

State of California
Department of Water Resources
California Code of Regulations, Title 23. Waters.
Division 2. Department of Water Resources
Chapter 1. Dams and Reservoirs
Article 6. Inundation Maps

Final Statement of Reasons

1. Introduction

The proposed permanent regulations were noticed on June 8, 2018, for a 45-day public comment period, which ended with a public hearing to receive comments on July 24, 2018. The Department of Water Resources, Division of Safety of Dams (DSOD) received eight comment letters during this period, with a total of 13 comments, and received no comments at the hearing. Because of comments received, DSOD made minor substantive changes to the proposed regulations and published them for an additional 15-day comment period from August 17 through September 1. DSOD received ten comment letters during that period, with a total of 20 comments. Afterwards, DSOD made minor, non-substantive changes to the regulations which do not warrant an additional comment period. The California Water Commission unanimously approved the regulations at their meeting on September 19, 2018 (Resolution Number 2018-20).

This Final Statement of Reasons serves to update the Initial Statement of Reasons that was published with the notice on June 8, 2018.

2. Update of Initial Statement of Reasons

CCR Title 23. Article 6. Section 335. Scope and Applicability of Regulations

(a) The term “DSOD” was replaced by “the department” throughout the proposed regulations to be consistent with the statute and other regulations implemented by DSOD, which is within the Department of Water Resources (department). This change was made in subsection (b) of section 335, and all other applicable sections of the proposed regulations.

Section 335.2. Definitions

(a)(2) The purpose of adding a definition for “breach height” is to define the vertical distance along a structure that must be breached in the model. It is necessary to define the breach height of a dam and critical appurtenant structure because this height differs depending on the structure and providing a separate definition provides clarity. Additionally, it was brought to our attention by comments from multiple consultants that their model simulations would fail when using a breach height measured to the lower of the upstream or downstream toes. Therefore, this definition is needed to clarify that the breach height of the dam is measured from the upstream or downstream toe, whichever is higher, to

alleviate this modeling constraint. Also, this addition is more consistent with the likely failure mode of dams.

(a)(6) The definition for “DSOD” was deleted because it is no longer used and is not necessary.

(a)(12) The purpose of adding the projection information to the definition of “geospatial file” is to clarify that geospatial files, for the purposes of this regulation, include a projection assigned per section 335.12(g). This is necessary because many of the geospatial file submittals made so far have neglected to assign the required projection. Incorporating projection information into the definition of “geospatial file” provides greater clarity and a more complete definition that incorporates its required spatial parameters.

(a)(15) This text was modified to be consistent with §335.10(c). The addition “of one foot or greater” is necessary to clarify the original intent. This change was made after the final 15-day public comment period and is non-substantial because it clarifies the original intent without materially altering the regulations.

(a)(19) “Not including any flood surcharge” was deleted because the definition of flood surcharge is not clear. Two sentences were added that are necessary to clarify the maximum possible storage elevation when a reservoir is either restricted or not restricted.

Section 335.4. Downstream Hazard Potential Classification

(a)(4) The definition of “Extremely High Hazard Potential” was modified because the definition of “considerable loss of human life” was not clear.

(a)(4)(B) It is necessary to add the qualifying condition that the inundation of facilities or infrastructure posing a threat to public safety qualify a dam to be extremely high hazard because of the hazard posed to public safety. A case-by-case standard is necessary because such facilities and infrastructure are so unique that it is difficult to apply one standard.

(b) This section was modified to establish what is needed to request a hazard re-evaluation and establish a 60-day timeline for the department to respond to requests. This modification is necessary to provide clarity in the re-evaluation process.

(b)(1) This section establishes the two components of a complete request for hazard reclassification. It is necessary so dam owners know what they need to submit to request a re-evaluation.

(b)(1)(A) This section states that a justification letter is needed to initiate a request for re-evaluation. This is necessary for the department to consider the owner’s reasons for their request.

(b)(1)(B) This section requires dam owners to submit documentation to the department that supports their request for re-evaluation. This is necessary for the department to verify the owner’s assertions during the department’s review of the owner’s request.

(b)(2) The purpose of establishing a 60-day limit for the department to make a decision in response to an owner’s request is to provide owners with a timeline for planning purposes. This is necessary so that owners can plan to meet their statutory deadlines. The department considers 60 days to be a sufficient and reasonable amount of time to review all hazard considerations and respond to the owner’s request.

(b)(3) The purpose of explaining that the existing hazard classification will remain in effect during the department's review is to provide clarity to owners about the dam's classification pending review of the owner's re-evaluation request. This is necessary because statutory compliance dates are based on a dam's hazard classification.

Section 335.6. Modeling Requirements

(a)(1)(B) The purpose of removing the reference to dam height is to provide clarity on what height of the dam or critical appurtenant structure must be breached. It is necessary to remove the reference to dam height because that is not an appropriate measure for modeling a dam breach. Breach height was added as a definition in section 335.2(a)(2) to clarify the height to be breached for dams and critical appurtenant structures. It is necessary to reference the new definition of breach height in this section to replace the removed reference to dam height and clarify the breach height modeling requirement.

(a)(1)(C) The purpose of modifying this text is to clarify that impounded sediment must be modeled as water, and to reference how a request to model sediment must be made. It is necessary to modify this text because the department became aware that some dam owners were interpreting this provision differently, and were only releasing free water in their model and not releasing any sediment. The new language is more direct and clear.

As described in the Initial Statement of Reasons for this subsection, it is necessary to require the impoundment be modeled as water because it establishes a uniform and reasonably conservative standard regardless of the material impounded by the dam. While most dams impound water, many dams are partially filled with flowable sediment, and some dams impound flowable mine tailings. Sediment behavior in a dam breach is currently not well understood in all its complexities, so the uniform and reasonably conservative requirement to model all sediment as water is considered appropriate.

(a)(2) The purpose of modifying this section is to clarify and provide more detail on the process of how an owner requests department acceptance of a sediment release modeling approach. It is necessary to remove "modeling sediment release is not required" because it was being interpreted by some owners as only requiring the modeled release of free water above the sediment, similar to (a)(1)(C).

(a)(2)(A) It is necessary to define the components of a request for approval of a sediment release modeling approach to provide clarity to dam owners about what they must submit if they wish to pursue department approval of a sediment release modeling approach.

(a)(2)(A)(i) It is necessary to require owners to submit a letter to initiate a request for department approval for a sediment release modeling approach so that the department may formally begin review of the proposed approach.

(a)(2)(A)(ii) It is necessary to require submittal of data and analyses that support the proposed modeling approach so that the department may adequately review the proposed approach and make an informed decision. Examples of data and analyses are listed to provide guidance to owners.

Non-substantial language was added to this section to clarify the meaning of "inundation sensitivity analysis." This change was made after the final 15-day public comment period and is non-substantial because it clarifies the original intent without materially altering the regulations. The addition of "proposed" to qualify "inundation sensitivity analyses" clarifies that the sensitivity analyses should

reflect the approach proposed by the dam owner for modeling sediment release. This addition clarifies that sensitivity analyses only need to support the dam owner's proposed sediment release modeling approach.

The volume of impounded sediment is necessary to quantify the amount of sediment in the reservoir potentially available for release during a hypothetical dam break. Bathymetry data provided by a recent bathymetric survey is necessary to substantiate the estimate of the volume of impounded sediment. Geotechnical data from sediment samples are necessary because an accurate geotechnical characterization of the sediment is required to understand the sediment's propensity for release during a dam failure and/or its tendency to remain in suspension. Such geotechnical data may include grain-size distributions and estimates of cohesiveness. A characterization of the rheological properties of the sediment is necessary to understand the behavior of the sediment transport following the dam failure, which ultimately impacts the inundation extent, severity, and timing.

Sensitivity analyses are necessary because of the large uncertainty in modeling sediment flows during a dam breach. Sensitivity analyses provide a measure for the extent of variation of inundation results due to changes in sediment characteristics. Such analyses are especially important considering the extremely complex nature of reservoir sedimentation. A detailed understanding of sediment transport conditions within reservoirs during and after dam failures may lie beyond present knowledge. Because of the uncertainty in characterizing sediment volume released and flowability during and after a dam failure, sensitivity analyses are necessary to provide insight into the impact of these variables on modeled inundation results.

Many sediment transport models were developed for analysis of riverbeds dominated by coarse sediment. These models assume that the effects of wash load on fall velocity, viscosity, and relative density can be ignored. However, the fines that generally constitute wash load in rivers often comprise most of the total sediment in a reservoir. Therefore, many of the assumptions inherent to riverine sediment transport models break down when applied to the reservoir. This further substantiates the need for supporting data and analyses to facilitate a careful review by the department.

(a)(2)(A)(iii) It is necessary to require an inundation map showing the impounded sediment modeled as water to ensure that an inundation map is on file while the proposed sediment release modeling approach is being reviewed by the department. Due to the uncertainty in the current state-of-practice, it is necessary to require that the map reflect the conservative scenario of all sediment released through the breach.

(a)(2)(B) It is necessary to state that the department may require additional information to evaluate a request because the department must have the authority to request additional information if it is needed to adequately and thoroughly evaluate a request for a proposed sediment release modeling approach. It is also necessary so a dam owner knows additional information may be required.

(a)(2)(C) It is necessary to explain how the department will respond with a decision because dam owners need to be informed of the department's process. It is necessary to state the department's acceptance of an approach does not constitute approval of a resulting map because at that point the map hasn't yet been developed by an engineer, submitted by the owner, or reviewed by the department and may not meet all the requirements of Article 6. It is necessary to state that a department-approved sediment release inundation map supersedes any previously approved maps for that dam or critical appurtenant

structure because multiple approved maps would be confusing to emergency managers and the public. It is important to identify the most up-to-date department-approved map quickly and easily that is based on the best available information.

Section 335.8. Technical Memorandum

(a)(4)(C) The purpose of adding to this provision is to describe the modeling assumptions required for reporting in the technical memorandum. It is necessary to describe the modeling assumptions required for reporting in the memorandum to provide clarity, since prior to this addition, no specific requirements were described in this provision.

In general, it is good modeling practice to supplement any hydraulics model with adequate but concise documentation summarizing modeled assumptions. Specifically, the meteorological loading condition is necessary to summarize in the technical memorandum so that the DSOD staff reviewing the map and technical memorandum can understand if a sunny-day or storm-induced failure was modeled. The type of reservoir routing is necessary to summarize in the technical memorandum so that DSOD staff can identify whether the routing through the reservoir was done dynamically or via level-pool routing assumptions (see ISOR for a more detailed discussion of dynamic vs. level-pool routing). The downstream friction coefficients are necessary to summarize so that DSOD staff reviewing the submittal can understand the coefficients selected and evaluate their appropriateness. This is especially important if DSOD staff finds unexpected modeling results or other discrepancies. Additionally, if modifications were made to the coefficients that are unrealistic but necessary to ensure model stabilization, such information must be disclosed in the technical memorandum so that the source of any modeling discrepancies can be identified. Finally, the initial state of the downstream watercourse prior to the onset of the failure scenario must be documented because this information will assist the reviewer in understanding the modeled and mapped results.

Section 335.10. Inundation Maps

(c) This section was modified because the original text of “and” and “or” was an error and did not make sense. The proposed text stated that the flood wave needed to be confined to a “channel and canyon,” requiring both by using the word “and,” which does not make sense because channels and canyons are two different types of waterways, which is commonly understood in the mapping and modeling field. The proposed text also stated that an inundation boundary may be shown where the flood wave is confined “or where the flood wave no longer poses a threat to life or critical facilities.” This “or” was intended to be an “and,” which is necessary to effectuate the purpose of this subsection. This section clarifies how the inundation boundary must be displayed on the map. The idea is that the inundation boundary must be displayed as a one-foot maximum depth, except for certain limited scenarios where the flood wave is confined to a channel or canyon, and in manner that will not pose a threat to life or critical facilities. The criterion regarding confinement to a channel or canyon was included because that is a situation where flood waves with depths above one-foot may not pose a risk. There could, however, be a threat to life or critical facilities even if the flood wave is confined to a channel or canyon (e.g., camping areas adjacent to a channel), so that is why the second prong (no threat to facilities or life) was included. The confinement criterion must be read with the backdrop of the overall goal of the subsection, which is to display the boundary unless the flood wave does not pose a risk to critical facilities or human life. This is the only logical way to interpret this provision since the intent of the provision is to display the one-foot maximum inundation boundary, unless the flood wave would not pose a threat to life or critical facilities.

This change was made after the final 15-day public comment period and is considered non-substantive because the only legally tenable interpretation was to replace “and” with “or” and vice versa.

(d)(15)(B) It is necessary to require this statement to be printed on each inundation map so that emergency managers understand that there may be security-sensitive infrastructure that is not shown on an inundation map.

Section 335.12. Reporting Standards

(b) It is necessary to replace “discharge” with “flow rate” to improve clarity by using a more commonly used industry term.

(c) It is necessary to define the units for reporting velocity because it is a required part of an inundation map. Standard units provide consistency for all inundation maps and are easily understood by emergency managers during an emergency.

(g) The purpose of replacing “submitted” with “projected” in this provision is to provide clarity. It is necessary to make this replacement because “projected” is a clarifying verb that emphasizes the geospatial files must be assigned the projection stated in this provision prior to submittal to DSOD. The original verb “submitted” was redundant as each of the provisions in this section describe submittals.

(g)(1) – (g)(7) The purpose of this provision is to list the parameters of the NAD 1983 Teale (California) Albers projection to provide guidance to owners and/or consultants as to the exact specifications of the projection. It is necessary to list the parameters because depending on the Geographic Information System used, the name of the projection could vary, but the parameters are consistent no matter the software used to perform the projection. DSOD is checking all geospatial file submissions for conformance with these parameters so it is necessary to list them in this provision. Since many submissions made to-date have neglected to assign the NAD 1983 Teale (California) Albers projection, it was made evident that more clarity was needed in the regulation as to the projection parameters.

(h) The purpose of this added provision is to describe the required format for submission of raster data. This is necessary to provide clarity to owners and to ensure standardization of raster data submissions, which is helpful to emergency managers with a GIS unit who may rely on this raster data during a dam-related emergency.

(i) The purpose of this added provision is to describe the required format for submission of vector data. This is necessary to provide clarity to owners and to ensure standardization of vector data submissions, which is helpful to emergency managers with a GIS unit who may rely on this vector data during a dam-related emergency. It is necessary to require the format as either a shapefile or a feature class in a file geodatabase because some owners may elect to use a platform other than Environmental Systems Research Institute (ESRI) software. In this case, the owner may elect to submit the data as a shapefile, since a feature class in a file geodatabase may not be applicable.

(j) This provision was modified to clarify how geospatial files must be identified. It is necessary that geospatial files identify which failure scenario they are depicting so emergency managers can understand the maps and determine how they will make decisions during an actual emergency with respect to what hypothetical failure scenario is shown in the geospatial file.

Section 335.14. Submittals to the Department

(a)(2) It is necessary to require projection information with geospatial files so they can be accurately reviewed by the department and so that projection information is readily available to emergency managers for use during emergencies.

Section 335.16. Updates to Inundation Maps and Supporting Documentation

(a)(1) It is necessary to replace the word “and” with “or” to be consistent with statute.

3. Summary and response to comments received during the initial notice period of June 8, 2018 – July 24, 2018 (45-day comment period)

Comment 1.1

For maps produced using a two-dimensional model that outputs raster files, do not require submittal of an inundation boundary vector file. A boundary is not necessary because it is inherently displayed in the required raster files (arrival time, maximum depth, and maximum velocity).

Response 1.1

The department recognizes that raster files inherently show the inundation boundary. However, the department is developing a web application that will display vector boundary files to comply with the public availability requirement in the Water Code. In addition, it is not time-consuming or costly to produce a vector boundary file from raster files. No change is needed to clarify this text.

Comment 1.2

Section 335.6(a)(1)(B) If a modeled breach elevation is lower than the bottom of the reservoir and no more water can be released, this can cause modeling errors. Revise regulations to allow bottom of reservoir to be the lowest breach elevation.

Response 1.2

The department agrees with this comment. The department added Section 335.2(a)(2), providing a definition for “breach height” which defines the lower extent to be “the upstream toe or downstream toe, whichever elevation is higher.”

Comment 1.3

Sections 335.8(a)(5) and 335.10(d)(14): I am pleased that the inundation maps and technical memorandum must be signed and stamped by a licensed professional engineer. This requirement will greatly improve the quality of documents submitted to the department.

Response 1.3

The department agrees with this comment; no change is necessary.

Comment 1.4

Section 335.4(b): Provide guidance on how a dam owner can request a re-evaluation of hazard classification, including a time limit for the department to make a decision.

Response 1.4

The department agrees with this comment. Section 335.4(b) was modified to provide detailed guidance on how a dam owner may request a re-evaluation of the hazard classification. Section 335.4(b)(2) establishes a 60-day period for the department to complete the re-evaluation.

Comment 1.5

In some cases, an inundation map is not needed to determine an evacuation route.

Response 1.5

The department does not have the authority to waive the requirement for an inundation map. Water Code section 6161(a)(1) requires owners to submit inundation maps for dams and their critical appurtenant structures, except for low hazard dams.

Comment 1.6

Section 335.4 The department should reveal their justification for each hazard classification so owners considering a re-evaluation know what they need to address.

Response 1.6

The department agrees with this comment; however, existing text is provided in Section 335.4. This section defines each hazard classification, which are based on federal classifications as required by Water Code section 6160(b). Federal hazard potential classifications are defined in [FEMA 333](#), which is included in the Documents Relied Upon in the Initial Statement of Reasons.

Comment 1.7

Section 335.6(a)(2): For dams that impound sediment, the proposed regulations require the entire impoundment, including sediment, to be modeled as water. This requirement would result in an inaccurate map that overestimates the inundation area. In the event of a catastrophic event such as an earthquake, such inaccurate information could result in thousands of people unnecessarily attempting to evacuate on roads that may not be safe for travel, causing congestion that could interfere with first responders.

The regulations allow owners to submit a second failure scenario depicting the effects of sediment release with supporting documentation. Two maps in the public record will cause confusion among the public and first responders.

Response 1.7

The department agrees that modeling sediment as water is conservative and that doing so may overestimate the inundation area. However, modeling sediment flow from dams is not currently done in the state-of-practice with a high degree of confidence in the results. When there is a high degree of uncertainty, the department believes it is important to have a conservative estimate of the inundation. Modeling sediment release is time-consuming, and the department's review of sediment maps is also expected to be time-consuming.

The department believes it is important to have an inundation map approved for each dam in a timely manner, even if it is a conservative estimation of inundation to be revised in the future. In addition, sediment modeling is expensive; the department believes it is important to give owners a less expensive, simple, and conservative option to model sediment as water.

The department agrees that more detail is needed for owners who want to pursue sediment modeling. The department modified Section 335.6(a)(2) to allow for an owner to propose a sediment release modeling approach. The department also added Section 335.6(a)(2)(C), which states that if the department approves an inundation map based on an accepted sediment modeling approach, the

approved map will supersede any previously approved maps; this will minimize confusion for the public and emergency managers.

Comment 1.8

Section 335.6(a)(3)(A): Provide methodology for selecting dam breach parameters.

Response 1.8

Acceptable breach parameters are provided in Section 335.6(a)(3). Licensed engineers are required to prepare inundation maps and technical memorandum to document their modeling assumptions. The regulations are written to allow for engineering judgement given the wide variety of dam designs and construction methods that must be analyzed on a case-by-case basis. No change is needed to clarify this text.

Comment 1.9

Section 335.10(a)(4): Maximum velocity may not be helpful to emergency managers. Deflood times are more useful to emergency managers.

Response 1.9

The purpose and necessity for requiring maximum velocity is detailed in the Initial Statement of Reasons: It is necessary to require the maximum velocity be displayed on the map because it aids emergency managers in the dispatch of swift-water rescue teams where rapid flows are expected. Maximum velocity, combined with maximum depths, can inform emergency managers of the severity of flooding and risk to public safety.

Deflood time was removed from the emergency regulations during the readoption on July 18, 2018 (2018-0703-02EE) and the reasons for its removal were documented in the Finding of Emergency: Deflood time is not a required submittal because the specific assumptions used to model deflood time are not expected to be applicable in an emergency, and would potentially be unconservative. Emergency managers make repopulation decisions based on real-time data, not deflood maps.

Comment 1.10

The proposed regulation is unduly financially burdensome for many dam owners, particularly the requirement for a licensed engineer to prepare the maps and technical memorandum. The department should consider alternatives to the proposed regulation that are less onerous for dam owners. The department is already reviewing and approving the maps, so requiring the maps be prepared by licensed engineers is unnecessary.

Response 1.10

The department understands that the requirement for inundation maps to be prepared under the direction of a licensed engineer will result in costs that are significant for some dam owners, and these costs are estimated in the Economic and Fiscal Analysis Statement. The department believes that it is necessary to require that inundation maps and technical memorandums be prepared by licensed engineers because they are complex engineering documents that employ many engineering modeling assumptions. The department is sensitive to costs imposed on dam owners, but the costs must be balanced with public safety concerns. While the department has determined that the expertise required to prepare maps and concerns for public safety justify the requirement that inundation maps be prepared by or under the direction of a California licensed professional engineer, the department has

incorporated provisions in the regulations that are designed to reduce financial impacts to dam owners, as discussed below. Additional cost-saving measures are detailed in the Alternatives section.

Comment 1.11

Dam owners should have the option to incorporate bathymetric data in their analyses.

Response 1.11

If owners elect to model the sediment in their reservoir (in addition to modeling the sediment as water), the department added Section 335.6(a)(2)(A)(ii) requiring owners to provide supporting data, including bathymetric data.

Comment 1.12

Section 335.2(a)(19): Clarify the definition of “Maximum possible water surface.” Does the highest physical barrier not including flood surcharge mean the crest of the dam or the spillway?

Response 1.12

The department agrees that the definition needs to be clarified. Existing language states that this is the elevation of water that can be physically impounded without spilling, which implies the spillway crest, not the dam crest. The department modified the definition by removing reference to “flood surcharge” because its meaning was not clear. The department also added text that states that the maximum possible water elevation is usually the spillway crest, even when a reservoir is restricted below the spillway.

Comment 1.13

Section 335.6(b)(2): Instead of requiring modeling software that is capable of employing an unsteady hydraulic model, we recommend that DSOD consider an alternative which allows the use of software that is widely commercially available to the general public.

Response 1.13

The department agrees that it is important to allow the use of software that is widely commercially available to the public. There are several software products that meet the criteria of unsteady hydraulic modeling capability and being widely publicly available, including the free open-source HEC-RAS software developed by the U.S. Army Corps of Engineers.

List of comment letters received during 45-day comment period (June 8, 2018 – July 24, 2018)

- Ryan Greif, Mead & Hunt (6/25/18)
- Leland Frayseth (6/27/18)
- Loren Amelang, Walker Lake Association (7/15/18)
- Shawnda Grady, Stanford University (7/20/18)
- Priya Jain, East Bay MUD (7/20/18) – Letter #1
- Kirk Wilbur, CA Cattlemen’s Assn and Jack Rice, CA Farm Bureau Federation (7/23/18)
- Brian Brown, MBK (7/24/18)
- Priya Jain, East Bay MUD (7/24/18) – Letter #2
- Priya Jain, East Bay MUD (7/25/18 – not timely) – Letter #3

4. **Summary and response to comments received during the period the modified text was available to the public August 17, 2018 – September 1, 2018 (15-day comment period)**

Comment 2.1

Section 335.12(g) Clarify how dam owners must have geospatial projections “verified by the engineer?”

Response 2.1

The engineer must verify that the projection is projected in NAD 1983 Teale (California) Albers with the units specified in feet. The department believes the text is clear and no modification is necessary. This text is necessary to inform owners and engineers that this information must be verified because some submittals received by the department are not correctly projected.

Comment 2.2

Section 335.12(g) Teale Albers is not a projection option within the open source QGIS software. How can open source GIS software be used to comply with the required projection?

Response 2.2

The department agrees with this comment. The department previously added Sections 335.12(g)(1)-(7) to define the equivalent specifications for the NAD 1983 Teale (California) Albers projection so that this projection may be used in any GIS application. No further clarification is necessary. Providing specifications of the required projection is consistent with federal guidelines. The department wants dam owners and their engineers to be able to use open source software if it meets the engineering requirements to reduce cost to dam owners where possible.

Comment 2.3

Section 335.6(a)(1)(C): What is the definition of sediment? In the absence of geotechnical data from sediment samples, are owners required to assume all sediment is mobile?

Response 2.3

The term “sediment” does not need to be defined because its meaning is commonly understood in the context of the proposed regulations by licensed engineers as material deposited within a reservoir behind a dam. Owners are required to model sediment as water, as required by section 335.6(a)(1)(C), which assumes that all sediment is not only mobile, but has the fluid characteristics of water. If an owner would like to model the sediment with different material properties, the owner may request department acceptance to do so according to section 335.6(a)(2). No further clarification is necessary.

Comment 2.4

Sections 335.8(a)(5) and 335.10(d)(14): I am pleased that the inundation maps and technical memorandum must be signed and stamped by a licensed professional engineer. This requirement will greatly improve the quality of documents submitted to the department.

Response 2.4

The department agrees with this comment; no change is necessary.

Comment 2.5

Sections 335.2(a)(15) and 335.10(c): There is an inconsistency between the definitions of “inundation area” and “inundation boundary.” The latter is defined as the outside of the inundation area displayed

as one-foot depth, while the former is defined as the area that experiences a rise in water surface elevation, which implies less than one-foot depth.

Response 2.5

The department agrees with this comment. A non-substantial change was made to the definition of inundation area (section 335.2(a)(15)) to make the definitions consistent with each other. This change is considered non-substantial because it does not materially alter the regulations and is necessary to clarify the original intent.

Comment 2.6

Section 335.2(a)(2): Clarify the meaning of “whichever elevation is higher.”

Response 2.6

The phrase “whichever elevation is higher” refers to the text immediately before it, which identifies the subjects as the upstream toe or downstream toe of a dam. No change is needed to clarify this text.

Comment 2.7

Section 335.2(a)(6): Since the definition of DSOD was removed, recommend add a definition for “the department.”

Response 2.7

The term “the department” is used as a synonym for the Department of Water Resources throughout the referenced statutes in Water Code and other regulations in Title 23: Waters. No change is needed to clarify this text.

Comment 2.8

Section 335.10(d)(15)(B): Define “security sensitive infrastructure.” Revise this text so that including this disclaimer on inundation maps is optional. Owners may not know, or may not wish to call attention to the fact, that security sensitive infrastructure may or may not be shown on inundation maps.

Response 2.8

In the Initial Statement of Reasons, the necessity for Section 335.2(a)(3) stated that Emergency managers expressed concern that publishing sensitive critical facilities, such as energy infrastructure, on publicly available inundation maps would compromise their security.

This language must be on inundation maps so that emergency managers understand that infrastructure that is considered sensitive information for security reasons may not be shown on the maps. Emergency managers need to know this so they can identify facilities not shown on the map that may require their attention during an emergency. For example, this may include communication, power, and other lifeline infrastructure. The term “security sensitive infrastructure” has a common meaning to emergency managers who use inundation maps. The text says that such infrastructure “may” not be shown on maps, communicating the appropriate level of confidence to emergency managers; owners do not need to verify the presence or lack of security sensitive infrastructure to print this disclaimer on maps. No change is needed to clarify this text.

Comment 2.9

Section 335.10(d)(17): Define when a flood recession is considered to be slow and define that it is to a one foot level.

Response 2.9

The purpose of this text is to identify areas of slower flood recession so emergency managers can plan their response for longer flood times. Flood recession time depends on many factors whose cumulative effects are difficult to quantify, including but not limited to the relative elevation of the surrounding topography; the presence of culverts, drains, or other dewatering infrastructure; the maintenance and operation of such infrastructure; downstream antecedent flood conditions; and soil antecedent flood conditions. The department believes it is important for licensed engineers to identify potential areas of longer term flooding based on modeled results for emergency managers; however, the department does not want to apply a prescriptive standard that would imply an inaccurate degree of confidence in the precision of the information that is shown on the map. No change is needed to clarify this text.

Comment 2.10

Section 335.2(a)(19): Clarify the definition of “Maximum possible water surface.” Does this mean the reservoir is operationally full?

Response 2.10

Existing language states that this is the maximum elevation of water that can be physically impounded without spilling. The department previously added text that states that the maximum possible water elevation is usually the spillway crest, even when a reservoir is restricted below the spillway. The term “operationally full” has different meanings to different owners, and the department believes that including this term in the definition will reduce its clarity. No change is needed to clarify this text.

Comment 2.11

We did not have the opportunity to comment on the original proposed regulation text that was noticed on June 8, 2018.

Response 2.11

The organization that submitted this comment was sent the notice by both email and postal mail. The department made the regulation text available for public comment in four ways:

- 1) The notice was published in the OAL Notice Register on June 8, 2018.
- 2) The department mailed the notice to all jurisdictional dam owners.
- 3) The department emailed the notice to all persons who requested to be notified of DSOD-related regulation activities.
- 4) The department posted the notice, regulation text, and Initial Statement of Reasons on the DSOD website at damsafety.water.ca.gov and the department’s public notices page at water.ca.gov/News/Public-Notices.

Comment 2.12

Section 335.6(a): Provide more guidance on how to apply storm-induced loading conditions.

Response 2.12

A storm-induced loading condition is not required; the department will accept any storm frequency in lieu of a sunny-day loading condition. If a storm-induced loading condition, as defined in section 335.2(a)(25), is represented on an inundation map that is submitted to the department, the department will only review it to ensure compliance with the regulations. No change is needed to clarify this text.

Comment 2.13

Section 335.4(b)(3): Defer the obligation to develop inundation maps until after the department makes a decision in response to a hazard re-evaluation request.

Response 2.13

Water Code section 6161(a)(1) requires owners to submit emergency action plans for dams and their critical appurtenant structures by dates specified in Water Code section 6161(d) according to the assigned hazard classification, except for low hazard dams. Inundation maps are a necessary component of emergency action plans. The department does not have the authority to waive or pause the requirement for an emergency action plan, even during its consideration of a hazard re-evaluation request. If a dam owner believes that its dam has received an incorrect hazard classification, the dam owner should seek re-evaluation as soon as possible for planning purposes. No changes to the text were made.

Comment 2.14

Section 335.6(b)(2)(A): Add language explicitly stating that one-dimensional modeling may be acceptable, and provide guidance for when two-dimensional modeling is required.

Response 2.14

The selection of modeling software should consider the site-specific topography on a case-by-case basis by a licensed engineer using engineering judgment. One-dimensional modeling may be appropriate in some areas where the flow of water is generally in one direction and there is no lateral spreading or development; however, this must be determined by an engineer on a case-by-case basis and should not be a rule of general application. The text already contains guidance about when two-dimensional modeling is generally appropriate. The regulations allow for the licensed engineers who are preparing maps to exercise engineering judgement on which model is appropriate. The department has received maps based on one-dimensional models, two-dimensional models, and 1D coupled with 2D models. In addition, in many cases, two-dimensional modeling is becoming less expensive and time-consuming than one-dimensional modeling because large amounts of topographic data can be directly imported into a 2D model rather than constructing cross-sections in a 1D model. The text is written to allow for case-by-case application and to allow advances in the state-of-practice in hydraulic modeling. No changes to the text were made in response to this comment.

Comment 2.15

Section 335.6(b)(B): Provide a time limit for the department to make a decision to approve an alternative model.

Response 2.15

The department recognizes that dam owners proposing alternative models need a decision from the department as soon as possible so the owner can proceed with developing inundation maps. The department will evaluate proposed alternative models on a case-by-case basis to ensure that each proposed model has the capability to produce the inundation extent and timing described in Section 335.6(b)(2)(A). Engineering computer models that simulate water flow are complex and may be time-consuming for the department to evaluate, which must be done on a case-by-case basis. Given the variety of dams and the different types of models, it would be extremely difficult, if not impossible, to develop a standard timeframe for evaluating alternative models. Therefore, it is inappropriate for the

regulations to specify a timeline for the department's decision. No changes to the text were made in response to this comment.

Comment 2.16

Section 335.6(a)(2): For dams that impound sediment, the proposed regulations still require the entire impoundment, including sediment, to be modeled as water. This requirement would result in an inaccurate map that overestimates the inundation area. The regulations allow owners to submit a second failure scenario depicting the effects of sediment release with supporting documentation. Though a department-approved sediment map would supersede the all-water map, two maps in the public record will cause confusion among the public and first responders.

To better advise the public and first responders, we recommend that the regulations be amended to require analysis based on the presumption of a dam system to either the maximum possible storage elevation authorized or the maximum possible storage elevation due to other factors, including sedimentation, subject to appropriate supporting documentation.

Response 2.16

The department agrees that modeling sediment as water is conservative. However, modeling sediment flow from dams is not currently done in the state-of-practice with a high degree of confidence in the results. When there is a high degree of uncertainty, the department believes it is important to have a conservative estimate of the inundation. Modeling sediment release is time-consuming, and the department's review of sediment maps is also expected to be time-consuming. The department believes it is important to have an inundation map approved for each dam as soon as possible, even if it is a conservative estimation of inundation to be revised in the future. In addition, sediment modeling is expensive; the department believes it is important to give owners a less expensive, simple, and conservative option to model sediment as water.

The department previously modified Section 335.6(a)(2) to allow an owner to propose a sediment release modeling approach. The department also added Section 335.6(a)(2)(C) that states if the department approves an inundation map based on an accepted sediment modeling approach, the approved map will supersede any previously approved maps; this will minimize confusion for the public and emergency managers. No change was made to the text in response to this comment.

Comment 2.17

Section 335.6(a)(2)(B): What nature of additional information may the department require for further assessment of the sediment release modeling approach methodology?

Response 2.17

Additional information would depend on the proposed sediment release modeling approach on a case-by-case basis. In section 335.6(a)(2)(A)(ii) supporting documentation is listed that would apply to all proposed modeling approaches; more detailed information to support the modeling approach, if needed, would be determined on a case-by-case basis. No change is necessary.

Comment 2.18

Section 335.2(a)(2): Specify that breach height is measured from the upstream toe or downstream toe "of the dam."

Response 2.18

The context in this definition makes clear that the upstream and downstream toes are in reference to the dam. No change is necessary.

Comment 2.19

Section 335.6(a): Clarify that sediment modeling is only in reference to sediment that is located *below the maximum possible storage elevation*. Add that a letter requesting approval of a sediment release modeling approach must also include a request for department acceptance of a proposed sediment release model.

Response 2.19

It is unlikely that sediment would exist above the maximum possible storage elevation because sediment is deposited by water, and water cannot be stored above the maximum possible storage elevation. However, all material impounded behind a dam must be modeled in the inundation map. No change is necessary.

The acceptance of a sediment release modeling approach includes the acceptance of the proposed sediment release model, so it is not necessary that an owner includes this in their letter. No change was made in response to this comment.

Comment 2.20

Section 335.10(c): Striking “or” and replacing with “and” does not make sense. Consider striking “and canyon” from current text.

Response 2.20

The department agrees with this comment. The text was changed to replace “and” with “or” and vice versa.

List of comment letters received during 15-day comment period (August 17, 2018 – September 1, 2018)

- Loren Amelang, Walker Lake Association (8/17/18)
- Leland Frayseth (8/17/18)
- Ryan Greif, Mead & Hunt (8/20/18)
- Thomas Greene, Rancho California Water District (8/21/18)
- Martin Teal, WEST Consultants (8/22/18)
- Andrew Fisher, PG&E (8/23/18)
- Penny Lew, Orange County Public Works (8/27/18)
- Kirk Wilbur, CA Cattlemen’s Assn; Jack Rice, CA Farm Bureau Federation; Tim Schmelzer, Wine Institute (8/30/18)
- Shawnda Grady, Stanford University (8/30/18)
- Toby Roy, San Diego County Water Authority (8/31/18)

5. Local Mandate Determination

The proposed regulations do not impose any mandate on local agencies or school districts. The department has determined that the proposed regulations will not impose a mandate on local agencies or school districts that is required to be reimbursed under part 7 (commencing with section 17500) of Division 4 of the Government Code. Dams may be owned by local agencies or school districts. However,

the regulations apply to all dam owners, not exclusively to local agencies and school districts. The proposed regulations apply to all owners of state jurisdictional dams, which include both publicly and privately owned dams. While the proposed regulations will impose costs on local agencies that own dams subject to inundation map requirements, the proposed regulatory action will not result in a reimbursable state-mandated program.

6. Alternatives Determination

The department considered a proposed alternative that would not require a licensed engineer to prepare the inundation maps and technical memorandum (see Comment 1.10). This alternative would reduce the cost to prepare inundation maps; however, it would not be as effective.

It is necessary to require the signature, seal, and license number of the civil engineer responsible for preparing the map and technical memorandum because inundation maps display information that is developed through breach and hydraulic modeling, which necessitates preparation by a qualified engineer. DSOD polled other states and found that many require maps to be prepared and stamped by a registered professional engineer. This requirement is necessary to ensure the map(s) are prepared professionally with the backing of the Business and Professions Code. This certification on the map also designates it was prepared by or under the direction of a licensed civil engineer with expertise and experience in performing inundation studies.

The department understands that the requirement for inundation maps to be prepared under the direction of a licensed engineer will cause dam owners to incur expenses, which may be significant for some dam owners; these costs are estimated in the Economic and Fiscal Analysis Statement. The department believes that it is necessary to require that inundation maps and technical memorandums be prepared by licensed engineers because they are complex engineering documents that employ many engineering modeling assumptions. The department is sensitive to costs imposed on dam owners, but the costs must be balanced with public safety concerns. While the department has determined that the expertise required to prepare maps and concerns for public safety justify the requirement that inundation maps be prepared by or under the direction of a California licensed professional engineer, the department has incorporated provisions in the regulations that are designed to reduce financial impacts to dam owners, as discussed below.

The department implemented several cost-saving approaches in the proposed regulations. These include not requiring a new model for 10-year map updates if conditions are unchanged, not requiring owners to perform sediment release modeling, not requiring a breach parameter sensitivity analysis, allowing a model to be stopped if the flood wave is confined to a channel and is no longer a threat to life and property, not requiring a storm-induced failure, allowing one-dimensional modeling where appropriate, allowing 10-meter horizontal data resolution where appropriate, not requiring deflood time, allowing for alternative modeling approaches subject to department approval, and allowing the department to approve maps that demonstrate substantial compliance.

The department determined that no alternative it considered or that was otherwise identified and brought to its attention would be more effective in carrying out the purpose for which the action is proposed, would be as effective and less burdensome to affected private persons than the proposed action, or would be more cost-effective to affected private persons and equally effective in implementing the statutory policy or other provision of law.

The amendments adopted by the department are the only regulatory provisions identified by the department that accomplish the goal of establishing standards and acceptable engineering methodologies for developing inundation maps. The alternative proposed during the 45-day comment period to not require a licensed engineer to prepare inundation maps is not as effective as requiring a licensed engineer to prepare maps because the maps would be lower quality and potentially jeopardize public safety. Except as set forth and discussed in the summary and responses to comments, no other alternatives have been proposed or otherwise brought to the department's attention.

7. Incorporation by Reference

The department is incorporating by reference portions of three documents into the regulations. These documents are large, and only the relevant tables are incorporated by reference.

- Table 9-3 of [FEMA P-946](#)
- Table 1 of [FERC Ch. 2, Appendix II-A](#)
- Table 2 of [USBR-DSO-98-004](#)

The department determines that it would be cumbersome, unduly expensive, or otherwise impractical to publish the documents in the California Code of Regulations.

The documents were made available upon request directly from the department, and were reasonably available to the affected public from a commonly known or specified source: the department's website.