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Routine & Fracture Critical Member (FCM) Inspection Report (Interim)

Property ID No. 43-0434 – Los Alamos Canyon Bridge

DOE FIMS RPUID – 86471

NBI Structure No. – 7622

Los Alamos National Laboratory - NNSA

Los Alamos County, NM

Inspection Date: September 23 - 25, 2022

Los Alamos Canyon Bridge on NM-501 (Diamond Drive) over Omega Road

Prepared by:

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Prepared for:

National Nuclear Security Administration

Report Date: January 11, 2023

Project Number: Subcontract to Inspect Bridge No PO 614661

Certification of Inspection and Review

Statement of Inspection

Inspection of the Omega Bridge included a Routine Inspection and a Fracture Critical Member (FCM) Inspection. The inspection was completed according to the standards referenced in EXHIBIT “D” SCOPE OF WORK AND TECHNICAL SPECIFICATIONS including the National Bridge Inspection Standards (23 CFR Part 650, dated 12/14/2004) and other FHWA, NMDOT, and AASHTO codes and standards. The inspection team met the minimum qualifications of personnel as stated in NBIS Section 650.309.

David V. Jáuregui, PhD, PE

January 11, 2022

Statement of Review

The quality control (QC) review was performed by a qualified engineer to ensure consistency between the narrative provided in the report and the assigned condition states and ratings. In addition, the QC Reviewer provided general oversight of the field inspection work for purposes of safety and data accuracy. The QC Reviewer meets the qualifications of team leader based on education, training, and experience.

Brad D. Weldon, PhD

January 11, 2022

Executive Summary

This report covers the inspection findings for the Routine Inspection of the Omega Bridge conducted on September 23-25, 2022 and the Fracture Critical Member (FCM) Inspection conducted on June 26-27, 2021. **Note that due to complications with the under-bridge access unit, portions of the Routine Inspection and the entire FCM Inspection could not be completed in 2022. As a result, the superstructure condition reported herein is based on the 2021 inspection whereas the deck and substructure conditions are based on the 2022 inspection. The superstructure condition will be updated when the inspection is completed in 2023.** The inspections were completed according to the standards referenced in EXHIBIT "D" SCOPE OF WORK AND TECHNICAL SPECIFICATIONS including the National Bridge Inspection Standards (23 CFR Part 650, dated 12/14/2004) and other FHWA, NMDOT, and AASHTO codes and standards. Condition ratings for the bridge components are summarized below.

Element	Previous Condition (2021)	Current Condition (2022)
Deck	Fair	Fair
Superstructure	Fair	Fair *
Substructure	Poor	Poor

* NOTE: Current superstructure condition based on 2021 inspection (2022 inspection not completed due to under-bridge access issues).

Based on the 2022 Routine Inspection, the bridge deck is rated in FAIR condition. The chain drag performed on the deck identified several areas with delamination that are concentrated near the expansion joints, in the closure joint of the deck near the bridge centerline, and at the south end of the northbound lanes. The chain drag performed during the 2022 inspection revealed 243,939 sq. in. (1694 sq. ft.) of delaminations and patched areas (not including the sidewalk). This is approximately a 13% increase from 2021. It is recommended that the delaminations and spalls be repaired.

Based on the 2021 inspections (Routine and FCM), the superstructure is rated in FAIR condition due primarily to moderate to heavy corrosion, with section loss, of the superstructure elements. The floor beams including the outriggers and the spandrel girders of the Los Alamos Canyon Bridge are classified as fracture critical members. The National Bridge Inspection Standards (NBIS) defines a fracture critical member as a steel member in tension or with a tension element whose failure may cause a portion of or the entire bridge to collapse. The NBIS requires that fracture critical members be visually inspected within "arm's length" to assure the structural integrity of the bridge. During the 2021 inspection, the NMSU team used the under-bridge access unit to reach the fracture critical members. Particular attention was given to the connections of the spandrel girders and floor beams for signs of deterioration, damage, and distortion. The tension areas of the floor beams (including outriggers) and spandrel girders were also checked, particularly for corrosion, section loss, and fatigue cracks. Due to the corrosion and section loss on the outriggers, local failures are possible.

In the 2021 Routine Inspection of the arch rib members, areas with corrosion and section loss were found on the top flange plate and bottom flange angles. The arch columns to arch rib connections are corroded with pack rust. Corrosion / pack rust is also present at the corners between the plates of the built-up columns where the paint does not thoroughly cover the steel. The steel protective coating (paint) is in fair condition; however, paint failures are progressing leading to corrosion of the structural members. In general, the protective coating failures and corrosion in the affected locations continues to increase. **Note that a hands-on inspection of the arch ribs (including connections to arch columns) was conducted in 2022 using rope access methods. The rope access team also inspected other outlying areas of the primary components such as the bases of the steel skewback columns and top sides of the supporting concrete pedestals, and secondary members including the portal bracing towers at the ends of the arch and the lateral bracing between the arch ribs (including the end connections). The superstructure condition will be updated incorporating the 2022 inspection findings from the rope access team and the findings from the FCM Inspection when completed in 2023.**

The substructure is rated in POOR condition based on the 2022 Routine Inspection, specifically due to the condition of the abutments. The abutment concrete continues to degrade, particularly on the south end. The full width of the south abutment has numerous defects including cracking, delaminations, spalling, leaching, efflorescence, and corrosion of the reinforcement is evident from staining on the concrete. Additionally, the anchor bolts at the south abutment are in contact with the bearing device due to transverse movement in the east direction. Crack patterns and bridge seat surface measurements indicate minor settlement of the north abutment towards the west side of the bridge. The piers have numerous defects including cracking, delamination, spalling, efflorescence, rust staining, salt build up, and abrasion. The cracks have continued to propagate and increase in width and are characterized as moderate to wide cracks. Some cracks were previously sealed with epoxy but the cracks have progressed through the epoxy at most locations.

In general, there are several concerns with the Omega Bridge that need to be addressed since the bridge is subject to moderate-to-severe environmental loading and also services a large volume of traffic between the City of Los Alamos and the LANL. First, the steel superstructure and bearing devices continue to corrode. The outrigger beams and outer stringer on the west side of the bridge are heavily corroded due to the free flow of water runoff that occurred prior to installation of the drainage system in 2022. Second, the condition of the substructure continues to worsen, in particular the south abutment due to poor drainage of the water runoff and joint leakage. The substructure elements were previously repaired; however, the concrete repairs continue to deteriorate. Third, the steel protective coating on the west arch rib is deteriorating. Fourth, the bridge experiences significant and atypical movement (likely due to temperature) that continues to distress the expansion joints (particularly on the south end). Recommendations are provided below.

It is recommended that the south and north expansion joints continue to be repaired or replaced as needed due to damage caused by snow plows and bridge deformation. To accommodate the significant thermal movements experienced by a bridge of this size, the recommended types of joints are finger joints or modular expansion joints, the latter of which is currently being used. Due to possible misalignment of the "fingers" and increased water leakage through the joint, the finger joint type is not recommended for the Los Alamos Canyon Bridge. Installation of an approach slab may improve the transition on/off the bridge and help to minimize joint damage. It is also recommended that the use of "jointless" bridge technologies be investigated to effectively move the joint away from the abutment areas. This alternative could potentially improve the approach-to-bridge transitions, decrease the amount of water leaking through the joints and reaching the abutment, and reduce equipment-caused damage (e.g., snow plowing). It is imperative that proper design and installation procedures be followed for all joints. To gain a better understanding of the bridge behavior (specifically thermal movement) throughout the year, installation of a network of sensors at the abutment areas and periodic monitoring of the measured deformations is recommended. The bridge deformations collected throughout the year may provide meaningful information regarding the global movement of the bridge that is leading to problems with the expansion joints.

It is also recommended that the pedestrian rail be reconfigured to meet the AASHTO LRFD Bridge Design Specifications; LRFD Sections 13.8 and 13.9 provide guidelines to protect individuals from falling through. In general, openings between horizontal or vertical members on pedestrian railings must be small enough to prohibit a 6-inch sphere from passing through the lower 27 inches. For the portion of pedestrian railing that is higher than 27 inches, the openings should be spaced to prohibit an 8-inch sphere from passing through. **Note that chain-link fencing was installed on the pedestrian rail as pass-through protection; however, the rail configuration still does not meet AASHTO requirements.** During the 2022 Routine Inspection, a few damaged areas of fencing were found that need to be repaired or replaced.

Based on the 2021 and 2022 inspection findings, the repair and maintenance recommendations are summarized below under the corresponding priority level (1 – immediately, 2 – when contract mobilized, 3 – prior to next inspection, 4 – when resources allow):

Priority 1: None

Priority 2:

- Install erosion protection in areas surrounding abutments and piers, particularly in areas with undermining.
- Repair concrete on north and south abutments.

Priority 3:

- Repair or replace damaged fencing on pedestrian railing.

Priority 4:

- Repair the outriggers with special attention to those with significant section loss.
- Repair the deck locations with delaminations and spalls.
- Repaint and continue to clean movable bearings at abutments.
- Repair corroded light poles.
- Perform ultrasonic testing of pins at abutment, pier, and arch bearings.
- Repaint arch ribs and outriggers (including connections).
- Measure section loss on members with moderate to heavy corrosion.

During the 2021 Routine Inspection, three critical findings were reported to the LANL contact, Mr. Jonathan Stein, by text and / or email on June 26, 2021 (see below). No critical findings were identified during the partial 2022 Routine Inspection.

1. The south joint of the bridge had a modular section that could potentially come loose during the passing of vehicles. This was reported as a critical finding for safety. If the modular section was dislodged or deformed it could pose a serious hazard that could result in a punctured tire to vehicles, motorcyclists and/or bicyclists causing drivers / riders to lose control. <u>This finding was remedied by the end of 2021 inspection.</u>

2. The bracket plate located at the north end of the bridge on the pedestrian walkway was corroded through providing little protection to pedestrians and bicyclists. This was reported as a critical finding for safety to prevent individual injuries. <u>This finding was remedied prior to the 2022 inspection.</u>

3. The north approach rail had three missing posts. These posts help to ensure that traffic is redirected and the energy is absorbed by the rail. This was reported as a critical finding for safety. Additionally, the approach rail is on a curve with a nearby drop off. Immediate repair was recommended. <u>This finding was remedied prior to the 2022 inspection.</u>

Reported Inventory and Operating Load Rating values are HS15.0 and HS25.5, respectively, as determined based on the Load Factor (LF) Method. In 2018, a load rating was conducted by Bohannan Huston, Inc. (BHI) based on the Load and Resistance Factor (LRFR) Method. Updating of the load rating values is recommended based on the results of the 2018 BHI study prior to the next inspection. Bridge is not load posted (open, no restriction) and the posting status concurs with the 2018 BHI study results.

Conduct the entire FCM Inspection and remaining portions of the Routine Inspection (i.e., those not completed in 2022) in 2023. Conduct the next FCM Inspection and Routine Inspection on the currently established interval (yearly) until repainting of the steel superstructure and the repair or replacement of corroded elements are completed. After this work is completed, it is recommended that the FCM Inspection and Routine Inspection be conducted every two years.

RPUID 86471 – Routine and FCM Inspection Report (Interim)

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Bridge Summary and Description

Bridge Description and Location

The Los Alamos Canyon Bridge (also called the Omega Bridge) is a riveted, steel arch bridge that carries north and south bound traffic on Diamond Drive (NM 501) over the Los Alamos Canyon between the town of Los Alamos, New Mexico and technical areas of the Los Alamos National Laboratory (LANL) (see Fig. 1). Other identifying information for the bridge includes the following: NBI Structure Number = 7622; latitude = 35.88 degrees / longitude = 106.3219 degrees; Defense Highway = Not a STRAHNET highway; Highway System = Not on the National Highway System (NHS); and inventory direction = south-to-north.

The Omega Bridge was designed by Finney and Turnipseed, fabricated by the American Bridge Company, and erected by the Vinson Construction Company in 1951. In 1992, the floor system of the Omega Bridge was rehabilitated. Other major rehabilitation work done on the bridge included: light-weight concrete was used for the deck; shear studs were installed on the interior stringers and spandrel beams to provide composite action with the deck; cover plates were added to the interior stringers and spandrel beams for additional moment capacity; and exterior stringers supported by outrigger beams were added on both sides of the bridge width. Since 2014, significant work completed on the bridge (with the estimated date of completion) includes the following: HMWM protective coating applied to deck (September 2014); southwest bearing realigned and keeper plate replaced (August 2014); erosion control installed near south skewback column (2014); restriping of roadway and deck (2016); repaving of south approach roadway (2018); restriping of north approach (2020); installation of gutter on west side of pedestrian walkway (2021); and replacement of steel bridge rails on west and east sides of bridge deck (2021). In addition, the north and south expansion joints have been replaced frequently due to continued damage caused by snow removal activities. Note that the work described above may not be all inclusive.

As shown in Fig. 2, the bridge is 820 ft long with a 442.5 ft arch span and six 62 ft approach spans (there are three approach spans at each end of the bridge). Figures 3 and 4 show the cross section of the bridge before and after the 1992 rehabilitation, which increased the width of the cross section from 51 ft-3 1/2 in. to 55 ft-6 in. and the roadway from 39 ft-9 in. to 44 ft-0 in. to provide four 11 ft-0 in. wide traffic lanes. The original roadway had no shoulders and four lanes, each having a width of 9 ft-11 1/4 in.

FLOOR SYSTEM and ABUTMENTS

The floor system includes a reinforced concrete slab (with stay-in-place metal forms), six stringers (rolled steel), 28 floor beams (riveted steel), and two spandrel girders (riveted steel);

the stringers and spandrel girders are continuous spans supported by the floor beams and columns, respectively. At the north and south ends of the bridge, the spandrel girders are supported by reinforced concrete stub abutments. The slab concrete has a density of wc = 120 lb/ft^3 and a 28-day compressive strength = 4.5 ksi. The slab thickness is ts = 7.25 in. which includes a 0.5 in. integral wearing surface and the slab is topped with an HMWM overlay. Bridge rails consist of reinforced concrete / steel barriers (located on the west and east sides of the roadway) and a pedestrian walkway (i.e., sidewalk) is located on the west side of the bridge.

Bridge appurtenances include a sidewalk railing, west and east guardrails, fencing and light poles, and electric and steam utilities. The fencing is situated only on the 150 ft center portion of the bridge length on each side of the deck.

Each stringer is a continuous beam supported at the locations of the floor beams over a total of 27 spans; there are 12 spans on the approach to the arch (six on both the north and south ends) and 15 spans over the arch (see Fig. 2). The two exterior stringers are W21x62 sections (ASTM A36 steel) with no cover plates, which were installed during the 1992 retrofit. The four interior stringers are W21x62 sections (ASTM A7 steel), which were installed when the bridge was originally built in 1951.

The floor beams are built-up sections as shown in Fig. 5. The angle thickness is 9/16 in. for the floor beams located at the abutments and the eight floor beams situated at the center of the bridge; the remaining 18 floor beams have an angle thickness of 5/8 in. The span length of the floor beams measured center to center of the spandrel girders is 35 ft.

The spandrel girders are built-up sections as shown in Fig. 6. Each spandrel is a continuous girder supported by the abutments and the columns over a total of 21 spans; there are three approach spans on the north and south end of the bridge and 15 shorter spans over the arch.

COLUMNS, ARCH RIBS and SUBSTRUCTURE UNITS

Each spandrel beam lies in the arch rib plane and is supported by four pier columns, 14 arch columns, and two skewback columns. The pier columns have a riveted connection to the spandrel beam and either a roller or pinned support at the base. The substructure units of the pier columns (8 total) consist of reinforced concrete pedestals and footings. The top ends of the skewback and arch columns also are riveted to the spandrel beam. The bases of the skewback columns are fixed to a concrete foundation, while the bottom ends of the arch columns are riveted to the arch rib. Similar to the pier columns, the substructure units of the skewback columns (4 total) consist of reinforced concrete pedestals and footings. The cross sections of the pier and arch columns are identical. The pier and arch columns and the skewback columns' cross sections are shown in Fig. 7.

Each arch rib, which was originally built in 1951, is a two-hinge parabolic arch with a span of 422.5 ft and a rise of 106.6 ft as shown in Fig. 2. The steel used for the arch ribs is ASTM A7. The transverse distance between the two arch ribs is equal to 25 ft and the support locations of the east and west arch are at the same elevation. Furthermore, each arch rib is symmetrical about its centerline. The substructure units of the arch ribs (4 total) consist of reinforced concrete pedestals and footings. Fig. 8 shows the cross section of the arch ribs.

The fracture critical members (FCMs) of the Omega Bridge include the spandrel girders and floor beams / outriggers. Tension elements of spandrel girders include steel angles and web plate (below neutral axis) in positive moment regions (between columns) and steel angles, top plate, and web plate (above neutral axis) in negative moment regions (near and above columns). Tension elements of floor beams include steel angles and web plate (below neutral axis) in positive moment regions (between spandrel girders) and steel angles, steel rods (passing through spandrel girders), and web plate (above neutral axis) in negative moment regions (near spandrel girders). For the outriggers, the tension elements include the top flanges (and connections) and web (above neutral axis).

Figure 1. Bridge location on Diamond Drive (NM 501) over Los Alamos Canyon and Omega Road.

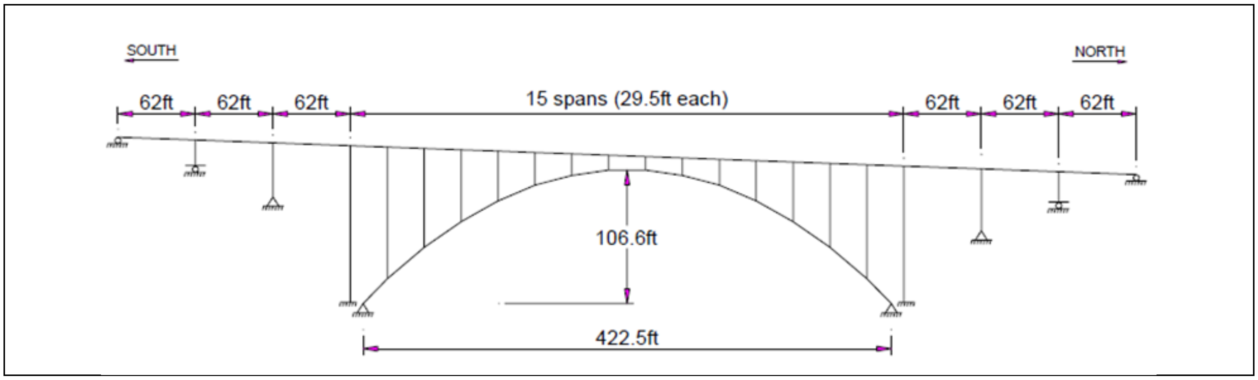


Figure 2. Elevation view of the Omega Bridge.

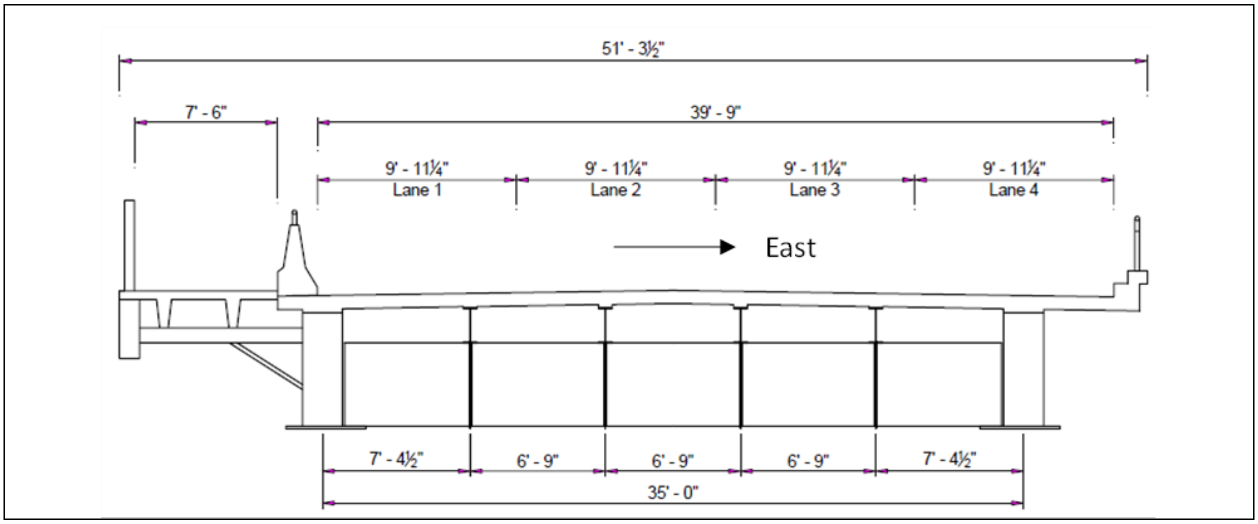


Figure 3. Cross-section of floor system before rehabilitation in 1992.

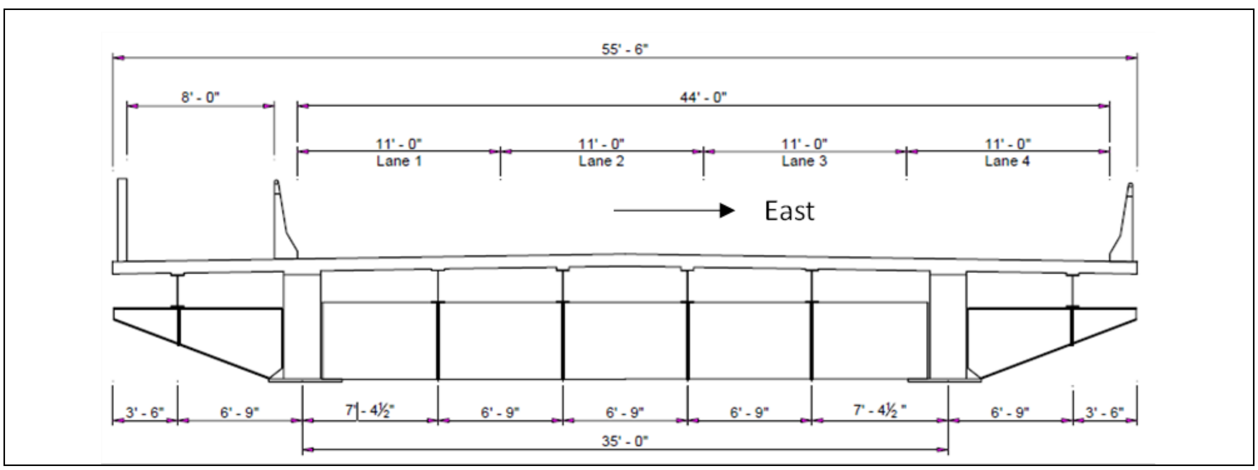


Figure 4. Cross-section of floor system after rehabilitation in 1992.

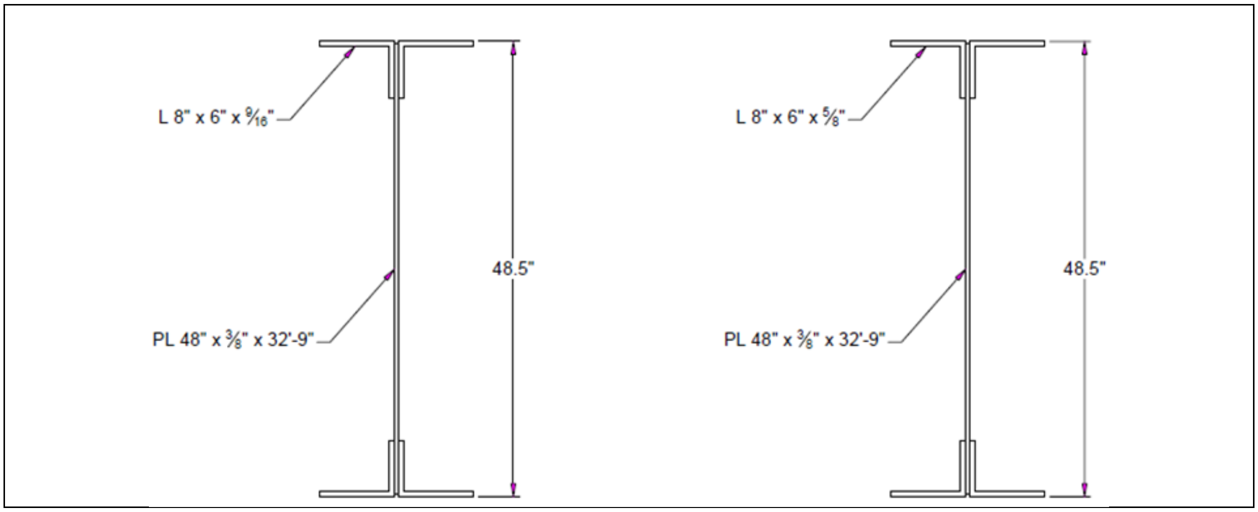


Figure 5. Floor beam sections.

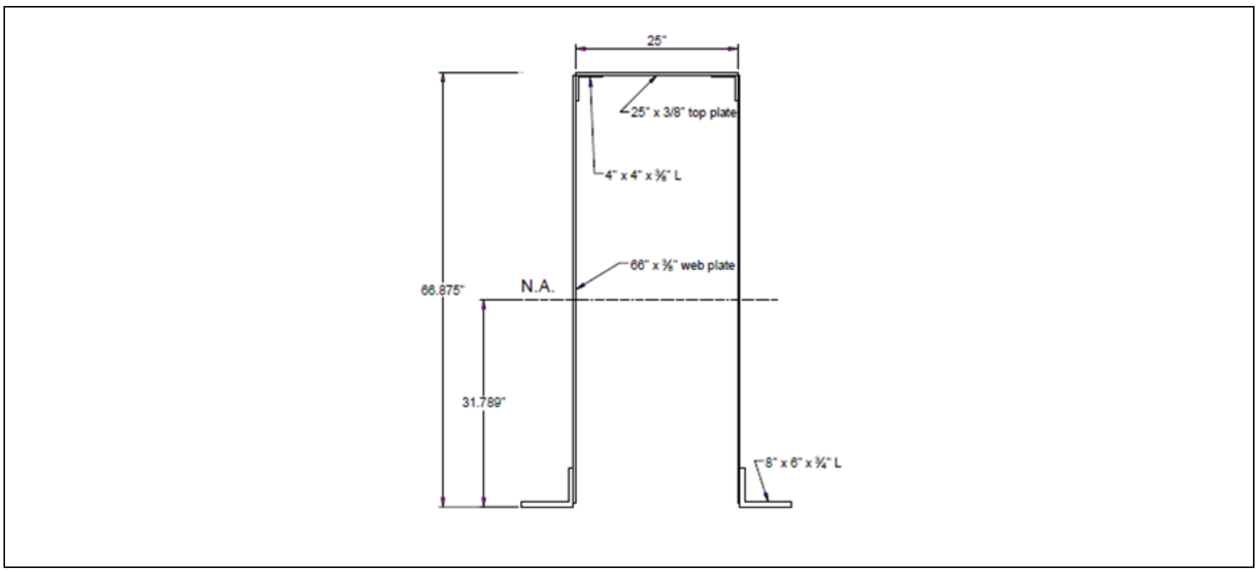


Figure 6. Spandrel girder section.

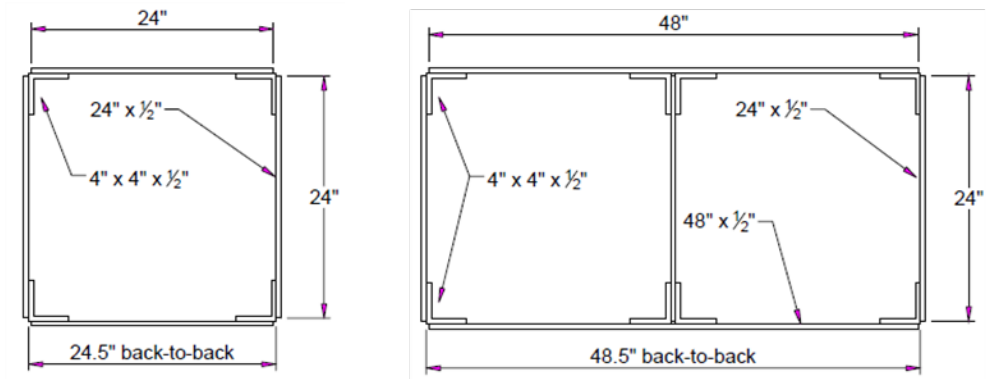


Figure 7. Cross-sections of pier / arch columns and skewback columns.

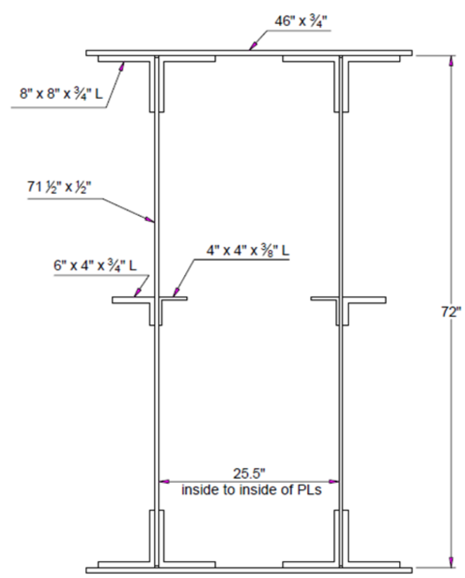


Figure 8. Cross-section of arch rib.

Photo 1. North approach looking south.

Photo 2. South approach looking north.

Photo 3. East elevation looking northwest.

Photo 4. West elevation looking east.

Orientation

The Omega Bridge has 21 spans (including 6 approach spans and 15 spans above the arch) numbered 1 to 21 from south to north. The abutments, pier columns, skewback columns, and arch columns are also numbered from south to north (i.e., abutment #1 and #2, pier columns #1 through #4, skewback columns #1 and #2, and arch columns #1 through #14). The substructure units for the pier and skewback columns are numbered in accordance with the supported column. The substructure units of the arch rib are numbered #1 and #2 on the south and north ends, respectively. The numbering and orientation of the bridge elements are shown in Figures 9 and 10.

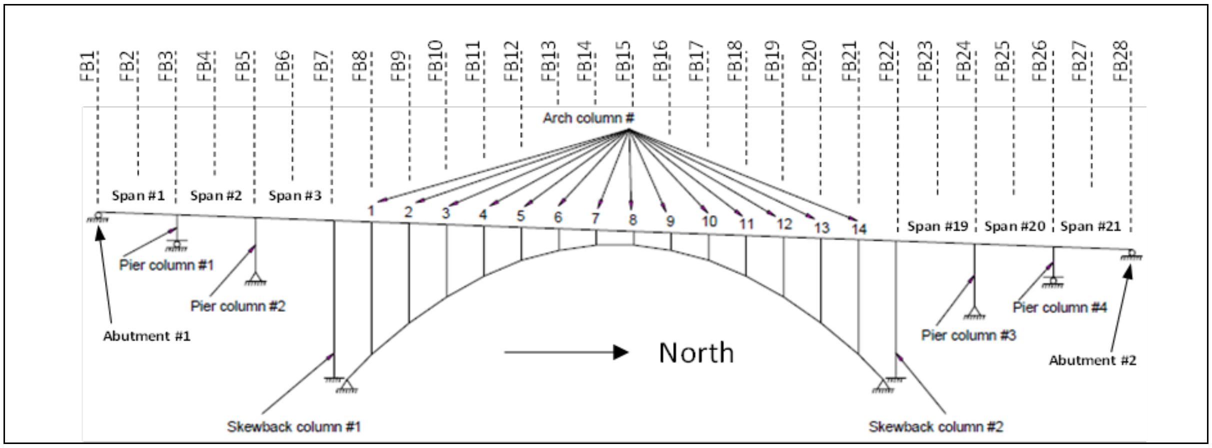


Figure 9. Bridge orientation and numbering – column and floor beam (FB) layout.

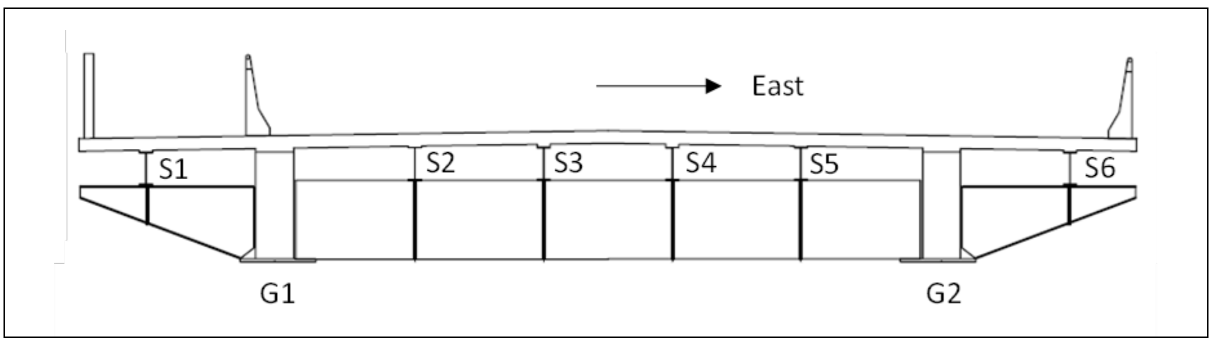


Figure 10. Bridge orientation and numbering – stringer (S) and girder (G) layout.

Inspection Summary

Scope of Inspection

The scope of work for the Omega Bridge inspection in 2022 included the following: (1) Routine Inspection and (2) Fracture Critical Member or FCM Inspection. However, due to complications with the under-bridge access unit rented from McClain & Co., the FCM Inspection could not be completed. Warning lights were activated on the unit and the associated vehicle problems required off-site corrective action (as determined by McClain & Co.) that resulted in postponement of the FCM Inspection. The inspection standards applied were those defined in EXHIBIT "D" SCOPE OF WORK AND TECHNICAL SPECIFICATIONS that included the National Bridge Inspection Standards (23 CFR Part 650, dated 12/14/2004) and other FHWA, NMDOT, and AASHTO codes and standards. The Omega Bridge was inspected in 2022 by NMSU in collaboration with Collins Engineers Inc. Inspection dates and the associated inspection work are summarized below:

Table 1. Inspection dates and work completed.

Day	Description of Inspection Work
09/23/22	***NMSU*** – inspected concrete abutments / steel bearings (supporting spandrel girders and arch ribs), concrete pedestals / steel bearings (supporting pier columns), concrete pedestals (supporting skewback columns – vertical faces) ***Collins Engineers Inc.*** – no inspection work performed (work started 09/24/22)
9/24/22	***NMSU*** – inspected top side of concrete deck (incl. pedestrian walkway), steel / concrete bridge rails, approach roadways, expansion joints, steel pedestrian rail, and base portion of luminaries ***Collins Engineers Inc.*** – inspected arch ribs and connections to arch columns, skewback columns (bearings and top side of concrete pedestals), outrigger connections to spandrel girders, and secondary bracing members
9/25/22	***NMSU*** – completed work started on 09/24/22 (described above) ***Collins Engineers Inc.*** – completed work started on 09/24/22 (described above)

* NOTE: floor system components including deck (bottom side), stringers and FCMs (spandrel girders and floor beams / outriggers) were not inspected in 2022 due to rental cancellation of under-bridge access unit caused by vehicle malfunctions. Utilities supported by floor system and portions of steel columns requiring use of under-bridge access unit were also not inspected. Findings from the 2021 inspection work are included in this interim report for completeness.

Inspection Team

TEAM LEADER:

The Bridge Inspection Team Leader is Dr. David V. Jáuregui. Dr. Jáuregui is the Department Head of Civil Engineering at New Mexico State University (NMSU) and the Director of the NMSU Bridge Inspection Program. He is a registered professional engineer in the state of New Mexico (License No. 17395) with an active license (Expiration Date 12/31/2023). In accordance with NBIS Section 650.309, Dr. Jáuregui meets the qualifications for Team Leader as a registered P.E. with more than 6 months of experience. He also has successfully completed the required bridge inspection training including a FHWA approved comprehensive course (May 11-22, 1992) and refresher course hosted by the Texas Department of Transportation (October 20-23, 2020). Dr. Jáuregui leads the Fracture Critical Member (FCM) Inspection of the Omega Bridge conducted from the under-bridge access unit and also assists with the Routine Inspection. He also coordinates the inspection work with LANL and subcontractors.

Dr. Jáuregui's work focuses on the condition evaluation of bridge structures using analytical techniques and experimental methods. He has served as Member of Transportation Research Board (TRB) Committees related to field testing, non-destructive evaluation, and maintenance of transportation structures and as Associate Editor for the ASCE Journal of Bridge Engineering and the MDPI Infrastructures Journal. Dr. Jáuregui is the organizer and lead instructor of NMSU's two-week Comprehensive Bridge Inspection Training Course and three-day Refresher Bridge Inspection Training Course. He has inspected and evaluated bridge structures for various agencies (including the NMDOT, Los Alamos National Laboratory, U. S. Army Corp of Engineers, and NASA White Sands Test Facility). Dr. Jáuregui has a B.S. and M.S. in Civil Engineering from NMSU and a Ph.D. from the University of Texas at Austin.

TEAM MEMBERS:

Team Member #1 is Dr. Brad D. Weldon. Dr. Weldon has a B.S. in Civil Engineering from NMSU and a M.S. and a Ph.D. in Civil Engineering from the University of Notre Dame. He has extensive experience in the area of concrete behavior and large-scale testing of structural systems and currently serves as the PI on research projects funded by the NMDOT investigating the use of ultra-high-performance concrete in prestressed concrete bridge design in New Mexico. Dr. Weldon has taught several undergraduate and graduate courses on mechanics, behavior, and design of structures under normal and extreme loading (mechanics of materials, wood design, masonry design, advanced concrete behavior, and earthquake engineering). Additionally, he has taught several sessions for the bridge inspection courses offered at NMSU and the Quality Concrete School offered every January at NMSU. Dr. Weldon successfully completed the required bridge inspection training including a FHWA-approved comprehensive course (August 2018). Dr. Weldon assists with the Routine Inspection of the Omega Bridge and is the person-in-charge of the overall safety of the inspection work. He also coordinates the inspection work with LANL and subcontractors.

Team Member #2 is Mr. George P. Baca. Mr. Baca has a B.S. in Civil Engineering from NMSU and he is a registered professional engineer in the state of New Mexico (License No. 5640) with an active license (Expiration Date 12/31/2024). He was employed by the New Mexico State Highway and Transportation Department (NMSHTD) for 27 years starting as an engineering cooperative student in January 1967 and retiring as the Division Director of Operations in 1993. Following his retirement from the NMSHTD, Mr. Baca has provided high-level bridge inspection services in NMSU's Bridge Inspection Program starting in 1995. In total, Mr. Baca has over 40 years of experience in the inspection and evaluation of bridges in the state of New Mexico. Mr. Baca assists Dr. Jáuregui in the Fracture Critical Member (FCM) Inspection of the Omega Bridge conducted from the under-bridge access unit and also assists with the Routine Inspection.

Team Member #3 is Mr. Eduardo Davila. Mr. Davila has a M.S. in Civil Engineering with an emphasis in structures from NMSU. He is an Engineer in Training (EIT) in the state of New Mexico. He started as a bridge inspector in July 2016 as an engineering cooperative student at NMSU. He was also a bridge load evaluator where he was part of a team that collected detailed information of bridges to then analyze them and complete bridge capacity load ratings that were then submitted to NMDOT for review. Mr. Davila's experience with bridges includes inspecting bridges, scanning bridges for rebar size, spacing and cover, instrumenting bridges for data collection, and creating as-built drawings for bridges.

Team Member #4 is Mr. Andres Alvarez. Mr. Alvarez has a M.S. in Civil Engineering with emphasis in structures from NMSU and he is currently pursuing a PhD in Civil Engineering at NMSU. He is a certified engineer in training in the state of New Mexico since Spring 2019. He was part of the bridge inspection co-op program in Spring 2016 and a bridge load rating evaluator from Spring 2017 to Summer 2018. As a graduate student, Mr. Alvarez has continued the inspection of bridges and associated structures by being part of the inspection team for a steel culvert at the White Sands Test Facility and a steel arch bridge for Los Alamos National Laboratory. In total, Mr. Alvarez has inspected and evaluated around 70 bridges and associated structures in the state of New Mexico.

OTHERS:

The climb inspection team leader is Kyle Branham. Kyle is a SPRAT Level I certified technician for 6 years along with on-site planning supervision by a SPRAT Level II technician, Brian Schroeder. Kyle is an active New Mexico PE (25861, Expires 12/31/2023) and meets the qualifications for a team leader per NBIS Section 650.309 with a PE, more than 6 months of experience (14 years' experience), and has completed the NHI 130055 Safety Inspection of In-Service Bridges (8/15/2014) and a refresher (2/21/2019).

Climb inspection team member Hayley Martin has been a SPRAT Level I certified technician for 1 year (2200324, Expires 02/18/25), with on-site planning supervision by a SPRAT Level II technician, Brian Schroeder. Hayley is a PE with New Mexico PE registration pending and has 4.5 years of bridge inspection and design experience.

Climb inspection team member Bri Sievenpiper has been a SPRAT Level I certified technician for 2 years (2100448, Expires 03/12/24), with on-site planning supervision by a SPRAT Level II technician, Brian Schroeder. Bri is an EIT with 3 years of bridge inspection experience.

Climbing Team Member Brian K Schroeder is a Senior Project Manager with Collins Engineers, Inc., certified SPRAT Level II Technician (#060219, expires 03/09/2024), and served as on-site climbing inspection coordinator having managed and participated in the previous climbing inspection. Mr. Schroeder meets the qualifications for bridge inspection team leader stated in NBIS Section 650.309 having passed NHI 130055 Safety Inspection of In-Service Bridges (04/19/2002), NHI 130053 Bridge Inspection Refresher (11/07/2019), and inspection experience greater than 2 years (22 years total).

Traffic Control Personnel (Duane Pacheco): Mr. Pacheco is the LANL foreman for the traffic control crew and is in charge of maintaining the traffic control devices. He is a certified traffic control supervisor through American Traffic Safety Services Association (ATSSA) and has over 10 years' experience at LANL.

GPS Surveyor for Deck Assessment (Abel Archuleta): Mr. Archuleta is the GPS surveyor for the bridge deck and has over 10 years' experience providing GPS surveying services in New Mexico.

Inspection Conditions

Inspection conditions for the on-site field work are summarized below:

Day	Start Time	End Time	Temp Range	Cloud Cover	Humidity	Wind
09/23/22	8:00 am	5:00 pm	60-80°F	Scattered	~ 60%	~ 15 mph
09/24/22	8:00 am	5:00 pm	60-80°F	Sunny	~ 35%	~ 15 mph
09/25/22	8:00 am	3:00 pm	60-80°F	Sunny	~ 35%	~ 15 mph

Inspection Procedures

ACCESS:

Unique features of the Omega Bridge include the following: (1) 422.5 ft arch spans with 106.6 ft rise from bottom of arch to crown; (2) fracture critical members consisting of the spandrel girders and floor beams; (3) vehicular and pedestrian traffic; and (4) steep / mountainous terrain surrounding bearing locations of pier / skewback columns and arch rib foundation. In addition, the Omega Bridge does not have an integrated form of access such as a catwalk.

The Omega Bridge features summarized above necessitate traffic control and various forms of access including an under-bridge access unit, rope access methods, and trekking activities. The under-bridge access unit is used to inspect the primary floor system and secondary lateral bracing elements and connections. Above all, the unit provides the most practical means of access for the hands-on inspection (i.e., within arm's reach) of the fracture critical members including the spandrel girders and floor beams (members and connections) as required by the National Bridge Inspection Standards for the FCM Inspection. The unit is also used to inspect the stringers and bottom sides of the deck and pedestrian walkway (including stay-in-place metal decking). Inspection of the arch ribs and columns is also conducted using the under-bridge access unit, but is limited to locations reachable from the maximum safest extension of the bucket and through the use of binoculars.

Due to the reach limitations of the under-bridge access unit, a hands-on inspection of the arch ribs (including connections to arch columns) was conducted using rope access methods. Inspectors from Collins Engineers, Inc. rappelled from the bridge deck and positioned themselves within arm's reach of the arch rib components. The rope access team also inspected other outlying areas of the primary components such as the bases of the steel skewback columns and top sides of the supporting concrete pedestals, and secondary members including the portal bracing towers at the ends of the arch and the lateral bracing between the arch ribs (including the end connections). All rope access procedures and safety precautions conformed to the Society of Rope Access Technicians (SPRAT).

Several components of the Omega Bridge were accessible from the roadway or ground level including the abutments, bearing devices, column pedestals, deck / pedestrian walkway (top sides), approach roadways / guardrails, expansion joints, and bridge / pedestrian rails. These non-FCMs along with others described above were inspected within arm's reach or observed with binoculars in accordance with the National Bridge Inspection Standards as part of the Routine Inspection.

Traffic Control:

The floor system inspection of the Los Alamos Canyon Bridge was scheduled on the weekend to minimize traffic disruption during operation of the under -bridge access unit. LANL personnel provided the necessary traffic control during the weekend inspection. Portable signage meeting the requirements of the NMDOT was installed by LANL at the ends of the bridge to warn on-coming traffic of the work zone ahead and/or the temporary closure of the bridge. In addition, an attenuator was positioned behind the under-bridge access unit to protect the unit from direct impact and ensure safety of inspectors. Traffic control was also necessary to safely inspect the topside portions of the bridge including the deck (particularly during the chain drag and GPS survey), expansion joints, barrier and guard rails, and approach roadways. In addition, the traffic control was positioned to provide a safe working environment for the rope access team (particularly when propelling down from the roadway on the east side of the bridge).

INSPECTION METHODS:

The National Bridge Inspection Standards (NBIS) require highway bridges to be inspected and evaluated by qualified inspectors. The inspection team meets the required NBIS qualifications and inspected the Omega Bridge in accordance with the applicable criteria for steel arch bridges. Equipment used for inspecting steel bridges was transported to the work site by the inspection team. Primary bridge components including the deck, superstructure, and substructure receive a thorough visual inspection (plus physical inspection) and photographic documentation using digital cameras are collected to support the inspection findings.

The field inspection team used clothing and accessories appropriate for the weather and work conditions encountered at the bridge site including, but not limited to, the following:

- work shirts and long pants;
- hard hat for head protection, safety vest for high-visibility, and work boots with steel toe for foot protection;
- gloves for hand protection, safety glasses/goggles for eye protection, and masks for respiratory protection; and
- full body harness and lanyard for fall protection during use of under-bridge access unit.

In addition to the safety equipment, the field inspection team used standard tools, maintained in good working order, as needed in accordance with the manufacturers' recommendations including, but not limited to, the following:

- cleaning tools – whisk brooms, wire brushes, scrapers, screw drivers, shovels;
- inspection tools – tool belts, rock hammers, plumb bobs, chain drags;
- visual aid tools – binoculars, flashlights, magnifying glasses, dye penetrant;
- measuring tools – tapes, crack gauge, thermometers, wind gauge, carpenter's level;
- documentation tools – inspection forms, field books, digital cameras, laptop computers;
- access tools – under-bridge access unit, SPRAT equipment; and
- miscellaneous equipment – insect repellent, sunscreen, first-aid kit, and cell phones.

As mentioned previously, the Scope of Work for the Omega Bridge inspection includes a Fracture Critical Member (FCM) Inspection of the spandrel girders and floor beams, and a Routine Inspection of all other bridge components. Both inspection types are performed in accordance with the visual / physical inspection procedures described in the AASHTO Manual for Bridge Evaluation and the Bridge Inspection Reference Manual. Nondestructive testing methods are not used for either inspection type.

In general, as part of the Routine Inspection, the concrete components (including the deck, bridge rails, abutments and column pedestals) are checked for typical defects including spalling

/ delaminations, exposed rebar, efflorescence / rusting, and cracking. The deck is chain dragged and the delaminations are marked by NMSU and surveyed by LANL to prepare a delamination map and provide an accurate estimate of the deteriorated area. The steel components (including the bridge / pedestrian rails, arch ribs, columns, bearings, and stringers) are checked for typical defects including corrosion, cracking, connection problems, and distortion / damage. The concrete / steel protective coatings (if applied), assembly joint seals, and approach roadway / guardrails are also evaluated. Defect quantities for the National Bridge Elements (NBEs) and Bridge Management Elements (BMEs) are documented according to the AASHTO Manual for Bridge Element Inspection.

Inspection of the Omega Bridge deck (underside) and superstructure components requires an under-bridge access unit, mainly for the hands-on inspection of the fracture critical members (i.e., FCM Inspection). The under-bridge access unit is operated from the “top side” and “bucket” by qualified employees of the rental agency. The procedures employed in the inspection with the under-bridge access unit include, but are not limited to, the following:

- inspectors complete the necessary safety training with respect to falls, falling objects and safety in construction zones as required by LANL;
- pre-inspection, on-site meetings are held between the responsible parties (e.g., NMSU inspection team, LANL, under-bridge access unit operators);
- inspectors working from under-bridge access unit bucket use a full body harness with lanyard for fall protection (connections have locking snap hooks to tie off to the bucket);
- communication between the inspectors and the under-bridge access unit operators is maintained through the use of two-way radio equipment; and
- use of the under-bridge access unit is postponed accordingly in times of inclement weather and/or passing of oversized / overloaded vehicles.

As previously shown, the floor system has 27 bays with a deck – stringer – floor beam – spandrel girder load path. Starting on the south end of the bridge (with traffic control in place), the floor system is inspected from bay to bay; the bays are numbered in the south-to-north direction (bay #1 spans from FB#1 to FB#2, bay #2 spans from FB#2 to FB#3, etc.). In each bay, the inspectors are positioned within arm’s reach of the tension areas of the floor beams / outriggers and spandrel girders as required for the FCM Inspection. Careful attention is given to inspecting these areas for section loss caused by corrosion and/or cracking. After inspection of the north end of the bridge is completed, the traffic control is repositioned and the inspection continues in the north-to-south direction (starting with bay #27 rather than bay #1). The inspection focuses on the outriggers and spandrel girder located on the west side since the floor beams and east side outriggers and spandrel girder were previously inspected.

As part of the Routine Inspection, the non-FCMs of the floor system (underside of deck, stay-in-place forms, and stringers) and the other non-FCMs of the superstructure (columns and arch ribs) are also inspected from the bucket of the under-bridge access unit. In addition, a rope access team performs a hands-on inspection of the arch ribs and other areas not reachable from the under-bridge access unit. The team rappels down to the skewback columns at the north and south ends of the east arch rib and work toward the center of the bridge using rope-to-rope transfers. The process is then repeated for the west arch rib. Close attention is given to evaluating the steel defects and the effectiveness of the steel protective coating applied to the superstructure components.

Hard hats are worn at all times for protection against falling objects and impact with bridge components. Safety vests are used during all inspection activities, including those on and off the roadway (i.e., traffic areas).

INSPECTION FREQUENCIES:

Inspection intervals currently established for the Omega Bridge are summarized below:

Inspection Type	Inspection Interval
Routine Inspection	12 months
Fracture Critical Member Inspection	12 months
Underwater Inspection	N/A
Special Inspection	N/A

FRACTURE CRITICAL MEMBER:

As mentioned above, the fracture critical members (i.e., spandrel girders and floor beams including outriggers) were inspected within arm's reach from the bucket of the under-bridge access unit as required by the National Bridge Inspection Standards for a FCM Inspection. Tension elements of spandrel girders include steel angles and web plate (below neutral axis) in positive moment regions (between columns) and steel angles, top plate, and web plate (above neutral axis) in negative moment regions (near and above columns). Tension elements of floor beams include steel angles and web plate (below neutral axis) in positive moment regions (between spandrel girders) and steel angles, steel rods (passing through spandrel girders), and web plate (above neutral axis) in negative moment regions (near spandrel girders). For the outriggers, the tension elements include the top flanges (and connections) and web (above neutral axis). Figures 11 and 12 delineate the tension elements of the spandrel girders (illustrated for spans #1 through #3) and a typical floor beam.

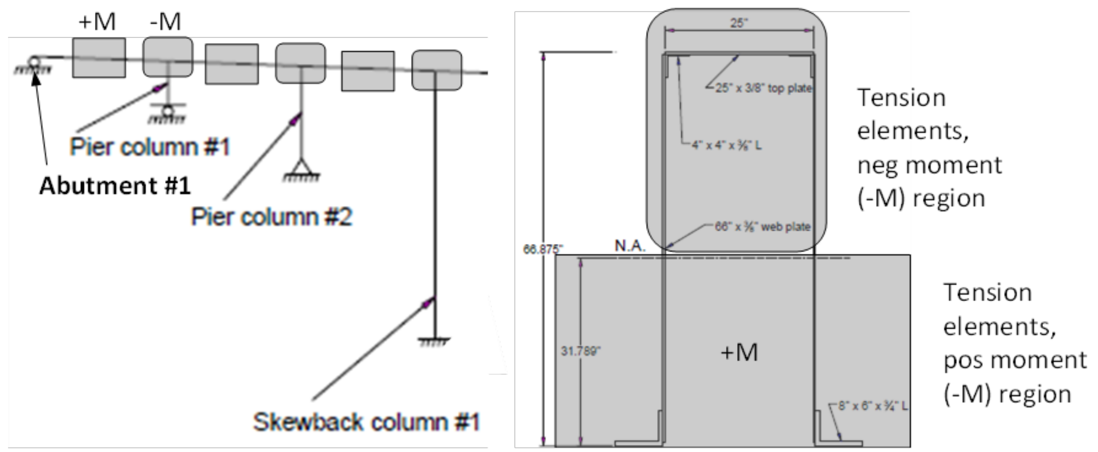


Figure 11. Tension elements of fracture critical members – spandrel girder (span #1-#3).

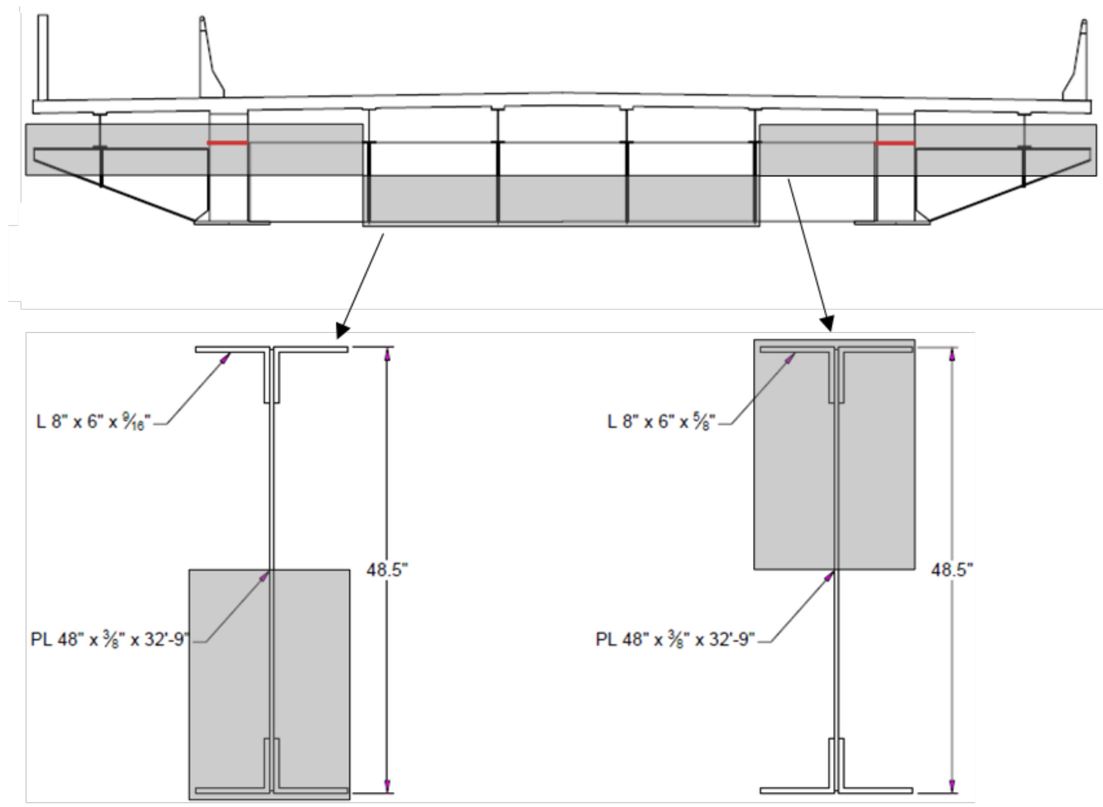


Figure 12. Tension elements of fracture critical members – floor beam / outrigger (typical).

COMPLEX BRIDGE FEATURES:

Not applicable.

Bridge Condition

DECK NBI ITEM 58 CONDITION RATING – FAIR {5}

DECK CONDITION

Overall, the deck is rated in fair condition. Element level data for the reinforced concrete deck (NBE 12) with concrete protective coating (BME 521) and assembly joint seals (BME 303) on the north and south ends of the bridge are attached at the end of this report.

Chain dragging the deck identified several delaminated areas. The delaminations increased by approximately 13% from the inspection conducted in 2021 and are concentrated adjacent to the south expansion joint, in the closure joint of the deck near the bridge centerline, and near previously patched areas. **At the south joint**, delaminated areas were found on the adjacent header areas of the bridge deck and approach roadway. See pictures LANL 1, LANL 2, and LANL 3. Patch repairs at both the north and south expansion joints are adhering but there are cracks and delaminations at both joints. See picture LANL 4. **In the deck closure joint near the bridge centerline**, there were several delaminated areas found over the total bridge length; the delaminations usually extend the full width (1-ft., 4- in.) of the closure joint. In addition, isolated spots of corrosion of the stay-in-place deck forms were found at several locations (based on the 2021 inspection). See picture LANL 5.

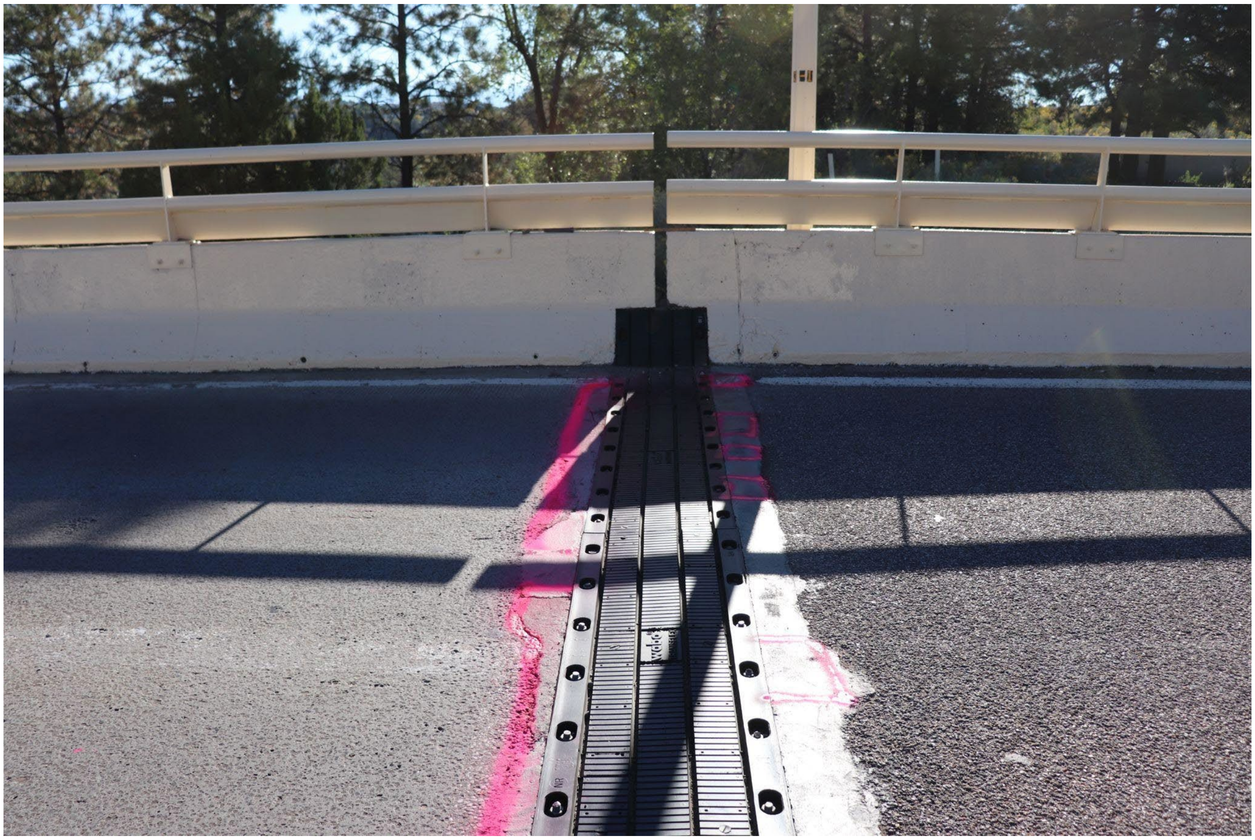
Chain dragging was also conducted on the pedestrian sidewalk during the 2022 inspection. Several spalls were found on the west side of the deck mainly near the pedestrian rail post locations. See picture LANL 6. The "delaminated area" map provided by LANL for the 2022 inspection is attached.

The **deck edges** adjacent to the east and west bridge barriers have light map cracking, light leaching, and several small spalls. This condition is likely caused by water runoff which drains transversely in the east and west directions and then from the south to north end of the bridge. Installation of new north and south joints was being completed during the time of the 2022 inspection. See pictures LANL 1, LANL 2, and LANL 3 (south joint), and LANL 4 (north joint).

The light poles and supports also have corrosion. See pictures LANL 7 and LANL 8.

LANL 1 (IMG_6306.jpg)

LANL 2 (IMG_7112.jpg)



LANL 3 (IMG_7101.jpg)

LANL 4 (IMG_7131.jpg)

LANL 5 (IMG_5502.jpg) (2017)

LANL 6 (IMG_5562.jpg [2017]; IMG_0261 [2019])

LANL 7 (IMG_7214.jpg)

LANL 8 (IMG_7215.jpg)

PEDESTRIAN WALKWAY CONDITION

In general, the concrete sidewalk on the west side of the bridge has areas of abrasion / wear with transverse, longitudinal and map cracks due to environmental factors (e.g., snow, rain) and human factors (e.g., pedestrian foot and bike traffic). There are numerous small spalls and delaminations located adjacent to the base plates of the pedestrian rail connecting to the concrete sidewalk. See picture LANL 9. Other inspection findings include minor leaching and scaling of the concrete sidewalk adjacent to the CBR, minor corrosion of the pedestrian rail, and minor debris buildup on the sidewalk. See pictures LANL 10, LANL 11, LANL 12 and LANL 13. Picture LANL 14 shows the condition of the pedestrian rail prior to replacement.

* NOTE: Prior to 2022, the pedestrian walkway lacked a drainage system to collect and divert water runoff. A new drainage system was added to the west side of the bridge which includes a gutter and downspout to capture the runoff and move the water away from the bridge. See pictures LANL 15 and LANL 16. Previously, there was a free flow of water over the west side of the pedestrian walkway which led to significant deterioration (debonding of steel protective coating and corrosion) of the superstructure particularly at the outriggers / connection plates, spandrel beam / splice plates, and arch rib located on the west side. Chain link fencing was

added to the pedestrian steel rail that spans the area between the rails. Several panels have been damaged since the installation. **Note that the pedestrian rail still does not meet the required standards to provide a safe passageway for pedestrians crossing the bridge.**

Overall, the deck is rated in fair condition. Element level data for the reinforced concrete deck (NBE 12) and assembly joint seals (BME 303) on the north and south ends of the bridge are attached at the end of this report. Element level data for the metal bridge railing (NBE 330) with steel protective coating (BME 515) are also provided.

LANL 9 (IMG_7173.jpg)

LANL 10 (IMG_7173.jpg)

LANL 11 (IMG_6368.jpg)

LANL 12 (IMG_unknown.jpg)

LANL 13 (IMG_0713.jpg) (2021)

LANL 14A (IMG_0732.jpg) (2021)

LANL 14B (IMG_0722.jpg) (2021)

LANL 15 (IMG_7206.jpg)

LANL 16 (IMG_7182.jpg)

SUPERSTRUCTURE NBI ITEM 59 CONDITION RATING – FAIR {5}

SUPERSTRUCTURE CONDITION

Based on the Routine Inspection and FCM Inspection conducted in 2021, the superstructure is rated in fair condition; note that the superstructure condition will be updated upon completion of the inspection work started in 2022. The arch bridge members are in fair condition with moderate paint failures at isolated locations particularly on the west side. There are missing bolts and poor welds at the channel connections to the spandrel columns. Failure of the steel protective coating has led to corrosion, section loss, and pack rust at the spandrel column to arch rib connections and top flanges of the outriggers (particularly on the west side). In general, the steel protective system was not applied to the superstructure components as thoroughly on the south side of the bridge as the north side. The west arch rib has minor to moderate section loss on several rivet heads and there are areas with section loss on the top and bottom flanges of the arch rib. There are some empty bolt holes or rivet holes at the top of several spandrel columns on both the west and east faces. Furthermore, there is minor to moderate corrosion and pack rust along the corners and the interior angles of several spandrel columns.

There are isolated areas of paint peeling on the web of the arch ribs with minor corrosion and paint failure and there is moderate corrosion on the top plate and bottom flanges. Debonding of the steel protective system continues to advance and there are new locations with early stages of corrosion. In general, the west arch rib is in worse condition than the east arch rib mainly due to the free flow of water spilling over the pedestrian walkway and the lack of a drainage system on the west side of the bridge (note that a gutter was recently installed).

Spandrel girders are in good condition but there are isolated areas of paint peeling with minor corrosion on the web and bottom side of the top flanges. In addition, there is moderate corrosion and pack rust between the bottom flange plates of numerous spandrel girder splice connections particularly on the west side. Similar to the arch ribs, the west spandrel girder is in worse condition than the east spandrel girder due to water runoff. The east spandrel girder has minor impact damage at the bottom flange angle between the skewback column and pier column on the north end and the arch rib also has impact damage.

In general, paint failure and moderate to heavy corrosion with section loss exists on the outrigger beams particularly on the west side; there is also moderate corrosion and pack rust / distortion at the bottom channel connection to the columns. Typical rotational distortion of the outriggers, particularly on east side was observed. In the interior, there are several locations where the floor beams are missing a bolt at the top bracket connection to the spandrel girders and also there are isolated locations with impact damage on the bottom flange angle.

Stringers are in good condition but there are areas of paint peeling and corrosion on the top and bottom flanges particularly at stringers 1 and 6 (on the east and west sides of the bridge). The stay-in-place forms are cut out and damaged at several locations with one area haphazardly supported by timber shoring. Additionally, leaching and efflorescence is present along the top flanges of the stringers and spandrel girders.

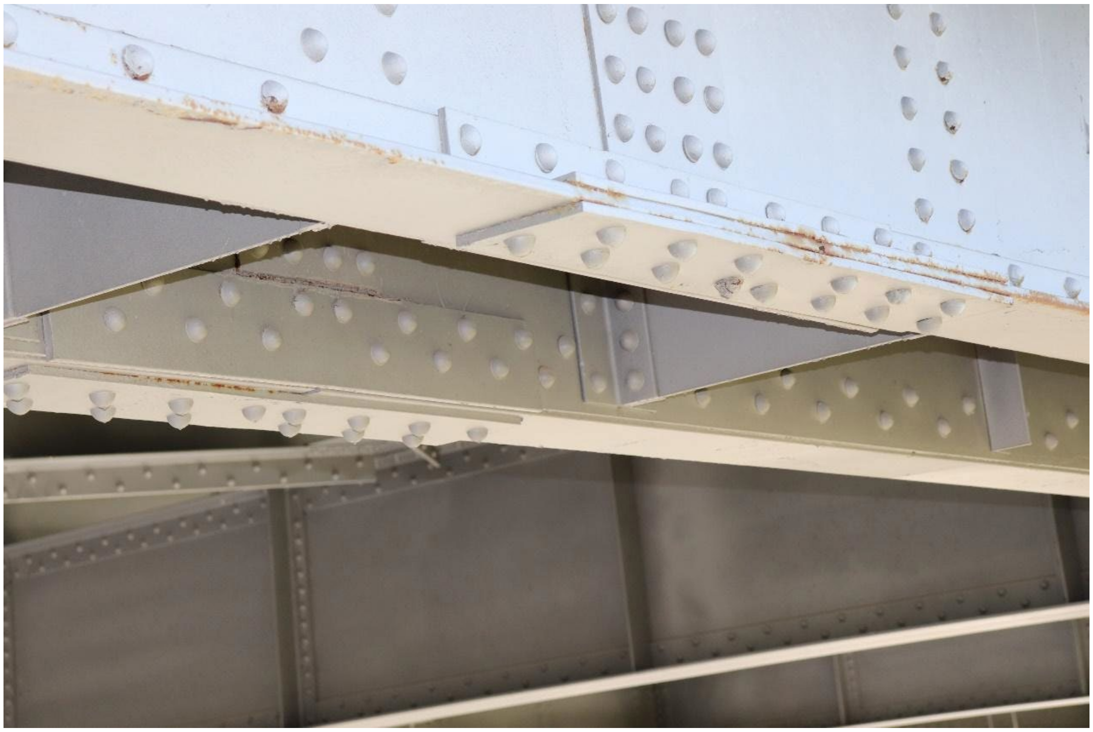
See pictures LANL 17 - LANL 29 for defects identified on the superstructure.

Overall, the superstructure is rated in fair condition. Element level data for the steel arches (NBE 141), steel columns (NBE 202), steel spandrel girders (NBE 107), steel floor beams including outriggers (NBE 152), and steel stringers (NBE 113) are attached at the end of this report. Data for the steel protective coating (BME 515) for all steel members are also provided.

(a)

(b)

LANL 17: Paint failure on spandrel girder and missing bolts / poor welds at channel connection to spandrel column (2011).



LANL 18A: Corrosion / pack rust on BF splice connection at west spandrel girder (2014).

LANL 18B: Paint failure / corrosion on west outrigger TF at south abutment (2014).

(a)

(b)

LANL 19: Moderate paint peeling on spandrel girder and column (2018).

(a)

(b)

LANL 20: Moderate paint peeling on arch rib (2017).

(a)

(b)

LANL 21: Pack rust at spandrel column to arch rib connections (2018) and corrosion on top flange of arch rib (2017).

(a)

(b)

LANL 22: Heavy corrosion at top of spandrel columns (2017).

(a)

(b)

LANL 23: West arch rib (typical): paint failure / corrosion of top plate and paint peeling on web.

(a) East arch rib (typical): minor paint peeling on web

LANL 24: (b) West spandrel girder (typical): paint peeling on web and minor corrosion

(a) East spandrel girder: impact damage to bottom flange angle (2012)

LANL 25: (b) Arch rib: impact damage to top plate (2018)

(a) West outrigger beam (typical): paint failure / moderate corrosion of beam and corrosion / pack rust / distortion at bottom channel connection to column

LANL 26: (b) West outrigger beam (typical): paint failure / heavy corrosion of beam and corrosion / pack rust / distortion at bottom channel connection to column (2013)

(a) Stringer: note leaching, paint failure, and corrosion at top flange

LANL 27: (b) Stay-in-place forms: note haphazard support by timber shoring

(a) Distortion (typical) of outriggers (2016)

LANL 28: (b) East Arch, typical paint peeling/cracking and surface corrosion on top flange

(a) East arch, column 14, 1/16” pack rust at base

LANL 29: (b) East arch, column 8, knee brace at floor beam 15, outside face, typical corrosion

SUBSTRUCTURE NBI ITEM 60 CONDITION RATING – POOR {4}

ABUTMENT CONDITION

Overall, the substructure is rated in poor condition. Element level data for the reinforced concrete abutments (NBE 215) with concrete protective coating (BME 521) and movable bearings (NBE 311) on the north and south ends of the bridge are attached at the end of this report.

South Abutment (#1): The back wall and breast wall were previously sealed with a concrete protective coating but there is significant cracking and peeling. Horizontal cracks exist below the bridge seat and extend the full width and almost the full height of the breast wall. The top front edge of the bridge seat is delaminated continuously between the bearings. Leaching observed throughout the breast wall with rust staining (evidence of reinforcement corrosion) and buildup of efflorescence. See picture LANL 30. The efflorescence has advanced at several cracks and the concrete protective coating has debonded on the breast wall and bridge seat exposing the original concrete which has resulted in spalling of original concrete and exposed rebar. Spalls greater than 1 in. deep and 6 in. diameter are present, and the exposed rebar has section loss. See pictures LANL 31 and LANL 32.

Soil has accumulated at the east and west bearings and the masonry plates are corroded with paint failure. At the southwest location, the bearing was realigned and the keeper plate was replaced previously (between 08/06/14 and 08/13/14); both elements were also previously repainted. See pictures LANL 33 and LANL 34. Pack rust and section loss is present at the east and west bearings and some wearing on the masonry plates has occurred. The protective coating on the bottom of the southwest bearing and the baseplate on the southeast bearing is no longer effective. See picture LANL 35 and LANL 36. The anchor bolts are in contact with the bearing device due to transverse movement in the east direction. See picture LANL 33.

North Abutment (#2): Abutment was previously sealed with a concrete protective coating which has significantly debonded throughout the length of the breast wall and on the bridge seat resulting in exposure of the original concrete surface and leaching. The debonded areas vary in size. See picture LANL 37. On the east side, debonding was observed on the back wall along with map cracking, leaching, and spalling (greater than 1 in. deep, 6 in. diameter) of the breast wall. Overall, adhesion of protective coating to original concrete is poor and debonding continues. Bridge seat has soil accumulation, the bearing elements are corroded with paint failure, and pack rust is present at east and west bearings. There is section loss on the base plate on the northwest bearing and the protective coating is no longer effective.

Map cracking exists on the east and west sides of the back wall. Cracks in the west wingwall and the east side of the back wall have been sealed with epoxy. The steel top plate just under the expansion joint has cracked through the full thickness between stringers 3 and 4 (initially observed in 2006) and corrosion is evident at the crack and front edge of the plate. See picture LANL 38. East side of the breast wall has undermined and the asphalt landing at the top of the slope continues to erode. See pictures LANL 39 and LANL 40. Minor settlement of the west end of the bridge seat is evident.

Periodic cleaning and repainting of the bearing elements and ultrasonic testing of the pins is recommended.

LANL 30 (IMG_0911)

LANL 31 (IMG_0913.jpg)

LANL 32 (IMG_0914.jpg)

LANL 33 (IMG_0916.jpg)

LANL 34 (IMG_0917.jpg)

LANL 35 (IMG_0919.jpg)

LANL 36 (IMG_6264.jpg)

LANL 37 (IMG_0896.jpg)

LANL 38 (IMG_0897.jpg)

LANL 39 (IMG_0898.jpg)

LANL 40 (IMG_0899.jpg)

PIER CONDITION

Overall, the substructure is rated in poor condition. Element level data for the reinforced concrete columns (NBE 205), movable bearings (NBE 311), fixed bearings (NBE 313), and other bearings (NBE 316) are attached at the end of this report.

South Pier Columns (#1)

East Concrete Column	
Location	Notes/Comments
North Face	- 24” x 12” spall has been patched on 55” to 61” exposed face - Map cracking up to 0.010” wide at 9” spacing
South Face	- Two small spalls on corners of 28” to 33” exposed face plus map cracking (0.007” wide) and single vertical crack (0.013” wide) - 7 in. spall on SE corner
East Face	- Minor scaling plus map cracking (0.009” wide at less than 6” spacing) on 29” to 55” exposed face - 7 in. spall on SE corner

	- 6” x 6” delamination near center of face
West Face	- 36” to 61” exposed surface - Minor rust staining from form steel - Minor horizontal and vertical cracking 0.013” wide
Top Face	- Bolts not fully engaged - Moderate scaling with cracks on chamfers (extend into vertical faces) - Pack rust under bearing and above masonry plate - Minor paint peeling and 100% corrosion of masonry plate on west side plus 50% corrosion on bottom of concave surface over plate length (otherwise coating is sound) - Pitting on east and west sides of masonry plate (more on west side likely through full width) - Section loss on masonry plate at bearing contact area - Cracks up to 0.02” wide at approximately 12” spacing

West Concrete Column	
Location	Notes/Comments
North Face	- 50” to 65” exposed surface with map cracking - 9” wide x 18” long x ½” deep spall and map cracking up to 0.016”
South Face	- Minor scaling - 6” diameter spall - 0.01” vertical crack - Map cracking (0.007” wide at 8” spacing) - Exposed surface continues to increase due to erosion (22” to 40”)
East Face	- 43” to 67” of exposed surface with minor scaling - Map cracking up to 0.010” - Honeycombing on NE corner - Vertical crack extending ¾” depth of pedestal with leaching and minor rust staining
West Face	- 26” to 45” exposed surface - Minor rust straining from form steel - Minor abrasion - Minor horizontal and vertical cracking 0.013” wide
Top Face	- Bolts not fully engaged - Moderate scaling with cracks on chamfers (extend into vertical faces) - Pack rust under bearing and above masonry plate - Minor paint peeling and 100% corrosion of masonry plate on west side plus 50% corrosion on bottom of concave surface over plate length (otherwise coating is sound) - Pitting on east and west sides of masonry plate (more on west side) - Section loss on masonry plate at bearing contact area - Cracks up to 0.02” wide at approximately 12” spacing

South Pier Columns (#2)

East Concrete Column	
Location	Notes/Comments
North Face	- 9’-9” exposed face has minor scaling and map cracking (0.013” wide)
South Face	- Minor scaling plus map cracking (0.020” wide at 6” spacing)
East Face	- Minor scaling and map cracking up to 0.020” (primarily towards top) - Single vertical crack (0.020” wide) down 36” from top
West Face	- 7’ to 11’-6” exposed face has two vertical cracks (0.016” wide) down 12” from top, and minor scaling and map cracking up to 0.013” (primarily towards top) - Horizontal crack at mid-height
Top Face	- Moderate cracking, 0.020” wide (extends into vertical faces about 6 to 8 in.) - Fixed bearing coating sound, all bolts in place - Corrosion on base of nut on masonry plate with section loss - Freckled rust on base of masonry plate

West Concrete Column	
Location	Notes/Comments
North Face	- Moderate scaling plus map cracking (up to 0.025” wide) - Rust staining due to formwork - Efflorescence on west corner - 114” to 120” exposed face
South Face	- 57” to 60“exposed surface with moderate scaling and map cracking (0.013” wide) sealed with epoxy - Horizontal cracks (0.060” wide) and delamination towards top extending 3/4 the width of the column - Epoxy seal broken at several crack locations
East Face	- Moderate scaling towards top and minor scaling towards bottom - Cracks sealed with epoxy showing through (up to 0.030”) - Map cracking towards top (0.010” – 0.030” at 4” spacing) - Vertical crack (0.030” wide) extending approximately 36” down - Epoxy seals broken - 71” to 113” exposed face
West Face	- Moderate scaling towards top and minor scaling towards bottom - Cracks sealed with epoxy showing through - Map cracking (up to 0.016” wide) - Efflorescence forming at crack locations - Staining near the top of the column - SW corner delamination 10” x 8” - NW corner spalling (approximately 12”) with delamination under spall - 59” to 106” exposed face
Top Face	- Moderate to heavy scaling (more on west and south region) - Cracking and delamination on north and south regions - Delaminations spalling - Rust staining originating from anchor bolts on west side, minor section loss on nuts - Fixed bearing coating sound with some isolated peeling and staining

	- Corrosion extends to bottom of column including rivets - Epoxy seal broken - Staining towards top from masonry plate - Map cracking more significant towards top - Cracking towards edge (0.025” wide)

North Pier Columns (#3)

East Concrete Column	
Location	Notes/Comments
North Face	- 0” to 25” exposed face with 4” x 4” spall approx. 8” from NW corner - Hairline map cracking (0.002” wide)
South Face	- Map cracking on 32” to 55” exposed face (less than 6” spacing and 0.020” wide) - Minor spalls (1”x1”) - Vertical cracks 0.016” at < 6” spacing
East Face	- Map cracking (0.007” wide) plus full-depth vertical crack (0.010” wide) on 0” to 32” deep exposed face - Horizontal cracks up to 0.016” at SW corner - Pin paint no longer effective on east side
West Face	- Map cracking on 32” to 55” exposed face - Two full-height vertical cracks at 12” spacing and 0.010” wide with leaching - Small spalls along vertical cracks with staining
Top Face	- Moderate to heavy scaling - Several spalls measuring 4” x 4” to 6” x 6” exposing square rebar - Minor corrosion around perimeter of masonry plates and anchor bolts - Paint starting to pull away from plate - Metal exposed with surface rust - Pop-outs on chamfer

West Concrete Column	
Location	Notes/Comments
General	- Cracks sealed previously are worse on west side; map cracking; horizontal cracking from 10”-12” down and around south face - Scaling on top surface (aggregate exposed) - Corrosion with section loss on bolts and masonry plate - Column has some pack rust on transition to support
North Face	- Minor scaling and map cracking up to 0.040” up to 0.050” with leaching at crack locations on 8” to 24” exposed face - Horizontal crack approx. 12” down with leaching (continues around to south face) - Spall near bottom middle of exposed face and a crack approximately 4” to the left of the spall

	- Cracks previously sealed
South Face	- Minor scaling and map cracking up to 0.020” on 65” to 69” exposed face - Scaling top west corner - Staining on bottom center; 6”x6” delamination on west side toward top - Spall bottom center 6”x6”
East Face	- Minor scaling and map cracking up to 0.012” wide at 12” spacing with leaching at crack locations on 34” to 62” exposed face
West Face	- Minor scaling and map cracking up to 0.025” wide (at 8” spacing horizontally and 4” vertically) with leaching at crack locations on 36” to 67” exposed face - Horizontal crack 0.023” wide extending from north to south face
Top Face	- Moderate scaling and cracking (0.030” wide at 6” spacing, extend into vertical faces) - 4” x 4” spall on NW corner of masonry plate - Heavy corrosion around perimeter of masonry plates and anchor bolts (coating is sound)

North Pier Columns (#4)

East Concrete Column	
Location	Notes/Comments
North Face	- Covered with soil (not visible)
South Face	- 10” exposed face with map cracking - 0.030” crack on SE corner
East Face	- 0” to 6” exposed face with map cracking - Crack on south corner from spall on top face
West Face	- Partially exposed with map cracking - Cracks near anchor bolts - Minor scaling
Top Face	- Minor scaling and map cracking up to 0.030” wide at 12” spacing - Anchor bolts do not extend fully through top nuts - Minor corrosion around perimeter of masonry plates and anchor bolts - Spall on SE corner with cracks down south and east faces up to 0.040”

West Concrete Column	
Location	Notes/Comments
North Face	- Covered with soil (not visible)
South Face	- 7” to 13” exposed face with map cracking
East Face	- Covered with soil (not visible) - Minor crack on NE corner with small spall of less than 6”
West Face	- 3” to 13” exposed face with map cracking - Minor undermining of SW corner - Riprap added to help prevent erosion
Top Face	- Minor scaling and map cracking up to 0.030” wide at 10” spacing - East anchor bolt does not extend through top nut - Minor corrosion around perimeter of masonry plates and anchor bolts

	- Protective coating is sound - Small spall on SE corner - Fretting corrosion around pin - Pack rust at bearing/masonry plate

* NOTE: Rip-rap and netting installed to control erosion on the embankment near west concrete column

South Skewback Columns (#1)

East Concrete Column	
Location	Notes/Comments
General	- Top half concrete finish not effective
North Face	- Moderate cracking visible in the concrete finish - Protective coating debonding towards base - 30% debonding toward top of finish - Rust staining at top end - 0.020” to 0.050” vertical cracks at 11” spacing (40% of height) – cracks in line with anchor bolt - Efflorescence - Small spall near top 6” x 6” - Abrasion with exposed aggregate on original concrete (1’ x 1’ + 1’ x 2’ + 1’ x 1’) at top of column
South Face	- Moderate cracking visible in the concrete finish up to 0.060” - Map cracking at about 1’ spacing (0.040” - 0.050” wide) - Two cracks starting at top end from bolts (entire height) - 2’ x 2’ delaminated patch at base of seal has spalled - Variable sounding - Efflorescence along vertical cracks - Debonding of concrete finish - Delamination near mid-height 12” x 12”
East Face	- Moderate cracking visible in the concrete finish - Scaling of finish - Map cracking (0.030” wide) approx. 8’ from top - Debonding of finish toward top (10%)
West Face	- Moderate cracking visible in the concrete finish - Scaling and debonding (30%) of finish about half the depth - Vertical crack at center of face (full-depth, at least 0.060” wide) – possible initiation of delamination - 2 full depth cracks 12” apart - Surface concrete finish debonding - Entire column has abrasion with exposed aggregates (loss of aggregates) - Finish is bubbling and trapping moisture, has some efflorescence
Top Face	- Not visible

	- Minor rust staining visible towards top of vertical faces (possibly originating from top face)

* NOTE: Erosion cavity (6' x 4') on southwest corner of column exposing bare concrete

West Concrete Column	
Location	Notes/Comments
North Face	- Moderate cracking visible in the concrete finish - Scaling and debonding (25%) of finish near top and middle of column - Rust staining at top end; 0.060" wide crack at middle of pier over full height (debonding along length of crack) - Heavy vegetation surrounding column - Original concrete exposed - Spalling (8" x 6") - Discoloration on top - Tree growing on NW side
South Face	- Cracking in the concrete finish - Scaling, bubbling, and debonding (100%) of finish (along with rust staining) - Vertical crack on bottom half of height - Two vertical cracks (greater than 0.060" wide) - Larger cracks near top and bottom - Efflorescence on surface finish and concrete - Separate concrete castings - Concrete abrasion (approximately 4 ft^2)
East Face	- Cracking visible in the concrete finish - Scaling of finish (debonding along height) - Two major cracks at middle of pier over full height (0.060" wide) approximately 1.5' apart - Vertical crack 0.030" full height - Scaling/debonding of finish with rust staining near top - Concrete exposed with exposed aggregate near mid-depth with efflorescence - Efflorescence is concentrated near debonded areas (more towards bottom) - 12 sq ft delamination and 3 sq ft of spalling
West Face	- Moderate cracking in the concrete finish - Two full-height vertical cracks (up to 0.060" wide) plus initiation of map cracking - Debonding (5%) of surface concrete finish over height - Exposed concrete in isolated areas - Bubbling of surface coating - Staining on lower ¼ of pier
Top Face	- Not visible - Minor rust staining visible towards top of vertical faces (possibly originating from top face)

South Arch Abutments/Fixed Bearings/East
Notes/Comments
- Rust on exposed masonry plate (5%)

- No surface concrete finish on abutment - Bearing covered with soil/debris on west side and east side - Pack rust between arch and bearing

South Arch Abutments/Fixed Bearings/West
Notes/Comments
- Minor corrosion (approximately 25%) on inside plates - No surface concrete finish on abutment - Map cracking (0.020" wide) at approximately 8" spacing - Delamination of east side, 24"x12" with efflorescence - Bearing partially covered with soil/debris on west side and east side - Lower half of plate not visible - Cover plate to bearing plate loose

North Skewback Columns (#2)

East Concrete Column	
Location	Notes/Comments
General	- Majority of cracks on top half of column (most have previously been sealed, cracks exposed through seal) - Edges of cracks have small "spalls"
North Face	- Minor to moderate cracking - Abrasion on bottom half and discoloration over full height - Moderate scaling - Cracks sealed with epoxy near top (1' spacing) but showing through seal - Map cracking (0.016" wide) on top ¾ of column height - 4" x 5" delamination at 4' of height at NW corner - Exposed aggregate (abrasion) on corners
South Face	- Light scaling - Effective patched spall at top end (4'x4') - Map cracks (0.020" wide at 12" spacing) over full height - Small aggregate pop-outs near bottom (approximately 1") - Resurfaced area (3'x3') toward top in good condition - Reeling along edges of patch (pop outs near bottom of patch) - Sealed towards bottom, starting to honeycomb with exposed aggregate - Patch with honeycombing near bottom (delamination 6" x 6" near bottom)
East Face	- Moderate map cracking (0.016" – 0.020" wide at approximately 12" spacing) over full height - 12" x 12" spall has been patched, cracks forming along edge of patch and spalling of patch on top corner - Sealed cracks showing through epoxy - Two spots of corrosion near bottom (form steel) - Abrasion with pop outs and abrasion at corners

West Face	- Moderate map cracking (0.020" wide between 9" and 12" apart) and scaling - Cracks sealed with epoxy and extend full height - Cracks propagated through epoxy
Top Face	- Not visible

* NOTE: North-West corner has small delamination

West Concrete Column	
Location	Notes/Comments
General	- Crack widths increase starting at mid-height - Sealed ~ 3' near top - Cracks showing through
North Face	- Vertical cracks extend full height (0.016" – 0.040" wide and spaced at 8" - 12" apart) and horizontal cracking at mid-height - Moderate cracking (top end sealed similar to abutment) - Vertical crack 0.016" – 0.030" wide near west edge of north face - Efflorescence (continues to advance) approximately 1/8 of height near west face - Concrete seal has cracks near top - Cracking is towards west side (>0.050") but is only on north face
South Face	- Light scaling - Vertical cracks extend full height (0.016" wide at 12" spacing) - ~ 6' from top, horizontal crack extends 2/3 of width - Abrasion visible on west side, bug holes/pop outs - Staining caused by corrosion on steel column - Delamination on the skewback (3" x 3") [might be top cover concrete only] - Cementitious coating approximately 50% effective
East Face	- Light scaling toward bottom and moderate map cracking (0.010") - Top sealed (3' height) - Vertical cracks extend full height (0.025" wide spaced 6" apart) - Top, east side has delaminations that extend down
West Face	- Vertical cracks (0.020" wide) extend full height (spaced at about 4" - 6") - Efflorescence at cracks near top; map cracking 2" – 4" apart, build up is visible - Abrasion in chamfer area with exposed aggregates but aggregate still secure (near areas with efflorescence) - Moderate crack on NW corner – 0.040" wide - Debonding of concrete with >1" wide spall (horizontal) on top region in line with rebar Horizontal crack approximately 6" down from top discolored leaching, possible exposed rebar - Spalling on chamfer area (4.5' long)
Top Face	- Not visible

North Arch Abutments/Fixed Bearings/East
Notes/Comments
- Map cracking at 6" spacing (0.020" – 0.025" wide) - Erosion on east side exposing unpainted concrete

- Honeycombing (exposed aggregate) at top of east side (1’ x 4’) near top and west side (3’x8”) and 3’x4” along top edge - Surface concrete finish good (on abutment and bearings) - Starting to flake in isolated areas (~ 5’ x 5’) - Pack rust between bearing and arch rib - Stains extend to concrete bearing - Two bolts on topside not fully engaged with nuts - Delamination on west side of masonry plate (18”x12”) - Delamination on east side of skewback (3’x6”) - Honeycombing with exposed aggregate (in line with delamination) - Bottom of masonry plate has corrosion with section loss - Top concrete finish spalling off - NE corner – delaminations with initiation of spalling - Corrosion around perimeter - Arch rib is in contact with west side of bearing - Top cover plate a bit loose

North Arch Abutments/Fixed Bearings/West
Notes/Comments
- Map cracking at about 4” – 6” spacing (0.009” – 0.030” wide) - Honeycombing and abrasion (6”x6”) - Surface concrete finish moderate (on abutment and bearings) - Starting to peel - Pack rust between bearing and arch rib - Corrosion around masonry plate - Staining extends to concrete - Section loss on masonry plate - Isolated corrosion of base metal (about 1%) - Protective top plate has corrosion - More staining and corrosion than east side (due to more water runoff; observed in rain) - 6” x 6” spall on east side with delamination (6”x6”) - 12” x 6” spall on west side of masonry plate - Efflorescence on west side cracks - Leaching (approximately 36 ft^2) - Cracks larger on the west side - Protective finish on west face in good condition, moderate on east side - Erosion has exposed bare concrete around base (no surface protective finish on west side and front of skew back) - Concrete spall at bottom of masonry plate - Abrasion throughout - Honeycombing on south face (1’x6’) - Staining extends from bearing to the concrete at bottom of masonry plate - Arch rib in contact with east side of bearing

LANL 41 (IMG_5969.jpg)

LANL 42 (IMG_5938.jpg)

LANL 43 (IMG_9962.jpg)

LANL 44 (IMG_0026.jpg [2021], IMG_0788.jpg [2019])

LANL 45 (IMG_9824.jpg)

LANL 46 (IMG_9827.jpg)

LANL 47 (IMG_0095.jpg) [2017]

CULVERT NBI ITEM 62 CONDITION RATING – {N/A}

Not applicable.

APPROACH ROADWAY ALIGNMENT NBI ITEM 72 ADEQUACY RATING – {6}

APPROACH ROADWAY CONDITION

In general, the transitions between approaches and bridge deck experience impact loading due to vertical / horizontal alignment and use of roadway equipment (e.g., snow plows). Horizontal curve at N and S approaches, minor speed reduction required.

At the north approach roadway, minor defects and deterioration (longitudinal cracks on the southbound / northbound lanes and transverse cracks adjacent to the expansion bearing) were observed on the roadway. There are spalls and delaminations on the header near the expansion joint. See pictures LANL 48 through LANL 51. The grate openings for drainage on the east and west sides had minimal debris.

* NOTE: the north approach roadway was repaved / restriped before the 2021 inspection and the expansion joint was replaced during the 2022 inspection.

At the south approach roadway, longitudinal cracks are present between lanes. Some spalling of the asphalt has occurred and there are several spalls and delaminations near the header and joint. During previous inspections, free flow of water through the joint was observed as it rained. See pictures LANL 52 through LANL 55. The grate openings for drainage have minor debris accumulation on the east and west sides.

* NOTE: the south approach roadway repaving was completed in 2018 and the expansion joint was replaced during the 2022 inspection.

Element level data is not applicable to the approach roadway.

LANL 48 (IMG_0547.jpg)

LANL 49 (IMG_6330.jpg)

LANL 50 (IMG_6350.jpg)

LANL 51 (IMG_6360.jpg)

LANL 52 (IMG_0693.jpg) (2021)

LANL 53 (IMG_0618.jpg) (2021)

LANL 54 (IMG_0623.jpg) (2021)

LANL 55 (IMG_7210.jpg)

TRAFFIC SAFETY FEATURES NBI ITEM 36 CONDITION RATING – {1111}

BRIDGE RAIL CONDITION

In general, the concrete barrier rails (CBRs) on the east and west sides of the bridge have vertical, horizontal, and map cracks with isolated areas of traffic damage. Additionally, there are several delaminations on the CBR that were repaired as part of the rail maintenance. The previously noted delaminations were near the original connections to the steel railing. The vertical cracks are concentrated near the drain holes at the bottom of the CBR and extend the full thickness of the CBR. The metal rails were replaced prior to the 2022 inspection. See pictures LANL 56 and LANL 57.

Note: Prior to the replacement, the brackets attaching the steel rails to the CBRs had moderate to heavy corrosion (on the side of the brackets exposed to vehicular traffic) along with paint failure; anchor bolts were also missing on the bracket connections at several locations. The concrete had spalled under the connection plates at several locations. At the west bridge rail, collision damage was previously found (consisting of severe cracking, delamination, and spalling) at a location adjacent to the north end of the pedestrian fencing and a longitudinal crack in the rail towards the south end. See pictures LANL 58 and LANL 59. At the east bridge rail, there was a large spall (measuring greater than 1 in. deep and greater than 6 in. diameter), a horizontal crack with delamination, and major scaling at the bottom half of the CBR located along the length of the pedestrian fencing. The bridge rail also had scrape marks with moderate corrosion on the north and sound ends and major corrosion on the south side of the pedestrian fencing. See pictures LANL 60. The steel bridge rail on the east side of the roadway was in worse condition than the west side.

In the element level data attached at the end of this report, the bridge rails located on the east and west sides of the roadway were separated based on material. The reinforced concrete bridge railing (NBE 331) corresponds to the CBRs located on both sides of the roadway. The metal bridge railing (NBE 330) corresponds to the steel pipe rails attached to the top of the CBRs. In addition, a metal bridge rail was used to describe the rail located on the west side of the pedestrian walkway. Furthermore, data for the steel protective coating (BME 515) for the metal bridge railings are provided.

LANL 56 (IMG_6362.jpg)

LANL 57 (IMG_6379.jpg)

LANL 58 (IMG_0722.jpg) (2021)

LANL 59 (IMG_0732.jpg)

LANL 60 (IMG_0732.jpg)

LANL 60 (IMG_0539.jpg) (2021)

APPROACH GUARDRAIL CONDITION

The approach guardrails consist of a steel guardrail with timber blockouts on timber posts or rubber blockouts on steel posts.

Prior to the 2022 inspection, **the north approach guardrail** had been repaired in response to a critical finding reported in 2021 for safety reasons. See pictures LANL 61 through LANL 63. The northeast guardrail is in good condition. See pictures LANL 64 and LANL 65.

At the south approach guardrail, there is collision damage. The steel guardrail is distorted and some timber posts are split along their height and/or deformed at the base. Spalling and damage is present near the joint on the east CBR. Significant corrosion with large cracks was noted near the joint on the steel rail on top of the CBR. See pictures LANL 66 through LANL 69.

Element level data is not applicable to the approach guardrails.

LANL 61 (IMG_7147.jpg)

LANL 62 (IMG_6190.jpg)

LANL 63 (IMG_6193.jpg)

LANL 64 (IMG_6324.jpg)

LANL 65 (IMG_6334.jpg)

LANL 66 (IMG_7143.jpg)

LANL 67 (IMG_7200.jpg)

LANL 68 (IMG_7201.jpg)

LANL 69 (IMG_7198.jpg)

FRACTURE CRITICAL MEMBERS NBI ITEM 92A CODE – **Y12**

Spandrel girders are in good condition but there are isolated areas of paint peeling with minor corrosion on the web and bottom side of the top flanges. In addition, there is moderate corrosion and pack rust between the bottom flange plates of numerous spandrel girder splice connections particularly on the west side. Similar to the arch ribs, the west spandrel girder is in worse condition than the east spandrel girder due to water runoff. The east spandrel girder has minor impact damage at the bottom flange angle between the skewback column and pier column on the north end and the arch rib also has impact damage.

In general, paint failure and moderate to heavy corrosion with section loss exists on the outrigger beams particularly on the west side; there is also moderate corrosion and pack rust / distortion at the bottom channel connection to the columns. Typical rotational distortion of the outriggers, particularly on the east side was observed. In the interior, there are several locations where the floor beams are missing a bolt at the top connection to the spandrel girders and also there are isolated locations with impact damage on the bottom flange angle.

CHANNEL AND CHANNEL PROTECTION NBI ITEM 61 CONDITION CODE – **N**

Not applicable.

SCOUR CRITICAL NBI ITEM 113 STATUS CODE – **N**

Not applicable.

UNDERWATER INSPECTION NBI ITEM 92B CODE – **N**__

Not applicable.

COMPLEX BRIDGE FEATURES

Not applicable.

UTILITIES AND ANCILLARY STRUCTURES

Utilities and ancillary items include fencing installed on the pedestrian rail (includes panels spanning the gaps between the individual rails and a raised section on the 150 ft portion center portion of the bridge length), light poles, and electric and steam utilities. During the 2022 Routine Inspection, a few damaged areas of fencing were found on the panels and raised section. The light poles and supports have light to heavy corrosion. Inspection of the utilities requires the use of the under-bridge access unit and thus, was not performed due to postponement of the FCM Inspection.

Recommendations and Cost Estimates

ID	Recommendation	Priority	Estimated Cost	Consequence of Delay	Date	
					Recommended	Complete
Priority 2						
-----	Install drainage system on west side of pedestrian walkway	2	-----	Advanced corrosion of bridge elements on west side	-----	2022

-----	Repair north approach guardrail	2	-----	Traffic accident / vehicle impact	-----	
-----	Upgrade pedestrian rail to current standards	2	-----	Pedestrian traffic accident	-----	2022 (fencing installed)
-----	Repair / replace joints (as needed based on damage)	2	-----	Vehicular traffic accident & abutment deterioration	-----	2022
-----	Repair concrete at abutments	2	-----	Loss of load carrying capacity	-----	
-----	Install erosion protection for substructure	2	-----	Undermining of substructure elements	-----	
Priority 3						
-----	Repair / replace damaged fencing on pedestrian rail	3	-----	Pedestrian traffic accident	2022	
Priority 4						
-----	Repair corroded light poles	4	-----	Improper lighting / traffic accident	2022	
-----	Clean / repaint abutment bearings.	4	-----	Restricted bridge movement	-----	
-----	Repair deck locations with delaminations and spalls	4	-----	Advanced deterioration of concrete deck & rebar corrosion	-----	
-----	Remove debris at abutments	4	-----	Continued debris buildup / restricted bridge movement	-----	
-----	Repair concrete & repaint steel of bridge rails	4	-----	Traffic accident / vehicle impact	-----	2022
-----	Monitor substructure for soil erosion	4	-----	Undermining of substructure elements	-----	
-----	Monitor drainage at expansion joints	4	-----	Advanced abutment deterioration	-----	
-----	Repaint pedestrian rail	4	-----	Advanced corrosion of rail base plates & anchors	-----	2022
-----	Repair outriggers with significant loss of section	4	-----	Loss of load carrying capacity	-----	

-----	Repair collision damage to metal bridge rail (west side)	4	-----	Traffic accident / vehicle impact	-----	2022
-----	Perform ultrasonic testing of bearing pins	4	-----	Bearing failure due to internal defects	-----	
-----	Repaint superstructure	4	-----	Advanced corrosion of superstructure elements	-----	
-----	Monitor alignment between deck and approach roadway	4	-----	Continued problems with expansion joints	-----	
-----	Perform inspection of arch rib-to-column connections via rope access methods	4	-----	Inaccurate estimate of load carrying capacity	-----	2022
-----	Measure section loss on members with moderate to heavy corrosion	4	-----	Inaccurate estimate of load carrying capacity	-----	
-----	Monitor bridge movement under temperature changes	4	-----	Distress of expansion joints and bearings	-----	

Evaluation Summary

Evaluation	**Evaluation Status** *(Complete, Underway, Not Completed, N/A)*	**Date of Most Recent Evaluation**	**Comments**
Load Rating	Complete	10/18/2018	Rating values need updating based on 2018 BHI study
Scour Evaluation	N/A	-----	
Level 1			
Level 2/3			
Plan of Action			
Seismic Vulnerability	Not Completed	-----	
Initial Screening			
Traffic Volume Count	Not Completed	-----	
Fracture and Fatigue Evaluations	Not Completed	-----	

Load Rating

A load rating was completed for this bridge by Bohannan Huston, Inc. (BHI) that was documented in the report titled "Bridge Rating Report for Los Alamos Canyon Bridge over Omega Road, Bridge No. 7622" (dated October 18, 2018). Reported Inventory and Operating Load Rating values are HS15.0 and HS25.5, respectively, as determined based on the Load Factor (LF) Method. The 2018 BHI study was conducted based on the Load and Resistance Factor (LRFR) Method. Recommend the site update the load rating values in the Bridge File based on the results of the 2018 BHI study prior to the next inspection. Bridge is not load posted (open, no restriction) and this posting status concurs with the 2018 BHI study results.

Scour Evaluation

Not applicable.

Seismic Evaluation

A seismic evaluation has not been documented for this bridge. Recommend the site review required performance level, bridge importance, and anticipated service life and complete a seismic evaluation prior to the next inspection.

Vehicle Traffic Volume

A vehicle traffic volume count has not been documented for this bridge. Reported value for Average Daily Traffic is 8265. Reported value for the percentage that is truck traffic is 14%. Recommend the site confirm these values and add a justification for the values to the Bridge File or complete a vehicle traffic volume survey prior to the next inspection.

A vehicle traffic volume forecast has not been documented for this bridge. Reported Forecasted Average Daily Traffic value is "Unknown". Reported value for the Future Year is "N/A". Recommend the site complete an estimate prior to the next inspection.

Fracture and Fatigue Evaluation

A fracture and fatigue evaluation has not been documented for this bridge. Recommend the site complete an evaluation in accordance with the AASHTO Manual for Bridge Evaluation (Section 7) with attention to the spandrel girders, floor beams / outriggers, and connecting elements (i.e., fracture critical members) prior to the next inspection. The arch column-to-rib connections should also be considered in the evaluation.

Personnel Qualifications

The qualifications of inspection personnel is summarized for key individuals from NMSU, Collins Engineers Inc., and LANL.

Attachments

1. Structure Inventory and Appraisal Data Sheet
2. Table of Bridge Element Condition States
3. Deck Delamination Map
4. Personnel Qualifications Summary

Attachment 1 – Structure Inventory and Appraisal Data Sheet

Department of Energy
Structure Inventory and Appraisal Data

NBIS STRUCTURE NUMBER	000000000007622
FIMS SITE NAME	NNSA-Los Alamos National Laboratory - NNSA
FIMS PROPERTY NAME	Los Alamos Cayon Bridge
UNITS	ENGLISH
FIMS PROPERTY NUMBER	43-0434
FIMS REAL PROPERTY UNIQUIE ID (RPUID)	86471
INSPECTION DATE	09/23-25/2022
SCOUR CRITICAL PLAN OF ACTION IN PLACE	N/A

IDENTIFICATION

(1)	STATE NAME	New Mexico	CODE 356
(8)	STRUCTURE NUMBER		000000000007622
(5)	INVENTORY ROUTE (ON/UNDER)	ON	131005010
(2)	STATE HIGHWAY DEPARTMENT DISTRICT		05
(3)	COUNTY CODE	028	(4) PLACE CODE 35
(6)	FEATURES INTERSECTED		Los Alamos Canyon
(7)	FACILITY CARRIED		NM-501
(9)	LOCATION		Junction of NM-501/Omega Road
(11)	MILE POINT		4.5
(12)	BASE HIGHWAY NETWORK		1
(13)	LRS INVENTORY ROUTE & SUBROUTE NUMBER		0000NM050100
(16)	LATITUDE: 35°52'48"	LONGITUDE: 106°19'19"	
(98)	BORDER BRIDGE STATE CODE	N/A	% SHARE -
(99)	BORDER BRIDGE STRUCTURE NO		-

STRUCTURE TYPE AND MATERIAL

(43)	STRUCTURE-MATERIAL	Steel	3
	STRUCTURE-TYPE	Stringer/Multi Beam or Girder	02
(44)	APPROACH-MATERIAL	Steel	3
	APPROACH-TYPE	Stringer/Multi Beam or Girder	02
(45)	NUMBER OF SPANS IN MAIN UNIT		1
(46)	NUMBER OF APPROACH SPANS		6
(107)	DECK-TYPE	Concrete Cast-In-Place	1
(108)	WEARING SURFACE (PROTECTION SYSTREM)		
	A) TYPE OF WEARING SURFACE	Epoxy Overlay	5
	B) TYPE OF MEMBRANCE	None	0
	c) TYPE OF DECK PROTECTION	Unknown	8

AGE AND SERVICE

(27)	YEAR BUILT	1952	(106) YEAR RECONSTRUCTED 1992
(42)	TYPE OF SERVICE	ON Highway-Pedestrian	5
		UNDER Highway-Waterway	6
(28)	LANES	ON 4	UNDER 2
(29)	AVERAGE DAILY TRAFFIC (ADT)		
(30)	YEAR OF ADT	2022	(109) TRUCK ADT 3%
(19)	BYPASS, DETOUR LENGTH (Miles)		4.0

GEOMETRIC DATA

(48)	LENGTH OF MAXIMUM SPAN		442.9
(49)	STRUCTURE LENGTH		819.6
(50)	CURB OR SIDEWALK	(LEFT) 7.9	(RIGHT) 0.0
(51)	BRIDGE ROADWAY WIDTH CURB TO CURB		44.0
(52)	DECKWIDTH OUT-TO-OUT		55.5
(32)	APPROACH ROADWAY WIDTH W/ SHOULDERS		44.0
(33)	BRIDGE MEDIAN	No Median	0
(34)	SKEW (DEG)	0	(35) STRUCTURAL FLARED 0
(10)	INVENTORY ROUTE MINIMUM VERTICAL CLEARANCE		25.00
(47)	INVENTORY ROUTE TOTAL HORIZONTAL CLEARANCE		44.00
(53)	MIN VERTICAL CLEARANCE OVER BRIDGE ROADWAY		99.99
(54)	MIN VERTICAL UNDERCLEARANCE	H	17.75
(55)	MIN LATERAL UNDERCLEAR ON RIGHT	N	-
(56)	MIN LATERAL UNDERCLEAR ON LEFT		2.6

NAVIGATION DATA

(38)	NAVIGATION CONTROL	N/A (No Waterway)	N
(111)	PIER PROTECTION		
(39)	NAVIGATION VERTICAL CLEARANCE		0.00
(116)	VERT-LIFT BRIDGE NAV MIN VERT CLEARANCE		N/A
(40)	NAVIGATION HORIZONTAL CLEARANCE		0

STRUCTURE CONDITION AND RISK CLASSIFICATION

NBI CONDITION RATING		POOR
LOWEST CONDITION RATING CODE	SUBSTRUCTURE	4
ROUTINE INSPECTION INTERVAL RISK CLASSIFICATION		HIGH
UNDERWATER INSPECTION INTERVAL RISK CLASSIFICATION		N/A

CLASSIFICATION

(112)	NBIS BRIDGE LENGTH	YES	Y
(104)	HIGHWAY SYSTEM	Route NOT on the NHS	0
(26)	FUNCTIONAL CLASS	Urban Other Principal Arterial	14
(100)	DEFENSE HIGHWAY	Not a STRAHNET Route	0
(101)	PARALLEL STRUCTURE	NO Parallel Structure	N
(102)	DIRECTION OF TRAFFIC	2-Way traffic	2
(103)	TEMPORARY STRUCTURE		-
(105)	FEDERAL LANDS HWY	Not Applicable	0
(110)	DESIG NATIONAL NETWORK	Route is not part of the national network for trucks	0
(20)	TOLL	On free road	3
(21)	MAINTAINANCE	Department of Energy	79
(22)	OWNER	Department of Energy	79
(37)	HISTORICAL SIGNIFICANCE	Not determinable at this time	4

CONDITION

(58)	DECK	Fair	5
(59)	SUPERSTRUCTURE	Fair	5
(60)	SUBSTRUCTURE	Poor	4
(61)	CHANNEL AND CHANNEL PROTECTION	Excellent	9
(62)	CULVERTS	Not applicable	N

LOAD RATING AND POSTING

(31)	DESIGN LOAD	M18 (H20)	4
(63)	MTHD TO DETERMINE OR	Load Factor	1
(64)	OPERATING RATING		25.50
(65)	METHOD TO DETERMINE IR	Load Factor	1
(66)	INVERNTORY RATING		15.00
(70)	BRIDGE POSTING	Posting NOT Required	5
(41)	STRUCTURE STATUS	Open, No Restriction	A

APPRAISAL

(67)	STRUCTURAL EVALUATION	No Entry - Calculated by FHWA	
(68)	DECK GEOMETRY	No Entry - Calculated by FHWA	
(69)	UNDERCLEARANCE, VERTICAL & HORIZONTAL	No Entry - Calculated by FHWA	
(71)	WATER ADEQUACY	Superior to present desirable criteria	9
(72)	APPROACH ROADWAY ALIGHNMENT	Equal to present minimum criteria	6
(36)	TRAFFIC SAFETY FEATURES	[illegible]	1111
(113)	SCOUR CRITICAL BRIDGES	Foundation on Dry Land	9

PROPOSED IMPROVEMENTS

(75)	TYPE OF WORK	351
(76)	LENGTH OF STRUCTURE IMPROVEMENT	814.5
(94)	BRIDGE IMPROVEMENT COST	-
(95)	ROADWAY IMPROVEMENT COST	-
(96)	TOTAL PROJEECT COST	-
(97)	YEAR OF IMPROVEMENT COST ESTIMATE	-
(114)	FUTURE ADT	-
(115)	YEAR OF FUTURE ADT	-

INSPECTION

(90)	INSPECTION DATE		0922	(91) INSP FREQUENCY	12
(92)	CRITICAL FEATURE INSPECTION (CFI)			(93) CFI DATES	
	A) FRACTURE CRITIAL DETAIL	Y	12	A)	0621
	B) UNDERWATER INSPECTION	N	N/A	B)	
	C) OTHER SPECIAL INSPECTION	Y	36	C)	0922

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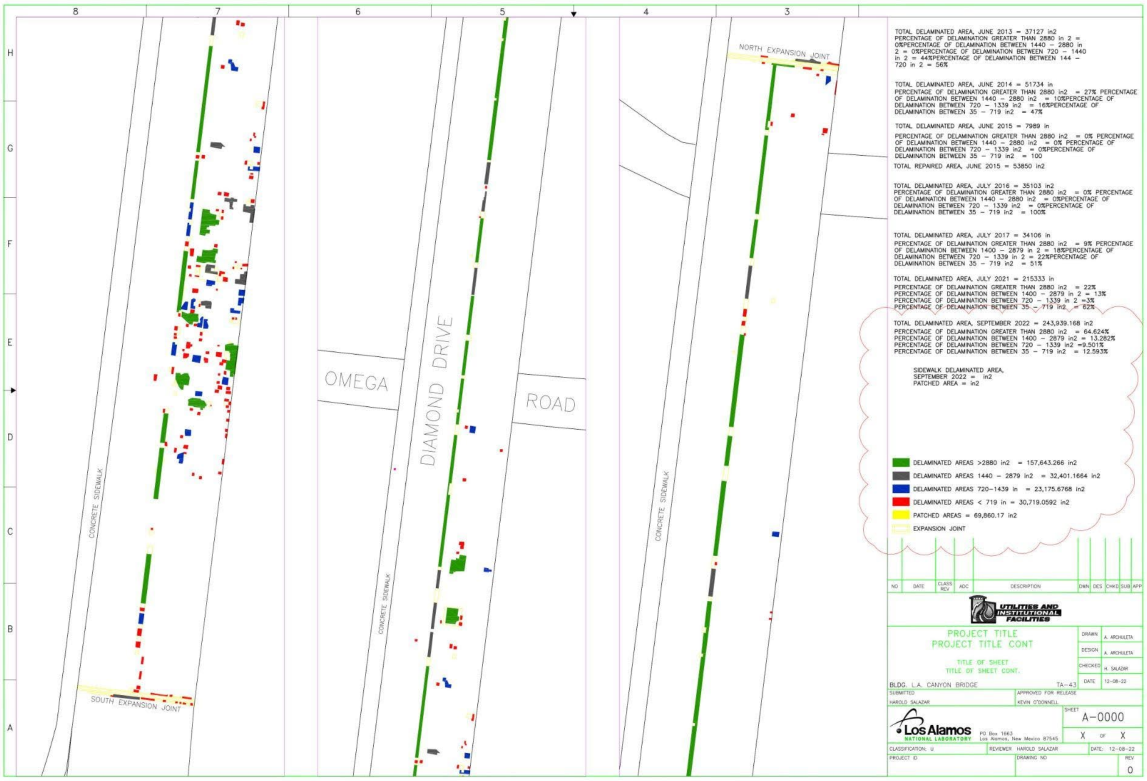
Attachment 2 - Table of Bridge Element Condition States

ELEMENT CONDITION								
Structure Number: 7622 - Omega Bridge @ Los Alamos								
Element	Element Description	Unit of	Total	CS1	CS2	CS3	CS4	Notes or other
12	Reinforced Concrete Deck	ft²	45487	43143	2316	28		
1080	*Delam/Spall/Patch*	ft²	1694		1684	8		
1090	*Exposed Rebar*	ft2	2		2			
1120	*Efflor/Rust*	ft²	20			20		
1130	*Cracking*	ft²	630		630			
521	Concrete Protective Coating	ft²	36675	36671		6		
3230	*Effectiveness*	ft²	36677	36671		6		
330	Metal Bridge Rail (E)	ft	837	795		42		East
1000	*Corrosion*	ft	42			42		
515	Steel Protective Coating	ft²	4703	4468		235		
3440	*Effectiveness*	ft²	235			235		
330	Metal Bridge Rail (W)	ft	837	788		49		West
1000	*Corrosion*	ft	42			42		
1010	*Cracking*	ft	7			7		
515	Steel Protective Coating	ft²	2741	2604		137		
3440	*Effectiveness*	ft²	137			137		
330	Metal Bridge Rail	ft	820	779		41		Pedestrian
1000	*Corrosion*	ft	41			41		
515	Steel Protective Coating	ft²	9454	8981		473		
3440	*Effectiveness*	ft²	473			473		
331	Concrete Bridge Rail (E)	ft	820		6	814		East
1080	*Delam/Spall/Patch*	ft	6		6			
1130	*Cracking*	ft	814			814		
521	Concrete Protective Coating	ft²	2964	2816		148		
3230	*Effectiveness*	ft²	148			148		
331	Concrete Bridge Rail (W)	ft	820		8	812		West
1080	*Delam/Spall/Patch*	ft	8		8			
1130	*Cracking*	ft	812			812		
521	Concrete Protective Coating	ft²	2964	2816		148		
3230	*Effectiveness*	ft²	148			148		
303	Assembly Joint Seal (N)	ft	56	48		8	0	North
2310	*Leakage*	ft	0					
2330	*Seal Damage*	ft	0					
2360	*Adj. Deck Header*	ft	8			8		
303	Assembly Joint Seal (S)	ft	56	49	3	4	0	South
2310	*Leakage*	ft	0					
2330	*Seal Damage*	ft	0					
2360	*Adj. Deck Header*	ft	7		3	4		
141	Steel Arch	ft	845	379	410	56		
1000	*Corrosion*	ft	466		410	56		
515	Steel Protective Coating	ft²	21754	14680	2894	4180		
3440	*Effectiveness*	ft²	7074		2894	4180		

Element	Element Description	Unit of	Total	CS1	CS2	CS3	CS4	Notes or other
107	Steel Open Girder - Spandrel	ft	1629	1498	104	27		
1000	*Corrosion*	ft	115		92	23		
1020	*Connection*	ft	14		10	4		
1900/7000	*Distortion/Damage*	ft	2		2			
515	Steel Protective Coating	ft²	45136	44826	250		60	
3410	*Chalking*	ft²	5		5			
3420	*Peeling*	ft²	285		245		40	
3440	*Effectiveness*	ft²	20				20	
152	Steel Floor Beams	ft	1442	1136	251	55		
1000	*Corrosion*	ft	267		212	55		
1020	*Connection*	ft	21		21			
1900/7000	*Distortion/Damage*	ft	18		18			
515	Steel Protective Coating	ft²	14634	14434	200			
3420	*Peeling*	ft²	200		200			
113	Steel Stringers	ft	4887	4643	244			
1000	*Corrosion*	ft	241		241			
1900/7000	*Distortion/Damage*	ft	3		3			
515	Steel Protective Coating	ft²	27256	26651	605			
3420	*Peeling*	ft²	605		605			
311	Movable Bearings	Each	8		2	6		
1000	*Corrosion*	Each	8		2	6		
313	Fixed Bearings	Each	8	4	2	2		
1000	*Corrosion*	Each	8	4	2	2		
316	Other Bearings	ft	4		4			
1000	*Corrosion*	ft	4		4			
215	Reinforced Concrete Abutment	ft	111	43	17	36	15	
1080	*Delam/Spall/Patch*	ft	5				5	
1090	*Exposed Rebar*	ft	4			4		
1120	*Efflor/Rust*	ft	45		7	28	10	
1190	*Abrasion/wear*	ft	14		10	4		
521	Concrete Protective Coating	ft²	334		184	80	70	
3520	*Peeling/bubbling*	ft²	334		184	80	70	
202	Steel Columns	Each	12		12			
1000	*Corrosion*	Each	12		12			
515	Steel Protective Coating	ft²	6623	6473	150			
3520	*Peeling/bubbling*	ft²	150		150			
205	Concrete Columns	Each	12	1	9	2		
1080	*Delam/Spall/Patch*	Each	5		4	1		
1130	*Cracking*	Each	7	1	5	1		

ATTACHMENT 3 - DECK DELAMINATION MAP



ATTACHMENT 4 – PERSONNEL QUALIFICATIONS SUMMARY

Name	Professional Registration (State, Year)	Comprehensive Bridge Inspection Course (Year)	Bridge Inspection Refresher Course (Year)	Other Bridge Inspection Related Training (Year)	Degree in Engineering from ABET Accredited College or University (Degree/Year)	SPRAT (Year, Level)	Visual Acuity Test (Year)	Qualifying Inspection Experience (No. of Years)
Team Leader								
David V Jauregui	NM, 2006	1992	2020	2019	BSCE/1992	N/A	N/A	> 6 months
Team Members								
Brad D Weldon	-----	2018	-----		BSCE/2001	N/A	N/A	
George P Baca	NM, 1974	2009	2015		BSCE/1970	N/A	N/A	> 6 months
Eduardo Davila	-----	2016			BSCE/2016	N/A	N/A	
Andres Alvarez	-----	2016			BSCE/2016	N/A	N/A	
Rope Access Personnel								
Kyle Branham	NM, 2019	2014	2019		BSCE/2008	2016, I	2022	> 6 months
Brian K Schroeder	NM, 2019	2002	2019	2004	BSCE/1999	2009, II	2022	> 6 months
Hayley Martin	NM, pending	2022	N/A		BSCE/2018	2022, I	2022	> 6 months
Bri Sievenpiper	N/A	N/A	N/A		BSCE/2020	2021, I	N/A	> 6 months