



INSTRUMENTATION AND MONITORING PLAN

Gordon Drive Viaduct Driven Pile Demonstration Program

Sioux City, Woodbury County, Iowa
Iowa DOT Project NHSN-012-1(075)--2R-97

Project Role	Organization
Owner	Iowa Department of Transportation (Iowa DOT)
Prime Consultant	HDR
Instrumentation Subconsultant	Wiss, Janney, Elstner Associates, Inc. (WJE)
Survey Subconsultant	Foth Infrastructure and Environment, LLC (Foth)

Document Control	Value
Status	Draft for Review / Threshold Confirmation
Issue Date	August 24, 2026
Prepared By	HDR
Monitoring Focus	Vibration, pier rotation, pier displacement, and ground surface deformation

Important: Final alert thresholds, contact information, and contractor means and methods shall be confirmed before field implementation.



Document Control and Certification

Revision	Date	Description	Prepared By	Reviewed By
0	08/18/2026	Integrated draft for Iowa DOT review	HDR	TBD
1	TBD	Issued for implementation	HDR	Iowa DOT

Approval and Distribution

Organization	Representative	Role	Approval / Date
Iowa DOT	TBD	Owner / acceptance authority	TBD
HDR	TBD	Prime consultant / Engineer	TBD
WJE	Nathaniel Rende / Mohamed ElBatanouny	Instrumentation monitoring lead	TBD
Foth	TBD	Survey monitoring lead	TBD
Contractor	TBD	Construction means and methods	TBD

Document Purpose

This Plan establishes the instrumentation, monitoring, communication, and response framework for the Gordon Drive Viaduct driven pile demonstration program. It consolidates requirements developed by HDR and detailed monitoring procedures developed by WJE and Foth. HDR is the prime consultant; WJE and Foth are subconsultants; and Iowa DOT is the Owner.

Limitations

- The Contractor remains responsible for construction means, methods, temporary works, safety, and protection of the public and existing facilities.
- Monitoring does not replace visual observation, engineering judgment, or the authority of Iowa DOT to suspend or restrict work.
- Values shown as TBD shall be completed through the pre-installation readiness process.



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1.0 Executive Summary

The Gordon Drive Viaduct driven pile demonstration program will evaluate vibration attenuation and movement of the existing viaduct during installation of up to four steel H-piles, one group of sheet piles, and one steel casing south of the existing structure. The monitoring results will support foundation-type selection, construction criteria, and monitoring requirements for the future replacement project.

The program integrates three complementary measurement methods: triaxial vibration monitoring, biaxial pier tilt monitoring with ambient air temperature measurements, and deformation surveying. Measurements will be collected at Piers 45, 46, and 47 and at selected ground locations between the test piles and the existing viaduct.

System	Lead	Primary Measurement	Active Period
Vibration	WJE	Peak particle velocity and frequency at pier and ground	Baseline (one week in advance) and active pile installation
Tilt/Temp	WJE	In-plane and out-of-plane pier rotation and ambient air temperature	One week before through three months after installation
Survey	Foth	Pier and ground horizontal/vertical displacement	Baseline (one week in advance), active work, 3-day and 3-month epochs

Key Controls

- Automated alerts at monitored pier vibration locations when the accepted alert or shutdown threshold value is exceeded.
- Immediate suspension of potentially causative pile work when a valid alert or shutdown criterion requires evaluation.
- Resume-work authorization by Iowa DOT after validation, engineering review, and implementation of corrective measures, as applicable.
- Integrated correlation of monitoring data with pile driving logs, hammer operation, pile penetration, extraction activity, and field observations.



2.0 Project Description and Basis

2.1 Project Setting

The project is located in Sioux City, Iowa, approximately 0.5 mile north of the Missouri River. The broader Gordon Drive reconstruction includes replacement of the existing viaduct and construction of new bridge facilities south of the existing structure. The demonstration program is intended to characterize vibration response and potential movement to inform both final design decisions and construction specifications.

2.2 Demonstration Work

Element	Anticipated Quantity	Monitoring Relevance
Driven H-pile	Up to 4	Impact/vibratory source amplitude, attenuation, and refusal response
Sheet pile	Group of approximately 10	Installation and planned extraction response
Steel casing	1	Installation method response and ground deformation

2.3 Reference Basis

Source	Integrated Content
HDR integrated draft	Project description, roles, plan framework, thresholds, reporting, access, and coordination
WJE monitoring plan	Detailed vibration and tilt equipment, procedures, point IDs, thresholds, and response protocols
Foth survey scope as summarized	Control, bridge prisms, ground monuments, observation epochs, accuracy, and reporting
Updated instrumentation plan figure	Approximate test pile and monitoring locations

2.4 Assumptions Requiring Confirmation

- Active pile installation is assumed to occur over approximately six days.
- Final as-built pile coordinates, installation sequence, hammer models, rated energies, and sheet pile extraction sequence will be provided by the Contractor.
- Alert and shutdown criteria will be reviewed and accepted by Iowa DOT before monitoring is commissioned.



3.0 Organization, Roles, and Communications

Party	Primary Responsibilities
Iowa DOT and Iowa DOT Construction Inspection Team	Owner; reviews and accepts plan and thresholds; receives alerts and reports; directs owner-level traffic or work restrictions. Maintain pile driving logs through assigned inspection team, documents pile ID, time, depth/penetration, hammer, energy/settings if available, interruptions, extraction, weather, and unusual events.
HDR	Prime consultant; coordinates all parties; develops/maintains plan and criteria; provides geotechnical and bridge engineering support; coordinates lift access; reviews alerts; leads final integrated reporting.
WJE	Subconsultant for instrumentation; installs, commissions, operates, and removes vibration/tilt systems; maintains remote data access; provides near-real-time review and alerts; compiles vibration and tilt/temperature results; promptly reports threshold exceedances
Foth	Subconsultant for survey monitoring; establishes control outside zone of influence; installs/documents prisms and monuments; conducts baseline, active construction, post-construction, and follow-up surveys; immediately reports threshold exceedances.
Contractor	Provides schedule, equipment and means/method data, access, protection/fencing, and timely stop-work compliance

3.1 Lines of Authority

Iowa DOT retains Owner authority. HDR is the prime point of technical coordination. WJE and Foth communicate technical findings through HDR while providing immediate field notifications when required by this Plan. The Contractor shall immediately comply with stop-work directions issued under the accepted response protocol.

3.2 Alert Communications

- Automated alerts: email and text message when configured.
- Field alert: direct verbal notification to the Contractor superintendent and HDR/Iowa DOT field representatives.



4.0 Monitoring Objectives and Performance Framework

4.1 Objectives

- Quantify vibration amplitude and dominant frequency in the ground, and on existing piers.
- Develop vibration attenuation relationships with distance from test pile activities.
- Identify measurable rotation or translation of Piers 45, 46, and 47.
- Differentiate construction-related response from thermal behavior, ambient vibration, survey uncertainty, and instrument disturbance.
- Provide timely data for safe work decisions and future project design and construction criteria.

4.2 Coordinate and Direction Conventions

The sensors will be oriented and attached to align with the axes of the pier, and tilt data will be reported and analyzed as in-plane and out-plane tilt of the pier. The tilt monitoring system will be configured to transmit tilt measurements from each sensor and to provide near real-time alerts if rotational movement exceeds the Tilt Alert Thresholds.

Longitudinal direction is parallel to the bridge centerline. Transverse direction is perpendicular to the bridge centerline. Vertical direction is positive upward unless the project survey convention specifies otherwise. Tilt directions shall be labeled by the direction of movement at the top of the pier, with sensor signs verified during commissioning.

4.3 Measurement Hierarchy

Condition	Evidence Considered	Decision Basis
Normal	Valid readings below alert criteria	Continue work and routine review
Alert	Value at or above alert criterion but below shutdown limit	Pause/stop as specified; validate and perform engineering review, obtain formal authorization before resuming (Per 11.3 and 11.4)
Shutdown	Value at or above shutdown limit or sudden unexplained movement	Stop work immediately; evaluate closure/inspection and obtain formal authorization before resuming activities
Instrument fault	Invalid, disturbed, saturated, or non-communicating sensor	Protect work area, diagnose, use redundant data, and restore monitoring



5.0 Monitoring Layout and Point Schedule

5.1 Overview

The layout provides paired ground and structural vibration measurements at the three nearest piers, additional ground vibration measurements at varying distances from the test piles, pier rotation measurements combined with ambient air temperature measurements, and independent survey measurements of bridge and ground movement.

IDs	Type	Location	Lead
VM-P45, VM-P46, VM-P47	Pier seismographs	Piers 45, 46, and 47 near ground line	WJE
VM-G45, VM-G46, VM-G47	Ground seismographs	Ground adjacent to monitored piers	WJE
VM-G-1, VM-G-2, VM-G-3	Ground seismographs	Between test piles and viaduct	WJE
T-P45, T-P46-1, T-P46-2, T-P47	Biaxial tilt sensors	Near top of monitored pier columns	WJE
SP-P45, SP-P46-1, SP-P46-2, SP-P47	Survey prisms	Piers 45, 46, and 47	Foth
SM-G45-1/-2, SM-G46-1/-2, SM-G47-1/-2, SM-G	Ground monuments	Near piers and near first seismograph row	Foth

5.2 Installation Documentation

- Record point ID, coordinates/elevation, mounting detail, orientation, serial number, calibration date, photographs, and access notes.
- Survey each applicable monitoring point and establish a consistent project datum.
- Measure actual horizontal distance from each pile installation location to each vibration monitor for attenuation analysis.



6.0 Vibration Monitoring Program

6.1 Equipment

WJE will use Sigicom C22 triaxial seismographs or accepted equivalent units. Each unit will measure peak particle velocity in three orthogonal axes in accordance with ISEE-type practice, with nominal amplitude range 0.002 to 10 in/s, frequency range 2 to 250 Hz, resolution 0.002 in/s, and manufacturer-stated amplitude accuracy of approximately +/-0.020 in/s. Calibration shall be current at installation.

6.2 Installation

- Pier units will be anchored directly to the pier near ground line and protected in impact-resistant enclosures.
- Ground units will be partially buried and firmly coupled/anchored to near-surface soil.
- Axes will be oriented longitudinal, transverse, and vertical, and orientation will be photographed.

6.3 Acquisition and Alerts

Parameter	Requirement
Routine logging	Maximum amplitude and associated frequency at 15-second intervals during pile installation
Event capture	10-second triaxial waveform when the alert or shutdown threshold is exceeded
Upload	Hourly and following alert or shutdown events, subject to cellular availability
Alert content	Monitor ID, date/time, maximum PPV, frequency, and axis
Onsite review	WJE personnel during active pile installations

6.4 Vibration Data Products

- Maximum PPV by monitor, axis, pile, and work activity.
- Amplitude-frequency, amplitude-time, and amplitude-distance plots.
- Attenuation model and comparison of ground and pier response.



7.0 Tilt Monitoring Program

7.1 Equipment and Locations

Four biaxial RST Instruments IC8160 submersible MEMS tilt sensors, or accepted equivalents, will monitor Piers 45, 46, and 47. The nominal sensor characteristics are +/-30-degree range, approximately 0.0002-degree resolution, and approximately 0.0013-degree precision. A Campbell Scientific CR6 data logger or similar system, cellular modem, battery, and solar charging system will support acquisition and transmission.

ID	Bridge Element	Location
T-P45	Pier 45 exterior column	Near top, centered on south face of pier cap
T-P46-1	Pier 46 exterior column	Near top, centered on south face of pier cap
T-P46-2	Pier 46 interior column	Near top, centered on west face of pier cap
T-P47	Pier 47 exterior column	Near top, centered on south face of pier cap

7.2 Data Collection

- Collect biaxial tilt and temperature approximately every 5 seconds during active pile installation.
- Collect tilt/temperature at 1-minute intervals after installation unless adjusted for power or data management constraints.
- Continue remote tilt/temperature monitoring for approximately three months after completion of pile installation.
- Compare tilt to ambient and internal sensor temperature to identify thermal behavior.

7.3 Sign and Axis Verification

During commissioning, WJE will perform a controlled functional check or document axis response to confirm in-plane/out-of-plane definitions, sign conventions, sensor stability, and communication.



8.0 Survey and Displacement Monitoring Program

8.1 Control and Equipment

Foth will establish stable survey control outside the anticipated zone of influence and coordinate with the Contractor for placement of control to provide continuous line-of-sight. Conventional total station and leveling procedures will be used as appropriate. The target program includes four surface-mounted bridge prisms and seven ground monuments consisting of nominal 1/2-inch by 24-inch rebar. Control monuments shall remain undisturbed and lines of sight shall be maintained.

8.2 Bridge Prism Schedule

ID	Pier / Column	Location
SP-P45	Pier 45	South column/west face of column
SP-P46-1	Pier 46 exterior	South column /west face of column
SP-P46-2	Pier 46 interior	Middle interior column/west face of column
SP-P47	Pier 47	South column /west face of column

8.3 Ground Monument Schedule

ID	Location
SM-G45-1 / SM-G45-2	South and north of Pier 45
SM-G46-1 / SM-G46-2	South and north of Pier 46
SM-G47-1 / SM-G47-2	South and north of Pier 47
SM-G	Near the first seismograph row / Test Piles 1 and 2

8.4 Survey Performance

The survey system is intended to report horizontal and vertical movement to a minimum precision of 0.010 ft (0.12 in), subject to final confirmation by Foth. Survey alert criteria shall account for demonstrated repeatability, control stability, atmospheric effects, sight distance, and target setup.



9.0 Baseline Monitoring and Readiness

9.1 Baseline Period

Vibration and tilt systems will be installed approximately one week before pile installation. Baseline data will establish ambient vibration, thermal tilt cycles, sensor noise, communication reliability, and survey repeatability. Foth will complete baseline observations before active pile driving and an immediate pre-work observation on the first day, where practicable.

9.2 Commissioning Checklist

- All monitoring points installed, labeled, photographed, and protected.
- Current equipment calibration documented.
- Sensor axes and positive directions verified.
- Remote data portals accessible to designated personnel.
- Email and text alert tests completed.
- Survey control closure and repeatability accepted by Foth/HDR.
- Pile locations and monitor distances documented.
- Contractor schedule, hammer data, and pile sequence received.
- Alert distribution list verified through a live communication test.
- Backup power, spare components, and field troubleshooting procedures available.

9.3 Kickoff/Tailgate Meeting

HDR will conduct a on-site kickoff/tailgate meeting with all stakeholders involved prior to start of work every day. The meeting will confirm thresholds, authority, stop-work communications, daily reporting timing, safety requirements, and unresolved items.



10.0 Construction-Phase Monitoring Procedures

10.1 Daily Start-Up

- WJE to confirm monitors are online and recording.
- Foth to confirm survey control/targets are accessible and undisturbed.
- Iowa DOT construction inspection team to record weather, temperature, planned pile ID, hammer, sequence, and anticipated work window.
- Confirm field and remote monitoring personnel and communication channels.
- Verify that activities are authorized to resume and no equipment issues from the previous shift remain open.

10.2 Active Monitoring

WJE will review vibration and tilt data in near real time while pile installation is active. Foth will perform survey monitoring generally at 15- to 30-minute intervals while onsite. The Iowa DOT construction inspection team will maintain synchronized pile activity records so monitoring events can be attributed to specific operations.

Record	Minimum Content
Pile driving log	Pile ID, start/stop times, depth, penetration/blow count if available, hammer/settings/energy, interruptions, refusal or unusual response
Monitoring event log	Time, monitor/point ID, value, axis, threshold status, validation notes, notifications, disposition
Daily coordination log	Weather, timestamp, access, equipment status, instrument issues, work changes, planned next-day activities

10.3 Daily Closeout

- HDR in collaboration with subconsultants to verify data upload and completeness.
- HDR to reconcile threshold exceedance events with construction logs.
- HDR to document instrument status and unresolved issues.
- WJE and Foth to issue a daily summary when requested by HDR/Iowa DOT.



11.0 Alert Thresholds, Shutdown Limits, and Response Protocols

11.1 Proposed Criteria for Confirmation

Parameter		Alert Threshold	Shutdown Limit	Applicability
Vibration PPV	(Pier 45, 46, and 47)	0.40 in/s	0.50 in/s	Pier and adjacent-ground monitors at Piers 45-47
	VM-G-1, 2, and 3	Not applicable	Not applicable	These vibration monitors should be set to record either continuously or for events at a relatively low level (e.g. 0.2-0.3 in/sec) for later review but should not send out alert notifications.
Longitudinal tilt	Pier 45	0.06 degrees	0.08 degrees	Monitored piers; sign-independent magnitude
	Pier 46	0.15 degrees	0.20 degrees	
	Pier 47	0.15 degrees	0.20 degrees	
Transverse tilt	Pier 45	0.06 degrees	0.08 degrees	Monitored piers; sign-independent magnitude
	Pier 46	0.06 degrees	0.08 degrees	
	Pier 47	0.06 degrees	0.08 degrees	
Vertical displacement (near Pier 45, 46, and 47), SM-G		0.75 in	1 in	Piers 45-47; SM-G

Threshold status: The values above had been changed since submitting a draft to DOT. Iowa DOT should review and accept the final criteria before field implementation. Alert values should provide margin below shutdown limits and shall not be lower than reliable instrument resolution/repeatability.

11.2 General Sequence for Exceedance of Alert Threshold or Shutdown Limit

Step	Action
1	Stop potentially causative pile installation when required by the accepted criterion.
2	Notify Contractor, Iowa DOT, HDR, WJE, and Foth through field and automated channels.
3	Validate reading, instrument condition, timing, axis, baseline, and redundant measurements.
4	Correlate with pile activity, survey, tilt, vibration, weather, and visual observations.
5	Perform engineering assessment and inspection as warranted.
6	Document disposition, corrective measures, and authorization before resuming work.



11.0 Alert and Shutdown Thresholds and Response Protocols (Continued)

11.3 Vibration Alert Threshold Exceedance

- Stop vibration-generating test pile activity as required by the accepted response matrix.
- WJE validates the waveform, amplitude, frequency, sensor coupling, and source timing.
- Review tilt, temperature, and survey results for associated movement.
- If no movement is indicated and the value is below the shutdown limit, Iowa DOT will authorize resumption of activities, but may require modified means and methods or enhanced monitoring.

11.4 Tilt or Displacement Alert Threshold Exceedance

- Stop potentially causative work immediately.
- Validate instrument and survey results and compare all monitored piers.
- Inspect the affected area if warranted and determine whether movement is construction-related, thermal, survey-related, or caused by disturbance.
- Work remains suspended until Iowa DOT/HDR completes the required review and authorizes resumption.

11.5 Shutdown Limit Exceedance

- Immediately stop work and secure equipment.
- If a valid tilt or displacement shutdown exceedance is confirmed and is not caused by instrumentation malfunction, implement the accepted traffic contingency, including bridge closure if directed by Iowa DOT.
- WJE and HDR bridge engineers will perform visual inspection and analysis as warranted.
- Resume only after cause evaluation, corrective measures, threshold review, revised means/methods, and written authorization.

11.6 False or Invalid Alerts

Invalid readings caused by disturbance, loss of coupling, target obstruction, communication artifacts, electrical issues, data spikes, or survey setup error will be documented. The monitoring lead will correct the cause, demonstrate restored performance, and communicate the disposition. Resume activities only after written authorization from Iowa DOT.



12.0 Data Management, Validation, and Quality Control

12.1 Time Synchronization

All monitoring systems, field logs, survey records, and Contractor/inspection logs shall use synchronized time with local time zone identified.

12.2 Data Validation

Check	Vibration	Tilt/TEMP	Survey
Completeness	Data coverage and waveform capture	Continuity and communication	Required epochs and points
Quality	Noise, clipping, coupling, frequency	Drift, spikes, thermal response	Control closure, residuals, repeatability
Correlation	Pile activity and distance	Pile activity and temperature	Pile activity and concurrent sensors
Disposition	Valid / invalid / qualified	Valid / invalid / qualified	Valid / invalid / qualified

12.3 File Management

- Use consistent point IDs and file naming including date, system, and revision.
- Retain raw data, processed data, calibration certificates, installation records, photographs, logs, alert messages, and reports.
- Maintain controlled backups and preserve original raw records from editing.
- Document processing methods, filters, baseline adjustments, excluded data, and revisions.

12.4 Quality Control Review

WJE will QC vibration and tilt compilations. Foth will QC survey observations and adjustments. HDR will perform an integrated engineering review, reconcile discrepancies, and confirm that conclusions are supported by validated data and construction records.



13.0 Reporting and Deliverables

Deliverable	Lead	Timing / Content
Installation/commissioning record	WJE / Foth	Before active work; point IDs, locations, photographs, serial numbers, calibration, axes, and readiness results
Automated alert	WJE	Immediately following programmed exceedance; time, point, value, axis, and threshold
Survey Alert Threshold or Shutdown Limit exceedance response summary	Foth	Immediately after event and validation; point, movement vector, epoch, control check, and uncertainty
Alert Threshold or Shutdown Limit exceedance response summary	WJE/HDR	Promptly after event; source activity, multi-system review, inspection, disposition, and recommendation
Weekly tilt report	WJE	During three-month follow-up; maxima, time histories, cumulative plots, and temperature comparison
Survey reports	Foth	Baseline, active construction, approximately 3-day, and approximately 3-month results
Final demonstration report	HDR	Integrated methodology, logs, results, attenuation, movement assessment, conclusions, and recommendations

13.1 Final Report Minimum Content

- Executive summary and conclusions.
- As-built monitoring layout and actual pile-to-monitor distances.
- Pile installation means, methods, sequence, schedule, and logs.
- Vibration PPV/frequency/time/distance results and attenuation relationships.
- Tilt time histories, maxima, and temperature comparison.
- Survey movement tables and plots with accuracy/uncertainty discussion.
- Alert Threshold or Shutdown Limit exceedance events, inspections, corrective actions, and dispositions.
- Implications for replacement bridge design and construction monitoring.



14.0 Access, Protection, Safety, and Coordination

14.1 Access

- HDR will coordinate access to bridge piers and provide lift access required for HDR and subconsultant personnel, subject to project safety requirements.
- The Contractor will maintain safe access routes and coordinate restrictions caused by active equipment or railroad/traffic operations.

14.2 Protection and Security

- The Contractor will provide temporary fencing/security around the demonstration area as required by the contract documents.
- All instruments, cables, enclosures, prisms, monuments, solar panels, and control points will be conspicuously marked and protected.
- No equipment, materials, or vehicle traffic will obstruct survey lines of sight or disturb monitoring points.

14.3 Disturbance or Damage

Any suspected disturbance, impact, vandalism, loss of power, blocked sight line, or damaged monitoring component shall be reported immediately. Affected data will be qualified, the point will be inspected/re-established, and a new baseline will be collected if required before relying on subsequent measurements.

14.4 Safety

All field activities shall comply with the approved project safety requirements, fall protection requirements, lift procedures, utility clearances, and Contractor site controls. This Plan addresses monitoring and does not supersede the project safety plan.



15.0 Demobilization and Closeout

15.1 Vibration System

Vibration monitors may be removed after completion of test pile installations when Iowa DOT confirms that no additional vibration-generating demonstration work remains and required data have been verified and backed up.

15.2 Tilt System

Tilt monitoring will continue for approximately three months. Before removal, WJE will verify final data retrieval, instrument status, and completion of the required follow-up period.

15.3 Survey System

Foth will complete the approximately three-day and three-month survey epochs. Removal or abandonment of prisms, monuments, and control will be coordinated with HDR and Iowa DOT after final data acceptance.

15.4 Closeout Records

- Final as-built point schedule. (HDR)
- Calibration and equipment records. (subconsultants)
- Complete raw and processed data archive. (subconsultants)
- Field logs, alert records, response summaries, and inspection records. (DOT)
- Final report files and supporting plots/tables. (HDR/WJE/FOTH)



16.0 Open Items and Pre-Installation Checklist

Item	Responsible Party	Due	Status
Accept final vibration, tilt, and displacement criteria	Iowa DOT / HDR	Before commissioning	OPEN
Complete alert/contact distribution list	All parties	Before alert test	OPEN
Confirm test pile coordinates and sequence	HDR / Contractor	Before installation	OPEN
Submit hammer models, energy, and means/methods	Contractor	Before readiness meeting	OPEN
Confirm Foth survey precision and alert basis	Foth / HDR	Before baseline	OPEN
Confirm bridge closure/detour authority and procedure	Iowa DOT / HDR	Before active work	OPEN
Confirm pile driving log responsibility	HDR / Contractor	Before active work	OPEN
Confirm lift/access schedule	HDR	Before instrument installation	OPEN
Complete live alert test and readiness meeting	HDR / WJE / Foth	Before active work	OPEN

Field Authorization

Pile installation shall not begin until the Engineer documents that required monitoring systems are operational, baseline data are acceptable, alert communications have been tested, final Alert Threshold and Shutdown Limit criteria have been accepted, and open items affecting safe implementation are closed.

Appendix A - Instrumentation Plan

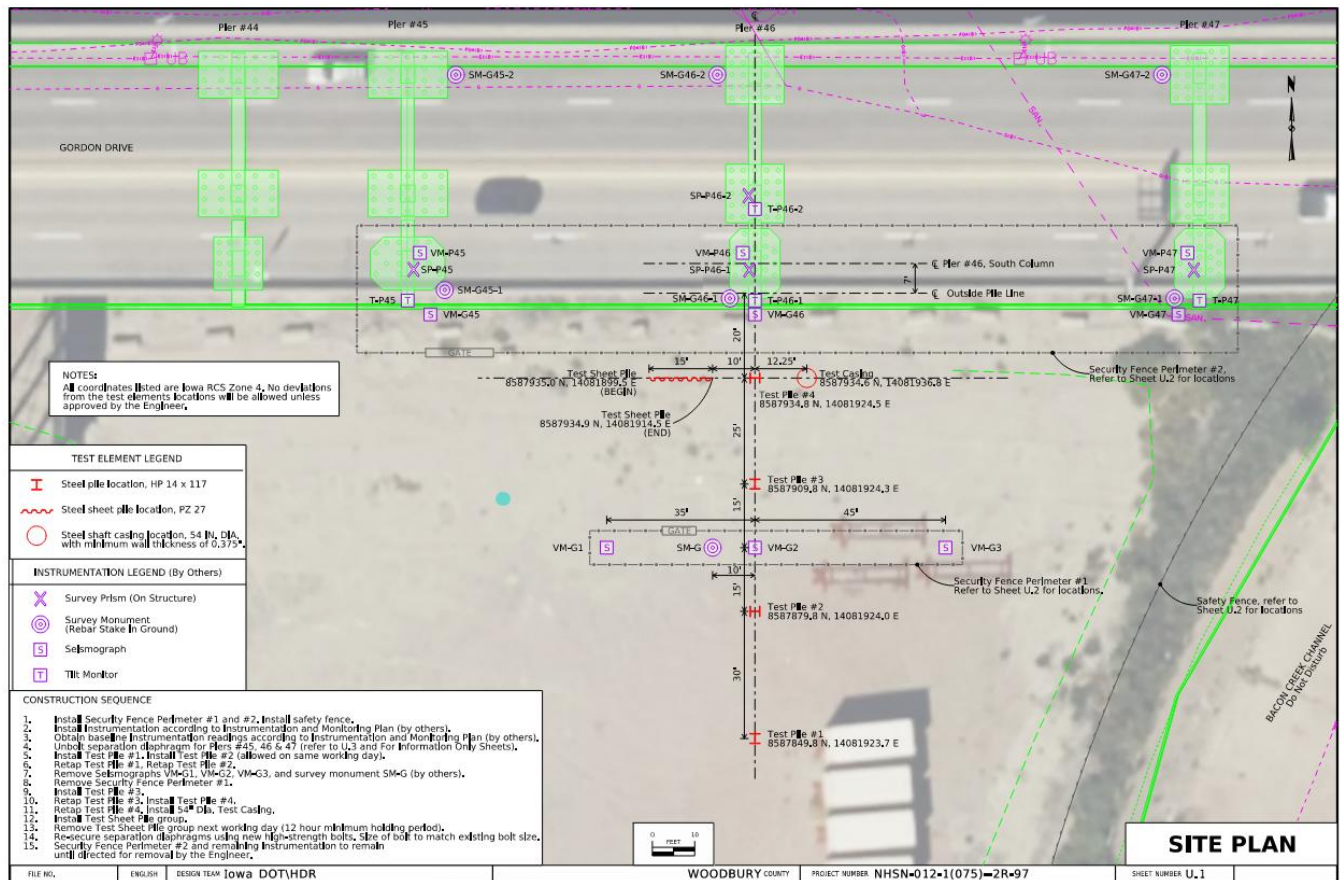


Figure A-1. Preliminary instrumentation plan showing test pile and monitoring locations.

The figure is preliminary. Final field installation records shall supersede approximate locations and shall include actual coordinates, elevations, distances, sensor axes, and photographs.



Appendix B - Detailed Instrument and Point Schedule

Point ID	System	Location / Purpose	Lead
VM-P45/P46/P47	Vibration	Pier near ground line; structural response	WJE
VM-G45/G46/G47	Vibration	Ground adjacent to each monitored pier, measure ground vibration adjacent to bridge pier	WJE
VM-G-1/G-2/G-3	Vibration	Varying distances between piles and viaduct, ground vibration	WJE
T-P45	Tilt	Pier 45 exterior column near top, measure rotation of the piers	WJE
T-P46-1	Tilt	Pier 46 exterior column near top, measure rotation of the piers	WJE
T-P46-2	Tilt	Pier 46 interior column near top, measure rotation of the piers	WJE
T-P47	Tilt	Pier 47 exterior column near top, measure rotation of the piers	WJE
SP-P45/P46-1/P46-2/P47	Survey	Bridge displacement prisms, measure vertical displacement of the piers	Foth
SM-G45-1/-2	Survey	Ground north/south of Pier 45, measure vertical displacement of the ground surface	Foth
SM-G46-1/-2	Survey	Ground north/south of Pier 46, measure vertical displacement of the ground surface	Foth
SM-G47-1/-2	Survey	Ground north/south of Pier 47, measure vertical displacement of the ground surface	Foth
SM-G	Survey	Ground near first seismograph row, near Pile #1 and #2, measure vertical displacement of the ground surface	Foth



Appendix C - Monitoring Alert and Reporting Distribution List

Name	Organization	Role	Email	Text Number
TBD	Iowa DOT	Owner representative	TBD	TBD
TBD	HDR	Prime / Engineer	TBD	TBD
Nathaniel Rende	WJE	Instrumentation lead	nrende@wje.com	630-346-3000
Mohamed ElBatanouny	WJE	Instrumentation lead	melbatanouny@wje.com	803-348-5182
TBD	WJE	Field personnel	TBD	TBD
TBD	Foth	Survey lead	TBD	TBD
TBD	Contractor	Superintendent	TBD	TBD

Privacy and readiness: Complete and test this list before work. The controlled project copy should be distributed only to personnel who require alert access.



Appendix D - Field Forms and Logs

D.1 Daily Monitoring Readiness Log

Check	Yes / No	Notes
Vibration units online		
Tilt DAQ online		
Survey points/control accessible		
Alert delivery tested/confirmed		
Weather recorded		
Pile/hammer plan confirmed		
Open alerts resolved		
Field contacts present		

D.2 Alert Event Record

Field	Entry
Event number	
Date/time/time zone	
Instrument / point / axis	
Measured value / threshold	
Pile activity and equipment	
Validation checks	
Notifications and stop time	
Inspection / supplemental data	
Disposition / corrective action	
Resume authorization / time	