5.14 Demineralized Water Tank, Pump House, and RO Unit

5.14.1 Summary of Demineralized Water Tank, Pump House, and RO Unit

Baseline information for the Demineralized Water Tank, Pump House, and RO Unit is provided in Section 2.0, Site History, Description, and Baseline Condition.

The Demineralized Water Tank is a 33-ft-inside-diameter storage tank that extends approximately 31 ft above grade. The tank is fabricated of stainless steel to meet the requirements of the API Standard 650. The tank is supported around its perimeter on a continuous cast-in-place concrete ring wall that is about 1.2 ft wide by 2 ft tall. The interior of the tank bears on a layer of sand on top of a geotextile filter fabric, which in turn is on top of a free-draining crushed limestone aggregate. The crushed limestone aggregate is drained by three 1.5-in.-diameter foundation drains spaced equally around the concrete ring wall.

The Pump House is a small pre-engineered metal building supported on a 6-in. slab.

The entire tank footprint, including the concrete ring wall and the interior crushed rock along with the Pump House slab, is supported on a rammed aggregate piers soil improvement system.

The RO Unit resides in the northern section of the Old Warehouse. The Old Warehouse is a pre-engineered metal building supported on a cast-in-place slab and perimeter stem wall on continuous footings that extend below frost depth.

5.14.2 Inputs/References Supporting the Analysis

Table 5.14-1 lists references provided by OPPD and other documents used to support HDR's analysis.

Table 5.14-1 - References for Demineralized Water Tank, Pump House, and RO Unit

Document Title	OPPD Document Number (if applicable)	Date	Page Number(s)
Site Plan		8/28/2009	1 of 2
Details		8/28/2009	2 of 2
Geopier® Foundation System P09-PMN-00097		4/20/2010	GEO-1 & GEO-2
Naval Facilities Engineering Command, Design Manual 7.01, Soil Mechanics		9/1986	All

Detailed site observations—field reports, field notes, and inspection checklists—for the Demineralized Water Tank, Pump House, and RO Unit are provided in Attachment 8.

Observed performance and pertinent background data are as follows:

- The soils below the Demineralized Water Tank and Pump House were improved by installation of fifty 30-in.-diameter-by-18-ft-minimum-depth rammed aggregate piers (see Geo-1 and Geo-2).
- A total of 41 rammed aggregate piers were installed below the tank footprint, and 9 were installed under the Pump House slab.

- The tank foundation system, including crushed rock interior, is shown on the site plan and detail sheets by LRA in table 5.14-1.
- Structural drawings for the Old Warehouse are not available, so descriptions of the foundations are assumed based on normal standard practice for foundation construction for a pre-engineered metal building.
- The Aqua Dam surrounding the Demineralized Water Tank and Pump House failed for an unknown amount of time, allowing floodwater to enter the area inside the perimeter of the Aqua Dam. Based on observed water marks on the Demineralized Water Tank and Pump House, water levels reached approximately 2.5 ft above grade.
- The interiors of the Pump House and Old Warehouse showed signs of upward seepage at slab-on-grade joints. Other HDR employees observed upward seepage from joints in the slab during previous inspections.
- Site soils were saturated at the times of inspection.
- Small channels of water flow were observed as water dissipated from the vicinity of the tank and Pump House.
- Neither the Demineralized Water Tank nor the Pump House has a foundation that extends below frost depth.
- Foundation drains for the tank were found to be clogged with sediment at the time of inspection.
- Areas of relatively soft soils were observed by using a fiberglass T-probe in the general vicinity of the tank and Pump House, but these areas are out of the zone of influence for the foundation systems.
- Probed areas around the Pump House are soft in the upper 6 in. in general. One spot near the southwest corner of the Pump House foundation did have softer soils; the fiberglass T-probe could be pushed in to a depth of 2 ft.
- In an area between the Demineralized Water Tank and Pump House approximately 10 ft from the east side of the structures, the fiberglass T-probe could be pushed in to the full depth of the probe. The soils were not uniform; some layers were soft and others stiffer. At this distance the soft soils are out of the zone of influence for the foundation systems.
- A void estimated to be 4 ft in diameter and 1.5 to 2 ft deep was observed below a transformer pad at the northeast corner of the Old Warehouse. This area was pumped with a small pump for the duration of the 2011 flood.
- The area directly east of the Old Warehouse between the rock road and the building was dug out and used as a water collection trough. These areas had multiple small portable pumps removing water from the trench.

5.14.3 Assessment Methods and Procedures

5.14.3.1 Assessment Procedures Accomplished

Assessments of the Demineralized Water Tank, Pump House, and RO Unit included the following:

- Visual inspection of the interior and exterior of the north side of the Old Warehouse at the water treatment facility and also the exterior of the tank and Pump House
- An assessment of collected survey data to date for indications of trends in the movement of the structures
- Probe of surrounding grades to determine stiffness and consistency of soils
- A review of previously referenced documents listed in Table 5.14-1

Additional investigations were performed. These included the following non-invasive geophysical and invasive geotechnical investigations:

- Geotechnical test borings in the PA. Note that OPPD required vacuum excavation for the first 10 ft of proposed test holes to avoid utility conflicts. Therefore, test reports will not show soil conditions in the upper 10 ft of test boring logs. (Test reports were not available at the time of Revision 0.)

5.14.3.2 Assessment Procedures Not Completed

Assessments of the Demineralized Water Tank, Pump House, and RO Unit that were not completed include the following:

- Review of as-built construction drawings for the Old Warehouse, including the water treatment area, was not completed because at the time of Revision 0, the drawings were not available.

5.14.4 Analysis

Identified PFMs were initially reviewed as discussed in Section 3.0. The review considered the preliminary information available from OPPD data files and from initial walk-down observations. Eleven PFMs associated with five different Triggering Mechanisms were determined to be "non-credible" for all Priority 1 Structures, as discussed in Section 3.6. The remaining PFMs were carried forward as "credible." After the detailed design review for each structure, the structure observations, and the results of available geotechnical, geophysical, and survey data were analyzed, a number of CPFMs were ruled out as discussed in Section 5.14.4.1. The CPFMs carried forward for detailed assessment are discussed in Section 5.14.4.2.

5.14.4.1 Potential Failure Modes Ruled Out Prior to the Completion of the Detailed Assessment

The ruled-out CPFMs reside in the Not Significant/High Confidence category and for clarity will not be shown in the Potential for Failure/Confidence matrix.

Triggering Mechanism 2 – Surface Erosion
CPFM 2a – Undermining shallow foundation/slab/surfaces
CPFM 2c – Undermined buried utilities

Reason for ruling out:

- The site was observed after floodwater had begun to recede from the area. No signs of surface erosion were seen that could contribute to undermining of the foundations or slabs for these structures.

Triggering Mechanism 4 – Hydrostatic Lateral Loading (water loading on structures)
CPFM 4c – Wall failure in flexure
CPFM 4d – Wall failure in shear
CPFM 4e – Excess deflection

Reasons for ruling out:

- In accordance with conversations with OPPD personnel, the Demineralized Water Tank was kept full during the 2011 flood, resulting in no net differential wall pressures.
- The Pump House was inundated at the time of the Aqua Dam failure, resulting in no net differential wall pressures.
- Water surrounded the Pump House and Demineralized Water Tank on all sides, creating equal hydrostatic pressure.
- The water treatment area of the Old Warehouse was isolated from floodwater by an Aqua Dam.

Triggering Mechanism 5 – Hydrodynamic Loading
CPFM 5a – Overturning
CPFM 5b – Sliding
CPFM 5c – Wall failure in flexure
CPFM 5d – Wall failure in shear
CPFM 5e – Damage by debris
CPFM 5f – Excess deflection

Reasons for ruling out:

- Overland flow velocity at this location was very low, creating very minimal forces due to hydrodynamic loading. Observed scouring in this location was isolated to areas where the flow area was reduced and the velocity increased (i.e., the King Tut blocks). In general, the area had sediment deposits that would indicate low flow velocity.
- Floodwater has since begun to recede from the site, and no signs of distress that could be attributed to hydrodynamic loading have been observed.

Triggering Mechanism 6 – Buoyancy, Uplift Forces on Structures
CPFM 6b – Cracked slab, loss of structural support
CPFM 6c – Displaced structure/broken connections

Reasons for ruling out:

- In accordance with conversations with OPPD personnel, the Demineralized Water Tank was kept full during the 2011 flood, resulting in no net buoyancy effects.
- The Pump House was inundated at the time of the Aqua Dam failure, resulting in no net differential wall pressures.
- Although a net uplift force from floodwater might have occurred on the Old Warehouse floor slabs, cracking or loss of structural support of the slabs was not observed at the time of the inspection.

Triggering Mechanism 7 – Soil Collapse (first time wetting)

CPFM 7a – Cracked slab, differential settlement of shallow foundation, loss of structural support

CPFM 7b – Displaced structure/broken connections

CPFM 7c – General site settlement

Reason for ruling out:

- Soil collapse due to first time wetting occurs immediately once soils are wetted. Degradation related to this CPFM would have been apparent at the time of inspection.

Triggering Mechanism 10 – Machine/Vibration-Induced Liquefaction

CPFM 10a – Cracked slab, differential settlement of shallow foundation, loss of structural support

CPFM 10b – Displaced structure/broken connections

Reasons for ruling out:

- Vibrations from equipment in the Pump House and Old Warehouse are very small and create minimal localized vibrations that could not cause liquefaction.
- No signs of liquefaction were observed during the inspection.

Triggering Mechanism 11 – Loss of Soil Strength due to Static Liquefaction or Upward Seepage

CPFM 11a – Cracked slab, differential settlement of shallow foundation, loss of structural support

CPFM 11b – Displaced structure/broken connections

Reason for ruling out:

- Visual observations and survey measurements show no structure movement. Therefore, degradation that can be attributed to this CPFM did not occur.

Triggering Mechanism 12 – Rapid Drawdown

CPFM 12a – River bank slope failure and undermining surrounding structures

CPFM 12b – Lateral spreading

Reason for ruling out:

- The structures are located outside of the PA and are a sufficient distance away from the riverbank to be outside the zone of influence of a bank slope failure.

Triggering Mechanism 13 – Submergence
CPFM 13b – Corrosion of structural elements

Reasons for ruling out:

- The Demineralized Water Tank and connected piping are stainless steel and have not been subjected to corrosive circumstances that would be considered beyond the normal conditions.
- The Pump House was inundated at the time of the Aqua Dam failure. However, this inundation duration was short, and no abnormal corrosion on the building was observed.
- The water treatment area of the Old Warehouse was isolated from floodwater by the Aqua Dam.

5.14.4.2 Detailed Assessment of Credible Potential Failure Modes

The following CPFMs are the only CPFMs carried forward for detailed assessment for the Demineralized Water Tank, Pump House, and RO Unit as a result of the 2011 flood. This detailed assessment is provided below.

Triggering Mechanism 3 – Subsurface Erosion/Piping
CPFM 3a – Undermining and settlement of shallow foundation/slab/surfaces (due to pumping)

Subsurface erosion was observed at the northeast corner of the Old Warehouse where localized pumping of floodwater occurred. The approximately 4-ft-diameter-by-1.5-ft-deep void has caused some undermining of the transformer foundation to the point of exposing some buried conduit. Observations made by HDR in June and July showed water coming up through the joints in the floor slab.

No pumping occurred in the vicinity of the Demineralized Water Tank or Pump House; therefore, these structures would not be subjected to this CPFM.

The following table describes observed distress indicators and other data that would increase or decrease the potential for degradation associated with this CPFM for the Demineralized Water Tank, Pump House, and RO Unit.

Adverse (Degradation/Direct Floodwater Impact More Likely)	Favorable (Degradation/Direct Floodwater Impact Less Likely)
Possible subsurface erosion due to pumping was observed under a transformer pad on the exterior northeast corner of the Old Warehouse building and warehouse floor.	Erosion observed did not appear to extend deep enough to reach the foundations of the Old Warehouse.
Soils in the vicinity were found to be of varying densities, which could include loose soils that are more susceptible to erosion due to pumping.	Soils where pumping occurred seemed to be a gravel/structural fill with relatively high density, which is less susceptible to erosion.

Adverse (Degradation/Direct Floodwater Impact More Likely)	Favorable (Degradation/Direct Floodwater Impact Less Likely)
Observations in June and July indicated water infiltration through the RO Unit building slab joints.	
Data Gaps: • The presence of subsurface erosion under the RO Unit in the Old Warehouse slab due to pumping is not known to exist. • Geotechnical borings and CPT soundings in the vicinity of the structures to determine current soil conditions and capacities have not been conducted.	

Conclusion

Significance

Potential for Degradation/Direct Floodwater Impact

Indicators for the CPFM have been observed, although they seem to be isolated to one area below a transformer pad on the northeast corner outside of the Old Warehouse and in the center of the Warehouse floor. The void below the transformer pad is known to exist, and the extent of the void can easily be observed. The void does not appear to extend below the building foundation. Because there are observed signs of flow under the floor and a known void adjacent to the Old Warehouse building, it is possible that this void extends under the building and possibly undermines the foundation, although observations do not indicate this to be the case. The potential is low that this CPFM will occur under the building in the area housing the RO Unit.

Implication

The occurrence of this CPFM could negatively impact the capacity of the Old Warehouse building foundation. This could lead to gradual foundation movement but should not negatively impact the integrity or intended function of the building before remedial action can be implemented. Therefore, the implication of the potential degradation for this CPFM is low.

Confidence

The extent of subsurface erosion and its potential impact on the Old Warehouse building is not known due to the lack of data gathered on subsurface conditions. Because there is not enough information on the subsurface conditions at this time, and the pumping occurred directly adjacent to the building that could have caused subsurface erosion under the building, the confidence for this PFM is low.

Summary

For CPFM 3a, as discussed above, the potential for degradation is low because the extent of erosion occurring is visible and does not extend below the building foundation. The combined consideration of the potential for degradation and the implications of that degradation to a structure of this type puts in the "not significant" category. The data currently collected are not sufficient to rule out this CPFM. Therefore, the confidence in the above assessment is low, which means continued monitoring is necessary to draw a conclusion.

Triggering Mechanism 14 – Frost Effects
CPFM 14a – Heaving, crushing, or displacement

The foundations for the Demineralized Water Tank and Pump House are not below frost depths and are therefore subjected to frost effects.

The Triggering Mechanism and CPFM could then occur as follows: soils may be saturated when the ground freezes, which would increase the potential for excessive frost heave. Drains below the tank appear to be clogged, not allowing water under the tank to drain before it freezes, which would not be the design intent of the tank.

The Old Warehouse is on footings that extend below frost and is not susceptible to this CPFM.

The following table describes observed distress indicators and other data that would increase or decrease the potential for degradation associated with this CPFM for the Demineralized Water Tank, Pump House, and RO Unit.

Adverse (Degradation/Direct Floodwater Impact More Likely)	Favorable (Degradation/Direct Floodwater Impact Less Likely)
Soils were saturated at the time of inspection.	The Demineralized Water Tank and Pump House have been previously subjected to freeze-thaw cycles.
Due to the time of year, groundwater could freeze at any time.	
Tank foundation drains were plugged.	
Data Gaps: • Geotechnical borings and CPT soundings in the vicinity of the structures to determine current soil conditions and capacities have not been conducted.	

Conclusion

Significance

Potential for Degradation/Direct Floodwater Impact

The potential for this CPFM exists on the Demineralized Water Tank and Pump House due to the foundation systems used for these structures and the clogged drains below the tank. Due to the saturated soils and the time of year, it is possible the ground will freeze before the water levels in the soil have a chance to reduce to normal levels, causing excessive soil expansion. Due to the type of foundation system used, the tank and pump house have been subjected to freeze-thaw cycles in the past although potentially not to this extent and not with the drains below the tank clogged. The potential is low that this CPFM will affect the Demineralized Water Tank and Pump House since the increase in effect due to the clogged drains and high groundwater levels is expected to have minimal effect.

Implication

The occurrence of this CPFM could potentially cause some movement in the Tank and Pump House foundation systems; however, because the foundations have always been subjected to

freeze-thaw cycles, the additional movement under current conditions is not expected to cause an excessive increase in movement. Therefore, the implication of the potential degradation for this CPFM is low.

Confidence

At this time, it is not known whether the ground will freeze before soil water levels are able to lower to a normal condition. In addition, the foundation drains were completely plugged with sediment, which does not allow the crushed rock bedding to drain and could cause adverse effects on the bottom of the tank if the ground were to freeze in this condition. Therefore, the data at hand are not sufficient to rule out this CPFM. As a result, the confidence in the assessment is low, which means more data are necessary to draw a conclusion.

Summary

For CPFM 14a, as discussed above, the potential for degradation is low because the effects due to frost heave are expected to cause minimal effects on the structures. The combined consideration of the potential for degradation and the implications of that degradation to the structures of this type puts it in the "not significant" category. The data currently collected are not sufficient to rule out this CPFM. Therefore, the confidence in the above assessment is low, which means continued monitoring is necessary to draw a conclusion.

5.14.5 Results and Conclusions

The CPFMs evaluated for the Demineralized Water Tank, Pump House, and RO Unit are presented in the following matrix, which shows the rating for the estimated significance and the level of confidence in the evaluation.

	Low Confidence (Insufficient Data)	High Confidence (Sufficient Data)
Potential for Failure **Significant**		
Potential for Failure **Not Significant**	CPFM 3a CPFM 14a	

5.14.6 Recommended Actions

Continued monitoring is recommended to include a continuation of the elevation surveys of the previously identified targets on this structures and surrounding site. The purpose is to monitor for signs of structure distress and movement or changes in soil conditions around the structures. The results of this monitoring will be used to increase the confidence in the assessment results. Elevation surveys should be performed weekly for 4 weeks and biweekly until December 31, 2011. At the time of Revision 0, groundwater levels had not yet stabilized to nominal normal levels. Therefore, it is possible that new distress indicators could still develop. If new distress indicators are observed before December 31, 2011, appropriate HDR personnel should be notified immediately to determine whether an immediate inspection or assessment should be conducted. Observation of new distress indicators might result in a modification of the recommendations for these structures.

5.14.7 Updates Since Revision 0

Revision 0 of this Assessment Report was submitted to OPPD on October 14, 2011. Revision 0 presented the results of preliminary assessments for each Priority 1 Structure. These assessments were incomplete in Revision 0 because the forensic investigation and/or monitoring for most of the Priority 1 Structures was not completed by the submittal date. This revision of this Assessment Report

includes the results of additional forensic investigation and monitoring to date for this structure as described below.

5.14.7.1 Additional Data Available

The following additional data were available for the Demineralized Water Tank, Pump House, and RO Unit for Revisions 1 and 2 of this Assessment Report:

- Additional groundwater monitoring well and river stage level data from OPPD.
- Results of geophysical investigation by Geotechnology (see Attachment 6C).
- Results of geotechnical investigation by Thiele Geotech (see Attachment 6A).
- Results of continued survey by LRA (see Attachment 6E).
- Review of as-built construction drawings for the Old Warehouse, including the water treatment area, was not completed because at the time of Revision 1, the drawings were not available.

5.14.7.2 Additional Analysis

The following analysis of additional data was conducted for the Demineralized Water Tank, Pump House, and RO Unit:

- Groundwater monitoring well and river stage level data from OPPD.

  Data shows that the river and groundwater have returned to nominal normal levels.

- Results of geophysical investigation by Geotechnology.

  Seismic Refraction and Seismic ReMi tests performed around the outside perimeter of the power block as part of KDI #2 identified deep anomalies that could be gravel, soft clay, loose sand, or possibly voids.

- Results of geotechnical investigation by Thiele Geotech.

  Six test borings were drilled, with continuous sampling of the soil encountered, to ground truth the Geotechnology seismic investigation results as part of the KDI #2 forensic investigation. Test bore holes were located to penetrate the deep anomalies identified in the seismic investigation. The test boring data did not show any piping voids or very soft/very loose conditions that might be indicative of subsurface erosion/piping or related material loss or movement.

  All of the SPT and CPT test results conducted for this Assessment Report were compared to similar data from numerous other geotechnical investigations that have been conducted on the FCS site in previous years. This comparison did not identify substantial changes to the soil strength and stiffness over that time period. SPT and CPT test results were not performed in the top 10 ft to protect existing utilities.

- Results of continued survey by LRA.

  Survey data to date compared to the original baseline surveys have exceeded the accuracy range of the surveying equipment. However, the deviations are small and are not of a concern for structures of this type.

Several CPFMs were identified in Revision 0. Since Revision 0, additional data have become available which has clarified the significance and confidence for these CPFMs. The following presents each of the previously identified CPFMs and the new interpretation of their significance and confidence based upon the new data.

Triggering Mechanism 3 – Subsurface Erosion/Piping

CPFM 3a – Undermining and settlement of shallow foundation/slab/surfaces (due to pumping)

Subsurface erosion was observed at the northeast corner of the Old Warehouse where localized pumping of floodwater occurred. The approximately 4-ft-diameter-by-1.5-ft-deep void has caused some undermining of the transformer foundation to the point of exposing some buried conduit. Observations made by HDR in June and July showed water coming up through the joints in the floor slab.

No pumping occurred in the vicinity of the Demineralized Water Tank or Pump House; therefore, these structures would not be subjected to this CPFM.

Significance

Potential for Degradation/Direct Floodwater Impact

Indicators for the CPFM have been observed, although they seem to be isolated to one area below a transformer pad on the northeast corner outside of the Old Warehouse. The void below the transformer pad is known to exist, and the extent of the void can easily be observed. The void does not appear to extend below the building foundation. Because there is a known void adjacent to the Old Warehouse building, it is possible that this void extends under the building and possibly undermines the foundation, although observations do not indicate this to be the case. The potential is low that this CPFM will occur under the building in the area housing the RO Unit.

Implication

The occurrence of this CPFM could negatively impact the capacity of the Old Warehouse building foundation. This could lead to gradual foundation movement but should not negatively impact the integrity or intended function of the building before remedial action can be implemented. Therefore, the implication of the potential degradation for this CPFM is low.

Confidence

The extent of subsurface erosion and its potential impact on the building was not known due to the lack of data gathered on subsurface conditions. Subsequent field inspections and a review of surveyed data indicate no significant structure movement. Since the structure has been monitored and no signs of movement have been detected, the confidence for this CPFM is high.

Summary

For CPFM 3a, as discussed above, the potential for degradation is low because signs of distress were not observed. It is unlikely this degradation would have caused enough erosion to impact the integrity or intended function of the structure. The combined consideration of the potential for degradation and the implications of that degradation to a structure of this type put it in the "not significant" category. The data collected since Revision 0 are sufficient to rule out this CPFM assuming the previously recommended monitoring schedule is continued. Therefore, the confidence in the above assessment is high, which means no additional data and inspections are necessary to draw a conclusion. The data previously thought to be required to rule out this CPFM, which includes a geotechnical investigation and a review of as-built drawings, are no longer required.

Triggering Mechanism 14 – Frost Effects

CPFM 14a – Heaving, crushing, or displacement

The foundations for the Demineralized Water Tank and Pump House are not below frost depths and are therefore subjected to frost effects. Soils were thought to have a potential of being saturated when the ground froze, creating a potential for excessive frost heave. Drains below the tank appeared to be clogged at the time of the initial inspection, not allowing water under the tank to drain, which would not meet the design intent for the tank. The Old Warehouse is on footings that extend below frost and is not susceptible to this CPFM.

Significance

Potential for Degradation/Direct Floodwater Impact

The groundwater elevation measured in the monitoring wells closely followed the river level as the floodwater receded. The data indicate that groundwater elevation was about 2 ft above the river level near the beginning of October 2011 and dropped to the river level by about October 14, 2011. Therefore, saturated soil conditions beyond normal are no longer an issue and the potential for degradation for this CPFM is low.

Implication

The occurrence of this CPFM could cause some movement in the tank and Pump House foundation systems; however, because the foundations have always been subjected to freeze-thaw cycles, the additional movement under current conditions is not expected to cause an excessive increase in movement. Therefore, the implication of the potential degradation for this CPFM is low.

Confidence

At this time, it is known that the ground will not freeze before soil water levels are able to lower to a normal condition because water levels have been determined to be at normal conditions at the time of Revision 1 and the ground has not frozen. Therefore, the data at hand are sufficient to rule out this CPFM. As a result, the confidence in the assessment is high, which means no other data are necessary to draw a conclusion.

Summary

For CPFM 14a, as discussed above, the potential for degradation is low because the effects due to frost heave are not applicable due to lowered groundwater levels. The combined consideration of the potential for degradation and the implications of that degradation to the structures of this type put it in the "not significant" category. The data currently collected are sufficient to rule out this CPFM. Therefore, the confidence in the above assessment is high, which means no additional data and inspections are necessary to draw a conclusion. The data previously thought to be required to rule out this CPFM, which includes the geotechnical information, are no longer required.

5.14.7.3 Revised Results and Recommendations

The CPFMs evaluated for the Demineralized Water Tank, Pump House, and RO Unit are presented in the following matrix, which shows the rating for the estimated significance and the level of confidence in the evaluation. CPFMs 3a and 14a for the Demineralized Water Tank, Pump House, and RO Unit are not associated with KDIs. Results of survey data, ground well monitoring data, and field inspections do not indicate signs of significant structure movement or other adverse effects that could be attributed to these CPFMs. Therefore, these CPFMs will be moved to the quadrant of the matrix representing "No Further Action Recommended Related to the 2011 Flood."

	Low Confidence (Insufficient Data)	High Confidence (Sufficient Data)
Potential for Failure **Significant**		
Potential for Failure **Not Significant**		CPFM 3a CPFM 14a

5.14.7.4 Conclusions

In the assessment of the FCS Structures, the first step was to develop a list of all Triggering Mechanisms and PFMs that could have occurred due to the prolonged inundation of the FCS site during the 2011 Missouri River flood and could have negatively impacted these structures. The next step was to use data from various investigations, including systematic observation of the structures over time, either to eliminate the Triggering Mechanisms and PFMs from the list or to recommend further investigation and/or physical modifications to remove them from the list for any particular structure. Because all CPFMs for the Demineralized Water Tank, Pump House, and RO Unit other than CPFMs 3a and 14a had been ruled out prior to Revision 1, and because CPFMs 3a and 14a have been ruled out as a result of the Revision 1 findings, no Triggering Mechanisms and their associated PFMs will remain credible for the Demineralized Water Tank, Pump House, and RO Unit. Therefore, HDR has concluded that the 2011 Missouri River flood did not impact the geotechnical and structural integrity of the Demineralized Water Tank, Pump House, and RO Unit because the potential for failure of this structure due to the flood is not significant.