stormwater management / treatment devices to optimize performance?

State DOT interview results:

(NY) Although NYSDOT does not require stormwater quality monitoring, some sampling has been done to show a pre-construction baseline condition. NYSDOT has not been asked to perform monitoring on a routine basis. NYSDOT has done automatic sampling, grab sampling, and composite sampling. Sampling was also done on a research project to evaluate the effectiveness of two oil/grit separators. The sampling equipment used for this project was the ISCO auto sampler model # 6712 and the rain gauge ISCO 674. This study can be found on the NYSDOT website[1].

NYSDOT has considered doing post-construction monitoring for controversial projects in the New York City Watershed; however, lack of funding has put these projects on hold. If it were to be performed, total rainfall would be used as the criterion for determining which events to

[1] https://www.nysdot.gov/divisions/engineering/environmental-analysis/repository/c-01-74.pdf

conduct sampling at BMPs, and sampling would be conducted at both inlets and outlets of the BMPs using automatic sampling. Although not required at NYSDOT, stormwater quality monitoring would be useful to verify the validity of the state standards (accepted practices in the NYS Stormwater Management Design Manual theoretically can achieve 80% TSS removal, 40% TP removal).

(WA) National Pollutant Discharge Elimination System (NPDES) stormwater permits (construction, municipal, and industrial) issued to WSDOT contain specific requirements for stormwater quality monitoring. Some highway projects incur post-construction stormwater monitoring requirements related to terms and conditions of Endangered Species Act (ESA) Biological Opinions, Section 401 Water Quality Certifications, and local permits. WSDOT also conducts stormwater quality monitoring in association with its WSDOT-initiated Best Management Practices (BMP) research and development efforts (e.g., developing new BMP, refining BMP design criteria, enhancing BMP design modeling tools, and evaluating BMP effectiveness). Storm event criteria are prescribed in the NPDES stormwater permits' monitoring requirements and in the Washington State Department of Ecology criteria for evaluating emerging stormwater treatment technologies.

The stormwater quality sampling typically occurs at BMP inlets (influent) and outlets (effluent). Other sampling locations include edge of pavements (i.e., runoff characterization) and at outfalls. Usually stormwater quality sampling is performed using automatic samplers, but grab samples are used for certain types of monitoring (e.g., fecal coliform & TPHs), and in-situ sampling (e.g., turbidity & temperature). Parameters to be sampled are prescribed in WSDOT's NPDES municipal stormwater permit and are based on permit requirements and site-specific conditions. Parameters include:

- Highway Runoff Characterization
- Sediment
- First Flush Toxicity Testing
- Rest Area Runoff Characterization
- Maintenance Facilities Runoff Characterization
- Ferry Terminal Runoff Characterization
- BMP Effectiveness (water quality) (sediment)

Laboratory analytical methods to be used are prescribed in WSDOT's NPDES municipal stormwater permit and can be downloaded online[2].

To answer certain research questions, WSDOT has found that stormwater quality monitoring is necessary. However, in many instances, the nature of the questions that stormwater professionals are called upon to answer is technically difficult (or impossible to answer) simply because the nature of the study design that would need to occur; in such cases, stormwater quality monitoring is technically or financially infeasible to implement.

[2] http://www.ecy.wa.gov/programs/wq/stormwater/municipal/wsdot/finalPermitdocs2009/WSDOT5.pdf and http://www.ecy.wa.gov/programs/wq/stormwater/municipal/wsdot/finalPermitdocs2009/WSDOT6.pdf.

Consultant survey results:

(WA) WSDOT's consultant has generally performed effluent stormwater quality monitoring for voluntary research related efforts and to meet specific requirement of WSDOT's NPDES permit. The consultant typically uses criteria that are specified in WSDOT's NPDES permit for determining the acceptability of specific storm events for sampling. These criteria are as follows:

1. Rainfall depth: 0.2 inch minimum
2. Antecedent dry period: less than 0.02 inches of rain or no surface runoff in the previous 24-hours.

The consultant typically samples both the inlet and outlet of BMPs as required by WSDOT's NPDES permit. The results are subsequently used to calculate pollutant removal efficiency. The consultant has generally found the calculated performance efficiency of WSDOT's BMPs to be slightly higher than literature values for the same BMP. Stormwater quality sampling is usually performed using automated samplers to obtain flow-weighted composite samples. However, grab sampling is occasionally performed for select parameters (e.g., total petroleum hydrocarbons and fecal coliform bacteria).

Typical parameters and laboratory methods are as follows:

Parameter	Method Number
Hardness	SM18 2340C
Total Suspended Solids	EPA 160.2
Total Phosphorus	EPA 365.1
Copper, Dissolved and Total	EPA 220.2/EPA 200.8
Zinc, Dissolved and Total	EPA 200.7/EPA 200.8
Total Petroleum Hydrocarbons	NWTPH-Dx

In general, the sampled parameters are specified based on permit requirements.

WSDOT's consultant feels that an advantage of requiring the use of stormwater quality monitoring is that it provides important feedback to WSDOT on the effectiveness of its stormwater management program. In turn, this information can be used to determine the most cost-effective means of meeting WSDOT's stormwater treatment requirements.

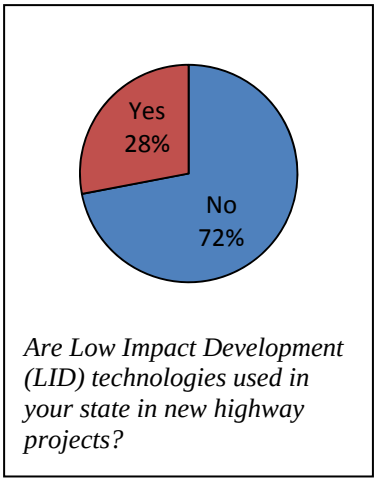
5. Topic: Low Impact Development (LID) Techniques

Online survey results:

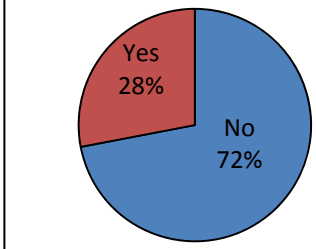
The states were asked whether Low Impact Development (LID) technologies are used in their state for new highway projects. Eighteen states said "no" and seven said "yes".

For the states that responded "yes", the question was asked whether LID techniques are used to retrofit existing treatment systems in older roadways. All seven of the states responded to this question. Five states responded "no" and two said "yes".

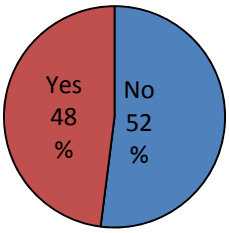
All of the states were then asked whether they use bioretention basins. Twelve states said "yes" and thirteen states said "no".



Are Low Impact Development (LID) technologies used in your state in new highway projects?



Are LID techniques used to retrofit existing treatment systems in older roadways?



Does your state DOT use bioretention basins?

State DOT interview results:

(NY) The use of LID techniques is a voluntary BMP in New York, but Bioretention is used and considered an accepted practice. Design issues (primarily volume control) do limit the use of many LID practices on highway rights-of-way.

(WA) Recognizing that the definition and interpretation of the term LID may vary among the states, the following are approaches that could be considered LID techniques and are approved for WSDOT use by the Washington State Department of Ecology:

- Dispersion (natural and engineered)
- Compost Amended Vegetated Filter Strip
- Bioinfiltration Pond
- Infiltration Basin, Trench, Vault
- Dry Well
- Wet Pond

- Media Filter Drain (a.k.a., Ecology Embankment)
- Constructed Stormwater Treatment Wetland
- Vegetated Filter Strip
- Biofiltration Swale
- Wet Biofiltration Swale
- Continuous Inflow Biofiltration Swale

A recent Washington State Pollution Control Hearings Board Order is laying the path that will require use of LID at the site and subdivision scale where "LID techniques" are determined to be "feasible". In responding to this Order, the Washington State Department of Ecology has been directed to develop criteria for determining the feasibility of using LID techniques and a LID performance standard.

Like "conventional BMPs", constraints exist for "LID techniques". Examples of these include:

- Right-of-way/Infrastructure siting limitations (e.g., highly urbanized settings)
- Geographic and geotechnical limitations (e.g., topography/steep slopes, proximity to wetlands and water bodies, floodplains)
- Hydraulic limitations (e.g., lack of hydraulic head, high groundwater)
- Limitations associated with protecting critical habitat for Endangered Species Act listed species
- Health-risk limitations (e.g., contaminated soils)

Performance data on the Media Filter Drain (a.k.a. Ecology Embankment) [3] and the Compost-Amended Vegetative Filter Strip[4] can be found on WSDOT's website.

Consultant survey results:

(WA) In terms of LID techniques used when working as a consultant to WSDOT, media filter drains have been used for design projects. The consultant has also conducted monitoring on media filter drains, compost-amended bioswales, compost-amended vegetated filter strips, and vegetated filter strips.

The use of LIDs by the consultant is voluntary. However, WSDOT's Highway Runoff Manual generally steers towards the use of media filter drains on design projects. Thus, use of LID is driven more by WSDOT policy as opposed to regulation.

Roadside safety issues can put constraints on the use of some LID features. For example, soil amendments required for LID facilities can create a "soft" surface that may contribute to vehicle rollover.

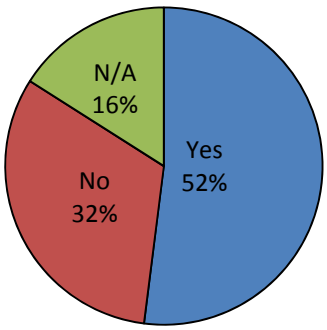
[3] http://www.wsdot.wa.gov/NR/rdonlyres/3D73CD62-6F99-45DD-B004-D7B7B4796C2E/0/EcologyEmbankmentTEER.pdf

[4] http://www.wsdot.wa.gov/NR/rdonlyres/8CA1089D-ECCE-4F8B-9252-20AA58DD4F71/0/CAVFSdraft2005Report.pdf and http://www.wsdot.wa.gov/NR/rdonlyres/B4785C56-C0C2-45C6-88B9-A9912FC2E031/0/CAVFSdraft2006Report.pdf

The consultant has evaluated the performance of a variety of LID techniques for WSDOT including: vegetated filter strips, compost-amended vegetated filter strips, ecology embankments, and unimproved highway embankments. Results from all of these evaluations have been summarized in data report to WSDOT. In addition, the consultant is currently performing performance monitoring for WSDOT on a compost-amended bioretention swale. Results from this study will be available at a later date.

6. Topic: Total Maximum Daily Load (TMDL) or Impaired Watersheds

Online survey results:



Does your state use more stringent BMPs with regards to discharges into impaired or TMDL watersheds in order to achieve permit compliance?

The states were asked whether they use more stringent BMP's with regards to discharges into impaired or TMDL watersheds in order to achieve permit compliance. Thirteen states said "yes", eight states said "no" and four states indicated that the question is "not applicable" to them.

State DOT interview results:

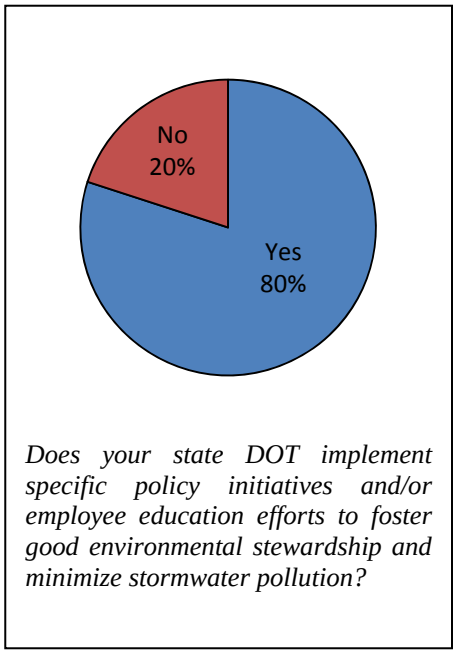
(NY) In order to achieve permit compliance for TMDL watersheds, the Water Quality Volume is increased to the one-year, 24-hour storm event. Thresholds of disturbances for coverage under a stormwater permit are reduced (one acre reduced to 5000 SF in NYC East of Hudson watershed).

(WA) TMDL or impaired watersheds can trigger additional BMP and field monitoring and/or retrofit obligations in order to achieve compliance with the municipal stormwater permit. For instance, regarding the Endangered Species Act (ESA), sufficient copper removal to minimize aquatic toxicity has been problematic. Similarly, it has been difficult to achieve the more stringent pollutant removals required for TMDL watersheds. In both cases, the issue is being addressed (and referred to as "retrofitting") by implementing conventional BMPs, not just on newly created impervious areas (as required by the regulations), but also on existing paved areas, in order to meet water quality goals. Also, in some cases, WSDOT, on their own initiative, has been removing curbs on paved roads and allowing runoff "sheet flow" in order to avoid concentrating pollutants that are ultimately discharged into receiving waters.

Consultant survey results:

(WA) For specific TMDL listed watersheds identified in WSDOT's NPDES permit, a TMDL monitoring Quality Assurance Project Plan must be developed and implemented by WSDOT. WSDOT must also comply with assigned loading allocations of the TMDL and/or assign BMP from a Detailed Implementation Plan for the applicable TMDL.

7. Topic: Other Field Practices, Specific Policy Initiatives, and/or Employee Education Efforts



Does your state DOT implement specific policy initiatives and/or employee education efforts to foster good environmental stewardship and minimize stormwater pollution?

Online survey results:

The survey asked states whether they had implemented any specific policy initiatives and/or employee education efforts to foster good environmental stewardship and minimize stormwater pollution. Twenty states responded "yes" and five states responded "no".

State DOT interview results:

(NY) NYSDOT has specific policy initiatives, and employee education efforts to control stormwater pollution and maintain stormwater permit compliance available on the DOT website. Documents that can be reviewed here include: the NYSDOT Design Requirements and Guidance For State Pollutant Discharge Elimination System (SPDES) General Permit GP-02-01; the Environmental Handbook for Transportation Operations; the Stormwater Facilities Operations & Maintenance Manual; Environmental Procedures Manual; and the NYSDOT Solid and Hazardous Waste Reduction Policy. NYSDOT is in the process of revising several of these items.

NYSDOT also has an internal project certification program: GreenLITES (Leadership in Transportation and Environmental Sustainability). GreenLITES is a self-certification program that distinguishes transportation projects based on the extent to which they incorporate sustainable design choices. This is primarily an internal management program for NYSDOT to measure their performance, recognize good practices, and identify and improve where needed. However, it will also provide the Department with a way to demonstrate to the public how they are advancing sustainable practices. NYSDOT project designs will be evaluated for sustainable practices, and an appropriate certification level, based on the total credits received, will be assigned to each project.

In the future, NYSDOT plans to have a statewide database of permanent stormwater management practices. Currently, these records are kept by only some of the 11 NYSDOT regional offices.

(WA) WSDOT's stormwater management program plan (SWMPP) describes WSDOT's overall program to control stormwater pollution and maintain stormwater permit compliance. This SWMPP can be downloaded online[5].

WSDOT is in the process of developing a Stormwater Information Management database to house the various data associated with implementation and compliance with their stormwater permitting requirements. For example, this database will contain information on WSDOT's stormwater features, stormwater monitoring data, illicit discharge detection and elimination reporting and remediation, underground injection control well registration, and BMP maintenance records.

Consultant survey results:

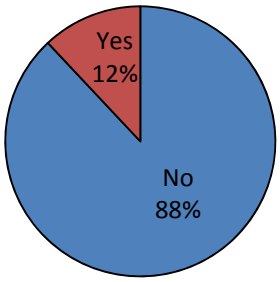
(WA) WSDOT's consultant has worked with their client to train their staff on monitoring and data management techniques. During this process, both WSDOT and the consultant gained valuable knowledge.

8. Topic: Cutting Edge Technologies and/or Procedures:

Online survey results:

The online survey asked the states whether they considered themselves to be at the forefront of cutting edge technology and/or procedure with regards to collecting, identifying and recording water resources data. Three states said "yes" to this question and twenty-two states said "no".

All three states indicating "yes," were willing to participate in a follow-up survey to discuss their *Water Permitting* fieldwork technologies in more depth; however, only two were actually available for the interviews.



Do you consider your state DOT to be at the forefront of cutting edge technology and/or procedure used to collect, identify and record water resources data?

State DOT interview results:

(NY) NYSDOT feels that the existence of the policy documents listed above have helped to bring them to the forefront of cutting edge technology in the field of water permitting. They also feel that the use of their GPS and GIS technologies discussed above have saved NYSDOT time and money. NYSDOT suggests that other states develop equivalent policies and documentation, as needs and resources allow. NYSDOT welcomes other states to contact the NYSDOT Office of Environment for additional information or assistance.

[5] http://www.ecy.wa.gov/programs/wq/stormwater/municipal/wsdot/finalPermitdocs2009/WSDOT7.pdf.

(WA) WSDOT believes that their stormwater design guidance manual for roads and highways (i.e., Highway Runoff Manual) and their innovative stormwater related research related to BMP design and stormwater design guidance has helped to bring WSDOT to the forefront of cutting edge technology and/or procedure in water permitting.

All states should possess stormwater design guidance modeling tools and the knowledge and capabilities to use them appropriately. Geotechnical assessment knowledge and capabilities are also critical skills to possess. WSDOT suggests to other states that they attract and retain a knowledgeable and talented interdisciplinary technical team of water quality, stormwater, and erosion control specialists, designers, hydrologists, geotechnical and hydraulics engineers, landscape architects, and maintenance staff in order to bring their state to the forefront of cutting edge technology. WSDOT also advises states to network and develop strong collaborative working relationships with technical specialists from other jurisdictions and regulatory entities.

Consultant survey results:

(WA) WSDOT's consultant has utilized "demonstrative" methods of meeting WSDOT's intentions. For example, the consultant has used crediting flow attenuation accomplished at a project's floodplain mitigation site as a means of satisfying stormwater flow requirements. The consultant recently finished design of a site that holistically melds aquatic habitat, wetlands, floodplain creation, and flood storage into one, and received credit from a regulatory perspective that it will achieve the necessary flow control such that conventional stormwater detention facilities are not needed.

The consultant feels that WSDOT's thorough stormwater manual covers almost any situation that will arise and offers designers effective choices. WSDOT's commitment to being an environmental steward is effectively demonstrated in its stormwater guidance and project reviews. WSDOT's investment in research and development over several years has paid off in terms of developing solid BMPs and associated design guidance that are gradually moving towards LID in lieu of old-fashioned stormwater BMPs. WSDOT's staff are actively engaged with others in the region who are doing cutting edge work.

WSDOT staff must have technical savvy themselves to convince design project managers to do things differently. Strong technical guidance that encourages LID for stormwater is required. Because so much of highway design is "by the book", the book needs to be forward thinking in order to foster the use of new and innovative BMPs. The consultant feels that WSDOT is at the forefront of monitoring innovative LID treatment techniques. For example, WSDOT recently worked with the consultant to quantify the pollutant and flow reductions on unimproved highway embankments. Results from this study have provided WSDOT with valuable information on the treatment potential of these areas relative to the more traditional, engineered types of BMPs.

The consultant feels that their role/responsibility to the state DOT is to share ideas, even the "crazy" ones, with DOT counterparts to encourage innovation. The consultant suggests leveraging hydrologic and hydraulic ability to demonstrate effectiveness of new ideas in ways

that regulators will understand. The consultant feels that they should proactively engage regulators to consider new BMPs that show promise, and that make sense from a cost and operational standpoint and not wait for regulators to dictate what is possible. As necessary, cutting edge monitoring equipment and experimental designs should be used to obtain hard data on the performance of innovative BMPs.

VI. Noise Analysis-Results

A total of 32 states participated in the *Noise Analysis* element of the survey, including: Alabama, Arizona, California, Colorado, Connecticut, Georgia, Hawaii, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Maryland, Michigan, Mississippi, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, Texas, Utah, Washington and Wyoming. The tabulated responses for each of the questions included in the *Noise Analysis* survey are presented below. The original online survey can be found in Appendix D.1 of this report. Although 32 states took the survey, not all of these states necessarily answered every question presented to them. In fact, for this particular survey, only 31 states actually responded to most of the questions. Therefore, the total number of answers may vary, and the percentages of responses presented for each question are based only on those states that did respond to that particular question.

Most of the questions presented below were answered with a simple "yes" or "no" response. However, for some of the questions, multiple response answers were permitted and because of that, the number of responses provided exceeds the number of states responding to the question.

Following the online survey, a total of four state DOTs (California, New Jersey, New York and Washington) were interviewed in greater detail about each specific topic related to *Noise Analysis*. In addition, a consultant familiar with performing noise analysis in the field for one of those states was surveyed as well. A consultant for a second state was also solicited, but no information was actually provided by that consultant. The original interview questions for the state DOTs and the survey questions for the consultants can be found in Appendix D.2 and D.3 of this report, respectively. The results of a website review of the state DOTs interviewed in greater detail are presented in Appendix D.4.

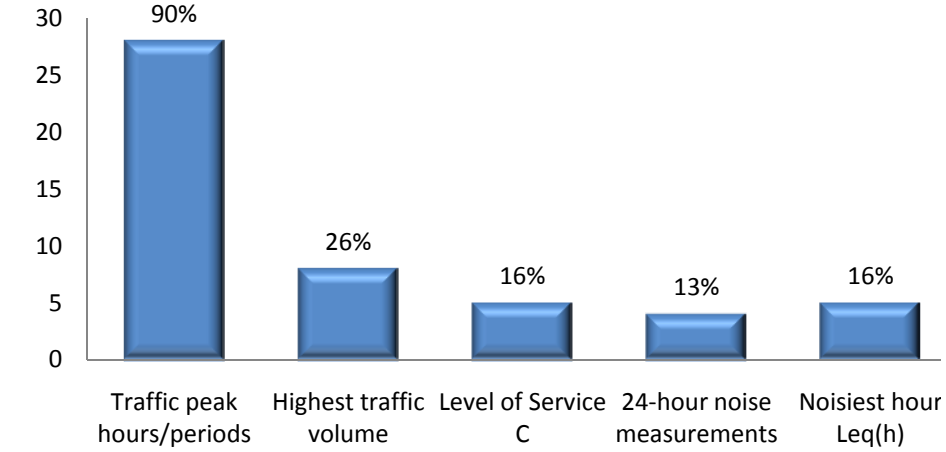
These three sets of responses (i.e., online survey, follow-up interviews with "cutting edge" state DOTs, and consultant surveys) are presented below for each of the major technologies and/or practices that can influence the amount of fieldwork required, the amount of time required for conducting fieldwork, and/or how the field data are collected.

1. Topic: Noise measurements:

Online survey results:

The states were asked whether they use or require any particular methodologies to be used in order to determine the appropriate sampling period to conduct noise measurements for NEPA projects. This question offered multiple selections for responses. Some states chose more than one of the answers in responding to this question, with the following results: Twenty-eight states responded that they use traffic peak hours/periods to determine the appropriate period. Eight states selected (or also selected) highest traffic volume as a methodology. Five states selected Level of Service C. Four states selected 24-hour noise measurements. Five states also

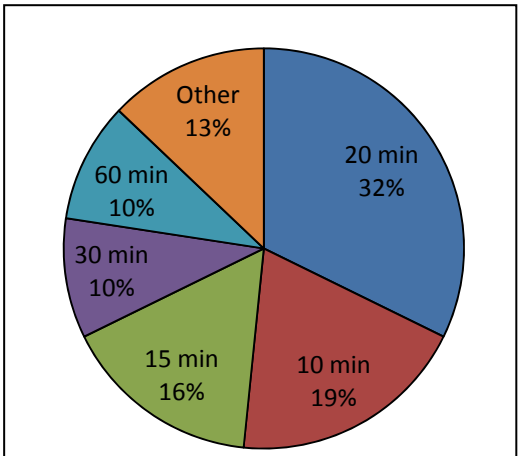
responded to the "other" category by indicating that the noisiest hour of the day is used as the sampling period.



Does your state DOT use or require that any of the following methodologies be used to determine the appropriate sampling period to conduct noise measurements for NEPA projects?

With regards to noise measurement, the states were also asked what is the typical length of time used for each noise measurement. The responses to this question were distributed as follows:

- Six states use 10 minute measurements.
- Five states use 15 minute measurements.
- Ten states use 20 minutes measurements.
- Three states use 30 minute measurements.
- Three states use 60 minute measurements.
- One state uses 24 hour measurements.
- Three states responded to the "other" category, with two of those states indicating that measurements varied depending on volume and could be between 15 and 30 minutes and one state responding that it varies with field conditions.



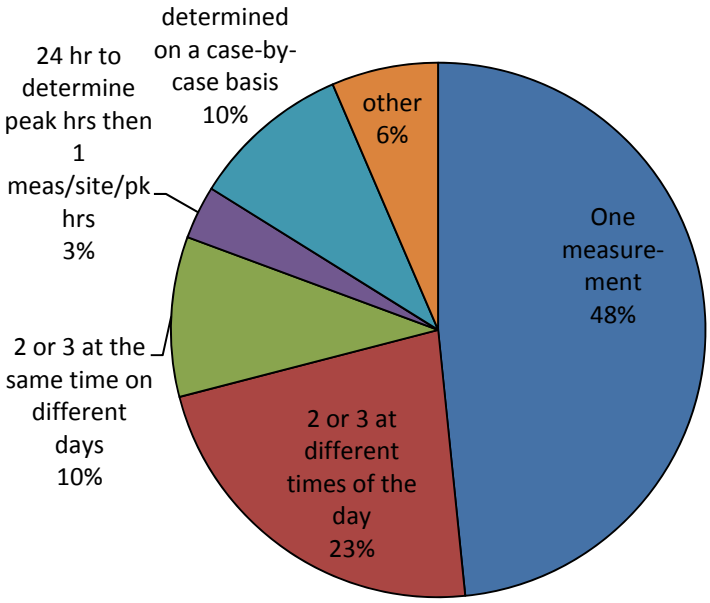
What is the typical length of time used for each noise measurement?

The states were also asked how many total short-term measurements are required to be taken at a given site. Fifteen states responded that one measurement was taken at a given site, one noting

that this was the worst case scenario. Seven states said that 2 or 3 measurements are taken at different times of the day while three states said that 2 or 3 measurements are taken at the same time on different days. Six states responded to the "other" category[1].

State DOT interview results:

(CA) The California Department of Transportation (Caltrans) conducts noise measurements during the peak noise hour, determined from 24-hour measurements, in order to conform with FHWA guidelines. Caltrans generally finds that after taking 24-hour noise measurements, the noisiest hour is not synonymous with the peak traffic periods, but instead, the noisiest hour occurs when there is the highest number of cars, traveling at high speeds. Stop-and-go traffic, which may be experienced during the peak traffic periods, is often not as loud as high speed traffic. Off-peak measurements may be used when trying to assist or comply with local municipality noise measurements that require 24-hour noise metrics.



How many total short-term measurements are required to be taken at a given site?

One, 20-minute L_{eq} noise measurement period is used by Caltrans, and is usually appropriate to match up with the loudest hour (assuming vehicle flow rate is constant), but proper engineering judgment should be used in determining the best measurement period. For example, if measurements are being taken by an airport or train, that specific type of noise activity must be accounted for and the measurement period is reduced in order to obtain a smaller L_{eq} to exclude other noises. Additionally, sometimes two 10-minute samples are used by consultants, depending on NEPA or California Environmental Quality Act (CEQA) impacts. In other cases, a Community Noise Equivalent Level (CNEL) measurement may be conducted by setting out a long-term meter for 24-hour measurements in order to comply with local municipality requirements.

[1] One state said that 24 hour measurements are taken to determine peak hours, then 1 measurement per site at peak hours.
One state said that "consecutive measurements should be consistent."
One state responded that "if environment is not homogenous, we'll conduct more than 1, same time on different day."
Two states responded that the decision is made on a case-by-case basis.
One state said that it varies with field conditions.

(NJ) NJDOT finds that when taking 24-hour measurements for identifying peak noise hour, the peak noise hour is not always synonymous with the peak traffic periods. One reason is that New Jersey is a heavy corridor state. Typically it is found that the noisiest hour is around 6 a.m., which is not the peak traffic hour. Depending on the receptor, other methodologies for determining peak noise hour may be used. For example, sometimes monitoring is adjusted for noise receptor usage and hours of operation, such as in the case of a park or a church.

A 60-minute noise measurement period is used to coincide with the hourly traffic data used for the TNM model. One measurement is the minimum used at each site during the course of the day. However, certain situations call for more than one measurement to be taken, such as those situations involving traffic traveling to the New Jersey Shore during the weekend. During this time, the peak noise hour may not fall into the peak traffic hour. Generally this type of traffic does not include truck traffic, so it is not as loud as other types of traffic.

(NY) New York State Department of Transportation (NYSDOT) generally conducts noise measurements during the design hour because it meets the requirement of the regulations, and the noise critical hour is usually in the AM or PM design hour. A 24-hour measurement may be used to determine if the noise critical hour falls outside of the design hour. However, for most projects, an AM and PM sampling period is considered to be sufficient. Off-peak field measurements are made as well.

A 15-25 minute noise measurement period is used because NYSDOT finds it to be experiential and empiric. Their method is to note the L_{eq} after 5 minutes, and then, while the meter continues to run, note the 10-minute and 15-minute L_{eq}. If the last two L_{eq} readings are the same, then the measurements can stop there. The purpose is to try to get a stabilized L_{eq}. If it is shifting or the measurement is of a low volume roadway where there is more variability, then the measurements will continue thru 20 and 25 minutes; however, there is no real benefit in measuring beyond that.

NYSDOT requires short term measurements to be taken at a given site 2-3 times in order to get a representative level. They usually find that visiting the site twice (morning and evening) is sufficient if levels are within 3 dBA of each other. If decibels are jumping around, then they may decide to take a third measurement; however, the need for a third measurement only occurs about 5-10% of the time.

(WA) Washington State Department of Transportation (WSDOT)[2] uses peak period traffic volumes for determining the appropriate sampling period to conduct noise measurements[3]. The reason for using traffic peak rather than noise peak is that they try to be as conservative and rational as possible, explaining that using peak period traffic running at posted speed yields more conservative (higher) results, which are in turn defendable and rational. Recognizing that it is highly unlikely that traffic travels at the posted speed, it is still the most conservative approach.

[2] For major highway projects, approximately 65% of the work is done in-house and approximately 35% of the work is done by consultants. WSDOT reviews all noise studies and local jurisdiction studies that are prepared.
[3] Alternate sampling periods are sometimes used for measuring construction noise.

Due to the technical nature of the subject, the only issues involved with the use of this method have been in explaining it to the public during public hearings and information sessions, especially in the Puget Sound area, which has a very active public. However, there have been no legal challenges or substantive issues to speak of.

WSDOT uses a 15-minute noise measurement period because it is the **s**hortest representative sample period allowed by FHWA. Circumstances where this 15-minute period would not be appropriate or utilized would be in areas of more sporadic or intermittent traffic, where they instead use longer sampling periods. Usually this is decided on a case-by-case basis, although the sampling period would not exceed one hour.

WSDOT does not typically use more than one measurement for each site during the course of a day, except for under special circumstances such as a Type I study situation like that which involved noise abatement for the Tacoma Narrows Bridge. For this project, instead of a number of smaller extension points, a fabricator designed a new type of massive expansion joint for the bridge and only two joints were needed. However, it was soon discovered that the new joints created a loud "zipper" sound, which affected the adjacent neighborhood that did not initially qualify for noise abatement. It was determined that the noise was due to reflection as sound was bouncing off the barrier and cable housing. Abatement measures were developed by building cable housing as a retaining wall on either side of the joint; the wall, as well as the crash barriers were coated with an absorptive product. Then, four, 1/3 octave band measurements were taken at noise sensitive receptors to evaluate the effectiveness of the noise abatement that was developed.

Consultant survey results:

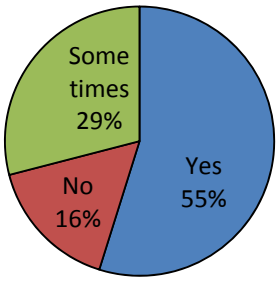
(NY) When working for NYSDOT, the consultant does not identify both AM and PM design hour volumes for determining the noise monitoring periods. There have been situations where the consultant has not used design hour volumes to determine the noise monitoring period, such as on studies when the measurements are used primarily for modeling validation, where they would typically measure throughout the day during periods with freely-flowing traffic.

NYSDOT's consultant typically conducts noise measurement for 20 to 30 minutes. If there are significant variations in traffic flow or contributions from non-traffic sources, they tend to measure for a longer, rather than a shorter period to adequately characterize traffic-only noise levels. In most situations, this period of time provides a good balance between an adequate sampling period at each site and the ability to measure at more locations.

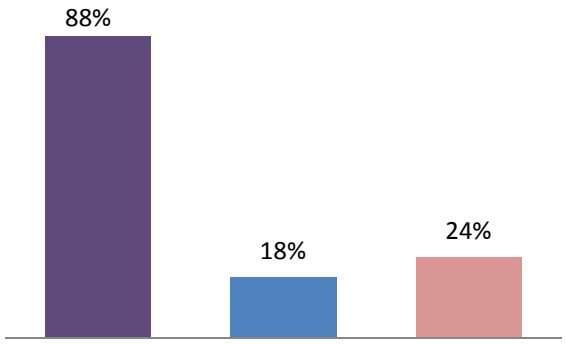
Barring unusual weather or traffic conditions, NYSDOT's consultant believes that one measurement per site often is adequate for modeling validation. As noted above, if unusual weather or traffic conditions are present, or if a measurement site is set back a considerable distance from the roadway, two measurements may provide a better indication of propagation under various conditions. The primary disadvantage is the trade-off between repeating measurements and gaining useful data at additional sites.

2. Topic: traffic counts and vehicle speed

The survey asked if the state DOT requires traffic counting in conjunction with noise measurements. In response, seventeen states responded "yes" and five said "no" to this question. The remaining nine states chose the "sometimes" open-ended response option[4].



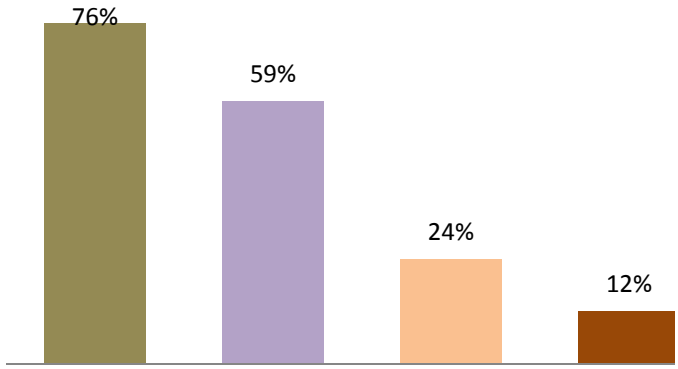
Does your state DOT require traffic counting in conjunction with noise measurements?



What is the purpose of the traffic counts?

If the state responded "yes" to the previous question, two follow-up questions were asked.

The first follow-up question asked what the purpose is for the traffic counts that are taken. A total of 17 states responded to this question, and several of them chose more than one response, resulting in more than 17 responses. Fifteen of the states said that the purpose was for model calibration. Three states responded that the reason traffic counts are taken is because they are required by regulations or DOT policy. One state explained that they are taken "to



What method or equipment does your state use for the traffic counts?

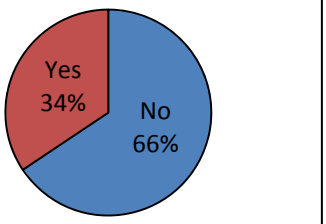
[4] Four states replied that traffic counting would be done in conjunction with noise measurements to either calibrate or validate/verify the TNM or other noise model.
One state responded that it is not required but usually done in practice.
One state responded that it is only done where there is no traffic data available.
One state explained that it would be done to better determine peak traffic.
One state replied that it was done when real classification volumes are needed.
One state responded that it depends on information readily available.

characterize the actual noise level measurements at the time of the measurement". One state said that "most of the time "yes", especially if the data could be utilized for model validation, or comparison with data gathered from other time periods; only for 24-hour tests, or in 'screening' or preliminary studies would traffic counts not be done, typically". One state said that they are taken for formula calculations and one state said that they are taken to estimate the percentage of trucks.

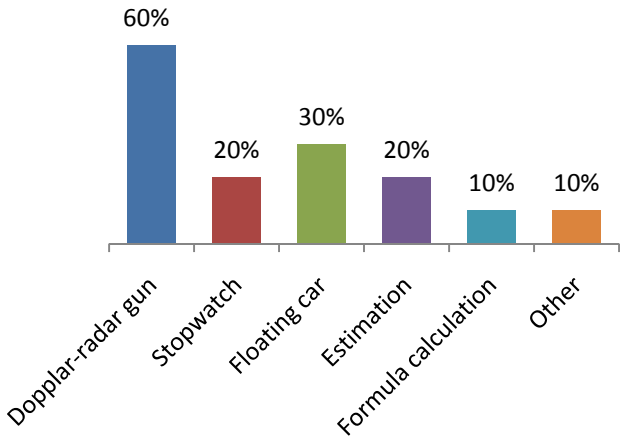
The states that answered "yes" to traffic counting were also asked what method or equipment they use for the traffic counts? A total of 17 states responded to this question, and several of them chose more than one response. Thirteen states indicated that they use a handheld counter for traffic counts. Ten states indicated that they use manual counts. Four states responded that they use camcorder/video recordings. Two states indicated the use of an Automatic Traffic Recorder.

The survey asked whether the state DOT obtains and/or requires collection of vehicle speeds. In response, twenty-one states said "no" and eleven states said "yes" to this question. Those states that responded "yes" were asked a follow-up question.

If the state responded "yes" to the previous question, they were asked a sub-question with regards to what types of tools are typically used for collection of speed data. A total of 10 states responded to this question and chose multiple responses. Six states said they use a Doppler-radar gun, two states said they use a stopwatch, three states responded that a "floating car" (vehicle drives in traffic to estimate speeds) is used. Two states said that speeds were estimated or observed. One state uses a formula calculation and one state responded that speed data is only collected if/when comparing to/ validating TNM.



Does your state DOT obtain and/or require collection of vehicle speeds?



What tools are typically used for collection of speed data?

State DOT interview results:

(CA) Traffic counts for model calibration are performed on all projects using either manual or handheld counters. Additionally, videotape might be used when there is a lot of traffic and not enough staff available, so that the video may be reviewed later in the office. To obtain speed data, Caltrans uses Doppler radar but warns that a disadvantage to using radar for speed data collection is the cosine error, which is the angle formed between the radar gun and the target. It works to the advantage of the driver because the speed read by the radar gun is lower than the actual travel speed (i.e., speeds are not always accurate).

(NJ) Traffic counts are normally taken for model calibration, except in the case of Categorical Exclusions. For major projects involving noise barriers, all attempts are made to coordinate noise monitoring with traffic work. If model calibration is not the purpose for traffic counts, the counts are used for building attenuation modeling in order to verify or explain noise levels. Traffic counts are conducted using handheld counters (50-60% of the time) and/or video (if available) and by coordinating with traffic experts. Coordinating with the traffic analysts is also found to save time and money. Speed data is obtained by using a chase car or radar gun. Alternatively, posted speed, design speed, and/or LOS C, are used to obtain speed data from the traffic data provided.

(NY) NYSDOT requires traffic counting in conjunction with noise measurements when real classification volumes (medium and heavy truck volumes) are needed. Factoring down average daily traffic to a design hourly volume and then further to a directional volume is not adequate. It is important to be sure that the available design volumes (truck volumes) are good. If adequate volumes are not available, they should be taken in the field. Approximately 1/3 of the time, volumes must be obtained in the field. Traffic counts are not conducted if the data is adequate and the calculations match the measurements. When traffic counts are conducted, they are usually done by traffic analysts within the DOT or by consultants on larger projects using pneumatic counters or other equipment. If noise analysts do traffic counts, it is generally done by hand.

NYSDOT uses Doppler and floating car for speed data collection. Floating car is preferred and while radar gun is also used, the accuracy of such measurements can be affected by radar detectors.

(WA) Model validation is performed on most projects, in which case traffic counts and speed data are obtained during the noise measurements. Manual or handheld counters are used to obtain volumes while radar guns are used to obtain speed. In some situations where there are multiple roadways and not enough staff to go out and do counts, a video recorder can be used and counts can be conducted later in the office. Projects for which model calibration is not performed, such as one where the likelihood of mitigation and/or impacts are low, FHWA TNM Version 2.5 Look-Up Tables will be used to initially screen for impacts. In that case, existing traffic volumes and posted speeds may be used rather than counting traffic and obtaining speeds during the noise measurements.

Consultant survey results:

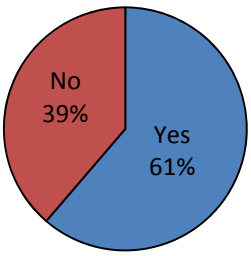
(NY) According to NYSDOT's consultant, more than 90% of the time, manual traffic counts are conducted during short term measurements to be used primarily for modeling validation. For some projects, the counts supplement classification data provided by NYSDOT or traffic engineers.

Speed data is typically measured or estimated along with classification counts. On projects with freely-flowing traffic and relatively consistent speeds, the consultant sometimes estimates speeds by driving the corridor ("floating car" method). On other projects, they time a sample of vehicles between identifiable landmarks or use a radar gun. When speeds vary considerably throughout the measurement program, estimates based on the floating car method may not be practical. Use of a radar gun can affect driver behavior. Timing vehicles can present practical difficulties.

3. Topic: meteorological data

Online survey results:

The survey asked whether the state DOTs obtain and/or require that meteorological data such as temperature and wind speed be obtained during noise measurements. Nineteen states answered "yes" and twelve said "no" to this question.



Does your state DOT obtain and/or require that meteorological data such as temperature and wind speed be obtained during noise measurements?

State DOT interview results:

(CA) Caltrans also obtains meteorological data during noise measurements to comply with regulations. Specifically, the FHWA regulations give a maximum wind speed that cannot be exceeded when taking noise measurements. Caltrans has a Technical Noise Advisory which is a document that explains how to correct for upwind and downwind effects on noise using vector math. However, it is preferable to measure during neutral meteorological conditions, if possible.

(NJ) Meteorological data is collected during 24 hour counts in order to determine if wind or rain occurred during the 24 hour period and skewed data. Wind direction is important and is collected by handheld equipment. Weather predictions could also be used if the analyst is comfortable with the source of the information, such as from the National Weather Service.

(NY) Meteorological data is noted, but it is not collected for its own sake. The collection of meteorological data is done for the purpose of the assurance that conditions were adequate for a noise measurement. Data is also collected to specifically show that wind speed was not affecting the measurement.

(WA) A handheld station is used to record wind speed/direction, humidity, and temperature during noise measurements. However, WSDOT does not believe that TNM accounts well for meteorological input. The collection of meteorological data is done to satisfy due diligence and is found not to have much of an effect on the outcome of the modeling results when incorporated into TNM.

Consultant survey results:

(NY) To the extent that weather conditions can affect sound propagation, meteorological data may be useful in interpreting noise measurement results. In addition, one needs to ensure that windspeed is within allowable limits. In some instances, the meteorological data collected can be useful during modeling validation. Also, it is necessary for thorough comparison of before/after barrier measurements.

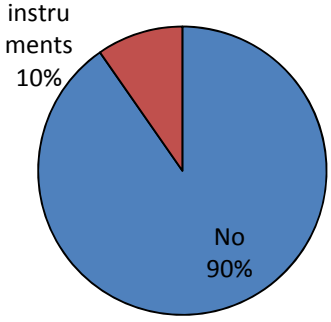
4. Topic: other equipment

Online survey results:

The state DOTs were asked if they require that any other instruments be used in conjunction with the noise meter for collecting noise measurements (e.g., a data recorder that is linked to the sound level meter which will record and identify specific noise sources to explain peaks).

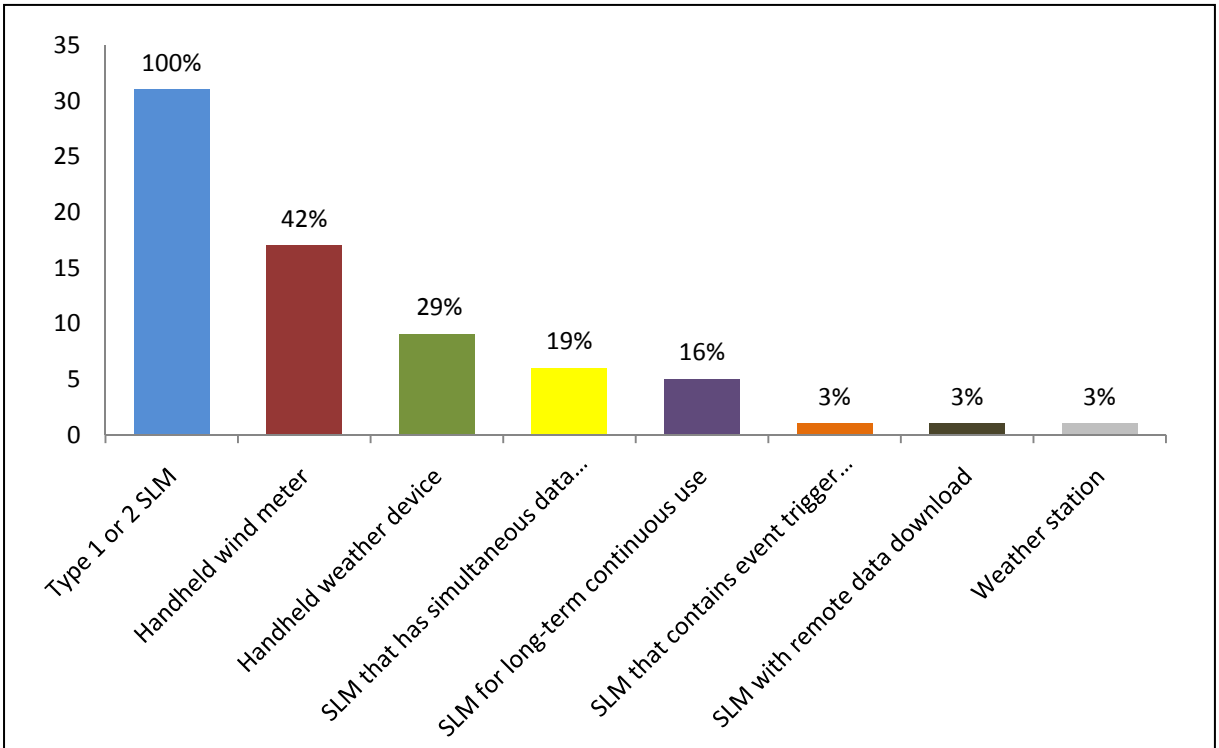
Twenty-eight states responded that no other instruments are required, while three states responded "yes," with the following elaboration:

- One state said that the Quest Noise meter has software for data logging.
- One state said that "unmonitored 24 hour meters many times have recordings to verify traffic or other source".
- One state said that their recorder automatically does several diagnostics on the readings.



Does your state DOT require that any other instruments be used in conjunction with the noise meter for collecting noise measurements?

The survey asked which types of equipment are used or are required to be used by their state DOT for noise measurements, traffic and/or meteorological data collection. The choices were as follows: Type 1 or Type 2 Sound Level Meter (SLM); handheld wind meter; handheld weather device; SLM that has simultaneous data collection for Broadband, Spectrum and Octave levels; SLM for long-term continuous use; SLM that contains event trigger recording software; and SLM with remote data download and weather station. All responding states identified the use of a Type 1or Type 2 SLM. Most of these states then also made other selections including the following:



Which of the following equipment is used or required to be used by your state DOT for noise measurements, traffic and/or meteorological data collection?

- Five states specified that the SLM was used for long-term continuous use.
- One state mentioned that SLM contained event trigger recording software.
- One state uses a SLM with remote data download.
- Six states selected the option that SLM has simultaneous data collection for Broadband, Spectrum and Octave levels.
- Thirteen states also selected handheld wind meter.
- Nine states selected handheld weather device.
- One state said weather station is used.
- Four states specified the use of an anemometer.

State DOT interview results:

(CA) Regarding the equipment used by Caltrans, oftentimes unmonitored 24-hour meters have recordings to verify traffic or other sources of noise depending on the situation and consultant, and if it is expected that the monitoring site would be near an ambient source. Analysts look at a long-term noise recording and see if there are patterns or spikes that can be disregarded that do not fit in with long-term measurements. This applies to situations such as nighttime noise measurements where microphone tampering may occur. The SLMs used by Caltrans do not have cameras but do have triggers and data recorders.

Caltrans notes that it is important to be mindful of filters used and check it against something known when dealing with complex equipment. However, with sound pressure measurements this is less of an issue.

(NJ) NJDOT does not require that any other equipment be used in conjunction with the noise monitoring equipment. NJDOT noted that most of the noise monitoring for NJDOT is performed by outside consultants and with regards to the equipment used, Octave band analyzers are utilized, but usually Type 1 or Type 2 SLMs are used. Octave band analyzers are used for measuring construction noise from equipment when detecting low pitch squeals or low rumbles, as well as for night monitoring. Additionally, Type 1 and Type 2 SLMs have data logging features.

(NY) NYSDOT also indicated that they do not require any other instruments to be used in conjunction with the noise meter for collecting noise measurements. NYSDOT uses standard meters.

NYSDOT recommends the use of Metrosonics as good field pieces. B&K is also good but generally a little more scientific and subsequently problematic when in the field, and repair and calibration costs can be expensive. States should get a good basic survey type meter rather than a more scientific type because in NYSDOT's experience, they will withstand over time and repeated use. Larson Davis meters are good for unattended noise monitoring.

(WA) WSDOT does not require any other instruments to be used in conjunction with the noise meter for collecting noise measurements. They record noise at 1/3 octave band and note that all SLMs record data at certain intervals that are set by the specialists.

WSDOT highly recommends the use of 1/3 octave band measurements as a fairly simple way of collecting a bit more data. WSDOT experiences situations where it is necessary to drive 2-3 hours to get a measurement and it is not possible to download data until arriving back at the office. If there was something that affected the measurement, using 1/3 octave band measurements gives a better idea of what could have caused the issue, and it is easy to do.

Consultant survey results:

(NY) In addition to a sound level meter, typical field gear for the NYSDOT consultant includes: acoustical calibrator for all measurements; manual traffic counters; stop watches or radar gun for speed measurements; handheld weather monitor; tape measure; and camera for site documentation. The following equipment is also used on NYSDOT projects:

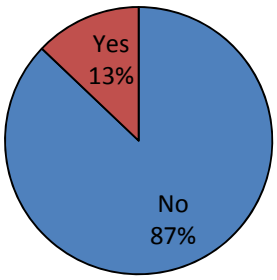
- Type 1 or 2 Sound Level Meter (SLM)
- SLM that has simultaneous data collection for Broadband, Spectrum and Octave levels
- SLM that contains event trigger recording software
- SLM for long-term continuous use

- Handheld weather device
- Handheld wind meter
- Anemometer

The consultant typically uses sound level meters that collect data by intervals for both short-term and long-term measurements. They often collect event-triggered data during long-term measurements.

5. Topic: Cutting Edge Technologies and/or Procedures and Recommendations/Advice

Online survey results:



Do you consider your state DOT to be at the forefront of cutting edge technology and/or procedure used to collect noise and associated data?

The survey asked state DOTs whether they consider themselves to be at the forefront of cutting edge technology and/or procedure used to collect noise and associated data. Twenty-seven states said "no" while four said "yes" to this question.

All four states indicating "yes," were willing to participate in a follow-up survey to discuss their *Noise Analysis* fieldwork technologies in more depth.

State DOT interview results:

(CA) Caltrans credits several current developments in technology which put them at the forefront of cutting edge technology regarding the collection, identification or recording of noise data. These technologies include:

- *Underwater bubble curtain*, for which Caltrans holds a U.S. patent. The curtain is used to mitigate underwater noise generated by pile driving. It greatly reduces impacts to endangered fish migration when doing bridge reconstruction.

- *On-Board Sound Intensity (OBSI)* used to measure, compare and track tire pavement noise. OBSI is a microphone probe attached to a standard tire and hanging 2 inches above ground surface. The test car drives at freeway speed and the OBSI collects the tire pavement noise level. Tire/pavement noise accounts for approximately 90% of traffic noise for light vehicles operating at freeway speeds and changing pavement textures can reduce noise levels by 7 to 8 dBA. A draft AASHTO specification is being written standardizing the California method. OBSI saves money because using the ISO Statistical Passby Method (having a person in the field) to determine acoustical differences between pavements takes much more time and money. OBSI takes less than 1/10 the time to collect data as wayside data collection. Caltrans participates in Tire Pavement Noise/Research Consortium (TPF) 135, along with the transportation departments in Arizona, Colorado, Florida, Kansas, Ohio and Washington.

- *Beamforming technology*, which should greatly improve noise modeling by pinpointing subsource noise generators on vehicles. This field technology creates a picture of the sound waves on trucks operating in a highway environment at 55+ mph.

Transportation departments may be able to lower high-speed traffic noise levels by changing the pavement. In some cases, changing pavements can significantly lower community noise levels. Flexible and rigid pavement surface texture impacts noise levels and low noise pavements and quieter pavement strategies should be used around sensitive receivers. Caltrans suggests that states inventory their pavement acoustics using the OBSI methodology to identify the loudest pavements and avoid placing these louder pavements next to sensitive receivers. To help other states move to the forefront of cutting edge technology in noise fieldwork, Caltrans suggests that they should join TPF 135 for assistance to implement the OBSI technology.

The beamforming technology used by Caltrans to take a 'picture' of the noise sources on a freeway-speed-heavy truck, clearly showed that most of the acoustic energy of the California trucks was near ground level and truck exhaust noise from a higher 12 ft position accounted for only 1-2% of the sound energy. A follow-up study, NCHRP 8-56 Truck Noise Source Mapping, also determined that the acoustic centroids are lower than the assumptions in the FHWA Traffic Noise Model. Both the Caltrans and NCHRP 8-56 studies found the beamforming technology to be viable and Caltrans strongly recommends that beamforming measurements be used to update (and lower) the aged REMEL data and assumptions currently used in the FHWA TNM software algorithms.

(NJ) NJDOT considers itself to be reactionary rather than proactive in terms of construction noise. In this regard, one type of cutting edge technology being used by NJDOT and its consultants is the use of a hydrophone for the monitoring of underwater noise during construction on the 36th Street Bridge. This type of monitoring is done to protect dolphins in the area. Monitoring of noise affecting other types of wildlife has also been conducted.

(NY) NYSDOT feels it is at the forefront of cutting edge technology when it comes to modeling and research, but not necessarily in terms of technology and equipment.

(WA) WSDOT is working on evaluating sections of quieter pavement called Open Graded Friction Courses (OGFC) that have been installed on several roads in the state using the On Board Sound Intensity (OBSI) method. By the end of the summer of 2009, WSDOT expects three test sections to be evaluated for noise through the entire pavement life. The Quieter Pavement Noise Program will look at the sound intensity of the quieter pavement OGFC versus traditional asphalt and evaluate the effects of the pavement treatment on sound levels within adjacent communities.

WSDOT feels that programs such as the Quieter Pavement Noise Program put them at the forefront of cutting edge technology in environmental fieldwork technologies. Other programs include a public-private partnership that looks at expansion joint noise. The noise compatible land use planning program is also an emerging component of WSDOTs program, since

Washington is a "home rule" state and planning only takes place at the local and community levels. WSDOT is working to educate planners on noise compatible planning in this regard because they feel that noise compatible planning will save time and money in the future, by discouraging noise sensitive development near the highways.

A new state of the art technology being used by WSDOT is called Interactive Sound Information System (ISIS) which is used at public hearings and has a number of features, such that various sounds can be adjusted to different levels and mimic sound levels that the public may be experiencing in their neighborhoods. Additionally, ISIS can be used to demonstrate what it would sound like with noise barriers. ISIS was featured at the Transportation Research Board annual meeting in 2008.

As active participants and collaborators in national academic and research committees, WSDOT strongly recommends states becoming part of the national noise community and participating in TRB committees such as ADC40. Participation such as this is especially effective for sharing ideas nationwide and learning other people's experiences throughout the country.

Consultant survey results:

(NY) According to NYSDOT's consultant, the sophistication and degree of knowledge of NYSDOT's central office noise staff in understanding noise issues has brought the department to the forefront of cutting edge technology. Permitting flexibility in approach when warranted is also a helpful quality. NYSDOT's consultant feels that for other states to be classified as cutting edge, they should have these characteristics as well. Specifically, other states should hire or cultivate a noise program manager and staff with sufficient skills and interest.

NYSDOT's consultant feels that its role/responsibility to the DOT in placing them at the forefront of cutting edge technology and/or procedure is in adhering to state procedures, but also advising the DOT of potential changes/improvements in technology or approach.

VII. Summary and Conclusions

1. Cultural Resources

According to the results of the online survey, the use of GPS is more common in the recordation of archaeological resources than in the recordation of historic architectural resources. Only 26% of the surveyed state DOTs requires the use of GPS for recording the location of historic architectural resources. According to some responses from the state DOTs on the topic of using GPS for architectural resources, street addresses are still generally used for architectural resources as well as aerial photos and other existing information. In the individual DOT interviews, this was also a reoccurring theme; if street addresses and/or adequate aerial photos are available, then they are utilized, rather than using GPS for architectural resources. It was also noted that the study of architectural resources does not necessarily require the kind of accuracy that results from the use of GPS. It was also mentioned several times that staff is not trained in the use of GPS and that the training, for this purpose, may not be cost effective. However, if consultants use GPS for this purpose, then it is accepted, and its use is growing. None of the consultants that were surveyed were involved with architectural surveys for their respective state DOT.

In the online survey, a greater number of states (43% - 44% of the state DOTs surveyed) indicated the increasing use of GPS in recording the locations and descriptions of archaeological tests, deposits, features and/or landscape elements. It appears that the states are beginning to use GPS more frequently in this regard and are also encouraging consultants to do the same. Oregon DOT (ODOT) was the only state interviewed that requires GPS to be used in its contracts with consultants, who do 85% of the work in Oregon. Georgia DOT (GDOT) uses a very cutting edge technology that incorporates the features of a total station with 3D imagery. States appear to still be using total station, when staff is not trained to use GPS. GPS may be used in situations where there is high potential for National Register sites, or in situations where there may be multiple occupations in an urban setting. The portability of handheld GPS units makes them convenient to use in field surveys and when large tracts of land are involved.

The geography of an area may determine whether it is appropriate to use GPS. Boundaries may be recorded using GPS and then total station may be used to record details of the site such as features, deposits and/or landscape elements. When using GPS, sub-meter accuracy is preferred, although surveys (total station) are still sometimes considered most accurate. Cheaper GPS models are considered to lack precision. Some GPS models were found to have difficulty in heavily forested areas of the Northwest, and may therefore only be used to record the location of sites, but not boundaries. Research grade units, as required by ODOT were also found not to perform accurately under heavy tree cover, and in those cases, recreational grade units may be used.

Consultants appear to use GPS between 90-100% of the time. In many cases, the use of GPS is combined with the use of a total station to achieve the highest level of accuracy, depending on

what the situation calls for. Consultants feel that while it is not flawless, the use of GPS presents a time and cost savings. The Oregon SHPO requires UTM site coordinates and initial site field maps are made using GPS. Predictive modeling is used by three of the four consultants surveyed. One of these consultants noted that it provides a level of informed guidance when normal review is not possible. The consultant that does not use predictive modeling found that it was not a good predictor of where buried resources are found.

The states participating in the online survey indicated that 47% of them routinely collect artifacts for analysis while only 7% routinely do not; the remaining states may or may not collect artifacts, depending on type or size of artifact, anticipated degree of impact to the artifact, location of the artifact in relation to the ground surface, the phase of investigation, or other factors. In the case of the state DOTs participating in the follow-up interviews, their responses closely paralleled the findings of the online survey on the issue of collecting artifacts. Whether or not a state DOT routinely practices artifact collection, decisions regarding collection are often made on a case-by-case basis. Potential reasons for leaving artifacts in place include existing agreements with tribes or land management agencies, or the fact that the artifacts may be redundant and it is unnecessary to collect them all. In these situations, the redundant artifacts are most likely sampled and recorded, but left in place or discarded in order to preserve curation space. Almost all of the states interviewed expressed issues associated with the cost and space required for curation of artifacts. While practices varied from state to state, it appears that most states do not collect all artifacts when there is redundancy; instead a sample may be taken and catalogued. An especially rare find may dictate more specific procedures.

A majority of the states participating in the online survey do use geomorphology/ geoarchaeology, at least on an occasional basis, but it was noted that the use of it is highly dependent on the project type and setting and it is not required. Only 17% of the state DOTs surveyed indicated that they require the use of geomorphology/geoarchaeology prior to making decisions about conducting archaeological surveys, while 59% indicated that they use this method on a case-by-case basis. States participating in the follow-up interviews noted that its use depends on the vertical APE. Some states noted specifically that it is used in geological areas with fluvial (river) deposits and/or floodplains. One state noted that its use in an urban environment would not be worthwhile because the site was likely already disturbed, while another state noted that it might be used in urban settings. The use of geomorphology/geoarchaeology seems to be strong in the Pacific Northwest. Almost all of the states noted that it gave them an advantage and that it is a useful tool. It may also be more cost effective than excavating trenches. The surveyed consultants indicated heavy usage of geomorphology/geoarchaeology (90-100% of the time) on DOT projects, especially major projects, noting that it is extremely helpful in predicting buried sites and in providing information on site formation.

Almost 60% of the states participating in the online survey indicated that their state does have a cultural resources database integrated with a GIS program that is available to the state DOT and its consultants from a centralized source. Of these states that have the database, a large majority (56%) indicated that the SHPO maintains the database; however, this may be in conjunction with

another entity. According to the state DOTs interviewed, the databases seem to be at various levels of development. They range from fully established databases that have both archaeological and architectural information available, with limited access to the public, to databases still in the development stages. In tandem, the states appear to be moving towards electronically archiving and storing reports as PDFs as well, making them more widely available to upload. The consultants surveyed indicated that for those states lacking a centralized database, the availability of one would be helpful but they were generally unaware of intentions by the state DOTs without their own databases to develop them. The consultants appear to have their own methods of gathering data and noted that this may sometimes result in discrepancies because the information is not necessarily centralized; in addition, the state DOT's own files may not necessarily match those of the SHPO or other agencies.

Only 14% of the states participating in the online survey do not use digital photography in the study of architectural resources. The states interviewed reported that for the most part, 35 mm film has been phased out, the only exception being for HABS/HAER work. It was noted that digital photography sometimes cannot capture the amount of detail necessary for significant resources in HABS/HAER work, and Large Format film is still required. The drawbacks of Large Format film is in the development of the film, whereas the drawback of digital photography can be in having adequate server space for storage and having the resources to properly log each photo. The consultants surveyed used digital photography exclusively.

Among the states using non-invasive techniques prior to excavation, surface reconnaissance and ground penetrating radar were the most popular techniques. Other non-invasive techniques mentioned were magnetometry, soil resistivity, gradiometry (and/or metal detection), historic/map research and/or GIS. The states participating in the follow-up interview reported using non-invasive techniques on a case-by-case basis; however, almost all states indicated that such techniques are always used in situations which may involve cemeteries, unmarked graves or Native American burial sites. Missouri and Georgia DOTs own their own non-invasive equipment and have found them to be well worth the investment. Missouri DOT (MoDOT) uses its GPR in urban settings as well as rural environments and it is utilized by other departments as well. One state that does not own its own equipment noted that the accuracy of these techniques depends upon the qualifications of the individual operating the equipment and for this reason, they require resumes to be provided if the consultant proposes its use.

The surveyed consultants' use of non-invasive techniques were varied depending on what is available to them and what the situation calls for, but seemed to be less frequent than the DOT's use. One consultant noted that they typically use these techniques on bigger projects, and that it was found not to be very helpful in complex site environments, such as in urban settings.

Only 19% of states participating in the online survey indicated that they do not have programmatic agreements in place with the SHPO to streamline the cultural resources process for DOT projects. The majority of the states interviewed have programmatic agreements in place with regards to the review involved in minor projects. Most states also have bridge agreements. Two of the states had agreements for tribal consultation. Washington State DOT

(WSDOT) has an agreement for design-build projects to deal with design modifications and frequent changes in footprint whereby areas are pre-designated to contractors as restricted or unrestricted. The surveyed consultants generally indicated their beliefs that any programmatic agreements, whether or not they already exist in the states where they work, would have little if any effect on the amount of work that they perform.

Seventy-three percent of the states participating in the online survey indicated that there are certain types of projects that are exempt from full archaeological investigation in their state. The types of projects that were most commonly exempted were those that were within the shoulder, median or existing right of way. Several states indicated that previously agreed-upon types of projects were exempt as indicated in a programmatic agreement or MOU in place with the SHPO, especially if there had been previous ground disturbance in the area, or if there was no potential for cultural resources. Some states automatically exempted Categorical Exclusions. Most of the states participating in the follow-up interviews have programmatic agreements in place with regards to projects that are exempt and such situations reflect those indicated in the online survey. Projects involving no change in footprint and projects that are located within the known vertical and horizontal limits of previous disturbance were generally exempted. One state suggested that it might be helpful to exempt hazardous waste locations and another state suggested that DOT material disposal sites (usually gravel pits or abandoned quarries) should be exempted because the landscape has already been disturbed. Delaware DOT (DelDOT) reported that they rarely exempt any projects. The consultants interviewed had very little involvement with the process of exempting projects, as this is something decided by the DOTs.

Approximately 39% of the state DOTs responding to the online survey indicated that they felt that they were at the forefront of cutting edge technology and/or procedure used to collect, identify and record cultural resources data. In the follow-up interviews, Caltrans felt that its use of thematic studies brings them to the forefront, as does their ongoing conversion of the TEA databases to a centralized database. GDOT feels that the non-invasive study equipment it owns, especially the newer 3D imaging equipment has brought it to the forefront of cutting edge technology. Indiana DOT (INDOT) points to its bridge program and its recently drafted management plan related to linear resources, brick roads and canals as examples of procedures that have brought them to the forefront. DelDOT looks to the completion of its online report database as something that will bring them to the forefront. Illinois DOT (IDOT) feels that its implementation of the SharePoint site for coordination with the tribes is something that has brought them to the forefront. MoDOT believes that having an in-house GPR puts them at the forefront. WSDOT feels that it is at the forefront of cutting edge technology because of its use of Rotosonic Coring, Geoprobes and GPR. ODOT feels that its presence at the forefront is owed to its success in working with the tribes.

2. Ecology

According to the results of the online survey, approximately three-fourths of the state DOTs are using GPS for both recording the location and actual data collection of ecologically sensitive sites, vegetation, threatened & endangered species. The state DOTs participating in the follow-

up interviews indicated that they are using both backpack and handheld units, the accuracy of which is determined by tree cover and topography for both of these types. In general, these state DOTs noted that there is a cost savings with using GPS, at least under certain situations. Caltrans noted that while GPS is used in collecting data for indirect impacts, for direct impacts they still prefer surveyors to obtain the most detailed data. Caltrans' consultant indicated that GPS is used for data collection about 10% of the time, but is routinely used to record the location of highway stream crossings during fish passage evaluation surveys. Ohio DOT's (ODOT) consultant has had 20 years of experience using GPS and uses it for data collection and recordation on over 50% of ODOT's projects. They find it to be a huge time and cost savings especially because it eliminates the need, in some cases, to work with a survey crew. Total station is still used by the consultant as well, when checking elevations in a wetland mitigation site.

For each state having a centralized source of GIS data available to the state DOTs and their consultants for performing ecological assessment, by far, the most popular type of data available relates to threatened & endangered species; land use and wetlands. A few states indicated that other types of data were available as well, including soils and floodplains. Maryland State Highway Administration (Maryland SHA) has a GIS database for reporting and sharing purposes called iMap. Wetland delineation/mitigation sites and critical area boundaries/mitigation sites will be included as Maryland SHA is getting ready to pilot this effort. The 100-year floodplains and forest cover information is currently available. Maryland SHA plans to add a new component known as LARS (Large Animal Recovery System) which will help identify areas of road kills so that consideration can be given to placement of fencing and wildlife passage corridors. Some of the GIS data available for California is uniform, such as that for wetlands and hydrology, but soil data varies regionally. Caltrans is working with the Department of Fish and Game to utilize data on fish passage and endangered species locations. Caltrans acknowledges that a centralized database would allow for an easy transfer of information back and forth between systems; however, they note that sometimes people can overestimate the accuracy or value of data such as in the case of wetland delineation, where the boundary is hardly ever a straight line, as depicted in GIS. Ohio has a GIS clearinghouse that includes National Wetland Inventory, Ohio wetland inventory, T&E species habitat, Natural Resources Conservation Service (NRCS), soils land use, roads, topography and floodplains. These GIS files, however, are not available to their consultant. The consultant must access Ohio Department of Natural Resources (DNR) files and the Ohio Geographically Reference Information Program (OGRIP).

Caltrans' consultant accesses a multitude of GIS data through a variety of publicly accessible sources including California Department of Fish and Game and California Environmental Resources Evaluation System (CERES). ODOT's consultant also accesses many different types of GIS data from various sources, and stores it on their server for future use. Although it is not in a centralized source, the consultant still feels that it is easy to locate.

Two thirds of the states responding to the online survey reported that they do actively use wetland banking in order to expedite the mitigation process and/or reduce the level of fieldwork

required for mitigation. Maryland SHA is working on developing its own banking system, since none currently exists in the state. Caltrans reported that they usually use wetland mitigation banks on smaller projects but they noted that while banking may reduce paperwork required for mitigation, it does not reduce the amount of paperwork that is involved in analyzing whether the site is a good match. ODOT has their own "pooled mitigation areas" that are associated with a project that has a 404/401 permit. ODOT can build them bigger than they need to be to generate extra credits, but they can only be used for ODOT projects and credits cannot be sold. They have found this to be a cost-effective option especially when a project involves only a small amount of mitigation. Since ODOT has its own mitigation areas, their consultant does not generally deal with mitigation issues for ODOT; however, in the consultant's dealings with private project and mitigation, they have found the regulatory agencies to be somewhat reluctant to approve the use of banks.

The majority of the states (62%) that responded to the online survey question of whether or not remote sensing tools were used in order to facilitate and/or streamline required field studies, said that they are not used. Five states responded that Light Detection and Ranging (LiDAR) is used and four states indicated the use of ground penetrating radar. Four states chose the "other" category, with one state identifying the use of electrical resistivity ERI and IR satellite images and one state indicating that existing GIS databases are used. The remaining two states choosing the "other" category were unsure if these technologies are used. When asked about whether the state DOT uses any new or state-of-the-art monitoring techniques for hydrologic monitoring of stream and wetland mitigation sites, the majority of the states chose electronic data logging (59%) and biological monitoring (45%).

During interviews and surveys, Maryland SHA indicated that while it has access to LiDAR and ground penetrating radar, they are not used in ecological studies because of the exorbitant cost, especially on smaller projects. However, Maryland SHA uses soil reduction probes, electronic data loggers and biological monitoring in hydrologic monitoring. Caltrans also reported limited use of such technologies, but does use multi-spectral imaging in cooperation with Fish & Game to determine vegetation cover types. Caltrans does not use state-of-the-art monitoring techniques to conduct hydrologic monitoring of streams or wetland mitigation sites, nor does its consultant. ODOT does not use remote sensing tools in the field and its consultant explains that U.S. Army Corps of Engineers wetland delineation procedures do not allow one to substitute remote sensing for field delineation techniques. However they do utilize several state-of-the-art monitoring techniques for conducting hydrologic monitoring of streams or wetland mitigation sites, including the use of electronic data forms for habitat/wetland delineation. ODOT's consultant has used a continuous data logger to monitor water levels at a marsh wetland mitigation site and feels that their use of such equipment is advantageous because of the amount of data that can be collected with minimal effort.

In the online survey, the state DOTs were asked whether digital photography was being used to aid in fieldwork. Because of the overwhelming majority of "yes" responses from 29 states, and only one "no" response, it was decided that this question did not require any follow up in the individual DOT interviews or with the consultants.

Twenty-five out of thirty states (83%) responding to the online survey indicated that they do have programmatic agreements in place with federal or state regulatory/review agencies to streamline the ecological processes for DOT projects. In interviews, Maryland SHA explained that they have a NEPA/404 Streamlined Process and a Programmatic General Permit in place that authorizes the state to make permitting decisions for the Corps. Maryland SHA is also working on a programmatic agreement for streamlining stimulus projects that are expected to have relatively low environmental impacts. Caltrans has what they call agreements on methodologies and data sharing with California Fish & Game with regards to fish passage and the U.S. Forest Service with regards to wetlands monitoring. ODOT has an ecological Memorandum of Agreement (MOA) between the US Fish and Wildlife Service (USFWS) and Ohio DNR for smaller projects regarding nationwide 404 permits. There is also an agreement for bundling bridge and culvert replacements with the Ohio Environmental Protection Agency. ODOT also has a coastal consistency MOA for Lake Erie and a streamlined biological assessment and biological opinion process under the Endangered Species Act with the USFWS for the Indiana Bat. ODOT's consultant felt that while the MOAs do not streamline the data collection process, they do streamline the agency coordination process.

Only seven of the 29 state DOTs participating in the online survey (24%), consider themselves to be at the forefront of cutting edge technology in the field of *Ecology*. Maryland SHA feels that technologies such as the use of engineer log jams help to bring them to the forefront of cutting edge technology, along with SHA's "going green" committee and Maryland's Green Infrastructure Assessment GIS data tool developed by the Maryland Department of Natural Resources. Caltrans is headed toward the integration of both measured information (GPS data) and predicted information (modeling) and feels that this move will put them at the forefront of cutting edge technology. ODOT feels that its use of such technologies as personal digital assistants and electronic data forms, along with well trained and qualified staff, have put them at the forefront. Caltrans' consultant points to Caltrans' advanced environmental review and compliance approach as cutting edge. ODOTs consultant felt that ODOT's use of GPS and GIS are the primary technology that have helped move them to the forefront.

3. Water Permitting

The online survey asked whether state DOTs use and/or require the use of GPS to collect and record locational and attribute information for stormwater features such as drainage outlets. Fourteen of the states (56%) said "yes" and eleven of the states (44%) said "no". Based on the follow-up interviews with some states, New York State DOT (NYSDOT) uses handheld GPS units in its recordation of locations of stormwater outfalls. They have implemented an outfall mapping GIS database which has been useful for downloading coordinates and other attributes. Washington State DOT (WSDOT) has been collecting stormwater features over the last 3 years for their Roadside Feature Inventory Program, including detention ponds, pipes, culverts, catch basins and various drainage inlets. All of these efforts are then implemented as GIS data sets. WSDOT primarily uses handheld resource grade GPS technology for this effort. WSDOT's consultant also uses GPS to obtain mapping coordinates for monitoring stations associated with

the NPDES monitoring program and prefers to use handheld models as well; however, they also use mile markers to locate monitoring stations through WSDOT's state route web program.

A large majority of the states answering the online survey indicated that they do not use field permeability or lab permeability testing to evaluate soil permeability rates, nor do they use automated groundwater level logging. During the follow-up interviews, NYSDOT indicated that these technologies are not used and that there is no regulatory requirement mandating that a standard procedure be used. WSDOT uses slug tests and an equation based on grain size and percent fines. WSDOT also performs rigid wall permeameter testing in their laboratory. Usually stormwater treatment facility groundwater monitoring is done manually via a site visit with a water level indicator, but in the past few years, WSDOT has been receiving more requests to install datalogging equipment at these sites. WSDOT's consultant uses field permeability testing as well as automated level logging instrumentation.

On the topic of streambed sediment analysis, the survey asked states whether they collect streambed sediment data at stream crossings for use during planning, design or monitoring. Eighty percent of the states said that they do not. Additionally, the states were asked if they employ specific sediment transport models such as HEC-RAS, which dictate specific field data collection needs. The states that responded were split almost evenly between the use of HEC-RAS, or no modeling at all. WSDOT indicated that it does collect streambed sediment data at stream crossings and the consultant confirmed this, stating that this work has typically been performed in the context of bank stabilization projects. NYSDOT does not collect this data for permitting purposes, but a qualitative description based on observation of the streambed is routinely incorporated into permit applications. Estimates of particle size and distribution are used when necessary and has been found to be sufficient.

With regards to stormwater quality monitoring, the online survey asked states whether or not they require effluent stormwater quality monitoring from construction sites or operation facilities to evaluate the efficiency of BMPs. Only twenty percent of the states said that they do. Those states that responded "yes" were then questioned about their standard methods and what the effluent is sampled for. Three states indicated that a state specified method is used, while two use the EPA method. All four responding states indicated that effluent is sampled for suspended solids, two indicated nutrients and one each for metals, petroleum hydrocarbons, pH and turbidity.

As part of this section of the online survey, all of the state DOTs were asked if they implement regular preventative maintenance of stormwater management/treatment devices (stormwater inlets, detention or bioretention basins, conveyance systems, hydrodynamic/vortex separators, etc.) to optimize performance. Slightly more (60%) of the states said that they do.

In the follow-up interviews, WSDOT indicated that several permits (NPDES, ESA, 401) require stormwater quality monitoring. WSDOT also monitors stormwater as part of its Best Management Practices (BMP) research and development efforts. They use both automatic samplers as well as grab samples. WSDOT's consultant confirmed these statements and noted

that storm event criteria are specified in the NPDES permit. NYSDOT does not require stormwater quality monitoring, but some has been done involving automatic sampling, grab sampling and composite sampling. They have considered doing post-construction monitoring for controversial projects in the New York City watershed, but lack of funding has been an issue.

The states were asked whether Low Impact Development (LID) technologies are used in their state for new highway projects. Almost 75% said that they were not. For the states that responded "yes", the question was asked whether LID techniques are used to retrofit existing treatment systems in older roadways, and the majority said "yes". All of the states were then asked whether they use bioretention basins and they were split almost evenly on this issue. In the follow-up interviews, WSDOT indicated the approved use of many LID techniques and indicated that criteria are being developed by Washington State Department of Ecology in determining the feasibility of using these techniques. WSDOT has used the Media Filter Drain and the Compost Amended Vegetative Filter Strip and has performance data available on their website. The consultant concurs with the use of these techniques for WSDOT and has also conducted monitoring on compost amended bioswales and vegetated filter strips. WSDOT's consultant notes that the use of LIDs is more driven by WSDOT policy than by regulation. NYSDOT uses bioretention; however, design issues have limited its use.

In the online survey, the states were asked whether they use more stringent BMPs with regards to discharges into impaired or TMDL watersheds in order to achieve permit compliance. About half of the states said that they do. Eight states said "no" and four states indicated that the question is "not applicable" to them. WSDOT refers to meeting TMDL BMPs as "retrofitting" and implements conventional BMPs on existing and new impervious areas, and on their own initiative, is removing curbs on paved roads to allow "sheet flow," which avoids concentrating pollutants discharged into receiving waters. WSDOT's consultant mentioned that a TMDL monitoring Quality Assurance Project Plan must be developed and implemented by WSDOT for specific TMDL listed watersheds as identified in WSDOT's NPDES permit. NYSDOT achieves permit compliance for TMDL watersheds by increasing the water quality volume to the one-year, 24-hour storm event. Thresholds of disturbances for coverage under a stormwater permit are reduced.

The online survey asked states whether they had implemented any specific policy initiatives and/or employee education efforts to foster good environmental stewardship and minimize stormwater pollution. Eighty percent of the states said that they had. WSDOT is in the process of developing a Stormwater Information Management database to aid in compliance efforts. WSDOT's consultant has aided in WSDOT's stewardship efforts by training WSDOT staff on monitoring and data management techniques. NYSDOT has an internal project certification program called GreenLITES (Leadership in Transportation and Environmental Sustainability). NYSDOT also plans to have a statewide database of permanent stormwater management practices.

In the online survey, only 12% of the surveyed state DOTs consider themselves to be at the forefront of cutting edge technology and/or procedure with regards to collecting, identifying and

recording water resources data. NYSDOT credits the existence of the policy documents discussed herein as bringing them to the forefront of cutting edge technology such as the NYSDOT Design Requirements and Guidance for State Pollutant Discharge Elimination System (SPDES) General Permit. WSDOT feels that their stormwater design guidance manual for roads and highways (i.e., Highway Runoff Manual) and their innovative stormwater research related to BMP design and stormwater design guidance has helped to bring them to the forefront of cutting edge technology and/or procedure in water permitting. WSDOT's consultant credits WSDOT's staff, environmental commitment, guidance, research and development in bringing the state to the forefront. WSDOT's consultant has also been credited with developing a site that holistically melds aquatic habitat, wetlands, floodplain creation, and flood storage into one, and received credit from a regulatory perspective that it will achieve the necessary flow control such that conventional stormwater detention facilities are not needed.

4. Noise Analysis

In the online survey, the states were asked whether they use or require that any particular methodologies be used to determine the appropriate sampling period to conduct noise measurements for NEPA projects. This question offered multiple selections for responses and 90% of the states chose "traffic peak hour/periods" as the method used. The second most popular answer was "highest traffic volume" as a methodology. With regards to noise measurement, the states were also asked what the typical length of time used for each noise measurement is. The responses to this question varied from 10 minute measurements to 24 hour measurements, with the most popular response (32%) being 20 minute measurements. The states were also asked how many total short-term measurements are required to be taken at a given site. Fifteen states (48%) responded that one measurement was taken at a given site, one noting that this was the worst case scenario. Seven states (23%) said that 2 or 3 measurements are taken at different times of the day while three states (10%) said that 2 or 3 measurements are taken at the same time on different days.

When interviewed, Washington State DOT (WSDOT) explained that they used peak period traffic volumes for determining the appropriate sampling period to conduct noise measurements because it usually yields more conservative (higher) results. They normally use a 15-minute noise measurement period, but longer periods may be used as determined on a case-by-case basis; however, they would not exceed one hour. One measurement is done per site unless there are special circumstances. New York State DOT (NYSDOT) conducts their noise measurements during the design hour. A 15-25 minute noise measurement period is used with the purpose of obtaining a stabilized L_{eq}. Short term measurements are taken 2-3 times in order to get a representative level. Caltrans conducts noise measurements during the peak noise hour, determined by 24-hour measurements, to conform with FHWA guidelines. California Department of Transportation (Caltrans) has found that the noisiest hour is not always synonymous with the peak traffic periods. One 20-minute noise measurement period is used by Caltrans, but sometimes consultants use two 10-minute measurements depending on the impacts. New Jersey DOT (NJDOT) also finds that the noisiest hour is not always synonymous with the peak traffic periods and determines this hour by using 24-hour measurements. A 60-minute

measurement period is used with one measurement being the minimum at each site, however this may vary depending on the situation. NYSDOT's consultant measures noise throughout the day during periods with freely flowing traffic for about 20-30 minutes depending on the flow of traffic. They believe that one measurement per site is usually adequate, barring unusual traffic or weather conditions.

When asked if the state DOT requires traffic counting in conjunction with noise measurements, 55% of the states said "yes", 16% said "no", and 29% said "sometimes". For those states that responded "yes" they were asked what is the purpose of the traffic counts that are taken. Eighty-eight percent of those states said that the purpose was model calibration. Eighteen percent said that they are required by regulations or DOT policy and 24% indicated other purposes.

The states that answered yes to traffic counting were also asked what method or equipment does their state use for the traffic counts. A total of 17 states responded to this question, and several of them chose more than one response. Thirteen states indicated that they use a handheld counter for traffic counts. Ten states indicated that they use manual counts. Four states responded that they use camcorder/video recordings. Two states indicated the use of an Automatic Traffic Recorder.

The survey asked whether the state DOT obtains and/or requires collection of vehicle speeds. In response, twenty-one states said "no" and eleven states said "yes" to this question. Those states that responded "yes" were asked the following question for follow-up: If the state responded "yes" to the previous question, a follow-up question was asked regarding what tools are typically used for collection of speed data. With a total of 10 states responding to this question (some choosing multiple responses), the majority (six) indicated the use of a Doppler-radar gun, two states said they use a stopwatch, three states responded that a "floating car" (vehicle drives in traffic to estimate speeds) is used, two states said that speeds were estimated or observed, one state uses a formula calculation, and one state responded that speed data is only collected if/when comparing to/validating TNM.

Three of the four states interviewed conduct traffic counting, mainly for the purpose of model calibration, using manual or handheld counters. NYSDOT conducts traffic counting in order to obtain real classification volumes and it is usually done using pneumatic counters, or by hand. WSDOT, Caltrans and NJDOT also indicated the occasional use of video to obtain traffic counts. All four states use radar guns to obtain speed data, NYSDOT also uses a "floating car" and NJDOT sometimes uses a "chase car". The consultant for NYSDOT does manual traffic counts during short term measurements for model calibration. They also collect speed data using the "floating car" method and by radar gun.

According to the results of the online survey, 61% of the states collect meteorological data during noise measurements. Three of the four noted that it is required that wind speed be shown to not have affected noise measurements. WSDOT explained that data is collected to satisfy due diligence. The consultant for NYSDOT also noted that windspeed must be within allowable limits.

Ninety percent of states responding to the online survey indicated that they do not require that other instruments be used in conjunction with the noise meter for collecting noise measurements. Of the ten percent that indicated they do, they used software for data logging, recordings to verify traffic and other diagnostic equipment. Of the states interviewed, NYSDOT and WSDOT were among the 90% not requiring additional instruments to be used. WSDOT highly recommends the use of 1/3 octave band measurements. NJDOT also does not require the use of other instruments, but did note that its consultants uses Type I or Type 2 SLMs, and sometimes Octave band analyzers are used. Caltrans was one of the states that does require that other instruments be used in conjunction with the noise meter, and stated that their SLMS have triggers and data recorders. Their 24-hour unmonitored meters have recordings to verify traffic or other sources of noise. The consultant for NYSDOT noted that they use many different types of equipment in conjunction with noise monitoring equipment in the field on NYSDOT projects, including traffic counting equipment, meteorological equipment and recording devices.

Only 13% of the states responding to the online survey consider themselves to be at the forefront of cutting edge technology and/or procedure used to collect noise and associated data. WSDOT feels that it is at the forefront of cutting edge technology because of its Quieter Pavement Program. They use the On Board Sound Intensity (OBSI) method to evaluate the quieter pavement sections called Open Graded Friction Courses (OGFC) versus traditional asphalt. They also use a new state-of-the-art technology at public hearing called Interactive Sound Information Systems (ISIS), which mimics sound levels to allow the public to experience sound after the installation of noise barriers. Caltrans credits several current developments in technology with putting them at the forefront of cutting edge technology. Caltrans uses the underwater bubble curtain to mitigate underwater noise generated by pile driving to reduce impacts to engendered fish migration when doing bridge construction. Caltrans also uses the OBSI method to compare and track tire pavement noise and participates in the Tire Pavement Noise/Research Consortium (TPF) 135. Caltrans also uses beam-forming technology to pinpoint subsource noise generators on vehicles and has produced studies on the results of its use.

NJDOT credits the use of a hydrophone, which monitors underwater noise during construction, with bringing them to the forefront of cutting edge technology, as well as the monitoring of how noise affects wildlife. NYSDOT feels that it is at the forefront of cutting edge technology in terms of modeling and research. NYSDOT's consultant credits the NYSDOT central office noise staff for their sophistication and degree of knowledge in understanding noise issues, as well as a flexibility in approach when it comes to permitting for bringing them to the forefront.

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Joseph Ofungwu – Principal Engineer
Margaret McBrien – Manager, Ecological Engineering

IX. Appendices

Appendix A: Cultural Resources

A.1. Cultural Resources Online Survey
A.2. State DOT Interview Questions
A.3. Consultant Survey Questions
A.4. State DOT Website Review

PREVIEW: NCHRP Project 25-25 (48) Compendium of Environmental Fieldwo...

Save and continue survey later

NCHRP Project 25-25 (48) Compendium of Environmental Fieldwork Technologies State DOT Survey

Select Discipline
Please select your particular discipline of expertise so that you can be directed to the appropriate set of questions.
Welcome!

This online survey is being conducted for research under the National Cooperative Highway Research Program (NCHRP) Project 25-25(48). The purpose of this research is to develop a compendium of environmental fieldwork technologies to be shared among state DOTs in order to promote time-and-cost savings for each DOT, while still providing the necessary level of detail required. This research seeks state-of-the-art practices, or even simple, tried-and-true practices that offer tools and tips that can provide cost and/or time savings for other DOTs.

The participation of your state DOT in this nationwide survey will provide a valuable contribution to the overall research for the compendium, which will ultimately be presented via a webcast to the state DOTs and others dealing with environmental issues and procedures for transportation projects. The findings presented in this first phase of the research will provide a better understanding of how state DOTs are currently conducting their fieldwork, as well as in identifying several states to target for a more detailed follow-up interview in each discipline. For this reason, it is requested that you please provide contact information when prompted by the survey.

If you happen to be the specialist for more than one of the four discipline areas you will need to complete a separate survey for each discipline; however, please limit to one responder in each discipline per state. If you find that you cannot complete the survey, please use the option provided to save your work and return to the same survey at a later time. When you are finished with your survey, please click the "next" button on the bottom of the page so that your survey is officially submitted.

This survey is very brief and should only take a few minutes of your time.

1. Please select your state:*
-- Please Select --

2. Please select your discipline;*
- ○ Cultural Resources
- ○ Ecology
- ○ Noise
- ○ Water Permitting

Click to Next Page

Take a look under the hood
Online Surveys powered by SurveyGizmo

Save and continue survey later

NCHRP Project 25-25 (48) Compendium of Environmental Fieldwork Technologies State DOT Survey

Cultural Resources
Please take a moment to answer the following questions regarding Cultural Resources field practices in your state.
3. Please provide your contact information.
First Name*

Last Name*

Title*

Email Address*

Phone Number*

4. Does your state DOT employ and/or require that GPS be used to record the location of historic architectural resources?
- Yes
- No
- Sometimes (please explain)

5. Does your state DOT employ and/or require that GPS be used to record the location of archaeological test locations?
- Yes
- No
- Sometimes (please explain)

6. Does your state DOT employ and/or require that GPS be used for recordation of location and descriptions of archaeological deposits, features, and/or landscape elements?
- Yes
- No
-

Sometimes (please explain)

7. Are all artifacts typically collected for subsequent lab analysis or are they left in place?

- ○ Collected
- ○ Left in place
- ○ Either one (please explain)

8. Does your state DOT require Geomorphology/Geoarchaeology prior to conducting archaeological surveys (particularly at stream crossings) in order to identify the archaeological resource potential of the project area before deciding to do detailed archaeological testing?

- ○ Yes
- ○ No
- ○ Sometimes (please explain)

9. Is there a cultural resource database covering your entire state that is integrated into a GIS program (i.e., GIS cultural resource data layers) which is available to your state DOT and its consultants from some centralized source within the state?

- ○ Yes
- ○ No

10. In your state, Is digital photography acceptable in the study of architectural resources rather than 35 mm film photography?

- ○ Yes
- ○ No

11. Does your state DOT have any Programmatic Agreements (general or project-specific) in place with the SHPO to streamline the cultural resources process for DOT projects?

- ○ Yes
- ○ No

12. Does your state DOT advocate, require, or recommend any non-invasive techniques to be used prior to excavations?

- ☐ Ground penetrating radar
- ☐ Surface reconnaissance
- ☐ Other

13. Are there specific types of projects or project settings that are generally exempt from full archaeological investigation (e.g., shovel tests, test units, etc.) in your state?

- ○ Yes
- ○ No

14. Do you consider your state DOT to be at the forefront of cutting edge technology and/or procedure used to collect, identify and record cultural resources data?

- ◉ Yes
- ○ No

15. Would you recommend or like for your state DOT to be considered for a follow-up telephone survey as a state-of-the-art practice leader in cultural resources field technologies?

- ◉ Yes
- ○ No

16. Please identify a cultural resources contact person within your agency who would be available to participate in a follow-up telephone survey (if other than yourself).

First Name

Last Name

Title

Email Address

Phone Number

Click to Next Page

Appendix A.2 Cultural Resources State DOT Interview Questions

Cultural Resources:

1. **Question 4 (For states that responded "yes**") – Is there a particular reason or set of reasons that have prompted your State DOT to employ or require the use of GPS for historic architectural resources? Are there situations where you don't use GPS in the recordation of historic architectural resources? If so, please explain the circumstances. In general, what percentage of your projects have utilized GPS in this regard? What do you feel are the primary benefits of using GPS for recordation of historic architectural resources? Do you believe that there are disadvantages of such use as well? What are the primary GPS tools that you use in this regard (e.g., handheld, backpack, total station with GPS interface, other), and how is the use of each tool influenced by the situation?

   Question 4 (For states that responded "no") – Is there a particular reason or set of reasons that have kept your State DOT from employing or requiring the use of GPS for historic architectural resources? Are there situations where you have considered or would consider the use of GPS in the recordation of historic architectural resources? If so, please explain the circumstances. What do you feel could be the primary benefits of using GPS for recordation of historic architectural resources? Do you believe that there are disadvantages of such use? Do you anticipate the use of GPS for recordation of historic architectural resources in the near future?

2. **Question 5 (For states that responded "yes") –** When GPS is employed in the recordation of archaeological test locations, what is the level of accuracy required (e.g., is sub-meter accuracy required)? Is there a particular reason or set of reasons that have prompted your State DOT to employ or require the use of GPS for archaeological test locations? Are there situations where you don't use GPS in the recordation of archaeological test locations? If so, please explain the circumstances. In general, what percentage of your projects have utilized GPS in this regard? What do you feel are the primary benefits of using GPS for recordation of archaeological test locations? Do you believe that there are disadvantages of such use as well? What are the primary GPS tools that you use in this regard (e.g., handheld, backpack, total station survey, other), and how is the use of each tool influenced by the situation?

   Question 5 (For states that responded "no") – Is there a particular reason or set of reasons that have kept your State DOT from employing or requiring the use of GPS for archaeological test locations? Are there situations where you have considered or would consider the use of GPS in the recordation of archaeological test locations? If so, please explain the circumstances. What do you feel could be the primary benefits of using GPS for recordation of archaeological test locations? Do you believe that there are disadvantages of such use? Do you anticipate the use of GPS for recordation of archaeological test locations in the near future?

3. **Question 6 (For states that responded "yes") –** When GPS is employed in the recordation of locations and descriptions of archaeological deposits, features and/or landscape elements,

what is the level of accuracy required (e.g., is sub-meter accuracy required)? Is there a particular reason or set of reasons that have prompted your State DOT to employ or require the use of GPS for recordation of locations and descriptions of archaeological deposits, features and/or landscape elements? Are there situations where you don't use GPS in the recordation of locations and descriptions of archaeological deposits, features and/or landscape elements? If so, please explain the circumstances. In general, what percentage of your projects have utilized GPS in this regard? What do you feel are the primary benefits of using GPS for recordation of locations and descriptions of archaeological deposits, features and/or landscape elements? Do you believe that there are disadvantages of such use as well? What are the primary GPS tools that you use in this regard (e.g., handheld, backpack, total station survey, other), and how is the use of each tool influenced by the situation?

Question 6 (For states that responded "no") – Is there a particular reason or set of reasons that have kept your State DOT from employing or requiring the use of GPS for recordation of locations and descriptions of archaeological deposits, features and/or landscape elements? Are there situations where you have considered or would consider the use of GPS in the recordation of locations and descriptions of archaeological deposits, features and/or landscape elements? If so, please explain the circumstances. What do you feel could be the primary benefits of using GPS for recordation of locations and descriptions of archaeological deposits, features and/or landscape elements? Do you believe that there are disadvantages of such use? Do you anticipate the use of GPS for recordation of locations and descriptions of archaeological deposits, features and/or landscape elements in the near future?

4. **Question 7 (For states that responded "yes" to collection)** – Are artifacts always collected rather than leaving them in place? If not, please describe situations when they are collected vs. when they are left in place. Does this apply to prehistoric and historic artifacts? What do you feel are the advantages and disadvantages to collection of artifacts vs. leaving them in place?

   Question 7 (For states that responded "no" to collection) – Are artifacts always left in place rather than collecting them? If not, please describe situations when they are collected vs. when they are left in place. Does this apply to prehistoric and historic artifacts? What do you feel are the advantages and disadvantages to collection of artifacts vs. leaving them in place?

5. **Question 8 (For states that responded "yes")** – Is Geomorphology/Geoarchaeology always considered prior to conducting archaeological surveys? If not, please explain the circumstances that determine whether Geomorphology/Geoarchaeology is to be considered. What percentage of your projects involve Geomorphology/Geoarchaeology at the early stages? What do you feel are the advantages / disadvantages of employing Geomorphology/ Geoarchaeology at the early stages?

   Question 8 (For states that responded "no") – Is Geomorphology/Geoarchaeology ever considered prior to conducting archaeological surveys? If yes, please explain the circumstances that determine whether Geomorphology/Geoarchaeology is to be considered. What are your reason(s) for not more routinely employing Geomorphology/Geoarchaeology

at the early stages? What do you feel are the potential advantages / disadvantages of employing Geomorphology/ Geoarchaeology at the early stages? Is your State DOT considering the use of Geomorphology/ Geoarchaeology in the future?

6. **Questions 9 and 10 (For states that responded "yes")** – Verify which types of data are currently available or not available from a centralized source within the state. How do you utilize the GIS information currently available from a centralized source? For those types of data not currently available, is there any intention to eventually include such GIS data in a centralized source in the future? What are the advantages and /or disadvantages to your state DOT and its consultants from having or not having a centralized GIS data source for certain data types within the state?

   Questions 9 and 10 (For states that responded "no") – How would the availability of a centralized source of GIS information make your cultural resource assessments more efficient? Which specific types of cultural resources data do you wish were available from a centralized GIS source? Is there any intention to eventually include such GIS data in a centralized source in the future?

7. **Question 11** – Do you find any disadvantages to using digital photography for the study of architectural resources rather than 35 mm film photography? Are there any situations where 35 mm film photography continues to be the medium of choice (please explain)?

8. **Question 12 (For states that responded "yes")** – What specific programmatic agreements do you have in place with the SHPO to streamline the cultural resources data collection process for DOT projects? Do you believe that they are effective in streamlining the data collection process (if so, please explain). Are there any basic changes that could be made to such agreements that would make them more effective?

   Question 12 (For states that responded "no") – Are there any specific programmatic agreements that you are currently developing with the SHPO to streamline the cultural resources data collection process for DOT projects? Do you believe that such agreements can be effective in streamlining the data collection process (if so, please explain).

9. **Question 13** – Of the various non-invasive techniques available to be used prior to excavations (e.g., ground penetrating radar, surface reconnaissance, magnetometry, soil resistivity, metal detection, gradiometer, etc.), which ones are specifically used or required by your State DOT? How frequently are each of these techniques actually used for your projects (in terms of percentage of projects where they are applied)? Are there certain types of situations where these techniques are used in the field (please explain)? What advantages and/or disadvantages of each technique have you encountered?

10. **Questions 14 and 15 (For states that responded "yes")** – Please clarify the situations where full archaeological investigation (i.e., shovel tests, test units, etc.) is exempt? Have you found this to be an appropriate and useful means of streamlining the cultural resources data collection process? Are there any other situations that you believe would also be appropriate for exempting the need for full archaeological investigation?

Questions 14 and 15 (For states that responded "no") – Is there a specific reason why your state does not exempt certain projects or situations from full archaeological investigation (i.e., shovel tests, test units, etc.)? Do you believe that exemption of certain projects or situations from full archaeological investigation would be an appropriate and useful means of streamlining the cultural resources data collection process (please clarify)? Is there any intent in the future to exempt certain projects or situations from full archaeological investigation (if yes, please clarify)?

11. **General** – Are there any other types of cutting edge technology and/or procedures not covered by our survey that your State DOT employs or requires to be used to collect, identify and/or record cultural resources data (if yes, please explain). Are there any other types of cutting edge technology and/or procedures not covered by our survey that your State DOT does not currently use or require, but is considering to be used to collect, identify and/or record cultural resources data in the future (if so, please explain).

12. **Question 28** – You have indicated that you believe that your state is at the forefront of cutting edge technology and/or procedure. What specific capabilities or technologies do you feel that you possess that puts you into that category? What specific capabilities or technologies do you feel are necessary for any state to possess in order for such state to be classified in that category as well? Is there any specific advice that you can offer to help another state to attain that category? Do you feel that the specific equipment and procedures that you use to collect cultural resources field data help you to save time and/or money (explain)? Are there specific equipment items that you currently do not possess which you plan on purchasing or requiring to be used which will further enhance your state's capabilities in the area of Cultural Resources?

13. If we were to reach out to one consulting firm that does much of your Cultural Resources work, who would you recommend? Please provide a contact name, address, phone number and firm name for up to three firms.

14. If we choose to present the results of this follow-up survey and specifically credit you as the interviewee and your agency as the subject case study, is that acceptable, or do you and the agency prefer to remain anonymous?

Appendix A.3 Cultural Resources Consultant Survey Questions

Cultural Resources:

1. **We asked (Specify State DOT): "Does your state DOT employ and/or require that GPS be used to record historic architectural resources?"**

   If the State DOT responded "yes":

   Are there situations where your firm/agency has not used GPS in the recordation of historic architectural resources for the state DOT in question? If so, please explain the circumstances.

   In general, on what percentage of the projects that your firm/agency has been involved for the state DOT in question have you utilized GPS in the recordation of historic architectural resources? How does this compare to any other state DOTs for whom you have worked?

   What do you feel are the advantages/disadvantages of using GPS for recordation of historic architectural resources?

   What are the primary GPS tools that you use in this regard (e.g., handheld, backpack, total station with GPS interface, other)?

   Would you use or propose to use GPS for the recordation of historic architectural resources, even if the state DOT in question did not employ or require such use? Why or why not?

   If the State DOT responded "no":

   Are there situations where your firm/agency has used GPS in the recordation of historic architectural resources for the state DOT in question, even though the state DOT does not employ and/or require such use? If so, please explain the circumstances.

   In general, on what percentage of the projects that your firm/agency has been involved for the state DOT in question have you utilized GPS in the recordation of historic architectural resources? How does this compare to any other state DOTs for whom you have worked?

   What do you feel are the advantages/disadvantages of using GPS for recordation of historic architectural resources?

   In situations or other states where you may use GPS in the recordation of historic architectural resources, what are the primary GPS tools that you use in this regard (e.g., handheld, backpack, total station with GPS interface, other)?

   To your knowledge, is there a particular reason that the State DOT in question has not employed or required the use of GPS for historic architectural resources?

Would you prefer to use, or do you actually use GPS for the recordation of historic architectural resources, even though the state DOT in question does not employ or require such use? Why or why not?

2. **We asked (Specify State DOT): "Does your state DOT employ and/or require that GPS be used to record the location of archaeological test locations?"**

If the State DOT responded "yes":

What is the level of accuracy required (e.g., is sub-meter accuracy required)?

Are there situations where your firm/agency has not used GPS in the recordation of archaeological test locations for the state DOT in question? If so, please explain the circumstances.

In general, on what percentage of the projects that your firm/agency has been involved for the state DOT in question have you utilized GPS in the recordation of archaeological test locations? How does this compare to any other state DOTs for whom you have worked?

What do you feel are the advantages/disadvantages of using GPS for recordation of archaeological test locations?

What are the primary GPS tools that you use in this regard (e.g., handheld, backpack, total station survey, other), and how is the use of each tool influenced by the situation?

Would you use or propose to use GPS for the recordation of archaeological test locations, even if the state DOT in question did not employ or require such use? Why or why not?

If the State DOT responded "no":

Are there situations where your firm/agency has used GPS in the recordation of archaeological test locations for the state DOT in question, even though the state DOT does not employ and/or require such use? If so, please explain the circumstances.

In general, on what percentage of the projects that your firm/agency has been involved for the state DOT in question have you utilized GPS in the recordation of archaeological test locations? How does this compare to any other state DOTs for whom you have worked?

What do you feel are the advantages/disadvantages of using GPS for recordation of archaeological test locations?

In situations or other states where you may use GPS in the recordation of archaeological test locations, what are the primary GPS tools that you use in this regard (e.g., handheld, backpack, total station with GPS interface, other), and how is the use of each tool influenced by the situation??

To your knowledge, is there a particular reason that the State DOT in question has not employed or required the use of GPS for archaeological test locations?

Would you prefer to use, or do you actually use GPS for the recordation of archaeological test locations, even though the state DOT in question does not employ or require such use? Why or why not?

3. **We asked (<u>Specify State DOT</u>): "Does your state DOT employ and/or require that GPS be used for the recordation of location and descriptions of archaeological deposits, features, and/or landscape elements?"**

   If the State DOT responded "yes":

   What is the level of accuracy required (e.g., is sub-meter accuracy required)?

   Are there situations where your firm/agency has not used GPS in the recordation of location and descriptions of archaeological deposits, features and/or landscape elements for the state DOT in question? If so, please explain the circumstances.

   In general, on what percentage of the projects that your firm/agency has been involved for the state DOT in question have you utilized GPS in the recordation of location and descriptions of archaeological deposits, features and/or landscape elements? How does this compare to any other state DOTs for whom you have worked?

   What do you feel are the advantages/disadvantages of using GPS for recordation of location and descriptions of archaeological deposits, features and/or landscape elements?

   What are the primary GPS tools that you use in this regard (e.g., handheld, backpack, total station survey, other), and how is the use of each tool influenced by the situation?

   Would you use or propose to use GPS for the recordation of location and descriptions of archaeological deposits, features and/or landscape elements, even if the state DOT in question did not employ or require such use? Why or why not?

   If the State DOT responded "no":

   Are there situations where your firm/agency has used GPS in the recordation of location and descriptions of archaeological deposits, features and/or landscape elements for the state DOT in question, even though the state DOT does not employ and/or require such use? If so, please explain the circumstances.

   In general, on what percentage of the projects that your firm/agency has been involved for the state DOT in question have you utilized GPS in the recordation of location and descriptions of archaeological deposits, features and/or landscape elements? How does this compare to any other state DOTs for whom you have worked?

What do you feel are the advantages/disadvantages of using GPS for recordation of location and descriptions of archaeological deposits, features and/or landscape elements?

In situations or other states where you may use GPS in the recordation of location and descriptions of archaeological deposits, features and/or landscape elements, what are the primary GPS tools that you use in this regard (e.g., handheld, backpack, total station with GPS interface, other), and how is the use of each tool influenced by the situation??

To your knowledge, is there a particular reason that the State DOT in question has not employed or required the use of GPS for recordation of location and descriptions of archaeological deposits, features and/or landscape elements?

Would you prefer to use, or do you actually use GPS for the recordation of location and descriptions of archaeological deposits, features and/or landscape elements, even though the state DOT in question does not employ or require such use? Why or why not?

4. **We asked (<u>Specify State DOT</u>): "Are all artifacts typically collected for subsequent lab analysis or are they left in place?"**

If the State DOT responded "collected for subsequent lab analysis":

Are artifacts always collected rather than leaving them in place when your firm/agency is working on behalf of the state DOT in question? If not, please describe situations when they have been collected vs. when they are left in place.

Does this apply to prehistoric and historic artifacts?

What do you feel are the advantages and disadvantages to collection of artifacts vs. leaving them in place?

Do the procedures regarding artifacts that you have used for the state DOT in question differ from other state DOTs for whom your firm/agency has worked? If yes, please explain.

As a consultant to the state DOT in question, would you suggest a different procedure regarding artifacts?

If the State DOT responded "left in place":

Are artifacts always left in place rather than collecting them when your firm/agency is working on behalf of the state DOT in question? If not, please describe situations when they are collected vs. when they are left in place.

Does this apply to prehistoric and historic artifacts?

What do you feel are the advantages and disadvantages to collection of artifacts vs. leaving them in place?

Do the procedures regarding artifacts that you have used for the state DOT in question differ from other state DOTs for whom your firm/agency has worked? If yes, please explain.

As a consultant to the state DOT in question, would you suggest a different procedure regarding artifacts?

5. **We asked (<u>Specify State DOT</u>): "Does your state DOT require Geomorphology/ Geoarchaeology prior to conducting archaeological surveys (particularly at stream crossings) in order to identify the archaeological resource potential of the project area before deciding to do detailed archaeological testing?"**

If the State DOT responded "yes":

When your firm/agency has worked for the state DOT in question, has Geomorphology/ Geoarchaeology always been considered/utilized prior to conducting archaeological surveys? If not, please explain the circumstances that determine whether it is to be considered.

In general, on what percentage of the projects that your firm/agency has been involved for the state DOT in question have you utilized Geomorphology/Geoarchaeology prior to conducting archaeological surveys? How does this compare to any other state DOTs for whom you have worked?

What do you feel are the advantages/disadvantages of employing Geomorphology/ Geoarchaeology at the early stages?

Would you use or propose to use Geomorphology/Geoarchaeology pror to conducting archaeological surveys, even if the state DOT in question did not employ or require such use? Why or why not?

If the State DOT responded "no":

Are there situations where your firm/agency has used Geomorphology/Geoarchaeology for the state DOT in question, even though the state DOT does not employ and/or require such use? If so, please explain the circumstances.

In general, on what percentage of the projects that your firm/agency has been involved for the state DOT in question have you utilized Geomorphology/Geoarchaeology prior to conducting archaeological surveys? How does this compare to any other state DOTs for whom you have worked?

What do you feel are the advantages/disadvantages of using Geomorphology/ Geoarchaeology at the early stages?

To your knowledge, is there a particular reason that the State DOT in question has not employed or required the use of Geomorphology/Geoarchaeology prior to conducting archaeological surveys?

Would you prefer to use, or do you actually use Geomorphology/Geoarchaeology prior to conducting archaeological surveys, even though the state DOT in question does not employ or require such use? Why or why not?

6. **We asked (Specify State DOT): "Is there a cultural resource database covering your entire state that is integrated into a GIS program which is available to your state DOT and its consultants from some centralized source within the state?"**

   If the State DOT responded "yes":

   Which types of data does your firm/agency have access to? And what is the process for gaining that access?

   How do you utilize the GIS information that you have access to?

   What are the advantages/disadvantages to both you and the state DOT in question from having a centralized GIS data source for certain data types within the state?

   What is your experience in this regard when working for the state DOT in question in comparison to any work that you have conducted for other state DOTs? In this regard, how does the work effort differ between the states and how do these differences affect you as the consultant?

   If the State DOT responded "no":

   To your knowledge, is there any intention to eventually develop a GIS database in the future?

7. **Does your firm use predictive modeling for archaeological site locations, as a consultant to State DOT? If yes, when is such modeling applied and how successful has this been. If not, why not and when would predictive modeling become a part of the standard approach used by the DOT?**

8. **We asked (Specify State DOT): "In your state, is digital photography acceptable in the study of architectural resources rather than 35 mm film photography?"**

   If the State DOT responded "yes" (which all states did):

   Do you find any disadvantages to using digital photography for the study of architectural resources rather than 35 mm film photography?

   Are there any situations where 35 mm film photography continues to be the medium of choice for projects in which you are involved for the state DOT in question? If yes, please explain.

Do you find the procedures regarding digital photography as used for the state DOT in question to be any different for other state DOTs for which your firm/agency has worked? If yes, please explain.

9. **We asked (Specify State DOT): "Does your state DOT have any Programmatic Agreements (general or project specific) in place with the SHPO to streamline the cultural resources process for DOT projects?"**

   If the State DOT responded "yes":

   What specific programmatic agreements between the SHPO and the state DOT in question do you deal with on a regular basis with regards to DOT projects? How have such agreements made your role as consultant to the state DOT in question affected your responsibilities as consultant? Is level of work for you as the consultant to the state DOT in question greater or lesser than before such programmatic agreements?

   How do programmatic agreements between the SHPO and the state DOT in question affect you as consultant in comparison to any programmatic agreements that may exist in other states where your firm/agency has worked as a consultant?

   In your opinion, are there any basic changes that could be made to such agreements that would make them more effective?

   If the State DOT responded "no":

   To your knowledge, are there any specific programmatic agreements that the state DOT in question and the SHPO for that state are currently developing to streamline the cultural resources data collection process for DOT projects? Do you believe that such agreement could have any impact on your firm's/agency's role or responsibilities as consultant to the state DOT in question? Do you believe that such agreement could have an impact on the level of work that you typically conduct for the state DOT in question?

   Do you believe that the lack of programmatic agreements between the SHPO and the state DOT in question affect your firm/agency in any manner as consultant to the DOT in comparison to any other state where programmatic agreements exist where your firm/agency has worked as a consultant? If yes, please explain.

10. **We asked (<u>Specify State DOT</u>): "Does your state advocate, require or recommend any non-invasive techniques to be used prior to excavations?"**

    Of the various non-invasive techniques available to be used prior to excavations (e.g., ground penetrating radar, surface reconnaissance, magnetometry, soil resistivity, metal detection, gradiometer, etc.), which ones have your firm/agency used in response to the procedures of the State DOT in question? Are there particular situations / conditions that have dictated the use of one or more of these techniques?

How frequently has your firm/agency actually used these techniques for projects undertaken for the state DOT in question (in terms of percentage of projects in which your firm/agency has been involved where such procedures could potentially be applied)? How does this frequency vary from projects for other state DOTs in which your firm/agency has served as consultant?

What advantages and/or disadvantages have you encountered in using such techniques?

Are there any specific types of projects or situations / conditions where you believe that the use of such non-invasive techniques should not be utilized?

11. **We asked (<u>Specify State DOT</u>): "Are there specific types of projects or project settings that are generally exempt from full archaeological investigation in your state? What types?"**

    If the State DOT responded "yes" and identified situations where exempt:

    Have you found this to be an appropriate and useful means of streamlining the cultural resources data collection process?

    In your opinion, are there any other situations that you believe would also be appropriate for exempting the need for full archaeological investigation?

    Based on any experience that you may have working as a consultant to other state DOTs, how do the exemptions used by the state DOT in question compare to procedures used by other state DOTs? Are there notable differences in this regard to the types and levels of work that you have become involved between the different states?

    If the State DOT responded "no":

    To your knowledge, is there a specific reason why the state DOT in question does not exempt certain projects or situations from full archaeological investigation? (i.e., shovel tests, test units, etc.).

    In your opinion, do you believe that exemption of certain projects or situations from full archaeological investigation would be an appropriate and useful means of streamlining the cultural resources data collection process? (please clarify).

    Based on any experience that you may have working as a consultant to other state DOTs, how do the lack of exemptions used by the state DOT in question compare to procedures used by other state DOTs? Are there notable differences in this regard to the types and levels of work that you have become involved between the different states?

12. **General** – Are there any other types of cutting edge technology and/or procedures not covered by our survey that your firm/agency has utilized for the state DOT in question or that are being considered for use in the future? If so, please explain.

Are there any other types of cutting edge technology and/or procedures not covered by our survey that your firm/agency has utilized for other state DOTs? If yes, please explain.

What other technologies would you like to see be used by the state DOT in question?

13. **Question 28** –The state DOT in question has indicated that it believes it is at the forefront of cutting edge technology and/or procedure. In your opinion, what specific capabilities or technologies do you feel helped put them into that category?

What specific capabilities or technologies do you feel are necessary for any state to possess in order for such state to be classified in that category as well?

Is there any specific advice that you can offer to help another state to attain that category?

What do you believe is the role / responsibility of a consultant to this or any other state DOT in placing them at the forefront of cutting edge technology and/or procedure?

14. If we choose to present the results of this follow-up survey and specifically credit you as the interviewee and your firm as the subject case study, is that acceptable, or do you and the firm/agency prefer to remain anonymous?

Appendix A.4 Cultural Resources State DOT Website Review

Following the Task 1 online survey, a review of the websites for those state DOTs responding that they consider themselves to be "at the forefront of cutting edge technology" in their field and are willing to participate in a follow-up interview was conducted. The purpose of this website review was to attempt to provide further background on each state's technologies and procedures in advance of the more detailed interviews to be conducted over the phone during Task 2 of this research. The intent of the follow-up interview is to obtain greater detail on the responses provided in the online survey in order get a better understanding of each state's practices.

A total of nine state DOTs that took the initial survey considered themselves to be at the forefront of cutting edge field technology in the area of *Cultural Resources* and were willing to participate in the follow-up interviews. These are; California, Delaware, Georgia, Illinois, Indiana, Missouri, New York, Oregon and Washington. The results of the website review for each of these state DOTs that may be solicited for participation in the follow-up interview are presented below.

California: Survey responses indicate that GPS is used by California DOT (Caltrans) for archaeological work and sometimes to record the location of historic architectural resources as well. Caltrans indicated that geomorphology/geoarchaeology is recommended for most projects. A Section 106 Programmatic Agreement is in place with the SHPO to streamline projects and provides a list of specific undertakings that may be exempt from full archaeological investigation if there is no potential for cultural resources. Non-invasive techniques such as ground penetrating radar, surface reconnaissance and historic research are also used by Caltrans specialists prior to excavations.

As of January 1, 2004, Caltrans has a Programmatic Agreement (PA) in place with Federal Highway Administration (FHWA), the California State Historic Preservation Officer, and the Advisory Council on Historic Preservation regarding compliance with Section 106 of the National Historic Preservation Act, as it pertains to the Federal-Aid Highway Program in California. The most recent annual report (July 1, 2007- June 30, 2008) found that the PA has continued to be an effective environmental streamlining tool, by improving project delivery while ensuring that effects to cultural resources are properly taken into account during project planning.

Delaware: The Delaware DOT (DelDOT) uses GPS to record the location of historical architectural resources, archaeological test locations, deposits, features and/or landscape elements at the SHPO's discretion. In Delaware, artifacts are collected and culled in the lab. Geomorphology / Geoarchaeology is used, if necessary, in consultation with the SHPO. There is not a cultural resource database covering the state of Delaware. DelDOT uses digital photography for the study area architectural resources. Ground penetrating radar and surface reconnaissance are some non-invasive techniques used prior to excavations. There are no Programmatic Agreements in place with the SHPO and there are not any types of projects that are exempt from full archaeological investigation in Delaware.

The DelDOT website provides an extensive collection of reports, literature and historic photos dating back to 1921. Surveys, annual reports and eligibility determinations are all available in PDF form on the site.

Georgia: Although GPS is not required, Georgia DOT (GDOT) is working towards full use of GPS in recording the location of architectural resources since all survey data are becoming automated. GPS is used to record the location of archaeological test locations, although it is not used to record the location and description of archaeological deposits, features, an/or landscape elements. Artifacts are typically collected for subsequent lab analysis. Geomorphology / Geoarchaeology is not used in Georgia prior to conducting archaeological surveys. There is a cultural resource database covering the entire state of Georgia that is integrated into a GIS program and is available to GDOT and its consultants from a centralized location. This database is maintained by the University/Institute. Digital photography is acceptable in the study of architectural resources rather than 35 mm film photography. GDOT has a Programmatic Agreement with the SHPO to streamline the cultural resources process for GDOT projects. GDOT also advocates, requires and/or recommends the following non-invasive techniques to be used prior to excavations: ground penetrating radar, gradiometer, soil resistivity and metal detection. Projects located entirely within the shoulder and/or median are generally exempt from full archaeological investigation.

A review of GDOT's website did not reveal any specific information with regards to the Cultural Resources program. However, more information on this program and GDOT's practices will be gathered during the follow-up interview, if selected as one of the states to be interviewed.

Illinois: Illinois DOT (IDOT) does not require the use of GPS to record the location of architectural resources, but they do use it to record the location of archaeological test locations, deposits, features and/or landscape elements. In Illinois, artifacts are typically collected for subsequent lab analysis. Geomorphology/Geoarchaeology is used in the state as well, in order to identify the archaeological resource potential of the project area before deciding to do a detailed archaeological testing. Illinois also has a cultural resource database covering the entire state integrated into a GIS program and available to the state DOT and its consultants. This database is maintained by the SHPO and the State Museum/State Historical Society. Digital photography is also used in the study of architectural resources, rather than 35 mm film. There is also a Programmatic Agreement in place with the SHPO in Illinois to streamline the cultural resources process. There are certain types of projects that are generally exempt from full archeological investigation such as projects entirely within the existing right of way, and projects located entirely within the shoulder and/or median.

Illinois Transportation Archaeological Research Program (ITARP) conducts archeological surveys and excavations throughout the state of Illinois for the IDOT. ITARP is a joint program between the University of Illinois and IDOT, with the central ITARP office located at the University of Illinois-Urbana campus in Champaign and several other offices and labs throughout the state. ITARP is very active in public outreach and making the history of Illinois available to the public via lectures and publications. The website itself provides a bibliography and listing of current projects in each district through an interactive map of the state as well as contacts for each district. Dr. John Walthall (survey respondent) and IDOT's cultural resources

management program were recently honored by being awarded the Society for American Archaeology's 2008 Award for Excellence in Cultural Resource Management.

Indiana: Indiana DOT (INDOT) uses GPS to record the location of historic architectural resources as well as archaeological test locations. Most archaeological features and deposits are mapped by a Total Station on the site, but everything is tied into a georeferenced site grid and mapped boundaries. Artifacts are collected on a case-by-case basis and INDOT and the SHPO allow historical architectural artifacts to be sampled; if there is an inordinate amount of redundant historic artifacts (i.e., whiteware), those artifacts may be sampled as well, as long as the principal investigator is qualified as a historic archaeologist. Geomorphology / Geoarchaeology is required prior to conducting archaeological surveys in order to identify the archaeological resource potential of the project area before deciding to do detailed testing. Indiana does not have a cultural resource database covering the state. Digital photography is used in the study of architectural resources. INDOT uses non invasive techniques prior to excavations such as ground penetrating radar, surface reconnaissance, magnetometry and resistivity, as appropriate. Certain types of projects, such as those located entirely within the shoulder and/or median, are exempt from full archaeological investigation. A Programmatic Agreement is also in place with the SHPO in order to streamline cultural resources processes and exempts many common INDOT projects from Section 106, including most projects within ground previously disturbed by construction activity.

The Cultural Resources Section is part of the Office of Environmental Services within INDOT. A review of INDOT's website shows that the Programmatic Agreement between FHWA, INDOT, Advisory Council on Historic Preservation, and the Indiana SHPO Regarding the Implementation of the Federal Aid Highway Program in the State of Indiana, has been in place since 2006. Appendices were added recently in October 2008 listing those projects that are exempt from review by INDOT cultural resources staff.

Missouri: In Missouri, GPS is rarely used to record the location of historic architectural resources because there are excellent aerial photos and GIS maps available for almost all projects. Although not required, GPS (either handheld, total station, or Trimbles) are used for almost all field investigations. Survey quality equipment is used on more detailed site specific investigations, and access to professional surveyors is available when needed. Archaeological deposits and landscape elements typically are recorded using some level of GPS. Site specific features may be recorded using GPS or are located with manual tapes from shot-in locations. Artifacts are typically collected for subsequent lab analysis. Geomorphological assessments are not required but are used as determined necessary by experienced archaeological staff. Missouri has a cultural resource database covering the entire state that is integrated into a GIS program and it is maintained by the environmental resources agency within the state. The use of digital photography is acceptable in Missouri in the study of architectural resources. Missouri DOT (MoDOT) advocates, requires and/or recommends non-invasive techniques such as ground penetrating radar and surface reconnaissance. There is a Programmatic Agreement in place between MoDOT, FHWA, the SHPO and the ACHP to streamline the cultural resources process in Missouri. The Programmatic Agreement identifies certain conditions in which it is unlikely that cultural resources will be located or adversely impacted. The conditions consider the kind of

project, how much existing or new right-of-way is needed, and the probability of cultural resources being found in the project setting.

The MoDOT website provides a history and overview of the studies of archaeology and architectural history in the state as well as a frequently asked questions page for the public's information.

New York: New York State DOT (NYSDOT) does not use GPS to record the location of historic architectural resources or archaeological test locations, deposits, features and/or landscape elements. Artifacts are typically collected for subsequent lab analysis. Geomorphology or Geoarchaeology is usually conducted if the archaeologist feels it is needed. For NYSDOT, there is a cultural resources database covering the entire state that is integrated into a GIS program and this database is maintained by the State Historic Preservation Office. Digital photography is considered acceptable in the study of architectural resources. NYSDOT has a Programmatic Agreement (PA) in place with the SHPO to streamline the cultural resource process for DOT projects. Ground penetrating radar is used prior to excavations. There are no projects in New York State that are generally exempt from full archaeological investigation.

The Socioeconomic/Cultural Resources/Environmental Processes Section of the Engineering Division of the Office of Environment provides links to the Environmental Processes Manual. Located on this website is a FHWA New York Division Programmatic Categorical Exclusion signed on July 15, 1996. There is also a Programmatic Section 4(f) Evaluation and Approval in place since 1983.

Oregon: The Oregon DOT (ODOT) is currently working on a new process with SHPO to do GPS mapping to record the location of historic architectural resources. GPS is currently used to record the location of archaeological test locations, deposits, features, and/or landscape elements. If Phase 3 warranted, artifacts are collected for subsequent lab analysis. Depending on the circumstances, geomorphology / geoarchaeology may be used prior to conducting archaeological surveys in order to identify the archaeological resource potential of the project area before deciding to do detailed archaeological testing. There is not a cultural resource database for Oregon. The state does use digital photography in the study of architectural resources. ODOT does have a Programmatic Agreement in place with the SHPO to streamline the cultural resource process for ODOT projects and includes criteria for specific types of projects that are generally exempt from full archaeological investigation. ODOT advocates, requires or recommends ground penetrating radar and surface reconnaissance as non-invasive techniques to be used prior to excavations.

The ODOT Cultural Resources Unit has just completed development of comprehensive guidance materials for local government agencies to assist in the preparation of Historic Downtown Main Street enhancement projects. The new guidance materials include information on the selection and design of streetscape enhancements, sidewalks, landscaping, pedestrian features, and lighting considerations and can be downloaded from the ODOT website.

The archaeology program, also administered through ODOT's Environmental Services Section, conducts most fieldwork through an interagency agreement with the Oregon State Museum of

Anthropology (OSMA). A strong partnership has existed between ODOT and OSMA for over 20 years. Some consultant projects contract with private archaeology firms; however, ODOT has the responsibility of reviewing all scopes of work and final products for sufficiency.

There is a Programmatic Agreement between the FHWA, ODOT, Oregon SHPO and the Advisory Council on Historic Preservation Regarding the Implementation of Minor Transportation Projects which was signed in 2001. Additionally, ODOT has developed the Collaborative Environmental and Transportation Agreement for Streamlining (CETAS), which includes the SHPO as one of the signatories. The Vision for Streamlining includes six pillars, one of which specifically addresses the development of a Natural and Cultural Resource Mapping Program. In this program, CETAS agencies with administration provided by ODOT would collectively map sensitive natural and cultural resources using geographic information systems (GIS) and global positioning systems (GPS). The program would map and record habitat and cultural resources, including critical habitat areas and identify the actions needed to sustain and improve them and provide early identification of sensitive areas to ensure they're avoided whenever possible in the course of transportation project development, construction and maintenance.

Washington: WSDOT's survey results indicated the use of GPS in rural areas to record the location of historic architectural resources as well as for the recordation of archaeological test locations, isolated features and site deposits. A total station is used to record features that are not part of a larger site. Digital photography is also used in the study of architectural resources. In Washington, collection of artifacts is site/project specific, but often artifacts are left in the field in site identification phases, and collected during testing phases. They are always collected during data recovery. Geomorphology/geoarchaeology is required prior to conducting detailed archaeological testing. Non-invasive techniques that may be used prior to excavations also include ground penetrating radar, surface reconnaissance and soil resistivity. Washington also has a cultural resource database covering the state that is integrated into a GIS program and is available to the DOT and consultants from a centralized source within the state. It is maintained by the SHPO, County/Municipal government, WSDOT and the tribes. Projects within the known vertical and horizontal limits of previous disturbance are generally exempt from full archaeological investigation. Washington State DOT (WSDOT) has a Programmatic Agreement (PA) in place with the SHPO.

In consultation with Native American tribes, WSDOT signed a PA with the Federal Highway Administration, the Advisory Council on Historic Preservation, and the Department of Archaeology and Historic Preservation to comply with Section 106 of the National Historic Preservation Act. The Statewide Section 106 Programmatic Agreement, signed on March 21, 2007, describes how WSDOT and FHWA will consult with tribes and the state on FHWA projects. Under the Agreement, some projects are exempt from further National Historic Preservation Act review. These projects are listed on a tracking sheet which is sorted by county. Highways & Local Programs projects must comply with the PA, but are tracked separately. The PA is available for download on WSDOT's website. Additionally, all WSDOT projects that involve ground disturbance are encouraged to have an "unanticipated discovery plan" that describes what will be done if archaeological materials or human remains are discovered during construction. A template for this plan is provided on WSDOT's website. WSDOT also provides

cultural resources training twice a year that is specifically intended for government agencies and tribal governments.

Appendix B: Ecology

B.1. Ecology Online Survey
B.2. State DOT Interview Questions
B.3. Consultant Survey Questions
B.4. State DOT Website Review

PREVIEW: NCHRP Project 25-25 (48) Compendium of Environmental Fieldwo...

Save and continue survey later

NCHRP Project 25-25 (48) Compendium of Environmental Fieldwork Technologies State DOT Survey

Select Discipline
Please select your particular discipline of expertise so that you can be directed to the appropriate set of questions.
Welcome!

This online survey is being conducted for research under the National Cooperative Highway Research Program (NCHRP) Project 25-25(48). The purpose of this research is to develop a compendium of environmental fieldwork technologies to be shared among state DOTs in order to promote time-and-cost savings for each DOT, while still providing the necessary level of detail required. This research seeks state-of-the-art practices, or even simple, tried-and-true practices that offer tools and tips that can provide cost and/or time savings for other DOTs.

The participation of your state DOT in this nationwide survey will provide a valuable contribution to the overall research for the compendium, which will ultimately be presented via a webcast to the state DOTs and others dealing with environmental issues and procedures for transportation projects. The findings presented in this first phase of the research will provide a better understanding of how state DOTs are currently conducting their fieldwork, as well as in identifying several states to target for a more detailed follow-up interview in each discipline. For this reason, it is requested that you please provide contact information when prompted by the survey.

If you happen to be the specialist for more than one of the four discipline areas you will need to complete a separate survey for each discipline; however, please limit to one responder in each discipline per state. If you find that you cannot complete the survey, please use the option provided to save your work and return to the same survey at a later time. When you are finished with your survey, please click the "next" button on the bottom of the page so that your survey is officially submitted.

This survey is very brief and should only take a few minutes of your time.

1. Please select your state:*
-- Please Select --

2. Please select your discipline;*
- ○ Cultural Resources
- ○ Ecology
- ○ Noise
- ○ Water Permitting

Click to Next Page

Take a look under the hood
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Save and continue survey later

NCHRP Project 25-25 (48) Compendium of Environmental Fieldwork Technologies State DOT Survey

Ecology
Please take a moment to answer the following questions regarding Ecology field practices in your state.
19. Please provide your contact information.
First Name*

Last Name*

Title*

Email Address*

Phone Number*

20. Does your state DOT use and/or require GPS to record the location of ecologically sensitive sites, vegetation, wildlife and/or threatened & endangered species?
- (●) Yes
- ( ) No

21. Does your state DOT use and/or require GPS for actual data collection and/or recordation with regards to ecologically sensitive sites, vegetation, wildlife and/or threatened & endangered species?
- (●) Yes
- ( ) No

22. Are there IT/GIS technologies available to your state DOT and its consultants from some centralized source within the state?

	Wetlands	Threatened & Endangered Species	Floodplains	Soils	Land Use	Other
Yes	( )	( )	( )	( )	( )	( )
No	( )	( )	( )	( )	( )	( )

23. Does your state DOT actively utilize wetland banking in order to expedite the mitigation process and/or reduce the level of fieldwork required for mitigation?

- (●) Yes
- ( ) No

24. Does your state DOT use and/or require the use of remote sensing tools in order to facilitate and/or streamline required field studies?

- [ ] Hyper spectral analysis
- [ ] Ground penetrating radar
- [ ] LIDAR
- [ ] None
- [ ] Other

25. Is digital photography used and/or required to be used by your state DOT to aid in field work?

- ( ) Yes
- (●) No

26. Does your state DOT use any new or state-of-the-art monitoring techniques for hydrologic monitoring of stream and wetland mitigation sites?

- [ ] Electronic data logging
- [ ] Biological monitoring
- [ ] Soil reduction probes
- [ ] Infrared cameras
- [ ] Other (please specify)

27. Does your state have any programmatic agreements (general or project specific) in place with federal or state regulatory/review agencies to streamline the ecological processes for DOT projects?

- ( ) Yes
- (●) No

28. Do you consider your state DOT to be at the forefront of cutting edge technology and/or procedure used to collect, identify and record ecological data?

- (●) Yes
- ( ) No

29. Would you recommend or like for your state DOT to be considered for a follow-up telephone survey as a state-of-the-practice leader in ecological field technologies?

- (●) Yes
- ( ) No

30. Please identify an ecology contact person within your agency that you would like to have participate in a follow-up telephone survey (if other than yourself).

First Name

Last Name

Title

Email Address

Phone Number

Click to Next Page

Take a look under the hood

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Appendix B.2 Ecology State DOT Interview Questions

Ecology:

1. **Questions 20 and 21 –** How does your State DOT use GPS for data collection and recordation of ecologically sensitive sites, vegetation, wildlife and/or threatened and endangered species? Do you find such use to be a benefit in terms of overall time and cost savings? Are there any situations where you don't or wouldn't use GPS for data collection and recordation? What are the primary GPS tools that you use in this regard (e.g., handheld, backpack, total station with GPS interface, other), and how is the use of each tool influenced by the situation?

2. **Question 22 –** Verify which types of data are currently available or not available from a centralized source within the state. How do you utilize the GIS information currently available from a centralized source? For those types of data not currently available, is there any intention to eventually include such GIS data in a centralized source in the future? What are the advantages and /or disadvantages to your state DOT and its consultants from having or not having a centralized GIS data source for certain data types within the state?

3. **Question 23 (For CA, OH and WA only)** – Being a State DOT that utilizes wetland mitigation banks, what do you perceive as the advantages of using a bank? Do you perceive any disadvantages of using a bank? Are there certain situations when you utilize a bank (if so, please explain). In addition to perhaps expediting the mitigation process, do you find that wetland banking effectively reduces the level of fieldwork required and associated costs for mitigation?

   Question 23 (For MD only) – Being a State DOT that does not utilize wetland mitigation banks, can you explain why such banks are not currently used (e.g., is there a technical impediment to such use)? Is there any intent to use banks in the future? Do you perceive any disadvantages of using a bank? Are there certain situations when you wish that you could utilize a bank (if so, please explain). In addition to perhaps expediting the mitigation process, do you believe that wetland banking could effectively reduce the level of fieldwork required and associated costs for mitigation?

4. **Question 24 (For CA and WA only)** – Being a State DOT that utilizes the use of remote sensing tools (such as LIDAR or ground penetrating radar) in the field, please explain the specific situation(s) when such tools are used? How do such technologies facilitate and/or streamline required field studies on your projects? Do you believe that there are real time and cost savings that result from such use (explain)?

   Question 24 (For MD and OH only) – Being a State DOT that does not utilize remote sensing tools (such as LIDAR or ground penetrating radar) in the field, can you explain why they are not used? Are there certain situations when you have considered the use, or wish that you could use remote sensing tools (if so, please explain). Do you believe that such technologies can facilitate and/or streamline required field studies on your projects? Do you

believe that there could be time and cost savings associated with the use of such technologies (explain)?

5. **Question 26 (For MD, OH and WA only)** – You've indicated the use of several new or state-of-the-art monitoring techniques for conducting hydrologic monitoring of streams or wetland mitigation sites. Provide three examples how such techniques have been used in this regard. Do you see any particular advantages or disadvantages to the use of the various techniques for various applications?

   Question 26 (For CA only) – Can you identify whether or not any new or state-of the-art monitoring techniques for conducting hydrologic monitoring of streams or wetland mitigation sites have been utilized for your projects? If so, please specify types. If not, can you explain why such techniques have not been used? Are there any situations where you have considered or wished that you could have used such techniques? Do you believe that there are any particular advantages or disadvantages to the use of such techniques for various applications?

6. **Question 27** – What specific programmatic agreements do you have in place with federal or state regulatory/review agencies to streamline the ecological data collection processes for DOT projects? Do you believe that they are effective in streamlining the data collection processes (if so, please explain). Are there any basic changes that could be made to such agreements that would make them more effective?

7. **General** – Are there any other types of cutting edge technology and/or procedures not covered by our survey that your State DOT employs or requires to be used to collect, identify and/or record ecological data (if yes, please explain). Are there any other types of cutting edge technology and/or procedures not covered by our survey that your State DOT does not currently use or require, but is considering to be used to collect, identify and/or record ecological data in the future (if so, please explain).

8. **Question 28** – You have indicated that you believe that your state is at the forefront of cutting edge technology and/or procedure. What specific capabilities or technologies do you feel that you possess that puts you into that category? What specific capabilities or technologies do you feel are necessary for any state to possess in order for such state to be classified in that category as well? Is there any specific advice that you can offer to help another state to attain that category? Do you feel that the specific equipment and procedures that you use to collect ecological field data help you to save time and/or money (explain)? Are there specific equipment items that you currently do not possess which you plan on purchasing or requiring to be used which will further enhance your state's capabilities in the area of Ecology?

9. If we were to reach out to one consulting firm that does much of your Ecology work, who would you recommend? Please provide a contact name, address, phone number and firm name for up to three firms.

10. If we choose to present the results of this follow-up survey and specifically credit you as the interviewee and your agency as the subject case study, is that acceptable, or do you and the agency prefer to remain anonymous?

Appendix B.3 Ecology Consultant Survey Questions

Ecology:

1. **We asked (Specify State DOT): "Does your state DOT use and/or require the use of GPS to record locations and/or for data collection with regards to ecologically sensitive sites, vegetation, wildlife and/or T&E species?"**

   If the State DOT responded "yes" (which all states did):

   How has your firm/agency specifically used GPS for data collection and recordation of ecologically sensitive sites, vegetation, wildlife and/or threatened and endangered species for the state DOT in question?

   In general, on what percentage of the projects that your firm/agency has been involved for the state DOT in question have you utilized GPS for data collection and recordation of ecologically sensitive sites, vegetation, wildlife and/or threatened and endangered species? How does this compare to any other state DOTs for whom you have worked?

   Do you find such use to be a benefit in terms of overall time and cost savings? Please explain.

   Are there situations where your firm/agency has not used GPS for data collection and recordation of ecologically sensitive sites, vegetation, wildlife and/or threatened and endangered species for a project conducted for the state DOT in question? If so, please explain the circumstances.

   In general, what situations do you believe would not call for the use of GPS for data collection and recordation of ecologically sensitive sites, vegetation, wildlife and/or threatened and endangered species?

   What are the primary GPS tools that you use in this regard (e.g., handheld, backpack, total station with GPS interface, other) and how is the use of each tool influenced by the situation?

   Would you use or propose to use GPS for data collection and recordation of ecologically sensitive sites, vegetation, wildlife and/or threatened and endangered species, even if the state DOT in question did not employ or require such use? Why or why not?

2. **We asked (Specify State DOT): "Are there IT/GIS technologies available to your state DOT and its consultants from some centralized source within the state?"**

   If the State DOT responded "yes" (which all states did):

   Which types of GIS data are currently available or not available to you as the consultant of the state DOT in question from a centralized source within the state? Which types of GIS

data that are currently available are most useful to your firm/agency as a consultant to the state DOT in question?

How do you access and utilize the GIS information currently available from a centralized source?

For those types of data not currently available, are you aware of any intention within the state in question to eventually include such GIS data in a centralized source in the future? Which types of data would you specifically like to see available which currently do not exist?

What do your feel are the advantages/disadvantages to your firm/agency working as a consultant to the state DOT in question from having or not having a centralized GIS data source for certain data types within the state?

3. **We asked (Specify State DOT): "Does your state DOT actively utilize wetland banking in order to expedite the mitigation process and/or reduce the level of fieldwork required for mitigation?"**

   If the state DOT responded "yes":

   What do you perceive as the advantages/disadvantages of using a bank, in terms facilitating project approvals, both for the state DOT in question and for your firm/agency working as a consultant?

   What are most common situations in which a bank is used for mitigation, either in the subject state or other states where your firm/agency has worked as a consultant?

   In addition to perhaps expediting the mitigation process, do you find that wetland banking effectively reduces the level of fieldwork required and associated costs for mitigation? What would be the implication of that to your firm/agency as the consultant?

   If the state DOT responded "no":

   To your knowledge, can you explain why such banks are not currently used within the subject state (e.g., is there a technical or administrative impediment to such use)?

   To your knowledge, is there any intent to use banks in the future? Are there banks that exist in other states in which you have served as consultant to the state DOT where you have recommended their use as mitigation for projects?

   What type of situation would you use a bank for if it were available?

   In addition to perhaps expediting the mitigation process, do you believe that wetland banking, if available, could effectively reduce the level of fieldwork required and associated costs for mitigation? What would be the implication of that to your firm/agency as the consultant?

4. **We asked (<u>Specify State DOT</u>): "Does your state DOT use and/or require the use of remote sensing tools in order to facilitate and/or streamline required field studies?"**

   If the State DOT responded "yes":

   Please identify the specific remote sensing tools used by your firm/agency as the consultant to the state DOT in question. Also, please explain the specific situation(s) when such tools have been used by your firm/agency as the consultant to the state DOT in question.

   Please identify any differences in specific remote sensing tools and specific situations when such tools have been used by your firm/agency as the consultant to any other state DOTs in comparison to when you have worked for the state DOT in question.

   How do such technologies facilitate and/or streamline required field studies on DOT projects?

   Do you believe that there are real time and cost savings to the state DOT in question that result from such use (explain)? How about to your firm/agency as the consultant to the state DOT in question?

   If the State DOT responded "no":

   To your knowledge, can you explain why remote sensing tools are not employed or required for use by the state DOT in question?

   Would you prefer to use, or do you actually use remote sensing tools even though the state DOT in question does not employ or require such use? Why or why not?

   Have you used remote sensing tools when your firm/agency has worked as a consultant for other state DOTs? Please elaborate.

   Do you believe that such technologies can facilitate and/or streamline required field studies on DOT projects?

   Do you believe that there could be real time and cost savings to the state DOT in question if remote sensing tools were used (please explain)?

5. **We asked (<u>Specific State DOT</u>): "Does your state DOT use any new or state of the art monitoring techniques for hydrologic monitoring of stream and wetland mitigation sites? (electronic data logging, biological monitoring, soil reduction probes, infrared cameras, other)"**

   If the state DOT responded "yes":

If possible, provide three examples how such techniques have been used by your firm/agency while working as a consultant to the state DOT in question? How about for other state DOTs for whom you have worked?

Would you use or propose to use such state-of-the art monitoring techniques even if the state DOT in question did not employ or require such use?

Do you see any particular advantages or disadvantages, both for the state DOT as well as for the consultant, in terms of the use of the various techniques for various applications? Please explain.

If the state DOT responded "no":

Do you know if the state DOT in question has any particular reasons why such techniques have not been used?

Would you prefer to use, or have you actually used such state-of-the-art monitoring techniques for hydrologic monitoring, even though the state DOT in question does not employ or require such use? Why or why not?

Do you see any particular advantages or disadvantages, both for the state DOT as well as for the consultant, in terms of the use of the various techniques for various applications? Please explain.

6. **We asked (Specify State DOT): "Does your state have any programmatic agreements (general or project specific) in place with federal or state regulatory/review agencies to streamline the ecological processes for DOT projects?"**

   If the State DOT responded "yes" (which all states did):

   Do you believe that the programmatic agreement(s) in place within the subject state are effective in streamlining the data collection processes, from both the state DOT and consultant perspectives? (Please explain). How about in other states where your firm/agency has worked as a consultant to the state DOT?

   In your opinion, are there any basic changes that could be made to such agreements that would make them more effective?

7. **General** – Are there any other types of cutting edge technology and/or procedures not covered by our survey that your firm/agency has utilized for the state DOT in question or that are being considered for use in the future? If so, please explain.

   Are there any other types of cutting edge technology and/or procedures not covered by our survey that your firm/agency has utilized for other state DOTs? If yes, please explain.

What other technologies would you like to see be used by the state DOT in question?

8. **Question 28** – The state DOT in question has indicated that it believes it is at the forefront of cutting edge technology and/or procedure. In your opinion, what specific capabilities or technologies do you feel helped put them into that category?

   What specific capabilities or technologies do you feel are necessary for any state to possess in order for such state to be classified in that category as well?

   Is there any specific advice that you can offer to help another state to attain that category?

   What do you believe is the role / responsibility of a consultant to this or any other state DOT in placing them at the forefront of cutting edge technology and/or procedure?

9. If we choose to present the results of this follow-up survey and specifically credit you as the interviewee and your firm as the subject case study, is that acceptable, or do you and firm/agency prefer to remain anonymous?

Appendix B.4 Ecology State DOT Website Review

Following the Task 1 online survey, a review of the websites for those state DOTs responding that they consider themselves to be "at the forefront of cutting edge technology" in their field and are willing to participate in a follow-up interview was conducted. The purpose of this website review was to attempt to provide further background on each state's technologies and procedures in advance of the more detailed interviews to be conducted over the phone during Task 2 of this research. The intent of the follow-up interview is to obtain greater detail on the responses provided in the online survey in order get a better understanding of each state's practices.

A total of four state DOTs that took the initial survey considered themselves to be at the forefront of cutting edge field technology in the area of *Ecology* and were willing to participate in the follow-up interviews. These are; California, Maryland, Ohio and Washington. The results of the website review for each of these state DOTs that may be solicited for participation in the follow-up interview are presented below.

California: According to the survey results, Caltrans uses GPS to record the location of certain sites as well as for actual data collection and recordation. GIS information on land use is available to Caltrans and its consultants as well. Caltrans uses wetland banking in the mitigation process and also uses ground penetrating radar and digital photography to facilitate required field studies. Caltrans also indicated that there are programmatic agreement(s) in place with federal or state regulatory/review agencies in order to streamline ecological processes for Caltrans projects.

A review of Caltrans Division of Environmental Analysis website under "biological resource issues" revealed that Caltrans, in coordination with the FHWA and the departments of transportation in Oregon and Washington, recently established a Fisheries Hydroacoustic Working Group (FHWG) in order to improve and coordinate information on fishery impacts due to underwater sound pressure caused by in-water pile driving. The FHWP includes representatives from several federal and state resource agencies. Caltrans also has a group that studies the construction and operational road noise effects on avian behavior and health-bird bioacoustics.

The California Essential Habitat Connectivity Project is a highly-collaborative endeavor sponsored by Caltrans and Department of Fish and Game (DFG) with three major goals: 1) Develop a statewide wildlife habitat connectivity map using GIS analysis and modeling; 2) Identify criteria and priorities for connectivity analyses, and; 3) Develop a strategic plan that will outline the framework necessary to complete connectivity analyses.

These initiatives, among others, will likely be discussed further during follow-up interviews with a Caltrans ecology specialist.

Maryland: Maryland State Highway Administration (Maryland SHA) uses GPS to record the location of ecologically sensitive sites, vegetation, wildlife and/or threatened & endangered species. GPS is also used for actual data collection and/or recordation in the same regard. Maryland has soils IT/GIS technologies available to its consultants from a centralized location within the state. Maryland SHA does not actively utilize wetland banking and does not use

and/or require the use of remote sensing tools in order to facilitate or streamline required field studies. Digital photography is used, as well as biological monitoring, electronic data logging and soil reduction probes. There are Programmatic Agreements in place as well, to streamline the ecological processes for Maryland SHA projects.

Maryland SHA's Department of the Environment has an extensive website covering all topics related to air, water and land.

Ohio: Ohio DOT (ODOT) uses GPS for collection and recordation of data related to ecologically sensitive sites, vegetation, wildlife and/or threatened and endangered species. There are also wetland IT/GIS technologies available to the ODOT and its consultants from a centralized source. ODOT actively utilizes wetland banking in order to expedite the mitigation process. Remote sensing tools are not used. Digital photography is used to aid in field work, and monitoring techniques such as biological monitoring and electronic data logging are also used for the hydrologic monitoring of stream and wetland mitigation sites. ODOT reports that there are Programmatic Agreements in place to streamline the ecological processes for ODOT projects.

The ODOT Environmental Services, Ecological Resources unit works with the Permits unit and deals with ecological surveys, water quality, wetland delineation, stream assessment, sole source aquifers, source water protection for drinking water (including wellhead protection), endangered species, farmland impact, scenic rivers and mitigation monitoring.

Washington: WSDOT's survey responses indicate the use of GPS to record the location and data recordation of ecologically sensitive sites, vegetation, wildlife and/or threatened and endangered species. WSDOT uses wetland banking in order to expedite the mitigation process. Some of the technologies being used by WSDOT include LIDAR, biological monitoring, electronic data logging, infrared cameras and digital photography. It was indicated that a Programmatic Agreement is in place with federal and or state regulatory/review agencies to streamline ecology fieldwork practices.

WSDOT's website has extensive publications, guidelines and templates available to users. There are also many agreements and Memorandums of Understanding between WSDOT, the Department of Ecology and various other state agencies. The website provides background material with opportunities for further exploration into the world of wetland delineation, mitigation and monitoring. WSDOT also provides internship opportunities in this field in partnership with The Evergreen State College.

Appendix C: Water Permitting

C.1. Water Permitting Online Survey
C.2. State DOT Interview Questions
C.3. Consultant Survey Questions
C.4. State DOT Website Review

PREVIEW: NCHRP Project 25-25 (48) Compendium of Environmental Fieldwo...

Save and continue survey later

NCHRP Project 25-25 (48) Compendium of Environmental Fieldwork Technologies State DOT Survey

Select Discipline
Please select your particular discipline of expertise so that you can be directed to the appropriate set of questions.
Welcome!

This online survey is being conducted for research under the National Cooperative Highway Research Program (NCHRP) Project 25-25(48). The purpose of this research is to develop a compendium of environmental fieldwork technologies to be shared among state DOTs in order to promote time-and-cost savings for each DOT, while still providing the necessary level of detail required. This research seeks state-of-the-art practices, or even simple, tried-and-true practices that offer tools and tips that can provide cost and/or time savings for other DOTs.

The participation of your state DOT in this nationwide survey will provide a valuable contribution to the overall research for the compendium, which will ultimately be presented via a webcast to the state DOTs and others dealing with environmental issues and procedures for transportation projects. The findings presented in this first phase of the research will provide a better understanding of how state DOTs are currently conducting their fieldwork, as well as in identifying several states to target for a more detailed follow-up interview in each discipline. For this reason, it is requested that you please provide contact information when prompted by the survey.

If you happen to be the specialist for more than one of the four discipline areas you will need to complete a separate survey for each discipline; however, please limit to one responder in each discipline per state. If you find that you cannot complete the survey, please use the option provided to save your work and return to the same survey at a later time. When you are finished with your survey, please click the "next" button on the bottom of the page so that your survey is officially submitted.

This survey is very brief and should only take a few minutes of your time.

1. Please select your state:*
-- Please Select --

2. Please select your discipline;*
- ○ Cultural Resources
- ○ Ecology
- ○ Noise
- ○ Water Permitting

Click to Next Page

Take a look under the hood
Online Surveys powered by SurveyGizmo

Save and continue survey later

NCHRP Project 25-25 (48) Compendium of Environmental Fieldwork Technologies State DOT Survey

Water Permitting
Please take a moment to answer the following questions regarding water permitting field practices in your state.

46. Please provide your contact information.

First Name*

Last Name*

Title*

Email Address*

Phone Number*

47. Does your state DOT use and/or require the use of GPS to collect and record locational and attribute information for stormwater features such as drainage outlets?

- ○ Yes
- ◉ No

48. During project planning does your state DOT use any of the following to collect site data at proposed stormwater facility locations or receiving waters?

- ☐ Field permeability tests performed to evaluate soil permeability rate
- ☐ Lab permeability tests performed to evaluate soil permeability rate
- ☐ Automated groundwater level logging performed to evaluate groundwater depth
- ☐ Neither

49. Does your state DOT collect streambed sediment data at stream crossings for use during planning/ design or monitoring stages?

- ○ Yes
- ◉ No

50. Do you employ specific sediment transport models such as HEC-RAS that dictate specific field data collection needs?

- ☐ HEC-RAS is typically used

- [ ] No sediment transport modeling is performed and no associated field data is collected
- [ ] Other specialized sediment transport models used

51. Does your state DOT require effluent stormwater quality monitoring from construction sites and/or operational facilities to evaluate the efficiency of BMPs?

- (•) Yes
- ( ) No

52. Are any of the following standard methods used for sampling and analysis?

- [ ] EPA- Environmental Protection Agency
- [ ] ASTM- American Society for Testing and Materials
- [ ] AWWA- American Water Works Association
- [ ] APHA- American Public Health Association
- [ ] Other

53. What is the effluent sampled for?

- [ ] Suspended solids
- [ ] Chlorides
- [ ] pH
- [ ] Petroleum hydrocarbons
- [ ] Nutrients
- [ ] Pathogens
- [ ] Other

54. Are Low Impact Development (LID) techniques used in your state in new highway projects?

- (•) Yes
- ( ) No

55. Are LID techniques used to retrofit existing treatment systems in older roadways?

- (•) Yes
- ( ) No

56. Does your state DOT use bioretention basins?

- (•) Yes
- ( ) No

57. Does your state DOT implement regular preventative maintenance of stormwater management/ treatment devices (stormwater inlets, detention or bioretention basins, conveyance systems, hydrodynamic/vortex separators, etc.) to optimize performance?

- (•) Yes
- ( ) No

58. Does your state use more stringent BMPs with regards to discharges into impaired or TMDL watersheds in order to acheive permit compliance?

- (•) Yes
- ( ) No
- ( ) Not Applicable

59. Does your state DOT implement specific policy initiatives and/or employee education efforts to foster good environmental stewardship and minimize stormwater pollution?

- (•) Yes
- ( ) No

60. Do you consider your state DOT to be at the forefront of cutting edge technology and/or procedure used to collect, identify and record water resources data?

- (●) Yes
- ( ) No

61. Would you recommend or like for your state DOT to be considered for a follow-up telephone survey as a state-of-the-practice leader in water resources permitting?

- (●) Yes
- ( ) No

62. Please identify a water resources permitting contact person within your agency who would be available to participate in a follow-up telephone survey (if other than yourself).

First Name

Last Name

Title

Email Address

Phone Number

Finished? Submit your Survey

Appendix C.2 Water Permitting State DOT Interview Questions

Water Permitting :

1. **Question 47 (For NY and WA only)** – Being a State DOT that utilizes GPS related technology for collection and/or recordation of stormwater features, please explain exactly how GPS is primarily used in this regard. In what manner has such use been effective as a means of streamlining the data collection and recordation process? Has your State DOT implemented an inlet identification or outfall mapping GIS database? If so, how successful/useful has this system been for you in your stormwater management / permit compliance operations? What are the primary GPS tools that you use in this regard (e.g., handheld, backpack, total station with GPS interface, other), and how is the use of each tool influenced by the situation? Are there other specific applications of GPS/GIS that your State DOT uses in order to optimize stormwater management efficiencies and save costs?

   Question 47 (For CA only) – Being a State DOT that does not utilize GPS technology related to collection and/or recordation of stormwater features, please explain why such technique is not used in this regard. Do you believe that such use can be an effective means of streamlining the data collection and recordation process? Has your State DOT implemented an inlet identification or outfall mapping GIS database? If so, how successful/useful has this system been for you in your stormwater management / permit compliance operations? Are there any specific applications of GPS/GIS that your State DOT uses in order to optimize stormwater management efficiencies and save costs?

2. **Question 49** – What specific field permeability test methods do you find to be the most reliable and how long have they been implemented? If laboratory permeability tests are also performed, do you find good correlation between the field and laboratory test results? Based on your test results, have you encountered a relative predictability of approximate soil permeability values for various soil types on subsequent projects, or do you find significant variability in test results (field or lab) for similar site conditions?

3. **Question 49 (For WA only)** – Being a State DOT that utilizes automated groundwater level logging to monitor groundwater elevations at stormwater management facility locations, can you identify which logger models have been found to provide the best performance? Are there only certain situations where you use such logging, or is such logging performed routinely? If certain situations only, please explain. Do you have any specific insights regarding groundwater monitoring field techniques, which may be worth sharing?

   Question 49 (For CA and NY only) – Being a State DOT that apparently does not use automated level logging to monitor groundwater elevations at stormwater management facility locations, can you identify if the use of such logging has ever been considered? If so, explain why it hasn't been utilized to date. Do you see potential advantage to the use of such logging either routinely or in certain situations (please explain)? Do you have any specific insights regarding groundwater monitoring field techniques, which may be worth sharing?

4. **Question 50 (For WA only) –** A common purpose of collecting and analyzing streambed sediment data along streams and at stream crossings is for streambed erosion/sediment transport analyses and/or bridge scour evaluations. Being a State DOT that collects streambed sediment data, please indicate if this is the primary use of the data, or are there other intended uses? What streambed sediment data collection methods have proven to be the most efficient/useful for your purposes?

   Question 50 (For CA and NY only) – A common purpose of collecting and analyzing streambed sediment data along streams and at stream crossings is for streambed erosion/sediment transport analyses and/or bridge scour evaluations. Being a State DOT that apparently does not collect streambed sediment data, please indicate if this has been an issue in the past. If so, please give some examples. Has any consideration been given to collecting streambed sediment data in the future? Are there specific data collection methods that would be preferable for use in this regard?

5. **Questions 52 - 54 (For WA only) –** As a State DOT that requires stormwater quality monitoring, please indicate its primary purpose(s) (e.g., meeting specific stormwater permit requirements; evaluating BMP performance as a purely voluntary effort; other - explain). What criteria are used for determining the storm events to sample (e.g., total rainfall amount, minimum inter-event period between sampling rounds, etc.)? Are BMP inlets (influent) sampled in addition to outlets (effluent), or is sampling only performed at outlets? Are there other sampling locations? If both inlet and outlet locations are sampled, are the results used to calculate BMP performance efficiency and if so, do you find a good correlation between the calculated performance efficiencies and those specified in the literature? How is stormwater quality sampling usually performed (e.g., automatic samplers, grab sampling, composite sampling, etc.)? What parameters are usually sampled and what laboratory analytical methods are used? Are the sampled parameters specified based on stormwater permit requirements, site-specific conditions, or both? Do you see substantial advantages in requiring the use of stormwater quality monitoring (if so, please explain)?

   Questions 52 - 54 (For CA and NY only) – As a State DOT that apparently does not require stormwater quality monitoring, please indicate if this has ever been an issue in the past. If so, please give examples. Has any consideration been given to requiring stormwater quality monitoring in the future for evaluation of BMP performance or other reason? If yes, what criteria would you like to be used for determining the storm events to sample (e.g., total rainfall amount, minimum inter-event period between sampling rounds, etc.)? Would you consider sampling at inlets (influent) in addition to outlets (effluent), or would you only consider sampling at outlets? What techniques would you consider using for performing stormwater quality sampling (e.g., automatic samplers, grab sampling, composite sampling, etc.). Do you see potential advantages in requiring the use of stormwater quality monitoring (if so, please explain)?

6. **Questions 55 – 57** – What Low Impact Development (LID) techniques are typically used by your State DOT for stormwater management? Is the use of LID a statutory requirement or a voluntary BMP? Are there any constraints (design, environmental, right-of-way, etc.) limiting the use of LID techniques by your State DOT (if yes, please explain)? Are there

performance data or experiences with LID techniques such as bioretention basins or other LID techniques that can be shared?

7. **Question 59** – For impaired or TMDL watersheds, how are BMPs and field monitoring procedures (if applicable) "tightened" (i.e., made more stringent) in order to achieve regulatory permit compliance?

8. **Question 60 –** Proper material (e.g., deicing salts, fuels, etc.) handling and storage to minimize contact with stormwater is one example of a good housekeeping practice for minimizing stormwater pollution. What other field practices, specific policy initiatives, and/or employee education efforts are implemented by your State DOT to control stormwater pollution and maintain stormwater permit compliance?

9. **General** – Are there any other types of cutting edge technology and/or procedures not covered by our survey that your State DOT employs or requires to be used to collect, identify and/or record water permitting data (if yes, please explain)? Are there any other types of cutting edge technology and/or procedures not covered by our survey that your State DOT does not currently use or require, but is considering to be used to collect, identify and/or record water permitting data in the future (if so, please explain)?

10. **Question 61** – You have indicated that you believe that your State is at the forefront of cutting edge technology and/or procedure. What specific capabilities or technologies do you feel that you possess that puts you into that category? What specific capabilities or technologies do you feel are necessary for any state to possess in order for such state to be classified in that category as well? Is there any specific advice that you can offer to help another state to attain that category? Do you feel that the specific equipment and procedures that you use to collect water permitting field data help you to save time and/or money (explain)? Are there specific equipment/technology items that you currently do not possess that you plan on purchasing or requiring to be used, which will further enhance your State's capabilities in the area of Water Permitting?

11. If we were to reach out to one consulting firm that does much of your Water Permitting work, who would you recommend? Please provide a contact name, address, phone number and firm name for up to three firms.

12. If we choose to present the results of this follow-up survey and specifically credit you as the interviewee and your agency as the subject case study, is that acceptable, or do you and the agency prefer to remain anonymous?

Appendix C.3 Water Permitting Consultant Survey Questions

Water Permitting:

1. **We asked (Specify State DOT): "Does your state DOT use and/or require the use of GPS to collect and record locational and attribute information for stormwater features such as drainage outlets?"**

   If the State DOT responded "yes":

   Please explain if, and exactly how your firm/agency has used GPS to collect and record locational and attribute information for stormwater features when working as a consultant for the state DOT in question.

   In what manner has such use been effective as a means of streamlining the data collection and recordation process for both the state DOT and for the consultant? Do you find such use to be a benefit in terms of overall time and cost savings? Please explain.

   What are the primary GPS tools that you use in this regard (e.g., handheld, backpack, total station with GPS interface, other), and how is the use of each tool influenced by the situation?

   Are there situations where your firm/agency has not used GPS to collect and record locational and attribute information for stormwater features when working as a consultant for the state DOT in question? If so, please explain the circumstances.

   In general, what situations do you believe would not call for the use of GPS to collect and record locational and attribute information for stormwater features when working as a consultant for the state DOT in question or any other state DOT?

   If the State DOT responded "no":

   To your knowledge, is there a particular reason that the State DOT in question has not employed or required the use of GPS to collect and record locational and attribute information for stormwater features?

   Are there situations where your firm/agency has used GPS to collect and record locational and attribute information for stormwater features for the state DOT in question, even though the state DOT does not employ and/or require such use? If so, please explain the circumstances.

   Do you believe that using GPS to collect and record locational and attribute information for stormwater features can be effective as a means of streamlining the data collection and recordation process for both the state DOT and for the consultant? Do you believe that there could be a benefit in terms of overall time and cost savings? Please explain.

1a. **We asked (Specify State DOT): "Does your state DOT typically use or require the use of GPS field data integrated with GIS software for real time field data validation and enhancing overall field mapping efficiency?"**

If the State DOT in question has implemented an inlet identification or outfall mapping GIS database, how has this benefited or impacted your work as a consultant dealing with stormwater management / permit compliance operations?

Are there any specific applications of GPS/GIS that the State DOT in question uses in order to optimize stormwater management efficiencies and save costs, and how have these applications benefited or impacted your work as a consultant?

2. **We asked (Specify State DOT): "What specific field permeability test methods do your find to be the most reliable?**

If applicable, what specific field permeability test methods do you find to be the most reliable when working as a consultant to the state DOT in question? How about when working as a consultant to other state DOTs, if different?

If laboratory permeability tests are also performed as part of your work as a consultant to the state DOT in question, do you find good correlation between the field and laboratory test results? How about when working as a consultant to other state DOTs, if different?

Based on your test results, have you encountered a relative predictability of approximate soil permeability values for various soil types on subsequent projects, or do you find significant variability in test results (field or lab) for similar site conditions?

3. **We asked (Specify State DOT): "During project planning does your state DOT use automated groundwater level logging to collect site data at stormwater facility locations or receiving waters?"**

If the State DOT responded "yes":

Has your firm/agency conducted any such automated groundwater level logging to collect site data at stormwater facility locations or receiving waters when working as a consultant to the state DOT in question? How about for any other state DOTs?

As applicable, in your opinion, which logger models have been found to provide the best performance?

Are there only certain situations where you would normally use such logging, or is such logging performed routinely? If certain situations only, please explain.

Do you see potential advantage to the use of such logging either routinely or in certain situations (please explain)?

Do you have any specific insights regarding groundwater monitoring field techniques, which may be worth sharing?

If the State DOT responded "no":

Even though the state DOT in question does not employ or require the use of such automated groundwater level logging to collect site data at stormwater facility locations or receiving waters, has your firm/agency conducted such groundwater level logging when working as a consultant to the state DOT in question? How about for any other state DOTs?

As applicable, in your opinion, which logger models have been found to provide the best performance?

Are there only certain situations where you would normally use such logging, or is such logging performed routinely? If certain situations only, please explain.

Do you see potential advantage to the use of such logging either routinely or in certain situations (please explain)?

Do you have any specific insights regarding groundwater monitoring field techniques, which may be worth sharing?

4. **We asked (<u>Specify State DOT</u>): "Does your state DOT collect streambed sediment data at stream crossings for use during planning/design or monitoring stages?"**

If the State DOT responded "yes":

A common purpose of collecting and analyzing streambed sediment data along streams and at stream crossings is for streambed erosion/sediment transport analyses and/or bridge scour evaluations. Working as a consultant to the specific state DOT in question, has your firm/agency ever collected streambed sediment data in this regard? How about for other state DOTs? If so (either case), please indicate if this is the primary use of the data, or are there other intended uses? What streambed sediment data collection methods have proven to be the most efficient/useful for your purposes?

If the State DOT responded "no":

Even though the state DOT in question does not typically collect streambed sediment data at stream crossings, when working as a consultant to the specific state DOT in question, has your firm/agency ever collected streambed sediment data in this regard? How about for other state DOTs? Do you believe that by not collecting streambed sediment data at stream crossings can be, or has been an issue in the past? If so, please explain. To your knowledge, has your firm/agency given any consideration to collecting streambed sediment data in the future for projects conducted for the state DOT in question? Are there specific data collection methods that would be preferable for use in this regard?

5. **We asked (<u>Specify State DOT</u>): "Does your state DOT require effluent stormwater quality monitoring from construction sites and/or operation facilities to evaluate the efficiency of BMPs? Are there any standard methods used for sampling and analysis? What is the effluent sampled for?"**

   If the State DOT responded "yes":

   Have you worked for the state DOT in question with specific regard to effluent stormwater quality monitoring from construction sites and/or operation facilities to evaluate the efficiency of BMPs? How about for other state DOTs? If so, from your perspective as the consultant, please indicate its primary purpose(s) (e.g., meeting specific stormwater permit requirements; evaluating BMP performance as a purely voluntary effort; other - explain).

   What criteria are used for determining the storm events to sample (e.g., total rainfall amount, minimum inter-event period between sampling rounds, etc.)?

   Are BMP inlets (influent) sampled in addition to outlets (effluent), or is sampling only performed at outlets? Are there other sampling locations? If both inlet and outlet locations are sampled, are the results used to calculate BMP performance efficiency and if so, do you find a good correlation between the calculated performance efficiencies and those specified in the literature?

   How is stormwater quality sampling usually performed (e.g., automatic samplers, grab sampling, composite sampling, etc.)?

   What parameters are usually sampled and what laboratory analytical methods are used?

   Are the sampled parameters specified based on stormwater permit requirements, site-specific conditions, or both?

   Do you see substantial advantages (or disadvantages) to either the state DOT or the consultant in requiring the use of stormwater quality monitoring (if so, please explain)?

   If the State DOT responded "no":

   Even though the state DOT in question does not require stormwater quality monitoring, has your firm/agency ever worked for the state DOT in question with specific regard to effluent stormwater quality monitoring from construction sites and/or operation facilities to evaluate the efficiency of BMPs? How about for other state DOTs? If so, from your perspective as the consultant, please indicate its primary purpose(s) (e.g., meeting specific stormwater permit requirements; evaluating BMP performance as a purely voluntary effort; other - explain).

   Do you believe that by not conducting stormwater quality monitoring can be, or has been an issue in the past. If so, please explain.

Whether or not you've actually conducted stormwater quality monitoring for the state DOT in question:

- What criteria would you like to be used for determining the storm events to sample (e.g., total rainfall amount, minimum inter-event period between sampling rounds, etc.)?

- Would you like the state DOT to consider sampling at inlets (influent) in addition to outlets (effluent), or would you only consider sampling at outlets?

- What techniques would you consider using for performing stormwater quality sampling (e.g., automatic samplers, grab sampling, composite sampling, etc.).

- Do you see potential advantages in requiring the use of stormwater quality monitoring (if so, please explain)?

Do you see substantial advantages (or disadvantages) to either the state DOT or the consultant in requiring the use of stormwater quality monitoring (if so, please explain)?

6. **We asked (<u>Specify State DOT</u>): "Are LID techniques used in your state in new highway projects? Are LID techniques used to retrofit existing treatment systems in older roadways? Does your state DOT use bioretention basins?"**

   What Low Impact Development (LID) techniques has your firm/agency used working as a consultant to the state DOT in question in terms of stormwater management? How about for other state DOTs?

   Have you applied the use of LID in response to a statutory requirement or a voluntary BMP in the subject state? How about in other states?

   Are there any constraints (design, environmental, right-of-way, etc.) limiting the use of LID techniques by the DOT in question (if yes, please explain)? How does that affect the work performed by your firm/agency working as a consultant to the state DOT?

   Are there performance data or experiences with LID techniques such as bioretention basins or other LID techniques that can be shared?

7. **We asked (<u>Specify State DOT</u>): "Does your state use more stringent BMPs with regards to discharges into impaired or TMDL watersheds in order to achieve permit compliance?"**

   For impaired or TMDL watersheds, how are BMPs and field monitoring procedures (if applicable) "tightened" (i.e., made more stringent) in order to achieve regulatory permit compliance?

8. **We asked (<u>Specify State DOT</u>): "Does your state DOT implement specific policy initiatives and/or employee education efforts to foster good environmental stewardship and minimize stormwater pollution?"**

   If the State DOT responded "yes":

   How have such initiatives benefited the work performed by your firm/agency or others working in the field of stormwater management?

   What other field practices, specific policy initiatives, and/or employee education efforts are implemented have been implemented by the state DOT in question to control stormwater pollution and maintain stormwater permit compliance? How about other state DOTs? How have they benefited the fieldwork conducted by your employees working as consultants to the state DOT?

   If the State DOT responded "no":

   Do you believe that such initiatives could benefit the work performed by your firm/agency or others working in the field of stormwater management?

   What other field practices, specific policy initiatives, and/or employee education efforts are implemented have been implemented by the state DOT in question to control stormwater pollution and maintain stormwater permit compliance? How about other state DOTs? How have they benefited the fieldwork conducted by your employees working as consultants to the state DOT?

9. **General** – Are there any other types of cutting edge technology and/or procedures not covered by our survey that your firm/agency has utilized for the state DOT in question or that are being considered for use in the future? If so, please explain.

   Are there any other types of cutting edge technology and/or procedures not covered by our survey that your firm/agency has utilized for other state DOTs? If yes, please explain.

   What other technologies would you like to see be used by the state DOT in question?

10. **Question 28:** The state DOT in question has indicated that it believes it is at the forefront of cutting edge technology and/or procedure. In your opinion, what specific capabilities or technologies do you feel helped put them into that category?

    What specific capabilities or technologies do you feel are necessary for any state to possess in order for such state to be classified in that category as well?

    Is there any specific advice that you can offer to help another state to attain that category?

    What do you believe is the role / responsibility of a consultant to this or any other state DOT in placing them at the forefront of cutting edge technology and/or procedure?

11. If we choose to present the results of this follow-up survey and specifically credit you as the interviewee and your firm as the subject case study, is that acceptable, or do you and firm/agency prefer to remain anonymous?

Appendix C.4 Water Permitting State DOT Website Review

Following the Task 1 online survey, a review of the websites for those state DOTs responding that they consider themselves to be "at the forefront of cutting edge technology" in their field and are willing to participate in a follow-up interview was conducted. The purpose of this website review was to attempt to provide further background on each state's technologies and procedures in advance of the more detailed interviews to be conducted over the phone during Task 2 of this research. The intent of the follow-up interview is to obtain greater detail on the responses provided in the online survey in order get a better understanding of each state's practices.

A total of three state DOTs that took the online survey considered themselves to be at the forefront of cutting edge field technology in the area of *Water Permitting* and were willing to participate in the follow-up interviews. These are; California, New York and Washington. The results of the website review for each of these state DOTs that may be solicited for participation in the follow-up interview are presented below.

California: According to the survey responses, Caltrans performs both field and lab permeability tests to evaluate soil permeability rates, and uses HEC-RAS as a sediment transport model for data collection. Caltrans also uses Low Impact Development (LID) techniques and bioretention basins in highway projects in the state. Caltrans implements regular preventative maintenance of stormwater management/treatment devices to optimize performance, and uses more stringent Best Management Practices (BMPs) with regards to discharges into impaired or TMDL watersheds in order to achieve permit compliance. Caltrans also implements specific policy initiatives and/or employee education efforts to foster good environmental stewardship and minimize stormwater pollution.

According to their website, Caltrans has a statewide Stormwater Program, which consists of the 2003 Stormwater Management Plan, regional work plans, monitoring and BMP development, public education and guidance for design, construction and maintenance activities. The overall goal of the Stormwater Program is to integrate appropriate stormwater control activities into ongoing activities, thus making control of stormwater pollution a part of Caltrans normal business practices.

New York: NYSDOT uses and/or requires the use of GPS to record the location and attribute information for stormwater features such as drainage outlets. Field permeability tests are performed to evaluate soil permeability rates. Streambed sediment data at stream crossings is not collected for use during planning, design or monitoring stages. HEC-RAS is typically used for the modeling of sediment transport. Effluent stormwater quality monitoring from construction sites and/or other operational facilities to evaluate the efficiency of BMPs is not required. Low Impact Development Techniques are used in new highway projects as well as to retrofit existing treatment systems in older roadways. Bioretention systems are used by NYSDOT, and regular preventative maintenance of stormwater management / treatment devices are also implemented by NYSDOT. More stringent BMPs are used with regards to discharges into impaired or TMDL watersheds in order to achieve permit compliance. NYSDOT also implements specific policy initiatives and/or employee education efforts to foster good environmental stewardship and minimize stormwater pollution.

NYSDOT's website provides links to stormwater management permits, certifications and procedures. Fact sheets and memorandums can also be found at the location.

Washington: WSDOT uses and/or requires the use of GPS to collect and record locational and attribute information for stormwater features such as drainage outlets. During project planning, WSDOT uses field permeability tests performed to evaluate soil permeability rates, lab permeability tests and automated groundwater level logging performed to evaluate groundwater depth to collect site data at proposed stormwater facility locations or receiving waters. Streambed sediment data is also collected at stream crossing for use during planning/design or monitoring states, typically using HEC-RAS. Effluent stormwater quality monitoring from construction sites and/or operation facilities is also required to evaluate the efficiency of BMPs. Both EPA standards and Washington State Department of Ecology Quality Assurance Project Plans are used for sampling and analysis. Effluent is sampled for: suspended solids, nutrients, pH, petroleum hydrocarbons and metals. WSDOT uses LID techniques in new highway projects, but not for retrofitting existing treatment systems in older roadways. Bioretention systems are also used. Regular preventative maintenance of stormwater management /treatment devices are not used by the State. The State does use more stringent BMPs with regards to discharges into impaired or TMDL watersheds in order to achieve permit compliance. Additionally, WSDOT has implemented specific policy initiatives and/or employee education efforts to foster good environmental stewardship and to minimize stormwater pollution.

WSDOT is currently undergoing an inventory of all stormwater outfalls throughout the state for the purpose of inventory database, prioritization, and retrofitting of all stormwater outfalls. Information will be gathered into a database and will include a thorough assessment of the conditions at each outfall. The database will then automatically generate a priority list of outfalls that require retrofit. Recommendations for retrofit best management practices (BMPs) are also included as part of the overall prioritization score for each outfall.

Appendix D: Noise Analysis

D.1. Noise Analysis Online Survey
D.2. State DOT Interview Questions
D.3. Consultant Survey Questions
D.4. State DOT Website Review

PREVIEW: NCHRP Project 25-25 (48) Compendium of Environmental Fieldwo...

Save and continue survey later

NCHRP Project 25-25 (48) Compendium of Environmental Fieldwork Technologies State DOT Survey

Select Discipline
Please select your particular discipline of expertise so that you can be directed to the appropriate set of questions.
Welcome!

This online survey is being conducted for research under the National Cooperative Highway Research Program (NCHRP) Project 25-25(48). The purpose of this research is to develop a compendium of environmental fieldwork technologies to be shared among state DOTs in order to promote time-and-cost savings for each DOT, while still providing the necessary level of detail required. This research seeks state-of-the-art practices, or even simple, tried-and-true practices that offer tools and tips that can provide cost and/or time savings for other DOTs.

The participation of your state DOT in this nationwide survey will provide a valuable contribution to the overall research for the compendium, which will ultimately be presented via a webcast to the state DOTs and others dealing with environmental issues and procedures for transportation projects. The findings presented in this first phase of the research will provide a better understanding of how state DOTs are currently conducting their fieldwork, as well as in identifying several states to target for a more detailed follow-up interview in each discipline. For this reason, it is requested that you please provide contact information when prompted by the survey.

If you happen to be the specialist for more than one of the four discipline areas you will need to complete a separate survey for each discipline; however, please limit to one responder in each discipline per state. If you find that you cannot complete the survey, please use the option provided to save your work and return to the same survey at a later time. When you are finished with your survey, please click the "next" button on the bottom of the page so that your survey is officially submitted.

This survey is very brief and should only take a few minutes of your time.

1. Please select your state:*
-- Please Select --

2. Please select your discipline;*
- ○ Cultural Resources
- ○ Ecology
- ○ Noise
- ○ Water Permitting

Click to Next Page

Take a look under the hood
Online Surveys powered by SurveyGizmo

Save and continue survey later

NCHRP Project 25-25 (48) Compendium of Environmental Fieldwork Technologies State DOT Survey

Noise
Please take a moment to answer the following questions regarding Noise field practices in your state.
31. Please provide your contact information.
First Name*

Last Name*

Title*

Email Address*

Phone Number*

32. Does your state DOT use or require that any of the following methodologies be used to determine the appropriate sampling period to conduct noise measurements for NEPA projects?
- ☐ Traffic peak hours/periods
- ☐ Highest traffic volume
- ☐ Level of Service C
- ☐ 24-hour noise measurements
- ☐ Other

33. What is the typical length of time used for each noise measurement?
- ○ 10 minutes
- ○ 20 minutes
- ○ 30 minutes
- ○ 60 minutes
- ○ 24 hours
- ○ Other

34. How many total short-term measurements are required to be taken at a given site?
- ○ One
- ○ 2 or 3 at different times of the day

- ○ 2 or 3 at the same time on different days
- ○ Other (please explain)

35. Does your state DOT require traffic counting in conjunction with noise measurements?

- ◉ Yes
- ○ No
- ○ Sometimes (please explain)

36. What is the purpose of the traffic counts?

- ☐ Model calibration
- ☐ Formula calculations
- ☐ Required by regulations
- ☐ Other (please explain)

37. What method or equipment does your state use for the traffic counts?

- ☐ Camcorder/video recordings
- ☐ Automatic Traffic Recorder (ATRs)
- ☐ Handheld counter
- ☐ Manual counts
- ☐ Other

38. Does your state DOT obtain and/or require collection of vehicle speeds?

- ◉ Yes
- ○ No

39. What tools are typically used for collection of speed data?

- ☐ Dopplar-radar gun
- ☐ Stopwatch
- ☐ Light sensor
- ☐ Pneumatic line
- ☐ Formula calculation
- ☐ Other

40. Does your state DOT obtain and/or require that meteorological data such as temperature and wind speed be obtained during noise measurements?

- ◉ Yes
- ○ No

41. Does your state DOT require that any other instruments be used in conjunction with the noise meter for collecting noise measurements (e.g., a data recorder that is linked to the sound level meter which will record and identify specific noise sources to explain peaks)?

- ☐ No
- ☑ Yes (please specify)

42. Which of the following equipment is used or required to be used by your state DOT for noise measurements, traffic and/or meteorological data collection?

- ☐ Type 1 or 2 Sound Level Meter (SLM)
- ☐ SLM that has simultaneous data collection for Broadband, Spectrum and Octave levels
- ☐ SLM that contains event trigger recording software

- [ ] SLM with remote data download
- [ ] SLM for long-term continuous use
- [ ] Handheld weather device
- [ ] Handheld wind meter
- [ ] Weather station
- [ ] Anemometer

43. Do you consider your state DOT to be at the forefront of cutting edge technology and/or procedure used to collect noise and associated data?

- (•) Yes
- ( ) No

44. Would you recommend or like for your state DOT to be considered for a follow-up telephone survey as a state-of-the-practice leader in noise field technologies?

- (•) Yes
- ( ) No

45. Please identify noise contact person within your agency that you would like to have participate in a follow-up telephone survey (if other than yourself).

First Name

Last Name

Title

Email Address

Phone Number

Click to Next Page

Appendix D.2 Noise Analysis State DOT Interview Questions

Noise:

1. **Question 32 (For CA and NJ only)** – You've indicated either in your response to Question 32 or to another question, that you use 24-hour measurements for identifying the peak noise hour. After taking 24-hour measurements to determine your noise measurement period, do you generally find that the noisiest hour is synonymous with the peak traffic periods? Is there any reason why you would ever use a methodology other than peak noise hour for identifying the period to conduct your noise measurements?

   Question 32 (For NY only) – You've indicated in your response to Question 32 that you use a variety of methods for determining the appropriate sampling period. How do you decide which method to apply in what conditions? In the case of 24-hour measurements to determine peak noise hour, do you generally find that the noisiest hour is synonymous with the peak traffic periods?

   Question 32 (For WA only) – You've indicated in your response to Question 32 that you use peak period traffic volumes for determining the appropriate sampling period. What is your reason for using traffic peak rather than noise peak? Have you ever had any problems with the use of this method? Is there ever a situation where you conduct 24-hour measurements to identify the sampling period? If so, explain.those situations.

2. **Question 33** – Is there any particular reason why you use the noise measurement period that you use? Is there any situation where this noise measurement period would not be appropriate or utilized?

3. **Question 34** (**For NY only)** – Do you require monitoring 2 – 3 times per day for each site in every situation? How about when you utilize peak noise hour and/or 24-hour measurements (as identified in Question 32)? If yes, how do you use the monitored information for the non-peak noise hours?

   Question 34 (For CA, NJ and WA only) – Is there any situation where you use more than one measurement (i.e., periods other than the peak noise or traffic period) for each site during the course of a day?

4. **Question 35 (For CA, NJ and WA only)** – Regarding the traffic counts that are taken for model calibration, is this performed on all projects? If model calibration is not to be performed, would traffic counts still be conducted in conjunction with noise measurements? If yes, for what purpose?

   Question 35 (For NY only) – Regarding the traffic counts that are taken for real classification volumes, is this performed on all projects? Please clarify – does this refer to the intent to conduct noise model calibration? If not, would traffic counts still

be conducted in conjunction with noise measurements, or are there any situations where such counts would not be conducted?

5. **Question 37 (For NJ and NY only)** – Please specify the method or equipment used for conducting traffic counts (refer to original list on survey). Are there any situations where you would use a different method or equipment?

   Question 37 (For CA and WA only) – You've indicated manual or handheld counters for Question 37. Are there any situations where you use a different method or equipment?

6. **Question 38/39 (For CA and NY only**) – Are there any perceived advantages or disadvantages to using the particular tools that you have identified as using for speed data collection? Are there any particular situations where such tools would not work?

   Question 38/39 (NJ and WA) – Since speed data is not required or not obtained through field work in your state, what alternate data is used for speed data: *i.e. LOS C speed, designed speed, posted speed etc?*

7. **Question 40** – What is the purpose of collecting meteorological data during noise measurements? How is the meteorological data used or applied?

8. **Question 41 (For CA only)** – Please provide clarification on your response regarding "unmonitored 24-hour meters many times have recordings to verify traffic or other source". Do your meters have the capability to provide the function that you've referenced in your Question 41 response?

9. **Question 42** – Do you use SLMs that have any special capabilities (e.g., automatic data logging feature that records noise level data by intervals; built-in data recorder or camera, etc.)? Are there any specific recommendations about any of the noise measurement, traffic count or meteorological equipment that you use that would help other states to improve their data collection capabilities?

10. **General** – Are there any other types of cutting edge technology and/or procedures not covered by our survey that your State DOT employs or requires to be used to collect, identify and/or record noise data (if yes, please explain). Are there any other types of cutting edge technology and/or procedures not covered by our survey that your State DOT does not currently use or require, but is considering to be used to collect, identify and/or record noise data in the future (if so, please explain).

11. **Question 43 (For CA, NY and WA)** – You have indicated that you believe that your state is at the forefront of cutting edge technology and/or procedure. What specific capabilities or technologies do you feel that you possess that puts you into that category? What specific capabilities or technologies do you feel are necessary for any state to possess in order for such state to be classified in that category as well? Is there any specific advice that you can offer to help another state to attain that

category? Do you feel that the specific equipment and procedures that you use to collect noise and associated field data help you to save time and/or money? Are there specific equipment items that you currently do not possess which you plan on purchasing or requiring to be used which will further enhance your state's capabilities in the area of noise?

Question 43 (For NJ Only) – You have indicated that you believe that your state is not at the forefront of cutting edge technology and/or procedure. What are some of the initiatives your state DOT can take to change your measurement practices that can bring you to the forefront? What specific capabilities or technologies do you feel are necessary for any state to possess in order for such state to be classified in that category as well? Do you feel that the specific equipment and procedures that you use to collect noise and associated field data help you to save time and/or money? Are there specific equipment items that you currently do not possess which you plan on purchasing or requiring to be used which will further enhance your state's capabilities in the area of noise?

12. If we were to reach out to one consulting firm that does much of your noise work, who would you recommend? Please provide a contact name, address, phone number and firm name for up to three firms.

13. If we choose to present the results of this follow-up survey and specifically credit you as the interviewee and your agency as the subject case study, is that acceptable, or do you and the agency prefer to remain anonymous?

Appendix D.3 Noise Analysis Consultant Survey Questions

Noise:

1. **We asked (Specify State DOT): "Does your state DOT use or require that any of the following methodologies be used to determine the appropriate sampling period to conduct noise measurements for NEPA projects?"**

   If the State DOT responded 24-hour measurements followed by peak noise hour measurements:

   After taking 24-hour measurements to determine your noise measurement period, do you generally find that the noisiest hour is synonymous with the peak traffic periods? Have there ever been situations, when working as a consultant for the state DOT in question, when you have not taken 24-hour measurements to determine the noise measurement period? If so, please explain.

   Are there ever situations where your firm/agency, working as a consultant to the state DOT in question, uses different procedures or criteria for conducting noise measurements? Please explain.

   Do these procedures vary from the procedures that your firm/agency follows for any other state DOTs? If so, please explain. Also, please indicate which procedure(s) you prefer to use in general?

   If the State DOT responded that design hour volumes/peak traffic periods are used to determine sampling periods:

   When working for the state DOT in question, do you usually identify both AM and PM design hour volumes for determining the noise monitoring periods?

   Have there ever been situations, when working as a consultant for the state DOT in question, when you have not used design hour volumes to determine the noise monitoring period(s)? If so, please explain.

   Do these procedures vary from the procedures that your firm/agency follows for any other state DOTs? If so, please explain. Also, please indicate which procedure(s) you prefer to use in general?

2. **We asked (Specify State DOT): "What is the typical length of time used for each noise measurement?"**

   Please verify the length of time that your firm/agency conducts noise measurements when working as a consultant to the state DOT in question. (If different from what the state DOT indicated, please explain).

Are there any situations where this standard length of time as identified by the state DOT in question would not be appropriate or utilized? Please explain.

Do you believe that there are any particular advantages or disadvantages to conducting the noise measurements for the period of time as identified by the state DOT in question? Please explain.

3. **We asked (Specify State DOT): "How many total short-term measurements are required to be taken at a given site?"**

   If the State DOT responded once per day:

   Is there any situation where your firm/agency, when working as a consultant to the state DOT in question, has used more than one measurement per site during the course of a day (i.e., periods other than the peak noise or peak traffic period)? Please explain.

   Do you feel that there are any advantages / disadvantages to conducting noise measurements only one time per site during the course of a day? Please explain.

   If the State DOT responded 2 – 3 times per day:

   Is there any situation where your firm/agency, when working as a consultant to the state DOT in question, has used more than two measurements per site during the course of a day? What could trigger the need to conduct noise measurements more than two times per day per site?

   Is there any situation where your firm/agency, when working as a consultant to the state DOT in question, has used fewer than two measurements per site during the course of a day? What could trigger the need to conduct noise measurements fewer than two times per day per site?

   Do you feel that there are any advantages / disadvantages to conducting noise measurements two times per site during the course of a day? Please explain.

4. **We asked (Specify State DOT): "Does your state DOT employ or require traffic counting in conjunction with noise measurements?"**

   If the State DOT responded "yes at all times":

   When working as a consultant for the state DOT in question, has your firm/agency always conducted traffic counts in conjunction with noise measurements? If not, please explain circumstances.

   What is the major purpose that you have conducted traffic counts in conjunction with noise measurements when working as a consultant for the state DOT in question (e.g., model calibration, classification counts, etc.).

If the State DOT responded "yes in certain situations or for certain purposes":

When working as a consultant for the state DOT in question, has your firm/agency ever conducted traffic counts in conjunction with noise measurements? If so, please explain circumstances.

What percentage of the time would you say that your firm/agency working as a consultant for the state DOT in question has actually conducted traffic counts in conjunction with noise measurements?

What is the major purpose that you have conducted traffic counts in conjunction with noise measurements when working as a consultant for the state DOT in question (e.g., model calibration, real classification counts, etc.).

5. **We asked (Specify State DOT): "What method or equipment does your state use for the traffic counts in conjunction with noise measurements?"**

   When working as a consultant to the state DOT in question, please specify the methods or equipment used for conducting traffic counts (manual counts, ATRs, video, etc.) in conjunction with noise measurements.

   Are there different situations that would influence which method or equipment type that you use when conducting traffic counts in conjunction with noise measurements for the state DOT in question? Please elaborate.

6. **We asked (Specify State DOT): "Does your state DOT obtain and/or require collection of vehicle speeds during noise measurements, and if so what tools are typically used for collection of speed data?"**

   When working as a consultant for the state DOT in question, has your firm/agency ever collected vehicle speed data in conjunction with noise measurements? If so, please explain frequency of such data collection and specific circumstances.

   Please explain what particular tools your firm/agency has used for collecting vehicle speed data.

   Are there any perceived advantages or disadvantages to using the particular tools that you have used for speed data collection? Are there any particular situations where such tools would not work?

7. **We asked (Specify State DOT):"Does your state DOT obtain and/or require that meteorological data such as temperature and wind speed be obtained during noise measurements?"**

   What is the purpose of collecting meteorological data during noise measurements?

How is the meteorological data used or applied?

8. **We asked (<u>Specify State DOT</u>): "Does your state DOT use and/or require that any other instruments be used in conjunction with the noise meter for collecting noise measurements (e.g., a data recorder that is linked to the sound level meter which will record and identify specific noise sources to explain peaks)?"**

   Although not specifically required by the State DOT in question, do you ever use any other instruments in conjunction with the noise meter? If so, in what situations and why?

9. **We asked (<u>Specify State DOT</u>): "Which of the following equipment is used or is required to be used by your state DOT for noise measurements, traffic and/or meteorological data collection?"**

   Have you ever, or do you generally use any of the following equipment when working as a consultant for the state DOT in question:

   ___ Type 1 or 2 Sound Level Meter (SLM)
   ___ SLM that has simultaneous data collection for Broadband, Spectrum and Octave levels
   ___ SLM that contains event trigger recording software
   ___ SLM with remote data download
   ___ SLM for long-term continuous use
   ___ Handheld weather device
   ___ Handheld wind meter
   ___ Weather station
   ___ Anemometer

   Do you use SLMs that have any special capabilities (e.g., automatic data logging feature that records noise level data by intervals; built-in data recorder or camera; etc.)?

   Do you have any recommendations about any of the equipment that you use that would help other states to improve their data collection capabilities?

10. **General:** Are there any other types of cutting edge technology and/or procedures not covered by our survey that your firm/agency has utilized for the state DOT in question or that are being considered for use in the future? If so, please explain.

    Are there any other types of cutting edge technology and/or procedures not covered by our survey that your firm/agency has utilized for other state DOTs? If yes, please explain.

    What other technologies would you like to see be used by the state DOT in question?

12. **Question 28** –The state DOT in question has indicated that it believes it is at the forefront of cutting edge technology and/or procedure. In your opinion, what specific capabilities or technologies do you feel helped put them into that category?

What specific capabilities or technologies do you feel are necessary for any state to possess in order for such state to be classified in that category as well?

Is there any specific advice that you can offer to help another state to attain that category?

What do you believe is the role / responsibility of a consultant to this or any other state DOT in placing them at the forefront of cutting edge technology and/or procedure?

13. If we choose to present the results of this follow-up survey and specifically credit you as the interviewee and your firm as the subject case study, is that acceptable, or do you and the firm/agency prefer to remain anonymous?

Appendix D.4 Cultural Resources State DOT Website Review

Following the Task 1 online survey, a review of the websites for those state DOTs responding that they consider themselves to be "at the forefront of cutting edge technology" in their field and are willing to participate in a follow-up interview was conducted. The purpose of this website review was to attempt to provide further background on each state's technologies and procedures in advance of the more detailed interviews to be conducted over the phone during Task 2 of this research. The intent of the follow-up interview is to obtain greater detail on the responses provided in the online survey in order get a better understanding of each state's practices.

A total of four state DOTs that took the initial survey considered themselves to be at the forefront of cutting edge field technology in the area of *Noise Analysis* and were willing to participate in the follow-up interviews. These are California, New Jersey, New York and Washington. The results of the website review for each of these state DOTs that may be solicited for participation in the follow-up interview are presented below.

California: Caltrans uses the noisiest hour Leq(h) to determine the appropriate sampling period to conduct noise measurements for NEPA projects. The typical length of time used for each noise measurement is 20 minutes. In order to determine how many short term measurements should be taken at a given site, a 24-hour measurement is taken to determine the peak hours, and then one measurement per site at peak hours is taken. Caltrans requires traffic counting in conjunction with noise measurements, taken manually or by camcorder/video recordings for the purpose of model calibration. Vehicle speeds are also obtained using a dopplar radar gun, and meteorological data are obtained as well. Caltrans also uses recordings to verify traffic or other sources on unmonitored 24-hour meters. Caltrans uses SLM / broadband /long term, anemometer and/or weather station equipment to obtain noise, traffic and/or meteorological data.

In March 2008, Caltrans made available The Annotated Noise Study Report Outline, which is designed to provide a consistent format for the noise impact analysis required on highway projects. This outline is intended to be used for all Type I projects that require NEPA compliance and provides a centralized location for all forms and guidance to be used in noise impact analysis. Caltrans also recently updated its 1998 Traffic Noise Analysis Protocol in August 2006. This FHWA-approved revised version is intended to provide a more concise document for ease of use by non-technical readers.

New Jersey: To determine the appropriate sampling period for noise measurements for NEPA projects, the New Jersey DOT (NJDOT) uses 24-hour and peak methodologies. The typical length of time for each noise measurement is 60 minutes, and one short-term measurement is required to be taken at each site. NJDOT usually requires traffic counting in conjunction with noise measurements in order to verify the TNM Model. Vehicles speeds are not obtained; however, meteorological data is obtained during noise measurements. Although other instruments are not required to be used in conjunction with the noise meter for collecting noise measurements, the following data collection equipment may be used: SLM, SLM Broadband, and handheld weather device.

The NJDOT website provides links to the Noise Policy Manual, Noise Policy Technical Appendix and the Traffic Noise Management Policy and Noise Wall Design Guidelines (Revised July 10, 2003).

New York: NYSDOT uses LOS C, peak volume, 24-hour and noise critical hour to determine the appropriate sampling period to conduct noise measurements for NEPA projects. The typical length of time used for each noise measurement is between 15 and 25 minutes. Two or three measurements are taken at a given site at different times of the day. NYSDOT requires traffic counting in conjunction with noise measurements when real classification volumes are needed. Vehicle speeds are also collected using a dopplar radar gun and the floating car method. Meteorological data such as temperature and wind speed is obtained during noise measurements as well. It is not required that other instruments be used in conjunction with the noise measurements. The equipment that is required is SLM, SLM broadband, SLM long term, and handheld wind meter.

The Noise Analysis Procedures Chapter 3 of the Environmental Procedures Manual can be found on the NYSDOT website.

Washington: According to the survey responses, WSDOT uses traffic peak hours and highest traffic volume methodologies to determine the appropriate sampling period to conduct noise measurements for NEPA projects. Typically a 15 minute length of time is used for each noise measurement, and one short term measurement is taken at each site. WSDOT requires traffic counting in conjunction with noise measurements for the purpose of model calibration. Traffic counts are obtained by hand, and vehicle speeds are not required to be collected. However, meteorological data is required to be obtained during noise measurements and is collected by a Type 1 or Type 2 Sound Level Meter (SLM), in conjunction with a handheld wind meter and handheld weather device. WSDOT does not require that other instruments be used in conjunction with the noise meter for collecting noise measurements.

WSDOT's Department of Air Quality, Acoustics and Energy Policy provides information on the different kinds of traffic noise, how noise is measured, noise abatement and information on federal funding in the role of noise barrier construction. A Noise FAQ page is also available on WSDOT's website.