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## CONSULTANT'S UPDATE

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### PARTIALLY CONSTRUCTED RESIDENTIAL DEVELOPMENTS

By David J. Buyens, PE



The housing market collapse has caused many developers to halt the investment needed to complete some residential subdivisions. Landowners and developers

have always faced challenges from competition, regulations, financing, engineering, and construction. Now, home foreclosures and increased competition have forced the sales price down significantly, thereby reducing profit margin. Financing has become very difficult for both developer and home purchaser. This article reviews the possible project stages, offers some strategies to mitigate some of the ill effects, and suggests a decision-making methodology for future action.

#### Background

The normal progression for a residential subdivision begins with an idea and a business plan. The developer must then progress through various engineering, construction, and sales activities according to the business plan:

- Due diligence
- Property purchase
- Engineering design
- Permitting
- Commencement of construction
- Completion of construction and agency approvals
- Marketing and sales
- Additional phases for multi-phase projects

*(Partial Developments—Continued on page 2)*

### LOW SCORE SITE INITIATIVE

By Thomas E. Lewis, PG, MBA



In 2010, we reported on efforts taking place to provide revisions to the Florida Department of Environmental Protection's (DEP) petroleum contamination site selection and cleanup criteria known as the Low-Scored Site Initiative (LSSI). As it turns out, changes as required in Chapter 2010-278, Laws of Florida [to be codified in Section 376.3071(11), Florida Statutes (FS)] have been made.

On February 21, 2011, DEP issued a Procedural and Technical Guidance for LSSI to "establish procedures for sites with a priority score of 10 points or less to be

issued a Site Rehabilitation Completion Order (SRCO), an LSSI No Further Action (LSSI NFA), or an LSSI No Further Action with Conditions Administrative Order (LSSI NFAC) if the requirements set forth in Chapter 2010-278 are met."

According to this guidance document, in order to participate in the LSSI, a facility must meet the following requirements:

- Upon reassessment pursuant to DEP rule, the site retains a priority ranking score of 10 or less.
- No excessively contaminated soil, as defined by DEP rule, exists on-site as a result of a release of petroleum products.

*(LSSI—Continued on page 4)*

### EOHS NEWS

EPA Amendments to the Spill Prevention, Control and Countermeasures (SPCC) Plan Regulations 40 CFR Part 112  
Effective January 14, 2010

#### Compliance Deadline Dates for Revising SPCC Plans

- November 11, 2010 Off-shore Drilling and Production Facilities
- November 11, 2011 All other regulated facilities

#### Summary of Amendment Implications

- Certain piping must have cathodic/corrosion protection
- New Facility Diagram requirements
- New tank closure requirements
- Integrity testing requirements
- New Personnel Training and discharge prevention procedures
- Designated site person/accountable for SPCC Plan/discharge prevention
- Mandatory annual SPCC Plan/discharge prevention briefings
- Brittle Fracture evaluations

*(More EOHS News on page 5...)*

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When the housing bubble burst, many developments were caught within the various stages of development mentioned previously. For developments undergoing the due diligence process, the land purchase was often halted, even if at the sacrifice of earnest money. Losing that investment was often the developer's best option, especially in light of the falling real estate market. Current land prices are now typically less than the original cost minus the earnest money. More importantly, though, additional financial commitments were avoided.

For projects that were in the engineering and permitting phase, the developer evaluated the point to stop work. Halting the engineering would minimize the expense that would not be soon recouped. Thus, a partial design is relatively worthless. Comparing the additional expense to complete the design against the value of having a product was required. Proceeding with permitting was also evaluated with expense minimization as one tactic and locking in the project according to current rules was another. Such decisions varied according to developer preference but rarely resulted in significant financial hardship.

Developers in the sales and multi-phase projects situations are experiencing reduced incomes. Where operating expenses exceed revenue, projects are often sold at a reduced price to more financially stable developers either via negotiation or bankruptcy proceedings. Some developers are able to endure the slow and less profitable sales.

The most damaging circumstance that developers are experiencing is where the property is purchased and construction is in some level of completion but where certificates of occupancy are not yet attainable. This circumstance is the primary topic of this article.

### **Considerations When Construction is Not Completed**

Whether due to a contractor failing to complete construction, an owner or developer failing to completely fund construction, or merely in an effort to minimize expense incurred toward an investment with an unknown return on investment time line, a variety of issues arise when a residential development is partially completed:

- **Asphalt.** Asphalt pavement deteriorates over time without routine traffic. Additionally, traffic on poorly installed asphalt can often provide the compaction not originally provided by the contractor. Years later, it will be difficult to determine if the asphalt was defective at installation or has deteriorated.
- **Platting.** Platting significantly increases taxes paid by the developer. Residential lots are taxed at a much higher rate than pasture land. Not platting also results in utility easements not being created, which in turn prevents acceptance by a utility provider. Further, lots cannot be sold.
- **Security.** Security of the property is a concern. When there are no residents, the facilities are prime targets for vandalism or dumping.
- **Pump Stations.** Wastewater pump stations can develop odors due to stagnant sewage caused by low flows. When multi-phase projects have a central wastewater collection and pumping system, lower than design populations can cause the pump station to run too infrequently.

- **Water Mains.** Water mains lose chlorine residual and become stagnant. This situation occurs when either the main lines within the subdivision are not connected to the water provider or there is a dead end line with no users.
- **Gravity Sewers.** Infiltration in gravity sewers becomes evident. Normally, even minimal flows obscure the telltale stain lines of minor leaks into the gravity sewer system. If there is no flow and the stain lines show that leaking occurred, then the wastewater utility may require leak repair from the developer long after the normal warranty period. The contractor usually repairs the leaks at no charge during the warranty period. However, once that period expires (normally a year), then the owner or developer may have to fund the repair.
- **Power.** Power companies are reluctant to install equipment if little power will be sold. Power companies want to see a return on investment. Hence, if there is to be little power usage, then they may be averse to invest in facilities.
- **Erosion.** Erosion can change the mass grading of a site. Normally the crown of the road is about two feet below the finished floor elevation. Without stabilization such as sod and maintenance that accompanies residents, storms can cause erosion of the earth, onto the road and into the storm sewers.
- **Maintenance.** Maintenance expense is borne by the developer longer because the homeowners' association either may not be established yet or does not have enough members to sustain it. Although it is typical for the owner/developer to handle maintenance costs during the active sales period, slow sales will extend this period significantly.
- **Utility Stubs.** Utility stubs can be damaged if obscured by uncontrolled weeds and vegetation. Until the final grading takes place during home construction, utility stubs are often left above ground to make them visible. When weeds grow, they obscure the locations and the stubs are often damaged. Repair expenses and loss of good will are experienced.
- **Permits.** Permits and approvals for the development may expire prior to the work being complete. Cash flow may dictate that the approvals are allowed to expire. However, there is no guarantee that the same design could be re-permitted due to the possibility of standards changing. When construction has already occurred, a change in design would require reconstruction.
- **Bonds.** Performance or maintenance bonds require extensions. Where required, bonds usually have to be renewed annually. The expense to renew is not great, but when profit is already hard to attain, such costs can impact performance significantly.
- **Retainage Payments.** Contractor requests payment of retainage but the work is not accepted for dedication. As stated previously, utility easements are often created through platting. Without the easements, the utility will not be able to maintain the facilities. Hence, the utility will not accept dedication of the utility. This situation puts the owner/developer in a situation wherein the contractor has been paid fully without all the expectations being satisfied.
- **Warranties.** Warranties expire before the required time. Most warranties start when delivery is made, yet the utility or municipality requires a full warranty upon acceptance.
- **Concurrency.** Concurrency can become an issue. With utility

*(Partial Developments—Continued on page 3)*

*Partial Developments—Continued from page 2)*

capacity being finite, the utility will often not hold capacity indefinitely for a particular development. Other concurrency issues such as road and school capacity also change with time. Hence, projects that are able to show concurrency at one point may not be able to do so at some time in the future. When a significant investment has already taken place, losing concurrency can result in significant monetary loss.

### Maintenance Strategy

To counteract the issues listed above, actions to both avert ancillary costs and to protect the investment already made can be implemented. Consider the following suggestions:

- Install a fence around the perimeter, even across the roads, to keep out vandals.
- Seed any bare earth to minimize erosion, especially near the roadway where washouts can impact the new asphalt or wash into the stormwater collection system.
- Keep asphalt fresh by maintaining it in a clean state and ensure compaction is complete during or after construction,
- Write metes and bounds legal descriptions and record utility easements for the installed water or other utility systems. Dedicate them to the utility, if possible.
- Remove the hardware from wastewater pumping stations and store for later use. Offer the pumps for sale or restock; otherwise, the warranty will run out prior to use.
- Barricade utility services to prevent damage and/or keep weeds mowed to maintain visibility.
- Provide fencing, security at entrances, and/or security patrols to control vandalism.
- Wait to plat until homes are sold.
- Flush water mains periodically to prevent deterioration from bacterial growth.
- Construct model homes to provide wastewater flow. Otherwise the utility may object to otherwise undetected infiltration instances.
- Encourage traffic on idle asphalt where possible.
- Attempt to negotiate lower construction bonds.

- Renegotiate with contractors to reflect lower material pricing that currently exists.
- Take advantage of the recent, more flexible permitting mindsets by municipal and state agencies.
- Take advantage of impact fee reductions implemented by many municipalities and counties.

### Planning Strategy

One way to determine the timing to complete construction of a development is to use a cash flow approach to engineering economy, also known as time value of money, economic analysis or economic decision analysis. Single event and recurring expenses are added to a time line and then inflation is applied to determine the total profit or loss over the length of the project. "What if" scenarios can be proposed and evaluated. Examples of alternative scenarios might be various sales predictions, impact of more advantageous permitting, or the hidden cost of construction deterioration. The economic analysis may not yield news that is encouraging but it will point the way to the optimum completion of the project.

As indicated previously, an investor will typically perform a business analysis during the due diligence phase of the project. Financing costs, taxes, salaries, and other such expenses are identified and weighed against the anticipated income. Of course, expenses and income do not happen during the same time periods. Hence, the time value of money approach is used to assess all expenses and profits. If sales do not occur at the assumed rate, then the development may not provide a profit even though costs and incomes are as planned. Some items such as salaries, loan interest, and taxes will increase with a longer duration. Indeed, projected income from sales has seen a downward pressure, further exacerbating the bleak profit picture.

One expense that might be new since the beginning of the recession is deterioration of a system prior to completion. Many developments for which infrastructure are partially in place were stopped due to the thinking that further investment would not be recouped. This can work in the short term because effects of halting construction are minimal. However, as the duration of the cessation increases, the magnitude of the deterioration cost also rises.

Consideration of this cost in particular can change the decision to proceed with development completion.

### Conclusion

There are many potential work stoppage situations between inception and completion of a residential development. The situation that can result in the greatest financial hardship is where construction has begun but has not been completed due to the financing and maintenance costs while the project is idle. An engineering analysis is the best method to optimize the timing of completing a project based on a sequence of known and estimated costs and projected profits.

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## RECENT PROJECTS AND CONTRACTS OF INTEREST

CSI was recently selected to perform asbestos surveys in the Historic Capitol Building, the New Capitol Building, the Collins Building and the Coleman Building in Tallahassee, FL. CSI will be providing asbestos re-inspection services for over 600,000 square feet of combined building space. Asbestos program management services will begin in July.



Credit: Visit Tallahassee

## LEGISLATIVE ALERT! COMPETITIVE BID PROCESS

Governor Scott signed HB 7223 into law on June 2, 2011.

This new law allows certain meetings and processes in design build procurement to be exempt from Florida's Public Records and Sunshine Laws.

Prior to this new law, sealed bids or proposals received by an agency pursuant to an Invitation to Bid or Request for Proposal were exempt from public disclosure until the agency provided notice of an intended decision or within 10 days after the bid or proposal opening, whichever was earlier. Section 119.071, Florida Statutes, was amended to provide that sealed bids or proposals are now protected until the agency provides notice of an intended decision or within 30 days after bid or proposal opening, whichever is earlier.

Of great significance, Section 286.0113, Florida Statutes, now provides an exemption for any portion of meetings at which negotiations with vendors are conducted pursuant to a competitive solicitation, and those portions of team meetings at which negotiations are discussed. This means that when a vendor makes oral presentations or answers questions as part of a competitive bid process with persons appointed to evaluate the bids and negotiate the contract, other bidders and the public will not be allowed to be present. The meetings, however, must be recorded, and are subject to disclosure at the time of an intended award or within 30 days of the bid or proposal opening, whichever is earlier.

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- A minimum of six months of groundwater monitoring indicates that the plume is shrinking or stable.
- The release of petroleum products at the site does not adversely affect adjacent surface waters, including their effects on human health and the environment.
- The area of groundwater contamination containing the petroleum products' chemicals of concern is less than one-quarter acre and is confined to the source property boundaries of the real property upon which the discharge originated.
- Soils onsite that are subject to human exposure found between land surface and two feet below land surface meet the soil cleanup target levels established by DEP rule or human exposure is limited by institutional controls and, if appropriate, engineering controls.

It should be noted that funding under LSSI is limited to only those sites with discharges eligible for an Inland Protection Trust petroleum cleanup program. Discharges covered by consent or

der and settlement agreements are to be handled on a case-by-case basis.

Under this program, there are three "Closure Options" for funded sites that meet the above-referenced criteria.

- If it is demonstrated that no petroleum contamination exists at the site, DEP may issue a SRCO pursuant to Chapter 62-770.
- If it is demonstrated that minimal contamination exists onsite and is not a threat to human health or the environment, and the criteria established in the statute and also listed in the above LSSI participation requirements are met, then a LSSI NFA acknowledging this shall be issued pursuant to Section 376.3071 (11), FS.
- If minimal soil contamination exists on-site (as outlined in the statute), but the top two feet of soil do not meet soil cleanup target levels and appropriate institutional controls and, if necessary, engineering controls limit human exposure, a LSSI NFAC shall be issued acknowledging this as required by statute.

Funding for any one facility is limited to \$30,000 and no more than 10 facilities in each fiscal year per responsible party (RP). The RP can choose to stop assessment activities (and the expenditure of state funds) and terminate participation in the LSSI if the initial assessment data demonstrates that the discharge will not satisfy the SRCO. However, if the RP continues to expend state funds and it later qualifies for LSSI NFAC, the RP must accept responsibility for all costs associated with the establishment of the required institutional and engineering controls.

So, what are the advantages of entering into the LSSI program? To begin with, based upon the scoring history of the program, and given that the current pre-approval funding score is 49, it is unlikely sites that scored 10 points or less will be authorized for normal pre-approval funding in the foreseeable future. Additionally, the LSSI provides a cost-effective streamlined process to potentially obtain closure via a SRCO, a LSSI NFA, or a LSSI NFAC. And, as already pointed out, the RP still has the ability to terminate participation as soon as enough data has been collected to demonstrate that the discharge would not qualify for a SRCO.

However, the LSSI procedures may require the RP to pay any deductible or co-pay prior to issuance of a SRCO, LSSI NFA, or LSSI NFAC. Additionally, the LSSI does not change the RP's Petroleum Cleanup Participation Program Limited Contamination Assessment Report or copayment requirements.

The funding will be available on a first-come, first-served basis. Chastain-Skillman can assist the property owner or the confirmed RP as the designated cleanup contractor for the respective site(s). This can be accomplished simply by signing DEP's Contractor Designation Form & Real Property Owner/Responsible Party Affidavit, which Chastain-Skillman can prepare and submit for the property owner or the confirmed RP.

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## TOP 3 COST SAVING AMENDMENTS TO EPA'S SPCC RULE 40 CFR PART 112

By Paul L. Osley, PE, BCEE, CIH, CSP



Finally, after eight years of effort, the Environmental Protection Agency (EPA) has authorized amendments to the 2002 Spill Prevention and

Countermeasures (SPCC) plan regulations, many of which will help non-oil production related facilities and small AST owners reduce costs associated with their SPCC programs. The final amendments are a revised combination of the 2006, 2008 and 2009 draft amendments.

In October 2010, the EPA established that all facilities, except drilling, production or workover facilities, must submit and/or update their SPCC plans in accordance with the new amendments by November 10, 2011 (note the compliance date for drilling, production and workover facilities was November 10, 2010).

### How will these amendments affect your business? Here's how they can save you money:

1. If your facility qualifies for one of the following exemptions, you may be able save some or all of the costs associated with your current SPCC plan program:

- Hot-mix asphalt facilities and containers
- Pesticide application equipment and related mix containers
- Residential heating oil Above Ground

Storage Tanks (ASTs) and Underground Storage Tanks (USTs)

- USTs at nuclear power generation facilities
- Non-transportation-related tank trucks

2. If your facility meets the following criteria for Tier I and/or Tier II facilities, you will have the option to take advantage of several potential cost saving opportunities and be eligible for the following:

- Minimized regulatory SPCC Plan requirements that generally do not apply to facilities that store or handle smaller volumes of oil (e.g. emergency power generators with ASTs)
- Reduced or no requirement for Professional Engineer (PE) plan certification and/or triennial re-certification (both can be prepared/performed by the facility owner and/or representative)
- Streamlined integrity testing requirements
- Streamlined facility security requirements

3. If your facility meets the criteria of a Tier I Qualified Facility, you will be eligible for reduced overall SPCC plan costs because Tier I facilities have:

- The least complicated SPCC plan program operations and facility requirements
- The option for the facility owner to complete an SPCC Plan template in lieu of a full SPCC Plan (no PE certification requirement)

- A template that is designed to be a simple SPCC Plan including only the basic requirements that should apply to this tier of regulated facilities
- No requirement for PE plan certification and/or triennial re-certification (both can be prepared/performed by the facility owner and/or representative)
- Minimized regulatory SPCC Plan requirements that generally do not apply to facilities that store or handle smaller volumes of oil (e.g. emergency power generators with ASTs)

If you're interested in learning more on how to potentially reduce your overall SPCC plan program regulatory costs, please contact Chastain-Skillman. We look forward to the opportunity to be of service in this regard.

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## EOHS NEWS (CONTINUED)

OSHA Releases Updated Compliance Directive Addressing Personal Protective Equipment Effective February 10, 2011: CPL 02-01-050 Enforcement Guidance for PPE in General Industry

- Clarification on what type of PPE must be provided at no cost, when it must be paid for and replaced, and when employers are not required to pay for PPE
- Clarification regarding PPE payment requirements for PPE worn off the jobsite, for PPE that must remain on the jobsite, and for employee-owned PPE
- Enforcement policies that reflect court and review committee decisions concerning PPE
- Guidance for use of PPE constructed in accordance with most recent national consensus standards

## SIMPLE OVERSIGHTS THAT LEAD TO ERRORS IN DATA EVALUATION

By James R. Chastain, Jr., PhD, PE, MPH



It has been said that the vast majority of mistakes in statistics (and life) result from a failure to plan. Prior to undertaking a quantitative study of a problem, it is appropriate to develop a clear plan of how the data will be evaluated to support the decision making process. Although this would seem to be common sense, it is a step that is frequently omitted. When the data collection effort is expensive, the planning effort becomes increasingly important. The advent of the internet has provided convenient access to large stores of data, which introduces the issue of effectively judging the “goodness” of the data. So even if the acquisition of the data has little cost associated with it, the accuracy or relevance of the data can affect the outcome in unpredictable ways if not adequately vetted. This article briefly presents a few aspects of statistical planning that might be useful in evaluating or interpreting a data set.

At the outset one must define the point or objective of the study. Again, this may seem like common sense, possibly even self-evident, but it is interesting how a little probing will produce the need to clarify our thinking. A few common questions to ask along these lines would include (but not be limited to) the following.

### **Are there spatial or temporal variations in Variable Y?**

This is probably one of the most common outcomes sought from a data collection effort. Routine statistical analysis methods such as analysis of variance (ANOVA) or regression methods are fairly well suited for describing these relationships. In many cases, this analysis should be viewed as an exploratory effort because underlying mechanisms or drivers may not be evident. However, without this step, it may not be possible to identify these initial relationships.

### **What is the effect of Factor X on Variable Y?**

This is another question that is frequently the result of a statistical analysis. To be

formally correct, this should be the result of an experimental (manipulative) design. In that way, confounding variables can be controlled or minimized. If performed in this way, the resulting p-value can be used to meaningfully test for significance of Factor X. Many times, however, observational data is used to test this relationship. While this approach does not necessarily invalidate the results, the resulting inferences are usually weaker because confounding variables are not managed.

### **Are the measurements of Variable Y consistent with the Hypothesis under consideration?**

This question is appropriate when the study is seeking to confirm an assertion (hypothesis) or mathematical model. Data from either an experimental or observational study can be used for this purpose. The challenge under this category is to plainly state the hypothesis. Unfortunately, in environmental studies, it may be difficult to state simple, falsifiable predictions. Therefore, care must be taken when interpreting and making confident assertions about the conclusions in that event.

### **Using the Measurements of Variable Y, what is the Best Estimate of Parameter $\theta$ in Model Z?**

This question is somewhat infrequently used, but is a powerful tool in confirming and refining mathematical models of a condition. Parameter estimation is required to develop functional predictive models. While there are a number of ways to do this, a careful statistical approach is probably the best. As with the other categories, by keeping in mind the overall objective of the study, care can be taken to understand and account for accuracy and variance in the underlying data. Otherwise, the predictive power of the model will suffer.

There are certainly other questions or data objectives that can be envisioned in a study. However, these are a few of the more common ones and provide some insight into the types of probing that should be carried out prior to beginning the study effort. Once the data is collected, it must be assessed and interpreted.

The following section provides a few considerations to keep in mind when developing the report.

### **Observations and Cautions When Forming Statistical Conclusions**

Understandably, the use of various statistical methods is related to the analyst's familiarity and depth of knowledge of those methods. A number of studies in reputable, peer-reviewed journals have illustrated that these errors can occur even in otherwise advanced treatment of complex issues. The point here is that the integrity of a well-researched study can be compromised by a fairly fundamental mishandling or misinterpretation of the data. A few of the more common problem areas are summarized in the following.

#### **Mean**

Computation of the mean (average) is such a fundamental statistical measure that most people give no thought to computing it as a representation of the central tendency of the data set. The mean does in fact have some amazing mathematical features and deserves a prominent place as a statistical parameter. The Central Limit Theorem assures us that, regardless of the underlying distribution of the data, the true value of the mean will lie within two standard deviations (actually 1.96) of the computed mean 95% of the time in repeated tests.

Unfortunately, while well known and commonly reported, the mean is commonly misunderstood. For example, the common relationships about the mean do not apply to individual values...they apply to the true values of the mean. This may seem to be a subtle issue, but it can make a significant difference in drawing conclusions from the data. For example, if the underlying data distribution is non-symmetrical, expecting some level of data to lie within a specified number of standard deviations will provide erroneous results.

Possibly a better way to present the central tendency of the data set is to compute both the median and the mean. Since the

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*(Errors—Continued from page 6)*

median is a non-parametric parameter, by comparing the two, one can quickly get an indication whether the data is symmetrically distributed. The more the two are separated in value, the more non-symmetrical the distribution. This provides a rough check on whether common statistical relations will be appropriate or not.

### Standard Error

The standard error is an important statistical parameter. Many technical journals require that the “mean ± standard error” be included with all data sets. Quantitatively, the standard error is defined as:

$$SE = \sum_{i=1}^n \frac{(x_i - \bar{x})^2}{\sqrt{n(n-1)}}$$

It is related to the standard deviation and in fact can be considered the standard deviation of the mean as opposed to the standard deviation of the data set.

Standard error is quite helpful if the data takes a normal (Gaussian) distribution. In this case, the data is symmetrical and as statisticians say “is well behaved”. Unfortunately, in many cases the data will have non-Gaussian or truncated data sets. In these cases, the standard error can't legitimately be used to draw the common inferences from the data set.

As noted above, the standard error is computed as the square of the difference between mean and individual values. Thus, if there are several exceptionally large (or small) values in the data set, it will have a noticeable impact on the interpretation. This is especially true if the values are outliers or the data set is small (less than 8 data points). In fact, if the data set is less than 6 data points, the standard error is virtually meaningless.

If the statistical parameter of interest is the mean (as opposed to other statistical measures), the good news about the standard error is that as the data set becomes larger, some of the discontinuities begin to resolve. The Central Limit Theorem will smooth some of the data unevenness, and the information about the mean will become more accurate. However, as mentioned above, this use of “± SE” will infer a symmetry to the data set that may not exist.

The key message here is that the sample size needs to be large enough to smooth the data for the standard error to be meaningful. Most texts recommend at least 30 data points.

### Confidence Interval

One technique that has been proven to help more accurately portray various parameters (in addition to the mean) is the use of confidence intervals. Most statistical software allows the convenient computation of these values within some stipulated probability (normally 95%). As a general rule, there should be at least 8 data points available in order to stabilize the computational values. Confidence intervals can be used to evaluate the precision of the estimates and the significance of hypothesis tests. It is important to realize, however, that the center of the confidence interval is no more likely to represent the true value

of the parameter than any other point within the interval. As with all statistical tests, the reliability of the results are only as good as the validity of the input data (i.e., GIGO).

### Recommendations

The key message here is that care must be used when interpreting data and the associated statistics. Computer software packages make it quite easy to compute statistics, regressions and inferences. However, each of those techniques have specific, implicit assumptions and when violated can produce inaccurate inferences. The following are a few rules of thumb to help minimize those problems.

1. Define the purpose of the study. Recognize whether the data is observational or generated from an experiment. Observational data is prone to biases and confounding, so it should be used more to develop hypotheses rather than to define or prove cause/effect relationships.
2. Always plot the data and look for underlying patterns and distributions.
3. In small data sets (less than 6 data points), summarize the data by using minimum, maximum, mean and median. Compare the mean and median for evidence of symmetry. The closer the mean and median, the more likely the distribution is symmetrical. Standard error statistics are ineffective in this range.
4. Larger data sets (8 or more data points) are generally large enough to begin stabilizing statistics, especially if the data set is normally distributed. Even with the larger data sets, non-symmetrical data would probably be better served by minimizing the use of statistics that are based on normal distributions. Techniques such as box-plots, median/mean relationships, and more advanced procedures such as bootstrapping will more accurately characterize the data.
5. With larger data sets, confidence intervals should be computed and reported.

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**Look for additional compliance details in our  
October-December CSI Newsletter Article:  
“Revising Your SPCC Plan for EPA  
Compliance”**

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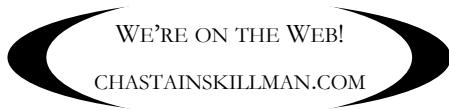
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