

# How to Estimate the Cost of a Temporary Site Dewatering System

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## **Section 1 - Introduction**

It is the intent of this technical paper to give the reader a basic understanding of a typical temporary site dewatering system and illustrate to an estimator how to determine the anticipated cost of the system. Generally speaking, dewatering is defined as the process of removing water from a given condition. Specifically as it relates to construction, temporary dewatering involves lowering the water table and intercepting water seepage which would otherwise emerge from the faces or bottom of an excavation. There are several different methods that can be utilized to achieve temporary dewatering. Some of the most common systems currently in use include wellpoints, deep wells, eductors, ground freezing, or a combination of these or other custom systems. The determination of what system to use is project specific and depends on several factors including the type of soils at the site, the soil permeability, the depth of the groundwater, the required excavation depth, and the physical constraints of the site. Wellpoint dewatering systems are one of the most versatile and commonly used systems and will be the main focus of this technical paper.

### **Main CSI Division (Construction Specifications Institute 2004 Master Format)**

Division 31 Earthwork

### **Main CSI Subdivisions (Construction Specifications Institute 2004 Master Format)**

Subdivision 31 23 19 Dewatering

### **Brief Description**

Groundwater often exists at various depths below the existing ground level. When the need arises to conduct construction activities at depths below the existing water table, a temporary site dewatering system can be used to lower the water table to allow work to be done in a dry environment. Some of the most common construction activities that may require dewatering include excavations for basements, deep foundations, or underground utilities. A basic wellpoint

temporary dewatering system consists of a series of small vertical wells (called wellpoints) around a given excavation area. The wells are connected at the surface level to a continuous header pipe, which is then connected to one or more pumps. The vacuum effect created by the system's pump will draw water from the wellpoints thereby lowering the level of the groundwater in the area requiring dewatering. A discharge line connected to the pump is the means by which the generated groundwater is expelled to a suitable collection area. A single wellpoint system can be used at depths up to about 22 feet. However, for deeper excavations, multiple wellpoint systems can be used together in a stepped or benched fashion.

On most construction projects, a specific dewatering method is not a part of the project architect's design, but rather the general contractor is responsible for selecting the most appropriate dewatering system for the particular project. In such cases, the general contractor is responsible for designing, furnishing, installing, operating, maintaining, and removing the temporary dewatering system as required to lower and control water levels and hydrostatic pressures during construction activities. The general contractor must also determine whether the pumped water can effectively be contained on-site or whether it will need to be disposed of off-site, as well as whether or not the pumped water will need to be treated. The estimate included in this paper will assume that the pumped water will be untreated and will be contained on site.

In many locations around the country, the control of groundwater during construction is a very common practice. Yet, despite its common occurrence, dewatering can be a complicated process depending on the site conditions and the excavation requirements. While it is not uncommon for a general contractor to make the choice to self-perform dewatering operations, this technical paper will approach the estimated cost from the point of view of a specialty dewatering subcontractor. Typically, the dewatering subcontractor will include the cost of

designing and engineering the system in their overall cost. However, the estimate presented in this paper will assume that the system is already designed and will therefore not address any design or engineering costs.

## **Section 2 - Types and Methods of Measurement**

Before the estimator begins his takeoff for the dewatering system, he should become very familiar with the requirements of the system by reviewing all of the project documents and paying special attention to the dewatering plan (typically depicted on a site plan with supporting details), as well as the specifications and geotechnical report. Once he is familiar with the design, the quantity takeoff can begin. On a typical wellpoint system, the estimator should look for the following main components and include them in his takeoff:

1. Total number of wellpoints (counted as each)
2. Length of vertical riser pipes (measured in linear feet)
3. Length of header pipe connecting the wellpoints (measured in linear feet)
4. Number of swing joints connecting the riser pipes to the header pipe (counted as each)
5. Number of wellpoint pumps (counted as each)
6. Length of discharge pipe (measured in linear feet)

Determining the total number of wellpoints is the first step in the takeoff process because this count will be used in determining quantities for other elements of the system. Depending on the design of the system, the bottom end of each riser pipe may be equipped with a filter screen or self-jetting tip. If so, the wellpoint count will be used as the quantity for these items.

Wellpoint riser pipes usually range in diameter from 1 inch to 6 inches depending on the project requirements. A typical size is 2 inches. Riser pipes are installed vertically into the ground at even intervals around the dewatering area. The typical spacing for risers is between 3 feet and

12 feet. Depending on the type of soil and length of the pipe, they can be inserted into the ground by hand, by drilling, or by water jetting into place. The length of each riser pipe is determined by the required depth of dewatering. In order to determine the total length of riser pipes, the estimator will multiply the total number of wellpoints by the depth of each one to come up with a total linear footage.

The header pipe that connects all of the wellpoints and encircles the excavation area is typically a 6 inch, 8 inch, or 10 inch pipe. The estimator will measure the total length of header pipe depicted on the dewatering plan and make note of the required diameter.

Swing joints are flexible pipes connecting each wellpoint riser pipe to the header pipe. Each swing joint is fitted with a regulator valve to adjust the flow of water coming into the header pipe from each wellpoint. One swing joint is included by the estimator for each wellpoint riser pipe location.

At least one wellpoint pump is required for any wellpoint system. Depending on the design of the system, more than one active pump may be required. Often times, the wellpoint design will recommend a backup pump to be utilized to minimize disruption to the dewatering activities in the event that a main pump is rendered unusable. When counting the number of pumps required, the estimator should make note of each pump's size.

The size and configuration of the discharge pipe will vary greatly depending on the volume of water being pumped and the proximity of the discharge area in relation to the pump. The estimator will measure the total length of discharge pipe depicted on the dewatering plan and make note of the required diameter.

### **Section 3 - Specific Factors to Consider Affecting Takeoff and Pricing**

Dewatering requirements are rarely the same from one project to the next. Therefore, it is important that the estimator carefully review the project requirements and speak with the general contractor to have a thorough understanding of the project requirements. In performing his review, the estimator should specifically look for a few special factors including the depth of dewatering, duration of usage, size of the overall system, and time of year the system will be used. All of these factors can affect the takeoff and pricing of the system and should be closely examined on every project.

The depth of dewatering for a project is variable and depends on many site specific factors and requirements, thereby making each system a custom setup. It is important for the estimator to take into account the depth of the system because the depth determines the length of the riser pipes. Riser pipes are generally one continuous, un-jointed pipe and are produced in standard lengths from 6 feet to 24 feet, in 2 foot increments. The estimator should make adjustments to the actual length of each riser pipe to account for standard purchase lengths. For example, if a project requires riser pipes that are 19 feet in length, the estimator should prepare his takeoff based on a length of 20 feet for each riser in order to have a sufficient quantity based on purchasing standard lengths.

Because wellpoint dewatering systems are only used temporarily, the estimator must fully understand what excavation activities the dewatering is intended to facilitate and understand how long the general contractor expects those activities to take. This duration will affect the estimator's overall pricing for such things as the pump operator and system maintenance costs.

It is always a good estimating practice to take into account the overall quantity of materials required for a project. In wellpoint dewatering, the size of the system will vary widely depending

on the excavation requirements of the particular project. There are certain economies of scale that can usually be achieved on a larger project that are not always realized on a smaller project. One example of this can be seen in the purchasing of materials. When purchased in larger quantities, the contractor is often able to obtain bulk discounts and purchase the piping materials at a lower cost per linear foot. Also, mobilization and demobilization to set up and remove the wellpoint system can be the same for a large project as it is on a small project. However, the larger project can spread that cost over a longer duration making the weekly or monthly cost of the system lower.

The time of year the dewatering system will be installed and used can have a big impact on the cost of the system. Because the system is typically installed in an outdoor environment, extreme weather conditions during certain times of the year can decrease production rates for the system's installation team, thereby increasing labor costs. To address and mitigate this variance, the estimator should maintain historical data for installations at different times of the year to be able to identify and account for seasonal fluctuations.

#### **Section 4 - Overview of Labor, Material, Equipment, and Indirect Costs**

Labor is included in a temporary wellpoint dewatering estimate to install, operate, maintain, and remove the dewatering system. The calculation of labor costs will take into account the company's labor rates, the makeup of the labor crew, and labor productivity rates. The pay that each worker makes per hour is determined by the company that employs them, but should be in line with standard wages in the area. On some projects where public funding is involved, wage rates may be set by government regulations (i.e., Davis-Bacon rates). When this is the case, the estimator must compare the stipulated rates to the company's standard rates and make labor adjustments to the estimating software database as necessary. In addition to the wages paid to the laborers, the estimator must also factor in the cost of the labor burden. The labor burden is

defined as the cost of the employee's fringe benefits plus taxes and insurance. Because labor burden rates will vary depending on the location where the work will be performed, the estimator whose company performs work in multiple cities and/or states should maintain a table of different burden rates for various locations. The labor burden can be added to the labor unit cost for each item, or it can be added as one lump sum based on a percentage of total labor cost.

A typical labor crew used to install and remove a wellpoint dewatering system can be made up of the following: 8 common laborers, 1 common laborer foreman, and 1 equipment operator. Productivity is generally defined as the quantity of work produced per unit of time and is used to determine the labor cost per unit of material. The example below shows how to calculate the labor cost per linear foot for a 6" header pipe using the crew previously identified.

**Example:** Daily productivity: the crew can install 350 LF of header pipe in an 8 hour day

Labor rate for the common laborers is \$16/hr

Labor rate for laborer foreman is \$28/hr

Labor rate for equipment operator is \$34/hr

Total crew labor cost per 8 hour day =  $(8 \times \$16) + (1 \times \$28) + (1 \times \$34) \times 8\text{hrs} = \$1,520$

Total labor cost per LF = daily cost divided by daily productivity:  $\$1,520 \div 350 = \$4.34/\text{LF}$

Even though wellpoint dewatering systems are only used temporarily, the pipe work portion of the system is generally regarded as disposable. Depending on the project, the riser pipes will either be cut off and left in place in the ground or pulled up and discarded along with the other pipes. The dewatering estimator should always prepare the estimate assuming the use of new materials and solicit pricing from local vendors accordingly. It is also helpful for the estimator to maintain recent historical material costs per unit in the estimating software's database to use when needed.

Equipment costs for the systems pumps will be based on rental expenses, if the company does not already own the pumps required. When the company does own the required pumps, the equipment cost will be developed internally and may be based on such factors as maintenance costs, future replacement costs, fair market rental prices, and depreciation.

Project indirect costs are costs incurred by the company as a result of performing the work and include such items as supervision, supplies, bonds, taxes, insurance, and general overhead. The total indirect costs can be itemized for the estimate or can be included as a percentage based on the company's experience on past projects.

Markups are generally defined as the profit or fee that the company plans to earn from performing the work. Although there are industry standards, project markups are subjective and will vary from company to company. The estimate should express markups as a percentage of the total cost. The percentage will be determined by company management and may depend on several factors including the company's current workload, competition, future goals, client relationship, and their overall interest in the project.

## **Section 5 - Special Risk Considerations**

Wellpoint dewatering systems have successfully been in use for well over 75 years and in many locations have become the most widely used method of temporary dewatering. Over their many years of use, certain inherent special risk considerations have been identified which the estimator should always take into account when preparing a detailed dewatering estimate. Some of the major risks include: schedule delays, seasonal groundwater fluctuations, and unforeseen conditions.

Because the duration of use is factored into the overall cost of a temporary wellpoint dewatering system, delays in the schedule can greatly increase the cost. Dewatering is always performed to facilitate the performance of other trades or work (e.g., underground utilities, basement excavations, or retaining walls). If the completion of any of these related activities takes longer than anticipated, the dewatering system will need to stay on site longer, thus resulting in a higher dewatering cost. The estimator can best mitigate this risk by determining a total cost for the system based on the anticipated duration and presenting an additional weekly or monthly cost for any extensions in time. Once the additional cost is agreed upon and incurred, the dewatering subcontractor will receive additional payment for the additional time.

Groundwater levels will fluctuate at various times of the year due to both natural and manmade conditions. If the water level is higher than anticipated, the dewatering system may need to run longer or the system may need to be upsized to lower the waterline to the desired elevation. If the water level is significantly lower than anticipated, a wellpoint system may not be the proper dewatering option at all. While the estimator can never determine conclusively whether these fluctuations will occur, he should thoroughly review the geotechnical report for any recommendations regarding likely seasonal groundwater fluctuations. If the estimator feels the dewatering system's design does not account for probable groundwater fluctuations, he should always make the general contractor aware of his concerns.

When unforeseen underground conditions are encountered, they can have a significant impact on dewatering costs. Elements such as rock ledges, unidentified underground utilities, or contaminated soil can be present on any project. These types of conditions are normally treated as an additional cost to the dewatering contract. Therefore, the estimator's cost proposal should always make a note of exclusion for unforeseen conditions.

## **Section 6 - Ratios and Analysis**

After the takeoff has been performed and final pricing has been applied for all labor, material, equipment, indirect costs, markups, and special risk considerations, the result will be a complete estimate. The final estimate should always be thoroughly reviewed by the estimator for any errors and a final review should be conducted by the company's appropriate management parties. Although every dewatering project is unique and costs can vary tremendously depending on project specific requirements, the estimator should develop and maintain a database of historical costs from past projects. A good way for the estimator to format historical wellpoint system costs is to develop a price per linear foot of header pipe for systems at specified depth and durations.

**Example:** 6' deep system in place for 1 month with 1" wells and 6" header pipe

(a) Total System Cost = \$28,000

(b) Total Length of Header Pipe = 400 LF

(c) Cost per LF of Header Pipe = (a) ÷ (b) = \$70 per LF

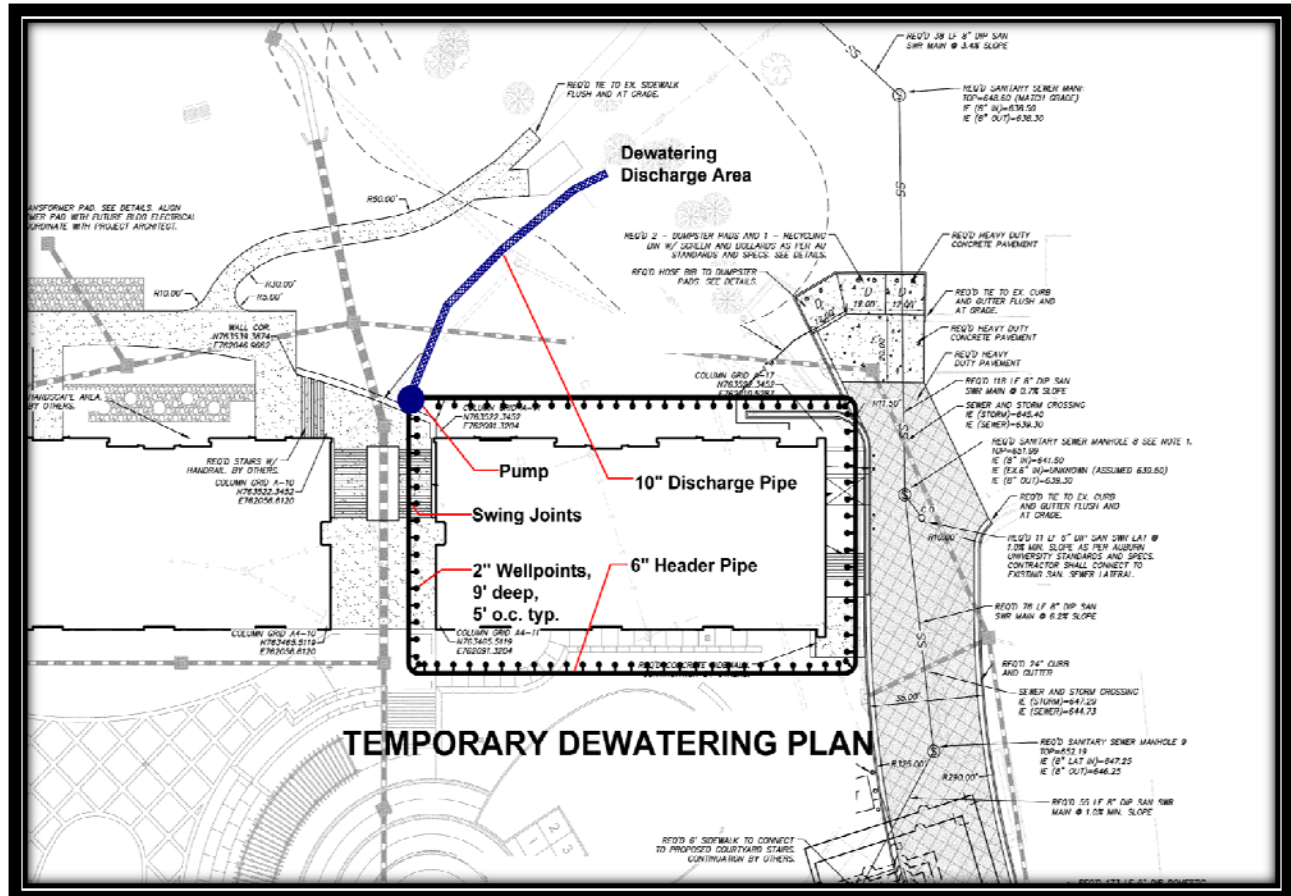
Although, this will not give an exact cost, it will allow the estimator to get "in the ballpark" and know whether a new project is within the company's commonly seen range of pricing for similar systems. To keep the historical data as accurate and current as possible, the estimator should update the database with every new project.

A well established historical cost database can also be input into an electronic spreadsheet or certain estimating software programs to create an assembly for use in preparing future budget estimates. The assembly should be set up to produce a budget estimate when the estimator enters the following key variables: 1) Number of wellpoints; 2) Length and size of Header Pipe; 3) Depth and size of Riser Pipes; 4) Number and size of Pumps; 5) Duration of use

## **Section 7 - Miscellaneous Pertinent Information**

Many construction projects today have constrained budgets, thereby making the value engineering process an important part of most projects. Therefore, the dewatering estimator should always look for ways to offer reductions in cost without compromising the functionality of the system. One option for doing this is to offer the general contractor a deductive alternate for the general contractor to use his own employees to operate the system. Another way is to offer an alternate type of pump. Because rental rates for diesel powered pumps can be less than for electric pumps, the estimator could present the electric pump price as an alternate. If the duration of use is long enough, the cost of purchasing fuel can more than offset the higher pump price and make this a desirable alternative.

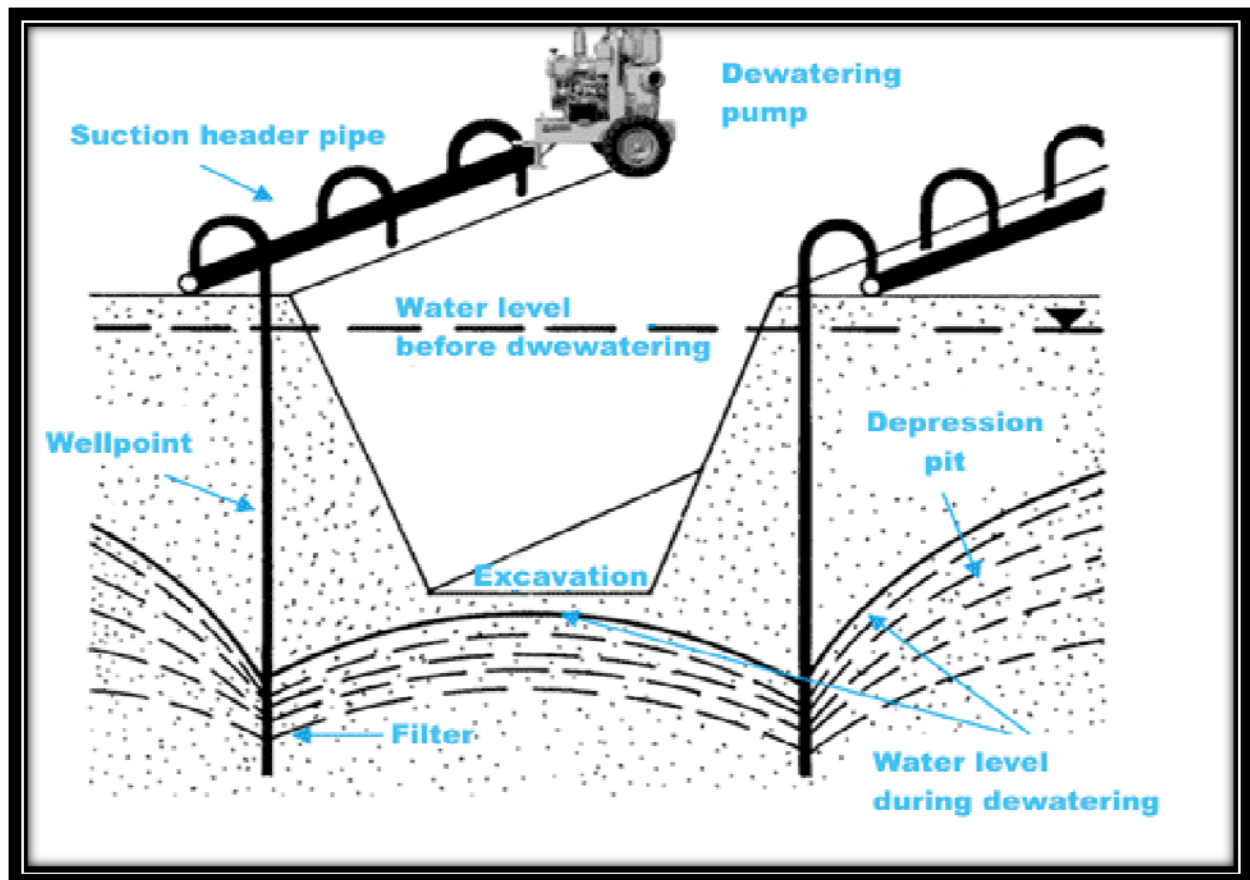
Figure 1 below illustrates the layout of a typical temporary wellpoint dewatering system.



### Figure 1

## **Section 8 - Sample Sketch (continued)**

Figure 2 below illustrates how a typical temporary wellpoint dewatering system functions. The vertical wellpoints are equally spaced around the excavation area. Swing joints connect the wellpoints to the header pipe which is then connected to the pump. Water is drawn out of the ground until the water level is lower than the desired excavation.



**Figure 2**

## Section 9 - Sample Takeoff and Pricing

### Sample Dewatering Project Quantity Survey:

Item	Size	#	Length	Width	Height	Total Quantity	Unit
Header Pipe	6"		870			870	LF
Wellpoints		174				174	EACH
Riser Pipes	2"	174			10	1,740	LF
Discharge Pipe	10"		90			90	LF
Swing Joints		174				174	EACH
Self-Jetting Tips	2"	174				174	EACH
Filter Screens		174				174	EACH
Discharge Stone			10	10	1	4	CUYD
Main Pump		1				1	EACH
Backup Pump		1				1	EACH
Installation Accessories						1	LS

### Sample Dewatering Project Estimate

Item	Quantity	Unit	Labor	Total Labor	Material	Total Material	Equipment	Total Equipment	TOTAL
6" dewatering header pipe	870	LF	3.38	2,938.69	3.85	3,349.50			
2" wellpoint riser pipe	1,740	LF	3.80	6,612.00	3.15	5,481.00			
10" discharge pipe	90	LF	3.38	304.00	6.14	552.60			
Swing joints w/valves	174	EACH	4.34	755.66	52.00	9,048.00			
Self-jetting tips	174	EACH	3.80	661.20	48.00	8,352.00			
Wellpoint screened tips	174	EACH	4.34	755.65	25.00	4,350.00			
Discharge Stone	4	CUYD	9.02	36.07	24.00	96.00			
Main wellpoint system pump - electric	1	EACH	208.00	208.00			1,250.00	1,250.00	
Backup wellpoint pump - electric	1	EACH	208.00	208.00			1,250.00	1,250.00	
Pump Operator (part time)	5	WKS	680.00	3,400.00					
Installation Accessories	1	LS	1,000.00	1,000.00	1,500.00	1,500.00			
Subtotal - Labor									\$ 16,879
Subtotal - Material									\$ 32,729
Subtotal - Equipment									\$ 2,500
Labor Burden	32%								\$ 5,401
Material Tax	8%								\$ 2,618
SUBTOTAL									\$ 60,128
General Conditions & Indirect Costs	9%								\$ 6,474
SUBTOTAL									\$ 66,602
Fee	8%								\$ 5,328
TOTAL COST									\$ 71,930

## **Section 10 –Glossary**

**Davis-Bacon Rates:** The government mandated wages and benefits that all contractors performing work on an applicable project must pay their employees as required by the Davis-Bacon Act of 1931.

**Filter Screen:** Fabric or mesh material at the bottom of a wellpoint used to minimize the infiltration of soil into the dewatering system.

**Groundwater:** Water that is naturally found underground in the soil or in the voids of rock layers.

**Self-Jetting Tip:** A pointed attachment on the bottom end of a riser pipe used to direct a high pressure stream of water into to the ground to assist in the installation of the riser pipe.

**Value Engineering:** The process of examining alternate ways of providing the necessary functions in a project at the lowest cost.

**Water Table:** The elevation below ground where water is first reached when digging or drilling into the ground; also referred to as Water Line.

## **Section 11 – References**

WEBSITE: [http://armypubs.army.mil/eng/DR\\_pubs/DR\\_a/pdf/tm5\\_818\\_5.pdf](http://armypubs.army.mil/eng/DR_pubs/DR_a/pdf/tm5_818_5.pdf)

Joint Departments of the Army, the Air Force, and the Navy, USA, Technical Manual TM 5-818-5/AFM 88-5, Chapter 6/NAVFAC P-418, Dewatering and Groundwater Control

## Section 12 - Signed Copy of Paper Topic Approval Letter



### American Society of Professional Estimators

### CERTIFICATION

Mailing & Administrative Office:

2525 Perimeter Place Drive, Ste. 103 • Nashville, TN 37214 • 615-316-9200 • Fax 615-316-9800 •

February 10, 2012

Basara Allah - E  
748 Wade Farm Drive  
Austell, GA 30168

Dear Candidate Number: 0112201

The Certification Committee is pleased to inform you of the acceptance of your Professional Evaluation Application for Certification with ASPE. Please read carefully, as important information is enclosed.

You have been accepted to the Winter 2012 Cycle. This cycle is schedule to begin March 1, 2012 with the Orientation Workshop. The GEK Study Guide will be mailed separately. The Guide is included for online workshop participants and may be purchased through the bookstore for all others.

**Online workshop participants** See page 2 for your link to the workshop and your password. The workshop will be available beginning today. Online workshop participant's progress and completion is noted through the electronic program. Once you have passed all quizzes, your workshop is complete. There is not an auto-response e-mail upon completion.

**All Chapter workshop participants** should contact their Chapter Certification Chair for the scheduled date of presentation. Chapter workshop participants should have the workshop verification form completed and returned to the Society Business Office by March 31, 2012.

The National Certification Committee has selected the following topic for your technical paper. Your technical paper is due by the end of day on June 15, 2012. Please reference the "Technical Paper" Booklet for submittal procedures.

*HTETCO = How to Estimate the Cost of .....*

#### **HTETCO a Temporary Site Dewatering System**

Your certification candidate number is 0112201 and should be included on all correspondence. This number will be used to identify your technical paper, exam(s), and/or DST Questions & Problems. Your number will maintain confidentiality throughout the certification process.

The GEK and DST Exams or DST Questions and Problems are to be completed during the month of July 2012. Your certification chair or a qualified CPE may proctor your exams. You will need to select and contact a proctor in your area to schedule a test date and location. The GEK exam has a 4 hour time limit and the DST exam has an 8 hour time limit. Your testing will require one and one half days to complete (these do not have to be consecutive). Once you have selected a proctor and your test date is scheduled, contact the Society Business Office with this information so that a test packet may be prepared and sent to your proctor as least 15 business days prior to testing.

Please mark your due dates on your calendar.

You may reference the Cycle Schedule at anytime by visiting [www.aspenationa.org](http://www.aspenationa.org)



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**CERTIFICATION**

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2525 Perimeter Place Drive, Ste. 103 • Nashville, TN 37214 • 615-316-9200 • Fax 615-316-9800 •

**Summary Certification Cycle/Topic Acceptance Form**

February 10, 2012

Candidate Number: 0112201

Chapter Number: 14

Region: SE

Workshop Completed by: **March 31, 2012**

Selected workshop format: **Online**

Technical Paper Topic: **HTETCO a Temporary Site Dewatering System**

Technical Paper Due Date: **June 15, 2012.**

Late papers are subject to penalty of score as stated in the "Technical Paper" booklet.

Testing: **Schedule test dates during the month of July, 2012. If submitting Q&P in lieu of DST,**

**The complete set of questions and problem will be due by July 30, 2012.**

Provide the Society Business Office with proctor information and schedule test dates 15 business days prior to testing.

Certification Discipline: **1.4 General Construction**

Contact Email Address: **ballah@wgyatcs.com**

Online Workshop link: **[http://cei2.com/SCRIPT/805/scripts/serve\\_home](http://cei2.com/SCRIPT/805/scripts/serve_home)**

Online Workshop User ID: **CB54**

Online Workshop Password: **wshp12**

*I agree to the selected topic and will prepare my technical paper according to the format stated for the ASPE Certification Program.*

*I will meet the deadlines for the completion of the workshop, submittal of my technical paper, and testing. If I do not meet these deadlines, I understand that this certification cycle will terminate and I will need to submit a new application.*

*I have read the above information and by signing below agree to meet the requirements of the ASPE Certification Program and adhere to the guidelines of the program.*

Signature: 

Date: 02.10.12

Please retain a copy of this form for your records and technical paper. Return this form to the Society Business Office

Fax: 615-316-9800 or email [tanya@aspenational.org](mailto:tanya@aspenational.org)