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INSTALLER TRAINING PROGRAM

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This final report contains no patentable inventions or discoveries.

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CIDWT
Consortium of Institutes for Decentralized Wastewater Treatment

Legal Notice

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ABSTRACT AND BENEFITS

Abstract:

Longevity and performance of decentralized wastewater treatment systems depends on proper management, including siting, design, installation, and operation and maintenance. An error in any phase of this process may result in premature malfunction or failure of the system. The Installer Training Program is focused on the aspect of installation. The program defines the critical steps of, and describes the best management practices for installation and startup of small scale wastewater treatment systems. This training program will move the wastewater industry toward the goal of uniform installation practices and raise the level of expertise and professionalism.

The program was developed through a multi-state collaborative effort facilitated through the Consortium of Institutes for Decentralized Wastewater Treatment (CIDWT).

Benefits:

- Addresses the critical need for education and training for decentralized wastewater treatment practitioners who install onsite wastewater treatment systems.
- Provides training materials for developing a base level of knowledge for professional installers.
- Establishes a national basis for best practices for installing onsite wastewater treatment systems fostering constancy across the nation.
- Supports the National Environmental Health Association installer credentialing program by providing a course for those desiring to earn the credential.
- Provides understanding of the science behind why and how to perform installation tasks critical to implementing reliable long-term systems.

Keywords: septic system, installer, professional standard, installation checklists, decentralized wastewater treatment system

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LIST OF ACRONYMS

BOD	Biochemical Oxygen Demand
CEU	Continuing Education Unit
CIDWT	Consortium of Institutes for Decentralized Wastewater Treatment
CIOWTS	Certified Installer of Onsite Wastewater Treatment Systems
CPSS	Certified Professional Soil Scientist
CSREES	Cooperative States Research, Education, and Extension Service
DO	Dissolved Oxygen
EPA	Environmental Protection Agency
KSFA	Kansas Small Flows Association
LSS	Licensed Soil Scientist
MSO	Missouri Smallflows Organization
NAWT	National Association of Waste Transporters
NCSU	North Carolina State University
NDEQ	Nebraska Department of Environmental Quality
NDWRCDP	National Decentralized Water Resources Capacity Development Project
NEHA	National Environmental Health Association
NOWRA	National Onsite Wastewater Recycling Association
NYSDEC	New York State Department of Environmental Conservation
O&M	Operation and Maintenance
OIPRC	Official Installation Practitioner Review Committee
OSHA	Occupational Health and Safety Administration
P.E.	Professional Engineer
P.G.	Professional Geologist
PI	Principal Investigator
PM	Project Manager
PRG	Project Review Group
PSS	Professional Soil Scientist
RFP	Request for Proposals
R.S.	Registered Sanitarian
REHS	Registered Environmental Health Specialist
TAMU	Texas A&M University
TSS	Total Suspended Solids
URI	University of Rhode Island
USDA	U. S. Department of Agriculture
VOWRA	Virginia Onsite Wastewater Recycling Association
WERF	Water Environment Research Foundation

EXECUTIVE SUMMARY

The United States Environmental Protection Agency (EPA) and state and local government entities all recognize the importance of onsite and decentralized wastewater treatment systems as an essential component of our wastewater infrastructure. The longevity and performance of decentralized wastewater treatment systems depend on proper siting, design, installation, and operation and maintenance (O&M). An error in any phase of this process produces a weak link and may result in premature system malfunction. As the decentralized wastewater treatment industry expands, it is important that it be supported by professionals who can provide systems that function in a manner that protects public and environmental health.

The Installer Training Program is designed to address one of the many vital aspects of decentralized wastewater treatment system management programs: installation. The goal of the program is to convey best practice standards for onsite wastewater treatment system installation processes as identified by industry stakeholders. The curriculum discusses the various treatment and distribution technologies currently available for managing wastewater onsite and establishes a benchmark for conducting installation and startup.

The knowledge, skills, and abilities to install systems are continually being refined by stakeholders and must be conveyed to installers. The Installer Training Program provides a complete package that can be used to train these industry professionals. The program covers key aspects of planning, material and equipment selection, soil and site concepts essential to understanding how to protect the site during installation as well as installation inspection procedures. Data collection on each of these aspects is facilitated through the use of detailed installation and startup checklists developed in conjunction with industry stakeholders. This information can be integrated into the professional installer's business model as appropriate. The checklists may be used for commercial systems, additional checklists may be needed for installation of systems other than those serving single-family residences. The program serves as a mechanism to move the industry one step closer to the goal of uniform installation practices while raising the level of expertise and industry professionalism.

The checklists that serve as the foundation for these materials have been developed to describe proper installation techniques and steps for commonly used technologies. In addition to the installation checklists, a startup checklist is included for many of the technologies. The activities on the startup checklist are necessary to verify the system was installed correctly and clear the system for operation. The startup checklists also document important parameters useful to the O&M service provider or for system troubleshooting and repair, if needed. Depending on the local code and the timing of the installation, an onsite wastewater professional other than the installer may perform the startup. Both the installation and startup checklists found throughout the manual are very thorough. The checklists document common steps in the process. These checklists assist in the process of training industry members by providing comprehensive descriptions of installation and operational startup practices.

This report describes the process through which the installer training materials were developed. A writing team was established representing expertise with the various technologies, climatic differences, and regional interests regarding the use of onsite wastewater treatment systems. An industry review team (OIPRC) and project review group (PRG) guided the scope, format, and breadth of the materials to ensure coverage of relevant topics for practitioners conducting installation and startup. Manufacturers, designers, installers, operation and maintenance practitioners, regulators, and educators also provided input through a broader review of the materials. Finally, a series of four pilot training events were conducted to make sure the materials were complete and to assess their versatility. These events also provided an opportunity to quantify the amount of knowledge gained by the practitioners and measure their willingness to use the checklists as a tool in conjunction with their installation activities.

CHAPTER 1.0

INTRODUCTION

1.1 The Installer Training Program

In November 2006, the Consortium of Institutes for Decentralized Wastewater Treatment (CIDWT) was awarded funding to develop training materials describing national best practice standards for installation of onsite wastewater treatment systems serving residential facilities. These best practice standards are presented as installation and startup checklists for the various onsite wastewater treatment technologies currently in use. This training package and the checklists were developed by CIDWT and others listed in the acknowledgements of this publication with the support of the U.S. Environmental Protection Agency (EPA) through the Water Environment Research Foundation (WERF) as a part of the National Decentralized Water Resource Capacity Development Project (NDWRCDP).

1.2 Purpose of Installer Training

Previous CIDWT curriculum projects have addressed issues related to system design and operation and maintenance (O&M). However, education of decentralized wastewater system installers to ensure sound long-lasting construction continues to be a challenge. This project addressed the critical need for Outreach Education and Training in onsite/decentralized wastewater treatment and management through third party development of a uniform and consistent set of training materials. The curriculum is specifically designed for professionals who will install onsite wastewater treatment systems and presents the construction issues so critical to proper wastewater treatment. The goal for this installation training material is to support the continuing education and professional development of installation professionals.

The Installation of Wastewater Treatment Systems Training Program represents a comprehensive introductory component of a training/certification program for professionals who install single-family residential onsite wastewater treatment systems. While the materials may be used for evaluating commercial systems, additional checklists may be needed for installation of systems other than those serving single-family residences.

1.3. Objectives of Training Materials

The specific objectives of these training materials are to:

- Clarify the responsibilities of professional installers.
- Familiarize installers with standardized techniques and procedures for constructing or installing various onsite wastewater treatment system technologies.

- Promote uniform communication between professional installers and their clientele through the use of standardized terminology.
- Establish a benchmark for competency of installers and enhance the overall status of the onsite wastewater treatment profession.
- Support the continuing education and professional development of installation professionals.

By achieving the above objectives, the program ensures that participants are able to effectively install wastewater treatment components. Through implementation of this program, installation practices can become more uniform, thus raising the level of industry expertise and professionalism. This will promote system O&M, increased long-term system reliability, alleviate potential risks to public and environmental health, and increase consumer satisfaction.

1.3.1 Installation of Wastewater Treatment Systems Training Materials

The training materials that were developed during this project include the Installation of Wastewater Treatment Systems training manual, standardized installation and startup checklists, and PowerPoint presentations with instructor notes.

1.3.2 Responsibilities of Professional Installers

The onsite wastewater treatment system service industry consists of a variety of specialists that include installers, site evaluators, designers, pumpers, O&M service providers and more. This project defines the types of activities that professional installer should be knowledgeable in. This list was developed in cooperation with the Official Installation Practitioner Review Committee (OIPRC).

The professional installer should:

- Function as a professional representative of the wastewater treatment industry.
- Possess basic knowledge of the purpose and function of wastewater treatment train components.
- Know the regulations that govern installation in the jurisdictions that work is performed.
- Conduct construction, installation, or alteration of a wastewater treatment system according to a design while meeting applicable safety and regulatory standards.
- Be able to evaluate site conditions relative to accuracy of system design and system constructability.
- Ensure that all work is done in accordance with the written design.
- Protect soil and site characteristics during construction to ensure that personal and public safety and public and environmental health risks are minimized.

- Consult with the designer of record and/or appropriate local unit of government regarding any necessary deviation from the design and necessary inspections for new construction or replacement.
- Document and retain quality control/quality assurance records.
- Document completed installation via as-builts, sketches, and photos as appropriate (including alterations to the installation).
- Conduct site restoration according to regulatory and/or contractual provisions.
- Provide monitoring, O&M guidelines, and educational resources regarding system function and capacity to the system owner.
- Provide for proper abandonment of system components as necessary.

1.3.3 Glossary of Terms

Lack of consistency in terminology is a barrier to acceptance of nationally developed training materials and guidance documents. Standardization of commonly used terms and definitions facilitates the continued exchange of information both in the academic realm and in the field. Definition of terms associated with installation was one of the first tasks achieved in the project in order to standardize technology terms in the installation and startup checklists. The CIDWT Decentralized Wastewater Treatment Glossary (CIDWT, 2007) served as the source for terms and definitions for the Installer Program and has been subsequently updated as a result of this project. Please see Appendix I for a list of terms associated with installation activities.

CHAPTER 2.0

LOGISTICS FOR PROJECT IMPLEMENTATION

2.1 Overview

To assure the quality and breadth of the materials, an extensive review and revision process was planned and implemented. The development process for these materials followed a similar approach to that described in the CIDWT Decentralized Wastewater Treatment O&M Service Provider Training Program (Deal et al., 2005). Official reviewers were designated, and broad, comprehensive industry review was solicited. Additionally, a Project Review Group (PRG) was named to provide oversight.

The process was conducted in several stages and various forums including:

1. Selection of project personnel, and task assignments.
2. Writing team meetings and structured review team meetings.
3. Peer review.
4. Pilot teaching.

Throughout the development process, individuals reviewed the materials and commented directly to the principal author and/or the writing team member.

2.1.1 Selection of Project Personnel

The Project Review Group (PRG) was established to provide broad oversight on the overall project, define the implementation plan, select the writing team, and monitor the progress of product development. In addition to the PI, the PRG consisted of four decentralized wastewater field/industry leaders. The PRG consisted of James Converse (NOWRA member), Anthony Smithson (NEHA Technical Liaison), Jerry Stonebridge (NOWRA Executive Committee Chair), and William Stuth, Sr., (NOWRA founding and current member). These individuals represent organizations with an interest in developing a set of non-biased, standardized, and peer-reviewed materials for use in conducting installer training. Their collective knowledge of the industry ensured critical review of the proposals submitted by potential team members and selection of a group with the proficiency needed to bring the project to a successful conclusion.

Writing team members were solicited through an RFP process. The RFP for generation of project deliverables was distributed to CIDWT member institutions in good standing. Submitted proposals were critically reviewed and ranked by the PRG. After which Texas AgriLife Extension Service (formerly Texas Cooperative Extension) generated subcontracts with successful institutions. Because the product is intended for use on a national basis, the writing and review teams were chosen from many different states across the country.

Each of the four participating institutions nominated two persons from their state to serve on the OIPRC. These potential participants were reviewed by the PRG for geographic coverage and expertise. The PRG suggested identification of an installer from the Florida area to balance the geographic expertise. One of the PRG discussion points for selection of the OIPRC members was the potential participants' work in the operation and maintenance (O&M) business along with their installation activities. This O&M experience was deemed critical because of the interest in having the installation training develop systems that can be readily maintained.

The OIPRC was established for the Installer Training materials during July 2007 and included:

David Burnham, Burnham Excavating, Inc. (Rhode Island)

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Anthony Gaudio, Apalachee Backhoe and Septic Tank, LLC (Florida)

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Timothy Stasiunas, Advanced Wastewater Technologies, Inc. (Rhode Island)

William L. Stuth, Jr., Stuth Company (Washington)

2.1.2 Writing Meetings and Structured Review Team Meetings

The writers met independently and with the PRG and OIPRC throughout the course of the project. Independent writers' meetings were conducted via both conference calls and in person. With few exceptions, in-person meetings were conducted in conjunction with other national meetings (NOWRA Annual Conference or USDA CSREES Conference). A writers' meeting was also conducted before and after each pilot training event.

Writers met with both the PRG and the OIPRC at the inception of the project in Bloomington, MN. The writers and PRG met once again after the third pilot training in Las Vegas NV in December 2008. The writers and the OIPRC met both before and after the second pilot training in Richmond VA.

The nature and outcome of each of these meetings is discussed in depth in Chapter 5 of this report.

2.1.3 Peer Review

The peer review process extended beyond the review meetings. The draft manual was sent to over one-hundred eighty reviewers (Appendix C). Although the response varied, peer reviewers provided constructive criticism that enhanced the end product. Throughout the review process, writers responded to individual comments by documented responses. Writers either accepted comments completely, accepted them with modifications, or rejected them with cause.

2.1.4 Pilot Training

Four pilot training events were used to introduce the program nationally (Appendix D). These training events began in December 2007 and continued through March 2009. Events were held in the southwest (Nevada), the east (Virginia) and the Midwest (Missouri). Pilot teaching consisted of presenting the material either in a national conference setting or as part of a continuing education course.

Pilot training allowed assessment of the completeness of the installation checklists and effectiveness of the training manual and associated presentations in real-world settings. Since the nature of each class varied, the writers were able to see how a variety of teaching styles worked on different audiences and gained insight on how to adapt the materials as a result of review comments. During the pilot training events, primary and secondary authors were able to develop and refine speaker notes as the slides were presented. Evaluation forms distributed after each pilot training event included questions phrased as a direct restatement of the Learning Objectives to measure the relative success in meeting those objectives (Appendices E).

2.1.5 CIDWT Executive Board Review

Members of the CIDWT Executive Board were sent hard copies of the Installer Training Manual and associated presentations and directed to review the materials as part of the quality control program (Appendix F). A description of the deliverables for the project accompanied this request. Board members were asked to review the materials relative to the following items:

- Completeness of discussion on the topics included in the table of contents.
- Appropriate presentation of material for practitioners entering the installer profession.
- Appropriateness of the manual for delivery of a two-day (minimum) classroom instruction program.
- Completeness of the standardized installation and startup checklists.

As these reviews were returned, comments and suggestions were considered and adopted or rejected as appropriate using the same approach outlined under **Peer Review Process** in this chapter.

CHAPTER 3.0

WEBSITE DEVELOPMENT

The CIDWT website (**www.onsiteconsortium.com**) is an interactive, dynamic web site that acts as:

- A public communication center for those seeking onsite wastewater information.
- A contact center for CIDWT members.
- A private communication forum for the CIDWT working groups.
- A repository and delivery mechanism for the training materials produced by the CIDWT committees.
- A communication hub where CIDWT member institutions are able to list and update program and research information.

Over the course of the Installer Training Program project, the CIDWT website was used for multiple purposes.

1. It facilitated seamless management and exchange of information for the primary and secondary writers. With a username and password, the team had the ability to upload, download, and review text files and slide presentations which typically exceeded email server capabilities because of their size. This reduced mailing and printing costs for the project and allowed the product to be reviewed and edited several times between official reviews and pilot training events.
2. The site served as a conduit for advertising the pilot training events conducted in conjunction with the project. A link to the posted brochure describing the logistics for each event could be emailed to a broad contact list for maximum effect.
3. Once the installation and startup checklists were in an advanced state of refinement, they were posted to the website in a modifiable format and made available to the public. The webpage containing the checklists is accessed through hyperlinks from multiple pages on the website.

CHAPTER 4.0

TARGET AUDIENCE, EXPECTED USES, AND IMPLEMENTATION

4.1 Characteristics of the Target Audience

The target audience of the Installer Training Program includes installers for individual onsite wastewater treatment systems (septic systems). The manual and presentation materials are aimed at both entry level and established practitioners and present basic concepts that are required for full understanding of processes and technologies common to decentralized wastewater treatment installation and startup. With appropriate adaptation, the materials can be used to train practitioners who install larger and more complicated systems.

In addition to installation practitioners, the following groups will benefit directly from these materials: state, county, and local regulators who provide wastewater installation oversight; system designers who may be required by code to provide installation oversight as the designer of record; those designers who may be required to provide installation criteria on plans to obtain design approval; and persons who perform system inspections related to real estate transactions.

4.2 Expected Uses

First and foremost the training manual supports installer training programs. It describes installation best practices for constructing sustainable onsite wastewater treatment systems. The installer manual will be a resource for practitioners taking professional installation training courses. Installation professionals in the industry can refer to this document when considering their first installation of a specific technology. Experienced professionals will gain new insight on installation methods that facilitate long-term system management.

The presentation materials in the program provide a basis for developing training on advanced topics. Practitioner training programs will utilize the installer manual as their primary reference for development of expanded training courses.

The breadth of the manual facilitates implementation of multiple levels of installer certification. Because it describes the knowledge, skills, and abilities required for installation professionals, certification entities will use it to develop examinations for measuring an installer's grasp of the required body of knowledge.

The installer manual is a reference for installation best practices. Regulators will utilize this manual and startup checklists to guide their evaluation of new installations and repaired systems.

The installation checklists include critical points to be addressed relative to providing access for operation, maintenance, and monitoring. In turn, the startup checklists serve as a point of beginning for system management after installation is complete. The professional installers utilizing these checklists can document critical operational information valuable to professionals that perform activities related to operation, maintenance, and troubleshooting of the system.

4.3 Mechanism for Implementation

This training program is intended for use by trainers who have attended a Train-the-Trainer Academy conducted by CIDWT. These academies are designed to not only provide instruction to potential trainers on effective delivery of the Installer Training Program but to also impart the philosophy behind training the installation professional. In short, the instructor must convey the fundamental point that the nature of the installation determines the longevity of the system and the efficacy of its performance as well as the associated cost of operation and maintenance.

In addition to this crucial installer training philosophy, potential topics include the expected outcomes of the course, methods to effectively use the presentation materials, and lessons learned during the pilot testing events. Past experience with the CIDWT Operation and Maintenance Service Provider Training Program indicates that this Train-the-Trainer component is a critical first step toward consistent delivery. Industry practitioners who served as reviewers on this and previous projects advocate this approach to protect the content of the materials without restricting their use. The Train-the-Trainer program also establishes a conduit for collecting comments that facilitate future revisions.

From a practical standpoint, the Train-the-Trainer concept allows potential trainers to become familiar with the overall program by first seeing the basic topics presented by the writers over a two-day period. This is preceded by an orientation meeting for attendees to inform them about the structure of the academy and allow them to meet the writers who will be present. On the third day of the academy, additional presentations provide insight into logistics for training programs in general and the Installer Training program in particular.

The academy agenda allows the writers to emphasize key points for those in attendance. For example, instructors are encouraged to present only those topics in this module that serve the needs of their specific audience. However, there is often a tendency to gloss over or eliminate topics that one is unfamiliar with. Trainers are strongly urged to include fundamental presentations such as Planning and Safety in their programs. They are also trained in how to present specific materials and convey key points identified over the course of the project. An important item of discussion is agenda structure; although the core materials can be presented in an intensive two-day training, the same materials could easily span 4 to 5 days due to the depth and breadth of the materials that have been developed. The writing team readily shares experiences from the pilot training events with the group so that they have an idea of issues that may be contentious and even specific questions that may be posed.

From a broad perspective, the academy is an opportunity to raise the bar for instructors through specific interaction. It also provides general information on how to develop training programs to persons who may have only moderate experience in this realm. Ultimately, the academy is a tool to build training capacity, i.e., it creates a pool of instructors who have a unified vision regarding standardized delivery of nationally reviewed materials and provides them with a user-friendly program that they can immediately implement. This results in increased numbers of well-trained instructors with knowledge of how to deliver the materials consistently across the country.

Attendance at a Train-the-Trainer Academy does not certify the trainers but deepens their understanding of the larger vision of the program. It is expected that those who wish to utilize the presentation materials will be CIDWT members in good standing and will attend a train-the-trainer installer program prior to accessing the presentation materials. It will remain the responsibility of the training entity to ensure accurate use and delivery of the program by its trainers.

CHAPTER 5.0

MATERIALS DEVELOPMENT PROCESS

5.1 Development of Initial Draft Manual and Checklists

In preparation for the first meeting with the OIPRC, the writing team exchanged information electronically to develop a rough draft of a manual with installation and startup checklists for review. Educational materials previously developed by CIDWT served as a starting point in the development of the rough draft. The CIDWT Operation and Maintenance training program materials (CIDWT, 2006) were used as a resource for formatting and introductory text for the technologies. The Practitioner and University curriculum materials (Lindbo and Deal, 2005 and Gross and Deal, 2005) were also used as a resource to collect background information. Current training materials used by members of the writing team at their respective state or region were also used.

5.2 Writing Team Meetings

Writers' meetings were conducted periodically throughout the project to assess project status, scope, and project deliverables and to efficiently collaborate on writing materials. Five writers' meetings were held during the project.

The first meeting was held August 13-16, 2007 in Bloomington, MN. Also in attendance at this meeting were the Official Installation Practitioner Review Committee (OIPRC) and Project Review Group (PRG). The purpose of this structured review was to discuss general concepts and key points, but it also included defining the roles of a professional installer, drafting installation and startup checklists, identifying and defining key installation terms to be included in the project glossary, and outlining the manual chapters. The agenda also included discussions of the project deliverables, including the format for the manual and presentations. The project timeline was described and consensus was reached.

The majority of time during the structured review was spent collecting comments on the specific content of the installation checklists from the reviewers. The OIPRC and PRG reviewed the checklists during this meeting to help define the "needs to know" for the program. The comments received during this review meeting where incorporated into the checklists and distributed to the OIPRC in September 2007 for further review and comment.

At the second writers' meeting held in Orlando, FL in October 2007, the authors incorporated OIPRC comments to develop the first complete draft of the installation and startup checklists. This was a significant accomplishment as the checklists constituted the outline for the body of text used in the manual as well as the content of the presentations. Initial drafts of the manual chapters were reviewed. In addition, an evaluation instrument was developed for use at the pilot training events to collect information on knowledge gained, willingness to adopt practices, and general comments. An advertising brochure describing the Installer Training Program was also drafted. At the conclusion of this meeting the writers developed the draft manual and presentations used for the first pilot training held in Las Vegas, NV, in December 2007.

The third writers' meeting was held concurrently with the USDA-CSREES 2008 National Water Quality Conference during February 3-7, 2008 in Sparks, NV. The primary focus of this meeting was an intense review of the manual for content and continuity prior to the second pilot training.

This meeting allowed the writers to address issues identified during the first pilot training and solidified the authors' vision regarding the goals of the installer training program.

William L Stuth, Jr. (OIPRC member) participated in the third meeting to provide industry feedback. His participation facilitated efficient development of training materials relevant to the industry. He was able to critically review the current draft materials and outline the critical areas needing attention for document completion. His insight facilitated identification of the key difference between a general contractor and a professional installer. A professional installer must construct the planned onsite wastewater treatment system while maintaining the site's natural ability to accept and treat wastewater. Identification of this key distinction helped the writing team gain a better perspective regarding the underlying theme for the training materials.

The fourth writers' meeting was held during the 2009 USDA-CSREES National Water Quality Conference February 3-7, 2009 in St. Louis, MO. Authors looked at the individual presentations to ensure that presentations built upon each other and covered all learning objectives without redundancy. It was also critical to finalizing the manual.

A fifth writers' meeting was conducted during the 2009 NOWRA Annual Technical Conference and Exhibition. The purpose of this meeting was to critically review the diagrams for the manual and presentations. Since this task had been given limited attention, it was a productive exercise that resulted in significant clarification of the diagrams.

Participation in writer meetings is documented in Table A-1. Time and previous in-state training commitments prevented some writers from participating in every meeting.

Additional writers' meetings (referred to as "development days") occurred during the four pilot training events. The team spent time before, during, and after each of these events to conduct rigorous review and revision of the materials to be used in the pilot training event, incorporate changes and brainstorm new ideas. These highly productive, face-to-face sessions were indispensable in the development process.

5.3 Official Installation Practitioner Review Committee Activities

The success of this project is attributable to the strong review and guidance provided by the team of industry reviewers. As previously mentioned, the first OIPRC meeting was held in Bloomington, MN in August 2007. The meeting focused on defining the project scope and drafting the installation and startup checklists for the technologies to be included in the training manual. The writers presented initial concepts for the checklists and the industry review team provided guidance on format, layout, and critical items for installation and startup. In addition, the OIPRC members were presented with a draft of the duties and responsibilities of a professional installer. Following an intense two-day meeting, the writers had an ample amount of information to condense into the checklists and a detailed installer job description.

A second meeting with the OIPRC was held in conjunction with the second pilot training in Richmond, VA, in March 2008. The OIPRC was asked to participate in the pilot training event to facilitate audience participation in the training while concurrently reviewing the training program. The writers and reviewers met before and after the actual training. Prior to the training, the writing team listed specific items they wanted the reviewers to evaluate. After the training during a structured review meeting, the OIPRC members had the opportunity to share both written and verbal comments. The OIPRC gave the writers input regarding the role of the installer, flow, order and content of the presentations, time spent on each topic, and items that were missing or unclear in the manual and/or the checklists. The input received from this meeting was taken and adapted into the materials before the manual was broadly distributed for national review.

5.4 Project Review Group Activities

The PRG was also in attendance at the previously described meeting in Bloomington, MN, in August 2007. Prior to the general sessions described above, the PRG and the writers met to discuss project scope, timeline, authors' roles, and the mechanism for releasing the materials.

The second official meeting of the PRG was at the third pilot training event at the NOWRA Installer Academy December, 8-10, 2008. Similar to what was done with the OIPRC at the second pilot training, the writers and the PRG met the day prior to the training to list specific items to be evaluated during the presentations. After the presentations, the PRG provided the writing team with an in-depth review of the manual and PowerPoint presentations. The meeting was also used to identify what concepts were missing or needed more clarification. As part of this analysis, the group discussed additional figures to be developed. In addition, the amount of time devoted to topics during the program was discussed to adjust the agenda for the final pilot training.

5.5 Distributions of the Draft Training Manual

Over the course of the project, drafts of the manual were distributed for review. The first two drafts were targeted to writers, OIPRC, PRG, and individuals requesting a draft. The third draft was distributed to a broader group to capture a wider industry viewpoint on the completeness of the manual and installation checklists. The list of individuals who received a draft of the training manual for review is provided in Appendix C. These individuals represent a broader cross-section of the industry, including manufacturers, regulators, training program coordinators, and designers.

The reviewers provided excellent comments on the training manuals. The majority of comments on the scope and quality of the material was positive and included constructive comments for improvement. Most comments were incorporated into the manual, but some were deemed to be outside the scope of this project and were excluded. Responses to all comments were documented in hard copy.

5.6 Pilot Training

Before, during, and after the pilot training, the writing team continued to review the materials with respect to completeness, consistency, and technical content. The following questions were addressed during these sessions:

1. Is the product complete?
2. Are the concepts correct?
3. Is it in the correct format relative to that mutually agreed upon?
4. Do the materials meet the requirements for the deliverables?

If the product was unacceptable, the writers added or changed materials in the product until it was deemed acceptable. These sessions were essentially supplemental writers' meetings and allowed for significant revision and improvement of the manual and presentations. Program evaluations were collected after each training event. The evaluation results can be found in Appendix E.

The pilot training sessions provided the writing team valuable insight to the delivery of training materials. Since the nature of each class varied, the writers were able to see how a variety of teaching styles worked on different audiences and gained insight on how to adapt the materials as a result of review comments. Importantly, these events allowed authors to capture detailed speaker notes on hard copies for later inclusion in electronic versions.

5.6.1 First Pilot Training Event: Las Vegas, NV

The first public review of the Installer Training Program took place at the 2007 NOWRA Installer Academy in Las Vegas, NV in December 10-11, 2007. The venue was an auditorium setting and attendance at each session ranged from 40 to 60 participants. The attendees were from across the country.

The materials were presented as modules taught by various instructors. These were presented electronically using PowerPoint, and printouts of slides were distributed to the students. The students were also given the draft Installation of Wastewater Treatment System manual for reference to the installation and startup checklists that comprised the foundation of the program.

At the conclusion of the first day of presentations, a homework assignment was distributed to participants. The homework problems were based on the learning objectives for the topics presented in the first day of training. The second day of training began with a review of the homework. The participants' ability to complete the homework problems was used as an indication of whether the learning objectives were effectively addressed for each section.

A program evaluation was developed specifically for this course and was completed by all participants. Comments received were generally positive. The format of the evaluation developed for Las Vegas was subsequently adapted and used at succeeding pilot training events. Another result of this pilot delivery was the modification of homework questions to be more relevant to the topics presented in the first half of the training. The NEHA CIOWTS examination was offered after this event and many attendees took this exam.

The writers and reviewers took notes on all presentations and elaborated on speaker notes for individual slides. Revisions were incorporated into the presentations and manual before the next review team meeting.

5.6.2 Second Pilot Training Event: Richmond, VA

This two day training event was held in March 2007 in a large classroom in a hotel conference room. The training event was conducted in cooperation with the Virginia Onsite Wastewater Recycling Association. There were more than 20 people in attendance. Attendees were from Virginia, North Carolina, and South Dakota. In addition, the OIPRC attended both days of training. All attendees indicated that they would recommend the course. All writers took notes during the presentation paying particular attention to flow of material, and identifying topics that were missing or unclear. As a result of this training, the writing team was able to address holes in the materials and adjust the agenda and manual table of contents in order to more effectively present the material topics. The NEHA installer exam was not offered in conjunction with the event. The participants desiring the exam were able to contact NEHA directly to schedule a date and location for the testing.

5.6.3 Third Pilot Training Event: Las Vegas, NV

The next pilot training took place at the NOWRA Installer Academy, December 8-10, 2008 in Las Vegas, NV. Attendance at the sessions ranged between 26 and 52 people from across the country with an average of 32 attendees per session. The course was taught over two and a half days which allowed extra time for a few of the topics.

All writers reviewed individual slides and specific attention was paid to monitoring the speaker notes for each slide. Notes that were missing were added on hard copies where appropriate and later incorporated into electronic copies by the author.

The NEHA installer exam was offered at the conclusion of the training and many of the participants took the exam.

5.6.4 Fourth Pilot Training Event: Liberty, MO

The final pilot training was held March 5-6, 2009 in Liberty, MO, in cooperation with Missouri Small Flows Organization and NOWRA. The training was held in a local health department conference room and 15 persons from Missouri and Kansas attended.

During the fourth pilot training event, secondary authors Miles and Buchanan joined the writing team to serve as instructors. To evaluate the transferability of the materials to third party presenters, each slide presentation was delivered by someone other than the original author. This exercise highlighted any shortcomings in the content and flow of the slides. Subsequent revision occurred to correct these deficiencies. Authors continued to assess, correct, and enhance speaker notes on hard copies for later incorporation into electronic versions.

CHAPTER 6.0

OUTLINE OF TRAINING MANUAL

6.1 Outline

The materials developed for the Installer Training manual follow the outline below. Each of the chapters has been repeatedly reviewed and revised.

I. Preface

II. Introduction
   A. Introduction
   B. Onsite wastewater treatment systems
   C. Key members of the onsite wastewater treatment system management team
   D. The professional installer
   E. Functioning as a professional installer
   F. Significance of proper installation
   G. Use of the installer program by the onsite wastewater treatment system industry
   H. Overall system evaluation
   I. Summ ary

III. Business Models and Industry Integrity
   A. Introduction
   B. Business Models
   C. Industry Integrity

IV. Safety
   A. Introduction
   B. Federal and state OSHA standards
   C. First aid and emergency response
   D. Personal protection
   E. General site issues

F. Electrical hazards
G. Transporting equipment and materials
H. Equipment-specific issues
I. Excavation and trench safety
J. Confined space and hazardous atmospheres
K. Materials hazards
L. Additional hazards identified
M. Summary and conclusions

V. Soil and Site concepts for Installers
A. Introduction
B. What is soil, and why is it important?
C. Important soil properties
D. Significant site conditions
E. Soil and site description summary
F. Water movement and soil treatment
G. Loading rates
H. Sediment and erosion control, storm water and surface water management
I. Summary

VI. Construction Materials and Techniques
A. Introduction
B. Equipment considerations for installers
C. Material selection issues
D. Soil treatment area installation techniques for different site conditions
E. System abandonment
F. Summary

VII. Planning
A. Introduction
B. Initial design/plan review
C. Site review
D. Owner interview during site/plan review

E. Components of a bid

F. Construction planning

G. Construction staging

H. Job scheduling

I. Job staging

J. Summary

VIII. Distribution

A. Introduction

B. Distribution and the infiltrative surface

C. Loading rates

D. Effluent delivery over time and space

E. Appropriate use of gravity and pressure distribution according to site limitations

F. Typical system configurations for gravity distribution

G. Installation of gravity distribution components

H. Typical system configurations for pressure distribution

I. Installation of pressure distribution components

J. Access for management

K. Protection of soil properties

L. Summary

IX. Watertight Piping and Tanks

A. Watertight piping for wastewater conveyance

B. Installation of piping systems

C. Piping installation checklist

D. Piping summary

E. Tanks overview

F. Tank installation steps

G. Tank startup

X. Installation of Dosing Systems and Controls

A. Overview

B. Pumps

C. Pump selection

D. Pump discharge assembly

E. Controls

F. Dosing regimes

G. Siphons

H. Installation

I. Startup

XI. Advanced Treatment

A. Overview

B. Media filters

C. Aerobic treatment unit

D. Constructed wetlands

E. Lagoons

F. Disinfection

1. Chlorine

2. Ultraviolet light

XII. Soil Treatment Areas

A. Introduction

B. Below- and above-grade

C. Evapotranspiration (ET) beds

D. Drip field

E. Spray field

F. Outfalls

XIII. Appendix A Tables and Figures

A. Pipe specifications

B. Friction loss

C. Pipe volume

D. Flow rate

E. Soil

XIV. Appendix B Math Overview

   A. Math review

   B. Relevant terms

   C. Units

   D. Basic calculations

   E. Calculating recirculation ratios at system startup

XV. Appendix C Volume Calculations

   A. Media/soil volume calculations

XVI. Appendix D Slope Intersection Calculations

   A. Slope intersection calculations

XVII. Appendix E Introduction to Surveying

   A. Bench mark transfer

   B. Elevations/invert transfers

XVIII. Appendix F Tank Buoyancy

XIX. Appendix G Watertightness Testing

XX. Appendix H Installer Glossary

   A. Terms

XXI. Appendix I System Malfunctions

XXII. References

CHAPTER 7.0

PROJECT AWARENESS AND DISSEMINATION

7.1 Introduction

This project was advertised using the CIDWT, Missouri Smallflows Organization (MSO), and NOWRA websites, brochures for the pilot training events, presentations at conferences across the country, articles, CIDWT and NOWRA email distribution lists, and word of mouth. The brochure can be found in Appendix H. The manual is available for purchase through Midwest Plan Service (**http://www**.mwpshq.org/). The Installer Training Program will be taught across the country and used in training and certification programs by trainers that have attended the Train the Trainer Academy conducted by the CIDWT.

7.2 Presentations

1. Lesikar, B., J. Buchanan, S. Christopherson, N. Deal, K. Farrell-Poe, D. Gustafson, D. Kalen, D. Lindbo, G. Loomis, R. Melton, and R. Miles. 2008. Installation Curriculum for Small Scale Wastewater Treatment Systems. USDA-CSREES 2008 National Water Quality Conference. February 3-7, 2008. Sparks, NV. (21 people).
2. Lesikar, B., J. Buchanan, S. Christopherson, N. Deal, K. Farrell-Poe, D. Gustafson, D. Kalen, D. Lindbo, G. Loomis, R. Melton, and R. Miles. 2008. Installation Training Curriculum. National Onsite Wastewater Recycling Association Annual Technical Conference and Exhibition. April 7-10, 2008. Memphis, TN. (63 people).
3. Lesikar, B., J. Buchanan, S. Christopherson, N. Deal, K. Farrell-Poe, D. Gustafson, D. Kalen, D. Lindbo, G. Loomis, R. Melton, and R. Miles. 2009. Installation Training Curriculum. USDA-CSREES 2009 National Water Quality Conference. February 8-12, 2009. St Louis, MO. (23 people).
4. Lesikar, B., J. Buchanan, S. Christopherson, N. Deal, K. Farrell-Poe, D. Gustafson, D. Kalen, D. Lindbo, G. Loomis, R. Melton, and R. Miles. 2009. CIDWT Installer Curriculum Program. National Onsite Wastewater Recycling Association. 18th Annual Technical Conference and Exhibition. April 6-9, 2009. Milwaukee, WI. (6 people).
5. Lesikar, B., J. Buchanan, S. Christopherson, N. Deal, K. Farrell-Poe, D. Gustafson, D. Kalen, D. Lindbo, G. Loomis, R. Melton, and R. Miles. 2009. Installation Curriculum for Small Scale Wastewater Treatment Systems. 25th NC Onsite Water Conference. April 29, 30, May 1, 2009. Raleigh, NC. (60 people).
6. Lesikar, B.J., D. Lindbo, and G. Loomis. 2009. Onsite Wastewater Education * Research Based Outreach Strategies to Help Minimize Nonpoint Source Pollution. 5th National Conference for Nonpoint Source and Stormwater Outreach. USEPA. May 11-14, 2009. Portland, OR. (12 people)

7.3 Distribution of Installer Training Informational Brochure

1. Loomis, G.W. 2007. Installer Training Program – Distributed flyer. New England Onsite Wastewater Training Center – Nitrogen Dynamics in the Environment and Onsite Wastewater Systems Workshop (OWT 160). December 13, 2007. Kingston, RI. (34 people).
2. Loomis, G.W. 2008. Installer Training Program – Distributed flyer. Missouri Smallflows Organization 12th Annual Conference and Exhibition Pre-conference Workshop on Media Filters. January 21, 2008. Columbia, MO. (170 people).
3. Loomis, G.W. 2008. Installer Training Program – Distributed flyer. Rhode Island Independent Contractors and Associates Annual Meeting. January 24, 2008. Warwick, RI. (150 people).
4. Lesikar, B.J. 2008. Installer Training Program – Distributed Flyer during presentation on Installation of Onsite Systems and Technologies. Washington On-Site Sewage Association's 12th Annual Conference, "In the Trenches". January 25-26, 2008. Vancouver, WA. (150 people).
5. Lindbo, D. 2008. Installer Training Program – Distributed brochure during meeting. North Carolina Septic Tank Association. January 28-30, 2008. Hickory, NC. (250 people).
6. Lesikar, B.J. 2008. Installer Training Program – Distributed Flyer during presentation on Designing Treatment and Disposal Systems for High Strength Wastes. 5th Annual Onsite Wastewater Professionals of Illinois Sewage Conference and Tradeshow. January 28-30, 2008. Collinsville, IL. (45 people).
7. Loomis, G.W. 2008. Installer Training Program – Distributed flyer. New England Onsite Wastewater Training Center – All About Media Filters Workshop (OWT 165). January 29, 2008. Kingston, RI. (10 people).
8. Lesikar, B.J. 2008. Installer Training Program – Distributed Flyer during presentation on Texas Soil Research – could we do the same? 6th Biennial Southwest On-Site Wastewater Conference, January 30-31, 2008. Laughlin, NV. (135 people).
9. Loomis, G.W. 2008. Installer Training Program – Distributed flyer. New England Onsite Wastewater Training Center – Regulatory Setbacks and Buffers Workshop (OWT 155). January 31, 2008. Kingston, RI. (94 people).
10. Loomis, G.W. 2008. Installer Training Program – Distributed flyer. New England Onsite Wastewater Training Center – Nitrogen Dynamics in the Environment and Onsite Wastewater Systems Workshop (OWT 160). February 12, 2008. Kingston, RI. (12 people).
11. Loomis, G.W. 2008. Installer Training Program – Distributed flyer. New England Onsite Wastewater Training Center – Innovative and Alternative Wastewater Technology Overview Workshop (OWT 105). February 15, 2008. Kingston, RI. (20 people).
12. Loomis, G.W. 2008. Installer Training Program – Distributed flyer. New England Onsite Wastewater Training Center – AutoCALCS Workshop (OWT 150). February 21, 2008. Kingston, RI. (5 people).

13. Lesikar, B.J. 2008. Installer Training Program – Distributed Flyer during presentation on Experts Review of ATU Operation and Maintenance, NAWT Education Day, Pumper & Cleaner Environmental Expo. February 27, 2008 Louisville, KY. (400 people).
14. Loomis, G.W. 2008. Installer Training Program – Distributed flyer. Third Northeast Onsite Wastewater Treatment Short Course and Equipment Exhibition. March 11-13, 2008. Kingston, RI. (140 people).
15. Loomis, G.W. 2008. Installer Training Program – Distributed flyer. Onsite Wastewater Management Training in Puerto Rico. March 27-28, 2008. San Juan, Puerto Rico. (110 people).
16. Loomis, G.W. 2008. Installer Training Program – Distributed flyer. Onsite Wastewater Management Training in the United States Virgin Islands. April 1 -2, 2008. Saint Thomas, USVI. (35 people).
17. Lesikar, B.J. 2008. Installer Training Program – Distributed Flyer during presentation on The Evolution of Decentralized Wastewater Treatment Philosophy. National Onsite Wastewater Recycling Association Annual Technical Conference and Exhibition. April 7-10, 2008. Memphis, TN. (35 people).
18. Lindbo, D. 2008. Installer Training Program – Distributed brochure during meeting. 24th Annual On-Site Wastewater Conference. McKimmon Center, North Carolina State University. April 15-17, 2008. Raleigh, NC. (300 people).
19. Loomis, G.W. 2008. Installer Training Program – Distributed flyer. New England Onsite Wastewater Training Center – Bottomless Sand Filter Design and Installation Workshop (OWT 125). April 17, 2008. Kingston, RI. (25 people).
20. Loomis, G.W. 2008. Installer Training Program – Distributed flyer. New England Onsite Wastewater Training Center – Conventional Onsite Wastewater System Inspection Workshop (INSP 100). April 30 – May 1, 2008. Kingston, RI. (25 people).
21. Loomis, G.W. 2008. Installer Training Program – Distributed flyer. New England Onsite Wastewater Training Center – Innovative & Alternative Technology Overview Workshop (OWT 105). May 8, 2008. Kingston, RI. (24 people).
22. Loomis, G.W. 2008. Installer Training Program – Distributed flyer. New England Onsite Wastewater Training Center – Field Innovative & Alternative Technology Overview Workshop (I&A Field). May 29, 2008. Kingston, RI. (25 people).
23. Loomis, G.W. 2008. Installer Training Program – Distributed flyer. New England Onsite Wastewater Training Center – Innovative & Alternative Systems Operation & Maintenance Workshop (INSP 200). June 4-5, 2008. Kingston, RI. (16 people).
24. Lesikar, B.J. 2008. Installer Training Program – Distributed brochure during presentation on Speaking the same language: an update on the CIDWT decentralized wastewater treatment glossary. Onsite wastewater session. 72nd Annual Educational Conference & Exhibition of the National Environmental Health Association. June 22-25, 2008. Tucson, AZ. (24 people).
25. Loomis, G.W. 2008. Installer Training Program – Distributed flyer. New England Onsite Wastewater Training Center – Bottomless Sand Filter Design & Installation Workshop (OWT 125). June 25, 2008. Kingston, RI. (15 people).

26. Loomis, G.W. 2008. Installer Training Program – Distributed flyer. New England Onsite Wastewater Training Center – Surveying Techniques for the Wastewater Professional Workshop (OWT 115). July 15, 2008. Kingston, RI. (7 people).
27. Loomis, G.W. 2008. Installer Training Program – Distributed flyer. New England Onsite Wastewater Training Center – Microbiology for Wastewater Professionals Workshop (OWT 170). July 17, 2008. Kingston, RI. (11 people).
28. Loomis, G.W. 2008. Installer Training Program – Distributed flyer. New England Onsite Wastewater Training Center – Surveying Basics for the Onsite Wastewater Contractor Workshop (OWT 110). August 7, 2008. Kingston, RI. (7 people).
29. Miles, R.J. 2009. Installer Training Program-Distributed flyer. Missouri Smallflow Organization Annual Trade Show and Convention. January 21, 2009, Columbia, MO (350 people).
30. Lesikar, B., J. 2009. Installation Training Program – Distributed brochure during presentation on the Installation Training Curriculum. USDA-CSREES 2009 National Water Quality Conference. February 8-12, 2009. St Louis, MO. (23 people).

7.4 Articles and Papers

1. Lesikar, B.J., J. Mechell, N. Deal, and K. Farrell-Poe. 2006. Training and Educational Materials Developed for University Curriculums, Practitioners (Operation and Maintenance) and Installers. WEFTEC Workshop 112, 79th Annual Technical Exhibition and Conference, Water Environment Federation, 10/21/06, Dallas, TX.
2. Lesikar, B., J. Buchanan, S. Christopherson, N. Deal, K. Farrell-Poe, D. Gustafson, D. Kalen, D. Lindbo, G. Loomis, R. Melton, and R. Miles. 2008. Installation Curriculum for Small Scale Wastewater Treatment Systems. USDA-CSREES 2008 National Water Quality Conference. February 3-7, 2008. Sparks, NV.
3. Lesikar, B., J. Buchanan, S. Christopherson, N. Deal, K. Farrell-Poe, D. Gustafson, D. Kalen, D. Lindbo, G. Loomis, R. Melton, and R. Miles. 2009. Installation Training Curriculum. USDA-CSREES 2008 National Water Quality Conference. February 9-12, 2008. St. Louis, MO.
4. Lesikar, B., J. Buchanan, S. Christopherson, N. Deal, K. Farrell-Poe, D. Gustafson, D. Kalen, D. Lindbo, G. Loomis, R. Melton, and R. Miles. 2008. Installation Training Curriculum. National Onsite Wastewater Recycling Association Annual Technical Conference and Exhibition. April 7-10, 2008. Memphis, TN.
5. NOWRA. 2008 Installer Academy in Las Vegas Was a Winner!. *Onsite Journal* [online] Winter **2009**, 18(1):25-26.
6. Lesikar, B., J. Buchanan, S. Christopherson, N. Deal, K. Farrell-Poe, D. Gustafson, D. Kalen, D. Lindbo, G. Loomis, R. Melton, and R. Miles. 2009. CIDWT Installer Curriculum Program. National Onsite Wastewater Recycling Association. 18th Annual Technical Conference and Exhibition. April 6-9, 2009. Milwaukee, WI.

APPENDIX A

WRITERS MEETING ATTENDANCE

Table A-1. Individuals Participating in Writers Meetings

Last Name	First name	MN Aug 2007	FL Oct 2007	1st D.D. Las Vegas, NV Dec 2007	CSREES Reno, NV Feb 2008	2nd D.D. VA Mar 2008	3rd D.D. Las Vegas, NV Dec 2008	CSREES St. Louis, MO Feb 2009	4th D.D. Liberty, MO Mar 2009	NOWRA Milwaukee, WI Apr 2009
*Buchanan	John							X	X	X
Christopherson	Sara	X	X	X	X	X	X	X	X	X
Deal	Nancy	X	X	X	X	X	X	X	X	X
*Farrell-Poe	Kitt							X		
*Gustafson	Dave	X		X			X			
Kalen	David	X	X	X	X	X	X	X	X	X
Lesikar	Bruce	X	X	X	X	X	X	X	X	X
Lindbo	Dave		X		X	X	X	X	X	X
Loomis	George	X	X	X	X	X	X	X	X	X
Melton	Rebecca	X	X	X	X	X	X	X		
*Miles	Randy							X	X	X
±Stuth, Jr.	William				X					

*Secondary Author
±OIPRC member
D.D. Development day

APPENDIX B

REVIEW TEAM

Table B-1. Individuals Participating in Industry Review Meetings

Name	Company	Minneapolis, MN (OIPRC and PRG)	Richmond, VA (OIPRC)	Las Vegas, NV (PRG)
David Burnham	Burnham Excavating, Inc.	X	X	
Sara Heger Christopherson	University of Minnesota	X	X	X
James Converse	University of Wisconsin	X		X
Kenneth Davis	Axis Enterprises, Inc.	X		X
Nancy Deal	North Carolina State University	X	X	X
Anthony Gaudio	Apalachee Backhoe and Septic Tank		X	
Scott Greene	Guilford County Health Department	X	X	
David Gustafson	University of Minnesota	X		X
David Kalen	OWT Center URI-NRS Dept.	X	X	X
Eric Larson	Septic Check, Inc.	X	X	
Bruce Lesikar	Texas AgriLife Extension Service	X	X	X
Dave Lindbo	North Carolina State University	X	X	X
George Loomis	OWT Center URI-NRS Dept.	X	X	X
Rebecca Melton	Texas AgriLife Extension Service	X	X	X
Albert Mills	Orange County Environmental Health Dept.		X	
Mark Ritter	Ritter Sewer and Excavating	X	X	X
Kyle Shern	BioGard, Inc.	X	X	X
Tony Smithson	National Environmental Health Association	X		X
Timothy Stasiunas	Advanced Wastewater Technologies, Inc.	X	X	
Jerry Stonebridge	National Onsite Wastewater Recycling Association	X		X
William L. Stuth, Sr.	Aqua Test, Inc.	X		X
William L. Stuth, Jr.	Stuth Company	X	X	

APPENDIX C

DISTRIBUTIONS OF DRAFT TRAINING MATERIAL

Table C-1. Individuals Distributed Drafts of Training Manuals

Last Name	First Name	Company
Adams	Mark	Northstar Engineering
Alexander	Donald	VA Department of Health
Amash	David	Pima County DEQ
Amoozegar	Aziz	North Carolina State University
Ashburn	Paul	Ashco A Corporation
Ballavance	Brett	Dulluth, MN
Banathy	Tibor	Wastewater Training and Research Center
Bannister	Tim	Tri-County Wastewater Mgmt
Bauter	Paul	Keuka Watershed Improvement Coop.
Benson	Ralph	Environmental Health Sanitarian, Clermont County General Health District
Berkowitz	Steven	Division of Environmental Health
Bishop	Colin	Bord na Mona Environmental Products US, Inc.
Blodig	Allison	Premier Tech Environment
Boekeloo	Tom	NYSDEC
Borgeson	Karen	SJE-Rhombus
Bounds	Terry	Orenco Systems, Inc.
Bowers	Fred	Bureau of Nonpoint Pollution Control
Brandt	Tom	New Mexico Environment Department
Bray	Walter	SUNY-Delhi Civil Engineering
Breezee	Rick	Hudson, WI
Briggs	James	Briggs Septic, Inc.
Brogdon	Jennifer	TVA, Environmental Engineering Services
Broyles	Dale	WA State Parks & Recreation Commission
Buchanan	John	U.T. Biosystems
Buffington	Beth	WPCSOCC
Buhre	Ted	Ted Buhre Building Firm, LLC
Burnham	David	Burnham Excavating, Inc.
Bush	Daniel	Septic Technologies, Inc.
Byers	Matthew	Zoeller Pump Co.
Caesar	Mel	Randolph County Env. Health
Cashell	Peg	Utah Water Research Laboratory
Christianson	Kevin	SJE-Rhombus
Christopherson	Sara	University of Minnesota
Christopherson	Kurt	Minnesota
Converse	Jim	Univesrity of Wisconsin
Cotton	Dave	Wastewater Technologies, Inc.
Crissman	Tim	Division of Environmental Health
Crosby	Jeff	St Louis County Health Dept – Duluth
Cruver	Sally	Salcor Incorporated
Cruz	Sonia	State of Florida- Dept of Health
Dail	Robert E.	Onslow Co. Public Utilities

Dallemand	Barbara	Church and Associates, Inc.
D'Allesandro	William	Scituate Cesspool, Inc.
Davidson	Edward	Town of Johnston (WWMB)
Davis	Mike	Kentucky Onsite Wastewater Training Center
Davis	K.R.	Commonwealth Onsite Solutions
Davis	Trapper	Coastal Plains Environmental Corp.
Davis	Kenneth	Axis Enterprises, Inc.
Deal	Nancy	NCSU Soil Science Cooperative Extension
Dix	Steve	Old Saybrook, CT
Douglas	Bruce	Questa Engineering Corporation
Duerre	Steven	MPCA Resource Management
Duree	David	Maryland Onsite Wastewater Training Center
Einweck	Debra	ADOT
Elmer	Peg	Dept of Housing, Vermont
Emery	Reuel	Clark County
Endgely	Allen	A&A Septic Design & Pumping, Inc.
Espersen	Thomas	Crow Wing County
Farrell-Poe	Kitt	University of Arizona
Ferrero	Tom	National Association of Wastewater Transporters
Foster	Don	Apache County Health Dept.
Fox	Bruce	National Association of Wastewater Transporters
Frank	Thomas	Tim Frank Septic Cleaning Company
Frederick	Rod	EPA (Retired)
Friend	Duane	Springfield Extension Center
Fritz	Tom	Residential Sewage Treatment Co.
Gale	Alan	NOWRA
Geary	Philip	University of New Castle
Gilstrap	Ann C. (Len)	Carteret County Environmental Health
Grantham	Deborah	Cornell Cooperative Extension
Gross	Mark	Orenco
Groover	Roxanne	Florida Onsite Wastewater Association
Gustafson	Dave	University of Minnesota Biosystems and Ag. Engineering
Hairston	James	Alabama Cooperative Extension
Hallahan	Dennis	Infiltrator Systems, Inc.
Hansen	Scott	Mille Lacs Band DNR
Hanson	Adrian	NMSU/SWEDTI Center
Harmon	David A.	Duke Power
Harrington	William M.	Environmental Services & Repairs
Hemby, Jr	Adrian	North Carolina
Henrie	Mike	Pima County DEQ
Hensarling	Doug	Aerobic System Inspection & Maintenance
Hext	Ken	Coconino County
Himschoot	Robert	Crews Environmental
Huber	Robert G.	Oklahoma Dept. of Environmental Quality
Hudson	Joyce	U.S. EPA Office of Wastewater Management
Hull	Terry	Puget Sound Action Team
Inman	J.R.	N.W. Cascade/FloHawks
Jablecki	Joe	University of Alabama- Birmingham
Johnson	George	Ecological Tanks, Inc.
Jowett	Craig	Waterloo Biofilter Systems, Inc.
Joy	Doug	University of Guelph School of Engineering
Kalen	David	OWT Center URI-NRS Dept.
Kauppi	Charles	Crow Wing County
Keckeisen	Lorraine	Delhi College of Technology
Kelley	David	State of Delaware, DNREC, GWDS
Kerri	Kenneth	Office of Water Programs, California State University
Knauss	Deb	RIDEM ISDS

Konsler	Tom	Orange County Health Dept
Larson	Eric	Septic Check, Inc.
Lashinski	Jim	Lashinski Services
Lee	Brad	Purdue University
Lee	Robert	VA Onsite Wastewater Recycling Association, Inc.
Lee	Robert	Loudoun County Environmental
Lenning	Dave	Washington
Lesikar	Bruce	Texas AgriLife Extension Service
Lindbo	Dave	North Carolina State University
Long	Dawn	First American Septic Service LLC
Loomis	Eva	Keene State College
Loomis	George	Dept. of NRS
Loudon	Ted	Michigan State University
Magilton	Edward	Sgt. Septic of Fairfield County
Mahmood	Ramzi	California State University- Sacramento
Manthey	Michael	The MESS Co., LLC
McBride	Karen	Rural Community Assistance Corporation
Melton	Rebecca	Texas AgriLife Extension Service
Mendoza	Sonya	Pinal County
Meyers	Darren	Zoeller Company
Miles	Randall	SEAS Department University of Missouri
Miller	Scott	Ukiah, CA
Mokma	Delbert	Michigan State University
Moore	Hilary	State of Delaware, DNREC, GWDS
Nelson	Doug	Knight Treatment Systems
Nelson	Valerie	Coalition for Alternative Wastewater Treatment
Oakley	Stewart	CSU- Chico
Ogden	Michael	Natural Systems International, LLC
Olson	Jon	Olson Sewer Service, Inc.
Oram	Brian	Center for Environmental Quality
Otis	Dick	Ayres Associates
O'Rourke	Peter	RIDEM ISDS
Papish	Uri	Oregon Department of Environmental Quality
Papp	Allan	WA State Parks & Recreation Commission
Passaro	Stacy	Water Environmental Federation
Peacock	Carl	VA Tech 7 VA Department of Health
Piluk	Richard	Anne Arundel County Health Dept
Polson	Dick	Clackamas County Building Code Agency
Potts	David	GEOMATRIX, LLC
Powell	Morgan	Kansas State University
Price	Michael	Norweco, Inc.
Prochaska	Jim	JNM Technologies, Inc.
Quinn	Amy	MPCA Northeast Region
Rachlin	Jeff	Pennsylvania Septage Management Association
Ramirez	Ruth	Pinal County
Redmond	Mike	Pima County DEQ
Reid	Steve	WPCSOCC
Rich	Barbara	Deschutes County Environmental Health
Ridgeway	George	Skagit County Health Dept.
Rock	Chet	University of Maine
Rodriguez	Erica	Pinal County
Rosefield	David	OWM, Inc.
Rubin	Robert	North Carolina State University
Rupp	Gretchen	MSU Extension Service
Saeed	Nausheen	NACCHO
Sanders	Paul	Clermont County Health District
Scheffe	Brian	Front Range Precast

Shaffer	Ginger L.	Shaffer Environmental Consluting, LLC
Shaffer	John M.	Shaffer Environmental Consluting, LLC
Shaw	Atul	Pinal County
Shelito	Patricia	MPCA North Central Region
Shepp	Eric	Pima County DEQ
Shon	Won	Aquamake Water Resource Group, LLC
Siegrist	Robert	Colorado School of Mines
Sims	Judy	Utah State University Utah Water Research Laboratory
Smithson	Anthony	Lake County Health Department
Snowden	Jeff	Snowden Onsite Septic, Inc.
Stasiunas	Timothy	Advanced Wastewater Technologies Inc.
Stonebridge	Jerry	Stonebridge Construction Co.
Stuth	William	AquaTest Inc.
Suchecki	Ron	Hoot Aerobic Systems, Inc.
Surface	Steve	ADOT
Swanson	Ed	ADEQ
Tartt	Allen	Alabama Onsite Training Center
Terry	Theo	Ring Industrial Group, Inc.
Theobald	David	Zoeller Company
Thomas	John	Washington OnSite Sewage Association
Trammel	Clifford	California Onsite Wastewater Association
Treinen	Gary	Santa Rosa, CA
Tucker	Daniel	Mining & Petroleum Training Services
Valentine	Eric	American Manufacturing, Inc.
Walker	Doug	Pinal County
Waller	Donald	Director of CWRS Dalhousie University
Wecker	Stephen	Onsite Consulting Services
Weldon	Roxanne	Eastern Shawnee Tribe of Oklahoma: Environmental/Land Mgmt. Dept.
White	Kevin	University of South Alabama
Williams	Craig	Maryland Dept. of the Environment
Williams	Jerry	Delaware Tech and Comm College
Wingert	Howard	Concrete Sealants
Wirth	Joelle	Coconino County
Wright	Denise	Indiana State Dept of Health
Yeager	Tom	Kennedy/Jenks Consultants
Yeldermann	Joe	Baylor University Environmental Studies

APPENDIX D

PILOT EVENT AGENDAS

Table D-1. Agenda for First Pilot Training Event in Las Vegas, NV (Dec 10-11, 2007)

Day 1	Monday – December 10, 2007	Instructor
10:00 - 10:45	Introduction, Business and Professional Ethics	Bruce Lesikar
10:45 - 11:30	Soils & Site Evaluation Overview	Nancy Deal
11:30 - 12:00	Installation Safety	Dave Gustafson
12:00-1:00	Lunch	
1:00 - 2:30	General Construction Material Management & Piping Installation	Sara Heger Christopherson
2:30-2:45	Break	
2:45-4:15	Installation Planning	David Kalen
4:15-5:00	Watertight Septic, Holding and Dose Tanks	Dave Gustafson
Day 2	Tuesday – December 11, 2007	
7:30-8:00	Homework Review	David Kalen
8:00-8:45	Installing Pumps and Controls	Dave Gustafson
8:45 - 9:30	ATU Installation	Bruce Lesikar
9:30 - 10:00	Disinfection Systems, George Loomis	George Loomis
10:00-10:30	Break	
10:30-12:00	Distribution: Pressure and Gravity	Nancy Deal
12:00-1:00	Lunch	
1:00-1:45	Media Filters	George Loomis
1:45-2:30	Below Grade Systems	Sara Heger Christopherson
2:30-3:00	Break	
3:00-4:15	Above Grade Systems	Sara Heger Christopherson
4:15-5:00	Drip Systems	Bruce Lesikar

Table D-2. Agenda for Second Pilot Training Event in Richmond, VA (March 17-18, 2008)

Day 1	Monday – March 17, 2008	Instructor
7:30-8:00	Registration	
8:00-9:10	Introduction, Business and Professional Ethics	Bruce Lesikar
9:10-10:15	Soils & Site Evaluation	David Lindbo
10:15-10:30	Break	
10:30-11:45	Distribution: Pressure and Gravity	Nancy Deal
11:45-12:30	Lunch	
12:30-1:30	Installation Techniques and Materials	Sara Heger Christopherson
1:30-1:40	Break	
1:40-2:50	Installation Planning	Dave Kalen
2:50-3:05	Break	
3:05-4:20	Piping & Watertight tanks	Sara Heger Christopherson
4:20-5:00	Installing Pumps and Controls	Nancy Deal
5:00	Distribute Homework Review Materials and Conclude	
Day 2	Tuesday – March 18, 2008	
7:30-8:15	Homework Review	Dave Kalen
8:15-9:30	Installation Safety	Nancy Deal
9:30-9:45	Break	
9:45-10:30	ATU Installation	Bruce Lesikar
10:30 – 12:00	Media Filters	George Loomis
12:00-12:45	Lunch	
12:45-1:15	Media Filters	George Loomis
1:15 – 2:00	Soil Treatment Areas	Sara Heger Christopherson
2:00-2:15	Break	
2:15-3:00	Soil Treatment Systems	Sara Heger Christopherson

3:00-3:20	Break	
3:20-4:20	Drip Systems	Bruce Lesikar
4:20-5:00	Disinfection	George Loomis
5:00	Distribute Homework, Collect Evaluations & Class Concludes	

Table D-3. Agenda for Third Pilot Training Event in Las Vegas, NV (Dec 8-10, 2008)

Day 1	Monday – December 8, 2008	Instructor
7:30-8:00	Registration	
10:15-11:15	Welcome and Introduction	Bruce Lesikar
11:15-12:00	Professional Ethics	Bruce Lesikar
12:00-1:00	Lunch	
1:00-1:45	Soils and Site Evaluation for Installers	David Lindbo
1:45-2:45	Distribution	Nancy Deal
2:45-3:15	Break	
3:15-4:15	Installation Safety	Nancy Deal
4:15-5:00	Installation and Techniques and Materials	Sara Heger Christopherson
Day 2	Tuesday – December 9, 2008	
8:00-9:15	Installation Planning	David Kalen
9:15-10:00	Installation of Piping	Sara Heger Christopherson
10:00-10:30	Break	
10:30-11:15	Watertight Tanks	Nancy Deal
11:15-12:00	Installing Pumps and Controls	David Kalen
12:00-1:00	Lunch	
1:00-2:15	Media Filters Installation	George Loomis
2:15-3:00	Installing Disinfection Systems	George Loomis
3:00-3:30	Break	
3:30-4:45	ATU Installation	Bruce Lesikar
4:45-5:00	Homework Distribution and Concluding Remarks	

Day 3	Wednesday – December 10, 2008	
7:30-8:30	Homework Review	David Kalen
8:30-10:00	Installing Soil Treatment Areas	Sara Heger Christopherson
10:00-10:30	Break	
10:30-11:45	Installing Drip Distribution Systems	Bruce Lesikar
11:45-12:00	Summary and Concluding Remarks	

Table D-4. Agenda for Fourth Pilot Training Event in Liberty, MO (Mar 5-6, 2009)

Day 1	Thursday – March 5, 2009	Instructor
7:30-8:00	Registration	
8:00-9:15	Introduction and Business	Nancy Deal
9:15-10:15	Soils & Site Evaluation	Randy Miles
10:15-10:30	Break	
10:30-11:45	Distribution: Pressure and Gravity	David Kalen
11:45-12:30	Lunch	
12:30-1:30	Installation Techniques and Materials	David Lindbo
1:30-1:40	Break	
1:40-2:50	Installation Planning	Bruce Lesikar
2:50-3:00	Break	
3:00-3:45	Installation Piping	John Buchanan
3:45-5:00	Water-tight Tanks	Sara Heger Christopherson
5:00	Distribute Homework Review Materials and Conclude	
Day 2	Friday – March 6, 2009	
7:30-8:15	Homework Review	George Loomis
8:15-9:15	Installation Safety	Randy Miles
9:15-9:30	Break	
9:30-10:45	Installing Pumps and Controls	Nancy Deal
10:45 – 12:00	Media Filters Installation	David Lindbo
12:00-12:45	Lunch	
12:45-1:40	Installing Disinfection Systems	Bruce Lesikar
1:40-1:50	Break	
1:50-2:45	ATU Installation	David Kalen
2:45-3:00	Break	

3:00-4:10	Installing Soil Treatment Areas	George Loomis
4:10-5:00	Installing Drip Fields	John Buchanan
5:00	Distribute Homework, Collect Evaluations & Class Concludes	

APPENDIX E

PILOT TRAINING EVENT EVALUATION RESULTS

Pilot Testing Evaluation Results

As a measure of the effectiveness of each pilot training event, program evaluations were distributed and collected from attendees. An example evaluation follows:

Figure E-1. Example evaluation form

CIDWT Program Evaluation

Installer Training Curriculum

Missouri Smallflows Organization; Liberty, MO; March 5-6, 2009

Name (optional): ____________________ Your Job Title: ______________________
Years in the Industry: ________________ State(s) where you work: ___________________

1. What were your expectations when entering this training course? _________________
____
____

2. Overall Evaluation:

a.	Objectives of this course were:	Clearly Evident 5 4 3 2 1 Vague
b.	Forms as guides for installation and start-up:	Excellent 5 4 3 2 1 Poor
c.	Power points presenting the material were:	Excellent 5 4 3 2 1 Poor
d.	Organization and presentation of material was:	Excellent 5 4 3 2 1 Poor
e.	Manual was clearly written and organized:	Excellent 5 4 3 2 1 Poor
f.	My expectations were:	Exceeded 5 4 3 2 1 Not Met
g.	Overall, I would consider this program:	Excellent 5 4 3 2 1 Poor

3. What topics would you like to see added to the course or given more time in the course?
____
____

4. What was the most helpful information presented through this training course?
____
____

5. What was the least helpful information presented through this training course?
____
____

____

6. What is your general impression of this training course? ______________________
____
____
____

7. How did you receive information on this course? ____________________________
____

8. Do you anticipate **benefiting economically** as a direct result of what you learned through participation in this Installer training event? (circle your response)

Yes No

9. I would recommend this course to another wastewater professional? (circle your response)

Yes No

(Please turn over and complete the other side)

For each of the items listed below, please circle the number that best reflects your level of understanding BEFORE the program (middle column) and the number that best reflects your level of understanding AFTER the program (right column).

LEVEL OF UNDERSTANDING

Poor	Fair	Good	Excellent
1	2	3	4

What is your level of understanding of each of the following items?	**Before the program**		**After the program**
Effectively evaluate the site conditions and system installation when developing a contract.	1 2 3 4		1 2 3 4
Review a design plan and conduct a site review to successfully develop a bid and plan for construction.	1 2 3 4		1 2 3 4
Evaluate site conditions with respect to OSHA construction safety practices.	1 2 3 4		1 2 3 4
Use of surveying practices to lay out the system, locate components and evaluate proper elevations.	1 2 3 4		1 2 3 4
Recognize how site conditions influence equipment selection and installation methods.	1 2 3 4		1 2 3 4
Understand how effective excavation, bedding, placement and backfilling methods help achieve stable watertight components.	1 2 3 4		1 2 3 4
Select and assemble pumping systems and properly adjust and verify control settings.	1 2 3 4		1 2 3 4
Implementation of critical practices needed for installation of advanced treatment system components.	1 2 3 4		1 2 3 4
Install soil treatment areas at the proper elevation using appropriate materials while maintaining natural soil conditions.	1 2 3 4		1 2 3 4

Understand how proper install installation influences subsequent operation and maintenance activities and facilitates management of wastewater treatment systems	1 2 3 4		1 2 3 4

For each item listed below, please indicate your intentions to adopt the following practice(s), or indicate whether you have already adopted them.

Practice	Will not adopt	Undecided	Probably will adopt	Adopted already	Tried it before; discontinued application
Utilize a checklist to document completeness of installation process.					
Utilize a checklist to document startup status of treatment system.					
Implement safety practices to minimize potential of work place accidents.					
Provide system owners information on proper system management.					
Implement watertightness testing procedures for evaluating tanks.					

Attendance at the first, second, third and fourth pilot training presentations ranged from 40 to 60, 20 to 23, 40 to 60 and 15, and the number of evaluations received was 30, 22, 19, and 14, respectively. The number of attendees returning their evaluations was lower for the first and third pilot training events. This lower response rate was attributed to the installer training course being held concurrently with other sessions of a larger conference. The fluctuation in attendance represented people entering and exiting the course to attend specific presentations. Overall, the attendees providing responses to the evaluation gave the installer training course a relatively high rating (Table E-1).

Table E-1. Overall program evaluation results (1=poor and 5= excellent).

Overall Evaluation	Avg. 1st	Avg. 2nd	Avg. 3rd	Avg. 4th
a. The objectives of this course were clear:	4.3	4.5	4.3	4.3
b. Forms as guides for installation and startup:	4.3	4.5	4.5	4.2
c. The powerpoints presenting the material were:	4.3	4.5	4.4	4.4
d. Organization and presentation of material was:	4.4	4.5	4.3	4.6
e. Manual was clearly written and organized:	4.5	4.6	4.3	4.6
f. My expectations were meet:	4.1	4.4	4.0	4.1
e. Overall, I would consider this program:	4.4	4.5	4.4	4.3

A retrospective pre-then-post evaluation test was used to rate knowledge gained through participation in the pilot training events (Table E-2). Course participants were asked to rate their knowledge of topics, skills and practices on a scale of 1 to 4 both before and after the course. These responses were counted and an average knowledge rating before and after the course was calculated for the respondents. The percent knowledge gained was calculated by subtracting the average knowledge before the course from the average knowledge after the course and then dividing this number by the average knowledge before the course. Because the goal of this course is to address the needs of both entry-level and advanced installers, the reported knowledge gain can be lower. Advanced installers may be proficient at some of the topics and report no knowledge gained. Others participants are amazed at the amount of information covered on a topic in a relatively short period of time and report a large knowledge gained. Members of the OIPRC completed evaluations during the second event. Their responses were removed from the pool of responses because most of their responses showed a limited knowledge gained on the topics. This response should be expected since these individuals were selected because of their extensive knowledge of installation practices.

Table E-2. Retrospective pre-then-post test percent knowledge gained by participants.

Topics	% Knowledge Gain, 1st	% Knowledge Gain, 2nd*	% Knowledge Gain, 3rd	% Knowledge Gain, 4th
a. Effectively evaluate the site conditions and system installation when developing a contract.	26.3	22.5	14.8	28.2
b. Review a design plan and conduct a site review to successfully develop a bid and plan for construction.	23.2	24.3	15.4	31.6
c. Evaluate site conditions with respect to OSHA construction safety practices.	34.3	38.9	35.0	41.2
d. Use of surveying practices to lay out the system, locate components and evaluate proper elevations.	25.3	25.6	22.0	32.4
e. Recognize how site conditions influence equipment selection and installation methods.	15.0	22.0	20.0	28.2
f. Understand how effective excavation, bedding, placement and backfilling methods help achieve stable watertight components.	26.2	15.2	17.3	22.0
g. Select and assemble pumping systems and properly adjust and verify control settings.	18.6	9.3	19.4	23.1
h. Implement critical practices needed for installation of advanced treatment system components.	30.3	22.5	23.9	20.5
i. Install soil treatment areas at the proper elevation using appropriate materials while maintaining natural soil conditions.	17.6	19.0	29.2	27.0
j. Understand how proper installation influences subsequent operation and maintenance activities and facilitates management of wastewater treatment systems.	21.3	18.2	31.3	19.5

* The responses by the OIPRC were removed from the calculation of % knowledge gained for the second pilot training event.

The installer training course is designed to raise awareness of installation practices, knowledge of methods to evaluate proper installation of system components, and methods to work safely while constructing systems. Additionally, the installer is typically the last person to communicate with the system owner following installation. Therefore the responsibility for providing information to the facility owner on proper operation and maintenance usually falls to the installer. The intention to adopt recommended practices is a gauge of whether the importance of the activity was conveyed relative to the effort required to implement the practice. The responses from the training events showed how many of the practitioners had already adopted the safe working practices, provided information to owners, or conducted watertightness testing (Tables E-3, E-4, E-5 & E-6). The practitioners also expressed an interest in adopting a checklist to document completeness of installation and startup conditions.

Table E-3. Intention to adopt recommended practices (First Pilot Training).

Topics	Will NOT adopt	Undecided	Probably Will adopt	Adopted already	Tried and discontinued use
a. Utilize a checklist to document completeness of installation process.	0	7	17	7	0
b. Utilize a checklist to document startup status of treatment system.	1	6	18	6	0
c. Implement safety practices to minimize potential of work-place accidents.	0	1	12	17	0
d. Provide system owner's information on proper system management	0	2	11	17	0
e. Implement watertightness testing procedures for evaluating tanks.	2	3	15	10	0

Table E-4. Intention to adopt recommended practices (Second Pilot Training).

Practice	Will NOT adopt	Undecided	Probably WILL adopt	Adopted Already	Tried and discontinued use
a. Utilize a checklist to document completeness of installation process:	1	0	12	7	0
b. Utilize a checklist to document startup status of treatment system:	0	1	12	7	0
c. Implement safety practices to minimize the potential of work-place accidents:	0	1	11	9	0
d. Provide system owners information on proper system management:	0	1	6	13	0
e. Implement watertightness testing procedures for evaluating tanks:	1	4	5	9	0

Table E-5. Intention to adopt recommended practices (Third Pilot Training).

Practice	Will NOT adopt	Undecided	Probably WILL adopt	Adopted Already	Tried and discontinued use
a. Utilize a checklist to document completeness of installation process:	0	3	11	2	0
b. Utilize a checklist to document startup status of treatment system:	0	3	11	2	0
c. Implement safety practices to minimize the potential of work-place accidents:	0	2	4	9	0
d. Provide system owners information on proper system management:	0	2	5	9	0
e. Implement watertightness testing procedures for evaluating tanks:	2	4	4	6	0

Table E-6. Intention to adopt recommended practices (Fourth Pilot Training).

Practice	Will NOT adopt	Undecided	Probably WILL adopt	Adopted Already	Tried and discontinued use
a. Utilize a checklist to document completeness of installation process:	0	0	8	6	0
b. Utilize a checklist to document startup status of treatment system:	0	2	10	2	0
c. Implement safety practices to minimize the potential of work-place accidents:	0	0	3	10	0
d. Provide system owners information on proper system management:	1	0	1	12	0
e. Implement watertightness testing procedures for evaluating tanks:	2	2	1	9	0

The evaluation forms also included a variety of free response questions. The questions and responses are as follows:

1. What were your expectations when entering this training course?

First training

- Gain knowledge and overview of entire wastewater industry
- Learn and exchange ideas

- Lots of info
- Info
- Educational program
- Get some new and updated installation methods and technologies
- Learn new technology regarding installing, help start installing and become more than just a pumper
- More training, become more knowledgeable than my immediate competitors
- Increase my knowledge of installation practices, learn new and different systems
- Just to learn about my system and the different types of systems that can be used
- Learn about systems used other places
- Didn’t have any
- As a designer and inspector, to increase my knowledge of the installation component
- Increase knowledge of various system types – principally through installer’s course
- Enhance my knowledge and advances of on-lot septic system and along with newer and advanced technology
- Fulfill continuing education for master installer license, Nebraska
- Gain new knowledge to apply to the industry and techniques to better my business
- Better understanding of wastewater treatment systems. New ways of thinking.
- None
- Enhance knowledge of onsite wastewater industry, processes, and techniques for design and installation
- Overview for onsite program plans, direction and future
- Learn more about wastewater treatment and aspects that installers run into on site – will be involved in the inspection side of the industry soon
- CEUs, professional advancement, pray for universal standards knowledge
- Learn new info on installation of systems
- Learn more about installing systems and locating some software specific to installer’s needs
- Enhance overall knowledge of wastewater industry
- Accredited and certification knowledge for professionalism
- Get a better feel for the direction that alternative systems are taking on a national level (future expectations)

Second training

- Learn all possible and become acquainted with material.
- I didn't have a lot of expectations coming into the course, I would highly recommend this class
- Some education fellowship with other people in our industry
- Basic installation practices relative to O&M and service providing
- Learning more about new systems and doing better than we already do
- General guidance
- Learn more about the installer business
- That I would learn a lot about the installation process, equipment involved, and background information, got it
- To see what other information was out there
- Learn material for the NEHA Installer Exam
- Learn about installation
- Learn and understand the installation of wastewater treatment systems
- Was not sure, it is my first time
- Ongoing education
- General information to help installers

Third training

- See different on site solutions to failed systems
- Learning and all expectations were met
- Gain a better understanding of hand-on septic installations in order to perform inspections with more expertise
- Connection between design and installation
- To see what septic systems on the east coast
- I was hoping to learn more about installing septic systems
- Gain more knowledge about on-site systems
- Learn the basic fundamentals of wastewater management
- Learn and review
- Learn more technical info.
- Learn more about installing system and prepare for the certification test
- Learn and review

- Help in NEHA advance to test
- Learning new tech products, etc.
- Thorough explanations not powerpoint, more professional installations, and instructors who have field experience
- Didn’t know

Fourth training

- To determine if course covered subjects currently covered by our State training and if we could consider reciprocity
- Learning more about different systems
- Gain more uniform knowledge of systems and procedures
- Learn more about how installers put systems in
- Some new information, some do-overs
- Obtain national certification
- Wanted to learn more about alternative systems and hear contractors talk about their experiences
- Didn't have expectations per se, took course to support NOWRA and Tom, thought I could benefit as a regulator in looking at installation practices
- None
- Learning about how to install systems properly
- To get tested
- To learn more about installing
- To refresh and gain more information and to expand my understanding of my industry
- To attain the most up to date knowledge on the OWTS industry and proper installation considerations

3. What topics would you like to see added to the course or given more time in the course?

First training

- Talk more about how other installers put in drip tubing “properly”
- Software for installers and DVDs on this seminar
- Five days would be sufficient; you may want to consider 2 levels/categories to break up the class
- Good as is
- More time all around, not enough time for all the questions

- Service provider installation and standards for system instructions (checklists)
- More technical courses for those who have done this before
- Innovative approaches to challenging industry problems
- Time
- More high strength/commercial and more business process discussions
- Practical installation methods
- More on soils
- Installation techniques, tools to help work timely and efficiently
- More time on OSHA requirements
- Advanced treatment- newer technology
- Educational program for homeowners
- Course should be longer, too much info for two very long days
- Tank section
- Examples of more actual jobsite installations
- All helpful
- Media examples that can be passed around (hand out sample schedule for example)
- More overview of historical systems that were used, how to troubleshoot issues
- Business (cost, bidding, ethics)
- Hows and whys of sewage and efficient treatment
- Repair: how to bring a failed system back from the grave
- Send CIDWT manual to all before the seminar, without this much of the presented material seems to quick to fully comprehend

Second training

- A bit on percolation testing
- All
- N/A
- N/A
- All of them, but need more days (a third?), sensitivity to trees and long term effects of installation on those to be kept, consult an arborist
- Regulations for our state
- More installation tips

- Soil
- Maybe section on general troubleshooting would be interesting

Third training

- More time for everything
- Designer course
- Tank installation, pump sizing, and controls were rushed
- Designer course
- Need more time for questions
- None
- More information on certification test
- The basic calculations and formulas
- Site conditions and control panels
- More time on the entire course
- Last 4 chapters or sessions
- Math, more interaction with students, and practical applications
- Specific problems that occur with installation
- None

Fourth Training

- No time for others
- More explanations on installations of alternative systems
- Formulas and calculations
- More pictures, more time on topography and math equations
- More on our local soils
- More information on practical knowledge of installation systems such as wastewater ponds, lift stations, grinder pumps, differences in pipe and their particular wastewater system applications. Would also like class on how to document system installations and site plans. Regulator inspection class would be helpful and to emphasize to contractors the importance of working with regulators very early - before installation.
- We require application for OWWS before owner sets a permit to construct. This should be done before contractor even gets involved.
- How some systems work more in detail/maybe some troubleshooting

- More design
- More on construction of mounds
- Watertight tanks, more examples, methods and materials to achieve watertight tanks, ie., on risers, inlets, outlets

4. What was the most helpful information presented through this training course?

First training

- The exposure to systems that are not available in VA
- The new glossary
- Info: i.e., troubleshooting
- Sustainability- planning for it
- Checklist was a good idea
- Tank capacity formulas
- Some of the inspection details provided in several presentations
- Variety of vendor product training
- Sales for small businesses
- Safety and OSHA requirement and terminology
- Checklist for systems to help reduce going back and increase productivity of manpower and installers and marketability of services and recognition to standout from the competition
- All the info was helpful
- Media section
- Different forms of distribution media
- Types of systems, troubleshooting issues
- Different aspects of installation and methodologies
- Media filters, tanks, trenches
- Advanced treatment, aerobic, pumps, drip mounds
- OSHA tips
- Operation and maintenance
- Introduction, business and professional ethics, and installation

Second training

- Everything

- Soil concepts and building sand filters
- Safety
- Troubleshooting information, DOs and DON'Ts
- About pumps and elevation
- All
- All was informative
- Hard to judge, still absorbing it all
- Overviews (all topics)
- All information was helpful
- Learning about other systems that I did not know
- Types of systems
- Most information was helpful, well represented, good general information for field people

Third training

- I picked up something from each class
- NA - picked up new info with each segment, better than last year, especially drip section
- Distribution, piping, tanks
- The installer book
- Ethics
- Drip systems
- It was all very helpful
- Site planning
- All
- Everything
- Pick up little things throughout
- Manual
- OSHA guidelines
- All

Fourth training

- Elevations. Good manual, a shame it is not more involved in the course, not sure it will be read.
- All the different checklists and start-ups
- All of the checklists
- Soils and media filters, and tanks
- Siting, and elevation shooting
- Planning and pipe installation, actually all info was good
- Being introduced to systems that we don't see or have installed very often
- Pumps
- Soil and site evaluation, distribution, planning, media filters
- Have so good check list
- Soil and site evaluations
- Proper surveying and calculations, proper installation of pipe and connections

5. What was the least helpful information presented through this training course?

First training

- Excellent for new installers, redundant for experienced installers
- Disclaimer
- All good
- All was helpful
- Dave jokes- I hear them!
- Listening to same information every year, need more technical courses
- Checklists: providing them is good, but going over them is a waste of time
- All well thought out issues
- High strength waste
- Glue/primer
- Don’t just read power points
- Some areas were repeated from other seminars
- Soil and site evaluation was too general
- Disclaimers
- Equipment

- General construction, installation planning

Second training

- Safety information, however, I picked up something from every section that was covered.
- Business
- Do not use sand filter systems much in this area any more
- Regular gravel systems
- Lunch
- N/A
- None, I needed it all
- None
- None
- Too many details were covered during pre-lunch, ATU and media filters, too much design information

Third training

- Constant reminders of keeping it level
- None
- Disinfection/chlorine
- The expo hall thing
- All was relevant
- Drip systems
- None
- Can't think of one
- Safety, OSHA, we take this locally
- Portion on equipment (back hoes ck)
- Drip system
- None

Fourth training

- Really weren't any. It would have been nice if powerpoints would have followed manual better. Some chapters were ok, but other didn't.

- n/a
- This question is irrelevant, this is an excellent class and flows well
- None
- I felt like I was being talked down to by John Buchannon
- Homework, more time needs to be spent on math including rewording of some of the questions, what you were looking for was unclear
- Media filters
- For me (pumps), sizing, etc., my job responsibilities, type of pumps, good info
- Soils
- Equipment, cause we don't operate them, but still helpful
- Moss, bids
- None
- n/a
- Installing disinfection systems, although I did learn a lot, we don't use or see that often in our jurisdiction

6. What is your general impression of this training course?

First training

- Might be too fast for new installers, more time for individual comments/questions
- Great and long over-due
- A lot of info,maybe too much
- Too much info, confusing
- Lots of info was skipped because of time
- General, needs to branch off into more technical aspects, ee are taught the same thing for LEVs
- Very informative and well organized
- Topics well covered
- Help to reinforce some general perspectives but more importantly I now have some tools to help develop checklists for more efficient operation and installation practices and management to increase productivity, decrease cost and increase revenue
- Somewhat basic information
- So much info in such a short amount of time
- The powerpoints need to match the presentation exactly, makes it easier to follow

- Too much info in too little time

Second training

- Excellent
- It was a great course, wish it spent more time in all areas, would like to see it divided into 2 parts, Level 1 and Level 2, both 2 days long and spend more time on all subjects
- Good stuff, just a little rushed, need 1 to 2 more days to get it done, little shorter days
- Well organized, covers install techniques to startup
- I liked the class but they need to stretch the days out
- I thought it was very professionally done. It's nice to see credible instructors with such a good relevant background
- Excellent
- Excellent, probably the best wastewater course I've ever attended, really well organized, well presented, great handouts and materials, rotating speakers to avoid the "drone on" effect nicely done
- Very good
- Good
- It's a very informative class
- Excellent
- It was helpful
- Good general course, presented on appropriate level to contractors. This was the only class we've attended that was done on contractor's level. I was very disappointed that there was not a larger turn-out of contractors. This class seems very worthy and I'm a little ashamed of some local contractors not realizing need of continuing education and utilizing this class as a worthy addition to their professionalism.

Third training

- Good job
- Great
- Outstanding
- Good
- Good
- I think it was designed for older crowds not younger people and I found the course dull yet knowledgeable
- Would highly recommend it to others

- Very good
- Good
- Good
- It was very well organized and presenters were very knowledgeable and kept it interesting
- Very good
- Great
- Great, need to spread out the course over more time, or require speed listening course
- Very good
- Somewhat helpful, excellent manuals
- Alright
- Great

Fourth training

- Good, a lot of information in too short a time, great instructors, very knowledgeable and personable
- Quite good
- I enjoyed this course, it is probably the best onsite training that I have attended, keep up the good work. I am looking forward to taking the NEHA exam at this point.
- Very informative, would be good for anyone getting into this industry
- Very good, for a refresher, in some cases. I learned new things as well.
- Very good, Index needs more information, .It's hard to decide where some subjects are located.
- Excellent. I would like to see more opportunities for training on a variety of wastewater topics. Instructors did a great job! It would be nice if we had the speakers' e-mail addresses to send pictures and ask a few questions.
- Could have used this, had a existing sand filter on a home sold and no information on system. Owner asked me to find (proper information on system). Very good! Wonder what contractors think. We provide wastewater contractors - annual training once a year. Review our sanitation code and try.
- Positive
- Very good
- Very good/a lot of helpful information, I got a better idea of how our installers install systems and what they go through before installing
- Did a fair job of highlighting major points

- Very good, well worth the time
- A very informative course, I think this course should be mandatory for all installers
- Great! I would avoid Mondays and Fridays in the future trainings. The training manual is an awesome resource. I think more training on wastewater chemistry, BOD, TSS, DO, nitrogen, pH would be beneficial.

7. How did you receive information on this course?

First training

- Installer magazine
- Dr. Lesikar
- NOWRA
- Zoeller rep.
- Email from co-worker
- NOWRA
- Seen in journal
- NOWRA manufacturer
- Email
- NOWRA
- Ndeq, site for Nebraska
- NOWRA publication
- Installer magazine

Second training

- Reno
- VOWRA
- VOWRA
- VOWRA e-mail
- My boss
- Infiltration Systems Co
- VOWRA
- Virginia Onsite Water Reclamation Association
- VOWRA

- VOWRA
- VOWRA
- Mail
- Very good
- Email
- VOWRA email

Third training

- Email, magazines
- NOWRA
- Email
- Through my state
- My boss/______
- From Bruce L and Randy Miles
- Work
- Work
- Company
- I thought the course was very good
- Mailings
- From Doug Sharp
- Member of NOWRA
- Online
- NEHA
- NOWRA
- Bruce Lesikar

Fourth training

- MSO newsletter
- Beneficial
- E-mail
- Thru my company Residential Sewage and Tom Fritts
- Tom Fritz

- MSO
- Fellow friend sanitarian told me about training through KSFA
- Kenna Privat the other RS who had attended NOWRA Conference in Hutchinson, Kansas
- From employer
- Presentations was good
- From Tom Fritts
- MSFO
- At Kansas Small Flows
- MO Small Flows, Tom Fritts
- MO Small Flows

All respondents from the first, second, and third pilot training and all but one respondent from the fourth pilot trainings stated that they would recommend this course to other wastewater professionals. The question, "Do you anticipate benefiting economically as a direct result of what you learned through participation in this Installer Training Event?" was added to the evaluation form at the fourth training event. Nine individuals indicated that they anticipated benefiting economically while five did not. These five individuals were regulators and would not benefit economically.

Opportunities to Provide Input to Material Development

The development process was designed to facilitate input by all interested parties. Two methods to provide input were attendance at meetings and participation in pilot training events. Meetings conducted for material review were open to the public. These meetings were advertised through the CIDWT web site. Participants at pilot training events gained valuable information and provided comments on the materials being developed.

Summary

Installer training materials were developed specifically targeting the installation and startup of onsite wastewater treatment systems. These materials focus on describing the essential knowledge, skills, and abilities for professionals working on the installation of wastewater treatment systems. These materials promote uniformity in practitioner training for installation practices and support credentialing of the installation professional.

The materials were developed through a peer review process. This process facilitates input by selected industry professionals representing a diverse background and any interested individual willing to provide input during the developmental stages. Broad, comprehensive review of the materials by the industry during the summer of 2008 helped refine the materials and capture broader industry input. Four pilot testing events refined the training materials for completeness of concepts and clarity of delivery. The materials were completed by July 2009.

APPENDIX F

CONSORTIUM EXECUTIVE BOARD

Table F-1. Consortium Executive Board Members

Board Member	Position	Affiliation
John Buchanan	Chair	University of Tennessee
Kitt Farrell-Poe	Past Chair	University of Arizona
Bruce Fox	Training Center/Program/Association Representative	Allstate Septic Systems LLP
George Loomis	Practitioner/Training Center Chair	University of Rhode Island
Randy Miles	University Curriculum Committee Chair	University of Missouri
David Lindbo	Research Committee Chair	North Carolina State University
David Gustafson	At Large Delegate	University of Minnesota

APPENDIX G

DESCRIPTION OF EXPERTISE

Table G-1. Writing Team Description of Expertise

Name	Description of expertise
John Buchanan	Associate Professor and Extension Specialist with 20 years of teaching, research and outreach experience in wastewater management and water quality.
Sara Heger Christopherson	Extension Specialist with over 10 years experience teaching and course development in onsite wastewater treatment.
Nancy Deal	Extension Associate with over 10 years experience in the regulatory sector and 9 years in extension teaching and course development.
Kitt Farrell-Poe	Professor and Water Quality Specialist and agricultural engineer with experience in development and delivery of educational programs. Director of the onsite wastewater treatment training program at the University of Arizona.
Dave Gustafson	Extension Specialist with over 18 years experience teaching and course development in onsite wastewater treatment.
David Kalen	Environmental engineer responsible for developing courses and conducting practitioner training short courses on onsite wastewater treatment systems. Manager of New England Onsite Wastewater Training Center at the University of Rhode Island.
Bruce Lesikar	Professor and Extension Agricultural Engineer with the Texas Agricultural Extension Service. Teacher and researcher on appropriate utilization of wastewater treatment technologies for management of wastewater onsite. Conducts practitioner training short courses on onsite wastewater treatment systems. Director of Onsite Wastewater Treatment Training Centers located in Texas.
Dave Lindbo	Professor and University Extension Specialist with over 20 years experience in extension, teaching and research.
George Loomis	University Research and Extension Soil Scientist with responsibilities in onsite wastewater treatment, environmental soil science; over 25 years experience in teaching and research.
Rebecca Melton	Extension Assistant for Texas AgriLife Extension Service with experience in course development in onsite wastewater treatment.
Randy Miles	University Faculty member with 25 years of teaching and research in soil science and wastewater treatment. Director of the Missouri Smallflows Wastewater Research and Education Training Center.

Table G-2. Project Review Group Description of Expertise

Name	Description of expertise
James Converse	Professor emeritus with the Biological Systems Engineering Department at the University of Wisconsin - Madison. Dr. Converse is a professional engineer and has over 35 years of experience working with onsite wastewater treatment systems. He is an active member of the National Onsite Wastewater Recycling Association.
Anthony Smithson	Director of the Lake County Health Department/Community Health Center in Illinois. He is a registered sanitarian and regulator involved with the permitting and inspection of onsite wastewater treatment systems. He is an active member of the National Environmental Health Association and is assisting them with

	implementation of their Certified Installer of Onsite Wastewater Treatment Systems (CIOWTS) credentialing program.
Jerry Stonebridge	System installer and O&M Service Provider. Instrumental in implementation of the onsite designer certification program in Washington State and for the formation of the Washington State Onsite Sewage. Past president for the National Onsite Wastewater Recycling Association.
William L. Stuth, Sr.	Over 45 years experience in all aspects of wastewater treatment; inventor of several onsite products including the Nibbler Wastewater Treatment System for commercial systems, and the Nibbler Jr. for residential systems. Founding member of the National Onsite Wastewater Recycling Association.

Table G-3. Official Installation Practitioner Review Committee Description of Expertise

Name	Description of expertise
David Burnham	President of RI Independent Contractor's Association. Experienced designer and installer of Innovative & Alternative wastewater systems. He has over 40 years experience in conventional system installation and 20 years experience in Innovative & Alternative system installation. Experienced O&M service provider. Helps to deliver training for several short courses at the RI Onsite Wastewater Training Center.
Kenneth Davis	Designer, installer, and operation and maintenance practitioner for aerobic treatment units, drip distribution systems and spray distribution systems.
Anthony Gaudio	An installer of onsite wastewater treatment systems in Florida. He has extensive experience in working with the climatic conditions of the southeast. He also has experience with onsite wastewater treatment system installation in the soil and site conditions in Florida.
Scott Greene	Experience as a county and state regulator inspecting 1000's of system installations across the state of North Carolina. Has been involved with the installation of numerous systems over his 19 year of experience in the onsite industry. Has assisted with training in NC for over 15 years.
Eric Larson	Owner and operator of full onsite professional management service in central Minnesota, with over 10 years experience in the onsite industry.
Albert Mills	Has 30 years in the onsite industry. Helped start the first county septic system maintenance and monitoring program in Durham County, NC. Helped develop and teach the first statewide operator training and certification program. Has installed and operated large and small subsurface systems. Helps teach classes to septic installer for NC certification.
Mark Ritter	Has 25 years experience personally installing systems and his company has been installing and servicing systems for over 40 years.
Kyle Shern	He has been installing and maintaining systems for 14 years. He has a wealth of experience with advanced technology. One of the founding charter board members for the Missouri Small Flows Organization and has served as the organization's President.
Timothy Stasiunas	Owner and operator of Advanced Wastewater Technologies, Inc. Experienced designer and installer of Innovative & Alternative wastewater systems. Experienced O&M service provider. Helps to deliver training for several short courses at the RI Onsite Wastewater Training Center.
William L. Stuth, Jr.,	President of Stuth Company. Designer and installer with over 34 years experience. Serves as a reviewer of onsite wastewater designers on the WA Board of Registration for Professional Engineers.

APPENDIX H

INSTALLER TRAINING PROGRAM BROCHURE

The following two pages contain the O&M Service Provider Program brochure printed from a PDF format.

Course dates and locations*

December 10-11, 2007 • Las Vegas, Nevada
NOWRA Installer Academy
http://www.nowra.org/academy.html
nowra@nowra.org
800-966-2942 or 831-464-4884

March 17 - 18, 2008 • Richmond, Virginia
Sponsored by Virginia Onsite Wastewater Recycling Association (VOWRA) & NOWRA
http://www.vowra.org
vowra@shentel.net
540-465-9623

December 2008 • Las Vegas, Nevada
NOWRA Installer Academy
http://www.nowra.org/academy.html
nowra@nowra.org
800-966-2942 or 831-464-4884

March 2009 • Kansas City
Sponsored by Iowa Onsite Wastewater Association, Kansas Small Flows Association, Missouri Smallflows Organization, Nebraska Onsite Waste Water Association & NOWRA

**Contact these locations for arrangements and associated fees for participation.*

Training Format

This program is lecture-style with PowerPoint slides to aid in discussion. Lectures focus on the items that need to be verified and recorded on the installation and startup checklists associated with each technology. The checklists provide a detailed guide for achieving a quality installation and are included in the draft training manual that will be provided to each participant.

Continuing Education Credits

These course materials were not submitted for continuing education credits. Please check with your certifying entity for approval for continuing education. Local sponsoring organizations may request CEU credit for their sponsored events.

Consortium of Institutes for Decentralized Wastewater Treatment

The Consortium of Institutes for Decentralized Wastewater Treatment (CIWDT), often referred to as "The Consortium," is a group of professionals from educational institutions, training entities, private industry, and regulatory agencies as well as citizens' groups. These professionals cooperate on decentralized wastewater research projects and development of outreach training programs and education.

Co-Sponsors

- National Decentralized Water Resources Capacity Development Project
- National Environmental Health Association
- National Onsite Wastewater Recycling Association
- USDA-Cooperative State Research, Education, and Extension Service
- U.S. Environmental Protection Agency
- Water Environment Research Foundation

Installer Training Program

for Onsite Wastewater Treatment Systems

CIDWT
Consortium of Institutes for Decentralized Wastewater Treatment

CIDWT Installer Training Program for Onsite Wastewater Treatment Systems

The CIDWT Installer Training Curriculum discusses the various treatment and distribution technologies available for managing wastewater onsite and establishes a benchmark for conducting installation. Standardization of installation practices helps you compete for jobs and clarifies communication with your clients.

CIDWT is working cooperatively with NOWRA and NEHA to establish and communicate a set of minimum guidelines for the installation of onsite wastewater treatment systems.

The curriculum is designed to support the NEHA Certified Installer of Onsite Wastewater Treatment Systems (CIOWTS) credential. CIDWT has enlisted a group of installers from across the country to provide input on the installation manual and training materials.

Four pilot training events will be conducted during development of the materials. These training events are a unique opportunity for installers to take advantage of training while participating in a national curriculum development process.

Your participation will allow the CIDWT writing team to gauge the effectiveness of these critical training materials. The instructors for this program are nationally recognized for their expertise and effectiveness as educators and their ability to work with stakeholders to develop high-quality, peer-reviewed curriculum materials that are being used both nationally and internationally.

Who should attend?

These course materials will directly benefit professionals who install onsite wastewater treatment systems. Installers, regulators, and designers of onsite wastewater treatment systems will gain a better understanding of the activities related to proper installation and startup to maximize the efficacy, longevity, and performance of these systems.

How will I benefit ?

You will benefit professionally and financially through participation in the course. Some of the best noted benefits are:

- Conducting your installation activities according to a national standard helps reduce your liability exposure.
- Clarification of installation practices through use of the installation and startup checklists leads to improved relationships with your clients.
- Improved communication allows you to respond to and meet your clients' wastewater infrastructure needs and maximize the use and value of their property.
- Critical construction planning and job site safety information is efficiently collected and documented through use of the checklist forms.
- Standardization of services improves your ability to compete in the marketplace.
- Improved communication with company's employees through standardized checklists.

Why participate?

This course will improve your ability to:

- Effectively evaluate site conditions and system installation when developing a contract.
- Review a design plan and conduct a site review to successfully develop a bid and plan for construction.
- Evaluate site conditions with respect to OSHA construction safety practices.
- Use surveying practices to lay out the system, locate components, and evaluate proper elevations.
- Recognize how site conditions influence equipment selection and installation methods.
- Understand how effective excavation, bedding, placement and backfilling methods help achieve stable, watertight components.
- Select and assemble pumping systems and properly adjust and verify control settings.
- Implement the critical practices needed for installation of advanced treatment system components.
- Install soil treatment areas at the proper elevation using appropriate materials while maintaining natural soil conditions.
- Use standardized checklists for verifying completion of installation process and subsequent startup activities.
- Appreciate how proper installation influences subsequent operation and maintenance activities and facilitates overall management of onsite wastewater treatment systems.

CIDWT
Consortium of Institutes for Decentralized Wastewater Treatment

APPENDIX I

GLOSSARY OF TERMS

For more decentralized wastewater treatment terminology, consult the CIDWT Decentralized Wastewater Treatment Glossary available at:
http://www.onsiteconsortium.org

Abandonment: discontinued use of a system component or components by removing them or rendering them inaccessible and inoperable.

Accepted engineering practices: those requirements which are compatible with standards of practice required of a registered professional engineer.

Alteration: changes to a wastewater treatment system on the basis of: an increase in the volume of permitted flow; a change in the nature of permitted influent; a change from the planning materials approved by the permitting authority; a change in construction; or an increase, lengthening, or expansion of the treatment or dispersal system.

Authorization for construction: approval to begin the system installation process.

Backfill: (**1**) material placed in an excavation; (**2**) to place material in an excavation; (**3**) portion of an excavation above the haunch zone; for straight-walled tanks or structures, that portion of an excavation above the bedding.

Backfill, initial: portion of an excavation above the haunch zone or bedding with a depth of 6 to 12 inches above the pipe, conduit tank, or structure.

Backfill final: portion of an excavation extending from above the initial backfill to final grade.

Backsight (BS or +): rod reading taken on a point of known elevation (or assumed where establishing the first bench mark – usually 100.00); the backsight reading is added to the elevation to determine the Height of Instrument (HI); *see also* **height of instrument.**

Bedding: (**1**) process of laying a pipe, conduit, or other structure in a trench shaped to the appropriate contour; (**2**) tamping earth around a pipe, conduit, or other structure to provide support; (**3**) material placed under a pipe, conduit, tank, or component for uniform structural support.

Bell-bottom pier hole: a type of shaft or footing excavation, the bottom of which is made larger than the cross section above to form a belled shape.

Bench level: surveying with a level to establish elevations on bench marks; usually run as part of a cross section, profile, or topographic survey.

Bench mark (BM): reference point of known elevation; a permanent bench mark can be established with a brass pin or cap set in concrete, a long metal stake driven in the ground, or a specific point on a concrete bridge or other solid object; a temporary bench mark (needed for only a few days or weeks until a job is completed) could be a wooden stake driven in the ground or a nail driven in a tree or post; for many temporary bench marks the elevation may be assumed - usually 100.00 feet; permanent bench mark locations should be accurately described in the field book so that a person who has never been to the area could find them.

Bench mark, assumed: temporary bench mark used as a reference; typically assigned an elevation of 100 feet.

Bench mark, referenced: an official, permanent point of known elevation; *see also* **monument.**

Bench mark, transfer: a local bench mark established from a referenced bench mark.

Benching (benching system): means a method of protecting employees from cave-ins by excavating the sides of an excavation to form one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels.

Berm: (1) natural or constructed raised drainage feature used to divert runoff (of stormwater) and direct the flow to an effective outlet; may be used in conjunction with a swale; (**2)** raised earthen structure designed to contain wastewater such as in a lagoon; see also **swale**.

Biomat: layer of biological growth and inorganic residue that develops at the infiltrative surface.

Biozone: zone of biologically active treatment in soil, fill, or other media; *see also* zone of treatment.

Buoyancy: the tendency of a body to float in water or other liquid; upward force that a fluid exerts on an object that is less dense than itself.

Cave-in: separation of a mass of soil or rock material from the side of an excavation or the loss of soil from under a trench shield or support system and its sudden movement into the excavation, either by falling or sliding, in sufficient quantity so that it could entrap, bury, or otherwise injure and immobilize a person.

Certificate of completion: documentation of the proper construction of the system.

Compactor, vibratory: mechanical device that consolidates loose soil material such as a jumping jack.

Competent person: one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees and who has authorization to take prompt corrective measures to eliminate them; *see also* **qualified person. OSHA**

Construction: to engage in any activity related to the installation, alteration, extension, or repair of a wastewater treatment system, including all activities from disturbing the soils through connecting the system to the building or property served by the wastewater treatment system.

Construction zone: physical area occupied by personnel, equipment, and materials during the installation, alteration, extension, or repair of a wastewater treatment system; *see also* **limit of disturbance**.

Contour: multiple points on the land surface that are of equal elevation.

Contour interval: vertical distance between level surfaces forming the contours.

Contour line: line drawn on a map that connects points having the same elevation.

Contour map: map consisting of contour lines that illustrate the irregularities of the land surface.

Contractor-assembled: built or put together by the entity that is installing a system; *see also* **manufacturer-assembled**.

Cross braces: horizontal members of a shoring system installed perpendicular to the sides of the excavation, the ends of which bear against either uprights or wales.

Cross section: vertical section of the ground surface at right angles to a base line or center line**;** side view of a cutaway of the earth's surface.

Cut and fill: process of using excavated material removed from one location as fill material in another location on the same site.

Drain-waste-vent (DWV): (**1)** assemblage of pipes which facilitates the removal of liquid and solid wastes as well as the dissipation of sewer gases; (**2)** pipe specified for use in the removal of liquid and solid wastes as well as the dissipation of sewer gases.

Datum: level surface to which elevations are referenced; for example, mean sea level.

Deflection: any change in the inside diameter of a pipe resulting from installation and imposed loads; deflection may be either vertical or horizontal and is usually reported as a percentage of the base (undeflected) inside pipe diameter.

Design: (**1)** process of selecting, sizing, locating, specifying, and configuring treatment train components that match site characteristics and facility use as well creating the associated written documentation; (2) written documentation of size, location, specification, and configuration.

Designer: service provider who creates plans for the installation, alteration, extension, or repair of a wastewater treatment system.

Differential leveling: method of leveling used to find the difference in elevation (vertical distance) between two points.

Down gradient: (**1)** direction water flows by gravity; (**2)** location down slope.

Dry soil: means soil that does not exhibit visible signs of moisture content.

Elevation: 1. height relative to a fixed point of known elevation such as sea level or a bench mark; 2. high place or position; 3. drawing or diagram made by projection on a vertical plane; a two-dimensional drawing of the front, side, or back of a building.

Excavation: any man-made cut, cavity, trench, or depression in an earth surface, formed by earth removal.

Existing grade: natural, unaltered land surface; also referred to as original ground surface.

Expansion: increasing the capacity of a wastewater treatment system.

Extension: alteration of a wastewater treatment system resulting in an increase in capacity, lengthening, or expansion of the existing treatment of dispersal system.

Faces: the vertical or inclined earth surfaces formed as a result of excavation work; *also known as* **sides**.

Feed: parameter that describes the orientation of the manifold relative to the supply line and/or laterals in a system.

Fill: (**1)** unconsolidated material that meets specific textural criteria and is used as part of a dispersal component; (**2)** unconsolidated material used to change grade or to enhance surface water diversion; (**3)** any other human-transported unconsolidated soil material; *see also* **cut and fill**.

Fissured: describes a soil material that has a tendency to break along definite planes of fracture with little resistance or a material that exhibits open cracks, such as tension cracks, in an exposed surface.

Floodplain (100-year): any area susceptible to inundation by flood waters from any source and subject to the statistical 100-year flood; such an area has a 1 percent chance of flooding each year.

Floodway: the channel of a watercourse and the adjacent land areas (within a portion of the 100-year floodplain) that must be reserved in order to discharge the 100-year flood without cumulatively increasing the water surface elevation more than 1 foot above the 100-year flood elevation before encroachment into the 100 year floodplain.

Foresight (FS or -): rod reading taken on a point of unknown elevation; foresight reading is subtracted from the Height of Instrument (HI) to determine the elevation of the desired point.

Foundation: the natural or prepared ground or base on which some structure rests.

Grade: rate of rise or fall along a specified line; grade is the same as slope; can be expressed in percent, as feet of rise or fall per 100 feet of horizontal distance, or in a decimal equivalent as feet of rise or fall per foot or horizontal distance.

Grade, existing: *see* **existing grade.**

Grade, proposed: finish grade as specified on a plan.

Grade, finish: final earth grade required by specifications.

Grade elevation: elevation of the bottom of an excavated trench, ditch or other finished surface; the term *grade* is sometimes used to denote the elevation of the finished surface of an engineering project.

Grade stake: stake.

Granular soil: gravel, sand, or silt (coarse grained soil) with little or no clay content; granular soil has no cohesive strength; some moist granular soils exhibit apparent cohesion; granular soil cannot be molded when moist and crumbles easily when dry.

Guard stake: *see* **stake, guard.**

Haunch: (1) portion of a pipe or conduit extending from the bottom to the spring line; (**2)** lower third of the circumference of a cylindrical tank; (**3)** portion of non-straight-walled tank below the horizontal plane defined by its greatest width.

Haunching: (**1)** material placed around a pipe, conduit, tank, or component for uniform structural support within the haunch zone. (**2)** action of placing backfill or embedment around a conduit or structure in an excavation such that the void area is stabilized.

Haunch zone: portion of an excavation where the haunch of a pipe, conduit, tank or structure is located.

Hazardous atmosphere: atmosphere which by reason of being explosive, flammable, poisonous, corrosive, oxidizing, irritating, oxygen deficient, toxic, or otherwise harmful may cause death, illness, or injury.

Height of instrument (HI): elevation of the line of sight of the surveying instrument; determined by adding the Backsight (BS or +) to the known elevation of the point upon which the rod reading was taken, usually a bench mark or turning point.

Hub stake: short stake placed at a station and driven almost flush with the ground; hub stakes are used to obtain station elevations in drainage and other kinds of elevation work; also called a hub.

Inspector: service provider who evaluates and reports upon the status of a wastewater treatment system.

Inspection: evaluation of and reporting on the status of a wastewater treatment system.

Install: to put in place or construct any portion of a wastewater treatment system.

Installer: service provider who is compensated to construct a wastewater treatment system.

Invert: elevation of the bottom of the inside pipe wall or fitting.

Junction box: metal or hard plastic electrical box housing only wire or cable connections; in exterior locations, must be watertight.

Kickout: the accidental release or failure of a cross brace.

Land clearing: removal of vegetation including root mass.

Layered system: two or more distinctly different soil or rock types arranged in layers; micaceous seams or weakened planes in rock or shale are considered layered.

LTAR: *see* long-term acceptance rate.

Layout: staking out the system on the site including staging areas for completion of the project.

Level: (1) instrument for observing levels, having a sighting device, usually telescopic, and capable of being made precisely horizontal; also called a surveyor's level; **(2)** observation made with this instrument.

Level, laser: level that employs the use of a laser projected on a target.

Level, optical: level consisting of a high-powered telescope with a spirit level attached to it in such a manner that when its bubble is centered, the line of sight is horizontal.

Level, rotating-beam laser: laser level providing a plane of reference over open areas.

Level, self-leveling: optical level with a prismatic device suspended on fine, nonmagnetic wires, such that when it is approximately centered the force of gravity on the prismatic device causes the optical system to swing into a position such that the line of sight is horizontal.

Level, single-beam laser: laser level projecting a string line that can be seen on a target regardless of lighting conditions.

Level, spirit: device for determining true horizontal or vertical directions by the centering of a bubble in a slightly curved glass tube or tubes filled with alcohol or ether.

Line of sight: straight line passing through the center of the barrel of a telescope used in surveying; always parallel to the datum.

Liquid limit: moisture content at which soil becomes unstable and will flow; measured by ASTM Standard Test Method ASTM D4318 (2005).

Loading rate, areal: quantity of effluent applied to the footprint of the soil treatment area (or the absorption area of an above-grade soil treatment area) expressed as volume per area per unit time, e.g., gallons per day per square foot (gpd/sq. ft.).

Loading rate, biochemical: quantity of BOD_5 delivered to a treatment component expressed as mass per time (e.g., pounds of BOD_5 per day).

Loading rate, biological: quantity of organic matter delivered to a treatment component expressed mass per time (e.g., pounds per day).

Loading rate, contour: cumulative total of effluent applied to the soil profile at the down gradient end of a dispersal system installed on a slope, expressed as volume per unit length per unit time along the contour (e.g., gpd/ft.).

Loading rate, hydraulic: quantity of water applied to a given treatment component, usually expressed as volume per unit of infiltrative surface area per unit time, e.g., gallons per day per square foot (gpd/ ft^2).

Loading rate, instantaneous: quantity of effluent discharged to a unit area of the infiltrative surface during a dosing event expressed as volume per unit time, e.g., gallons per minute per square foot (gpm/ft^2).

Loading rate, landscape: *see* **loading rate, contour.**

Loading rate, linear: quantity of effluent applied along the length of a lateral, trench or bed, typically expressed as volume per unit length per unit time (e.g. gallons per foot per day).

Loading rate, mass: sum of organic and inorganic effluent constituents delivered to a treatment component in a time interval, expressed as mass per time.

Loading rate, nutrient: sum of organic and inorganic nutrients (primarily nitrogen and phosphorus) delivered to a treatment component in a specified time interval expressed as mass per time.

Loading rate, organic: biodegradable fraction of chemical oxygen demand (biochemical oxygen demand, biodegradable FOG, and volatile solids) delivered to a treatment component in a specified time interval expressed as mass per time or area; e.g., pounds per day or pounds per cubic foot per day (pretreatment); pounds per square foot per day (infiltrative surface or pretreatment); typical residential system designs assume biochemical loading equals organic loading; *see also* **biochemical oxygen demand; chemical oxygen demand;** *and* **FOG**.

Long-term acceptance rate (LTAR): design parameter expressing the rate that effluent enters the infiltrative surface of the soil treatment area at equilibrium, measured in volume per area per time, e.g. gallons per square foot per day (g/ft^2/day).

Manifold: pipe network having several outlets or inlets through which a liquid or gas is distributed or collected.

Manifold, bottom feed: manifold configuration in which a short manifold is located at the lower elevation of a soil treatment area.

Manifold, center feed: manifold configuration in which a long manifold is installed perpendicular to two sets of distribution laterals that extend in opposite directions along the slope; the supply line may connect to the manifold in the center or at one end; used on level or nearly-level sites.

Manifold, distributed feed: manifold configuration in which the supply line connects to an alternating valve that doses one zone at a time.

Manifold, dual feed: manifold configuration in which the supply line is connected to a manifold at two points.

Manifold, looped feed: manifold configuration in which the supply line connects to the manifold and a return line is installed to create a complete connection; used in drip distribution.

Manifold, side feed: manifold configuration in which a long manifold is installed perpendicular to one set of distribution laterals that extend in one direction along the slope; the supply line may connect to the manifold in the center or at one end; used on level or nearly-level sites.

Manifold, top feed: manifold configuration in which a short manifold is installed at the higher elevation of a soil treatment area.

Manufacturer-assembled: provided to the contractor in an operable condition ready for final plumbing and/or electrical connections at the site; *see also* **contractor-assembled.**

Mean high water (MHW): tidal datum described by the average of all the high water heights observed over the National Tidal Datum Epoch (the specific 19-year period adopted by the National Ocean Service as the official time segment over which tide observations are taken and reduced to obtain mean values for tidal datums)**.**

Mean tide level (MTL): tidal datum described as the arithmetic mean of mean high water and mean low water; half-tide level.

Mean sea level (MSL): tidal datum described as the arithmetic mean of hourly heights observed over the National Tidal Datum Epoch.

Moist soil: means a condition in which a soil looks and feels damp; moist, cohesive soil can easily be shaped into a ball and rolled into small diameter threads before crumbling. Moist granular soil that contains some cohesive material will exhibit signs of cohesion between particles.

Monument: a permanent surveyor's bench mark.

Ordinary high water level: boundary of water basins, watercourses, public waters, and public waters wetlands, and: (**1**) the ordinary high water level is an elevation delineating the highest water level that has been maintained for a sufficient period of time to leave evidence upon the landscape, commonly the point where the natural vegetation changes from predominantly aquatic to predominantly terrestrial; (**2**) for watercourses, the ordinary high water level is the elevation of the top of the bank of the channel; and (**3**) for reservoirs and flowages, the ordinary high water level is the operating elevation of the normal summer pool.

Orientation: position relative to true north, to points on the compass, or to a specific place or object.

Peak enable: operating parameter that increases the frequency of timer operation of a pump to result in effluent delivery equal to design flow rate.

Physical feature, manmade: prominent or conspicuous part or characteristic of a site that is created by the human hand.

Physical feature, natural: prominent or conspicuous part or characteristic of a site that is not created by the human hand.

Piggy back: electrical plug configuration wherein a float switch plugs into the outlet and the pump plugs into the back of the float switch plug.

Pipe embedment: portion of an excavation including the bedding, haunching, and initial backfill.

Pipe zone: portion of an excavation where a pipe or other conduit is located.

Pit run: unprocessed sand or gravel found in natural deposits; also known as bank gravel or bank run.

Plan: drawing or diagram made by projection on a horizontal plane.

Plan view: a view from above; also known as bird's eye view.

Planimetric: two-dimensional details that reflect accurate dimensions of and horizontal distances between features on a site.

Plastic limit: moisture content at which soil can be rolled into 1/8 inch diameter wire without breaking; represents the soil moisture content above which manipulation will cause compaction or smearing; measured by ASTM Standard Test Method ASTM D4318 (2005).

Plasticity: 1. degree to which a soil can be molded or deformed continuously and permanently using relatively moderate pressure without appreciable volume change or rupture; **2.** soil consistence term defined under wet conditions.

Plasticity index: numerical difference between the liquid limit and plastic limit of a soil; measured by ASTM Standard Test Method ASTM D4318 (2005).

Plow, chisel: (**1**) shank tillage implement that disrupts the soil to loosen and roughen the surface; (**2**) static plow shank used to slice the soil during installation of subsurface drip tubing.

Plow, parabolic: a curved tillage implement used to disrupt a hardpan or plowpan.

Poorly sorted: material of variable size with minimum pore space; also known as well-graded.

Poorly graded: material of uniform size with maximum void space; also known as well-sorted.

Pot-holing: the process of locating and excavating buried utilities.

Profile leveling: method of finding the elevations of a series of points at measured, horizontal distances along a line or path; process used in the development of a topographic map.

Property line: legal boundary separating land parcels.

Protective system (soil): method of protecting employees from cave-ins, from material that could fall or roll from an excavation face or into an excavation, or from the collapse of adjacent structures; protective systems include support systems, sloping and benching systems, shield systems, and other systems that provide the necessary protection.

Pumper: service provider who removes the contents of septic tanks, pump tanks, media filters, and aerobic treatment units and disposes of them according to specific regulatory parameters.

Pumping: the action of removing septage from a wastewater treatment system component.

Qualified person: one who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience has successfully demonstrated the ability to solve or resolve problems relating to the subject matter, the work, or the project; *see also* **competent person.**

Ramp: an inclined walking or working surface that is used to gain access to one point from another and is constructed from earth or from structural materials such as steel or wood.

Range pole: long pole with painted red and white delineations of 1 foot; used to mark points that are difficult to see from a distance.

Redundant off: optional operating parameter in a timed-dosed configuration that acts as a fail-safe by preventing pump operation when effluent levels reach a specified level below the normal off level; typically, this sensor is directly wired into the pump circuit, thus bypassing the timer or control circuits.

Registered professional engineer: person who is registered as a professional engineer in the state where the work is to be performed; however, a professional engineer, registered in any state is deemed to be a *registered professional engineer* within the meaning of this standard when approving designs for *manufactured protective systems* or *tabulated data* to be used in interstate commerce.

Remediation: act or process of correcting a fault or deficiency without changing system structure or form.

Rod, level: a pole marked with a gradation facilitating the determination of a relative elevation for a point, typically constructed of wood and graduated in feet and tenths and hundredths of a foot; also known as a stadia rod.

Rod reading: reading taken on a leveling rod when sighting through the telescope of an optical leveling instrument.

SDR (Standard dimensional ratio): ratio of pipe or tubing diameter to wall thickness.

Scale: (**1)** proportion between two sets of dimensions, as between those of a drawing and its original; for example, the scale of a drawing may be expressed as 1/4 inch = 1 foot; (**2)** measuring tool used by architects and engineers in preparing drawings to a proportionate scale; (**3)** to measure a drawing with a scale; (**4)** either pan or tray of a balance; (**5)** to climb, as a ladder; (**6)** series of graduated marked spaces for measuring something, as on a thermometer; (**7)** rust occurring in thin layers; (**8)** hard deposit of minerals on heater coils and pool surfaces.

Sensor: part or device that detects a chemical, physical, or mechanical signal and converts it into an electronic one.

Service provider: any person who performs work in relation to wastewater treatment systems; may include site evaluators, designers, inspectors, installers, operation and maintenance service providers, and pumpers.

Service provider, operation and maintenance (O&M): professional who performs operation and maintenance on a wastewater treatment system.

Setback: minimum horizontal separation distance between system components and site/facility features; typically defined by code or regulation.

Shield (Shield system): structure that is able to withstand the forces imposed on it by a cave-in and thereby protect employees within the structure; can be permanent structures or can be designed to be portable and moved along as work progresses; additionally, shields can be either pre-manufactured or job-built in accordance with OSHA 1926.652(c)(3) or (c)(4). Shields used in trenches are usually referred to as "trench boxes" or "trench shields."

Shoring (Shoring system): structure such as a metal hydraulic, mechanical, or timber shoring system that supports the sides of an excavation and which is designed to prevent cave-ins.

Shoring, aluminum hydraulic: a pre-engineered shoring system comprised of aluminum hydraulic cylinders (cross braces) used in conjunction with vertical rails (uprights) or horizontal rails (wales). Such system is designed specifically to support the sidewalls of an excavation and prevent cave-ins.

Sides: *see* **faces.**

Site evaluation: comprehensive analysis of soil and site conditions for a given land use.

Site evaluator: service provider who conducts preconstruction site evaluations, including visiting a site and performing soil analysis, a site survey, or other activities necessary to determine the suitability of a site for an onsite wastewater treatment system.

Site plan: plan-view drawing that provides a graphical representation of existing and proposed natural and manmade physical features on a site.

Site restoration: reconstitution of the surface of a site to approach as nearly as possible the original grade and vegetative cover.

Slope: 1. ratio of the rise divided by the run between two points, typically described as a percentage (rise/run multiplied by 100). **2.** landscape form or feature; *see also* **slope, concave; slope, convex;** *and* **slope, linear.**

Slope, concave: landscape form or feature that is curved or rounded inward such as a segment of the interior of a hollow sphere; slope becomes progressively flatter as one moves downslope.

Slope, convex: landscape form or feature that has a surface that is curved or rounded outward; slope becomes progressively steeper as one moves downslope.

Slope, linear: landscape form or feature that is narrow and elongated; the slope is uniform as one moves downslope.

Sloping (Sloping system): method of protecting employees from cave-ins by excavating to form sides of an excavation that are inclined away from the excavation so as to prevent cave-ins; the angle of incline required to prevent a cave-in varies with differences in such factors as the soil type, environmental conditions of exposure, and application of surcharge loads.

Soil classification system: method of categorizing soil and rock deposits in a hierarchy of stable rock, Type A, Type B, and Type C, in decreasing order of stability. The categories are determined based on an analysis of the properties and performance characteristics of the deposits and the environmental conditions of exposure.

Spring line: horizontal axis defined by the greatest width dimension of a pipe, conduit, tank, or other structure.

Stable rock: means natural solid mineral material that can be excavated with vertical sides and will remain intact while exposed; unstable rock is considered to be stable when the rock material on the side or sides of the excavation is secured against caving-in or movement by rock bolts or by another protective system that has been designed by a registered professional engineer.

Stable rock: natural solid mineral matter that can be excavated with vertical sides and remain intact while exposed.

Stake: stout stick or post sharpened at one end and driven into the earth as a support or boundary marker.

Stake, grade: stake indicating the amount of cut or fill required to bring the ground to a specified level.

Stake, guard: stake, strip, or lath placed beside a hub stake to identify it.

Stake, slope: in earthwork, a stake marking the line where a cut or fill meets the original grade.

Station (Sta): point where a rod reading is taken; points along the line of a survey; stations are usually marked with a peg or wood stake, or in grade settling, marked with a grade stake.

Structural ramp: means a ramp built of steel or wood, usually used for vehicle access; ramps made of soil or rock are not considered structural ramps.

Submerged soil: means soil which is underwater or is free seeping.

Support system: structure such as underpinning, bracing, or shoring which provides support to an adjacent structure, underground installation, or the sides of an excavation.

Survey, construction: a survey used to locate structures and providing required elevation points during their construction.

Survey, land: plane surveys made for locating property lines, subdividing land into smaller parts, and determining land areas and other information involving the transfer of land from one owner to another; also known as a property survey, boundary survey, or cadastral survey.

Surveys, topographic: a survey made for locating objects and measuring the relief, roughness, or three-dimensional variations of the earth's surface; detailed information is obtained pertaining to elevations as well as to the locations of man-made and natural features (buildings, roads, streams, etc); *also known as a* **topographic map.**

Surveying: the science of determining the dimensions and contour (or three-dimensional characteristics) of the earth's surface by the measurement of distances, directions, and elevations.

Swing ties: distance from two fixed points used to locate a system component.

Tabulated data: tables and charts approved by a registered professional engineer and used to design and construct a protective system.

Take-off: activities related to preparing to bid a system installation including reading blueprints and specifications; making notes of special details concerning the project after gathering the necessary information; estimating the quantities of labor, materials, equipment and special items needed to complete the job.

Timer enable: operating parameter that allows pump operation via a specified schedule; *see also* peak enable.

Topographic plan: *see* **survey, topographic.**

Topographic map: plotted form of information gained through a topographic survey.

Trench (Trench excavation): narrow excavation (in relation to its length) made below the surface of the ground; in general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 feet (4.6 meters); if forms or other structures are installed or constructed in an excavation so as to reduce the dimension measured from the forms or structure to the side of the excavation to 15 feet (4.6 meters) or less (measured at the bottom of the excavation), the excavation is also considered to be a trench.

Trench box: *see* **shield**.

Trench shield: *see* **shield.**

Turning point (TP): temporary point on which rod readings are taken to move the leveling instrument along a survey path; a Foresight (FS or +) is taken on the turning point to obtain its elevation (initially, elevation of turning point is unknown); the instrument is then moved from its position and set up at a new position beyond the turning point; a backsight (BS or +) is then taken on the turning point to determine the height of the instrument (HI); the turning point must be a firm object, such as a stone, stake, pipe, fence post, or axe head so that the elevation will not change while the instrument is being moved; if the turning point is altered while the instrument is being moved, the survey must go back to the last permanent point of known elevation (i.e., a bench mark).

Type A: OSHA soil classification that includes cohesive soils with an unconfined compressive strength of 1.5 ton per square foot (tsf) (144 kPa) or greater; examples of cohesive soils are clay, silty clay, sandy clay, clay loam, and in some cases silty clay loam and sandy clay loam; cemented soils such as caliche and hardpan are also considered Type A; however, no soil is Type A if: (i) the soil is fissured; or (ii) the soil is subject to vibration from heavy traffic, pile driving, or similar effects; or (iii) the soil has been previously disturbed; or (iv) the soil is part of a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical (4H:1V) or greater; or (v) the material is subject to other factors that would require it to be classified as a less stable material.

Type B: OSHA soil classification that includes cohesive soil with (i) an unconfined compressive strength greater than 0.5 ton per square foot (tsf) (48 kPa) but less than 1.5 tsf (144 kPa); or (ii) granular cohesionless soils including angular gravel (similar to crushed rock), silt, silt loam, sandy loam, and in some cases silty clay loam and sandy clay loam; (iii) previously disturbed soils except those which would otherwise be classed as Type C soil; (iv) soil that meets the unconfined compressive strength or cementation requirements for Type A but is fissured or subject to vibration; or (v) dry rock that is not stable; or (vi) material that is part of a sloped, layered system where the layers dip into the excavation on a slope less steep than four horizontal to one vertical (4H:1V) but only if the material would otherwise be classified as Type B.

Type C: OSHA soil classification that includes cohesive soil with (i) an unconfined compressive strength of 0.5 ton per square foot (tsf) (48 kPa) or less; or (ii) Granular soils including gravel, sand, and loamy sand; or (iii) submerged soil or soil from which water is freely seeping; or (iv) submerged rock that is not stable, or (v) material in a sloped, layered system where the layers dip into the excavation or a slope of four horizontal to one vertical (4H:1V) or steeper.

Unconfined compressive strength: load per unit area at which a soil will fail in compression; it can be determined by laboratory testing or estimated in the field using a pocket penetrometer, by thumb penetration tests, and other methods.

Vibratory compactor: *see* **compactor, vibratory.**

Wales: horizontal members of a shoring system placed parallel to the excavation face whose sides bear against the vertical members of the shoring system or earth.

Water packing: method of settling backfill using water.

Well-sorted: material of uniform size with maximum void space; *also known as* poorly graded.

Well-graded: material of variable size with minimum pore space; *also known as* poorly sorted.

Wet soil: soil that contains significantly more moisture than moist soil, but in such a range of values that cohesive material will slump or begin to flow when vibrated; granular material that would exhibit cohesive properties when moist will lose those cohesive properties when wet.

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