

Peer Review Summary Document

(9/11/2014)

Peer Review Plan

<https://www.usgs.gov/about/organization/science-support/science-quality-and-integrity/information-quality-guidelines> [19 KB PDF].

Title and Authorship of Information Product Disseminated

The 3D Elevation Program Initiative—A call for Action, by Larry J. Sugarbaker, Eric W. Constance, Hans K. Heidemann, Allyson L. Jason, Vicki Lukas, David L. Saghy, and Jason M. Stoker.

Peer Reviewers Expertise and Credentials

Peer Reviewer #1 – Over 30 years of experience in mapping and remote sensing, including focused work in photogrammetry, commercial remote sensing, lidar science, and national elevation program development. Has a B.A. in Geography and an M.S. in Mapping Science.

Peer Reviewer #2– Research physical scientist with more than 20 years' experience focused on development, assessment, and applications of topographic data and derivative products. Ph.D. in geospatial science and engineering.

Peer Reviewer #3 – Chief of a state geodetic survey office. Licensed as a Professional Land Surveyor (PLS) since 1980. Held numerous professional survey association officer and board positions.

Peer Reviewer #4 – Past state geologist and past county GIS director, numerous committee and association officer positions. Ph.D. in geophysics.

Charge Submitted to Peer Reviewers

Peer reviewers were asked to make an objective evaluation of the report.

Summary of Peer Reviewers Comments and Summary of USGS Response to Comments

Peer Reviewers 1 and 2 used the manuscript document titled "3DEP Plan Ver 1.31. Comments A1 – A33 can be attributed to this version of the report. Peer Reviewers 3 and 4 used the PDF version 3 document to record comments. Page numbers and other references are associated with a file named "Sugarbaker_book_V3". Comments B1 – B35 can be attributed to this version of the report. Highlights of all four reviewers' comments and the authors' responses to them are below. Reviewers made numerous suggestions for grammar or stylistic changes throughout the document. Some of these suggestions were accepted

and some were rejected during subsequent editing of the document. No further references to these types of changes are addressed in the peer review summary.

Comment A1: The NEEA information, which appears in three places (mainly in two), seemed a bit detailed but in conversation with authors it was explained that this detail was based on community interest.

Author Response: No changes were made in reference to the more detailed background on NEEA which the authors felt was an important part of the plan and needed to be conveyed to the reader.

Comment A2: Call to action by who to whom? Alternatively, "is a USGS proposal." or something like that. Not a showstopper.

Author Response: While the question is understood, the initiative and the leadership and participant role is explained in the prospectus. The author feels that it would distract from the statement to explain who is calling for the action within the introductory text. No change was made.

Comment A3: Rather than stating the data need in technology (lidar) terms it may be better to focus on the data e.g., "accelerate the collection of improved (i.e., temporal, resolution, accuracy) **national elevation data.**" ... with the leading technologies acknowledged as lidar and ifsar. Having made this point up front, further clarifications may not be needed.

Author Response: The term lidar is known to a large audience and includes much more than "elevation", therefore the terms lidar and ifsar were retained.

Comment A4: Especially in a USGS series publication, for a program goal, I'm not sure you can assert this "will" happen – may be preferable to say that the "program (or partnership) **goal** is to complete" or something like that.

Author Response: The "will" language has been reviewed by the USGS budget office and our senior reviewing official. It is clearly stated to be an initiative and the document is clear about the need for funding growth. Mitigation strategies are also outlined in the manuscript in the event that investment growth does not meet the goal of completing the work in 8 years. No changes were made.

Comment A5: Clarify if this is federal government investments, or investments of fed., state, local, and private combined.

Author Response: Word "combined" was added to clarify that these are investments by federal, state, local and private organizations.

Comment A6: Seems like most of this NEEA paragraph could be moved to the background section, it kind of breaks the 3DEP flow. But it's understandable if the "prospectus" is like an exec summary or overview.

Author Response: The prospectus needs to stand alone and the NEEA background is important for the reader who only looks at the prospectus so no changes were made. Added note – the front end of the report was subsequently modified while in the editing step. The prospectus has been dropped and an Abstract, Foreword, and Introductions section have been significantly modified, in part, addressing the reviewer's comments.

Comment A7: Which data collection strategy is "this" – believe it's the piecemeal approach but this could be clarified.

Author Response: The reviewer's interpretation is correct, however, language was modified to clear up any possible confusion.

Comment A8: Why not – needs explanation if retained.

Author Response: The language was modified to be clear that a nationwide dataset could not be created under this scenario.

Comment A9: Who is “we”? USGS? Federal government? All lidar users? It would be better to say the group specifically instead of using “we”.

Author Response: Two comments above resolved by specifying “partner agencies” as this is not solely a USGS effort.

Comment A10: 25 percent gain over what?

Author Response: This statement has been modified to be clearer.

Comment A11: All inset maps have a scale bar, but the main CONUS map does not.

Author Response: New status graphic with scale bar has been created and is current as of May 2014.

Comments A12: Reviewer reference to objective to create an annual report - Who does this refer to? USGS? NDEP? Completed by whom? USGS? NDEP? Please specify.

Author Response: “by USGS” was added to the end of the statement. This should clarify that “its” means “USGS” and that USGS will be producing the annual report.

Comment A13: Suggest either adding an example of one of these committees or indicate that they are discussed later – it begged the question, what committees?

Author Response: This was changed to simply read that the partner agencies are working together. The governance and committee structures are discussed later but this should no longer provoke the question as suggested by the reviewer.

Comment A14: Reviewer comment about CoNED acronym - Believe it is actually “Database” for CoNED. Please verify.

Author Response: Name was corrected to read “Database”. The data layer started out as “Dataset” and it was later changed to “Database”, hence the confusion.

Comment A15: Reviewer comment referencing the NEEA requirements questionnaire. Non-government sector didn’t complete the questionnaire. That said, probably no need to get into that kind of distinction here. The open file report (OFR) went to lengths to clarify how the data was collected by other sectors. Although the OFR focused on data collection, it also points to the 3DEP website for later program developments. It would be good to cite the OFR somewhere in this section. <http://pubs.usgs.gov/of/2013/1237/pdf/of2013-1237.pdf>

Author Response: Issue was resolved following author discussion with reviewer and as modified in the text. The OFR has been cited in the report.

Comment A16: Reviewer reference to the cost benefit analysis and whether or not partial benefits were considered - Not clear if the “partial benefits” are reflected in either of these numbers. Perhaps drop unless explained, and that may be too much detail.

Author Response: Sentence was modified to indicate that partial benefits were assigned to implementation scenarios.

Comment A17: Reviewer comment about report statement that benefits were underestimated - How do you know they “significantly underestimated”? This seems like a subjective or opinion statement that should be revised (or eliminated).

Author Response: We know that they significantly underestimated benefits because survey participants reported that there were major dollar benefits but that they were unable to quantify them. Text has been adjusted to be clear about this.

Comment A18: Suggest that environmental or ecosystem benefits be explained or dropped. To the reader several business uses may well look like they are “environmental”.

Author Response: Environmental or ecosystem services has become common usage so the author has elected to leave these very important unquantified benefits in the list. No definitions are necessary.

Comment A19: Reviewer comment referencing OFR publication benefits table - When this table was published in the OFR, numbers were rounded, you may want to lift that table and save publishing staff the time. <http://pubs.usgs.gov/of/2013/1237/pdf/of2013-1237.pdf>

Author Response: These numbers are rounded. If we round to the nearest million, as was done in the OFR, we will lose all benefits in a number of the business use areas. This does not seem like a prudent approach. We do not want to report or imply that there are no benefits when in fact we have some (albeit, limited) benefits documented for some uses. Numbers were not further modified.

Comment A20: Reviewer comment referencing 3DEP program implementation scenarios - What are these scenarios? This is the first time they are mentioned, so a brief intro would be useful here.

Author Response: A new sentence was added to explain the various combinations of quality and replacement cycle.

Comment A21: Reviewer comment in reference to the 10 3DEP implementation scenarios that were further evaluated - OK, I understand these to be the Dewberry 8 (+ 2 developed post NEAA).

Author Response: Clarification statements were added to be clear that multiple optimization scenarios were created. Some of these held one or multiple variables constant.

Comment A22: Reviewer comment about considering the value of ecosystem services for justifying the data collection strategy - I don't think that this is sufficiently developed to mention, or not without a little explanation, or caveat, since they were not part of the study.

Author Response: Additional text was added to clarify and explain the importance of ecosystem services. Contrary to the reviewer's comment, ecosystem services were part of the study. It would be correct to state that since the benefits were unquantified, they did not contribute to the benefit cost analysis.

Comment A23: In figure 5, why is the 59% scenario not recommended? Its costs look to be exactly the same as the recommended scenario but it does get 1% more of the needs, and the gap between the next scenario (66%) and the 59% scenario seems to be a natural break point.

Author Response: Additional clarification was provided to explain the differences between scenarios. The reader is also referred to the full requirements report if they want more information.

Comment A24: Reviewer was not clear why two similar (benefit/cost and return on investment for 3DEP) charts were needed. This was a tough paragraph to understand, with too much going on to get the main message. The charts are basically two views of the same thing. Perhaps use only one and base the message on that.

Author Response: Paragraph was split and additional clarifying text was provided. While the charts are different analysis of the same data, Benefit to cost ratio and return on investment are quite different. The return on investment chart was retained to demonstrate that all areas of the country will have a positive return on investment in less than 14 years.

Comment A25: Reviewer comment referencing the report descriptions of NEEA and of 3DEP - Some transition seems needed here from NEAA to 3DEP.

Author Response: The previous section of the report and the 3DEP section have been significantly modified to provide a smoother transition.

Comment A26: Reviewer comment about 3DEP objective to reduce cost by 25 percent when larger projects are flown by contractors - Reduced 25% over current costs, right? As written this might be misinterpreted as saying the costs shown here could be reduced by 25%. Please clarify.

Author Response: Sentence has been rewritten to eliminate any possible confusion.

Comment A27: Reviewer comment about statement referencing current costs to 25% reduced cost estimate - With savings and why are the overall costs higher than estimates, and what estimates are being referred to?

Author Response: Sentence was rewritten to clear up any confusion. Current costs are actually lower than historical costs but still slightly higher than the estimated costs that could be achieved if larger projects are flown. The plan to fly larger projects will not be implemented until 2015.

Comment A28: There is a lack of clarity between collection blocks, and overall project size. A project could be a statewide, comprised of many large collection blocks. Added "or larger" rather than getting wordy. The preferred project is larger than a collection block which as I understand it is based on efficient flight lines while not straying too far from a GPS ground station. The larger the project the better, but if less than a collection block is not as cost effective. If you deem sufficiently important Heidemann could clarify, not a show stopper.

Author Response: No changes were made to text since the project size is not related to preplanned collection blocks. There is currently no strategy to go to preplanned collection blocks so the concept has not been introduced in this initiative plan. Commenter has prior knowledge of earlier discussions and was simply raising a point to consider.

Comment A29: Reviewer reference to state roles - If states haven't already all agreed to this then "will" seems like strong perhaps dictatorial language. Here and forward in the bullets there are a lot of "wills"- these are "expected" benefits.

Author Response: The bullet section has been reworded to describe the characteristics of a successful partnership rather than a list of specific roles.

Comment A30: Reviewer reference to large area data collections and multi-year state plans. Not sure what this bullet means exactly as relating project size and multi-year.

Author Response: The larger project size will not be a hindrance to state multi-year plans but then again, neither were the smaller projects. The statement has been modified to be clear that the larger project size will not hinder state multi-year plans (which are encouraged).

Comment A31: Reviewer reference to paragraph about 3DEP product development and delivery plans - What does this (referenced paragraph) mean? Don't know what can be done specifically here, but this reads like "we might do this, but it depends..." or "we might do that, but we'll see..." Can it be rewritten to be more definitive and less wishy-washy?

Author Response: This paragraph was significantly modified to address comments to reduce any ambiguity or uncertainty that may have been implied about products and services.

Comment A32: Reviewer comment about 1/9th arc second DEM product - Thought that the 1/9th was at least feathered across projects, not sure.

Author Response: The 1/9th arc second products are not edge matched across project tiles.

Comment A33: Multiple Reviewer comments about risk mitigation strategies - How are they built into to the plan?

Author Response: As originally written it was incorrectly implied that the risk mitigation strategies are detailed in each applicable part of the report. Clarification of how the known risks were dealt with and the purpose of the five strategies have been added. The objective is to address all known risk within the plan itself. These strategies are steps that have been taken to deal with unmitigated risks or issues that arise.

Comment B1, title page - There should a prominent case made for why we must do this (3DEP initiative) now.

Author response – The report is an implementation plan as much as it is a “call for action”. The reader should be able to understand the need to respond now if they read the section in the report about benefits. As such, this is not an advocacy report but rather a USGS Circular that should provide the material necessary to understand the importance and need for this program. The authors agree with the reviewer comment and a conclusions section has been added to the report to reinforce the importance of 3D elevation data and the need to respond now to the well documented needs.

Comment B2, page iii – Reviewer reference to a “call for action” - This is good-the rest of the doc should reflect the call for action theme.

Author response – Additional text and a conclusions section were added to the report to help emphasize the importance of the call for action and to reflect the overall theme as suggested by the reviewer.

Comment B3, page iii - for the United States. Using Google Trends I can't find "for The Nation" used this way. Stick with a neutral term people understand.

Author response – The authors understand that this particular usage of “for the Nation” may be confusing to some readers. The foreword has been modified to be clear this is a national program to collect data nationwide.

Comment B4, page iii - you might want to say EVERY citizen will benefit and also these areas....

Author response – The foreword as written correctly expresses the value to the private sector and to citizens in paragraph 2. The Director is pointing out in the final sentence, based on the NEEA report that there are significant business reasons to move forward with 3DEP. The NEEA study did not survey the needs of citizens and would not support the conclusion that “every citizen” will benefit from 3DEP except as identified in the benefits of improved government and industry services. The foreword was not changed to reflect this recommendation of the reviewer.

Comment B5, page v - add Conclusions or "Call to Action"

Author response – The authors agree and a conclusions section has been added to the report.

Comment B6, page vii - Should note that two conversions are available. US and International foot. foot (ft).

Author response - This comment is in reference to the conversion chart. Reviewer is suggesting that an international foot conversion to metric be included. The authors concur; Intl and US feet, while not used explicitly in the report has been added to the conversion factors table.

Comment B7, page viii - maybe add file formats of interest here instead of Appendix (reference to acronym list)

Author response – The 3DEP report is a “call to action” as well as a high level implementation plan which outlines the components and steps for accomplishing a major objective to collect lidar and ifsar data nationwide. During the course of developing the report, it became clear there were many different usages of common terms. It is necessary to be clear about the report (and program) objectives. Others who are part of the target audience have routinely commented that this is a very useful and helpful addition to the report. Although the reviewer is suggesting an alternative way of addressing some of the appendix content, the product definitions and related material were placed in the appendix so as to not distract from the high level nature of the report. As such, the appendix is optional reading and has been retained.

Comment B8, abstract - why? The first sentence ought to say "because we as a nation, need this"

Author response – The first paragraph of the abstract has been modified to reflect the response to a call for action as the lead in sentence. Other changes to accent the importance of the call for action were also made as follows:

Abstract

The 3D Elevation Program (3DEP) initiative is accelerating the rate of three-dimensional (3D) elevation data collection in response to a call for action to address a wide range of urgent needs nationwide. It began in 2012 with the recommendation to collect (1) high-quality light detection and ranging (lidar) data for the conterminous United States (CONUS), Hawaii, and the U.S. territories and (2) interferometric synthetic aperture radar (ifsar) data for Alaska. ~~in eight years~~ [8 yr used below]. ~~3D elevation data collection~~ Specifications were created for collecting 3D elevation data, and the data management and delivery systems are being modernized. The National Elevation Dataset (NED) will be completely refreshed with new elevation data products and services. The call for action requires broad support from a large partnership community committed to the achievement of national 3D elevation data coverage. The initiative is being led by the U.S. Geological Survey (USGS) and includes many partners—Federal agencies and State, Tribal, and local governments—who will work together to build on existing programs to complete the national collection of 3D elevation data in 8 years. Private sector firms, under contract to the Government, will continue to collect the data and provide essential technology solutions for the Government to manage and deliver these data and services. The 3DEP governance structure includes (1) an executive forum established in May 2013 to have oversight functions and (2) a multiagency coordinating committee based upon the committee structure already in place under the National Digital Elevation Program (NDEP).

Comment B9, abstract – nationwide "For the Nation" evokes something else and just sounds awkward to the general public.

Author response – The abstract text has been changed from “for the Nation” to “nationwide”.

Comment B10, page 1 - Good overview of the report.

Author response – Supportive comment, no changes are needed.

Comment B11, page 2 - Good background on the history of the program and connection to the NEEA.

Author response – Supportive comment, no changes are needed.

Comment B12, page 4, figure 2 - Didn't you already define lidar? Why does PA have a little blob of old data when it has all been covered? Are other states equally inaccurate?

Author response – The use of repeated definitions of terms such as "lidar" in captions, tables, the abstract, the text, and the appendix is USGS style so that figures and tables stand alone and are useful if they are copied and inserted into other reports. The figure 2 map showing missing data in Pennsylvania is correct as the data in the referenced area is missing. USGS staff are working to fill these DEM voids with currently available lidar sourced DEMs as referenced by the peer reviewer. While there may be other missing datasets as hypothesized by the reviewer, the USGS is actively working to clean up any anomalies which may exist in the database.

Comment B13, page 5 - This doesn't sound like a Call to Action. Rather it a nice rational explanation of what organizations will do. Given the document title I am expecting a forceful call for why this MUST happen.

Author response – While this is a call for action, it is also an implementation plan to guide the development of 3DEP. To address this comment, the leading statements in the abstract have been modified and a conclusion section has been written to convey a stronger sense of urgency for the reader and commitment on the part of the government to respond.

Comment B14, page 6, figure 4 - These are close but not the same top 6 applications found in the table 2. Why not make it consistent. Why just 6? Some photos are better than others. B D E could be more exciting. C and F grab you. A could use a tractor with GPS.

Author response – The six examples include the top four from the conservative benefits column and the two additional business uses which have very high potential return on investment as indicated in the potential benefits column. While some of the images may not be as exciting as the collapsed bridge and the river flooding, they are intended to convey an important message that 3D elevation data are important for a wide range of everyday activities in commerce, conservation, development, and agriculture.

Comment B15, page 8, table 2 - this makes it look like 3DEP has no utility for these applications (reviewer reference to no benefits for 3 business uses in table 2).

Author response – The authors agree and additional text (see below) has been added to the caption to explain that while not all business uses had quantified benefits, they all were identified as having mission critical requirements with major benefits. For those business uses, the NEEA respondents were unable to quantify the benefits.

p. 8, table 2, headnote: Add two sentences to the headnote for table 2 and add the definition for 3D. The quote needs a source (Dewberry, 2012) and page number from Larry. I did not find the term (major but not quantified) in searching the body of the report. Was it in an appendix?

[For benefits that were identified as a range, the conservative value represents the lower end and the potential value represents the upper end of the range. With the exception of the potential benefit of \$7 billion associated with land navigation and safety, all of the dollar benefits represent immediate needs. The land navigation benefit is realized from vehicle fuel reductions that

are expected to result from intelligent vehicle navigation systems. In addition to the identified dollar benefits, all of the business uses were identified by NEEA respondents as having mission-critical activities requiring 3D elevation data whether or not they were able to quantify the benefits. The NEEA report identifies those benefits as "major or moderate but not quantified" (Dewberry, 2012, p. 558–670). Table modified from Snyder and others (2014, p. 7, table 2) and Dewberry (2012, p. 5, table 1.3). Definitions: 3D, three dimensional; dollars, constant 2012 dollars; K–12, kindergarten through twelfth grade].

Comment B16, page 9 - this is an excellent description of how you decided.

Author response – Supportive comment about how USGS evaluated information and developed the recommended program. No changes are needed.

Comment B17, page 10, figure 6 - Most of this is proportional to population. However, the southern and eastern borders of Oregon stand in sharp contrast to Idaho, Nevada and California. This suggests a political consideration and weakens the graphic for convincing the public/legislators.

Author response – The variation in benefits that are most obvious across the borders of a few states are a result of the independent nature of the individual state NEEA surveys. The authors believe that the states showing higher benefits are generally the states that have invested more in understanding their requirements and were therefore better prepared to respond to the survey. If this observation is correct, then the real benefits may be significantly higher in the other states. The NEEA study authors made a decision to accept the benefits as recorded and to not attempt to normalize benefits across state lines. Had this been done, there would have been concerns about the overall integrity of the survey. For these reasons, the authors of the NEEA study made every attempt to fully document the benefits as they were identified in each of the 50 states.

Comment B18, page 13 – You probably don't need to hear this level of concern but this could be problematic - there could be pressure to bring in all sorts of non-federal players. I think it would work best with all federal agencies (reviewer reference to statement about including other organizations - non Federal - on the coordinating committee).

Author response – Earlier versions of the 3DEP initiative plan were reviewed by the NGAC and many of the States. A consistent review comment received was that States need to be part of the plan and have active input to the program. Considering the significant contributions that States make, this was decided by the project team to be a very reasonable request and an important addition to the report. No changes have been made to the report regarding this comment.

Comment B19, page 15 - There could be rapid advancements in technology which would affect cost. UASs and David Harding's work could provide a much faster and cheaper technique. Some mention should be made of his work and the changing world of drones.

Author response – The peer reviewer makes an excellent point. While it is too early to project when advancements in technology might significantly alter the overall program costs, it is important to recognize the possibility this will occur. The assumption of 25 percent cost reductions based on project size has been modified to recognize this possibility. In addition, the research agenda has been modified to be clear about USGS research activities to evaluate new technologies. Also see author response for peer reviewer 4 comment 40 below. A new research objective has been added to reflect USGS work in sensor technology assessments.

“Larger data acquisition projects will result in a 25-percent cost savings when compared to 2013 acquisition costs. Should new technologies become commercially available, data-collection costs may be further reduced due to efficiency gains in sensor technologies.”

Comment B20, page 15 - Could you have an alternative possible investment based on a new technology? No one really expects flat projections. You'll either need more money if you stick with old tech or less if you don't.

Author response – Until the budget development, cost structure, and technologies evolve to a more sustainable operations state, it would be difficult to either refine or to add other models. The model which is presented in the report is intentionally conceptual and inexact, in part to convey the importance of contributions from a broad community over any one particular funding model. As such, the model is agnostic to any technology. While the authors understand the point which the peer reviewer is making, no changes were made to the report.

Comment B21, page 16, table 5 This would be easier to visualize if there were a graph showing data vs date.

Author response – There is a significant amount of detail within the table that could not be duplicated in a graph. No changes were made to the report. The peer reviewer makes an excellent point about simplifying the product delivery date information and the authors intend to develop a graph which will be used in presentation outreach materials.

Comment B22, page 18, figure 9 - lidar or ifsar derived elevation data.

Author response – The peer reviewer is correct in that the first sentence is a little misleading. The text has been updated to replace “elevation” in the caption with “lidar and ifsar (in Alaska)”. The second sentence was deleted.

Comment B23, page 22 - It might be good to play up the USGS role of being an Authoritative Source.

Author response – The peer reviewer makes an excellent point. The last sentence of the first paragraph under the section titled “USGS Commitment to Manage National Elevation Data Assets” (p. 4) has been modified as follows:

“The 3DEP initiative continues and improves upon the USGS commitment to coordinate the collection of terrestrial elevation data, to assess data contributed by partners, and to manage these authoritative national elevation data assets.”

Comment B24, page 22 - Recommend that you modify this bullet to note that the vertical accuracy testing should be independent of the contractor collecting the elevation data.

Author response – The referenced bullet item addresses vertical accuracy testing for compliance with specifications under the data quality control and acceptance section of the report. The bullet text will be modified to say “Independent vertical accuracy testing...”

Comment B25, page 25 - There should be mention of ongoing research into new mapping technologies-multispectral lidar, waveform, etc. This should be evident through the whole document. NASA provides an important contribution. Otherwise industry will invest heavily in old technology and use it as long as possible.

Author response – The peer reviewer comment about new sensor technologies makes an excellent point. Some of this work has been ongoing within USGS but was not incorporated into the plan document. A high priority research objective to assess new technologies has been added to the plan to correct this omission (see below).

"6. High priority- Research the utility and evaluate new technologies that could be used as data-collection mechanisms for 3DEP in the future. These technologies include, but are not limited to, (1) maturing range detection capabilities such as waveform digitization (Harding and others, 2004), Geiger-mode avalanche photodiodes (Aull and others, 2004), photon-counting detectors (Priedhorsky and others, 1996), and flash arrays (Bulyshev and others, 2009); (2) maturing laser capabilities such as green lasers (Brock and others, 2004), multiwavelength lasers (Wei and others, 2012), and polarimetric filters (Tan and Narayanan, 2004); and (3) potential lidar collection platforms such as satellites, mobile platforms bearing Aerostar, unmanned aircraft systems UAS, and mobile mapping systems on cars or boats. In addition, increase research on evaluating passive imaging technologies such as machine vision, structure from motion, stereo compilation, and others that may be able to produce XYZ information of comparable quality and character as current commercial lidar point clouds."

Comment B26, page 26 - It just sort of ends. Shouldn't there be a Conclusion with a passionate exposition on why we need funding now- a call to action?

Author response – A conclusion section has been added to the report. Also see author response to peer reviewer 4 comment 9.

Comment B27, page 26 - Information about NGS's plan to adopt new horizontal and vertical datums in 2022 should be included. This will have a major impact on the data collected prior to 2022.

Author response – This comment is addressed with modifications to research topic six, "Design a strategy to implement ongoing changes to the National Spatial Reference System". Reference to the planned 2022 update will be included. We note however that this document is not a technical specification and the information included will be high-level. See author response to peer reviewer 3 comment 7 below for further details.

Comment B28, page 27 - Harding, David

Author response – Additional citations for advanced technologies have been added in conjunction with the ongoing research activities as identified.

Comment B29, page 29, Appendix 1 - I'm not sure you need this at all. The pertinent info could be incorporated into the text. The definitions are not really necessary to making your case.

Author response – See author response to peer reviewer 4 comment 14, which stated in part, others who are part of the target audience have routinely commented that this is a very useful and helpful addition to the report. The product definitions and related material were placed in the appendix so as to not distract from the high level nature of the report. As such, the appendix is optional reading and has been retained.

Comment B30, page 29, Appendix 1 - Would be better off saying that you will provide the data in a non-proprietary format and drop this long list. It does not advance the cause for funding 3DEP.

Author response – While having a long list of products that will be available does not advance the cause of 3DEP, it does provide a thorough accounting of what is planned to be provided. The rationale to keep it in here demonstrates specific deliverables that should be expected. No changes necessary.

Comment B31, page 30 - The change in datums in 2022 will require key metadata in order to perform accurate transformations.

Author response – This comment is attached to the Enhanced Spatial Metadata description. The metadata related to the 2022 update will be part of the extended

metadata. We note however that this document is not a technical specification and the information included is high-level. Research topic 6 has been changed as follows:

“Medium priority—Design a strategy to implement ongoing changes to the National Spatial Reference System (NSRS), which includes geoid models being developed by the National Geodetic Survey (NGS) of NOAA out of the Gravity for the Redefinition of the American Vertical Datum (GRAV-D) program. Planned adjustments to the NSRS will have significant effects on the elevation values. If data will be stored as received, then processing will need to occur to account for the differences in ellipsoids and geoid models used. The horizontal and vertical datums will change significantly in 2022. Data collected over the next 8 years must have metadata necessary to convert the database to the 2022 datum. Ongoing collaboration between USGS and the NGS is a necessary part of this research objective.”

Comment B32, page 31, Appendix 1 - Perhaps they should be listed as Public Domain (preferred) and Proprietary. As mentioned earlier I don't think you need this.

Author response – We do not think that this discrimination would be very informative. We would also argue that Public Domain does not always equal preferred. No changes necessary.

Comment B33, page 32, Appendix 1 - so why change it to GRID or IMG in the table?

Author response. Reviewer confused generic DEM with old USGS .dem file format. No changes necessary.

Comment B34, page 32, Appendix 1, table 1-2 - Why only proprietary formats? One of the great virtues of USGS has been that you provided raw data in publicly accessible formats.

Author response – These formats are currently ubiquitous, and although proprietary are accepted by most GIS software programs and libraries. However we also will be providing data via an Open Geospatial Consortium WCS, which allows for downloads of data in publicly available formats. This information was mistakenly omitted. The following statement was added for clarification:

“In addition to these downloadable products, we also will be providing bare-earth data via a Web Coverage Service (WCS), which allows users to save raster products directly to their computers. Supported output formats for WCS services are GeoTIFF, NITF, HDF, JPEG, JPEG2000, and PNG.”

Comment B35, page 34 - Other methods are used to derive contours.

Author response – While other methods can be used to derive contours, the most commonly used method is from the bare-earth surface data usually stored as a DEM. The wording has been modified to indicate that this is the most common method.

The Dissemination

The published information product will be released in the USGS Circular publication series and will be available at <http://pubs.usgs.gov/>.