SOAH DOCKET NO. 582-15-2082

TCEQ DOCKET NO. 2015-0069-MSW

APPLICATION OF 130	**§**	**BEFORE THE STATE OFFICE**
ENVIRONMENTAL PARK, LLC	**§**	**OF**
FOR PROPOSED PERMIT NO.	**§**	**ADMINISTRATIVE HEARINGS**
2383	**§**	

TJFA, LP's & ENVIRONMENTAL PROTECTION IN THE INTEREST OF CALDWELL COUNTY'S (and ALIGNED INDIVIDUAL PROTESTANTS') REPLY TO RESPONSES TO CLOSING ARGUMENTS

TO THE HONORABLE ADMINISTRATIVE LAW JUDGES KERRIE JO QUALTROUGH AND CASEY BELL:

Protestants TJFA, L.P. ("TJFA"), and Environmental Protection in the Interest of Caldwell County ("EPICC") and aligned individual Protestants (collectively, "Protestants") hereby submit their Reply to Responses to Closing Arguments. Protestants urge the Honorable ALJs to deny the application for a landfill permit submitted by Applicant 130 Environmental Park, LLC (Applicant). For support, Protestants respectfully offer the following:

I. INTRODUCTION AND COMMENT O PROPREITY OF REPLY

By their Order No. 31, the ALJs comment that "Protestants' actions have impaired the ALJ's ability to review the highly technical information and make reasoned recommendations on the issues." While Protestants appreciate the concerns raised by the ALJs, and certainly did not intend to impair the ALJs' ability to review the evidence, it is also worth noting that the nature of Applicant's closing argument—more specifically, the lack of discussion of the evidence presented at hearing—placed Protestants in an awkward position. Throughout its closing argument, Applicant simply parroted the prefiled testimony submitted by its witnesses or by the Executive Director's witnesses, providing no new substantive arguments. Assuming that Applicant was lying behind the log and saving its substantive arguments for its response brief, Protestants attempted to anticipate some of those arguments and respond to them in their response brief, rather than risk leaving them unaddressed. [cite, as an example, the discussion re: the expired QA/QC rule]

Protestants' pre-filed testimony, and the hearing on the merits in this case, raised several particular issues related to the application. As the party with the burden of proof, the Applicant had a responsibility to address these issues in contention within its own Closing Arguments. Instead, with regard to drainage and floodplain issues, for instance, the Applicant's Closing Arguments merely parroted generalities drawn from the Application and Applicant's pre-filed testimony. Applicant's Closing Arguments regarding Drainage and Flooding lacked a single citation to the transcript of the hearing on the merits, or any exhibits submitted by any party at the hearing on the merits other than the party's pre-filed testimony. Likewise, Applicant's Closing Arguments regarding drainage and floodplains contained no citation to any pre-filed evidence presented by the other parties after the filing of Applicant's direct case. In short, Applicant's Closing Arguments are nothing more than a general summary of its pre-filed testimony that could have just as easily been written prior to the submission of Protestant's pre-filed testimony.

It is Applicant's right to pretend in its closing arguments that the hearing on the merits in this case never occurred, to pretend that no critiques of its own evidence have been made thus far in this proceeding, and to ignore all evidence contrary to its own position. But, when the Applicant chooses to take such an approach, it is also fair for Protestants to respond by identifying the deficiencies and problems that an applicant has chosen to ignore in the applicant's arguments and the applicant's cited evidence. Although written closing arguments and response briefs are the method most often employed in these types of proceedings, it is also the norm for an applicant to make some attempt in its closing arguments to address the particular issues in contention in the proceeding at the time of closing arguments. At the least, the Applicant, in this case, equally had a hand in creating the current predicament by failing to address the disputes that have arisen in this case in its Closing Arguments, despite the fact that the Applicant bears the burden of proof in the proceeding.

II. RESPONSE TO DAVID GREEN AFFIDAVIT

In Order No. 32, the ALJs admitted into evidence the affidavit of David Green, offered by Applicant, and noted that the parties would have an opportunity to respond to the affidavit in these reply briefs. Protestants offer their response to the affidavit here.

The only legitimate relevance of the new David Green affidavit is to confirm Protestants' evidence and argument that the Application is inaccurate and that Applicant failed to alert the ALJs of the inaccuracies in its application when it submitted its closing arguments. The affidavit does not controvert Protestants' evidence or even provide any real response to Patton King's affidavit. It cannot be considered an amendment to the Application to correct the deficiencies, at this juncture. And the opportunity for Green to be cross-examined on the new testimony in his Affidavit has long passed.

In its Motion to Admit the David Green Affidavit, Applicant takes the position that inaccurate information in the Application need not be corrected so long as it was

current at the time it was submitted.[1] This position is based on the argument that updating the information in the Application would be onerous and "an application could never be 'done'."[2] In attempting to support this argument, Applicant created a straw man by equating the owner/principal/operator identification requirements with the obligation to identify "regional land use and growth trends, adjacent property ownership, the names of elected officials and government representatives." But this straw man argument provides no support for Applicant's position.

The obligation to identify adjacent landowners and elected officials goes to the issue of notice. The notice obligation is met (or not) at the beginning of the application process; so updating information related to notice indeed would not be necessary after the hearing commences. Regarding land use considerations, if the Applicant is aware of significant changes to land use and growth trends, why would the Applicant not need to inform the ALJs of this fact? Once the evidence regarding land use considerations is no longer accurate, Applicant has a responsibility to point this out.

The Applicant offered into evidence, during the August 2016 contested case hearing, affirmative statements as to the owners' principals and supervisors contained in the Application. Yet as of July 26, 2016 this information was known to be false by the Applicant.[3] Applicant's counsel continued to use this evidence three months later on October 24 by asserting on page five of the Closing Argument brief that the "Application includes the names of the principals and supervisors of 130 Environmental Park's organization, together with previous affiliations with other organizations engaged in solid waste Activities." This was a day before David Green publicly testified in another proceeding that Ernest Kaufmann "doesn't hold any responsibilities" and was no longer President. The statement in Applicant's closing argument did not say that the

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[1] In their closing briefs, Protestants point out that the competency information contained in the Application was not even accurate or complete at the time it was submitted and these arguments are not here repeated.

[2] Applicant's Motion to Admit the Affidavit of David Green, page 4.

[3] Affidavit of David Green, page 1 ¶ 3.

Application contains the names of former principals and supervisors; rather it used the present tense to say the Application was still accurate. This is unacceptable conduct in any context. *See* Tex. Disciplinary Rule of Professional Conduct 3.03(a)(5) ("A lawyer shall not knowingly offer or use evidence that the lawyer knows to be false").

Instead of informing the ALJs and the parties that the information was no longer accurate, the Applicant hid the new facts by offering up in the contested case hearing an "expert" sponsoring witness on competency, who knew nothing of any of these facts. Kerry Maroney, the engineer who sealed the competency section of the Application had no independent knowledge of who the principals and supervisors of 130 EP were and made no independent effort to find out, even after receiving a notice of deficiency from TCEQ.[4] He simply filled out the application as instructed by Kaufmann.[5] *Compare* Tex. R. Civ. P. 193.5(b) (if a party's discovery response is "complete and correct when made, [but] is no longer complete and correct, the party must amend or supplement the response").

Applicant should have alerted TCEQ staff when it became aware that the information in the application was no longer accurate. It had a duty to alert the ALJs and parties once Applicant became aware that the evidence it offered was no longer accurate. And yet, now that the Applicant has, at long last, been exposed with evidence demonstrating that its Application is knowingly inaccurate, the Applicant responds by asserting that the information does not need to be accurate. Adopting Applicant's argument—that its evidence need not be accurate—would establish a dangerous precedent and deprives the protesting parties of the opportunity to vet and challenge the actual facts and circumstances surrounding the proposed landfill and permit application.

III. SPECIFIC ISSUES

2. Evidence of Competency and

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[4] Tr. V. 9, p. 2074, lines 5-25 & p. 2075, lines 1-11.

[5] Tr. V. 9, p. 2075, lines 24-25 & 2076, lines 1-3, 12-18 & 2077, lines 1-5; Tr. V. 9, p. 2077, lines 10-14 & 17-18.

3. Compliance History

In its Response to Closing Arguments, Applicant argues that it is owned by a "member" of an LLC—*i.e.,* Green Group Holdings, LLC—and that this member has no interest in the facility, which Applicant argues is all "contiguous land and structures, other appurtenances and improvements on the land for the storage, processing or disposal of solid waste." This argument is largely beside the point and is calculated to produce absurd results.

Applicant essentially argues that TCEQ has drafted its regulations so as to allow the effective owner of multiple landfills to avoid providing information about its compliance history simply by assigning its rights to the site to a separate, wholly-owned LLC. This interpretation of TCEQ rules would defeat the very purpose of requiring information about compliance history and affiliate operations. It contravenes the requirement that rules "be interpreted to … facilitate the administration and enforcement of state and other laws by the agency." 30 Tex. Admin. Code § 1.1. It contravenes the Texas Code Construction Act's requirement that rules be construed to effectuate "a just and reasonable result" and to favor the public interest over any private interest. Code Construction Act § 311.021(3) & (5).[6] *See also* § 311.023(1) & (5) (construction properly considers the "object sought to be attained" and "consequences of a particular construction").

Even if Applicant's argument were valid, which it is not, Section 330.59(f)(4) requires the "principals" of 130 Environmental Park to be identified "together with previous affiliations with other organizations engaged in solid waste activities." Whether Green Group Holdings has a specific property interest in the landfill facility, Green Group Holdings, Ernest Kaufmann and David Green were all principals of 130 Environmental Park at the time the Application was submitted and all except Ernest

[6] *See* Code Construction Act § 311.002(4) (Code Construction Act applies to "each rule adopted under a code").

Kaufmann remain so.[7] 130 Environmental Park was required to disclose in the Application all of these persons and entities' affiliations with other organizations engaged in solid waste activities. None of this was in the Application.

Finally, Applicant makes the argument that the TCEQ rules do not actually require an applicant to prove itself competent, but rather, the applicant must simply provide information that is considered "evidence of competency"—"*i.e.*, evidence the Commission may consider in valuating [sic] an applicant's competency[.]" [8] This is simply a distinction without a difference. It is nonsensical to suggest that "evidence of competency" does not need to actually demonstrate competency.

Applicant goes on to complain that were it required to provide "affirmative evidence of competency," this would work to prevent new operators with no relevant experience from obtaining permits and would provide a monopoly to existing owners and operators. But Applicant fails to mention that it is not a new operator of a solid waste facility. Applicant is not even new to the Texas permit application process. Applicant simply does not want its history of solid waste permitting and operations to be vetted during this hearing process, which is why it has elected to create a new, unfunded LLC for the purpose of seeking a landfill permit in Caldwell County. Moreover, if an applicant were indeed new to the landfill operating business, then, it makes sense to require actual evidence of competency in that case, to ensure that the new operator at least retained competent consultants and personnel to operate the proposed landfill in a manner that is protective of human health and the environment—contrary to Applicant's argument. TCEQ's charge is to protect human health and the environment. New, inexperienced, incompetent prospective landfill operators are not entitled to a landfill permit, and TCEQ

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[7] *See, e.g., Terraces at Cedar Hill, LLC v. Gartex Masonry & Supply, Inc.*, 2011 WL 1050852 (Tex. App. – Dallas 2011, pet. denied) (owner and president of an LLC is principal of the LLC).

[8] For this proposition, Applicant cites to a Proposal for Decision in the case of *Post Oak Clean Green, Inc., Application for MSW Permit*. But that PFD remains pending. After it was issued, the parties submitted exceptions and responses, which are, presumably, still be evaluated by the ALJs; the ALJs have not yet responded to the exceptions and responses. So, it is unclear what, if any, precedential value this pending PFD has at this time.

owes no duty to ensuring that such operators are issued a permit by lowering the bar for demonstrating evidence of competency.

4. Land Use Compatibility

In its Closing Arguments, Applicant claims that its only burden regarding land use compatibility was to provide the ED with the specific information listed in Rule 330.61(h). Because Applicant provided this information, it satisfied its burden. Applicant goes on to state that "the ED determined the Application contained sufficient information to demonstrate the landfill is a compatible land use," and "the information contained in the Application is sufficient to demonstrate land use compatibility."[9] But the issue presented here is not whether the Applicant listed the specific data that is mentioned in Rule 330.61(h). Rather, the issue here is whether the proposed landfill will "not adversely impact human health or the environment."[10] To address this issue, Applicant must do more than simply check off the boxes.

Having a retained a land use expert and having been made aware that the proposed landfill site is located adjacent to a reservoir and dam that has been designated high hazard, Applicant should have known that any impact on the dam and reservoir is likely to result in adverse impacts on human health and the environment. Indeed, that is the whole point of the high hazard designation.[11] More specifically, based on TCEQ's "breach method" analysis, a catastrophic flood breach wave would place at risk 26 downstream houses, 3 Farm-to-Market roads, and 3 county roads used by more than 6,000 vehicles daily.[12] And because the current Site 21 dam does not meet the applicable design standards, the failure potential for the structure is "judged to be high."[13] Yet, as acknowledged by engineer-of-record Kerry Maroney, he made no attempt to evaluate impacts to the dam:

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[9] Applicant's Response to Closing Arguments, p, 15.

[10] 30 Tex. Admin. Code § 330.61(h).

[11] Ex. P-5, p. 38 & Ex. P-5X.

[12] Ex. P-5, p. 38.

[13] Ex. P-5, p. 39, ll. 4-6 & Ex. P-5X.

Q: Have you made any attempt to collect additional information regarding the Site 21 Dam and Reservoir near the proposed landfill footprint?

A: No, ma'am.

Q: Have you conducted any evaluation of Site 21?

A: No, ma'am.[14]

That Applicant would fail to consider the integrity of the dam and render it inconsequential to any land use compatibility analysis is remarkable. Even if TCEQ's Rule 330.61 does not specifically list impacts to a high-hazard dam as a specific factor that must be considered during a land use compatibility analysis, the Rule does contemplate that information regarding "other factors associated with the public interest" should be provided to the Commission as part of the land use analysis. Potential impacts of a proposed landfill on a dam that has been designated as high hazard would appear to qualify, under any standard, as a "factor associated with the public interest."

Finally, it is worth noting that Applicant's argument regarding the validity of the County's landfill siting ordinance has been rejected by TCEQ. In short, Applicant argued, in its Response to Closing Arguments, that Mr. Worrall was not required to consider the existence of the County's ordinance because the ordinance was adopted after the application for this proposed landfill was submitted to TCEQ and after the application for a transfer station registration was submitted to TCEQ. According to Applicant, this renders the siting ordinance invalid.

But Applicant's sister corporation, Pintail, made the same argument to the ED when its landfill permit application was returned and it sought to re-submit it. That is, after Pintail's landfill permit application was returned because of Mr. Snyder's errors regarding groundwater elevations, Pintail attempted to re-submit Parts I and II of the landfill permit application, even though the proposed landfill location was prohibited by landfill siting ordinances (the City of Hempstead's ordinance and Waller County's

[14] Tr. V. 9, p. 2073, ll. 9-14.

ordinance). In that case, Pintail also had a transfer station registration for the same area as the proposed landfill. And that registration application had also been submitted before the local siting ordinances were adopted. Yet, the ED agreed that the local siting ordinances remained valid and prohibited the issuance of a landfill permit application that was filed after the adoption of the ordinances.

Admittedly, in this case, landfill permit application here was filed with TCEQ before the adoption of the County's landfill siting ordinance. But that does not render the ordinance invalid, as acknowledged by the ED in the Pintail matter. Mr. Worrall acknowledged that the existence of a landfill siting ordinance reflects the desires of the county regarding where they believe landfills should be sited within the county.[15] Yet, he did not even check to see whether the County had enacted a landfill siting ordinance in this case.[16]

6. Geology and Soils

Having extensively briefed this issue in both the initial Closing Arguments and Response to Closing Arguments, Protestants will not repeat its arguments on this issue here. But there are some points made in Applicant's Response to Closing Arguments that warrant a reply.

Timeliness of evidentiary challenges

First, Applicant makes the argument that any evidentiary challenges or requests for spoliation instructions are too late. But Applicant is mistaken.

Protestants timely objected to Snyder's testimony, but even if they hadn't, the failure to do so does not waive error. This is because his testimony and opinions were incompetent, and "baseless opinions will not support a judgment even if there is no objection to their admission in evidence."[17] A party may complain about legally

[15] Tr. V. 1, p. 67, ll. 14-18.

[16] Tr. V. 1, p. 67, ll. 10-13.

[17] *City of San Antonio v. Pollock*, 284 S.W.3d 809, 816 (Tex. 2009) (quoting *Coastal Transportation Co. v. Crown Central Petroleum Corp.*, 136 S.W.3d 227, 232 (Tex. 2004)).

insufficient evidence, such as incompetent and baseless expert opinion testimony, even if no objection was made to the admission of the testimony.[18]

Furthermore, a spoliation remedy is timely, at this juncture of the proceedings. A spoliation instruction is generally appropriate after consideration of the evidence, especially evidence that demonstrates a party's deliberate destruction of relevant evidence.[19] In this case, testimony was elicited during the hearing on the merits establishing that Applicant's consultants knowingly and deliberately destroyed relevant evidence. So, a spoliation remedy is appropriate at this juncture.

Failure to comply with regulatory requirements and professional standards

Applicant further argues that Protestants "rarely identify a TCEQ rule requirement that they assert has not been complied with" by Applicant in its geologic investigations or in its Geology Report. This too is simply wrong.

In their Closing Arguments, Protestants pointed out how Applicant's consultants, namely Mr. Snyder, violated TCEQ rules during every step of the process of preparing the geology report—from commencing the drilling of borings before obtaining approval, to Mr. Snyder's failure to supervise the subsurface investigation, to his failure to observe all the soils before sealing the logs, and his failure to record all significant secondary features. Furthermore, TCEQ's rules and legal evidentiary standards require any conclusions or opinions included in the geology report be based on reliable, competent foundational data. Applicant failed to comply with this standard. Applicant was unable to demonstrate that the foundational data relied on by Mr. Snyder were reliable or competent. Mr. Snyder's destruction of relevant evidence further rendered his opinions unreliable and incompetent because they could not be tested for accuracy. And much of the evidence that was admitted affirmatively demonstrated that it was inaccurate and unreliable.

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[18] *Id.*

[19] *Wal-Mart Stores, Inc. v. Johnson*, 106 S.W. 3d 718, 723 (Tex. 2003).

The piezometer logs were not based on actual data or observations that corresponded to the representations included in the logs. Applicant's expert admitted that even though he sealed the logs, those logs did not represent what they purported to represent. They did not reflect the materials that were actually encountered during the drilling of the piezometers.

Snyder attempted to explain away the false representations in the piezometer logs by stating that it was better to use the boring logs for the lithologic descriptions because he had actually looked at some of the samples from the borings and there were laboratory analyses for some of those samples. While that may explain why Snyder chose to rely on the soils from the borings to describe the subsurface lithology, it does not absolve Mr. Snyder from misrepresenting facts in the piezometer logs. The bottom line is that Snyder sealed and submitted to TCEQ data that he knew was inaccurate.

Applicant seeks to justify Mr. Snyder's destruction of materials by relying on a "confidential" document that was not offered into evidence,[20] which, according to Applicant, explains that Mr. Snyder was not required to preserve soil samples and field logs, under Rules 30 Tex. Admin. Code § 330.57 and 22 Tex. Admin. Code § 851.106. But the testimony and evidence in this case demonstrate that Mr. Snyder was well-aware that these field logs and soil samples were relevant evidence, based on his past experience in landfill permitting proceedings. He has been asked for this data, via discovery, in past landfill permitting proceedings, including in the Pintail matter. Mr. Snyder also received a preservation of evidence letter from Protestants' counsel shortly after the landfill permit application was submitted to TCEQ.

Assuming, for the sake of argument only, that the cited rules above did not impose on Mr. Snyder a duty to preserve soil samples and field logs, professional standards of conduct mandated preservation of this data. Mr. Feather Wilson recognized this professional duty to preserve data and testified that any soil samples relevant to pending litigation would be maintained in his barn, at least through the end of the litigation

[20] By a separate motion, Protestants seek to strike this attachment and any references to this attachment.

because "[i]t's evidence," and "[i]t would be unethical for me [Wilson] to destroy those samples."[21] He further testified that he might refer back to those samples as he prepared to testify in any litigation for which the samples might be relevant.[22] Legal standards also require preservation of relevant evidence, which has been pointed out to Mr. Snyder in past landfill permitting proceedings as well as in the preservation of evidence letter sent to him in this permitting proceeding.

And finally, even if Mr. Snyder was completely ignorant of his duty and responsibility to preserve the data that formed the basis for his opinions, that may provide Mr. Snyder a defense to any claim of malpractice. But it does not remedy the fact that there is no foundational data—no evidence—in the record that supports his professional opinions regarding the subsurface of the landfill site and no basis for concluding that his opinions are reliable and competent. In fact, the only foundational data that exists in the record proves that his opinions are not reliable, because his opinions are contrary to and unsupported by the data obtained during the subsequent 2016 subsurface investigation.

Applicant also argues that there is no requirement that Applicant or its consultants comply with ASTM standards, and any suggestion by Protestants that these standards should have been adhered to is wrong. But Applicant has missed the point with this argument.

Protestants' argument regarding the subsurface investigation and geology report is that Applicant failed to comply with any standards—professional standards, legal standards, or ASTM standards. Even if there is no explicit rule that states that Applicant must comply with ASTM or any other standard in conducting its subsurface investigation and preparing its expert conclusions, there is no dispute that experts are nevertheless held to comply with professional standards. ASTM provides one form of such standards; ASTM standards are some evidence of the professional standards that Mr. Snyder should have complied with. (TCEQ's rule regarding QA/QC procedures is another example of a

[21] Ex. P-8, p. 69, ll. 16-23.

[22] Ex. P-8, p. 69, ll. 24-25 thru p. 70, ll. 1-5.

professional standard, even if it expired.) Applicant offered no rebuttal evidence regarding applicable professional standards that informed its consultants' subsurface investigation and preparation of its expert reports. There is no written QA/QC policy that Applicant's consultants rely on. There is no written retention data policy that Applicant's consultants could point to in support of their decision to destroy relevant data. In fact, Applicant's argument appears to be that there is no professional standard that applies to its consultants' collection and analysis of data, unless it is explicitly spelled out in TCEQ rules. Applicant's arguments regarding the irrelevance of ASTM standards (or any applicable standards) is simply unsupportable and absurd.

Characterization of Soils in Applicant's boring logs

On page 29 of Applicant's Response to Closing Arguments, Applicant argues that Protestants' statement that Applicant's subsurface characterization described the subsurface as consisting of fat clay is "simply not true." That is, Applicant argues that Protestants are wrong in claiming that Applicant described the subsurface as consisting of fat clay. In fact, Applicant is wrong.

Every single boring log in the application classifies the lithology as "CH," which is the nomenclature for fat clay. That Applicant may have also included some additional notations in the comment section of the boring logs does not negate the fact that every soil classification included in the boring logs indicates "CH" or fat clay.

BME-31

Only a few of the soil samples collected by Applicant were sent to a lab for analysis. But of those few, the lab results for one of those samples indicated that the sample consisted of lean clay or "CL," not fat clay. Yet, Mr. Adams labeled this interval of boring BME-31 as fat clay or "CH." This evidence demonstrates that the soil classifications are not reliable. The point of the testimony regarding the erroneous soil classification in BME-31 is to demonstrate that there was no reliable basis for the opinions expressed in the boring logs or in the geology report, and there were no consistent professional standards that were employed in developing the soil classifications that were included in the boring logs.

This one discrepancy at BME-31 was discovered because lab analyses were available to compare to the boring logs. But the vast majority of the soil samples collected during the Applicant's 2013 subsurface investigation were not sent to a lab for analysis. And those samples were destroyed before TCEQ staff or Protestants' experts could observe them and compare them to the boring logs. There is simply no telling how many other errors in soil classification are included in the boring logs.

Mr. Adams attempted to justify the CH (or fat clay) classification of the soil sample from BME-31 even though the lab results indicated lean clay, by explaining that he used his "experience and judgment" and "compared the other samples to all of the surrounding samples that classified as CH." But Mr. Adams is not a geologist. His soil classifications were based on lab analyses, because he is an engineer. In any event, it makes no sense to send samples to a lab to determine the soil classification if those lab results are going to be disregarded if they are not consistent with the pre-determined and more favorable soil descriptions preferred by the consultants.

Differences in nomenclature

Next, Applicant attempts to explain the discrepancies between its 2013 subsurface investigation and the 2016 subsurface investigation by describing them as a difference in nomenclature. More specifically, Applicant points out that Mr. Rubinov's logs identify numerous fissures, but Mr. Snyder's boring logs describe similar features as "blocky." But this is simply an untenable position.

First, the discrepancies between the 2013 subsurface investigation and the 2016 subsurface investigation are not limited to differences between Mr. Rubinov's logs and Snyder's logs. The discrepancies are also demonstrated in differences between Applicant's own 2016 logs compared to its 2013 logs. In the 2016 logs, Applicant identified 19 fractures, whereas the 2013 logs identified none. This cannot be explained by a difference in nomenclature.

Moreover, TCEQ Rule 330.63(e)(4) specifically states that the boring logs must include a detailed description of discontinuities such as "fractures, fissures, slickensides,

lenses, or seams."[23] There is no mention, in this rule, of blocky textures. So, Mr. Snyder, had he complied with this rule, should have been looking for and identifying "fractures and fissures," rather than using other, cryptic terminology that obscures the presence of these features.

Finally, although Applicant eschews references to ASTM standards unless TCEQ rules require compliance with them, there is an ASTM standard that explains the difference between a fissure and blocky texture. This standard makes clear that the two are not interchangeable. Mr. Snyder's failure to recognize the distinction between these two types of features calls into question the reliability of all his lithological descriptions in the boring logs.[24]

Finally, Applicant makes the illogical assumption that because Protestants only drilled a few borings and sent only some samples to the lab for analysis that this must mean that Protestants were only able to discover a few, minor discrepancies with Applicant's subsurface investigation. But this assumption is erroneous.

As explained in Protestants' earlier arguments, Protestants were not attempting to characterize the subsurface of the entire site. That was not their responsibility. Rather, Protestants were attempting to test the veracity of Applicant's characterization of the site as consisting solely of fat clays. And after drilling only a few borings and analyzing the data collected from those few borings, Protestants discovered that Applicants' subsurface characterization was erroneous and unreliable. Even one error would have demonstrated the unreliability of the Applicant's subsurface characterization, but Protestants discovered multiple errors, many of which were significant. The extent of the errors in the Applicant's subsurface characterization is unknown because Protestants did not attempt to replicate the Applicant's entire subsurface investigation program. But what is known is that the site is not underlain by consistent fat clay (contrary to what was represented in

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[23] 30 Tex. Admin. Code § 330.63.

[24] The ASTM standard is included as an attachment to this brief. Protestants do not seek to admit this into evidence because Protestants are not relying on this ASTM standard to prove any element of their case. Rather, it is offered for demonstrative purposes, and as a rebuttal to Applicant's latest argument that Mr. Snyder recognizes no distinction between fissures and blocky texture.

Applicant's geology report), and there are numerous migration pathways that are not reflected in the geology report included in the application.

The erroneous representations included in the Applicant's geology report are consistent with past practices by its consultants. Applicant's consultants have a history of preparing erroneous and unreliable geology reports (which is explained in greater detail in Protestants' Response to Closing Arguments) and then discarding the data that forms the basis for those reports, and this case is no different.

The logical conclusion to be drawn from the errors and inconsistencies in Applicant's geology report is that Applicant's geology report and subsurface characterization are unreliable. They do not meet the standard for competent, reliable evidence. In fact, the opinions included in the geology report were impeached by Applicant's own subsequent 2016 subsurface investigation. The geology report included in the application therefore constitutes legally insufficient evidence.

7. Hydrogeology

Both Protestants and PCCD have explained, in their earlier briefs, that Applicant failed to appreciate and acknowledge the evidence demonstrating how close the Carrizo-Wilcox aquifer is to the proposed landfill site. Protestants will not repeat those arguments here.

Protestants will, however, reply here to Applicant's arguments regarding analysis of groundwater flow direction. In the Response brief, Applicant criticizes Dr. Ross for failing to take into account the supplemental piezometer data included in its supplemental Geology Report. According to Applicant, the new piezometer elevation data included in the supplemental geology report "differed from the elevations originally shown in Table E-9" of the original geology report in the application. Applicant goes on to argue that "Dr. Ross' failure to use this updated information renders her analysis based on the outdated information meaningless." But if Dr. Ross' failure to consider this updated data renders her analysis meaningless, it must also render the ED's technical review and analysis of the outdated data equally meaningless.

A review of Applicant's Exhibit 130EP-7, at pages 22 and 23, reveals that every single elevation for all piezometers and every single northing and easting coordinate for the piezometers was wrong and had to be changed.[25] These errors and corrections are not even uniform. That is, one cannot say that there was a single benchmark data error that resulted in the same type of error, by the same margin, for each of the piezometers. Instead, each of the revisions is different. This means that the data that was submitted to the ED for his technical review was outdated, and his analysis of the data was meaningless.

Furthermore, there is no reason to believe that the updated data is now reliable and correct. There was no explanation provided for Applicant's initial erroneous piezometer data, included in the application. So, there is no reason to believe that similar errors were avoided in the updated or revised piezometer data.

These errors were not insignificant, contrary to Applicant's representations. Correlating stratigraphy and groundwater elevations across borings and wells depends upon accurate and reliable survey information regarding well tops-of-casing and ground surface elevations. These elevations are foundational to conclusions regarding the relationship between stratigraphic intervals across borings, the relationship of measured groundwater elevations to observed stratigraphy, and to conclusions regarding the direction, or potential direction of groundwater flow.

Errors in well tops-of-casing and ground surface elevation information submitted as part of the permit application were not identified by the Applicant prior to the May 2016 supplement. When the elevation changes were submitted in the supplement, Applicant's Exhibit 130EP-7 at pages 22 and 23 indicate that every location, surface elevation, top of casing, filter pack, and well screen elevations changed for every piezometer on the site. No information was provided in the supplement regarding the reason for the location and elevations changes.

[25] Ex. 130EP-7, pp. 22-23.

Additionally, the supplement provided no information regarding the magnitude of the elevation differences between the application and the supplement. The supplemental text stated, however, that "revised information provided in this supplement does not include significant changes"[26]

A comparison of the elevation changes reveals that the magnitude of each piezometer elevation change amount was unique. With no explanation for the differences, the highly unusual situation in which every value in the original application was in error, and the Applicant's statement that the changes were insignificant, Dr. Ross' use of the original application elevations was a reasonable basis for comparing her measured bottom of the well to site stratigraphy. In fact, the ED's staff relied on this same information when conducting his technical review.

If there were significant differences that would have made an analysis based on the application data inaccurate, the Applicant had a duty to clearly indicate in the supplement that the changes were significant, a duty to describe the magnitude of the changes in the tables on Applicant's Exhibit 130EP-7 pages 22 and 23, and a duty to provide clear and compelling reasons why updated survey information was more accurate than the values in the permit application. The vehicle for accomplishing these revisions is an application amendment. That is, Applicant should have requested a remand to the ED to provide the updated information and to allow the ED to conduct a new technical review based on this new data.

That the errors in the original application were more significant than acknowledged by Applicant is evidenced by the fact that the revisions influence the groundwater flow interpretations. In fact, Applicant acknowledged this in its response to closing arguments. As explained above, other aspects of the geology report also depend upon accurate piezometer elevation data. For instance, the location of the contact between the weather and unweathered zones depends on accurate piezometer elevations. In short, Applicant is correct when it argues that the revised data included in its Exhibit 130EP-7

[26] Ex. 130EP-7, p. 5.

renders meaningless any analysis of the original data included in the application. But that means that Applicant's revised piezometer data has effectively impeached and rendered unreliable the data and the analyses included in the application materials—the very same data that the ED relied on when performing his technical review.

8. Faults

Applicant's arguments regarding faults focus only on the rule regarding location restrictions: 330.555. But, as explained in Protestants' arguments, faults are also relevant to the issues of subsurface geology and hydrogeology and groundwater monitoring. Faults, even those that have not had displacement in Holocene time, are significant migration pathways for contaminants. In this case, they also reflect that Applicant's geology report was much too simplistic, in that it did not identify any fractures. Subsequent subsurface investigations revealed that fractures are indeed present in the subsurface, providing migration pathways, but faults are also likely present, indicating additional migration pathways.

To be clear, of all the witnesses who testified at the hearing, only Mr. Rubinov was present when a loss of fluid circulation was observed. Thus, his logs and conclusions are the most reliable because they are based on his observations.

Applicant attempts to argue that Mr. Rubinov's observations are consistent with the representations in the Applicant's geology report. That is, Applicant argues that the "evidence actually shows that the weathered/unweathered contact is at 50 feet bgs in both BME-43 and MP-3." But Applicant is mistaken.

An examination of Applicant's Exhibit 130EP-7, p. 110 and 111, the log for Boring BME-43 clearly show that the applicant has characterized a single lithology from 36 to 56 feet below grade. This continuous lithology is indicated in the first interval on p. 111 by "(continued)" following a lithology description that is identical to the last interval on the previous page. Thus, Applicant's argument is actually contradicted by the Applicant's boring log for BME 43.

15. Wetlands

Initially, a housekeeping matter: the EPA/Corps of Engineers federal-law "wetlands" definition in currently-effective law is set out at 33 CFR § 328.3(b). Mr. Marusak and various others have mistakenly cited to the now-suspended recodification of that definition, 33 CFR § 328.3(c)(4). The text of each definition is the same,[27] but we ought to cite to the currently-effective law.

The breadth of the definition: The Applicant's responsive closing argument reiterates the observation that the federal-law definition – by which it means the § 328.3(b) definition – is ***potentially*** more broad than is the state-law definition. This just is not a relevant consideration. Whether a definition is "potentially" more broad is no indication that it is more broad. The § 328.3 definition exists, at all, only to elaborate on the definition of "waters of the United States," of which "wetlands" can be a subset, so long as they are (1) interstate,[28] or (2) their degradation could affect interstate or foreign commerce,[29] or (3) they are adjacent to wetlands described in (1) or (2),[30] ***and*** (4) they are ***not*** croplands – even, unirrigated croplands – converted to that use prior to a date in 1985[31] or waste water treatment ponds or lagoons (whenever created).[32] So, there are lots of sites that could fall within the state-law "wetlands" definition, e.g., unirrigated croplands created after 1985, but that, if they had a prevalence of hydrophytic vegetation, would not fall within in the § 328.3 definition. Also, of course, the §328.3 wetlands definition plainly requires a prevalence of hydrophytic vegetation, while the state-law definition plainly does not.

The Applicant's response, next, argues that it makes no difference that there are both state-law and federal-law "wetland" definitions, because the Water Code has another provision, § 11.506, provides that if the state-law definition conflicts with the federal-law

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[27] *In Re: EPA*, 803 F.3d 804 (6th Cir. 2015).

[28] 33 CFR § 328.3(a)(2).

[29] 33 CFR § 328.3(a)(3).

[30] 33 CFR § 328.3(a)(5).

[31] 33 CFR § 328.3(a)(8).

[32] 33 CFR § 328.3(a)(8).

definition, the federal-law definition prevails. The most glaring problem with this argument is that it assumes a fact of which there is no proof: that the legislature understood the federal-law definition to be the one focused on hydrophytic vegetation and developed by EPA in 1980 and adopted by the Corps of Engineers in 1986 rather than the one focused on hydric soils and adopted by Congress in the Food Security Act of 1985.

> The Food Security Act of 1985[33] defined "wetland" to mean:
> except when such term is part of the term "converted wetland", [ ] land that has a predominance of hydric soils and that is inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of hydrophytic vegetation typically adapted for life in saturated soil conditions.

This definition has not gone away. It exists unchanged (though slightly reformatted), today, at 16 U.S.C. § 3801(27)(A).

> The state-law "wetland" definition, again, reads:
> an area (including a swamp, marsh, bog, prairie pothole, or similar area) having a predominance of hydric soils that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support and that under normal circumstances supports the growth and regeneration of hydrophytic vegetation.[34]

These federal-law and state-law definitions are obviously very, very similar. As the Applicant's response notes, the state-law definition has a few exceptions (stated outside the heart of the definition, itself), but these exceptions have no known bearing on the 130EP site.

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[33] Sec. 1201, PL 99–198 (HR 2100), PL 99–198, December 23, 1985, 99 Stat 1354.

[34] Tex. Water Code § 11.502.

The most rational read of the Water Code's "conflict" provision, i.e, of § 11.506, is that, if there were to be some instance in which the state-law definition was at odds with the Food Safety Act definition, the latter would prevail. This is re-enforced by the fact the State Legislature set out a definition, at all. If the EPA/Corps definition, which is on its face clearly different from the state-law definition, were always to prevail, what is the point of setting out the state-law definition at all? It makes sense to set out a definition in an easily-accessible place, i.e., the Water Code, but only if that is the definition that will be used in almost all circumstances.

As Protestants noted in their responsive argument and as is clear from reading 33 CFR § 328.3 as a whole, EPA/Corps federal definition is not relevant to demonstrations related to non-jurisdictional wetlands. The § 328.3 wetlands definition does not purport to have any bearing on sites that are non-jurisdictional to the federal government. There can be no conflict between laws, if one law is applicable to a decision and the other law is not.

The Applicant also argues that the use of the state-law definition would result in fewer sites being categorized as wetlands than were so categorized under the EPA/Corps definition. This argument is specious. It assumes that sites having a predominance of hydric soils would also have to have a prevalence of hydrophytic vegetation. That is not so, under the state-law definition; that definition does not require a prevalence of such vegetation.

The Corps of Engineers permit: The Applicant argues that the Corps of Engineers permit obviates, under 30 TAC § 330.61(m)(2), the need for a wetlands determination under applicable federal and state laws or a discussion of wetlands in accordance with 30 TAC § 330.553. Sec. 330.61(m)(2) indicates a Corps of Engineers permit "demonstrates" something, but it does not say what it demonstrates. Inasmuch as the Corps of Engineers does not concern itself with non-jurisdictional wetlands, it makes no sense to interpret the § 330.61(m)(2) demonstration to extend to non-jurisdictional wetlands. The understanding sponsored by the Protestants makes sense: the Corps permit obviates the need to determine and discuss wetlands that are jurisdictional to the

Corps, i.e., there is no benefit to the TCEQ's revisiting the federal issues the Corps has already decided, but the Applicant must still identify and discuss wetlands that are non-jurisdictional to the federal government. It would be very unlike TCEQ to relinquish to the Corps State sovereignty over state-definition wetlands, especially in the present situation, where lower-level Corps staff have allowed an applicant to simply forget about hydric soils, if a prevalence of hydrophytic vegetation is not found.

No net loss of wetlands: The Applicant argues that Texas merely has a "policy," not a "law," that there be no net loss of the State's wetlands resource base. 30 TAC § 279.2(b) was adopted – in the face of adverse comment from one industry commenter – after the full notice and comment procedures of the Administrative Procedures Act. It is as much a "law" as is any other regulation. It and, particularly, the *Texas Register* preamble language related to it and previously cited by Protestants, make no mention of a limitation of the regulation to water quality certifications. The Applicant argues the location of the "no net loss" provision within the regulations limits the provision to water quality certifications, but the Applicant cites nothing to back up that alleged proposition of law.

A final observation regarding the wetlands issues: Protestants urge you to weigh the fact that the Applicant did not respond, at all, to Protestant's arguments showing that there were sites surveyed by Halff Associates with predominantly hydric soils that, nonetheless, did not make the "wetlands" cut simply because they lacked a prevalence of hydrophytic vegetation. They did not make the cut, because, on the authorization of a Corps employee and with no input from TCEQ, sites lacking a prevalence of hydrophytic vegetation were automatically disqualified from "wetlands" categorization or, even, further study. This is particularly indefensible, given the instructions of the "Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Great Plains Region." All parties agree this is an authoritative document, and it calls for investigation beyond hydrophytic vegetation under conditions, e.g., climate variability and man-made surface alterations, like those found at the 130EP site.

16. and 17. Surface Water Drainage and Floodplains

The Applicant has chosen to merge the issues of drainage and floodplains into a single topic for the Applicant's Response, and Protestants feel it is appropriate to likewise merge the issues for purposes of this Reply.

Applicant Improperly Relies on Reservoir 21 for Off-Site Mitigation

Applicant's response regarding adverse impacts on drainage patterns continues to rely heavily on the alteration of drainage volume downstream of the off-site Reservoir 21.[35] As noted in Protestant's response, this type of off-site mitigation should not be allowed, and to the degree it is allowed, TCEQ practice requires that an easement be obtained by the permittee for the off-site drainage features that are relied upon in the drainage analysis.[36]

Applicant has not obtained the required easement. In fact, Johnnie Halliburton testified on behalf of Plum Creek Conservation District that, "There is a potential, then, that the landfill operations, if not designed, constructed and operated correctly, could be inconsistent with the District's use of its easement rights."[37] As noted by PCCD in PCCD's Closing arguments, the easement held by the District should be interpreted to assure that the operation and maintenance of the dam at Site 21 and related impoundment are not adversely impacted, and any actions that would interfere with the District's responsibilities under the Texas Dam Safety Act and regulations adopted pursuant to that State for the dam located on the easement would also not be allowed under the terms of the easement held by the District. Yet, neither the application nor Applicant's testimony addresses whether Applicant's plans are consistent with the easement held by the District.

In sum, not only has the Applicant failed to procure the necessary easement for it to rely on off-site mitigation of drainage impacts, but Applicant has also failed to demonstrate that its plans will not violate the downstream easement held by the District. Without demonstrating that the alteration of runoff caused by the construction and

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[35] Applicant's Response to Closing Arguments, p. 65.

[36] Tr. V. 8, p. 1900-1901; Ex. ED-SO-4.

[37] Ex. PCCD 1.0, p. 22.

operation of the Facility is consistent with this downstream easement, Applicant has failed to demonstrate that the facility will not adversely impact drainage patterns.

The Proposed Facility Endangers Reservoir 21

In asserting that the alteration of drainage patterns will not adversely impact Reservoir 21, Applicant continues to rely upon hearsay statements by unidentified TCEQ staff with the Dam Safety Program that a 1% increase in volume is insignificant.[38] Reservoir 21 has been classified as a "High Hazard Dam,"[39] meaning that should it fail or malfunction the TCEQ expects that it would result in the loss of seven or more lives, three or more habitable structures, or excessive economic loss.[40] As such, the dam must be protected against a flood event equaling 75% of the "probable maximum flood."[41] Although Applicant now relies on the dam safety program to claim that the landfill will not have an adverse flooding impact, this consideration did not factor into Mr. Traw's analysis:

> Q: Did you do an evaluation to determine whether the changes resulting from this landfill would compromise the ability of this reservoir to handle the probable maximum flood?
>
> A: No. The probable maximum flood was not incorporated into my analysis.[42]

For applicant to rely on the dam safety criteria, then some analysis of that flood should be included. Simple hearsay testimony as to the significance of the increase does not make this showing. Furthermore, TCEQ rules prohibit any adverse alteration of drainage patterns, without limiting this to significantly adverse impacts. The size of the increased volume is irrelevant if that increased volume adversely impacts the ability of the reservoir to perform its intended flood control function.

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[38] Applicant's Response to Closing Arguments, p. 65.

[39] Ex. PCCD 1.0, p. 16: 6.

[40] 30 TAC 299.14(3).

[41] 30 TAC 299.15(a)(1)(A), setting forth criteria for high hazard medium sized dam as PMF. Reservoir 21 has maximum storage in excess of 1,000 but less than 2,000, rendering it a medium size dam. PCGCD Ex. 1.4.

[42] Tr. V. 3, p. 678-679.

By increasing the volume of floodwater that Reservoir 21 must handle during flood events, the proposed facility adversely alters drainage patterns.[43] As noted by Dr. Ross, the preliminary Reservoir 21 improvements design does not account for construction of the 202-acre landfill facility, but, instead assumes that all future development in the contributing watershed will **fully** mitigate storm runoff impacts.[44] The increased volume of floodwater from the landfill site is contrary to this assumption underlying the revised design of Reservoir 21.

Furthermore, the location of a high hazard dam in this case warrants a long-term view of the potential flooding impacts of the facility. Dr. Ross noted that stormwater management basins, including flood detention basins, require maintenance to function as designed.[45] Such maintenance includes repairing eroded berms, removing sediment, maintaining outfall clearance, and controlling vegetation to maintain berms.[46] But, at the 130 Environmental Park Facility, maintenance of the stormwater management basins is only required to extend for 30 years after landfill closure, which can be shortened with permission of the Executive Director.[47] Without maintenance, the detention basins cannot be relied upon to function as designed.[48] Given that the maintenance of the stormwater measures is merely temporary in comparison to the long-term presence of the landfill and the long-term presence of Reservoir 21, it cannot be said that the landfill will remain protective of the Reservoir.

The Facility Will Result in Adverse Flood Impacts

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[43] Protestants previously addressed the potential impact of the landfill on Reservoir 21 in Protestants Closing Arguments at pp. 18 – 24, in addressing the issue of Land Use. Those arguments are equally applicable to the question of whether the facility will adversely alter drainage patterns, and will not be repeated here.

[44] Ex. P-5, p. 40.

[45] Ex. P-5, p. 43.

[46] Ex. P-5, p. 43.

[47] Ex. P-5, p. 43.

[48] Ex. P-5, p. 43.

In addressing the floodplain issue, Applicant's Response mistakenly focuses on the narrow question of whether the landfill footprint will be located within the 100-year floodplain. This does not resolve whether the applicant has sufficiently addressed dangers created by the proximity of the landfill to the 100-year floodplain. As explained in Protestants' Response Brief, TCEQ rules require that potential flooding impacts be considered in several different ways, and the location of the waste footprint outside of the 100-year floodplain does not resolve these concerns.[49] Additionally, Dr. Ross observed that there is a better than 50-50 chance of a flood greater than the 100-year flood occurring during the operational life and post-closure period for the landfill.[50] At a site where flooding places a high-hazard dam at risk, focusing narrowly on the exact contours of the 100-year floodplain does not sufficiently protect human health and the environment.

Applicant further claims that all experts agree that the landfill footprint will be outside of floodplain.[51] This is incorrect. Tyson Traw himself admitted that upstream development could increase the extent of the floodplain in the future.[52] Bob Harden observed that the 100-year floodplain was likely to increase in the future as the result of upstream development.[53] Tracy Bratton likewise expressed concern that upstream development would expand the size of the 100-year floodplain.[54] And PCCD is likewise concerned about upstream development. The witnesses in this case did not concur that the waste footprint would be located outside of what will be the extent of the 100-year floodplain in the future.

Mr. Traw's Opinions Premised on his Undocumented Site Visits are Not Relevant and Reliable

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[49] Protestants' Response Brief, p. 51 – 55.

[50] Ex. P-5, p. 42.

[51] Applicant's Response to Closing Arguments, p. 66.

[52] Tr. V. 3, p. 694-698.

[53] Ex. P-9, p. 16-17.

[54] Tr. V. 8, p. 1812-1813.

Applicant attempts to justify Mr. Traw's characterization of certain areas as "shallow concentrated flow" based on a claim that the characterization of flow is best determined by field inspection.[55] The problem with this argument is that Mr. Traw made no documentation of how his field inspection related to his characterization of the runoff in the watershed. Mr. Traw made no field notes during his inspection of the site, took no photos during his inspection, and made no effort to document his observations made during his site visits.[56] Apparently, Mr. Traw is not accustomed to documenting his opinions:

> Q: I'm not just talking about taking notes; I'm talking about any documentation at any point of how your observations on the site visit related to and informed your assumptions on things such as the roughness coefficient.··Did you document that thought process in any way?
>
> A: I guess, you know, I don't -- I don't write down things that I think all the time. So I certainly don't, you know, document everything that I think when I -- when I go on a site visit.[57]

Instead of documenting his observations in any way, Mr. Traw testified that after walking the creeks, "I would take a mental picture of what that looks like." He simply said that he would take a "mental picture" of the area during his site visits.[58]

In a similar way, Applicant claims that Mr. Traw's opinion on Manning's roughness were accurate and appropriate based on "actual aerial photographs and walking stream channels during several site visits he made and the use of "Manning's N" tables." None of these justifies the Manning's roughness used by Mr. Traw. With regard to aerial photographs, Mr. Traw himself said that:

> For the floodplain, you can typically have a pretty good understanding of what the roughness might be from the aerial photo.··But that's not the case

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[55] Applicant's Response to Closing Arguments at p. 67.

[56] Tr. V.3, p. 713.

[57] Tr. V.3, p. 717:7-16.

[58] Tr. V.3, p. 716.

for the channel.··And that's because the cover often obscures the channel, like, for example, trees and that type of cover, such that you can't get a depiction of what that channel might look like.[59]··

Thus, by Traw's own admission his evaluation of aerial photgraphs cannot justify the Manning's roughness selected.

To the degree that Mr. Traw relies on his site visits in expressing an opinion on shallow concentrated flow, or Manning's n, his opinion is neither relevant nor reliable due to the lack of any documentation of his observations, and the relationship of those observations to his characterization of the channels.[60] There must be some basis for the expert opinion offered to show its reliability. The data underlying an expert's opinion should be "independently evaluated in determining if the opinion itself is reliable." *Merrell Dow Pharmaceuticals, Inc. v. Havner*, 953 S.W.2d 706, 713 (Tex. 1997); *accord Gammill v. Jack Williams Chevrolet, Inc.*, 972 S.W.2d 717, 728 (Tex. 1998). Evidence is to be excluded when "there is simply too great an analytical gap between the data and the opinion proffered." *Id.* (instructing courts not to ignore fatal gaps in an expert's analysis or assertions that are simply incorrect). It is the basis of an expert's opinion, and not the opinion itself, that holds probative value. *City of San Antonio v. Pollock*, 284 S.W.3d 809, 816 (Tex. 2009) (quoting *Coastal Transportation Co. v. Crown Central Petroleum Corp.*, 136 S.W.3d 227, 232 (Tex. 2004)). A mere conclusory opinion is not relevant evidence, because it fails to make the existence of a material fact more or less probable. *Id.* (quoting *Casualty Underwriters v. Rhone*, 132 S.W.2d 97, 99 (1939)). "If the foundational data underlying opinion testimony are unreliable, an expert will not be permitted to base an opinion on that data because any opinion drawn from that data is likewise unreliable." *Havner*, 953 S.W.2d at 713. Moreover, an expert opinion is unreliable "even when the underlying data are sound if the expert draws conclusions from

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[59] Tr. V.9, p. 2015.

[60] Notably, Mr. Traw's failure to document his observations during the site visits, and the relationship of his observations to his conclusions, poses a problem similar to that created by the failure of applicant's geologist, Mr. Snyder, to maintain documentation of his direct observation of material obtained from field investigations.

that data based on flawed methodology." *Id.* Where an expert's opinions are based upon unreliable underlying data they are inadmissible and, thus, no evidence at all. *Pollock*, 284 S.W.3d at 816. In this case, Mr. Traw has offered no underlying data regarding his site visits, and no documentation of how the information gleaned from those visits inform his assumptions as to manning's roughness, nor the appropriate lengths for shallow concentrated flow. Considering this absence, his conclusory opinions that his assumptions are justified by his field observations is neither relevant nor reliable.

The use of "Manning's n" tables does not independently justify the values used. The values derived from those tables depend upon the observations utilized as input for the tables. Mr. Traw did not document those observations in any way, rendering them unreliable, and an unreliable input cannot produce a reliable output.

Applicant's Response to Closing Arguments also relies on the TxDOT hydraulic design manual, which is not in evidence. TJFA and EPICC object to the consideration of this manual, as it is not in evidence.

In argument, applicant's attorney asserts that the TxDOT Hydraulic Design Manual[61] provides a "Manning's n" value of 0.50 to 0.80 for channels "described with words nearly identical to those used by Mr. Bratton."[62] No expert testified that the language used is equivalent, and Applicant's attorney is not qualified to offer the opinion on this comparison contained in Applicant's response brief. Quite simply, the words utilized in the design manual are not identical to those used by Mr. Bratton, but differ in important respects. TxDot allows the use of a value ranging from 0.50 to 0.80 for minor streams that are, "sluggish reaches, weedy, deep pools."[63] In his pre-filed testimony, Mr. Bratton notes that a Manning's Roughness of 0.45 "is an appropriate Manning's n for small natural streams that are winding, weedy, and include ineffective areas or areas of

[61] By a separate motion, Protestants move to strike arguments relying on the Design Manual and move to strike the Design Manual itself from Applicant's Response to Closing Arguments. In the event that this motion is denied, Protestants offer their reply, above, to Applicant's arguments that are based on this Design Manual.

[62] Applicant's Response to Closing Arguments, p. 67.

[63] TxDOT Manual at p. 4-43.

pooling."[64] The TxDOT Manual sets forth that a Manning's n of 0.040-0.050 is appropriate for "winding" minor streams with "some pools and shoals," "some weeds and stones," and "more ineffective." This language in the Manual, which is more similar to that used by Mr. Bratton, supports a characterization of the streams with a Manning's n of 0.045, rather than the 0.065 utilized by Mr. Traw. Of equal importance, Mr. Traw at no point documented how his observations during his site visits related to the characterization of the channels utilized in applying the TxDOT manual.

Applicant goes on to assert that the use of a lower roughness in accordance with Mr. Bratton's opinion, would result in not only higher peak flows but also less friction in the channels, which would "offset" each other.[65] Even if this were true for the impact of the Manning's coefficient's on the extent of the floodplain, such an "offset" does not alleviate concern regarding the underestimation of peak flows, which is itself a problem.

Dr. Ross is more than qualified to offer testimony regarding hydrology

In its Closing Arguments, Applicant attempts to attack the credentials of Dr. Ross. But any attempt to challenge Dr. Ross' qualifications is too late at this juncture. In any event, Dr. Ross not only possesses more than the requisite credentials to offer testimony regarding hydrology, but among the testifying witnesses, she is the only one who attended the PCCD meeting regarding proposed improvements to the Site 21 reservoir and dam and has reviewed and analyzed them extensively, unlike any of Applicant's consultants.

Dr. Ross has a Bachelor of Science, Master of Science, and Doctor of Philosophy degrees in civil engineering, each with an emphasis in water resources engineering. Completion of each degree included multiple courses in surface water and drainage analysis, floodplain analysis, hydrologic and hydraulic modeling. Dr. Ross has also completed additional training and short courses in hydrologic and hydraulic modeling

[64] Ex. Caldwell-1, p. 13.

[65] Applicant's Response to Closing Arguments, p. 67-68.

using the US Army Corps of Engineer Hydrologic Engineering Center (HEC) simulation tools.

Applicant also criticizes Dr. Ross' testimony regarding Tyson Traw's failure to account for storage capacity of existing features in his hydrologic modeling. Applicant argues that Dr. Ross "does not realize it, but the analyses done by Tyson Traw did include modeling significant areas as 'water'." But Applicant misses the point here.

Dr. Ross' critique is that there is no indication that available water storage capacity of existing wetland and pond features on the site hast been accounted for in the hydrologic modeling. Representation of these features as "water" fails to account for their water storage capacity.

Next, Applicant criticizes Dr. Ross' reliance on FEMA policies, arguing that "what Dr. Ross described as FEMA 'standard policy' applies only to FEMA staff and FEMA contractors doing work on FEMA flood maps, not to work done for TCEQ MSW permit applications." Here, again, Applicant gets it wrong.

The purpose of FEMA Standards for Flood Risk Analysis and Mapping is to establish *"consistent, fair, and equitable"* standards in the performance of flood hazard mapping and to *"enhance the credibility of the NFIP and **all** flood risk mapping efforts"* (emphasis added). While the policy is directly applicable to Federal Emergency Management Agency staff, the policy document also states: *"this policy may be pertinent to states, tribes, communities, homeowners and their consultants who are interested in the flood insurance rate map process."* Because the Texas Commission on Environmental Quality has an interest in consistent, fair, credible and equitable flood plain delineations, the policy would be directly applicable to their deliberations regarding the reliability of the applicant's floodplain modeling.

In short, Applicant's attempt to discredit Dr. Ross is misguided, and fails.

Conclusion & Prayer

Because Applicant has failed to demonstrate compliance with a number of TCEQ requirements, Protestants urge the ALJs to issue a Proposal for Decision, recommending denial of the permit application. In the alternative, if the ALJs determine that issuance of

a permit is warranted, then, Protestants urge the ALJs to recommend including the special provisions described above.

Respectfully submitted,

Marisa Perales
State Bar No: 24002750
Brad Rockwell
State Bar No: 17129600
Eric Allmon
State Bar No: 24031819

FREDERICK, PERALES, ALLMON & ROCKWELL, P.C.
707 Rio Grande, Suite 200
Austin, Texas 78701
Phone: (512) 469-6000
Facsimile: (512) 482-9346

COUNSEL FOR TJFA & EPICC

CERTIFICATE OF SERVICE

By my signature, below, I hereby certify that a true and correct copy of the foregoing document has been served on the following attorneys of record by electronic mail, facsimile, or US Mail on this 22nd day of December, 2016.

Marisa Perales

FOR 130 ENVIRONMENTAL PARK, LLC
Brent W. Ryan
bryan@msmtx.com
MCELROY, SULLIVAN, MILLER, WEBER & OLMSTEAD, LLP
P.O. Box 12127
Austin, TX 78711
Fax: 512.327.6566

FOR TCEQ EXECUTIVE DIRECTOR
Anthony Tatu
anthony.tatu@tceq.texas.gov
Kayla Murray
Kayla.Murray@tceq.state.tx.us
Aaron Vargas
Aaron.Vargas@tceq.texas.gov
Environmental Law Division, MC-173
P.O. Box 13087
Austin, Texas 78711-3087
Fax: 512.239.0606

FOR TCEQ PUBLIC INTEREST COUNSEL
Aaron Tucker
aaron.tucker@tceq.texas.gov
Office of Public Interest Counsel, MC-103
TCEQ
P.O. Box 13087
Austin, Texas 78711-3087
Fax: 512.239.6377

FOR CALDWELL COUNTY
Eric Magee
e.magee@allison-bass.com
ALLISON, BASS & MAGEE, LLP
402 W. 12th St
Austin, Texas 78701
Fax: 512.480.0902

FOR PLUM CREEK CONSERVATION DISTRICT
Bob Wilson
bwilson@jacksonsjoberg.com
JACKSON, SJOBERG, MCCARTHY & TOWNSEND, LLP
711 West 7th Street
Austin, Texas 78701
Fax: 512.225.5565

Ben Pesl
PO Box 242
Dale, TX 78616

VIA US MAIL

Attachment A

Sections Taken From Lauren Ross' Prefiled Testimony and Hearing Transcript Supporting Protestants' Claims Regarding Reservoir 21 and the Dam

Prefiled Testimony:

Sections Specifically Cited in Protestants' Reply Brief:

10. Ex. P-5, p. 40.

Q: Do you have concerns regarding whether proposed improvements for Floodwater Retarding Structure No. 21 are consistent with findings in the Dam Assessment Report?

A: Yes. Information presented in the public hearing on February 3, 2016 failed to address whether proposed improvements for Floodwater Retarding Structure No.21 would achieve the design standards required for high-hazard dams. Specifically, there is no information documenting storage of the 100-year, 10-day storm without flow through the auxiliary spillway, drawdown of at least 85% of the temporary storage capacity within 10 days, or capacity to pass runoff from the Probable Maximum Precipitation storm without overtopping, as recommended in the dam assessment report. The preliminary Floodwater Retarding Structure No. 21 improvements design fails to account for construction of the proposed 202-acre 130 Environmental Park LLC Landfill and supporting facilities within this structure's contributing watershed. The Floodwater Retarding Structure No. 21 improvement design assumes that future development in the contributing watershed, including the proposed 130 Environmental Park LLC landfill will fully mitigate storm runoff impacts. This assumption, however, fails to address downstream flood protection 2 for several reasons.

16. Ex. P-5, p. 42.

Q: Please explain why, in your opinion, this assumption fails to address downstream flood protection.

A: Existing soils at the proposed landfill site are primarily Wilson gravelly loam, with 1 to 5 percent slopes. The Natural Resource Conservation Service Web Soil Survey describes their saturated hydraulic conductivity rating as 8 x 10-5 centimeters per second. The available water capacity for these soils is 0.13 centimeters per centimeter, and the available water storage is 19 centimeters in the soil profile from 0 to 150 centimeters. By contrast, the proposed final cover system for the landfill will include a flexible membrane cover. This flexible membrane layer, consisting of 40-mil thick linear low-density polyethylene, would limit infiltration into the proposed landfill subsurface, compared to existing conditions, and limit the available water capacity of the final landfill cover. Both of these factors would increase storm runoff volume from the site compared to current conditions.
The proposed landfill design includes a perimeter drainage system designed to convey runoff from the 25-year and 100-year rainfall events. Detention ponds are proposed to provide storage to mitigate landfill impacts on downstream receiving
channels. The landfill design, however, fails to account for the following factors:

- Final cover drainage swales and chutes are designed to convey the 25-year, 24-hour peak flow rates. These peak flow rates, however, fail to account for decreases in times of concentration over the landfill surface that will change the timing of runoff in Floodwater Retarding structure No. 21 reservoir.
- Protestants' Exhibit 5-Y shows that detention ponds and drainage structures are proposed to be located either close or immediately adjacent to the FEMA-mapped 100-year floodplain. Given the limitations of both floodplain mapping, and of the 100-year flood design standard, there is a significant probability of flood encroachment of the proposed drainage facilities over the 44-year projected facility life and the 30-year post closure period. The probability of a flood equal to or greater than the 100- year flood during the projected 44-year landfill operational life is 36 percent. The probability of a flood equal to or greater than the 100-year flood during the projected landfill operational life plus 30-year post-closure period is 52 percent. In other words, there is a better than 50-50 chance of a flood greater than the 100-year flood, with

more extensive inundation and erosion during the landfill operational life and post-closure period. A landfill storm runoff retention berm failure during flood conditions would further exacerbate flooding downstream.

- Hydraulic modeling for the proposed landfill was accomplished based on a downstream boundary condition resulting from a maximum water surface elevation in Reservoir No. 21 of 518.9 feet. There is no analysis, however, of the effect of raising the dam top from 4.0 feet to 526.5 feet, or constructing a new auxiliary spillway with a crest elevation of 517.4 feet on the hydraulic modeling. These changes may result in higher upstream elevations and increased risk of landfill drainage structure erosion and/or inundation.
- Protestants' Exhibit 5-Z: Comparison of Detention Pond Berm Elevations and 100-Year Water Elevations compares applicant's calculated maximum water surface elevation and perimeter berm elevation to the 100-year water elevation in adjacent streams. Elevation differences of more than 13 feet are predicted where segments of the floodplain and pond berm boundaries are virtually collinear (see Ponds 1 and 2, for example).Differences of this magnitude indicated that it may not be possible to construct berms for the proposed detention ponds without incursions into the 100-year flood plain. These incursions will reduce flood storage behind Floodwater Retarding Structure No. 21.

11. Ex. P-5, p. 43. & 12. Ex. P-5, p. 43. & 13. Ex. P-5, p. 43. & 14. Ex. P-5, p. 43

Q: Do you have concerns regarding the reliability of the proposed landfill detention ponds?

A: Yes. Flood storage capacity within the proposed landfill detention ponds must be maintained to achieve no increase in peak runoff from the proposed landfill. There are factors, however, that limit indefinite maintenance of the proposed flood storage capacity. Stormwater management basins, including flood detention basins require regular maintenance to function as designed. This maintenance includes repairing eroded berms, removing sediment, maintaining outfall clearance, and controlling vegetation to maintain berms. After the landfill is closed, however, the landfill operator would only be obliged to maintain the proposed landfill site and structures for 30 years. Furthermore, the post-closure care period may be shortened by the TCEQ if 130 Environmental Park LLC, submits the required certification with supporting documents, signed by an independent registered professional engineer. Without maintenance, the detention basins are unreliable for continuing to function as designed. Further, existing water availability for the proposed landfill operations is limited. To the extent that proposed detention storage would be used to store water and supplement the available water supply, the flood mitigation capacity of the proposed ponds would be impaired.

Sections Supporting Claims Made in the Reply Brief:

Ex. P-5, p. 8

Q: Please summarize your opinions briefly.

A: In my opinion, the 130 Environmental Park LLC landfill permit application is based on information that fails to achieve minimum professional standards for reliability and quality control. The permit application fails to adequately characterize subsurface conditions and the potential risk of landfill leachate migration and groundwater contamination from the proposed facility. The facility would be located within the contributing watershed of Floodwater Storage Reservoir No. 21, which is under-designed for its current high-hazard rating. Furthermore, parts of the proposed landfill storm runoff management, leachate storage system and road access are proposed to be located near and/or partly within the currently effective FEMA 100-year floodplain. Uncertainties regarding floodplain modeling indicate a likely risk of inundation of parts of the landfill facility during the operational, closure, and post-closure life of the proposed landfill. These opinions and their basis is presented in the testimony below.

Ex. P-5, p.22

Q: Other than the published sources you cited, did you encounter other inconsistencies regarding the description of the surface geology in the application?

A: Yes. The permit application description of surface strata as containing ***"only remnant pebbles and cobbles"*** is contradicted by other local observations. One such observation is documented in Protestants' Exhibit 5-J: Plum Creek Reservoir 21 Plan and Profile Sheets 1 through 3. This document presents boring logs in cross-sections for the Plum Creek Conservation District Reservoir No. 21 dam, located within the proposed landfill property boundary and slightly more than 1,000 yards south of the facility boundary. I have colored this exhibit to highlight intervals of clayey sand and intervals of clayey gravel. Cross-sections constructed from the borings on Protestants' Exhibit 5-J demonstrate that these intervals can be correlated among borings, indicating the presence of continuous strata.

Ex. P-5, p-38-40

Q: Where is the proposed 130 Environmental Park LLC landfill facility located in Caldwell County with respect to surface hydrology?

A: The proposed 130 Environmental Park LLC is located within the watershed of Dry Creek and an unnamed tributary to Dry Creek. It is proposed to be located upstream of the Plum Creek Floodwater Retarding Structure No. 21.

Q: Please describe the Plum Creek Floodwater Retarding Structure No. 21.

A: Plum Creek Floodwater Retarding Structure No. 21 was constructed in 1962 on Dry Creek, a tributary to Plum Creek, and five miles north of Lockhart, Texas. The dam is a homogeneous earthfill structure, 2,982 feet long and a maximum of 30 feet high. Front and back slopes are 2.5 horizontal to 1 vertical. Floodwater Retarding Structure No. 21 was constructed to provide flood control for storm runoff from the 5,075-acre upstream watershed. The original evaluated project life was 50 years. The dam was designed to temporarily store runoff from a 25-year frequency rainfall, or 5.45 inches of runoff from the contributing watershed, without flow through the earthen auxiliary spillway. This standard was based on Class A, low hazard conditions wherein a dam break would affect downstream agricultural land and facilities but not result in potential loss of life. The Dam Assessment Report, however, reclassified the dam as high hazard due to downstream urban development in the intervening years. The Texas Commission on Environmental Quality Simplified Breach Method predicted a 21-foot catastrophic flood breach wave with a maximum discharge of 54,660 cubic feet per second. Such a breach would place at risk 26 downstream houses, three Farm-to-Market roads and three county roads used by more than 6,000 vehicles daily.Based on Floodwater Retarding Structure No. 21's reclassification as a high hazard dam, the appropriate design standard would be temporary storage of the 100-year, 10-day storm without flow through the earthen auxiliary spillway, with (Protestants' Exhibit 5, p. 39) a drawdown of at least 85% of the temporary storage within 10 days, and capacity to the pass runoff from the Probable Maximum Precipitation (PMP) storm without overtopping. The current dam does not meet these high-hazard standards. Therefore the failure potential for this structure due to deficient hydrologic capacity is ***"judged to be high."*** Furthermore, a dam inspection by M&E Consultants (for Natural Resources Conservation Service) and a representative of the Plum Creek Conservation District on November 3, 2009 found that grass cover on the dam and auxiliary spillway was poor due to drought and grazing. Poor vegetation cover due to drought and grazing increases the risk of soil erosion and further contributes to the failure potential of this dam, beyond its deficient hydrologic capacity.

Q: Do you have information about what it would take to rehabilitate the Floodwater Retarding Structure No. 21?

A: Yes. Based on information presented in a public hearing that I attended on February 3, 2016 hosted by the Plum Creek Conservation District, rehabilitation of Floodwater Retarding Structure No. 21 would consist of the following elements:

a. Removing the existing principal spillway inlet and constructing a new principal spillway inlet tower and 42-inch discharge conduit. The principal spillway crest would be lowered approximately 5.94 feet to an elevation 500.0.

b. The dam would be lengthened by 400 feet to the east to close off the existing auxiliary spillway. A new, 300-foot wide reinforced concrete auxiliary spillway with a crest elevation of 517.4 feet would be constructed.
c. The top of the dam would be raised approximately 4.0 feet to elevation 526.5 feet.
d. New rock riprap wave protection would be provided (presumably on the upstream dam face).(Protestants' Exhibit 5, p. 40)
e. Upstream and downstream embankment slopes would be flattened to slopes of 3 horizontal to 1 vertical. The proposed improvements would provide a safer dam by beginning water evacuation behind the dam more quickly; and by providing a dam and spillway structure more resistant to failure through seepage, over-topping, and/or slope instability. The proposed flatter slopes would reduce the slope instability potential and allow increased rainfall infiltration and more robust vegetation during drought conditions. The proposed dam improvements are projected to cost $6,285,600. The Natural Resources Conservation Service (NRCS) share of the total cost would be $4,360,400. Local sponsors would be required to contribute $1,925,200. Whether federal agencies would participate in the project's cost share beyond its original project life is questionable, as is the availability of funds from local sponsors.

Ex. P-5, p. 43-44

Q: Do you have any concerns regarding the potential impacts from erosion and sedimentation?

A: Yes. Vegetation clearing and regrading associated with construction and operation of the proposed landfill and associated drainage system and detention ponds will result in erosion. The landfill application is vague and noncommittal regarding which specific construction-phase erosion and sedimentation controls would be implemented. Furthermore, the application's erosion calculations fail to account for portions of the landfill cover that will be occupied by drainage berms that are steeper than the assumed four horizontal to one vertical slopes in the erosion calculations. Proposed Floodwater Retarding Structure No. 21 improvements fail to account for increases in flood flows associated with sedimentation into either the proposed landfill drainage system or into Floodwater Retarding Structure No. 21 flood pool. (Protestants' Exhibit 5, p. 44)

Q: Do you have an opinion about the potential consequences if the proposed improvements to the Floodwater Retarding Structure No. 21 are not completed?

A: Yes. The proposed landfill storm runoff management system is not designed to control runoff for the Probable Maximum Precipitation event, which is the design storm event for a high-hazard dam. Adequate design of Floodwater Retarding Structure No. 21 improvements to meet this standard must consider, therefore, the hydrologic impacts of the proposed landfill during these design conditions. If the proposed improvements to Floodwater Retarding Structure No. 21 are not funded and completed, the proposed landfill will increase the risk of downstream flooding because:

- The current Floodwater Retarding Structure No. 21 design has not been shown to mitigate increased runoff during the Probable Maximum Precipitation event;
- Construction of the proposed landfill runoff management and drainage facilities will likely encroach into the existing 100-year flood plain;
- There is an increased risk of storm runoff drainage system failure compared to flood mitigation provided by the existing natural landscape;
- Landfill construction is likely to result in increased sediment in the Floodwater Retarding Structure No. 21 reservoir; and
- The maintenance period for the landfill storm water management system is limited to 30 years and, with TCEQ approval, could be even shorter.

Ex. P-5, p. 46-47

Q: Is there a requirement to account for storage in determining existing site runoff?

A: Yes. Existing storm runoff storage on the proposed landfill site affects discharge. The proposed landfill will alter the hydrologic characteristics of its footprint. Based on the landfill application, there are currently eight open-water stock ponds or natural water features on the site. Altogether they occupy more than 20 acres. There are additionally 46 emergent wetlands that have been identified onsite. Both the open-water and wetland features provide existing upstream and supplemental flood storage within the Floodwater Retarding Structure No. 21 (Protestants' Exhibit 5, p. 47) contributing watershed. This storage would be eliminated by the proposed regular landfill contours, graded to efficiently drain water from its surface. Even though wetland features were deemed isolated by the Applicant and not regulated as waters of the United States, they still have a significant hydrologic storage impact on downstream flows. The Federal Emergency Management Agency has established program standards for flood risk analysis and mapping activities in adherence to National Flood Insurance Program requirements. Those standards have been published as a FEMA policy and are included here as (Protestants' Exhibit 5-AF): Federal Insurance and Mitigation Administration Policy. Standard SID # 81 on page 16, effective as of November 1, 2009 requires ineffective and non-conveyance areas must be designated to reflect the actual conditions (such as topography and surface roughness) as closely as practical. The site stock ponds, water features and emergent wetland would constitute such ineffective and non-conveyance areas.

Q: Has the applicant considered the existing ponds and wetlands on the site in performing their hydrologic analysis?

A: Not that I can tell.

Hearing Transcript pg.1345-1427

Sections Supporting Claims Made in the Reply Brief:

Tr. V.6, p. 1365

Q: Okay.
A: Mr. Magee, can I go back and -- I also meant to say an answer to a previous question that another reason why they're important is because they are upstream of the reservoir No. 21, and so sediment into that reservoir will decrease its flood capacity.
Q: So when I asked why was this important to have such plans, you'd like to amend that answer and include that?
A: Right.

Tr. V.6, p. 1413

Q: And, Dr. Ross, your submission of comments and Mr. Irvin's response to those comments, was that a part of the NRCS process of evaluating options for the Site 21 dam and reservoir?
A: Yes.
Q: And isn't it true that among the options that were identified were a no action option where they wouldn't do anything at all?
A: I think that's right, yeah.
Q: And another option -- there were either one or two versions of this, as I recall -- would have been control breach and removal of the dam?
A: That sounds right.
Q: Okay. And yet another option that was under consideration was rehabilitation work and some level of rebuilding of the dam?
A: Yes.
Q: Okay. And in connection with NRCS's process for public comment, you submitted these comments, and Mr. Irvin sent you this response?
A: That's right.

Sections Taken From Bob Harden's Prefiled Testimony Supporting Protestants' Claims Regarding Reservoir 21 and the Dam

Ex. P-9, p. 8

Q: What role do the peak flow rates and runoff volumes play in the drainage analysis for a Landfill?
A: To answer this, it is first important to understand that a Landfill Facility inherently alters the existing land surface topography, vegetation, and possibly surface soils.
These changes have the potential to alter the way rainfall runs off the landscape from the native, baseline conditions to the post-developed Landfill condition. The ways that water runoff can be altered include changes in peak flow rate or total volume of runoff. Peak flow rates are a concern for flooding and erosion. If the Landfill Facility increases the peak flow rate in downstream, receiving streams then adverse flooding or erosion of soil can occur. If a Landfill Facility increases the total volume of runoff, then a pond or reservoir that is designed to capture a certain volume of runoff can be put at risk because the increased volume can cause water to rise above the reservoir dam and increase the chance the dam will fail. If the dam fails, then catastrophic type losses can ensue.

Ex. P-9, p.21-23

Q: Is there an existing reservoir at the Landfill site?

A: Yes. If you look at the southern area of the Landfill property boundary shown on Exhibit 9-E, you will see that the Soil Conservation Service Site 21 Reservoir is located downstream of the Landfill site. This reservoir was originally constructed and classified as a NRCS low hazard dam. Recently, NRCS has now classified the reservoir as a high hazard dam due to additional home construction and human presence downstream of the reservoir. With this added hazard classification, the reservoir requires greater safety restrictions to protect human health and welfare.

Q: In your opinion, is there a potential for the Landfill to impact this reservoir?

A: Yes. The Landfill, as designed, will increase rainfall-runoff downstream of the Facility in a manner that contradicts the design standards of that reservoir.

Q: In your opinion, how does the potential impact of the Landfill on this reservoir constitute a hazard to human health and welfare?

A: Due to changes in land cover of the Facility, the total runoff volume increases. The storm water ponds are not designed to retain this volume increase in runoff. The increased runoff from the Landfill will potentially cause the floodwaters stored in the reservoir to more frequently flow over the top of the dam, and also increase the time it takes to drain the floodwater to be ready for a new flood event. Each of these issues is a specific design standard for the reservoir. So, the increased runoff from the Landfill Facility increases the chance of a dam breach and dam failure with subsequent potential loss of human life downstream of the reservoir. In my opinion, the lack of retaining runoff volumes does not comply with TAC §330.63(c)(1)(D)(iii) which requires an analysis to demonstrate that existing drainage patterns will not be adversely altered as a result of the proposed Landfill development.

Q: Does the application address the Landfill effects on the design standards of Reservoir 21?

A: No, the application contains no discussion or analysis that addresses this concern.

Ex. P-9, p.25-26

But, what is far more important in hydrologic design and Facility siting is to consider the potential for unknown events, changed conditions in the future, the hazard potential, and inherent variability in hydrology to arrive at a hydrologic design that provides a suitable level of protection for safeguarding the health, welfare, property, and the environment. Often, it is best to design for "what could go wrong" rather than trying to "exactly calculate" a hydrologic model to fit regulatory requirements. In this case, there are several natural conditions present that give rise to greater concerns. These include:

(1) just downstream, the presence of Plum Creek Reservoir 21 and the associated and documented safety concerns of this reservoir,

(2) The greater rainfall runoff volumes from the Facility that do not comply with the design standards of the reservoir and increase the chance of dam failure.

(3) The large extent of the Facility boundary adjacent to the existing floodplain,

(4) the inevitability of the floodplain to expand over time with greater degrees of urbanization,

(5) Landfill site access is limited to only one road that would be at risk in a large future flood event and associated safety concerns for emergency personnel accessibility to the site,

(6) the close proximity of drainages located downhill of the Landfill, and

(7) the potential for pollution into these drainages to occur and be unmonitored by the groundwater monitoring system.

In this case, the site selection and engineering design should consider the natural conditions present to the degree necessary to provide adequate levels of protection for the associated hazard conditions. A Landfill that is "perched" above directly adjacent creeks and a floodplain is located on a peninsula during large flood events. In addition, a major reservoir with safety concerns is located immediately downstream.

Sections Taken From Tracy Bratton's Deposition Supporting Protestants' Claims Regarding Reservoir 21 and the Dam

Bratton Dep. 85-92

Q: In your opinion, how does proximity to a floodplain impact the ability to safely construct and operate a landfill?

A: I believe that, as an engineer, we have responsibility to look at complete systems and not just individual pieces to make sure that they work together. And also to look at and consider what are the effects of a condition that exceeds what our minimum required design standard is.

And in relation to the specific application, the location of -- the construction of the landfill with 4 to 1 and 2 to 1 slopes immediately adjacent to a floodplain and immediately upstream of an existing reservoir creates a situation in which a failure of, as an example, one of the diversion berms on the face of the landfill, could cause a failure of the landfill face, could overwhelm a detention pond, cause the detention pond to fail, that then all flowing into the reservoir potentially causing it to fail; it's the stacking of things immediately adjacent to each other that I believe we have a responsibility to look at in context and see what the results are, even if the individual components do meet the minimum standard for each one of them.

Q: Let me see if I understand this. Is it your opinion that the failure of one of the side slope diversion berms on the landfill could result in the failure of the dam associated with Reservoir 21?

A: Through a chain of events, yes.

Q: In your opinion, would the failure of a diversion berm on the landfill slope -- if a berm – if a diversion berm on a landfill slope failed, do you believe that would likely lead to a failure of the dam?

A: If the failure of the diversion berm occurred during a 100-year or 500-year storm event or a probable maximum flood, it is my opinion that it could cause breaches of the detention ponds, and those failures and the subsequent wave of water and surface soils entering into the reservoir, which would at that time be at its maximum capacity, could indeed induce a failure of the dam.

Q: Okay. So let me ask my question again.

A: Uh-huh.

Q: Is it your opinion that the failure of a diversion berm during a 100-year or greater storm event would be likely to result in a failure of the dam?

A: All I can say is could. The word "likely" is subjective, and I'm not sure if that means I think there's a 90 percent likelihood or a 50-50 or –

Q: You'll stick with could, which means that you believe it's possible?

A: Yes.

Q: Okay. Do you also believe it's possible that the failure of a diversion berm during a 100-year or greater storm event would not lead to a failure of the dam?

A: It is possible.

Q: Do you believe that either of those two conditions would be more likely to occur than the other?

A: In order to say -- I would begin to want to talk about which diversion berm and where it's located.

Is it a diversion berm up near the top, furthest away from one of the detention ponds which would potentially cause the greatest amount of soil loss as it eroded its way to the next diversion berm and overwhelmed it and went to the next and the next and then run into the detention pond, or is it the bottom diversion berm? That would all contribute to how likely it is to fail the detention pond.

Q: Okay. Well, considering whatever scenario -- whatever diversion berm failure you think would represent the worst case.

A: Okay.

Q: If that diversion berm, whichever one it is, wherever it's located, were to fail, do you think it is more likely that that would result in a failure of the dam or more likely that that would not result in the failure of the dam?

A: I wish I had the dam plans in front of me to review what the auxiliary spillway looks like.

Q: Let's see.

A: Do you have those?

Q: Well –

A: No, what I'm interested in is the elevation of the dam versus the elevation of a 500-year flow over the auxiliary spillway.

Q: Okay. So the condition that would be of concern to you would be a 500-year storm event?

A: I -- not necessarily. It's just as a benchmark, I was curious to see where the elevation of the top of the dam is versus the elevation of flows through the spillway, and does a sudden introduction of large quantities of water potentially push it in the spillway up to the point that it is near the height of the dam. That information is not contained on there. It would be –

Q: Well, there's information about the elevation of the dam and the elevation of the spillway.

A: Yes.

Q: So what's missing?

A: The water surface elevation through the spillway for a hundred-year, 500-year, a PMF event.

Q: Well, do you recall that the 100-year water surface elevation, as it was modeled, is Elevation 519?

A: I do not recall that, but if you represent that, I will accept that.

Q: Okay. Well, let's say -- assume with me if you will –

A: Uh-huh.

Q: --that that is the hundred-year flood water surface elevation.

Q: Uh-huh.
Q: And I think you can tell from looking at Exhibit -- what is that? -- 4 there, that the elevation of the emergency spillway around the dam at the top of that is somewhere around 517?

A: Okay.

Q: And the top of the dam somewhere in the 520s? Does it look like what that shows?

A: If -- I do see a 520 there, okay.

Q: All right.

A: So that is to say, based upon the numbers as I understood you to say them, is the hundred-year water surface elevation is 519 –

Q: Yes.

A: --and the top of the dam is 520?

Q: Somewhere in the 520s.

A: I would be very concerned about the failure of the dam with the introduction of any sudden slug of water to it, because there's only 1 foot of elevation difference between the water surface in the spillway and the top of the dam based upon those numbers.

Q: Okay. But you haven't evaluated that?

A: No.

Q: So would it be your recommendation -- how far from a dam like the one at Site 21 do you think development should be allowed to occur? You think there should be a limit on development within a certain distance from a dam like that?

A: No, I do not have a distance away from the dam that I think development should occur. It is more a proximity of detention facilities immediately adjacent to the reservoir that a flood wave from the failure of this would introduce itself suddenly into the dam. So if you were to do, as an example, development here where you're proposing –

Q: Uh-huh.

A: --and instead of having your detention right here immediately adjacent to the reservoir, you're to instead, so that you have the same resulting flows entering the reservoir, do a detention somewhere upstream where in the case of a dam failure, the flood wave would be greatly attenuated by the time it got to the reservoir, you could accomplish the same thing without the risk of your pond being immediately adjacent to the reservoir, and that flood wave is entering the reservoir immediately. The flood wave dissipates over distance.

Q: So you're suggesting that you could mitigate the potential effects that you're describing by locating your detention storage further upstream?

A: Yes. Some -- in fact, from an engineering perspective, it's often more efficient you end up with a smaller flood detention volume requirement if you detain your upstream flows and let your site flows go rather than detaining your site flows. Because of the differences in peak timing, you can often get a much more efficient detention design that way.

Q: Okay. Isn't it true that the scenarios that you've been describing, that you believe could result in overtopping or breach or failure of the dam, would all be related to a catastrophic failure of the stormwater management and detention systems at the landfill?

A: Yes.

Bratton Dep. 92-93

Q: Mr. Bratton, have you ever done a dam breach analysis?

A: I have not performed the calculations. I've been responsible charge for several.

Q: What does that -- what does "responsible charge" mean?

A: Means that I was supervising the engineers who conducted the dam breach analysis. And I was responsible for overall responsibility of the project of which the dam breach analysis was one component.

Q: Okay. And what projects have you done that for?

A: Okay. There are three dam breach analyses that I have been a responsible charge or principal in charge for in Burnet County, three in Hays County. I have been a first responder on the scene of two dam breaches in Bastrop County that involved us conducting a simplified dam breach analysis to determine homes to evacuate while the breach was in progress. Those are the ones I recall at this time.

Q: Okay. Do you know if there's a requirement in Texas for professionals who review plats for governmental entities to be licensed surveyors?

A: No.

Q: Okay. Are you a licensed surveyor?

A: I am not.

Q: Okay.

A: I do have RPLSs in my office who participate in the reviews of our plats and provide me comments related to certain aspects of the review.

Q: Okay. Other than the TCEQ rules that you've previously testified about today, are there other TCEQ rules that you believe have not been adequately addressed by the information in the 130 Environmental Park Landfill permit application?

A: No.

Bratton Dep. 95-96

Q: And where does the drainage from the 130 EP, where does all of it go? Does it all -- my question is: Does it all go into the basin behind Site 21 of Plum Creek?

A: Yes. A hundred percent of the runoff from the proposed 130 Environmental Park Landfill will end up in Reservoir 21. If you begin to include parts of their proposed entry road, portions of that end up in a tributary that is downstream of the Site 21 reservoir.

Q: Thank you.

Now, of course, the entire drainage area for -- that contributes to the water going into Site 21 is much larger than the Environmental Park 130. Right?

A: Yes, it is.

Q: Okay. Do you know whether a study is underway to evaluate potential improvements of the dam at Site 21 in light of its change from a low hazard to a high hazard classification?

A: It is my belief that there is, but that's been by word of mouth as part of these processes, and I have no direct knowledge of that.

Q: Okay. My question is: Should that evaluation wait until we know about the details of this permit and the design of it to see what upgrades might have to be made?

A: It depends, and I don't know the legal structure of the easement versus the ownership of the property. If -- it would be my opinion, if I was doing it, I would determine what the required upgrades are and what the dam can handle, and that ought to be a criteria in whether this landfill -- or landfill is appropriate and the improvements that are proposed are appropriate for this location rather than get the landfill done and hope that you could modify the dam in such a way that accommodates the changes resulting from the landfill.

Q: My question was really coming at it the other way. Under the assumption that a permit of something will be granted and final plans developed and a landfill installed, does -- do those changes have the potential to impact what might be done to upgrade the dam at Site 21?

A: Those changes do have the potential impact, the required dam upgrades, yes.

Attachment B

Designation: D2488 – 09a

Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)[1]

This standard is issued under the fixed designation D2488; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 This practice covers procedures for the description of soils for engineering purposes.

1.2 This practice also describes a procedure for identifying soils, at the option of the user, based on the classification system described in Test Method D2487. The identification is based on visual examination and manual tests. It must be clearly stated in reporting an identification that it is based on visual-manual procedures.

1.2.1 When precise classification of soils for engineering purposes is required, the procedures prescribed in Test Method D2487 shall be used.

1.2.2 In this practice, the identification portion assigning a group symbol and name is limited to soil particles smaller than 3 in. (75 mm).

1.2.3 The identification portion of this practice is limited to naturally occurring soils (either intact or disturbed).

NOTE 1—This practice may be used as a descriptive system applied to such materials as shale, claystone, shells, crushed rock, etc. (see Appendix X2).

1.3 The descriptive information in this practice may be used with other soil classification systems or for materials other than naturally occurring soils.

1.4 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.5 *This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* For specific precautionary statements see Section 8.

1.6 *This practice offers a set of instructions for performing one or more specific operations. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this practice may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word "Standard" in the title of this document means only that the document has been approved through the ASTM consensus process.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D653 Terminology Relating to Soil, Rock, and Contained Fluids

D1452 Practice for Soil Exploration and Sampling by Auger Borings

D1586 Test Method for Penetration Test (SPT) and Split-Barrel Sampling of Soils

D1587 Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes

D2113 Practice for Rock Core Drilling and Sampling of Rock for Site Investigation

D2487 Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

D3740 Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

D4083 Practice for Description of Frozen Soils (Visual-Manual Procedure)

3. Terminology

3.1 *Definitions:*

3.1.1 Except as listed below, all definitions are in accordance with Terminology D653.

[1] This practice is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.07 on Identification and Classification of Soils.

Current edition approved June 15, 2009. Published July 2009. Originally approved in 1966. Last previous edition approved in 2009 as D2488 – 09. DOI: 10.1520/D2488-09A.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

***A Summary of Changes section appears at the end of this standard**

NOTE 2—For particles retained on a 3-in. (75-mm) US standard sieve, the following definitions are suggested:
Cobbles—particles of rock that will pass a 12-in. (300-mm) square opening and be retained on a 3-in. (75-mm) sieve, and
Boulders—particles of rock that will not pass a 12-in. (300-mm) square opening.

3.1.2 *clay*—soil passing a No. 200 (75-µm) sieve that can be made to exhibit plasticity (putty-like properties) within a range of water contents, and that exhibits considerable strength when air-dry. For classification, a clay is a fine-grained soil, or the fine-grained portion of a soil, with a plasticity index equal to or greater than 4, and the plot of plasticity index versus liquid limit falls on or above the "A" line (see Fig. 3 of Test Method D2487).

3.1.3 *gravel*—particles of rock that will pass a 3-in. (75-mm) sieve and be retained on a No. 4 (4.75-mm) sieve with the following subdivisions:

coarse—passes a 3-in. (75-mm) sieve and is retained on a ¾-in. (19-mm) sieve.

fine—passes a ¾-in. (19-mm) sieve and is retained on a No. 4 (4.75-mm) sieve.

3.1.4 *organic clay*—a clay with sufficient organic content to influence the soil properties. For classification, an organic clay is a soil that would be classified as a clay, except that its liquid limit value after oven drying is less than 75 % of its liquid limit value before oven drying.

3.1.5 *organic silt*—a silt with sufficient organic content to influence the soil properties. For classification, an organic silt is a soil that would be classified as a silt except that its liquid limit value after oven drying is less than 75 % of its liquid limit value before oven drying.

3.1.6 *peat*—a soil composed primarily of vegetable tissue in various stages of decomposition usually with an organic odor, a dark brown to black color, a spongy consistency, and a texture ranging from fibrous to amorphous.

3.1.7 *sand*—particles of rock that will pass a No. 4 (4.75-mm) sieve and be retained on a No. 200 (75-µm) sieve with the following subdivisions:

coarse—passes a No. 4 (4.75-mm) sieve and is retained on a No. 10 (2.00-mm) sieve.

medium—passes a No. 10 (2.00-mm) sieve and is retained on a No. 40 (425-µm) sieve.

fine—passes a No. 40 (425-µm) sieve and is retained on a No. 200 (75-µm) sieve.

3.1.8 *silt*—soil passing a No. 200 (75-µm) sieve that is nonplastic or very slightly plastic and that exhibits little or no strength when air dry. For classification, a silt is a fine-grained soil, or the fine-grained portion of a soil, with a plasticity index less than 4, or the plot of plasticity index versus liquid limit falls below the "A" line (see Fig. 3 of Test Method D2487).

4. Summary of Practice

4.1 Using visual examination and simple manual tests, this practice gives standardized criteria and procedures for describing and identifying soils.

4.2 The soil can be given an identification by assigning a group symbol(s) and name. The flow charts, Fig. 1a and Fig. 1b for fine-grained soils, and Fig. 2, for coarse-grained soils, can be used to assign the appropriate group symbol(s) and name. If the soil has properties which do not distinctly place it into a specific group, borderline symbols may be used, see Appendix X3.

NOTE 3—It is suggested that a distinction be made between *dual symbols* and *borderline symbols*.

Dual Symbol—A dual symbol is two symbols separated by a hyphen, for example, GP-GM, SW-SC, CL-ML used to indicate that the soil has been identified as having the properties of a classification in accordance with Test Method D2487 where two symbols are required. Two symbols are required when the soil has between 5 and 12 % fines or when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart.

Borderline Symbol—A borderline symbol is two symbols separated by a slash, for example, CL/CH, GM/SM, CL/ML. A borderline symbol should be used to indicate that the soil has been identified as having properties that do not distinctly place the soil into a specific group (see Appendix X3).

5. Significance and Use

5.1 The descriptive information required in this practice can be used to describe a soil to aid in the evaluation of its significant properties for engineering use.

5.2 The descriptive information required in this practice should be used to supplement the classification of a soil as determined by Test Method D2487.

5.3 This practice may be used in identifying soils using the classification group symbols and names as prescribed in Test Method D2487. Since the names and symbols used in this practice to identify the soils are the same as those used in Test Method D2487, it shall be clearly stated in reports and all other appropriate documents, that the classification symbol and name are based on visual-manual procedures.

5.4 This practice is to be used not only for identification of soils in the field, but also in the office, laboratory, or wherever soil samples are inspected and described.

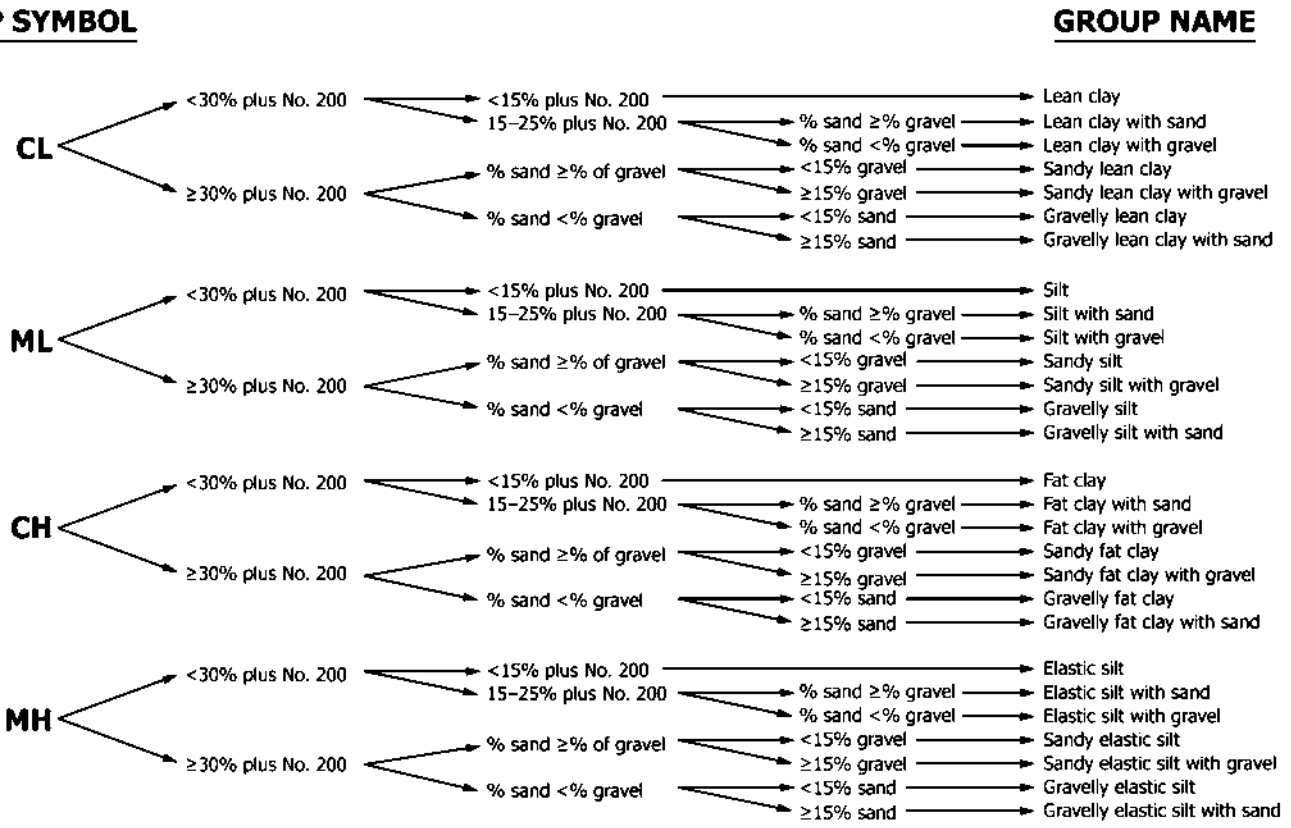
5.5 This practice has particular value in grouping similar soil samples so that only a minimum number of laboratory tests need be run for positive soil classification.

NOTE 4—The ability to describe and identify soils correctly is learned more readily under the guidance of experienced personnel, but it may also be acquired systematically by comparing numerical laboratory test results for typical soils of each type with their visual and manual characteristics.

5.6 When describing and identifying soil samples from a given boring, test pit, or group of borings or pits, it is not necessary to follow all of the procedures in this practice for every sample. Soils which appear to be similar can be grouped together; one sample completely described and identified with the others referred to as similar based on performing only a few of the descriptive and identification procedures described in this practice.

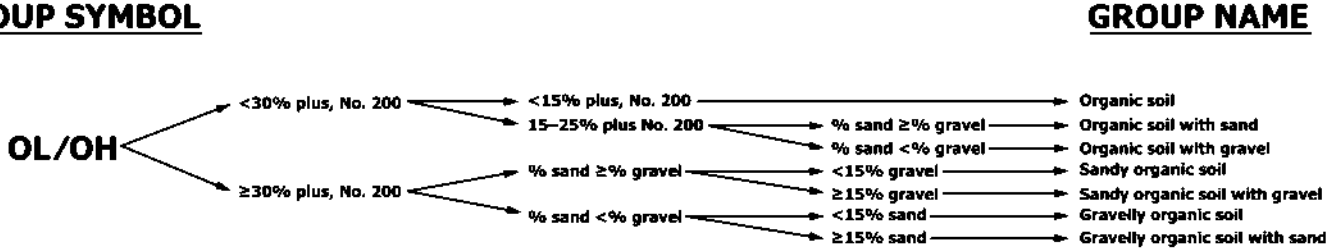
5.7 This practice may be used in combination with Practice D4083 when working with frozen soils.

NOTE 5—Notwithstanding the statements on precision and bias contained in this standard: The precision of this test method is dependent on the competence of the personnel performing it and the suitability of the equipment and facilities used. Agencies that meet the criteria of Practice D3740 are generally considered capable of competent and objective testing. Users of this test method are cautioned that compliance with Practice D3740 does not in itself assure reliable testing. Reliable testing



NOTE 1—Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5 %.

FIG. 1a Flow Chart for Identifying Inorganic Fine-Grained Soil (50 % or more fines)



NOTE 1—Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5 %.

FIG. 1 b Flow Chart for Identifying Organic Fine-Grained Soil (50 % or more fines)

depends on several factors; Practice D3740 provides a means for evaluating some of those factors.

6. Apparatus

6.1 *Required Apparatus:*

6.1.1 *Pocket Knife or Small Spatula.*

6.2 *Useful Auxiliary Apparatus:*

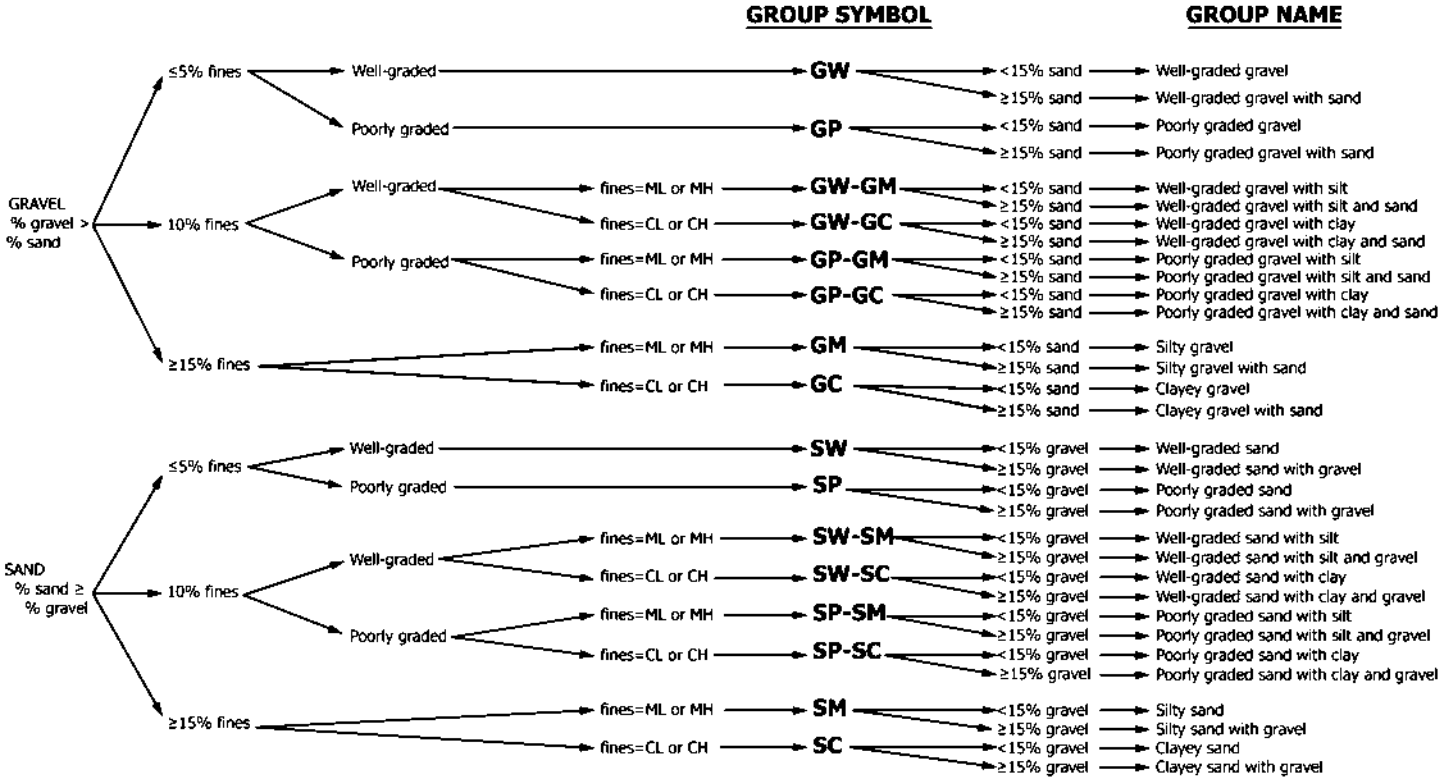
6.2.1 *Test Tube and Stopper* (or jar with a lid).

6.2.2 *Hand Lens.*

7. Reagents

7.1 *Purity of Water*—Unless otherwise indicated, references to water shall be understood to mean water from a city water supply or natural source, including non-potable water.

7.2 *Hydrochloric Acid*—A small bottle of dilute hydrochloric acid, HCl, one part HCl (10 *N*) to three parts water (This reagent is optional for use with this practice). See Section 8.



NOTE 1—Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5 %.

FIG. 2 Flow Chart for Identifying Coarse-Grained Soils (less than 50 % fines)

8. Safety Precautions

8.1 When preparing the dilute HCl solution of one part concentrated hydrochloric acid (10 *N*) to three parts of distilled water, slowly add acid into water following necessary safety precautions. Handle with caution and store safely. If solution comes into contact with the skin, rinse thoroughly with water.

8.2 **Caution**—Do not add water to acid.

9. Sampling

9.1 The sample shall be considered to be representative of the stratum from which it was obtained by an appropriate, accepted, or standard procedure.

NOTE 6—Preferably, the sampling procedure should be identified as having been conducted in accordance with Practices D1452, D1587, or D2113, or Test Method D1586.

9.2 The sample shall be carefully identified as to origin.

NOTE 7—Remarks as to the origin may take the form of a boring number and sample number in conjunction with a job number, a geologic stratum, a pedologic horizon or a location description with respect to a permanent monument, a grid system or a station number and offset with respect to a stated centerline and a depth or elevation.

9.3 For accurate description and identification, the minimum amount of the specimen to be examined shall be in accordance with the following schedule:

Maximum Particle Size, Sieve Opening	Minimum Specimen Size, Dry Weight
4.75 mm (No. 4)	100 g (0.25 lb)
9.5 mm (⅜ in.)	200 g (0.5 lb)
19.0 mm (¾ in.)	1.0 kg (2.2 lb)
38.1 mm (1½ in.)	8.0 kg (18 lb)
75.0 mm (3 in.)	60.0 kg (132 lb)

NOTE 8—If random isolated particles are encountered that are significantly larger than the particles in the soil matrix, the soil matrix can be accurately described and identified in accordance with the preceeding schedule.

9.4 If the field sample or specimen being examined is smaller than the minimum recommended amount, the report shall include an appropriate remark.

10. Descriptive Information for Soils

10.1 *Angularity*—Describe the angularity of the sand (coarse sizes only), gravel, cobbles, and boulders, as angular, subangular, subrounded, or rounded in accordance with the criteria in Table 1 and Fig. 3. A range of angularity may be stated, such as: subrounded to rounded.

10.2 *Shape*—Describe the shape of the gravel, cobbles, and boulders as flat, elongated, or flat and elongated if they meet the criteria in Table 2 and Fig. 4. Otherwise, do not mention the shape. Indicate the fraction of the particles that have the shape, such as: one-third of the gravel particles are flat.

TABLE 1 Criteria for Describing Angularity of Coarse-Grained Particles (see Fig. 3)

Description	Criteria
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular	Particles are similar to angular description but have rounded edges
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges
Rounded	Particles have smoothly curved sides and no edges

10.3 *Color*—Describe the color. Color is an important property in identifying organic soils, and within a given locality it may also be useful in identifying materials of similar geologic origin. If the sample contains layers or patches of varying colors, this shall be noted and all representative colors shall be described. The color shall be described for moist samples. If the color represents a dry condition, this shall be stated in the report.

10.4 *Odor*—Describe the odor if organic or unusual. Soils containing a significant amount of organic material usually have a distinctive odor of decaying vegetation. This is especially apparent in fresh samples, but if the samples are dried, the odor may often be revived by heating a moistened sample. If the odor is unusual (petroleum product, chemical, and the like), it shall be described.

10.5 *Moisture Condition*—Describe the moisture condition as dry, moist, or wet, in accordance with the criteria in Table 3.

10.6 *HCl Reaction*—Describe the reaction with HCl as none, weak, or strong, in accordance with the critera in Table 4. Since calcium carbonate is a common cementing agent, a report of its presence on the basis of the reaction with dilute hydrochloric acid is important.

10.7 *Consistency*—For intact fine-grained soil, describe the consistency as very soft, soft, firm, hard, or very hard, in accordance with the criteria in Table 5. This observation is inappropriate for soils with significant amounts of gravel.

10.8 *Cementation*—Describe the cementation of intact coarse-grained soils as weak, moderate, or strong, in accordance with the criteria in Table 6.

10.9 *Structure*—Describe the structure of intact soils in accordance with the criteria in Table 7.

10.10 *Range of Particle Sizes*—For gravel and sand components, describe the range of particle sizes within each component as defined in 3.1.2 and 3.1.6. For example, about 20 % fine to coarse gravel, about 40 % fine to coarse sand.

10.11 *Maximum Particle Size*—Describe the maximum particle size found in the sample in accordance with the following information:

10.11.1 *Sand Size*—If the maximum particle size is a sand size, describe as fine, medium, or coarse as defined in 3.1.6. For example: maximum particle size, medium sand.

10.11.2 *Gravel Size*—If the maximum particle size is a gravel size, describe the maximum particle size as the smallest sieve opening that the particle will pass. For example, maximum particle size, 1½ in. (will pass a 1½-in. square opening but not a ¾-in. square opening).

10.11.3 *Cobble or Boulder Size*—If the maximum particle size is a cobble or boulder size, describe the maximum dimension of the largest particle. For example: maximum dimension, 18 in. (450 mm).

10.12 *Hardness*—Describe the hardness of coarse sand and larger particles as hard, or state what happens when the particles are hit by a hammer, for example, gravel-size particles fracture with considerable hammer blow, some gravel-size particles crumble with hammer blow. "Hard" means particles do not crack, fracture, or crumble under a hammer blow.

10.13 Additional comments shall be noted, such as the presence of roots or root holes, difficulty in drilling or augering hole, caving of trench or hole, or the presence of mica.

10.14 A local or commercial name or a geologic interpretation of the soil, or both, may be added if identified as such.

10.15 A classification or identification of the soil in accordance with other classification systems may be added if identified as such.

11. Identification of Peat

11.1 A sample composed primarily of vegetable tissue in various stages of decomposition that has a fibrous to amorphous texture, usually a dark brown to black color, and an organic odor, shall be designated as a highly organic soil and shall be identified as peat, PT, and not subjected to the identification procedures described hereafter.

12. Preparation for Identification

12.1 The soil identification portion of this practice is based on the portion of the soil sample that will pass a 3-in. (75-mm) sieve. The larger than 3-in. (75-mm) particles must be removed, manually, for a loose sample, or mentally, for an intact sample before classifying the soil.

12.2 Estimate and note the percentage of cobbles and the percentage of boulders. Performed visually, these estimates will be on the basis of volume percentage.

NOTE 9—Since the percentages of the particle-size distribution in Test Method D2487 are by dry weight, and the estimates of percentages for gravel, sand, and fines in this practice are by dry weight, it is recommended that the report state that the percentages of cobbles and boulders are by volume.

12.3 Of the fraction of the soil smaller than 3 in. (75 mm), estimate and note the percentage, by dry weight, of the gravel, sand, and fines (see Appendix X4 for suggested procedures).

NOTE 10—Since the particle-size components appear visually on the basis of volume, considerable experience is required to estimate the percentages on the basis of dry weight. Frequent comparisons with laboratory particle-size analyses should be made.

12.3.1 The percentages shall be estimated to the closest 5 %. The percentages of gravel, sand, and fines must add up to 100 %.

12.3.2 If one of the components is present but not in sufficient quantity to be considered 5 % of the smaller than 3-in. (75-mm) portion, indicate its presence by the term *trace*,

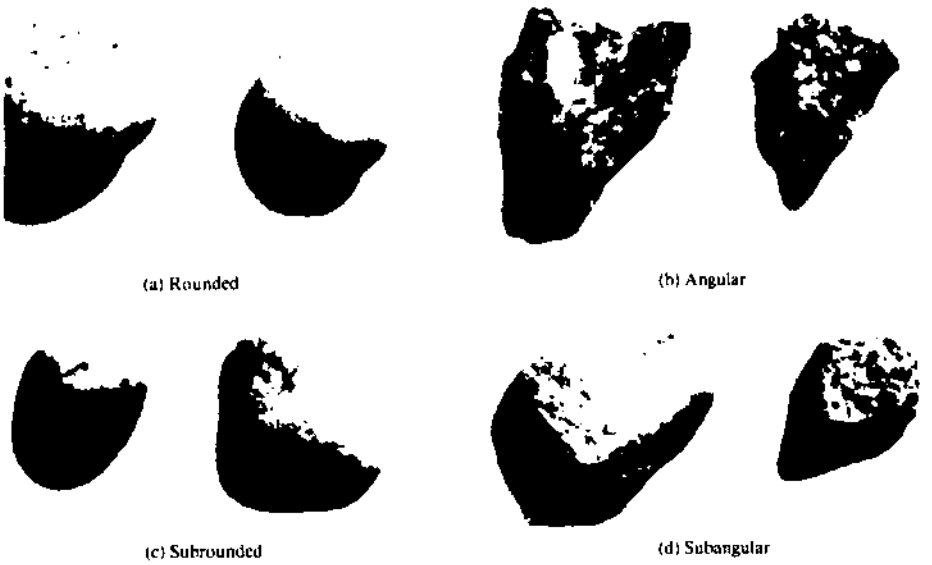


FIG. 3 Typical Angularity of Bulky Grains

TABLE 2 Criteria for Describing Particle Shape (see Fig. 4)

The particle shape shall be described as follows where length, width, and thickness refer to the greatest, intermediate, and least dimensions of a particle, respectively.

Flat	Particles with width/thickness > 3
Elongated	Particles with length/width > 3
Flat and elongated	Particles meet criteria for both flat and elongated

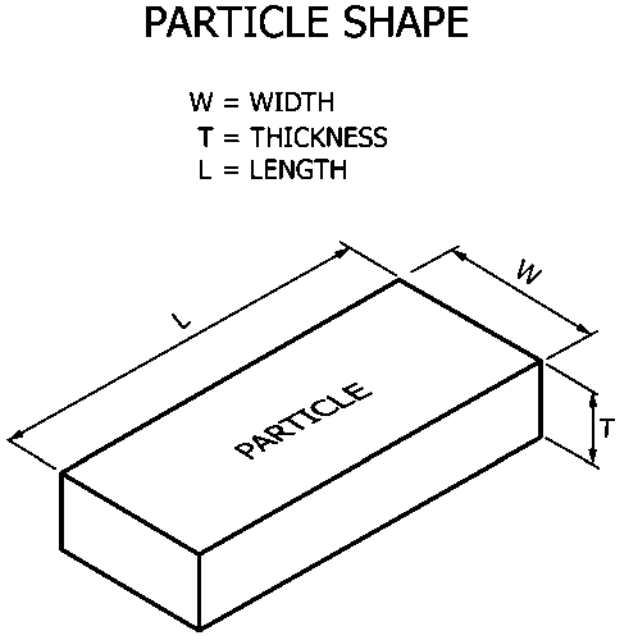


FIG. 4 Criteria for Particle Shape

for example, trace of fines. A trace is not to be considered in the total of 100 % for the components.

13. Preliminary Identification

13.1 The soil is *fine grained* if it contains 50 % or more fines. Follow the procedures for identifying fine-grained soils of Section 14.

13.2 The soil is *coarse grained* if it contains less than 50 % fines. Follow the procedures for identifying coarse-grained soils of Section 15.

14. Procedure for Identifying Fine-Grained Soils

14.1 Select a representative sample of the material for examination. Remove particles larger than the No. 40 sieve (medium sand and larger) until a specimen equivalent to about a handful of material is available. Use this specimen for performing the dry strength, dilatancy, and toughness tests.

14.2 *Dry Strength:*

14.2.1 From the specimen, select enough material to mold into a ball about 1 in. (25 mm) in diameter. Mold the material until it has the consistency of putty, adding water if necessary.

14.2.2 From the molded material, make at least three test specimens. A test specimen shall be a ball of material about ½

TABLE 3 Criteria for Describing Moisture Condition

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

TABLE 4 Criteria for Describing the Reaction With HCl

Description	Criteria
None	No visible reaction
Weak	Some reaction, with bubbles forming slowly
Strong	Violent reaction, with bubbles forming immediately

TABLE 5 Criteria for Describing Consistency

Description	Criteria
Very soft	Thumb will penetrate soil more than 1 in. (25 mm)
Soft	Thumb will penetrate soil about 1 in. (25 mm)
Firm	Thumb will indent soil about ¼ in. (6 mm)
Hard	Thumb will not indent soil but readily indented with thumbnail
Very hard	Thumbnail will not indent soil

TABLE 6 Criteria for Describing Cementation

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure
Moderate	Crumbles or breaks with considerable finger pressure
Strong	Will not crumble or break with finger pressure

TABLE 7 Criteria for Describing Structure

Description	Criteria
Stratified	Alternating layers of varying material or color with layers at least 6 mm thick; note thickness
Laminated	Alternating layers of varying material or color with the layers less than 6 mm thick; note thickness
Fissured	Breaks along definite planes of fracture with little resistance to fracturing
Slickensided	Fracture planes appear polished or glossy, sometimes striated
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay; note thickness
Homogeneous	Same color and appearance throughout

in. (12 mm) in diameter. Allow the test specimens to dry in air, or sun, or by artificial means, as long as the temperature does not exceed 60°C.

14.2.3 If the test specimen contains natural dry lumps, those that are about ½ in. (12 mm) in diameter may be used in place of the molded balls.

NOTE 11—The process of molding and drying usually produces higher strengths than are found in natural dry lumps of soil.

14.2.4 Test the strength of the dry balls or lumps by crushing between the fingers. Note the strength as none, low, medium, high, or very high in accorance with the criteria in Table 8. If natural dry lumps are used, do not use the results of any of the lumps that are found to contain particles of coarse sand.

14.2.5 The presence of high-strength water-soluble cementing materials, such as calcium carbonate, may cause exceptionally high dry strengths. The presence of calcium carbonate can usually be detected from the intensity of the reaction with dilute hydrochloric acid (see 10.6).

TABLE 8 Criteria for Describing Dry Strength

Description	Criteria
None	The dry specimen crumbles into powder with mere pressure of handling
Low	The dry specimen crumbles into powder with some finger pressure
Medium	The dry specimen breaks into pieces or crumbles with considerable finger pressure
High	The dry specimen cannot be broken with finger pressure. Specimen will break into pieces between thumb and a hard surface
Very high	The dry specimen cannot be broken between the thumb and a hard surface

14.3 *Dilatancy:*

14.3.1 From the specimen, select enough material to mold into a ball about ½ in. (12 mm) in diameter. Mold the material, adding water if necessary, until it has a soft, but not sticky, consistency.

14.3.2 Smooth the soil ball in the palm of one hand with the blade of a knife or small spatula. Shake horizontally, striking the side of the hand vigorously against the other hand several times. Note the reaction of water appearing on the surface of the soil. Squeeze the sample by closing the hand or pinching the soil between the fingers, and note the reaction as none, slow, or rapid in accordance with the criteria in Table 9. The reaction is the speed with which water appears while shaking, and disappears while squeezing.

14.4 *Toughness:*

14.4.1 Following the completion of the dilatancy test, the test specimen is shaped into an elongated pat and rolled by hand on a smooth surface or between the palms into a thread about ⅛ in. (3 mm) in diameter. (If the sample is too wet to roll easily, it should be spread into a thin layer and allowed to lose some water by evaporation.) Fold the sample threads and reroll repeatedly until the thread crumbles at a diameter of about ⅛ in. The thread will crumble at a diameter of ⅛ in. when the soil is near the plastic limit. Note the pressure required to roll the thread near the plastic limit. Also, note the strength of the thread. After the thread crumbles, the pieces should be lumped together and kneaded until the lump crumbles. Note the toughness of the material during kneading.

14.4.2 Describe the toughness of the thread and lump as low, medium, or high in accordance with the criteria in Table 10.

TABLE 9 Criteria for Describing Dilatancy

Description	Criteria
None	No visible change in the specimen
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing

TABLE 10 Criteria for Describing Toughness

Description	Criteria
Low	Only slight pressure is required to roll the thread near the plastic limit. The thread and the lump are weak and soft
Medium	Medium pressure is required to roll the thread to near the plastic limit. The thread and the lump have medium stiffness
High	Considerable pressure is required to roll the thread to near the plastic limit. The thread and the lump have very high stiffness

14.5 *Plasticity*—On the basis of observations made during the toughness test, describe the plasticity of the material in accordance with the criteria given in Table 11.

14.6 Decide whether the soil is an *inorganic* or an *organic* fine-grained soil (see 14.8). If inorganic, follow the steps given in 14.7.

14.7 *Identification of Inorganic Fine-Grained Soils:*

14.7.1 Identify the soil as a *lean clay*, CL, if the soil has medium to high dry strength, no or slow dilatancy, and medium toughness and plasticity (see Table 12).

14.7.2 Identify the soil as a *fat clay*, CH, if the soil has high to very high dry strength, no dilatancy, and high toughness and plasticity (see Table 12).

14.7.3 Identify the soil as a *silt*, ML, if the soil has no to low dry strength, slow to rapid dilatancy, and low toughness and plasticity, or is nonplastic (see Table 12).

14.7.4 Identify the soil as an *elastic silt*, MH, if the soil has low to medium dry strength, no to slow dilatancy, and low to medium toughness and plasticity (see Table 12).

NOTE 12—These properties are similar to those for a lean clay. However, the silt will dry quickly on the hand and have a smooth, silky feel when dry. Some soils that would classify as MH in accordance with the criteria in Test Method D2487 are visually difficult to distinguish from lean clays, CL. It may be necessary to perform laboratory testing for proper identification.

14.8 *Identification of Organic Fine-Grained Soils:*

14.8.1 Identify the soil as an *organic soil*, OL/OH, if the soil contains enough organic particles to influence the soil properties. Organic soils usually have a dark brown to black color and may have an organic odor. Often, organic soils will change color, for example, black to brown, when exposed to the air. Some organic soils will lighten in color significantly when air dried. Organic soils normally will not have a high toughness or plasticity. The thread for the toughness test will be spongy.

NOTE 13—In some cases, through practice and experience, it may be possible to further identify the organic soils as organic silts or organic clays, OL or OH. Correlations between the dilatancy, dry strength, toughness tests, and laboratory tests can be made to identify organic soils in certain deposits of similar materials of known geologic origin.

TABLE 11 Criteria for Describing Plasticity

Description	Criteria
Nonplastic	A ⅛-in. (3-mm) thread cannot be rolled at any water content
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit

TABLE 12 Identification of Inorganic Fine-Grained Soils from Manual Tests

Soil Symbol	Dry Strength	Dilatancy	Toughness and Plasticity
ML	None to low	Slow to rapid	Low or thread cannot be formed
CL	Medium to high	None to slow	Medium
MH	Low to medium	None to slow	Low to medium
CH	High to very high	None	High

14.9 If the soil is estimated to have 15 to 25 % sand or gravel, or both, the words "with sand" or "with gravel" (whichever is more predominant) shall be added to the group name. For example: "lean clay with sand, CL" or "silt with gravel, ML" (see Fig. 1a and Fig. 1b). If the percentage of sand is equal to the percentage of gravel, use "with sand."

14.10 If the soil is estimated to have 30 % or more sand or gravel, or both, the words "sandy" or "gravelly" shall be added to the group name. Add the word "sandy" if there appears to be more sand than gravel. Add the word "gravelly" if there appears to be more gravel than sand. For example: "sandy lean clay, CL", "gravelly fat clay, CH", or "sandy silt, ML" (see Fig. 1a and Fig. 1b). If the percentage of sand is equal to the percent of gravel, use "sandy."

15. Procedure for Identifying Coarse-Grained Soils

(Contains less than 50 % fines)

15.1 The soil is a *gravel* if the percentage of gravel is estimated to be more than the percentage of sand.

15.2 The soil is a *sand* if the percentage of gravel is estimated to be equal to or less than the percentage of sand.

15.3 The soil is a *clean gravel* or *clean sand* if the percentage of fines is estimated to be 5 % or less.

15.3.1 Identify the soil as a *well-graded gravel*, GW, or as a *well-graded sand*, SW, if it has a wide range of particle sizes and substantial amounts of the intermediate particle sizes.

15.3.2 Identify the soil as a *poorly graded gravel*, GP, or as a *poorly graded sand*, SP, if it consists predominantly of one size (uniformly graded), or it has a wide range of sizes with some intermediate sizes obviously missing (gap or skip graded).

15.4 The soil is either a *gravel with fines* or a *sand with fines* if the percentage of fines is estimated to be 15 % or more.

15.4.1 Identify the soil as a *clayey gravel*, GC, or a *clayey sand*, SC, if the fines are clayey as determined by the procedures in Section 14.

15.4.2 Identify the soil as a *silty gravel*, GM, or a *silty sand*, SM, if the fines are silty as determined by the procedures in Section 14.

15.5 If the soil is estimated to contain 10 % fines, give the soil a dual identification using two group symbols.

15.5.1 The first group symbol shall correspond to a clean gravel or sand (GW, GP, SW, SP) and the second symbol shall correspond to a gravel or sand with fines (GC, GM, SC, SM).

15.5.2 The group name shall correspond to the first group symbol plus the words "with clay" or "with silt" to indicate the plasticity characteristics of the fines. For example: "well-graded gravel with clay, GW-GC" or "poorly graded sand with silt, SP-SM" (see Fig. 2).

15.6 If the specimen is predominantly sand or gravel but contains an estimated 15 % or more of the other coarse-grained constituent, the words "with gravel" or "with sand" shall be added to the group name. For example: "poorly graded gravel with sand, GP" or "clayey sand with gravel, SC" (see Fig. 2).

15.7 If the field sample contains any cobbles or boulders, or both, the words "with cobbles" or "with cobbles and boulders" shall be added to the group name. For example: "silty gravel with cobbles, GM."

16. Report

16.1 The report shall include the information as to origin, and the items indicated in Table 13.

NOTE 14—*Example: Clayey Gravel with Sand and Cobbles, GC*—About 50 % fine to coarse, subrounded to subangular gravel; about 30 % fine to coarse, subrounded sand; about 20 % fines with medium plasticity, high dry strength, no dilatancy, medium toughness; weak reaction with HCl; original field sample had about 5 % (by volume) subrounded cobbles, maximum dimension, 150 mm.

In-Place Conditions—Firm, homogeneous, dry, brown

Geologic Interpretation—Alluvial fan

NOTE 15—Other examples of soil descriptions and identification are given in Appendix X1 and Appendix X2.

NOTE 16—If desired, the percentages of gravel, sand, and fines may be stated in terms indicating a range of percentages, as follows:

Trace—Particles are present but estimated to be less than 5 %

Few—5 to 10 %

Little—15 to 25 %

Some—30 to 45 %

Mostly—50 to 100 %

16.2 If, in the soil description, the soil is identified using a classification group symbol and name as described in Test Method D2487, it must be distinctly and clearly stated in log forms, summary tables, reports, and the like, that the symbol and name are based on visual-manual procedures.

TABLE 13 Checklist for Description of Soils

1. Group name
2. Group symbol
3. Percent of cobbles or boulders, or both (by volume)
4. Percent of gravel, sand, or fines, or all three (by dry weight)
5. Particle-size range:
   Gravel—fine, coarse
   Sand—fine, medium, coarse
6. Particle angularity: angular, subangular, subrounded, rounded
7. Particle shape: (if appropriate) flat, elongated, flat and elongated
8. Maximum particle size or dimension
9. Hardness of coarse sand and larger particles
10. Plasticity of fines: nonplastic, low, medium, high
11. Dry strength: none, low, medium, high, very high
12. Dilatancy: none, slow, rapid
13. Toughness: low, medium, high
14. Color (in moist condition)
15. Odor (mention only if organic or unusual)
16. Moisture: dry, moist, wet
17. Reaction with HCl: none, weak, strong

For intact samples:

18. Consistency (fine-grained soils only): very soft, soft, firm, hard, very hard
19. Structure: stratified, laminated, fissured, slickensided, lensed, homogeneous
20. Cementation: weak, moderate, strong
21. Local name
22. Geologic interpretation
23. Additional comments: presence of roots or root holes, presence of mica, gypsum, etc., surface coatings on coarse-grained particles, caving or sloughing of auger hole or trench sides, difficulty in augering or excavating, etc.

17. Precision and Bias

17.1 This practice provides qualitative information only, therefore, a precision and bias statement is not applicable.

18. Keywords

18.1 classification; clay; gravel; organic soils; sand; silt; soil classification; soil description; visual classification

APPENDIXES

(Nonmandatory Information)

X1. EXAMPLES OF VISUAL SOIL DESCRIPTIONS

X1.1 The following examples show how the information required in 16.1 can be reported. The information that is included in descriptions should be based on individual circumstances and need.

X1.1.1 *Well-Graded Gravel with Sand (GW)*—About 75 % fine to coarse, hard, subangular gravel; about 25 % fine to coarse, hard, subangular sand; trace of fines; maximum size, 75 mm, brown, dry; no reaction with HCl.

X1.1.2 *Silty Sand with Gravel (SM)*—About 60 % predominantly fine sand; about 25 % silty fines with low plasticity, low dry strength, rapid dilatancy, and low toughness; about 15 % fine, hard, subrounded gravel, a few gravel-size particles fractured with hammer blow; maximum size, 25 mm; no reaction with HCl (Note—Field sample size smaller than recommended).

In-Place Conditions—Firm, stratified and contains lenses of silt 1 to 2 in. (25 to 50 mm) thick, moist, brown to gray; in-place density 106 lb/ft^3; in-place moisture 9 %.

X1.1.3 *Organic Soil (OL/OH)*—About 100 % fines with low plasticity, slow dilatancy, low dry strength, and low toughness; wet, dark brown, organic odor; weak reaction with HCl.

X1.1.4 *Silty Sand with Organic Fines (SM)*—About 75 % fine to coarse, hard, subangular reddish sand; about 25 % organic and silty dark brown nonplastic fines with no dry

strength and slow dilatancy; wet; maximum size, coarse sand; weak reaction with HCl.

X1.1.5 *Poorly Graded Gravel with Silt, Sand, Cobbles and Boulders (GP-GM)*—About 75 % fine to coarse, hard, subrounded to subangular gravel; about 15 % fine, hard, subrounded to subangular sand; about 10 % silty nonplastic fines; moist, brown; no reaction with HCl; original field sample had about 5 % (by volume) hard, subrounded cobbles and a trace of hard, subrounded boulders, with a maximum dimension of 18 in. (450 mm).

X2. USING THE IDENTIFICATION PROCEDURE AS A DESCRIPTIVE SYSTEM FOR SHALE, CLAYSTONE, SHELLS, SLAG, CRUSHED ROCK, AND THE LIKE

X2.1 The identification procedure may be used as a descriptive system applied to materials that exist in-situ as shale, claystone, sandstone, siltstone, mudstone, etc., but convert to soils after field or laboratory processing (crushing, slaking, and the like).

X2.2 Materials such as shells, crushed rock, slag, and the like, should be identified as such. However, the procedures used in this practice for describing the particle size and plasticity characteristics may be used in the description of the material. If desired, an identification using a group name and symbol according to this practice may be assigned to aid in describing the material.

X2.3 The group symbol(s) and group names should be placed in quotation marks or noted with some type of distinguishing symbol. See examples.

X2.4 Examples of how group names and symbols can be incororated into a descriptive system for materials that are not naturally occurring soils are as follows:

X2.4.1 *Shale Chunks*—Retrieved as 2 to 4-in. (50 to 100-mm) pieces of shale from power auger hole, dry, brown, no reaction with HCl. After slaking in water for 24 h, material identified as "Sandy Lean Clay (CL)"; about 60 % fines with medium plasticity, high dry strength, no dilatancy, and medium toughness; about 35 % fine to medium, hard sand; about 5 % gravel-size pieces of shale.

X2.4.2 *Crushed Sandstone*—Product of commercial crushing operation; "Poorly Graded Sand with Silt (SP-SM)"; about 90 % fine to medium sand; about 10 % nonplastic fines; dry, reddish-brown.

X2.4.3 *Broken Shells*—About 60 % uniformly graded gravel-size broken shells; about 30 % sand and sand-size shell pieces; about 10 % nonplastic fines; "Poorly Graded Gravel with Silt and Sand (GP-GM)."

X2.4.4 *Crushed Rock*—Processed from gravel and cobbles in Pit No. 7; "Poorly Graded Gravel (GP)"; about 90 % fine, hard, angular gravel-size particles; about 10 % coarse, hard, angular sand-size particles; dry, tan; no reaction with HCl.

X3. SUGGESTED PROCEDURE FOR USING A BORDERLINE SYMBOL FOR SOILS WITH TWO POSSIBLE IDENTIFICATIONS.

X3.1 Since this practice is based on estimates of particle size distribution and plasticity characteristics, it may be difficult to clearly identify the soil as belonging to one category. To indicate that the soil may fall into one of two possible basic groups, a borderline symbol may be used with the two symbols separated by a slash. For example: SC/CL or CL/CH.

X3.1.1 A borderline symbol may be used when the percentage of fines is estimated to be between 45 and 55 %. One symbol should be for a coarse-grained soil with fines and the other for a fine-grained soil. For example: GM/ML or CL/SC.

X3.1.2 A borderline symbol may be used when the percentage of sand and the percentage of gravel are estimated to be about the same. For example: GP/SP, SC/GC, GM/SM. It is practically impossible to have a soil that would have a borderline symbol of GW/SW.

X3.1.3 A borderline symbol may be used when the soil could be either well graded or poorly graded. For example: GW/GP, SW/SP.

X3.1.4 A borderline symbol may be used when the soil could either be a silt or a clay. For example: CL/ML, CH/MH, SC/SM.

X3.1.5 A borderline symbol may be used when a fine-grained soil has properties that indicate that it is at the boundary between a soil of low compressibility and a soil of high compressibility. For example: CL/CH, MH/ML.

X3.2 The order of the borderline symbols should reflect similarity to surrounding or adjacent soils. For example: soils in a borrow area have been identified as CH. One sample is considered to have a borderline symbol of CL and CH. To show similarity, the borderline symbol should be CH/CL.

X3.3 The group name for a soil with a borderline symbol should be the group name for the first symbol, except for:

CL/CH lean to fat clay
ML/CL clayey silt
CL/ML silty clay

X3.4 The use of a borderline symbol should not be used indiscriminately. Every effort shall be made to first place the soil into a single group.

X4. SUGGESTED PROCEDURES FOR ESTIMATING THE PERCENTAGES OF GRAVEL, SAND, AND FINES IN A SOIL SAMPLE

X4.1 *Jar Method*—The relative percentage of coarse- and fine-grained material may be estimated by thoroughly shaking a mixture of soil and water in a test tube or jar, and then allowing the mixture to settle. The coarse particles will fall to the bottom and successively finer particles will be deposited with increasing time; the sand sizes will fall out of suspension in 20 to 30 s. The relative proportions can be estimated from the relative volume of each size separate. This method should be correlated to particle-size laboratory determinations.

X4.2 *Visual Method*—Mentally visualize the gravel size particles placed in a sack (or other container) or sacks. Then, do the same with the sand size particles and the fines. Then, mentally compare the number of sacks to estimate the percentage of plus No. 4 sieve size and minus No. 4 sieve size present. The percentages of sand and fines in the minus sieve size No. 4 material can then be estimated from the wash test (X4.3).

X4.3 *Wash Test (for relative percentages of sand and fines)*—Select and moisten enough minus No. 4 sieve size material to form a 1-in (25-mm) cube of soil. Cut the cube in half, set one-half to the side, and place the other half in a small dish. Wash and decant the fines out of the material in the dish until the wash water is clear and then compare the two samples and estimate the percentage of sand and fines. Remember that the percentage is based on weight, not volume. However, the volume comparison will provide a reasonable indication of grain size percentages.

X4.3.1 While washing, it may be necessary to break down lumps of fines with the finger to get the correct percentages.

X5. ABBREVIATED SOIL CLASSIFICATION SYMBOLS

X5.1 In some cases, because of lack of space, an abbreviated system may be useful to indicate the soil classification symbol and name. Examples of such cases would be graphical logs, databases, tables, etc.

X5.2 This abbreviated system is not a substitute for the full name and descriptive information but can be used in supplementary presentations when the complete description is referenced.

X5.3 The abbreviated system should consist of the soil classification symbol based on this standard with appropriate lower case letter prefixes and suffixes as:

Prefix:	Suffix:
s = sandy	s = with sand
g = gravelly	g = with gravel
	c = with cobbles
	b = with boulders

X5.4 The soil classification symbol is to be enclosed in parenthesis. Some examples would be:

Group Symbol and Full Name	Abbreviated
CL, Sandy lean clay	s(CL)
SP-SM, Poorly graded sand with silt and gravel	(SP-SM)g
GP, poorly graded gravel with sand, cobbles, and boulders	(GP)scb
ML, gravelly silt with sand and cobbles	g(ML)sc

SUMMARY OF CHANGES

Committee D18 has identified the location of selected changes to this standard since the last issue (D2488 – 09) that may impact the use of this standard. (Approved June 15, 2009.)

(1) Revised Section 1.2.3.