Geographic Positioning Accuracy Standards
Log of Comments

Log number	Comment	Substantive	Resolution	Status
1	The standard requires tested data products to be labeled, "Tested ___meters horizontal at 95% confidence level."My question: Can any accuracy number be input, such as 2.31 meters? Or must this number be rounded up to some level such as 2.4, 3 or 5? Or can it be rounded off, say to 2.3 or 2 meters? Note that a 1:2400 product satisfying NMAS requirements meets a 2.03 meter CE 90% or a 2.31 meter CE 95% requirement, so the example is relevant to present-day products. For this example, rounding up to 5 meters, as is done for NSRS control points, would greatly understate the accuracy of the product. I believe 2.3 or 3 meters are reasonable answers, but would like to know the NSSDA position on this issue.	Y	Insert in Section 3.2.3, "The number of significant digits in the accuracy value shall be equal to the number of significant digits in the data set point coordinates."	COMPLETE
2-1	The relationship between the parts is not clear. A diagram showing the relationship of the parts might help.	Y	The diagram will be developed in parallel as the Geospatial Positioning Accuracy Standard goes forward for final draft. Words to explain the relationship among the parts will be added to Section 1.1.2, Scope	COMPLETE
2-2	Standards should stand on their own. FGDC might want to have a separate glossary document, but not as part of the standard.	Y	A glossary will be added as an informative appendix to Part 1, Geospatial Positioning Accuracy Standards.	COMPLETE
2-3	Page 1-1 bottom of 1st paragraph--The phrase 'represent the *best* estimate of the *true* value' is confusing - suggest it be replaced by 'are suitable.'	Y	Delete quotation marks from sentence. Replace "numerical" by "coordinate." The sentence will now read: It is increasingly important for users to not only know the coordinate values, but also the accuracy of those coordinate values, so users can decide which *coordinate* values represent the best estimate of the true value for their applications.	COMPLETE
2-4	On page 1-1 and repeated on page 2-1 *Geodetic control surveys are usually performed to establish a basic control network (framework) from...* This might better be said as *Geodetic control surveys are performed to establish accurate spatial referencing, a framework from...*	Y	Leave as is.	COMPLETE

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2-5	On page 1-5 reference to the obsolete vertical datum NGVD 29 should not be encouraged, thus the mention of NGVD 29 as the National coordinate system for vertical coordinates is inappropriate. It is preferable to use NAVD 88.	Y	Many legacy maps and data sets are based on older National datums, such as NAD 27 and NGVD 29. The final draft is rewritten to clarify this point: “Coordinate values should be based on National datums. Horizontal coordinate values should preferably be referenced to the North American Datum of 1983 (NAD 83). Vertical coordinate values should preferably be referenced to North American Vertical Datum of 1988 (NAVD 88). However, it is recognized that many legacy maps and geospatial data are referenced to older national datums, such as the North American Datum of 1927 (NAD 27) and the National Geodetic Vertical Datum of 1929 (NGVD 29).”	COMPLETE
2-6	Part 2: The Title *Standards for Geodetic Networks* should be expanded to include Spatial Referencing. New title could be *National Standards for Geodetic Networks and Spatial Referencing.*	Y	Leave title as is.	COMPLETE
2-7	On page 2-1, section 2.1; Are the requirements established by the NGS adopted or approved by the FGCS? If so, this should also be stated.	Y	Change from “National Geodetic Survey (NGS)” to “Federal Geodetic Control Subcommittee (FGCS).”	COMPLETE
2-8	On Standards Development Procedures, page 2-2, section 2.4; How do we get new standards or make changes?	Y	The reviewer is referred to the FGDC Standards Reference Model	COMPLETE
2-9	Twice in section 2.5 Accuracy Standards, the phrase *horizontal, ellipsoid height and orthometric height* is used, also on page 2-5. Why not use *horizontal and vertical?*	Y	To educate users, it is necessary to make the distinction between GPS-derived (ellipsoidal) heights and traditionally derived (orthometric) heights.	COMPLETE
2-10	In section 2.5 Accuracy Standards: What is the relationship of the new accuracy standard to the old accuracy standard? Some comparisons and contrasts would be useful (could be an appendix) .	Y	This topic will be addressed in new field specifications being developed by the FGCS.	COMPLETE
2-11	Section 2.5 Accuracy Standards: Where are the level of accuracy recommendations for application such as GPS, leveling, and gravity surveys? (Note this is recommended in part 1 section 1.6.)	Y	This topic will be addressed in new field specifications being developed by the FGCS.	COMPLETE
2-12	Page 2-5, last paragraph: Should the local accuracy along measured lines be part of this standard? Perhaps it should be an appendix. It does not seem to fit.	Y	The paragraph on local accuracy along measured lines has been deleted.	COMPLETE
2-13	What statement should accompany geodetic control data to reflect the accuracy standard?	Y	Section 2.3.2 has been added to provide guidelines on accuracy reporting for geodetic data.	COMPLETE

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2-14	In section 3.2.1--It seems that the reported accuracy is not the cumulative result of all uncertainty, but rather the result of a test.	Y	Change phrase to "The reported accuracy value *reflects* all uncertainties, including those introduced by geodetic control coordinates, compilation, and final computation of ground coordinate values for the product." While the reported accuracy is the result of a test, that result reflects uncertainties introduced by the process.	COMPLETE
2-15	In section 3.2.3 -- The first paragraph seems to conflict with the last paragraph.	N	Delete "the amount of testing" to resolve the conflict.	COMPLETE
2-16	In several sections the accuracy of the check source is stated as within one-third the accuracy of the data set, this seem confusing. Perhaps saying the check data should be three times more accurate would be clearer or instead give a specific numeric example.	N	Reference to a *specific* level of accuracy of the independent check source has been deleted; instead, the final draft will say that the independent check source of higher accuracy must have the highest accuracy feasible and practicable to evaluate the accuracy of the data set.	COMPLETE
2-17	In 3.2.4 first sentence: What are ground units? This not clear at all.	Y	Change "in ground units" to "in ground distances."	COMPLETE
2-18	The appendices that explain the other accuracy standards are a good addition to part 3.	N	NONE	COMPLETE
3-1	I believe that some formulas in Appendix A, "Explanatory Comments" are incorrect. . . The mean discrepancy is Sum[d(i)] / n, not d(i) / n as stated	N	NONE - the omission of the summation symbol probably was an error in transmission.	COMPLETE
3-2	The referenced formulas calculate the standard deviation of the point errors about the average point error. Thus if the project had a large datum shift but small deviations about that datum shift, it would be evaluated as having small circular errors.	Y	Formulas have been changed to RMSE to account for bias and precision.	COMPLETE

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3-3	The referenced formulas calculate deviations in radial distance, r(i), from some unstated origin of the (x,y) coordinate system. Here is a pathological example showing the weakness of this calculation: An (x,y) origin is established and a GPS reference station is placed at the origin with x defined to be north and y defined to be east. The entire survey is North and East of the base station by a kilometer or two. Using differential GPS techniques, the survey is carried out to centimeter accuracy. A catastrophic blunder in the data processing reverses a sign in the (x,y) data. So all of the data points are at very precise radial distances from the coordinate system origin so the accuracy check calculates small errors. This despite the fact that all points are several kilometers in the wrong direction from the base station!	Y	This statement has been included in the final draft: "Errors in recording or processing data, such as reversing signs or inconsistencies between the data set and independent source of higher accuracy in coordinate system definition must be corrected before computing the accuracy value."	COMPLETE
3-4	The vertical accuracy calculation has a similar problem for vertical data errors. If the entire project is done to an incorrect vertical datum, the standard deviation about the average error might be small and yet the average vertical error might be large.	Y	See resolution to comment 3-3	COMPLETE
3-5	The horizontal RMSE calculation does not appear to have the radial problem, but it does have the datum shift problem. Deviations should be differences from the true value, not about the average error.	N	RMSE calculations are not computed about an average error.	COMPLETE
3-6	The vertical RMSE calculation has a similar datum shift problem.	N	See resolution to comment 3-3.	COMPLETE

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3-7	Alternative proposal: Let: N = number of check points i = index of check points, i = 1, ... N Xmi = x-coordinate of check point i, as measured in data being transferred Xci = x-coordinate of check point i from more accurate, check, method such as differential GPS Ymi = y-coordinate of check point i as measured in data being transferred Yci = y-coordinate of check point i from more accurate, check, method such as differential GPS The root-means square error and circular error at 95% probability can now be calculated as RMSE = Sqrt[Sum[((Xmi - Xci)^2 + (Ymi - Yci)^2) / (2 N)]] CE95 = 2.447 * RMSE.	Y	The equation for RMSE given here is mostly correct, except that the denominator should be N, not 2*N. The RMSE formula has been adopted for estimating accuracy.	COMPLETE
3-8	Similarly for vertical calculations: Zmi = x-coordinate of check point i as measured in data being transferred Zci = x-coordinate of check point i from more accurate, check, method such as differential GPS The root-means square error and linear error at 95% probability can now be calculated as RMSE = Sqrt[Sum[((Zmi - Zci)^2) / N]] LE95 = 1.960 * RMSE	Y	This equation has been adopted for estimating vertical accuracy.	COMPLETE
3-9	The proposed formulas (comments 3-7, 3-8) include errors both in absolute datum position and relative positioning of points about that datum when evaluating error statistics. I believe these are more realistic measures of absolute accuracy.	Y	See resolution for comments 3-7 and 3-8.	COMPLETE

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4-1	In the 1995 version, errors were defined in terms of "root mean square errors" (rmse) which imply no characteristics of dispersion. However, in the referenced draft, the error definitions have been changed to 95% confidence level values taken about the sample mean. Biases that may exist between the sample point position and the check value for the same point are eliminated (see Appendix 3 A 1.: the mean discrepancy [d] is removed from each observation). I do not believe that this is what is intended since in most cases the simple bias may be quite large.	Y	The RMSE formula has been adopted for estimating accuracy.	COMPLETE
4-2	. . .the distribution characteristics of the deviations are usually not known; as a consequence, statements that depend on knowledge of distribution such as "95% confidence level" must be questioned.	Y	It is assumed that systematic effects have been eliminated as much as possible; therefore, only random error remains and accuracy computations are based on normally distributed error. These assumptions have been made explicit in the final draft.	COMPLETE
5	There appear to be multiple errors in the equations on page 3-9, item 1, of the Draft Geospatial Positioning Accuracy Standards document, dated December 1996. I believe correct statistics for Horizontal Accuracy requires that the radius r be computed after the other listed computations are first performed separately for x and y.	Y	Agreed. Changes made accordingly.	COMPLETE
6-1	Section 3.2.3, Page 3-3: Accuracy Test Paragraph 2--Select the check source so that its accuracy is within one-third the accuracy of the data set at the 95% confidence level. 1. This wording is also used on page 3-4. It implies that you already know the 95% level. However, that value is still unknown, which is why you are testing it. 2. Better wording is found on page 3-10 under Check Survey Design. To be consistent, the wording on pages 3-3 and 3-4 should read, "within one-third the intended accuracy for the data set at the 95% confidence level."	Y	See resolution to Comment 2-16. Please note that while the estimated accuracy value has not been computed (and is “unknown”), there is a conformance level in the product specification for the data set that the data producer intends- or expects - to achieve. Terms such as “intended accuracy” or “expected accuracy” will be omitted to minimize confusion.	COMPLETE

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6-2	Section 3.2.3, Page 3-3: Accuracy Test Paragraph 3--The horizontal position of the ground point of elevations may be shifted in any direction by an amount no more than twice its expected accuracy at 95% confidence level. 1. What statistic are you using for “expected accuracy”? 2. Two times the 95% confidence level is much more lax than the current NMAS where permissible horizontal movement is essentially only the 90% limit. In previous ASPRS documents on interim standards, the 2X rule was based on a limiting RMS, not a 95% statistic. To provide consistency with previous standards, and with expected horizontal accuracy of the product, the permissible horizontal shift applied to vertical should not exceed the 95% confidence level. Permissible movement should be kept to a maximum of the 95% confidence level.	Y	1. See resolution to comment 6-1 2. Reference to shifting horizontal position has been deleted on recommendation from comment 16.	COMPLETE

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6-3	Section 3.2.3, Page 3-3: Accuracy Test Paragraph 4--Errors two times or more than that allowed for the intended accuracy at the 95% confidence level are blunders and must be corrected. 1. Is “intended accuracy” the same as “expected accuracy” in paragraph 3 and is that the same as the maximum allowable error in accuracy? 2. The criteria for shifting test points in paragraph 3 and that for correcting test points considered to be blunders in paragraph 4 seem to be in contradiction, because the two sets of criteria overlap. 3. Elaboration is needed here. This is an accuracy test. Individual errors may well exceed twice the 95% level and thus be reflected in the statistic. Is the intent to find and reject bad check points or to correct the product?. The introduction to the standard already states that the "user" must set his or her own pass/fail standards. What if you know that the check points are good and photoidentification is good? The way this paragraph is worded sounds like a holdover from mapping where we can go back to the compilation/collection phase and fix a problem. It is only within production standards based on accuracy testing where blunders should be identified and corrected. However, this is an accuracy standard which indicates how good or bad the data are in reality.	Y	1. See resolution to comment 6-1 2. Please note that the criterion for shifting the position of well-defined points has been deleted (see resolution to comment 16), so that conflict has been eliminated. 3. The accuracy standard “indicates how good or bad these data are in reality.” See resolution to Comment 3-3 to indicate which errors should be corrected. Concerning the comment that “the ‘user’ must set his or her own pass/fail standards,” the NSSDA states that “Agencies are encouraged to establish thresholds for their product specifications and applications and for contracting purposes.”	COMPLETE

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6-4	Paragraph 5--Test a minimum of 20 check points, distributed to reflect the geographic extent and the distribution of error in the data set. It is not uncommon to find a data set with fewer than 20 independent, well-defined check points. The standard makes no provision for reporting the accuracy of such data sets. In fact, the standard fails to indicate whether or not these data sets should even be labeled. It is recommended here that all data sets be labeled in some way (the label need not be a "statistical" label). Consider the following cases: A. If a data set, regardless of the number of check points, is the product of a process that is being statistically controlled, then the data set can be labeled with the same statistical accuracy as all other data sets produced by the process. In this case, a data set with fewer than 20 check points can thus be labeled with a statistical accuracy statement. B. Similarly, if a data set is "accepted" as part of a batch, then the data set (as recommended in an earlier remark) could be labeled with a common batch statistical accuracy statement. (See comments on Section 3.2.4 below.) C. If, however, a data set with less than 20 valid check points needs to be tested individually (like a one-off data set, or a contractor-delivered data set that is not part of a batch), then there are at least two ways of reporting the data set accuracy. One way would be to label the data set with a non-statistical, qualified accuracy statement. For example, the following general statement could be issued (note the use of the word "typically"): Because this product contains, or is the derivative of a product that contains, an insufficient number of independent, well-defined check points, no statistical accuracy statement is provided. However, the process used to produce this product typically has an accuracy of .... In this way, the user is at least provided with an empirically based, "good faith" (albeit non-statistical) representation of quality.	Y	The "compiled to meet" statement is used to handle cases A, B, and C. To clarify this point, the guidelines for showing this note have been changed from "*produced to established procedures*" to "*produced according to procedures that have been demonstrated to produce data with particular…accuracy values.*" Appropriate wording has been added to the final draft about evaluating accuracy when fewer than 20 well-defined points can be identified for testing.	COMPLETE

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6-5	A second way of reporting the accuracy of a data set with fewer than 20 check points would be to issue a statistical accuracy statement. In this situation, it is usually inappropriate to base the accuracy on percentage points from a normal distribution. Instead, some type of sampling distribution (such as a Student's t, a Chi-Square, or a Snedecor's F) that is more sensitive to small sample sizes should be used. This is particularly the case when parameters of the normal distribution (mean and standard deviation) are unknown and must be estimated from sampled data (sample average and sample standard deviation). For data sets with less (sic) than 20 check points, the development of a standard based on a sampling distribution should be investigated, particularly when reporting vertical accuracy, where the number of qualified vertical check points is typically limited.	Y	See response to Comment 6-4.	COMPLETE
6-6	Section 3.2.4, Page 3-4: Accuracy Reporting (See also comments on Section 3.2.3, paragraph 5 above regarding the accuracy reporting of data sets with fewer than 20 valid check points.) Provision is made for reporting horizontal and/or vertical accuracy for a data set that is (1) individually tested (i.e., no inferences are drawn about the population from which the data set is selected), or (2) produced by a process that is monitored in such a manner that the process is "statistically guaranteed" to produce data sets of a prescribed quality (i.e., the data set in question may or may not have been tested, but the process used to produce the data set is continually tested). However, no provision is made for reporting the accuracy of a data set that has been "statistically accepted" as part of a batch (or lot) of data sets. In this case, a given data set may or may not have been individually tested, but the batch of data sets has been tested, and each data set in the batch should be labeled with the same quality statement (inferred from the acceptance test performed on the batch). This type of labeling should be addressed in the standard.	Y	For a data set that has been accepted as part of project, but was not tested, use the “compiled to meet” statement.	COMPLETE
6-7	Appendix 3-A and 3-B, General Comment Change “Appendix A” and “Appendix B” to “Appendix 3-A” and “Appendix 3-B” in headers.	Y	Change implemented.	COMPLETE

Log number	Comment	Substantive	Resolution	Status
6-8	Appendix 3-A, Section 1, Page 3-9: Horizontal Accuracy The terms used in the definitions for obtaining horizontal accuracy need to be clarified. It is unclear as to whether individual coordinates (X or Y) are being considered, or whether a radial distance is being considered. If individual X or Y coordinates are being referenced, then use of the term "r" should be avoided. Even the use of "d" for "discrepancy" could be confused with "diagonal."	Y	The variable d has been deleted from the equation. However, the variable r is retained to represent radial error, which, in turn, is computed from errors in x and y components.	COMPLETE
6-9	Appendix 3-A, Section 1, Page 3-9: Horizontal Accuracy 1. The difference is defined as $d_i = r_{data1} - r_{check1}$, where r_i is defined as $r_i = sqrt(x_i^2 + y_i^2)$. This indicates that a diagonal distance is to be computed. As defined, the accuracy test appears to be based on absolute distance from the origin of the ground coordinate system, not the straight-line distance between the data point and the check point. This is incorrect. If diagonal error (radius) is to be determined, the formula should be expressed as: $\mathbf{d_i = sqrt((x_{idata} - x_{icheck})^2 + (y_{idata} - y_{icheck})^2)}$	Y	This equation is correct and has been incorporated in the final draft; however, we are deleting the variable d to avoid confusion.	COMPLETE
6-10	2. The formula used for calculating sigma determines the dispersion of the errors about a mean. There is an implied assumption here that the mean error is zero. This is the case for randomly distributed linear errors having equal numbers of negative and positive results. The problem here is that diagonal errors (radius) are always positive, therefore, the mean error can never be zero. The statistic called sigma (circular) is a statistic about the variation in the errors themselves. There is no accounting for the mean error of the sample. This must be accounted for in the 95% confidence level statistic. All the statistic "2.4477 * $sigma_r$" indicates is that the expected variation in errors "about the mean" should include 95% probability. However, two samples could have mean diagonal errors of 10 feet and 100 feet respectively, while the sigmas are identical. The RMS formula takes this into account.	Y	The RMSE formula has been adopted.	COMPLETE

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6-11	What is the point of the accuracy statistic? Is it to inform the user about the positional accuracy of the data or the standard error of the error? If the diagonal error is to be used to express accuracy, then the equation for determining the 95% confidence limit should be: **Accuracy_r = d + 2.4477 * sigma_r** where, **d = average diagonal error**	Y	The purpose of the accuracy statistic is to provide the user an estimate of the accuracy of the data set. Since the true value is not known, accuracy can only be estimated. The RMSE statistic is actually a measure of precision that can be used to estimate accuracy if biases and systematic errors have been removed.	COMPLETE
6-12	In any event, the circular standard error (sigma) has probably been misdefined. The ACIC (Aeronautical Chart and Information Center) publication <u>Principles of Error Theory and Cartographic Applications</u>, 1962, makes a point of defining circular standard error (sigma_c) in terms of $\text{sigma}_x = \text{sigma}_y = \text{sigma}_c$. In fact, a great deal of effort was spent on treating those cases where sigma_x <> sigma_y. While several step functions were developed based on the min/max ratio of the two sigmas, a rapid approximation can be used where circular error is approximated as equal to the mean of sigma_x plus sigma_y. This approximation is fairly accurate for min/max ratios higher than 0.5. I would suggest that this approach is the better method of determining circular standard error, and thus, the 95% statistic. The formulas would then be **Accuracy = 2.4477 * sigma_c** where **$\text{sigma}_c = 0.5 * (\text{sigma}_x + \text{sigma}_y)$** and, **$\text{sigma}_{x \text{ or } y} = \text{sqrt}[\Sigma(dx_i - \mu_{dx})^2 / (n-1)]$** or **$\text{sqrt}[\Sigma(dy_i - \mu_{dy})^2 / (n-1)]$** where **Discrepancy in X or Y (dx, dy) = $(X_{data} - X_{check})$** or **$(Y_{data} - Y_{check})$** and **Mean discrepancy in X or Y (μ_{dx}, μ_{dy}) = $\Sigma dx_i / n$** or **$\Sigma dy_i / n$**	Y	The formula $\text{sigma}_c \sim 0.5 * (\text{sigma}_x + \text{sigma}_y)$ for sigma_x <> sigma_y has been adopted where sigma_c is the circular standard error at 39.35% confidence and $\text{sigma}_{min} / \text{sigma}_{max}$ (sigma_{min} being the smaller of sigma_x and sigma_y and sigma_{max} the larger) is between 0.6 and 1.0.	COMPLETE

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6-13	Appendix 3-A, Section 3, Page 3-10: Well Defined Points When making statistical inferences, assumptions are usually made that ultimately place constraints on the testing procedure. For example, in the vertical case, the assumption is typically made that the residual difference between the data (observed) elevation and the true (known) elevation is normally distributed with mean zero and standard deviation sigma. Irrespective of whether or not this assumption is correct, the assumption itself has an impact on the testing procedure. One of the constraints stemming from the assumption is that the well-defined test points used to evaluate the accuracy of the data set must be independent. These test points should not be used to control any mathematical (or other) solution upon which elevation values are derived. For example, a control point used in a least squares adjustment or a point used as a node in an interpolation polynomial cannot be subsequently used as a test point. The use of such a point in the testing procedure compromises the validity of the test and any inferences drawn. *Therefore, it is recommended that this constraint be explicitly stated in defining the criteria for a well-defined test point.*	Y	This sentence has been added to the final draft: "The independent source of higher accuracy shall be acquired separately from data used in the aerotriangulation solution or other production procedures."	COMPLETE
6-14	Appendix 3-A, Section 3, Page 3-10: Well Defined Points Paragraph 1 -- Well-defined points identified within a precision of one-third of the maximum uncertainty for the data set. 1. A precision of one-third of the 95% level to identify check points is too broad. Too much of the allowable error budget is taken up by "guessing" the point location. If the 95% level for 24K mapping is 45.6 feet, this would allow up to 15.2 feet in identification error. Even with NAPP photography, centerline intersections can be located more accurately than that. Criteria of 15% would yield about 7 feet in the above example. This is a reasonable expectation. 2. This criteria needs to be further explained. Is this criteria intended for locating the check point on the ground or for locating the point in the geospatial data set (map, DOQ, DLG, etc)?	Y	See resolution to comment 2-16.	COMPLETE

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6-15	Appendix 3-A, Section 3, Page 3-10: Well Defined Points Paragraph 2 -- For small-scale products, acceptable features could include approximate right-angle intersections of roads and railroads; small isolated shrubs or bushes; and corners of structures or buildings. 1. There is no definition in the document for small-scale. A statement should be added to indicate what scales are considered small-scale and large-scale. 2. If small-scale includes 1:24,000-scale, the acceptable features for well-defined points should not include small isolated shrubs or bushes, and corners of structures or buildings.	Y	This section has been rewritten, based on resolutions to comments 12-29 through 12-35. Statements such as "large scale" and "small scale" have been replaced by scale values.	COMPLETE

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6-16	Appendix 3-A, Section 4, Pages 3-10 and 3-11: Check Survey Design Paragraph 1 -- Check survey points must have an accuracy of one-third or better of the intended accuracy of the data set at 95% confidence level. (Also stated in Section 3.2.3, Pages 3-3 and 3-4: Accuracy Test.) 1. This error allowance for check point accuracy is too broad. Without sufficient accuracy in the check point survey, the results of the accuracy test are meaningless. ASPRS interim standards did mention designing a check survey with one-third of the "limiting rms error." This was in linear x or y, not circular. This ratio cannot be blindly transferred to a 95% statistic. Assuming that an NMAS accuracy of 40 feet is equivalent to a standard error (limiting error) in x or y of 18.6 feet, the accuracy for the check point survey would be 6.2 feet in x or y or 8.8 feet diagonal. This value is 22% of the NMAS limit of 40 feet. Using the same approach with the 95% statistic (45.6 feet), 22% would give 10 feet (diagonal) as the check point accuracy. Modern survey techniques can easily produce accuracies of 3 or 6 feet. 2. Under this standard, with another third allowed for choosing a well-defined point (see above), two-thirds of the permissible error is already "soaked up." The accuracy test noise level is so high that only errors that exceed two-thirds of the expected 95% confidence level are meaningful. For example, with a 95% level set at 45.6 feet (NMAS 40 feet) which gives up to 15 feet for check point accuracy and 15 feet for identifying accuracy, only errors in excess of 30 feet are above the noise level. 3. A second consideration should also be that modern survey technology provides much more accurate results. One meter and two meter accuracies are easily and quickly obtainable as are submeter surveys. A two-meter diagonal error in a check point would translate to only 15.5% of a 95% statistic for 1:24000 mapping. It has become much more realistic to expect higher accuracy field surveys.	Y	See resolution to comment 2-16.	COMPLETE

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6-17	Paragraph 2 -- Check Survey Design indicates that all check point accuracies are referenced to Continuously Operating Reference Stations (CORS). 1. Why specifically require reference relative to a CORS when many surveys are local networks adjusted prior to use of any CORS? Since surveying requirements may not include GPS adjusted in relation to a CORS, use of GPS at all, or even network surveys, why must one indicate accuracy with reference to a CORS? Since the check point accuracy is one-third of the maximum error expected at 95%, check point accuracy can be very rough. For example, for an NMAS 40 foot product, the equivalent 95% might be 45.6 feet. The allowable check point error is then 15 feet. There are several techniques that would provide that accuracy without needing to be referenced to a CORS.	Y	References to CORS in Part 3 have been deleted.	COMPLETE
6-18	Paragraph 2 -- Check Survey Design 2. Would not references to general positional accuracy (network, traverse, or otherwise) standards be more applicable, cover more cases, and make it less restrictive for data providers to test their data?	Y	This approach to data acquisition for the independent source of higher accuracy is only one of many possible approaches - it is intended to be merely informative.	COMPLETE
6-19	Appendix 3-B, Section1.1, Page 3-14: Explanation of RMSE Component Accuracy 1. Many accuracy tests have been reported in diagonal RMS. While the X or Y RMS gives a more accurate conversion to NSSDA, shouldn't a factor also be derived for diagonal RMS where the component RMS values are unknown? X or Y RMS can be approximated from Diagonal RMS by assuming that the component RMS values are equal. Then **Accuracy = 2.447 * sqrt(diagonal RMS^2 / 2)**	Y	Radial RMSE can be derived from RMSE's in each of the x and y components *or* computed from straight line measures between the data set and the check source. This is included in the final draft.	COMPLETE
6-20	Appendix 3-B, Section1.1, Page 3-14: Explanation of RMSE Component Accuracy 2. What is the purpose of the second to the last sentence of paragraph 1.1? The explanation of the cumulative errors in the RMS calculation applies just as well to the NSSDA.	Y	This sentence has been deleted. Since the NSSDA statistic has been changed to RMSE, repeating this statement is redundant.	COMPLETE

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6-21	Appendix 3-B.1.4, Page 3-15: RMSE Accuracy Reporting Change “as described in Section 2.4" to “as described in Section 3.2.4.”	Y	Change implemented, but section 3.2.4 has been renumbered as 3.2.3.	COMPLETE
7-1	3.1.1 1st paragraph change statistic to statistical (statistic is a noun not an adjective)	Y	Change implemented.	COMPLETE
7-2	3.1.1 1st paragraph I assume the spatial data is derived from sources such as aerial photographs, satellite imagery, and maps. This is not really clear from the wording of the 1st sentence. It could be interpreted as the testing methodology is derived from sources such as	Y	This has been revised as follows: “The NSSDA applies to fully georeferenced maps and digital geospatial data, in either raster, point, or vector format, derived from sources such as aerial photographs, satellite imagery, and ground surveys. It provides a common language for reporting accuracy to facilitate the identification of spatial data for geographic applications.”	COMPLETE
7-3	In 3.1.1, switch the position of the 2nd and 3rd paragraphs. It makes more sense to describe the type of standard and then discuss the limits.	Y	Change implemented.	COMPLETE
7-4	3.1.4 Spell out FGCS.	Y	Change implemented.	COMPLETE
7-5	3.2.1 Change smaller to greater. The accuracy should be greater than the reported value.	Y	The sentence has been rewritten as, “Accuracy reported at the 95% confidence level means that 95% of positions have an error …smaller than or equal to the reported accuracy value.”	COMPLETE
7-6	3.2.4 Accuracy Reporting Does the standard need to specify “@95% confidence level”? We don’t print the 90% figure on our maps that meet NMAS. Seems like the 95% is part of the definition of the NSSDA. Specifying 95% implies that there might be some other percent that could be used.	Y	The standard needs to specify 95% confidence level, as quantitative accuracy values are being reported.	COMPLETE
7-7	3.3 NSSDA AND OTHER MAP ACCURACY STANDARDS The NSSDA by itself doesn’t report anything. In the 1st sentence change ‘reported by’ to ‘reported according to the’. Second sentence insert ‘as specified’ between ‘reported’ and ‘by’.	Y	Changes implemented.	COMPLETE
7-8	I assume there are standards for the format of FGDC documents and that this one follows the standards. There are no headers or footers and the footnote figures are not in the right format. Presumably they will be in the final document.	N	The final draft will conform to Directive #6 on Formatting FGDC Standards Documents, issued by the Standards Working Group.	COMPLETE

Log number	Comment	Substantive	Resolution	Status
8-1	The proposed statistics for horizontal and vertical accuracy (forth on pages 3-9 and 3-10) are essentially measures of dispersion or variation about a mean value. Such a statistic reflects *precision* but does not take into account the possibility of *bias* in the data. If the mean discrepancy is not small (and, in general, the radial discrepancy associated with the horizontal measure will have non-zero mean), then the proposed accuracy value could provide a very misleading idea of the reliability of the map. As an extreme example, a map whose mean locational error is 100' (a very large bias) and standard deviation is 2' (high precision) would be deemed more accurate under the proposed standard than one whose mean error is 2' and standard deviation is 10' (low precision). The *accuracy* of spatial data should reflect both bias (mean) and precision (variation about that mean value). Reporting the standard deviation only, as suggested in the proposed standard, neglects the potential influence of bias. In order to faithfully reflect both the bias and precision it is necessary to report two values; the mean and standard deviation are often employed (Eisenhart in Ku, H. H. 1969. *The Measurement Process*. National Bureau of Standards, Special Publication No. 300 and Deming, W. E. 1950. *Some Theory of Sampling*, page 129). In a national standard, where simplicity and ease of application are required, a single statistic will probably have to suffice. A more meaningful and useful way to characterize accuracy (instead of the standard deviation) is through the use of the root mean square error statistic, or RMSE. The RMSE takes into account both the bias and the precision of the data in a single number. The appropriate RMSE for horizontal discrepancy can be defined as follows: $RMSE_r = sqrt[\sum r_i^2/n]$ where, $r_i = sqrt[(x_{data, i} - x_{check, i})^2 + (y_{data, i} - y_{check, i})^2]$, the radial error at check point i $x_{data, i}$, $y_{data, i}$ are the data set coordinates of the *i* th check point	Y	This RMSE formula has been adopted.	COMPLETE
8-1 (continued)	$x_{check, i}$, $y_{check, i}$ are the coordinates of the *i* th check point from the check survey n = the number of points being checked.			

Log number	Comment	Substantive	Resolution	Status
8-2	In the case of the vertical error, the quantity *ri* would be replaced by linear difference between the elevation value from the data and the (known) more accurate check value.	Y	See response to comment 8-1.	COMPLETE
8-3	Similarly, accuracy reporting (set forth on pages 3-4 and 3-5) should use the RMSE value instead of the standard deviation. Mention of confidence intervals (95% or whatever) should probably be deleted from the standard. It may be misleading to build such statistical conclusions into the national standard when the empirical error data may not (and often will not) warrant (Deming, page 502).	Y	The 95% confidence level is essential to this standard. The assumptions underpinning the application of confidence intervals are explicitly stated in the final draft.	COMPLETE
8-4	. . . the assertions at the top and in the middle of page 3-15 and elsewhere--that the RMSE and standard deviation are nearly equivalent when sample sizes are large--probably depends on the assumption of a zero-mean distribution. [This assumption is not valid for radial distance errors, which are strictly non-negative.] While the errors may or may not have a zero mean in a given situation, the standard should explicitly acknowledge the assumption.	Y	Assumptions about normally distributed values will be explicitly stated in the final draft.	COMPLETE
8-5	A key point concerning the factors used to produce the 95% confidence levels from the sample standard deviations (pages 3-9 and 3-10) is the assumption that the errors are normally distributed. This assumption of normality should be stated in some way.	Y	Assumptions about normally distributed values will be explicitly stated in the final draft.	COMPLETE
8-6	I suspect the definitions of the quantities related to horizontal accuracy, section 1 on page 3-9 need to be revised. One way they might be redefined is as follows: $sr = sqrt[\sum(r_i - r_{mean})]$, where $r_i = sqrt[(x_{data, i} - x_{check, i})^2 - (y_{data, i} - y_{check, i})^2]$, the radial error at check point i $r_{mean} = \sum r_i /n$ $x_{data, i}$, $y_{data, i}$ are the data set coordinates of the *i* th check point $x_{check, i}$, $y_{check, i}$ are the coordinates of the *i* th check point from the check survey n = the number of points being checked.	Y	The RMSE equation will be adopted as the accuracy statistic.	COMPLETE
9-1	In Appendix B, pg. 15, in item 2.1: I believe the terms smaller and larger, in reference to the scale tolerances are switched, OR the values 1/30 and 1/50 need to be switched to the proper sentence.	Y	The referenced statements were accurately copied from the National Map Accuracy Standards.	COMPLETE

Log number	Comment	Substantive	Resolution	Status
9-2	Similarly in item 2.2 in the last 3 lines The math (1.14*S/360) AND (1.14*S/600) need to be switched to go with the proper larger/smaller terms.	Y	These statements are correct as written, given that the referenced statements in comment 9-1 are correct.	COMPLETE
10-1	I have reviewed the Draft GPAS document. I find it to be an excellent piece of work with extensive guidance for the survey community.	N		COMPLETE
10-2	The mapping and GIS community needs a little more work. This document has one major deficiency, the draft GPAS is to replace the National Mapping Accuracy Standards (NMAS). Unfortunately the GPAS only covers one minor aspect of the NMAS, that is the method of reporting accuracy. I do comment this move, 95% is more widely used and is clearly moving spatial integrity to a higher lever of accountability. The issue of mapping ethics and the appropriateness of display at a specific scale or scale compatibility completely missing. While there is some attention given in Introduction Part 3 of GPAS, this is wholly inadequate. We the users of these standards do not expect and statement [sic] of recommended scales for specific data or data types. We do need a method of stating the appropriate scale of use for a data set who's level of accuracy is clearly known. Please, do not assume that the mapping community knows right from wrong when is comes to ethical or appropriate use of spatial data. With the mass influx of individuals, with no formal training, into the Geographic Information Systems field individuals need appropriate guidance. The guidance provided in the NMAS will be missed. Please continue to provide the kind of guidance to those who don't have a strong back ground in the spatial sciences and sorely need to make informed decisions. Help those of us who do have the back ground in the spatial sciences by providing us with a standard that we can use as a tool to improve or maintain a minimal level of mapping quality and integrity.	Y	It was realized that it was impractical to replace NMAS, because many legacy maps and geospatial data use NMAS criteria. However, once the NSSDA is endorsed as an FGDC standard, positional accuracy for new and revised maps or digital geospatial data products shall be reported according to the NSSDA. The NSSDA puts the onus on producers to define appropriate scales and conformance quality levels for positional tolerances in their product specifications. If producers determine that conformance quality levels and appropriate scales from standards such as the NMAS or American Society for Photogrammetry and Remote Sensing (ASPRS) Accuracy Standards for Large-Scale Maps are acceptable, they may incorporate them into their product specifications.	COMPLETE
11-1	PART 1: Reporting Methodology EPA rarely deals with nice well-defined and small area points. Defining accuracy of a facility centroid or “front gate” in these specific terms may not be appropriate.	N	Since Geospatial Positioning Accuracy Standards applies to well-defined points, the kind of positional accuracy the reviewer requires seems to be outside the scope of the GPAS.	COMPLETE

Log number	Comment	Substantive	Resolution	Status
11-2	PART 1: Reporting Methodology In addition to geospatial phenomena/accuracy topics, have other data quality elements such as completeness, logical consistency, temporal accuracy, and thematic accuracy been considered?	N	The Subcommittee for Base Cartographic Data will develop standards for *all* data quality elements identified in Content Standards for Digital Geospatial Metadata.	COMPLETE
11-3	PART 1: Reporting Methodology Will there be a published product specification for all geospatial products, covering regulatory, monitoring, and base framework data? Does this already exist?	N	The reviewer should be directed to current FGDC standards projects.	COMPLETE
11-4	PART 3: National Standard for Spatial Data Accuracy Standard is weak on details on defining the methodology for determination of accuracy. Discussion sounds great in theory, but it doesn't say much in real life practice.	N	An example of accuracy calculations will be included in an informative appendix to Part 3.	COMPLETE
11-5	PART 3: National Standard for Spatial Data Accuracy Another weak area is how to deal with uncertainty in boundary or edge values, that tend to have higher error rates associated with them, than center values of classified polygons.	N	Boundary or edge values are outside the scope of Part 3, National Standard for Spatial Data Accuracy.	COMPLETE
11-6	PART 3: National Standard for Spatial Data Accuracy The standard cites preference for using National coordination systems. A discussion is omitted concerning coordinate conversion, and the source and method to make the conversion.	N	Coordinate systems and coordinate conversion are beyond the scope of this standard.	COMPLETE
11-7	GENERAL COMMENTS Most current EPA applications might not meet this standard. Might be useful to show examples of projects that currently record data that 'meets' the standard and projects that record something different from the standard.	Y	A decision tree will be included in a subsequent version of Part 1 so that there are guidelines for determining which part of Geospatial Positioning Accuracy Standards should be used for a particular application.	COMPLETE
11-8	GENERAL COMMENTS Authors should include a short discussion of more casual types of locational data efforts, such as most of the ones being run by states. Is the level of accuracy proposed appropriate in these cases?	N	See response to comment 11-7	COMPLETE

Log number	Comment	Substantive	Resolution	Status
11-9	GENERAL COMMENTS The new FGDC Geospatial Positioning Accuracy Standard will probably be as expensive to perform the prescribed accuracy determinations as it was to do the original GPS data collection. The standard requires you to be able to determine, on a statistically representative sample of original locational data points, a much more accurate coordinate (+/- cm's). The deviation from the more accurate positioning is the accuracy of the original data collection effort. The difference in cost for acquiring a +/- 5.0 meter point and a +/- 5.0 cm point is considerably greater than a factor of 10. It would make things less expensive under this procedure if the 'statistically representative sample' could be a less rigorous (i.e smaller), number of the original points.	N	Please note that testing by an independent source of higher accuracy is only the *preferred* method of estimating accuracy. Testing does not necessarily have to be done by executing an independent field survey: a data producer may select high accuracy points from a pre-existing data base.	COMPLETE
12-1	The NSSDA does not provide a real target value or a pass-fail criterion for agencies to achieve. It is intended to replace a standard that does provide a pass-fail standard level of accuracy in national spatial data products. We believe that the proposed NSSDA is not really an accuracy standard, and that we're inviting confusion if it were to be called one. We believe a national accuracy standard should be setting guidelines to establish a level of consistency for both the measurement of accuracy and for the interpreting of accuracy values. As stated in the first paragraph of the purpose, "It provides a common language to **<u>report</u>** accuracy to facilitate the identification of spatial data for geographic applications." (Our emphasis). Therefore, we recommend that a more descriptive and truthful title of the document is: "National Standard for <u>Reporting</u> Spatial Data Accuracy."	Y	The title will remain as is, because the geospatial data community has become accustomed to this name.	COMPLETE

Log number	Comment	Substantive	Resolution	Status
12-2	It is stated that the NSSDA is intended for use with new and revised spatial data. This is a good statement, however an assumption is being made that all new spatial data are being collected directly from recent observations of the ground, as was in the past when graphic maps were manually produced. We would suggest that spatial data has a much more broader meaning today, in that many new spatial data products are now derived from other spatial data products. Even though an accuracy test that references the data to the ground with regards to what is true is by far the best way to determine accuracy, it is also far from being a reality in terms of what technology allows us to do today. The trend that has actually taken place for spatial data is that users are testing for “Relative Accuracy”, i.e. digital spatial data are tested against the source from which they were derived as a check on the process used to make the product. This is part of what makes spatial data so popular. … we believe that due to a growing lack of resources in government and in the absence of field parties to collect ground test points, “Relative Accuracy” would be the most common measurement used for comparing the accuracy of spatial data in both government and the private sector of the mapping industry.	Y	The final draft of the NSSDA makes provision for estimating positional accuracy using methods other than comparison with an independent source of higher accuracy.	COMPLETE
12-3	We suggest that consideration be made to broaden this standard for inclusion of “Relative Accuracy” conditions. If this were to be done, data producers would also be required to report the existing accuracy of the source from which the data was derived. Along with the spirit of truth-in-labeling, perhaps another label could be applied that would state something to the effect that “This data set has been derived with a relative accuracy of ____ feet from various source data.”	Y	Introducing another label would needlessly complicate accuracy reporting.	COMPLETE

Log number	Comment	Substantive	Resolution	Status
12-4	This standard does not really define what *accuracy* is, with regards to the true meaning of the term. The term "Accuracy" actually has a broad usage and as a result has many meanings under its umbrella, with all of them being somewhat correct. Please reference sections 11.0 through 11.8 (pages 15-17) of the FGDC Draft Content Standards for Digital Elevation Data, Jan. 1997 version. The DEM standard offers some very excellent definitions for what accuracy truly is and also references different types of accuracy measurements. It seems that these same kind of definitions belong in the NSSDA. We believe that defining the different types of accuracies that are in use will make it less likely for a user to misinterpret the true meaning of the term and its intended usage within this standard.	Y	A glossary of terms will be added as an informative appendix to Part 1. See response to comment 2-2.	COMPLETE
12-5	Given that this entire section suggests what the NSSDA is and is not, concerning spatial accuracy, we question whether it is in the best interests of the nation to propose a ***replacement*** of NMAS, (which does contain accuracy thresholds), with a national standard that provides no accuracy thresholds. The NMAS may have some faults, however, to suggest that it is obsolete and no longer applicable for stating the accuracy of map information is far-reaching and potentially impacts every federal mapping agency. We recommend that the NSSDA ***supplement*** or be an addition to the NMAS as a standard means agencies can use to state and report the accuracy of their products. We do not question the need to have a national reporting standard for accuracy. We believe replacing NMAS will negatively impact the users of data from federal agencies because each agency potentially may determine different specific accuracy tolerance levels, even within the same product series. The result of having a variety of accuracy tolerances throughout the federal community has the potential to cause less cooperation and data sharing. This is because the accuracy of data from different producers and cooperators will vary and be inconsistent from one data set (or even feature or theme) to another.	Y	See resolution to comment 10-2. NMAS measures are not fully applicable to digital geospatial data because digital data is not constrained by map characteristics such as publication scale and contour interval. Also, the geospatial data community has expanded to include many more data producers with different product specifications and many more data users with different application requirements. The NSSDA was developed to provide a common reporting method so that users can directly compare data sets for their applications.	COMPLETE

Log number	Comment	Substantive	Resolution	Status
12-6	It is possible that our agency would not adopt a specified accuracy tolerance value to be applied across all products and product series. We would end up with a product line that has every imaginable accuracy level and would no longer be consistent. Our customers have come to rely on the dependable accuracy of our products. We believe our reputation for having a consistent and defined accuracy tolerance will be eroded by the replacement of NMAS with a standard that does not define a national accuracy tolerance value as opposed to a value named after our agency and which could be confused with a value determined by a different agency.	Y	The NSSDA encourages your agency to set accuracy threshold values for its product specifications.	COMPLETE
12-7	We are also concerned with the legality and authority of the FGDC replacing the NMAS through the issuance of a new standard. The NMAS was established by an act of Congress through the US Bureau of the Budget (now Office of Management and Budget - OMB). Has this been addressed and are there any legal or political implications which could arise through the "automatic" replacement of NMAS with the NSSDA?	Y	This issue is beyond the authority of the panel adjudicating comments from public review. If reviewers feel strongly about this issue, they should raise it with the FGDC Secretariat.	COMPLETE
12-8	It is unclear to us if the NSSDA is intended to apply to graphics products which may be derived from image or digital geospatial data. If so, we have concerns for applying strict accuracy criteria to representative information that is occasionally displaced and generalized for cartographic symbolization and presentation of data onto hardcopy media. We recommend that this be addressed in the standard and that strict accuracy specifications may not necessarily apply to some derivative products which are subject to generalization and symbolization.	Y	The NSSDA applies to maps as well as digital geospatial data: read Section 3.1.1. It merely provides an estimate of how close the point coordinates on the map or in the data set are to ground position.	COMPLETE
12-9	Sections 3.1.4 and 3.1.5, pg 3-2 We are assuming that FGCS stands for the Federal Geodetic Control Subcommittee, however, from the text on this page, that is unclear. Please list agency or committee acronyms by "full name, (abbreviation)", the first time it occurs in each part of the standard.	Y	See Resolution to log number 7-4.	COMPLETE

Log number	Comment	Substantive	Resolution	Status
12-10	Section 3.2.3, Accuracy Test The first paragraph states: "The producer of spatial data will determine the geographic extent of the data to be tested and the amount of testing". At the same time in the last paragraph the statement is made: "Test a minimum of 20 check points...". We suggest that a minimum size for the geographic extent, based on scale, also needs to be specified. This would establish a pattern of consistency between the spacing of test points by scale. The following two examples show the extremes that could occur: 1-Degree x 1-Degree area with 20 test points **vs.** 7.5-minute x 7.5-minute area with 20 test points	Y	This information is more appropriate for inclusion in product specifications than in a national standard. Because of the diversity of users' requirements, it is not realistic to include statements that specify the spatial distribution of check points.	COMPLETE
12-11	Section 3.2.3, Accuracy Test The 2nd sentence of paragraph 2 should read, "Select the check source so that its accuracy is within one-third the **intended** accuracy of the data set at the 95% confidence level."	Y	See resolution to comment 2-16.	COMPLETE
12-12	Section 3.2.3, Accuracy Test In paragraph 3, sentence 1, well-defined points don't exist with regards to graphic contour data and vector hypsographic data. To obtain a single linear value for vertical accuracy, an elevation value from a digital derivative product can only be compared against the source at the same exact X-Y coordinate. In other words, vertical measurements are a point-to-point linear value of the same X-Y coordinate. Therefore, we recommend rewording to: "Test vertical accuracy for Z by comparing the elevations of the source and check source against the same X-Y coordinate value of each data set.	Y	The following wording has been added to the draft: "For data such as gridded digital elevation data or topographic contours, which most likely do not contain well-defined points, test vertical accuracy by comparing the elevation of a point in the data set with the elevation at the same position in the independent source of higher accuracy."	COMPLETE
12-13	Section 3.2.3, Accuracy Test Paragraph 3, sentence 3 should read, "Select the check sources so that accuracies at check point locations are within one-third the data set's **intended** accuracy at the 95% confidence level."	Y	See resolution to comment 2-16.	COMPLETE

Log number	Comment	Substantive	Resolution	Status
12-14	In the last paragraph, some 24K and 100k series maps and their corresponding digital products do not always have enough geographic area to be able to fit 20 check points, for example, quadrangles with large void areas due to bounding limits of Canada, Mexico and large open water such as occurs with the Atlantic and Pacific Oceans. Therefore, we recommend adding wording such as: “When the geographic extent contains an excessive amount of area that is void of data coverage, due to things like national boundaries or water bodies, then the producer may proportion the number of collected test points with that of the coverage which does exist.”	Y	The sentence has been rewritten as: “A minimum of 20 check points shall be tested, distributed to reflect the *geographic area of interest* and the distribution of error in the data set.” Areas void of coverage would not be in the geographic area of interest. Similarly, if an urban area is the geographic area of interest, the urban area would have a higher concentration of sample points than rural areas.	COMPLETE
12-15	Section 3.2.4, Accuracy Reporting Statements The second paragraph (page 3-4) may read better by prefacing it with “There are three conditions for reporting accuracy:” and then list each sentence as a separate bullet below.	Y	Each sentence has been listed as a bullet item in the final draft: “Below are guidelines for reporting accuracy of composite data sets:” followed by the bullet items.	COMPLETE
12-16	Section 3.2.4, Accuracy Reporting Statements We do not believe the statements provided for reporting accuracy are very meaningful in their current form. In fact, to an average lay person who is not necessarily a scientist or statistician, they are rather confusing. Most map and data producers have little room left on their product to be wordy and to include lots of references. We believe these statements should be simple and easily express what the producer actually intends to say about the accuracy of their product.	N	See responses to comments 12-17 to 12-21.	COMPLETE
12-17	Section 3.2.4, Accuracy Reporting Statements We also question whether or not a user may interpret the “tested by...” statement to mean tested against ground truth. Many accuracy tests will be against some comparison source other than ground truth. Perhaps the statement more specifically state the source used to test the data?	Y	“Tested” means that the data set has been compared against an independent source of higher accuracy. The higher accuracy data need not be surveyed positions, but it should provide higher accuracy positions than the data set. Information about the source will be included in Metadata.	COMPLETE
12-18	Section 3.2.4, Accuracy Reporting Statements The NSSDA has not established the pass-fail accuracy threshold, only the data producer has. Including the line “National Standard for Spatial Data Accuracy 1997" is not meaningful and adds nothing of value. In fact it may create confusion again, because someone might assume that the given thresholds were taken from NSSDA. Therefore, we recommend deleting the line.	Y	The line “National Standard for Spatial Data Accuracy 1997" has been deleted.	COMPLETE

Log number	Comment	Substantive	Resolution	Status
12-19	Section 3.2.4, Accuracy Reporting Statements We also recommend removing the "( )" around the words 'horizontal' and 'vertical' and to incorporate these words directly into the statement.	Y	Change implemented.	COMPLETE
12-20	Section 3.2.4, Accuracy Reporting Statements We recommend using the following statements for reporting accuracy: Tested data are within _____ meters/feet of true horizontal position, 95% of the time. Tested data are within _____ meters/feet of true vertical position, 95% of the time. Well-defined points are compiled within _____ meters/feet of true horizontal position, 95% of the time. Well-defined points are compiled within _____ meters/feet of true vertical position, 95% of the time.	Y	The accuracy reporting statements will be left as they are. "Confidence level" has a particular statistical meaning from which we can draw inferences about *all* items of interest (well-defined points or elevations) in the data set, not merely the sampled items.	COMPLETE
12-21	Section 3.2.4, Accuracy Reporting Statements The last sentence on page 3-5 suggests that data sets not containing vertical information be labeled as such. The same could hold for vertical data sets which do not contain horizontal accuracy information, as in DEM products. Therefore, add the following sentence: "If a data set does not contain horizontal information, label for vertical accuracy information only".	Y	This sentence has been added: "Conversely, if a data set, e.g., a gridded digital elevation data set or elevation contour data, does not contain well-defined points for horizontal accuracy testing, label for vertical accuracy only."	COMPLETE
12-22	Bibliographic References, pg 3-7 We strongly recommend adding complete bibliographic information for all sources and references used to obtain the equations, statistics information, and constants used in every occasion throughout this document. This will lend credibility to the document, will allow readers to verify all mathematical and theoretical references, and will cover the authors against potential copyright infringements.	Y	Complete citations and references have been added.	COMPLETE

Log number	Comment	Substantive	Resolution	Status
12-23	Appendix A, 1. Horizontal Accuracy We strongly recommend that <u>all</u> terms used, including subset terms, be completely described in the definition of the equations. For example, in the "where" statement, $r_{data\ I}$ and $r_{check\ I}$, as well as r_i do not show up in the main equation and there is no explanation defining these terms. Likewise, the x_i and y_i have not been defined.	Y	All variables have been defined in the final draft.	COMPLETE
12-24	Appendix A, 1. Horizontal Accuracy In our interpretation of the "where" statement, the equations $d_i =$ and $r_i =$ are used to determine the same value, that is, the linear distance between to (X,Y) coordinate pairs. The need for the term "r" actually is not necessary. Therefore, the need for two equations can be reduced from two to one (d_i = sqrt $[x_i^2 + y_i^2]$).	Y	The variable d has been deleted to eliminate confusion. The variable r is retained to signify radial error.	COMPLETE
12-25	Appendix A, 1. Horizontal Accuracy We recommend the equation to determine the standard deviation for the horizontal coordinates be changed to: $$sigma = \sigma = \pm\sqrt{\frac{\sum(d_i - d)^2}{(n - 1)}}$$ where: d_i = $\sqrt{(x_s^2 - x_{cs}^2) + (y_s^2 - y_{cs}^2)}$ d = $\sum d_i / n$ (the mean discrepancy) n = total number of points checked and where: i = one point from the domain of test points x_s and y_s =data set coordinates x_{cs} and y_{cs} = check source coordinates	Y	RMSE based on radial error has been adopted as the accuracy statistic.	COMPLETE

Log number	Comment	Substantive	Resolution	Status
12-26	Appendix A, 1. Horizontal Accuracy We also recommend that a small sample data set, data table, and set of calculations for about 20 test points be included in the Appendix to illustrate the use of each equation that needs to be used for determining circular error and comparing that result to a 95% confidence level. This would help facilitate explaining how this system works to all users of this standard and how it is different from currently established accuracy standards.	Y	An example of computing positional accuracy according to the NSSDA will be included as an informative appendix.	COMPLETE
12-27	Appendix A, 1. Horizontal Accuracy We recommend rewording the last sentence of the first paragraph to: “The standard deviation for the set of horizontal test points are:” The standard deviation is used to evaluate a set of horizontal test points, i.e. for 20 data points together with 20 corresponding check points, not just one coordinate pair. The singular reference to a horizontal coordinate is incorrect.	Y	The erroneous wording has been deleted in the final draft.	COMPLETE
12-28	Appendix A, 1. Horizontal Accuracy After the “where” section, it states “NSSDA horizontal accuracy is:” Since NSSDA is not a pass-fail system . . ., it is incorrect to make the statement that the result is NSSDA accuracy. . . Therefore, the statement should read (in this case): “The circular horizontal accuracy which would be reported according to NSSDA specifications is:” Please also correct this for section 2, Vertical Accuracy, (pg 3-10).	Y	The sentences have been changed to read “according to the NSSDA” in the final draft.	COMPLETE
12-29	Appendix A, 3. Well-Defined Points Well-defined test points must not only be easily visible or recoverable on the ground, they must also be easily visible and recoverable on sources which are used to produce and/or test the product and on the product itself. If a test point is not recoverable on any of these three items, the test point could become invalid, especially if there are problems or errors associated with the point. Persons performing the accuracy test must be able to validate all test points and be able to check the locations of the points on all sources as well as the final product, as necessary. Therefore, we recommend rewording the second sentence as: “These features must be easily visible or recoverable on the ground, on the sources used to produce the product, and on the product itself.”	Y	The wording, “well-defined points must be readily visible or recoverable on the ground, on the independent source of higher accuracy, and on the product itself,” has been included in the final draft.	COMPLETE

Log number	Comment	Substantive	Resolution	Status
12-30	Appendix A, 3. Well-Defined Points The document is correct in stating that features selected for well-defined test points will differ depending on the data source and the product scale. However, the test points will also differ depending on the product being produced. Test point requirements are different for image products (such as orthophotos) than they are for paper topographic map products and for elevation products. We recommend that this paragraph be redeveloped and expanded to provide examples of the kinds of test points that are suitably well-defined for typical geospatial products.	N	More specific recommendations are provided in subsequent comments.	COMPLETE
12-31	Appendix A, 3. Well-Defined Points …for orthophoto (or image) products, suitable well-defined features, visible on the ground as well as the source and product, include small isolated shrubs or bushes, right-angle intersections of roads and railroads, and other linear planimetric features that intersect at or near right angles, such as canals, ditches, trails, fence lines, and pipelines.	Y	These ideas have been added to the final draft.	COMPLETE
12-32	Appendix A, 3. Well-Defined Points For graphic map products, suitable well-defined features, visible on the ground as well as the source and product, include right-angle intersections of roads and railroads, and other linear mapped planimetric features that intersect at or near right angles, such as canals, ditches, trails, fence lines, and pipelines.	Y	These ideas have been added to the final draft.	COMPLETE
12-33	Appendix A, 3. Well-Defined Points For much larger scale map products such as engineering plats or property maps, suitable well-defined features, visible on the ground as well as the source and product, may include additional features such as utility access covers, intersections of sidewalks, curbs, or gutters as long as they are visible on both the source and the product.	Y	These criteria has been added to the final draft. Note: Engineering plats or property maps have been identified at being scales of 1:5,000 or larger. Terms such as “large scale” and “small scale” mean different things for different applications.	COMPLETE
12-34	Appendix A, 3. Well-Defined Points Based on our experience, the “corners of structures or buildings” are not good test points because of radial distortion on imagery, shadows, and that it is very difficult to get a good position on the feature, especially with GPS (much of the satellite view may be blocked). Also, these features typically are symbolized with an exaggerated symbol size and may be displaced from roads, railroads, or other “more important” features during mapping which would provide false positioning errors	Y	Corners of structures or buildings have been deleted as examples of well-defined points.	COMPLETE

Log number	Comment	Substantive	Resolution	Status
12-35	Appendix A, 3. Well-Defined Points Our experience also shows that "monuments or markers, such as bench marks and property boundary monuments" will not be visible on source imagery because they are too small. The only time they might be appropriate is if they are already mapped and that map product is used as the source of higher accuracy. However, one must use caution if one does not know how accurately these features have been plotted on that source. There are numerous other features that make much better test points.	Y	Monuments or markers have been deleted as examples of well-defined points.	COMPLETE
12-36	Appendix A, 3. Well-Defined Points Also, well-defined points do not exist with regards to graphic contour data and digital hypsographic data. We recommend that this section clarify that it is applicable only to horizontal data.	Y	The sentence, "Graphic contour data and digital hypsographic data may not contain well-defined points," has been added to clarify this point.	COMPLETE
12-37	Appendix A, Check Survey Design In the second paragraph, we have concern with the statement that the positional accuracy of the data set should be compared with the FGCS network accuracy for the check source and that network accuracy of a control point is the uncertainty of its coordinates with respect to the nearest Continuously Operating Reference Station (CORS). The CORS network is currently operating in an experimental mode. NGS will not guarantee the accuracy of the data. Also, positional coordinates for the CORS stations are continually refined, although the changes are minute. We believe the use of CORS data should be reevaluated as the "ultimate" accuracy source.	Y	Reference to CORS has been deleted in Part 3.	COMPLETE
12-38	Appendix A, Check Survey Design We are unclear as to why horizontal check surveys cannot be tied to <u>any</u> horizontal station published by NGS, or established using real time DGPS that guarantees (at the 95% confidence level) an accuracy better than 1/3 the proposed accuracy of the product being tested. Vertical accuracy should not be tested using real time DGPS unless the correctors used can meet the necessary vertical requirements, which is more questionable than the horizontal component.	Y	Using National Spatial Reference System (NSRS) points as an independent source of higher accuracy is only one of many possible ways to estimate the accuracy of a data set.	COMPLETE

Log number	Comment	Substantive	Resolution	Status
12-39	Appendix A, FGCS Accuracy Classification chart, pg 3-11 We recommend the entire chart be completed rather than using the "etcetera". For an official national document such as this, we don't believe items should be left to chance or assumption about interpretation and comprehension by the user.	Y	The chart has been deleted.	COMPLETE
12-40	Appendix B, Section 1.2, pg 3-14 After the "where" section, it states "RMSE may then be converted to NSSDA horizontal accuracy". . . . it is incorrect to make the statement that the result is NSSDA accuracy. . . Also, the conversion is to a circular error rather than a straight RMSE. Therefore, the statement should read (in this case): "The RMSE value may be converted to a circular accuracy value and reported according to NSSDA specifications, " Please also make a similar correction for Appendix B, Section 1.3, RMSE Vertical Accuracy, (pg 3-15).	Y	Since RMSE has been adopted as the accuracy reporting statistic for NSSDA, this is no longer an issue. The final draft contains methods for converting between radial RMSE and RMSE in each x, y component. The wording has been changed to "can be converted and reported *according to the* NSSDA."	COMPLETE
12-41	Appendix B, Section 2.2, pg 3-16 As similarly stated in previous comments, the NMAS are not converted to NSSDA, rather, NMAS is converted to CMAS. . . it is incorrect to make the statement that the result is NSSDA accuracy. . . Therefore, the sentences beginning "The quantity sqrt..." should be changed to read: "The quantity sqrt[*equation*] is a factor in CMAS horizontal accuracy. Therefore, the CMAS can be converted to a 95% confidence level, $Accuracy_r$:" After the equation, it should read: "Therefore, NMAS converted to circular error at a 95% confidence level is:" Please make similar corrections in section 2.3 (NMAS vertical accuracy, pg 3-16, section 3.2 (ASPRS horizontal accuracy, pg 3-19), and section 3.3 (ASPRS vertical accuracy, pg 3-20).	Y	The wording has been changed to "can be converted and reported *according to the* NSSDA" for all occurrences.	COMPLETE

Log number	Comment	Substantive	Resolution	Status
13-1	Comments on Draft Geospatial Positioning Accuracy Standards, Part 3: National Standards for Spatial Data Accuracy We question the validity of this being a standard without their being some kind an expected accuracy specification for everyone to hold to. Webster's dictionary defines a standard as "An accepted measure of comparison for quantitative or qualitative value." Were the specification's contained within the NMAS so bad that we had to discard them in their entirety? Was the 40 foot rule for horizontal and the one half contour interval rule for vertical too strident (sic)? If it was indeed considered to be stringent, then we should of explored the possibility a larger value to measure against, like maybe 50 feet or more, instead of a total omission. We believe that this National Standard should be setting guidelines to establish a level of consistency for both the measurement of accuracy and for the interpreting of accuracy values. Recommend: That an accuracy specification be identified and hence, included within the content of this standard. This would establish a set level of consistency among all producers of spatial data.	Y	See resolution to comments 10-2, 12-5, and 12-6.	COMPLETE

Log number	Comment	Substantive	Resolution	Status
13-2	It is written that the NSSDA is intended for use with new and revised spatial data. This statement makes the assumption that all new spatial data are being collected directly from recent observations of the ground, as it was in the past when we were manually compiling graphic maps. It should be recognized that spatial data has a much more broader meaning by today's standards; in that many spatial data products are now derived from other spatial data products. Even though an accuracy test that references the data to the ground in regards to what is true, is by far the best way to determine an "Absolute Accuracy;" it is also far from reality in terms of what the technology allows us to do today. The trend that has actually taken place for spatial data, is that users are testing for "Relative Accuracy", i.e. digital spatial data are tested against the source from which it was derived, as a check on the process used to make the product. This is in part, what makes spatial data so popular. USGS Examples are: DLG's are collected from base topographic maps (manuscript) DEM's are collected from DLG hypsographic overlays DOQ's are made from NAPP aerial photos and DEM's DRG's are a raster scan of a graphic map. In essence, all spatial products currently being produced within NMD production units are now tested for a "Relative Accuracy" in terms of how well the digital product represents the source from which it was derived. Given the absence of field parties to collect ground test points and the growing lack of resources in government; it is likely that you will find "Relative Accuracy" is the most common measurement being used for spatial data in government today. <u>Recommend</u>: That the focus of this standard be broadened to also include the condition for "Relative Accuracy." With the understanding, that the data producer be required to report the existing accuracy of the source from which the data was derived.	Y	See resolution to comment 12-2	COMPLETE

Log number	Comment	Substantive	Resolution	Status
13-3	The standard doesn't really define what accuracy is, in regards to the true meaning of the term "Accuracy." The term Accuracy actually has a broad usage and as a result has many meanings under its umbrella, with all of them being correct. Please reference to the sections 11.0 through 11.8 (pages 15-17) of the FGDC, Draft Content Standards for Digital Elevation Data, Jan. 1997 version. This standard offers some very excellent definitions for what accuracy truly is and also identifies the different types of accuracy for which measurements are in reference to. With the inclusion of these definitions within a National Standard of this type, it is less likely that a user will misinterpret the true meaning of the term "Accuracy" and its intended usage within this standard. Recommend: That the definitions being used within the FGDC, Standards for Digital Elevation Data; also be adopted for inclusion within this standard.	Y	See resolution to comment 12-4	COMPLETE
13-4	Section 3.2.3, Accuracy Test First paragraph states "The producer of spatial data will determine the geographic extent of the data to be tested and the amount of testing" while at the same time in the last paragraph to this section makes the statement that the user must "Test a minimum of 20 check points..." We should be specifying a maximum size for a geographic area to be tested based on extent and/or scale to which 20 check points are applied. This would establish a pattern of consistency between the spacing of test points by either scale or extent. The following two examples show the inconsistency and the extremes that can occur with the current wording in the standard: 1-Degree x 1-Degree area with 20 test points 7.5-minute x 7.5-minute area with 20 test points Recommend: That the first paragraph be deleted and hence, replaced with a specification that designates a maximum geographic extent for the containment of test points, based on either geographic extent, scale, or both.	Y	See resolution to comment 12-10	COMPLETE

Log number	Comment	Substantive	Resolution	Status
13-5	Section 3.2.3, Accuracy Test Paragraph 3, sentence 1, page 3-4 states: "Test vertical accuracy by comparing the elevations of well-defined points with the same points as determined from a source of higher accuracy." Well defined points don't exist in regards to graphic contours, DLG hypsographic data, or with any kind of elevation data. An elevation value from a digital derivative product can only be compared against the source, of the same exact X-Y coordinate, in order to obtain a single linear value for vertical. In other words: Vertical measurements are a point-to-point linear value of the same X-Y coordinate. Reword to: "Test vertical accuracy for Z by comparing the elevations of the source and check source against the same X-Y coordinate value of each data set."	Y	See resolution to comment 12-12	COMPLETE
13-6	Section 3.2.3, Accuracy Test, Paragraph 3, Last paragraph, sentence 1 For some of 24K- and 100k-scale maps and their corresponding digital products, there is not always enough geographic area available to allow for 20 check points, i.e. specifically for quadrangles with large void areas due to the bounding limits of Canada, Mexico and large open water areas (such as along the coasts Atlantic and Pacific Oceans, and etc). Add: When the geographic extent contains an excessive amount of area that is void of data coverage, due to either national boundaries or a large water body; then the producer may proportion the number of collected test points with that of the coverage that does exist.	Y	See resolution to comment 12-14.	COMPLETE
13-7	Section 3.2.4, Accuracy reporting Second paragraph would be easier to read if it was depicted with bullets. Add the following sentence to the end of the first paragraph and then show the three "if conditions" as bullets as follows: ...data set coordinates are in feet. Conditions for reporting accuracy are: • If data of varying accuracies can be identified separately..... • If data of varying accuracies are composited and cannot be separately identified...... • If a composited data set is not tested, ...	Y	See resolution to comment 12-15.	COMPLETE

Log number	Comment	Substantive	Resolution	Status
13-8	Section 3.2.4, Accuracy reporting To be consistent with section 3.1.4; for the second and third examples, change wording from "intended" to that of "expected." I believe the word "expected" might better identify with an existing accuracy from the source to which the data was collected from.	Y	"Expected" has a specific meaning in statistics. All references to "expected accuracy" or "intended accuracy" will be changed to refer to the accuracy value given by product specifications.	COMPLETE
13-9	Section 3.2.4, Accuracy reporting For USGS DEMs and probably some other products, we only test for a vertical RMSE value, i.e. a point-to-point linear value of the same X-Y coordinate. Hence, we do not test for horizontal accuracy. Therefore, add the statement: "If a data set does not contain horizontal information, label for vertical accuracy information only" to the statement, "If a data set does not contain vertical information, label for horizontal accuracy information only"	Y	See resolution to comment 12-21	COMPLETE
13-10	Section 3.2.4, Accuracy reporting Recommend that "Relative Accuracy" also be allowed as a condition within the labeling. This would support the concept of "Truth in Labeling." Instead of forcing a user into finding a work around that allows them to report their measurement as an Accuracy; allow for both conditions of "Accuracy" and "Relative Accuracy."	Y	See resolution to comment 12-2.	COMPLETE
13-11	Appendix A, Section 1, Horizontal Accuracy Standard deviation evaluates a set of horizontal test points, i.e. for 20 data points together with 20 corresponding check points, and not just one coordinate pair. The singular reference to horizontal coordinate is incorrect. Reword sentence from "The standard deviation for the horizontal coordinate r is:" to: "The standard deviation for the set of horizontal test points are:"	Y	See resolution to comment 12-27	COMPLETE

Log number	Comment	Substantive	Resolution	Status
13-12	Reference; "where: d_i=, r_i=" Basically both of these equations are used to determine the same value, i.e. the linear distance (diagonal) between two X-Y coordinate pairs. As it was pointed out in the previous rewording, the need for the term "r" is not necessary. Therefore we can reduce the need from two equations to that of one, being (d_i = sqrt [$x^2_i + y^2_i$]). Further, It is believed, that not everyone reading this standard will have the background or experience to understand the intended usage of the subscripts, and etc. Therefore, we also suggest that the equations should be simplified as much as possible for easier interpretation, while at the same time explaining the nature of the subscripts. To summarize these comments, we recommend the following. <u>RECOMMEND:</u> The standard deviation for the set of horizontal test points are: σ = ± sqrt[Σ (d_i - d) 2 /(n-1)] where d_i = sqrt[($x^2_s - x^2_{cs}$) + ($y^2_s - y^2_{cs}$)] d = Σd_i / n, the mean discrepancy n = total number of points checked subscripts: i = one set of points of a domain s = data set coordinate cs = check source coordinate	Y	See resolution to comments 12-23 and 12-25	COMPLETE
13-13	<u>Appendix A, section 3, Well-Defined Points</u> As it was explained earlier; well defined points don't exist in regards to graphic contour data and DLG hypsographic data. <u>Recommend</u>: That a note be added that makes it clear to the user that this section is only applicable to horizontal data points.	Y	See resolution to Comment 12-36	COMPLETE

Log number	Comment	Substantive	Resolution	Status
14-1	In general this new standard is more flexible, and the standard is very readable. It allows agencies to clearly define a "pass/fail# criteria as the current NMAS does, however it is more of a reporting standard, as there are no defined accuracy specifications. Although the current title is adequate it is suggested that consideration be given to a different title such as National Standard for *Reporting* Spatial Data Accuracy.	Y	See resolution to Comment 12-1	COMPLETE
14-2	Part 1- Reporting Methodology, pg 5, last full paragraph "The method used to determine accuracy should be defined. Examples include: ... estimation." This seems like a drastic departure from set amounts to a guess? Is this reference appropriate?	Y	This reference is appropriate. Accuracy values obtained through any of the referenced methods are estimates, as the true ground position can only be estimated.	COMPLETE
14-3	Part 1 Section 1.6 The BLM Geographic Coordinate Data Base does not, at the present time, provide relevant vertical data.	N	Then report for horizontal accuracy only. To clarify this point, this wording is contained in the final draft: "The standard for reporting positional accuracy is defined for horizontal and/or vertical coordinates, depending on the characteristics of the data sets."	COMPLETE
14-4	Part 2 Geodetic Networks: General In general, we concur. The concept of new accuracy standards is elegant in its simplicity.	N		COMPLETE
14-5	Part 2 Section 2.1 Purpose Many BLM conventional and GPS surveys fall within the accuracy of Table 2.1, yet do not fit the definition of a geodetic control surveys in Section 2.1.	Y	Accuracy of cadastral surveying data will be reported according to Table 2.1, Accuracy Standards, in Part 2, Geodetic Networks, according to Ken Bays of BLM.	COMPLETE
14-6	Part 2 Section 2.5 Accuracy Standards The second paragraph of section 2.1 implies that three-dimensional network accuracies are not being considered, although GPS is a three-dimensional measuring system. (Our understanding is that a three-dimensional accuracy standard is not being considered because although GPS is a three-dimensional system, the horizontal component is more accurate than the vertical component. Many in the GPS user community expressed a desire to report a separate horizontal and vertical accuracy in order not to dilute the horizontal accuracy with the vertical component.)	N	It is correct that GPS users prefer to report separate horizontal and vertical accuracies because the vertical component is considerably less accurate than the horizontal component. Furthermore, we reference ground points to a horizontal datum (NAD 83 or NAD 27) and a vertical datum (NAVD 88 or NGVD 29).	COMPLETE

Log number	Comment	Substantive	Resolution	Status
14-7	Part 2 Section 2.6 National Spatial Reference System The section describes a four-step procedure to classify surveys and is generally well written. Some terms should be better defined, i.e., local and network accuracy measures. How do you define "the approximate average"?	Y	The term "approximate" has been deleted.	COMPLETE
14-8	Part 2 Section 2.6 National Spatial Reference System Surveys are examined to "verify compliance with the specifications for the intended accuracy of the survey," yet no specifications exist which are written which provide guidelines for achieving the new accuracy standards in Table 2.1. The existing Federal Geodetic Control Committee GPS specifications only address the old 1st , 2nd, and 3rd-order accuracy standards, as well as new Order AA, A, and B-order geodetic surveys. Therefore, this element of accuracy evaluation cannot be performed unless new specifications are also written.	Y	The procedure leading to accuracy classification is outlined in Section 2.3, National Spatial Reference System, in Part 2, Geodetic Networks.	COMPLETE
14-9	Part 2 Section 2.6 National Spatial Reference System Local and network accuracies are defined. Network accuracy is defined with respect to the Continuously Operating Reference Stations (CORS). In many states, common survey practice is to establish control in relation to the High Accuracy GPS Reference Networks (HARNs), because the CORS stations are too distant. For example, if a geodetic network in were established in southeast Oregon, the nearest CORS station would be several hundred kilometers away on the Oregon coast, yet HARN stations are available within 50 Km. Common practice is to establish the network using HARN stations. Should there be a third definition of accuracy with respect to the HARN, or will CORS stations be densified to such a level as to make the question irrelevant?	Y	CORS stations will be densified from 104 to 200 within two to three years so that they are spaced 100-200 km.	COMPLETE
14-10	Part 2 Section 2.6 National Spatial Reference System It was recommended that the final document include a chapter addressing topics such as network error ellipses, local error ellipses, and error circle radii. Such information would better define how to classify a survey under the new accuracy standards.	Y	These topics may be included as part of a separate FGCS document.	COMPLETE

Log number	Comment	Substantive	Resolution	Status
14-11	Part 3 - National Standard: General It is noted that this standard represents a significant departure from previous views of accuracy standards. The standard dictates that accuracy should and must be reported, but does not make recommendations on the data accuracy as far as usability is concerned. This is somewhat of a buyer beware.	N	See resolution to comments 10-2 and 12-6.	COMPLETE
14-12	Part 3 - Sec 3.2.4, Accuracy Test Second sentence of paragraph 2 change: “Select the check source so that its accuracy is within one-third the data set’s intended accuracy at the 95% confidence level.	Y	See resolution to comment 2-16.	COMPLETE
14-13	Part 3 - Sec 3.2.4, Accuracy Test Paragraph 3, sentence 3 change: “Select the check sources so that accuracies at check point locations are within one-third the data set’s intended accuracy at the 95% confidence level.”	Y	See resolution to comment 2-16	COMPLETE
14-14	Part 3 - Sec 3.2.4, Accuracy Reporting statements, pg 3-5 To the lay person this may be confusing. These statements should be simplified and express the intent of the producer regarding the accuracy of the information contained in the product. As this does not seem to be an accuracy standard, but more of a reporting standard, does the statement “National Standard for Spatial Data Accuracy 1996" mean anything? Consider something like: “Tested data are ___ meters/feet of true vertical/horizontal position, 95% of the time.” and “Defined points are compiled to meet ___meters/feet of true horizontal/vertical position.”	Y	See resolution to comments 12-18 and 12-20	COMPLETE
14-15	References should be inclusive of equations, statistics, etc. used in producing this standard. This will allow users to verify mathematical references and lend credibility to the standard.	Y	See resolution to comment 12-22	COMPLETE
14-16	Under Appendix A, after the “where” section it states, “NSSDA horizontal accuracy is:” This is confusing, since it implies that there is an accuracy result from NSSDA when actually it is a reporting mechanism and the authority for the accuracy value comes from the producer of the data.	Y	See resolution to comment 12-28	COMPLETE

Log number	Comment	Substantive	Resolution	Status
14-17	The document in Appendix A, 3 under Well-Defined points needs to clarify test points. Test points will differ depending on the product being produced. This may need to be clarified and include examples of the kinds of test points that could be used and are suitable for spatial products.	Y	See resolutions to comments 12-29 through 12-36.	COMPLETE
14-18	In Appendix A page 11 the classification stops at 10 meters. Classification should reflect any accuracy or circle of error that might be used for digital mapping, GIS, and LIS. Admittedly, a circle of error accuracy value of 300 feet for a single point entity may not be desirable, it may indeed be the best available. Knowing that accuracies may be very poor is valuable information for all users of the data. It is in fact an inventory of where accuracies are reliable and where they are not. Ultimately, data users must identify acceptable accuracies for their applications.	Y	Table has been deleted: see resolution to comment 12-39	COMPLETE
15-1	Is there a formal definition of spatial data?	Y	A definition will be included as a part of a glossary that will be included as an informative appendix to Part 1.	COMPLETE
15-2	Should more attention be given to the difference between primary (measured) data and derived (computed) data? It makes a difference in error propagation?	Y	This standard is concerned only with the accuracy of point coordinates in the final data product, after all process steps.	COMPLETE
15-3	Past practice has been to store spatial in analog form on flat maps. Current practice is to store spatial data in digital form in an electronic data base. The interaction of issues - digital/analog and primary/derived should be discussed further?	Y	See response to comment 15-2.	COMPLETE
15-4	Is it correct to say network accuracy is defined by the standard deviations of geocentric X/Y/Z coordinates of a point and that local accuracy is derived using the covariance values of a point pair? . . . For myself, I'd feel better with more mathematical specificity than just saying local accuracy expresses an average of local uncertainties.	Y	See response to comment 17-1	COMPLETE
15-5	What accuracy standards were published by the Federal Geodetic Data Subcommittee (sic)?	Y	See references for Part 2, Standards for Geodetic Networks	COMPLETE
15-6	Address comments to FDGC Secretariat?	N	Once the FGDC has endorsed the standard, please direct questions to the agency identified in the "Maintenance" section of each part of this standard.	COMPLETE

Log number	Comment	Substantive	Resolution	Status
15-7	Page 2-5: Did someone miss the superscripts in the equation for local accuarcy?	Y	Superscripts have been added to the final draft.	COMPLETE
15-8	Page 3-9: Where does the number 2.4477 come from? I think I know, but I couldn't find it in the document. What assumptions are implicit in its use?	Y	2.4477 is the factor for circular error at the 95% confidence level. It assumes that error is equal and independently distributed in the x, y coordinate. There will be citations and bibliographic references for this factor.	COMPLETE
16	As for horizontal shifting of the well-defined point, we believe it probably should not be done and … now recommend that you remove that from the standard. It is a difficult concept to understand and would need some very hard and fast rules. As it is now, people in NMD don't really understand it and sort of interpret it in various ways. Realize too that this shift was an imaginery (sic) shift. We really did not shift the feature on the map or digital product. During testing, we basically measured a circle around the feature and re-interpolated the elevation depending on where that circle fell with respect to the contour lines. We had specific criteria for when and how much a feature could be horizontally shifted to help it pass the vertical test. In the [USGS] Procedure Manual for Map Accuracy Testing, 5/87, on pages 32 - 36, there are instructions and a table that gives the shift values we were allowed for our tests. The amount of horizontal shift was also dependent on the spacing of the contours. Since there may be a wide variety of producers having various scales and contour intervals, etc. I think it would be difficult for FGDC to define something that all producers could consistently apply.	Y	Reference to shifting the position of the well-defined point to re-interpolate the elevation has been deleted.	COMPLETE

Log number	Comment	Substantive	Resolution	Status
17-1	The way I read and understand the proposed geospatial positioning accuracy standards, the network accuracy of a point would be given by the standard deviations… The standard deviation of the inverse distance between points would be the local accuracy between points not directly connected as stated on page 2-5. But since these two points were directly connected by a simultaneous GPS survey, correlation does exist and the local accuracy is determined as per the example in the second attachment. But, the proposed accuracy standards say something about "average" local accuracy on page 2-4. Is that really the way it should be done? I get the feeling someone is trying to do too much thinking for the user. Doesn't the user community deserve to know specifically what equations and methods are being used to determine this thing called local accuracy?	Y	There still may be some confusion about network accuracy. Basically, network accuracy represents how accurate a point's coordinates are relative to the coordinate system. Since the coordinate system will be realized through the national network of GPS Continuously Operating Reference Stations (CORS), the length accuracy of a point relative to the nearest CORS (with the assumption that the CORS has "zero" uncertainty, i.e., its coordinates are fixed) provides the network accuracy. That's why network accuracy is defined that way. . . . local accuracies are computed using all covariance information. Covariance information is used in the computation of the length (or distance) relative accuracy between two points. That's what local accuracy is: the length relative accuracy between two points. Because users want a single horizontal classification for a point, the local accuracy of a point (not a very scientific statistic) is the average of all local accuracies to nearby, directly connected (via observations in our data base) points. Because there are usually more than one nearby, directly connected point, we decided that an average was a "fair" number to represent the local accuracy of a point. However, all local accuracies at a point to nearby, directly connected points (up to a maximum of some reasonable number, probably about 20) will also be provided to users ("published") with the adjusted coordinates. Therefore, users will have the "real" local accuracy value between any two NGS-directly-connected points they're using. Please note that we will not be providing local accuracies (length relative accuracies) between nearby UNCONNECTED points. If users request this information between a specific pair of points, we should be able to "grab" a piece of the network containing these two points, do a quick adjustment, and provide an estimate. This may not be a rigorous solution, but the estimate will be an excellent approximation, which is really all that accuracies are anyway.	COMPLETE

Log number	Comment	Substantive	Resolution	Status
17-2	Multiple accuracy (3.2.2) acknowledges different accuracy for horizontal and vertical. Radical thought - Why not just use accuracy in each component separately. It simplifies the statistics (one does not need to worry about that factor of 2.4477 I asked about earlier) and the GSDM [Global Spatial Data Model] competently tracks spatial accuracy in all three dimensions while permitting the user to look at standard deviations of all three local components with equal ease. That may be too big a jump to do now? We are all still hung up on horizontal and vertical as opposed to considering accuracy component by component? Have I misunderstood anything?	Y	Regarding stating a single horizontal accuracy (in terms of the radius of a circle) versus separate x and y values, … users are still "horizontal" and "vertical" oriented and for now that was the way to go. Also, the ISO (International Standards Organization) uses this methodology… We discussed with our photogrammetry friends for over a year which method to use (since they originally proposed separate x and y accuracy values), but all agreed in the end that a single horizontal value was more "user friendly." Also, we debated the 1-sigma (67-percent) versus the 2-sigma (95-percent) confidence levels, but the 2-sigma level won out. So the thoughts you now raise were carefully considered during the development of these accuracy standards.	COMPLETE
17-3	You asked about primary spatial data versus secondary spatial data. In my opinion, the difference lies in its creation. Spatial data are created by the physical measurement of some combination of fundamental physical quantities. Distances (spatial data) computed from those measurements have an accuracy determined by the measurement configuration and the competent propagation of uncertainty to the computed result. Those are primary spatial data. Secondary spatial data are those derived from primary spatial data by computation, transformation, or other manipulation. In the simplest case, secondary spatial data can be used and discarded because the only investment in their creation is copying the data from some primary source.	Y	This standard is concerned with estimating the accuracy of point coordinates in the final data product, after all process steps have been completed, not with the process by which point coordinates are derived.	COMPLETE

Key to comments: by prefix

1	Gene Dial, Space Imaging, Colorado
2	Milo Robinson, State Geodetic Advisor, Vermont
3	Gene Dial, Space Imaging, Colorado
4	Dean Merchant, Topo Photo, Inc., Ohio
5	Mr. Arliss Whiteside, GDE Systems, Inc
6	Mid-Continent Mapping Center, USGS
7	Jo Anne Stapleton, Mapping Applications Center, USGS
8	Rob Schmidley, Senior Research Associate, Center for Mapping, OSU
9	Larry Christenson, via Karen Schuckman, Piedmont Aerial Surveys
10	James Robeson, State of Florida Department of Environmental Protection
11	Environmental Protection Agency
12	Tom Schulz, Rocky Mountain Mapping Center (RMMC), USGS (in response to request for clarification)
13	Ken Osborn, Chair, RMMC Elevation Team
14	Ken Bays and Dave Meier, Bureau of Land Management
15	Earl F. Burkholder, Global COGO
16	Tom Schulz, Rocky Mountain Mapping Center (RMMC), USGS
17	Earl F. Burkholder, Global COGO (in response to requests for clarification)