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Dear Mark and the MEMA mitigation planning team:

Thank you for opportunity to provide feedback on the draft 2016 Maryland State Hazard Mitigation Plan (“the Plan”). As an environmental organization dedicated to safeguarding human health and curbing global warming, NRDC appreciates Maryland’s demonstrated commitment to protecting communities from natural hazards, including those that will be exacerbated by climate change. As the Federal Emergency Management Agency (FEMA) states in its 2015 *State Mitigation Plan Review Guide*, “the challenges posed by climate change, such as more intense storms, frequent heavy precipitation, heat waves, drought, extreme flooding, and higher sea levels, could significantly alter the types and magnitudes of hazards impacting states in the future.”<sup>1</sup>

The current draft Plan includes many strong components that will help Maryland address these challenges. At the same time, it misses some significant opportunities to fully integrate climate change projections into the risk assessment and mitigation strategies; in some ways, it represents a regression from the previous plan with regard to climate change considerations. We offer the following suggestions to strengthen the Plan’s treatment of climate change and look forward to working with you to further improve the Plan to bring it into full compliance with FEMA policy.

#### Risk and Vulnerability Assessment

FEMA’s *State Mitigation Plan Review Guide* requires that risk assessments must include “consideration of changing environmental or climate conditions that may affect and influence the long-term vulnerability from hazards in the state.”<sup>2</sup> Specifically, the risk assessment must address future “projected changes in occurrences *for each natural hazard*,” including the effects of climate change.<sup>3</sup> The Plan’s current risk assessment and vulnerability assessment sections meet this standard for some natural hazards, but not for “each natural hazard” as FEMA policy requires.

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<sup>1</sup> FEMA, *State Mitigation Plan Review Guide* at 13 (2015), available at [http://www.fema.gov/media-library-data/1425915308555-aba3a873bc5f1140f7320d1ebeb18c6/State\\_Mitigation\\_Plan\\_Review\\_Guide\\_2015.pdf](http://www.fema.gov/media-library-data/1425915308555-aba3a873bc5f1140f7320d1ebeb18c6/State_Mitigation_Plan_Review_Guide_2015.pdf).

<sup>2</sup> *Id.* at 3.

<sup>3</sup> *Id.* at 15 (emphasis added).

*The Plan appropriately includes information from the National Climate Assessment.*

We commend MEMA for including excerpts from the National Climate Assessment in the Plan to help understand the future probability of natural hazards in the state. The NCA is a comprehensive, extensively peer-reviewed document that is a reliable source of information about climate change. Including this information makes the Plan stronger by providing a national context for the changes in hazard risk that Maryland can expect to see in the coming years.

*The Plan includes climate change information for some natural hazards.*

Climate change is discussed in the Plan sections addressing flooding and coastal hazards. The risk assessment section acknowledges climate change as a factor that can exacerbate flooding and erosion, and the vulnerability assessment section incorporates the Coastal Vulnerability Assessment and notes that areas of low flood risk could become high-risk areas in the future.

Recognizing that climate change is projected to affect the risk of flooding and coastal hazards in the future is important because it empowers MEMA with the information needed to appropriately develop and prioritize future mitigation activities for those hazards.

*The Plan omits climate change information from the discussion of other natural hazards.*

While the Plan includes some national-level climate change information from the NCA, and discusses the impact of climate change on flooding and coastal hazards, it omits any discussion of climate change from the risk/vulnerability assessments of all other hazards. Specifically, climate change is not mentioned at all in the assessments for winter storms, tornadoes, wind, thunderstorms, wildfires, or drought. In fact, the risk/vulnerability assessments for these hazards do not seem to address future probability of occurrence in Maryland *at all*, even outside the context of climate change. (The word “future” is not mentioned once in all of Section II, the risk assessment section.) This omission runs afoul of FEMA’s requirement that future probability, including climate change, must be assessed “for each natural hazard” individually.<sup>4</sup>

As discussed above, considering how a particular hazard’s risk might evolve in the future is critical to the process of developing and prioritizing mitigation strategies to reduce vulnerability. When climate change information is omitted for the risk/vulnerability assessment for a hazard, MEMA does not have that knowledge to draw upon when creating a strategy to keep communities safe. Including generalized climate change information in a separate section of the Plan does not substitute for this careful hazard-by-hazard consideration of future probability.

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<sup>4</sup> *Id.*; see also FEMA, *State Mitigation Planning Key Topics Bulletins: Risk Assessment* at 8 (June 2016), available at [http://www.fema.gov/media-library-data/1464972786707-d686a56e54284eb815b1624224dfaa5b/RiskAssessment\\_KeyTopics\\_Bulletin\\_Final.pdf](http://www.fema.gov/media-library-data/1464972786707-d686a56e54284eb815b1624224dfaa5b/RiskAssessment_KeyTopics_Bulletin_Final.pdf) (“States should use the information, data, and analyses from these resources to qualitatively and quantitatively identify the effects climate change may have on the future probability, and impact, of *each of their identified hazards*” (emphasis added)).

The omission is puzzling given that Maryland’s previous (2011) State Hazard Mitigation Plan did attempt to address the future impacts of climate change in its hazard-specific risk assessments. Each hazard-specific assessment included a section titled “Probability of Future Occurrence” that in many cases included climate change information where available, or an explanation of why none was included where data was unavailable (with a commitment to incorporate such information in the next plan update).

For example, while this draft Plan does not discuss the impact of climate change on tropical storms and hurricanes, the 2011 plan included the following information within the “Probability of Future Occurrence” subsection for those hazards:<sup>5</sup>

Based on a range of long-term global climate models under Intergovernmental Panel on Climate Change (IPCC) warming scenarios, it is possible that hurricanes will become more intense, with stronger winds and heavier precipitation through the 21st century. Using an ensemble-mean of 18 climate models, IPCC A1B emissions scenario<sup>9</sup>, and operational hurricane forecast models, one study<sup>10</sup> showed a decrease in the total number of tropical storms and hurricanes, but an increase in the number of intense hurricanes, particularly Category 4 or 5 hurricanes. Future plan updates should consider a review of the latest climate science to determine what impact, if any, climate change might have on the future frequency or intensity of hurricanes and tropical storms and how this might apply to Maryland.

Likewise, this draft Plan does not discuss the impact of climate change on winter storms, but the 2011 plan included this passage in its “Probability of Future Occurrence” for winter storms:<sup>6</sup>

Climate change is expected to bring an increase in precipitation to Maryland during the winter, however, the precipitation is expected to be increasingly in the form of liquid rather than frozen. A 25 percent decrease in snow volume is projected by 2025 and a 40 percent decrease by the end of the century. The Chesapeake Bay currently freezes over from shore to shore at the Chesapeake Bay Bridge roughly once every ten years. This is projected to occur less frequently in the future as temperatures warm; occurring once every 25 years for a low emissions scenario and roughly every 40 years in the case of a higher emissions scenario.<sup>38</sup>

This draft Plan does not discuss the impact of climate change on drought, but the 2011 plan included this passage in its “Probability of Future Occurrence” for drought:<sup>7</sup>

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<sup>5</sup> MEMA, 2011 Maryland State Hazard Mitigation Plan Update, at 97 (2011), *available at* <http://mema.maryland.gov/community/Documents/MD%20HMP%20Update%20EMAP%20Complete.pdf>.

<sup>6</sup> *Id.* at 188.

<sup>7</sup> *Id.* at 225.

Future droughts can also be expected due to more frequent extreme heat events as a result of a warming climate. Long-term climate forecast models suggest that a warming planet will lead to changes in precipitation distribution and more frequent and severe drought in some parts of the country. In spite of projections of moderate increases in annual precipitation in Maryland, increases in temperatures in climate models lead to decreases in soil moisture throughout the year.<sup>56</sup> The Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report indicates that it is very likely that hot extremes and heat waves will become more frequent as the Earth warms. In Maryland, the number of days above 90F is projected to more than double under a lower greenhouse gas emissions scenario and roughly triple under a higher emissions scenario by the end of the century. Extended heat waves (temperatures above 90F for at least three consecutive days) are expected to be much more frequent and longer lasting, particularly under higher emissions scenarios. The predictions for increasing heat waves and temperature extremes are likely, with moderate confidence.<sup>57</sup>

And the 2011 plan's wildfire and landslides sections included these brief but nonetheless useful references to climate change:<sup>8</sup>

In the future, the possibility of more frequent short-term drought<sup>39</sup> associated with a changing climate could result in more frequent occurrence of wildfire.

Climate change impacts, including the possibility of more frequent, intense precipitation events and more frequent short-term drought creating conditions more favorable for wildfires, could result in greater surface runoff and an increased probability of landslide in the future.

We strongly urge MEMA to take a similar approach in this Plan and clearly explain how climate change is projected to affect the future probability of *each* hazard. MEMA should build on the analysis that was included in the 2011 plan, make use of the additional data now available from the NCA and other sources, and assess how each hazard's risk is likely to change in the future in response to climate change.

At the very least, information from the NCA about climate change impacts in the Northeast Region (which includes Maryland) should be integrated into the risk/vulnerability assessments for each hazard. More localized data should be included where available; partner agencies and local academic researchers should be able to provide information to MEMA without difficulty. FEMA describes the options best in its recent risk assessment "key topics bulletin":<sup>9</sup>

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<sup>8</sup> *Id.* at 199, 207.

<sup>9</sup> FEMA, *State Mitigation Planning Key Topics Bulletins: Risk Assessment*, at 8.

- **Good:** Inclusion of qualitative information about how changing weather patterns and climate can impact the probability of future occurrence of each of the plan’s identified hazards.
- **Better:** Integration of national or regional models that identify quantitative changes in the frequency or probability of future occurrence of each hazard in the plan.
- **Best:** Integration of state-wide, or more localized, analyses, based on down-scaled temperature and precipitation data, of the probability of future occurrence of each hazard in the plan, as well as identification of the effect climate change will have on the overall impact of each hazard in the state.

As FEMA makes clear in that document, climate change information may be omitted only if “there is *no* other data available on the probability of future occurrences of hazard events.”<sup>10</sup> There is ample information available on the projected effects of climate change in Maryland that should be included in the Plan, particularly with regard to hazards such as extreme heat, drought, wildfires, and tropical storms/hurricanes. Several additional sources of information that could be utilized are discussed below on pages 7-8.

*In the hazard-specific assessments that include climate change, the discussion is incomplete or confusing.*

The climate change information included in the flooding and coastal hazard assessment sections is not presented as clearly or thoroughly as it could be. As an initial matter, it is unclear why climate change is discussed in the vulnerability assessment section as opposed to the risk assessment section, where assessments of future probability are typically included. Maryland’s 2011 plan presented the risk of a particular hazard and the state’s vulnerability to it in the same section, which conveyed the information in an easy-to-read way. The current draft Plan divides these discussions confusingly into two separate chapters. If these chapters are to remain separate, any discussion of climate change projections properly belongs in the risk assessment section, pursuant to FEMA guidance.<sup>11</sup>

Additionally, as mentioned above, the future probability of each hazard’s occurrence is not presented in its own subsection. Climate change information is woven into the text, making it difficult to find. This information is critical to MEMA’s overall assessment of risk and should be called out more prominently.

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<sup>10</sup> *Id.* at 9.

<sup>11</sup> FEMA, *State Mitigation Plan Review Guide*, at 15 (“The risk assessment must provide a summary of the probability of future hazard events that includes projected changes in occurrences for each natural hazard . . .”).

The discussion is also fairly cursory and should also be supplemented with as much quantitative information as possible, in accordance with FEMA's "good, better, best" policy copied above. For example, the discussions of climate change's impact on flooding and sea level rise in the 2011 plan were more detailed and quantitative than what this draft Plan contains:<sup>12</sup>

More intense rainfall, the result of climate change, is likely to increase peak flooding, particularly in urban environments in the future. The magnitude of this increase is dependent on the level and rate of greenhouse gas emissions through the end of the century. It is projected that there will be a 20 percent increase in the magnitude of the 100-year flood under a higher greenhouse gas emissions scenario (A26) and a 10 percent increase in magnitude under a lower greenhouse gas emissions (B17) scenario.<sup>8</sup> For the 10-year flood recurrence interval, the increase in magnitudes is expected to be approximately 29 percent and 16 percent respectively.

The Maryland Commission on Climate Change Scientific and Technical Working Group provided estimates of RSLR by the end of the century. Projections were derived from the 2007 Intergovernmental Panel on Climate Change (IPCC) global SLR projections and combined with regional land subsidence magnitudes. The values, presented as "conservative", include estimates from 1-1.3 feet by 2050 to 2.7-3.4 feet by 2100 (Figure 3-23). Numerous projections have subsequently appeared in the scientific literature by various independent researchers that note increased rates of ice melt and produced estimates of eustatic SLR by 2100 up to just under 6 feet (above 1990 levels)<sup>14</sup>. The next IPCC synthesis report, which should provide an updated consensus prediction, is expected in fall 2014.

Similarly detailed and quantitative information should be included in this Plan for flooding and sea level rise, as well as the other hazards discussed above for which no climate change information has been provided.

One approach that MEMA has not included in this Plan, but which could be useful in performing assessments using probabilistic climate change projections, would be to develop a "risk matrix" that assesses the likelihood of an event occurring against the magnitude of consequence of that event for a given asset or location.

*Hazards were identified and prioritized in a backward-looking way that ignores climate change.*

The Plan states that natural hazards were identified for discussion based on past federal disaster declarations and other previous hazard occurrences. This backward-looking approach does not account for the impact that climate change will have on hazard risk in the future. Hazards that have not yet seriously affected Maryland could become more severe and/or frequent in the coming years.

As a result of this backward-looking approach, it is possible that the Plan does not include some hazards that Maryland could experience more in the future. This omission hinders MEMA in its mission of mitigating the risk of such hazards to communities in the state. For example, extreme heat is not included in the list of eight hazards considered in the Plan, even though the brief

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<sup>12</sup> MEMA, 2011 Maryland State Hazard Mitigation Plan Update, at 76.

section of the Plan summarizing the NCA mentions that heat waves are expected to affect Maryland more due to climate change. (In fact, the occurrence of heat waves has already doubled in Maryland since the 1960s, and are expected to roughly double again by 2040.<sup>13</sup> And Baltimore City, in its hazard mitigation/climate adaptation plan, lists extreme heat as a hazard that poses a threat.<sup>14</sup>) This omission runs counter to the FEMA policy that “[t]he plan must include *all* natural hazards with the potential to cause harm or difficulty in the state; it should not only include high-risk or recent hazards.”<sup>15</sup>

Along the same lines, the method used to prioritize the hazards for MEMA’s attention was based on factors that are also entirely backward-looking. This approach runs the risk of miscalculating the relative importance of different hazards in the future. MEMA should reassess the selection and prioritization of hazards in light of climate change projections. For example, California’s 2013 Hazard Mitigation Plan uses the probability of future occurrence as one of the factors used in prioritizing hazards.<sup>16</sup>

*The Plan’s overall conception of future probability is too static.*

The Plan’s “Probability Rating” system rates each hazard as being “unlikely,” “likely,” or “highly likely” to occur in the future. This categorization system does not account for the fact that the probability of a hazard may change over time due to climate change. For example, drought may be “likely” now, but “highly likely” in the coming years. MEMA should determine whether changes in these hazards are already being experienced relative to historical occurrences and assess future hazard risks at different timeframes: the immediate term (present to 10 years), near term (10-20 years), medium term (20-60 years), and long term (60-100 years) to better account for future probability and inform the development of mitigation strategies with different timelines or lifespans.

*The Plan should incorporate additional sources of climate change information.*

While the NCA is a reliable and trustworthy source of climate change information, additional sources are available that include information more specific to Maryland. For example:

- FEMA has provided a list of resources in its risk assessment “key topics bulletin” that MEMA should consider and incorporate.<sup>17</sup>

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<sup>13</sup> Maryland Institute for Applied Environmental Health, *Maryland Climate and Health Profile Report* at 17, Table 8 (Apr. 2016), available at [http://phpa.dhmfh.maryland.gov/OEHFP/EH/Shared%20Documents/Reports/MD\\_climate\\_and\\_health\\_FullReport\\_04182016%20Final.pdf](http://phpa.dhmfh.maryland.gov/OEHFP/EH/Shared%20Documents/Reports/MD_climate_and_health_FullReport_04182016%20Final.pdf).

<sup>14</sup> City of Baltimore, *Disaster Preparedness and Planning Project: A Combined All Hazards Mitigation and Climate Adaptation Plan* (2013), available at <http://www.baltimoresustainability.org/plans/disaster-preparedness-plan/>.

<sup>15</sup> FEMA, *State Mitigation Planning Key Topics Bulletins: Risk Assessment*, at 5 (emphasis added).

<sup>16</sup> California Office of Emergency Services, *State Hazard Mitigation Plan* at 91-92 (2013), available at <http://www.caloes.ca.gov/cal-oes-divisions/hazard-mitigation/hazard-mitigation-planning/state-hazard-mitigation-plan>.

<sup>17</sup> FEMA, *State Mitigation Planning Key Topics Bulletins: Risk Assessment*, at 22-23.

- The Maryland Commission on Climate Change’s 2008 *Comprehensive Assessment of Climate Change Impacts in Maryland*, though nearly a decade out of date, contains copious quantitative information about the projected effects of climate change in the state that could help to inform the Plan.<sup>18</sup>
- Climate Central published a report in 2014 that contains detailed information about climate-related flooding and sea level rise risk in Maryland.<sup>19</sup>
- A recent report by the University of Maryland, for the Maryland Department of Health, details the anticipated effects of climate change on public health in Maryland and contains projections relevant to this Plan.<sup>20</sup>
- MEMA should also include any climate change projections that have been included in local plans, particularly Baltimore’s combined hazard mitigation/climate change adaptation plan.<sup>21</sup> FEMA policy requires that “[s]tate risk assessments must be current, relevant, and include . . . information from local and tribal mitigation plans, as applicable.”<sup>22</sup>

### Mitigation Strategies

As FEMA states in its *State Mitigation Plan Review Guide*, regarding the establishment of prioritized mitigation actions: “This is the heart of the mitigation plan, and is essential to leading statewide mitigation programs to reduce risk. . . . The Plan must identify actions based on the current risk assessment to reduce the vulnerability of jurisdictions within the state as well as the vulnerability of state- owned or operated buildings, infrastructure, and critical facilities.”<sup>23</sup>

*Some mitigation strategies in the Plan are explicitly focused on climate change.*

We are pleased to see that several mitigation actions proposed in the draft Plan are focused on mitigating the risks associated with climate change. MEMA has included mitigation actions that would educate local governments about the impacts of climate change; establish a climate change/hazard mitigation resiliency officer; and protect shorelines from sea level rise. These are all worthwhile actions that would help to build resilience in Maryland communities into the future. We encourage MEMA to continue including climate change-focused mitigation strategies into this Plan and future plans. That includes increased integration into the Plan of the

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<sup>18</sup> [http://www.mde.state.md.us/programs/Air/ClimateChange/Documents/FINAL-Chapt%20%20Impacts\\_web.pdf](http://www.mde.state.md.us/programs/Air/ClimateChange/Documents/FINAL-Chapt%20%20Impacts_web.pdf).

<sup>19</sup> Climate Central, *Maryland and the Surging Sea* (2014), available at <http://sealevel.climatecentral.org/uploads/ssrf/MD-Report.pdf>.

<sup>20</sup> Maryland Institute for Applied Environmental Health, *Maryland Climate and Health Profile Report* (Apr. 2016), available at [http://phpa.dhmh.maryland.gov/OEHFP/EH/Shared%20Documents/Reports/MD\\_climate\\_and\\_health\\_FullReport\\_04182016%20Final.pdf](http://phpa.dhmh.maryland.gov/OEHFP/EH/Shared%20Documents/Reports/MD_climate_and_health_FullReport_04182016%20Final.pdf).

<sup>21</sup> City of Baltimore, *Disaster Preparedness and Planning Project: A Combined All Hazards Mitigation and Climate Adaptation Plan*, at Appendix L.

<sup>22</sup> FEMA, *State Mitigation Plan Review Guide*, at 3.

<sup>23</sup> *Id.* at 18.

ongoing efforts by other branches of state government to promote climate change adaptation, such as those mentioned in passing in Section I.

*Climate change must be a ranking or prioritization factor for mitigation strategies.*

According to the Plan's mitigation implementation status report, the previous 2011 plan called for MEMA to determine the feasibility of adding climate change as a ranking factor for mitigation strategies in the next plan update. However, this was not completed. Climate change (or any "surrogate" criteria, like promoting long-term resilience) is also absent from the criteria for funding local hazard mitigation projects.

It is critical to factor climate change into any decisions about which mitigation strategies to prioritize. Actions that do more to promote long-term resilience should be preferred over actions that do not address climate change when other factors are equal.

As FEMA has recognized, the entire point of assessing risk is to understand which actions should be taken to mitigate that risk. "An understanding of vulnerabilities will assist with prioritizing mitigation actions and policies that reduce risk from future events."<sup>24</sup> More specifically, within the climate change context: "The findings from risk assessments that consider the effects of a changing climate on their future hazards and vulnerabilities should be used in developing a mitigation strategy, as well as in prioritizing and successfully implementing projects to reduce hazard impacts."<sup>25</sup>

It seems possible or even likely that the absence of climate change from MEMA's ranking/prioritization factors explains why only one of the new climate-focused mitigation actions was ranked as a "high priority" action, and also why none of the climate-focused actions in the previous 2011 plan have yet been implemented. (The 2011 plan included the following climate-focused actions that were not completed: incorporating climate change into building codes; inventorying hazard risks to state owned facilities due to climate change; and investigating the inclusion of climate change into K-12 curricula.) This must change moving forward. Maryland must prioritize mitigation strategies, including "no-regrets" strategies, that will build long-term climate change preparedness so that these actions will be carried out over the next plan cycle.

*Climate change should be taken into account in the design of mitigation strategies, even when they are not specifically adopted as climate adaptation measures.*

Even when a mitigation strategy is not specifically focused on reducing climate change risks, climate change should be taken into account in connection with the concept and design of *all* mitigation strategies. Climate change will affect the likelihood, severity, and extent of many hazards into the future, and mitigation actions must be designed with those impacts in mind,

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<sup>24</sup> *Id.* at 3.

<sup>25</sup> FEMA, *State Mitigation Planning Key Topics Bulletins: Risk Assessment*, at 9.

especially when the action involves constructing, retrofitting, or repairing any form of infrastructure.

For example, the following actions are proposed in the Plan as measures to mitigate against the risk of flooding:

- Obtaining elevation certificates and applying flood risk mitigation practices for historic properties (#1)
- Enhancing Maryland’s flood maps (#3)
- Providing flood mitigation guidance for historic properties (#5)
- Developing additional floodplain boundaries reflecting selected freeboard increases (1-ft, 2-ft, 3-ft, etc.) (#6)
- Obtaining elevation certificates for state facilities in Special Flood Hazard Areas and identifying high-risk vs. low-risk facilities (#13)
- Inventorying wells susceptible to flooding and retrofitting with protection (#31)
- Assessing roadway flooding vulnerability (#34)

When carrying out each of these actions, the projected impact of climate change on flood risk must be considered so that the benefits of the action will last into the future and not be reversed by more frequent or deeper floods. The same holds true for mitigation actions designed to reduce vulnerability to other types of hazards. As FEMA has stated, “The challenges posed by climate change, such as more intense storms, frequent heavy precipitation, heat waves, drought, extreme flooding, and higher sea levels, could significantly alter the type and magnitude of hazards impacting affecting states in the future and, as such, states *must take this into account* when building long-term mitigation strategies.”<sup>26</sup>

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Thank you again for the opportunity to provide these comments. We would embrace the opportunity to work with MEMA on improving the Plan in the respects described above.

Sincerely,

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Cc: FEMA Region III

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<sup>26</sup> *Id.* at 7.