OS-600 (12-24)

Pennsylvania
Department of Transportation

MEMO

DATE: October 14, 2025

SUBJECT: Implementation of April 2025 DM-2, Chapter 10 Drainage Design Updates

TO: District Executives
Assistant District Executives - Design

FROM: Jonathan A. Eboli, P.E. Jonathan A. Eboli, P.E.
Chief Engineer
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The latest revisions to Design Manual, Part 2, Contextual Roadway Design, April 2021 Edition, Change No. 8 released April 2025 include the rewrite of Chapter 10, Drainage Design and Related Procedures. The associated transmittal letter states that updates "should be effective as soon as practical without affecting letting schedules, but no later than October 1, 2025."

The rewrite of Chapter 10 includes new design criteria which cannot practically be incorporated into projects that have substantial design completed without affecting letting schedules. Districts may fully apply the updated methodology in the April 2025 DM-2 Chapter 10 immediately, but the following list and table in **Attachment A** provide guidance for implementation based on the project schedule:

1. Districts are not obligated to implement DM-2 Chapter 10 changes if:
    a. Projects are in preliminary engineering with anticipated let dates prior to January 1, 2027, or;
    b. Projects are in preliminary engineering or final design, with Waterway or NPDES permits already submitted or anticipated to be submitted by December 31, 2025, regardless of let date.
2. Districts shall implement of **ALL** DM-2 Chapter 10 changes if:
    a. Projects begin preliminary engineering after October 1, 2025, or;
    b. Projects are in preliminary engineering with anticipated let dates of January 1, 2027, and later, and will not have Waterway or NPDES permits submitted by December 31, 2025.
3. Districts shall implement the <u>significant</u> DM-2 Chapter 10 changes listed in **Attachment B, EXCEPT** the Resilient Design Assessment (RDA) in Section 10.6.7 if:
    a. Projects are in final design with let dates January 1, 2027, and later; <u>and</u>

b. Projects will not have Waterway or NPDES permits submitted by December 31, 2025; and
c. Project let date will not be affected.

Projects for which PROTECT funds are requested may require an RDA depending on the project type, even if the project falls into categories 1 or 3 above.

In some cases, the design consultant agreement may require a supplement to address updated methods and requirements of DM-2 Chapter 10.

A table showing the required action for implementing DM-2 Chapter 10 updates by project development stage, permit submission schedule, let date, and PROTECT funding is included in **Attachment A**. A summary of significant changes to DM-2 Chapter 10 is included in **Attachment B**. The entirely new RDA section of Chapter 10, which was developed based on recommendations from FHWA, is included in **Attachment C**. The RDA report is a separate deliverable intended to provide interdisciplinary design considerations based on future conditions and is NOT to be included in the H&H Report or the Waterway Permit. Additional WBS scope and mutual gains guidance has been developed and is included in **Attachment D**. Once the WBS is updated in ECMS, districts are responsible to remove item 10 if it is not applicable to their project. A range of 20 to 80 hours per structure is anticipated to complete the RDA, depending on the complexity of the site or project.

If you have questions regarding the attached guidance, please contact Brenda Stouffer, P.E., at brenstouff@pa.gov or 717-705-1333.

Attachments

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Attachment A: Implementation of Changes in DM-2 Chapter 10 (April 2021 Edition, Change No. 8 released April 2025) **Based on Project Schedule**

Project Development Stage	Permit Submitted By 12/31/2025?	Let Date By 1/1/2027?	Using PROTECT Funds?	Required Action
Final Design	no	no	no	Implement all <u>significant</u> Chapter 10 changes **EXCEPT RDA**.
Preliminary Engineering or Final Design	yes	yes	no	Project Development Stage does not require adherence to Chapter 10 updates.
	yes	no	no	
	no	yes	no	
Preliminary Engineering or Final Design	yes	yes	yes	Project Development Stage does not require adherence to Chapter 10 updates; RDA may be required for PROTECT funding.
	yes	no	yes	
	no	yes	yes	
Preliminary Engineering or Final Design	no	no	yes	Implement **ALL** changes to Chapter 10.
Preliminary Engineering	no	no	no	Implement **ALL** changes to Chapter 10.
Preliminary Engineering begins 10/1/2025 or after	Implement **ALL** changes to Chapter 10.			

Attachment B: List of Significant Changes in DM-2 Chapter 10 April 2025 Edition

1. Items updated throughout the manual:
    - References from XX-year flood to Annual Exceedance Probability (AEP) to align with the FEMA, USGS, and FHWA transition to this terminology.
    - Environmental Permit related items were updated to provide a brief overview and point to PennDOT Publication 783 – Environmental Permitting Handbook for detailed information.
2. **Section 10.3.1.f Inlets and Junctions**—Change to process for inlet grate types and design procedure from previous charts to HEC-22 process.
3. **Section 10.3.2.d Alternate Pipe Designs—**Change to pipe alternates section such that alternate pipe types are no longer required. A Pipe Alternatives Worksheet must be completed and included in the Drainage Report if alternates are used (NEW Appendix L).
4. **Section 10.5 Waterway Approval—**Majority of section revised to point to the Publication 783 – Environmental Permitting Handbook. Incorporated previous separate sections on US Coast Guard Permits, USACE Permits, and FHWA approvals into this section.
5. **Section 10.5.3.d - Aids to Navigation (ATON)—**Revised.
6. **Section 10.6.3.d – Hydrologic Methods and Models—**Significant updates include:
    - Revised rainfall distribution to replace the 1965 USDA SCS Rainfall distributions with the NRCS NOAA Atlas 14 rainfall distributions.
    - Revised **10.6.3.d.iii Regression Methods**:
        - Deleted PSU-IV method
        - Provided information on the new SIR 2019-5094 regression method and included a process for considering regression and the ability to use some of the older regression methods due to areas of over-prediction and under-prediction between the three methods.
        - Added Appendix J to include information related to SIR 2008-5102 and WRIR 2000-4189 that was originally in Publication 584 Chapter 7.
    - Deleted TR-55 section but kept Win TR-55 section.
7. **Section 10.6.3.e – Hydraulic Models—**Significant updates include:
    - WSPRO section was deleted.
    - HEC-2 section was deleted and a sentence was added to HEC-RAS about old HEC-2 models.
    - Other models section (2D section) was revised/expanded to include more detailed information related to applicability of 2D models.
8. **Section 10.6.7 Resilient Design Assessment and Appendix K– NEW SECTION**
    - Section 10.6.7 provides the process that was developed based on FHWA recommendations. The Resilient Design Assessment (RDA) is used to assess potential flooding vulnerabilities and, with interdisciplinary coordination, considers design measures to plan for future conditions. The RDA Report

deliverable is a **separate memo/document** that is for internal purposes and submitted to PennDOT only. It is **not** included in the H&H Report or the Waterway Permit Submission.
    - **Appendix K** is a new appendix that provides sample RDA deliverable documents for three different scenarios including a culvert, bridge, and roadway.
9. **Section 10.7.2.e Summary Data Sheet—**The Summary Data Sheet has eliminated several redundant permitting items that are not required in the H&H Report. The following items were deleted:
    - Temporary and permanent wetland impacts,
    - Minimum underclearance, and
    - Fill below ordinary high water.
10. **Section 10.7.4.h - FEMA Consideration—**Revisions include:
    - FEMA Overview was moved from Section 10.7.4 to Section 10.5.7 and revised.
    - FEMA Municipal Coordination Section 10.7.4.a.viii was modified slightly.
    - Appendix C – FEMA Modeling for a CLOMR, minor modifications made to the appendix.
11. **Appendix D—**H&H Checklists were updated

Attachment C: Section 10.6 – Resilient Design Assessment

10.6.7 – Resilient Design Assessment

PennDOT has developed a process to assess potential flooding vulnerabilities and risks to transportation infrastructure, including bridges, culverts, and roadways. This process is termed the Resilient Design Assessment (RDA) and, for a typical project, shall be completed during the design phase with the findings incorporated based on interdisciplinary coordination (e.g., bridge, geotechnical, right-of-way, etc.). The RDA was developed using information obtained from a review of FHWA guidance, other state agencies' processes, and the PennDOT pilot study *Development of Site-Specific Hydrologic and Hydraulic Analyses for Assessing Transportation Infrastructure Vulnerability & Risks to Climate Change*. The pilot study included three site-specific H&H assessments that were expanded (as compared to current PennDOT procedures) to address the impacts of more intense and frequent precipitation events under future climate scenarios. The pilot study report can be found at https://rosap.ntl.bts.gov/view/dot/58570 .

The purpose of the RDA is to address the impacts of more intense and frequent precipitation events under future climate scenarios and considers project-specific vulnerability. This is done by applying future climate considerations to evaluate adaptive strategies that improve infrastructure resiliency. Several examples outlining the RDA step-by-step process are provided in Appendix 10K.

Resilient Design Assessment

- Assess potential flooding vulnerabilities and evaluate adaptation strategies.
- Initiate early in the project.
- Follow eight-step assessment process.
- Submit documentation of Resilient Design Assessment with TS&L/Design Field View, after existing and proposed hydraulic analyses have been performed, prior to the final H&H Report submission.

For each project that requires an H&H Report, completion of an RDA is required for PennDOT's internal risk assessment. The RDA is a separate document and shall not be included in the H&H Report. A preliminary RDA will be included with the TS&L/Design Field View submission. The RDA includes the eight (8) steps, shown below, to be initiated early in the project and finalized after the existing and proposed hydraulic analyses have been performed. The final RDA documentation should be submitted to the District prior to the final H&H Report. The intent of the RDA is to consider design adaptations and countermeasures and is not intended to replicate or replace the information submitted with the final H&H Report. It is understood that design changes may occur that are not incorporated in the RDA.

1) Determine the Vulnerability Score. For projects where PennDOT has assigned Resilient Design Level (RDL) 3 at project scoping, a Vulnerability Score analysis is not required, and the RDA can start at step 2.b. Otherwise, determine the Vulnerability Score for the project using **Exhibit 10.6.4**. The following resources may be helpful in determining which conditions are applicable for a project:

   (i) The completed existing and proposed hydraulic analysis.

(ii) Scour history at the project site and/or scour calculations performed for the proposed project, if available.

(iii) BMS2 (bridge inspection) data and maintenance records.

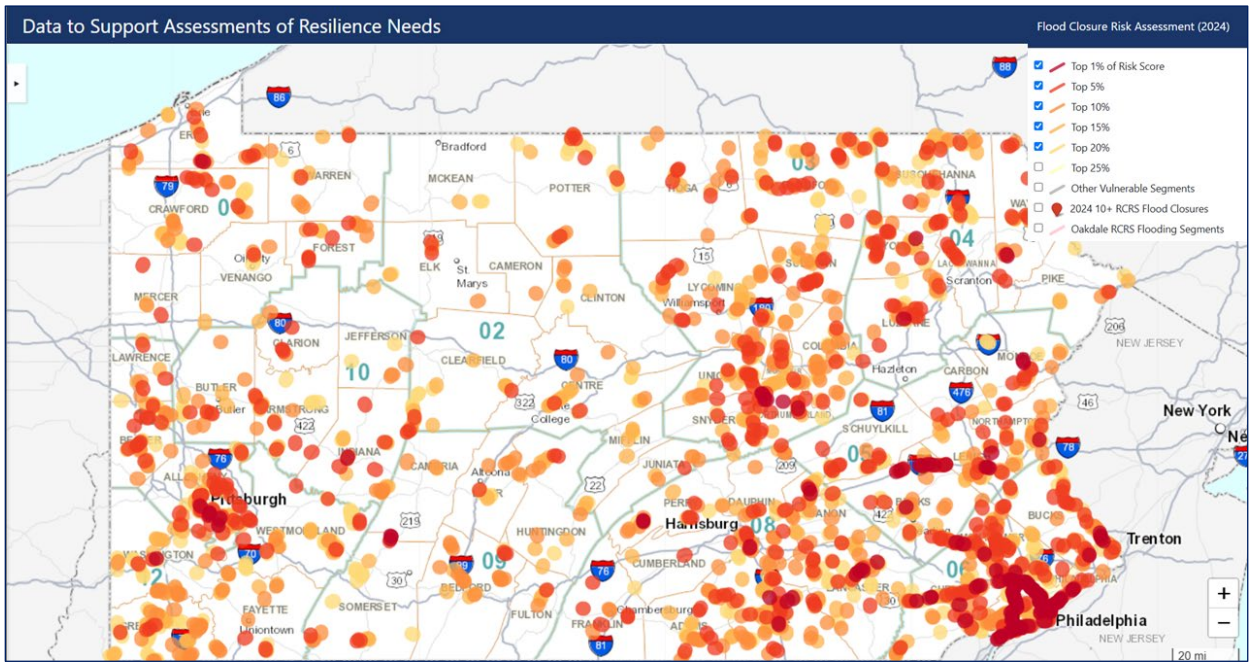
(iv) Field observations, including local testimony.

(v) Project scoping/PennDOT Connects information.

(vi) Environmental documents.

(vii) Floodplain maps.

(viii) Historic Flooding Vulnerability Locations and Risk Assessment Score (https://tmp-map.s3.amazonaws.com/dot/rcrs-2023/rcrs2023-flooding.html.



2) Determine if the project meets the requirements for an Exception. Projects must meet ALL of the following criteria for an Exception:

(i) Any proposed structures are culverts (closed-bottom structures); and

(ii) Roadway has an ADT less than 400; and

(iii) Vulnerability Score is 2 or less.

a. If the project does meet the requirements for an Exception, a full, quantitative RDA is not required. However, it is recommended to consider resilient design options as part of the project (as further discussed in Step 7), and it is required to document the Vulnerability Score and any resiliency measures that were included in the design. Prepare and submit a memo to be included with the TS&L/Design Field View submission. If the project does not meet the requirements for an exception, then complete steps 3-8.

Exception Requirements

ALL of the following must be met for an exception:

- Proposed structures are closed-bottom structures; and
- Roadway has an ADT less than 400; and
- Vulnerability Score is 2 or less.

b. If the project does not meet the requirements for an Exception based on the Vulnerability Score, or an RDL 3 is designated for the project due to existing risk factors, apply the applicable ratio from **Exhibit 10.6.5** to project design discharges computed using applicable methods in Section 10.6.3. Alternatively, a designer can choose to increase discharges using best available climate science for future conditions out to the year 2080 under representative concentration pathway (RCP) 8.5.

3) After saving the hydraulic model into a separate file for the RDA, re-run the proposed hydraulic model for the project using the future condition discharges determined in Step 2 for the project design event, 0.01 AEP (100-year)) event, and additional worst-case scour design events, as required per DM-4, Chapter 7. The RDA should include two models: the proposed project geometry with existing design flows and proposed project geometry with future flows. The minimum level of detail needed to evaluate the resilient design flows in the hydraulic model should be incorporated.

4) Complete the Resilient Design Checklist (RDC) that is applicable for your project (**Exhibit 10.6.6** for bridges and culverts and **Exhibit 10.6.7** for roadways). The RDC includes parameters for Site Data, Design Event, and 0.01 AEP (100-year) Event. It is anticipated that the preliminary RDA submitted with the TS&L/Design Field View will not have detailed scour calculations but instead should provide preliminary indication if scour is expected to be a significant concern. Detailed scour calculations using the resilient design flows will be included with the final RDA.

Scour Calculations

Preliminary RDA: Provide preliminary indication if scour is expected to be a significant concern.

Final RDA: Detailed scour calculations.

Note that the H&H Report which is separate submission will only include the scour calculations based on the standard flows. It is important to note in the checklist if a project site is eligible for PROTECT funds. Coordinate with the District Project Manager to determine if the project has been submitted for consideration or has been approved for PROTECT funds. PennDOT will determine eligibility based on PROTECT Formula Program Implementation Guidance and/or coordination with FHWA.

5) Determine the project's potential for resilient design by using the results of the RDC, engineering judgment, interdisciplinary coordination, and knowledge of existing and proposed site conditions. The checklists consist of interdisciplinary parameters, including hydraulics, traffic, safety, and others, that are compared between proposed and future conditions to determine if the site will be more vulnerable to issues such as scour, stability, and roadway overtopping. The "Potential for Resilient Design" column in the checklists should be completed with the following classifications to indicate the level of potential for resilient design considerations:

   - **Low:** minor or no special designs for resiliency anticipated
   - **Medium:** considerations for resiliency related designs may be beneficial
   - **High:** consideration for resiliency design modifications is highly recommended

   Because every site is different, establishing ranges or thresholds for checklist parameters is not practical. When determining the potential for resilient design, evaluate the following:

   - Risk posed to physical infrastructure and the traveling public,
   - Comparison of results using existing and future flows, and
   - Magnitudes of future condition parameters and their effects on infrastructure performance.

6) **Consider design adjustments to freeboard based on future conditions.** Where possible, design adjustments should be considered to provide at least one (1) foot of freeboard for the design storm under future conditions. However, adjustments to freeboard that would require roadway profile increases and result in upstream water surface elevation increases should be avoided. Where the freeboard requirement cannot be met, additional consideration should be given to other countermeasures as discussed in Step 7.

7) **Recommend reasonable design adaptations and countermeasures to improve the resiliency.** These adaptations and countermeasures for the project design under future climate scenarios may include:

   (i) Adjustments to scour protection, foundations, or structure hydraulic opening to reduce future scour potential.

   (ii) Additional embankment protection or changes to structure anchoring to reduce impacts of increased frequency, depth, or velocity of overtopping flow. In addition

to hydraulic model output, embankment adaptations should be based on site conditions, such as the height and material of the embankment (vegetation, rock, bare soil, etc.).

(iii) Possible changes to bridge or beam type if structure low chord may be inundated under future conditions, but not under current proposed conditions.

(iv) Possible superstructure design adjustments to prevent uplift and overturning if future condition may increase overtopping depth at bridge or result in bridge barrier overtopping.

8) **Document the RDA process and any resiliency measures recommended for consideration in the RDA Report.** Appendix 10K, includes examples of RDAs for bridge and roadway projects. Resiliency measures that are recommended based on the RDA are to be coordinated with other disciplines on the design team, such as structures, roadway, and foundations, and incorporated into the design, as appropriate.

Exhibit 10.6.4 Vulnerability Scores by Condition

Concern	Condition	Number to Add to Score	
		Yes	No
Access (Essential)	The site provides access to essential services, such as hospitals, other emergency services, major utilities, etc., or is an evacuation route for residential or public facilities, such as nursing homes or prisons.	4	0
Detour	The official detour length for alternate access, if the project site is closed due to an emergency, exceeds 10 miles.	3	0
Access (Sole)	The route is an only point of access for homes, schools, businesses, etc., with no available detour.	4	0
Access (Mobility)	Serves members of the community that rely on non-motorized transportation options.	3	0
Flooding	The site is located in a FEMA Zone AE floodplain (detailed study area).	1	0
Overtopping	The site has a proposed overtopping frequency of 0.01 AEP (100-year) or more.	2	0
Buildings	There are buildings in the 0.01 AEP (100-year) floodplain.	1	0
Scour	There are existing scour or stream stability concerns, such as migration or deposition, or the site has potential for future concerns.	3	0
Pressure Flow	The proposed bridge is under pressure flow for the 0.01 AEP (100-year) event or more frequent.	2	0

Exhibit 10.6.5 Resilient Design Discharge Multiplier

Vulnerability Score (Based on Exhibit 10.6.4) or Pre-Determined RDL*	Discharge Multiplier
0-3 (Level 1)	1.1 (10% increase)
4-7 (Level 2)	1.2 (20% increase)
8+ (Level 3)*	1.3 (30% increase)

*RDL Level 3 may be assigned by PennDOT during project scoping.

Exhibit 10.6.6 Resilient Design Checklist for Bridges and Culverts

	Parameter		Proposed Condition (Existing Flows)	Proposed Condition (Flows with Discharge Multiplier)	Indicates Potential for Resilient Design
Site Data	Hydrology Method	-			N/A
	Embankment Instability	Y/N			
	Overtopping Frequency	years			
	Design Event Frequency	years			N/A
	Provides Access to Critical Services	Y/N			
Design Event	Discharge	cfs			N/A
	% Q Bridge	%			
	Pressure Flow	Y/N			
	Bridge Velocity	ft/s			
	Overtopping Velocity	ft/s			
	Overtopping Depth (Roadway)	ft			
	Overtopping Depth (Structure)	ft			
	Adjacent Roadway(s) Impacted	Y/N			
0.01 AEP Event	Discharge	cfs			N/A
	% Q Bridge	%			
	Pressure Flow	Y/N			
	Bridge Velocity	ft/s			
	Scour Depth	ft			
	Riprap Size	R Class			
	Overtopping Velocity	ft/s			
	Overtopping Depth (Roadway)	ft			
	Overtopping Depth (Structure)	ft			
	Adjacent Roadway(s) Affected	Y/N			
Eligible for PROTECT Funding?			☐ Yes		☐ No

Exhibit 10.6.7: Resilient Design Checklist for Roadways

	Parameter		Proposed Condition (Existing Flows)	Proposed Condition (Flows with Discharge Multiplier)	Indicates Potential for Resilient Design
Site Data	Hydrology Method	-			N/A
	Embankment Instability	Y/N			
	Overtopping Frequency	years			
	Design Event Frequency	years			N/A
	Provides Access to Critical Services	Y/N			
Bank full Flow	Discharge	cfs			N/A
	Channel Velocity	ft/s			
	Scour Depth	ft			
	Event Frequency	years			
Design Event	Discharge	cfs			N/A
	Channel Velocity	ft/s			
	Overtopping Velocity	ft/s			
	Overtopping Depth (Roadway)	ft			
0.01 AEP Event	Discharge	cfs			N/A
	Channel Velocity	ft/s			
	Overtopping Velocity	ft/s			
	Overtopping Depth (Roadway)	ft			
Eligible for PROTECT Funding?			☐ Yes	☐ No	

Attachment D: Anticipated WBS Scope Change and Mutual Gains Estimates

STANDARD PENNDOT ECMS SCOPE FOR H&H REPORT With Revisions

New Item 10 under Scope 2.7.1 recommended updates to incorporate the New section of DM Part 2 Contextual Roadway Design, Chapter 10, Section 10.6.7 – April 2025 Release (April 2021 Edition, Change No. 8)

Hydrologic and Hydraulic Report

Objective:

2.7.1 - Hydrologic and Hydraulic Report

This task consists of the preparation of Hydrologic and Hydraulic reports for all bridges, culverts and longitudinal encroachments to size waterway openings properly and to satisfy permitting requirements. Publication 13, Design Manual Part 2, Contextual Roadway Design, Publication 15M, Design Manual Part 4; and PADEP Chapter 105 and Chapter 106 apply to this task.

Scope:

2.7.1 - Hydrologic and Hydraulic Report

A separate Hydrologic and Hydraulic Report is required for each hydraulic structure. However, dual structures or structures located within the same hydraulic system should be combined into one report.

The following work elements are required for the successful completion of this task:

1. Gather existing information to be used in the development of the hydrologic and hydraulic analyses and in the preparation of the H&H Report.
2. Perform a hydrologic analysis of the watershed at each proposed crossing using one or more of the Department approved methodologies. The use of a particular model shall be justified as valid for the situation in which it is being used. All assumptions and/or limitations of each model shall be clearly identified and referenced. Multiple hydrologic models are recommended to assist in validating the selected approach. An analysis of the flood history according to the guidelines contained in Design Manual Part 2 should also be considered.
3. Perform a hydraulic analysis for each proposed crossing including alternatives, if necessary, using one or more of the Department approved hydraulic models. The use of a particular model shall be justified as valid for the situation in which it is being used. All assumptions and/or limitations of each model shall be clearly identified and referenced. Where a Flood Insurance Study has been established by FEMA, the hydraulic data included in the study should be utilized to the maximum extent deemed appropriate. Each proposed alternative shall be modeled to assist in the justification for the selected alternative. The hydraulic model shall extend a sufficient distance upstream and downstream to adequately evaluate the potential impacts due to the proposed construction. The hydraulic model should be used to compare existing and proposed conditions with respect to water surface elevations and channel velocities for the design discharge rate(s), including the 500-year event for the scour evaluation and the "overtopping event" for the risk assessment.
4. Evaluate the scour potential at bridge abutments and piers in accordance with Design Manual Part 4. Evaluate the erosion potential at culvert outlets in accordance with HEC-14.
5. Evaluate the channel stability and design countermeasures, if needed.
6. Perform a risk assessment or analysis for each applicable waterway structure or Encroachment alternative.

7. Evaluate the hydraulic impacts as a result of temporary encroachments and/or permanent bank protection, if applicable.
8. Prepare the Hydrologic and Hydraulic Report following the general outline described in Design Manual Part 2.
9. If applicable, prepare a Conditional Letter of Map Revision (CLOMR) in accordance with FEMA regulations. The scope of work for the preparation of the CLOMR is not included herein and should be developed prior to initiating the work.
10. Develop a Resilient Design Assessment (RDA) to evaluate the impacts of more intense and/or frequent precipitation based on project-specific conditions. The RDA memo will be developed in accordance with Design Manual Part 2 – Contextual Roadway Design. The preliminary RDA memo will be submitted to PennDOT with the TS&L/Design Field View submission. The Final RDA memo should be submitted to PennDOT once the final resilient measures planned in design are determined and prior to the Final H&H Report. The RDA is an internal PennDOT document used for interdisciplinary design considerations and is **not** part of the Preliminary or Final H&H Report that is submitted to both PennDOT and PADEP.

Detail Task 1 - Hydrologic and Hydraulic Report

Department Details:

For projects where PennDOT has assigned Resilient Design Level (RDL) 3 at project scoping, note that in the Department Details.

Draft Mutual Gains Items for Resilient Design Assessment

(New section of DM Part 2 Contextual Roadway Design Section 10.6.7 – April 2025 Edition (April 2021 Edition, Change No. 8)

2.7.1 Hydrologic and Hydraulic Report (New Items Related to Resilient Design Assessment) –

WBS Task	Task	Staff Hour Range	Narrative
	Develop Vulnerability Score	1-8 hours (per structure or facility)	Develop Vulnerability Score based on site conditions using DM2 Exhibit 10.6.4 to determine the Resilient Design Level (RDL) and resulting Discharge Multiplier or if the project meets criteria for an exception. Considerations Include: a. For projects where PennDOT has assigned RDL 3, the vulnerability score is complete. b. For proposed culverts ONLY - evaluate if site meets Exception criteria and document justification if project does meet exception requirements. c. For all other projects, Vulnerability score and related documentation is required. Low-range – RDL 3 assigned Mid-range – Culvert and meets requirements for Exception High range – Full Vulnerability assessment and related documentation required
	Resilient Hydraulic Modeling and Resilient Design Checklist	6-24 hours (per structure or facility)	This is a separate hydraulic model based on the proposed project geometry and discharges with the RDL Discharge Multiplier (Exhibit 10.6.5). Evaluate the project design event, the 0.01 AEP (100-year) event and additional worst-case scour events per DM4, Chapter 7. The RDA should only include 2 scenarios in the model – the proposed project geometry with existing design flows and the proposed project geometry with flows with Discharge Multiplier. Calculate scour depths and compute riprap size per DM4, Chapter 7. Complete the Appropriate Resilient Design Checklist (Exhibit 10.6.6 for bridges and culverts or Exhibit 10.6.7 for roadways) Low-range – Culvert that does not meet Exception criteria Mid-range – Single-span bridge or roadway embankment with minimal overtopping High range – Multi-span bridge with local pier scour calculations and/or extensive roadway overtopping
	Develop Resilient Design Options with Interdisciplinary Coordination	2-12 hours (per structure or facility)	Use engineering judgment, interdisciplinary coordination, and knowledge of existing and proposed site conditions to determine the project's potential for resilient design. Consider design adjustments to freeboard based on future conditions. Recommend reasonable design adaptations and/or countermeasures to improve resiliency.

			Low-range – Culvert, single-span bridge, or roadway embankment with freeboard and no overtopping Mid-range – Single-span bridge or roadway embankment with overtopping High range – Multi-span bridge and/or extensive roadway overtopping
	Develop and Submit the Preliminary RDA memo with the TS&L/Design Field View	6-24 hours	Document the RDA Process and preliminary resiliency recommendations and submit a preliminary RDA memo with the TS&L/Design Field View. This is a separate document from the H&H Report. Low-range – Culvert, single-span bridge, or roadway embankment without overtopping with minimal design adaptations or countermeasures recommended Mid-range – Single-span bridge or roadway embankment with overtopping and some design adaptations or countermeasures recommended High range – Multi-span bridge, multiple structures, and/or extensive roadway overtopping with complex or multiple design adaptations or countermeasures recommended
	Develop and Submit the Final RDA Memo	2-6 hours	Once the final resiliency measures have been determined in coordination with the interdisciplinary design team, finalize the RDA with the final planned resiliency measures and submit the RDA memo to the District before the final structure or roadway plans are submitted.
	TOTAL RDA Estimates	10 hours for Exception Low Range -18 hours Mid Range – 50 hours High Range – 78 hours (per structure or facility)	**For Culverts that Meet Exception Criteria** – documentation of vulnerability score and applicable resiliency measures are required to be submitted in a Memo. **Low-range** – Culvert that does not meet exception, single-span bridge, or roadway embankment with no overtopping **Mid-range** – Single-span bridge or roadway embankment with overtopping **High range** – Multi-span bridge and/or extensive roadway overtopping