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Volume 1

Waste Isolation Pilot Plant

Geotechnical Analysis Report for July 2022 – June 2023

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FOREWORD AND ACKNOWLEDGMENTS

This report contains the most recent assessment of the geotechnical status of the Waste Isolation Pilot Plant (WIPP). During the excavation of the WIPP underground access and experimental areas, the status was reported quarterly. Since 1987, when the initial construction phase was completed, reports have been published annually. This report analyzes data collected from July 1, 2022, to June 30, 2023.

This Geotechnical Analysis Report (GAR) was written to meet several regulatory requirements. It satisfies requirements contained in the WIPP Hazardous Waste Facility Permit[1] (HWFP) Part 4 Section 4.6.1.2, Reporting Requirements, and Attachment A2, Section A2-5b(2), Geomechanical Monitoring, and the Certification of Compliance[2] with Subparts B and C, Title 40 Code of Federal Regulations (CFR) Part 191, Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes. Part 191 defines the waste containment requirements. One of these requirements, stipulated in Part 191.14(b), is “Disposal systems shall be monitored after disposal to detect substantial and detrimental deviations from expected performance.” Title 40 CFR, Compliance Certification and Re-certification, Part 194.42, Monitoring, describes the minimum post-disposal system parameters to be analyzed. (Part 191 and Part 194 requirements for monitoring apply after disposal—i.e., “when all the shafts to the repository are backfilled and sealed” §191.02(l). However, pre-disposal monitoring establishes baseline conditions and is useful to validate modeling assumptions and parameters that support expected performance.) This report focuses on the geotechnical performance of the various components of the WIPP underground facility, including shaft stations, access drifts, and waste disposal areas. The results of investigations of excavation effects and other geotechnical studies are also included.

This report compares the geotechnical performance of the repository to the design criteria outlined in Table 9-1. It describes the techniques used to acquire the data. The depth and breadth of the evaluation of the different components of the underground facility vary according to the types and quantities of data available, as well as the complexity of the recorded geotechnical responses. Graphic presentation of data and tabular documentation of instrument history can be provided upon request.

This GAR was prepared by Salado Isolation Mining Contractors, LLC, for the U.S. Department of Energy (DOE), Carlsbad Field Office, in Carlsbad, New Mexico. Work was supported by the DOE under Contract No. 89303322-DEM-000077.

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[1] New Mexico Environment Department (NMED), 2023, Waste Isolation Pilot Plant Hazardous Waste Facility Permit, NM4890139088-TSDF, Santa Fe, NM

[2] U.S. Environmental Protection Agency, 1998, "Criteria for the Certification and Recertification of the Waste Isolation Pilot Plant's Compliance with the Disposal Regulations: Certification Decision," *Federal Register*, Vol. 63, No. 95, pp. 27354, May 18, 1998, Washington, DC

CHANGE HISTORY SUMMARY

Revision Number	Date Issued	Description of Changes
0	10/31/24	• Initial issue.

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ACRONYMS AND ABBREVIATIONS

ASTM	American Society for Testing and Materials
bp	before present
CFR	Code of Federal Regulations
CH	contact-handled
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ft	foot (feet)
GAR	Geotechnical Analysis Report
GIS	Geomechanical Instrumentation System
HWDU	Hazardous Waste Disposal Unit
HWFP	Hazardous Waste Facility Permit
in	inch(es)
m	meter(s)
Ma	million years
MB	marker bed
NMED	New Mexico Environment Department
OMB	orange marker bed
psi	pound(s) per square inch
RH	remote-handled
SDI	Salt Disposal Investigation
SDDI	Salt Defense Disposal Investigation
SPDV	Site and Preliminary Design Validation
TRU	Transuranic
WIPP	Waste Isolation Pilot Plant

1.0 INTRODUCTION

This GAR presents and interprets geotechnical data from the underground excavations at the WIPP. The data obtained as part of a regular monitoring program are used to characterize conditions, compare actual performance to the design criteria, and evaluate and forecast the performance of the underground excavations.

During the operation of the Site and Preliminary Design Validation (SPDV) Program, the architect/engineer for the project produced these reports quarterly to document the geomechanical performance during and immediately after early excavations of the underground facility. Since the completion of the construction phase of the project in 1987, the management and operating contractor for the facility has prepared these reports annually. This report describes the performance and condition of selected areas of the WIPP for the period July 1, 2022, to June 30, 2023.

This report is divided into ten sections.

- Section 1.0, Introduction, provides background information on the WIPP, its mission, and the purpose and scope of the geomechanical monitoring program.
- Section 2.0, Geology, describes the local and regional geology of the WIPP Site.
- Section 3.0, Performance of Shafts and Keys, and Section 4.0, Performance of Shaft Stations, describe the geomechanical instrumentation in the shafts and shaft stations, present the data collected by that instrumentation, and interpret these data.
- Section 5.0, Performance of Access Drifts, and Section 6.0, Performance of the Waste Disposal Area, present the results of geomechanical monitoring in the two main portions of the WIPP underground (the access drifts and the waste disposal area).
- Section 7.0, Performance of the Salt Disposal Investigations and Salt Defense Disposal Investigations, introduces the Salt Disposal Investigation (SDI) and Salt Defense Disposal Investigation (SDDI) areas.
- Section 8.0, Geoscience Program, discusses the results of the Geoscience Program, which include fracture mapping and observation-borehole information.
- Section 9.0, Summary, summarizes the results of geomechanical monitoring and compares the current excavation performance to the design requirements.
- Section 10.0, References, lists references.

1.1 Location and Description

The WIPP facility is in southeastern New Mexico, 26 miles east of Carlsbad (Figure 1-1, WIPP Location). The surface facilities were built on flat to gently rolling terrain characteristic of the Los Medaños area. The underground facility is being excavated approximately 2,150 feet (ft) beneath the surface in the Salado Formation.
Figure 1-2, Underground Mining and Waste Disposal Configuration as of June 30, 2023, shows a plan view of the underground mining and waste disposal configuration of the WIPP as of June 30, 2023. This map satisfies the reporting requirement regarding the extent of Hazardous Waste Disposal Unit (HWDU) excavation in Permit Attachment 4, Section 4.6.1.2.

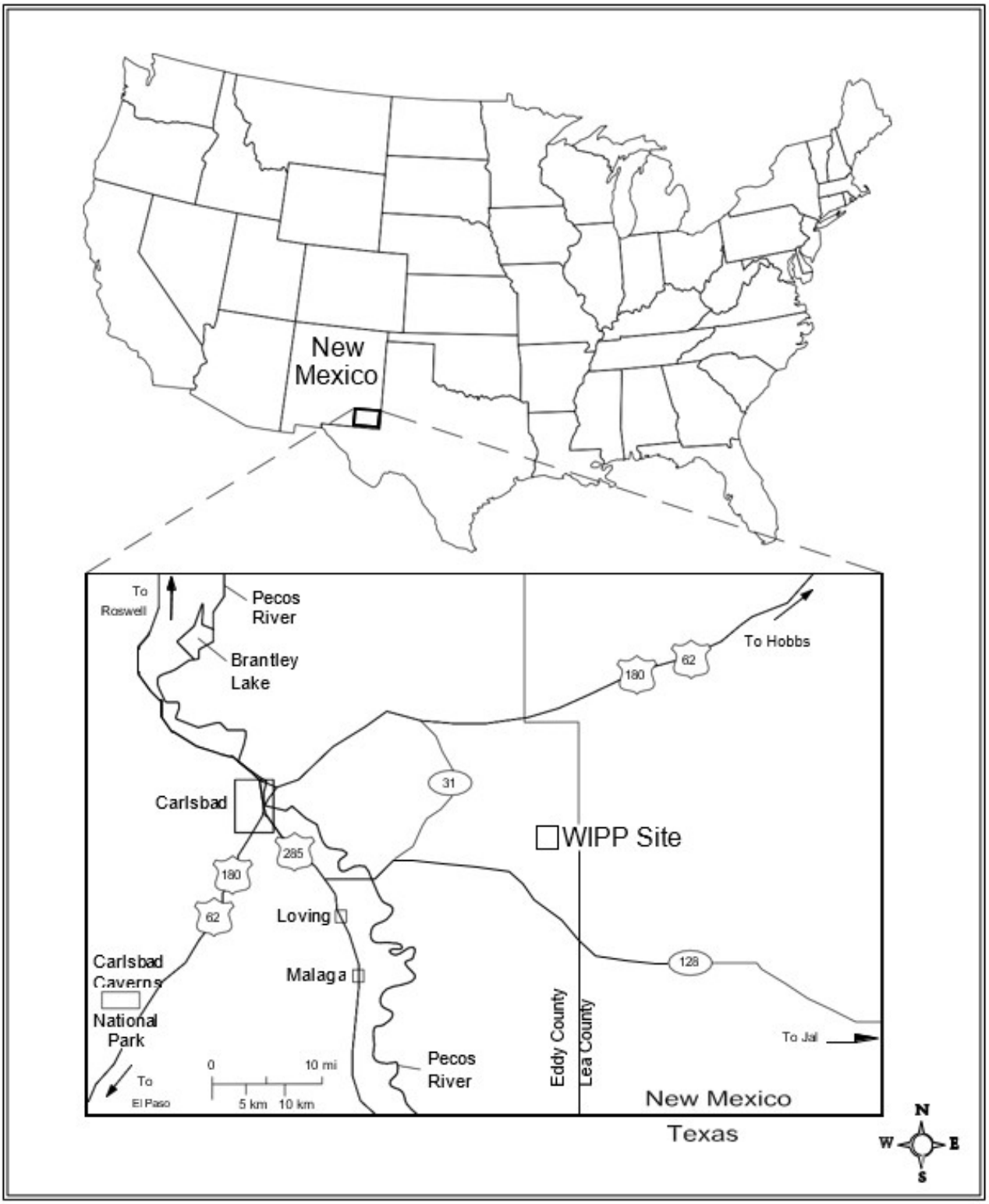

Figure 1-1 WIPP Location

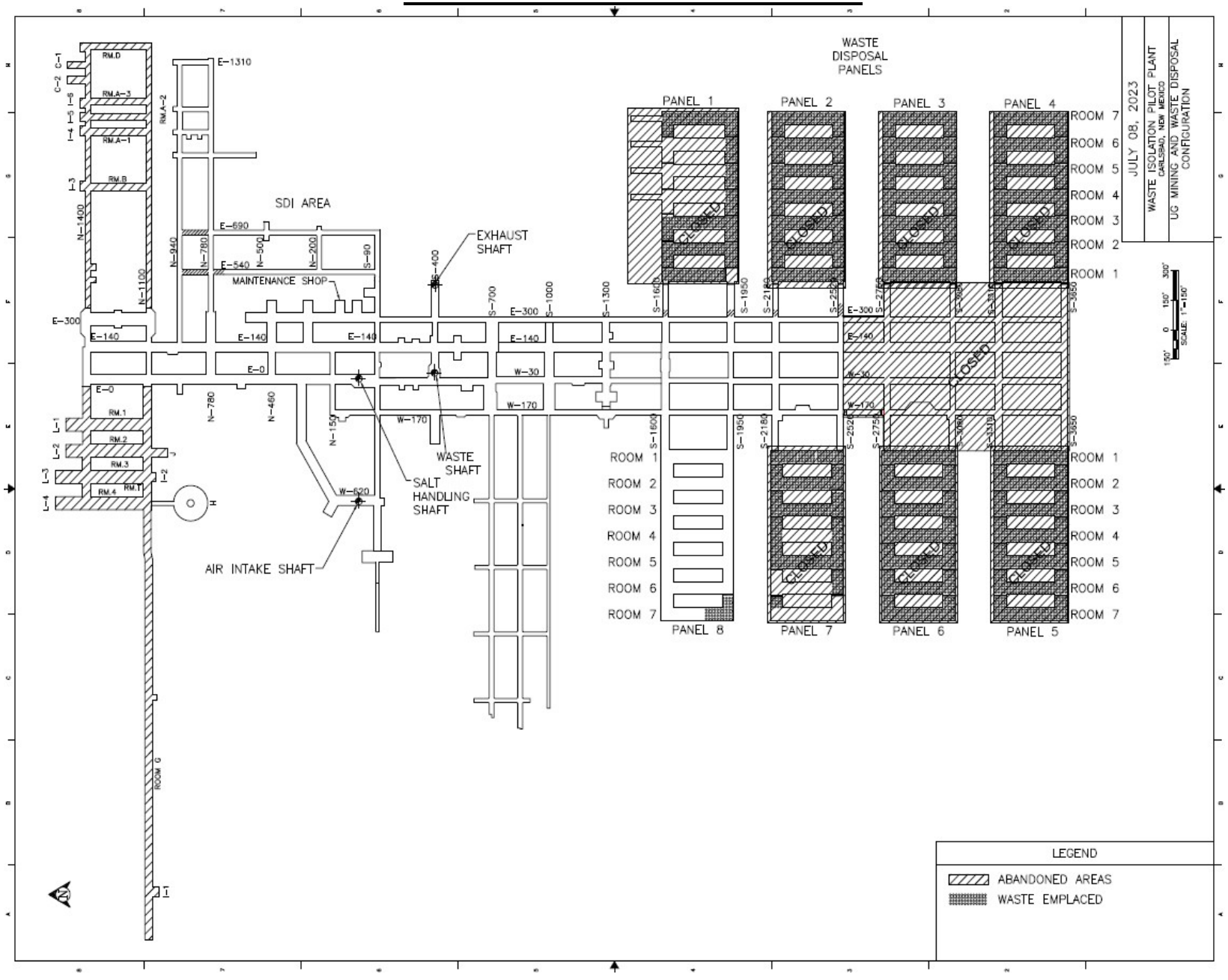

Figure 1-2 Underground Mining and Waste Disposal Configuration as of June 30, 2023

1.2 Project Background

In 1979, Congress authorized the WIPP (Public Law 96-164, Department of Energy National Security and Military Applications of Nuclear Energy Authorization Act of 1980) to provide "… a research and development facility to demonstrate the safe disposal of radioactive wastes resulting from the defense activities and programs of the United States exempted from regulation by the Nuclear Regulatory Commission." To fulfill this mission, the DOE constructed a full-scale facility to demonstrate technical and operational principles of the permanent disposal of transuranic (TRU) and TRU mixed wastes. Technical aspects are concerned with the subsurface excavations' design, construction, and performance. Operational elements refer to the facility receiving, handling, and emplacement of TRU wastes. The facility was first used for *in situ* studies and experiments without radioactive waste. The WIPP facility now receives, handles, and permanently disposes of TRU waste and TRU mixed waste.

1.3 Development Status

To fulfill its mission, the DOE developed the WIPP in a phased manner. The goal of the SPDV phase, begun in 1980, was to characterize the site and obtain *in situ* geotechnical data from underground excavations to determine whether site characteristics and *in situ* conditions were suitable for permanent waste disposal. During this phase, the Salt Shaft, a Ventilation Shaft, a drift to the southernmost extent of the proposed Waste Disposal Area, a four-room experimental panel, and access drifts were excavated. Surface-based geological and hydrological investigations were also conducted. The data obtained from the SPDV investigations were reported in the Summary of the Results of the Evaluation of the WIPP SPDV Program (DOE, 1983).

Based on the favorable results of the SPDV investigations, additional activities were initiated in 1983. These included constructing surface structures, converting the ventilation shaft for use as the Waste Shaft, excavating the Exhaust Shaft, developing additional access drifts to the Waste Disposal Area, and excavating additional experimental rooms to support research and development. Geotechnical data acquired during this phase were used to evaluate the performance of the excavations in the context of established design criteria (DOE, 1984). The results of these evaluations were reported in geotechnical field data reports (DOE, 1985; DOE, 1986a) and were summarized in the WIPP Design Validation Final Report (DOE, 1986b).

The WIPP Design Validation Final Report concluded that the facility, including Waste Disposal Areas, could be developed and operated to fulfill the long-term mission of the WIPP (DOE, 1986b). All available information validated the design of underground openings to safely accommodate the permanent disposal of waste under routine operating conditions.

The Air Intake Shaft was constructed between March 1988 and November 1989. Panel 1 mining began in 1986 and was completed in 1988. Panel 1 was intended to receive waste for an initial operations demonstration and pilot plant phase scheduled to start in October 1988. However, the demonstration and pilot plant phases were not implemented because waste could not be emplaced without the necessary permits.

In October 1996, the DOE submitted to the U.S. Environmental Protection Agency (EPA) a compliance certification application per Title 40 CFR Part 191, Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes, and Title 40 CFR Part 194, Criteria for the Certification and Re-Calibration of the Waste Isolation Pilot Plant's Compliance with the 40 CFR Part 191 Disposal Regulations, which addressed the long-term (10,000-year) performance criteria for the disposal system. On May 18, 1998, the EPA published the final certification that allowed for the receipt of TRU waste at the WIPP. Immediately before this certification, the DOE Carlsbad Area Office completed an Operational Readiness Review, which the DOE requires before any nuclear facility's start-up or process change. As a result of the review, the DOE Carlsbad Area Office notified the Energy Secretary on April 1, 1998, that the WIPP was operationally ready to receive waste. On March 26, 1999, the first shipment of TRU waste was received from Los Alamos National Laboratory. Since then, many additional waste generator sites had shipped waste to the WIPP. The cleanup of several small-quantity waste generator sites and one large-quantity site (Rocky Flats Environmental Technology Site) is now complete.

The New Mexico Environment Department (NMED) is primarily responsible for permitting, implementing, and enforcing most aspects of the Resource Conservation and Recovery Act. In 1999, the NMED issued the WIPP HWFP to the DOE. The WIPP HWFP was renewed for ten years in 2010. In March 2020, the HWFP renewal application was submitted to the NMED for renewal and modification. In March 2022, the renewal application was updated to include the construction and use of Panel 11 and Panel 12. The HWFP renewal application review was ongoing during this reporting period but a renewed permit has since been finalized, with an effective date of November 3, 2023.

Waste disposal in Panel 1 through Panel 7 is complete. Panels 1, 2, and 3 contain only contact-handled (CH) waste. The first remote-handled (RH) waste shipment arrived on January 24, 2007. Panel 4 was the first to receive both CH and RH waste. Contact-handled TRU and RH TRU waste emplacement had commenced in Panel 7 but was halted initially by a truck fire underground, followed by an unrelated radioactive release in Panel 7. Contact-handled waste emplacement resumed in January 2017, and RH waste emplacement was resumed in Panel 7 in February 2019 using shielded containers only. No additional borehole emplacement occurred during this reporting period. Panel 8 began receiving waste in November 2022, upon the completion of waste disposal in Panel 7.

1.4 Project Objective

As specified in the WIPP HWFP, Part 4, Section 4.6.1.2, Reporting Requirements, and Attachment A2, Section A2-5b(2), Geomechanical Monitoring (NMED, 2023), the purpose of the geomechanical monitoring program is to obtain *in situ* data to support the continuous assessment of the design for underground facilities.

Specifically, the program provides for:

- Early detection of conditions that could affect operational safety.
- Evaluation of disposal room closure that ensures adequate access.
- Guidance for design modifications and remedial actions.
- Data for interpreting the behavior of underground openings in comparison with the established design criteria.

This GAR evaluates and reports data taken by or input into the Geomechanical Instrumentation System (GIS). This annual report fulfills the requirements outlined in Part 4.6.1.2., Attachment A2, Section A2-5b (2) of the WIPP HWFP (NMED, 2023), and and sets baseline data for 40 CFR §191.14, Assurance Requirements, implemented through the certification criteria, 40 CFR Part 194.

The Geomechanical Monitoring Program generates the data for four of the compliance monitoring parameters:

- Creep closure and stresses
- Extent of deformation
- Initiation of brittle deformation
- Displacement of deformation features

The instrumentation system for geomechanical monitoring provides data for routine evaluations of the safety, stability, and performance of underground openings. *In situ* data are also used to model long-term disposal system performance. Changes resulting from excavations are monitored by routine inspections of selected observation borehole arrays and fracture mapping to detect and quantify occurrences of discontinuities such as fractures and bed separations. Data analysis indicating potential instability allows timely corrective action before the areas become unsafe. Other geoscience activities include geologic and stratigraphic mapping, core logging, and seismic monitoring.

The GIS provides data collected, processed, and stored for analysis. The following subsections briefly describe the major components of the GIS.

1.4.1 Instrumentation

Instrumentation installed for measuring the geomechanical response of the shafts, drifts, and other underground openings includes convergence points, convergence meters, extensometers, rock bolt load cells, pressure cells, strain gauges, piezometers, and joint meters. Table 1-1, Geomechanical Instrumentation Data Acquisition, summarizes the specifications for geomechanical instrumentation.

Instrument Type	Measures	Range[2]	Resolution[2]
Convergence point (tape extensometer)	Cumulative deformation	2 – 66 ft	0.001 in
Wire convergence meter	Cumulative deformation	0 – 40 in	0.005 in
Embedded strain gauge	Cumulative strain	0 – 3000 microstrain	1 microstrain
Spot-welded strain gauge	Cumulative strain	0 – 2500 microstrain	1 microstrain
Rock bolt load cell	Load	0 – 50 tons	40 pounds
Earth pressure cell	Pressure	0 – 1000 psi	1 psi
Piezometer	Fluid pressure	0 – 500 psi	0.5 psi
Joint meter	Cumulative deformation	0 – 4 in	0.001 in
Wire extensometer	Cumulative deformation	0 – 50 in	0.005 in

Table 1-1 Geomechanical Instrumentation Data Acquisition

Geomechanical instruments are read manually, using portable devices, or remotely by electronically polling the stations from the surface per approved operating procedures. Remotely read instruments are connected to one of the underground data loggers, and readings are collected by initiating the appropriate polling routine. Data are transferred to an electronic database upon completion of a verification process. Manual readout devices are taken to instrument locations in the underground. Data are recorded on data sheets and later entered into an electronic database.

The underground data acquisition system consists of instruments, polling devices, and a communications network. Instruments are connected to polling devices installed in electrical enclosures near the instrument locations. A data link to a surface computer connects polling devices.

Whether acquired manually or remotely, geomechanical data are entered into the database files of the GIS data processing system. The data processing system consists of computer programs used to enter, reduce, and transfer the data to permanent storage files. Additional routines allow access to the permanent storage files for numerical analysis, tabular reporting, and graphical plotting. Copies of the reports are available upon request[3].

[2] Manual readout boxes for the instruments were manufactured to render measurements in U.S. customary units. Range and resolution measurement units have not been converted to metric units. PSI denotes pounds per square inch.

[3] Instrumentation data and data plots are presented in "Geotechnical Analysis Report for July 2022 - June 2023 Supporting Data" (DOE/WIPP-24-3610 Volume 2). The document is available upon request from the National Technical Information Service. See page ii for details and addresses.

1.4.2 Data Evaluation

Rounding and significant digits are used in the data tables of this document. The reference document is the American Society for Testing and Materials (ASTM) document ASTM D 6026-06, Standard Practice for Using Significant Digits in Geotechnical Data.

Closure measurements are acquired manually from convergence point anchors and remotely from convergence meters. Data are presented in plots of closure versus time. Closure rates are calculated and presented as part of the data analysis.

Extensometers provide displacement data from instrumented rods or wires anchored at various depths. Plots show displacement versus time for individual anchors.

Displacement rate data from the hole (collar) to the deepest anchor are presented in the data analysis.

The annual closure rate is calculated as follows:

$$Rate\ (\frac{inches}{year}) = [\frac{reading2 - reading1}{date2 - date1}] * 365.25\ \frac{days}{year}$$

reading = the change from the initial reading (inches)

reading1 = reading closest to the beginning of the reporting period

reading2 = reading closest to the end of the reporting period

Comparisons between closure rates of the previous and current reporting periods are presented as percent changes in rate and are calculated as follows:

$$Percent\ change\ in\ rate = (Rate_{Current\ Period} - Rate_{Previous\ Period}) / (Rate_{Previous\ Period}) \times 100\%$$

Rock bolt load cells are used to determine bolt support performance. Plots show load versus time for each instrumented bolt.

Earth pressure cells and strain gauges measure the stresses and deformation in and around the shaft liners. Data are depicted in time-based plots. Piezometers are used to measure the gauge pressure of groundwater and are installed in the shafts at varying elevations to monitor the hydraulic head acting on the shaft liners. Data are plotted as pressure versus time.

Joint meters, installed perpendicular to a fracture, monitor the dilation of the fracture with time. Data are presented as displacement versus time.

1.4.3 Data Errors

The GIS data are processed through a comprehensive database management system. Whether acquired manually or remotely, GIS data are processed and permanently stored according to approved procedures. On occasion, erroneous readings can occur. There are several possible explanations for erroneous readings, including the following:

- The measuring device was misread.
- The reading was recorded incorrectly.
- The measuring device was not functioning within specifications.

When a reading is believed to be erroneous, the suspect reading is evaluated, and, if necessary, a second reading is collected. If the second reading falls in line with the instrument trend, the first reading is discarded, and the second reading is entered into the database. If the second reading and subsequent readings remain out of the instrument trend, the ground conditions near the instrument are assessed to determine the reason for the discrepancy. In addition, the reading frequency may be increased.

2.0 GEOLOGY

This section provides a stratigraphic summary of the WIPP region and the Site. Readers desiring further geologic information may consult the Geological Characterization Report, WIPP Site, Southeastern New Mexico (Powers et al., 1978). This report was developed as a source document on the geology of the WIPP Site for individuals, groups, or agencies seeking basic information on geologic history, hydrology, geochemistry, or detailed information, such as physical and chemical properties of repository rocks. A more recent survey of WIPP stratigraphy is included in the Geologic Mapping of the Air Intake Shaft at the WIPP (Holt and Powers, 1990).

2.1 Regional Stratigraphy

The stratigraphy in the vicinity of the WIPP site includes rocks of Permian (295 to 250 million years [Ma] before present [bp]), Triassic (250 to 203 Ma), and Quaternary (1.75 Ma to present) ages. The descriptions of formations provided in this section are given in order of deposition (oldest to youngest), beginning with the Castile Formation (Figure 2-1, Regional Geology).

2.1.1 Permian

The Permian system in southwestern North America is divided into four series. The last of these, the Ochoan Series, contains the host rock in which the WIPP repository is located.

The Ochoan Series is of mainly marine origin and consists of four formations: three evaporite formations (the Castile, the Salado, and the Rustler) and one redbeds formation (the Dewey Lake). The Ochoan evaporites overlie marine limestones and sandstones of the Guadalupian Series (Delaware Mountain Group). The younger redbeds represent a transition from the lower evaporite deposition to fluvial deposition on a broad, low-relief, fluvial plain. The Permian rocks are overlain by fluvial deposits of the Triassic and Quaternary periods.

2.1.1.1 Castile Formation

The Castile Formation, the lowermost of the four Ochoan formations, is approximately 1,250 ft thick in the WIPP vicinity. Lithologically, the Castile is the least complex of the evaporite formations and is composed chiefly of interbedded anhydrite and halite, with limestone present in minor amounts.

2.1.1.2 Salado Formation

The Salado Formation comprises nearly 2,000 ft of evaporites, primarily halite. The formation is subdivided into three informal members: the unnamed lower member, the McNutt potash zone, and the unnamed upper member. Each member contains similar amounts of halite, anhydrite, and polyhalite and is differentiated based on soluble potassium- and magnesium-bearing minerals. The WIPP disposal horizon is within the unnamed lower member, 2,150 ft below the surface.

2.1.1.3 Rustler Formation

The Rustler Formation is subdivided into five members, starting from its base: the Los Medaños Member, the Culebra Dolomite Member, the Tamarisk Member, the Magenta Dolomite Member, and the Forty-niner Member.

In the vicinity of the WIPP Site, the Rustler is approximately 310 ft thick and thickens to the east. The lower portion (Los Medaños Member) contains primarily fine sandstone to mudstone with lesser amounts of anhydrite, polyhalite, and halite. Bedded and burrowed siliciclastic sedimentary rocks with cross-bedding and fossil remains signify the transition from the strongly evaporitic environments of the Salado to the brackish lagoonal environments of the Rustler (Holt and Powers, 1990).

The upper portion of the Rustler contains interbeds of anhydrite, dolomite, and mudstone. The Culebra Dolomite Member is generally brown, finely crystalline, and locally argillaceous. The Culebra contains rare to abundant vugs with variable gypsum and anhydrite filling and is the most transmissive hydrologic unit within the Rustler. The Tamarisk Member consists of lower and upper sulfate units separated by a unit that varies laterally from mudstone to mainly halite. The Magenta Dolomite Member is a gypsiferous dolomite with abundant primary sedimentary structures and well-developed algal features. The Forty-niner Member comprises lower and upper sulfate units separated by a mudstone with sedimentary features and bedding. To the east of the Site, halite correlates with mudstone. The Culebra and Magenta Dolomite members are persistent and serve as important marker units.

2.1.1.4 Dewey Lake Redbeds

The Dewey Lake Redbeds are the uppermost of the Ochoan Series formations. Within the series, the Dewey Lake represents a transition from the lower marine evaporite deposition to fluvial deposition on a broad, low-relief, fluvial plain. The redbeds, approximately 475 ft thick, consist of predominantly reddish-brown interbedded fine-grained sandstone, siltstone, and claystone. This formation is differentiated from others by its lithology and distinctive color (both of which are remarkably uniform), as well as by sedimentary structures, including horizontal- and cross-laminae and ripple marks. The redbeds also contain locally abundant greenish-gray reduction spots and gypsum-filled fractures. The formation thickens from west to east due to eastward dips and erosion to the west.

2.1.2 Triassic

The only Triassic rocks in the WIPP region belong to the Dockum Group.

2.1.2.1 Dockum Group

The Dockum Group consists of fine-grained floodplain sediments and coarse alluvial debris of the Triassic age. From a pinch-out near the center of the WIPP Site, it thickens eastward, forming an erosional wedge. Local subdivisions of the Dockum Group are the Santa Rosa Sandstone and the Chinle Formation; however, only the Santa Rosa occurs near the Site. It consists primarily of poorly sorted sandstone with conglomerate lenses and thin mudstone partings and contains impressions and remnants of fossils. These rocks have more variegated hues than the underlying uniformly colored Dewey Lake.

2.1.3 Quaternary

Quaternary Period deposits include the Gatuña Formation, Mescalero Caliche, and surficial sediments.

2.1.3.1 Gatuña Formation, Mescalero Caliche, and Surficial Sediments

The Gatuña Formation (ranging in age from approximately 1.3 million to 600,000 years bp) (Powers and Holt, 1993) is a stream-laid deposit overlying the Dockum Group in the WIPP vicinity. At the Site center, the formation consists of poorly consolidated sand, gravel, and silty clay at a thickness of approximately 13 ft. The Gatuña Formation is light red and mottled with dark stains. The unit contains abundant calcium carbonate but is poorly cemented. Sedimentary structures are abundant (Powers and Holt, 1993, 1995).

The Mescalero Caliche (approximately 100,000 years (Hall and Goble, 2011)) is approximately 4 ft thick in the WIPP vicinity. The Mescalero is a hard, resistant soil horizon beneath a wind-blown sand cover. The horizon is petrocalcic (i.e., very strongly cemented with calcium carbonate). Petrocalcic horizons form slowly beneath a stable landscape at the average infiltration depth of soil moisture, indicating the land surface's stability and integrity. Many of the surface buildings at the WIPP are founded on top of the Mescalero Caliche.

Surficial sediments include sandy soils developed from eolian material and active dune areas. The Berino Series (a soil type) covers about 50 percent of the Site and consists of deep sandy soils that developed from wind-worked material of mixed origin. Based on sample analyses, the Berino soil from the WIPP Site formed between the broad range of 18,000 to 50,000 years (Hall and Goble, 2012).

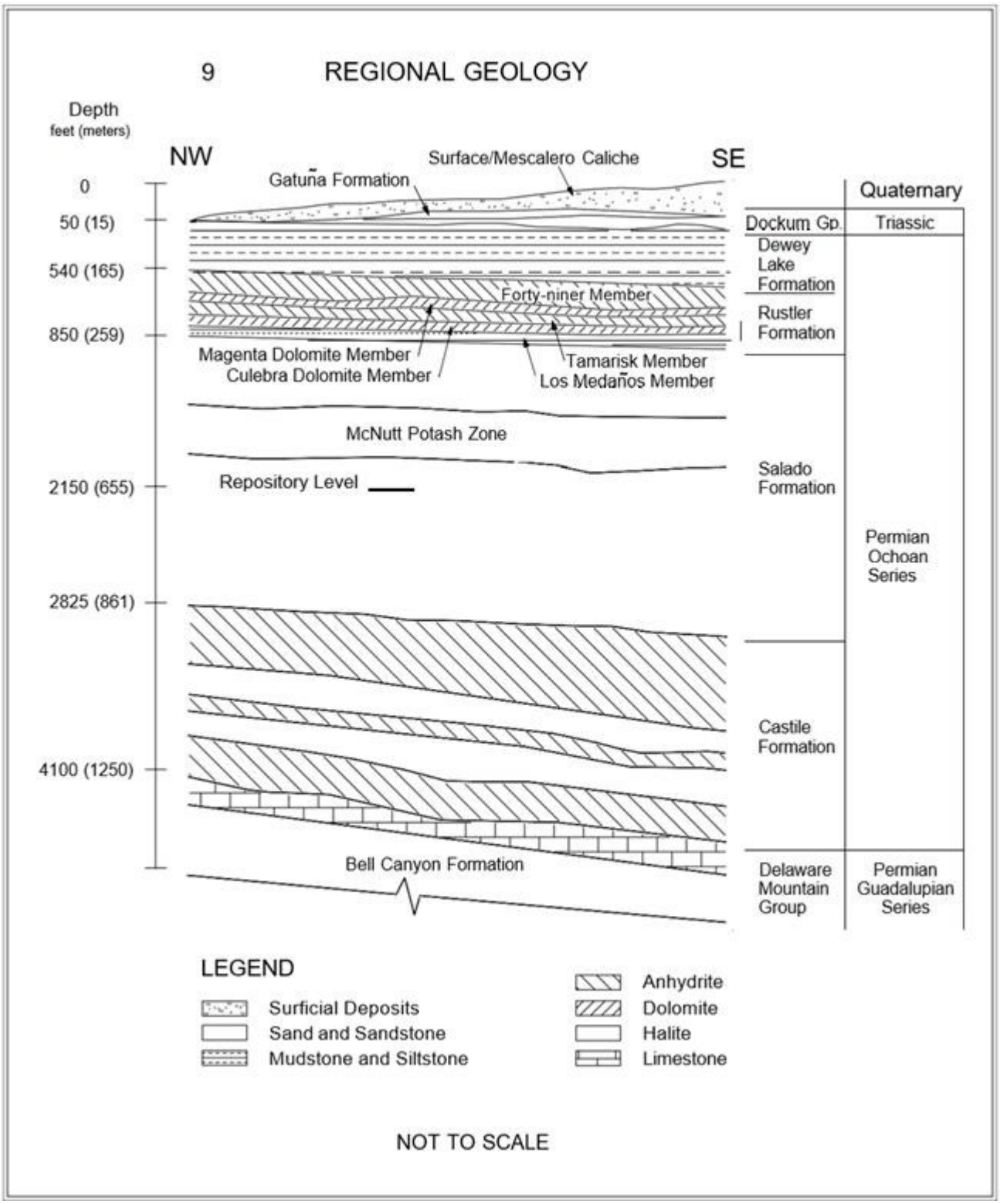

Figure 2-1 Regional Geology

2.2 Underground Facility Stratigraphy

The WIPP disposal horizon lies near the midpoint of the Salado Formation. The Salado was deposited in a shallow saline lagoon environment, which progressed through numerous inundation and desiccation cycles that are reflected in the formation. An "ideal" cycle progresses upward as follows: a basal layer consisting predominantly of claystone, followed by a layer of sulfate, which is, in turn, followed by a layer of halite. The entire sequence is capped by a bed of argillaceous (clay-rich) halite accumulated during a period of mainly subaerial exposure.

A regional system used to number the more significant sulfate beds within the Salado designates these beds as marker beds (MBs), counted from MB100 near the top of the formation to MB144 near the base. The repository is located between MB138 and MB139 within a sequence of laterally continuous depositional cycles described above. Within this sequence, layers of clay and anhydrite that are locally designated (as shown) can significantly impact the geomechanical performance of the excavations. Clay layers provide surfaces along which slip and separation can occur, whereas anhydrites form brittle layers that do not deform plastically.

In the vicinity of the WIPP, the stratigraphy is relatively continuous and uniform. Beds generally dip toward the south-southeast at a slope of approximately 3 percent.

2.2.1 Disposal Horizon Stratigraphy of Panels 1, 2, and 7

This disposal horizon contains Panel 1, Panel 2, and Panel 7, the shaft areas, the shop areas, the SPDV areas (which are now closed), and the access drifts north of S-2520.

Farther south, the four main entries rise in a ramp that starts at S-2520 and ends at S2750. Panel 7 excavation was completed in January 2013. Most underground excavations are located within this disposal horizon (Figure 2-2, Repository Level Stratigraphy of Panels 1, 2, and 7). The Orange Marker Bed (OMB) lies near the middle of the rib (i.e., the excavation wall). The OMB is a laterally consistent unit of moderate to light reddish-orange translucent halite, about 6 inches (in) thick, used as a point of reference during excavation.

MB139 lies approximately 11.5 ft below the OMB. MB139 is a 20 to 32-inch thick layer of polyhalitic anhydrite. The top of the anhydrite undulates up to 15 in, while the bottom is sub-horizontal and is underlain by Clay E.

Above MB139, a halite unit terminates at the OMB's base. Within this unit, polyhalite is locally abundant and decreases upward, while argillaceous material increases upward.

Above the OMB, a thin band of argillaceous halite gives way to a thick sequence of clear halite that becomes increasingly argillaceous upward and is capped by Clay F. This constitutes a thin layer occasionally interrupted by partings and breaks and is readily visible in the upper ribs. Above Clay F, another halite sequence begins that, as in lower sequences, becomes increasingly argillaceous upward. This sequence terminates at the Clay G/Anhydrite "b" interface, approximately 6.5 ft above the roof of most disposal horizon excavations, forming a roof beam that typically acts as a structural unit.

The roof of some disposal horizon excavations (e.g., the E-140 drift between S-1000 and S-1950) has been excavated to the upper contact of Anhydrite "b". In this case, a roof beam is formed by the next depositional sequence beginning with Anhydrite "b" and progressing upward to the Clay H/Anhydrite ”a” interface, approximately 6.5 ft above the upper contact of Anhydrite "b."

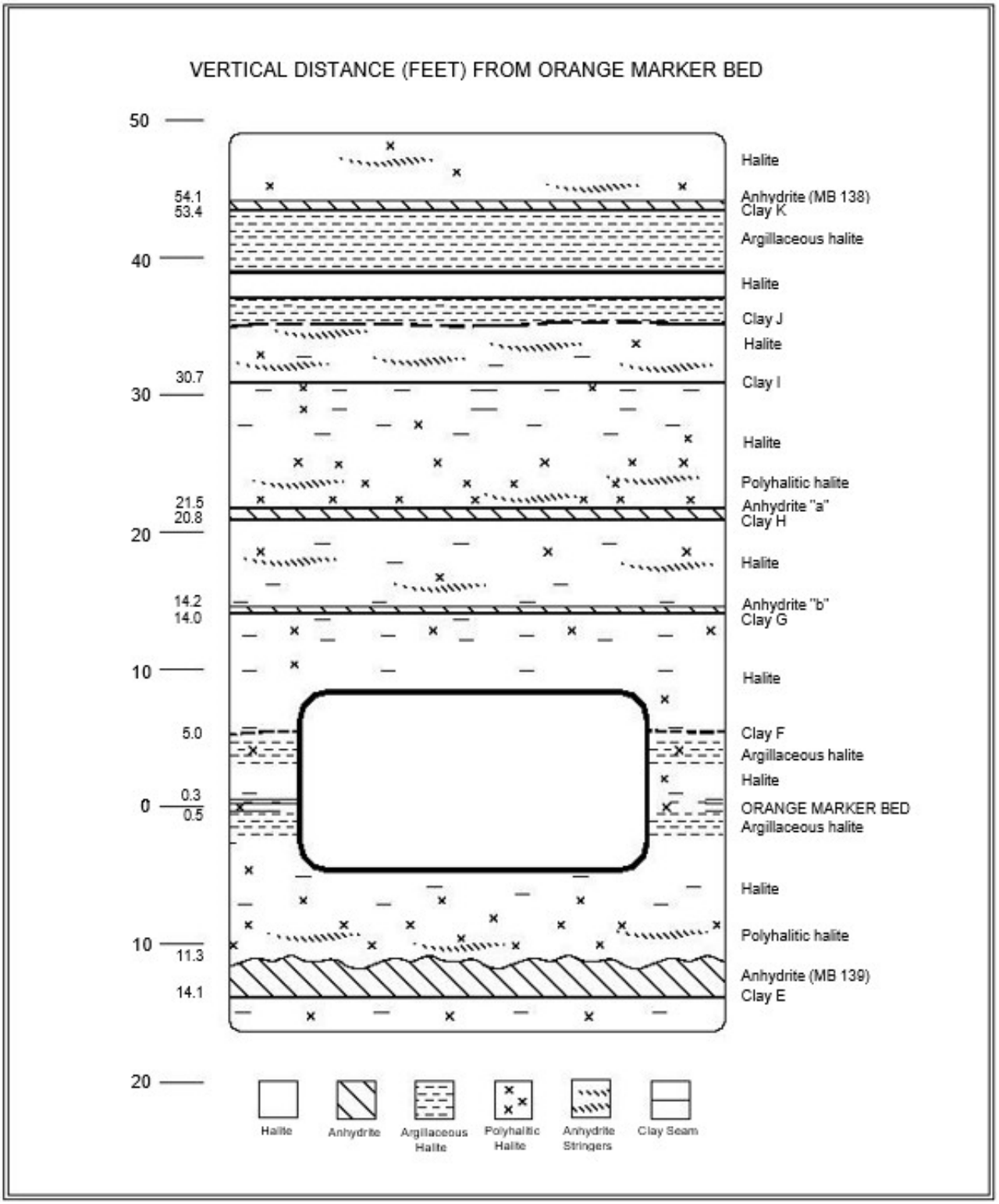

Figure 2-2 Repository Level Stratigraphy of Panels 1, 2, and 7

2.2.2 Disposal Horizon Stratigraphy of Panels 3, 4, 5, and 6

Field observations and computer modeling indicated that moving the disposal horizon stratigraphically upward (so that the roof was located at Clay G) would improve long-term ground conditions and provide a more stable roof configuration without significantly impacting repository performance. Consequently, In 2000, the mining horizon was moved up approximately 6 ft. Subsequently, in 2000 and 2001, ramps were mined in the W-170, W-30, E-140, and E-300 drifts between S-2520 and S-2750 (Figure 1-2). As a result, the disposal horizon for Panels 3, 4, 5, and 6, and the associated connecting drifts, lie above the horizon for the other panels (Figure 2-3, Repository Level Stratigraphy of Panels 3, 4, 5, and 6).

In the disposal horizon of Panel 3, 4, 5, and 6, the OMB lies at or below the floor. MB139 lies about 12 ft below the floor. The roof lies at or slightly above Anhydrite "b". Clay G/Anhydrite "b" is used as the mining reference during the excavation of this disposal horizon. Locally continuous anhydrite stringers within this horizon extend to Clay Hat Anhydrite “a”, generally concentrated in the lower portion toward Anhydrite "b". These effectively divide the roof beam into a series of thinner, independent beams, weakening the overall beam strength.

2.2.3 Disposal Horizon Stratigraphy of Panel 8

Panel 8 was mined initially on the lower horizon due to the interruption in mining. This interruption resulted in significant low-angle shear and separation in the immediate back. To increase back stability, the back of Panel 8 has been mined to the upper horizon (Clay G / Anhydrite “b”), placing MB138 approximately 30 ft above the back. The floor of Panel 8 lies 2 ft below the OMB to reduce floor heave and movement. MB139 is located 8 ft below the floor of Panel 8. Figure 2-4, Repository Level Stratigraphy of Panel 8, shows the change in stratigraphy at different depths.

2.2.4 Northeast Area Stratigraphy

The Northeast Area, formerly an experimental area, is now deactivated and closed for access. These excavations lie at a higher stratigraphic level than the disposal excavations. Floors are at Anhydrite "b". As in the lower units, the halite intervals between the clay seams/anhydrite beds contain relatively pure halite that becomes increasingly argillaceous upward. Above Clay I, two more halite intervals complete the underground facility stratigraphy. At the top of the first of these intervals, Clay J may consist of a distinct seam or merely an argillaceous zone. Clay K tops the second interval and is overlain by MB138.

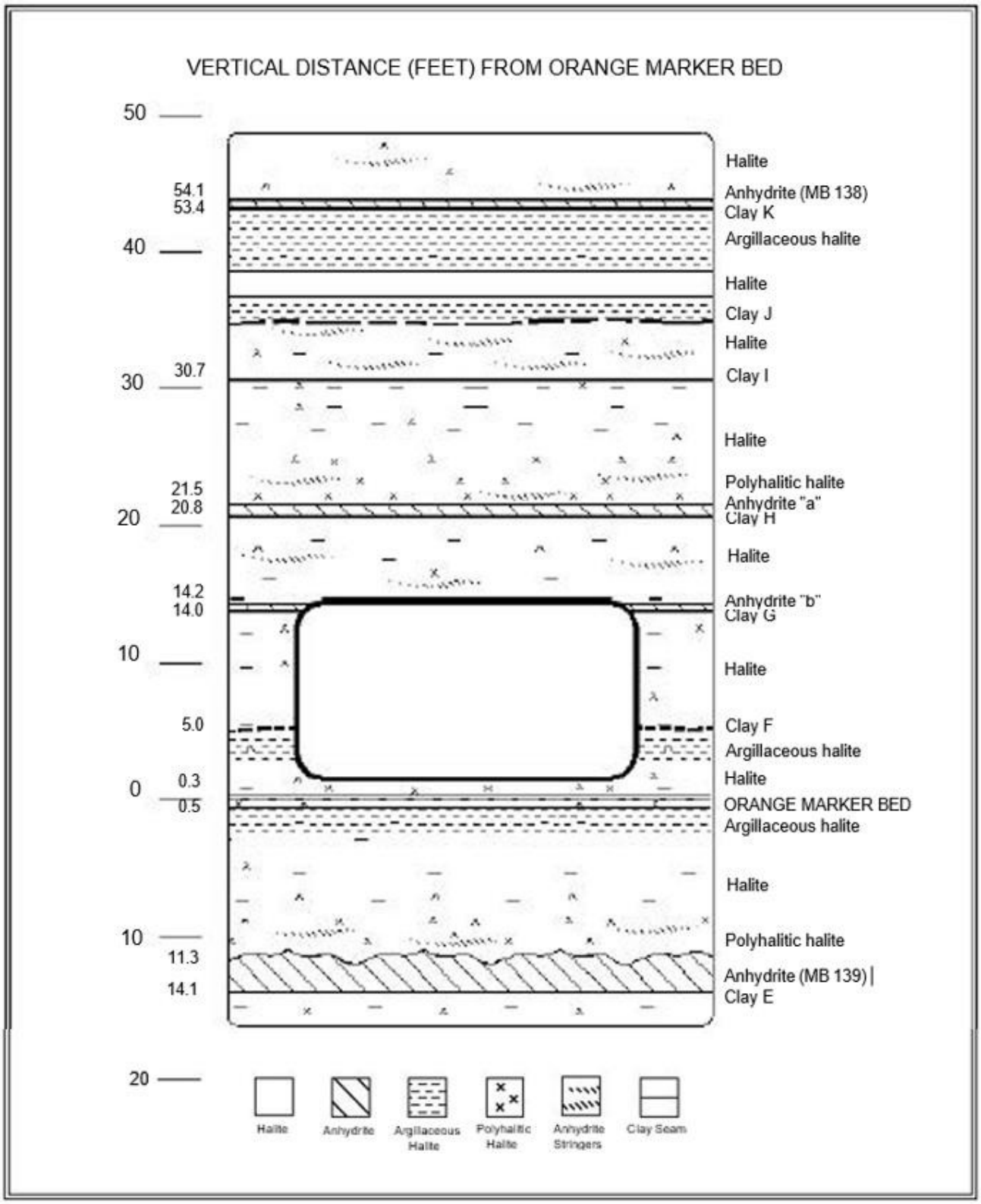

Figure 2-3 Repository Level Stratigraphy of Panels 3, 4, 5, and 6

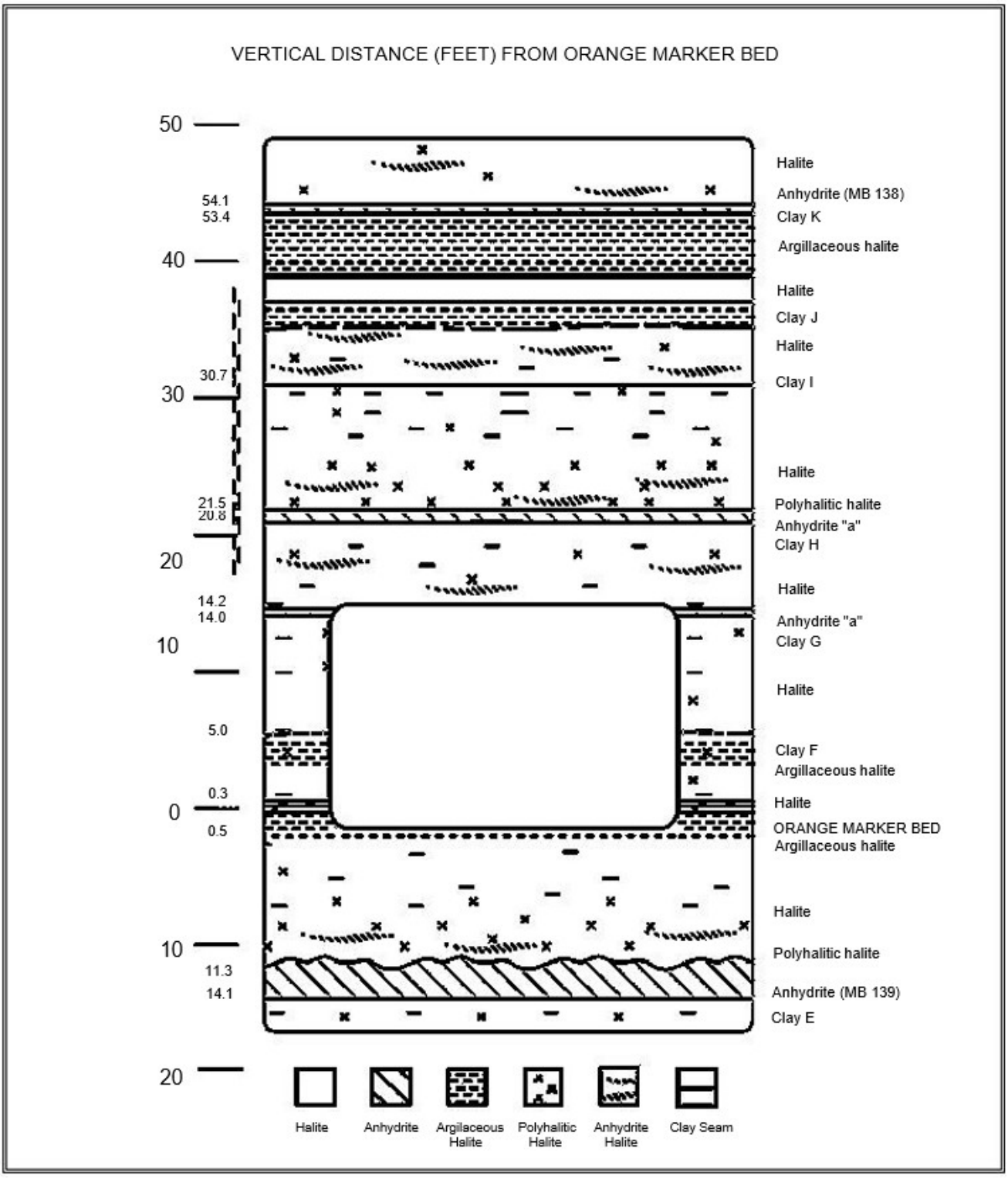

Figure 2-4 Repository Level Stratigraphy of Panel 8

3.0 PERFORMANCE OF SHAFTS AND KEYS

Four shafts connect the surface with the underground at the WIPP. They are the Salt Shaft, which is used primarily for removing excavated salt from the underground and for transporting personnel and materials; the Waste Shaft, which is mainly used for transporting TRU waste to the underground and for transporting personnel and materials; the Exhaust Shaft, which is used to exhaust the ventilation air from the underground; and the Air Intake Shaft, which is the primary source of fresh air ventilation to the underground. This section describes the geomechanical performance of these shafts.

Although much of the instrumentation installed in the shafts has failed through the years, there are no plans to replace it. Information on each failed instrument is still available in Section 3.1.2, Instrumentation. The DOE has a good understanding of the expected movements in the shafts. Monitoring results up to the point of instrument failure did not indicate unusual shaft movements or displacements.
Continued periodic visual inspections confirm the expected shaft performance and provide necessary observations to evaluate shaft performance. Replacement of failed instrumentation will not provide significant additional information. Investigations into new technologies such as Lidar and drones are being evaluated for functional use of measuring salt creep within the shafts at WIPP.

3.1 Salt Shaft

The first construction activity undertaken by the SPDV Program was the excavation of the Exploratory Shaft. This shaft was subsequently referred to as the Construction and Salt Shaft and is currently designated the Salt Shaft (see Figure 1-2). The shaft was drilled from July 4 to October 24, 1981, and geologically mapped in the spring of 1982 (DOE, 1983). Figure 3-1, Salt Shaft Stratigraphy, presents the stratigraphy in the shaft.

The Salt Shaft is lined from the surface to 846 ft with steel casing having an inside diameter of 10 ft. The thickness of the steel liner (including external stiffener rings) increases from 0.62 in at the top to 1.5 in at the key. Cement grout was placed between the liner and the rock face. The 10-ft-diameter steel liner extends through the concrete shaft key to 880 ft. The shaft key is a 37.5-ft-long reinforced concrete structure that begins 3.5 ft above the bottom of the steel liner. From the key to the bottom at 2,298 ft, the shaft has a nominal diameter of 12 ft.

Wire mesh anchored by rock bolts is installed in sections of the lower shaft as a safety screen to contain rock fragments that may become detached. The shaft extends approximately 140 ft below the repository horizon to accommodate the skip-loading equipment and a sump. The Salt Shaft Pocket loading facility was evaluated and determined to need improvements. Bids were submitted at the end of the reporting period to develop a design to support removing the existing salt pocket steel structure and equipment, relieve the salt pocket rib convergence, and re-establish it to its original design dimensions.

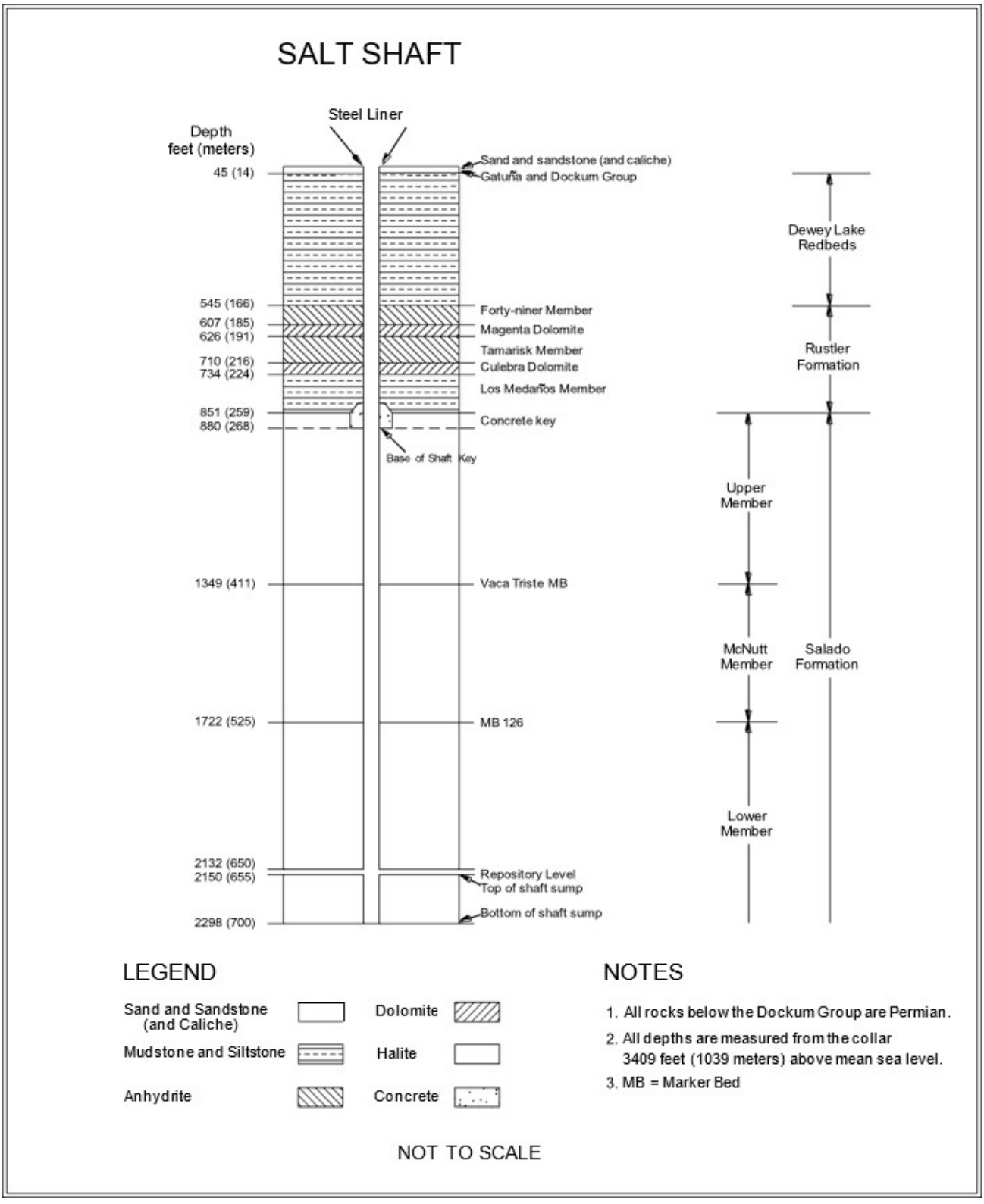

Figure 3-1 Salt Shaft Stratigraphy

3.1.1 Shaft Observations

Underground operations personnel conduct weekly visual inspections. These inspections are performed principally to assess the condition of the hoisting and mechanical systems, but they also include examining the shaft walls for water seepage, loose rock, or sloughing. Visual inspections during this reporting period found that the shaft remains in satisfactory condition. Only routine ground control activities were required.

3.1.2 Instrumentation

Geomechanical instruments (radial convergence points, extensometers, earth pressure cells, embedment strain gauges, and piezometers) are installed at various levels in the shaft (Figure 3-2, Salt Shaft Piezometer Locations, and Figure 3-3, Salt Shaft Key Instrumentation Locations). No new instrumentation was installed during this monitoring period. Instruments in the shaft key include strain gauges, pressure cells, and piezometers. Radial convergence points were installed before outfitting. Upon completion of shaft outfitting, no more readings were taken.

Eight piezometers continue to provide data. Due to age-related instrumentation degradation and unreliability in the data provided, the array of piezometers in the salt shaft is considered a legacy system.

Four Earth pressure cells were installed in the key section during concrete emplacement at the 860-ft level. These instruments measure the normal stress between the concrete key and the Salado as salt creep loads up the key structure.

Two out of the four Earth pressure cells continue to provide data. Both instruments indicate no contact pressure since installation, which is most likely due to an installation problem.

Sixteen spot-welded and 24 embedment strain gauges were installed on and in the shaft key concrete at the 856.3-ft (261-m) level and 862.4-ft (263-m) level. One spot-welded strain gauge still functions at the 856.3-ft (261-m) level. The maximum strain recorded in this reporting period is 669 microstrain, and the maximum for the 2021-2022 reporting period was 683 microstrain.

Eighteen embedment strain gauges are still functioning. The strains of the twelve embedment strain gauges at the 856.3-ft (261-m) level ranged from -683 to 994 microstrain. Negative strain gauge readings in the shaft are caused by salt creep. The strains from the six embedment strain gauges at the 862.4-ft (263-m) level were 47 to 3704 microstrain. The strain recorded by the spot-welded strain gauge and the embedment strain gauges during this reporting period are similar to the strains recorded by these instruments at the end of the previous reporting period.

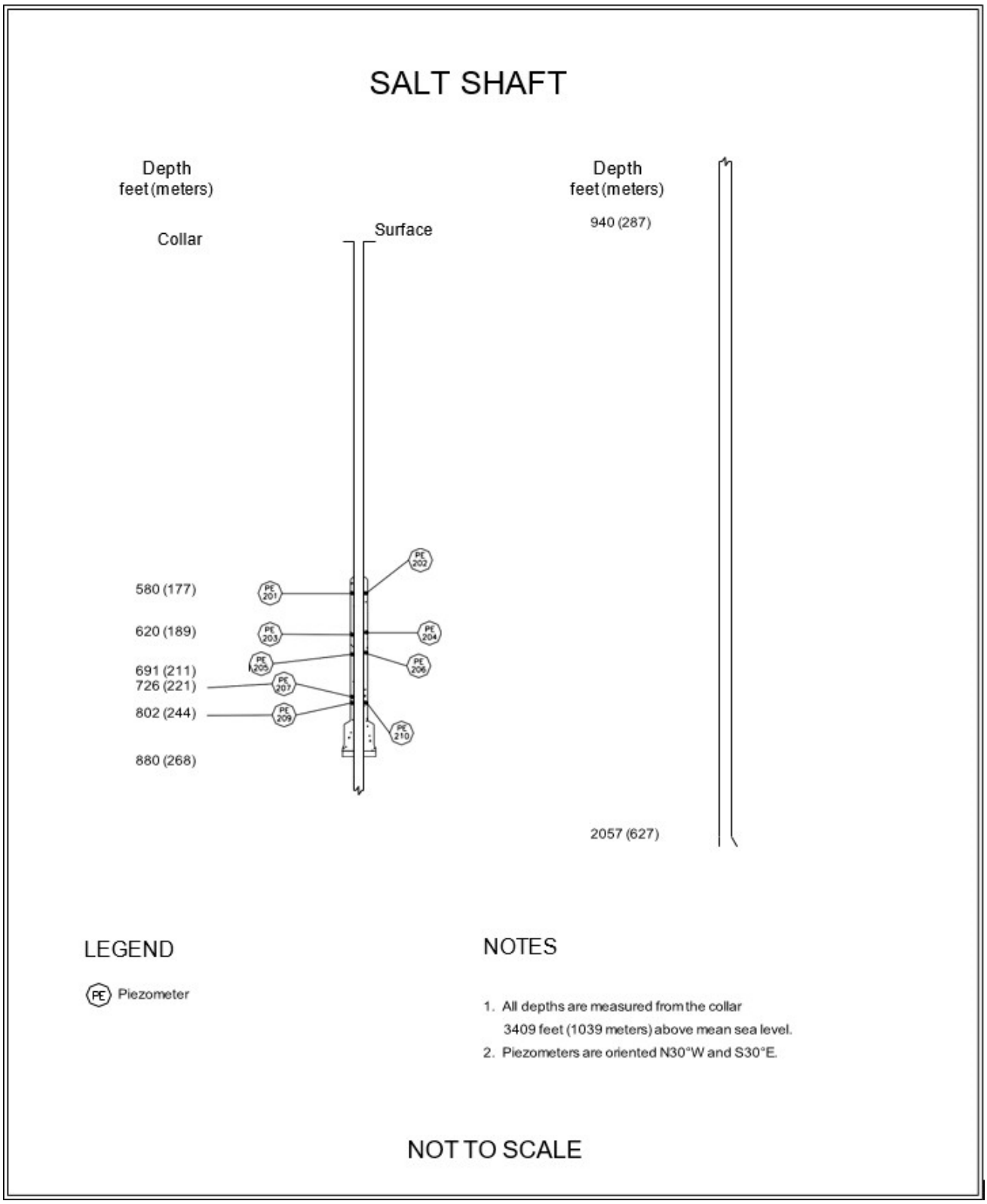

Figure 3-2 Salt Shaft Piezometer Locations

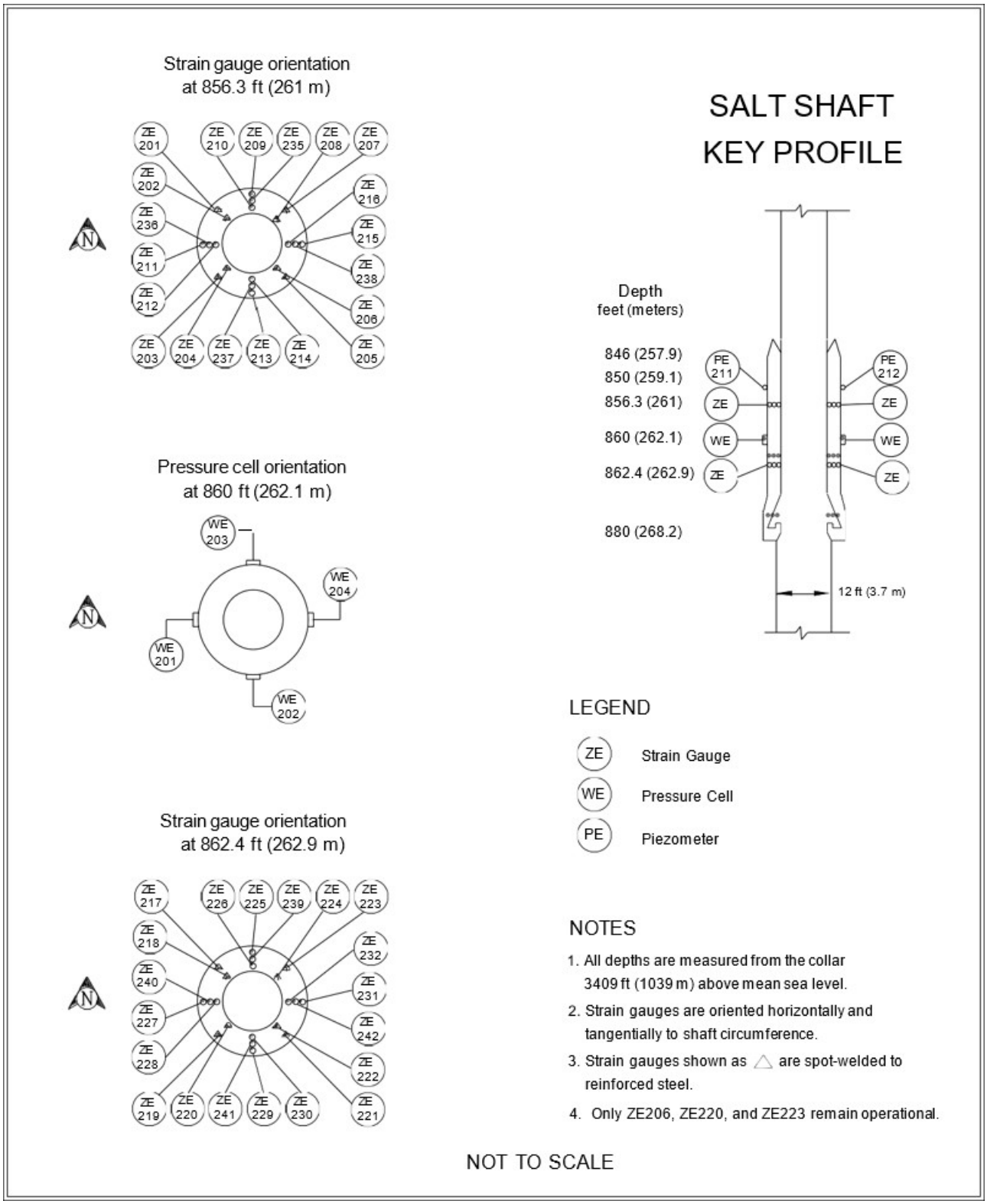

Figure 3-3 Salt Shaft Key Instrumentation Locations

3.2 Waste Shaft

The Waste Shaft is used primarily for transporting TRU waste, personnel, and materials to the underground. Formerly called the Ventilation Shaft, the Waste Shaft was excavated between December 1981 and February 1982 as part of the SPDV program (Figure 1-2). Between October 11, 1983, through June 11, 1984, the Waste shaft was enlarged to a diameter of 20 ft to 23 ft and lined above the key. In addition, stratigraphic mapping (Figure 3-4, Waste Shaft Stratigraphy) was conducted during shaft enlargement from December 9, 1983, to June 5, 1984 (Holt and Powers, 1984).

The Waste Shaft is lined with non-reinforced concrete to the top of the key at 837 ft. Liner thickness increases from 10 in at the surface to 20 in at the key. The key is 63 ft long and 4.25 ft thick and constructed of reinforced concrete. Below the key, the shaft is lined with wire mesh anchored by rock bolts. A seepage collection sump is situated at the base of the shaft. The top and bottom depths of the sump are 2,167 and 2,286 ft, respectively.

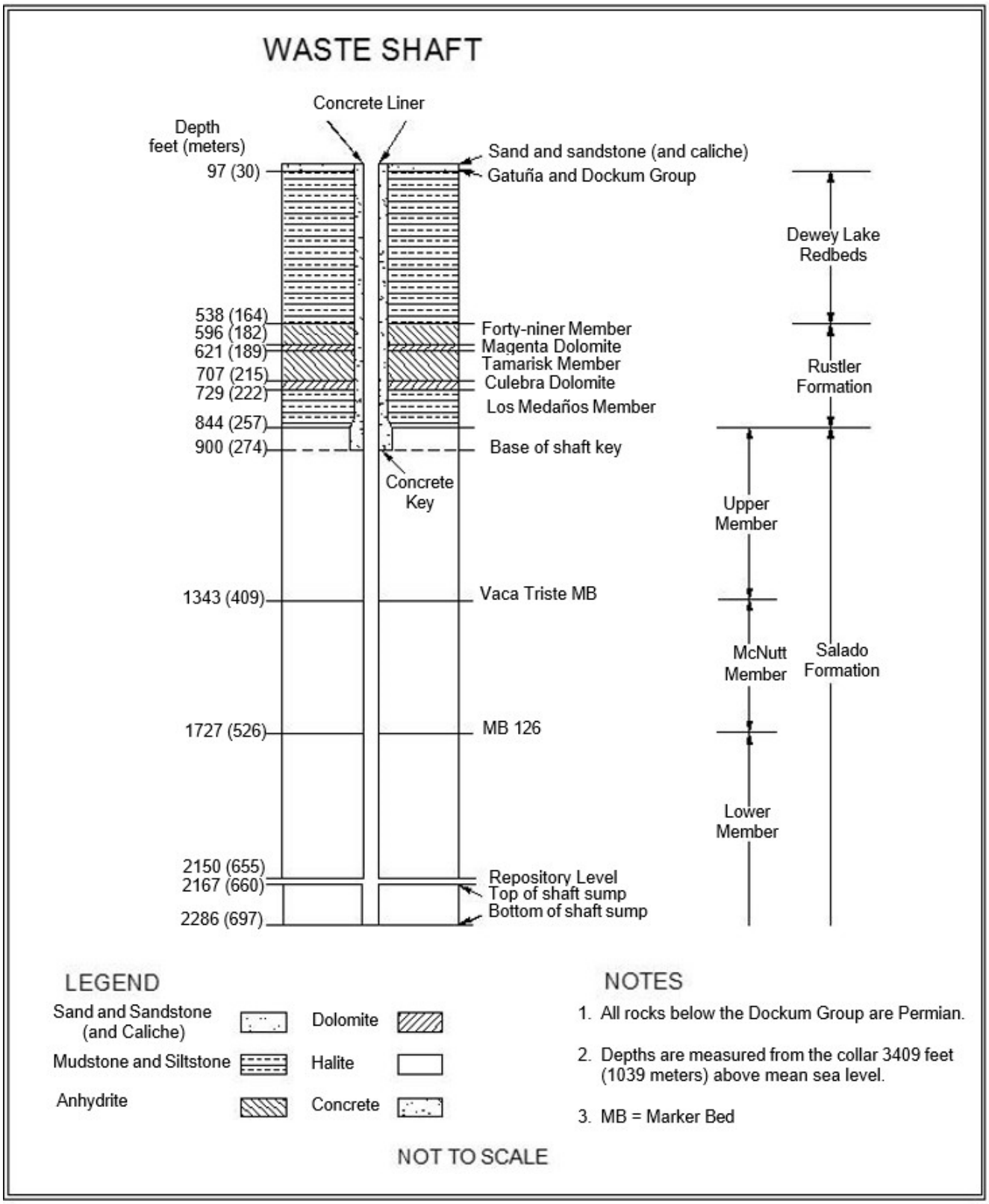

Figure 3-4 Waste Shaft Stratigraphy

3.2.1 Shaft Observations

Underground operations personnel conduct weekly visual inspections to assess the condition of the hoisting and mechanical systems and to examine the shaft walls for water seepage, loose rock, or sloughing. Visual inspections during this monitoring period concluded that the shaft was in satisfactory condition. No ground control activities other than routine maintenance were required.

3.2.2 Instrumentation

Radial convergence points, extensometers, piezometers, and earth pressure cells were installed in the Waste Shaft before the outfitting between August 27 and September 10, 1984. Upon completion of shaft outfitting, no more radial convergence readings were taken. Figure 3-5, Waste Shaft Piezometer Locations, and Figure 3-6, Waste Shaft Key Instrumentation Locations, show the instrument locations in cross-section view.

Nine multi-position extensometers were installed in arrays 1,071 ft, 1,566 ft, and 2,059 ft below the surface, as shown in Figure 3-5. Each array consists of three extensometers. No extensometer data have been collected in recent years due to the malfunction of the data acquisition equipment. Efforts to reestablish connection have been unsuccessful because the type of extensometer installed in the shaft is no longer manufactured or supported.

Twelve piezometers were installed in the lined section of the Waste Shaft on September 7 and September 8, 1984, to monitor fluid pressure behind the shaft liner and the key section. As of this reporting period, data are no longer being received from the piezometers.

Four Earth pressure cells were installed in the key section of the Waste Shaft during concrete emplacement, which occurred between March 23, 1984, and April 3, 1984. Earth pressure cells measure the normal stress between the concrete key and the Salado Formation as salt creep loads the key structure. As of this reporting period, data is no longer being received from any of the Earth pressure cells.

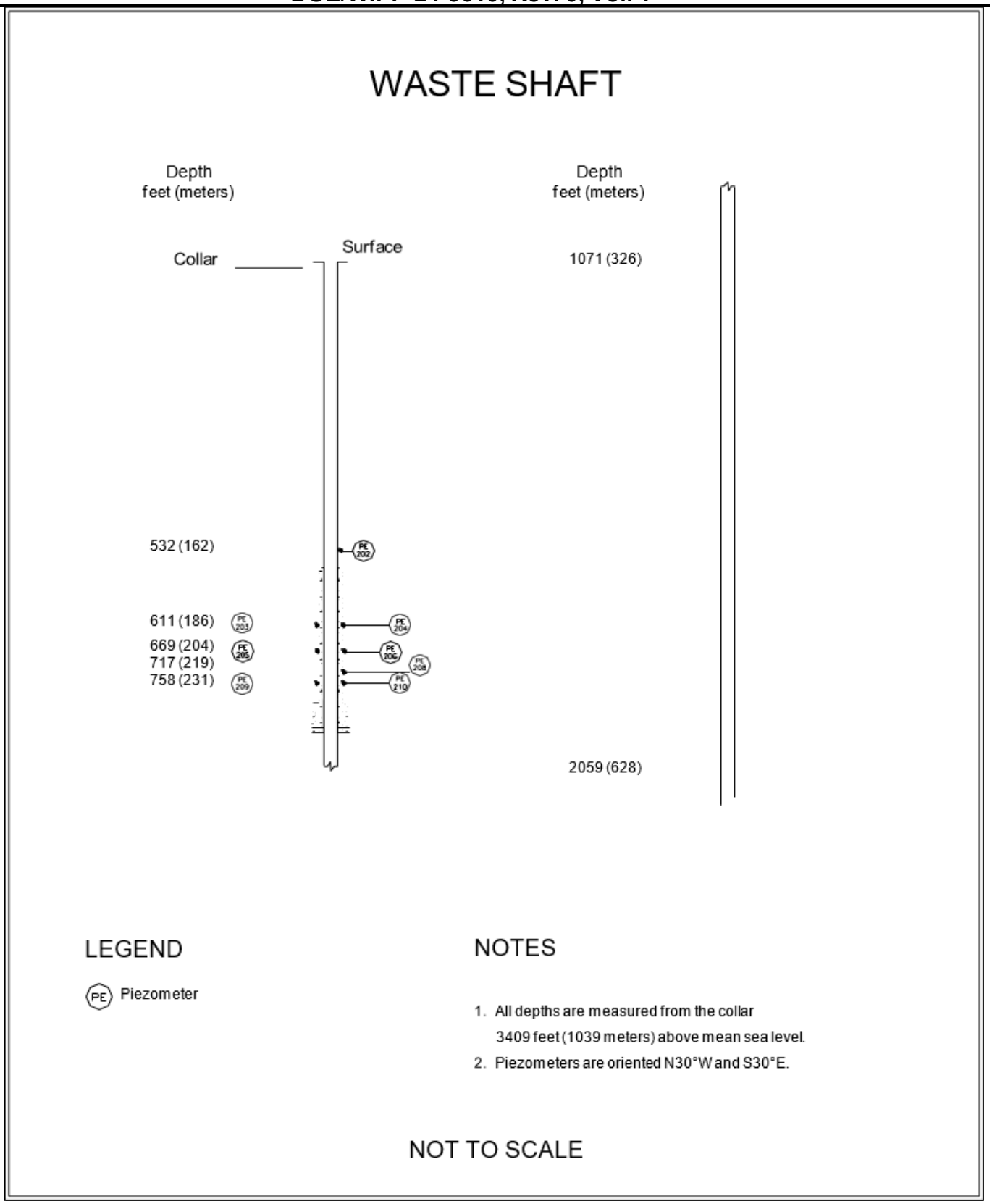

Figure 3-5 Waste Shaft Piezometer Locations

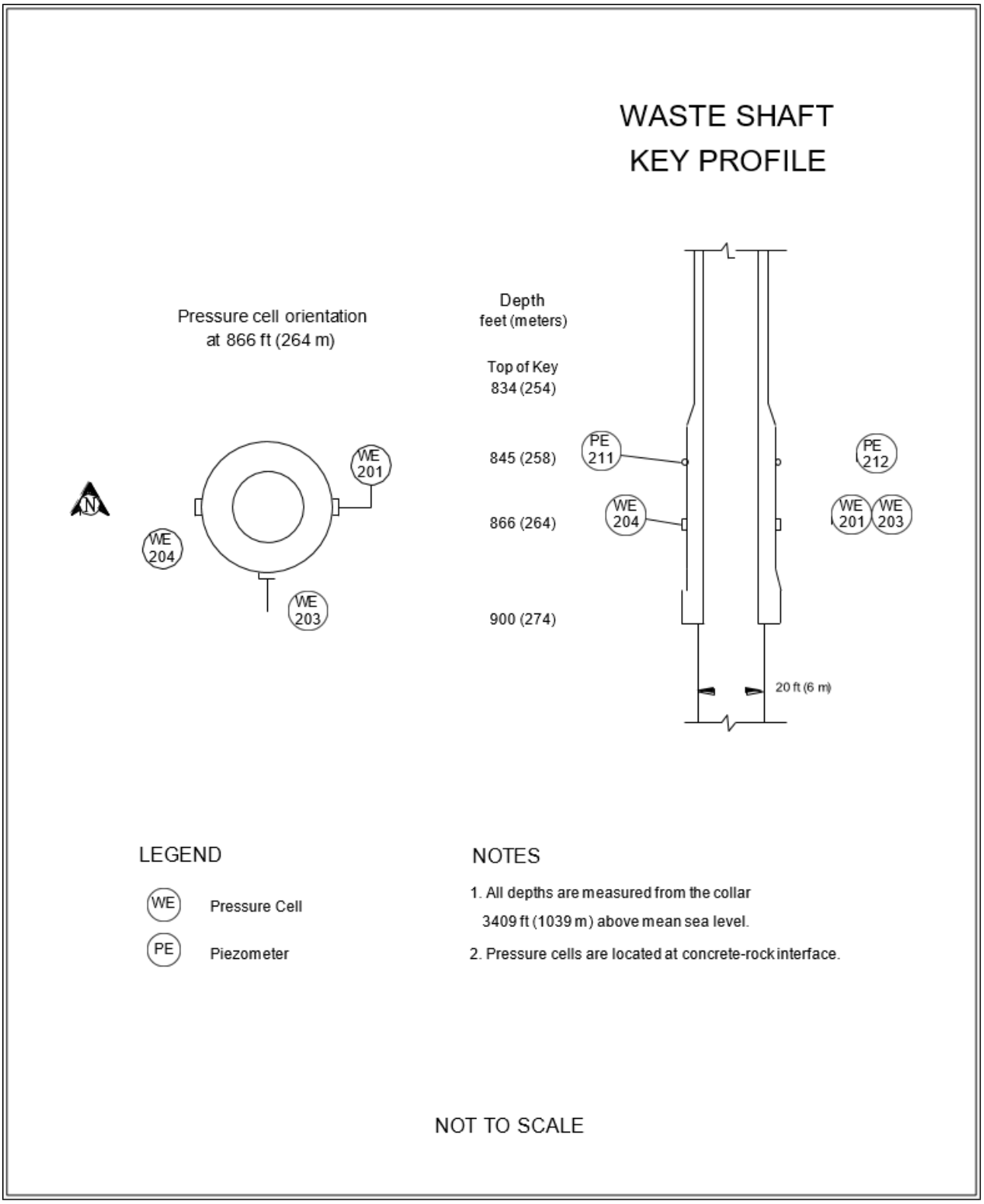

Figure 3-6 Waste Shaft Key Instrumentation Locations

3.3 Exhaust Shaft

The Exhaust Shaft exhausts the ventilation air from the underground to the surface. Drilling of the Exhaust Shaft began on September 22, 1983, and was completed on November 29, 1984. The location of the shaft is shown in the plan view in Figures 1 and 2. Stratigraphic mapping was conducted from July 16, 1984, to January 18, 1985 (DOE, 1986). Figure 3-7, Exhaust Shaft Stratigraphy, illustrates the shaft stratigraphy.

The Exhaust Shaft is lined with non-reinforced concrete from the surface to the top of the shaft key at 844 ft. The liner thickness increases from 10 to 16-in over that interval. The key is 63-ft-long and 3.5-ft- thick. The shaft diameter below the key is 15 ft, and the interval below the key is lined with wire mesh anchored by rock bolts. The shaft terminates at the facility horizon, approximately 2,150 ft deep. This shaft has no sump.

3.3.1 Exhaust Shaft Visual Inspection

Quarterly video inspections of the Exhaust Shaft are conducted according to approved WIPP procedures. Inspections are performed to evaluate the condition and to verify the integrity of the shaft. The shaft is examined for cracks, corrosion, deterioration, salt buildup, seepage, and debris. In addition, inspections examine the condition of anchors, brackets, and down-hole equipment. Exhaust Shaft video inspections were performed this reporting period in September 2022, November 2022, February 2023, and May 2023. A custom-designed, vertical-drop color camera with pan, tilt, and zoom capability in aerodynamic housing was utilized for the inspections. The camera is suspended by a dual-armored cable. The cable contains five copper conductors and two multi-mode optical fibers. It is reeled out by a winch mounted in a control trailer. Inspections are recorded electronically. The interpretation of data focuses on four primary areas: the air-monitoring system, shaft liner, shaft walls, and equipment support and cabling.

The air-monitoring system consists of one tube providing a conduit for air-velocity measurements and three tubes for monitoring possible radionuclides within the exhaust air stream (Figure 3-8, Sample Intake of Exhaust Shaft Air Monitoring System). Each device was inspected, including the transport assembly, guide tubes, the sample intake, and the support brackets that extend from Station "A" above the shaft to the shaft collar.

The shaft walls were examined for salt buildup, cracks, moisture, and encrustations, with particular attention paid to power cables, instrument cables, air, and water lines, and the three water rings occurring at the base of the Magenta and Culebra members of the Rustler Formation and the bottom of the shaft key. The condition of the shaft wall with respect to salt buildup varies depending on airflow, humidity, temperature, and underground mining activities. The shaft conditions for this reporting period largely mirror the conditions during the previous reporting period. There were no significant changes in the thickness of the salt in the shaft plenum, ranging from zero to several feet thick. The principal seepage in the shaft liner during this period was located at about 60-65 ft and 80-85 ft below the shaft collar. Also, there continues to be an increase in salt buildup along the shaft walls in the form of stalactites in the lower portion of the shaft.

Similar to previous inspections, sporadic salt buildup continues on the remaining cables in the shaft. The long-term implication of salt buildup is increased loading on cables and cable hangers, accompanied by intermittent falling of debris. The 4-in compressed airline and the 2-in water line extend from the surface to the bottom of the shaft. At present, neither line is being used. The integrity of the brackets holding the air and water lines continues to be impossible to assess because of salt buildup.
Many instrumentation cables and the abandoned 13.8-kilovolt ampere(s) power cables have broken off and fallen to the base of the shaft. There are no visible signs of dissolution of the salt below the key.

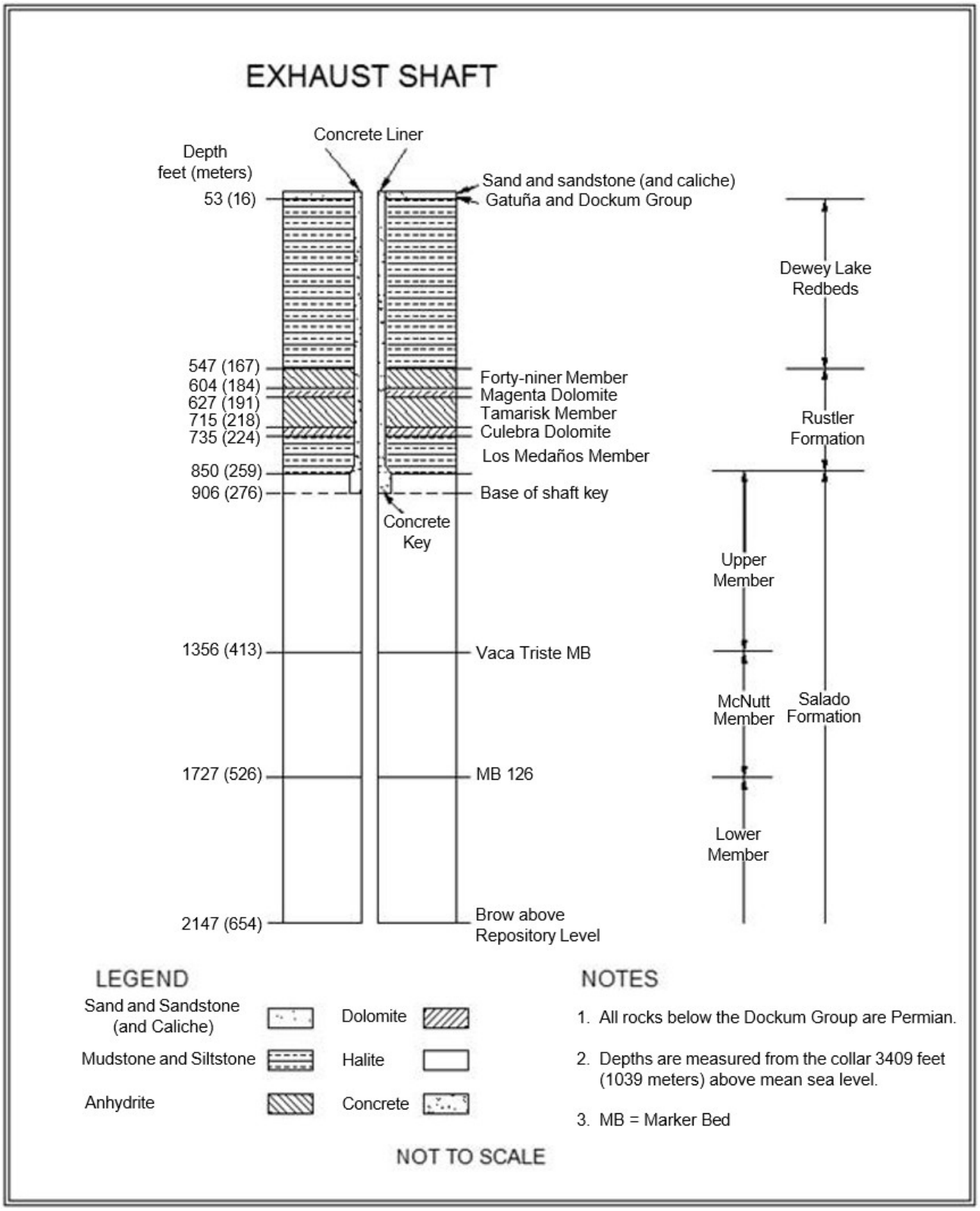

Figure 3-7 Exhaust Shaft Stratigraphy

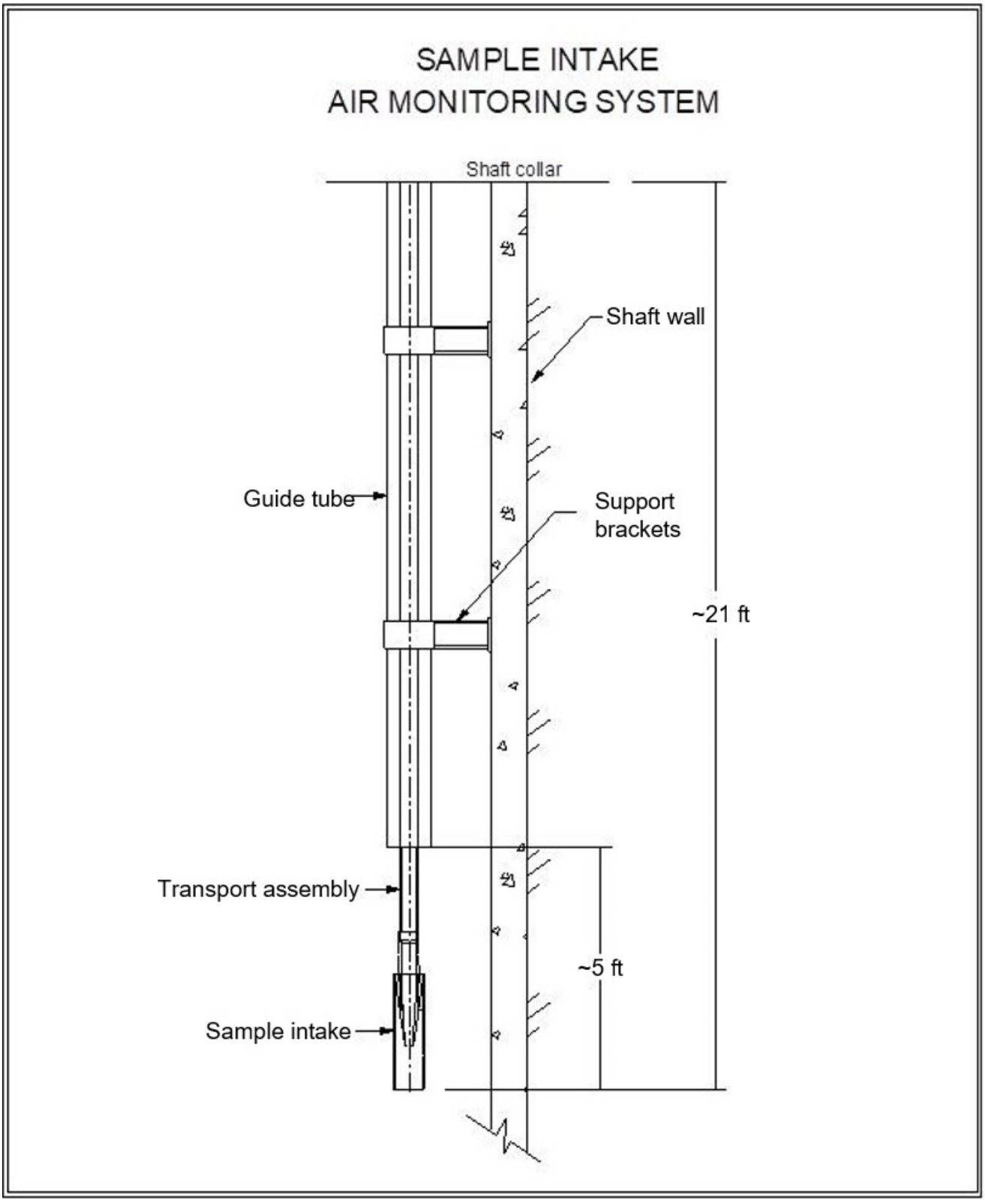

Figure 3-8 Sample Intake of Exhaust Shaft Air Monitoring System

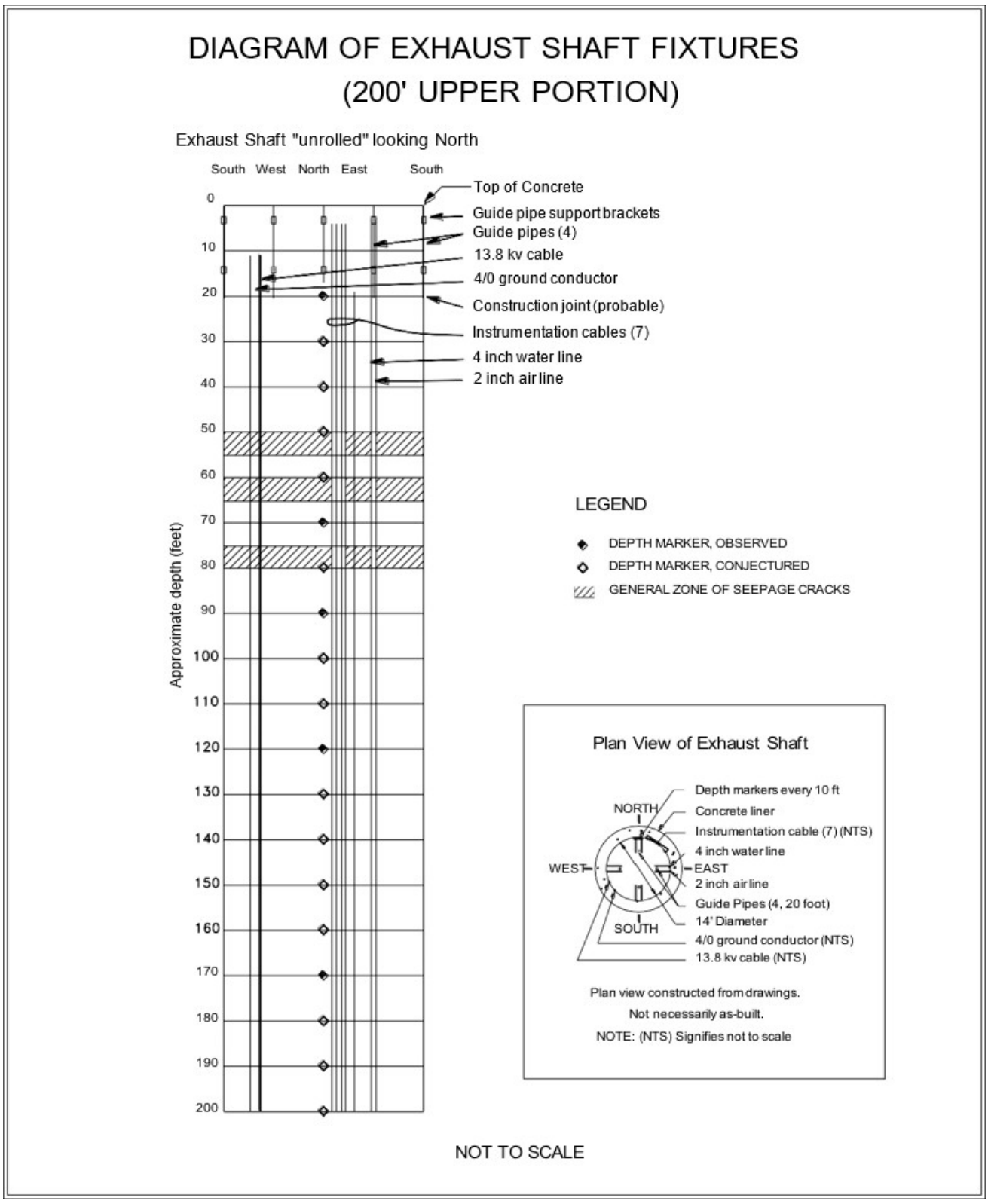

Figure 3-9 Diagram of Exhaust Shaft Fixtures and Seepage Zones (Upper 200 ft)

3.3.2 Instrumentation

The Exhaust Shaft was equipped with geomechanical instrumentation in two stages. Earth pressure cells were installed behind the liner key in November 1984. Piezometers and nine multi-position extensometers were installed during November and December 1985. Figure 3-10, Exhaust Shaft Instrumentation, and Figure 3-11, Exhaust Shaft Key Instrumentation, show the instrument locations. None of these instruments currently provide data. Due to inaccessibility to the inside of the shaft, the failed instrumentation and associated cabling cannot be replaced. Visual Exhaust shaft inspections, as described above, are used to monitor the condition of the shaft in lieu of these instruments.

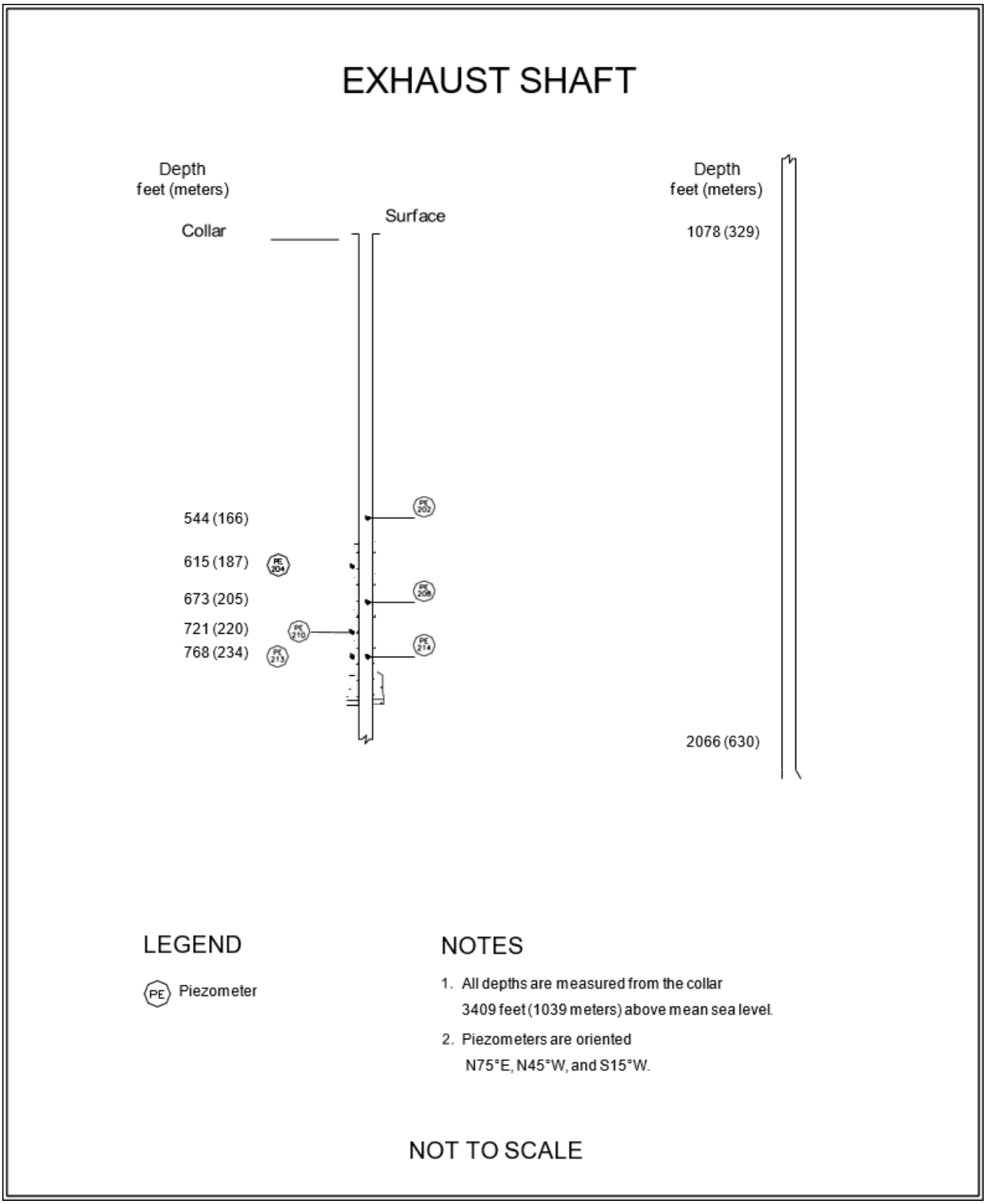

Figure 3-10 Exhaust Shaft Instrumentation

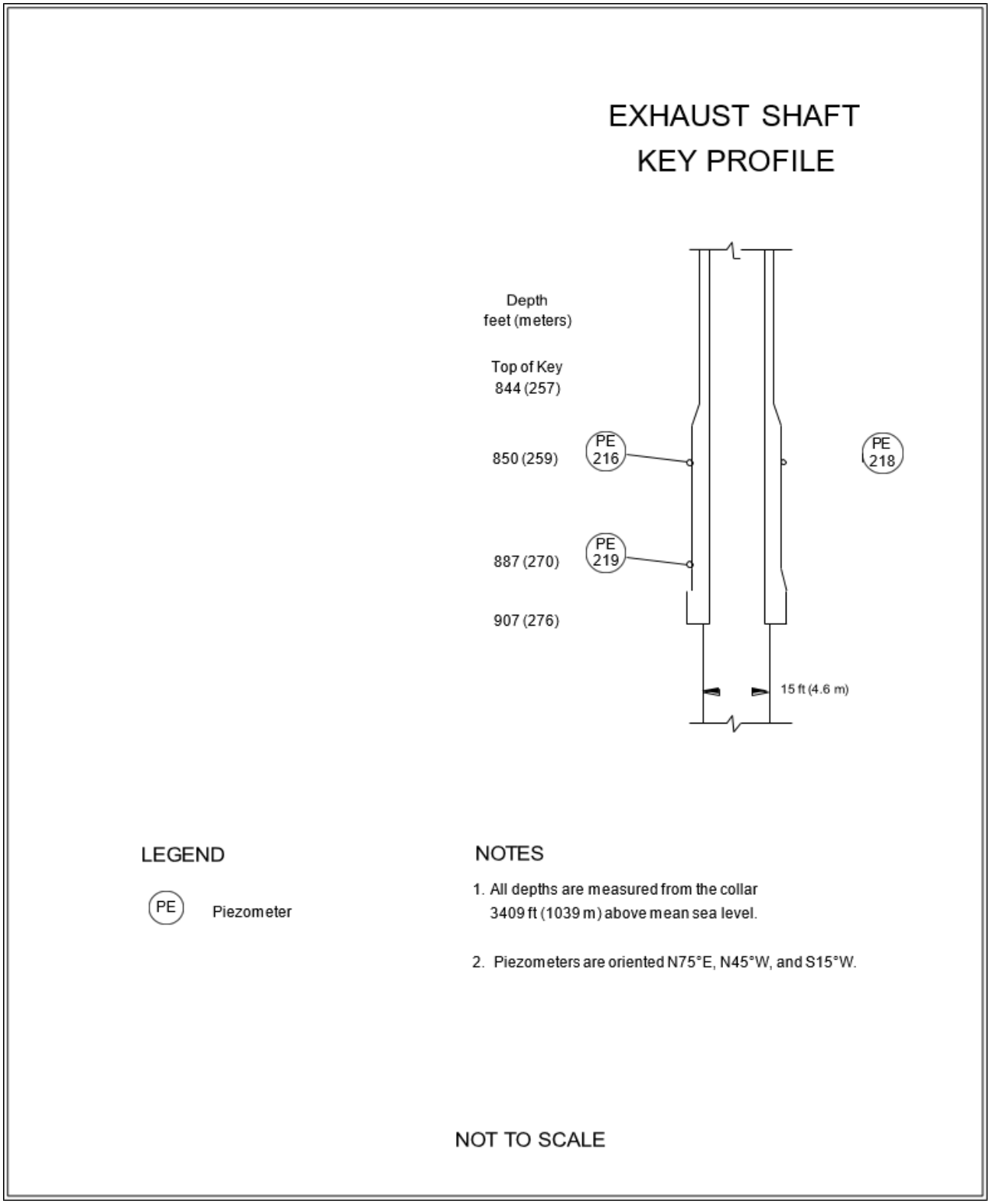

Figure 3-11 Exhaust Shaft Key Instrumentation

3.3.3 Interception Well System

Currently, there are three principal zones of seepage in the shaft originating from perched-shallow-water-bearing horizons at the base of the Santa Rosa. The depths of the zones are approximately 50 to 55 ft, 60 to 65 ft, and 80 to 85 ft below the shaft collar, respectively (Figure 3-9, Diagram of Exhaust Shaft Fixtures and Seepage Zones (Upper 200 ft)). Based on the review of inspection videos, seepage estimates suggest that the flow rate into the shaft is approximately 1 to 1.5 gallons per minute. After seepage was detected in the shaft, catch basins were designed and installed at the base of the Exhaust Shaft to intercept water and prevent it from draining into the Waste Shaft sump. After the catch basins failed, an interception well system was installed as a replacement between November 2005 and March 2006. The wells were drilled down-gradient in S-400 between E-140 and E-300 (Figure 3-12, Location of Interception Wells and Storage Tanks).

The interception well system initially consisted of four 30-ft-deep 9-7/8-in-diameter seepage collection boreholes with a submersible pump and pressure transducer in each; however, two additional wells were drilled to increase fluid recovery. Figure 3-12 shows the location of the interception well system, which collected seepage water until June 2016. The largest reported volumes are typically associated with periods of reduced ventilation and increased humidity. For a discussion of the factors affecting the quantity of fluid produced in the Exhaust Shaft, refer to DOE/WIPP-00-2000, Brine Generation Study (DOE, 2000). The system has collected no fluid since June 2016 due to the movement of the fluid collection tanks from the S-550 to the S-410 alcove. In November 2016, refurbishment and tank relocation activities were suspended due to severe ground control issues in Panel 7. Since August 2022, a restart of the system is ongoing. Work orders, procurements, and an Engineering Change Notice have been prepared and submitted; parts have been received. As of this reporting period, Work Packages have been prepared to install four new pumps with new power terminations and complete the fluid collection tank work. This work is scheduled to be started in October 2023 and will be updated in the 2025 GAR.

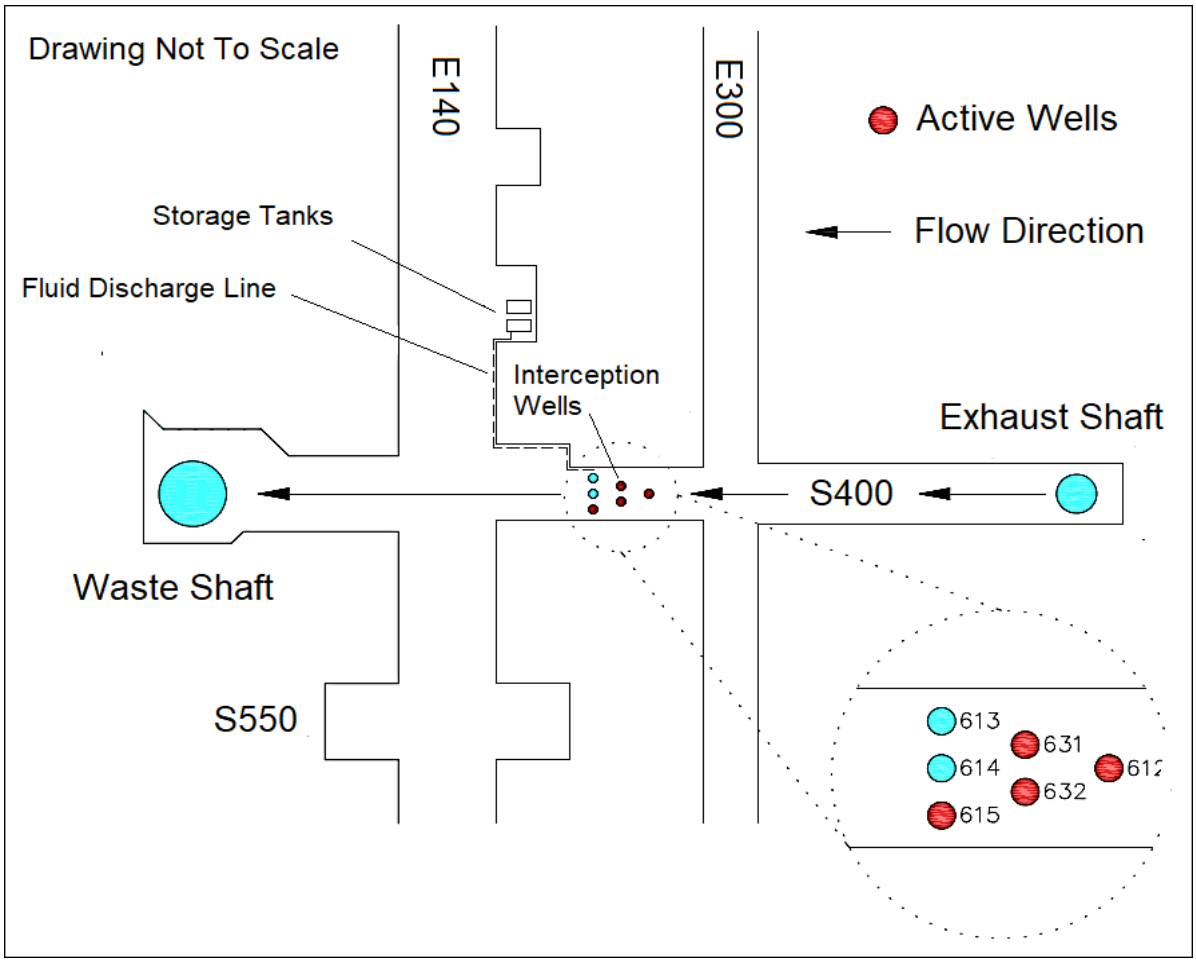

Figure 3-12 Location of Interception Wells and Storage Tanks

3.4 Air Intake Shaft

The Air Intake Shaft is the primary source of fresh air ventilation to the underground. The Shaft was drilled from December 4, 1987, to August 31, 1988 (see Figure 1-2). The stratigraphy was mapped from September 14, 1988, to November 14, 1989 (Holt and Powers, 1990). Figure 3-13, Air Intake Shaft Stratigraphy, summarizes the shaft stratigraphy.

The Air Intake Shaft is lined with non-reinforced concrete from the surface to the bottom of the shaft key at 903 ft. The key is 81 ft long with an inner diameter of 16 ft. The shaft diameter below the key is 20 ft, and the shaft below the key is unlined to the facility horizon at 2,150 ft. The shaft walls are bolted and meshed from just below the key to the shaft station. This shaft has no sump.

3.4.1 Shaft Performance

Weekly visual inspections were performed on the Air Intake Shaft during this reporting period, and the shaft was found to be in satisfactory condition. No ground control activities other than routine maintenance were required during this reporting period.

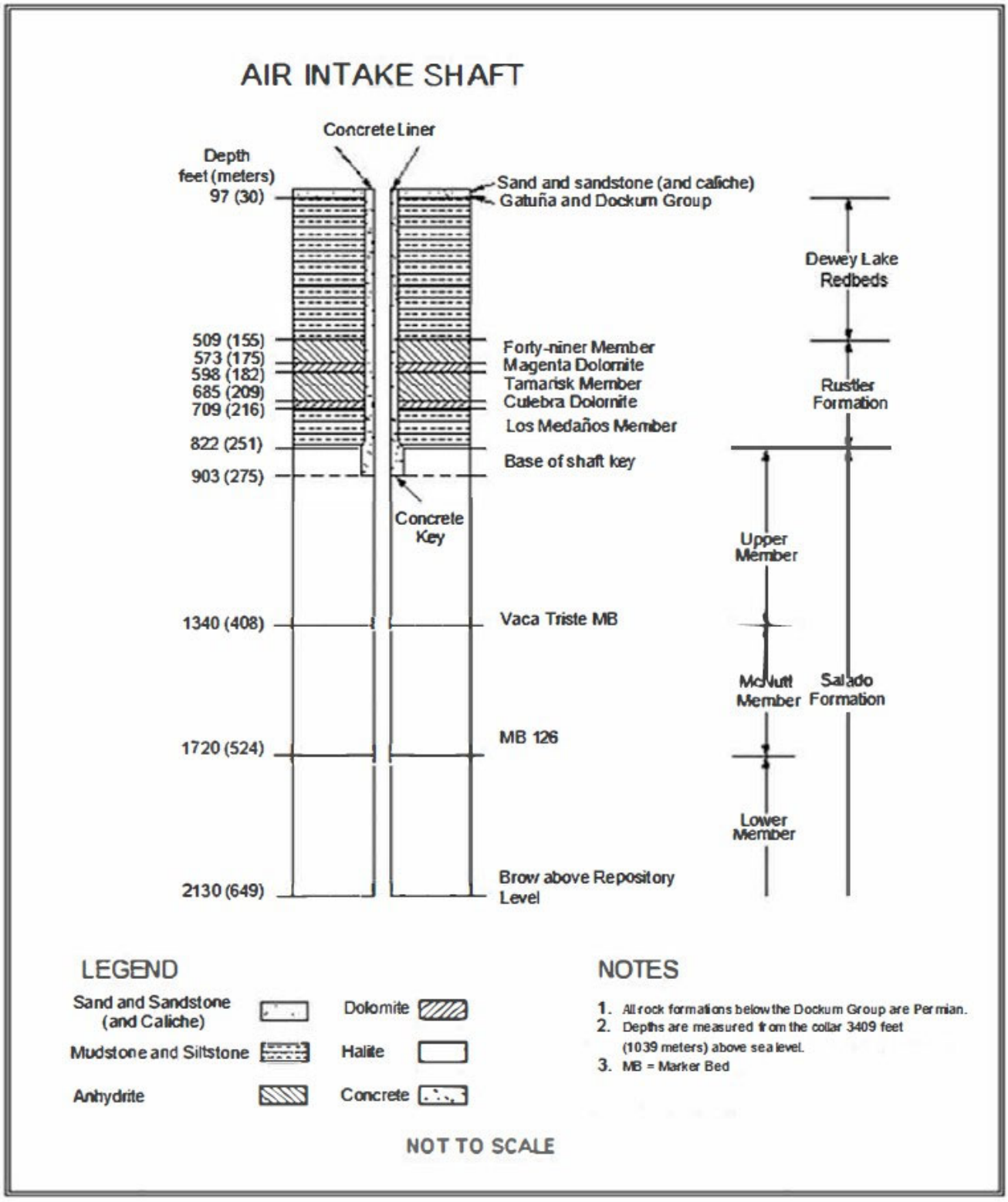

Figure 3-13 Air Intake Shaft Stratigraphy

4.0 SHAFT STATIONS

This section summarizes the current geotechnical conditions of the stations at the base of the Salt, Waste, and Air Intake Shafts based on instrumentation monitoring of ground movements. The Exhaust Shaft does not have an enlarged shaft station; therefore, it is not included in this assessment.

4.1 Salt Shaft Station

The Salt Shaft Station was excavated by drilling and blasting between May 2 and June 3, 1982. In 1987, the station was enlarged by removing the roof beam up to Anhydrite "b" between S-90 and N-20 using a mechanical scaler. In 1995, the roof beam at the north end of the station was removed up to Anhydrite "b". The station area south of the shaft is 90 ft long and 32 to 38 ft wide. The height of the station south of the shaft is 18 ft. The station dimensions north of the shaft are approximately 30 ft long, 32 to 35 ft wide, and 18 ft high. The shaft extends approximately 140 ft below the facility horizon to accommodate the skip-loading equipment and a sump (referred to as the Salt Pocket). Figure 4-1, Salt Shaft Station Stratigraphy, shows a cross-section of the station.

The Salt Shaft Station was not modified during this reporting period. Ground control activities were limited to routine maintenance. Rework of the Salt Pocket is anticipated for future reporting periods.

4.1.1 Salt Shaft Station Instrumentation Review

Geomechanical instrumentation was installed in the Salt Shaft Station between June 1982 and February 1983, with subsequent re-installation of extensometers and convergence points, as necessary. Figure 4-2, Salt Shaft Station Instrumentation After Roof Beam Excavation, shows the instrument locations after removing the roof beam.

Five vertical convergence points are currently monitored. Table 4-1, Closure Rates in the Salt Shaft Station, summarizes the vertical closure rates in the Salt Shaft Station from July 2022 through June 2023. The closure rates for this reporting period are slightly lower than those for the previous period.

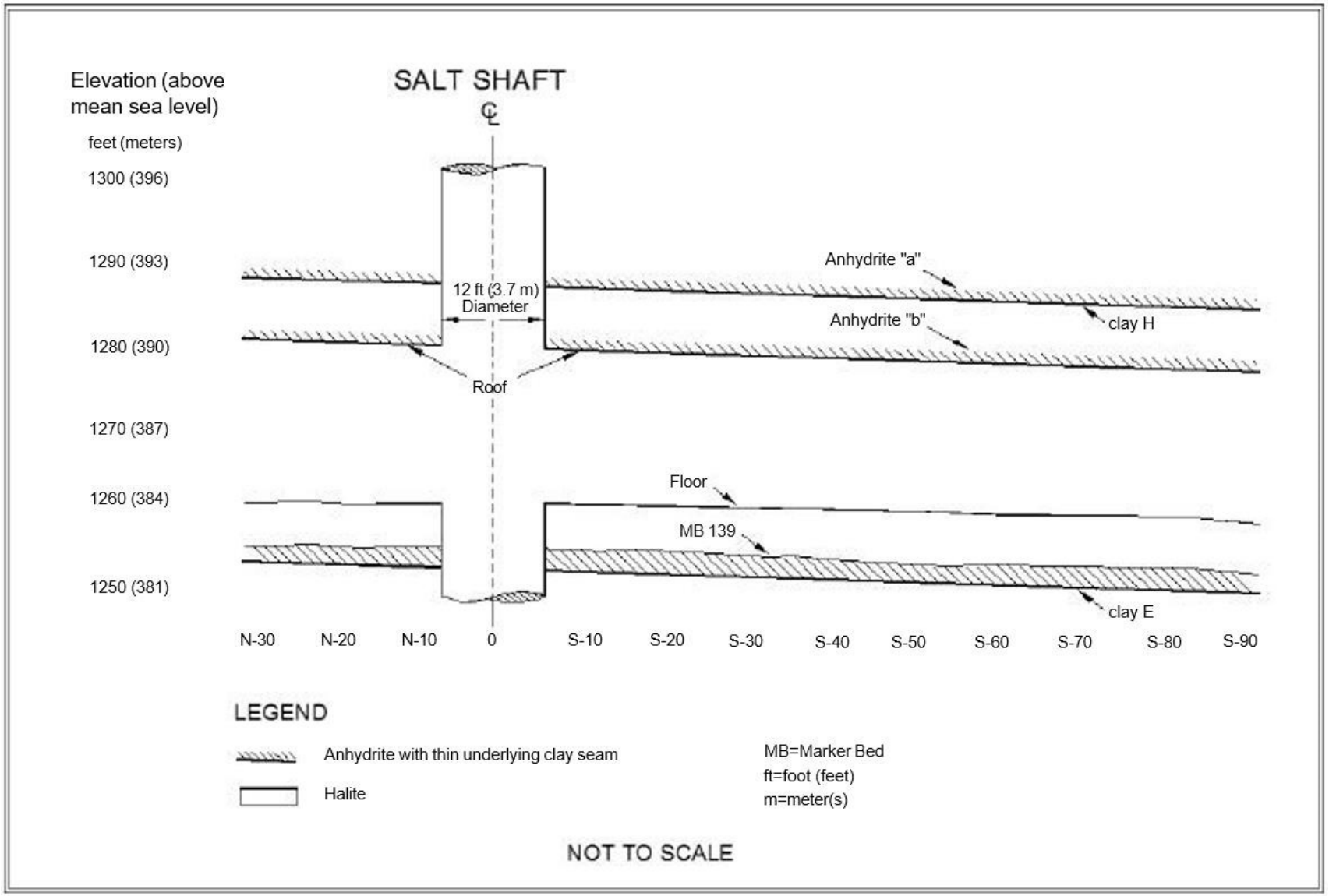

Figure 4-1 Salt Shaft Station Stratigraphy

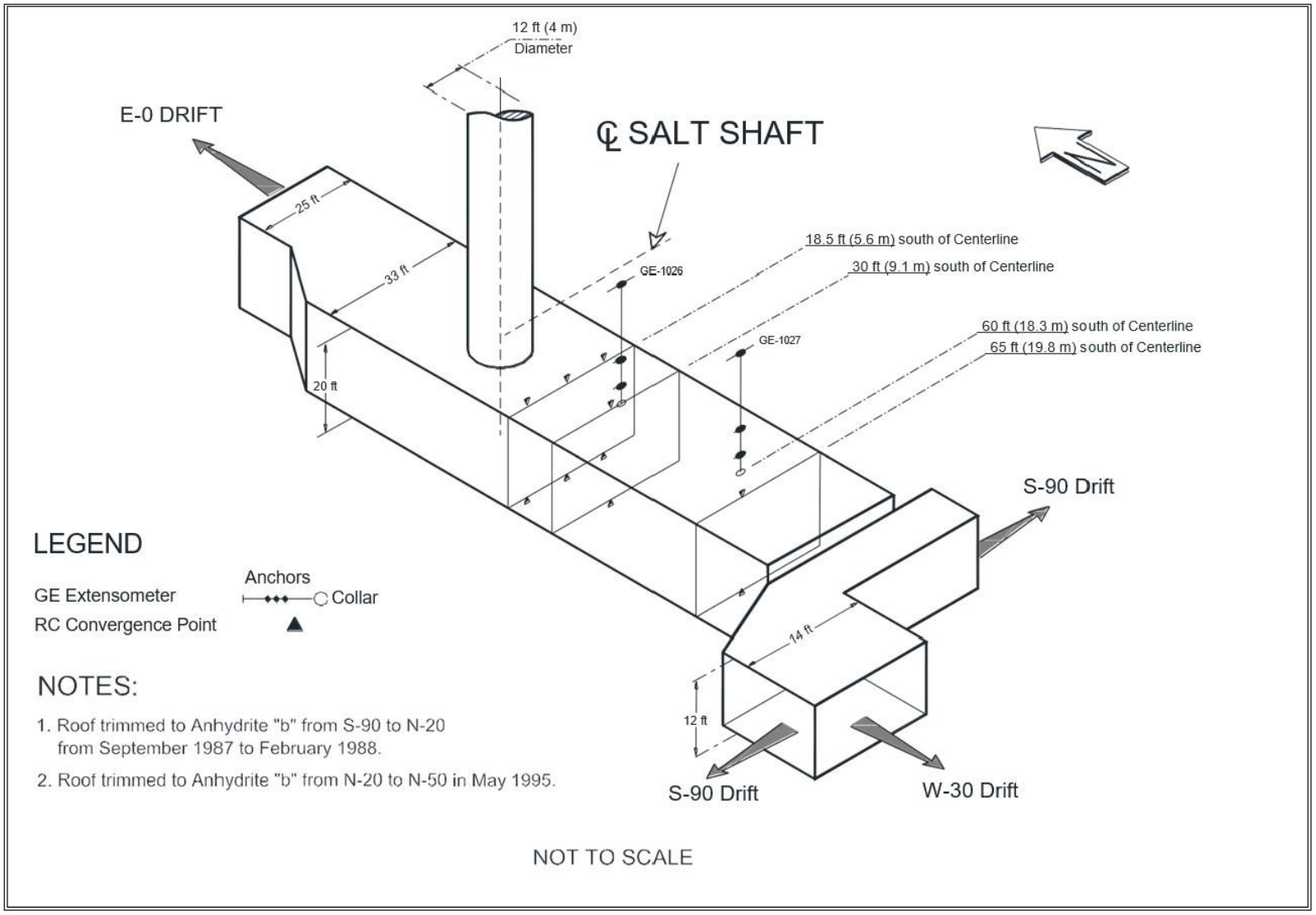

Figure 4-2 Salt Shaft Station Instrumentation After Roof Beam Excavation

Location	Chord[4]	Last Reading	Total Cumulative Displacement (in)	Closure Rate 2022-2023 (in/yr)	Closure Rate 2021-2022 (in/yr)	Rate Change (%)
E0-S18	A-E	06/30/23	59.189	2.1	2.1	0
E0-S18	B-D	06/30/23	62.484	2.6	2.9	-10
E0-S18	H-F	06/30/23	37.809	1.2	1.4	-14
E0-S30	A-C	06/30/23	74.117	2.2	2.2	0
E0-S65	A-C	06/30/23	59.378	1.4	1.5	-7

Table 4-1 Closure Rates in the Salt Shaft Station

4.2 Waste Shaft Station

The Waste Shaft Station was initially excavated with a continuous miner in November 1982 to serve as a ventilation connection to a 6-ft-diameter exhaust shaft. In 1984, the station was enlarged to a height of 15 to 20 ft and a width of 20 to 30 ft. The station is approximately 150 ft long. In 1988, the station walls were trimmed, and concrete was placed on the floor. Since 1988, the Waste Shaft Station has undergone five major floor renovations. A 53-ft long section of the reinforced concrete was removed in February 1991. In 1995, an additional 30-ft section of concrete was removed. In 2000, floor maintenance included trimming the floor and reinstalling the rails supported by segmented concrete panels on a crushed rock backfill. The roof of the Waste Shaft Station was mined up to Clay G in December 2008 to ensure adequate operational clearance. Chain link fencing and 12-ft resin-anchored roof bolts were installed for ground support. Figure 4-3, Waste Shaft Station Stratigraphy, shows a cross-section of the Waste Shaft Station stratigraphy.

No modifications to the Waste Shaft Station were made during this reporting period. Ground control activities were limited to routine maintenance.

[4] Chord is defined in Section 5.2.2 and illustrated in Figure 5-1.

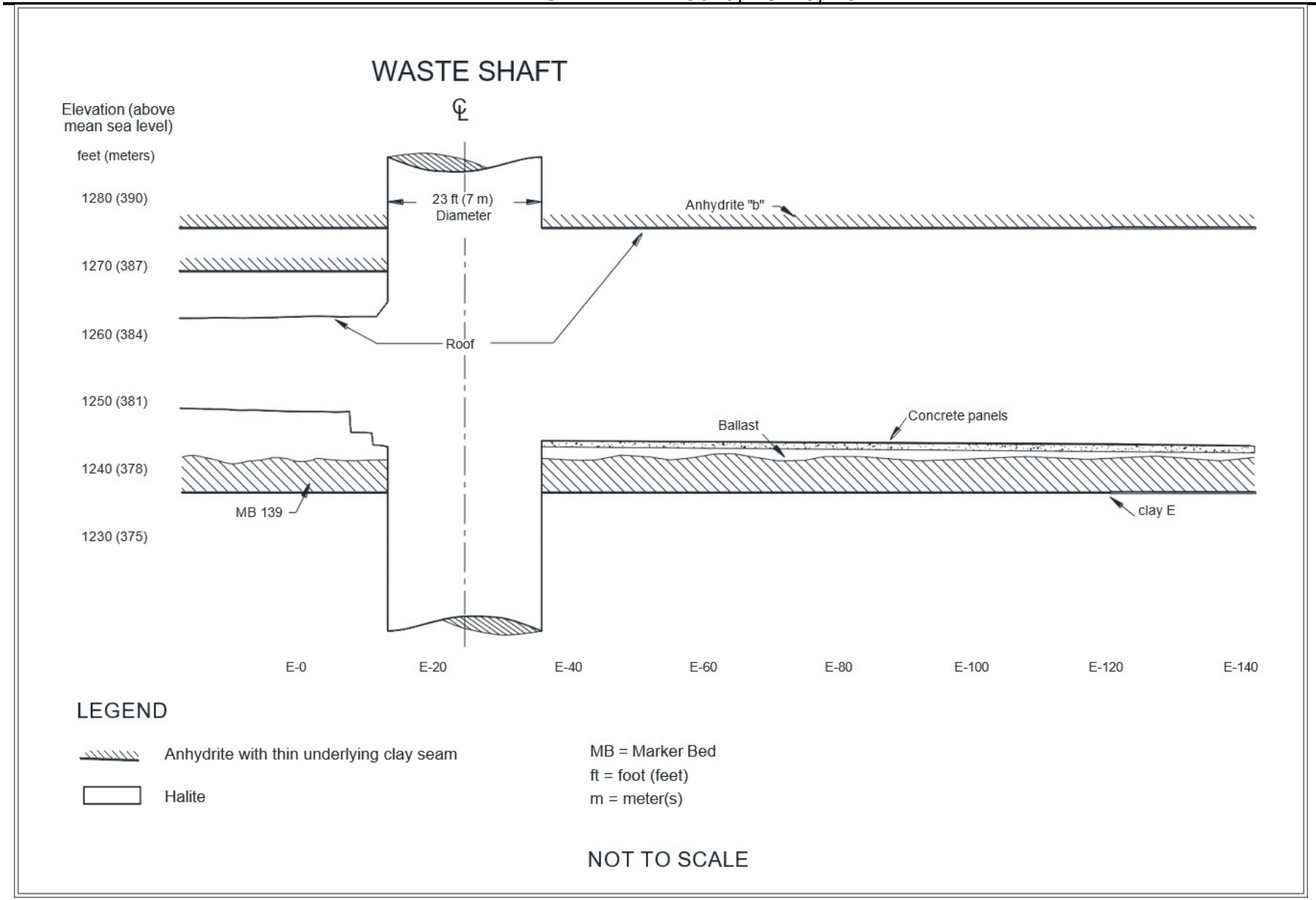

Figure 4-3 Waste Shaft Station Stratigraphy

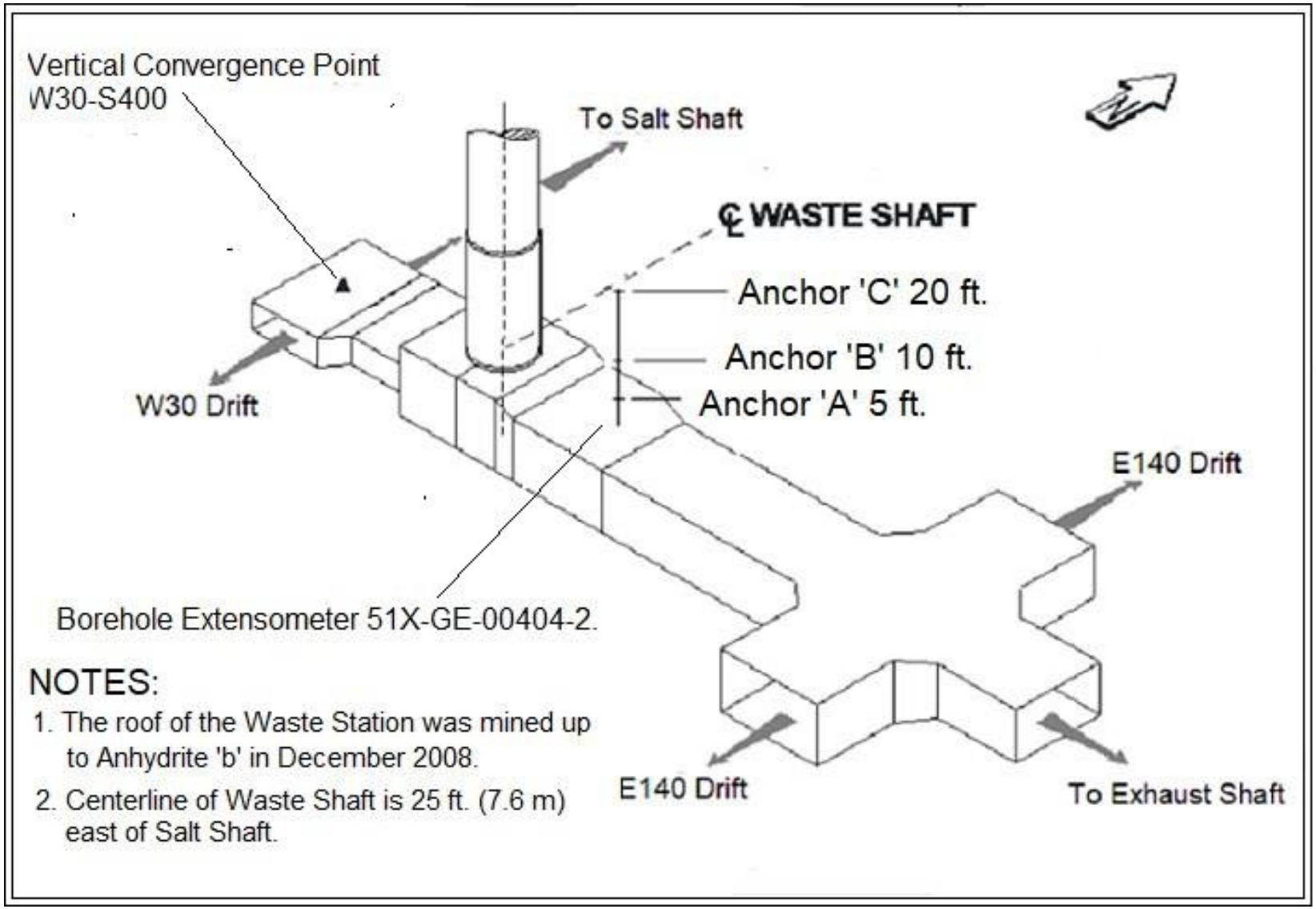

Figure 4-4 Waste Shaft Station Instrumentation

4.2.1 Instrumentation

The Waste Shaft Station geomechanical instrumentation, as depicted in Figure 4-4, Waste Shaft Station Stratigraphy, consists of a vertical convergence point in W30-S400 and a borehole extensometer east of the Waste Shaft at S400-E35. The convergence rate this reporting period was 1.2 in/yr. The beam expansion rate measured by the extensometer was 0.3 in/yr. The data are representative of a very stable back.

4.3 Air Intake Shaft Station

The Air Intake Shaft Station was excavated using a continuous miner in late 1987 and early 1988. The Air Intake Shaft has a work platform and a small cage that can be raised and lowered to perform routine ground maintenance. The principal purpose of the cage is to provide emergency ingress and egress.

4.3.1 Modifications to Excavation and Ground Control Activities

The Air Intake Shaft Station was not modified during this reporting period. Ground control activities were limited to routine maintenance.

4.3.2 Instrumentation

Radial convergence point and extensometer instrumentation data near the Air Intake Shaft Station are presented in Section 5.0 as part of the discussion on the performance of the access drifts.

5.0 PERFORMANCE OF ACCESS DRIFTS

This section describes the geomechanical performance of the underground access drifts. The Waste Disposal Area is discussed in Section 6.0, and the SDI areas are discussed in Section 7.0. Four major north-south drifts in the WIPP underground are intersected by shorter east-west cross-drifts. Drift dimensions range from 13 ft to 21 ft high and 14 ft to 33 ft wide.

5.1 Modifications to Excavation and Ground Control Activities

Rock bolting, meshing, and drilling observational bore holes were performed during this reporting period. Table 5-1, Summary of Modifications and Ground Control Activities in the Access Drifts: July 1, 2022, to June 30, 2023, summarizes these activities.

Location	Work Activity
0E from N150 to N1400	Installed 4 ft. mechanical bolts in the back and ribs at various spots
0E- N1100	Installed a new 14 ft. resin anchored bolt pattern in the back
AIS	Installed a new 14 ft. resin anchored bolt pattern in the back
E0 between N1400 and N100	Installed a new 14 ft. resin anchored bolt pattern in the back
SDI Area	Installed 4 ft. and 10 ft. mechanical bolts in the back and ribs
E140 between S700 and S1950	Installed a new 14 ft. resin anchored bolts, straps, and slings
E140 from N150 - N1400	Installed a new 14 ft. resin anchored bolt pattern in the back
E140- N&S E0	Secured 14 ft. resin anchored bolts with lanyard
E140 from the S1950 Transition Line to S2180	Installed a new 14 ft. resin anchored bolt pattern in the back
West Mains S700 from W170 to W780	Installed 4 ft. mechanical bolts in the back and ribs
E140-N940	Installed 4 ft. mechanical bolts in the back and ribs
Mine Wide	Installed new 20ft. Observation holes
E140-S1600	Installed 4 ft. mechanical bolts/clips in the back and ribs
E140-S90	Installed 4 ft. mechanical bolts in the back and ribs
S700 between W30 and E140	Installed a new 14 ft. resin anchored bolt pattern in the back
E300 between S2180 and S1000	Installed 4 ft. mechanical bolts in the back and ribs
E300 between S2520 and S1000	Installed a new 14 ft. resin anchored bolt pattern in the back
E300 between S2180 and S2520	Installed 6 ft. mechanical bolts in the back and ribs
E300 between S2180 and S2520	Installed 4 ft. mechanical bolts in the back and ribs
E300-N460	Installed a new 14 ft. resin anchored bolt pattern in the back
EXO area (E300 from N1100 to N1400)	Installed 4 ft. mechanical bolts in the back and ribs
EXO area (E300 from N1100 to N1400)	Installed a new 14 ft. resin anchored bolt pattern in the back
N1400 between E300 and E0	Installed a new 14 ft. resin anchored bolt pattern in the back
W170 N150	Installed 4 ft. mechanical bolts/clips in the back and ribs
N460 between E140 and E300	Installed a new 14 ft. resin anchored bolt pattern in the back
N780 between E1200 and E140	Installed 4 ft. mechanical bolts in the back and ribs
Panel 7	Installed 4 ft. mechanical bolts in the back and ribs and new 20 ft. observation holes
Panel 7	Installed a new 14 ft. resin anchored bolt pattern in the back
Panel 8	Installed a new 14 ft. resin anchored bolt pattern in the back
Panel 8	Installed 4 ft. mechanical bolts in the back and ribs
Panel 8	Installed 10 ft. mechanical bolts in the back and ribs
Panel 8	Installed 2 ft. mechanical bolts in the back and ribs
Panel 8	Installed new 20 ft. observation holes
S700 between W170 and E300	Installed 4 ft. mechanical bolts/clips in the back and ribs
S700 between W30 and W170	Installed a new 14 ft. resin anchored bolt pattern in the back
S700 between W30 and W170	Installed 10 ft. mechanical bolts in the back and ribs
SS #4	Installed 4 ft. mechanical bolts/clips in the back and ribs
SS #4	Installed a new 14 ft. resin anchored bolt pattern in the back
SS #1	Installed 4 ft. mechanical bolts/clips in the back and ribs
West Mains S850 and S1000 drifts	Installed 4 ft. mechanical bolts in the back and ribs
W170 between S700 and S400	Installed a new 14 ft. resin anchored bolt pattern in the back

Location	Work Activity
W170 between S700 and S400	Installed 4 ft. mechanical bolts in the back and ribs
W170-S550	Installed 4 ft. mechanical bolts in the back and ribs
W30 between S1000 and S1200	Installed a new 14 ft. resin anchored bolt pattern in the back
W30 between S1000 and S700	Installed a new 14 ft. resin anchored bolt pattern in the back
W30- S1000	Installed 4 ft. mechanical bolts/clips in the back and ribs
W30-S550	Installed 4 ft. mechanical bolts/clips in the back and ribs
Waste Station	Installed a new 14 ft. resin anchored bolt pattern in the back
Welding Shop	Installed 4 ft. mechanical bolts in the back and ribs

Table 5-1 Summary of Modifications and Ground Control Activities in the Access Drifts: July 1, 2022, to June 30, 2023

5.2 Instrumentation

This section discusses instrumentation details in the access drifts.

5.2.1 Extensometers

Sixteen extensometers continue to be monitored at various locations in the access drifts. Where displacement data were available, annual displacement rates were calculated (see Section 1.4.3, Data Errors) for each active installation and compared to the annual displacement rates from the previous reporting period (see Table 4-1, Closure Rates in the Salt Shaft Station in the 2022-2023 Supporting Data document [Vol 2]). Extensometer data are obtained by measuring the displacement from the reference head anchor (collar) to each fixed anchor of the extensometer. These measurements are scheduled at least monthly throughout the WIPP underground. Many of the E-140 extensometers indicate movement in the roof beam that may be attributed to shallow fracturing and the effects of anhydrite stringer separations in the roof. Lateral deformation in the roof beam may influence the extensometer readings, causing an increase in the measured displacement. Although the extensometer data indicate continued deformation and breakup of the lower beam, borehole logging indicates the roof bolt anchorage zone remains competent.

5.2.2 Convergence Points

Convergence point data are obtained by measuring the change in distance between fixed points anchored into the rock across an opening, either from rib to rib or from roof to floor. The measurement end-points constitute a "chord." Figure 5-1, Typical Convergence Point Array Configurations Showing Anchor Designations, shows typical convergence point array configurations and chord designations.

Convergence points are routinely installed following new mining and in areas where ground maintenance has been performed and previously installed convergence points have been removed. A listing of convergence point installations performed in the access drifts during this reporting period is shown in Table 5-2, Radial Convergence Point Installations in the Access Drifts: July 1, 2022, to June 30, 2023.

Where possible, annual closure rates were calculated from convergence point array data gathered in the access drifts. During this reporting period, the active convergence points in the underground were distributed as follows: 249 convergence points in the access drifts, two accessible convergence points in Panel 7, and 49 convergence points in Panel 8. A complete tabulation of the accessible convergence point data and calculated closure rates is presented in the supporting data document for this report (Vol 2).

Locations with increases in annual vertical closure rates of greater than 20 percent are shown in Table 5-3, Vertical Closure Rate Changes over Twenty Percent in the Access Drifts.

5.3 Analysis of Convergence Point and Extensometer Data

The 338 convergence points for this period had a roof-to-floor closure range of -9.6 to 11.4 in/yr, a mean rate of 2.8 in/yr, and a standard deviation of 1.7. Statistically high standard deviation in access drift convergence rates is caused by wide-ranging excavation variables such as drift dimension, age, horizon level, etc. Negative convergence readings are generally caused by floor fractures.

Vertical loading on mine pillars results in lateral stresses on the roof and floor beams. In part, the composition of those beams determines how these structures will react to the horizontal stresses. In particular, horizontally continuous anhydrite stringers (see Section 2.2.2, Disposal Horizon Stratigraphy of Panels 3, 4, 5, and 6) divide the beam into smaller independent beams.

The lateral strain on the beam imposed by vertical loading on the pillars is accommodated by vertical displacement over the mined opening. This strain requires the horizontally oriented beam to separate along the most favorable or weakest planes.

Where anhydrite stringers interpose the beam, they constitute a plane of weakness, and delamination occurs. The material is confined in the plane above, so the roof accommodates the lateral strain by bending convex into the mined opening.

Two distinct results develop from this action. First, voids form within the beam as the portions closer to the opening move away from those deeper within the beam. Second, the convex portion of the bent plane is subjected to tensile loading perpendicular to the axis of the drift, and superficial tears known as "tensile fractures" develop generally parallel to the axis of the drift.

Where anhydrite stringers are small, discontinuous, or absent within the beam, horizontal loading is accommodated along shear planes. These develop at angles of approximately 35 degrees to the horizontal. In some cases, a plane develops preferentially on one side of the drift, and the bulk of the material is pushed into the mined opening on that side. This development may be thought of as a cantilevered beam.

Whatever mechanism is used, vertical displacement into the mined opening is measured by convergence monitoring. Convergence points consider the displacement between two opposing surfaces: either the roof and floor or the two ribs. Extensometers consider the displacement between one surface (usually the back) and one or more points within the beam. Where a convergence point and an extensometer are adjacent, it is possible to determine the individual displacements of both floor and roof beams.

These data are used to analyze the stability and mechanics of the beam and to determine what actions may be taken to ensure the safety of personnel and equipment is consistent with the safe operation of the facility.

5.4 Excavation Performance

Approximately 338 convergence points were read and assessed regularly throughout the WIPP underground during this reporting period. Due to the effect rock temperature has on salt creep, convergence rates vary seasonally, typically increasing during the warmer summer months and decreasing during the cooler and drier winter months. These temperature effects are more pronounced nearer the fresh air intake.

The performance of the access drift excavations during this reporting period was within acceptable criteria. "Acceptable criteria" means that a drift remains accessible, and the ground can be controlled by routine maintenance. Standard remedial ground control in some areas was required to maintain the performance of the excavations. The accessible drifts remain stable and controlled. Of the 249 convergence locations measured in the access drifts, 13 locations had annual closure rates over 20 percent from the previous year’s value. See Table 5-3, Vertical Closure Rate Changes over Twenty Percent in the Access Drifts for convergence point installations in the access drifts.

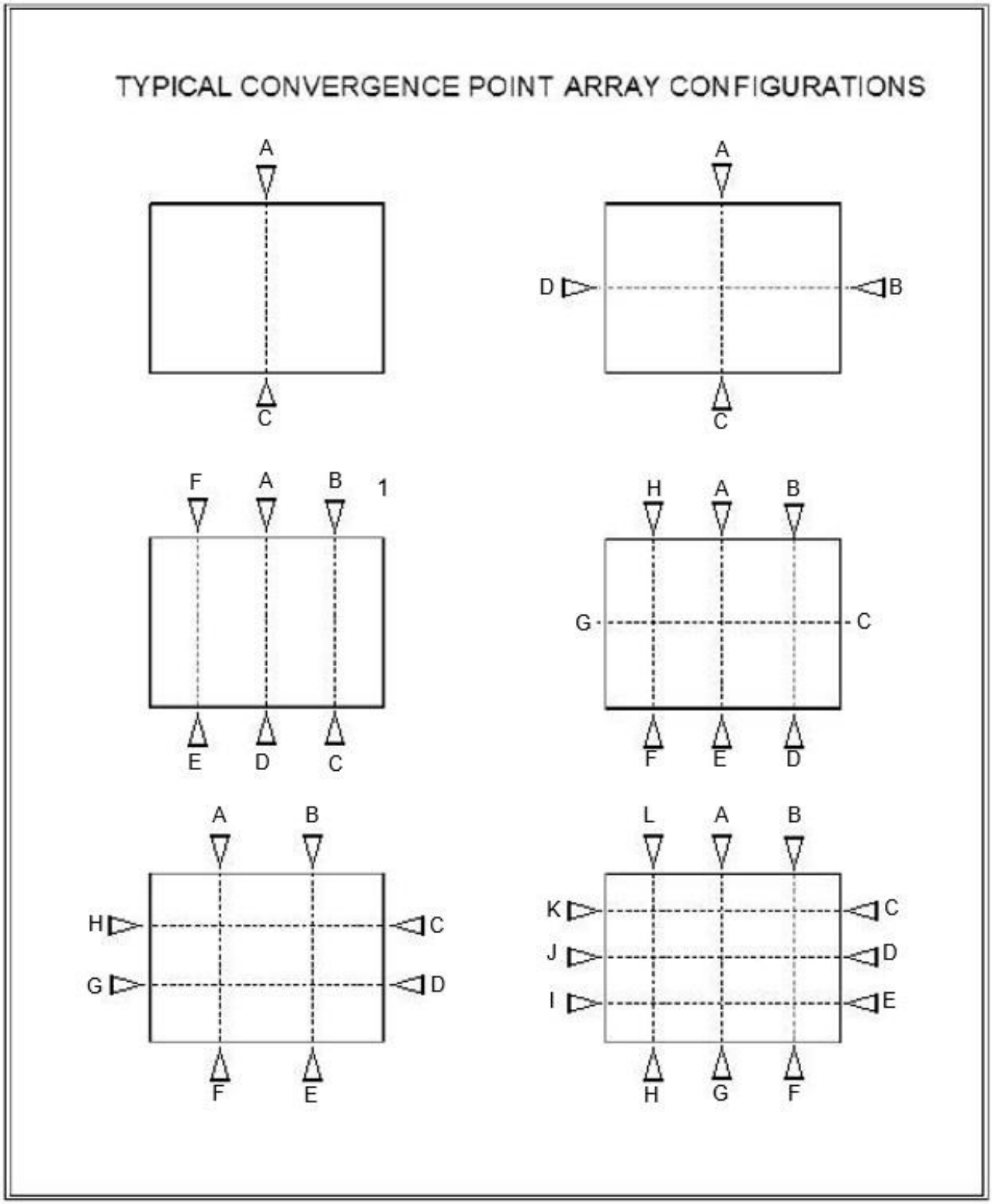

Figure 5-1 Typical Convergence Point Array Configurations Showing Anchor Designations

Location	Installation Date	Type of Installation[5]	Field Tag[6]
E140-S850	7/22/2022	R	E140-S850-11 A-C
S1000-E120	7/22/2022	R	S1000-E120-4 A-C
E140-S1000	7/22/2022	R	E140-S1000-6 A-C
E140-S1025	7/22/2022	R	E140-S1025-7 A-C
E140-S1075	7/22/2022	R	E140-S1075-6 A-C
S1000-W245	8/2/2022	N	S1000-W245-1 A-C
S1000-W320	8/2/2022	N	S1000-W320-1 A-C
S1000-W395	8/2/2022	N	S1000-W395-1 A-C
S1600-E55	8/23/2022	N	S1600-E55-1 A-C
E140-S1600	8/23/2022	R	E140-S1600-9 A-C
W30-S1600	8/23/2022	R	W30-S1600-6 A-C
S1600-W100	8/26/2022	R	S1600-W100-3 A-C
W170-S1600	8/26/2022	R	W170-S1600-7 A-C
S1600-W285	8/26/2022	R	S1600-W285-4 A-C
W170-N150	9/23/2022	R	W170-N150-4 A-C
W30-S1150	9/23/2022	R	W30-S1150-4 A-C
S1950-W100	9/23/2022	R	S1950-W100-3 A-C
W30-S1950	9/23/2022	R	W30-S1950-4 A-C
S700-W960	9/27/2022	N	S700-W960-1 A-C
S700-W875	9/27/2022	N	S700-W875-1 A-C
S700-W790	9/27/2022	N	S700-W790-1 A-C
S700-W705	9/27/2022	N	S700-W705-1 A-C
S1000-W470	9/27/2022	N	S1000-W470-1 A-C
E140-S1534	9/29/2022	R	E140-S1534-7 B-D
E140-S1667	9/29/2022	R	E140-S1667-2 B-D
E140-S1717	9/29/2022	R	E140-S1717-2 A-E
W960-S775	10/4/2022	N	W960-S775-1 A-C
S850-W960	10/4/2022	N	S850-W960-1 A-C
W960-S925	10/4/2022	N	W960-S925-1 A-C
S1000-W960	10/4/2022	N	S1000-W960-1 A-C
S700-W1045	10/5/2022	N	S700-W1045-1 A-C
S700-W1130	10/5/2022	N	S700-W1130-1 A-C
S700-W1215	10/5/2022	N	S700-W1215-1 A-C
S700-W1300	10/5/2022	N	S700-W1300-1 A-C
E0-S18	10/7/2022	R	E0-S18-8 B-D
E140-S1699	10/7/2022	R	E140-S1699-2 H-F
S700-E55	10/7/2022	R	S700-E55-4 A-C

Table 5-2 Radial Convergence Point Installations in the Access Drifts: July 1, 2022, to June 30, 2023

[5] R - denotes a replacement installation, e.g., roof or floor point(s) that could have been mined out, damaged, etc. N – represents a new installation at that location.
[6] Field Tag (aka field tag) is a string consisting of 'location' + '- number of times a reinstall was conducted at that location' + ' chord'. Note that new installations do not have a reinstallation number.

Location	Installation Date	Type of Installation[5]	Field Tag[6]
N940-E420	10/20/2022	R	N940-E420-4 A-C
S90-E70	10/27/2022	R	S90-E70-2 A-C
N150-W140	10/27/2022	N	N150-W140-1 A-C
N150-W85	10/27/2022	N	N150-W85-1 A-C
S550-E100	11/29/2022	N	S550-E100-1 A-C
S550-E180	11/29/2022	N	S550-E180-1 A-C
W30-S1600	11/29/2022	R	W30-S1600-7 A-C
S400-W188	11/30/2022	N	S400-W188-1 A-C
S400-W198	11/30/2022	R	S400-W198-2 A-C
S400-W240	11/30/2022	R	S400-W240-2 A-C
E140-S1496	12/28/2022	R	E140-S1496-3 A-E
W170-S1300	2/7/2023	R	W170-S1300-5 A-C
W170-S700	4/11/2023	R	W170-S700-5 A-C
S700-W245	4/11/2023	R	S700-W245-2 A-C
S700-W320	4/11/2023	R	S700-W320-2 A-C
S700-W395	4/11/2023	R	S700-W395-2 A-C
S700-W470	4/11/2023	R	S700-W470-2 A-C
S700-W545	4/11/2023	R	S700-W545-2 A-C
S700-W960	4/12/2023	R	S700-W960-2 A-C
S700-W1045	4/12/2023	R	S700-W1045-2 A-C
S700-W1130	4/12/2023	R	S700-W1130-2 A-C
S700-W1215	4/12/2023	R	S700-W1215-2 A-C
S700-W1300	4/12/2023	R	S700-W1300-2 A-C
S700-W620	4/25/2023	R	S700-W620-2 A-C
S700-W705	4/25/2023	R	S700-W705-2 A-C
S700-W790	4/25/2023	R	S700-W790-2 A-C
S700-W875	4/25/2023	R	S700-W875-2 A-C
N460-E310	4/26/2023	R	N460-E310-2 A-C
N460-E220	4/26/2023	R	N460-E220-3 A-C
E0-N780	4/27/2023	R	E0-N780-3 A-C
E0-N686	4/27/2023	R	E0-N686-2 A-C
E0-N626	4/27/2023	R	E0-N626-6 A-C
E0-N562	4/27/2023	R	E0-N562-2 A-C
E0-N460	4/27/2023	R	E0-N460-6 A-C
E0-N300	4/27/2023	R	E0-N300-8 A-C
W170-S1000	5/2/2023	R	W170-S1000-5 A-C
S1000-W245	5/2/2023	R	S1000-W245-2 A-C
S1000-W320	5/2/2023	R	S1000-W320-2 A-C
S1950-E255	5/3/2023	N	S1950-E255-1 A-C
S700-W98	5/4/2023	R	S700-W98-6 A-C
W1300-S925	5/9/2023	N	W1300-S925-1 A-C

Table 5-2 Radial Convergence Point Installations in the Access Drifts: July 1, 2022, to June 30, 2023 (Cont)

Location	Installation Date	Type of Installation[5]	Field Tag[6]
S1000-W1300	5/9/2023	N	S1000-W1300-1 A-C
S1000-W395	5/10/2023	R	S1000-W395-2 A-C
S1000-W470	5/10/2023	R	S1000-W470-2 A-C
W1300-S775	5/10/2023	N	W1300-S775-1 A-C
S850-W1300	5/26/2023	N	S850-W1300-1 A-C
E140-S1667	5/26/2023	R	E140-S1667-2 A-E
S850-W1215	5/31/2023	N	S850-W1215-1 A-C
S850-W1130	5/31/2023	N	S850-W1130-1 A-C
S850-W1045	5/31/2023	N	S850-W1045-1 A-C
S850-W960	5/31/2023	R	S850-W960-2 A-C
W960-S775	5/31/2023	R	W960-S775-2 A-C
S850-W875	5/31/2023	N	S850-W875-1 A-C
S850-W790	5/31/2023	N	S850-W790-1 A-C
S850-W705	5/31/2023	N	S850-W705-1 A-C
S850-W620	5/31/2023	N	S850-W620-1 A-C
W620-S775	5/31/2023	N	W620-S775-1 A-C
S850-W245	6/1/2023	R	S850-W245-2 A-C
S850-W320	6/1/2023	R	S850-W320-2 A-C
S850-W395	6/1/2023	N	S850-W395-1 A-C
S850-W470	6/1/2023	N	S850-W470-1 A-C
S850-W545	6/1/2023	N	S850-W545-1 A-C
W170-S850	6/1/2023	R	W170-S850-10 A-E
S1000-W545	6/13/2023	N	S1000-W545-1 A-C
S1000-W620	6/13/2023	N	S1000-W620-1 A-C
W620-S925	6/13/2023	N	W620-S925-1 A-C
S1000-W705	6/13/2023	N	S1000-W705-1 A-C
S1000-W790	6/14/2023	N	S1000-W790-1 A-C
S1000-W875	6/14/2023	N	S1000-W875-1 A-C
S1000-W960	6/14/2023	R	S1000-W960-2 A-C
S1000-W1045	6/14/2023	N	S1000-W1045-1 A-C
S1000-W1130	6/14/2023	N	S1000-W1130-1 A-C
S1000-W1215	6/14/2023	N	S1000-W1215-1 A-C
W960-S925	6/14/2023	R	W960-S925-2 A-C
N300-W170	6/14/2023	R	N300-W170-3 A-C
S1000-W1470	6/27/2023	N	S1000-W1470-1 A-C
S1000-W1555	6/27/2023	N	S1000-W1555-1 A-C
S850-W1385	6/27/2023	N	S850-W1385-1 A-C
S850-W1470	6/27/2023	N	S850-W1470-1 A-C
S850-W1555	6/27/2023	N	S850-W1555-1 A-C
S1000-W1385	6/27/2023	N	S1000-W1385-1 A-C

Table 5-2 Radial Convergence Point Installations in the Access Drifts: July 1, 2022, to June 30, 2023 (Cont)

Location	Chord[7]	Last Reading Date	Closure Rate 2022 to 2023 (in/yr)	Closure Rate 2021 to 2022 (in/yr)	Rate Change (%)
E0-N460	A-C	06/30/23	3.7	2.3	61
E0-N562	A-C	06/30/23	3.7	2.8	32
E0-N626	A-C	06/30/23	4.2	2.7	56
E0-N686	A-C	06/30/23	3.6	2.8	29
E0-N780	A-C	06/30/23	3.1	2.2	41
N300-W170	A-C	06/30/23	3.1	1.8	72
S1000-W120	A-C	06/13/23	2.9	2.0	45
S1000-W98	A-C	06/13/23	3.2	2.3	39
S400-W208	A-C	11/07/22	1.9	1.4	36
S700-E55	A-C	06/13/23	2.7	2.1	29
W170-S1000	A-C	06/09/23	2.3	1.7	35
W170-S850	A-C	06/09/23	4.3	3.3	30
W30-S1775	A-C	06/05/23	3.5	2.4	46

Table 5-3 Vertical Closure Rate Changes over Twenty Percent in the Access Drifts

[7] Chord is defined in Section 5.2.2 and illustrated in Figure 5-1.

6.0 PERFORMANCE OF THE WASTE DISPOSAL AREA

The Waste Disposal Area, as of June 30, 2023, consisted of Panel 1 through Panel 7, and Panel 8. Panel 1 through Panel 6 were closed during previous reporting periods. The discussion in this section satisfies the requirement to evaluate the geomechanical monitoring program for each HWDU and to report the data collected as required by Permit Attachment 4, Section 4.6.1.2. Measured data are included in Volume 2.

6.1 History

Excavation of Panel 1 began in May 1986 with the mining of the access entries. Initially, the disposal rooms and drifts were developed as pilot drifts and later excavated to nominal operational dimensions of 13 ft high, 33 ft wide, and 300 ft long. Room 1 was completed to these dimensions in August 1986, and pilot drifts for Room 2 and Room 3 were excavated in January and February 1987. Room 2 and Room 3 were completed in February and March 1988, and Room 4 through Room 7 were completed in May 1988. Four short access drifts designed to lead to smaller test alcoves were excavated north of the S-1600 drift and Room 4 through Room 7 in June 1989. Only the access drifts to the alcoves were completed; the alcoves were not excavated. Panel 1 waste emplacement (in Rooms 1, 2, 3, 7, adjacent areas of S-1600, and all of S-1950) was completed in March 2003, and the panel is closed to all access.

Excavation of Panel 2 began in September 1999 with the mining of access entries. Initially, the disposal rooms and drifts were developed as pilot drifts, which were trimmed to finished dimensions. Room 1 was completed in January 2000, and pilot drifts for Rooms 2 and 3 were excavated in February 2000. Pilot drifts were completed for Room 4 through Room 6 in April 2000. The pilot drift for Room 7 was excavated in May 2000. The rooms were excavated to final dimensions by August 2000. Waste emplacement in Panel 2 was completed during a prior reporting period, and the panel is closed to all access.

Excavation of Panel 3 began in May 2002 with the mining of access entries. As with Panel 2, the disposal rooms and drifts were initially developed as pilot drifts trimmed to finished dimensions. All the rooms were excavated to final dimensions by the end of March 2004. Waste emplacement in Panel 3 was completed in February 2007. Substantial barriers and bulkheads were installed in the exhaust and intake drifts of Panel 3 to prevent access into the panel and to isolate it from the ventilation circuit.

Panel 4 access drift mining began in January 2005. The disposal rooms were initially developed as pilot drifts and were later trimmed to final dimensions. Mining was completed by June 2006. Waste emplacement in Panel 4 was completed in March 2009. Substantial barriers and bulkheads were installed in the exhaust and intake drifts of Panel 4 to prevent access into the panel and to isolate it from the ventilation circuit.

Panel 5 excavation activities began in June 2006. The panel was initially mined to less-than-final dimensions and later trimmed to specification. Mining was completed by February 2008. Waste emplacement was conducted from March 2009 through July 2011. Isolation walls were completed in November 2011.

Panel 6 mining began in April 2008. The panel was initially mined to less-than-final dimensions and later trimmed to specification. Mining was completed by April 2010. Waste emplacement started in March 2011 and was completed in January 2014.

Panel 7 mining began in April 2010 and was completed in August 2011.
Initial mining placed the floor within 2 ft. of a polyhalitic bed (designated PH-4), which sits atop a thick anhydrite bed designated MB-139. Horizontal stresses caused a significant uplift, and the floor was then mined down through MB-139 and backfilled with run-of-mine salt. The remediation of the floor was completed in January 2013. Subsequent geomechanical monitoring indicates stable vertical convergence. Remote-handled waste emplacement began in Panel 7 in September 2013, and CH waste emplacement started in January 2014. Waste emplacement and ground control activities were suspended in February 2014 due to a truck fire in the underground, followed by an unrelated radiation release in Panel 7. Panel closure was initiated during the reporting period. Ground control activities resumed in 2015. Waste emplacement resumed in January 2017 at the intersection of Room 6 and S-2520.

Panel 8 rough-cut mining began on the lower horizon in September 2013. Mining was suspended in February 2014 due to an underground haul truck fire and a radioactive release in Panel 7. Panel 8 mining resumed in February 2018. The rough-cut mining with the back at Clay G (upper horizon) was completed in January 2020. Mining was moved to the upper horizon due to deformation in the immediate roof beam of the lower horizon caused by the lapse in mining and bolting after the events in 2014. The rib-cut mining was completed in October 2020. The installation and testing of the geomechanical instrumentation was completed in April 2022. Waste Emplacement began in November 2022.

6.2 Modifications to Excavations and Ground Control Activities

No planned excavation modifications were performed during this reporting period in Panel 7. An anticipated roof fall is thought to have occurred in Panel 7, S2180-W985 (a prohibited area closed to personnel access) around July 10, 2021. The potential for a fall was predicted by increasing room closure rates, as seen in Figure 6-1, Data from Wire Extensometer 51X-GE-00417-S2180-W985. The data obtained from the instrument after July 10, 2021, did not indicate a fully operational instrument, inferring a roof fall had damaged the instrument. Due to waste emplacement, a visual confirmation of the roof fall was impossible. However, data from previous roof falls would support a roof fall as indicated by the response of the displacement rate data in Figure 6-1 and the final instrument reading measuring a displacement rate of over 150 in/yr.

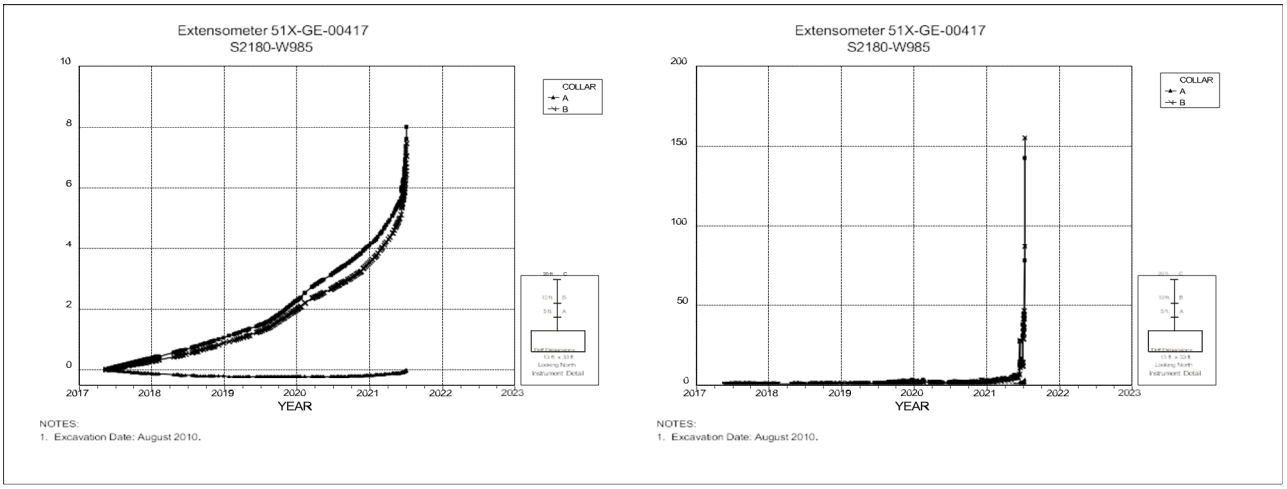

Figure 6-1 Data from Wire Extensometer 51X-GE-00417-S2180-W985

Routine ground control activities were performed in Panel 7 to include scaling and meshing, as needed, and the replacement of broken roof bolts with 14-ft resin anchored bolts in areas that are still accessible.

A significant modification to Panel 8 (see Section 6.1, History) is the mining of the back, up to the upper horizon at Clay G. The back of Panel 8 is fully bolted with 6-ft resin anchor roof bolts. The bolts were installed as soon as possible after mining to slow the development of separations along anhydrite stringers within the roof beam and subsequent surface tension crack development. A final bolt pattern consisting of 14 ft resin-anchored bolts was installed in Panel 8 to ensure long-term stability as waste is emplaced. During the reporting period, this full pattern of 14 ft resin-anchored bolts was completely installed in January of 2023.

6.3 Instrumentation

Panel 7 and Panel 8 instrumentation originally consisted of the following:

- Forty-nine vertical convergence points, distributed as 14 in each of the intake and exhaust drifts and three in each of the rooms, and
- Eleven wire extensometers, distributed as two in each of the intake and exhaust drifts and one in each room.

A schematic of the geomechanical instrumentation layout found in Panels 7 and 8 is shown in Figure 6-2, Typical Waste Panel Instrument Layout. This layout meets the minimum monitoring requirement in Permit Attachment A2, Section A2-5b(2)(a). This figure presents a typical Waste Panel instrumentation layout since emplacement began in Panel 1.

6.4 Analysis of Extensometer and Convergence Point Data

Panel 7 continues to experience age-appropriate roof-beam, expansion, and floor deformation in areas accessible to ground maintenance. Due to the aforementioned S2180~W985 ground event in July 2021, remote monitoring capabilities are limited in Panel 7 to only Room 1.

Absent in this section are Room 4, Room 6, and Room 7. The rooms are inaccessible due to the following reasons:

- Room 4 experienced an anticipated roof fall over approximately 80% of the room in November 2016.
- Room 6 also experienced an anticipated roof fall over much of the room sometime between December 19, 2018, and January 2, 2019.
- Access to Room 7 was prohibited to general access immediately following the radioactive release in February 2014 and was subsequently closed following the video investigation of the waste stack.

The Room 1 extensometer measured a roof beam expansion rate during this period of 0.2 in/yr, a 60 percent decrease from the previous year's reading of 0.5 in/yr. The convergence points in Panel 7 measured rates of 2.0 and 5.0 in/yr, a five and two percent increase from the previous reporting period, respectively.

Readings from Panel 8 show an average steady roof beam expansion rate of 1.2 in/yr through the 11 wire extensometers located throughout the panel. Convergence monitoring of the newly mined Panel 8 shows closure rates between 2.3 and 6.2 in/yr through 49 convergence stations. Convergence rates are typically higher in freshly mined areas before reaching a steady state and decrease once sufficient ground support is installed.

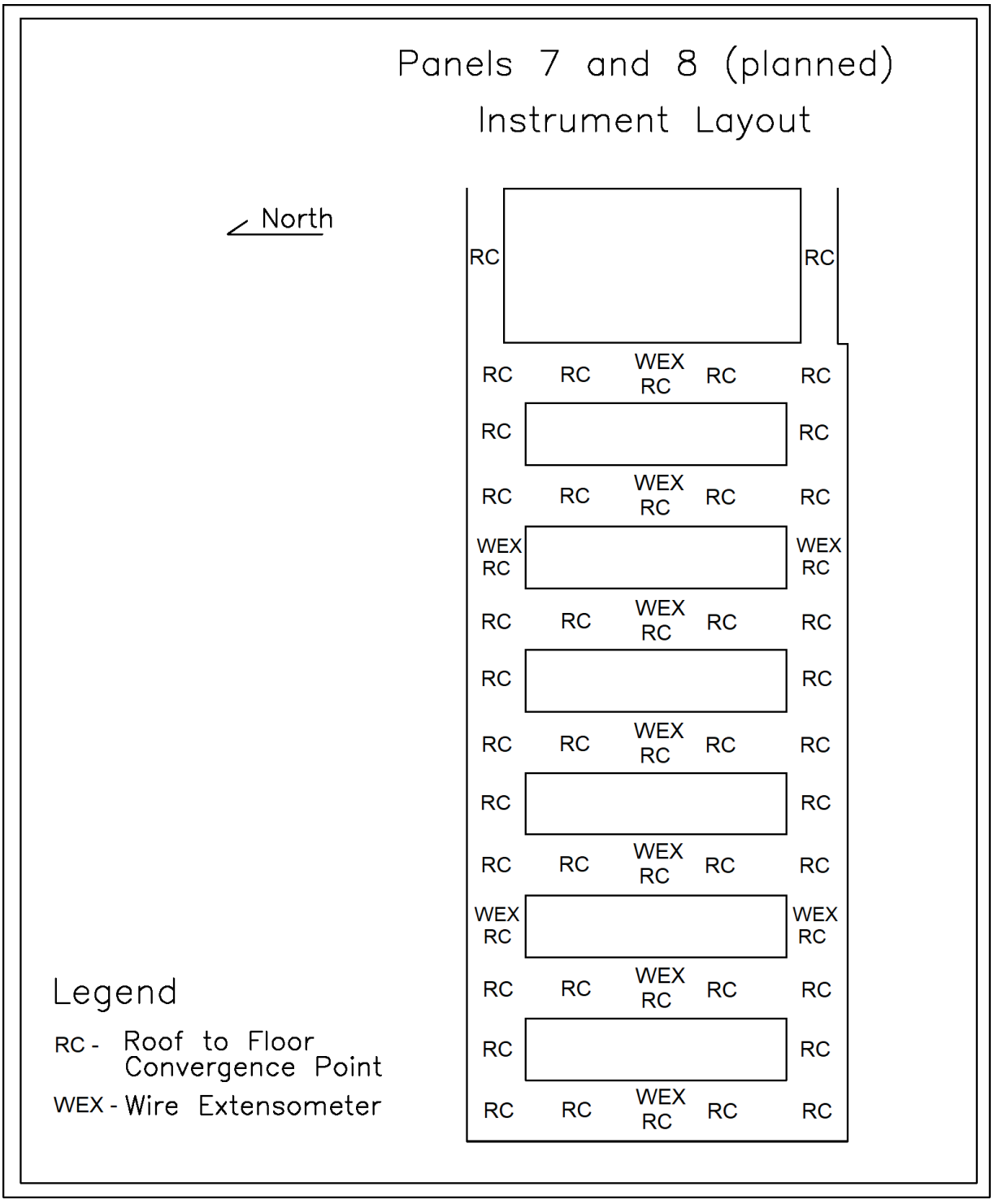

Figure 6-2 Typical Waste Panel Instrument Layout

6.5 Excavation Performance

Panel 7 performed as expected, and closure was completed in October 2022.

Panel 8 is performing as expected. The panel should fulfill its intended purpose as long as ground control efforts continue.

7.0 PERFORMANCE OF THE SALT DISPOSAL INVESTIGATIONS AND SALT DEFENSE DISPOSAL INVESTIGATIONS

This chapter describes the geomechanical performance of the SDI and SDDI areas (hereafter referred to as SDI). Development of the area began in January 2012. When completed, most of the area will have nominal dimensions of 13 ft high and 16 ft wide.

7.1 Ground Control Program

Due to the relatively narrow drifts (nominally 16 ft across) and favorable mining horizon, ground control plans in the SDI area are confined to installing 4 ft mechanically anchored bolts and chain-link mesh over the roof and ribs of the entire area to control minor spalling and drummy roof. More substantial engineered ground control systems may be applied if ongoing geomechanical monitoring and analysis of the area are identified as needed.

7.2 Instrumentation

Fifty-five convergence arrays have been installed in the SDI area. The arrays are read periodically when accessible. During this reporting period, 35 arrays were accessible.

7.3 Analysis of Convergence Point Data

The 35 convergence points for this period had a roof-to-floor closure range of 0.8 to 3.0 in/yr, with a mean rate of 1.4 in/yr, with a standard deviation of 0.4. Low closure rates are expected for this area due to the factors described in Section 7.1.

7.4 Excavation Performance

A combination of ground control and, to some extent, ventilation challenges led the Operations Department to restrict access to the SDI so the resources could be channeled to address more significant ground control remediation in other areas. The same operational challenges apply to this reporting period. The restricted areas primarily cover N-780 and N-940 drifts and their associated crosscuts. The prohibited areas are limited to SDI south of the N-780 drift, including 20 convergence stations.

8.0 GEOSCIENCE PROGRAM

The geoscience program confirms the suitability of the WIPP site by collecting various geologic data and excavation characteristics from the underground. Data collected through these activities support the design and evaluation of ground support systems. These include the inspection of open observation holes for fractures (separations) and offsets (lateral displacements) in roof beams and mapping fracture development on roof surfaces.

Fracture development in the roof is primarily caused by the concentration of compressive stresses in the roof beam. It is influenced by the size and shape of the excavation and the stratigraphy near the opening. Pillar deformations in a thick roof beam induce lateral compressive stresses into the immediate roof and floor. With time, the buildup of stress causes differential movement along stratigraphic boundaries. This differential movement is identified as offsets in observation holes and by the bends in failed rock bolts. Large strains associated with lateral movements can induce fracturing in the roof, which is frequently seen near the ribs. However, this process may take years to develop.

At the upper repository horizon, clay or anhydrite stringers exert significant influence over the effective thickness of the roof beam. The presence of these stringers causes the roof beam to behave as a series of thin, independent beams. Little or no tensile support is provided across the stringer interface. As horizontal end-loading continues, each beam can deflect downward, causing a tensile fracture to develop along the bottom of the beam. These tensile fractures can develop in relatively new excavations soon after separation occurs along the stringer interface.

Over this reporting period, the geoscience program has seen a large increase in observation hole inspections and the resumption of marking fractures within the mine. A description of the activities performed for this reporting period is summarized in the remainder of Section 8.0.

8.1 Observation Hole Inspections

Geotechnical observation holes were drilled to depths of 20 ft at various locations throughout the underground facility (Figure 8-1, Location of Observation Holes as of June 30, 2023). An area may contain one or more holes arranged in an array. These holes allow for monitoring of fracture development and offsetting that generally occur 9 ft above or closer to the back of the mine and the bolt anchorage zone for competence. Roof observation holes usually extend past Clays G and H (Figure 8-2, Example of Observation Hole Layout at Lower Horizon, and Figure 8-3, Typical Fracture Pattern at Lower Horizon).

The clay seams nearest the excavation surfaces define the immediate roof beam. The roof beam is bounded by Clay G in most access drifts and Panels 1, 2, and 7. Some areas, such as the Salt Shaft Station, portions of the E-0 and E-140 drifts, the mains south of S-2620, and Panels 3, 4, 5, 6, and 8 are excavated to Clay G and have roof beams bounded by Clay H.

The offset in an observation hole is determined by visually estimating the degree of occlusion. The direction of offset along clay seams is observed as the movement of the strata nearer to the observer relative to the strata farther away. Typically, the nearer strata move toward the center of the excavation (Figure 8-4, Example Observation Hole Layout at Upper Horizon, and Figure 8-5, Typical Fracture Patterns at Upper Horizon). Based on previous observations in the underground, the magnitude of the offset is usually greater in holes located near ribs than in those located along excavation centerlines. Offsetting along the clay layers is observable until the total offset is reached or visibility is obstructed by intervening offsets at other clay seams or fractures.

Over this reporting period, 76 observation holes (Vol. 2, Table 7-1 Observation Borehole Inspection Summary) were inspected as opposed to just four during the previous reporting period, and 27 new observation holes were drilled (Vol. 2, Table 7-2 New Observation Holes Summary).

Historically, an aluminum rod with a perpendicular flattened steel wire on the end was used to feel for separations and irregularities in the borehole wall. This equipment was updated to a ViewTech™ 6mm VJ-3 dual view camera, which allows a live feed view parallel and horizontal to the direction of the borehole during the inspection. Along with the historically recorded features, the inspection system and a newly developed database allow personnel to look for fluid production zones, fracture networks, rubble zones, and stringers.

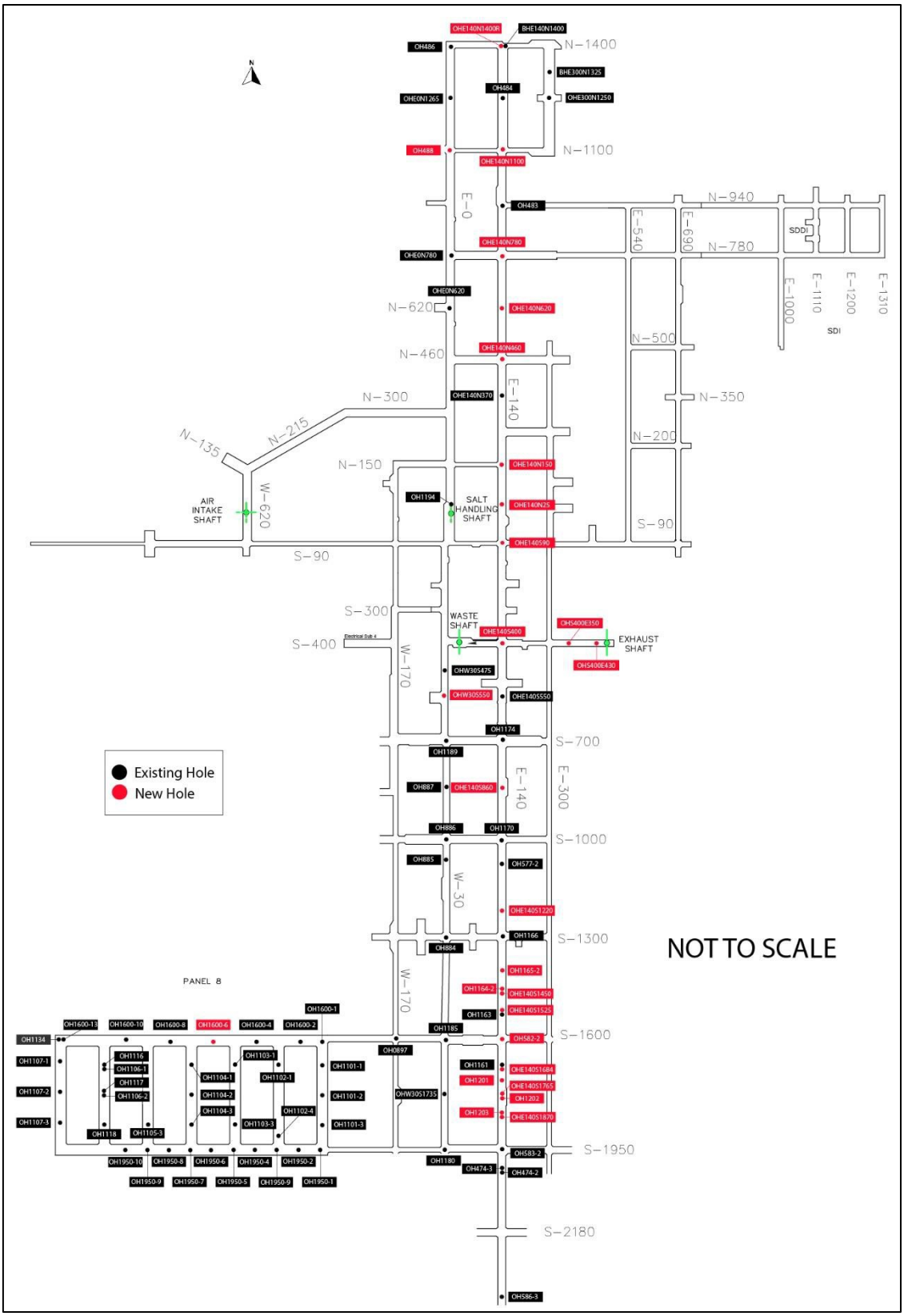

Figure 8-1 Location of Observation Holes as of June 30, 2023

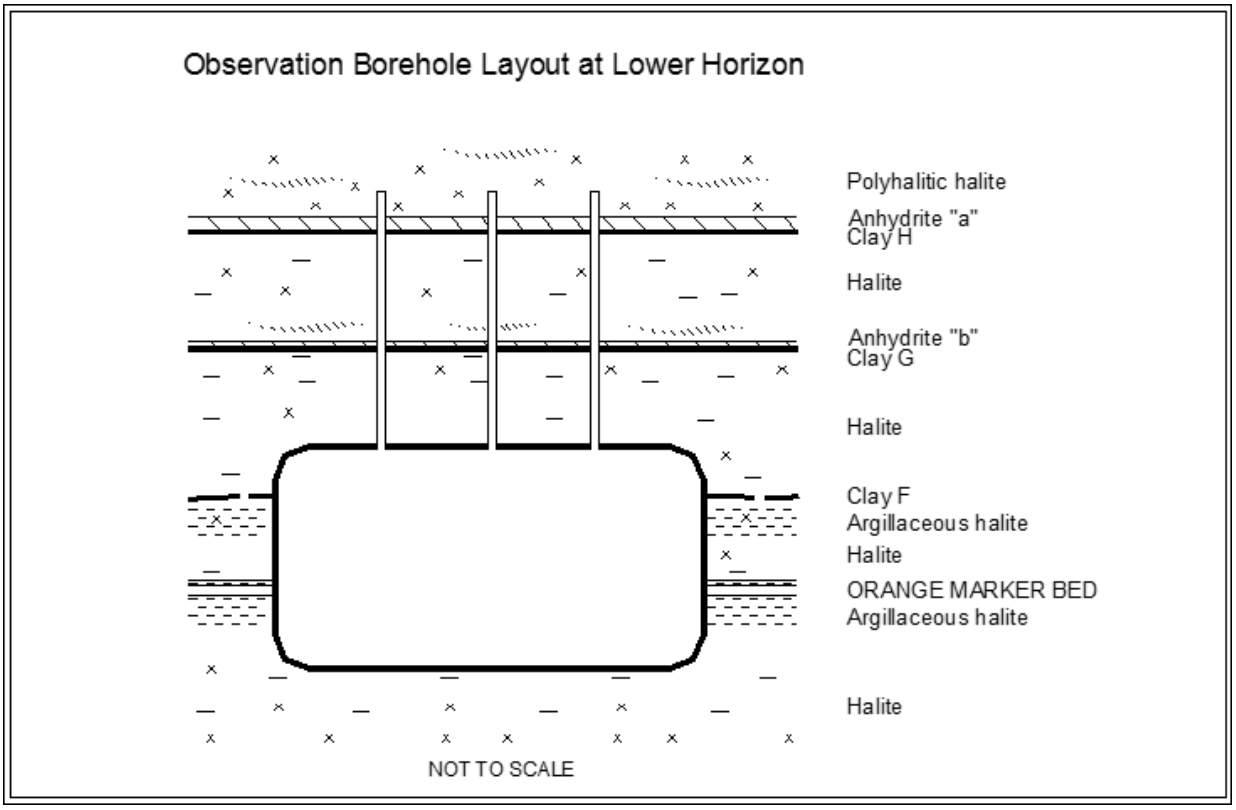

Figure 8-2 Example of Observation Hole Layout at Lower Horizon

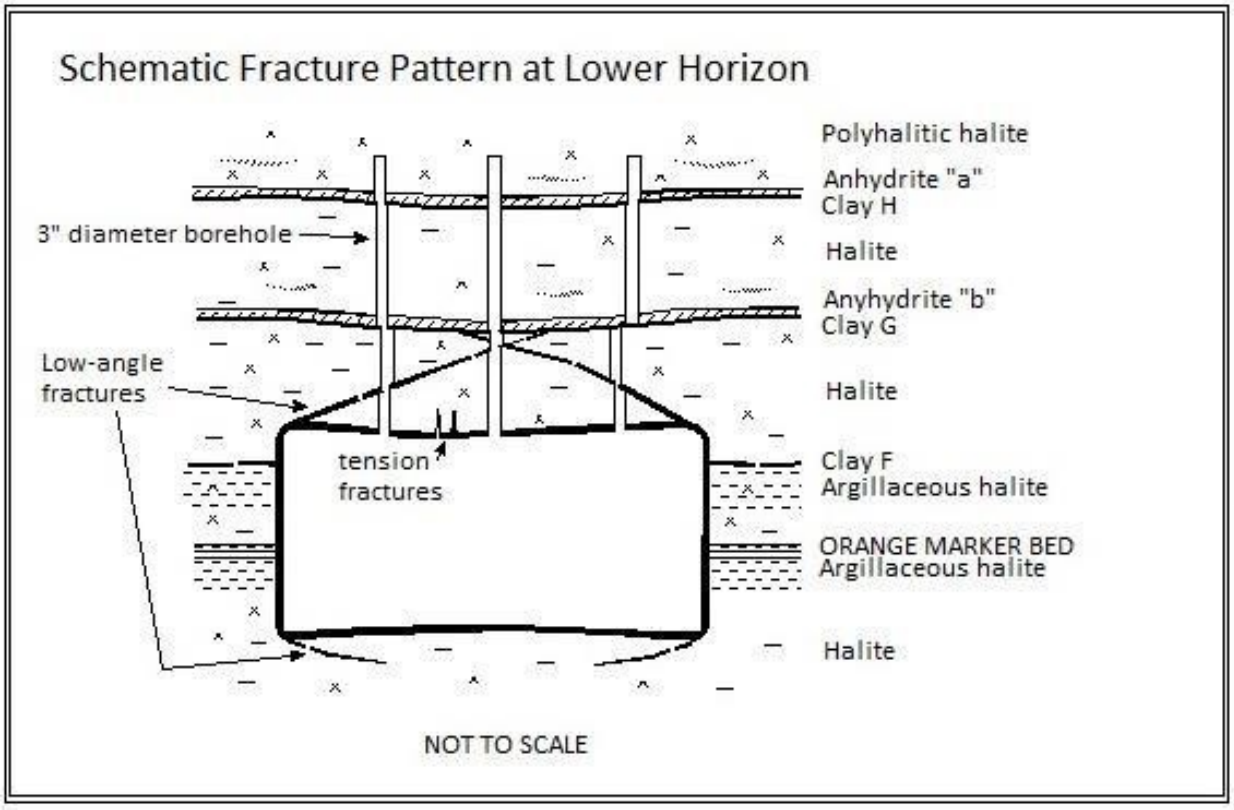

Figure 8-3 Typical Fracture Pattern at Lower Horizon

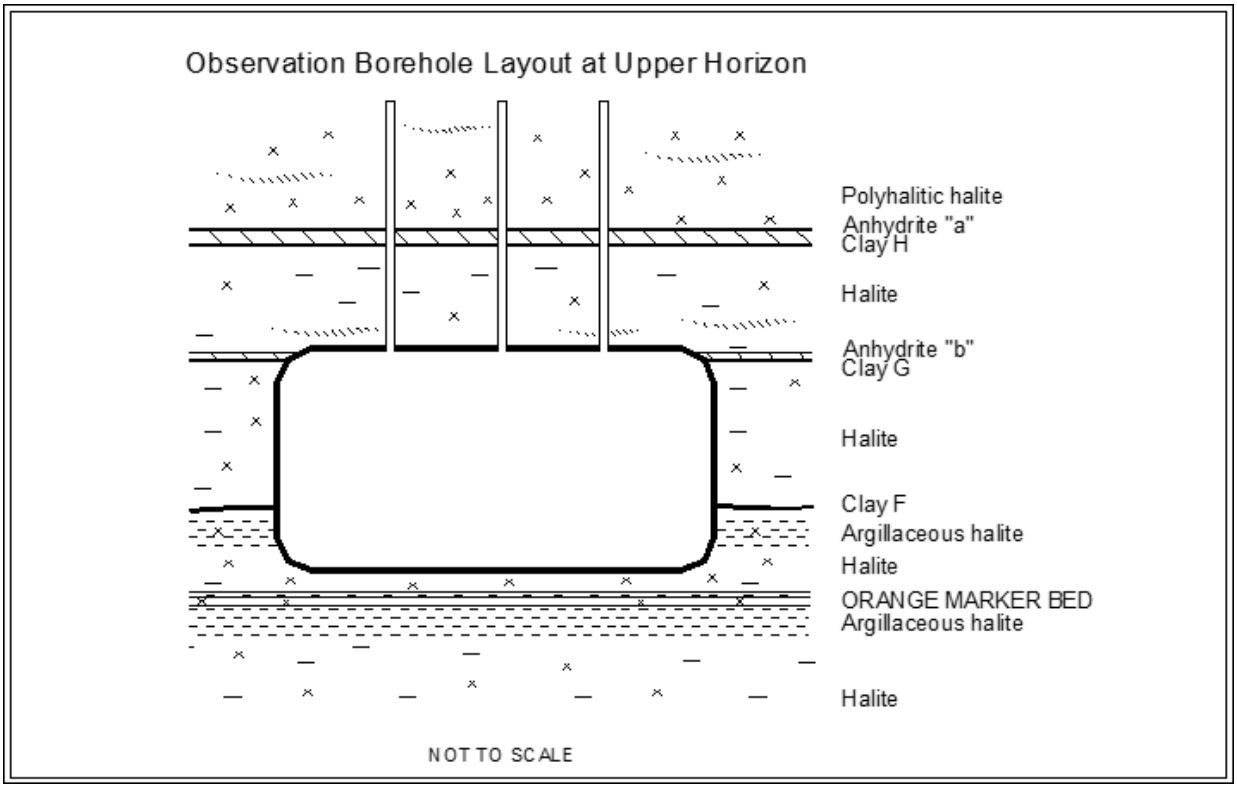

Figure 8-4 Example Observation Hole Layout at Upper Horizon

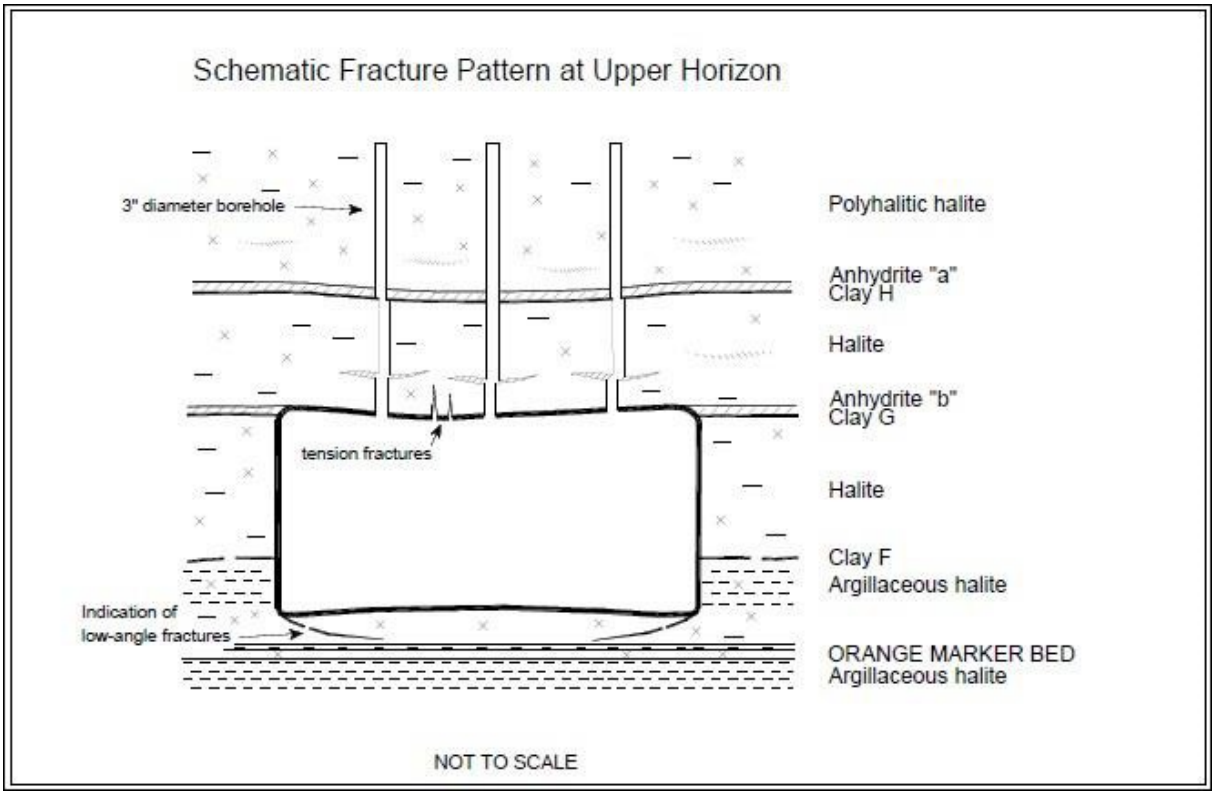

Figure 8-5 Typical Fracture Patterns at Upper Horizon

8.2 Fracture Mapping

Routine mapping documents the progression of fractures in the roof exposed on the excavation surfaces of the drifts and rooms in the underground repository. The fracture surveys are generally performed annually, and the maps are updated. The fracture maps facilitate strain analysis in the immediate roof beam because they document the development and propagation of fractures through time.
The Fracture Mapping program is being updated for more accurate and interpretable data. Fractures in the underground are currently being marked to allow the geotechnical team to track growth in the future.

8.3 Stratigraphic Mapping

Stratigraphic mapping is the identification and partitioning of the sequence of rock strata based on their form, distribution, and lithological composition. It is used to verify that there are no nonconformities in the geology within the waste disposal horizon at the WIPP. No stratigraphic mapping has been completed over this reporting period, as no new panels have been mined.

8.4 Drilling and Geologic Core Descriptions

As new panels and new experimental areas are excavated, holes are typically drilled and cored vertically into the back and the floor to depths of 50 ft to identify and describe the stratigraphic units present. No drilling or core descriptions were completed during this reporting period.

9.0 SUMMARY

At the inception of the WIPP, criteria were developed that addressed the design requirements (DOE, 1984). They pertained to aspects of the mined facility and its operation as a pilot plant to demonstrate technical and operational methods for permanently disposing of CH and RH TRU waste. In 1994, as the WIPP focus moved toward the permanent disposal of TRU waste, these design requirements were reassessed and replaced by a new set of requirements called system design descriptions. Table 9-1, Comparison of Excavation Performance to System Design Requirements, compares these design requirements with conditions observed in the underground from July 2022 through June 2023.

The performances of the accessible and bolted excavations continue to satisfy the appropriate design criteria. Although improvements to ground control maintenance activities in inaccessible areas in the underground have been made, additional efforts are still needed. Future changes to the planned life of some openings may require changing the geometry of the access drifts by removing unstable roof beams or rib spalls, milling the floor for added clearance, and installing roof bolts with mesh or straps.

In addition to underground instrumentation, qualitative assessments of fracture development are documented by mapping the underground repository and inspecting the observation holes. As indicated in Section 8.0, 27 new observation boreholes were drilled, and 76 holes were inspected. Additionally, the accumulation of many years of collected information acquired from these programs contributes to the understanding of the dynamic geomechanical processes in the WIPP underground. This understanding aids in the design of effective ground control and support systems.

Based on the observations during this period, there have been no substantial or detrimental deviations from the expected performance of the mined repository. Observations included an assessment of lithology, deformation, and closure rates. In addition, the requirements of the Permit regarding geomechanical monitoring have been met, including the installation of required instrumentation, data collection, and inspection of the shafts. The WIPP repository complies with the requirements of 40 CFR § 191.14 and the Permit.

Requirement	Comments
"The lining shall be designed for a hydrostatic pressure ..... "	Water pressure observed on piezometers located behind the shaft liners remains below design levels.
"The key shall be designed to resist the lateral pressure generated by salt creep."	Visual inspections of all shaft keys do not indicate any deterioration due to creep loading.
"The key shall be designed to retain the rock formation and will be provided with chemical seal rings and a water collection ring with drains to prevent water from flowing down the unlined shaft from the lining above."	Shaft inspection observations show no indication of instability due to salt dissolution. No water has been observed flowing along the rock-liner interface.
"The underground waste disposal facilities shall be designed to provide space and adequate access for the underground equipment and temporary storage space to support underground operations."	Geomechanical instrument data and visual observations indicate that the current design provides adequate access, storage, and disposal space. Ground control maintenance is performed as necessary to maintain access. If ground control activities cannot be performed on time and the geomechanical data suggest potential instability, access to the drift is to be restricted or even prohibited until ground remediation can occur.
"Entries and subentries to the underground disposal area and the experimental areas shall be provided and sized for personnel safety, adequate airflow, and space for equipment."	Deformation of excavation remains within the required limits. Routine periodic maintenance consisting of rock bolting, wire meshing, trimming, and scaling continues throughout accessible areas of the repository. Areas such as the waste transport route undergo periodic floor trims to maintain adequate operating height.
"Geomechanical instrumentation shall be provided to measure the cumulative deformation of the rock mass surrounding mined drifts ....."	Geomechanical instrumentation is operated and maintained to meet this requirement. This annual report provides a summary and analysis of the geomechanical data.

Table 9-1 Comparison of Excavation Performance to System Design Requirements[8]

[8] DOE-WIPP-86-010, *Waste Isolation Pilot Plant Design Validation Final Report*, U.S Department of Energy, 1986, Bechtel National, Inc., San Francisco, California.

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DOE/WIPP- 24-3610
Volume 2

Waste Isolation Pilot Plant

Geotechnical Analysis Report for July 2022 – June 2023

Supporting Data

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Waste Isolation Pilot Plant

Geotechnical Analysis Report For July 2022 – June 2023

Supporting Data

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October 31, 2024

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FOREWORD AND ACKNOWLEDGMENTS

This report contains an assessment of the geotechnical status of the Waste Isolation Pilot Plant (WIPP). During the excavation of the WIPP principal underground access and experimental areas, the status was reported quarterly. Since 1987, when the initial construction phase was completed, reports have been published annually. This report presents and analyzes data collected from July 1, 2022 to June 30, 2023.

The Geotechnical Analysis Report (GAR) is based on the recommendations for periodic reporting of ongoing data collection in the Design Validation Final Report (DOE, 1986) and to satisfy several audiences. It satisfies requirements contained in the WIPP Hazardous Waste Facility Permit[1] and the Certification of Compliance[2] with Subpart B and Subpart C, Title 40 Code of Federal Regulations, Part 191, Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes (Part 191 and Part 194 requirements for monitoring apply after disposal—i.e., “when all the shafts to the repository are backfilled and sealed” §191.02(l). However, pre-disposal monitoring establishes baseline conditions and is useful to validate modeling assumptions and parameters that support expected performance.). The report focuses on the geotechnical performance of the various components of the WIPP underground facility, including the shafts, shaft stations, access drifts, and waste disposal areas. The results of investigations of excavation effects and other geotechnical studies are also included.

The report compares the geotechnical performance of the repository to the design criteria. It describes the techniques that were used to acquire the data. The depth and breadth of the evaluation of the different components of the underground facility according to the types, qualities, and quantities of data available and the complexity of the recorded geotechnical responses. Graphic documentation of data and tabular documentation of instrument history can be provided upon request.

This GAR was prepared by Salado Isolation Mining Contractors, LLC for the U.S. Department of Energy (DOE), Carlsbad Field Office in Carlsbad, New Mexico. Work was supported by the DOE under Contract No. 89303322-DEM-000077.

[1] New Mexico Environment Department, 2023, Waste Isolation Pilot Plant Hazardous Waste Facility Permit, NM4890139088-TSDF, Santa Fe, NM

[2] U.S. Environmental Protection Agency (EPA), 1998, "Criteria for the Certification and Recertification of the Waste Isolation Pilot Plant's Compliance with the Disposal Regulations: Certification Decision," Federal Register, Vol. 63, No. 95, pp. 27354, May 18, 1998, Washington, DC

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Figure 5-62 Convergence Point Array – S1950 W1120 – Roof to Floor 222
Figure 5-63 Convergence Point Array – S1950 W1190 – Roof to Floor 222

SDI

Figure 6-1 Convergence Point Array – E540 N860 – Roof to Floor 226
Figure 6-2 Convergence Point Array – E690 N860 – Roof to Floor 226
Figure 6-3 Convergence Point Array – E1110 N860 – Roof to Floor 227
Figure 6-4 Convergence Point Array – E1300 N860 – Roof to Floor 227
Figure 6-5 Convergence Point Array – N780 E220 – Roof to Floor 228
Figure 6-6 Convergence Point Array – N780 E300 – Roof to Floor 228
Figure 6-7 Convergence Point Array – N780 E420 – Roof to Floor 229
Figure 6-8 Convergence Point Array – N780 E540 – Roof to Floor 229
Figure 6-9 Convergence Point Array – N780 E615 – Roof to Floor 230
Figure 6-10 Convergence Point Array – N780 E690 – Roof to Floor 230
Figure 6-11 Convergence Point Array – N780 E768 – Roof to Floor 231
Figure 6-12 Convergence Point Array – N780 E845 – Roof to Floor 231
Figure 6-13 Convergence Point Array – N780 E922 – Roof to Floor 232
Figure 6-14 Convergence Point Array – N780 E1050 – Roof to Floor 232
Figure 6-15 Convergence Point Array – N780 E1100 – Roof to Floor 233
Figure 6-16 Convergence Point Array – N780 E1150 – Roof to Floor 233
Figure 6-17 Convergence Point Array – N780 E1200 – Roof to Floor 234
Figure 6-18 Convergence Point Array – N780 E1250 – Roof to Floor 234
Figure 6-19 Convergence Point Array – N780 E1300 – Roof to Floor 235
Figure 6-20 Convergence Point Array – N940 E220 – Roof to Floor 235
Figure 6-21 Convergence Point Array – N940 E300 – Roof to Floor 236
Figure 6-22 Convergence Point Array – N940 E420 – Roof to Floor 236

Figure 6-23 Convergence Point Array – N940 E540 – Roof to Floor 237
Figure 6-24 Convergence Point Array – N940 E615 – Roof to Floor 237
Figure 6-25 Convergence Point Array – N940 E690 – Roof to Floor 238
Figure 6-26 Convergence Point Array – N940 E768 – Roof to Floor 238
Figure 6-27 Convergence Point Array – N940 E845 – Roof to Floor 239
Figure 6-28 Convergence Point Array – N940 E922 – Roof to Floor 239
Figure 6-29 Convergence Point Array – N940 E1000 – Roof to Floor 240
Figure 6-30 Convergence Point Array – N940 E1050 – Roof to Floor 240
Figure 6-31 Convergence Point Array – N940 E1100 – Roof to Floor 241
Figure 6-32 Convergence Point Array – N940 E1150 – Roof to Floor 241
Figure 6-33 Convergence Point Array – N940 E1200 – Roof to Floor 242
Figure 6-34 Convergence Point Array – N940 E1250 – Roof to Floor 242
Figure 6-35 Convergence Point Array – N940 E1300 – Roof to Floor 243

1.0 INTRODUCTION

This report is the compilation of geotechnical data for each active instrument installed in the underground at the WIPP facility from July 1, 2022 through June 30, 2023. A summary of the geotechnical analyses that were performed using the compiled data is provided in the Volume 1 of the GAR.

1.1 Instrumentation

Geomechanical instrument data included in this report reflect the measurements of the geotechnical response of the underground mine. The instruments consist of convergence points, borehole extensometers, rock bolt load cells, pressure cells, strain gauges, piezometers, and joint meters.

Closure measurements are taken at convergence points. Rock displacement is calculated by measuring the distance between two opposing points. Displacement is monitored over time and is plotted as closure versus time. Annual rates of closure are calculated from the convergence data and are compared with annual closure rates from previous reporting periods.

Borehole extensometers are used to determine the absolute movements of the ground around the openings within the mine. With these instruments, stainless steel cables are installed into a hole and anchored at various depths. The displacement at the extensometer head (located near the excavation face) is measured relative to each of the fixed anchors. These data are used in the extensometer displacement plots presented in this report. Annual rates of displacement are calculated for each extensometer and are compared with the annual displacement rate reported during the previous reporting period.

Rock bolt load cells are used to measure the load exerted by the overburden and the effectiveness of rock bolts. Plots for each instrumented rock bolt are presented as load versus time.

Earth pressure cells and strain gauges are used in and around the shaft liners to determine the load on the liners. The data are depicted in time-based plots. Monitoring of these instruments indicates whether there are stresses building up in the shaft lining systems.

Piezometers are used to measure the gauge pressure of groundwater. They have been installed in the shafts at varying elevations to monitor the hydraulic head acting on the shaft liners. Plots from piezometers are presented as pressure versus time.

Joint meters are installed perpendicular to a crack and monitor changes in separation of the crack which may occur over time.

1.2 Data Plot Explanation

Data are presented in graphical form for ease of interpretation. Time-based plots are used in this report. Each plot generally displays a legend in the upper right-hand corner that gives the array name and specific location of the instrument or point evaluated. The legend ties the graphical cross-sectional representation of the drift or shaft typically presented in the lower right-hand corner to the symbols on the curve in the graph. For extensometers, each anchor is designated with an alpha character "A" closest to the collar and "B," "C," "D," or "E" for the furthest point from the collar (the deepest anchor). For convergence points, the horizontal and vertical sections of the drift are referred to as chords. Breaks in the graph for convergence data and a numeric designator added to the legend typically indicate that the convergence point was lost due to normal mine maintenance activities and later reinstalled.

1.3 Report Organization

Section1.0, Introduction, establishes a foundation for this Supporting Data volume of the GAR. Section 2.0, Instrumentation Summary for the Shafts, provides instrument data analysis for the Salt Shaft, followed by data plots for the piezometers, Earth pressure cells, spot welded strain gauges, and embedment strain gauges installed in the Salt Shaft. Section 3.0, Instrumentation Summary for the Shafts Stations, provides instrument data analysis for the Salt Shaft Station and data plots for convergence points located within the station. Section 4.0, Instrumentation Summary for the Access Drifts, provides instrument data analysis for the access drifts followed by data plots for the extensometers, convergence points, joint meters, and rock bolt load cells. Section 5.0, Instrumentation Summary for the Waste Disposal Area, provides instrument data analysis for the Waste Disposal Area followed by data plots for the extensometers and convergence points. Section 6.0, Instrumentation Summary for the SDI Area, provides convergence point instrument data analysis for the Salt Disposal Investigations (SDI) area. Section 7.0, Geoscience Summary, provides geologic data collected through the mapping of fractures, stratigraphic mapping, and the observed displacements in vertical boreholes.

2.0 INSTRUMENTATION SUMMARY FOR THE SHAFTS

Geomechanical instrumentation was originally installed in the Salt, Waste, and Exhaust Shafts. Following the construction of the Air Intake Shaft (AIS), the shaft was instrumented under the direction of Sandia National Laboratories (SNL). SNL also read and maintained the data from the AIS instrumentation for a period of time after installation.

Some instrument readings from the Waste, AIS, and Exhaust Shafts are no longer available due to failed instruments, broken cabling, and/or inoperable/obsolete data acquisition equipment. Although much of the instrumentation installed in the shafts has failed through the years, there are no plans to replace it. The project has a good understanding of the expected movements in the shafts. Instrument readings up to the point of instrument failure did not indicate unusual shaft movements or displacements. Continued periodic visual inspections confirm the expected shaft performance and provide necessary observations to evaluate shaft performance. Replacement of failed instrumentation is not expected, at this time, to provide significant additional information, and will depend on what types of instruments are available due to funding.

Table 2-1, Salt Handling Shaft Data Analysis, presents data and analysis of the Salt Shaft instrumentation. Plots of the instrument data are presented as Figure 2-1, Piezometers Salt Handling Shaft – Level 580 at the Forty-niner Member, through Figure 2-11, Embedment Strain Gauge – Salt Handling Shaft Key – Level 862.4.

Table 2-1 Salt Handling Shaft Data Analysis

Piezometers								
Field Tag	Level feet	Figure Number	Date of 2022-2023 Max. Reading	2022-2023 Maximum Pressure Readings (psi)	Date of 2021-2022 Max. Reading	2021-2022 Maximum Pressure Readings (psi)	Change in Maximum Pressure From Previous Year (psi)	Comments[1]
37X-PE-00201	580	2-1	12/20/2022	73.3	6/17/2022	74.5	1.2	N/A
37X-PE-00202	580	2-1	12/20/2022	88.7	6/17/2022	89.5	0.8	N/A
37X-PE-00203	620	2-2	12/20/2022	145.4	6/17/2022	141.9	-3.5	N/A
37X-PE-00205	691	2-3	10/27/2022	132.7	5/11/2022	144.5	-11.8	N/A
37X-PE-00206	691	2-3	10/27/2022	128.3	5/11/2022	140.1	-11.8	N/A
37X-PE-00210	802	2-4	12/20/2022	0.1	04/01/2022	1.7	1.6	N/A
37X-PE-00211	850	2-5	12/20/2022	28.8	2/8/2022	34.6	5.8	N/A
37X-PE-00212	850	2-5	10/18/2022	46.4	5/11/2022	45.4	-1	N/A
Earth Pressure Cells								
Field Tag	Level feet	Figure Number	Date of 2022-2023 Max. Reading	2022-2023 Maximum Pressure Readings (psi)	Date of 2021-2022 Max. Reading	2021-2022 Maximum Pressure Readings (psi)	Change in Maximum Pressure From Previous Year (psi)	Comments[1]
37X-WE-00201	860	2-6	4/28/2023	-13.7	02/25/2022	-13.6	0.1	N/A
37X-WE-00202	860	2-6	4/28/2023	-29.1	06/17/2022	-28.9	0.2	N/A
Spot-Welded Strain Gauges								
Field Tag	Level feet	Figure Number	Date of 2022-2023 Max. Reading	2022-2023 Maximum Strain Readings (με)	Date of 2021-2022 Max. Reading	2021-2022 Maximum Strain Readings (με)	Change in Maximum Strain From Previous Year (με)	Comments[1]
37X-ZE-00206	856.3	2-7	04/28/2023	669	05/11/2022	683	-14	N/A

Table 2-1 Salt Handling Shaft Data Analysis (continued)

Embedment Strain Gauges								
Field Tag	Level feet	Figure Number	Date of 2022-2023 Max. Reading	2022-2023 Maximum Strain Readings (με)	Date of 2021-2022 Max. Reading	2021-2022 Maximum Strain Readings (με)	Change in Maximum Strain From Previous Year (με)	Comments[1]
37X-ZE-00209	857	2-8	03/30/2023	-501	06/17/2022	-495	-6	N/A
37X-ZE-00210	857	2-8	10/18/2022	994	02/08/2022	1005	-11	N/A
37X-ZE-00211	857	2-8	10/18/2022	347	02/25/2022	344	3	N/A
37X-ZE-00212	857	2-8	07/29/2022	-683	06/17/2022	-674	-9	N/A
37X-ZE-00213	857	2-8	04/28/2023	447	06/17/2022	446	1	N/A
37X-ZE-00214	857	2-8	04/28/2023	107	05/11/2022	107	0	N/A
37X-ZE-00215	857	2-8	10/18/2022	175	06/17/2022	169	6	N/A
37X-ZE-00216	857	2-8	10/18/2022	660	05/11/2022	669	-9	N/A
37X-ZE-00225	862.4	2-9	10/18/2022	314	02/25/2022	315	-1	N/A
37X-ZE-00226	862.4	2-9	10/18/2022	47	05/11/2022	45	2	N/A
37X-ZE-00229	862.4	2-9	10/18/2022	924	05/11/2022	930	-6	N/A
37X-ZE-00230	862.4	2-9	04/28/2023	707	05/11/2022	717	-10	N/A
37X-ZE-00232	862.4	2-9	04/28/2023	3704	06/17/2022	3704	0	N/A
37X-ZE-00235	857	2-10	03/30/2023	-350	06/17/2022	-343	-7	N/A
37X-ZE-00236	857	2-10	04/28/2023	178	05/11/2022	152	26	N/A
37X-ZE-00237	857	2-10	04/28/2023	103	06/17/2022	112	-9	N/A
37X-ZE-00238	857	2-10	04/28/2023	574	05/11/2022	577	-3	N/A
37X-ZE-00239	862.4	2-11	10/18/2022	422	02/25/2022	420	2	N/A

1. N/A : Not Applicable or No Comments or None

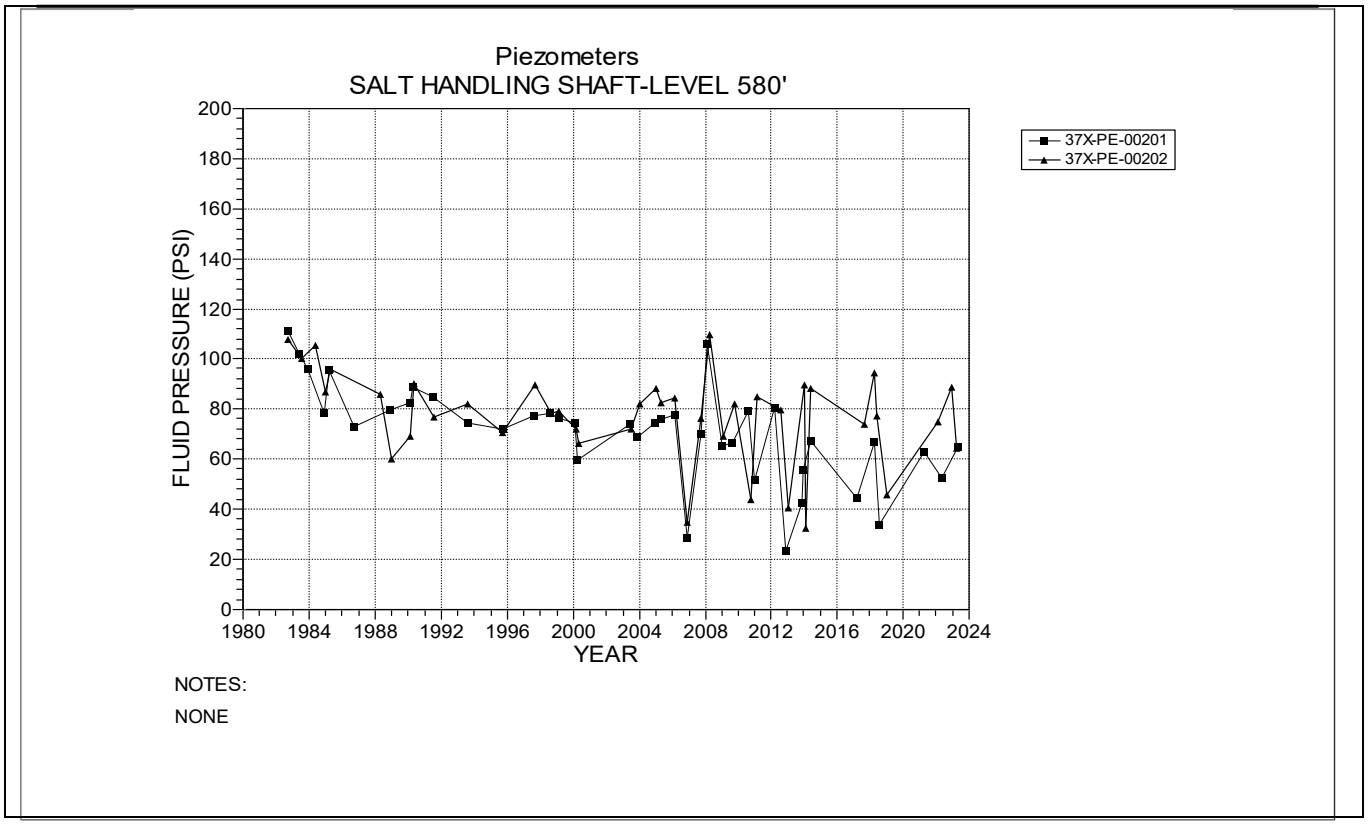


Figure 2-1 Piezometers Salt Handling Shaft – Level 580 at the Forty-niner Member

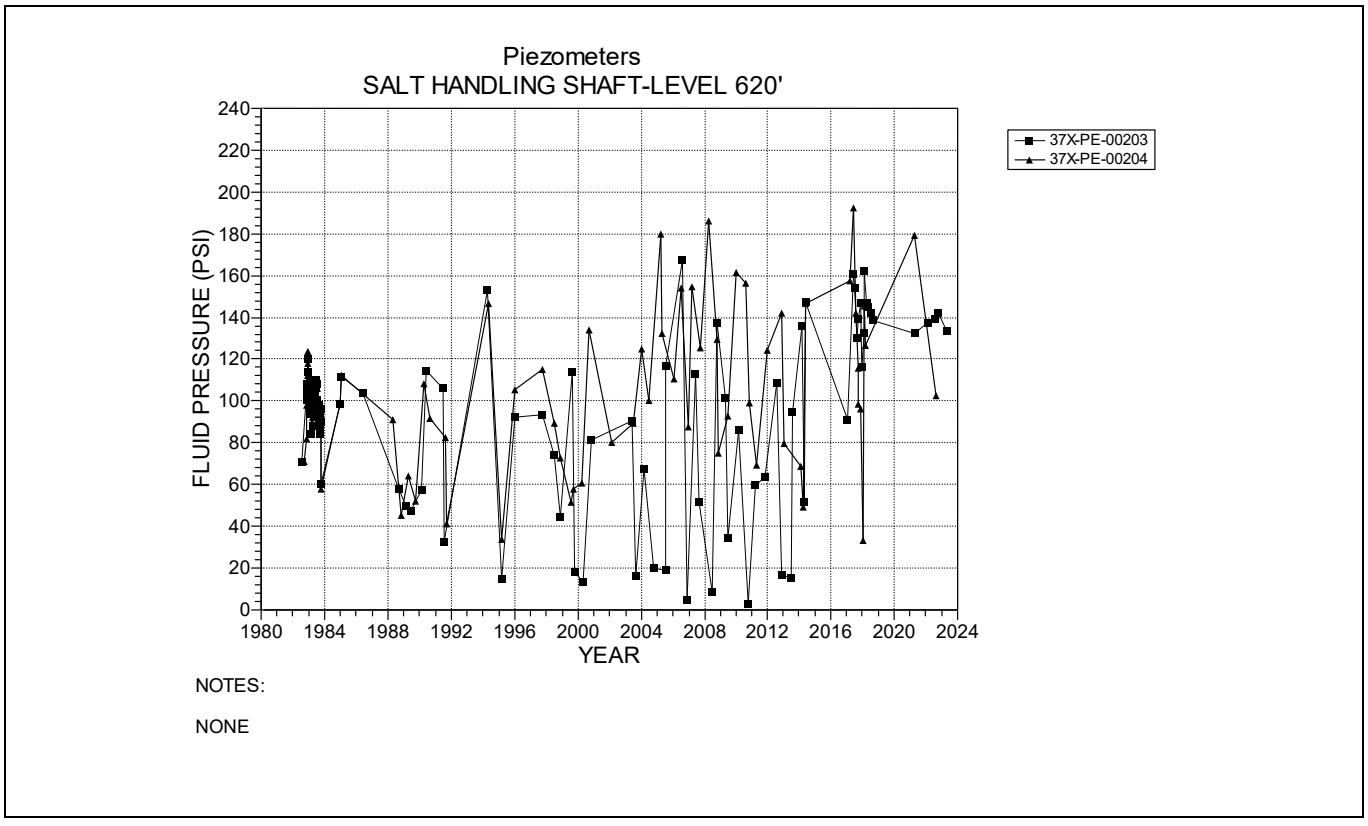


Figure 2-2 Piezometers Salt Handling Shaft – Level 620 at the Magenta Dolomite Member

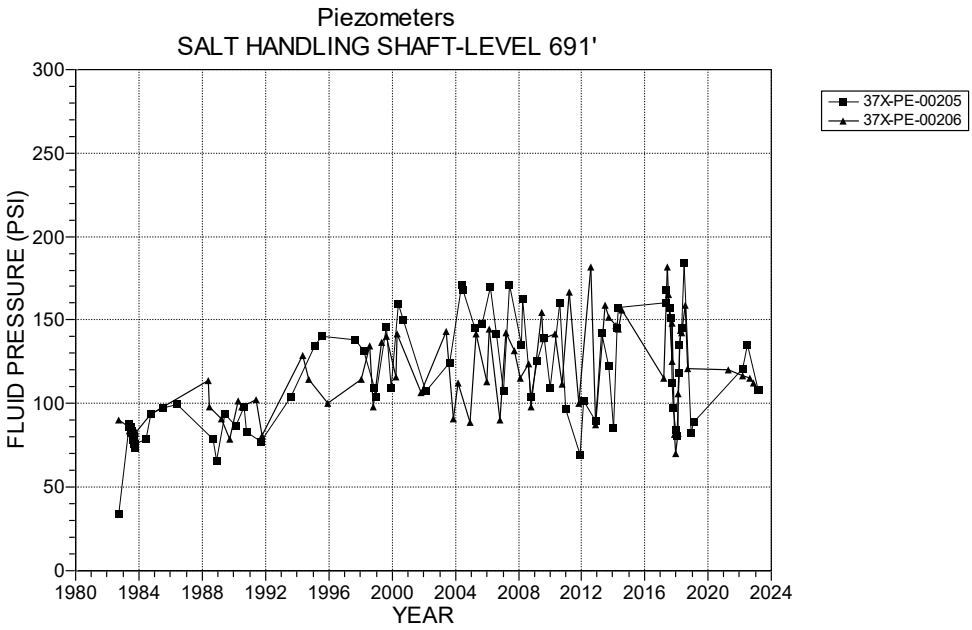


Figure 2-3 Piezometers Salt Handling Shaft – Level 691 at the Tamarisk Member

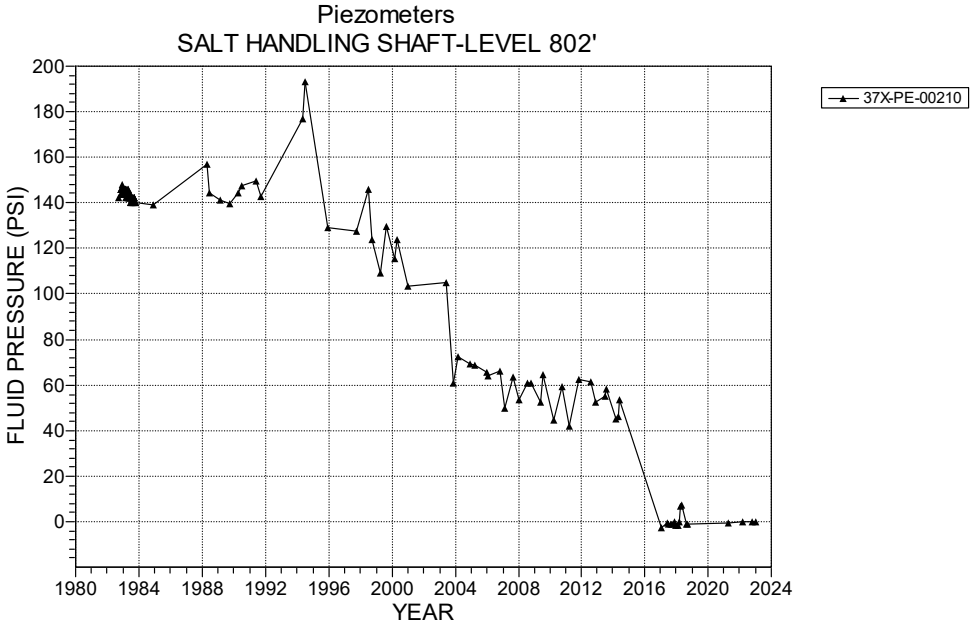


Figure 2-4 Piezometer Salt Handling Shaft – Level 802 at the Los Medaños Member

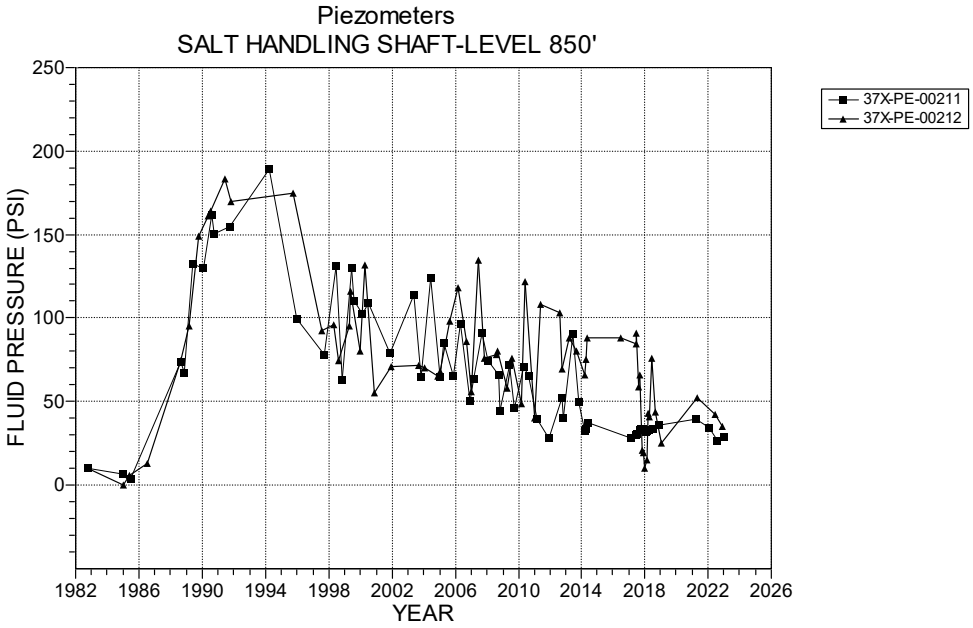


Figure 2-5 Piezometer Salt Handling Shaft – Level 850 at the Rustler-Salado Contact

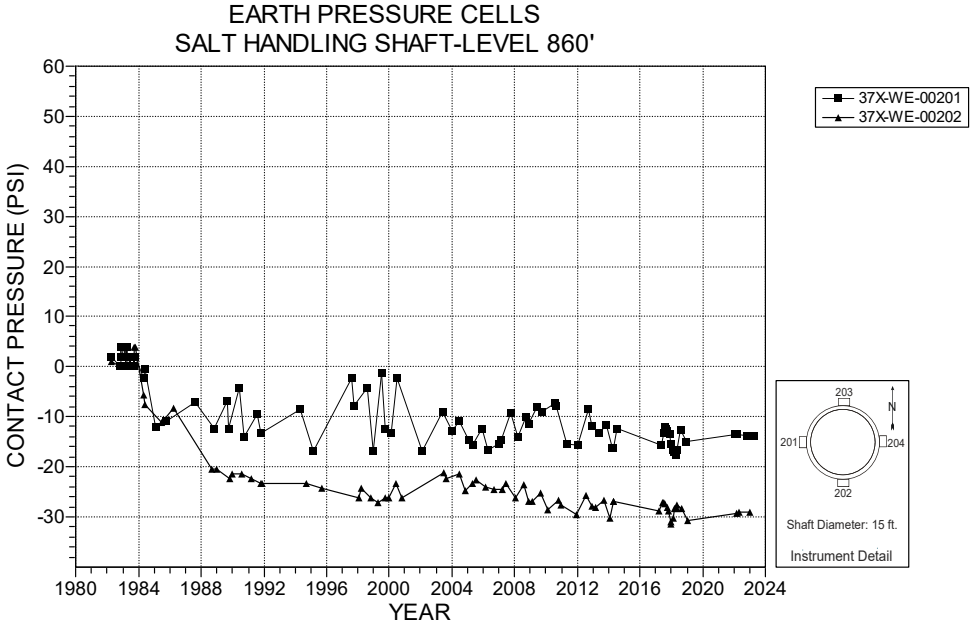
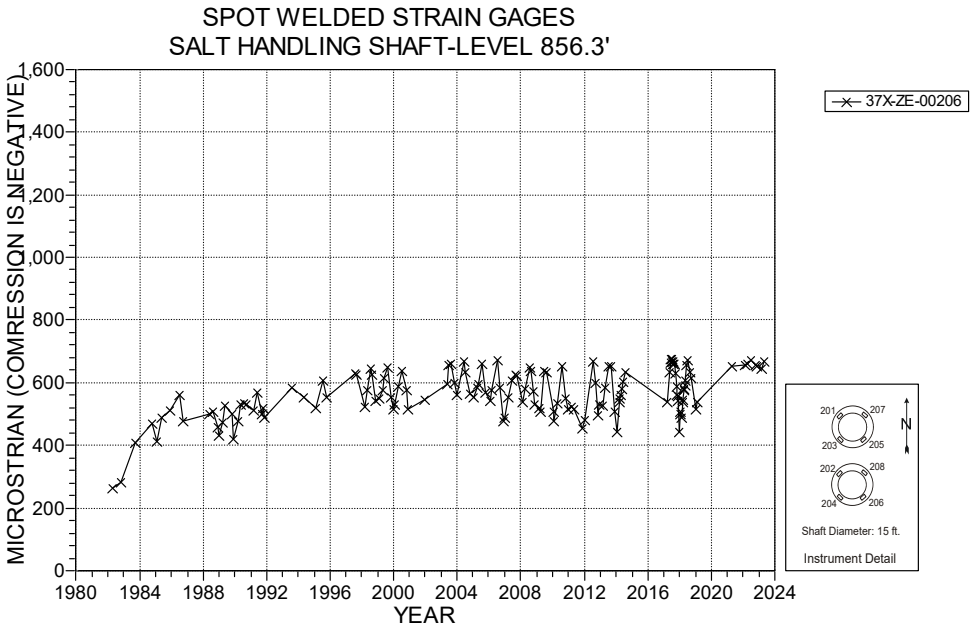


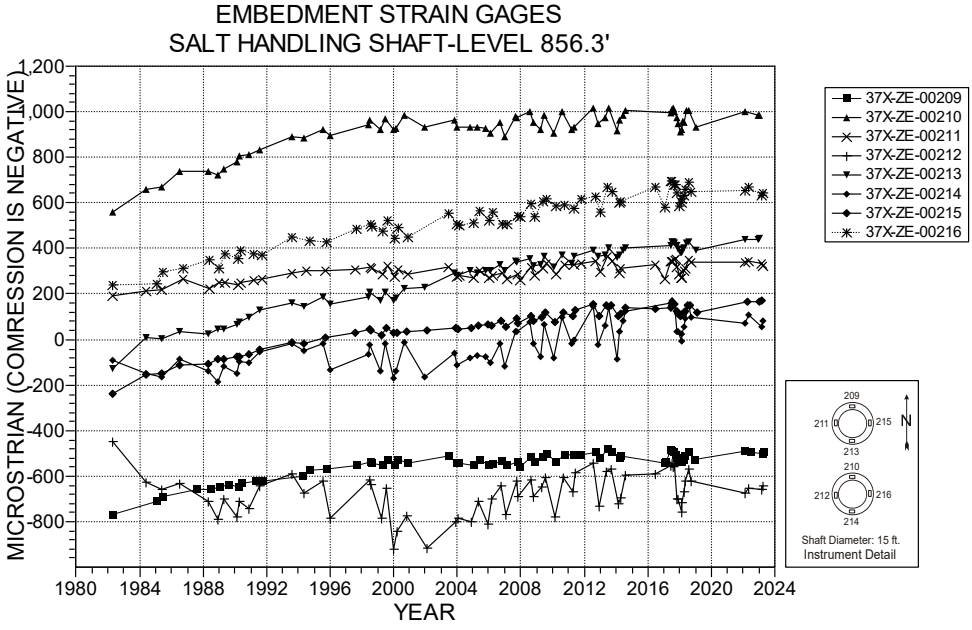
Figure 2-6 Earth Pressure Cells – Salt Handling Shaft Key – Level 860



NOTES:

NONE

Figure 2-7 Spot Welded Strain Gauge – Salt Handling Shaft Key – Level 856.3



NOTES:

NONE

Figure 2-8 Embedment Strain Gauge – Salt Handling Shaft Key – Level 856.3

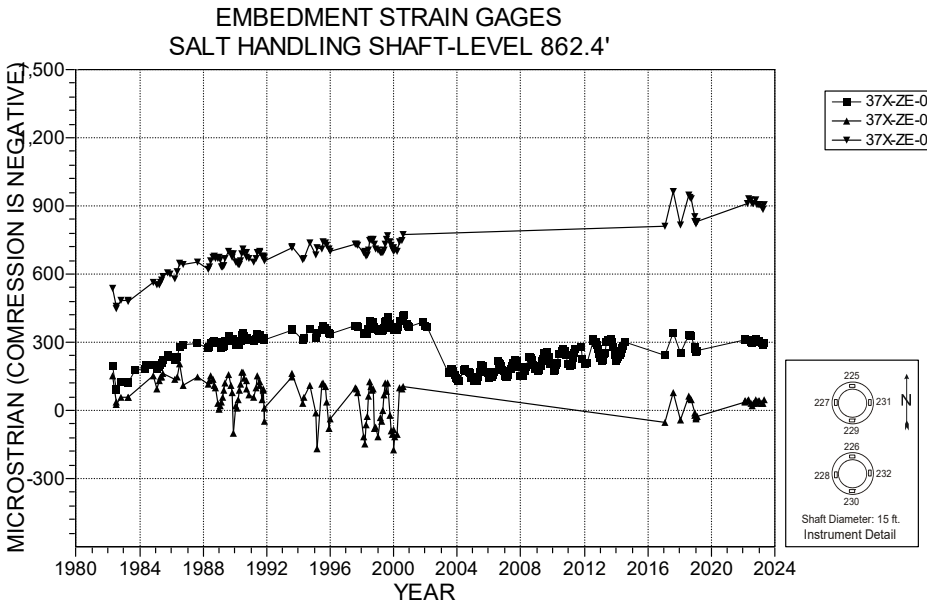


Figure 2-9 Embedment Strain Gauge – Salt Handling Shaft Key – Level 862.4

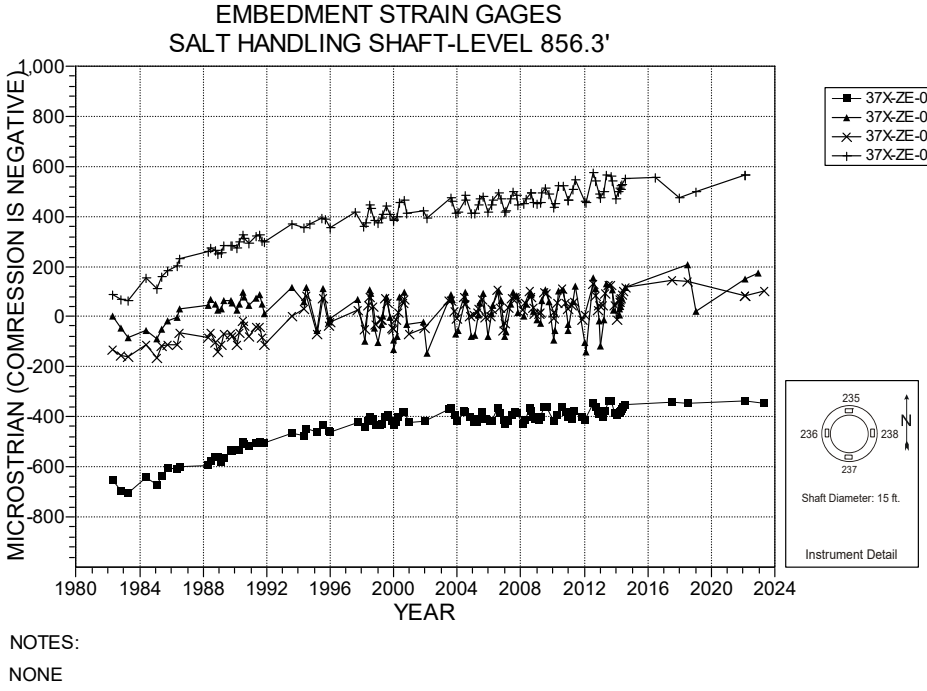


Figure 2-10 Embedment Strain Gauge – Salt Handling Shaft Key – Level 856.3

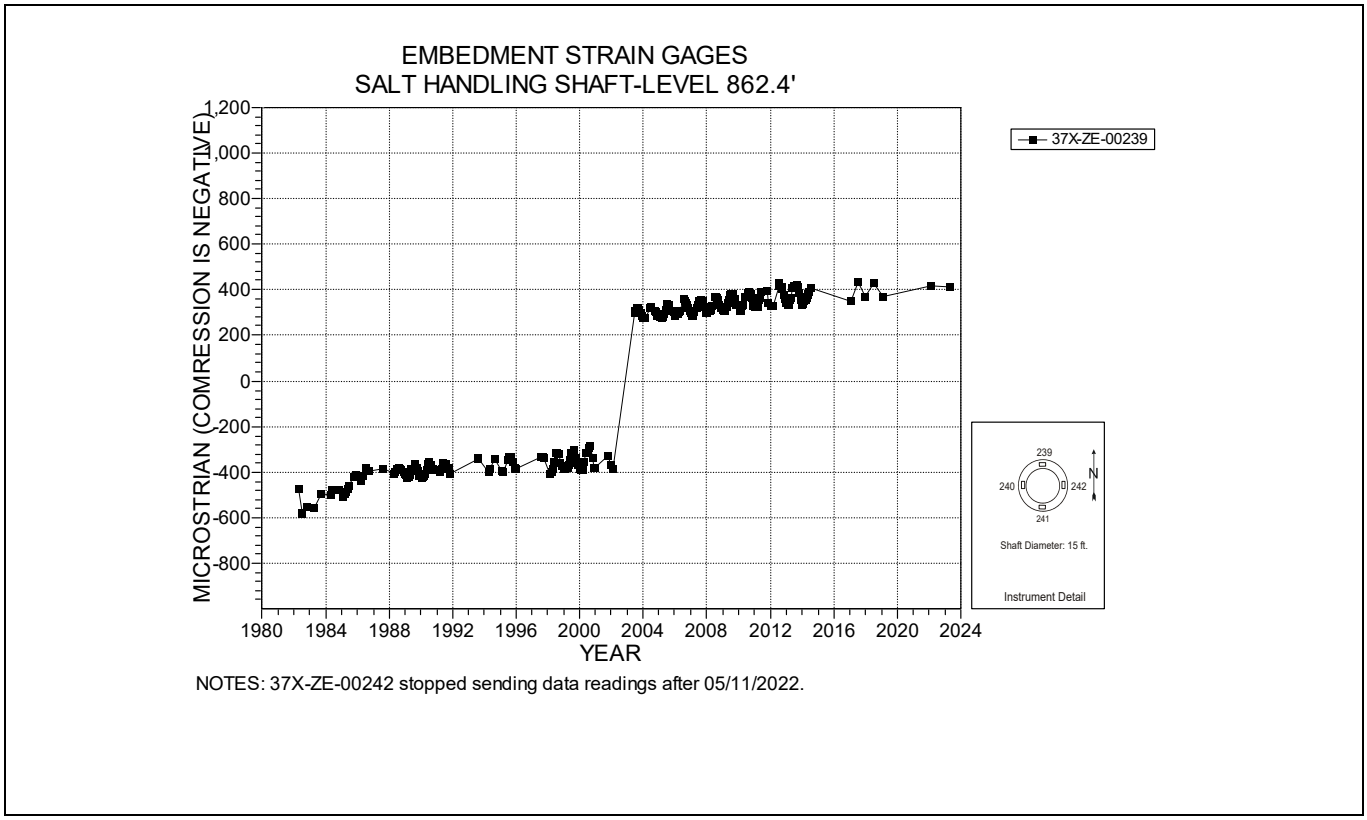


Figure 2-11 Embedment Strain Gauge – Salt Handling Shaft Key – Level 862.4

3.0 INSTRUMENTATION SUMMARY FOR THE SHAFTS STATIONS

The following instrumentation data analysis is for the Salt Handling Shaft Station. Table 3-1, Salt Handling Shaft Station Data Analysis, presents data analyses for each of the Salt Handling Shaft Station instruments. Figure 3-1, Convergence Point Array – Salt Handling Shaft Station at S18 – Roof to Floor, through Figure 3-4, Convergence Point Array – Salt Handling Shaft Station at S65 – Roof to Floor, present plots of the instrumentation data for the Salt Handling Shaft Station. The Waste Shaft Station and the area around the bottom of the AIS are presented in Section 4.0, Table 4-1, Access Drifts Data Analysis, and in the applicable graphs. Please note below the corresponding Instrument Field Tags, Locations, and Figure Number in the report.

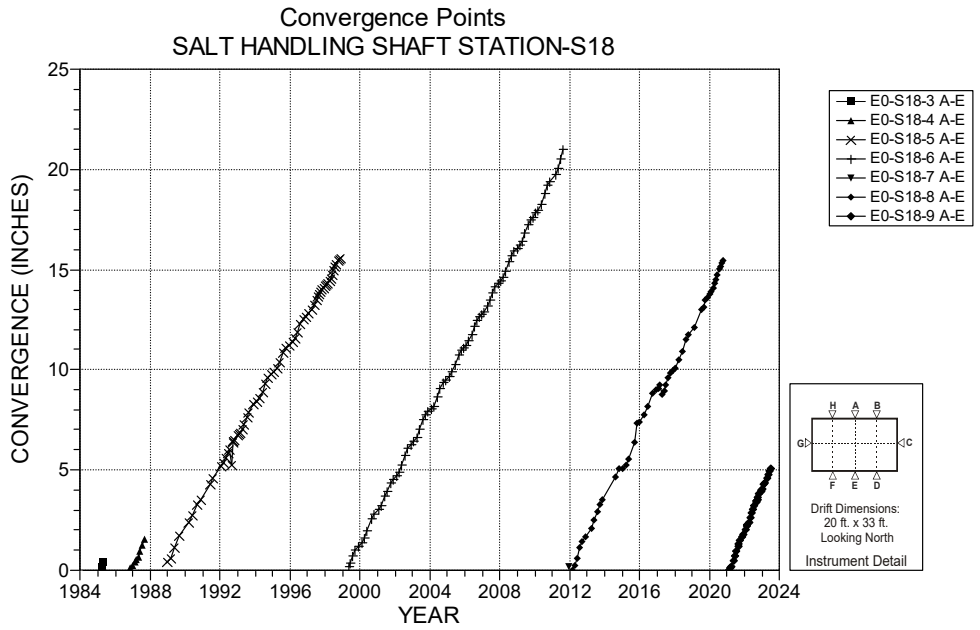
Waste Shaft Station			
Instrument Field Tag	Instrument Type	Location	Table 4-1 Access Drifts Data Analysis Figure Number
51X-GE-00404-2	Extensometer	S400-E35	4-17
W30-S400-2 A-C	Convergence Point	W30-S400	4-237

AIS Shaft Station			
Instrument Field Tag	Instrument Type	Location	Table 4-1 Access Drifts Data Analysis Figure Number
51X-GE-00401	Extensometer	W620- N20	4-16
51X-GE-00440	Extensometer	AIS North Brow	4-18
51X-GE-00441	Extensometer	AIS South Brow	4-19

Table 3-1 Salt Handling Shaft Station Data Analysis

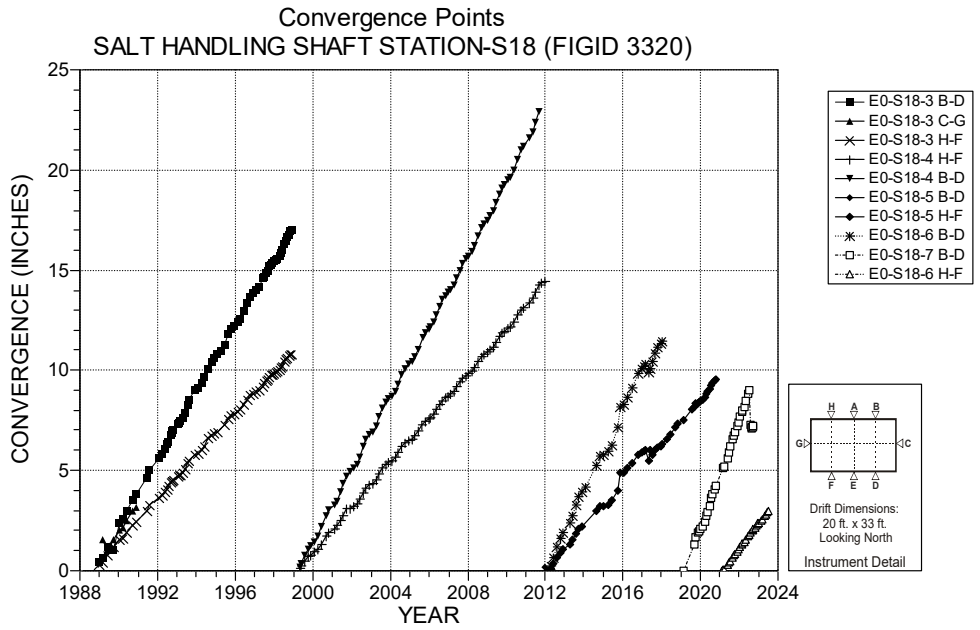
Convergence Points									
Field Tag	Location	Figure Number	Last Reading 2022-2023		Cumulative Displacement (inches)	Closure Rate 2022 to 2023 (in/year)	Closure Rate 2021 to 2022 (in/year)	Rate Change Percent	Comments[1]
			Date	Inches					
E0-S18-9 A-E	E0-S18	3-1	06/30/2023	5.043	59.189	2.1	2.1	0	N/A
E0-S18-7 B-D	E0-S18	3-2	09/21/2022	7.195	60.61	-9.6	2.9	-431	Floor Fracture
E0-S18-8 B-D	E0-S18	3-2	06/30/2023	1.874	62.484	2.6	2.9	-10	N/A
E0-S18-6 H-F	E0-S18	3-2	06/30/2023	2.991	37.809	1.2	1.4	-14	N/A
E0-S30-7 A-C	E0-S30	3-3	06/30/2023	5.214	74.117	2.2	2.2	0	N/A
E0-S65-6 A-C	E0-S65	3-4	06/30/2023	3.503	59.378	1.4	1.5	-7	N/A

1. N/A: Not Applicable or Not Available or No Comments



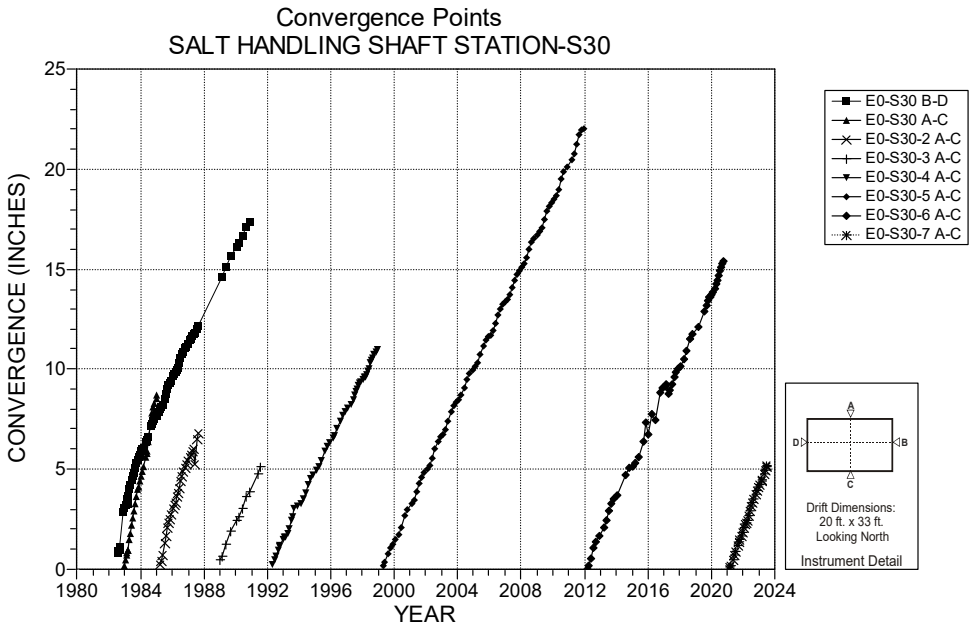
NOTES:
1. Excavation date: May 1982.

Figure 3-1 Convergence Point Array – Salt Handling Shaft Station at S18 – Roof to Floor



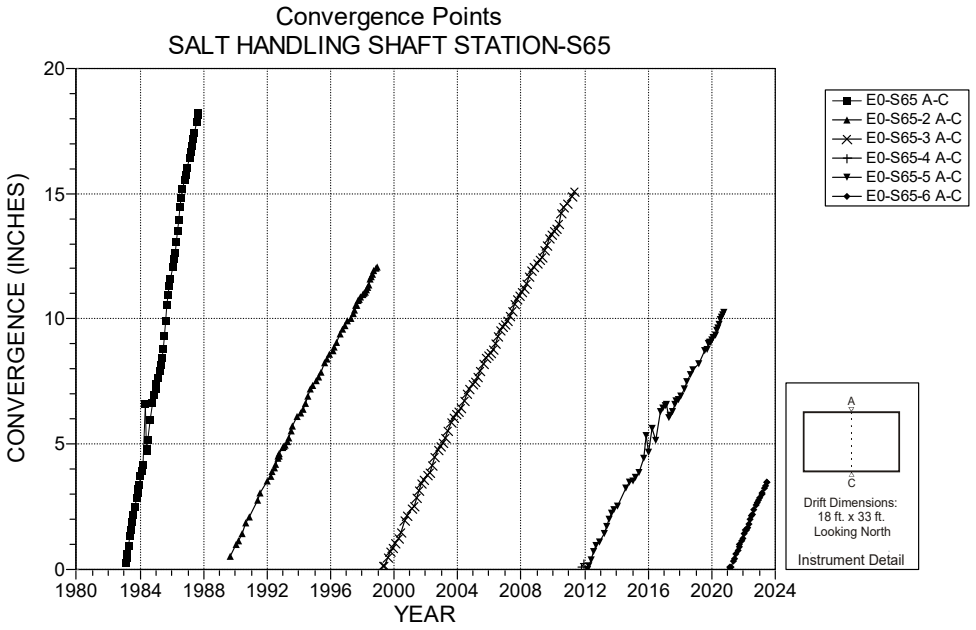
NOTES:
1. See FIGID 8455 for most recent history.
2. Rate drop on E0-S18-7 due to suspected floor fracturing at floor anchor point.

Figure 3-2 Convergence Point Array – Salt Handling Shaft Station at S18 – All Chords



NOTES:
1. Excavation date: May 1982.

Figure 3-3 Convergence Point Array – Salt Handling Shaft Station at S30 – All Chords



NOTES:
1. Excavation date: May 1982.

Figure 3-4 Convergence Point Array – Salt Handling Shaft Station at S65 – Roof to Floor

4.0 INSTRUMENTATION SUMMARY FOR THE ACCESS DRIFTS

This section presents the instrumentation data and data analyses for the access drifts throughout the WIPP underground:

- Table 4-1 provides the results of analyses performed on the instrument data including displacement, convergence rates, and rock bolt loading.

- Figure 4-1, Wire Convergence Meter 51X-CW-01037 - Roof to Floor, through Figure 4-7, Wire Convergence Meter 51X-PG-00452 – Roof to Floor, present data from wire convergence meters in the access drifts.

- Figure 4-8, Extensometer 51X-GE-00352-2 – E0 N940 – Roof, through Figure 4-26, Extensometer 51X-GE-00462– E140 S2195 – Roof, present data from borehole extensometers installed in the access drifts.

- Figure 4-27, Convergence Point Array – E0 N75 – All Chords, through Figure 4-276, Convergence Point Array – W1300 S925 – Roof to Floor, present the convergence point data.

- Figure 4-277, Rock Bolt Load Cell 51X-WG-00236 – 51X-WG-00240 – AIS South Brow, through Figure 4-280, Rock Bolt Load Cell 51X-WG-00251 – 51X-WG-00255 – AIS North Brow, present the AIS brow support rock bolt load cell data.

Table 4-1 Access Drifts Data Analysis

Wire Convergence Meters								
Field Tag	Location	Figure Number	Date of Last Reading	Displacement (inches)	Displacement Rate 2022 to 2023 (in/year)	Displacement Rate 2021 to 2022 (in/year)	Rate Change Percent[1]	Comments
51X-CW-01037	E140-S2750	4-1	6/07/2023	23.38	1.8	4.4	-59	Suspected Contact with Equipment
51X-CW-01038	W30-S2750	4-2	12/14/2022	37.00	9.3	5.1	82	Max range reached 3/16/2022
51X-CW-01039	W170-S2735	4-3	6/02/2023	13.26	1.7	2.4	-29	N/A
51X-CW-01051-2	S2180-E80	4-4	4/19/2023	11.88	4.0	4.6	-13	N/A
51X-CW-01052	S2180-E100	4-5	6/02/2023	5.89	2.3	2.1	10	N/A
51X-PG-00446	N460-E320	4-6	1/06/2023	4.93	1.2	1.2	0	N/A
51X-PG-00452	E300-N490	4-7	1/06/2023	2.44	1.1	1.0	10	N/A
Extensometers								
Field Tag	Location	Figure Number	Date of Last Reading	Collar Displacement Relative to Deepest Anchor (inches)	Displacement Rate 2022 to 2023 (in/year)	Displacement Rate[1] 2021 to 2022 (in/year)	Rate Change Percent[1]	Comments
51X-GE-00352-2	E0-N940	4-8	6/30/2023	5.12	1.2	1.2	0	N/A
51X-GE-00353	E0-N626	4-9	6/30/2023	-0.88	N/A	-18.2	N/A	Max range reached 4/22/2022
51X-GE-00355-2	E0-N300	4-10	6/30/2023	0.17	0.4	N/A	N/A	New Installation
51X-GE-00364	E140-N1266	4-11	6/30/2023	15.06	0.8	0.6	33	N/A
51X-GE-00365-2	E140-N940	4-12	6/30/2023	0.00	N/A	N/A	N/A	New Installation
51X-GE-00373-2	E300-N1341	4-13	6/30/2023	0.34	0.8	N/A	N/A	New Installation
51X-GE-00374	E300-N1186	4-14	6/30/2023	16.46	0.7	0.8	-13	N/A
51X-GE-00388	E300-N1266	4-15	6/30/2023	13.32	0.8	0.7	14	N/A
51X-GE-00401	W620- N20 (AIS Shaft Station)	4-16	6/30/2023	3.82	0.5	0.2	150	Failed Anchorage
51X-GE-00404-2	S400-E35 (Waste Shaft Station)	4-17	6/30/2023	3.84	0.3	0.3	0	N/A
51X-GE-00440	AIS North Brow	4-18	6/30/2023	1.86	0.3	0.3	0	N/A
51X-GE-00441	AIS South Brow	4-19	6/30/2023	2.20	0.3	0.3	0	N/A
51X-GE-00445	E140-S1665	4-20	6/30/2023	5.75	1.5	1.5	0	N/A
51X-GE-00446	E140-S1694	4-21	6/30/2023	4.57	1.2	1.3	-8	N/A
51X-GE-00447	E140-S1717	4-22	6/30/2023	5.51	2.1	1.4	50	Failed Anchorage
51X-GE-00448	E140-S1498	4-23	6/30/2023	2.52	0.9	0.7	29	N/A
51X-GE-00449	E140-S1518	4-24	6/30/2023	2.77	0.8	0.7	14	N/A

Table 4-1 Access Drifts Data Analysis (continued)

Extensometers (continued)								
Field Tag	Location	Figure Number	Date of Last Reading	Collar Displacement Relative to Deepest Anchor (inches)	Displacement Rate 2022 to 2023 (in/year)	Displacement Rate[1] 2021 to 2022 (in/year)	Rate Change Percent[1]	Comments
51X-GE-00450	E140-S1546	4-25	6/30/2023	4.50	0.9	1.2	-25	N/A
51X-GE-00462	E140-S2195	4-26	6/30/2023	0.80	0.9	N/A	N/A	New Installation

Convergence Points									
			Last Reading 2022 - 2023						
Field Tag	Location	Figure Number	Date	Inches	Cumulative Displacement (inches)	Closure Rate 2022 to 2023 (in/year)	Closure Rate[1] 2021 to 2022 (in/year)	Rate Change Percent[1]	Comments
E0-N75 A-C	E0-N75	4-27	6/30/2023	43.675	43.675	2.3	2.4	-4	N/A
E0-N225-5 A-C	E0-N225	4-28	6/30/2023	7.399	37.557	1.6	1.8	-11	N/A
E0-N300-8 A-C	E0-N300	4-29	6/21/2023	0.373	73.398	2.5	2.9	-14	N/A
E0-N460-6 A-C	E0-N460	4-30	6/30/2023	0.648	69.148	3.7	2.3	61	N/A
E0-N562-2 A-C	E0-N562	4-31	6/30/2023	0.644	45.086	3.7	2.8	32	N/A
E0-N626-6 A-C	E0-N626	4-32	6/30/2023	0.742	91.018	4.2	2.7	56	N/A
E0-N686-2 A-C	E0-N686	4-33	6/30/2023	0.636	50.584	3.6	2.8	29	N/A
E0-N780-3 A-C	E0-N780	4-34	6/30/2023	0.549	62.914	3.1	2.2	41	N/A
E0-N940-5 A-C	E0-N940	4-35	6/30/2023	50.924	98.976	2.7	2.8	-4	N/A
E0-N1110-5 A-C	E0-N1110	4-36	6/30/2023	30.883	65.668	1.5	1.6	-6	N/A
E0-N1266-4 A-C	E0-N1266	4-37	6/30/2023	47.335	84.242	1.9	2.2	-14	N/A
E0-N1420-2 A-C	E0-N1420	4-38	6/30/2023	23.285	37.749	1.0	1.2	-17	N/A
E140-N5-8 A-C	E140-N5	4-39	6/14/2023	4.025	73.981	2.0	2.0	0	N/A
E140-N150-7 A-C	E140-N150	4-40	6/14/2023	4.085	49.689	1.9	2.0	-5	N/A
E140-N250-5 A-C	E140-N250	4-41	6/14/2023	3.633	68.806	1.7	1.8	-6	N/A
E140-N355-3 A-C	E140-N355	4-42	6/14/2023	5.643	48.409	2.7	2.7	0	N/A
E140-N460-4 A-C	E140-N460	4-43	6/14/2023	4.366	66.908	2.0	2.1	-5	N/A
E140-N562-4 A-C	E140-N562	4-44	6/14/2023	6.471	63.683	3.1	3.0	3	N/A
E140-N626-4 A-C	E140-N626	4-45	6/14/2023	10.917	93.599	3.6	3.9	-8	N/A
E140-N686-3 A-C	E140-N686	4-46	6/14/2023	8.239	64.162	2.7	2.7	0	N/A
E140-N780-5 A-C	E140-N780	4-47	6/14/2023	4.410	82.584	2.0	2.1	-5	N/A
E140-N940-3 A-C	E140-N940	4-48	6/14/2023	4.789	57.346	2.4	2.6	-8	N/A

Convergence Points (continued)									
Field Tag	Location	Figure Number	Last Reading 2022-2023		Cumulative Displacement (inches)	Closure Rate 2022 to 2023 (in/year)	Closure Rate[1] 2021 to 2022 (in/year)	Rate Change Percent[1]	Comments
			Date	Inches					
E140-N1100-2 A-C	E140-N1100	4-49	6/14/2023	31.218	50.941	1.3	1.5	-13	N/A
E140-N1266-3 A-C	E140-N1266	4-50	6/14/2023	50.907	88.662	2.4	2.5	-4	N/A
E140-N1420-2 A-C	E140-N1420	4-51	6/14/2023	34.344	50.814	1.5	1.7	-12	N/A
E140-S90-5 A-C	E140-S90	4-52	6/14/2023	4.424	51.460	2.2	2.1	5	N/A
E140-S262-5 A-C	E140-S262	4-53	6/14/2023	23.090	60.111	2.4	2.3	4	N/A
E140-S460-8 A-C	E140-S460	4-54	6/5/2023	4.248	74.284	2.3	2.1	10	N/A
E140-S550-8 A-C	E140-S550	4-55	6/5/2023	6.976	66.685	2.5	2.4	4	N/A
E140-S700-9 A-D	E140-S700	4-56	6/12/2023	7.660	59.575	2.6	2.5	4	N/A
E140-S850-11 A-C	E140-S850	4-57	6/12/2023	3.457	87.057	3.9	3.6	8	N/A
E140-S1000-6 A-C	E140-S1000	4-58	6/12/2023	1.866	58.637	2.1	2.1	0	N/A
E140-S1025-7 A-C	E140-S1025	4-59	6/12/2023	2.073	49.449	2.3	2.5	-8	N/A
E140-S1075-6 A-E	E140-S1075	4-60	6/12/2023	3.283	61.945	3.7	3.6	3	N/A
E140-S1150-7 A-G	E140-S1150	4-61	6/12/2023	7.878	76.667	3.5	3.4	3	N/A
E140-S1225-7 A-E	E140-S1225	4-62	6/12/2023	7.945	71.461	3.4	3.4	0	N/A
E140-S1300-7 A-C	E140-S1300	4-63	6/19/2023	4.645	54.469	2.0	2.1	-5	N/A
E140-S1378-4 A-E	E140-S1378	4-64	6/19/2023	33.994	76.535	3.2	3.2	0	N/A
E140-S1450-6 A-G	E140-S1450(1456)	4-65	6/19/2023	38.693	78.150	4.0	4.1	-2	N/A
E140-S1496-3 A-E	E140-S1496 (Test Area)	4-66	6/5/2023	1.440	13.384	3.3	3.6	-8	N/A
E140-S1496-2 B-D	E140-S1496 (Test Area)	4-67	6/19/2023	2.089	5.689	1.6	1.6	0	N/A
E140-S1496 H-F	E140-S1496 (Test Area)	4-68	6/19/2023	8.205	8.205	2.1	2.2	-5	N/A
E140-S1534-5 A-E	E140-S1534 (Test Area)	4-69	6/19/2023	12.967	83.481	3.1	3.2	-3	N/A
E140-S1534-7 B-D	E140-S1534 (Test Area)	4-70	6/19/2023	2.231	63.334	3.1	6.5	-52	Floor Heave
E140-S1534-6 H-F	E140-S1534 (Test Area)	4-71	6/19/2023	4.397	70.427	3.3	3.3	0	N/A
E140-S1548 A-E	E140-S1548 (Test Area)	4-72	6/19/2023	12.968	12.968	3.2	3.2	0	N/A
E140-S1548 B-D	E140-S1548 (Test Area)	4-73	6/19/2023	7.659	7.659	2.0	2.0	0	N/A
E140-S1548 H-F	E140-S1548 (Test Area)	4-74	6/19/2023	11.825	11.825	3.0	3.1	-3	N/A
E140-S1600-9 A-C	E140-S1600	4-75	6/12/2023	3.162	75.103	3.9	3.7	5	N/A
E140-S1667-2 A-E	E140-S1667 (Test Area)	4-76	6/19/2023	0.227	13.967	3.5	3.3	6	N/A

Convergence Points (continued)									
Field Tag	Location	Figure Number	Last Reading 2022-2023		Cumulative Displacement (inches)	Closure Rate 2022 to 2023 (in/year)	Closure Rate[1] 2021 to 2022 (in/year)	Rate Change Percent [1]	Comments
			Date	Inches					
E140-S1667-2 B-D	E140-S1667 (Test Area)	4-77	6/19/2023	2.585	12.787	3.6	3.9	-8	N/A
E140-S1667 H-F	E140-S1667 (Test Area)	4-78	6/19/2023	13.234	13.234	3.1	3.4	-9	N/A
E140-S1687-5 A-E	E140-S1687	4-79	10/13/2022	17.266	80.72	4.1	3.9	5	N/A
E140-S1699 B-D	E140-S1699 (Test Area)	4-80	6/19/2023	13.041	13.041	3.3	3.5	-6	N/A
E140-S1699-2 H-F	E140-S1699 (Test Area)	4-81	6/19/2023	1.947	11.683	2.8	3.4	-18	N/A
E140-S1717-2 A-E	E140-S1717 (Test Area)	4-82	6/19/2023	2.644	13.555	3.7	3.7	0	N/A
E140-S1717 B-D	E140-S1717 (Test Area)	4-83	6/19/2023	10.227	10.227	2.7	2.7	0	N/A
E140-S1717 H-F	E140-S1717 (Test Area)	4-84	6/19/2023	18.529	18.529	4.8	5.0	-4	N/A
E140-S1775-5 A-G	E140-S1775 (1784)	4-85	6/19/2023	8.956	107.933	3.9	3.9	0	N/A
E140-S1862-5 A-E	E140-S1862	4-86	6/19/2023	8.505	90.048	3.7	3.8	-3	N/A
E140-S1950-8 A-C	E140-S1950	4-87	6/28/2023	9.679	97.808	4.0	4.1	-2	N/A
E140-S2007-8 A-C	E140-S2007	4-88	6/28/2023	47.259	91.786	4.4	4.4	0	N/A
E140-S2065-8 A-C	E140-S2065	4-89	6/28/2023	22.447	86.197	3.5	3.6	-3	N/A
E140-S2122-8 A-C	E140-S2122	4-90	6/28/2023	24.951	84.694	3.9	4.1	-5	N/A
E140-S2170 A-C	E140-S2170	4-91	6/2/2023	8.688	8.688	3.8	4.1	-7	N/A
E140-S2190 A-C	E140-S2190	4-92	6/2/2023	7.821	7.821	3.5	3.6	-3	N/A
E140-S2275-7 A-C	E140-S2275	4-93	5/8/2023	57.869	136.806	5.5	5.8	-5	N/A
E140-S2350-7 A-C	E140-S2350	4-94	5/8/2023	57.470	123.244	6.0	6.1	-2	N/A
E140-S2425-6 A-C	E140-S2425	4-95	5/8/2023	48.071	103.577	4.8	4.8	0	N/A
E140-S2520-4 A-C	E140-S2520	4-96	6/7/2023	40.376	81.152	3.6	3.8	-5	N/A
E220-S2180-2 A-C	E220-S2180	4-97	6/7/2023	5.265	30.024	1.8	1.9	-5	N/A
E300-N45-2 A-E	E300-N45	4-98	6/14/2023	18.527	51.408	1.6	1.8	-11	N/A
E300-N170-3 A-E	E300-N170	4-99	6/14/2023	22.546	56.020	2.0	2.2	-9	N/A
E300-N250-5 A-C	E300-N250	4-100	6/14/2023	13.833	65.754	2.1	2.3	-9	N/A
E300-N280 A-C	E300-N280	4-101	6/14/2023	9.977	9.977	1.6	1.7	-6	N/A
E300-N360 A-C	E300-N360	4-102	6/14/2023	9.316	9.316	1.6	1.7	-6	N/A
E300-N440 A-C	E300-N440	4-103	6/14/2023	9.197	9.197	1.5	1.5	0	N/A
E300-N500 A-C	E300-N500	4-104	6/14/2023	6.254	6.254	0.8	1.1	-27	N/A
N1100-E300-2 A-C	N1100-E300	4-105	6/30/2023	21.219	23.444	1.5	1.7	-12	N/A
E300-N1262-5 A-C	E300-N1262	4-106	6/30/2023	8.005	56.138	2.7	2.9	-7	N/A
E300-N1341-4 A-C	E300-N1341	4-107	6/30/2023	7.725	50.884	2.3	2.5	-8	N/A

Convergence Points (continued)									
Field Tag	Location	Figure Number	Last Reading 2022-2023		Cumulative Displacement (inches)	Closure Rate 2022 to 2023 (in/year)	Closure Rate[1] 2021 to 2022 (in/year)	Rate Change Percent [1]	Comments
			Date	Inches					
E300-S45-3 A-E	E300-S45	4-108	6/14/2023	15.166	42.370	1.4	1.5	-7	N/A
E300-S90-3 A-C	E300-S90	4-109	6/14/2023	12.565	32.842	1.1	1.2	-8	N/A
E300-S250-2 A-C	E300-S250	4-110	6/14/2023	18.426	22.811	0.8	1.0	-20	N/A
E300-S400 A-C	E300-S400	4-111	6/7/2023	4.243	4.243	1.1	1.3	-15	N/A
E300-S550 A-C	E300-S550	4-112	6/7/2023	2.277	2.277	0.6	0.8	-25	N/A
E300-S700-2 A-C	E300-S700	4-113	6/7/2023	18.772	38.508	1.6	1.7	-6	N/A
E300-S850-2 A-E	E300-S850	4-114	6/7/2023	9.791	24.873	0.9	1.0	-10	N/A
E300-S1000-2 A-C	E300-S1000	4-115	6/7/2023	13.181	32.726	1.2	1.3	-8	N/A
E300-S1150-5 A-E	E300-S1150	4-116	6/7/2023	7.411	37.333	2.0	2.0	0	N/A
E300-S1300-3 A-C	E300-S1300	4-117	6/7/2023	5.505	29.936	1.3	1.5	-13	N/A
E300-S1450-3 A-C	E300-S1450	4-118	6/7/2023	7.264	27.303	1.8	1.9	-5	N/A
E300-S1687-4 A-C	E300-S1687	4-119	6/7/2023	3.850	25.721	2.0	2.0	0	N/A
E300-S1775-3 A-C	E300-S1775	4-120	6/7/2023	6.870	26.598	1.9	1.9	0	N/A
E300-S1862-3 A-C	E300-S1862	4-121	6/7/2023	6.329	27.783	1.6	1.8	-11	N/A
E300-S2065-3 A-C	E300-S2065	4-122	6/7/2023	7.049	31.271	1.6	2.0	-20	N/A
E300-S2275-3 A-C	E300-S2275	4-123	6/7/2023	12.943	48.346	3.2	3.4	-6	N/A
E300-S2350-3 A-C	E300-S2350	4-124	6/7/2023	14.077	62.613	3.9	3.8	3	N/A
E300-S2425-3 A-C	E300-S2425	4-125	6/7/2023	12.115	52.112	3.2	3.4	-6	N/A
N140-E90-3 A-C	N140-E90	4-126	6/14/2023	7.947	26.582	0.9	1.0	-10	N/A
N150-W85-1 A-C	N150-W85	4-127	6/30/2023	0.740	0.740	1.1	N/A	N/A	New Installation
N150-W140-1 A-C	N150-W140	4-128	6/30/2023	0.728	0.728	1.1	N/A	N/A	New Installation
N215-W500-2 A-C	N215-W500	4-129	6/30/2023	26.050	44.379	1.4	1.4	0	N/A
N215-W620-2 A-C	N215-W620	4-130	6/30/2023	20.584	36.802	1.1	1.2	-8	N/A
N250-E220-5 A-E	N250-E220	4-131	6/14/2023	3.346	66.398	2.4	2.5	-4	N/A
N300-W170-3 A-C	N300-W170	4-132	6/30/2023	0.137	54.918	3.1	1.8	72	N/A
N460-E70-3 A-C	N460-E70	4-133	6/30/2023	33.421	49.832	1.4	1.5	-7	N/A
N460-E220-3 A-C	N460-E220	4-134	6/14/2023	0.178	7.953	1.3	N/A	N/A	No Readings Taken for ’21 – ‘22
N460-E310-2 A-C	N460-E310	4-135	6/14/2023	0.258	10.364	1.9	1.8	6	N/A

Convergence Points (continued)									
Field Tag	Location	Figure Number	Last Reading 2022-2023		Cumulative Displacement (inches)	Closure Rate 2022 to 2023 (in/year)	Closure Rate[1] 2021 to 2022 (in/year)	Rate Change Percent [1]	Comments
			Date	Inches					
N780-E70 A-C	N780-E70	4-136	6/30/2023	29.298	29.298	1.5	1.6	-6	N/A
N1420-E79 A-C	N1420-E79	4-137	6/30/2023	9.628	9.628	1.4	1.5	-7	N/A
N1420-E212 A-C	N1420-E212	4-138	6/30/2023	8.722	8.722	1.2	1.4	-14	N/A
N1420-E300 A-C	N1420-E300	4-139	6/30/2023	34.274	34.274	1.7	1.8	-6	N/A
S90-E70-2 A-C	S90-E70	4-140	6/13/2023	0.538	0.538	0.9	N/A	N/A	New Installation
S90-E220 A-C	S90-E220	4-141	6/14/2023	9.755	9.755	0.8	1.0	-20	N/A
S90-E360-1 A-C	S90-E360	4-142	6/14/2023	2.052	2.052	1.0	1.1	-9	N/A
S90-E420-1 A-C	S90-E420	4-143	6/14/2023	2.839	2.839	1.4	1.6	-13	N/A
S90-E480-1 A-C	S90-E480	4-144	6/14/2023	2.575	2.575	1.3	1.4	-7	N/A
S90-W120 A-C	S90-W120	4-145	6/9/2023	15.045	15.045	0.7	0.8	-13	N/A
S90-W400-3 A-C	S90-W400	4-146	6/9/2023	5.824	24.676	0.5	0.7	-29	N/A
S90-W590-2 A-C	S90-W590	4-147	6/9/2023	11.002	20.331	0.7	0.8	-13	N/A
S90-W620 A-C	S90-W620	4-148	6/9/2023	37.822	37.822	1.1	1.1	0	N/A
S400-E10 A-C	S400-E10	4-149	6/5/2023	2.493	2.493	1.0	1.1	-9	N/A
S400-E360 A-C	S400-E360	4-150	6/7/2023	4.338	4.338	1.1	1.3	-15	N/A
S400-E420 A-C	S400-E420	4-151	6/7/2023	3.968	3.968	1.0	1.3	-23	N/A
S400-W20-2 A-C	S400-W20	4-152	6/13/2023	2.863	2.984	1.3	1.4	-7	N/A
S400-W188-1 A-C	S400-W188	4-153	6/9/2023	0.660	0.660	1.3	N/A	N/A	New Installation
S400-W198-2 A-C	S400-W198 CORE STORAGE	4-154	6/9/2023	0.582	33.602	1.1	1.4	-21	N/A
S400-W208 A-C	S400-W208 CORE STORAGE	4-155	11/7/2022	34.797	34.797	1.9	1.4	36	N/A
S400-W240-2 A-C	S400-W240 CORE STORAGE	4-156	6/9/2023	0.762	42.735	1.5	1.6	-6	N/A
S400-W251 A-C	S400-W251 CORE STORAGE	4-157	11/7/2022	42.369	42.369	2.0	1.7	18	N/A
S400-W279 A-C	S400-W279 CORE STORAGE	4-158	6/9/2023	41.266	41.266	1.5	1.4	7	N/A
S400-W295 A-C	S400-W295 CORE STORAGE	4-159	6/9/2023	36.978	36.978	1.3	1.2	8	N/A
S550-E100-1 A-C	S550-E100	4-160	6/5/2023	0.482	0.482	0.9	N/A	N/A	New Installation
S550-E180-1 A-C	S550-E180	4-161	3/2/2023	0.220	0.220	0.9	N/A	N/A	New Installation

Convergence Points (continued)									
Field Tag	Location	Figure Number	Last Reading 2022-2023		Cumulative Displacement (inches)	Closure Rate 2022 to 2023 (in/year)	Closure Rate[1] 2021 to 2022 (in/year)	Rate Change Percent [1]	Comments
			Date	Inches					
S700-E55-4 A-C	S700-E55	1-162	6/13/2023	1.844	28.338	2.7	2.1	29	N/A
S700-W98-6 A-C	S700-W98	4-163	6/9/2023	0.308	47.836	3.1	3.7	-16	N/A
S700-W245-2 A-C	S700-W245	4-164	6/27/2023	0.829	3.793	3.9	4.8	-19	N/A
S700-W320-2 A-C	S700-W320	4-165	6/27/2023	0.938	3.746	4.5	5.7	-21	N/A
S700-W395-2 A-C	S700-W395	4-166	6/27/2023	1.039	4.626	4.9	7.7	-36	Newly Mined Area
S700-W470-2 A-C	S700-W470	4-167	6/27/2023	1.211	6.655	5.7	10.7	-47	Newly Mined Area
S700-W545-2 A-C	S700-W545	4-168	6/27/2023	1.239	4.703	5.9	11.2	-47	Newly Mined Area
S700-W620-2 A-C	S700-W620	4-169	6/27/2023	1.222	8.552	7.1	33.6	-79	Newly Mined Area
S700-W705-2 A-C	S700-W705	4-170	6/27/2023	1.225	1.979	7.1	N/A	N/A	New Installation
S700-W790-2 A-C	S700-W790	4-171	6/27/2023	1.275	2.115	7.4	N/A	N/A	New Installation
S700-W875-2 A-C	S700-W875	4-172	6/27/2023	1.193	2.256	6.9	N/A	N/A	New Installation
S700-W960-2 A-C	S700-W960	4-173	6/27/2023	1.406	3.939	6.8	N/A	N/A	New Installation
S700-W1045-2 A-C	S700-W1045	4-174	6/27/2023	1.522	3.061	7.3	N/A	N/A	New Installation
S700-W1130-2 A-C	S700-W1130	4-175	6/27/2023	1.317	3.196	6.3	N/A	N/A	New Installation
S700-W1215-2 A-C	S700-W1215	4-176	6/27/2023	1.185	3.261	5.7	N/A	N/A	New Installation
S700-W1300-2 A-C	S700-W1300	4-177	6/27/2023	1.374	4.478	6.6	N/A	N/A	New Installation
S850-W245-2 A-C	S850-W245	4-178	6/27/2023	0.232	2.153	3.3	4.0	-18	N/A
S850-W320-2 A-C	S850-W320	4-179	6/27/2023	0.263	2.755	3.7	5.1	-27	N/A
S850-W395-1 A-C	S850-W395	4-180	6/27/2023	0.324	0.324	4.6	N/A	N/A	New Installation
S850-W470-1 A-C	S850-W470	4-181	6/27/2023	0.332	0.332	4.7	N/A	N/A	New Installation
S850-W545-1 A-C	S850-W545	4-182	6/27/2023	0.341	0.341	4.8	N/A	N/A	New Installation
S850-W620-1 A-C	S850-W620	4-183	6/27/2023	0.418	0.418	5.7	N/A	N/A	New Installation
S850-W705-1 A-C	S850-W705	4-184	6/27/2023	0.338	0.338	4.6	N/A	N/A	New Installation
S850-W790-1 A-C	S850-W790	4-185	6/27/2023	0.338	0.338	4.6	N/A	N/A	New Installation
S850-W875-1 A-C	S850-W875	4-186	6/27/2023	0.350	0.350	4.7	N/A	N/A	New Installation
S850-W960-1 A-C	S850-W960	4-187	6/27/2023	0.414	0.414	5.6	N/A	N/A	New Installation
S850-W1045-1 A-C	S850-W1045	4-188	6/27/2023	0.363	0.363	4.9	N/A	N/A	New Installation
S850-W1130-1 A-C	S850-W1130	4-189	6/27/2023	0.394	0.394	5.3	N/A	N/A	New Installation

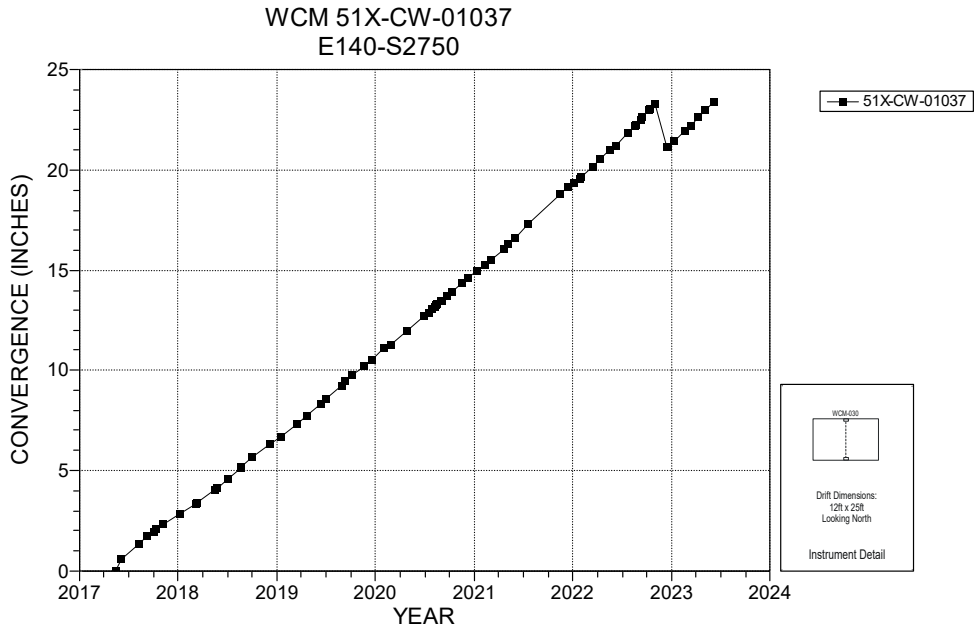
Convergence Points (continued)									
Field Tag	Location	Figure Number	Last Reading 2022-2023		Cumulative Displacement (inches)	Closure Rate 2022 to 2023 (in/year)	Closure Rate[1] 2021 to 2022 (in/year)	Rate Change Percent [1]	Comments
			Date	Inches					
S850-W1215-1 A-C	S850-W1215	4-190	6/27/2023	0.410	0.410	5.6	N/A	N/A	New Installation
S850-W1300-1 A-C	S850-W1300	4-191	6/27/2023	0.637	0.637	7.3	N/A	N/A	New Installation
S850-W1385-1 A-C	S850-W1385	4-192	6/30/2023	0.043	0.043	5.2	N/A	N/A	New Installation
S850-W1470-1 A-C	S850-W1470	4-193	6/30/2023	0.081	0.081	9.9	N/A	N/A	New Installation
S850-W1555-1 A-C	S850-W1555	4-194	6/30/2023	0.094	0.094	11.4	N/A	N/A	New Installation
S1000-E58-4 A-C	S1000-E58	4-195	6/5/2023	24.728	40.194	1.6	1.5	7	N/A
S1000-E120-4 A-C	S1000-E120	4-196	6/5/2023	1.208	29.861	1.4	1.4	0	N/A
S1000-E160-3 A-C	S1000-E160	4-197	6/5/2023	14.198	22.408	1.0	1.1	-9	N/A
S1000-W98-2 A-C	S1000-W98	4-198	6/13/2023	39.456	58.204	3.2	2.3	39	N/A
S1000-W120 A-C	S1000-W120	4-199	6/13/2023	7.806	7.806	2.9	2.0	45	N/A
S1000-W245-2 A-C	S1000-W245	4-200	6/27/2023	0.442	1.714	2.9	N/A	N/A	New Installation
S1000-W320-2 A-C	S1000-W320	4-201	6/27/2023	0.556	1.990	3.6	N/A	N/A	New Installation
S1000-W395-2 A-C	S1000-W395	4-202	6/27/2023	0.436	2.220	3.3	N/A	N/A	New Installation
S1000-W470-2 A-C	S1000-W470	4-203	6/27/2023	0.467	1.259	3.6	N/A	N/A	New Installation
S1000-W545-1 A-C	S1000-W545	4-204	6/27/2023	0.120	0.120	3.1	N/A	N/A	New Installation
S1000-W620-1 A-C	S1000-W620	4-205	6/27/2023	0.131	0.131	3.4	N/A	N/A	New Installation
S1000-W705-1 A-C	S1000-W705	4-206	6/27/2023	0.142	0.142	3.7	N/A	N/A	New Installation
S1000-W790-1 A-C	S1000-W790	4-207	6/27/2023	0.139	0.139	3.9	N/A	N/A	New Installation
S1000-W875-1 A-C	S1000-W875	4-208	6/27/2023	0.093	0.093	2.6	N/A	N/A	New Installation
S1000-W960-2 A-C	S1000-W960	4-209	6/27/2023	0.152	1.805	4.3	N/A	N/A	New Installation
S1000-W1045-1 A-C	S1000-W1045	4-210	6/27/2023	0.123	0.123	3.5	N/A	N/A	New Installation
S1000-W1130-1 A-C	S1000-W1130	4-211	6/27/2023	0.129	0.129	3.6	N/A	N/A	New Installation
S1000-W1215-1 A-C	S1000-W1215	4-212	6/27/2023	0.125	0.125	3.5	N/A	N/A	New Installation
S1000-W1300-1 A-C	S1000-W1300	4-213	6/27/2023	0.623	0.623	4.6	N/A	N/A	New Installation
S1000-W1385-1 A-C	S1000-W1385	4-214	6/30/2023	0.031	0.031	3.8	N/A	N/A	New Installation
S1000-W1470-1 A-C	S1000-W1470	4-215	6/30/2023	0.044	0.044	5.4	N/A	N/A	New Installation
S1000-W1555-1 A-C	S1000-W1555	4-216	6/30/2023	0.066	0.066	8.0	N/A	N/A	New Installation
S1300-E24-2 A-C	S1300-E24	4-217	6/13/2023	10.154	36.137	1.7	1.8	-6	N/A

Convergence Points (continued)									
Field Tag	Location	Figure Number	Last Reading 2022-2023		Cumulative Displacement (inches)	Closure Rate 2022 to 2023 (in/year)	Closure Rate[1] 2021 to 2022 (in/year)	Rate Change Percent [1]	Comments
			Date	Inches					
S1300-E120 A-C	S1300-E120	4-218	6/5/2023	26.603	26.603	1.2	1.1	9	N/A
S1300-E160 A-C	S1300-E160	4-219	6/5/2023	51.029	51.029	3.1	3.0	3	N/A
S1300-W100-4 A-C	S1300-W100	4-220	6/13//2023	10.031	66.180	2.8	3.0	-7	N/A
S1300-W155 A-C	S1300-W155	4-221	2/7/2023	3.422	3.422	1.8	1.7	6	N/A
S1600-E55-1 A-C	S1600-E55	4-222	6/5/2023	2.301	2.301	2.9	N/A	N/A	New Installation
S1600-E170-3 A-C	S1600-E170	4-223	6/5/2023	6.053	30.670	1.6	1.6	0	N/A
S1600-W100-3 A-C	S1600-W100	4-224	6/5/2023	2.702	21.957	3.5	3.9	-10	N/A
S1950-E113-5 A-C	S1950-E113	4-225	6/5/2023	3.089	27.525	1.4	1.5	-7	N/A
S1950-E160-2 A-C	S1950-E160	4-226	6/28/2023	4.859	11.493	2.1	2.1	0	N/A
S1950-E226 A-C	S1950-E226	4-227	6/28/2023	12.029	12.029	2.2	2.1	5	N/A
S1950-E255-1 A-C	S1950-E255	4-228	6/28/2023	0.288	0.288	1.9	N/A	N/A	New Installation
S1950-E281-3 A-C	S1950-E281	4-229	6/7/2023	30.156	36.698	1.3	1.4	-7	N/A
S1950-W100-3 A-C	S1950-W100	4-230	6/6/2023	3.107	24.032	4.4	4.0	10	N/A
S2520-E55-3 A-C	S2520-E55	4-231	6/7/2023	6.318	45.126	2.7	3.1	-13	N/A
S2520-E220 A-C	S2520-E220	4-232	6/7/2023	40.796	40.796	1.7	2.0	-15	N/A
S2520-W100-3 A-C	S2520-W100	4-233	6/2/2023	7.329	57.536	3.5	3.8	-8	N/A
W30-S90-2 A-C	W30-S90	4-234	6/13/2023	2.839	6.516	1.1	1.4	-21	N/A
W30-S120-4 A-C	W30-S120	4-235	6/13/2023	2.504	36.646	1.0	1.2	-17	N/A
W30-S250-5 A-C	W30-S250	4-236	6/13/2023	20.269	46.502	1.3	1.4	-7	N/A
W30-S400-2 A-C	W30-S400	4-237	6/13/2023	16.841	34.669	1.2	1.3	-8	N/A
W30-S500-3 A-C	W30-S500	4-238	6/13/2023	12.034	42.441	1.6	1.7	-6	N/A
W30-S550 A-C	W30-S550	4-239	6/13/2023	2.838	2.838	0.8	0.8	0	N/A
W30-S700-6 A-C	W30-S700	4-240	6/13/2023	3.693	63.174	2.7	2.4	13	N/A
W30-S850-7 A-E	W30-S850	4-241	6/13/2023	3.155	48.232	2.4	-1.3	-285	Suspected Floor Fracture
W30-S1000-5 A-C	W30-S1000	4-242	6/13/2023	26.597	64.776	2.5	2.2	14	N/A
W30-S1150-4 A-C	W30-S1150	4-243	6/13/2023	2.536	47.284	3.5	3.2	9	N/A
W30-S1300-3 A-C	W30-S1300	4-244	6/13/2023	4.563	49.707	2.3	2.4	-4	N/A
W30-S1453-3 A-C	W30-S1453	4-245	6/13/2023	20.031	49.259	2.9	3.2	-9	N/A

Convergence Points (continued)									
Field Tag	Location	Figure Number	Last Reading 2022-2023		Cumulative Displacement (inches)	Closure Rate 2022 to 2023 (in/year)	Closure Rate[1] 2021 to 2022 (in/year)	Rate Change Percent [1]	Comments
			Date	Inches					
W30-S1600-7 A-C	W30-S1600	4-246	6/5/2023	1.338	51.949	2.6	2.4	8	N/A
W30-S1775-9 A-C	W30-S1775	4-247	6/5/2023	11.678	49.371	3.5	2.4	46	N/A
W30-S1950-4 A-C	W30-S1950	4-248	6/6/2023	2.259	58.238	3.2	3.1	3	N/A
W30-S2067-4 A-C	W30-S2067	4-249	6/6/2023	33.468	60.408	3.8	3.6	6	N/A
W30-S2520-5 A-C	W30-S2520	4-250	6/2/2023	7.198	61.317	3.5	3.7	-5	N/A
W170-N150-4 A-C	W170-N150	4-251	6/9/2023	0.485	18.202	0.7	0.8	-13	N/A
W170-S5-2 A-C	W170-S5	4-252	6/9/2023	6.206	22.402	0.7	0.8	-13	N/A
W170-S90-3 A-C	W170-S90	4-253	6/9/2023	19.865	27.067	1.0	1.2	-17	N/A
W170-S232-2 A-C	W170-S232	4-254	6/9/2023	14.308	19.897	0.8	0.9	-11	N/A
W170-S400-2 A-C	W170-S400	4-255	6/9/2023	1.568	24.495	1.3	1.6	-19	N/A
W170-S560-5 A-C	W170-S560	4-256	6/9/2023	2.508	23.531	2.0	3.0	-33	N/A
W170-S700-5 A-C	W170-S700	4-257	6/9/2023	0.781	37.315	3.3	5.1	-35	N/A
W170-S850-10 A-E	W170-S850	4-258	6/9/2023	0.093	31.536	4.3	3.3	30	N/A
W170-S1000-5 A-C	W170-S1000	4-259	6/9/2023	0.234	42.235	2.3	1.7	35	N/A
W170-S1150-6 A-E	W170-S1150	4-260	6/9/2023	1.862	35.066	1.4	1.3	8	N/A
W170-S1300-5 A-C	W170-S1300	4-261	6/9/2023	1.053	55.281	3.2	2.7	19	N/A
W170-S1445-4 A-C	W170-S1445	4-262	6/9/2023	30.553	41.845	2.7	2.5	8	N/A
W170-S1600-7 A-C	W170-S1600	4-263	6/5/2023	2.402	54.766	3.1	3.7	-16	N/A
W170-S1779-3 A-C	W170-S1779	4-264	6/5/2023	34.449	49.420	3.0	3.1	-3	N/A
W170-S1950-3 A-C	W170-S1950	4-265	6/6/2023	27.915	41.096	2.3	2.3	0	N/A
W170-S2180-3 A-C	W170-S2180	4-266	6/2/2023	25.997	49.561	2.4	2.6	-8	N/A
W170-S2275 A-C	W170-S2275	4-267	6/2/2023	37.158	37.158	2.1	2.4	-13	N/A
W170-S2425 A-C	W170-S2425	4-268	6/2/2023	38.451	38.451	1.7	2.2	-23	N/A
W170-S2520-3 A-C	W170-S2520	4-269	1/11/2023	6.183	59.596	4.0	3.9	3	N/A
W620-S775-1 A-C	W620-S775	4-270	6/27/2023	0.252	0.252	3.4	N/A	N/A	New Installation
W620-S925-1 A-C	W620-S925	4-271	6/27/2023	0.130	0.130	3.4	N/A	N/A	New Installation
W660-N150-2 A-C	W660-N150	4-272	6/30/2023	2.953	6.176	0.8	0.9	-11	N/A
W960-S775-2 A-C	W960-S775	4-273	6/27/2023	0.260	0.500	3.5	N/A	N/A	New Installation

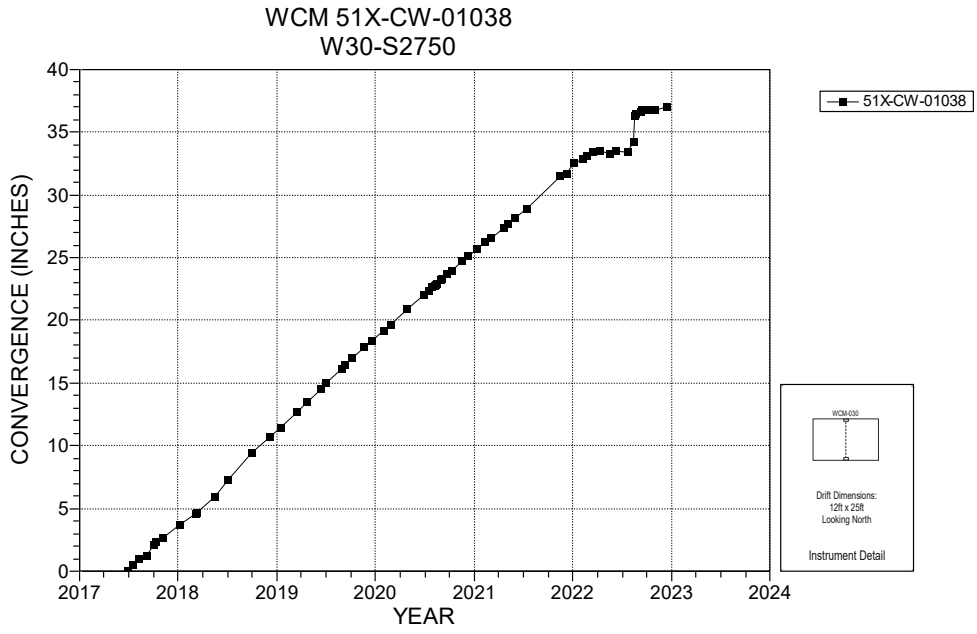
Convergence Points (continued)									
			Last Reading 2022-2023						
Field Tag	Location	Figure Number	Date	Inches	Cumulative Displacement (inches)	Closure Rate 2022 to 2023 (in/year)	Closure Rate[1] 2021 to 2022 (in/year)	Rate Change Percent [1]	Comments
W960-S925-2 A-C	W960-S925	4-274	6/27/2023	0.121	0.456	3.4	N/A	N/A	New Installation
W1300-S775-1 A-C	W1300-S775	4-275	6/27/2023	0.740	0.740	5.6	N/A	N/A	New Installation
W1300-S925-1 A-C	W1300-S925	4-276	6/27/2023	0.804	0.804	6.0	N/A	N/A	New Installation

Rock Load Bolt Cells					
Field Tag	Location	Figure Number	Date of Last Reading	Load (kips)	Comments
51X-WG-00238	AIS South Brow	4-277	3/30/2023	4	N/A
51X-WG-00239	AIS South Brow	4-277	3/30/2023	49	N/A
51X-WG-00243	AIS South Brow	4-278	3/30/2023	30	N/A
51X-WG-00244	AIS South Brow	4-278	3/30/2023	28	N/A
51X-WG-00248	AIS North Brow	4-279	3/30/2023	52	N/A
51X-WG-00250	AIS North Brow	4-279	3/30/2023	10	N/A
51X-WG-00251	AIS North Brow	4-280	3/30/2023	19	N/A
51X-WG-00254	AIS North Brow	4-280	3/30/2023	6	N/A
51X-WG-00255	AIS North Brow	4-280	3/30/2023	7	N/A



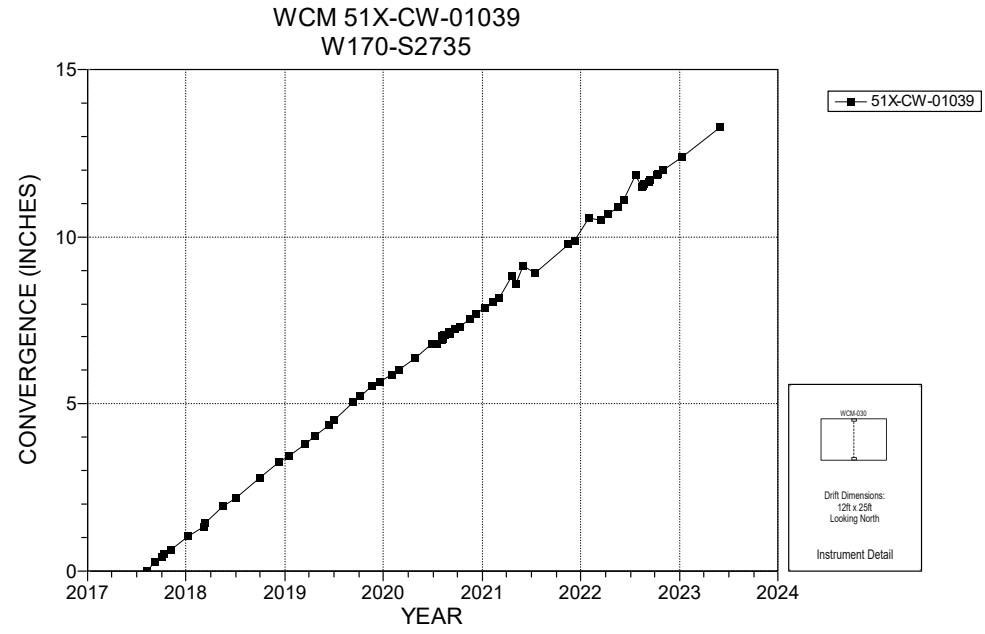
NOTES:
1. Excavation Date: January 1983.

Figure 4-1 Wire Convergence Meter 51X-CW-01037 – Roof to Floor



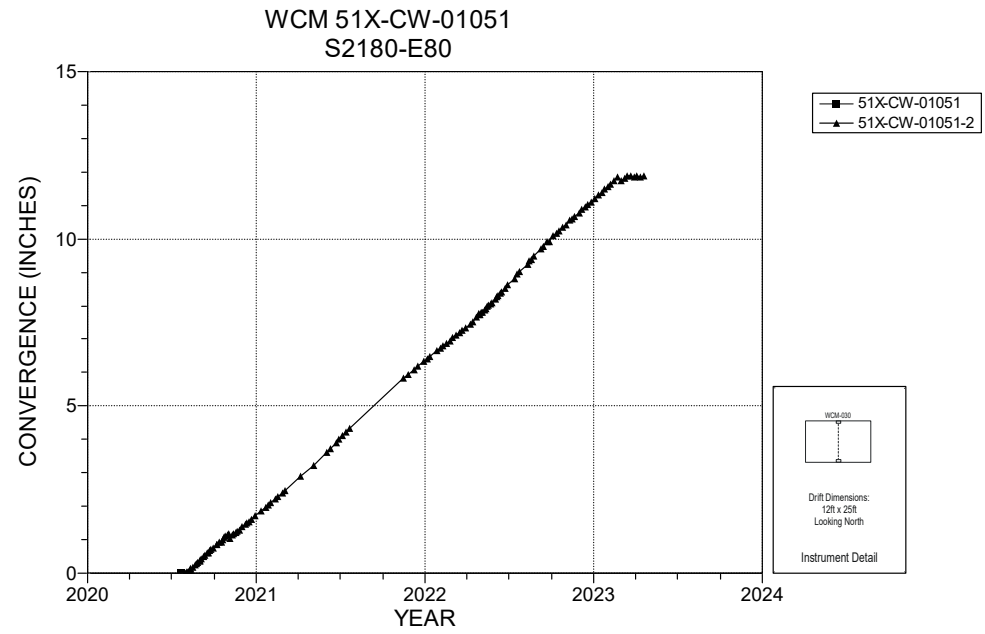
NOTES:
1. Excavation date: December 2000.
2. As of 3/16/2022, instrument reached its maximum range.
3. Instrument is in an inaccessible area.

Figure 4-2 Wire Convergence Meter 51X-CW-01038 – Roof to Floor



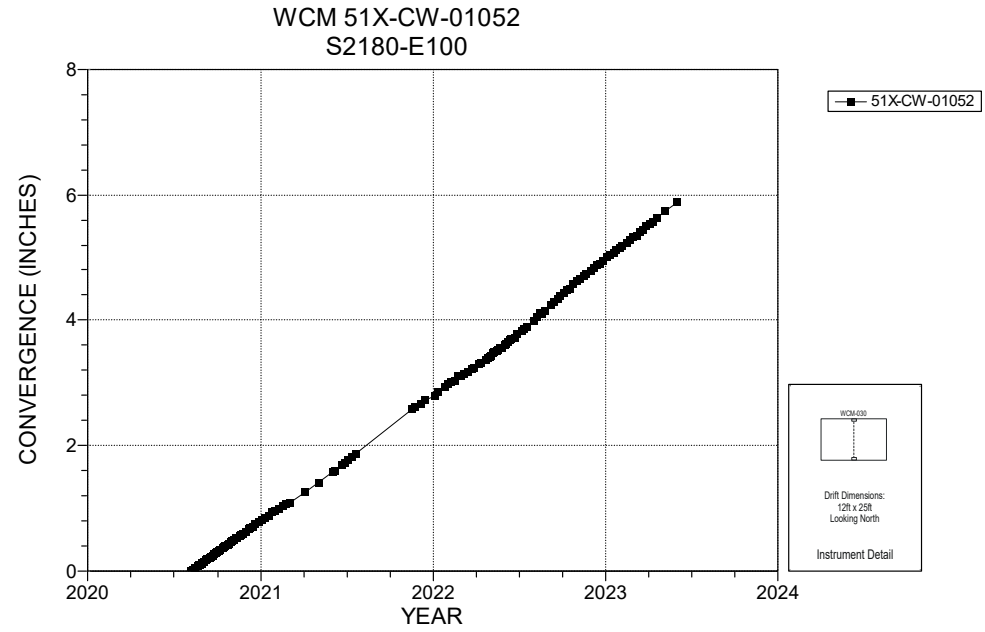
NOTES:
1. Excavation date: December 2000.

Figure 4-3 Wire Convergence Meters 51X-CW-01039 – Roof to Floor



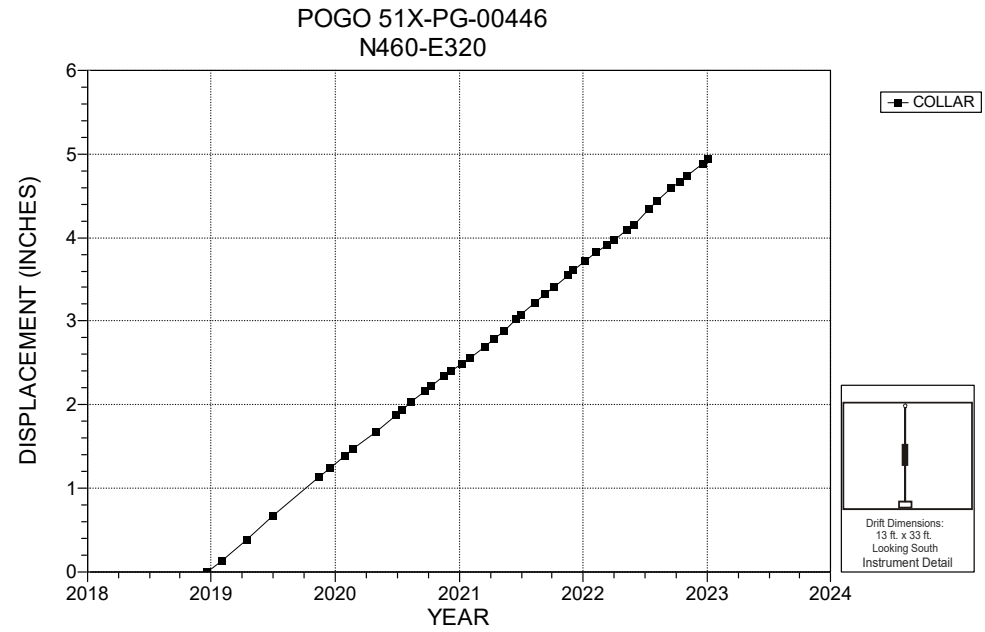
NOTES:
NONE

Figure 4-4 Wire Convergence Meters 51X-CW-01051-2 – Roof to Floor



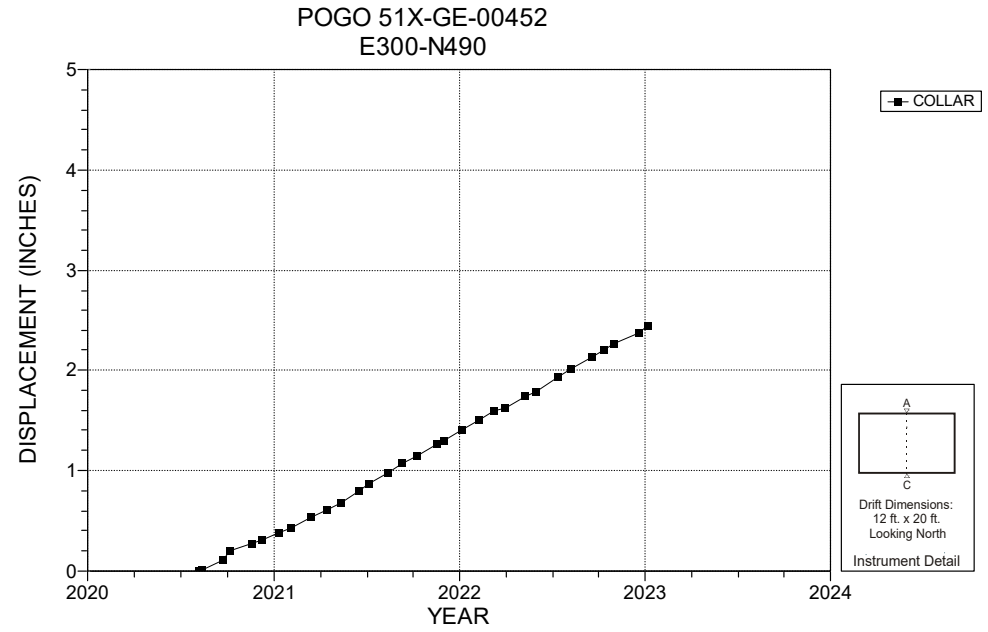
NOTES:
NONE

Figure 4-5 Wire Convergence Meter 51X-CW-01052 – Roof to Floor



NOTES:
1. Excavation Date: January 1988.

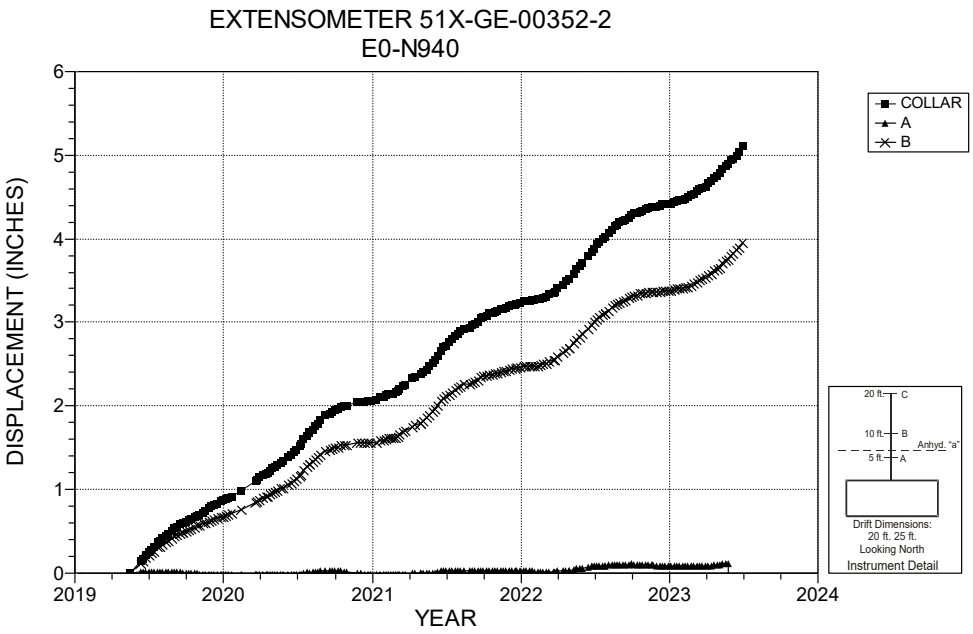
Figure 4-6 Wire Convergence Meter 51X-PG-00446 – Roof to Floor



NOTES:

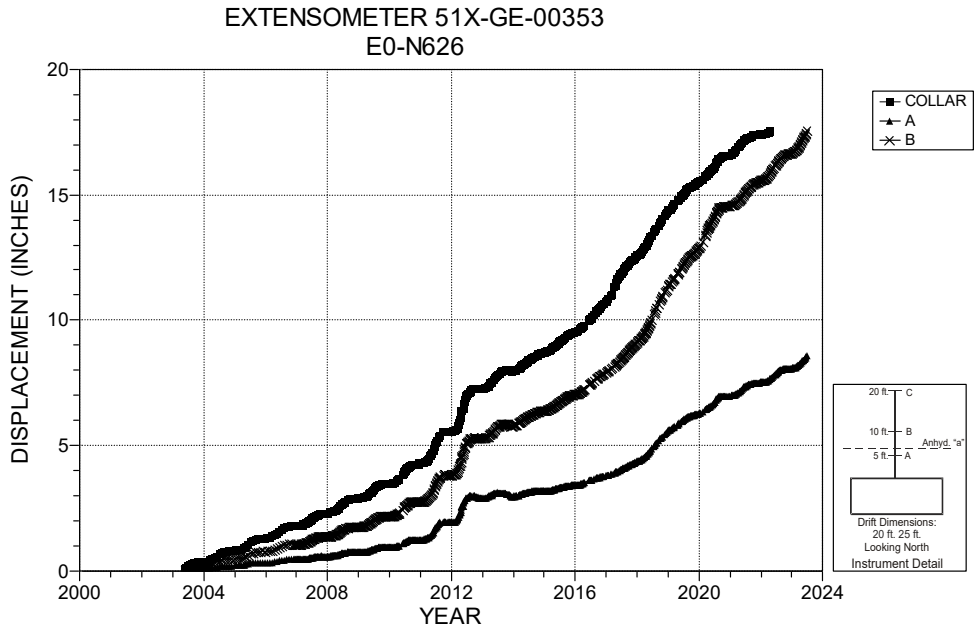
NONE

Figure 4-7 Wire Convergence Meter 51X-GE-00452 – Roof to Floor



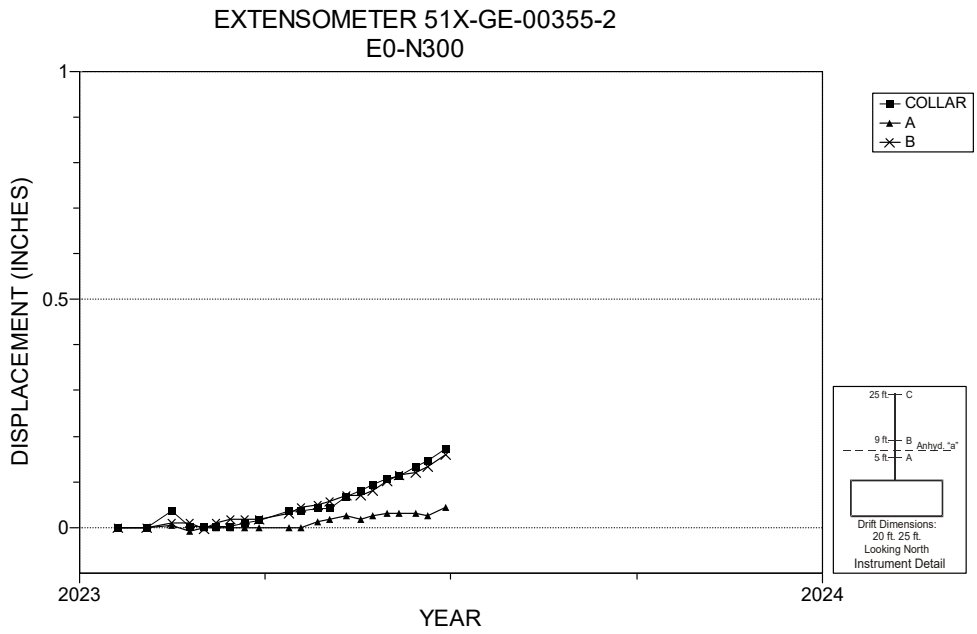
NOTES:
1. Excavation date: February 1983.
2. WEX Replacement. New WEX Field ID is 51X-GE-00352-2.

Figure 4-8 Extensometer 51X-GE-00352-2 – E0 N940 – Roof



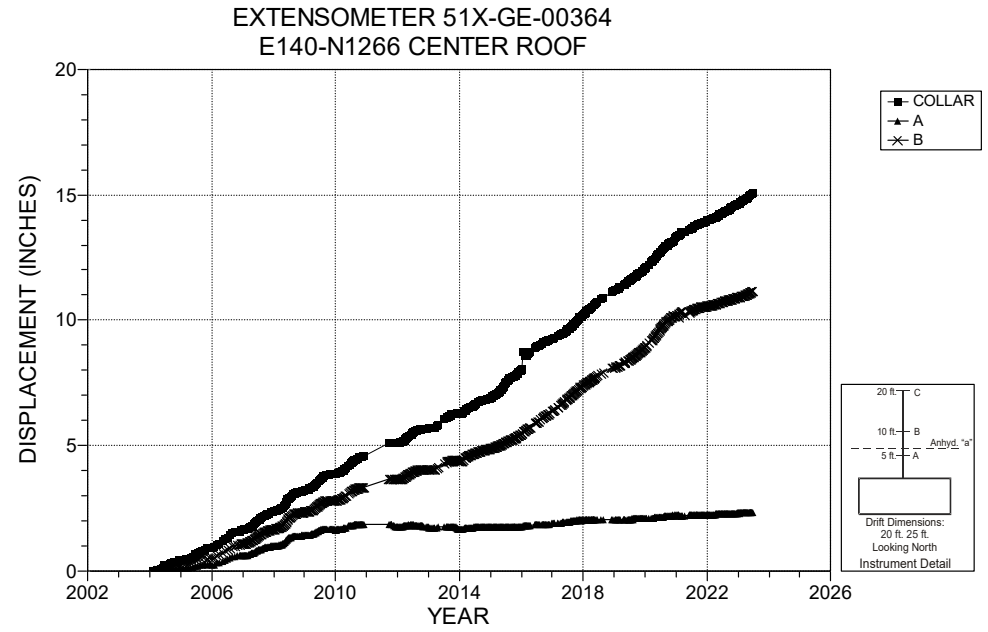
NOTES:
1. Excavation date: February 1983.
2. Anchor 'C' has reached its maximum range and the mechanical connection to the anchor has failed.

Figure 4-9 Extensometer 51X-GE-00353– E0 N626 – Roof



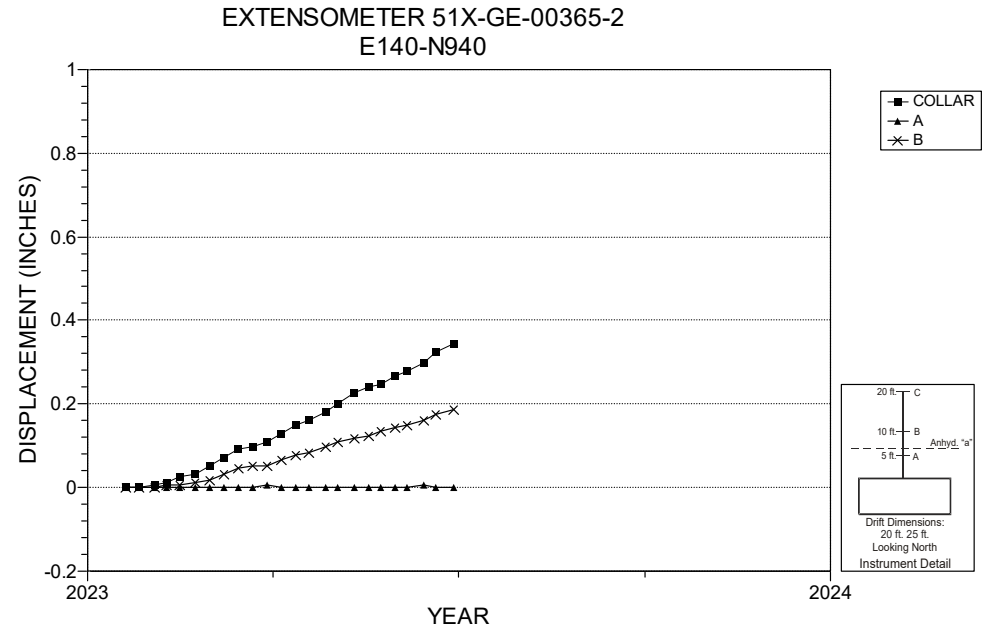
NOTES:
1. Excavation date: December 1982.

Figure 4-10 Extensometer 51X-GE-00355-2– E0 N300 – Roof



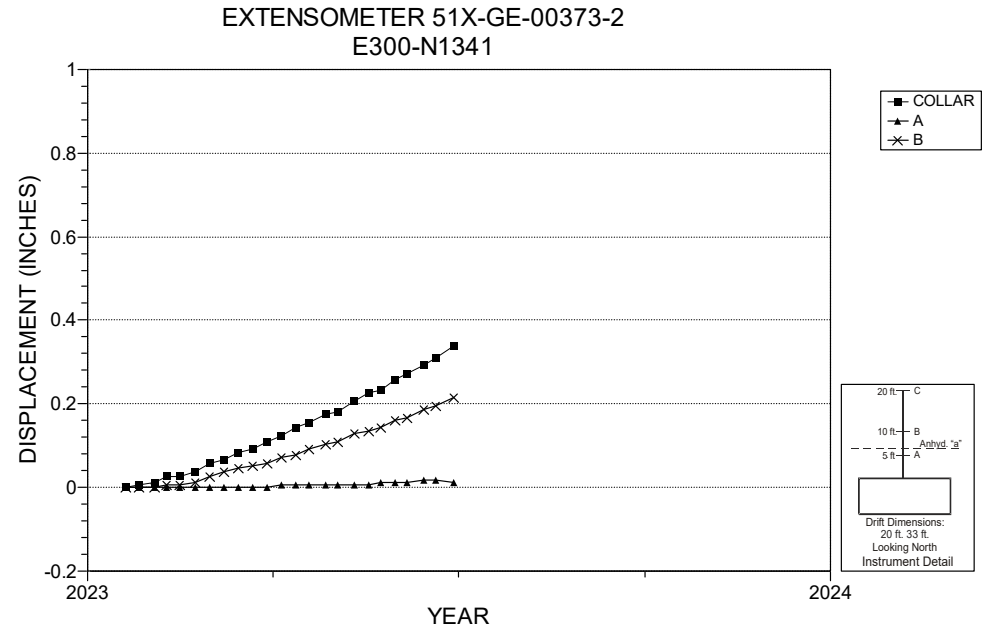
NOTES:
1. Excavation date: February 1983.

Figure 4-11 Extensometer 51X-GE-00364– E140 N1266 – Roof



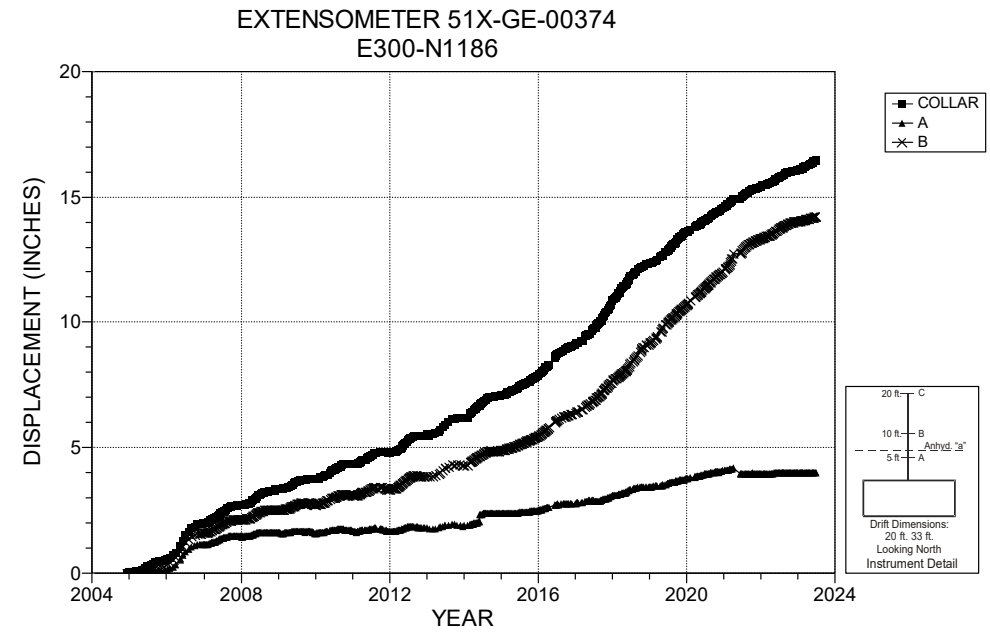
NOTES:
1. Excavation date: February 1983.

Figure 4-12 Extensometer 51X-GE-00365-2 – E140 N940 – Roof



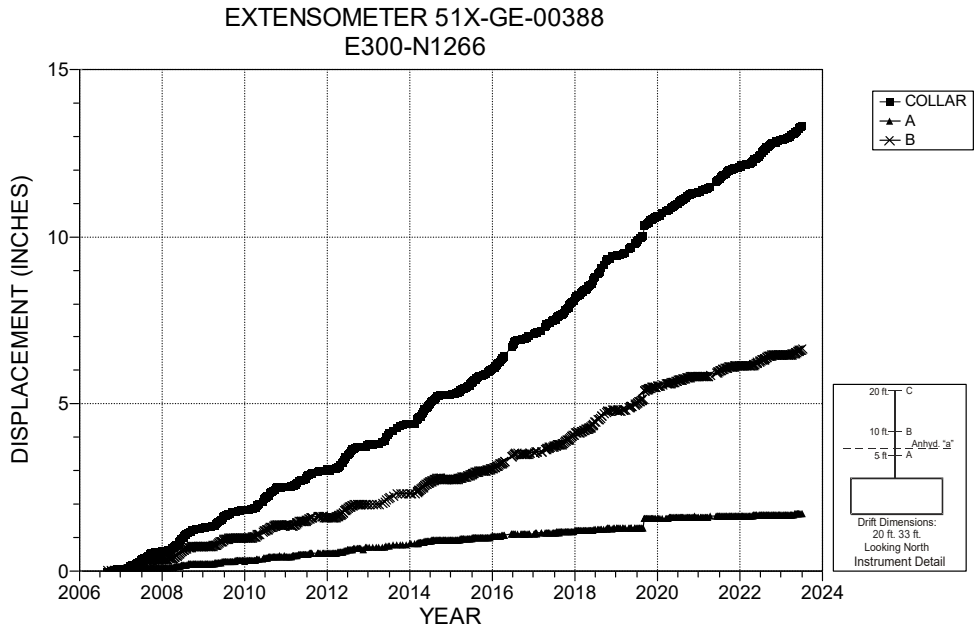
NOTES:
1. Excavation date: August 1989.

Figure 4-13 Extensometer 51X-GE-00373-2 – E300 N1341 – Roof



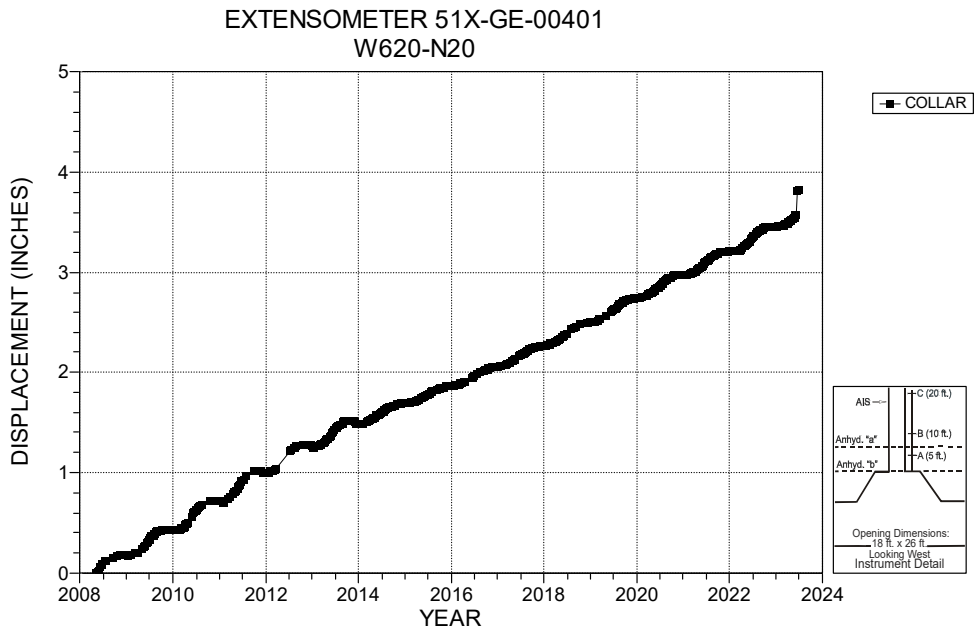
NOTES:
1. Excavation date: August 1989.

Figure 4-14 Extensometer 51X-GE-00374 – E300 N1186 – Roof



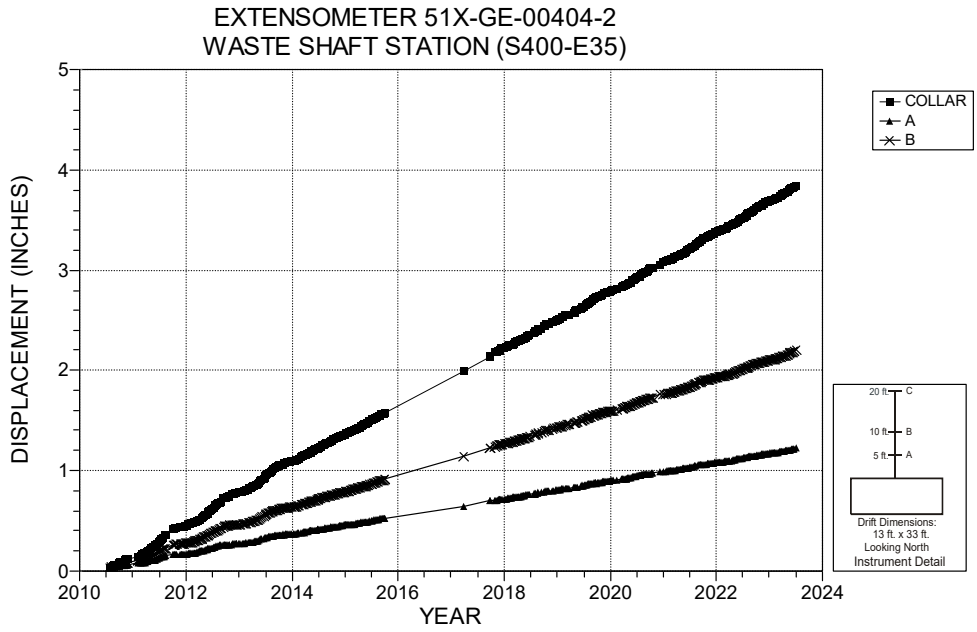
NOTES:
1. Excavation date: August 1989.
2. Instrument replaced in August 2006.

Figure 4-15 Extensometer 51X-GE-00388 – E300 N1266 – Roof



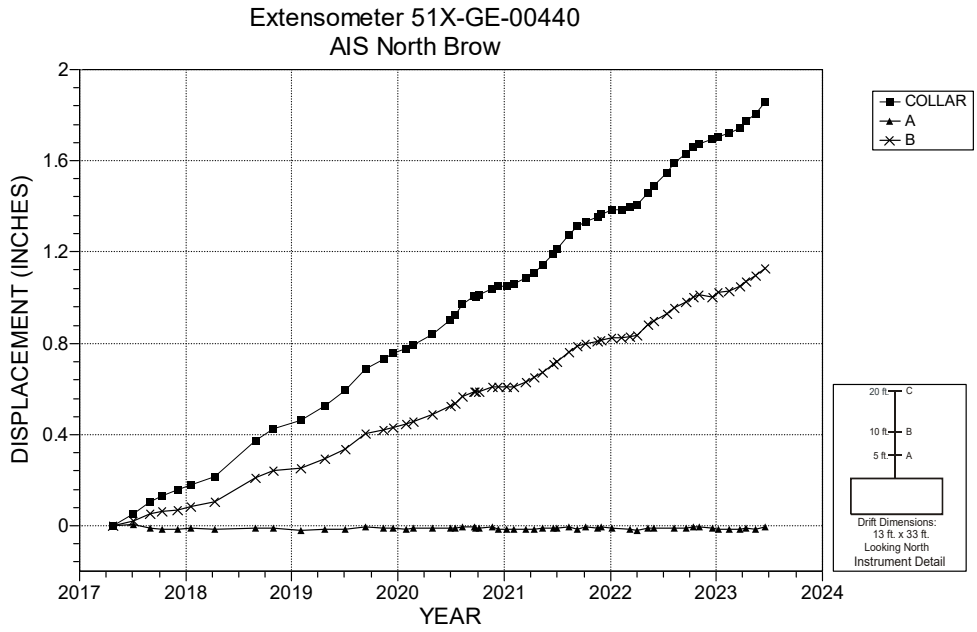
NOTES:
1. Excavation date: January 1988.
2. The mechanical connection to anchors "A" & "C" have failed, select CFI to view the plot.

Figure 4-16 Extensometer 51X-GE-00401 – W620 N20 – Roof



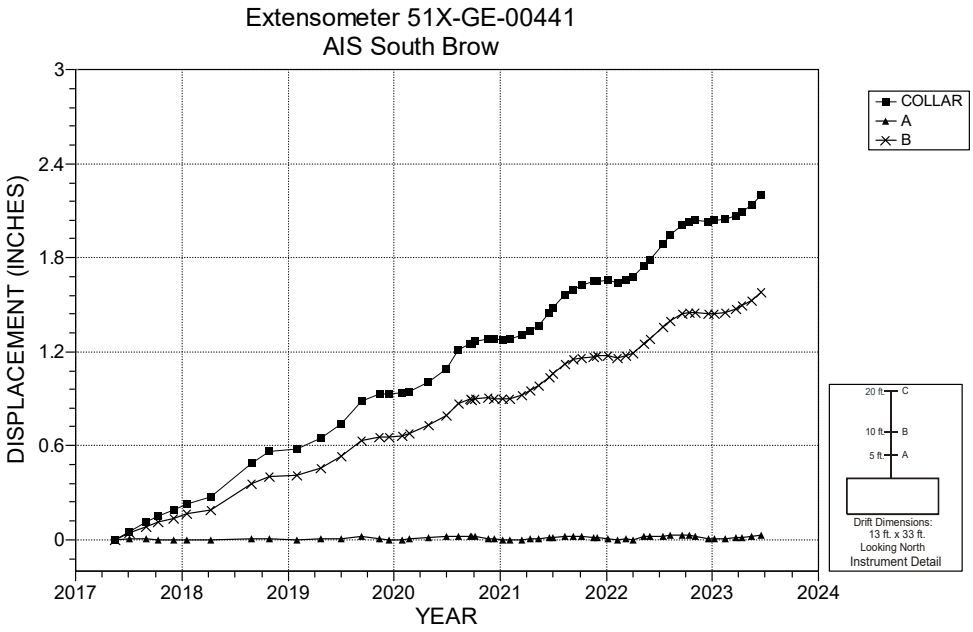
NOTES:
1. Excavation date: November 1982.
2. Extensometer 51X-GE-00404 was replaced by 51X-GE-00404-2 in July 2010.

Figure 4-17 Extensometer 51X-GE-00404-2 – Waste Shaft Station (S400 E35) – Roof



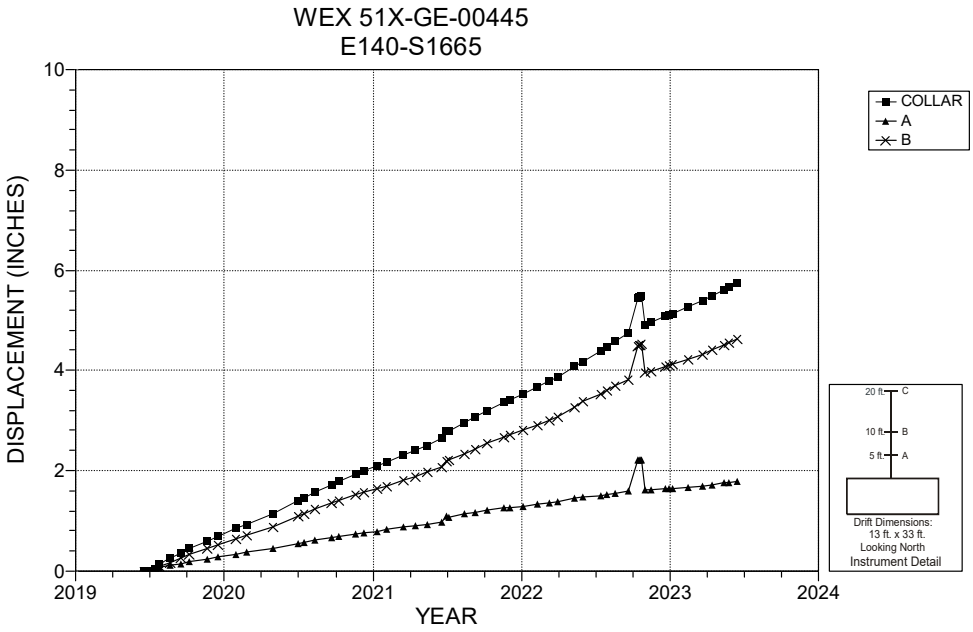
NOTES:
1. Excavation Date: January 1988.

Figure 4-18 Extensometer 51X-GE-00440 – AIS North Brow – Roof



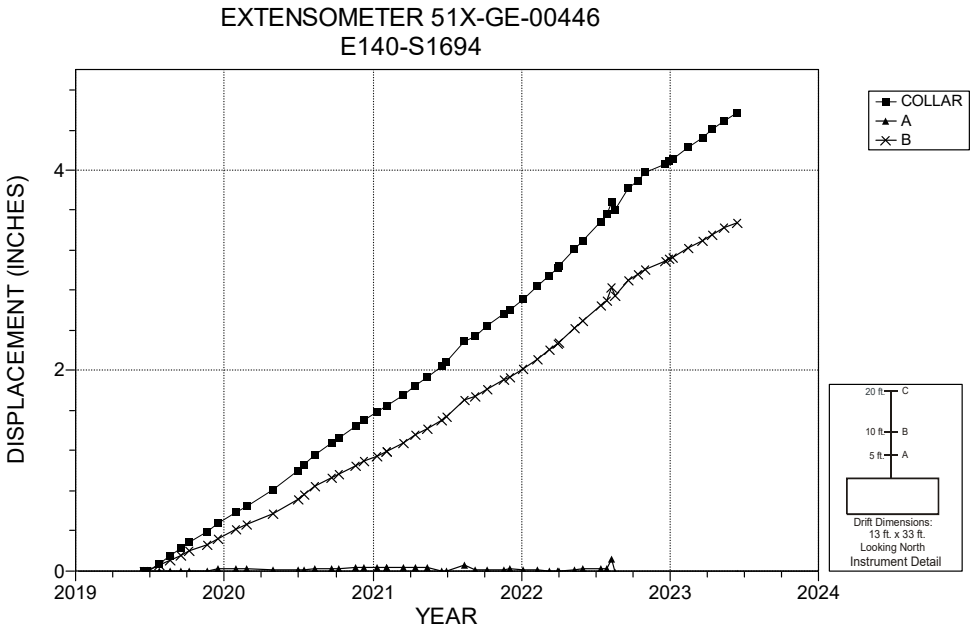
NOTES:
1. Excavation Date: January 1988.
2. Select CFI to view the plot.

Figure 4-19 Extensometer 51X-GE-00441– AIS South Brow – Roof



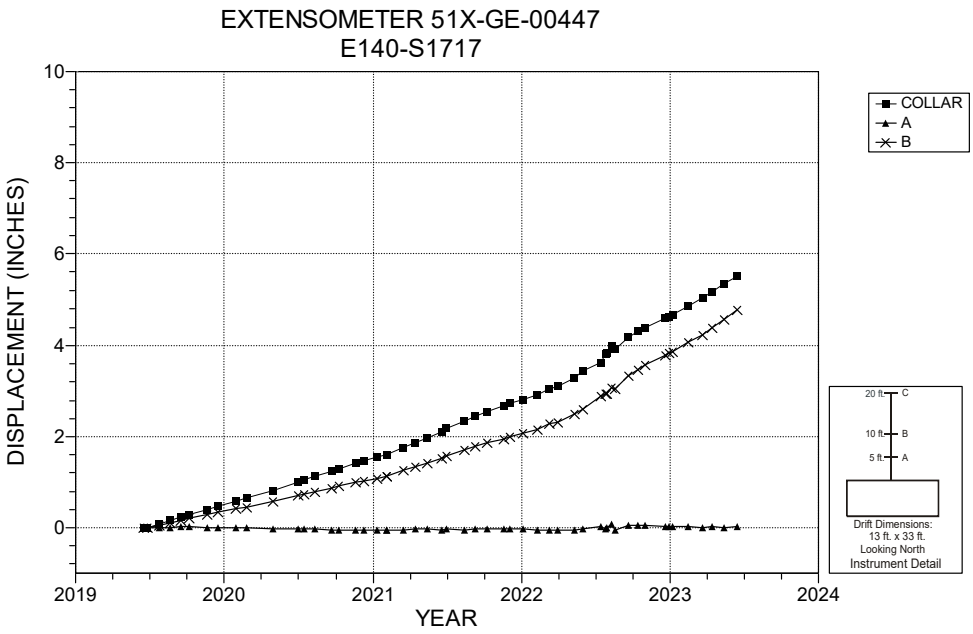
NOTES:
1. Excavation date: November 1982.
2. New installation: Sling Test Area
3. Cable sling plate wedged on WEX box interferred with readings from 10-14-22 to 10-24-22.

Figure 4-20 Extensometer 51X-GE-00445– E140 S1665 – Roof



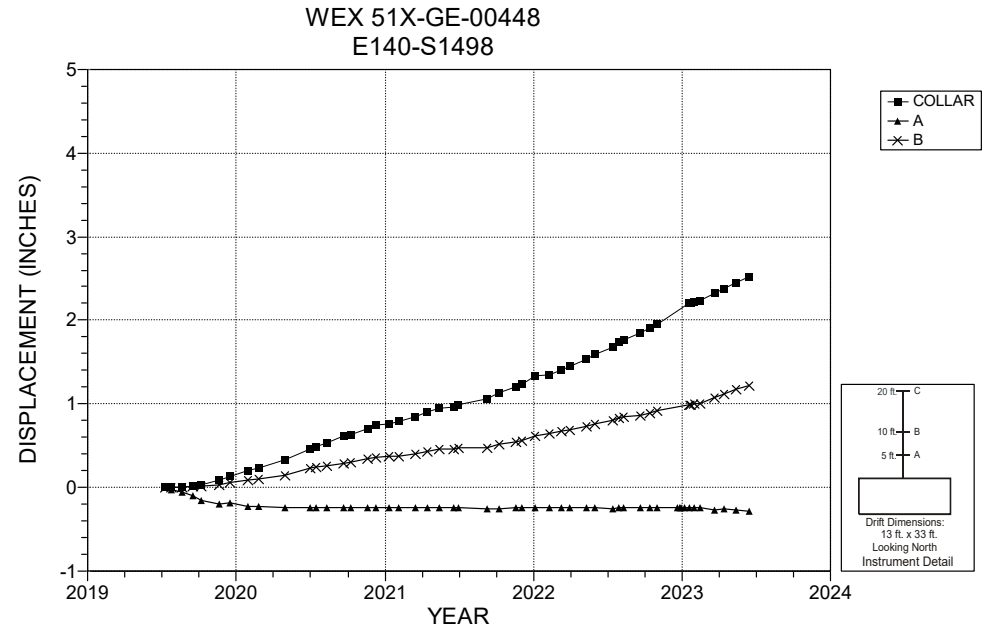
NOTES:
1. Excavation date: November 1982.
2. New installation: Sling Test Area
3. Cable sling failed at E140-S1691 on 4/1/22.

Figure 4-21 Extensometer 51X-GE-00446– E140 S1694 – Roof



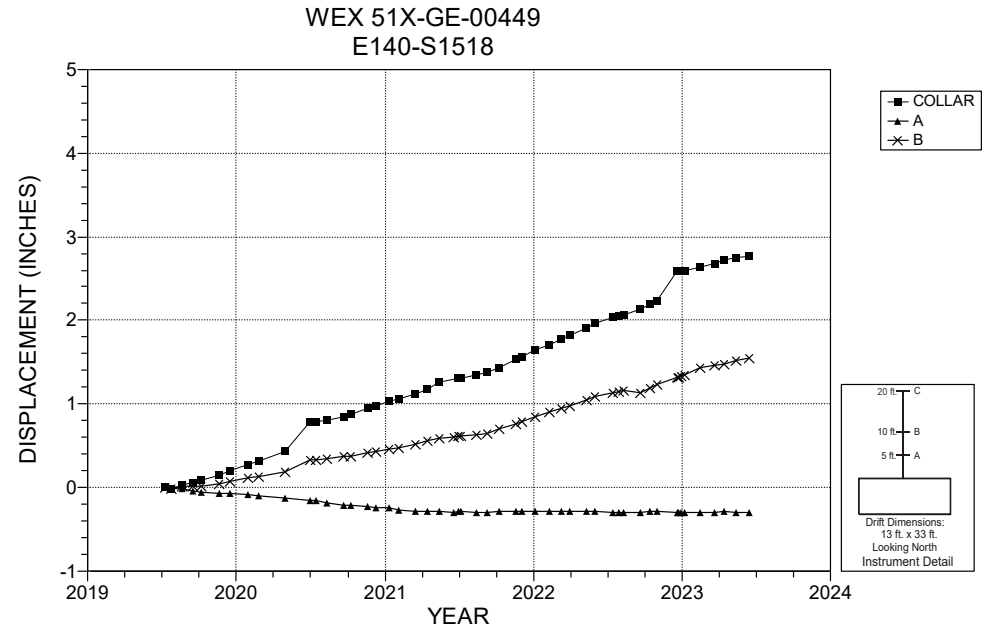
NOTES:
1. Excavation date: November 1982.
2. New installation: Sling Test Area

Figure 4-22 Extensometer 51X-GE-00447– E140 S1717 – Roof



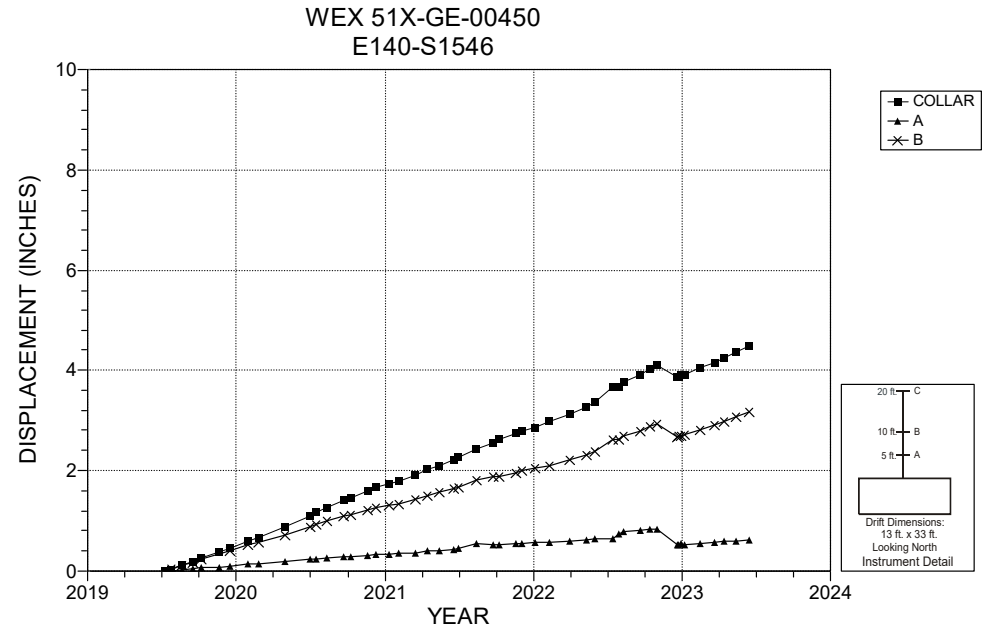
NOTES:
1. Excavation date: November 1982.
2. New installation: Test Area 1.

Figure 4-23 Extensometer 51X-GE-00448– E140 S1498 – Roof



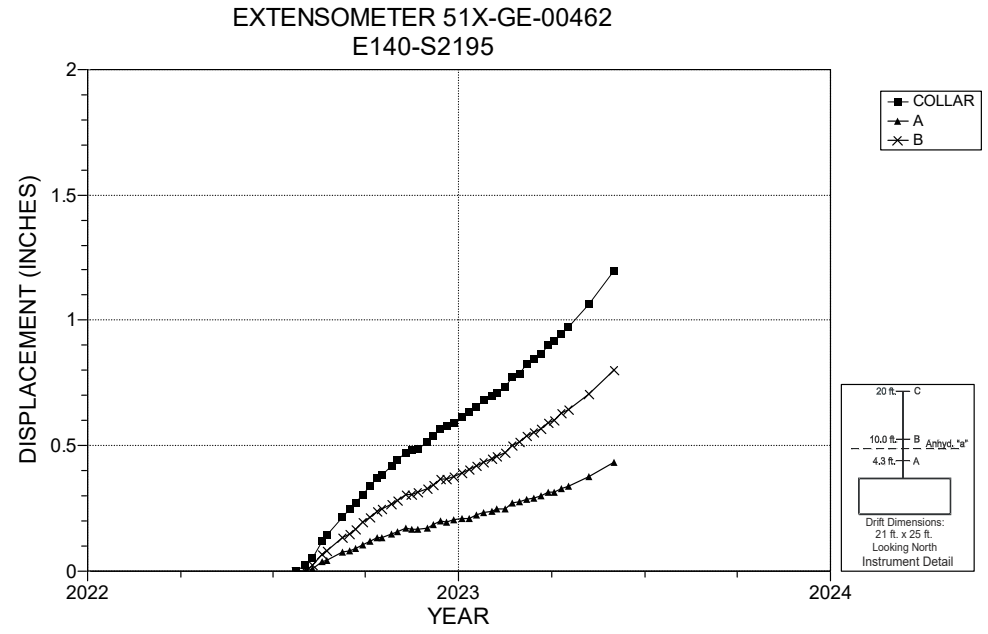
NOTES:
1. Excavation date: November 1982.
2. New installation: Test Area 1.

Figure 4-24 Extensometer 51X-GE-00449– E140 S1518 – Roof



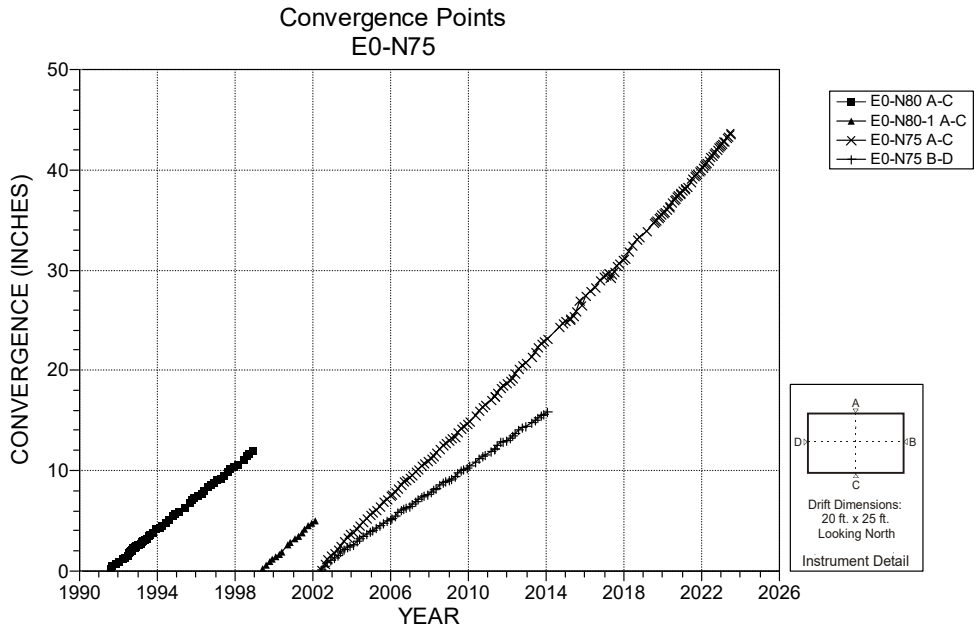
NOTES:
1. Excavation date: November 1982.
2. New installation: Test Area 1.

Figure 4-25 Extensometer 51X-GE-00450– E140 S1546 – Roof



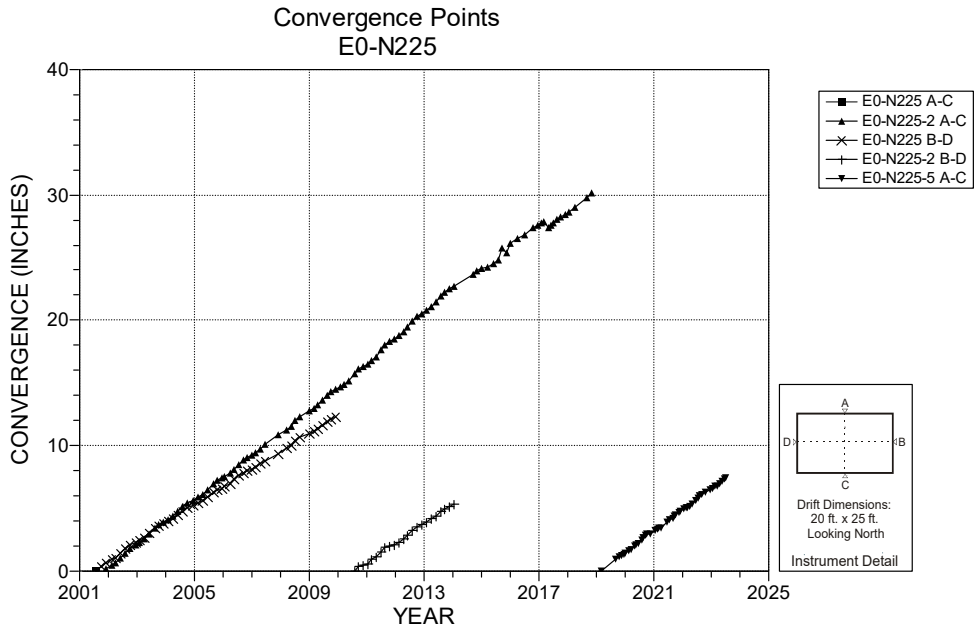
NOTES:
1. Excavation date: January 1983.

Figure 4-26 Extensometer 51X-GE-00462– E140 S2195 – Roof



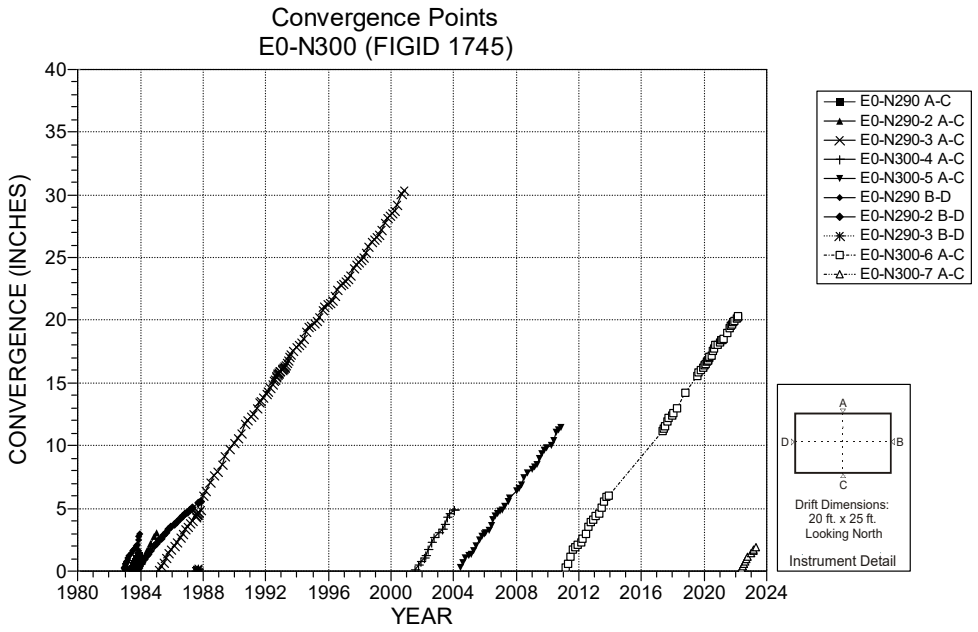
NOTES:
1. Excavation date: October 1982.
2. Roof excavated to Anhydrite "b".

Figure 4-27 Convergence Point Array – E0 N75 – All Chords



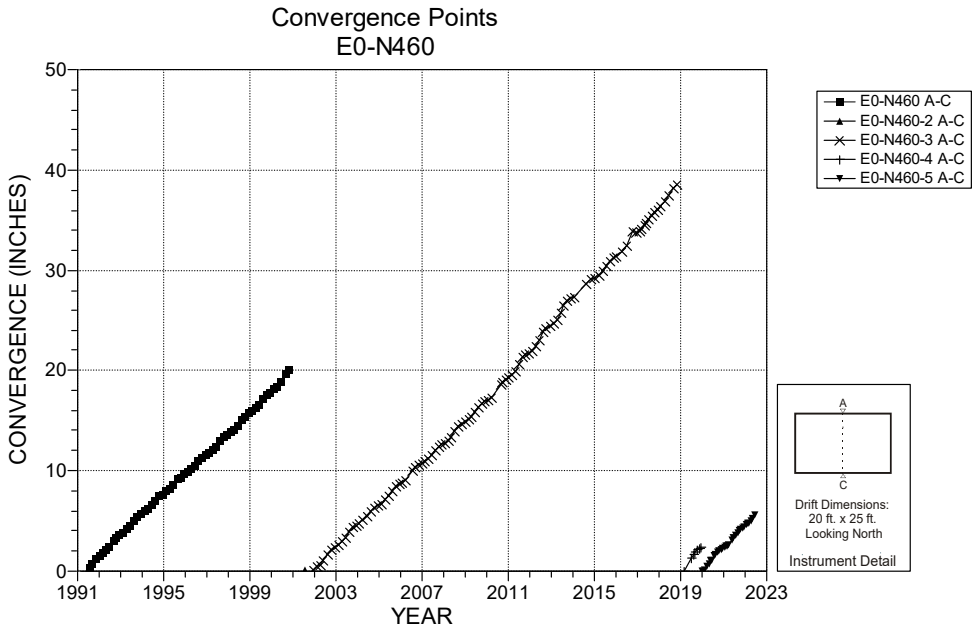
NOTES:
1. Excavation date: November 1982.
2. Roof excavated to Anhydrite "b".

Figure 4-28 Convergence Point Array – E0 N225 – All Chords



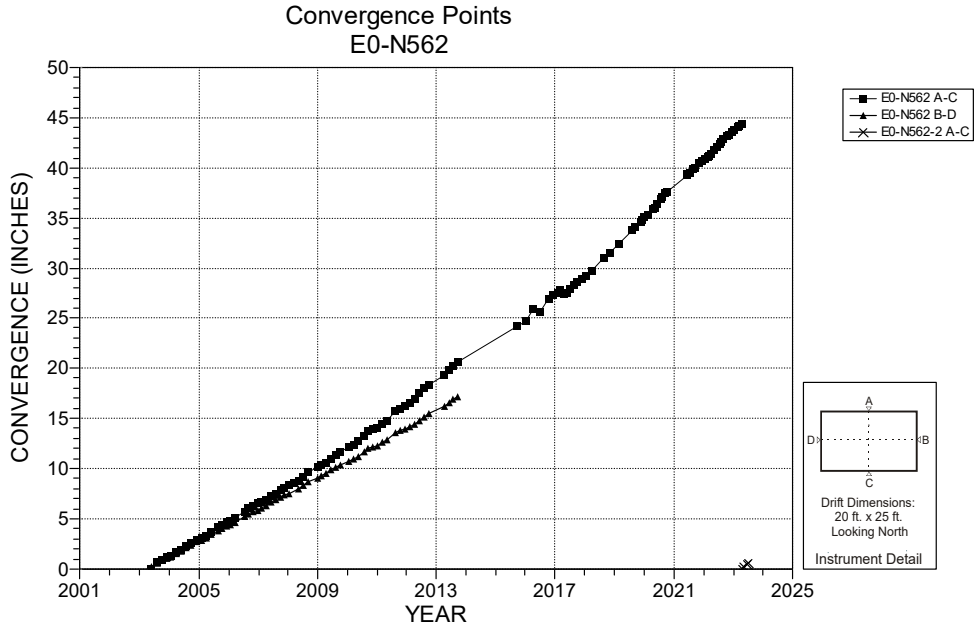
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b".
3. See FIGID 8472 for most recent history.

Figure 4-29 Convergence Point Array – E0 N300 – All Chords



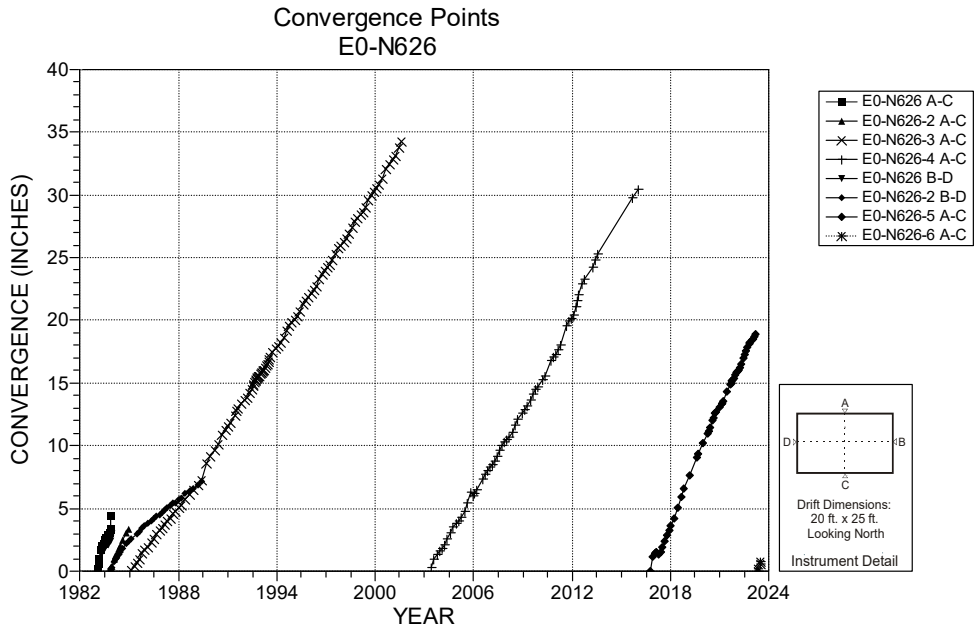
NOTES:
1. Excavation date: January 1983.
2. Roof excavated to Anhydrite "b".

Figure 4-30 Convergence Point Array – E0 N460 – Roof to Floor



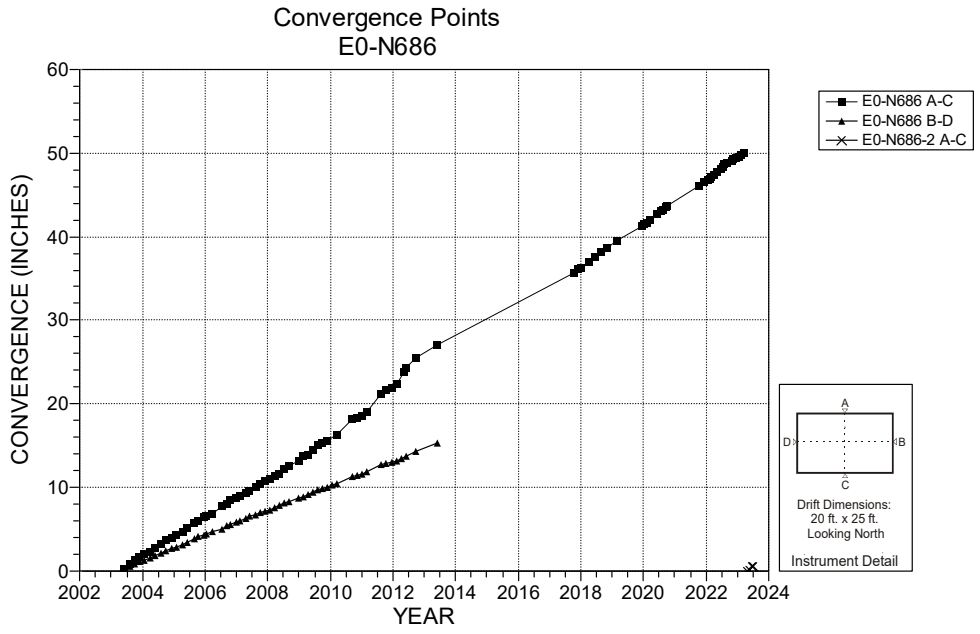
NOTES:
1. Excavation date: February 1983.
2. The RC floor point is covered by a muck pile.

Figure 4-31 Convergence Point Array – E0 N562 – All Chords



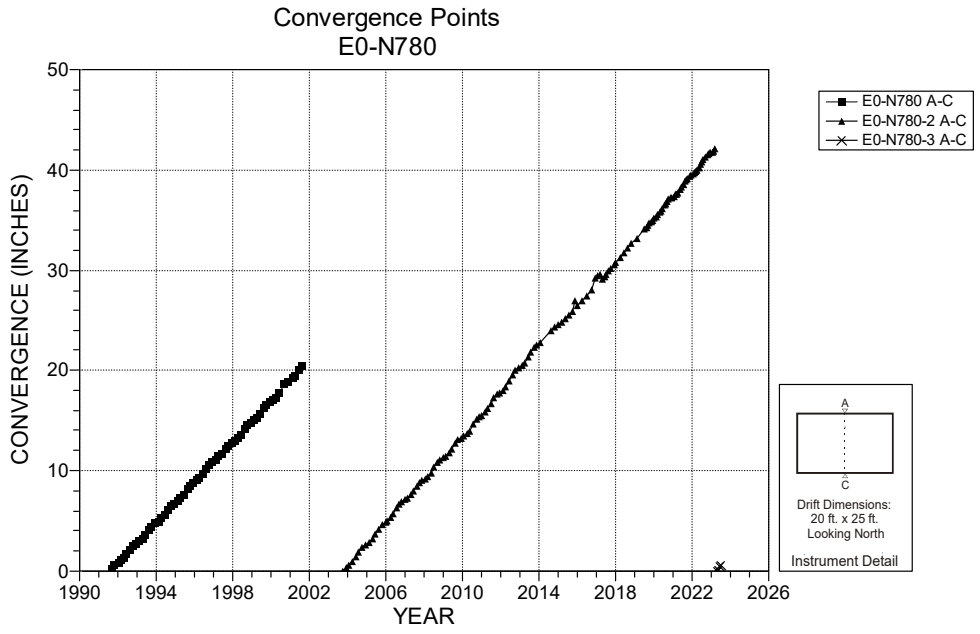
NOTES:
1. Excavation date: February 1983.
2. Roof excavated to Anhydrite "b".
3. The RC floor point is covered by a muck pile.

Figure 4-32 Convergence Point Array – E0 N626 – All Chords



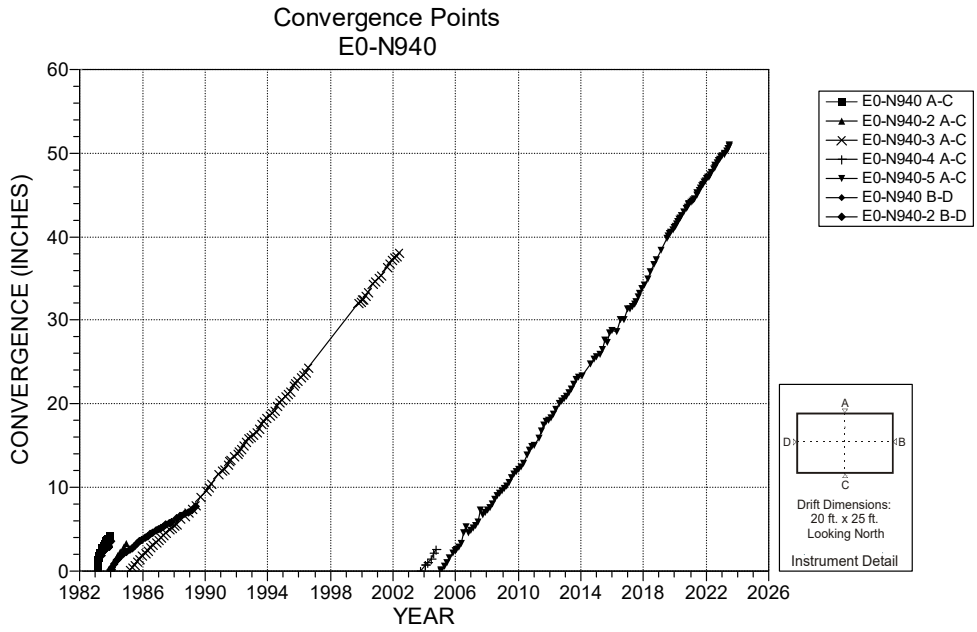
NOTES:
1. Excavation date: February 1983.
2. The RC floor point is covered by a muck pile.

Figure 4-33 Convergence Point Array – E0 N686 – All Chords



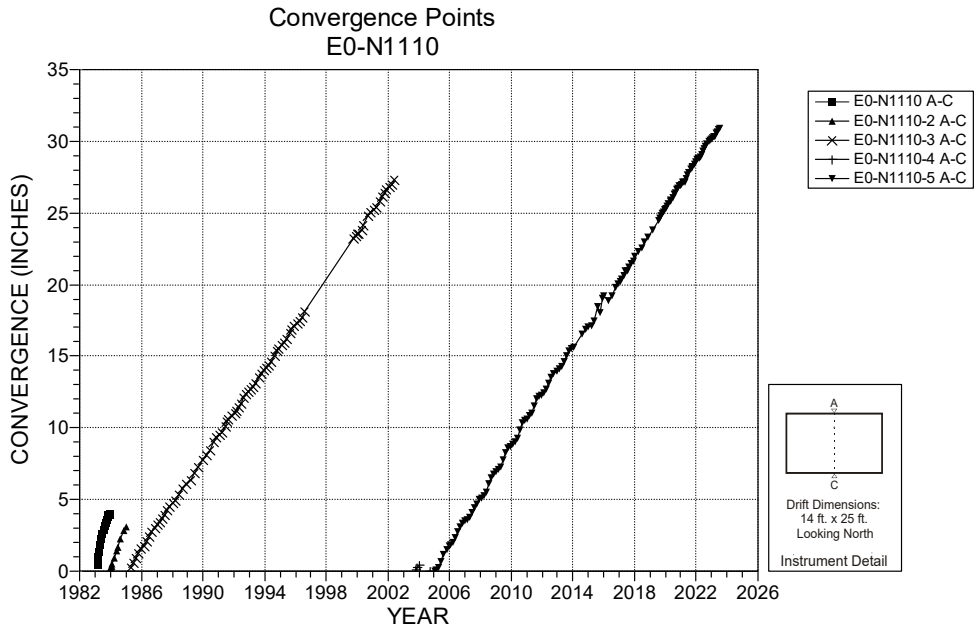
NOTES:
1. Excavation date: February 1983.

Figure 4-34 Convergence Point Array – E0 N780 – Roof to Floor



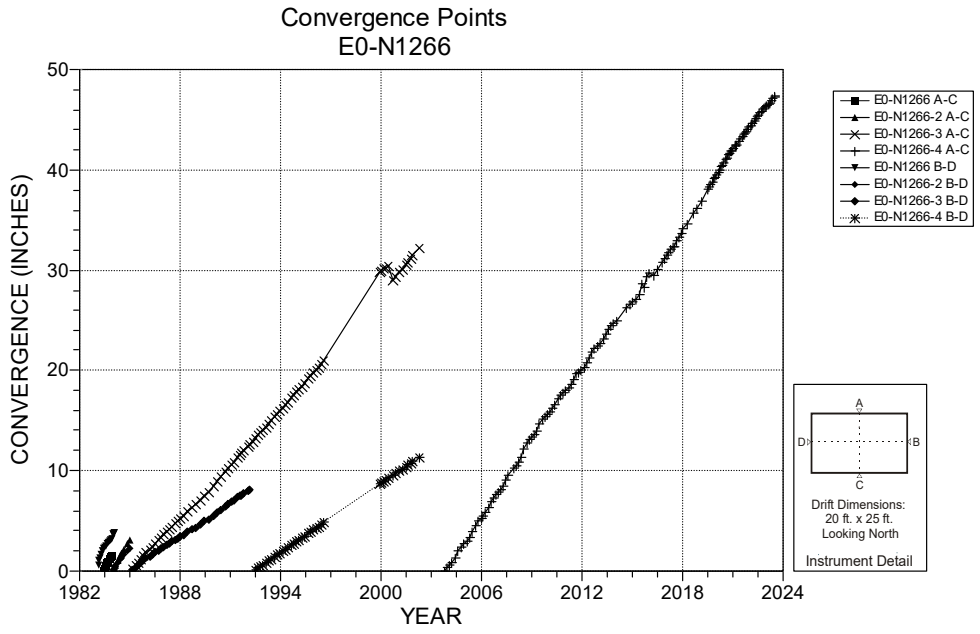
NOTES:
1. Excavation date: February 1983.

Figure 4-35 Convergence Point Array – E0 N940 – All Chords



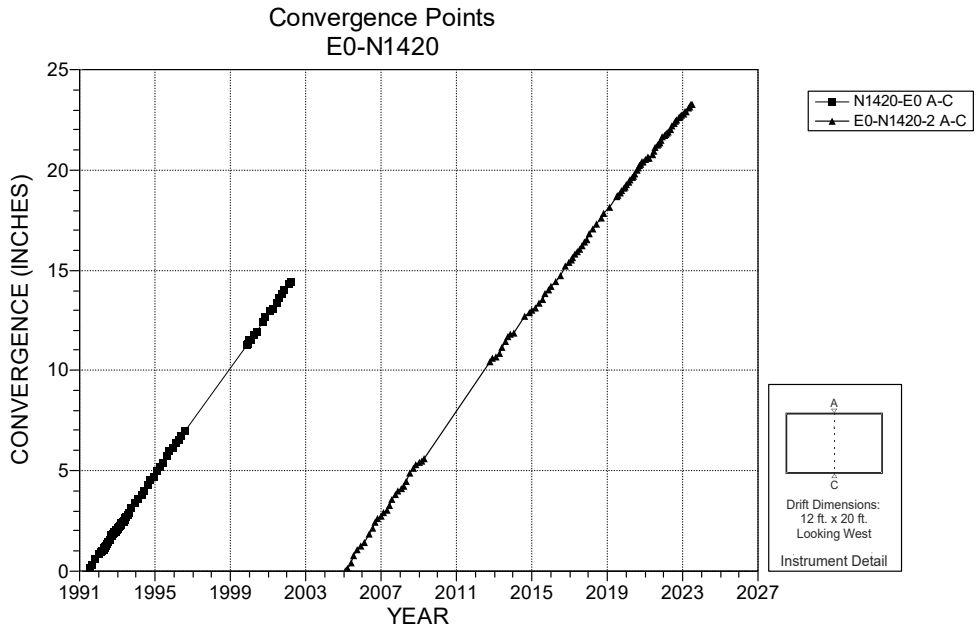
NOTES:
1. Excavation date: February 1983.
2. Inaccessible from 8/96 to 11/99.
3. Possible anchor slippage occurred between late January and early April 2004.

Figure 4-36 Convergence Point Array – E0 N1110 – Roof to Floor



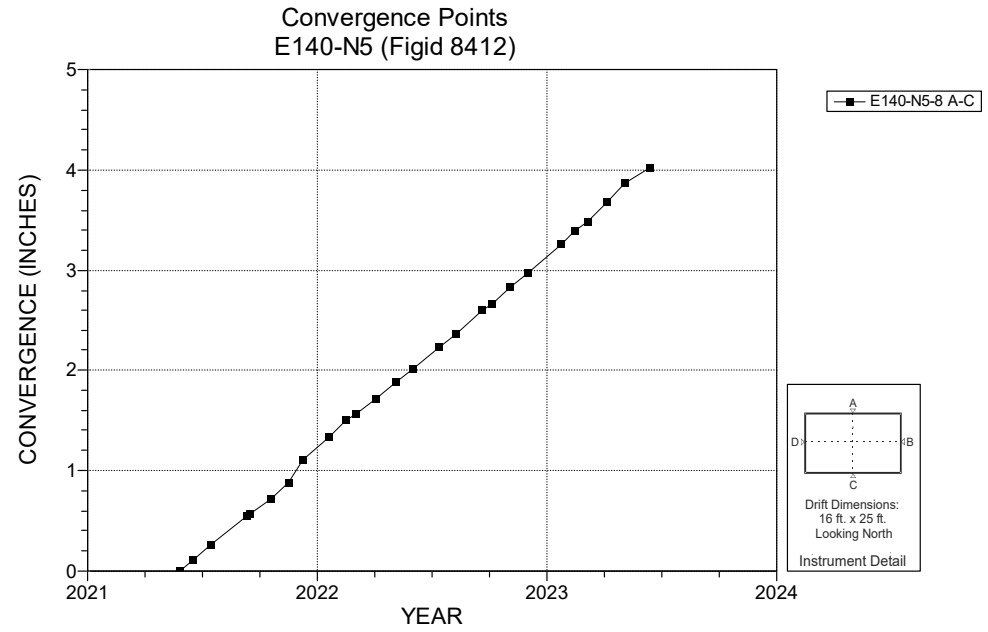
NOTES:
1. Excavation date: February 1983.

Figure 4-37 Convergence Point Array – E0 N1266 – All Chords



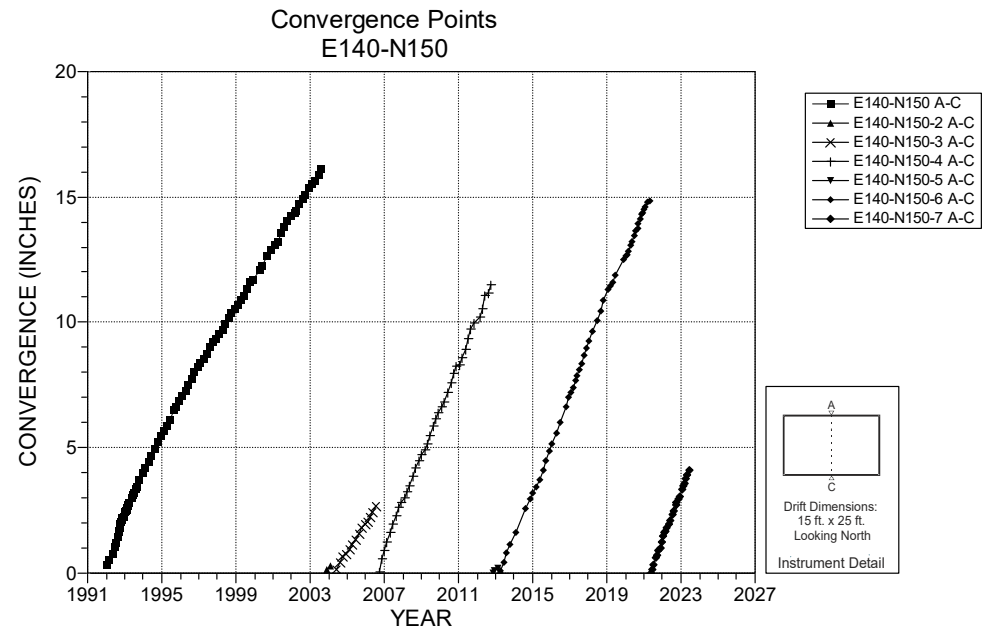
NOTES:
1. Excavation date: February 1983.
2. Inaccessible from 08/96 to 11/99.

Figure 4-38 Convergence Point Array – E0 N1420 – Roof to Floor



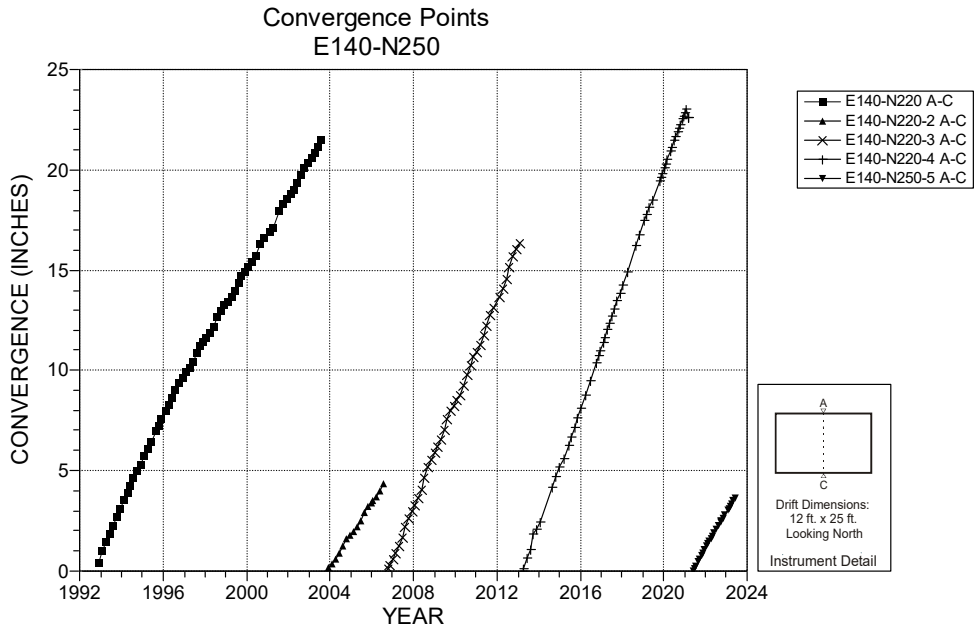
NOTES:
1. Excavation date: November 1982.
2. See Figid 1375 for prior history.

Figure 4-39 Convergence Point Array – E140 N5 – Roof to Floor



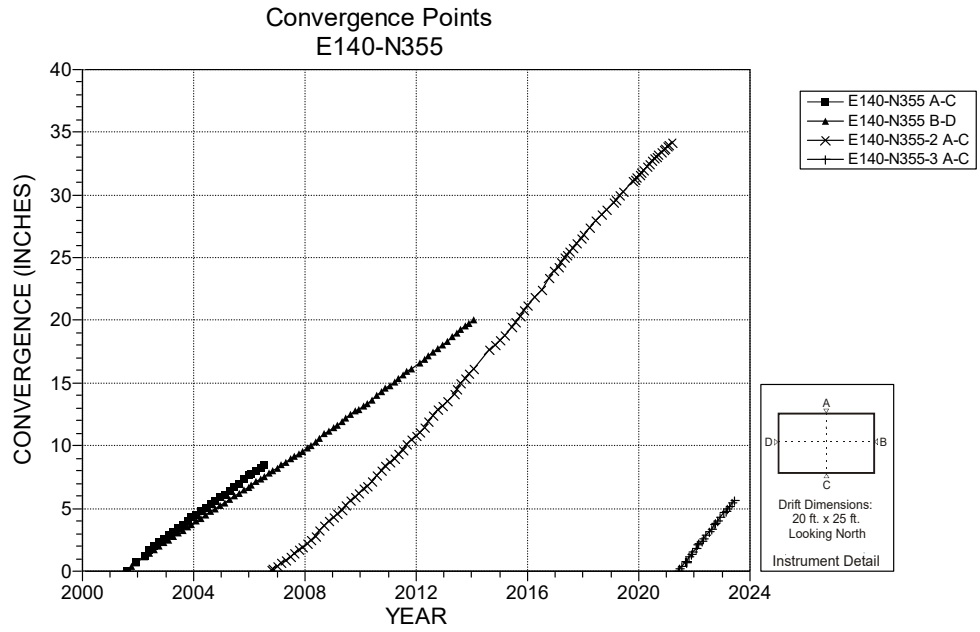
NOTES:
1. Excavation date: November 1982.
2. "C" Point mined out, reinstalled September 2006.

Figure 4-40 Convergence Point Array – E140 N150 – Roof to Floor



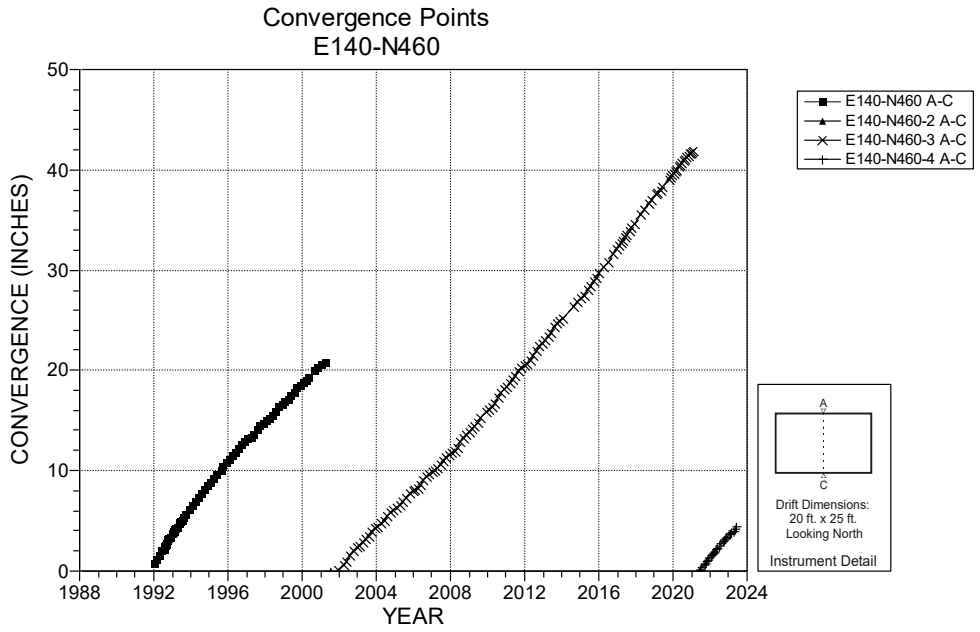
NOTES:
1. Excavation date: November 1982.
2. Reinstalled "C" point 9-27-2006.

Figure 4-41 Convergence Point Array – E140 N250 – Roof to Floor



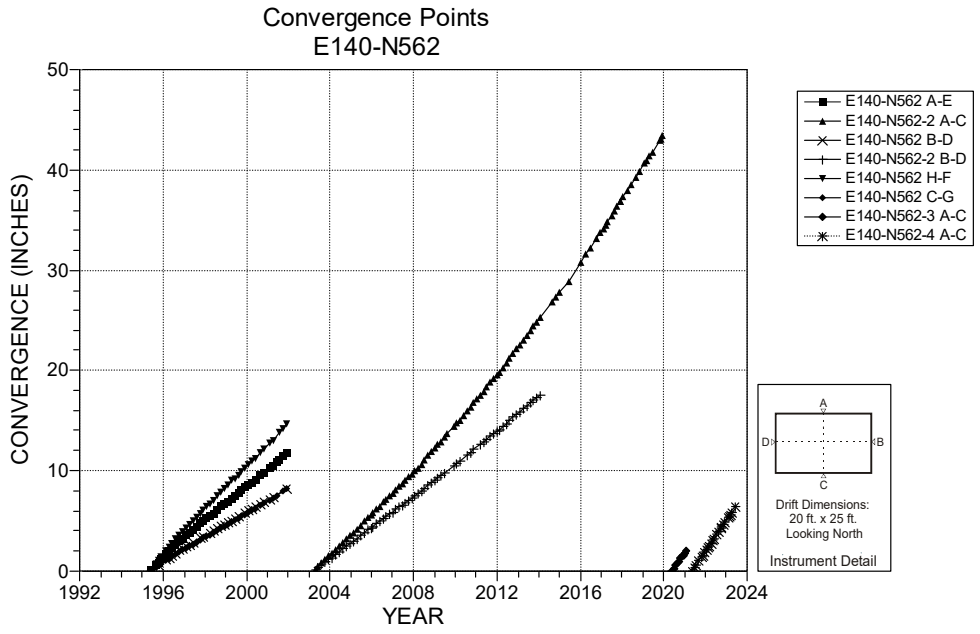
NOTES:
1. Excavation date: February 1983.
2. Roof excavated to Anhydrite 'b' in mid 2001.
3. Reinstalled "C" point 9-27-2006.

Figure 4-42 Convergence Point Array – E140 N355 – All Chords



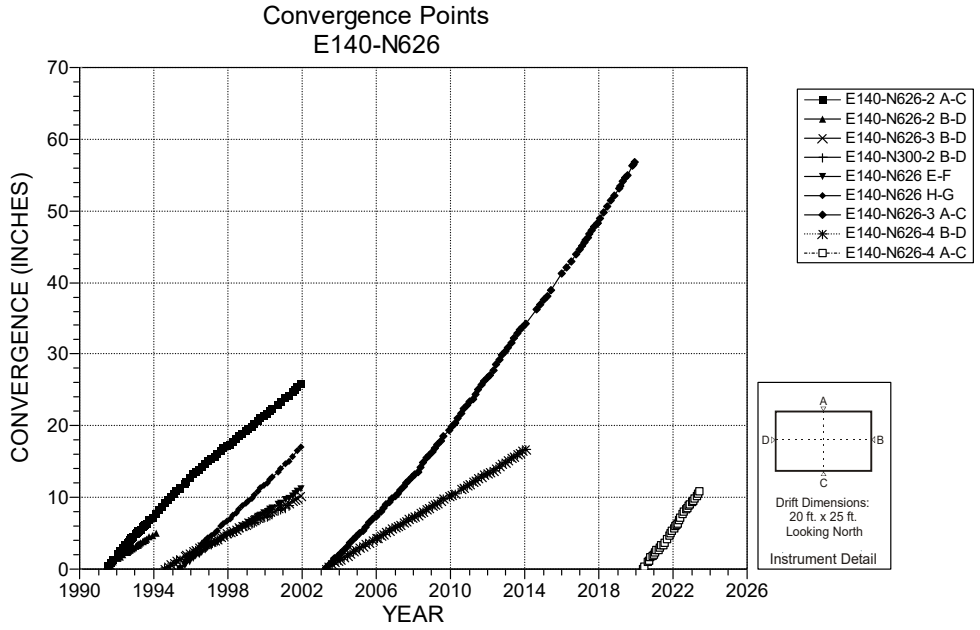
NOTES:
1. Excavation date: February 1983.
2. Roof excavated to Anhydrite 'b' in mid 2001.0

Figure 4-43 Convergence Point Array – E140 N460 – Roof to Floor



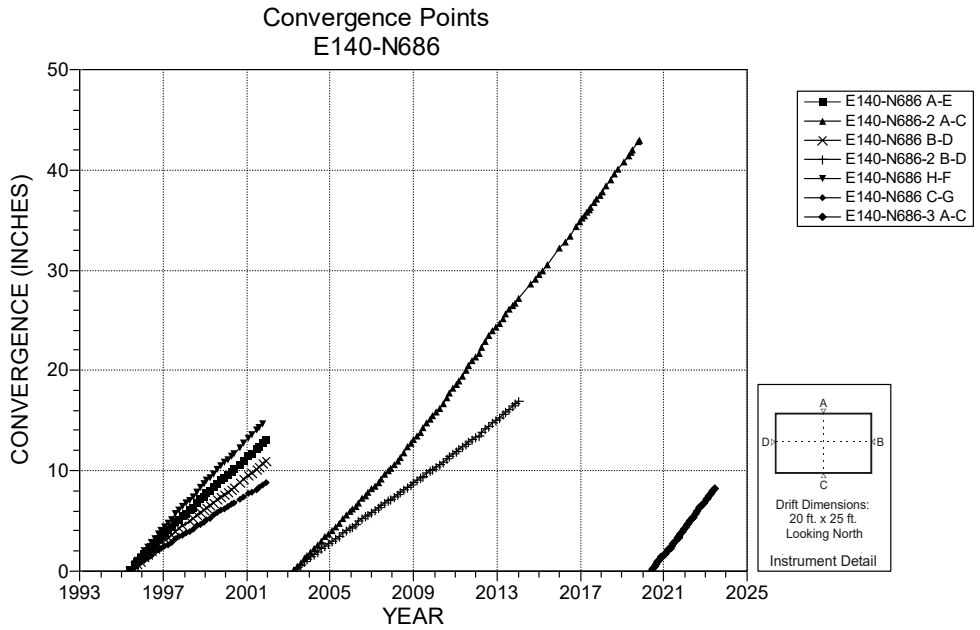
NOTES:
1. Excavation date: February 1983.
2. Roof excavated to Anhydrite "b" in early 2002.
3. Initially this location had three vertical chords: A-E, B-D, and H-F and a horizontal chord, G-G.

Figure 4-44 Convergence Point Array – E140 N562 – All Chords



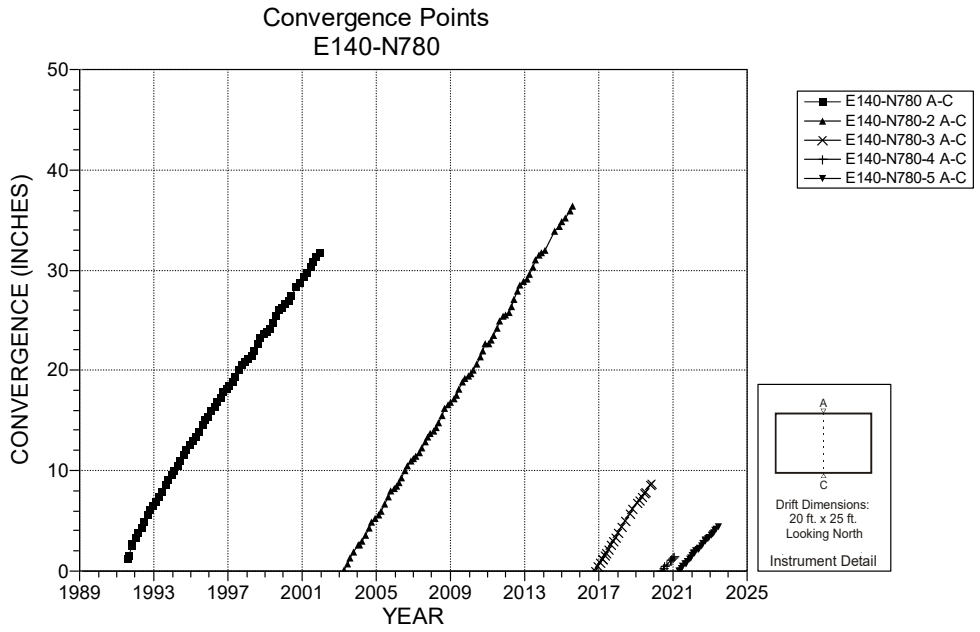
NOTES:
1. Excavation date: February 1983.
2. Roof excavated to Anhydrite "b" in early 2002.

Figure 4-45 Convergence Point Array – E140 N626 – All Chords



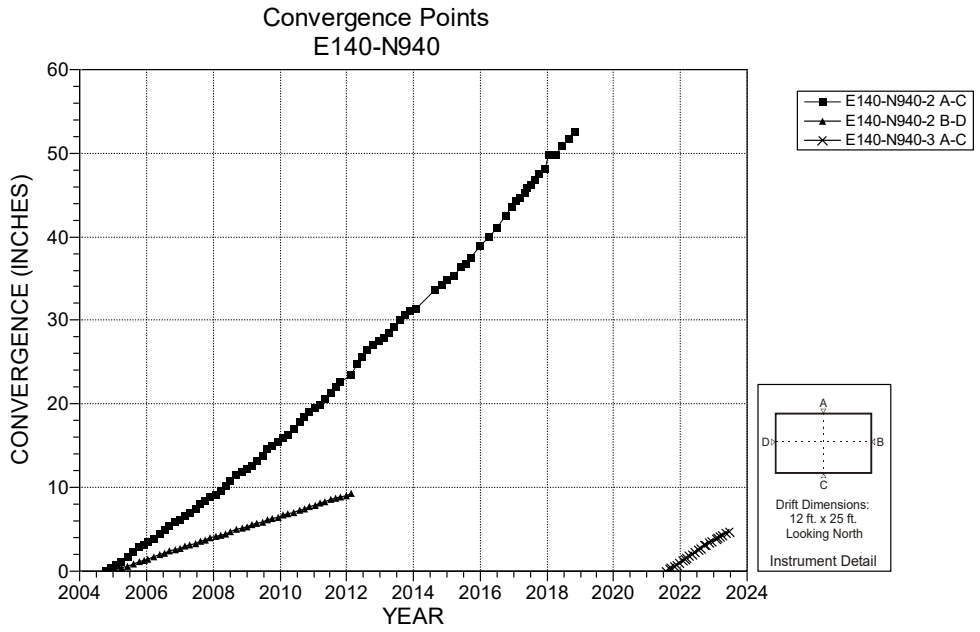
NOTES:
1. Excavation date: February 1983.
2. Roof excavated to Anhydrite "b" in early 2002.
3. Initially this location had three vertical chords: A-E, B-D, and H-F and a horizontal chord, G-G.

Figure 4-46 Convergence Point Array – E140 N686 – All Chords



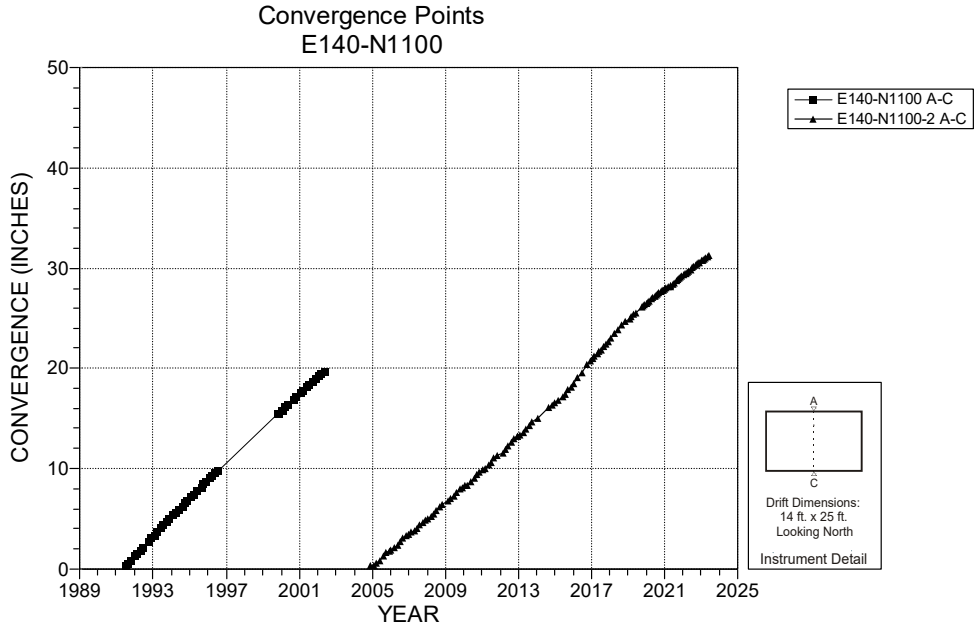
NOTES:
1. Excavation date: February 1983.
2. Roof excavated to Anhydrite 'b' in early 2002.
3. Anchor 'C' damaged by equipment, reinstalled October 2016.

Figure 4-47 Convergence Point Array – E140 N780 – Roof to Floor



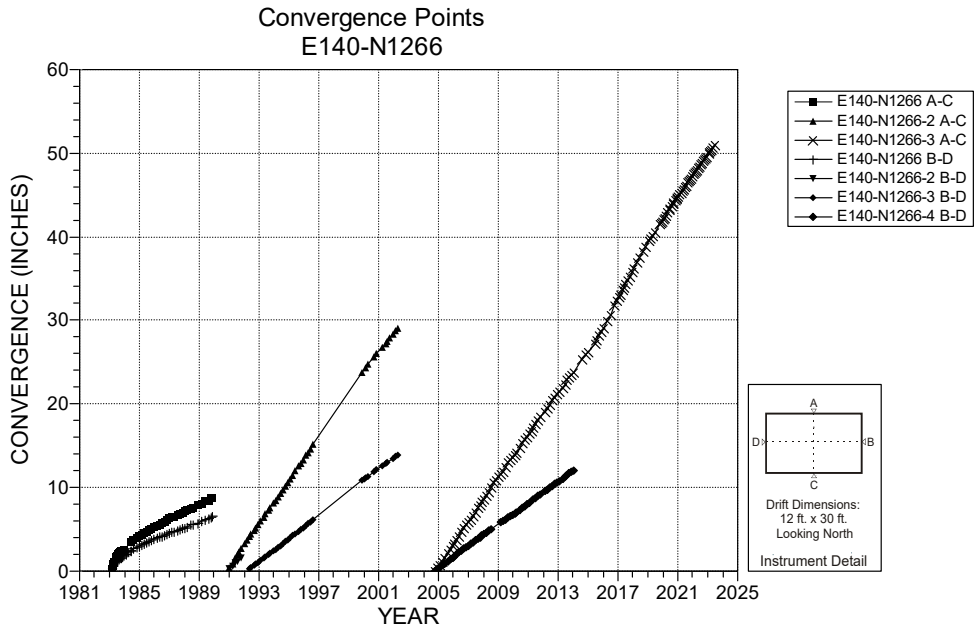
NOTES:
1. Excavation date: February 1983.
2. B-D chord location was mined out during SDI mining.

Figure 4-48 Convergence Point Array – E140 N940 – All Chords



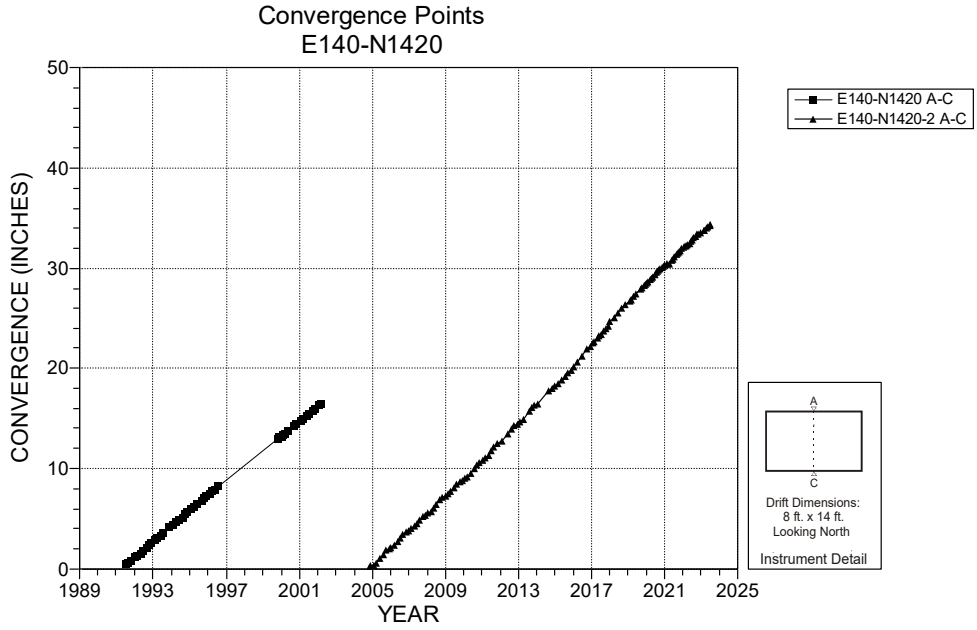
NOTES:
1. Excavation date: February 1983.
2. Inaccessible from 08/96 to 11/99.

Figure 4-49 Convergence Point Array – E140 N1100 – Roof to Floor



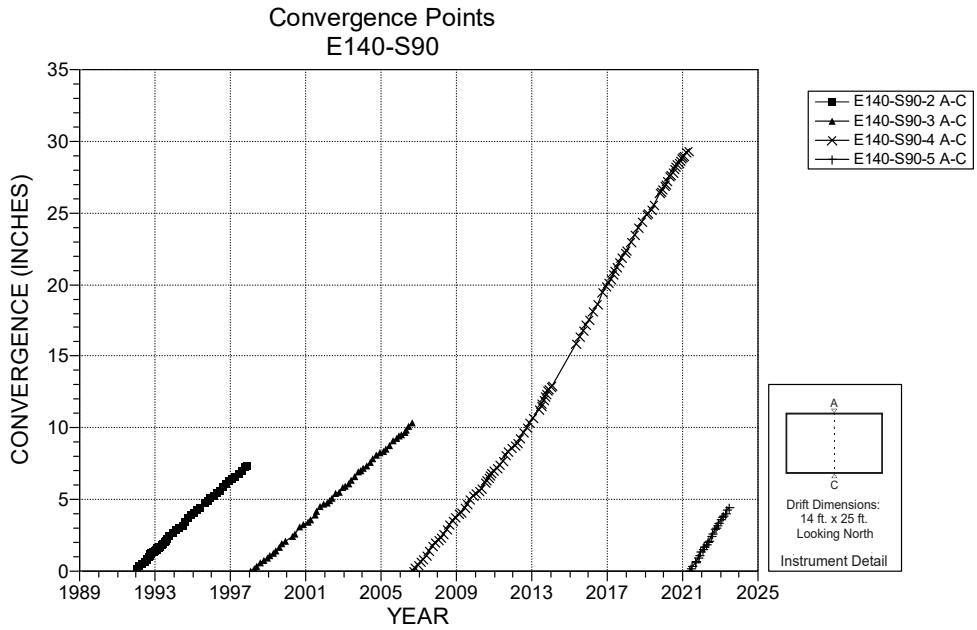
NOTES:
1. Excavation date: February 1983.
2. Enlarged from 8ft x 14ft in January 1990.
3. Inaccessible from 8/ 96 to 11/99.

Figure 4-50 Convergence Point Array – E140 N1266 – All Chords



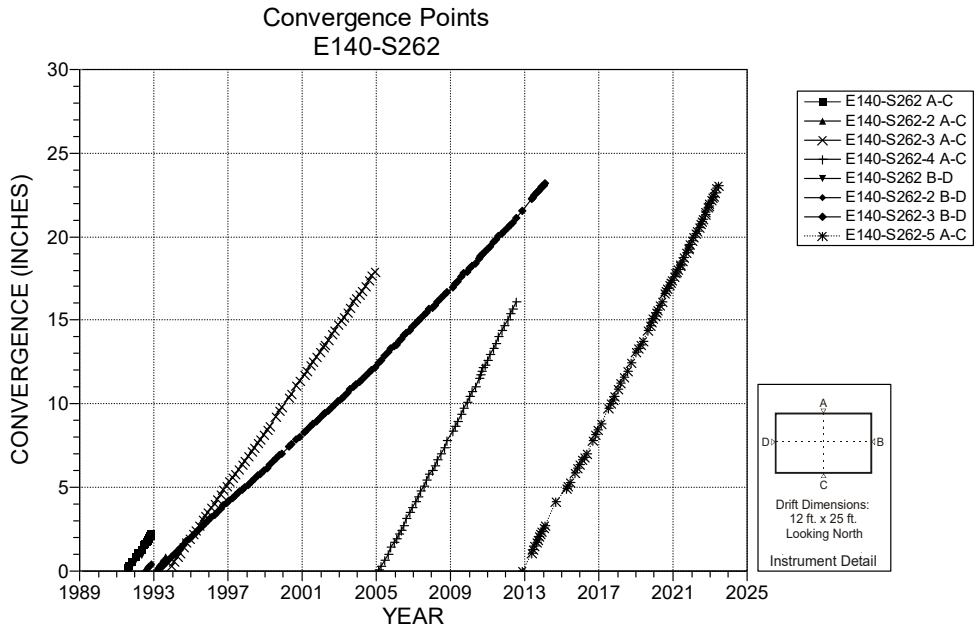
NOTES:
1. Excavation date: February 1983.
2. Inaccessible from August 1996 to November 1999.

Figure 4-51 Convergence Point Array – E140 N1420 – Roof to Floor



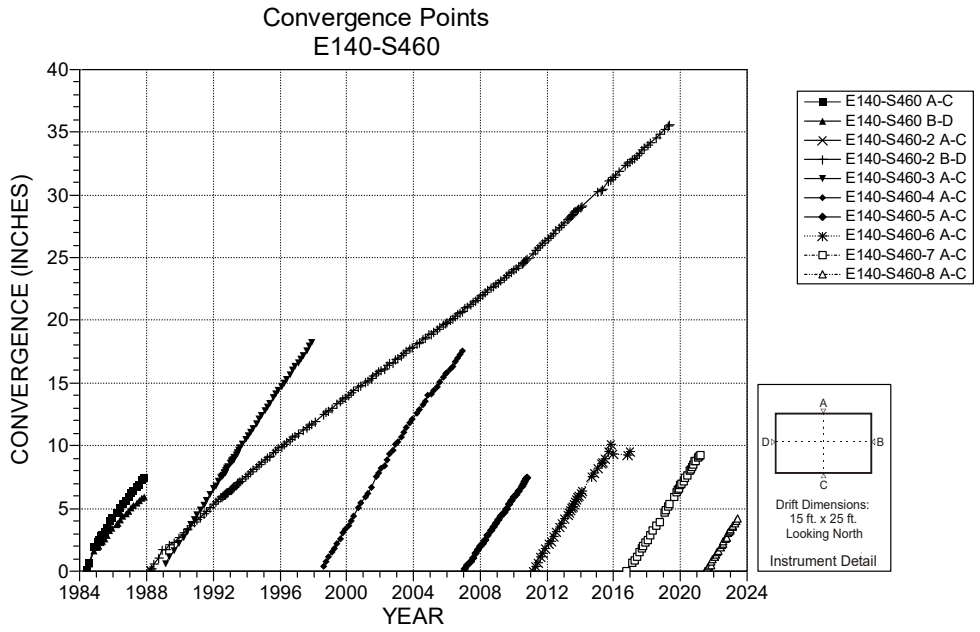
NOTES:
1. Excavation date: October 1982.
2. "C" Point mined out, reinstalled Sepetmber 2006

Figure 4-52 Convergence Point Array **–** E140 S90 – Roof to Floor



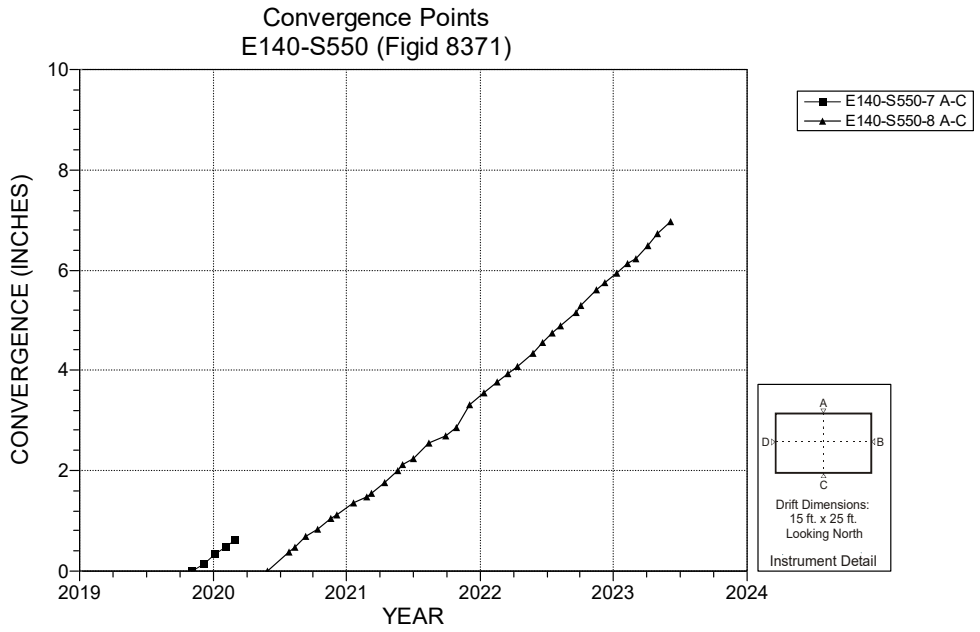
NOTES:
1. Excavation date: November 1982.

Figure 4-53 Convergence Point Array – E140 S262 – All Chords



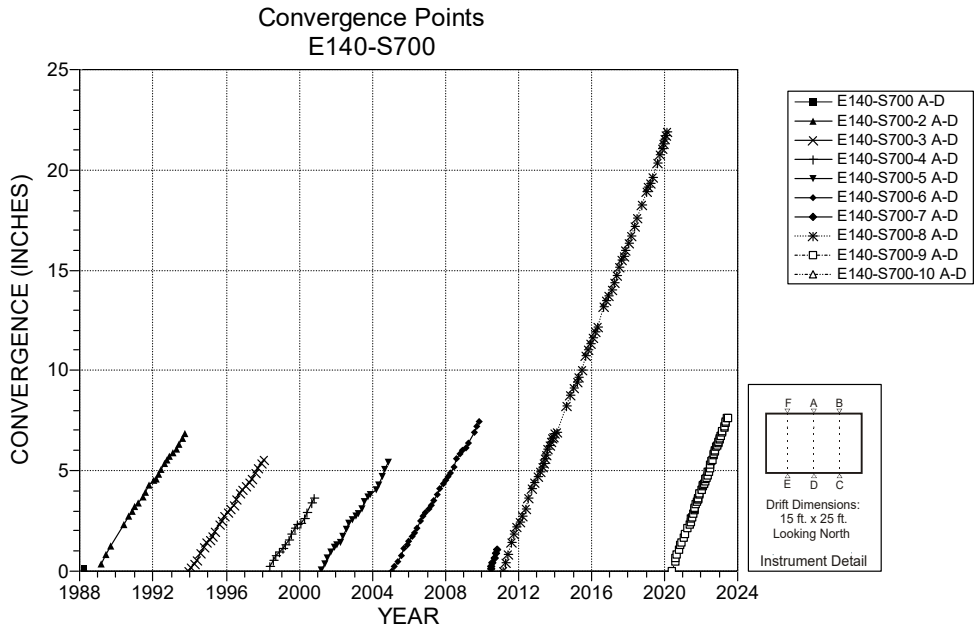
NOTES:
1. Excavation date: December 1982.
2. "C" point mined out, reinstall January 2007
3. Anchor 'C' mined out, reinstalled October 2016.

Figure 4-54 Convergence Point Array – E140 S460 – All Chords



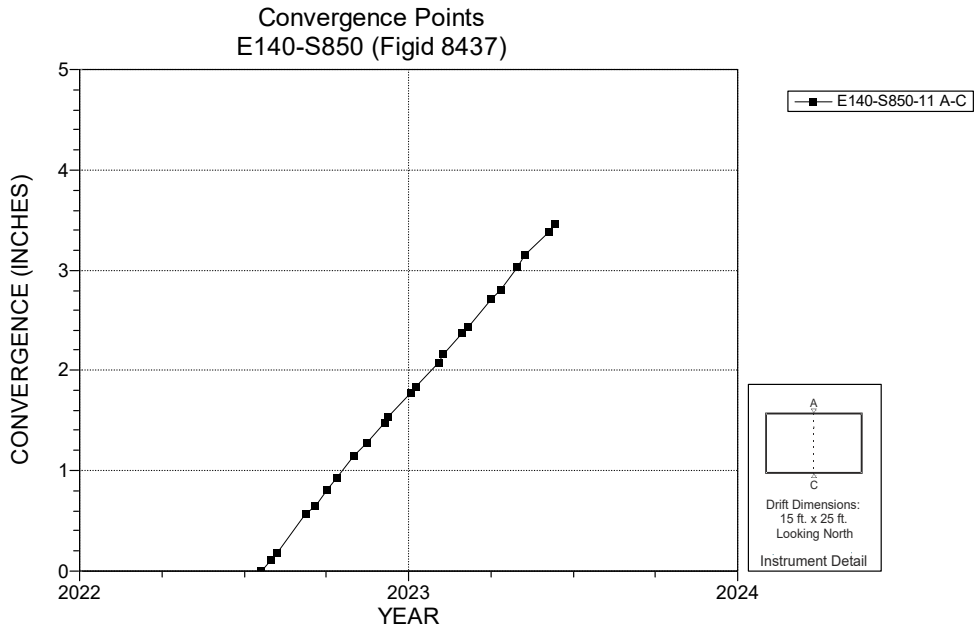
NOTES:
1. Excavation date: December 1982.
2. See FIGID 1745 for prior history.

Figure 4-55 Convergence Point Array – E140 S550 – Roof to Floor



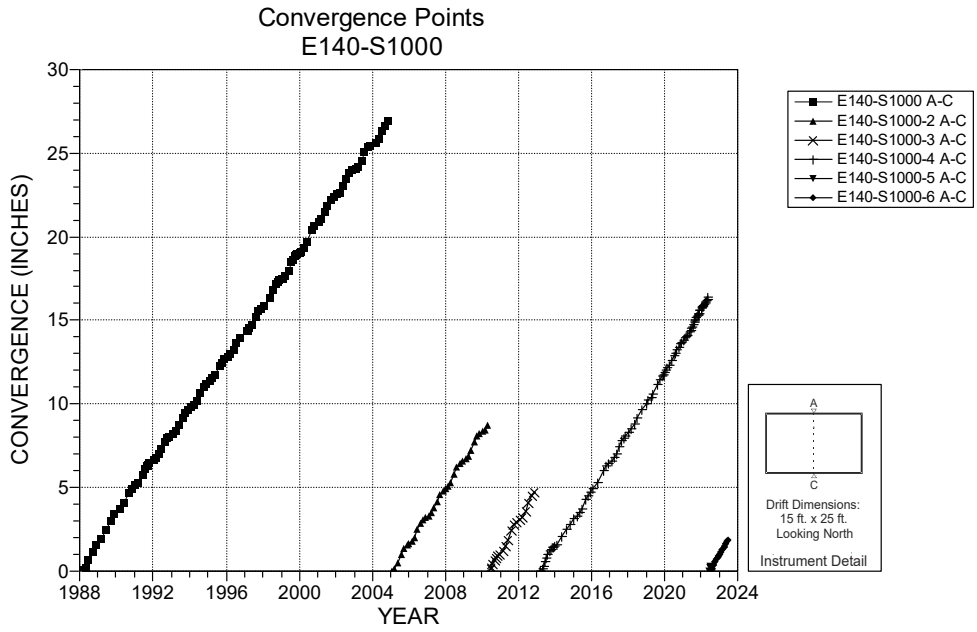
NOTES:
1. Excavation date: December 1982.

Figure 4-56 Convergence Point Array – E140 S700 – Roof to Floor



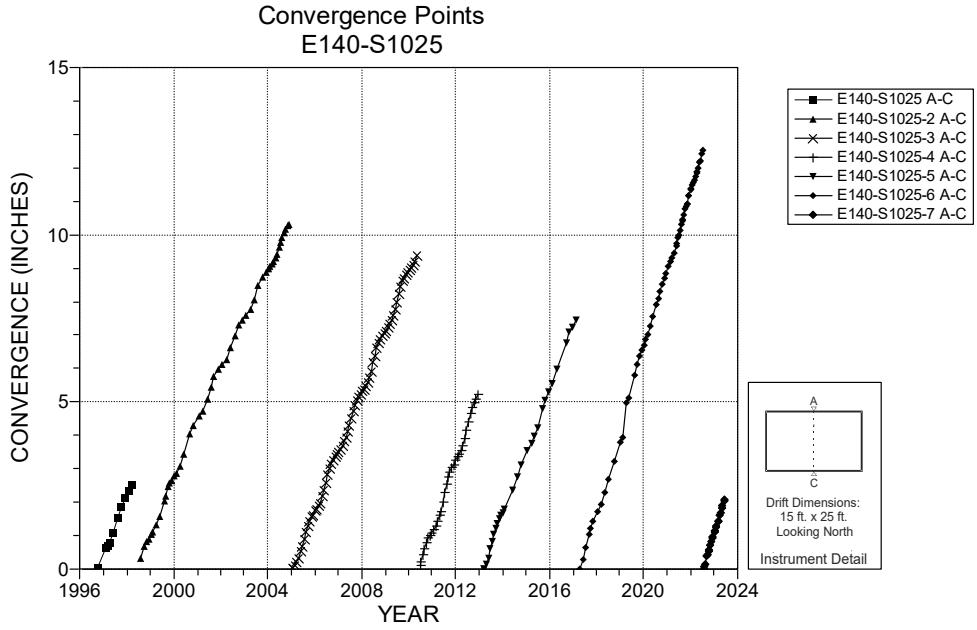
NOTES:
1. Excavation date: December 1982.

Figure 4-57 Convergence Point Array – E140 S850 – Roof to Floor



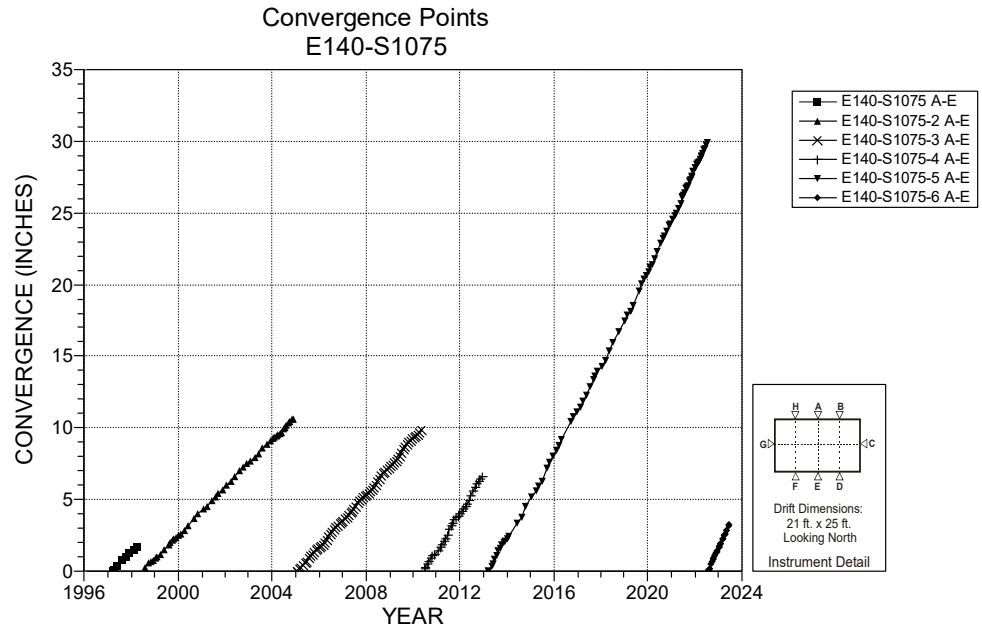
NOTES:
1. Excavation date: December 1982.

Figure 4-58 Convergence Point Array – E140 S1000 – Roof to Floor



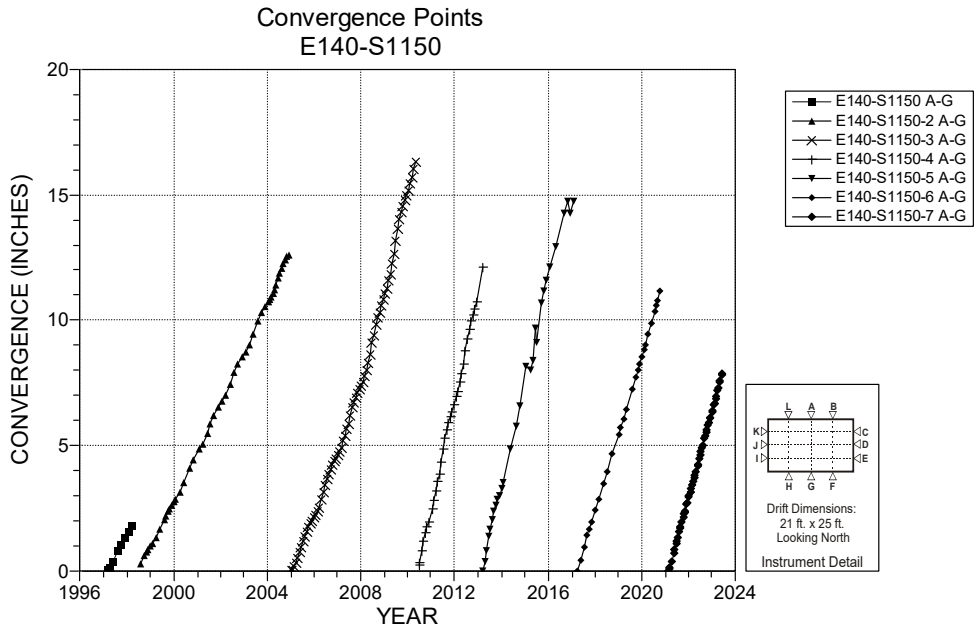
NOTES:
1. Excavation date: December 1982.

Figure 4-59 Convergence Point Array – E140 S1025 – Roof to Floor



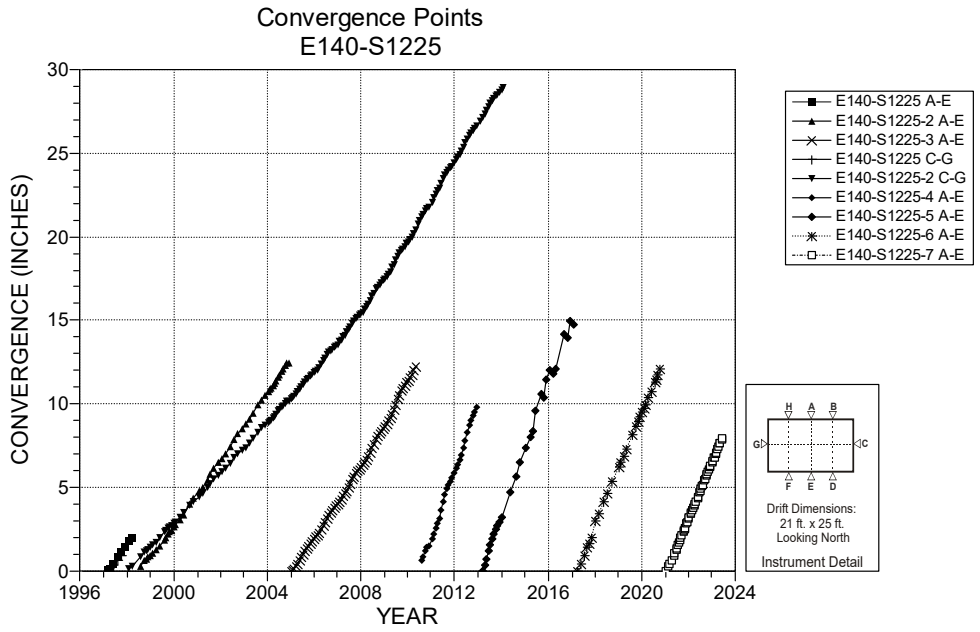
NOTES:
1. Excavation date: December 1982.

Figure 4-60 Convergence Point Array – E140 S1075 – All Chords



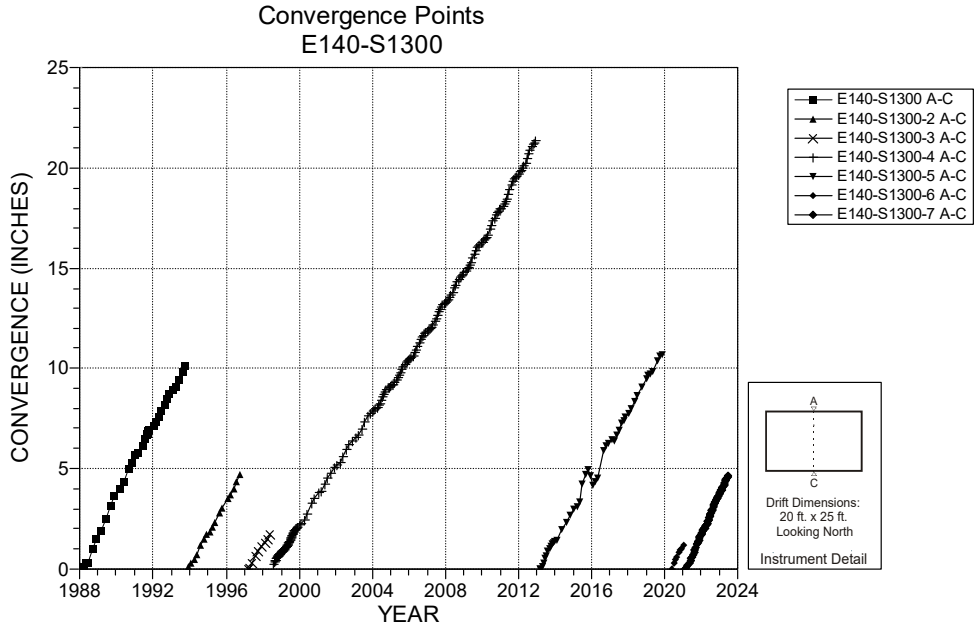
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b", November 1996.

Figure 4-61 Convergence Point Array – E140 S1150 – All Chords



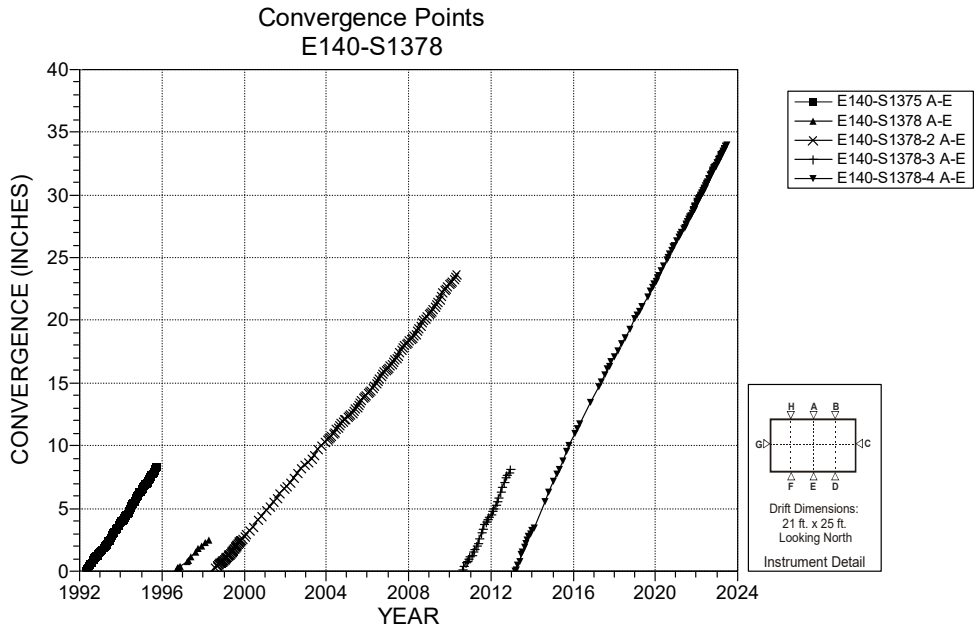
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b", November 1996.

Figure 4-62 Convergence Point Array – E140 S1225 – All Chords



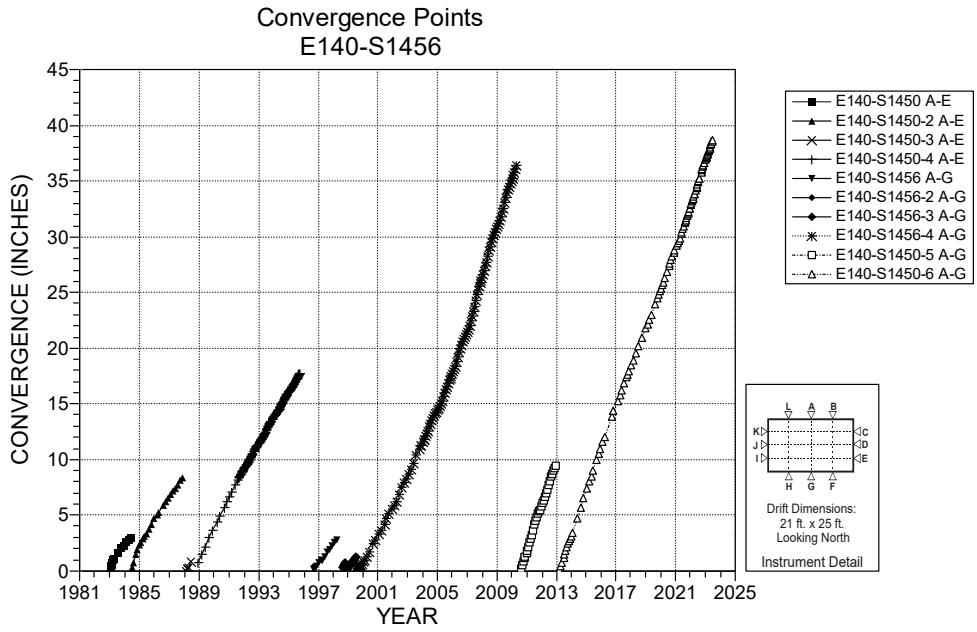
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b" in December 1996.

Figure 4-63 Convergence Point Array – E140 S1300 – Roof to Floor



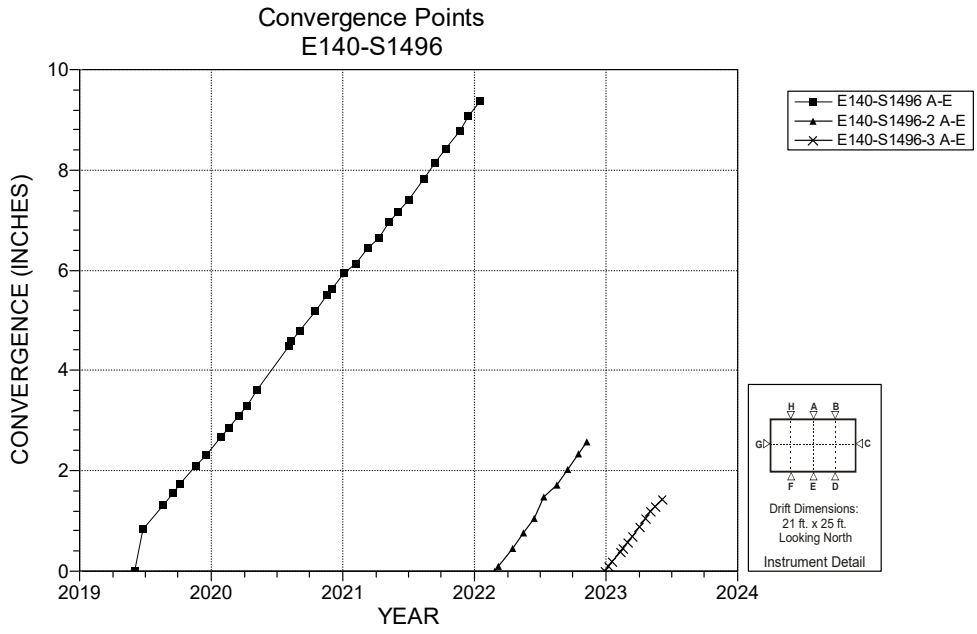
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b" in December 1995.

Figure 4-64 Convergence Point Array – E140 S1378 – Roof to Floor



NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b" in December 1995.

Figure 4-65 Convergence Point Array – E140 S1456 – Roof to Floor



NOTES:
1. Excavation date: December 1982.

Figure 4-66 Convergence Point Array – E140 S1496 A-E – Roof to Floor – Test Area

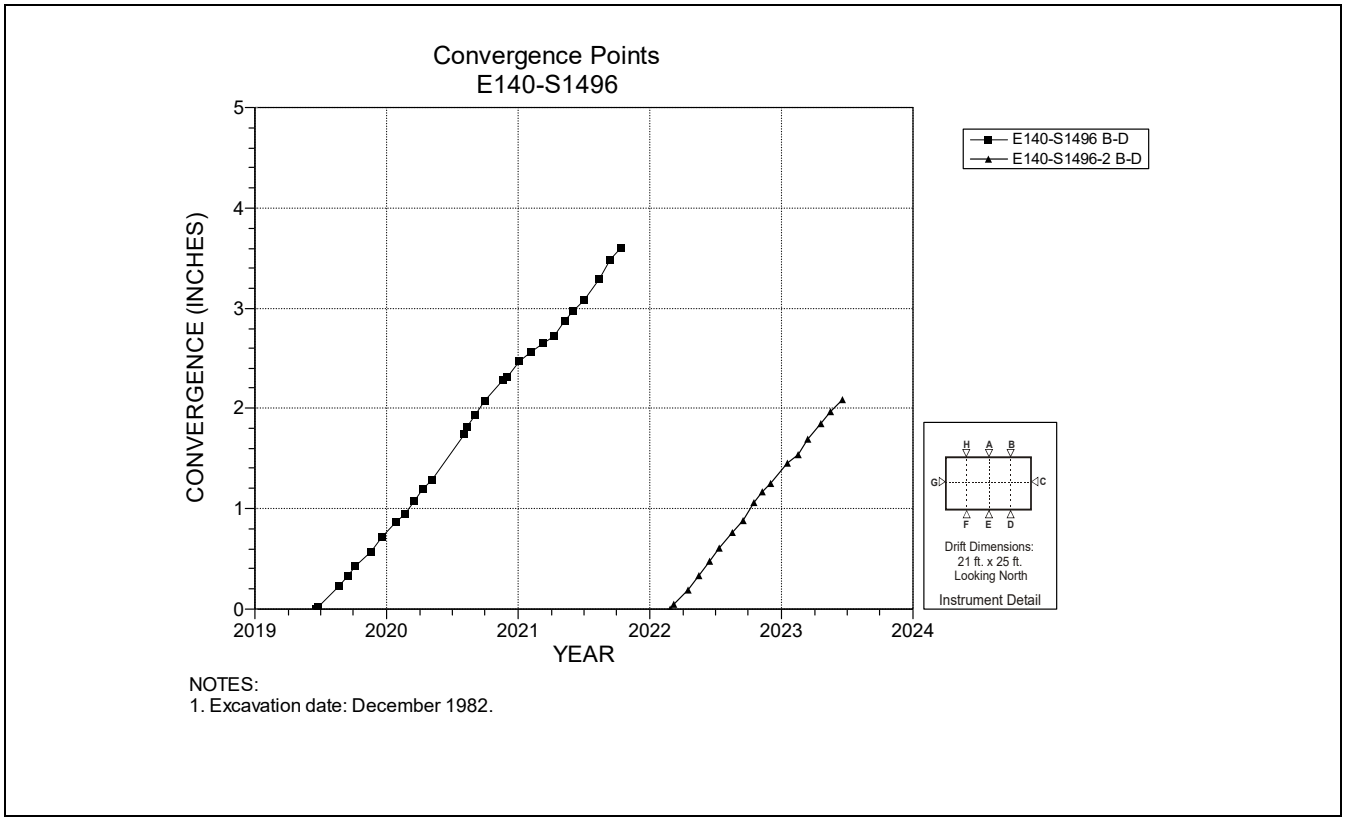


Figure 4-67 Convergence Point Array – E140 S1496 B-D – Roof to Floor – Test Area

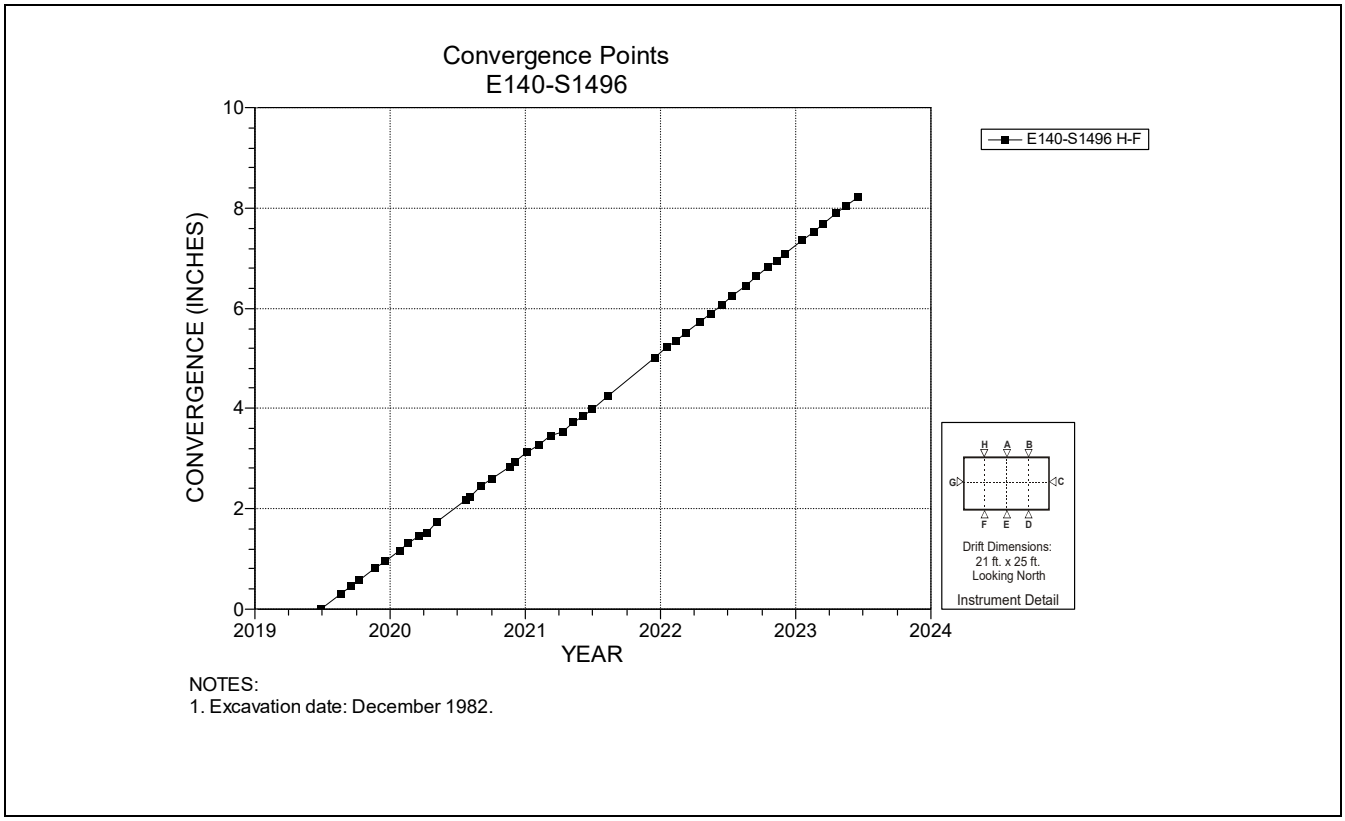
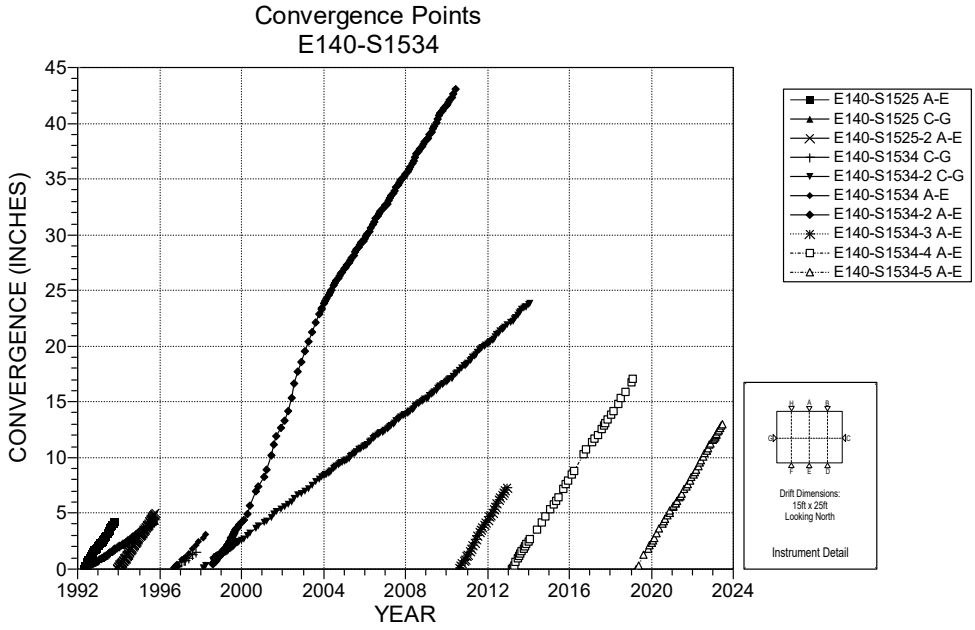
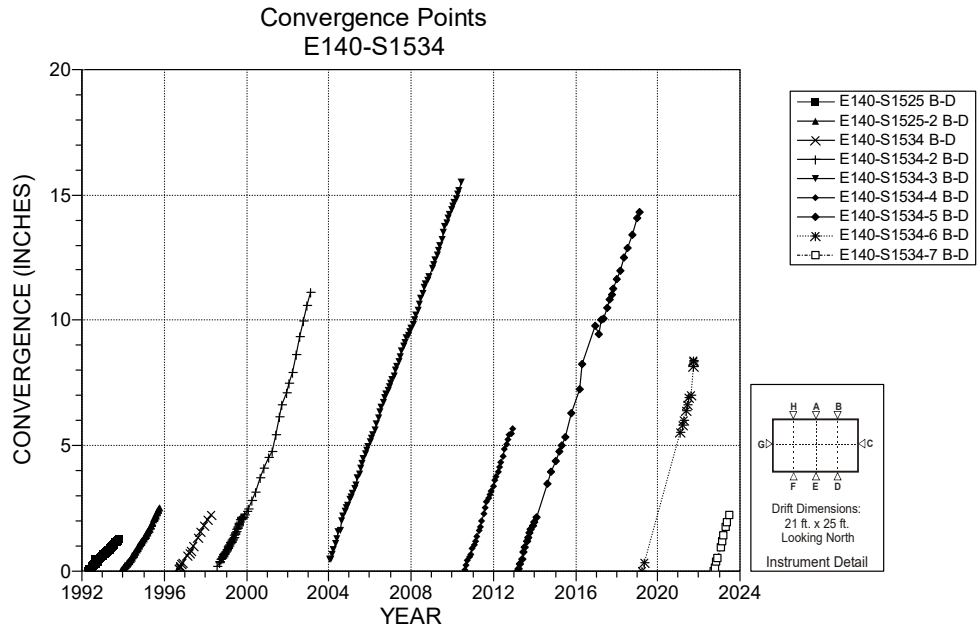


Figure 4-68 Convergence Point Array – E140 S1496 H-F – Roof to Floor – Test Area



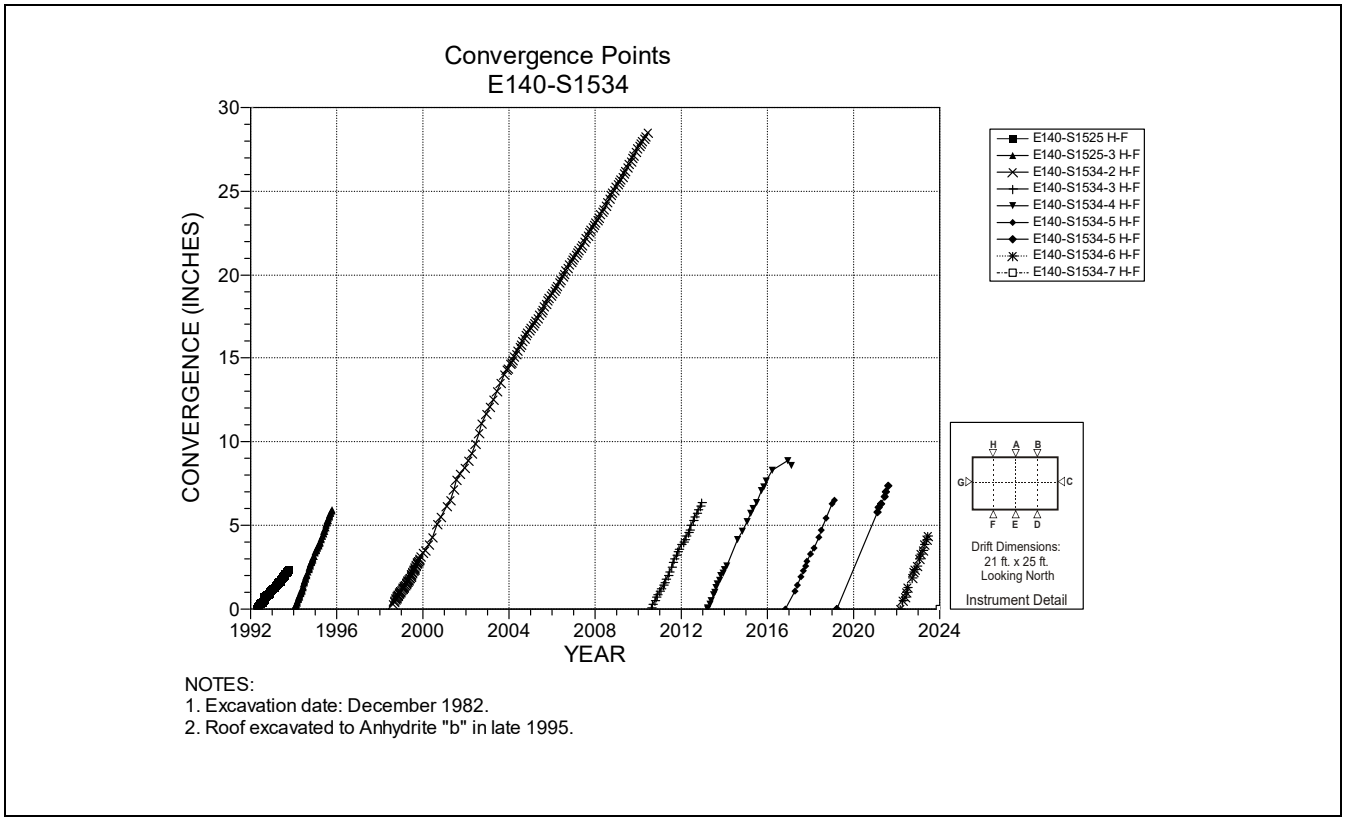
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b" in December 1995.
3. Replaced by E140-S1534.

Figure 4-69 Convergence Point Array – E140 S1534 A-E – Roof to Floor – Test Area



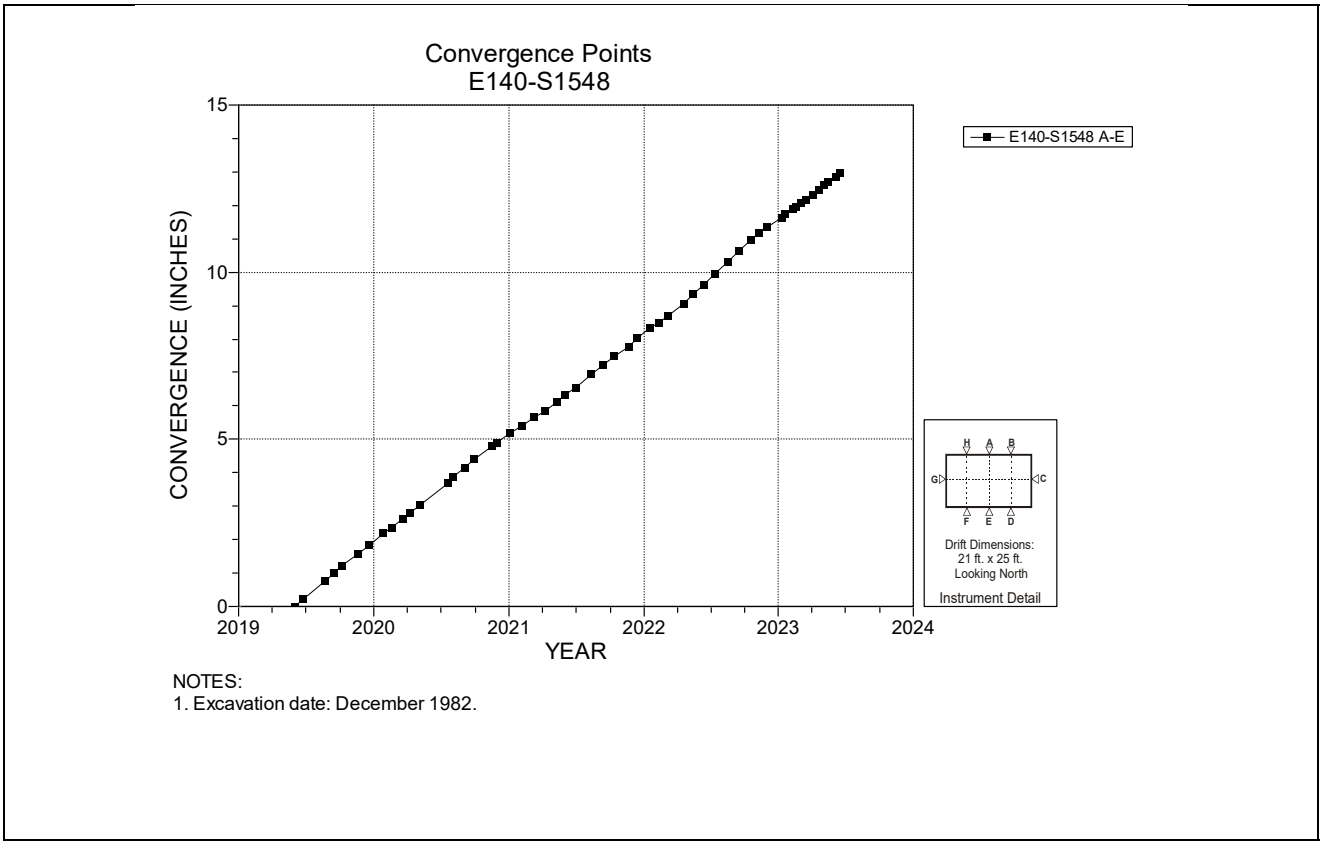
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b" in late 1995.

Figure 4-70 Convergence Point Array – E140 S1534 B-D – Roof to Floor – Test Area



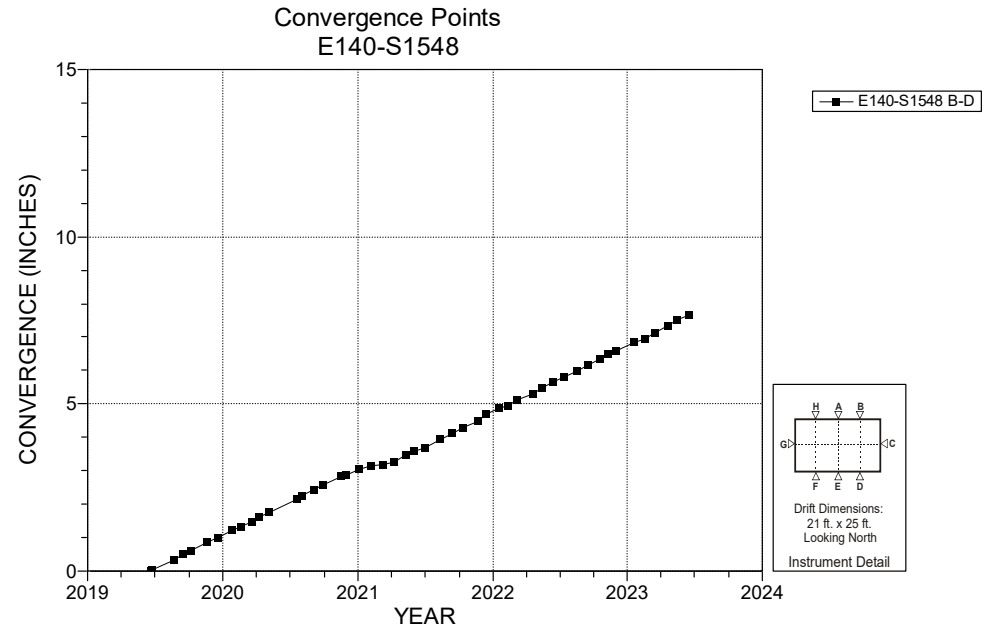
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b" in late 1995.

Figure 4-71 Convergence Point Array – E140 S1534 H-F – Roof to Floor – Test Area



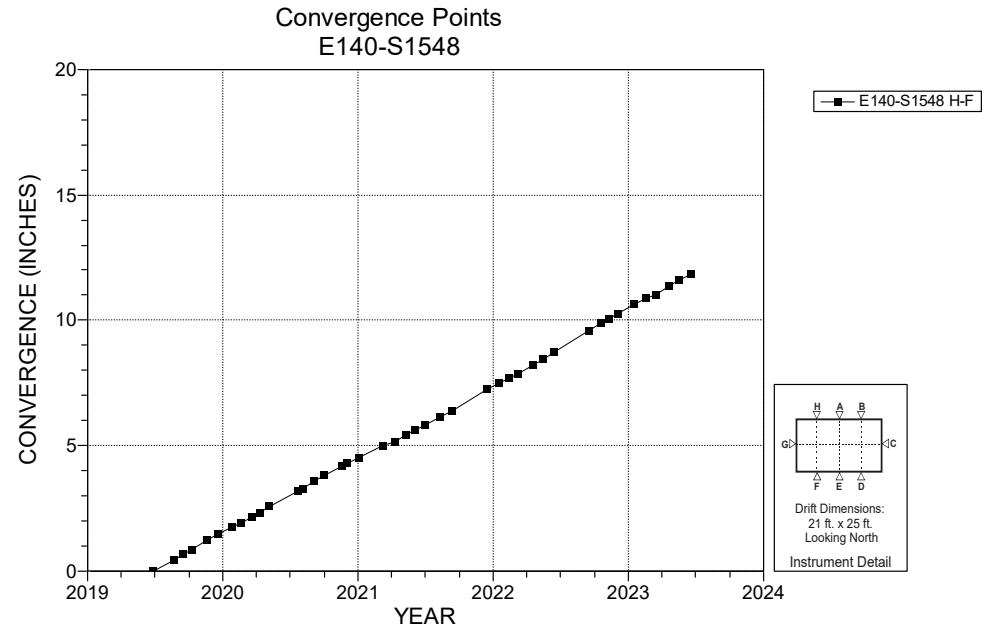
NOTES:
1. Excavation date: December 1982.

Figure 4-72 Convergence Point Array – E140 S1548 A-E – Roof to Floor – Test Area



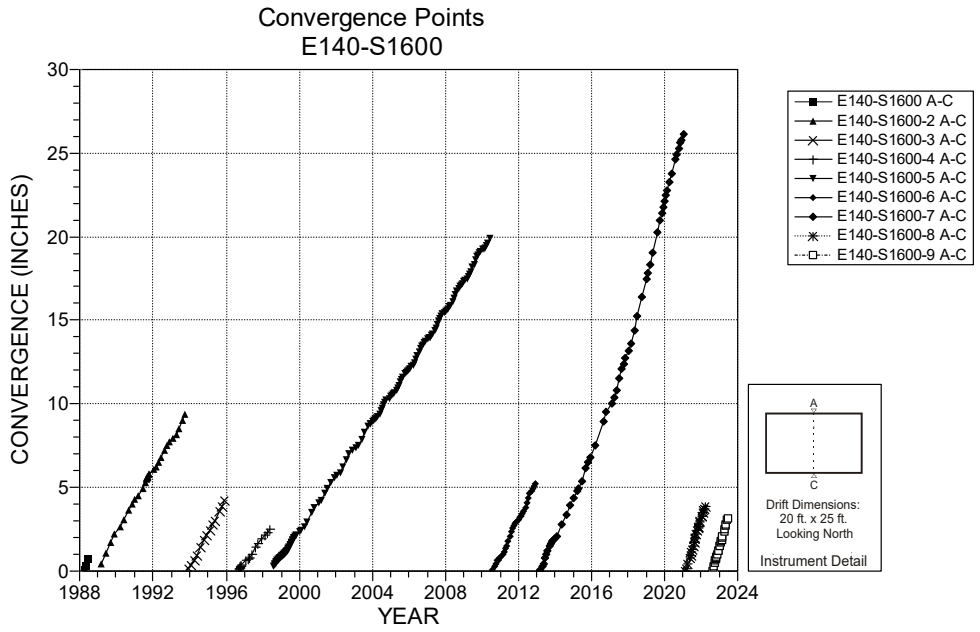
NOTES:
1. Excavation date: December 1982.

Figure 4-73 Convergence Point Array – E140 S1548 B-D – Roof to Floor – Test Area



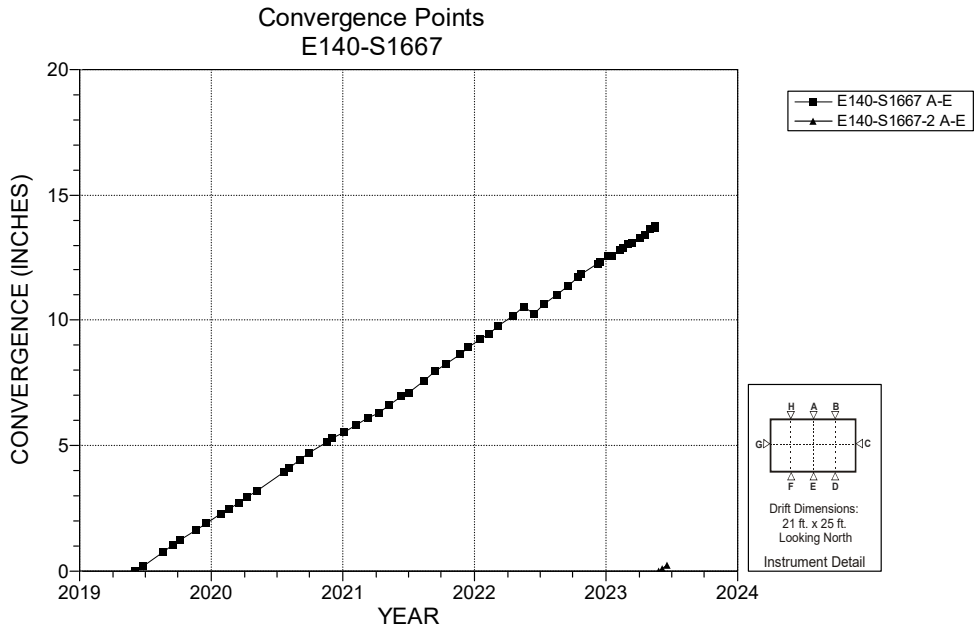
NOTES:
1. Excavation date: December 1982.

Figure 4-74 Convergence Point Array – E140 S1548 H-F – Roof to Floor – Test Area



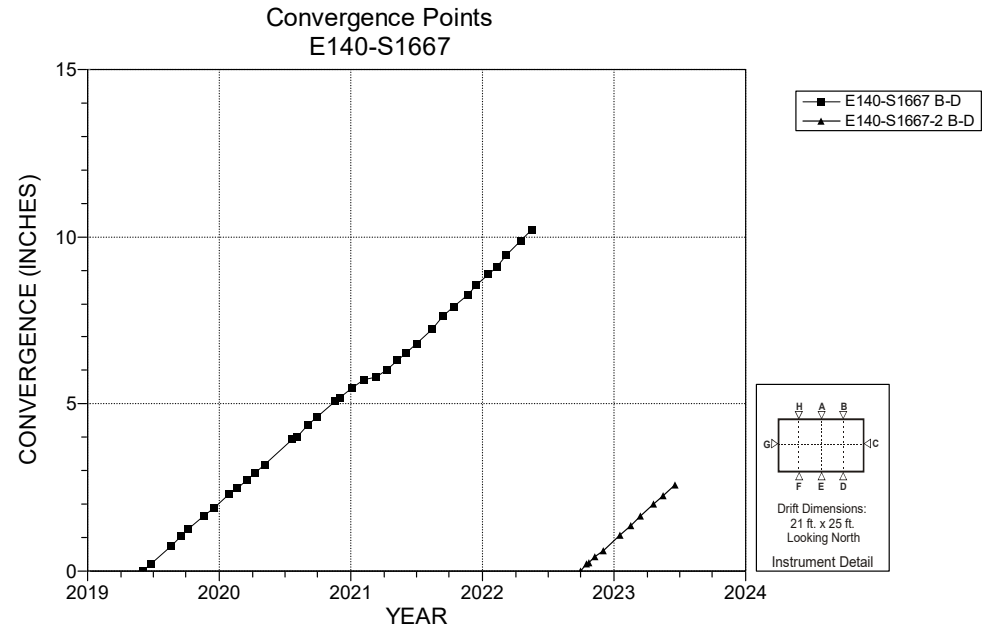
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b" in December 1996.

Figure 4-75 Convergence Point Array – E140 S1600 – Roof to Floor



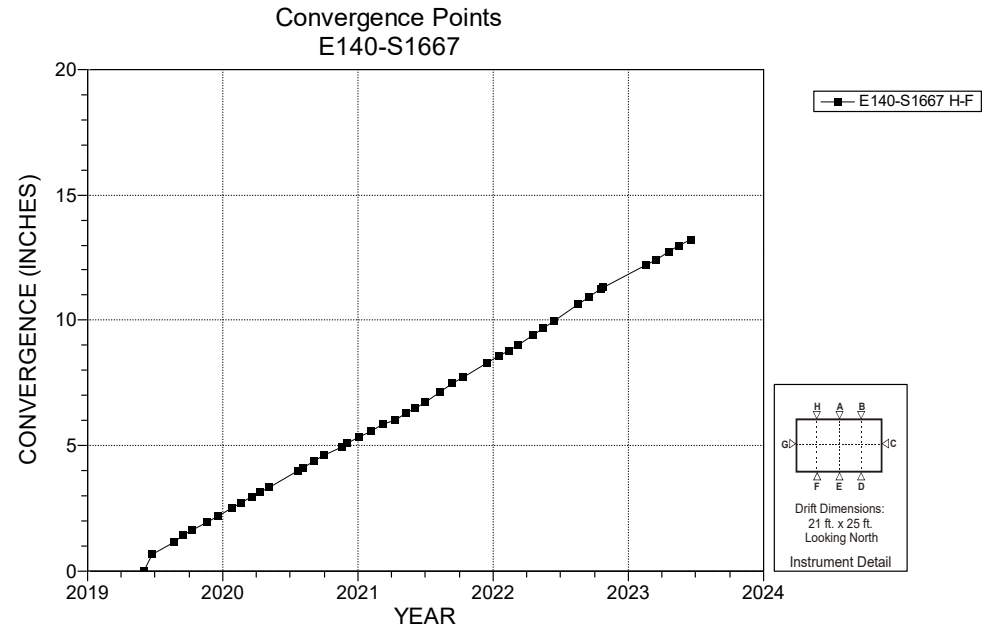
NOTES:
1. Excavation date: December 1982.

Figure 4-76 Convergence Point Array – E140 S1667 A-E – Roof to Floor



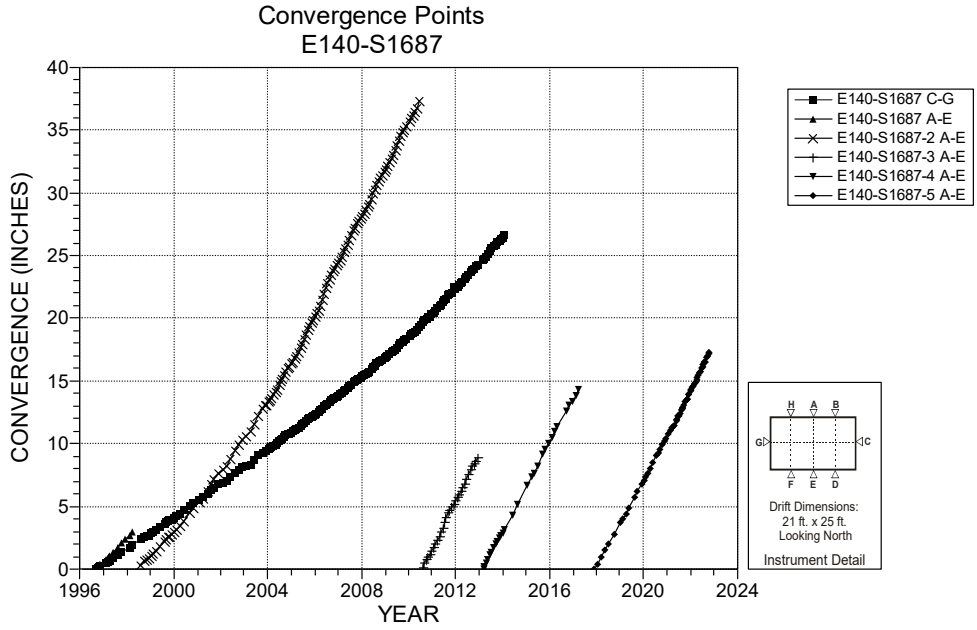
NOTES:
1. Excavation date: December 1982.

Figure 4-77 Convergence Point Array – E140 S1667 B-D – Roof to Floor



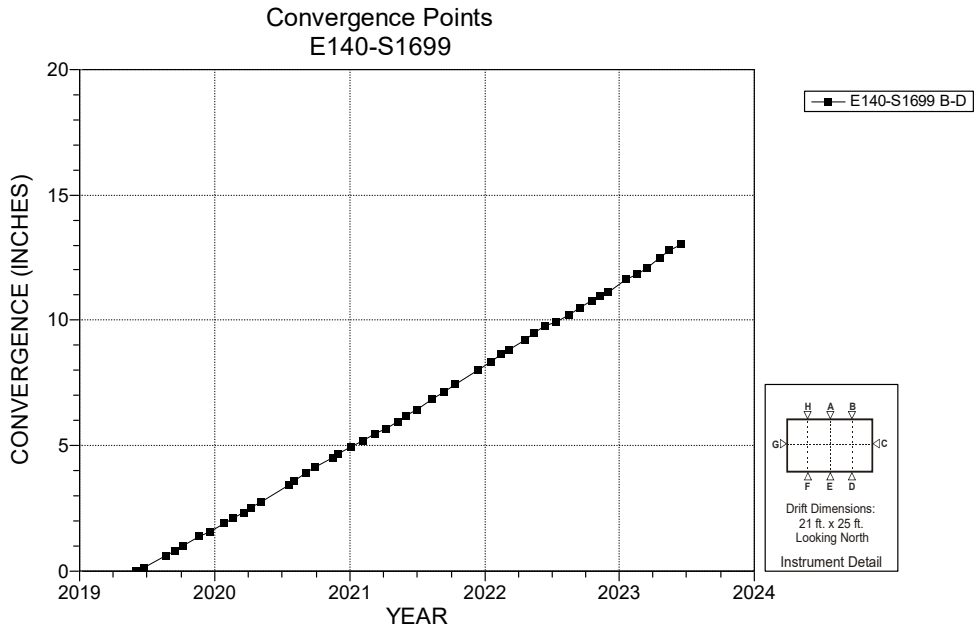
NOTES:
1. Excavation date: December 1982.

Figure 4-78 Convergence Point Array – E140 S1667 H-F – Roof to Floor



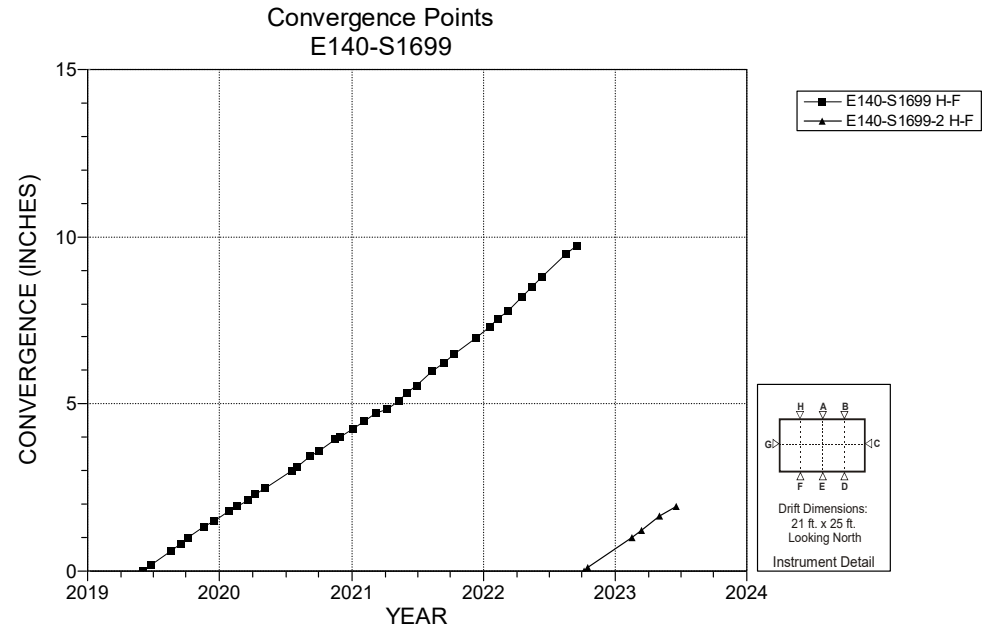
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b" in early 1996.

Figure 4-79 Convergence Point Array – E140 S1687 – Roof to Floor



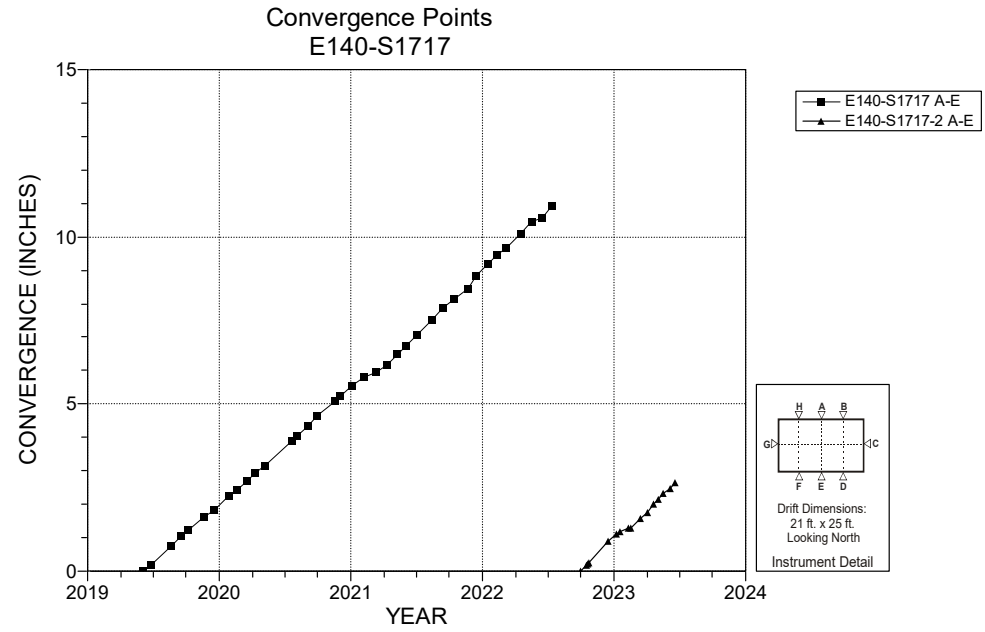
NOTES:
1. Excavation date: December 1982.

Figure 4-80 Convergence Point Array – E140 S1699 B-D – Roof to Floor



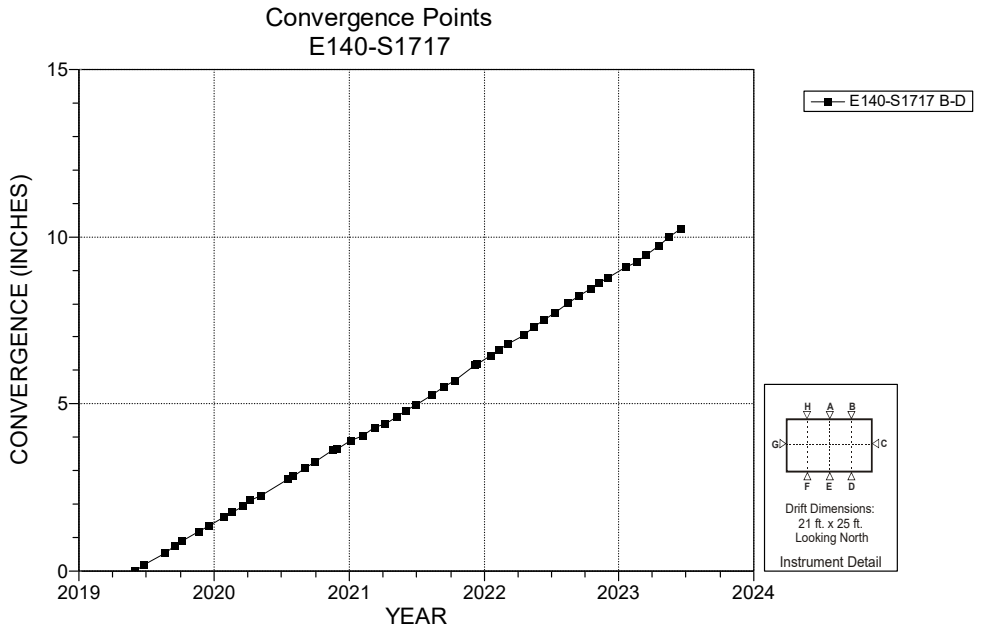
NOTES:
1. Excavation date: December 1982.

Figure 4-81 Convergence Point Array – E140 S1699 H-F – Roof to Floor



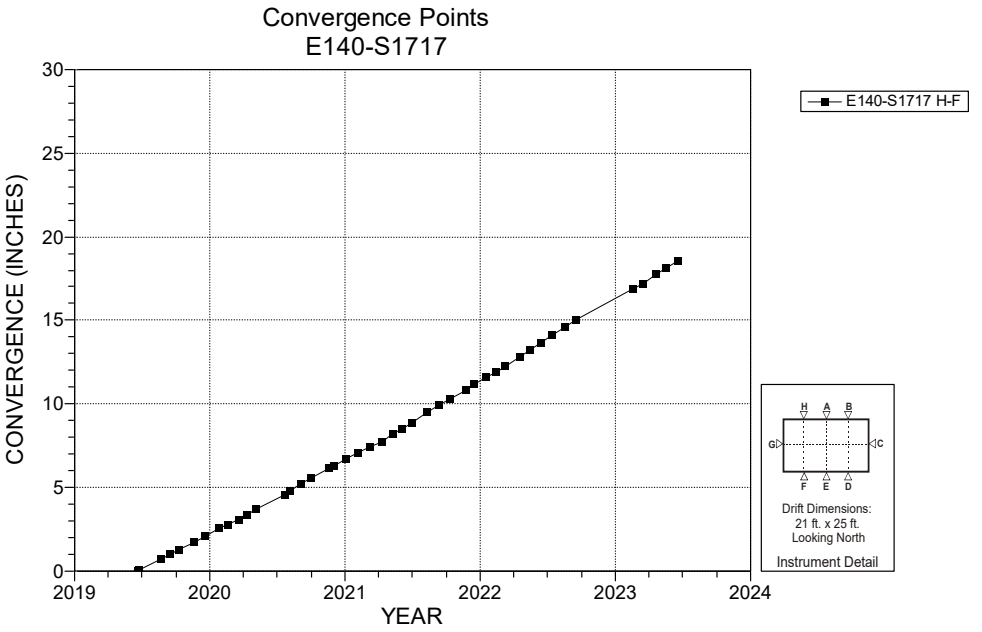
NOTES:
1. Excavation date: December 1982.

Figure 4-82 Convergence Point Array – E140 S1717 A-E – Roof to Floor



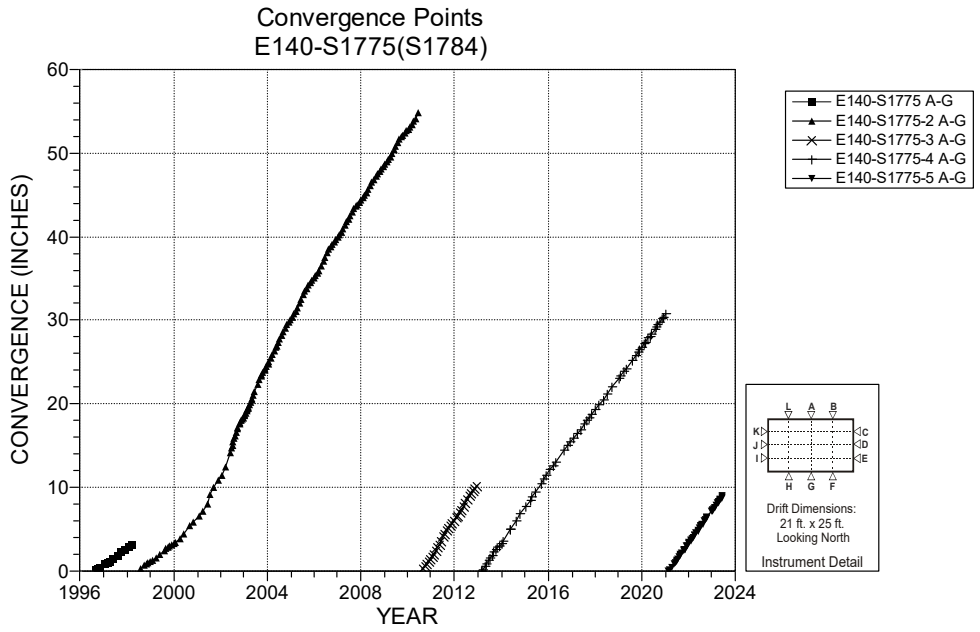
NOTES:
1. Excavation date: December 1982.

Figure 4-83 Convergence Point Array – E140 S1717 B-D – Roof to Floor



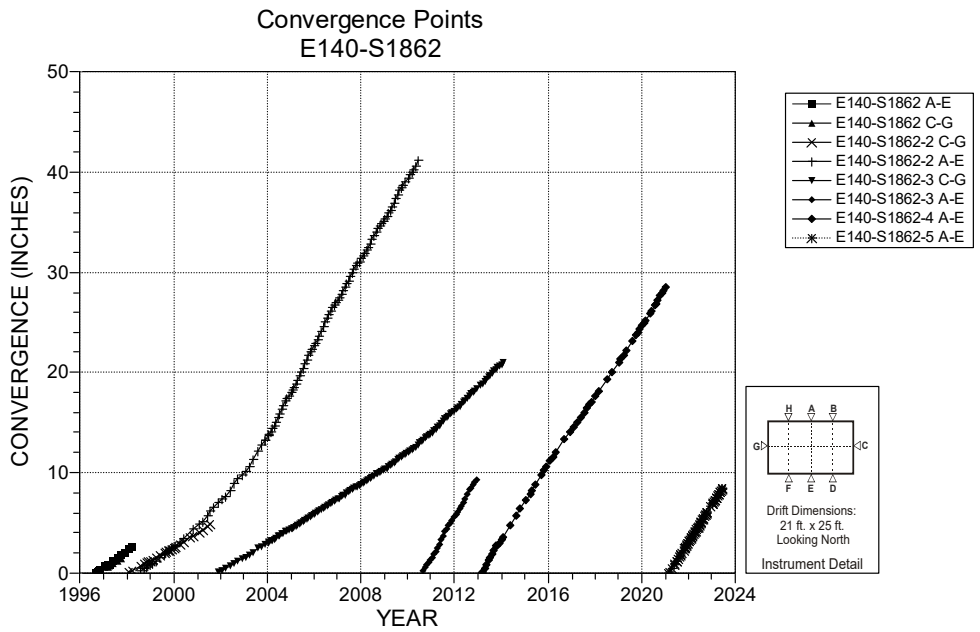
NOTES:
1. Excavation date: December 1982.

Figure 4-84 Convergence Point Array – E140 S1717 H-F – Roof to Floor



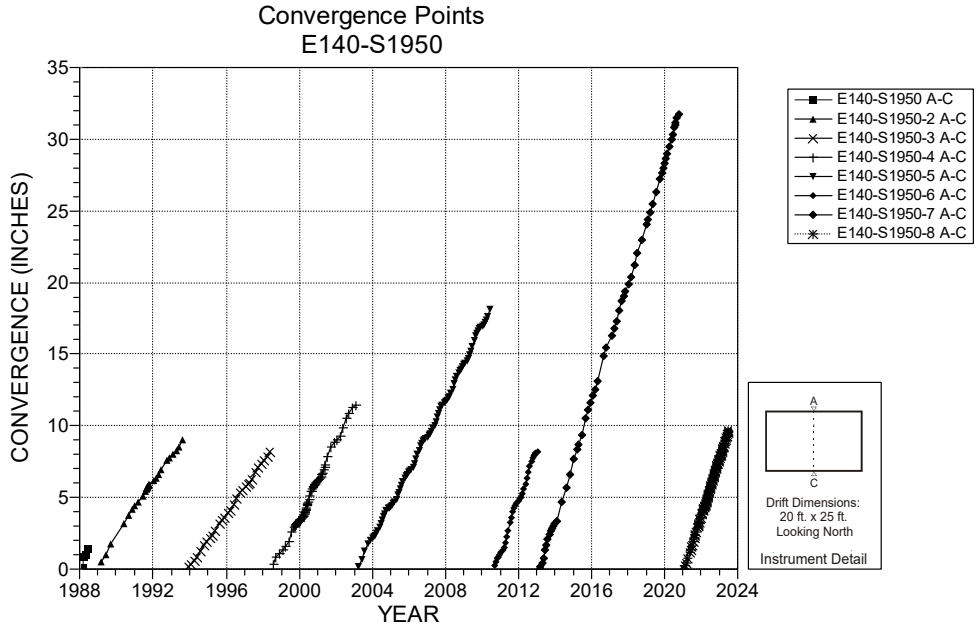
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b" in early 1996.

Figure 4-85 Convergence Point Array – E140 S1775 – Roof to Floor



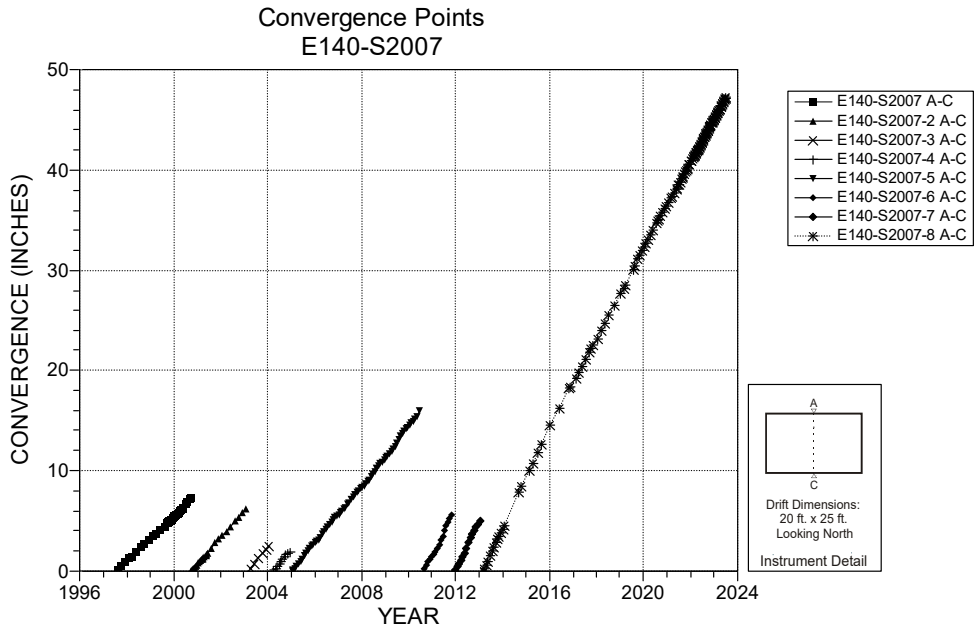
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b" in early 1996.

Figure 4-86 Convergence Point Array – E140 S1862 – All Chords



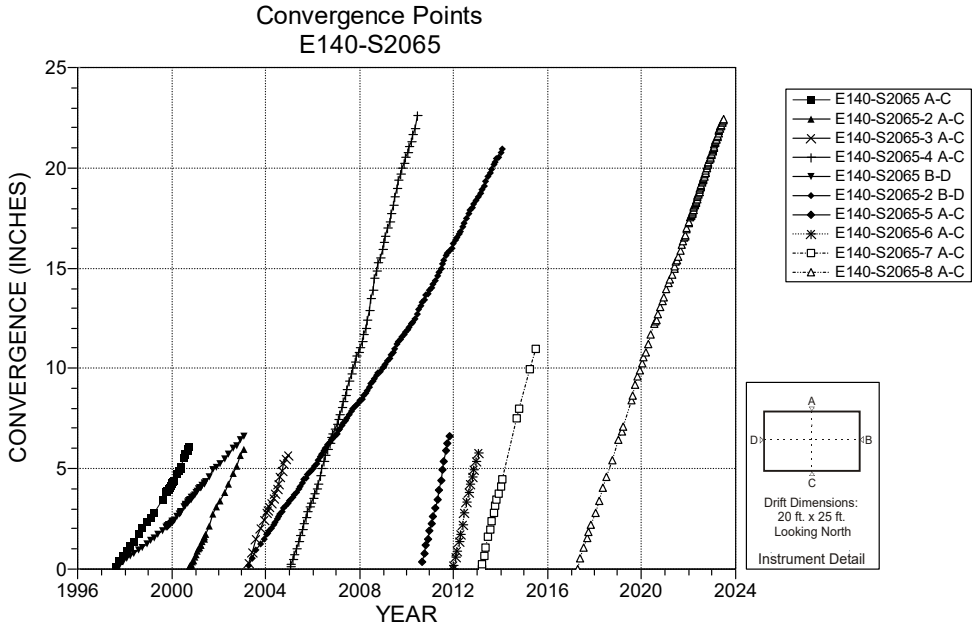
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b", March 2003.

Figure 4-87 Convergence Point Array – E140 S1950 – Roof to Floor



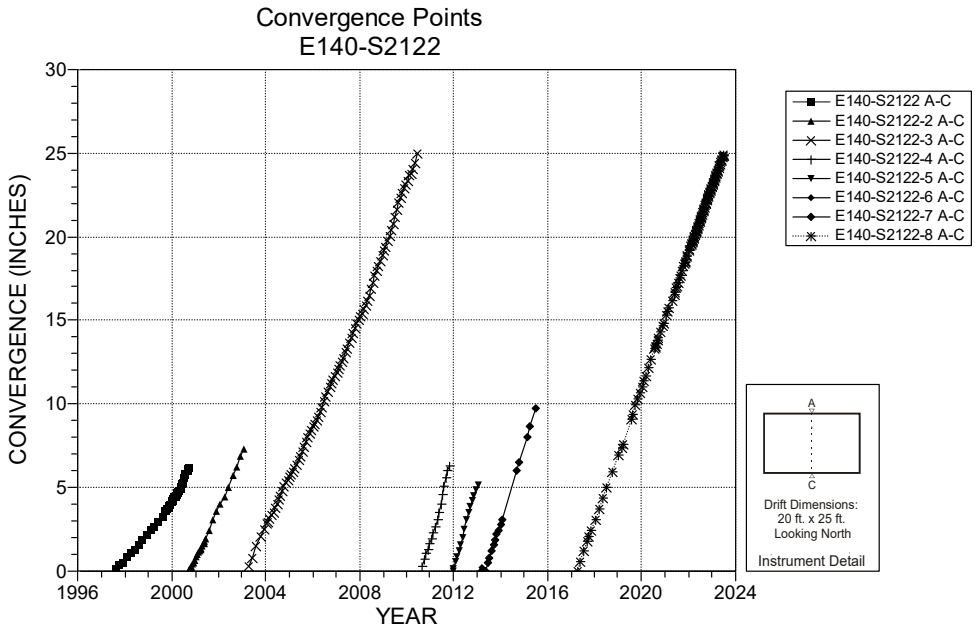
NOTES:
1. Excavation date: January 1993.
2. Roof excavated to Anhydrite "b", March 2003.

Figure 4-88 Convergence Point Array – E140 S2007 - Roof to Floor



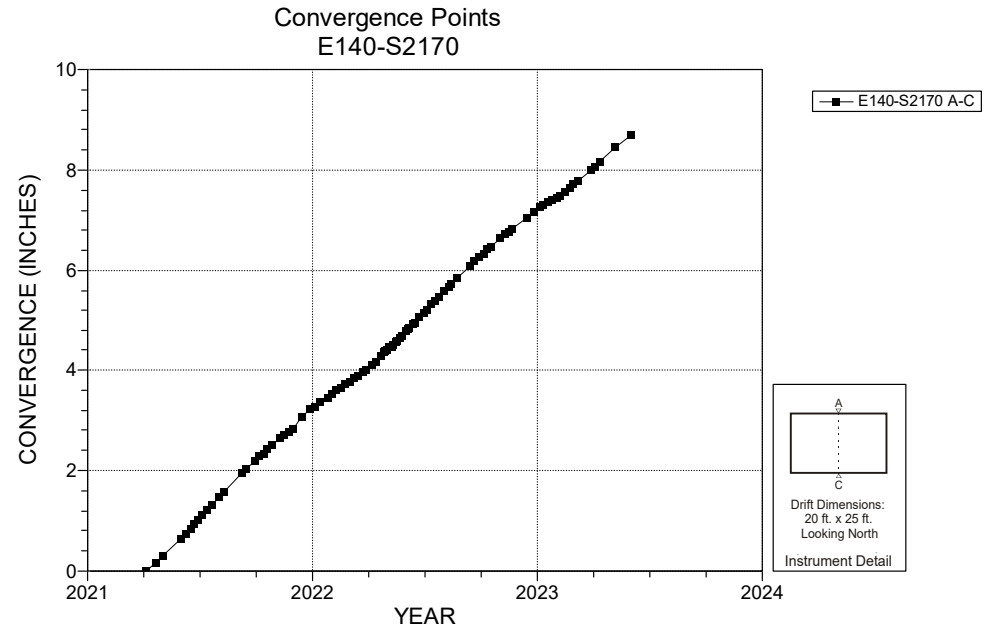
NOTES:
1. Excavation date: January 1993.
2. Roof excavated to Anhydrite "b", March 2003.

Figure 4-89 Convergence Point Array – E140 S2065 – All Chords



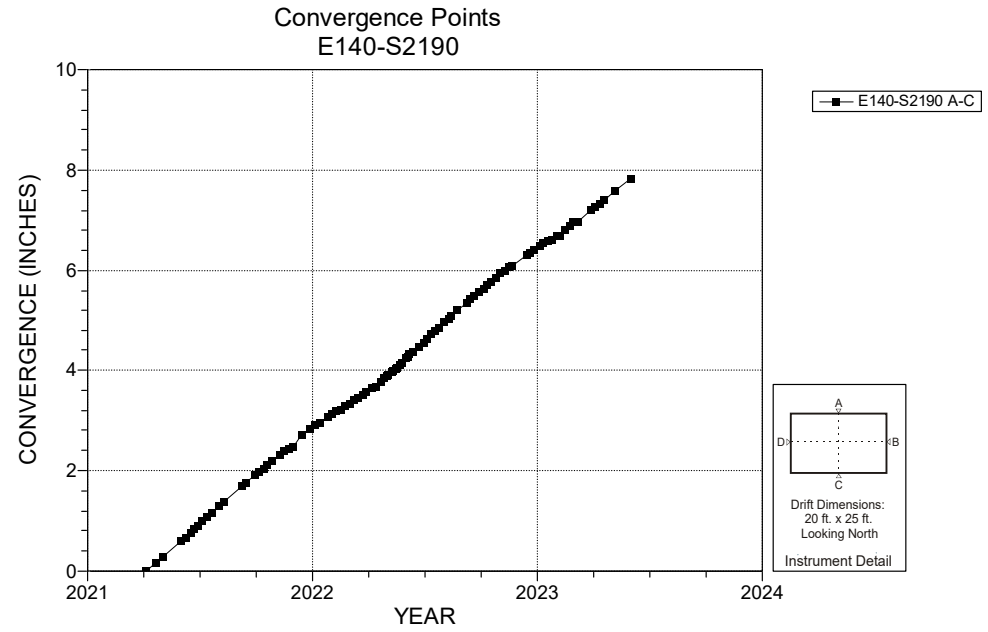
NOTES:
1. Excavation date: January 1993.
2. Roof excavated to Anhydrite "b", March 2003.

Figure 4-90 Convergence Point Array – E140 S2122 – Roof to Floor



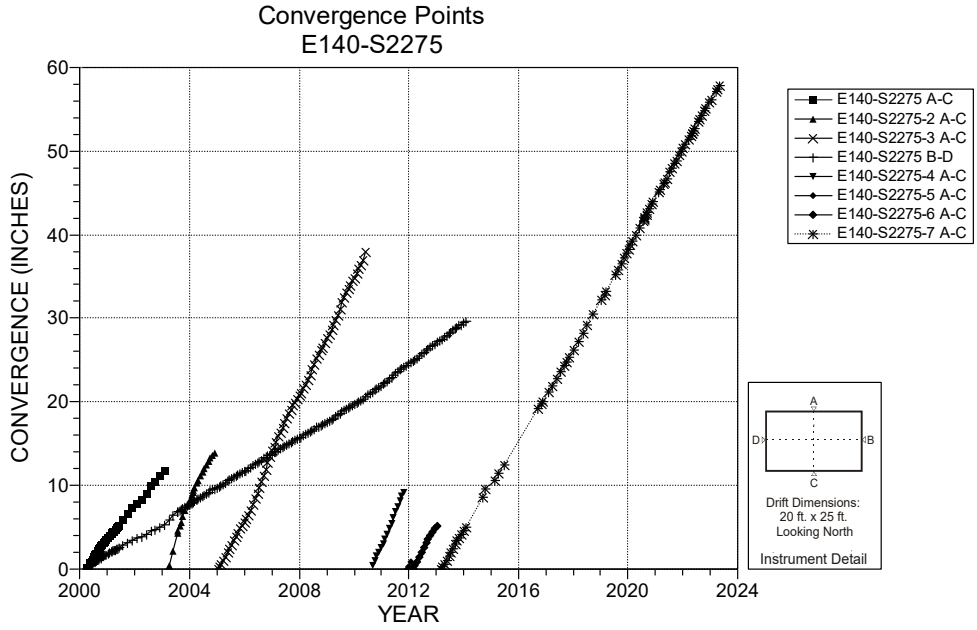
NOTES:
1. Excavation date: January 1993.
2. Roof excavated to Anhydrite "b", March 2003.

Figure 4-91 Convergence Point Array – E140 S2170 – Roof to Floor



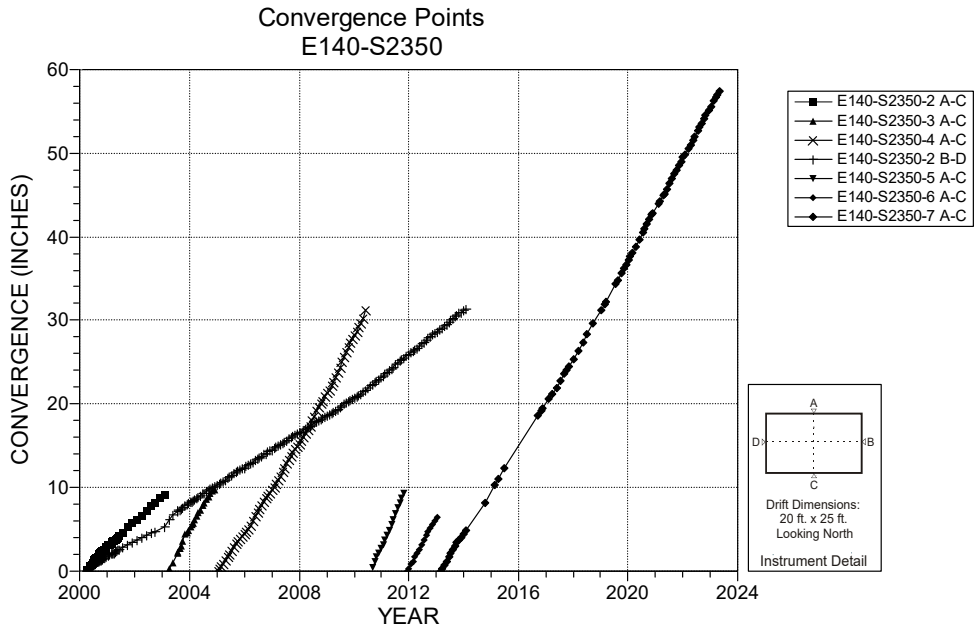
NOTES:
1. Excavation date: January 1983.
2. Roof excavated to Anhydrite "b", March 2003.

Figure 4-92 Convergence Point Array – E140 S2190 – Roof to Floor



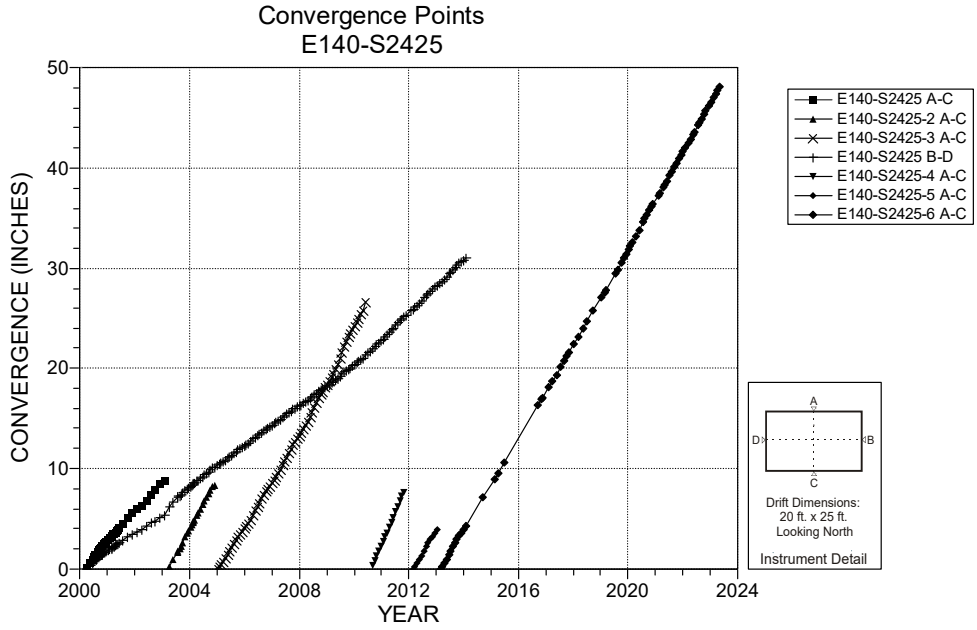
NOTES:
1. Excavation date: January 1983.
2. Roof excavated to Anhydrite "b", March 2003.

Figure 4-93 Convergence Point Array – E140 S2275 – All Chords



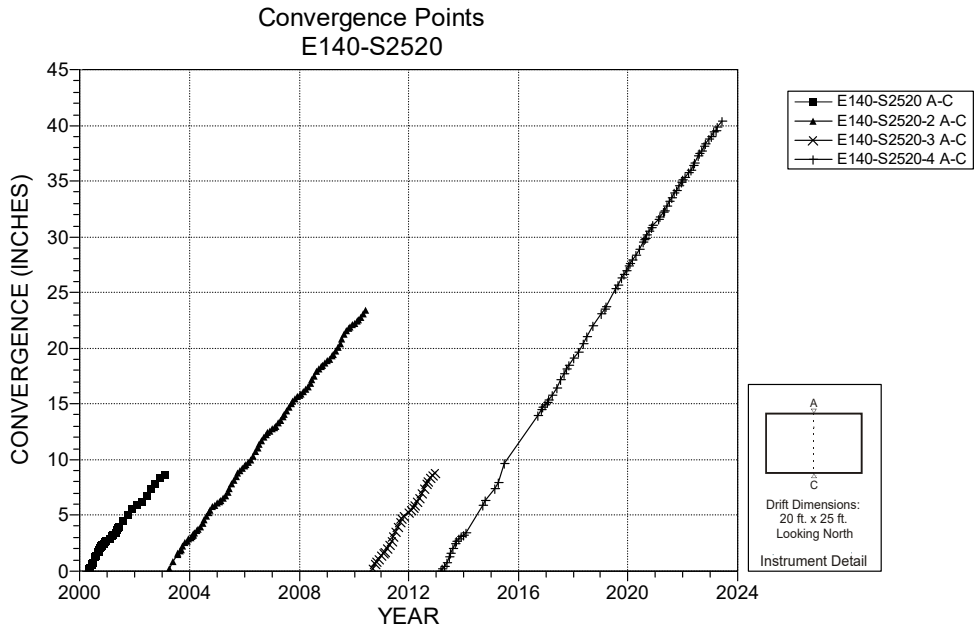
NOTES:
1. Excavation date: January 1983.
2. Roof excavated to Anhydrite "b", March 2003.

Figure 4-94 Convergence Point Array – E140 S2350 – All Chords



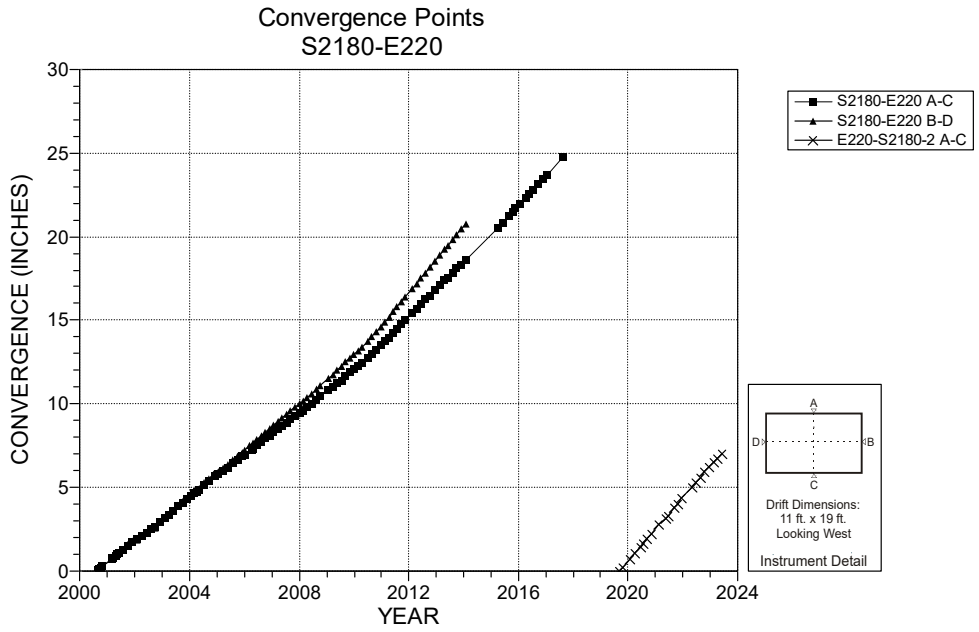
NOTES:
1. Excavation date: January 1983.
2. Roof excavated to Anhydrite "b", March 2003.

Figure 4-95 Convergence Point Array – E140 S2425 – All Chords



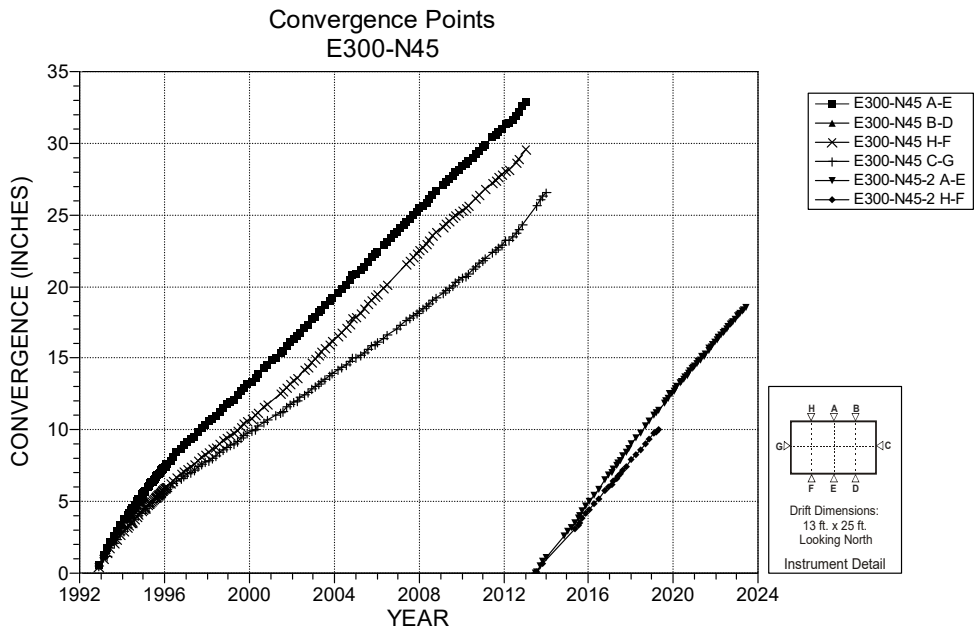
NOTES:
1. Excavation date: January 1983.
2. Roof excavated to Anhydrite "b", March 2003.

Figure 4-96 Convergence Point Array – E140 S2520 – Roof to Floor



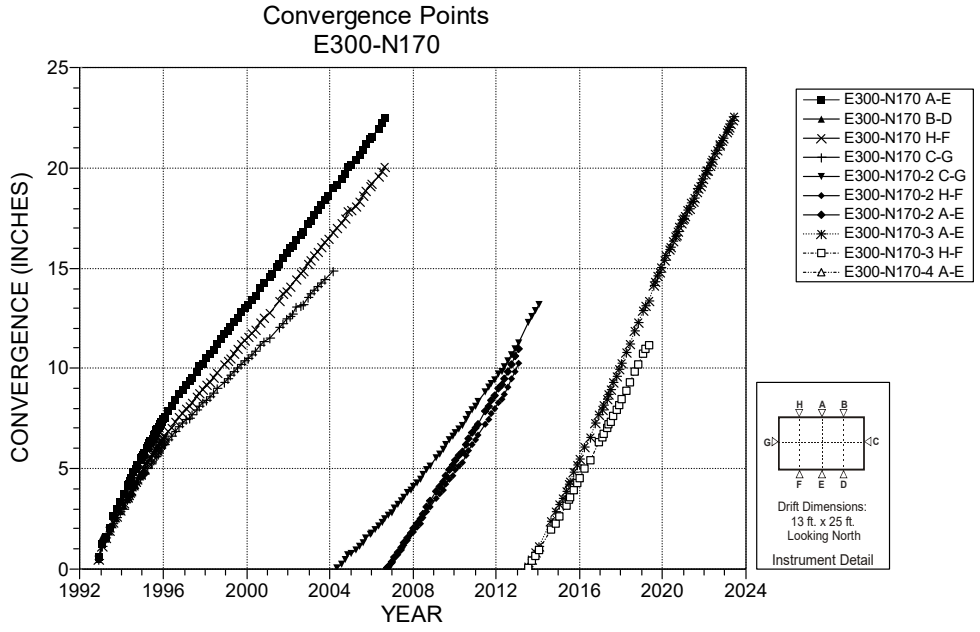
NOTES:
1. Excavation date: March 1986.

Figure 4-97 Convergence Point Array – E220 S2180 – All Chords



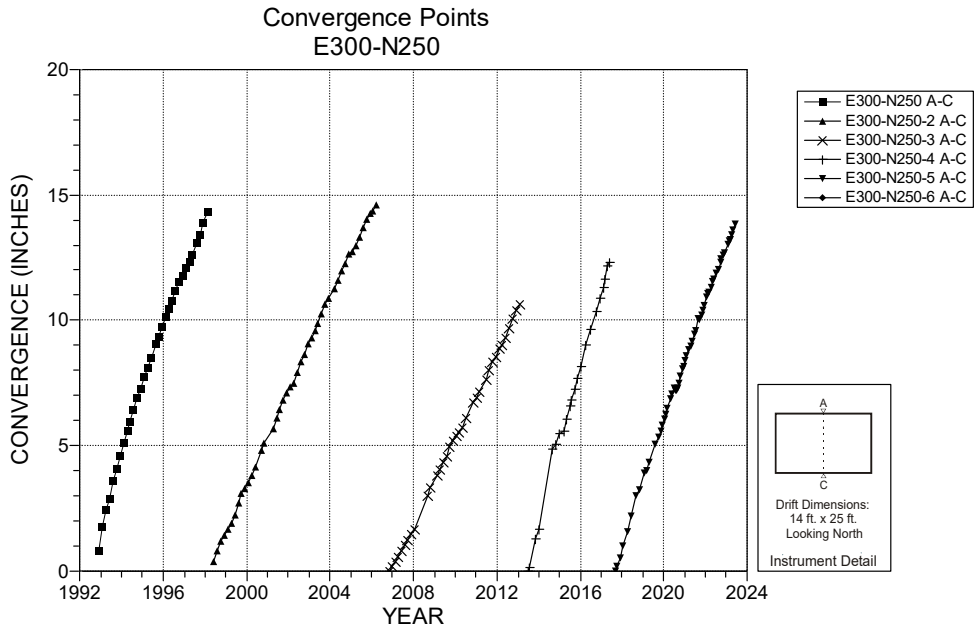
NOTES:
1. Excavation date: October 1992.

Figure 4-98 Convergence Point Array – E300 N45 – All Chords



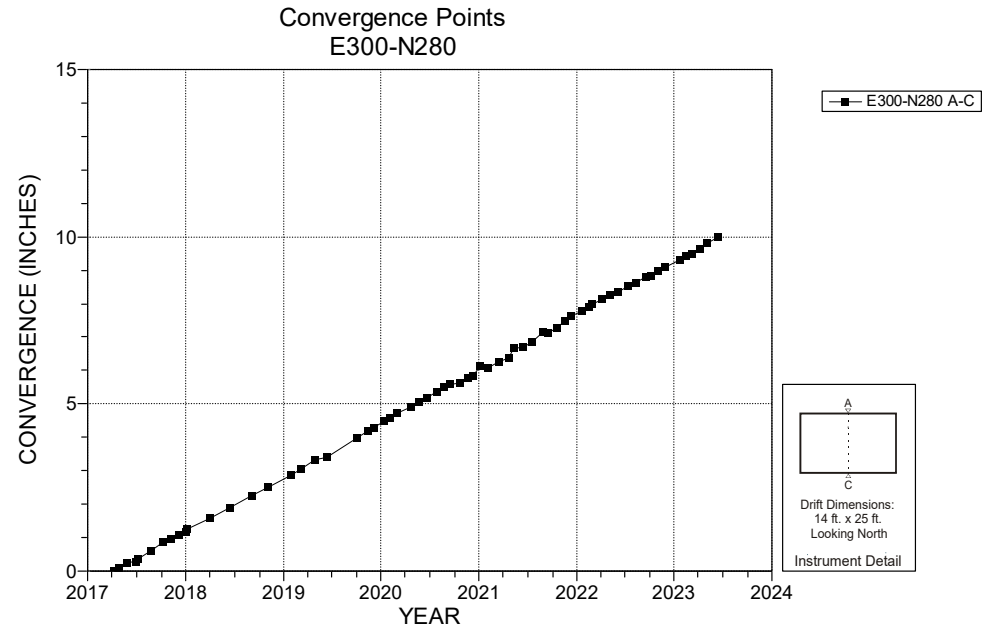
NOTES:
1. Excavation date: October 1992.
2. Reinstalled "E" and "F" points 9-27-2006.

Figure 4-99 Convergence Point Array – E300 N170 – All Chords



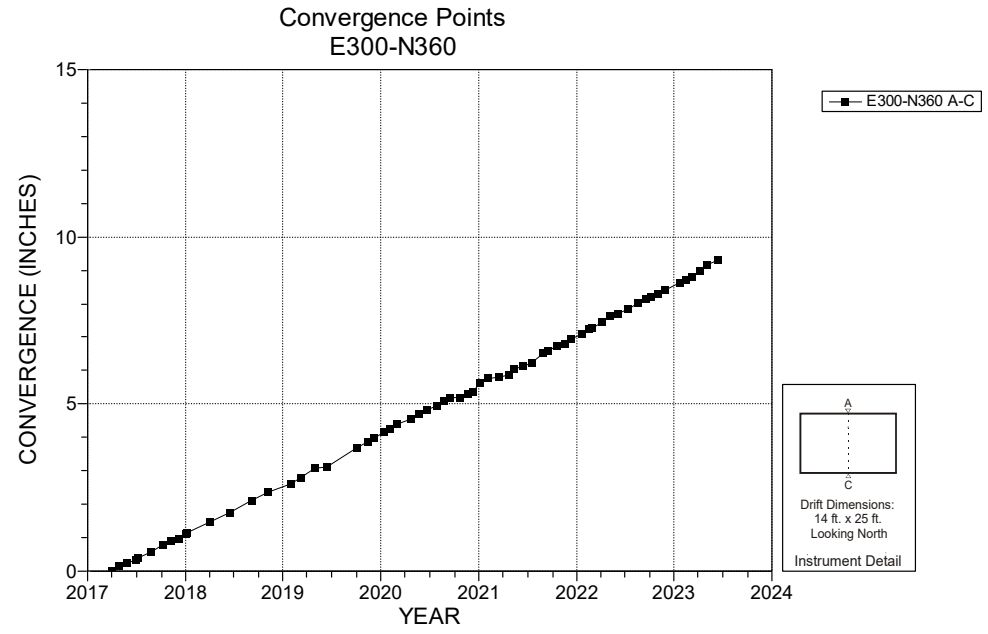
NOTES:
1. Excavation date: October 1992.
2. Reinstalled "c" point October 2006

Figure 4-100 Convergence Point Array – E300 N250 – Roof to Floor



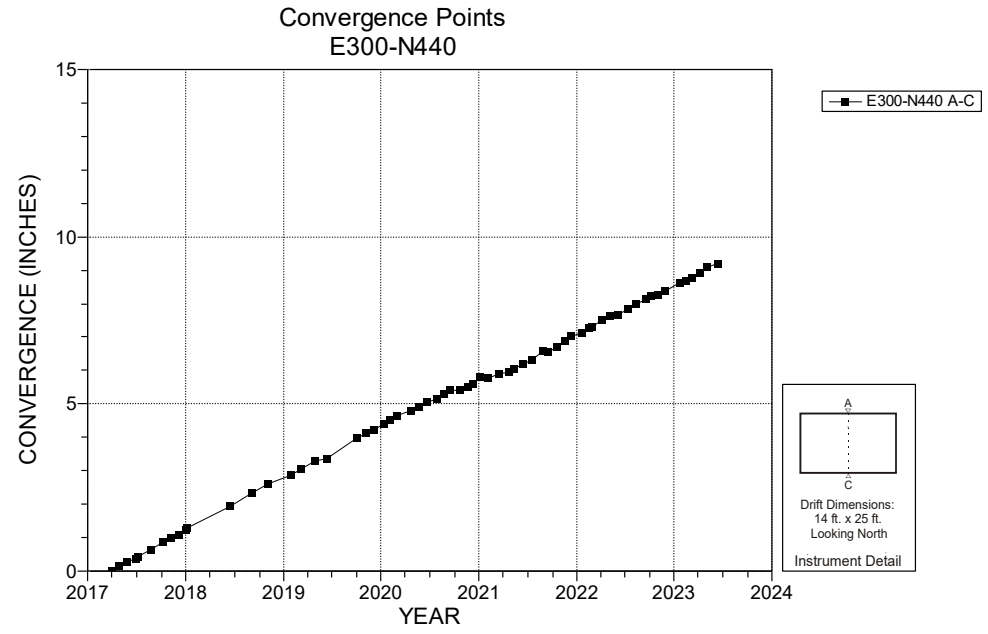
NOTES:
1. Excavation date: October 1992.

Figure 4-101 Convergence Point Array – E300 N280 – Roof to Floor



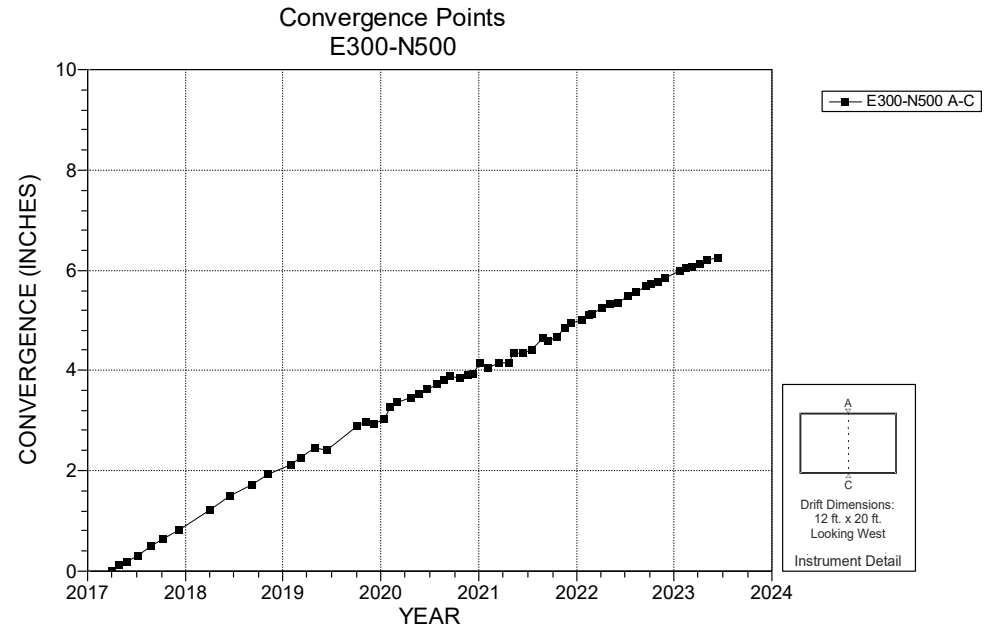
NOTES:
1. Excavation date: January 1991.

Figure 4-102 Convergence Point Array – E300 N360 – Roof to Floor



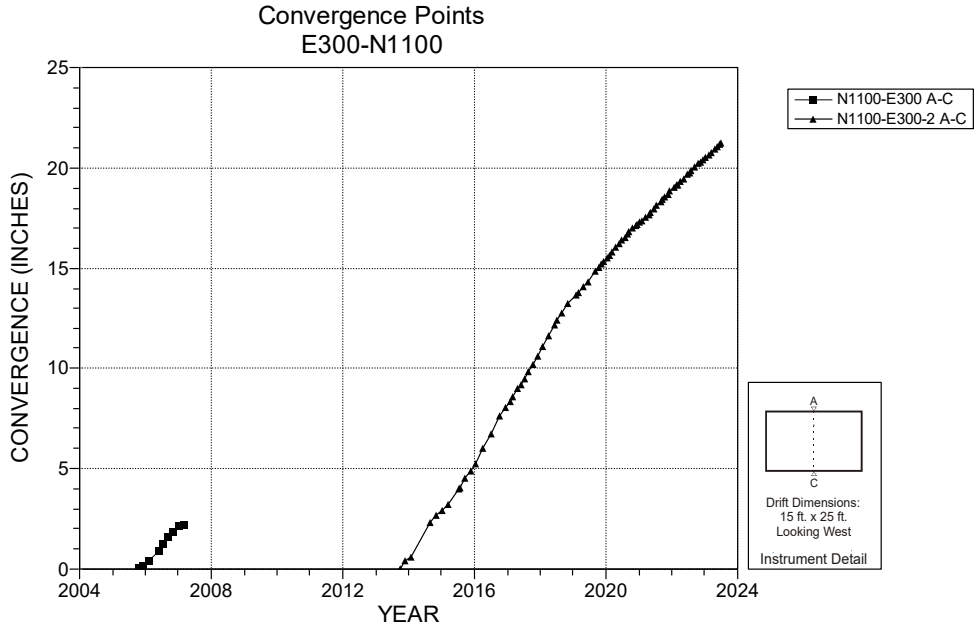
NOTES:
1. Excavation date: January 1991.

Figure 4-103 Convergence Point Array – E300 N440 – Roof to Floor



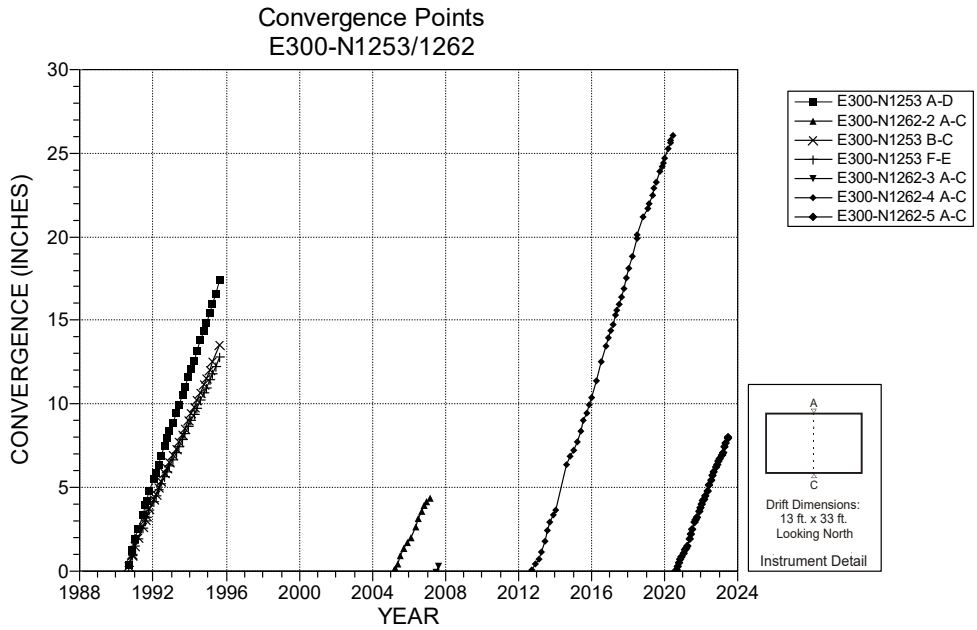
NOTES:
1. Excavation date: January 1991.

Figure 4-104 Convergence Point Array – E300 N500 – Roof to Floor



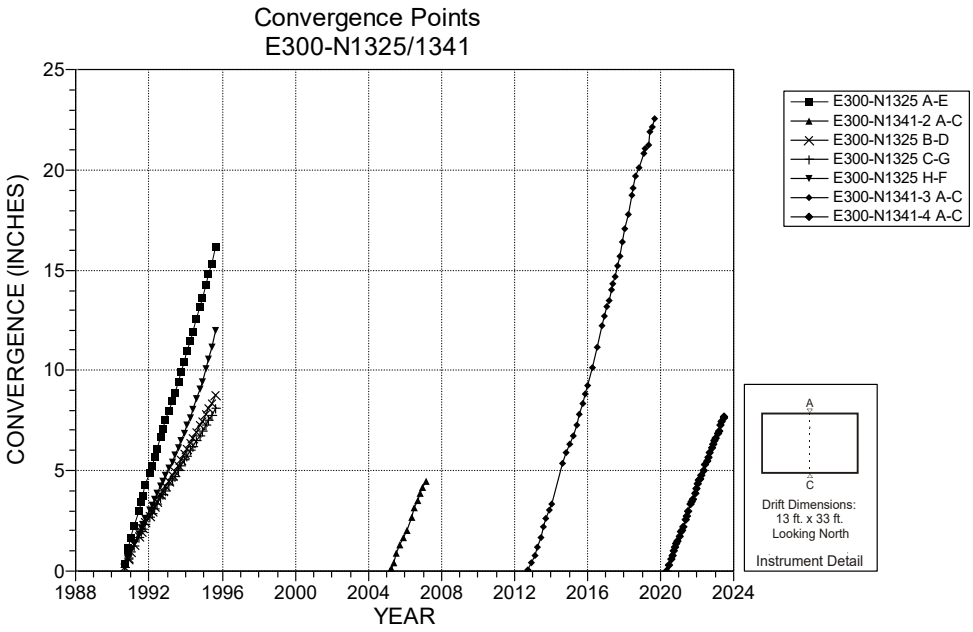
NOTES:
1. Excavation date: December 2004.
2. The gap in the readings was due to the area being inaccessible.

Figure 4-105 Convergence Point Array – E300 N1100 – Roof to Floor



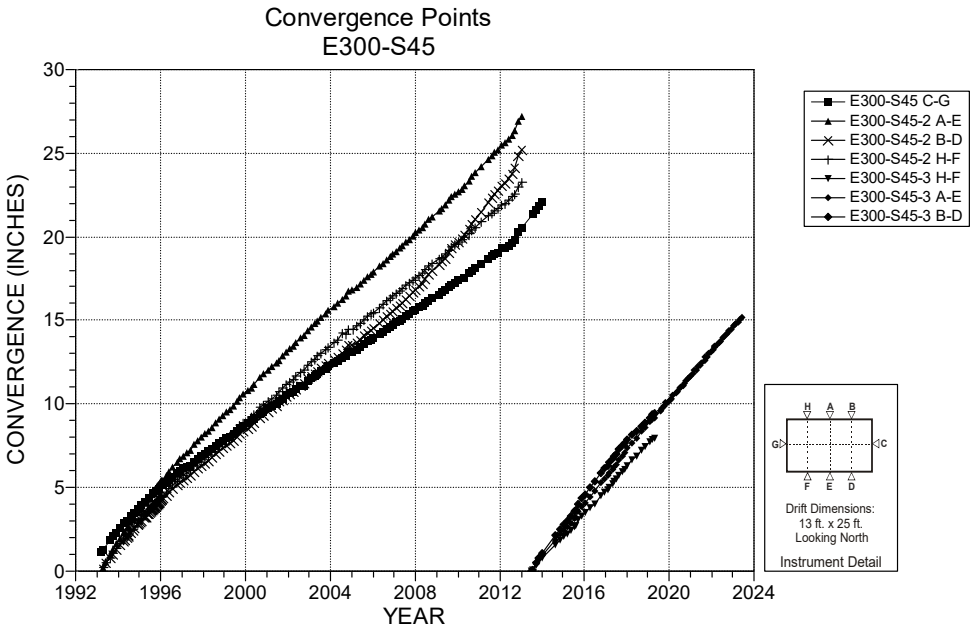
NOTES:
1. Excavation date: August 1989.
2. The gaps in the readings were due to the area being inaccessible.
3. The original installation had 3 vertical chords: A-D, B-C and F-E.

Figure 4-106 Convergence Point Array – E300 N1262 – Roof to Floor



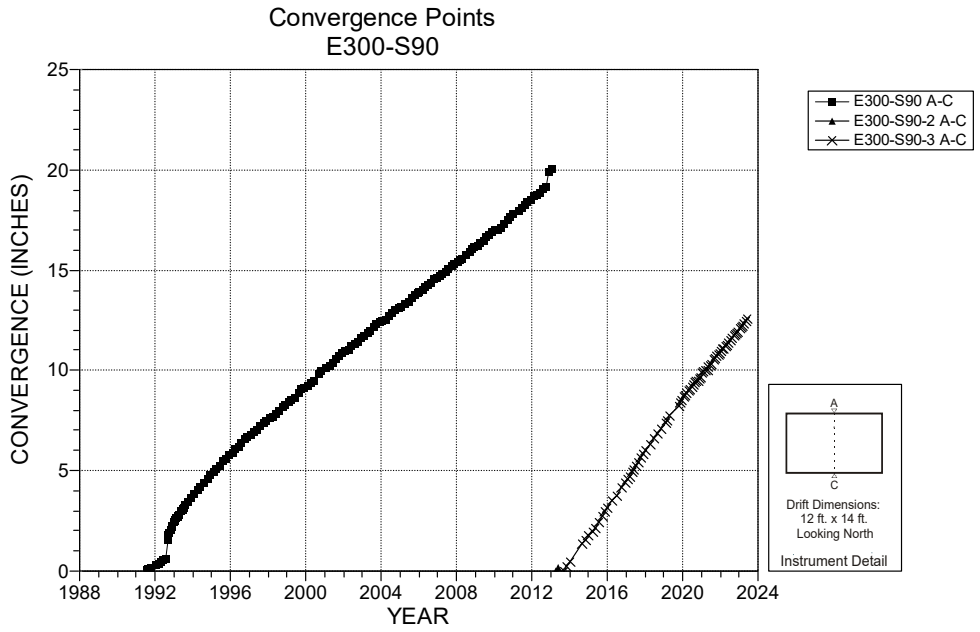
NOTES:
1. Excavation date: August 1989.
2. The gaps in the readings were due to the area being inaccessible.
3. The original installation had 3 vertical chords: A-D, B-C and F-E and horizontal chord C-G.

Figure 4-107 Convergence Point Array – E300 N1341 – Roof to Floor



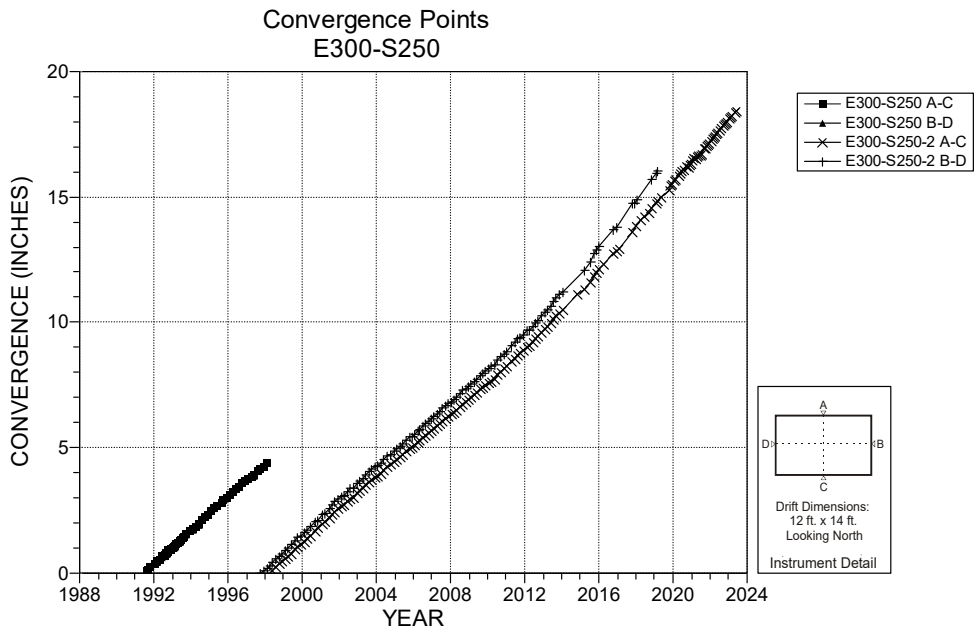
NOTES:
1. Excavation date: October 1992
2. The initial A-F, B-D and H-F chords were only read at installation.

Figure 4-108 Convergence Point Array – E300 S45 – All Chords



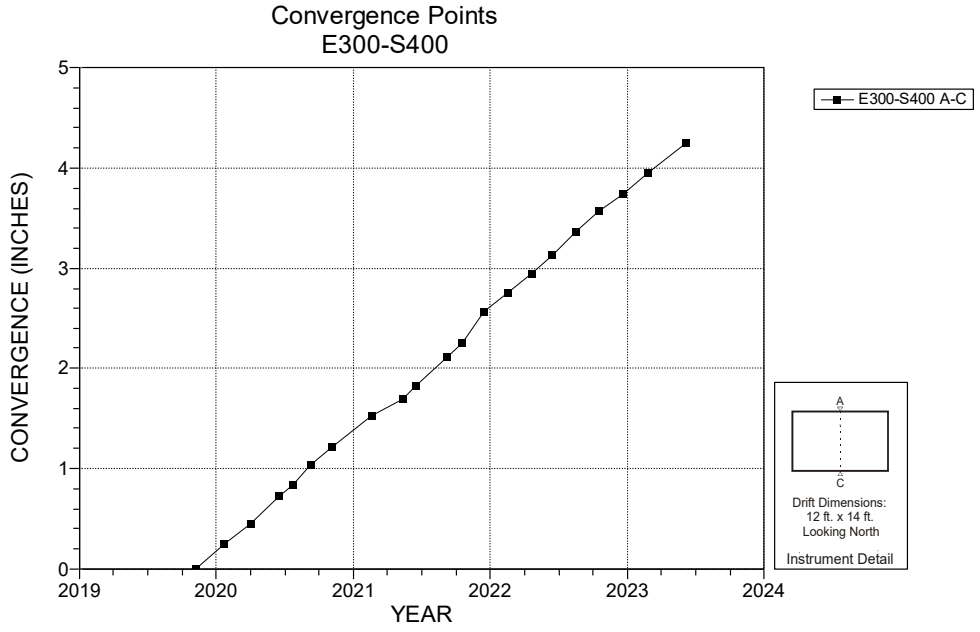
NOTES:
1. Excavation date: September 1985.

Figure 4-109 Convergence Point Array – E300 S90 – Roof to Floor



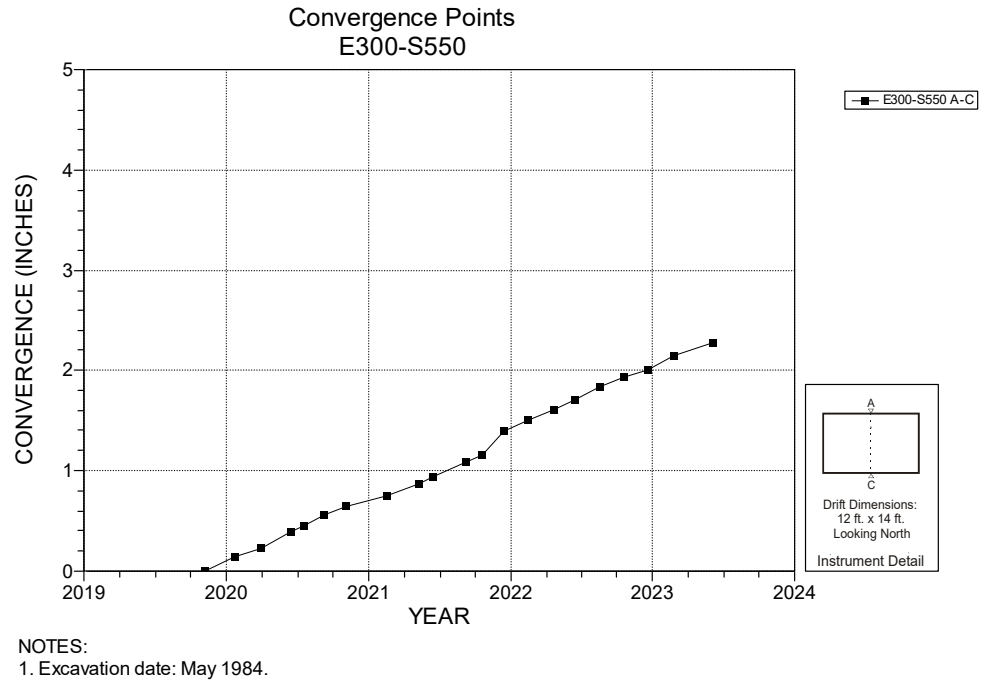
NOTES:
1. Excavation date: September 1985.

Figure 4-110 Convergence Point Array – E300 S250 – All Chords



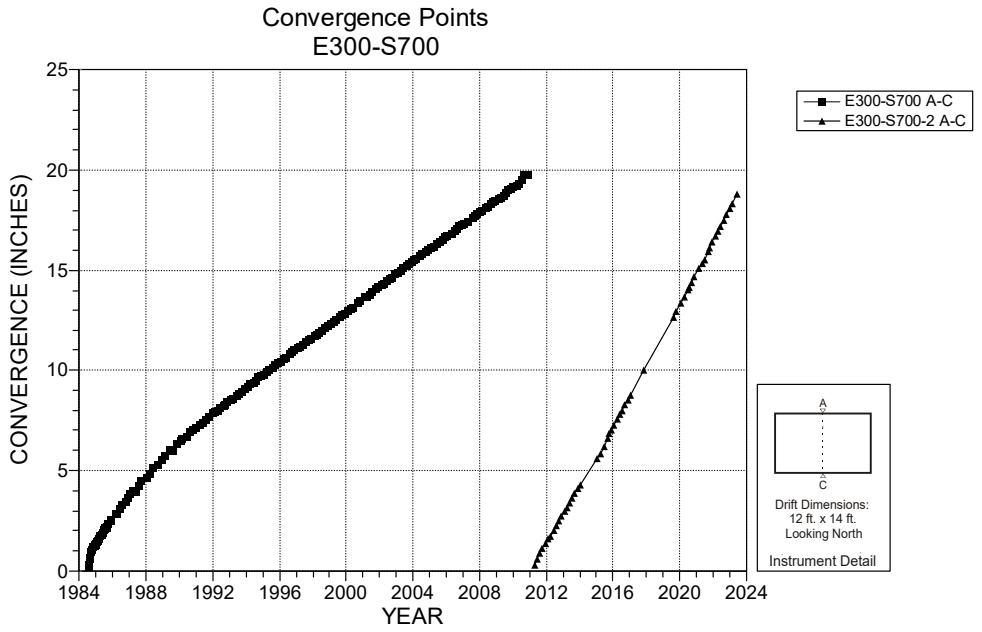
NOTES:
1. Excavation date: May 1984.

Figure 4-111 Convergence Point Array – E300 S400 – Roof to Floor



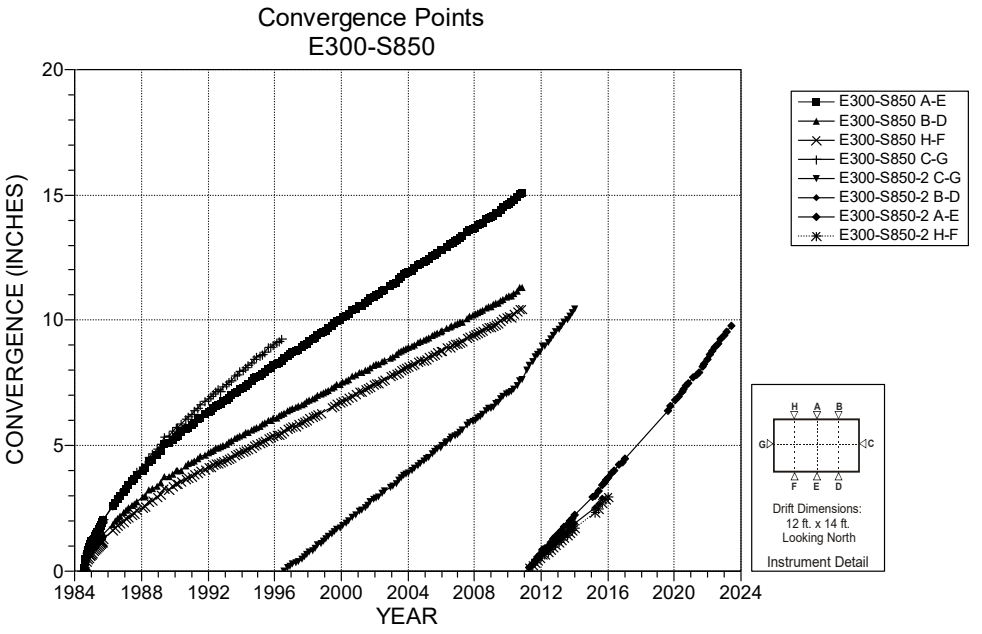
NOTES:
1. Excavation date: May 1984.

Figure 4-112 Convergence Point Array – E300 S550 – Roof to Floor



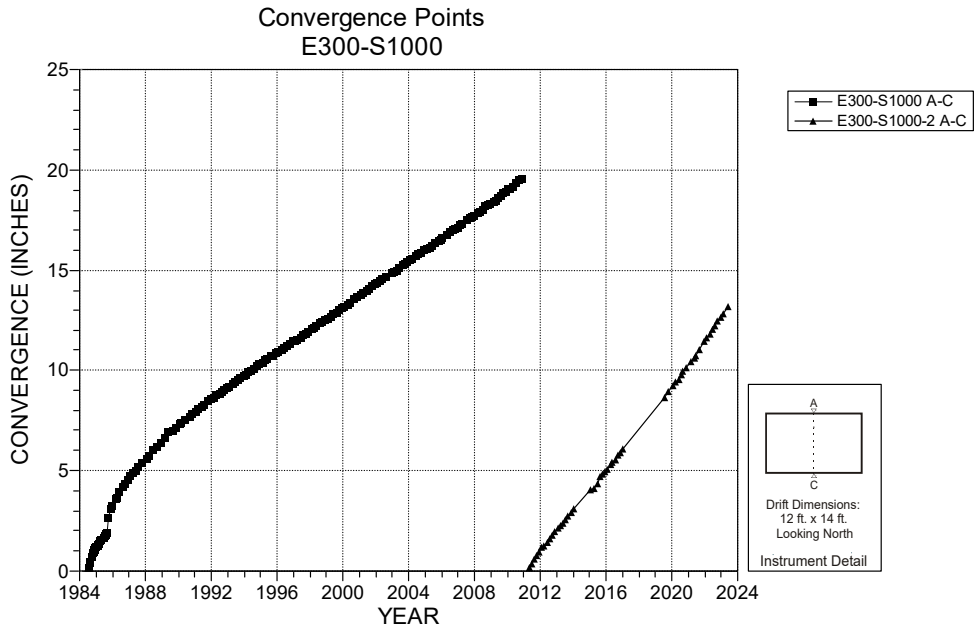
NOTES:
1. Excavation date: May 1984.
2. Reinstalled floor point mined out Dec. 2010.

Figure 4-113 Convergence Point Array – E300 S700 – Roof to Floor



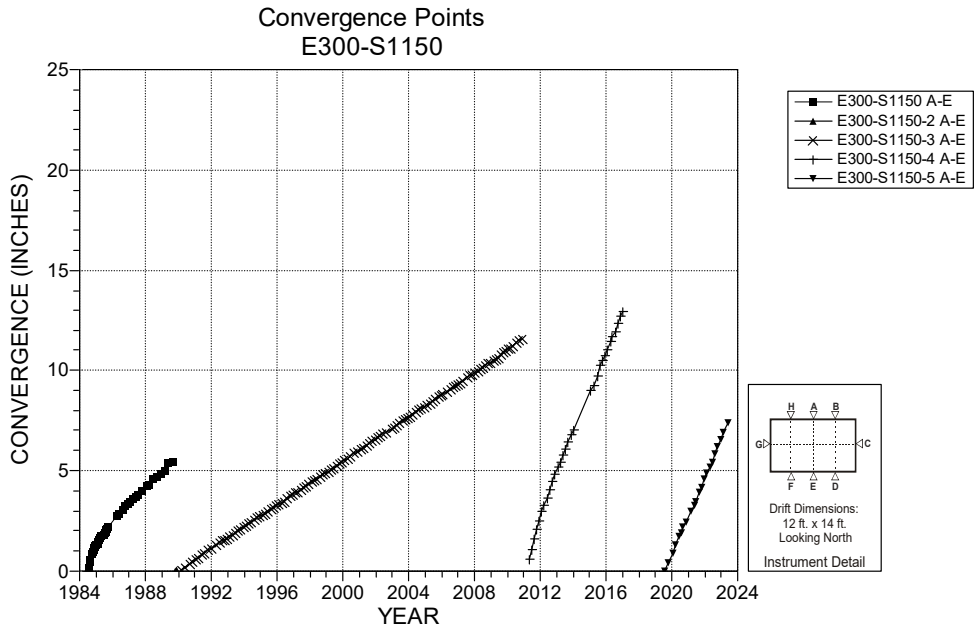
NOTES:
1. Excavation date: July 1984.
2. Reinstalled floor points mined out Dec. 2010.

Figure 4-114 Convergence Point Array – E300 S850 – All Chords



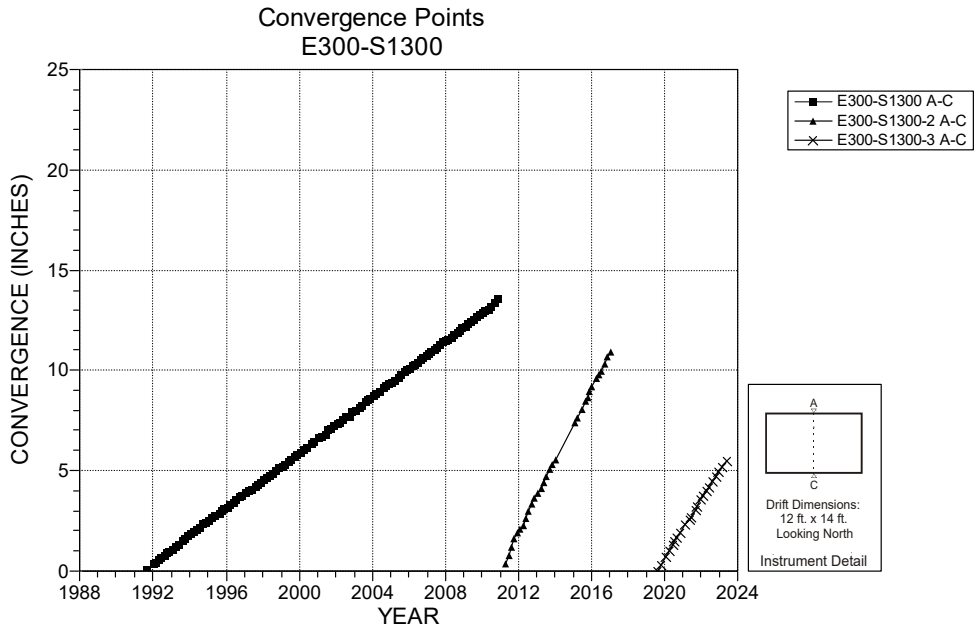
NOTES:
1. Excavation date: July 1984.
2. Reinstalled floor point mined out Dec. 2010.

Figure 4-115 Convergence Point Array – E300 S1000 – Roof to Floor



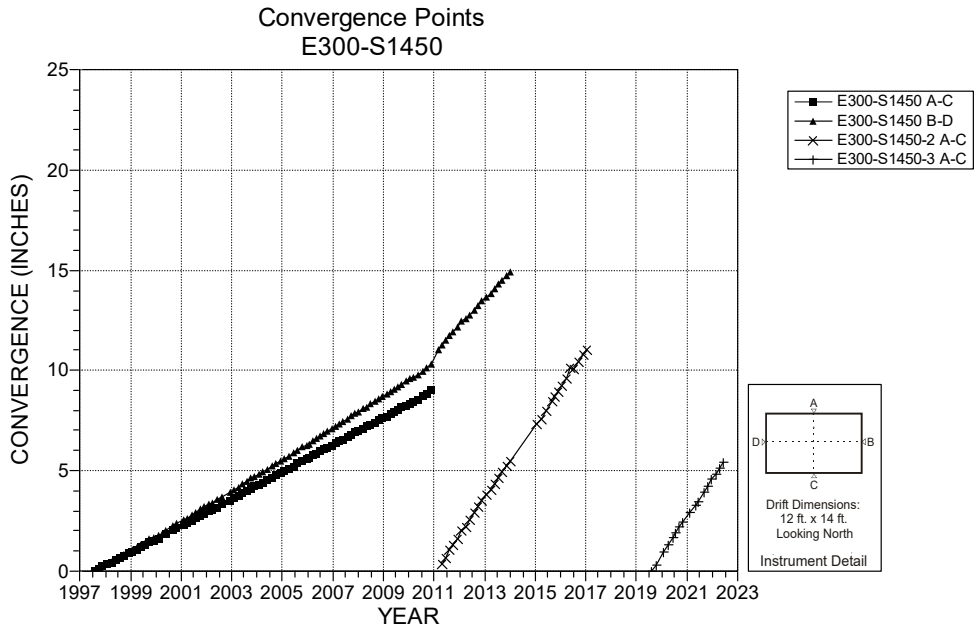
NOTES:
1. Excavation date: July 1984.
2. Reinstalled floor point mined out Dec. 2010.

Figure 4-116 Convergence Point Array – E300 S1150 – Roof to Floor



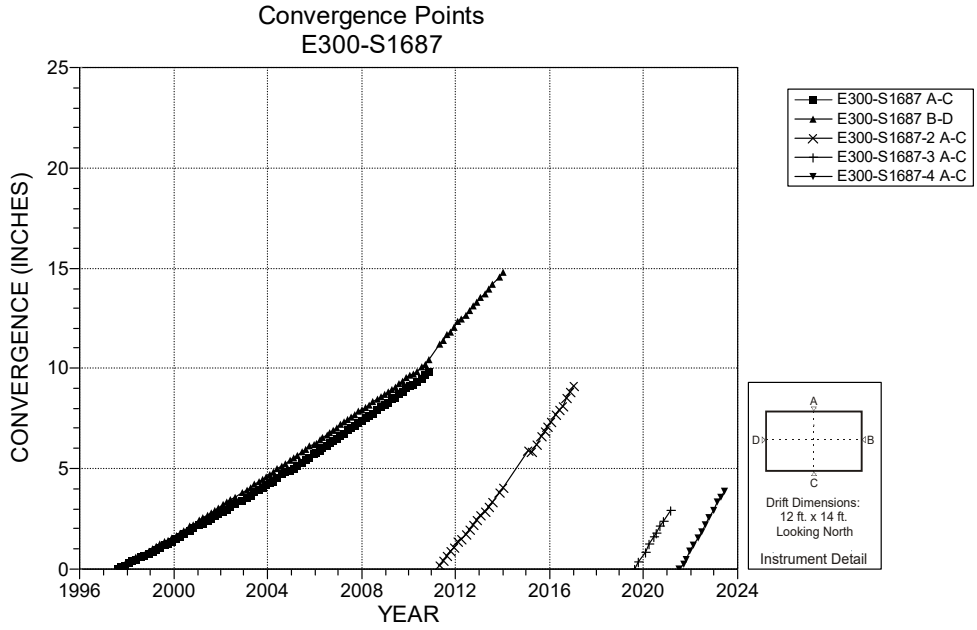
NOTES:
1. Excavation date: July 1984.
2. Reinstalled floor point mined out Dec. 2010.

Figure 4-117 Convergence Point Array – E300 S1300 – Roof to Floor



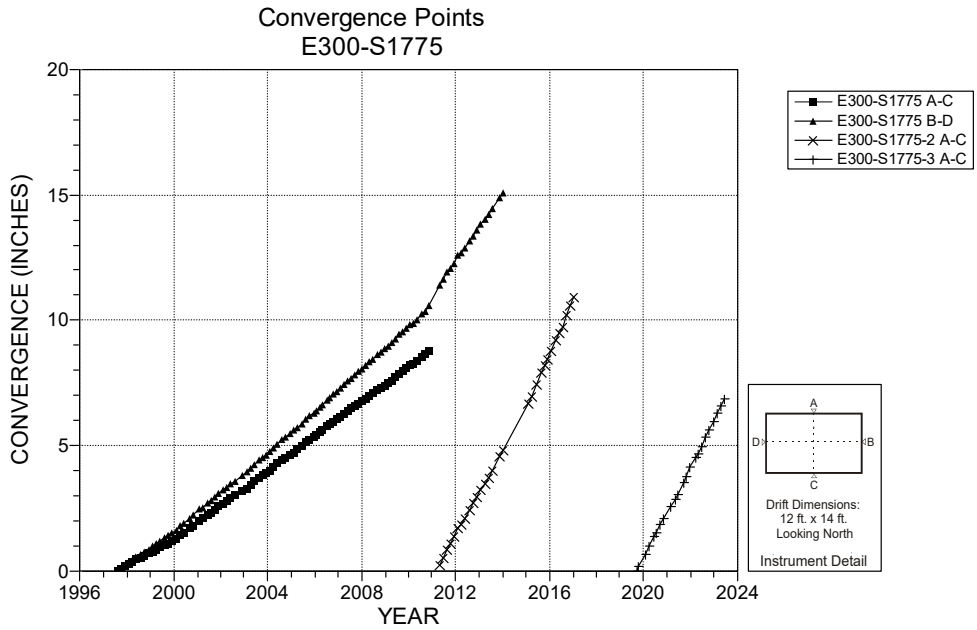
NOTES:
1. Excavation date: October 1985.
2. Reinstalled floor point mined out Dec. 2010.

Figure 4-118 Convergence Point Array – E300 S1450 – All Chords



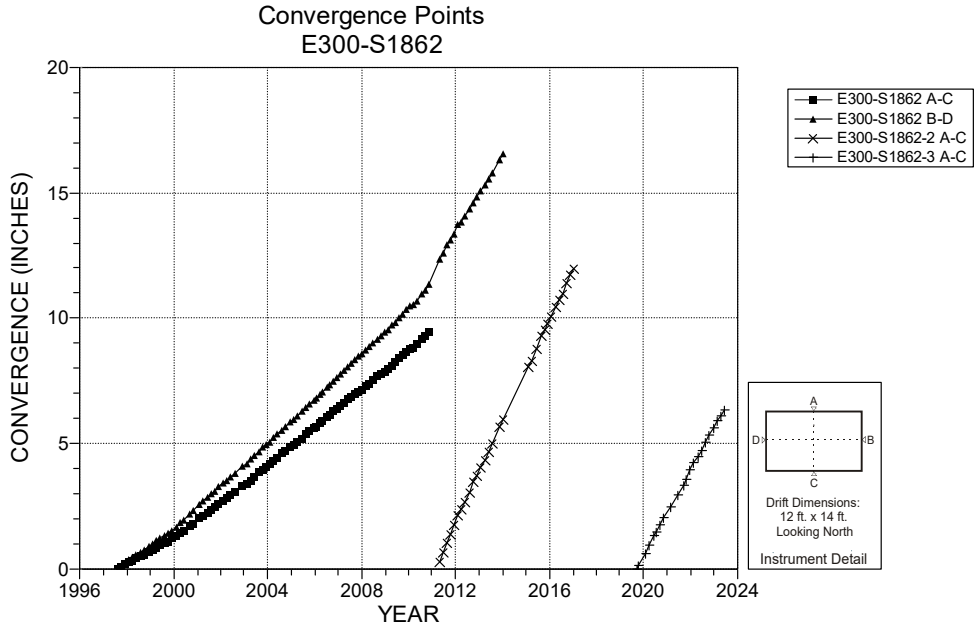
NOTES:
1. Excavation date: October 1985.

Figure 4-119 Convergence Point Array – E300 S1687 – All Chords



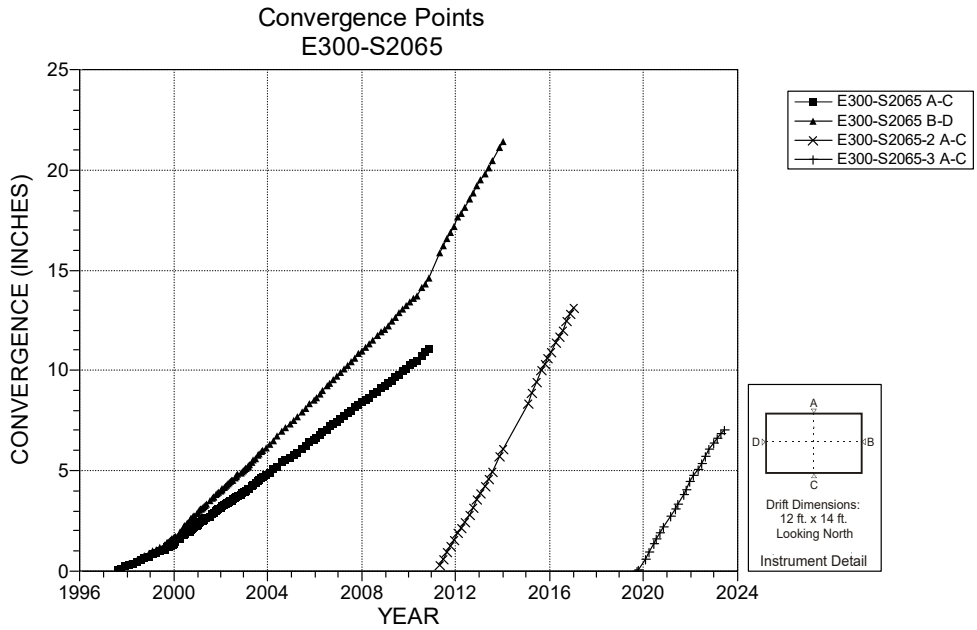
NOTES:
1. Excavation date: October 1985.

Figure 4-120 Convergence Point Array – E300 S1775 – All Chords



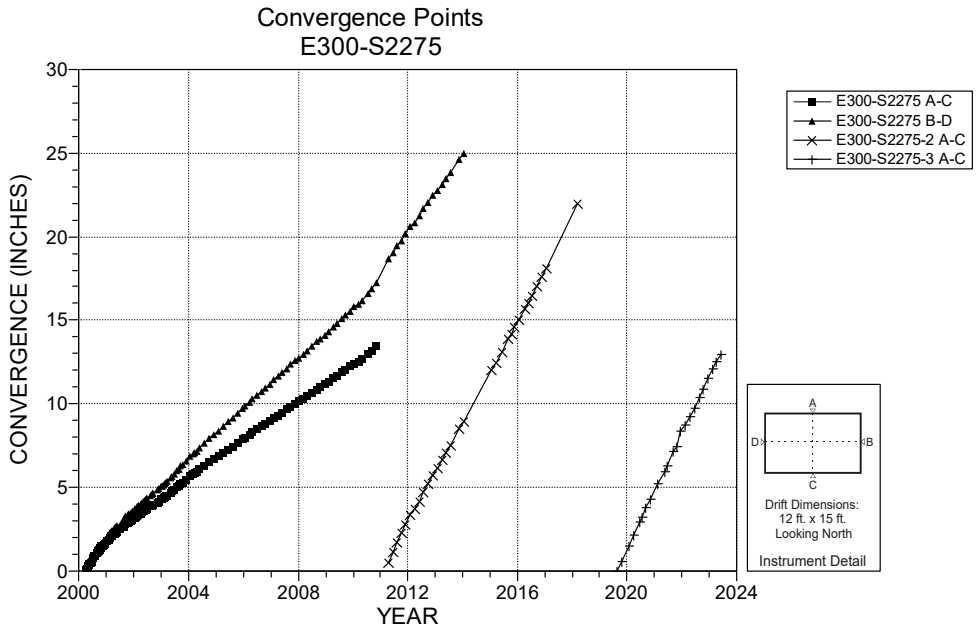
NOTES:
1. Excavation date: October 1985.

Figure 4-121 Convergence Point Array – E300 S1862 – All Chords



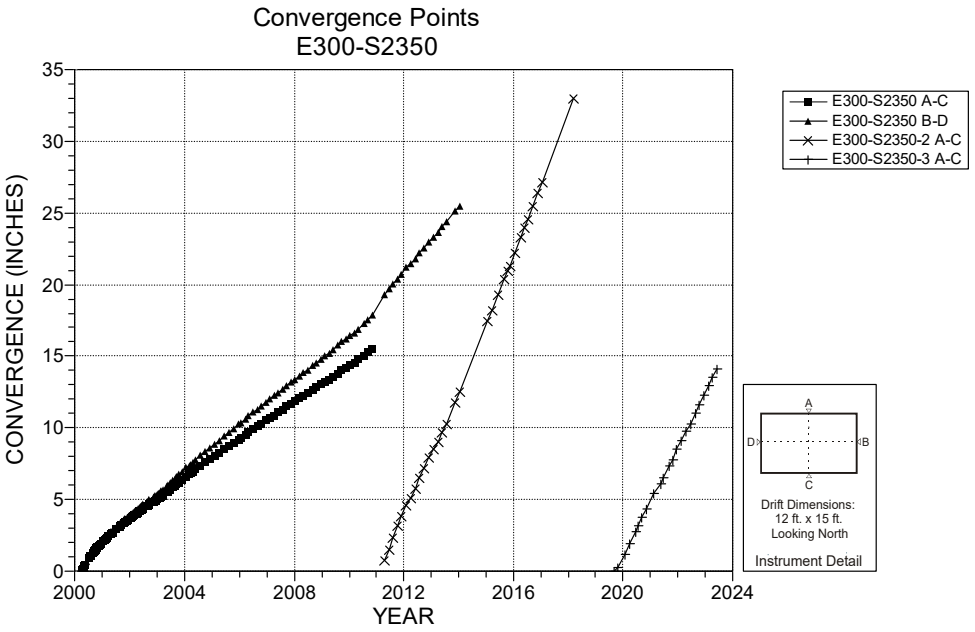
NOTES:
1. Excavation date: April 1986.

Figure 4-122 Convergence Point Array – E300 S2065 – Roof to Floor



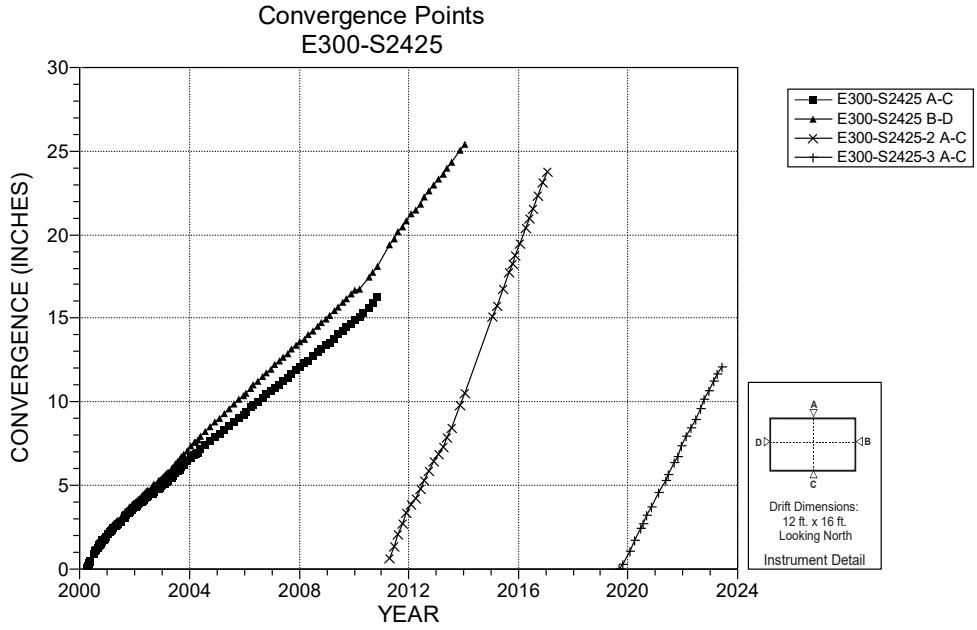
NOTES:
1. Excavation date: November 1999.

Figure 4-123 Convergence Point Array – E300 S2275 – All Chords



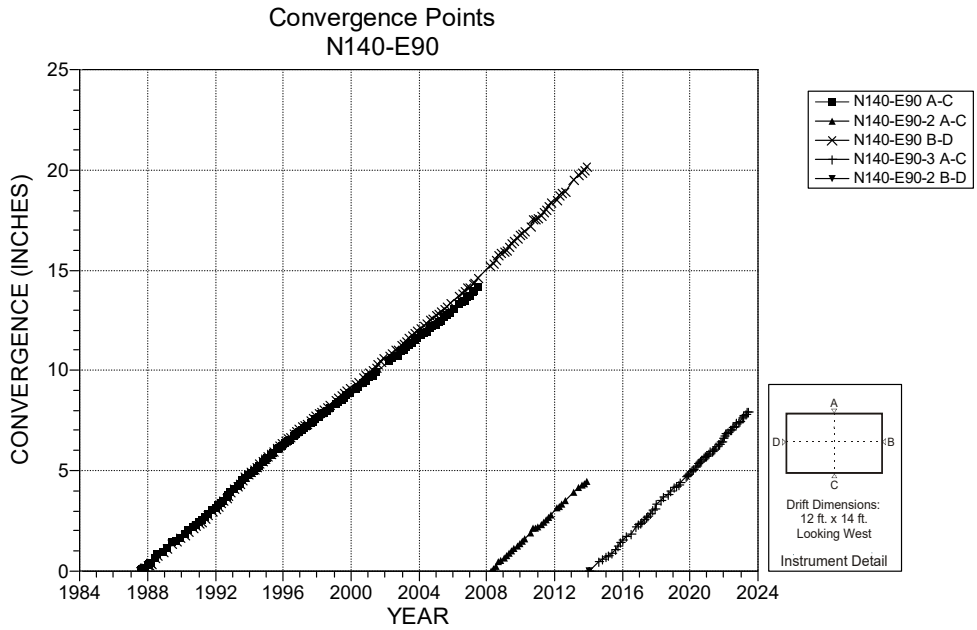
NOTES:
1. Excavation date: November 1999.

Figure 4-124 Convergence Point Array – E300 S2350 – All Chords



NOTES:
1. Excavation date: December 1999.

Figure 4-125 Convergence Point Array – E300 S2425 – All Chords



NOTES:
1. Excavation date: November 1982.

Figure 4-126 Convergence Point Array – N140 E90 – All Chords

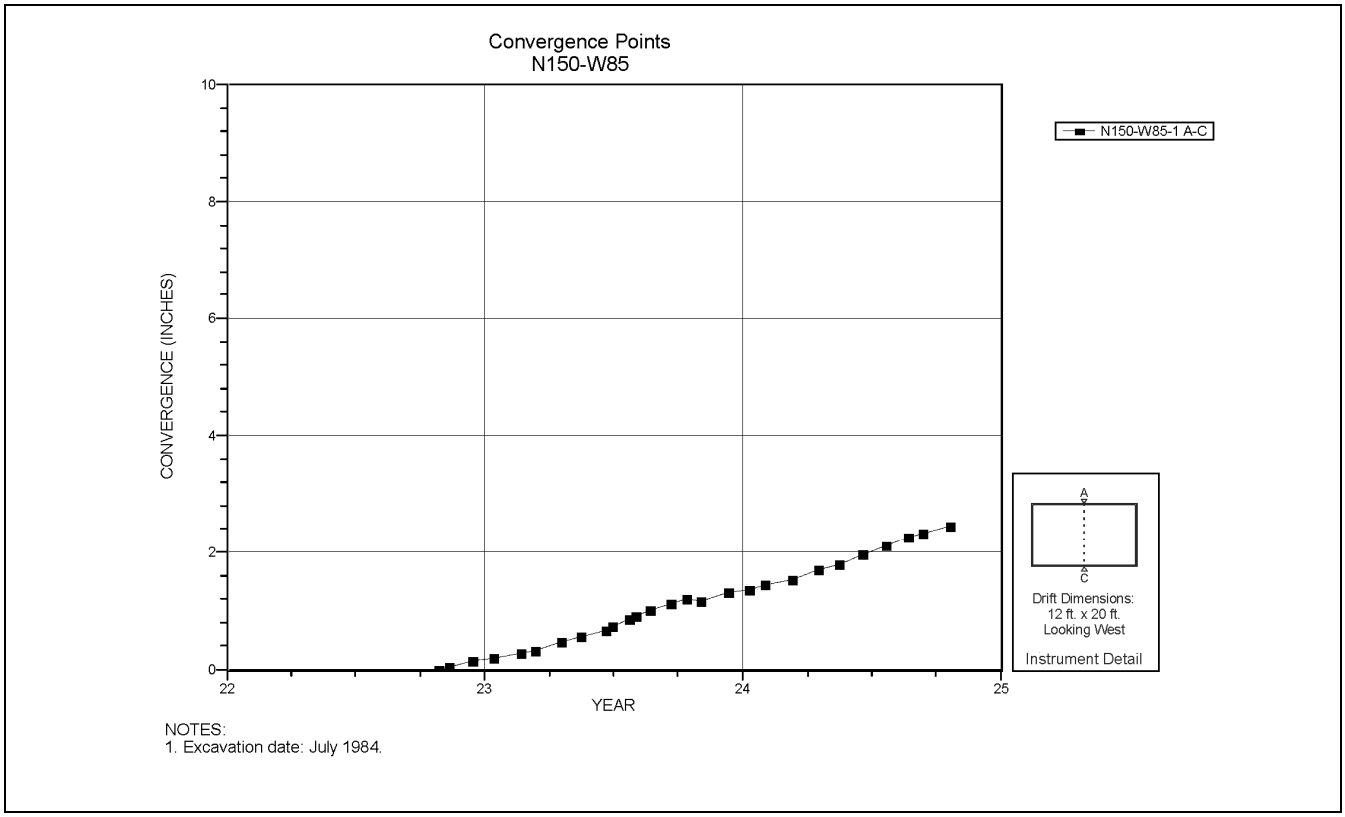


Figure 4-127 Convergence Point Array – N150 W85 – All Chords

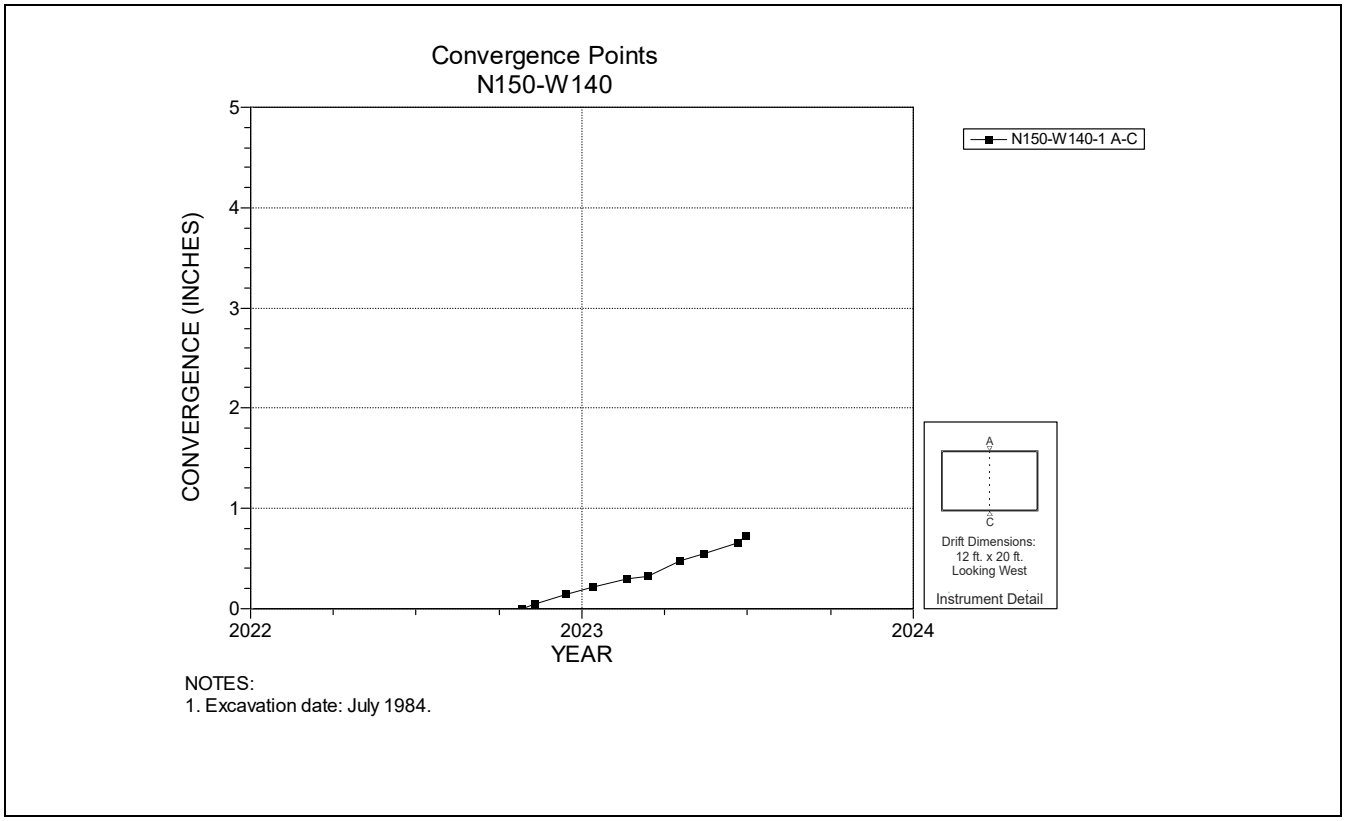
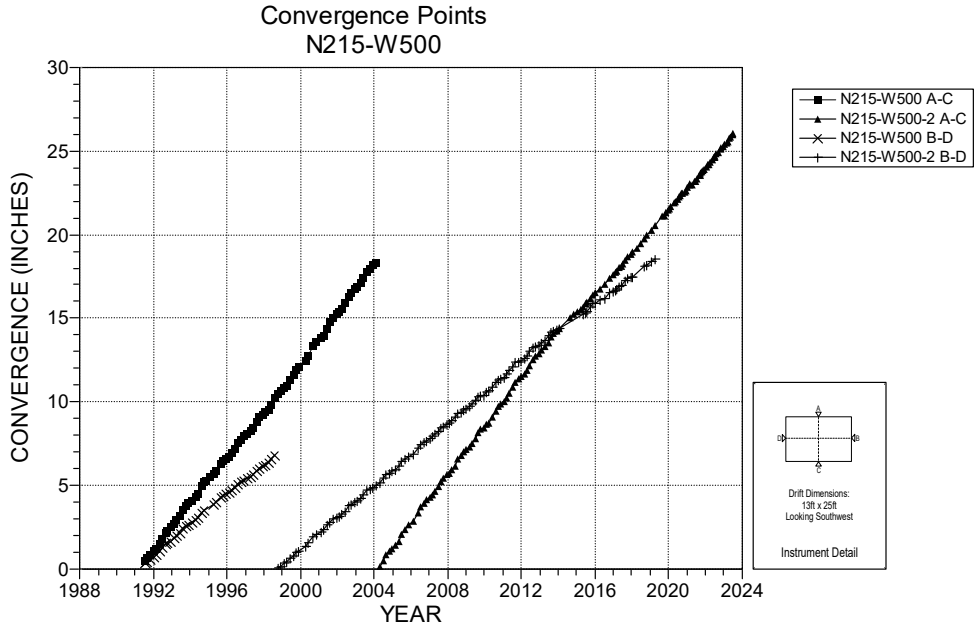
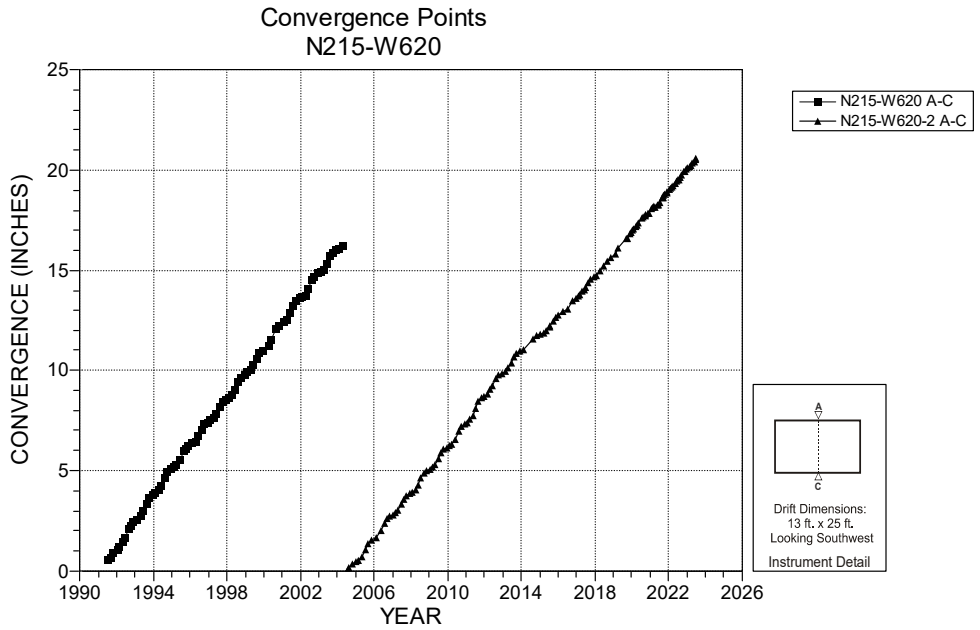


Figure 4-128 Convergence Point Array – N150 W140 – All Chords



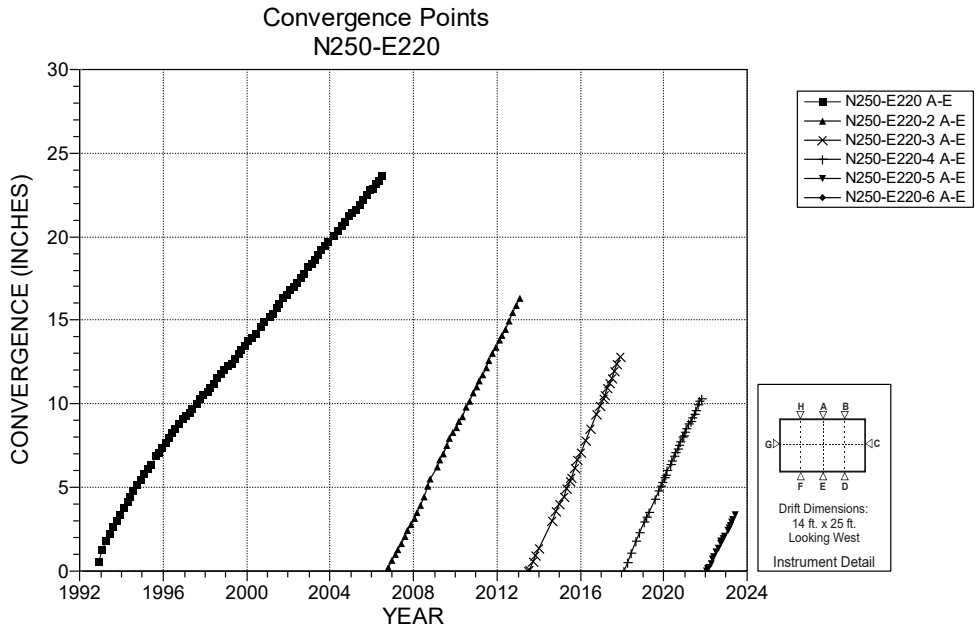
NOTES:
1. Excavation date: December 1987.

Figure 4-129 Convergence Point Array – N215 W500 – All Chords



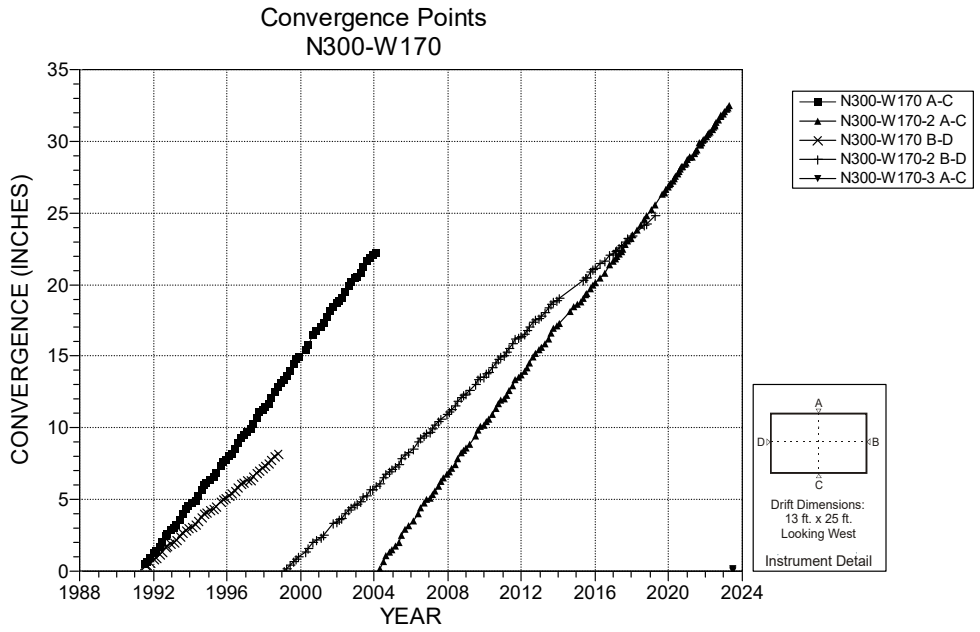
NOTES:
1. Excavation date: January 1988.

Figure 4-130 Convergence Point Array – N215 W620 – Roof to Floor



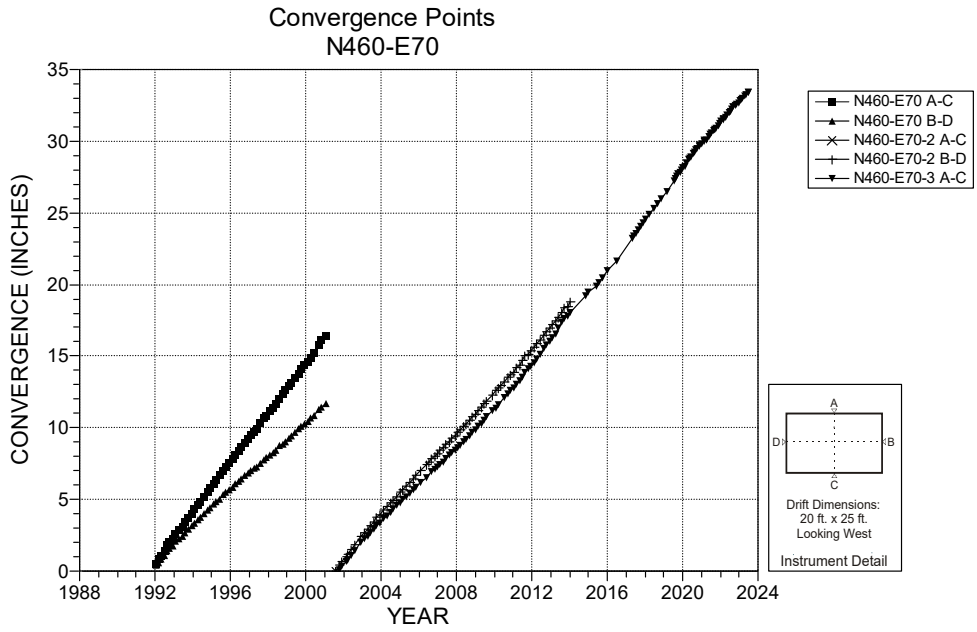
NOTES:
1. Excavation date: October 1992.

Figure 4-131 Convergence Point Array – N250 E220 – Roof to Floor



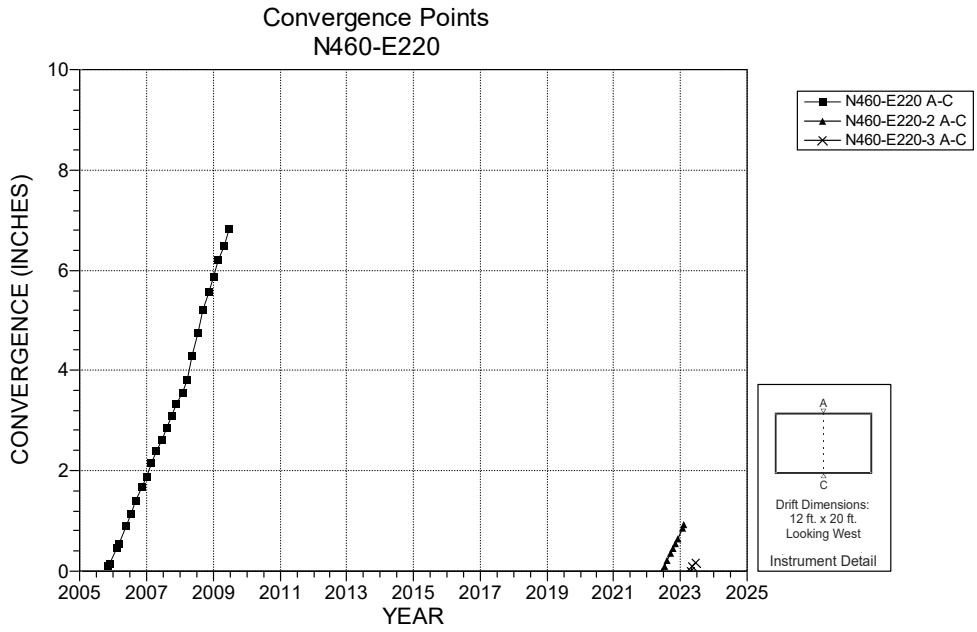
NOTES:
1. Excavation date: October 1987.

Figure 4-132 Convergence Point Array – N300 W170 – All Chords



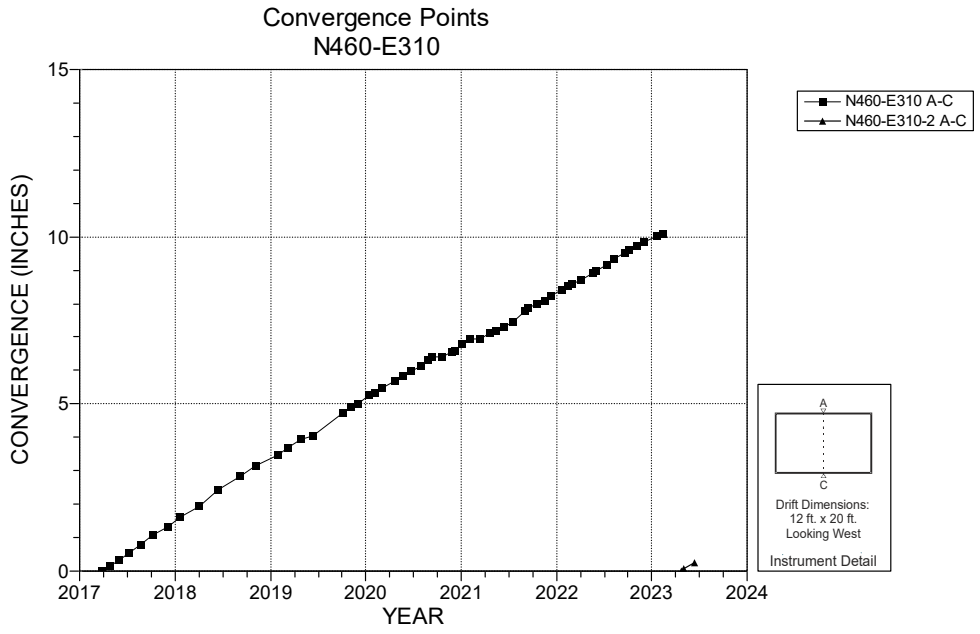
NOTES:
1. Excavation date: February 1983.
2. Roof excavated to Anhydrite "b".

Figure 4-133 Convergence Point Array – N460 E70 – All Chords



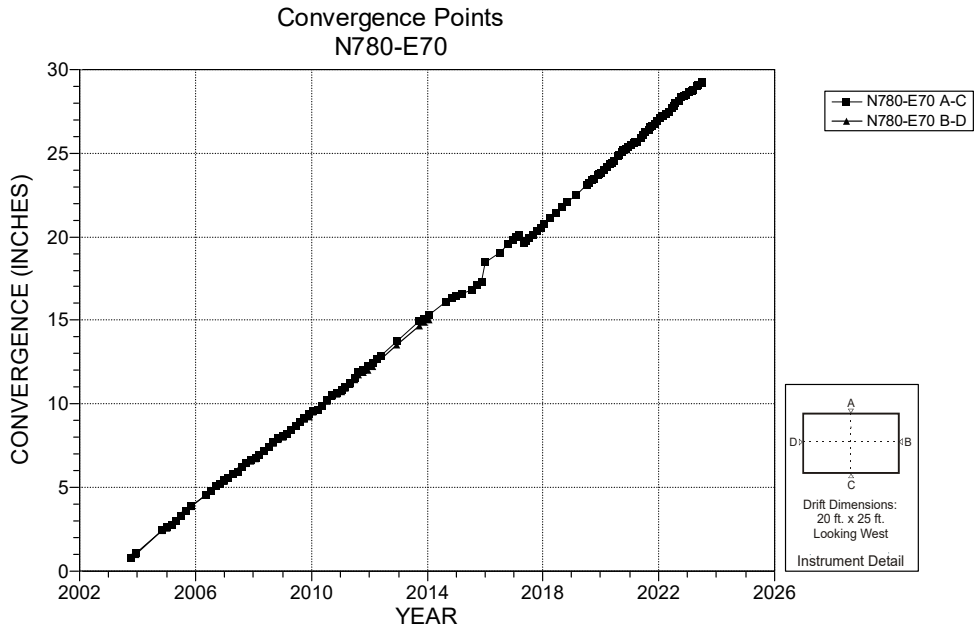
NOTES:
1. Excavation date: January 1991.

Figure 4-134 Convergence Point Array – N460 E220 – Roof to Floor



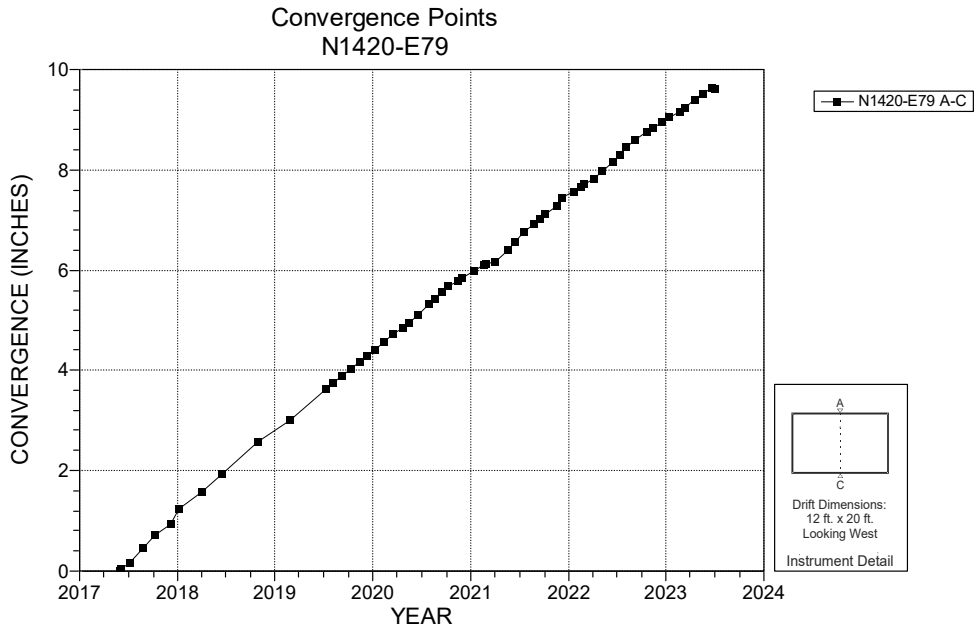
NOTES:
1. Excavation date: January 1991.

Figure 4-135 Convergence Point Array – N460 E310 – Roof to Floor



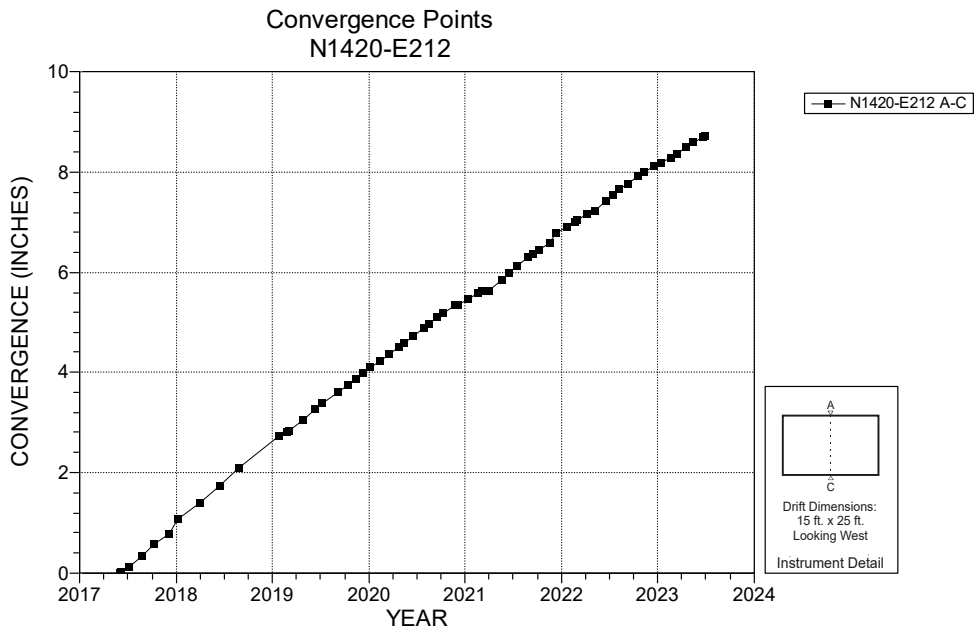
NOTES:
1. Excavation date: February 1983.

Figure 4-136 Convergence Point Array – N780 E70 – Roof to Floor



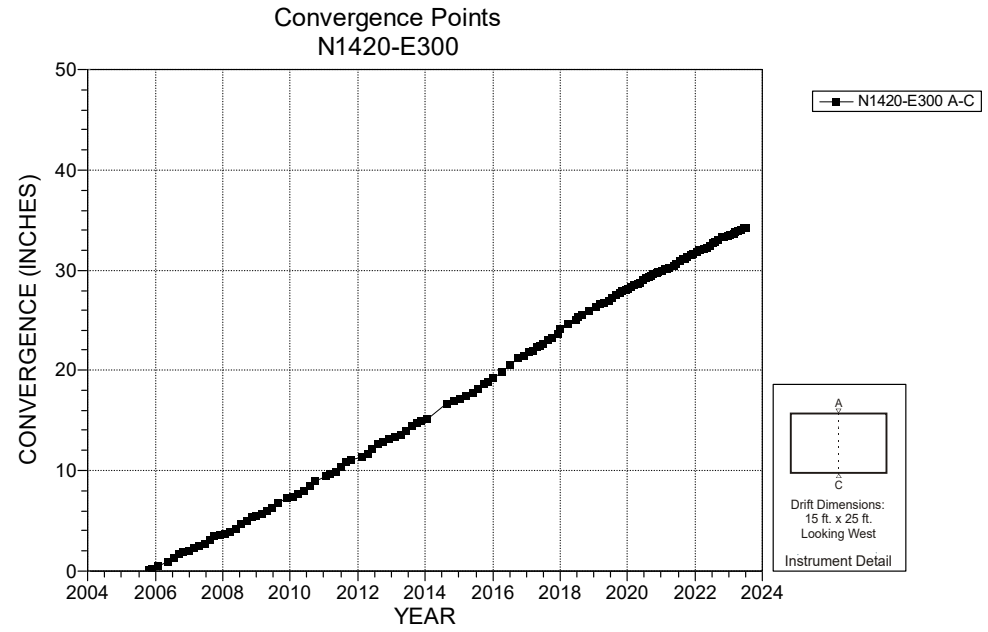
NOTES:
1. Excavation date: February 1983.

Figure 4-137 Convergence Point Array – N1420 E79 – Roof to Floor



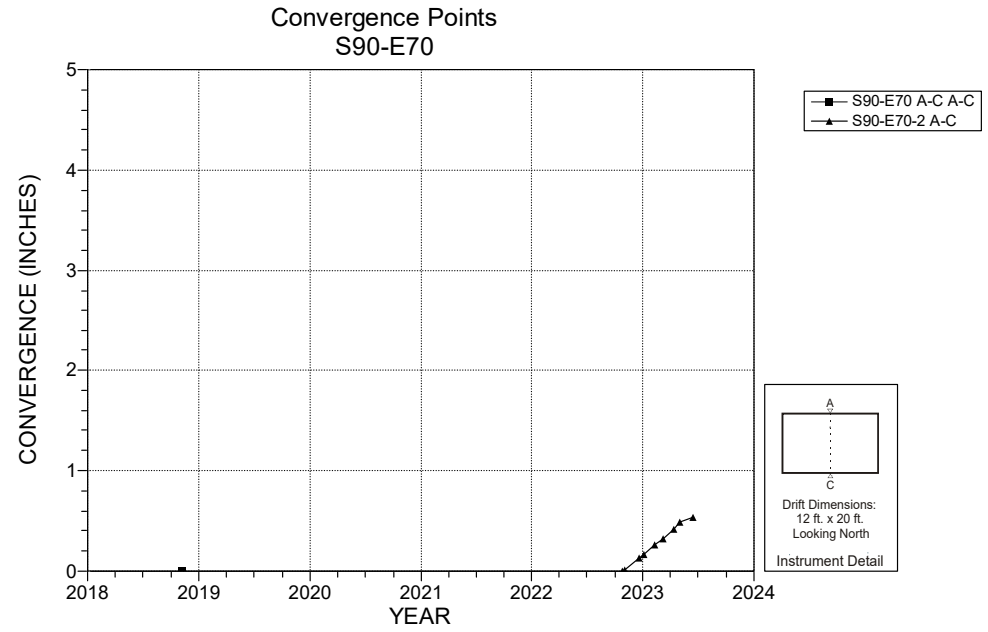
NOTES:
1. Excavation date: December 2004.

Figure 4-138 Convergence Point Array – N1420 E212 – Roof to Floor



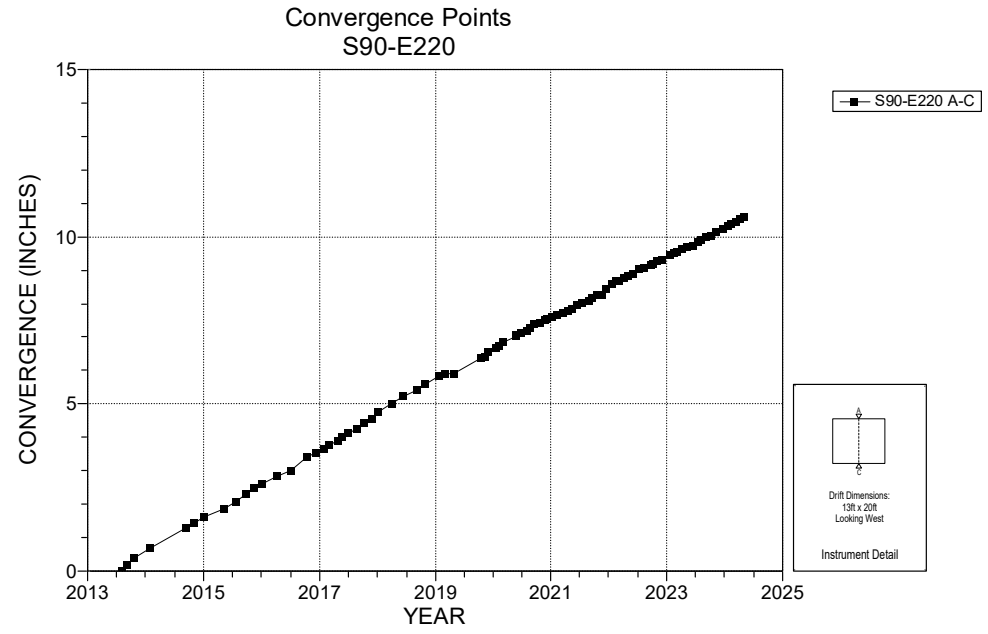
NOTES:
1. Excavation date: December 2004.

Figure 4-139 Convergence Point Array – N1420 E300 – Roof to Floor



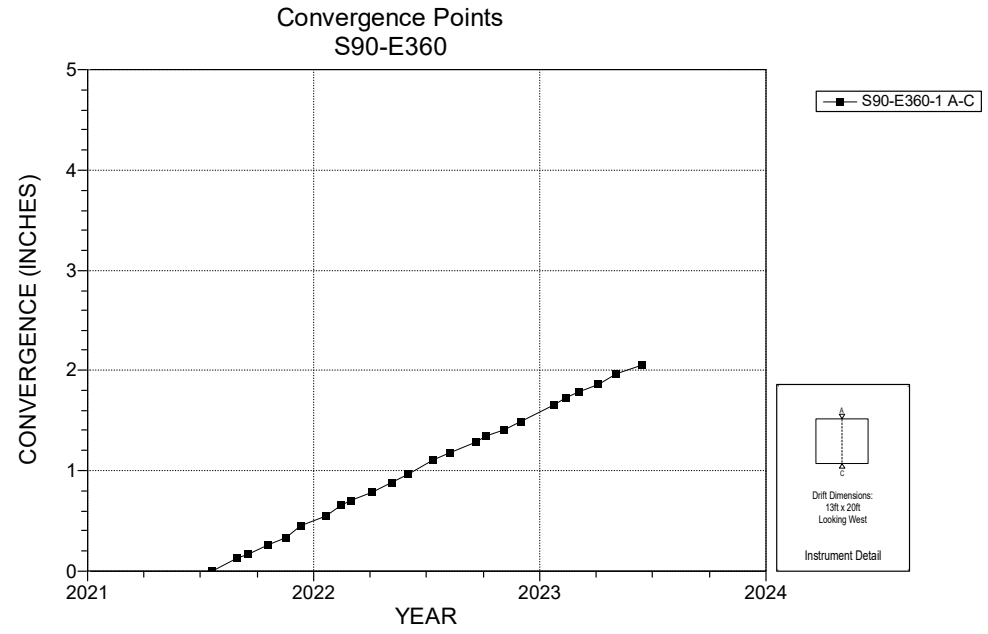
NOTES:
1. Excavation date: July 1985.

Figure 4-140 Convergence Point Array – S90 E70 – Roof to Floor



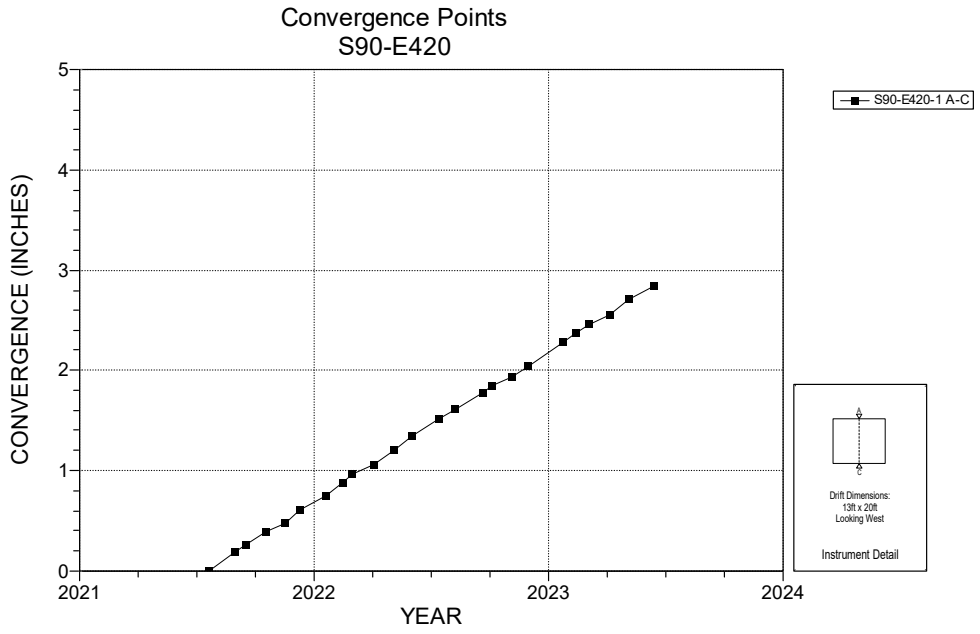
NOTES:
1. Excavation date: September 1985.

Figure 4-141 Convergence Point Array – S90 E220 – Roof to Floor



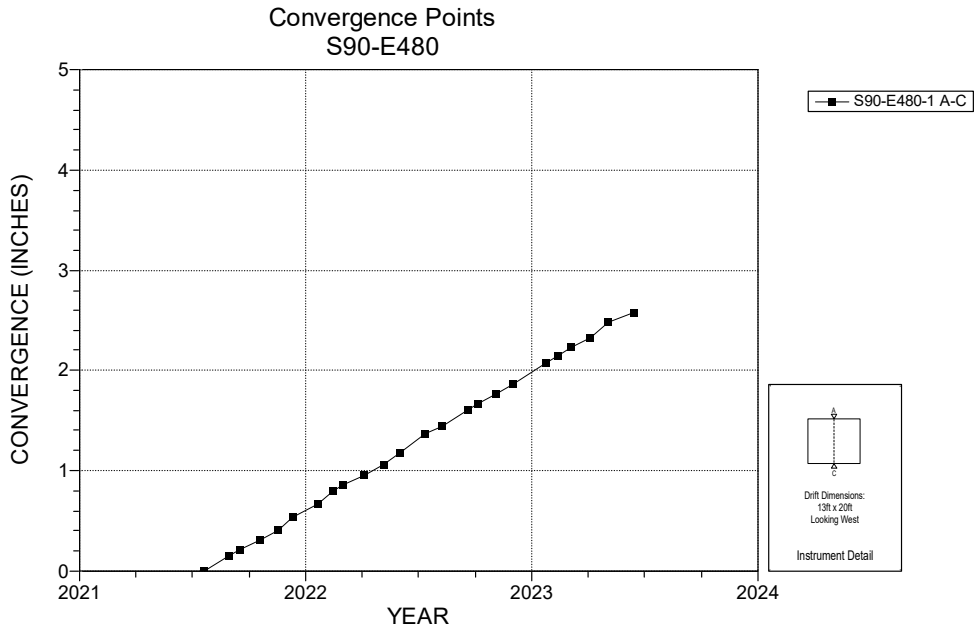
NOTES:
1. Excavation date: September 1985.

Figure 4-142 Convergence Point Array – S90 E360 – Roof to Floor



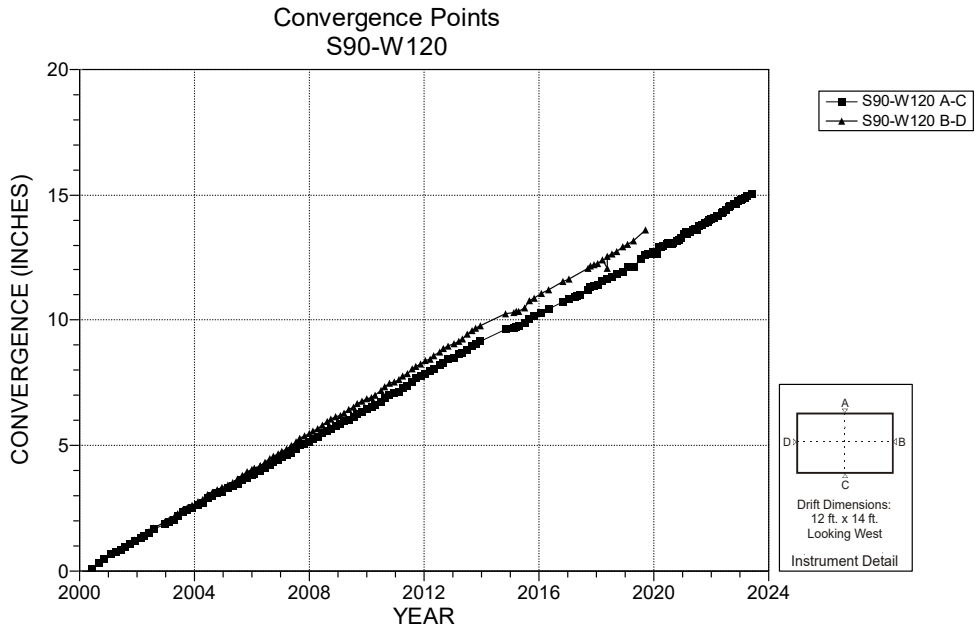
NOTES:
1. Excavation date: September 1985.

Figure 4-143 Convergence Point Array – S90 E420 – Roof to Floor



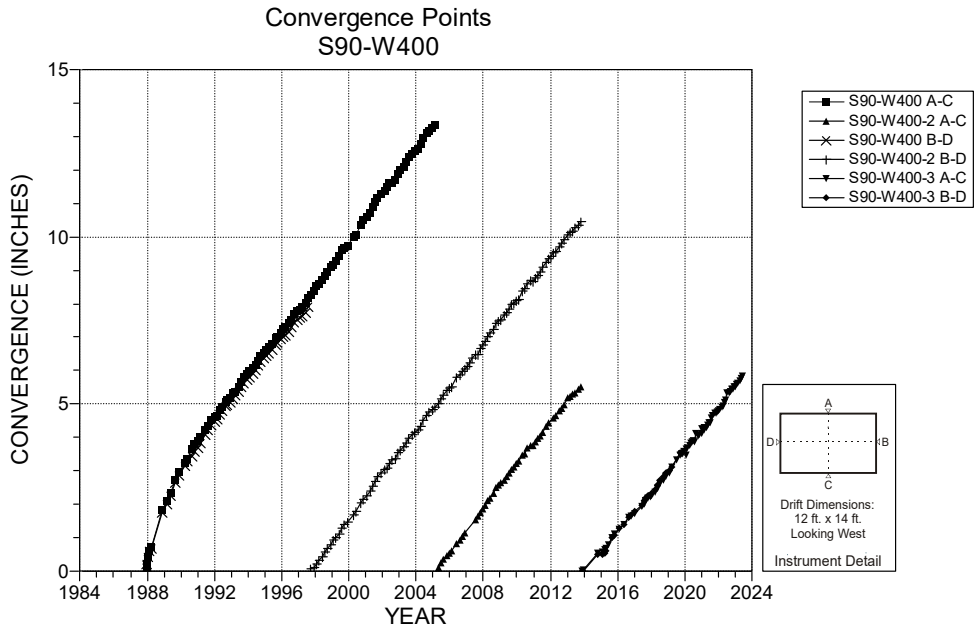
NOTES:
1. Excavation date: September 1985.

Figure 4-144 Convergence Point Array – S90 E480 – Roof to Floor



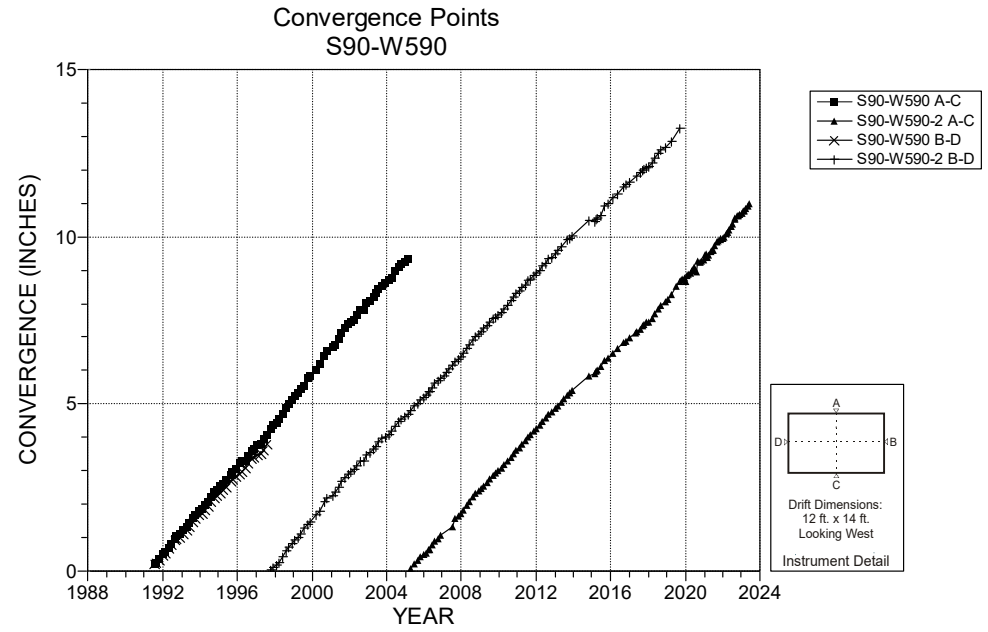
NOTES:
1. Excavation date: July 1985.

Figure 4-145 Convergence Point Array – S90 W120 – All Chords



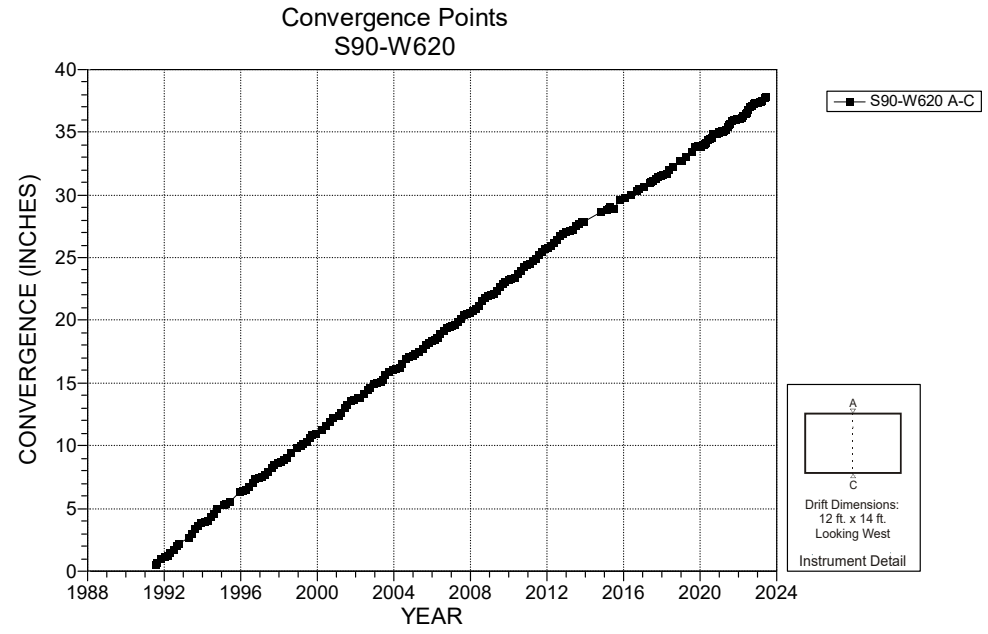
NOTES:
1. Excavation date: October 1987.

Figure 4-146 Convergence Point Array – S90 W400 – All Chords



NOTES:
1. Excavation date: November 1987.

Figure 4-147 Convergence Point Array – S90 W590 – All Chords



NOTES:
1. Excavation date: January 1988.

Figure 4-148 Convergence Point Array – S90 W620 – Roof to Floor

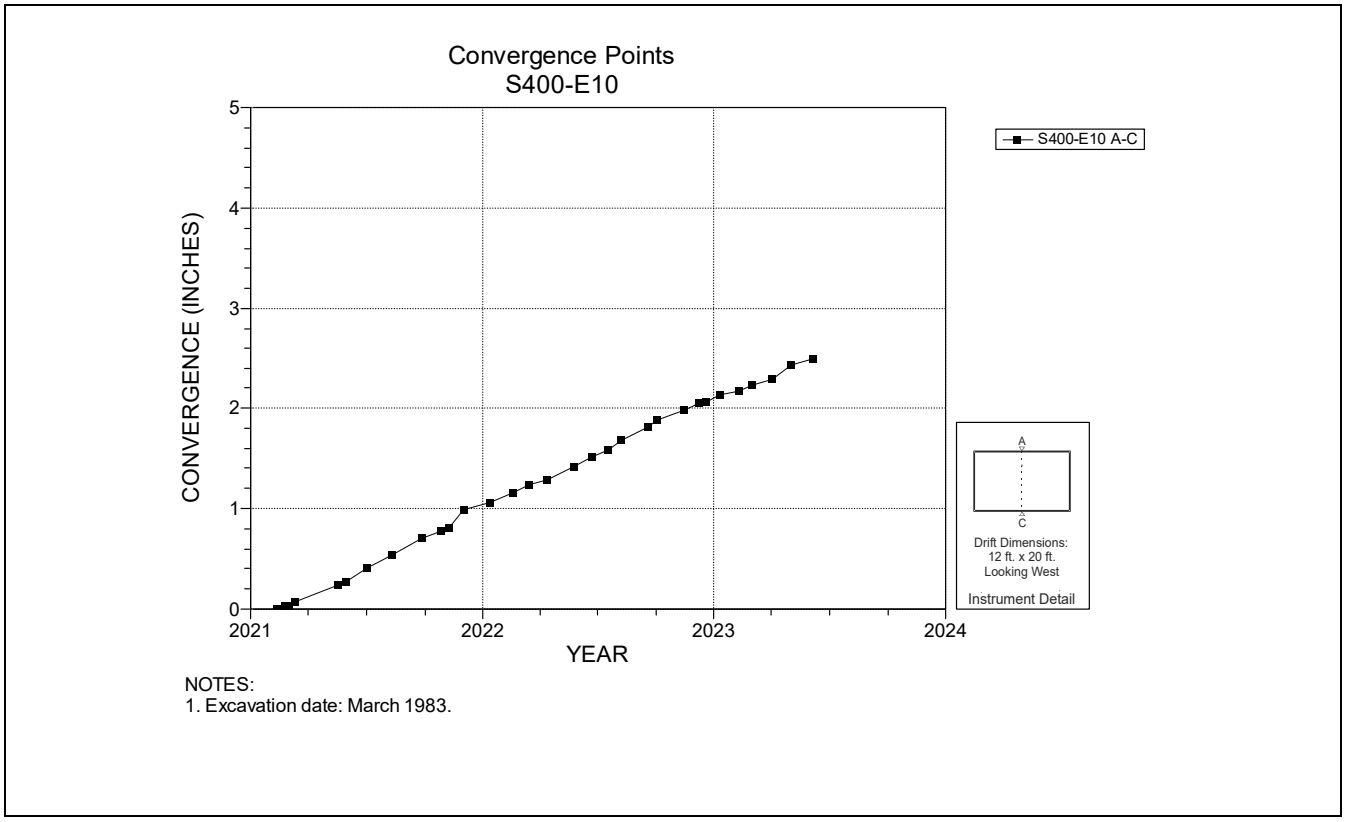


Figure 4-149 Convergence Point Array – S400 E10 – Roof to Floor

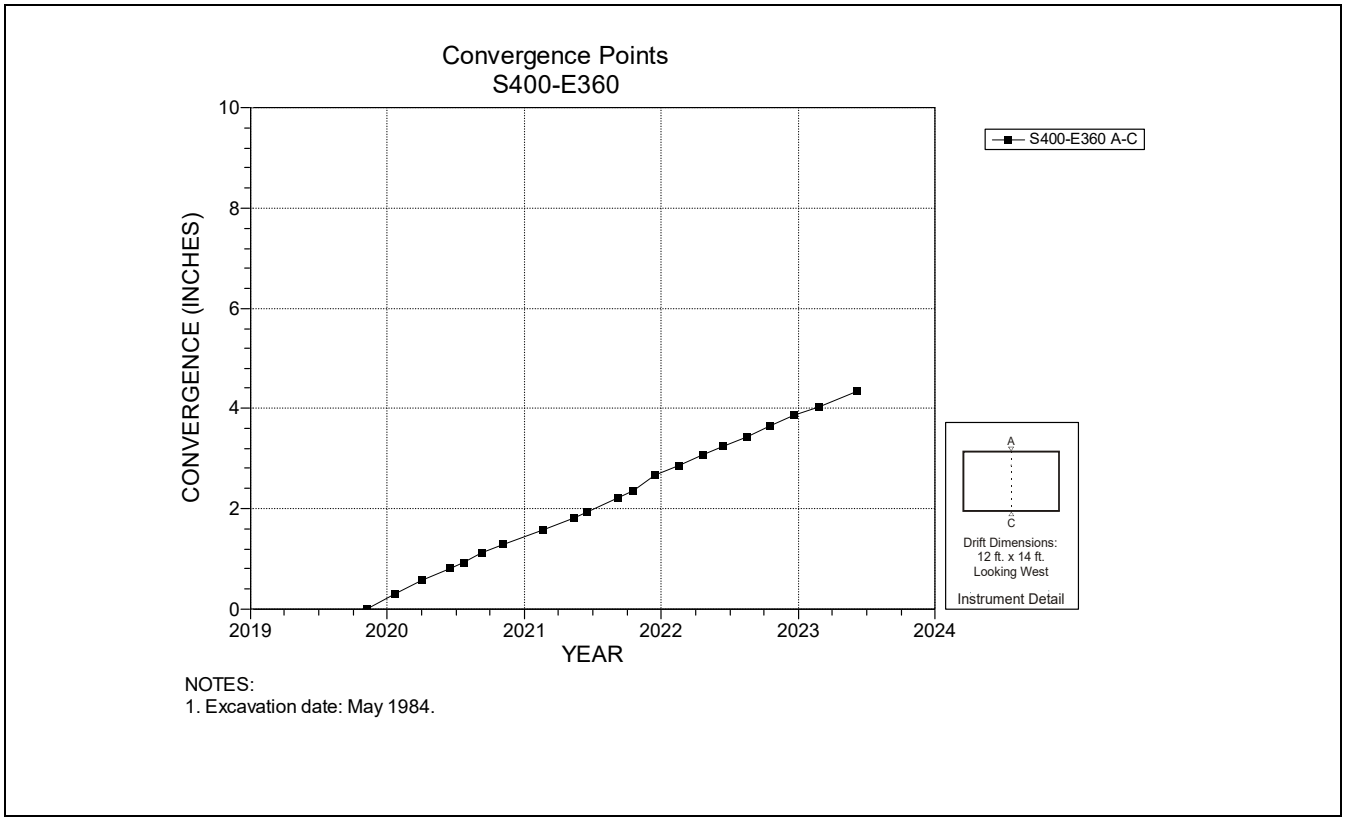
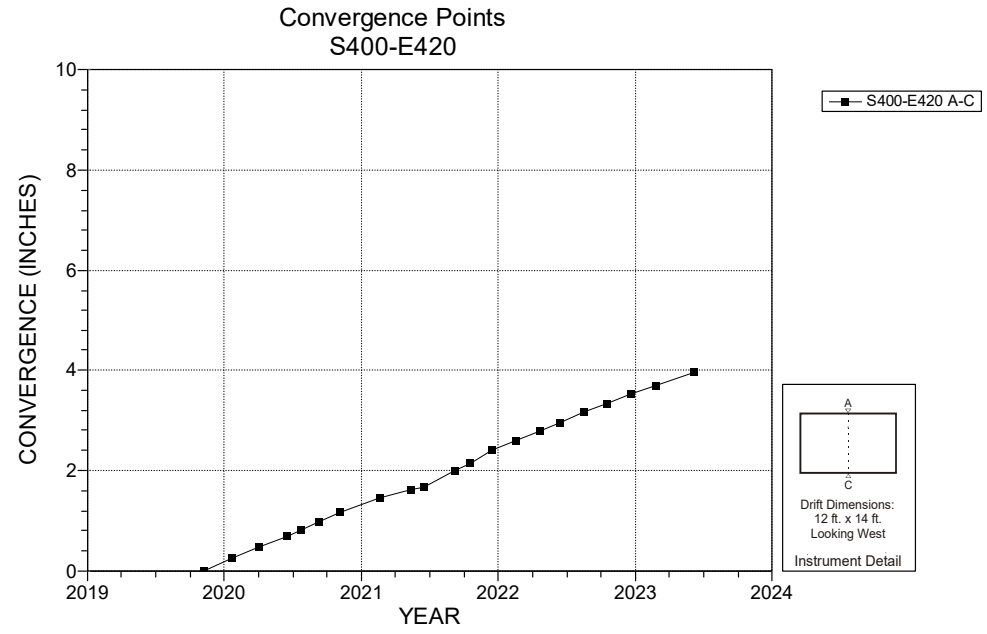
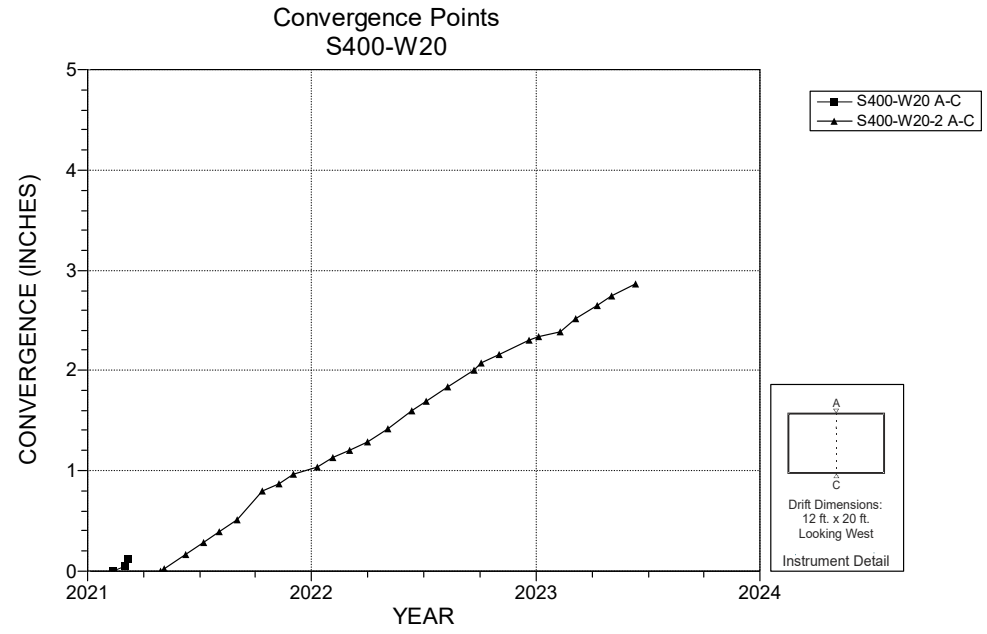


Figure 4-150 Convergence Point Array – S400 E360 – Roof to Floor



NOTES:
1. Excavation date: May 1984.

Figure 4-151 Convergence Point Array – S400 E420 – Roof to Floor



NOTES:
1. Excavation date: March 1983.

Figure 4-152 Convergence Point Array – S400 W20 – Roof to Floor

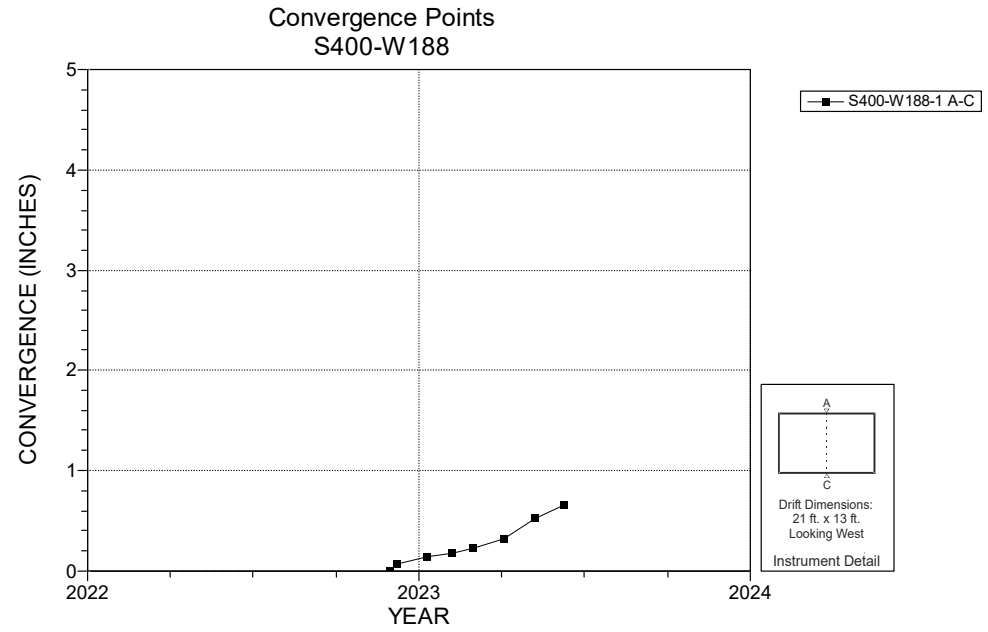


Figure 4-153 Convergence Point Array – S400 W188 – Roof to Floor

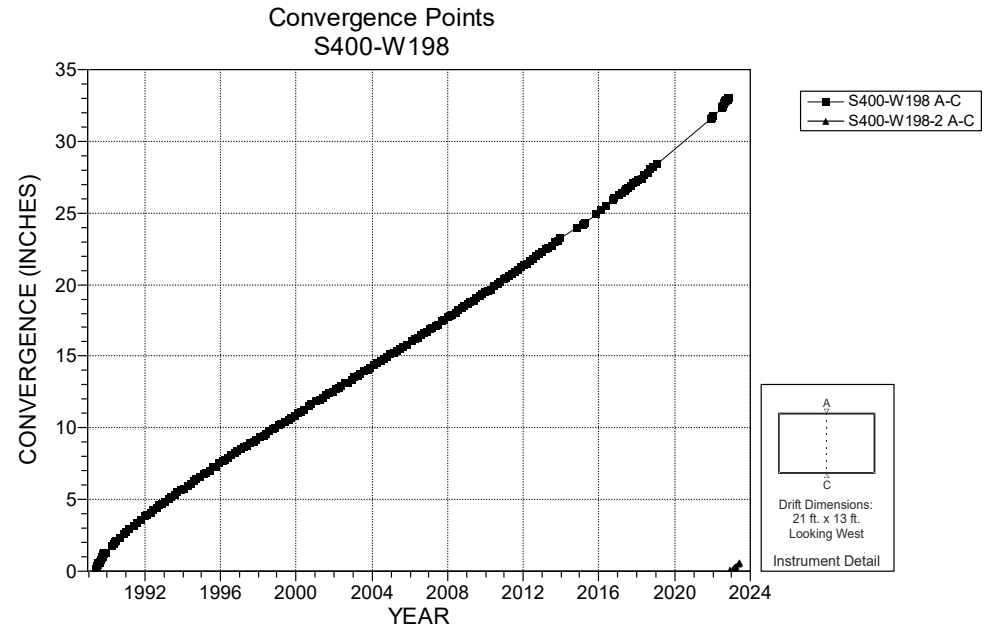
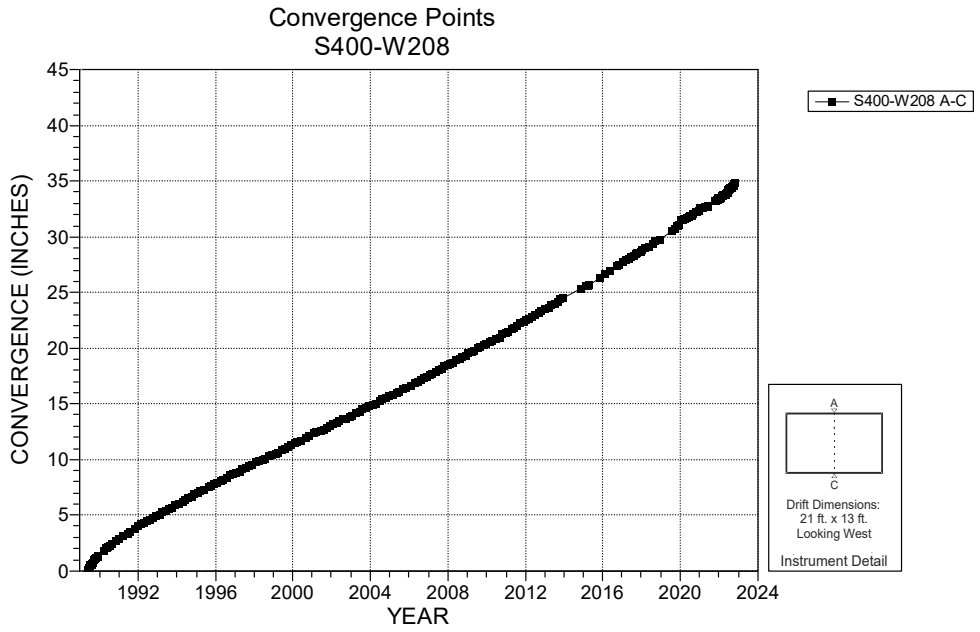
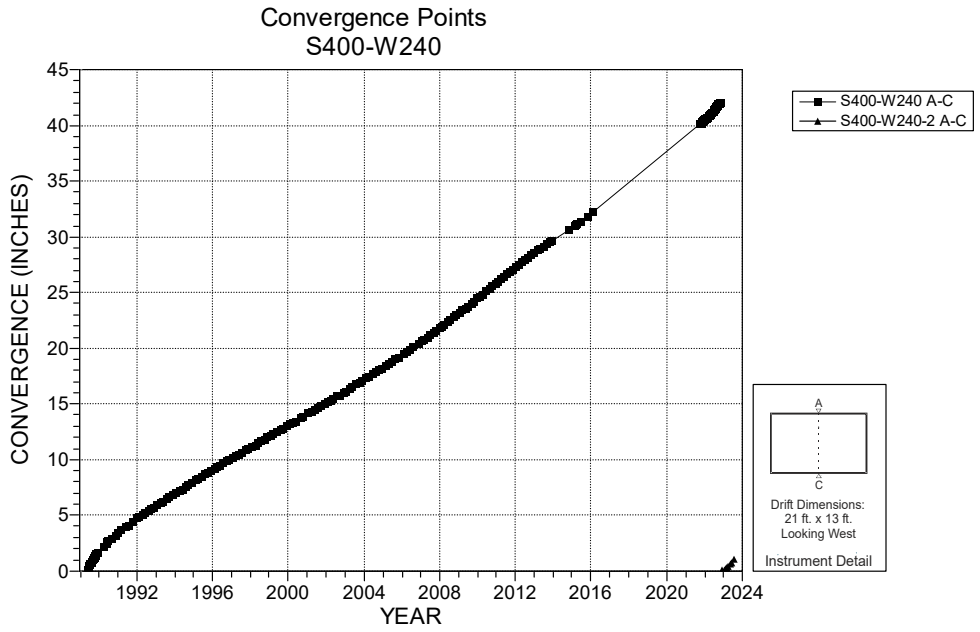


Figure 4-154 Convergence Point Array – S400 W198 – Roof to Floor



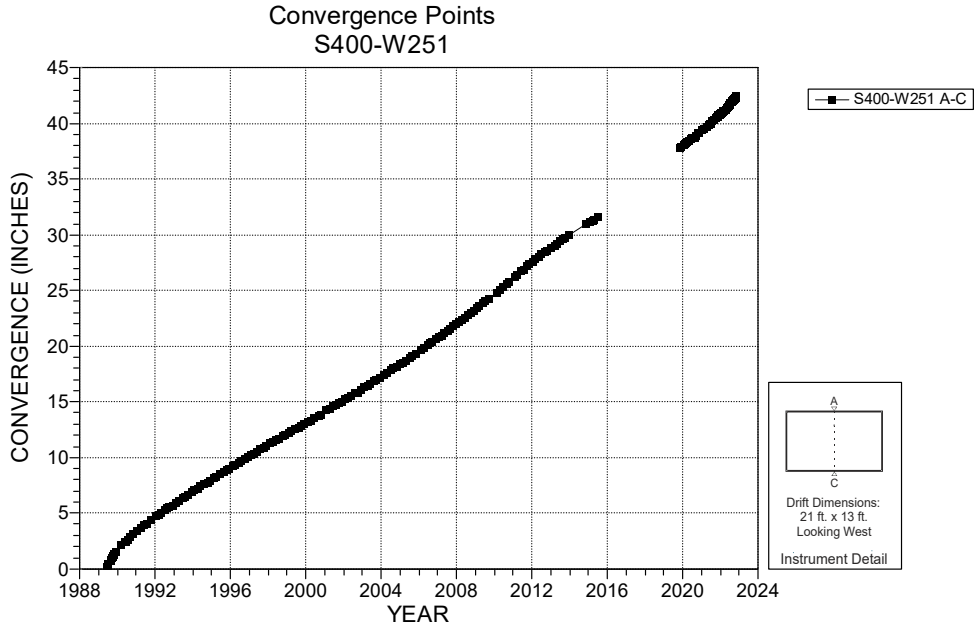
NOTES:
1. Excavation date: May 1989.

Figure 4-155 Convergence Point Array – S400 W208 – Roof to Floor



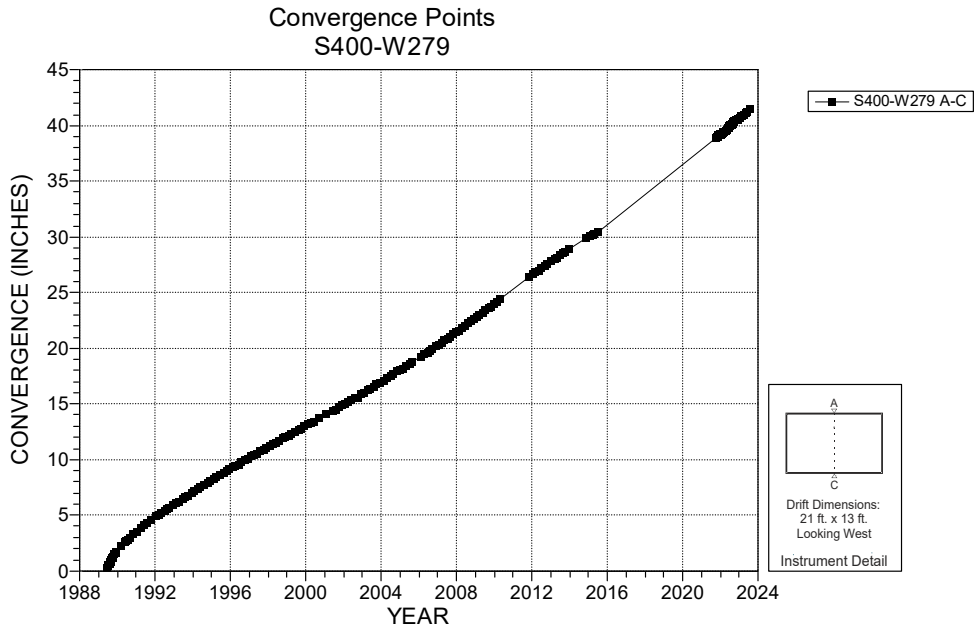
NOTES:
1. Excavation date: May 1989.

Figure 4-156 Convergence Point Array – S400 W240 – Roof to Floor



NOTES:
1. Excavation date: May 1989.

Figure 4-157 Convergence Point Array – S400 W251 – Roof to Floor



NOTES:
1. Excavation date: May 1989.

Figure 4-158 Convergence Point Array – S400 W279 – Roof to Floor

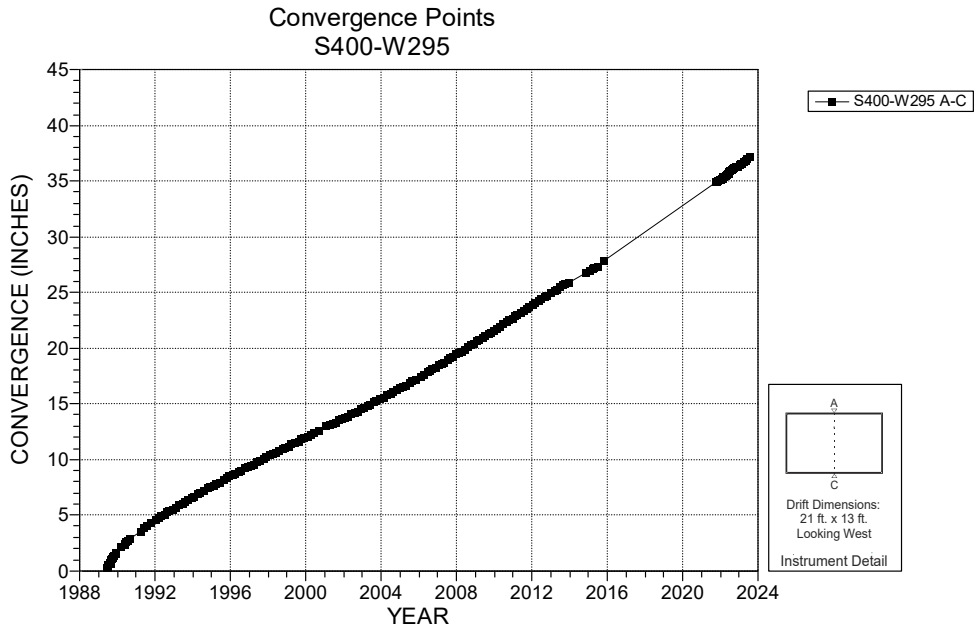


Figure 4-159 Convergence Point Array – S400 W295 – Roof to Floor

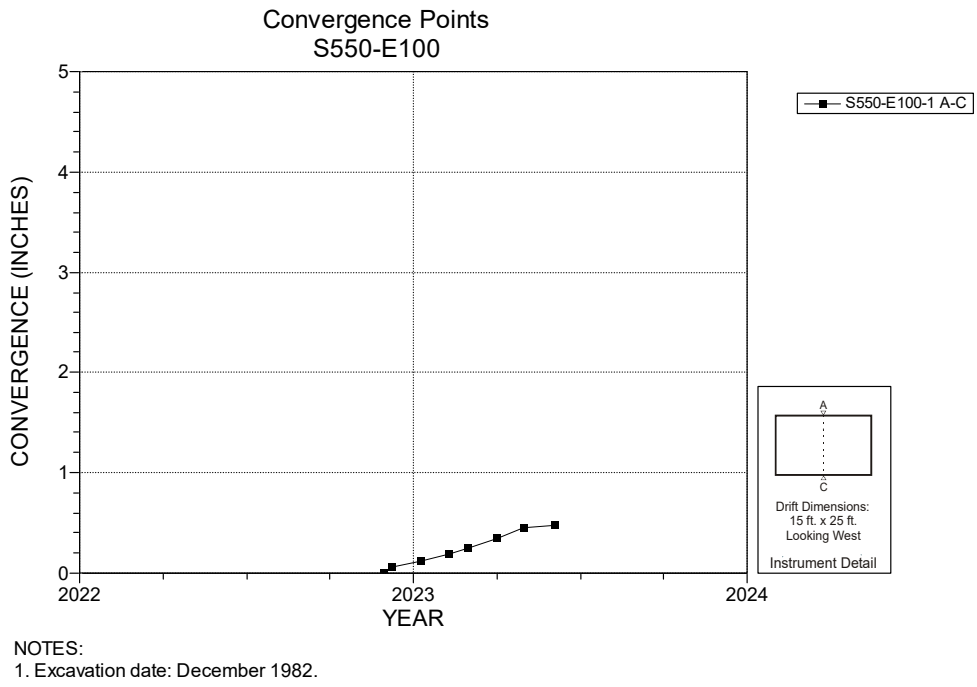
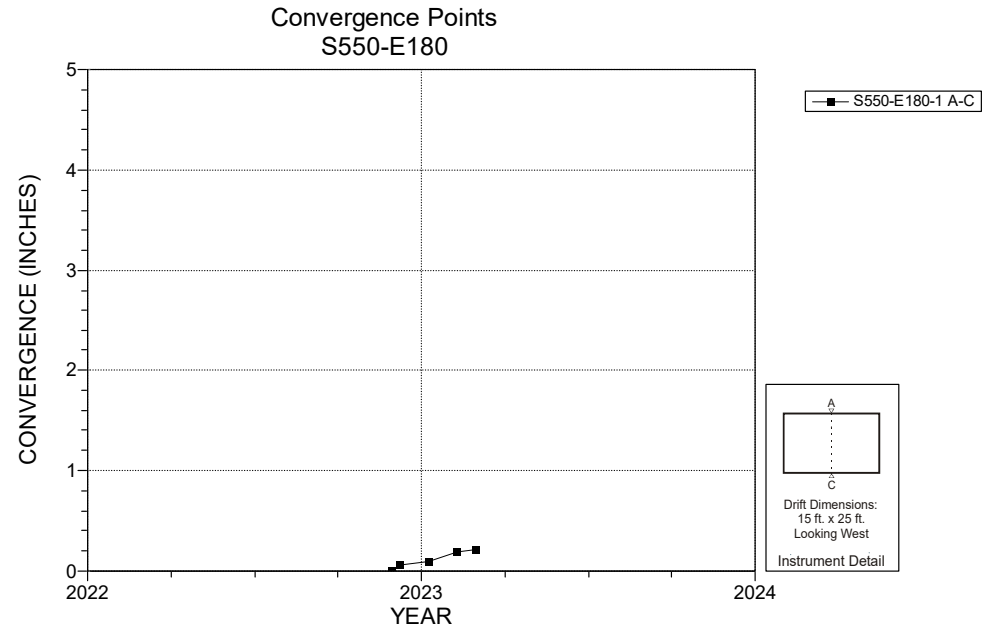
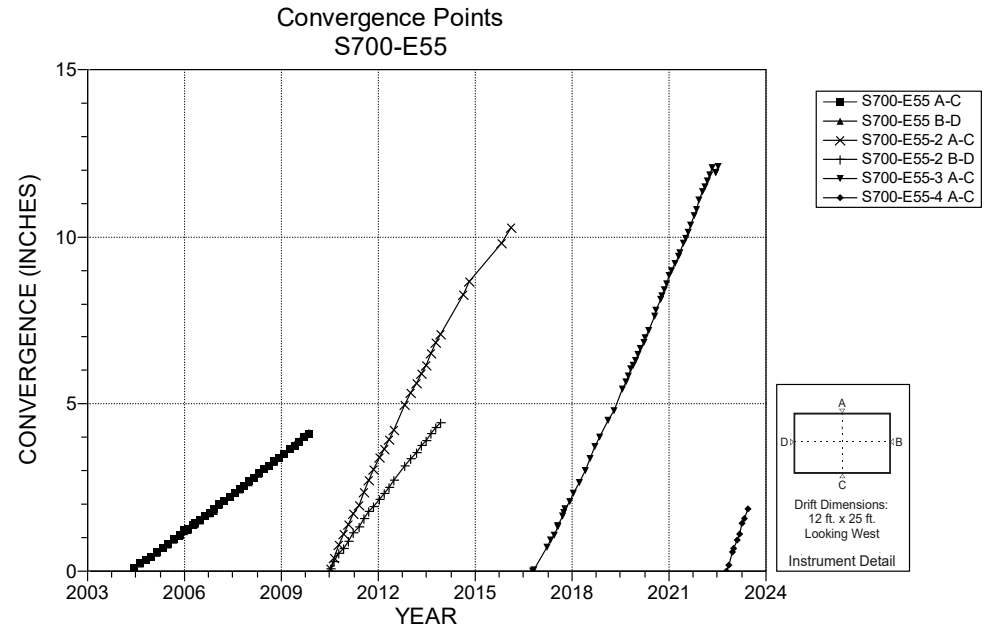


Figure 4-160 Convergence Point Array – S550 E100 – Roof to Floor



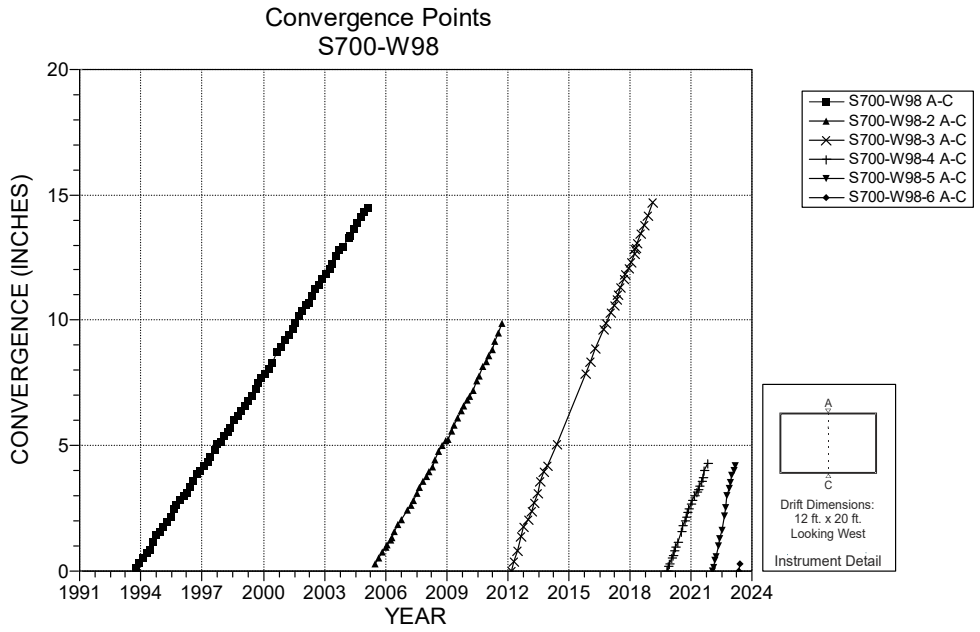
NOTES:
1. Excavation date: December 1982.

Figure 4-161 Convergence Point Array – S550 E180 – Roof to Floor



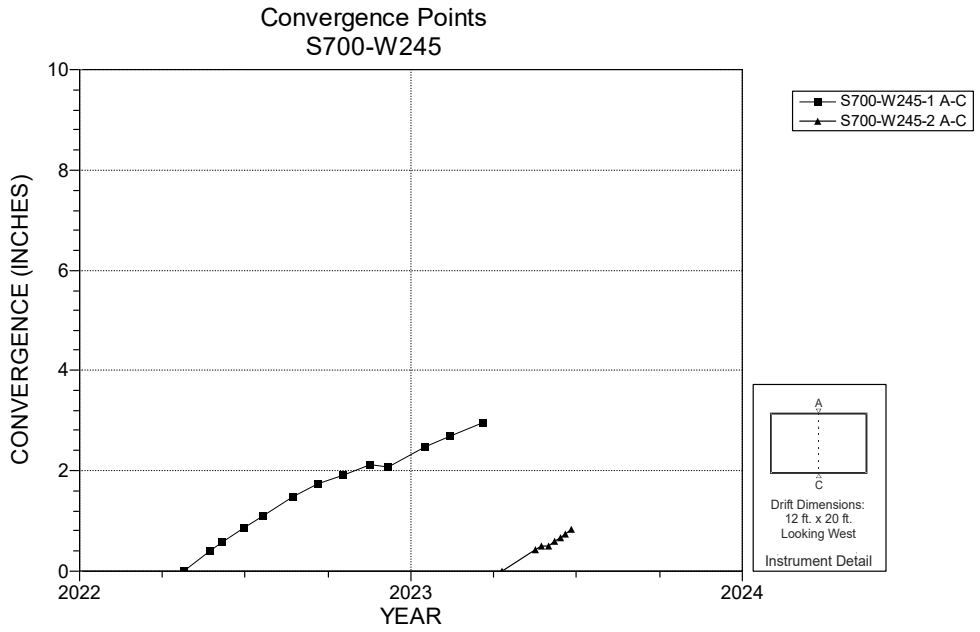
NOTES:
1. Excavation date: May 1984.
2. Anchor 'C' damaged by euqipment, reinstalled October 2016.

Figure 4-162 Convergence Point Array – S700 E55 – Roof to Floor



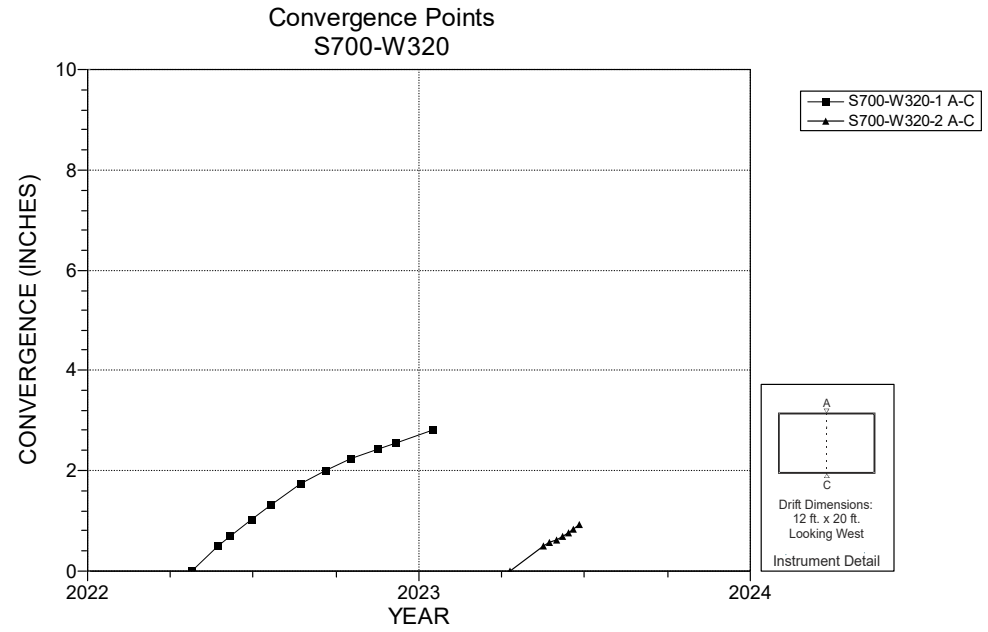
NOTES:
1. Excavation date: July 1985.

Figure 4-163 Convergence Point Array – S700 W98 – Roof to Floor



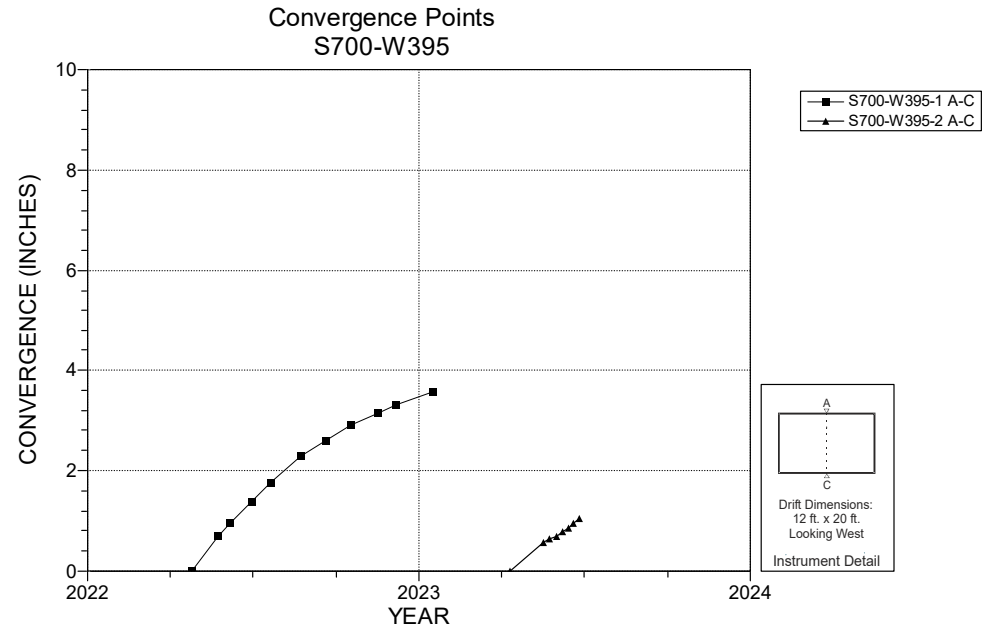
NOTES:
1. Excavation date: March 2022.

Figure 4-164 Convergence Point Array – S700 W245 – Roof to Floor



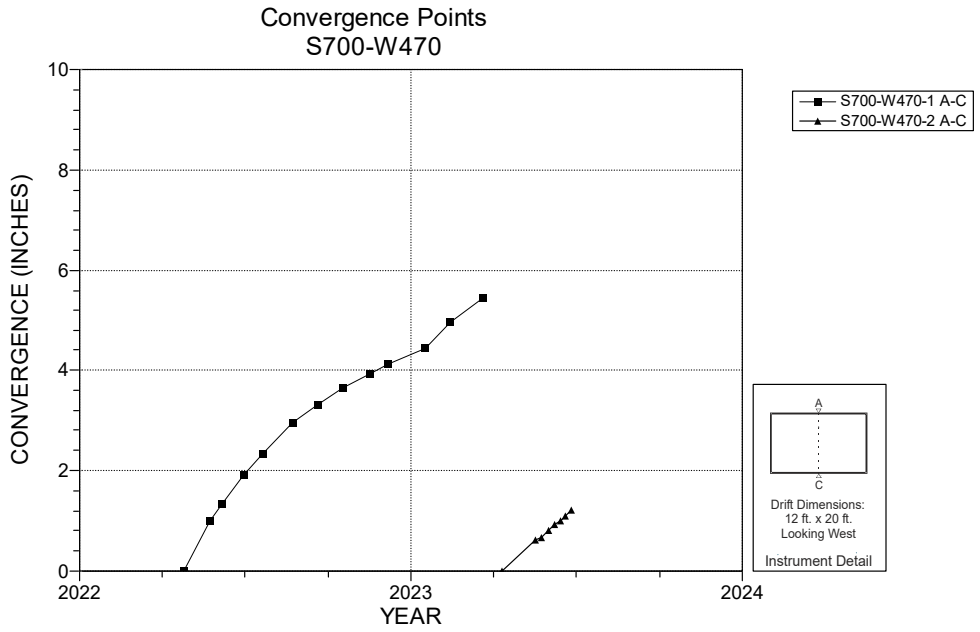
NOTES:
1. Excavation date: March 2022.

Figure 4-165 Convergence Point Array – S700 W320 – Roof to Floor



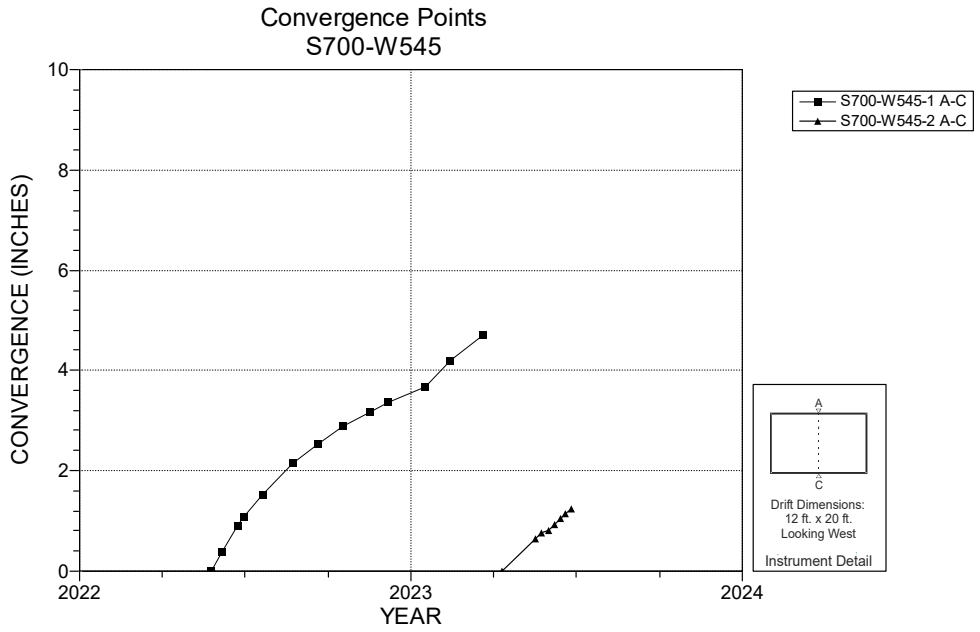
NOTES:
1. Excavation date: April 2022.

Figure 4-166 Convergence Point Array – S700 W395 – Roof to Floor



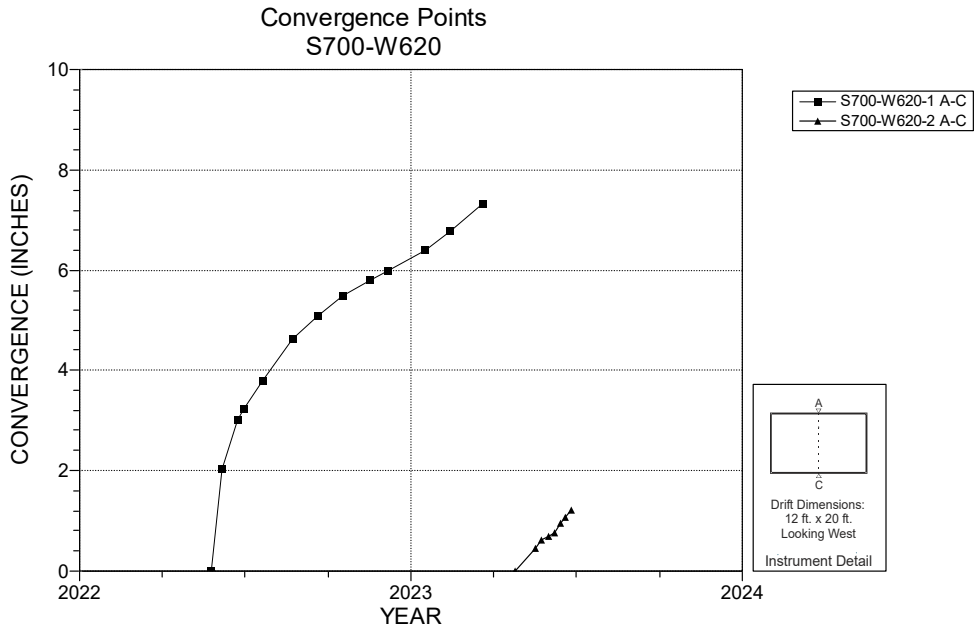
NOTES:
1. Excavation date: April 2022.

Figure 4-167 Convergence Point Array –S700 W470 – Roof to Floor



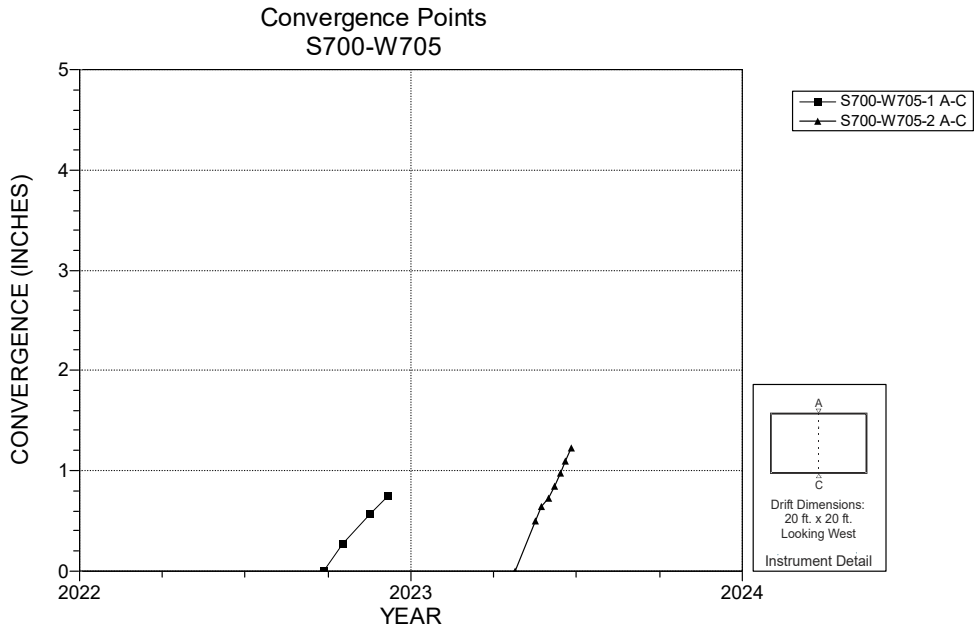
NOTES:
1. Excavation date: April 2022.

Figure 4-168 Convergence Point Array – S700 W545 – Roof to Floor



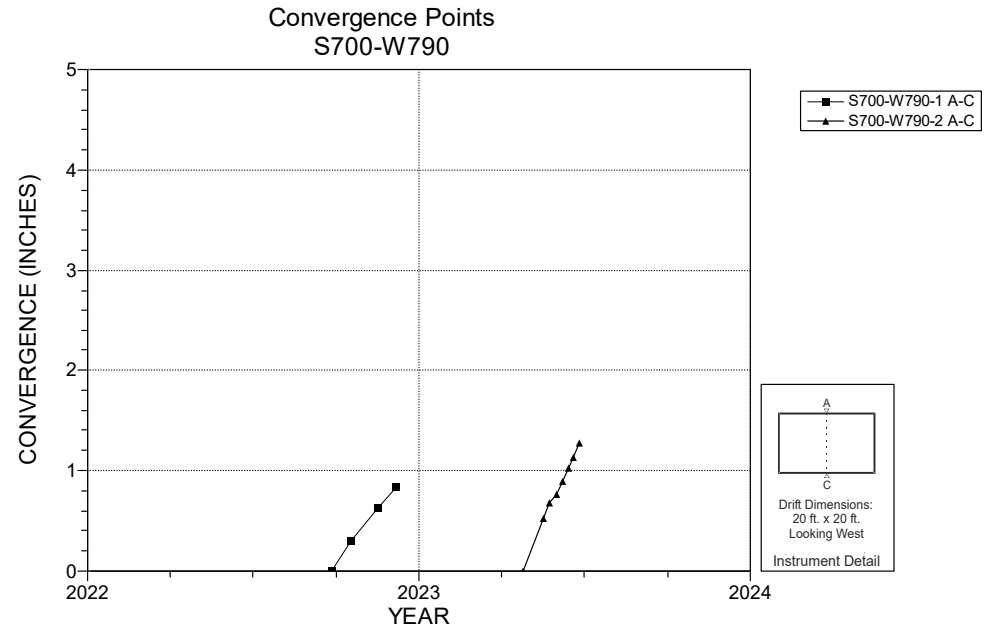
NOTES:
1. Excavation date: May 2022.

Figure 4-169 Convergence Point Array – S700 W620 – Roof to Floor



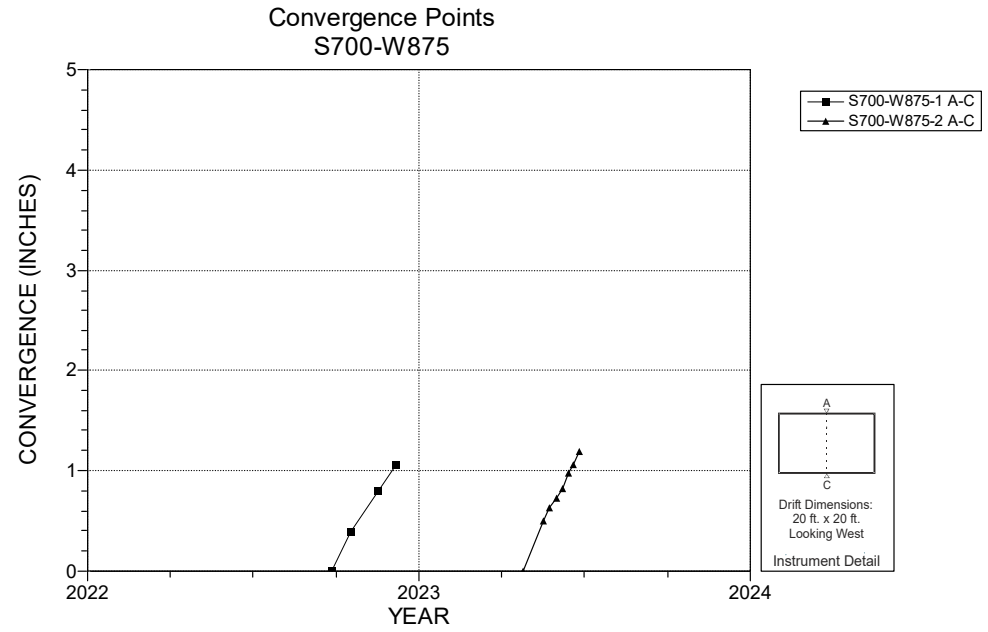
NOTES:
1. Excavation date: May 2022.

Figure 4-170 Convergence Point Array – S700 W705 – Roof to Floor



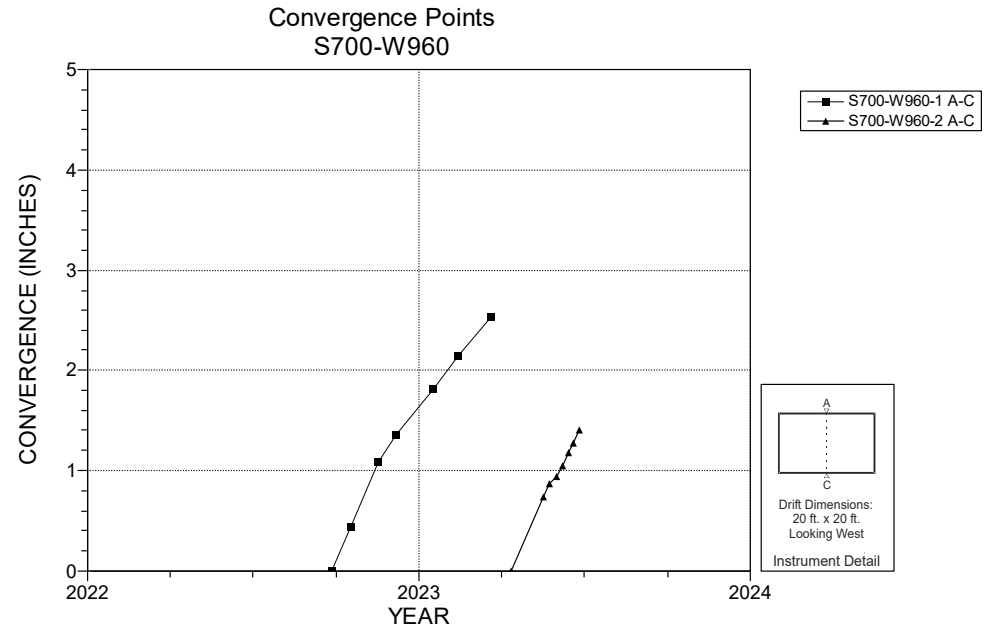
NOTES:
1. Excavation date: June 2022.

Figure 4-171 Convergence Point Array – S700 W790 – Roof to Floor



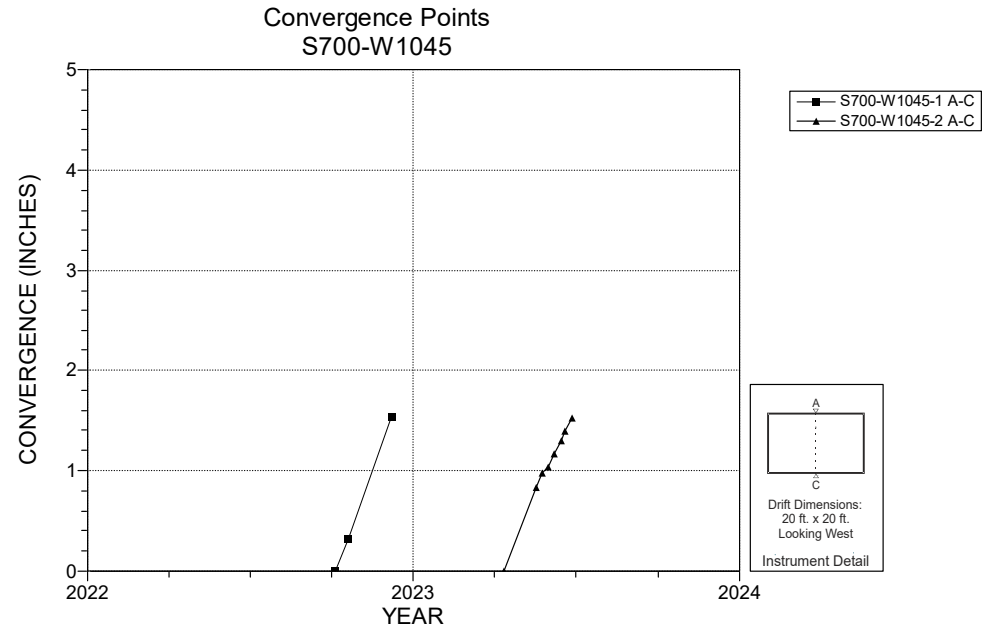
NOTES:
1. Excavation date: August 2022.

Figure 4-172 Convergence Point Array – S700 W875 – Roof to Floor



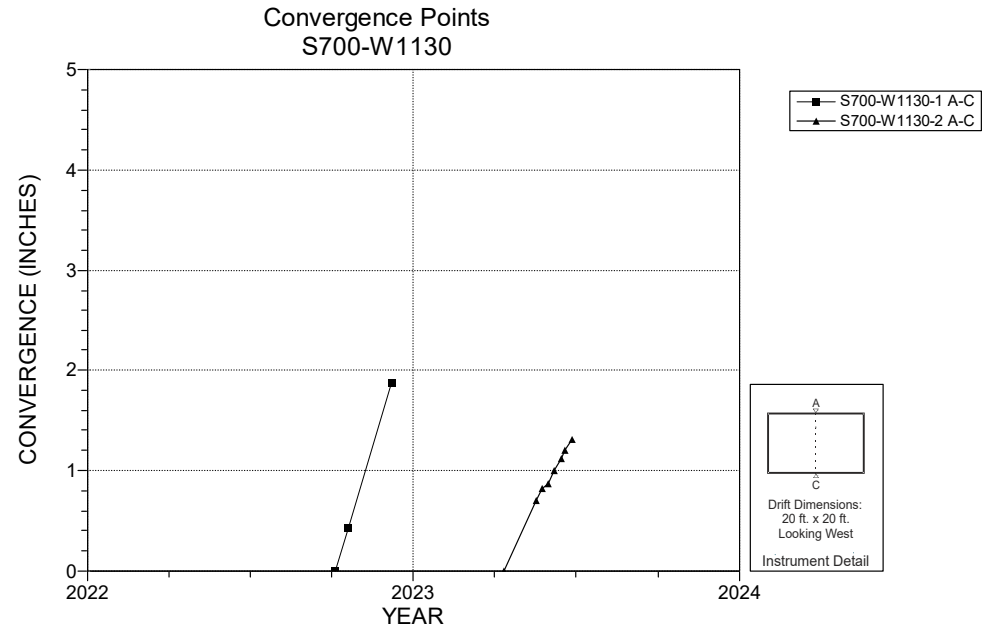
NOTES:
1. Excavation date: August 2022.

Figure 4-173 Convergence Point Array – S700 W960 – Roof to Floor



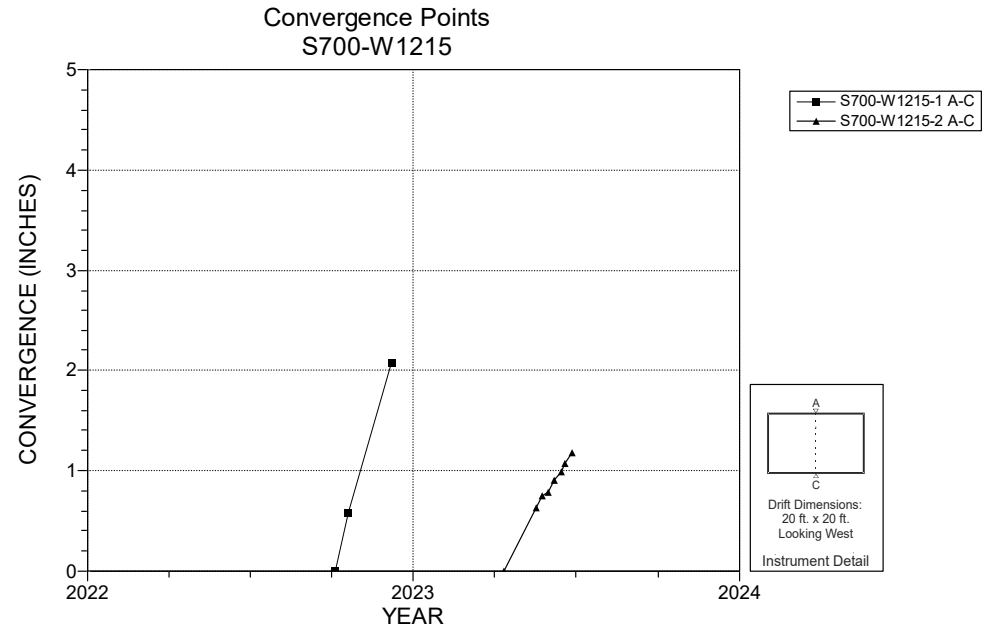
NOTES:
1. Excavation date: August 2022.

Figure 4-174 Convergence Point Array – S700 W1045 – Roof to Floor



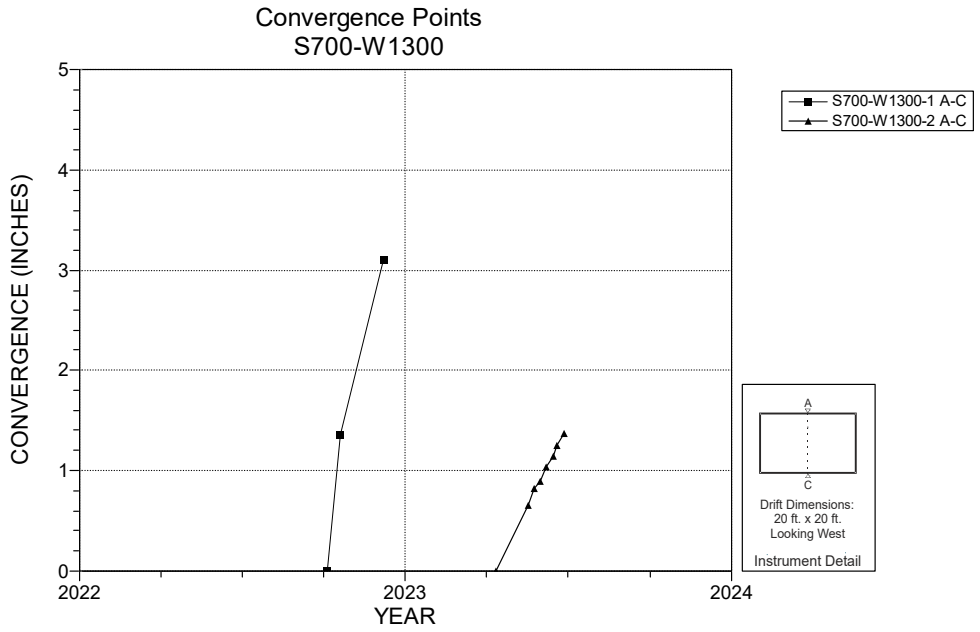
NOTES:
1. Excavation date: September 2022.

Figure 4-175 Convergence Point Array – S700 W1130 – Roof to Floor



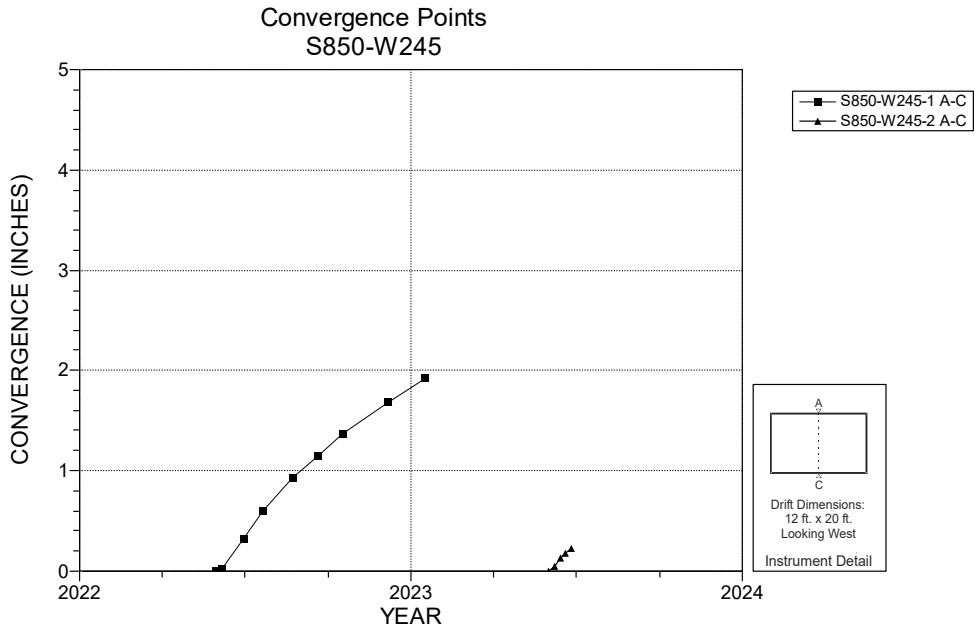
NOTES:
1. Excavation date: September 2022.

Figure 4-176 Convergence Point Array – S700 W1215 – Roof to Floor



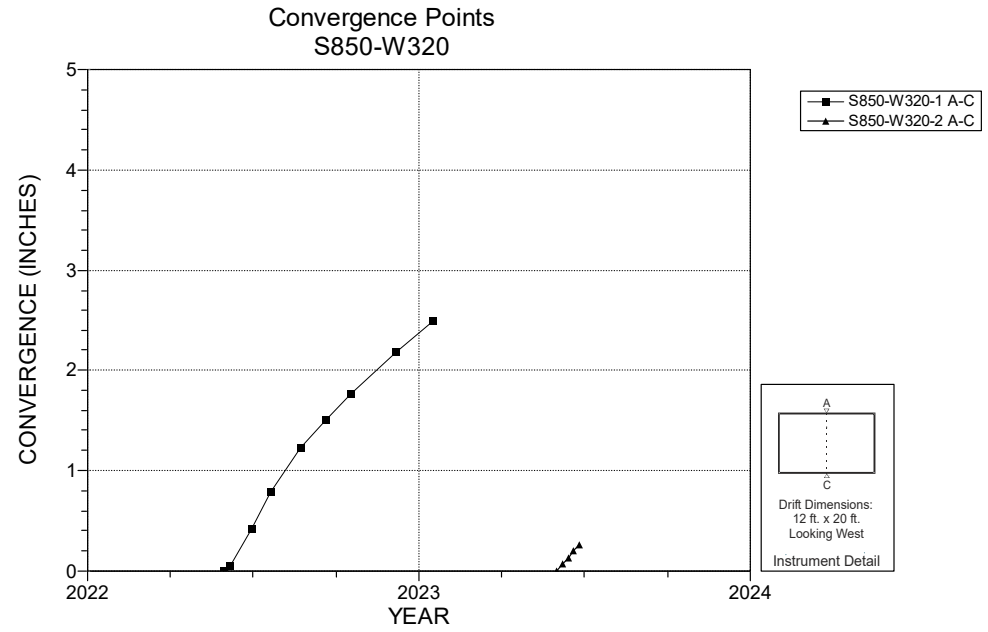
NOTES:
1. Excavation date: September 2022.

Figure 4-177 Convergence Point Array – S700 W1300 – Roof to Floor



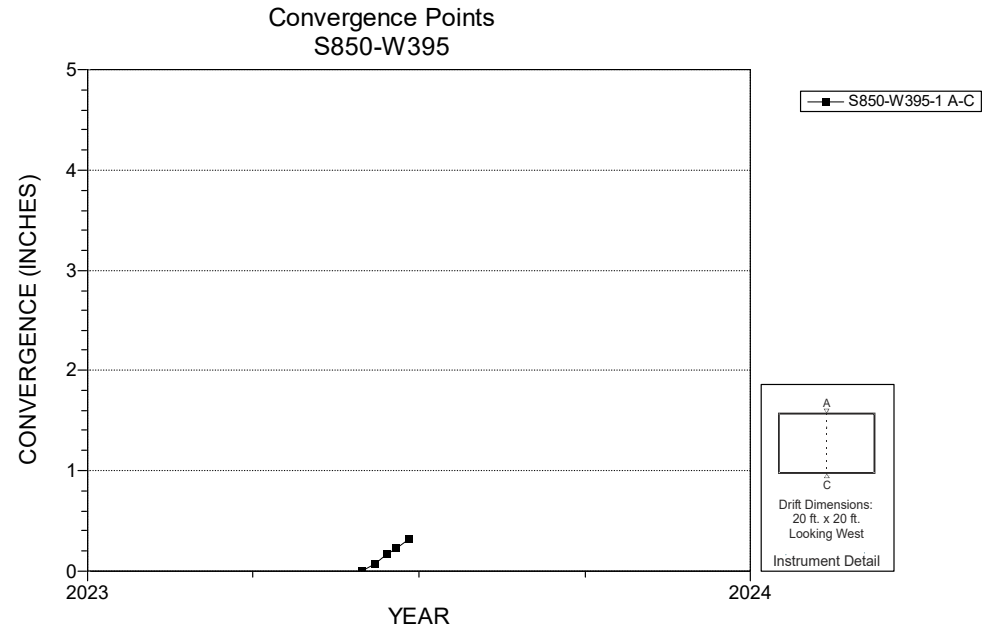
NOTES:
1. Excavation date: January 2022.

Figure 4-178 Convergence Point Array – S850 W245 – Roof to Floor



NOTES:
1. Excavation date: January 2022.

Figure 4-179 Convergence Point Array – S850 W320 – Roof to Floor



NOTES:
1. Excavation date: February 2022.

Figure 4-180 Convergence Point Array – S850 W395 – Roof to Floor

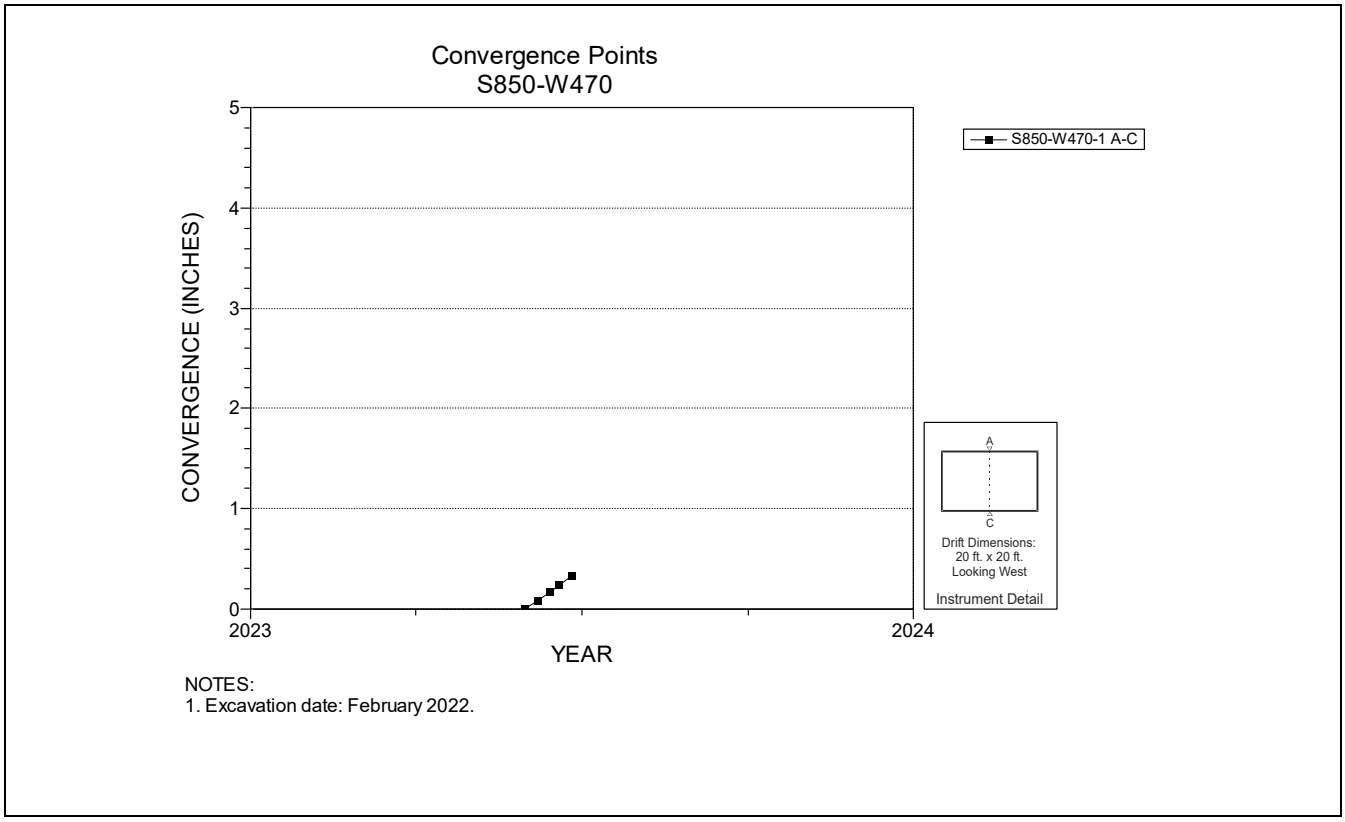


Figure 4-181 Convergence Point Array – S850 W470 – Roof to Floor

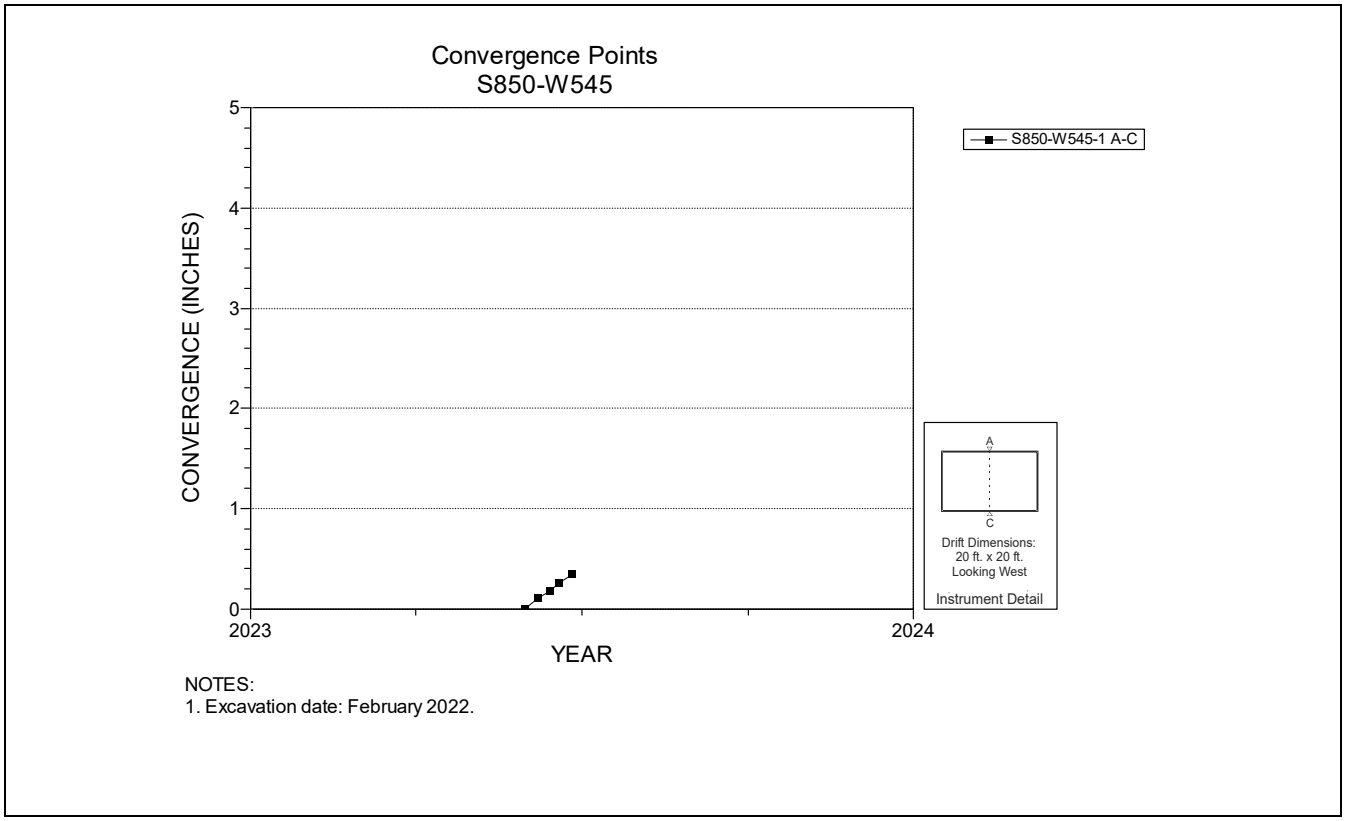


Figure 4-182 Convergence Point Array – S850 W545 – Roof to Floor

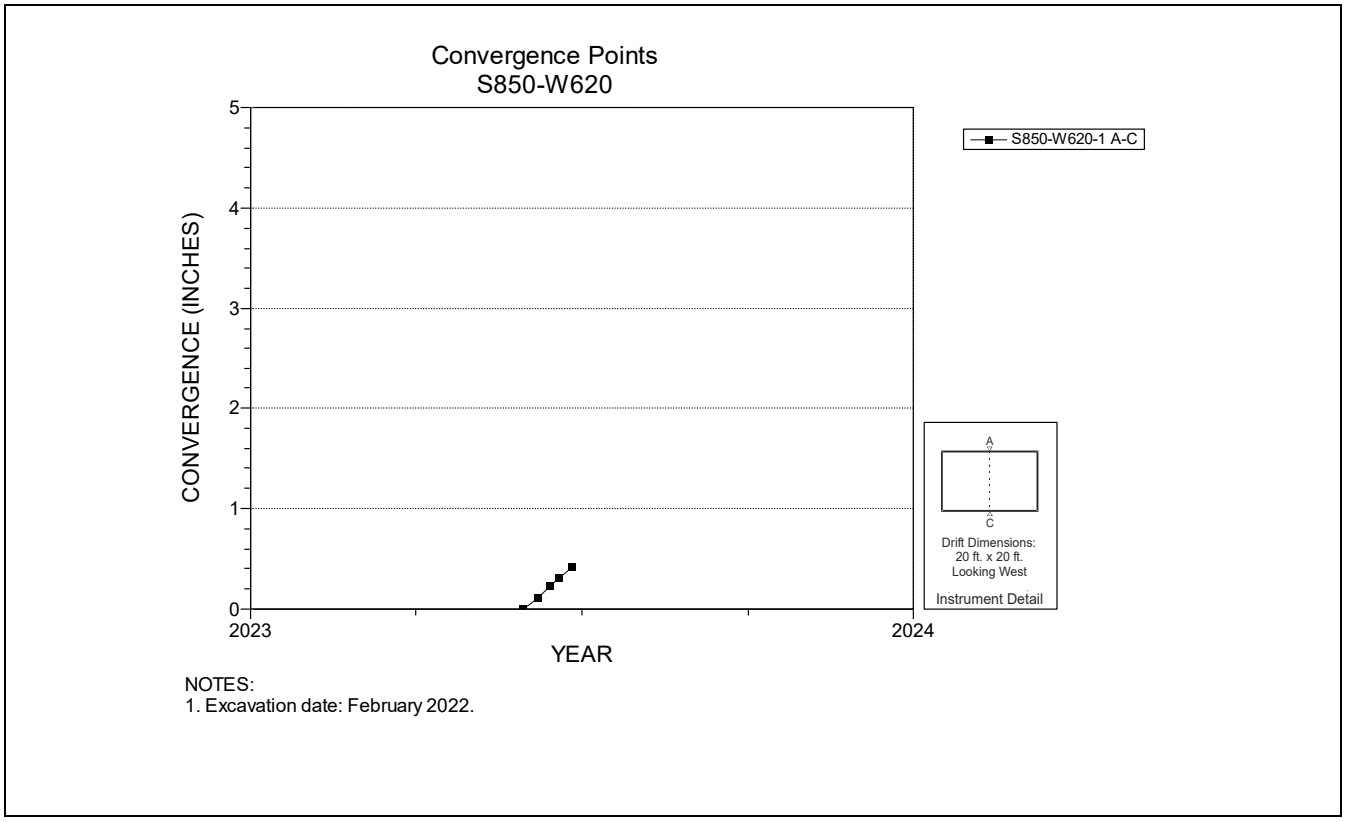


Figure 4-183 Convergence Point Array – S850 W620 – Roof to Floor

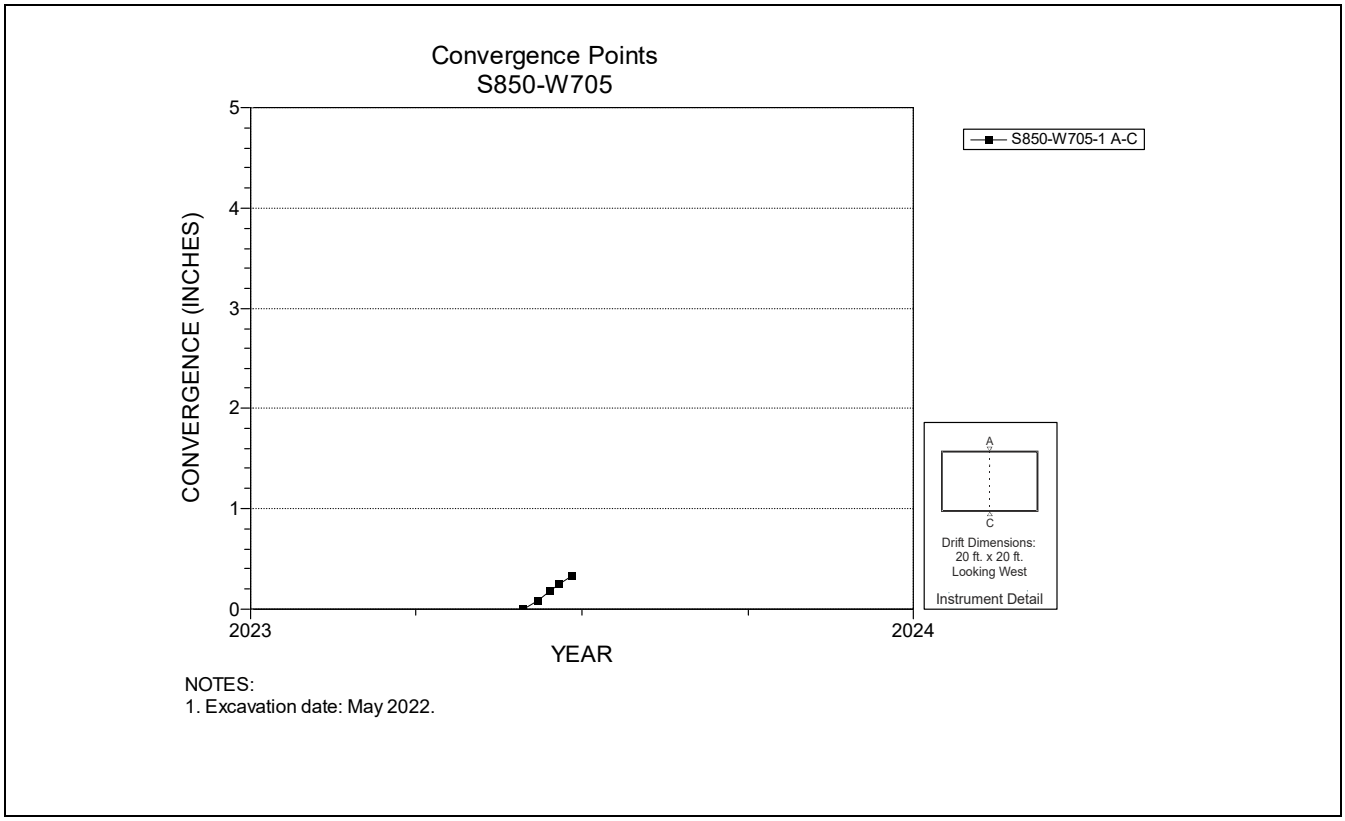


Figure 4-184 Convergence Point Array – S850 W705 – Roof to Floor

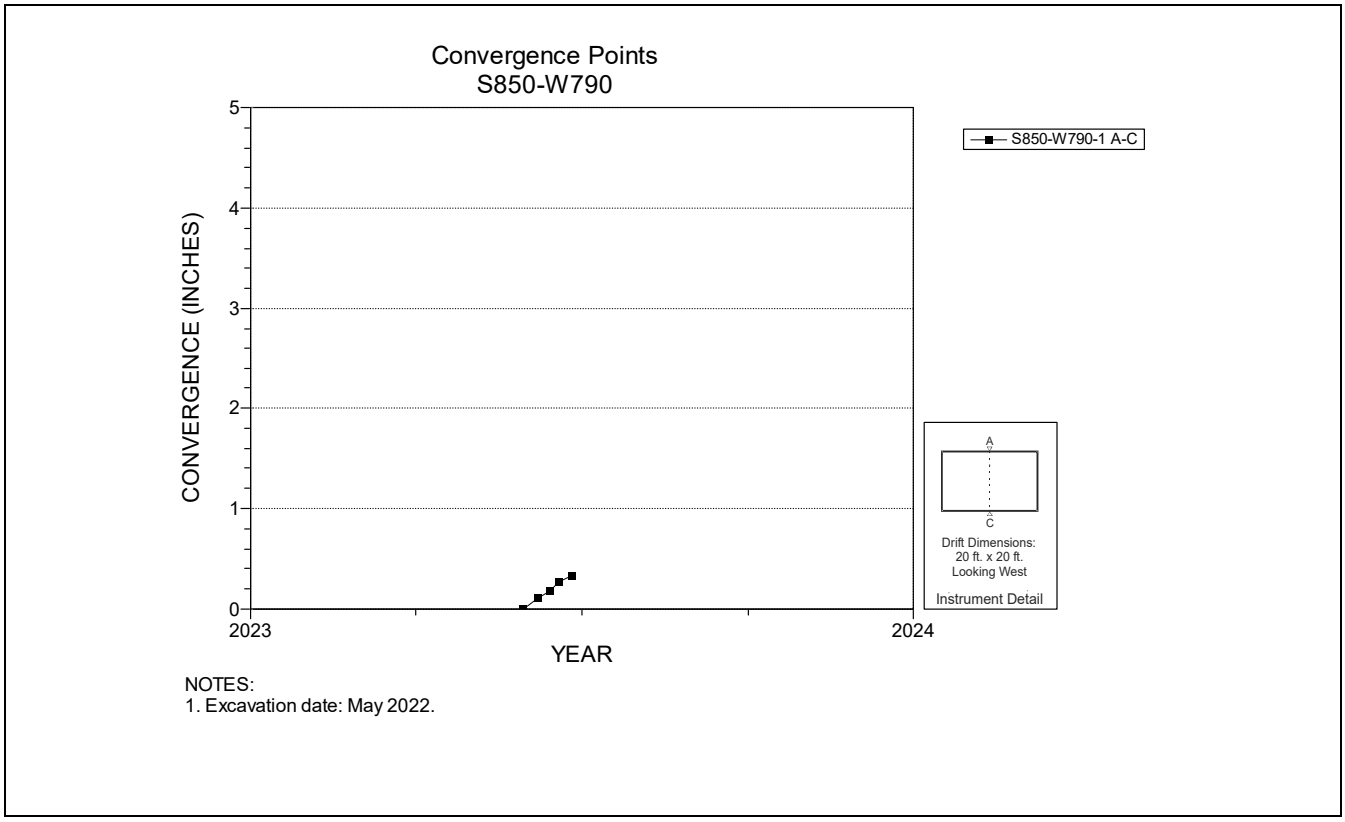


Figure 4-185 Convergence Point Array – S850 W790 – Roof to Floor

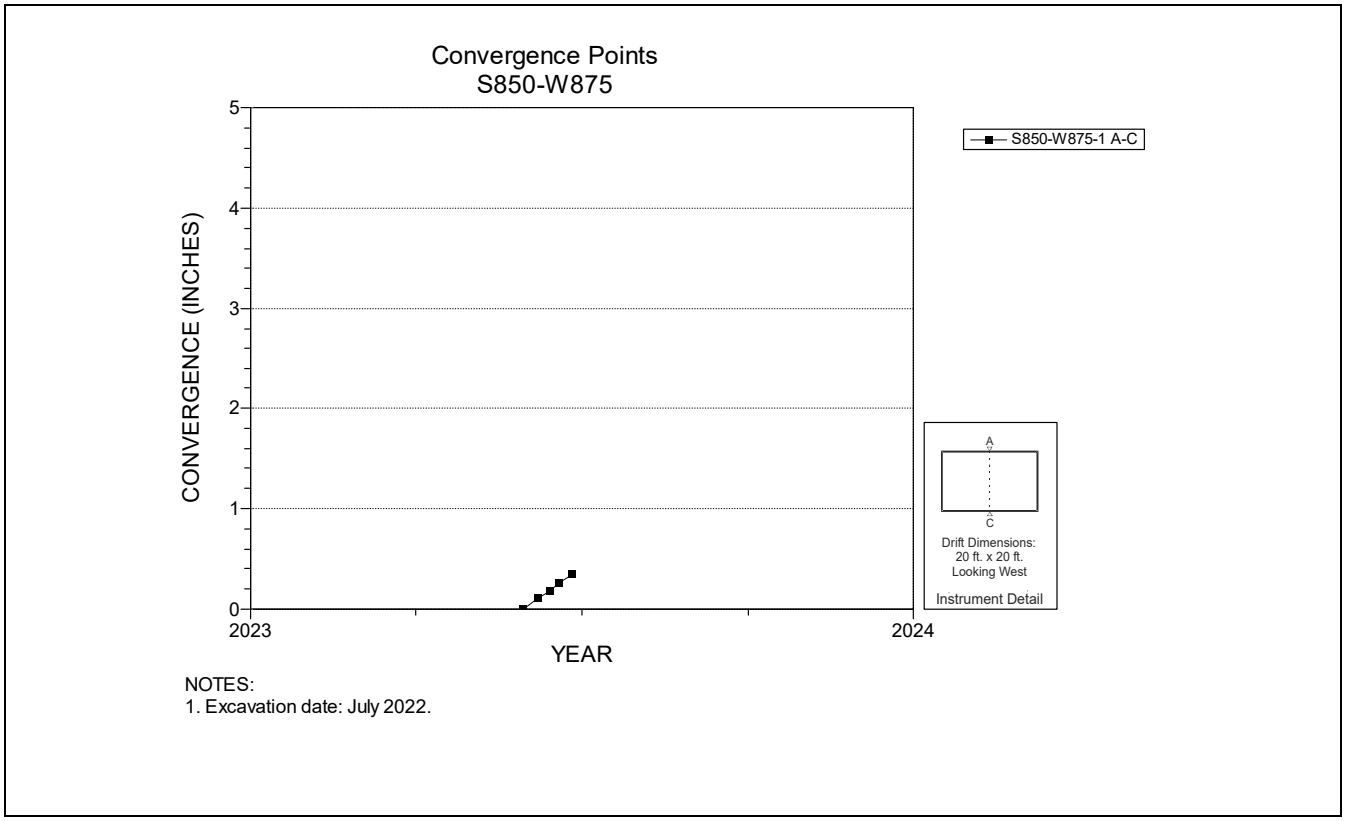


Figure 4-186 Convergence Point Array – S850 W875 – Roof to Floor

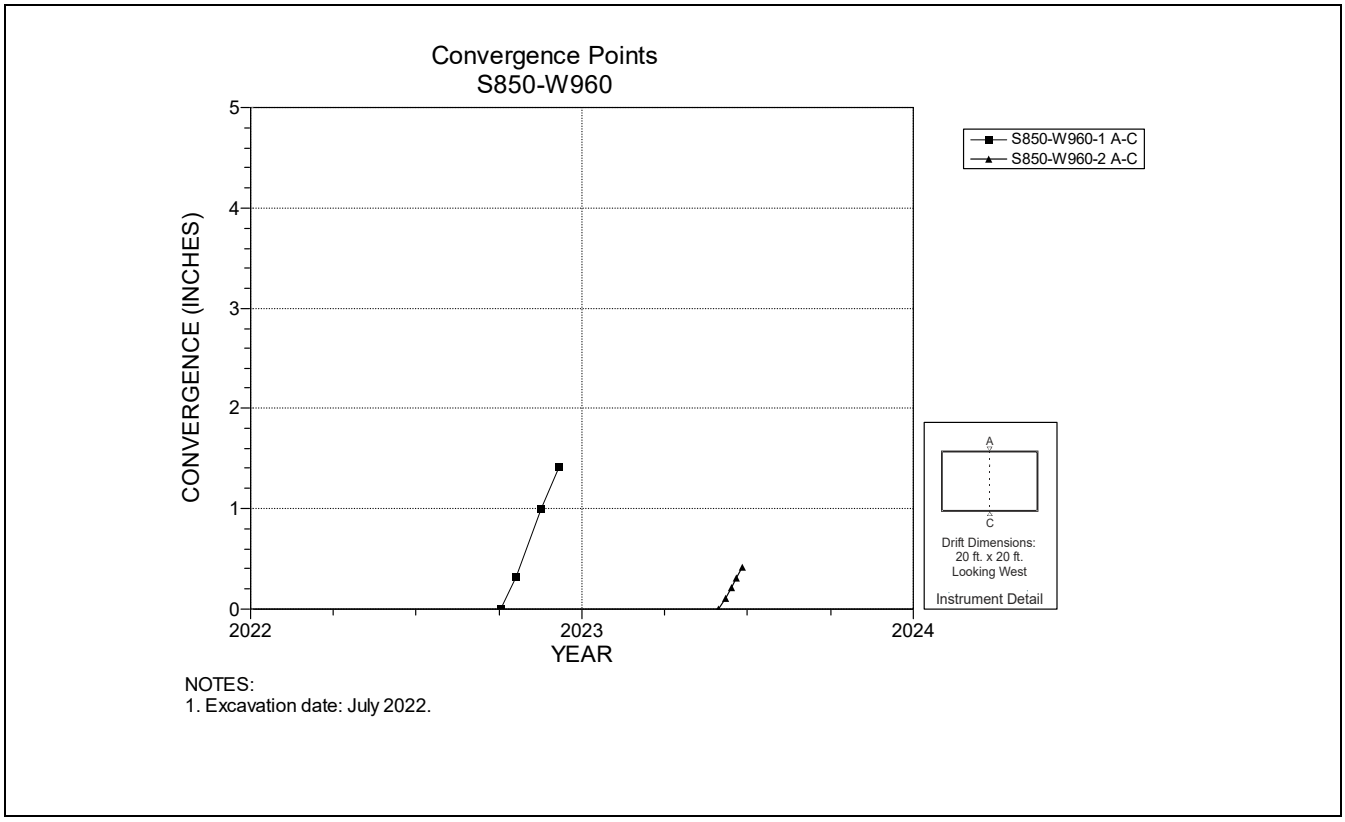


Figure 4-187 Convergence Point Array – S850 W960 – Roof to Floor

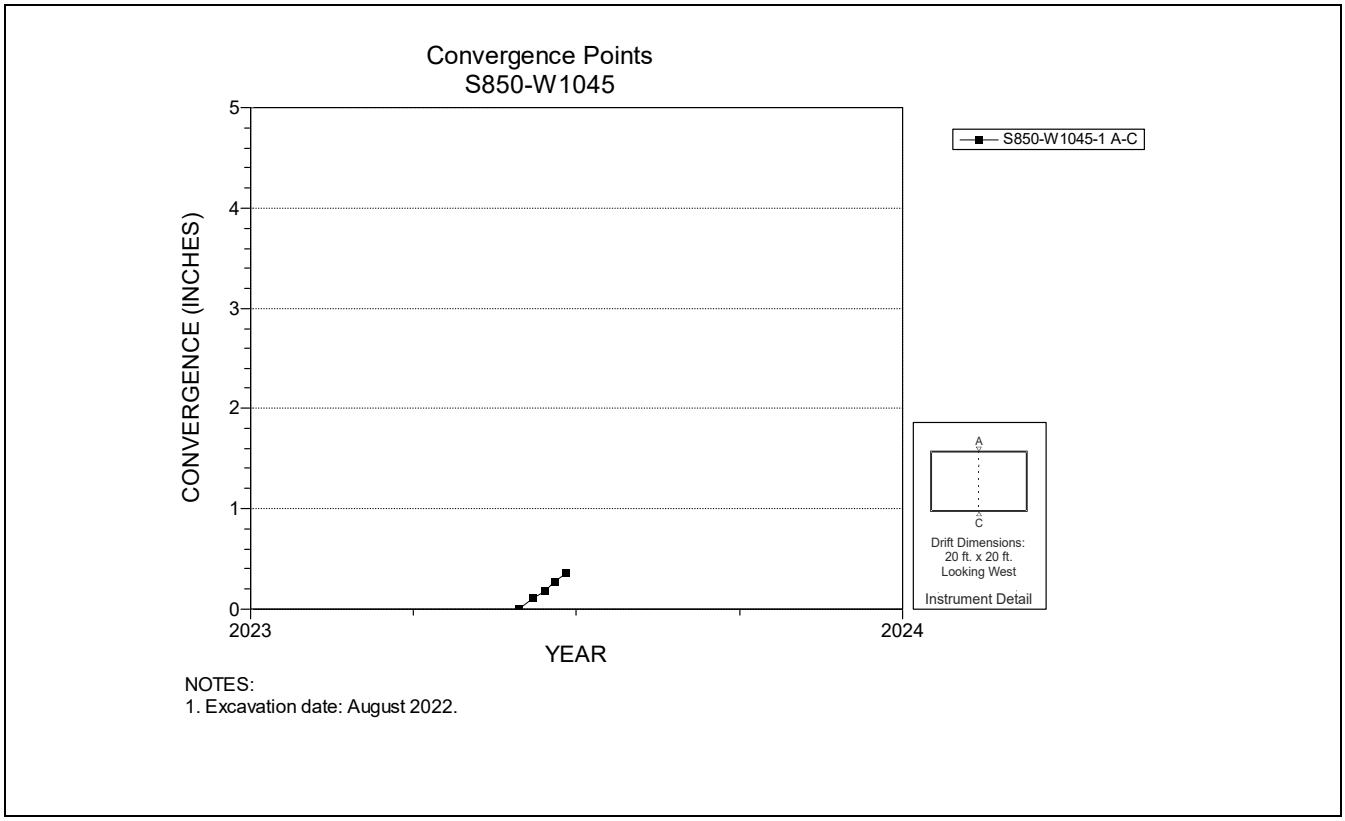


Figure 4-188 Convergence Point Array – S850 W1045 – Roof to Floor

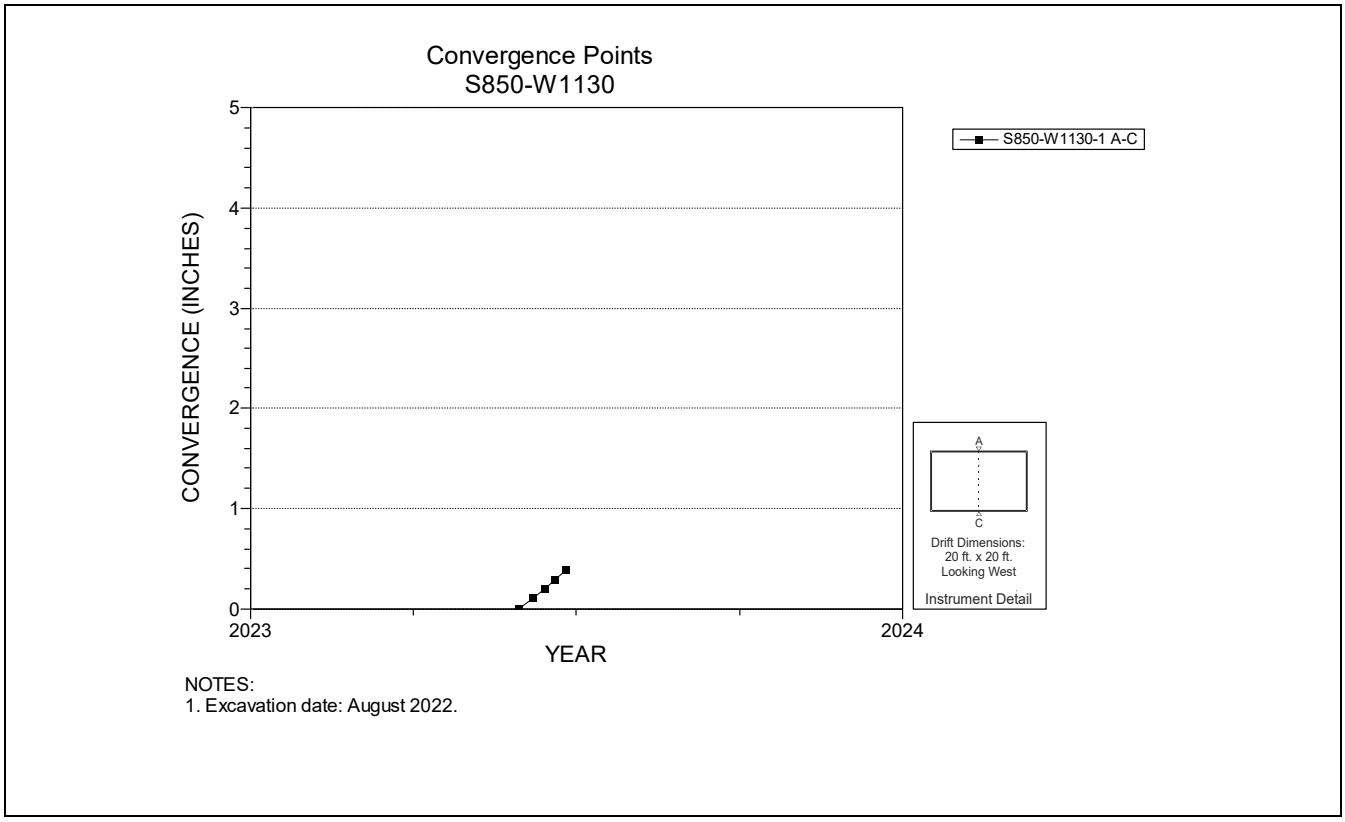


Figure 4-189 Convergence Point Array – S850 W1130 – Roof to Floor

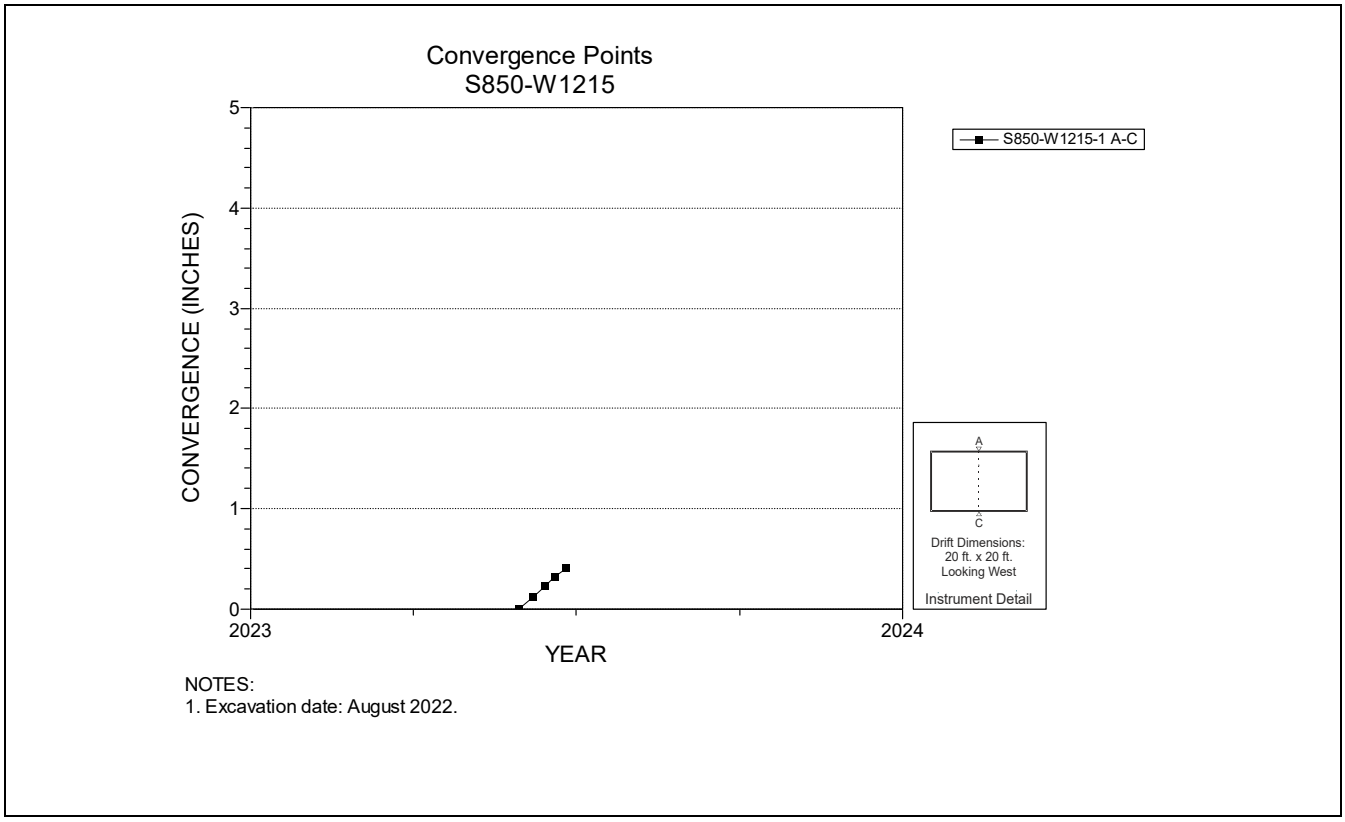


Figure 4-190 Convergence Point Array – S850 W1215 – Roof to Floor

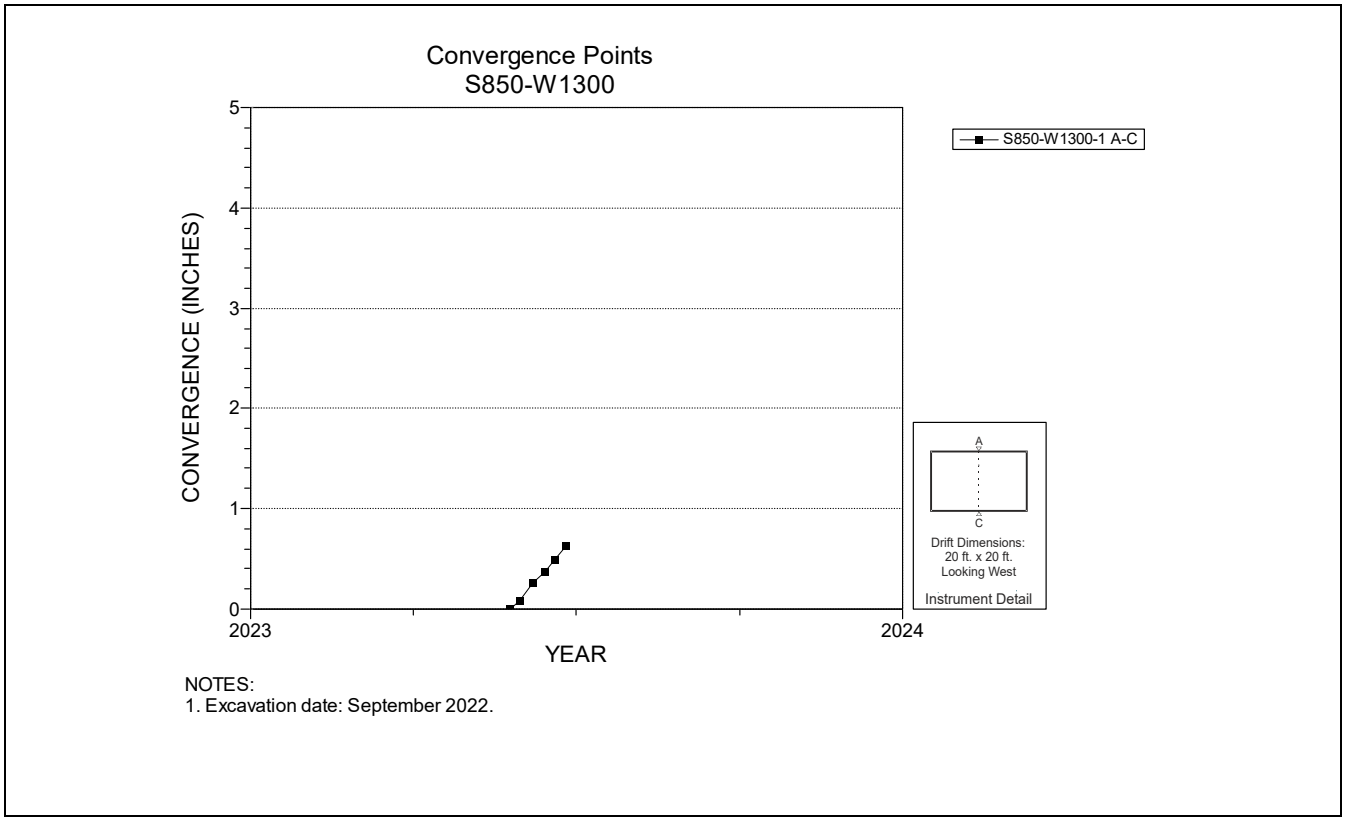


Figure 4-191 Convergence Point Array – S850 W1300 – Roof to Floor

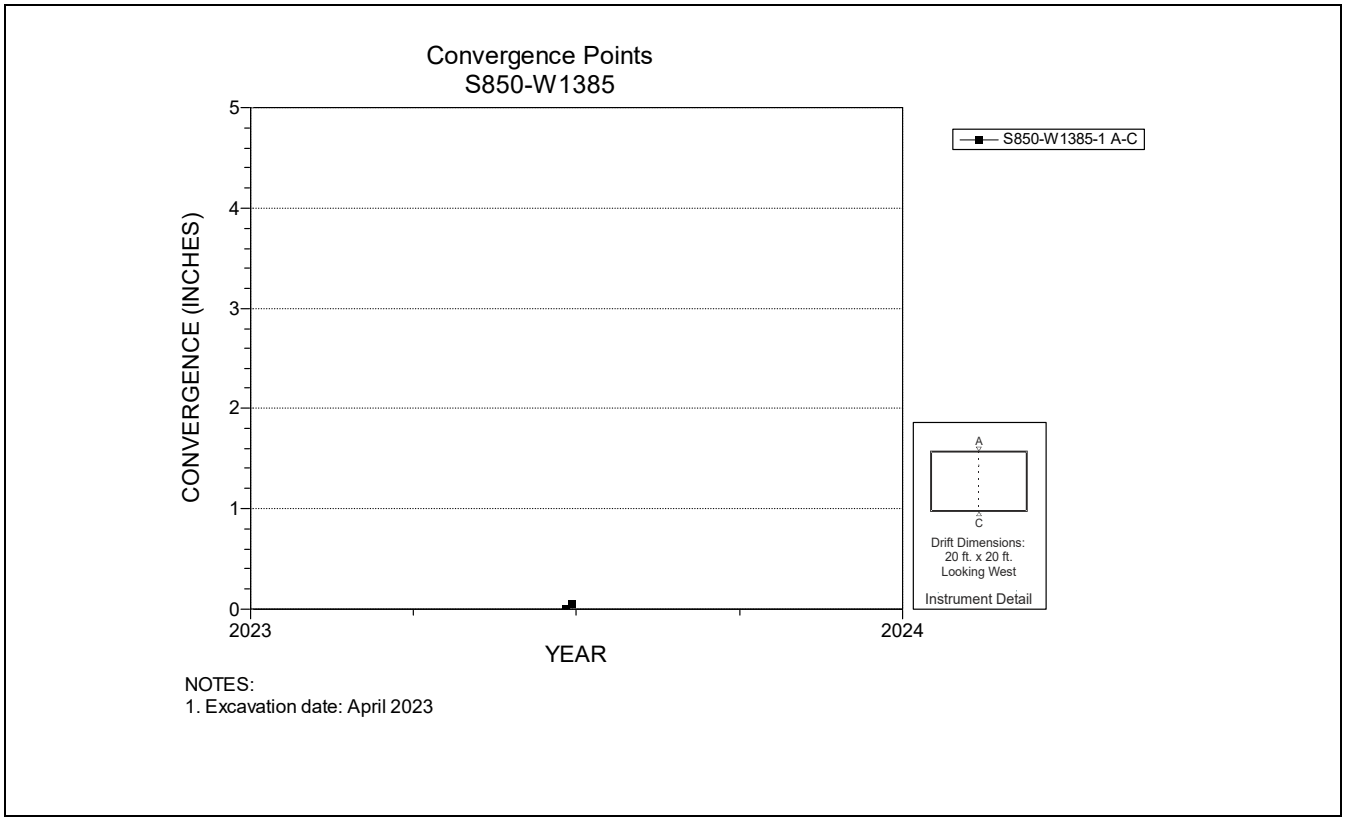


Figure 4-192 Convergence Point Array – S850 W1385 – Roof to Floor

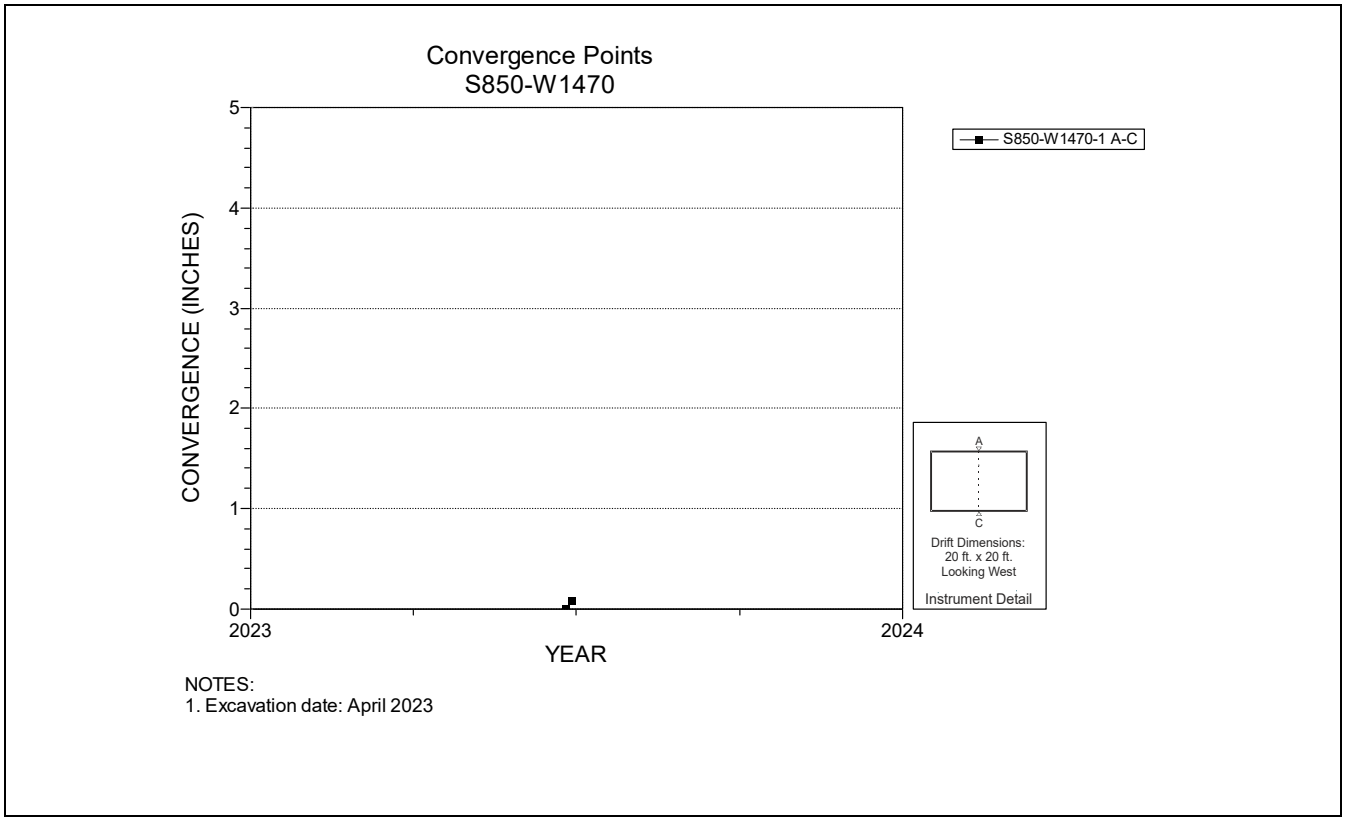


Figure 4-193 Convergence Point Array – S850 W1470 – Roof to Floor

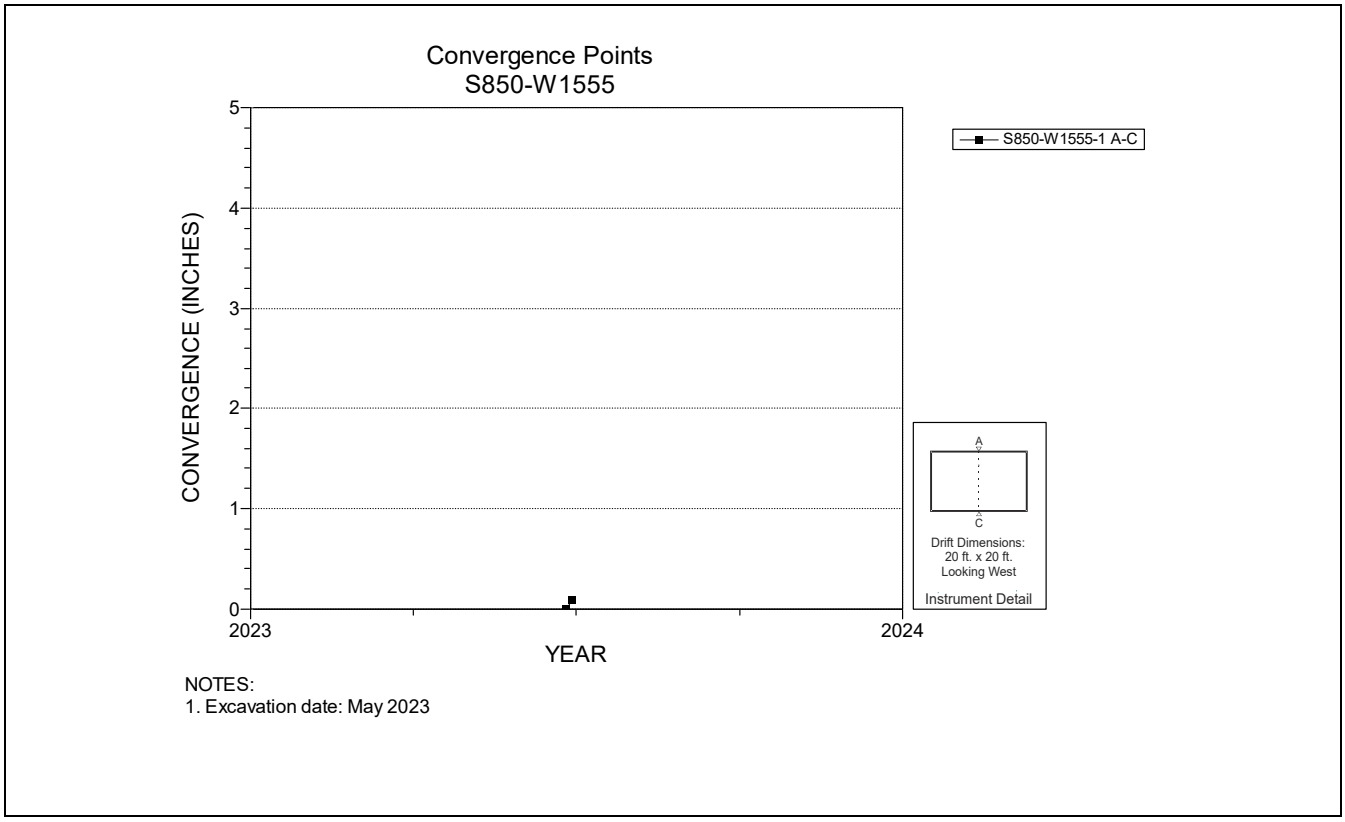
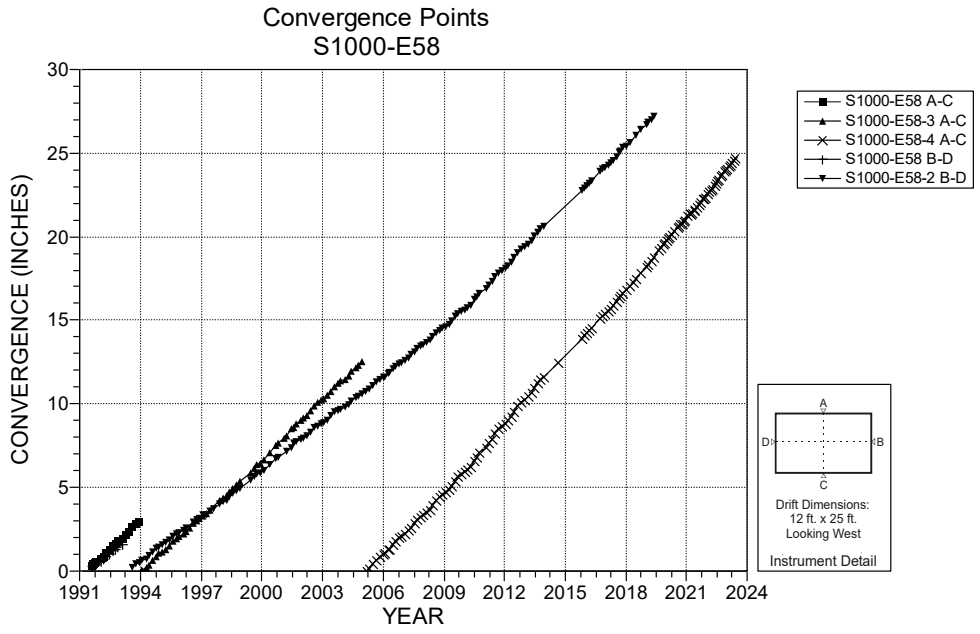
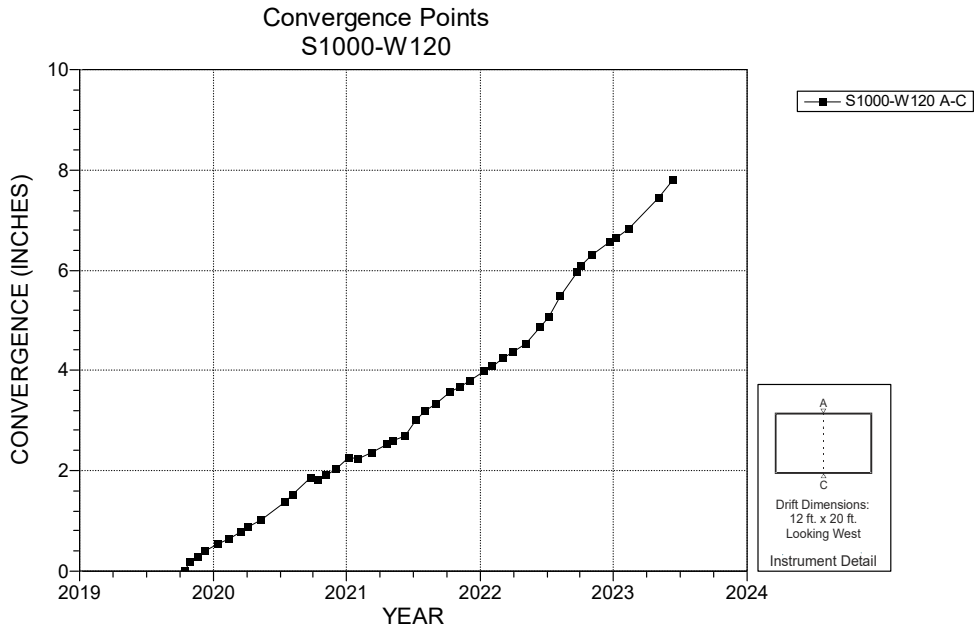


Figure 4-194 Convergence Point Array – S850 W1555 – Roof to Floor



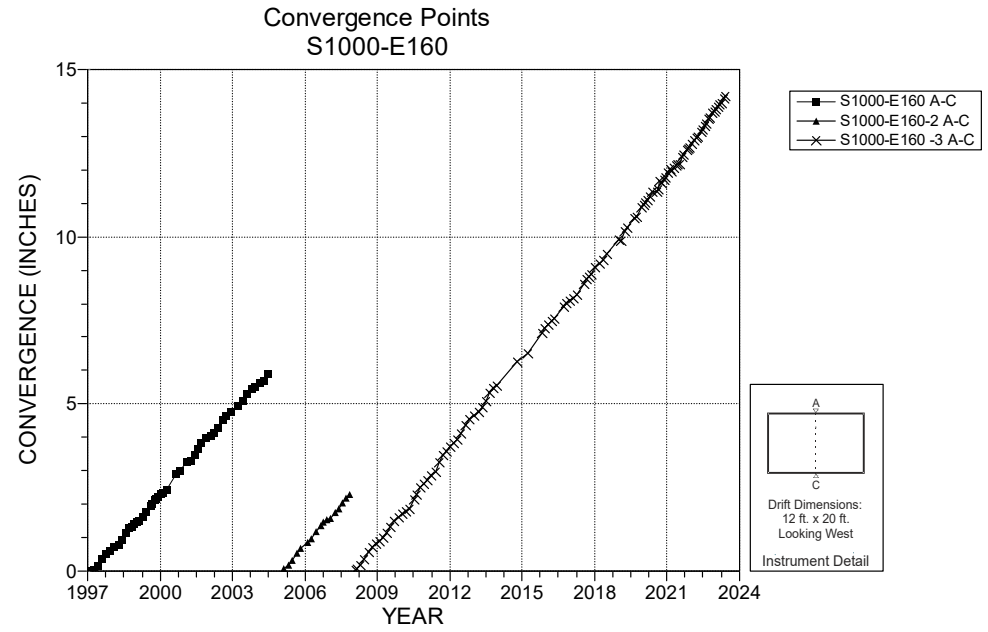
NOTES:
1. Excavation date: July 1984.

Figure 4-195 Convergence Point Array – S1000 E58 – All Chords



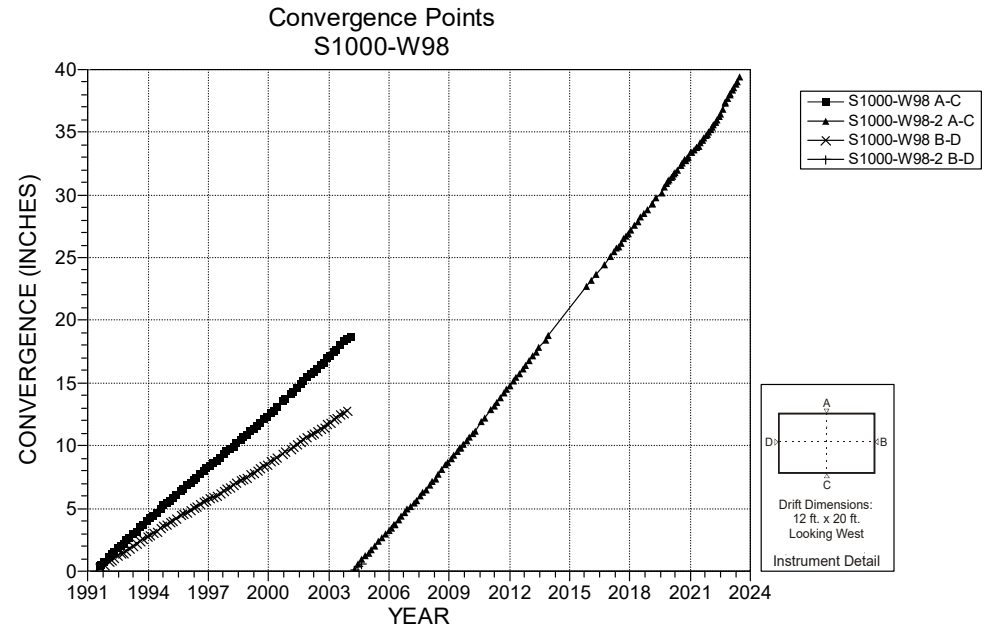
NOTES:
1. Excavation date: August 1985.

Figure 4-196 Convergence Point Array – S1000 W120 – Roof to Floor



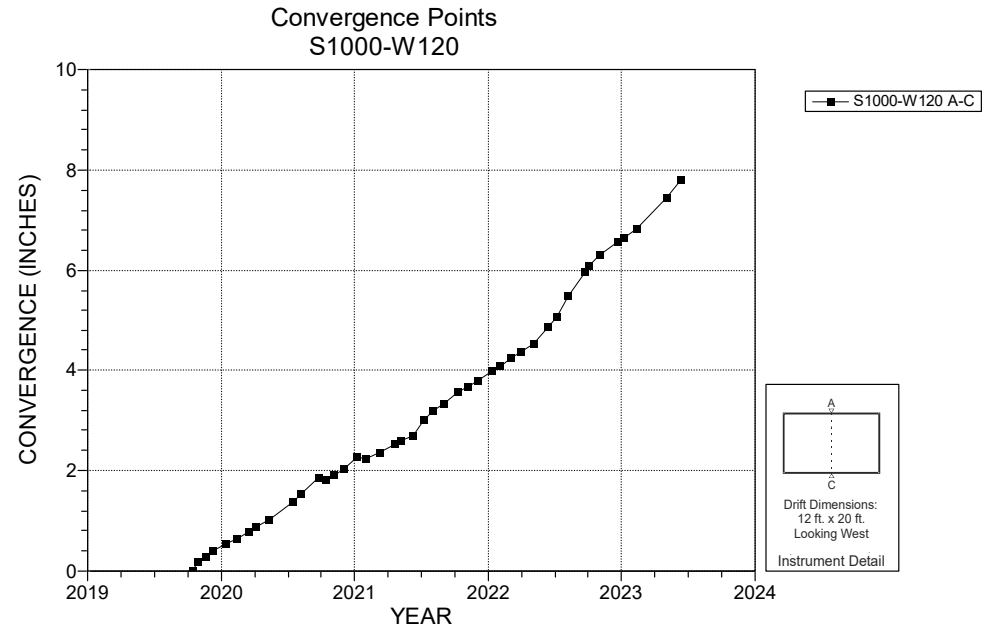
NOTES:
1. Excavation date: September 1985.
2. Reinstalled 'C' point, January 2008.

Figure 4-197 Convergence Point Array – S1000 E160 – Roof to Floor



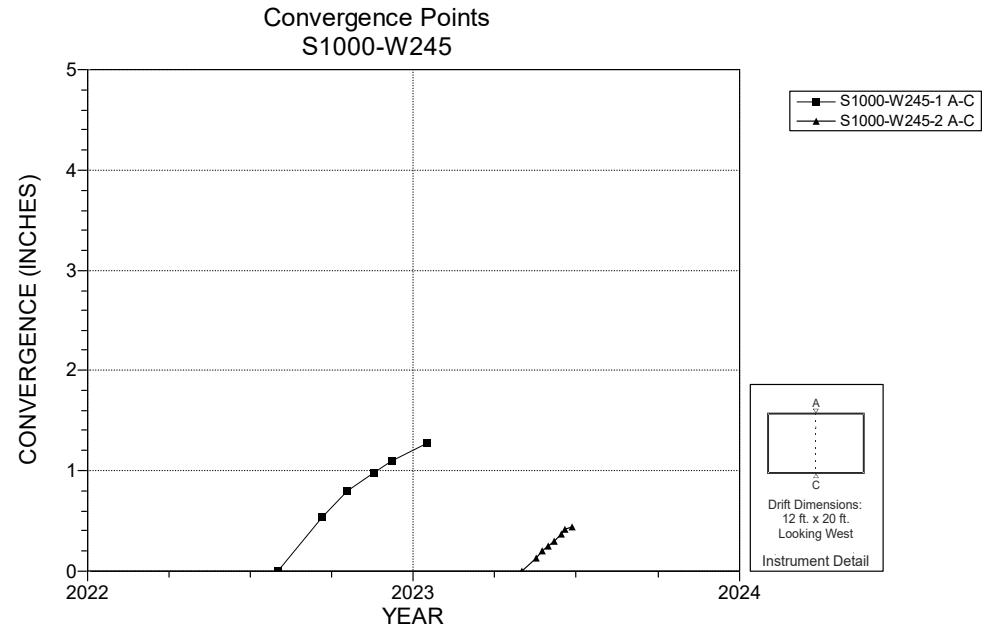
NOTES:
1. Excavation date: August 1985.

Figure 4-198 Convergence Point Array – S1000 W98 – All Chords



NOTES:
1. Excavation date: August 1985.

Figure 4-199 Convergence Point Array – S1000 W120 – Roof to Floor



NOTES:
1. Excavation date: July 2022.

Figure 4-200 Convergence Point Array – S1000 W245 – Roof to Floor

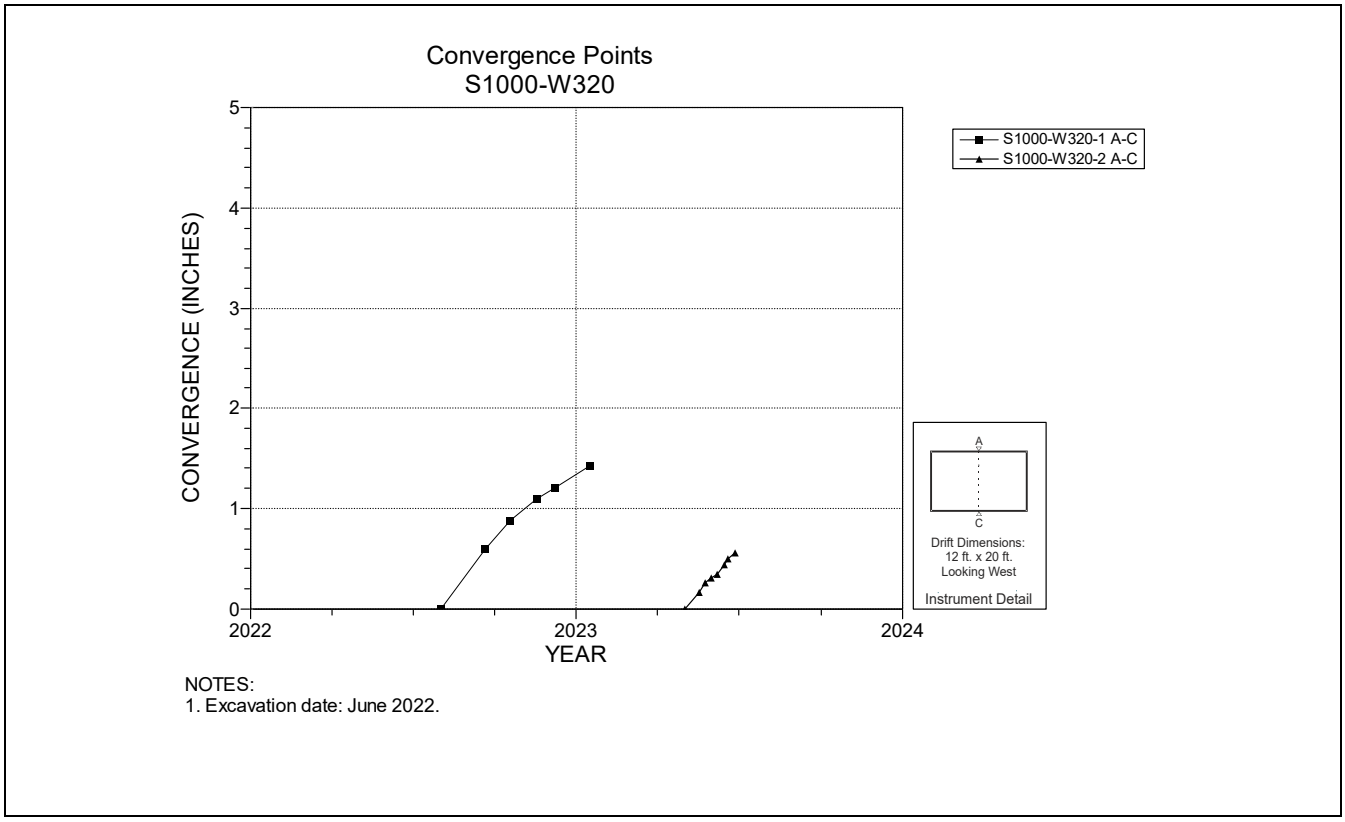


Figure 4-201 Convergence Point Array – S1000 W320 – Roof to Floor

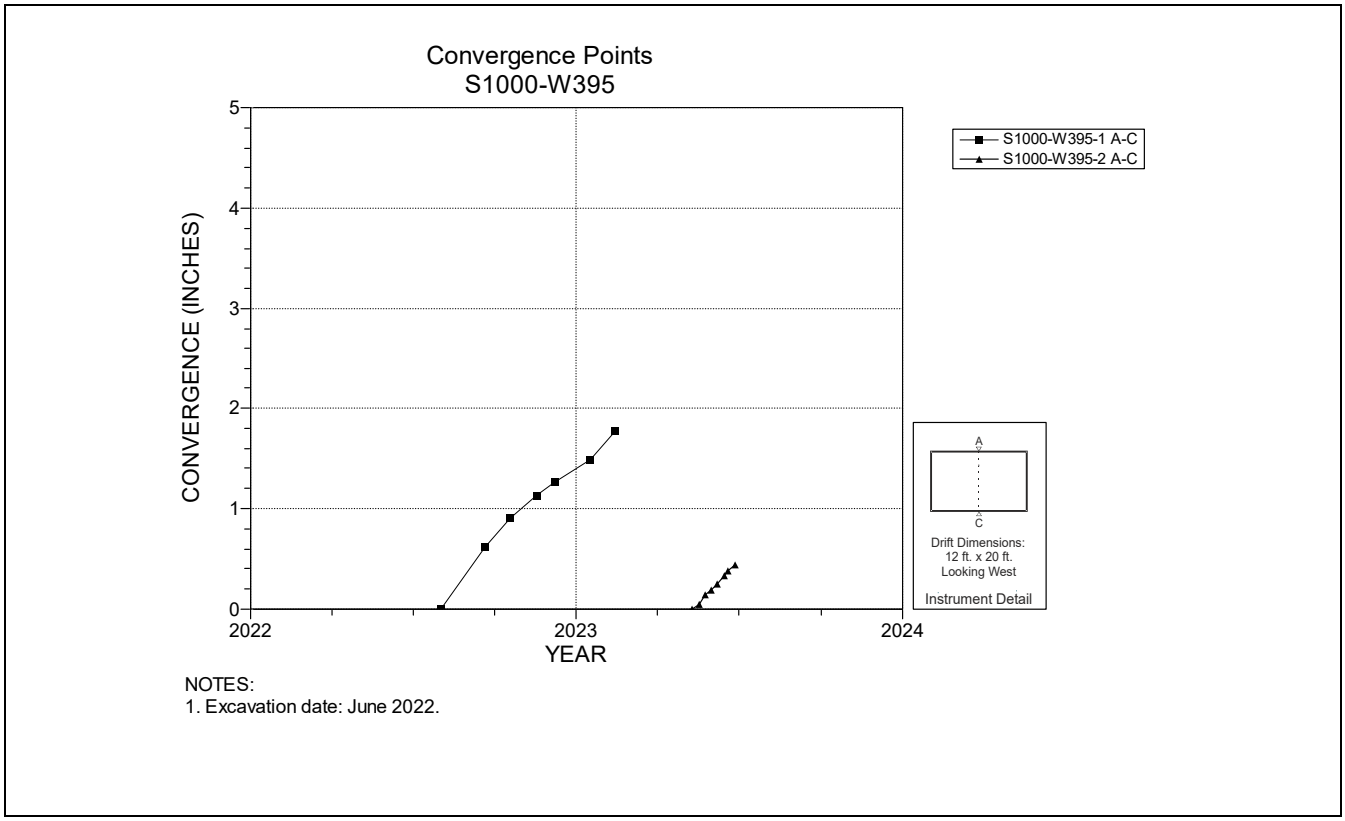


Figure 4-202 Convergence Point Array – S1000 W395 – Roof to Floor

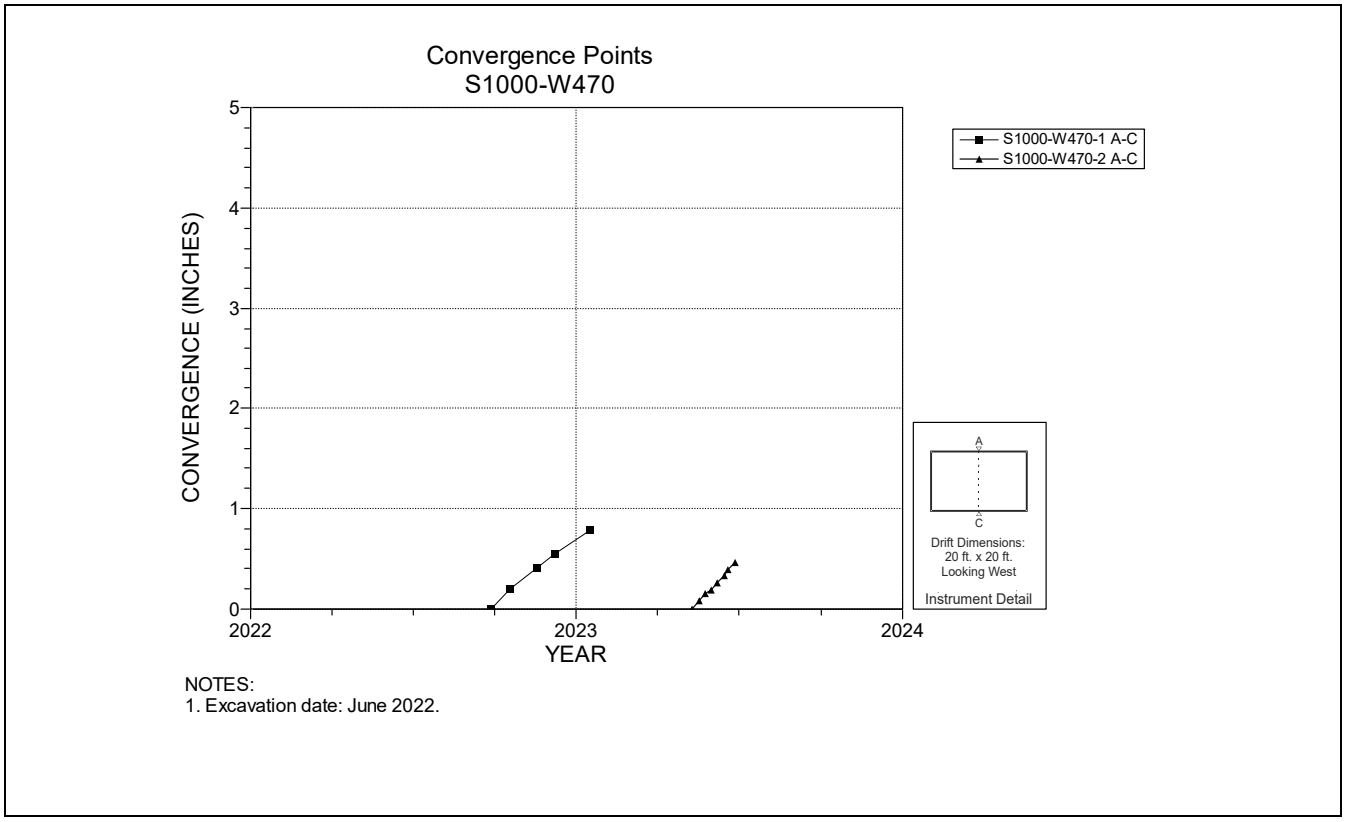


Figure 4-203 Convergence Point Array – S1000 W470 – Roof to Floor

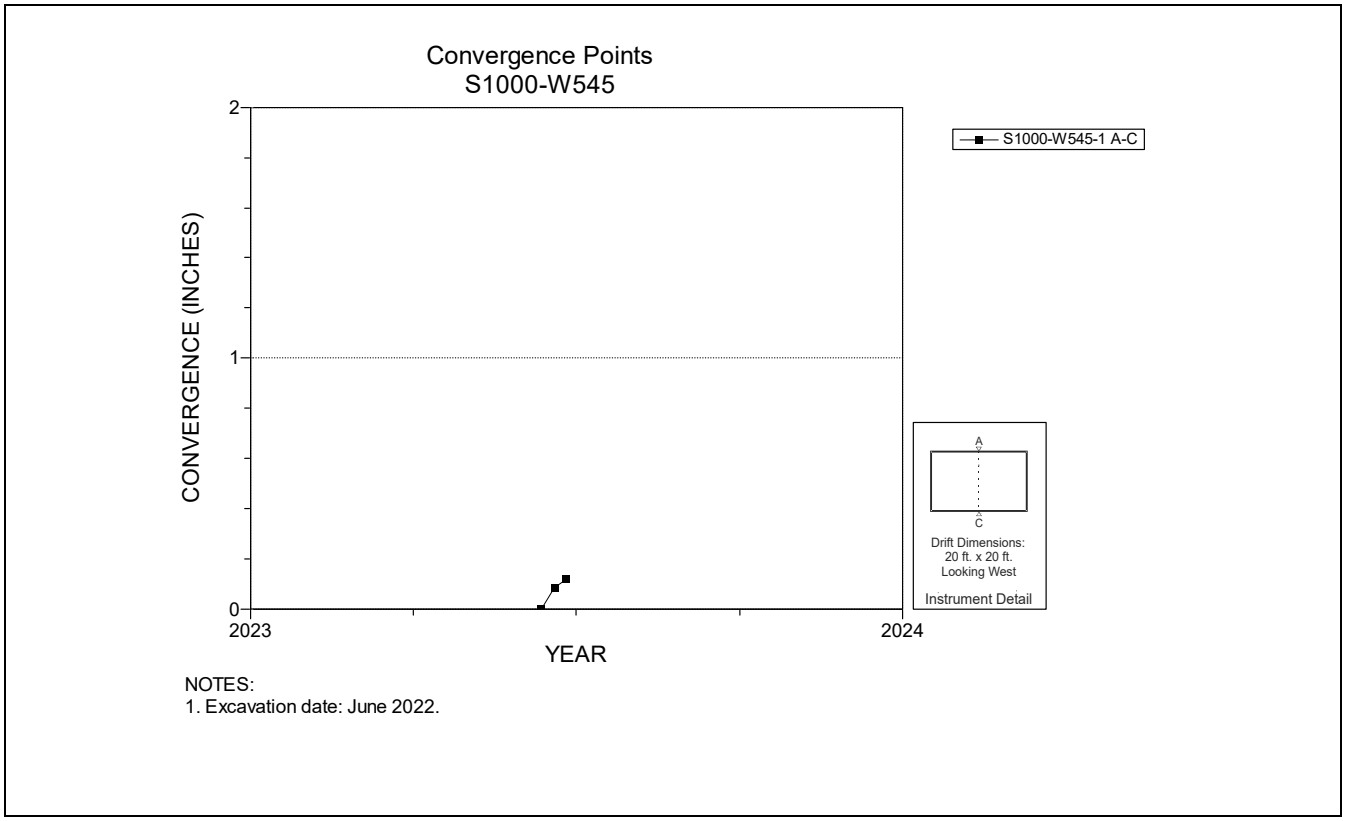


Figure 4-204 Convergence Point Array – S1000 W545 – Roof to Floor

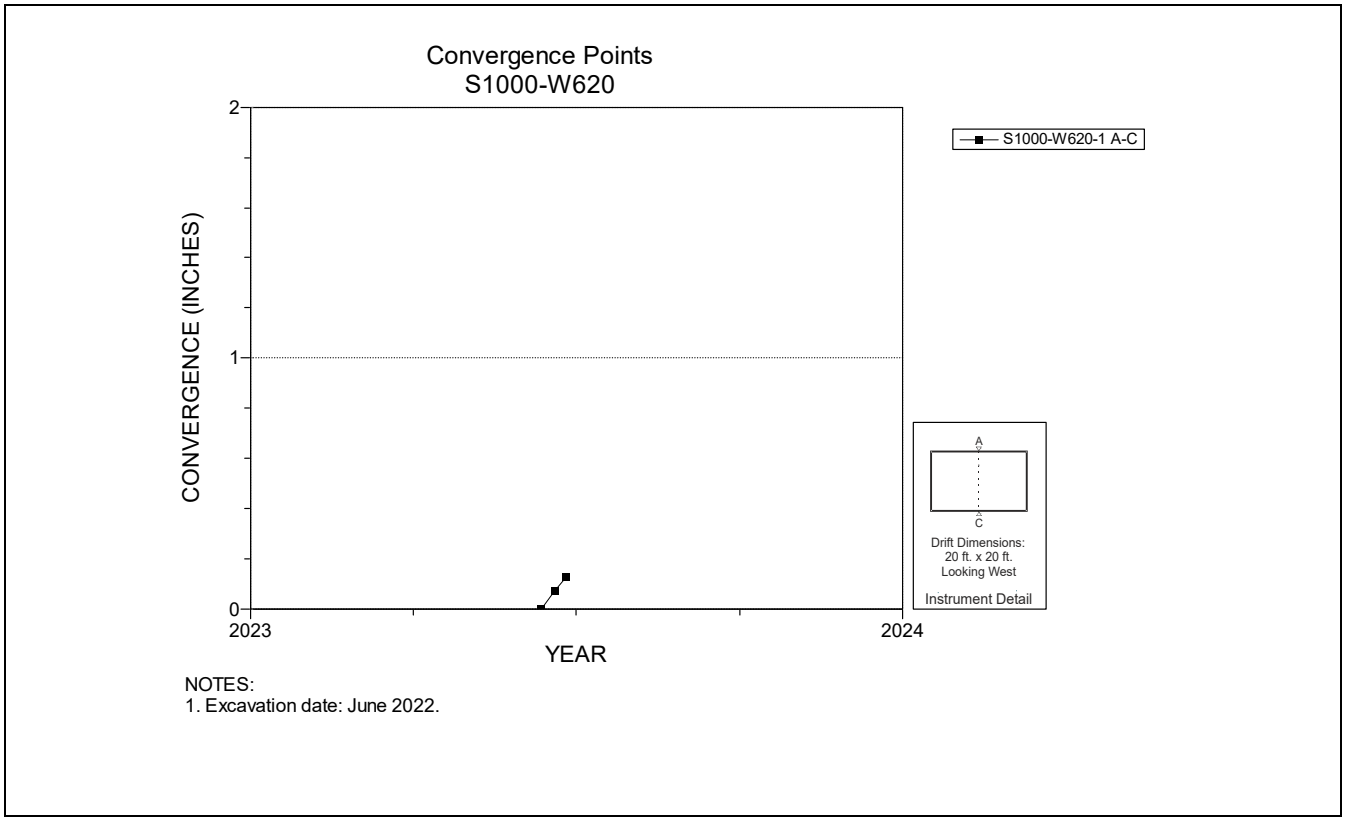


Figure 4-205 Convergence Point Array – S1000 W620 – Roof to Floor

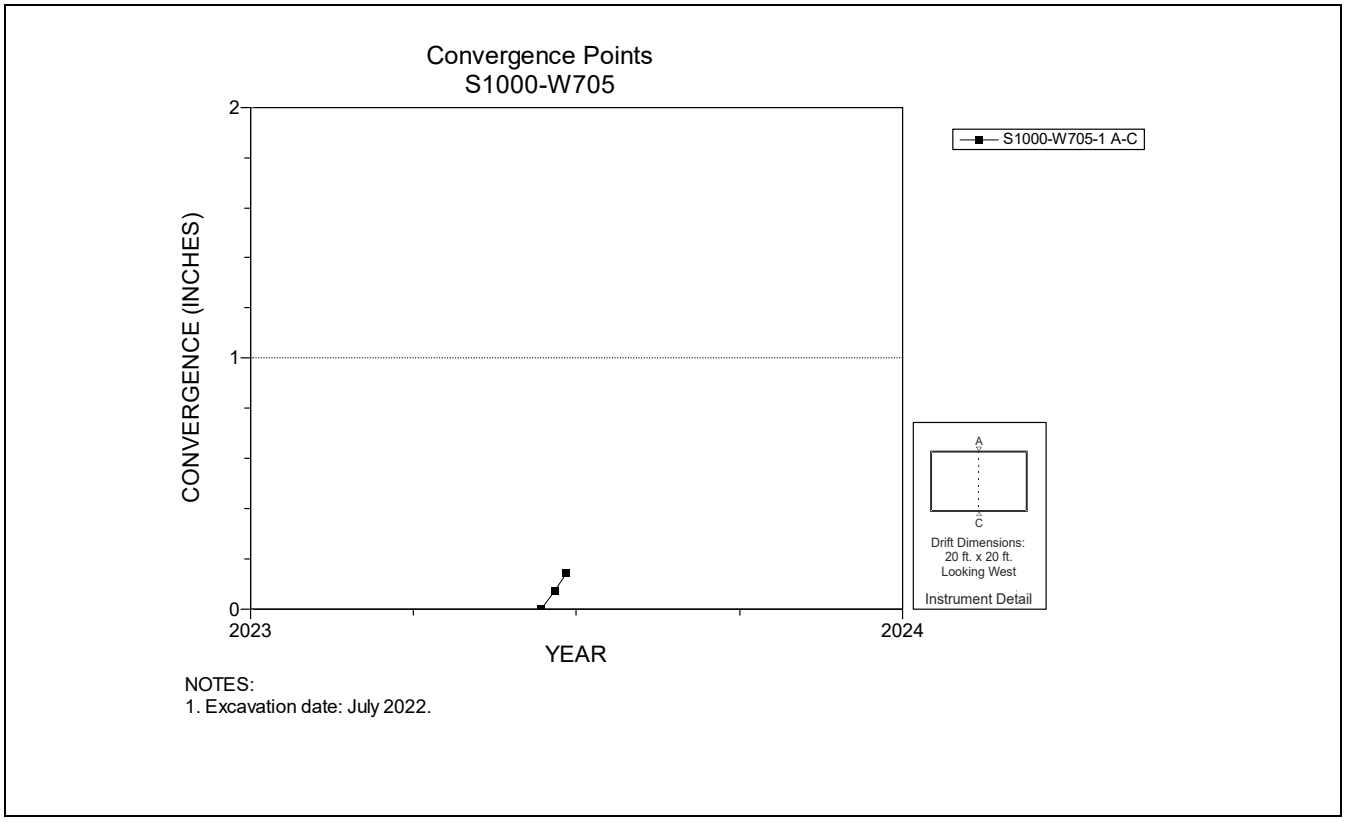


Figure 4-206 Convergence Point Array – S1000 W705 – Roof to Floor

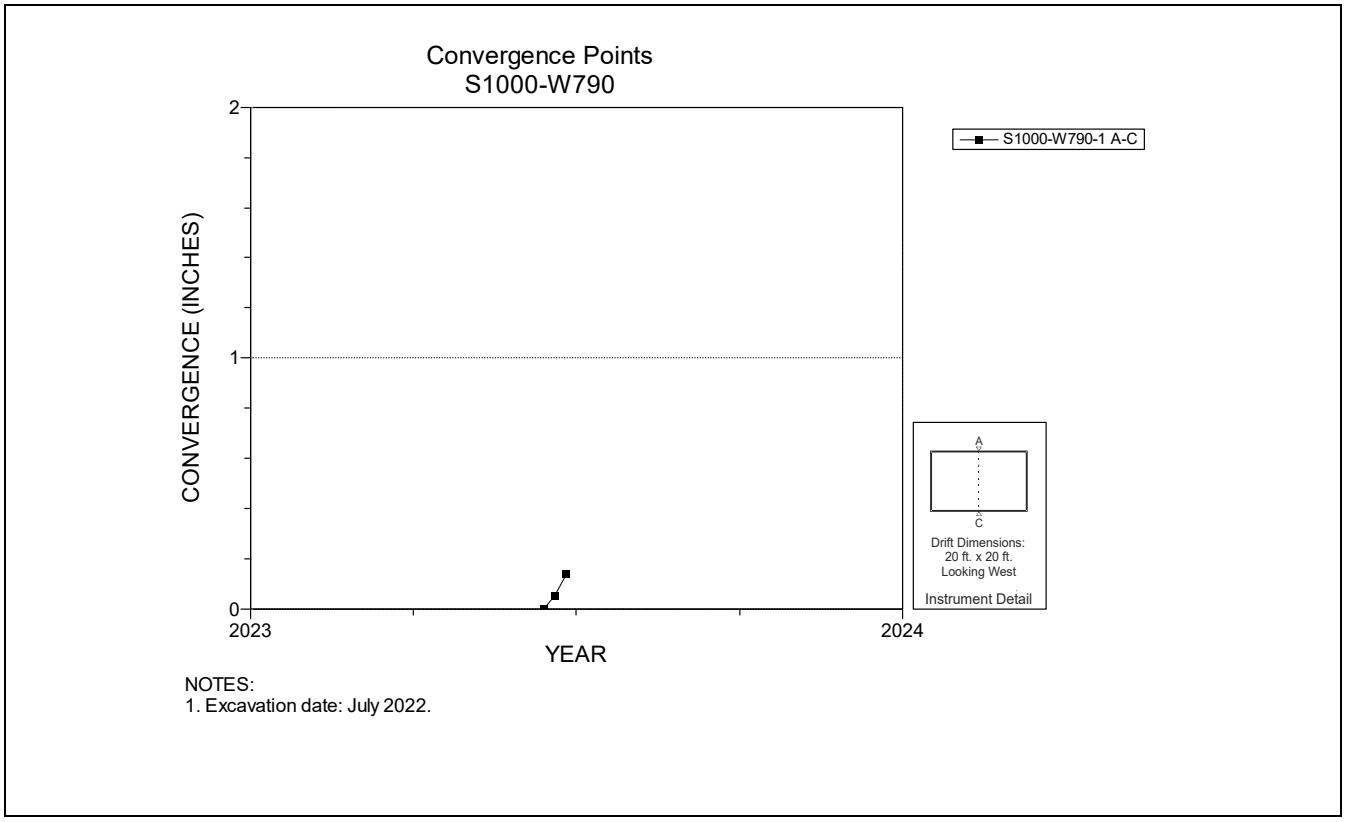


Figure 4-207 Convergence Point Array – S1000 W790 – Roof to Floor

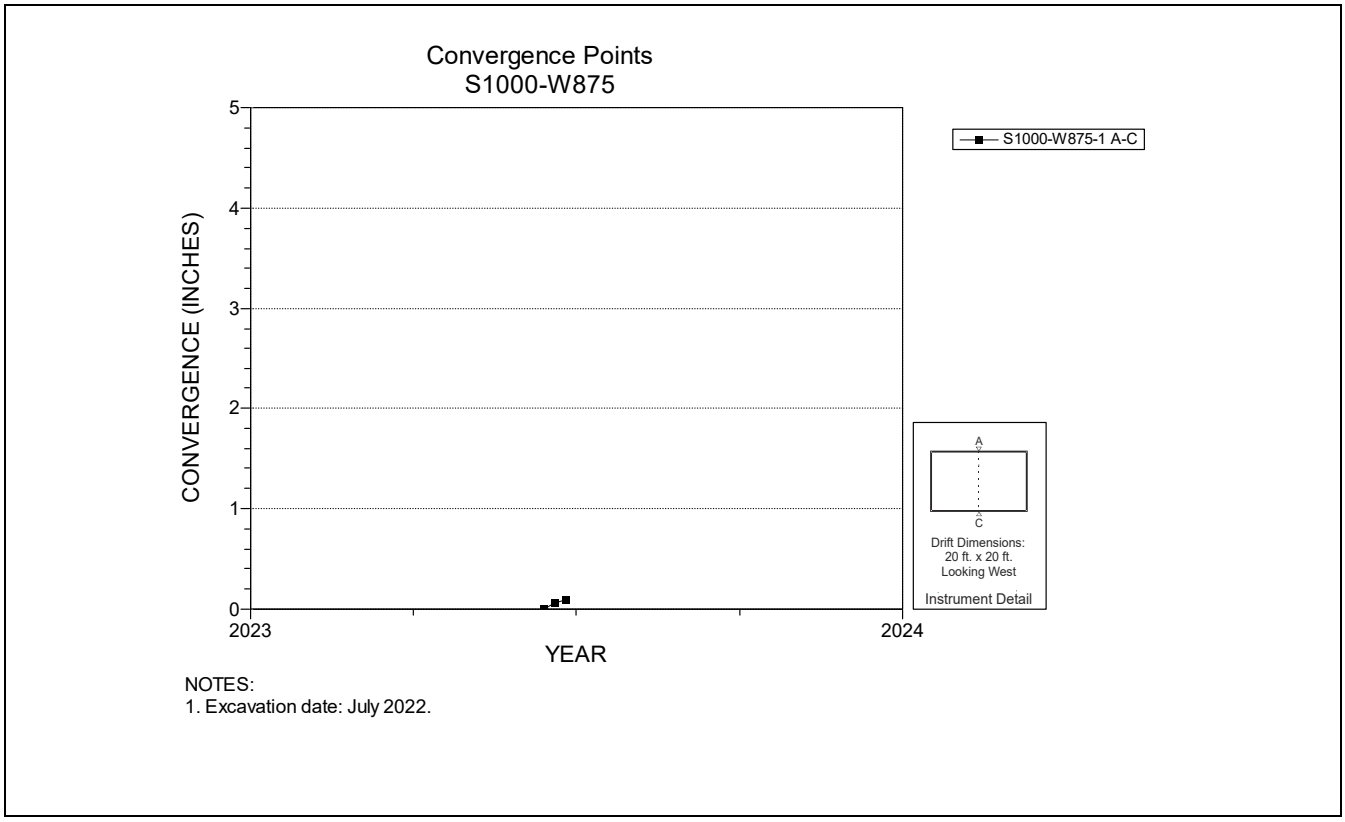


Figure 4-208 Convergence Point Array – S1000 W875 – Roof to Floor

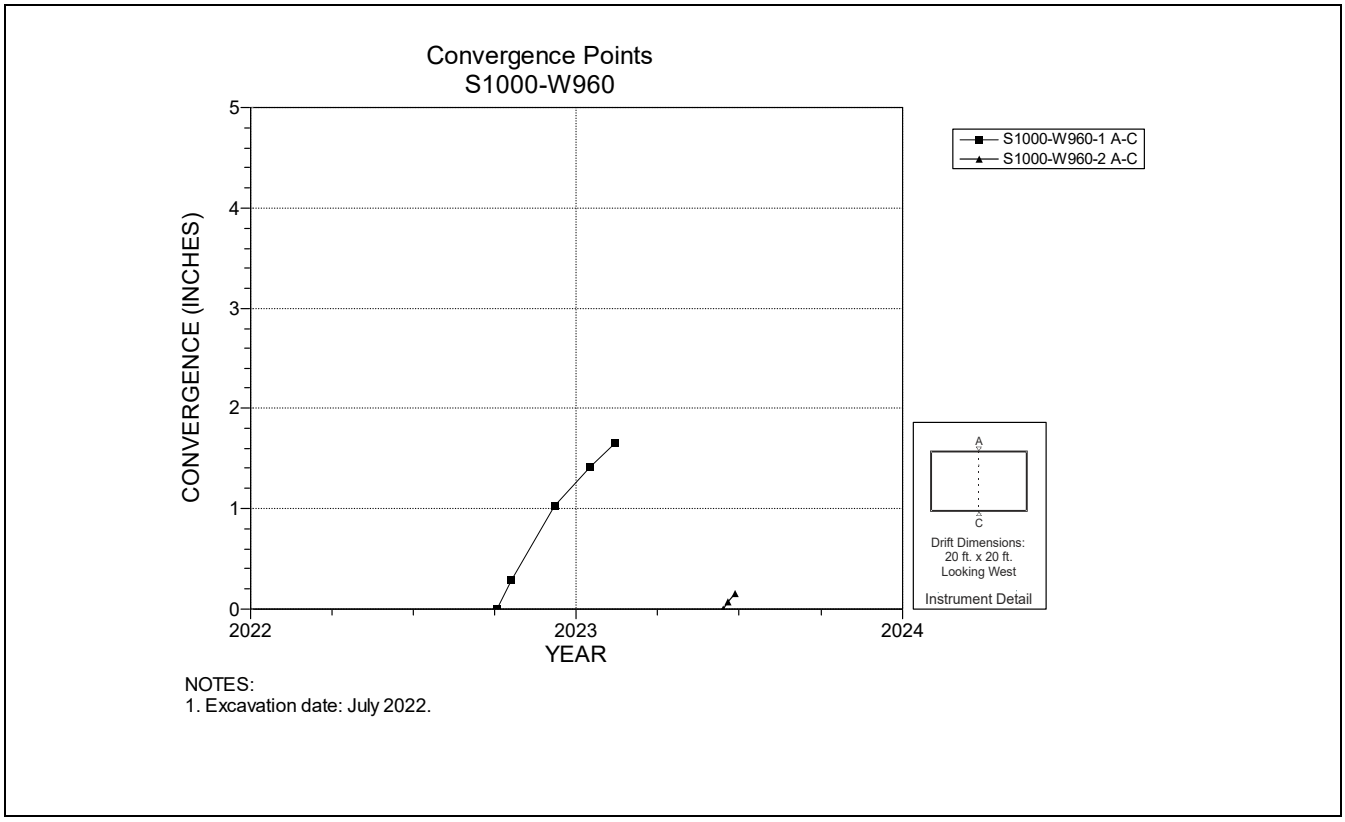


Figure 4-209 Convergence Point Array – S1000 W960 – Roof to Floor

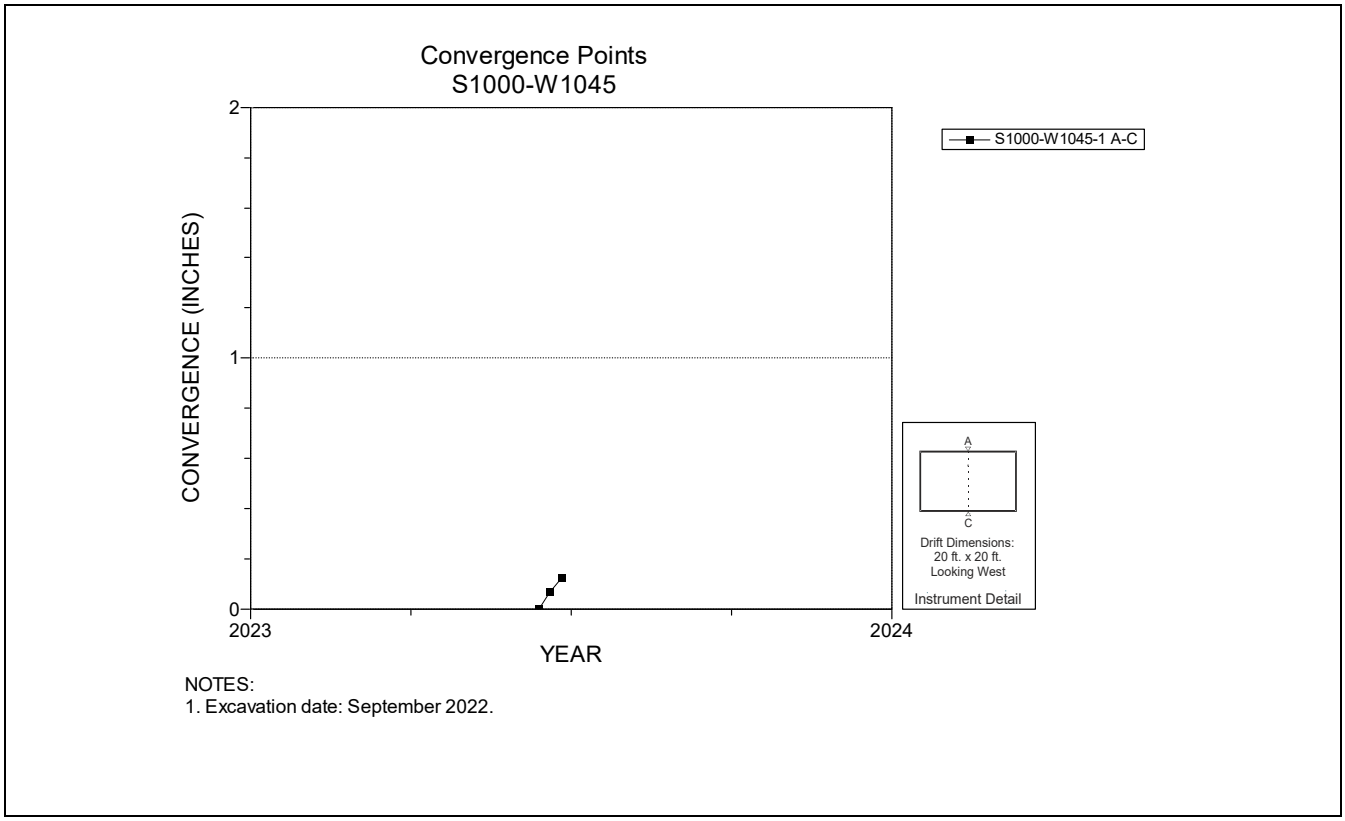


Figure 4-210 Convergence Point Array – S1000 W1045 – Roof to Floor

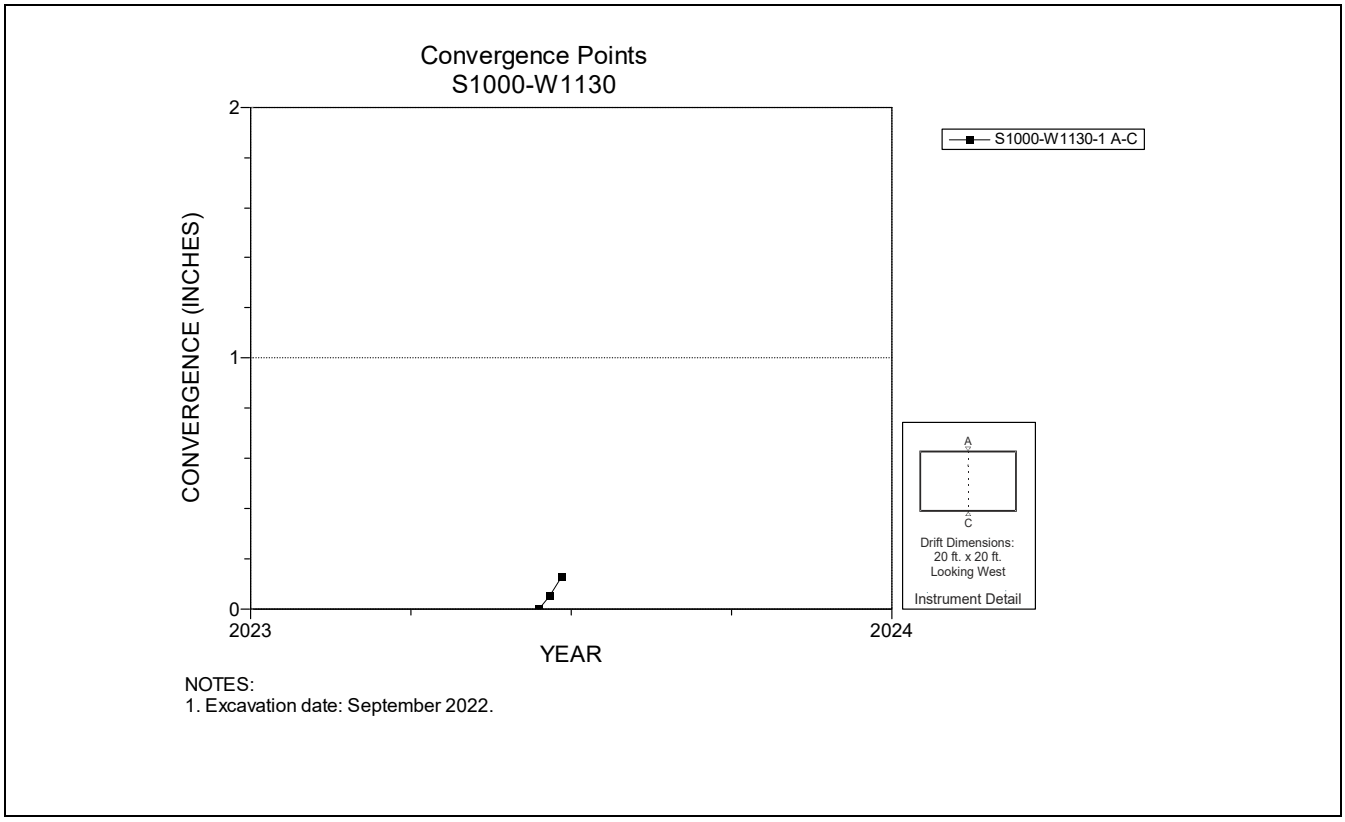


Figure 4-211 Convergence Point Array – S1000 W1130 – Roof to Floor

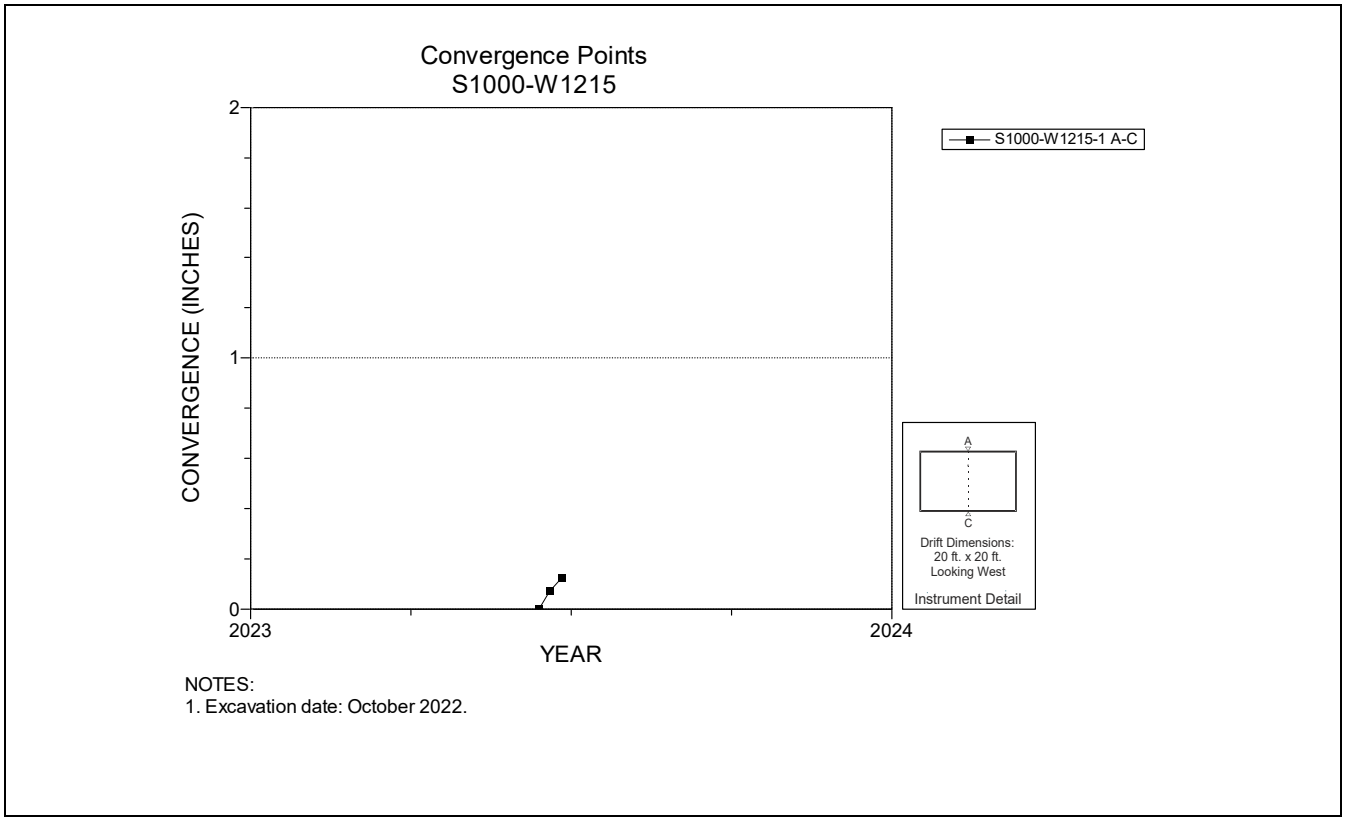


Figure 4-212 Convergence Point Array – S1000 W1215 – Roof to Floor

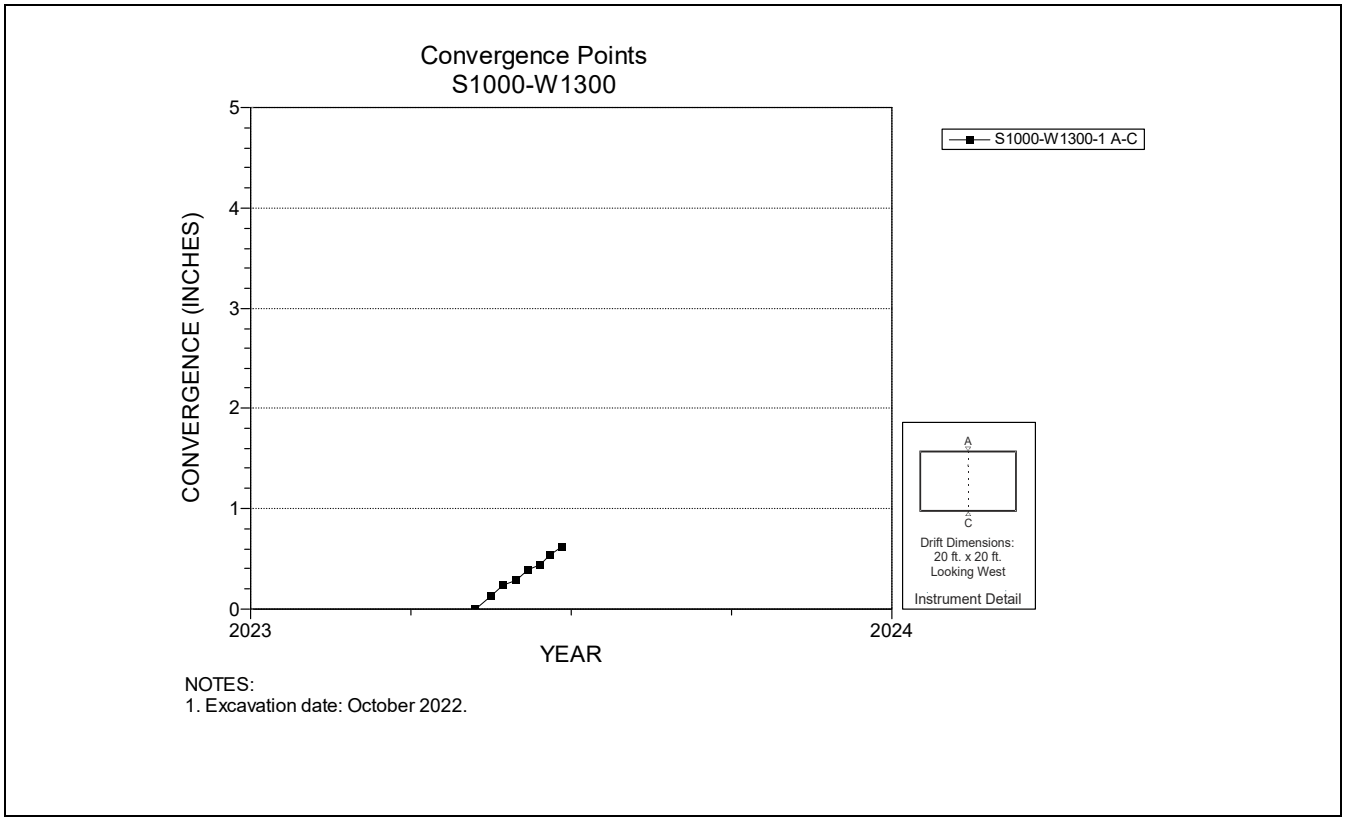


Figure 4-213 Convergence Point Array – S1000 W1300 – Roof to Floor

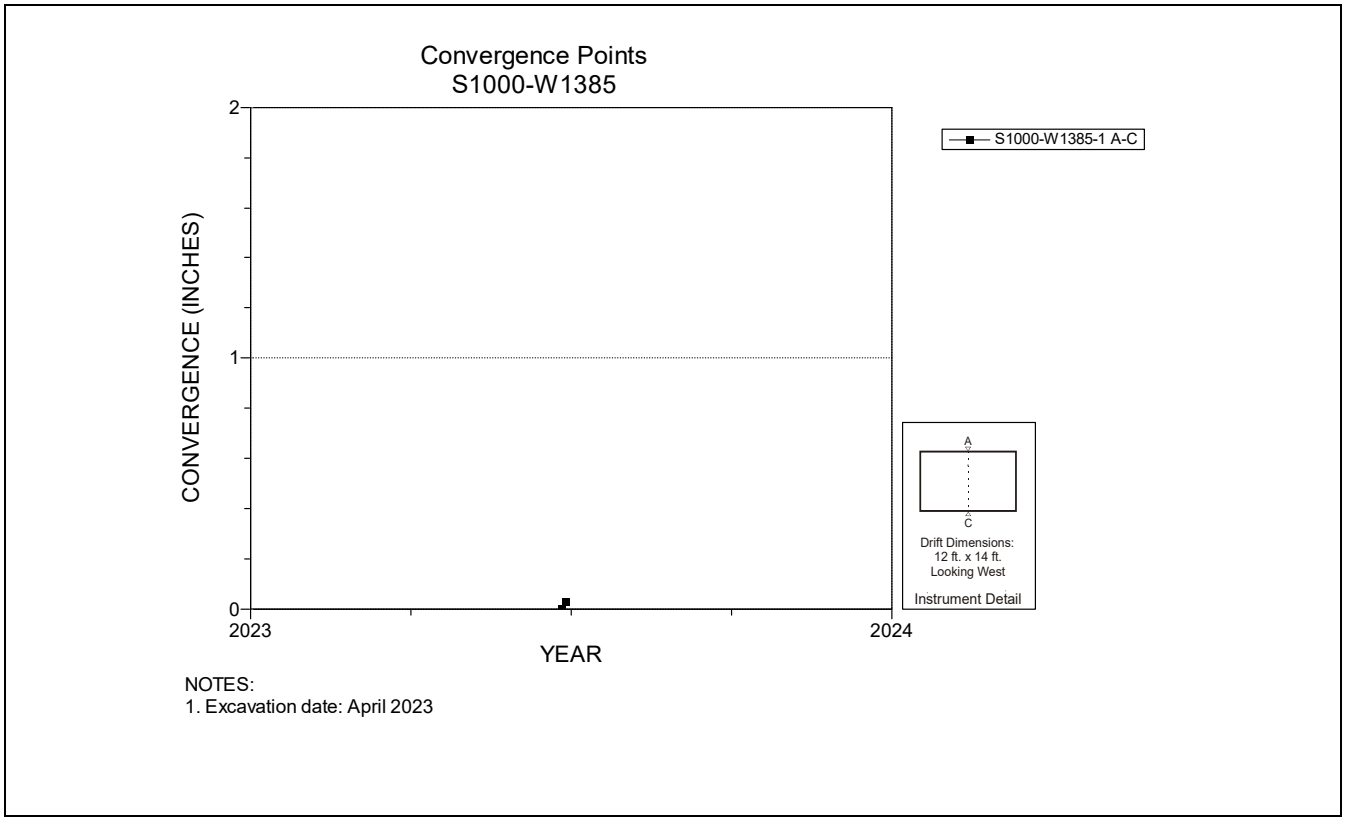


Figure 4-214 Convergence Point Array – S1000 W1385 – Roof to Floor

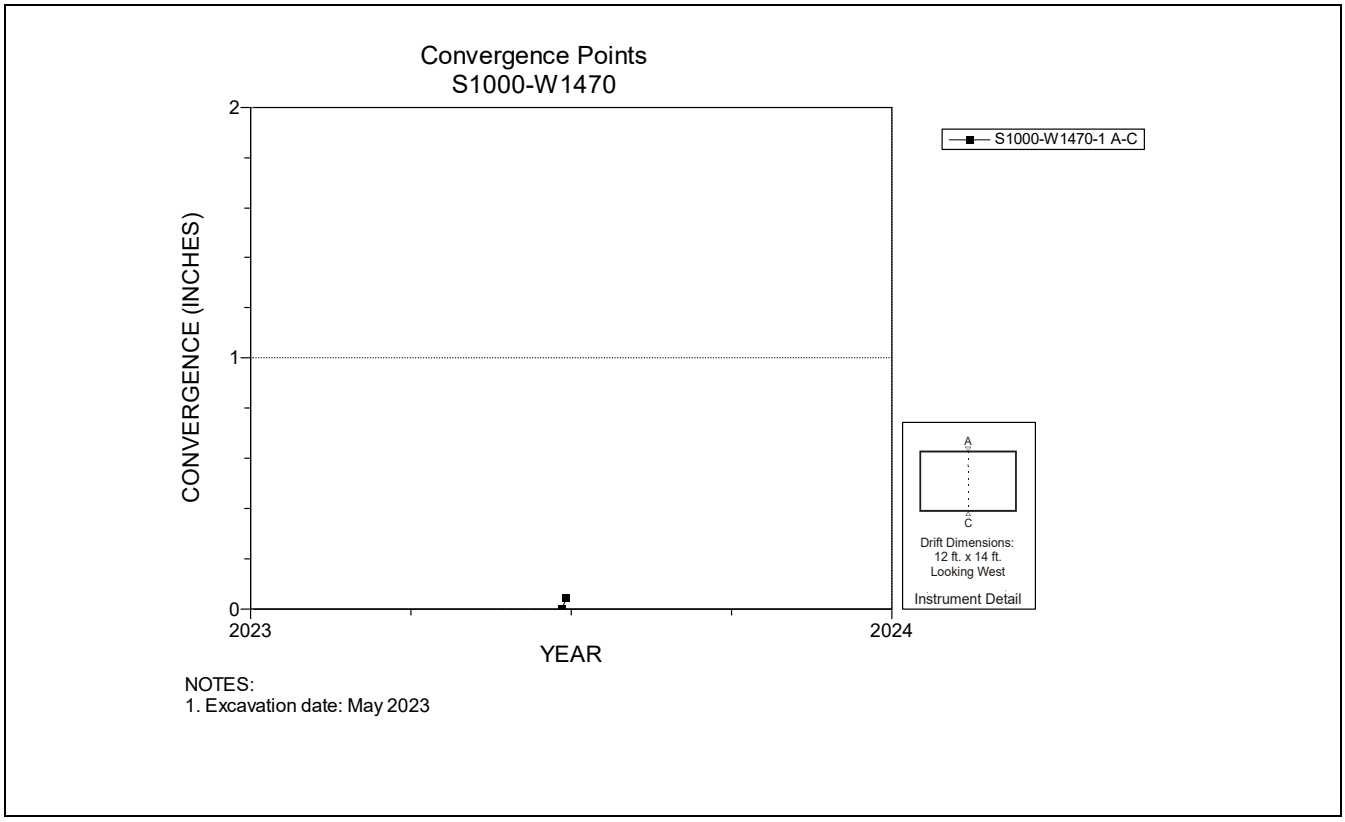


Figure 4-215 Convergence Point Array – S1000 W1470 – Roof to Floor

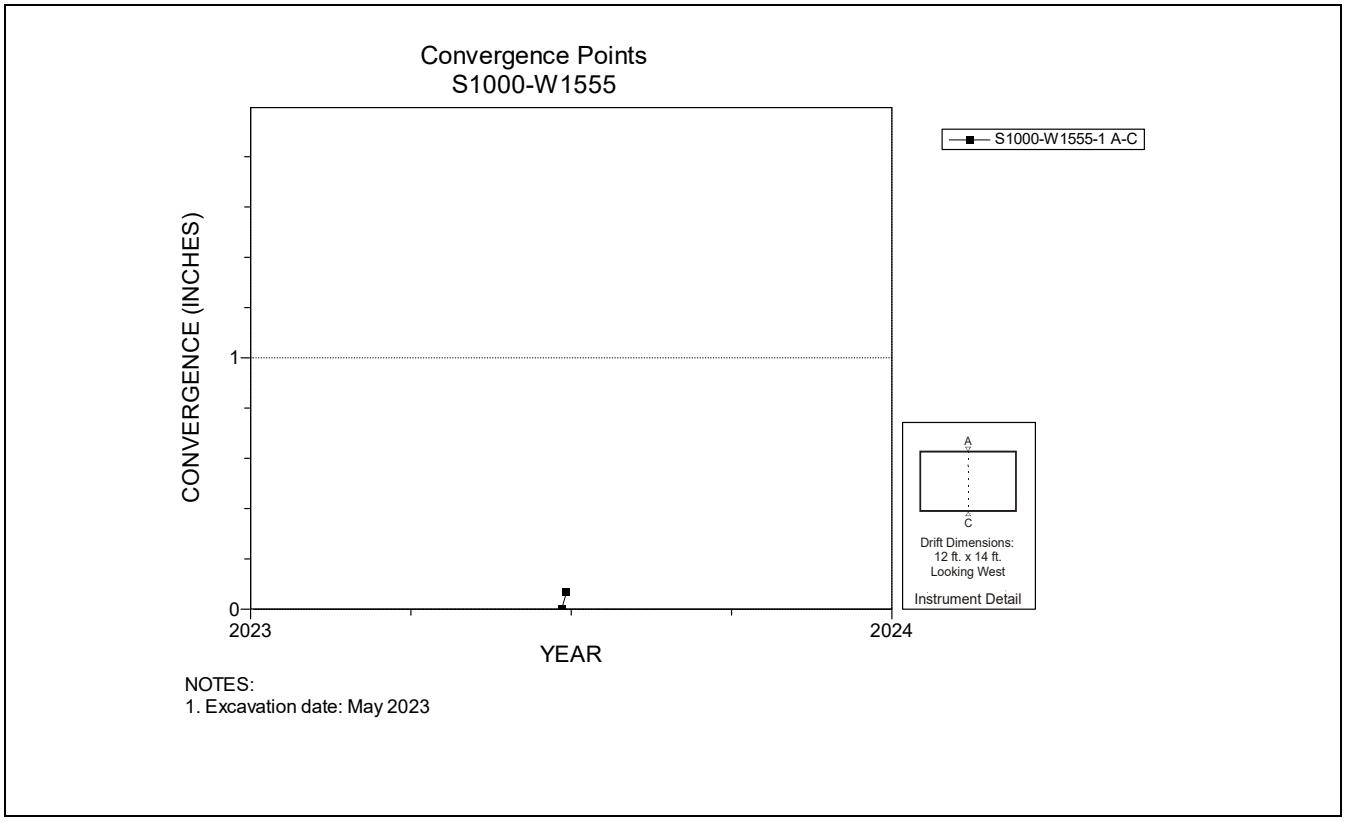
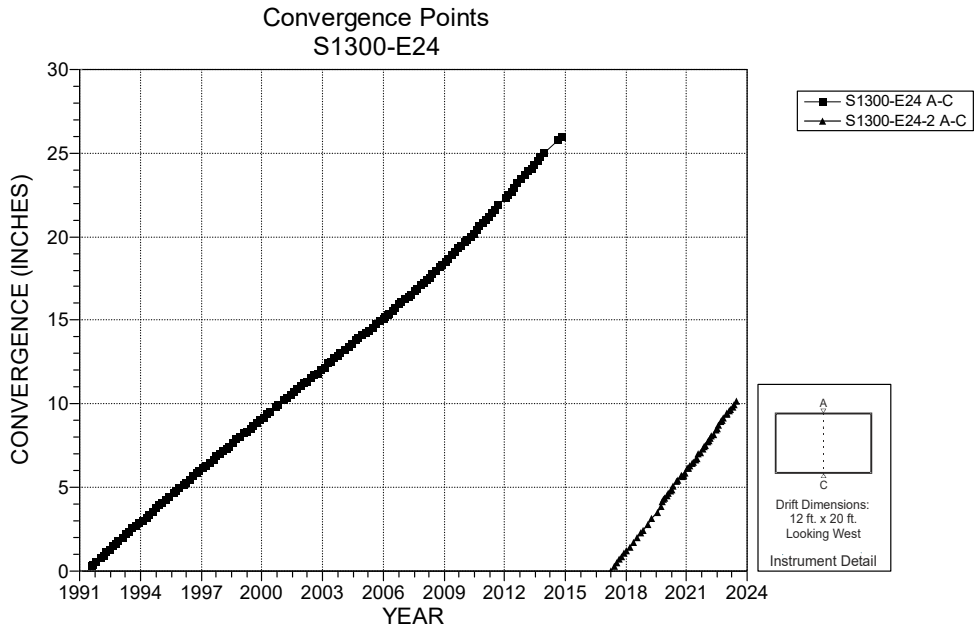
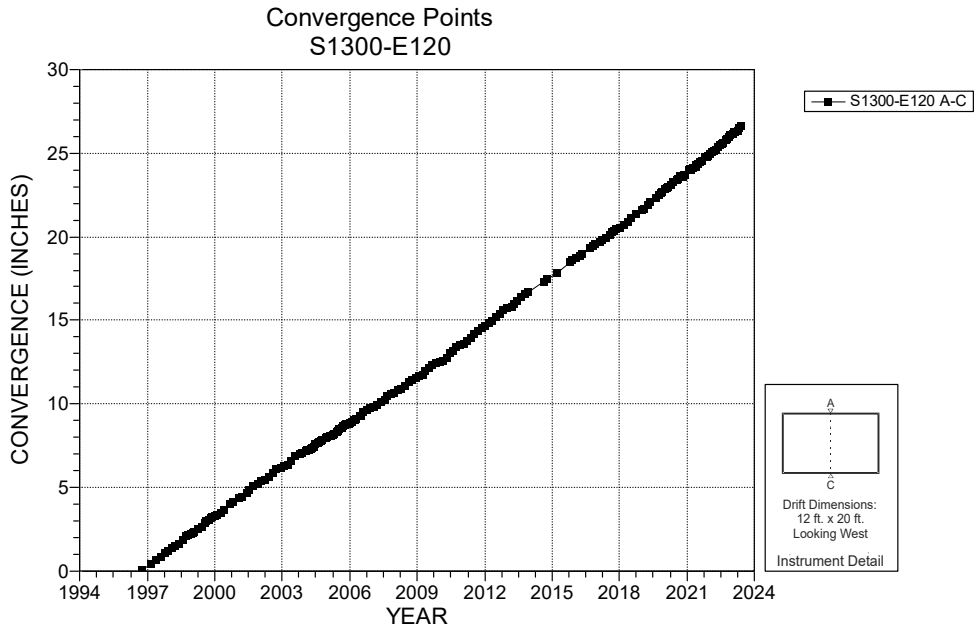


Figure 4-216 Convergence Point Array – S1000 W1555 – Roof to Floor



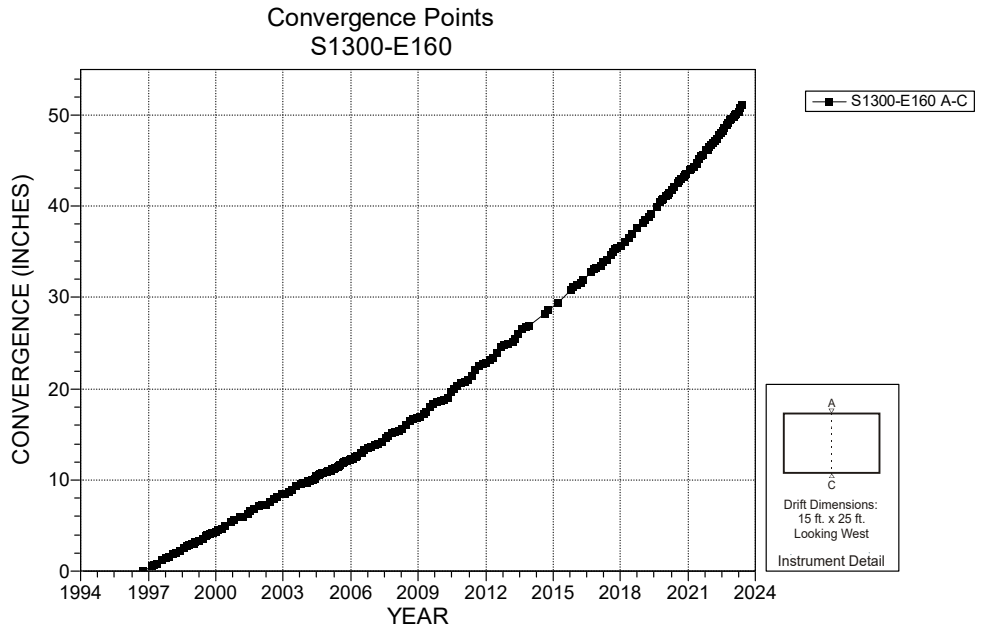
NOTES:
1. Excavation date: August 1985.

Figure 4-217 Convergence Point Array – S1300 E24 – Roof to Floor



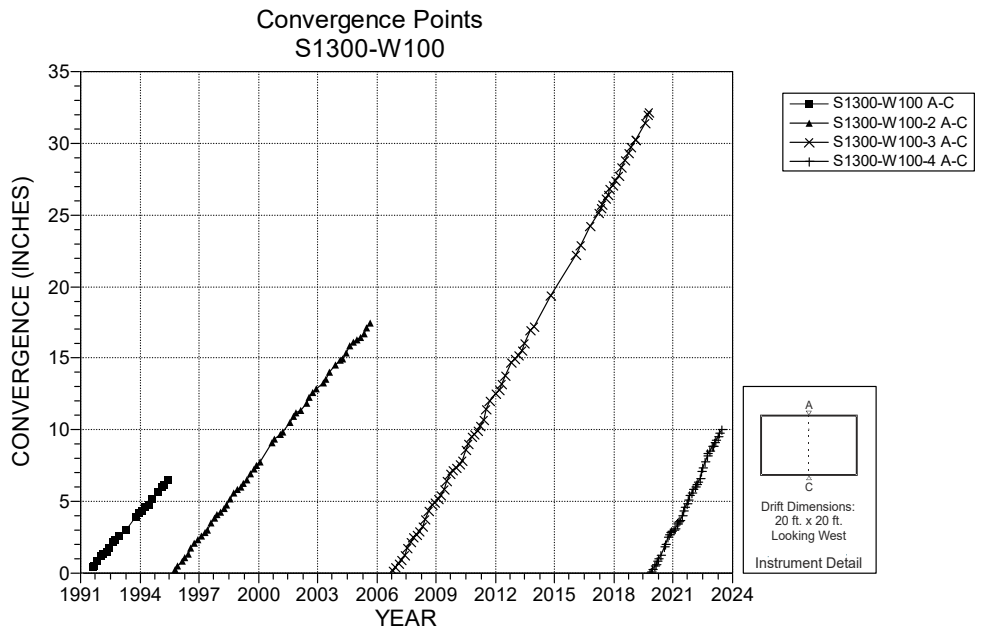
NOTES:
1. Excavation date: August 1984.

Figure 4-218 Convergence Point Array – S1300 E120 – Roof to Floor



NOTES:
1. Excavation date: June 1984.

Figure 4-219 Convergence Point Array – S1300 E160 – Roof to Floor



NOTES:
1. Excavation date: August 1984.
2. Instrument mined out, chord reinstalled September, 2006.

Figure 4-220 Convergence Point Array – S1300 W100 – Roof to Floor

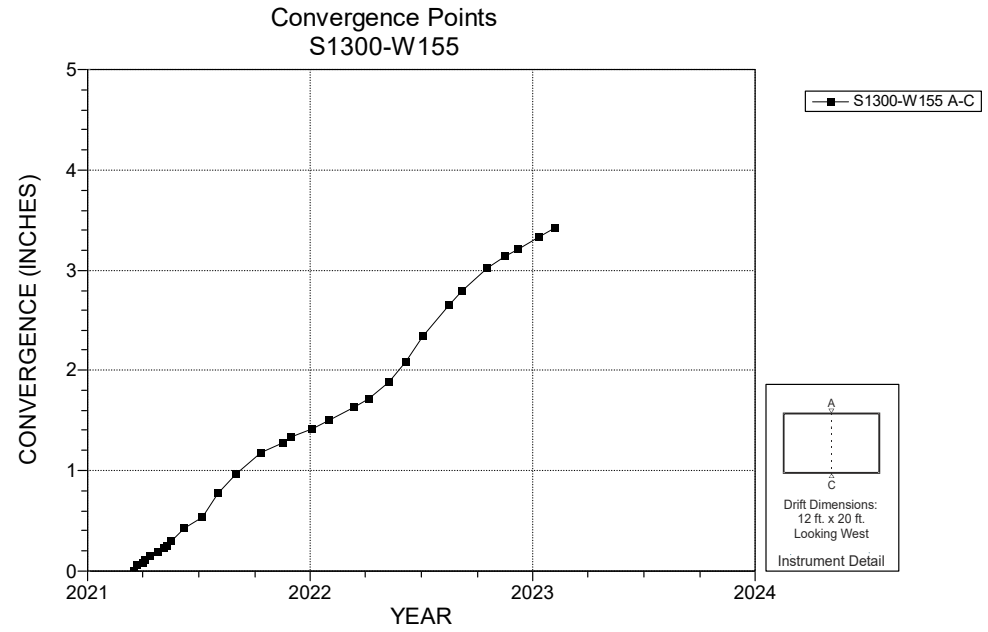


Figure 4-221 Convergence Point Array – S1300 W155 – Roof to Floor

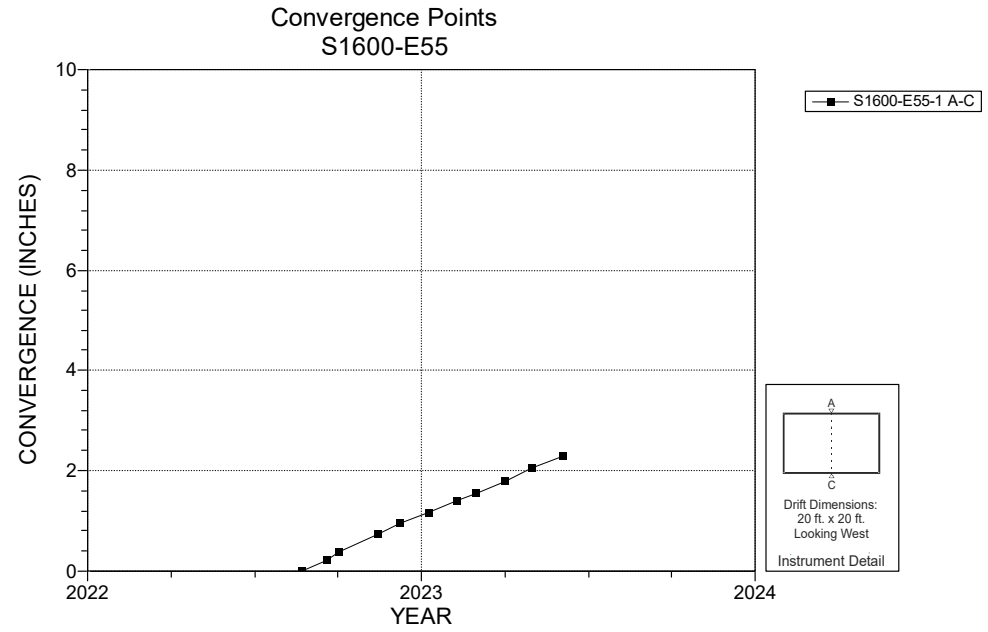
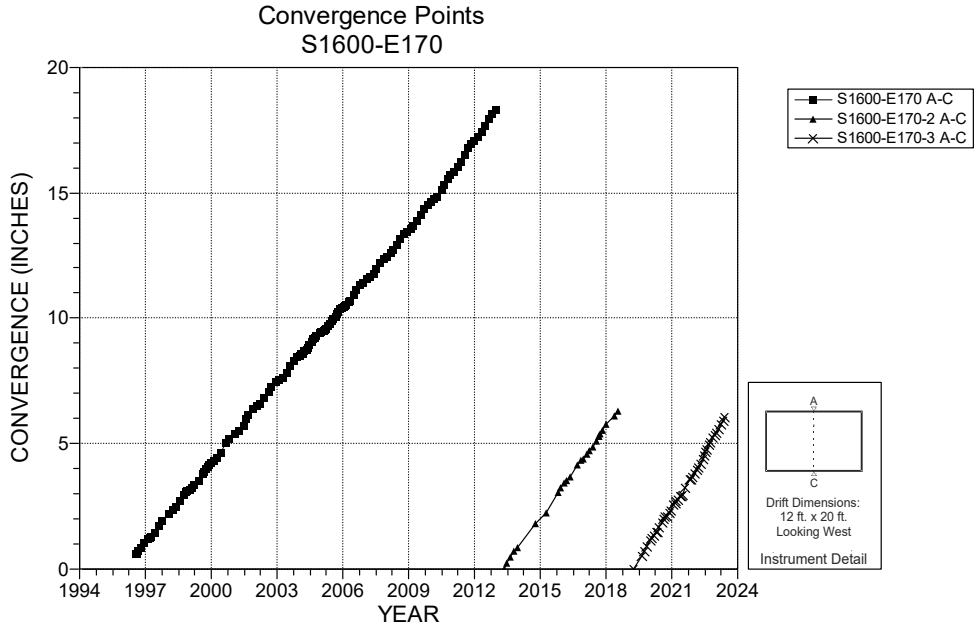
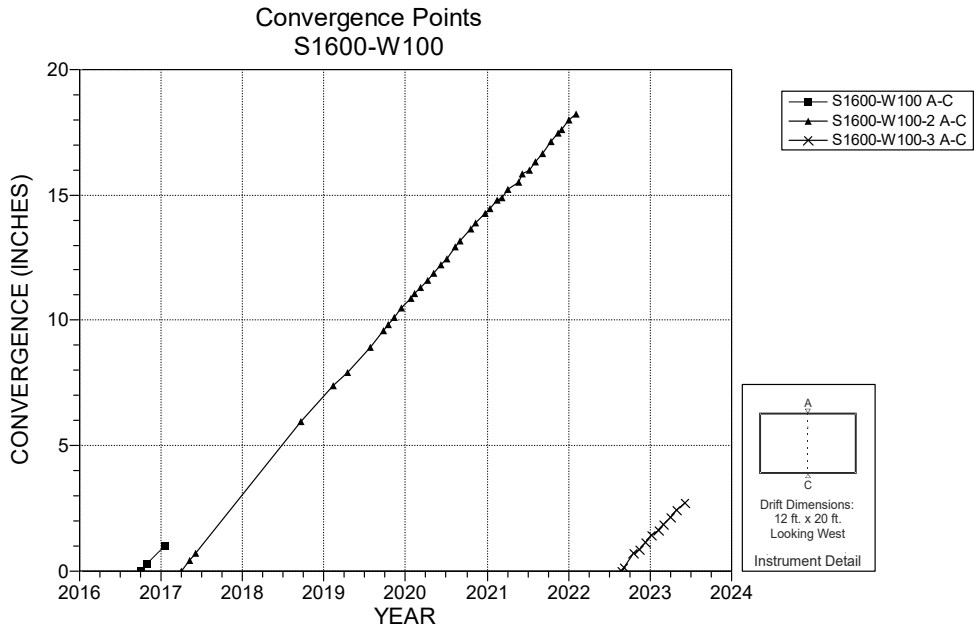


Figure 4-222 Convergence Point Array – S1600 E55 – Roof to Floor



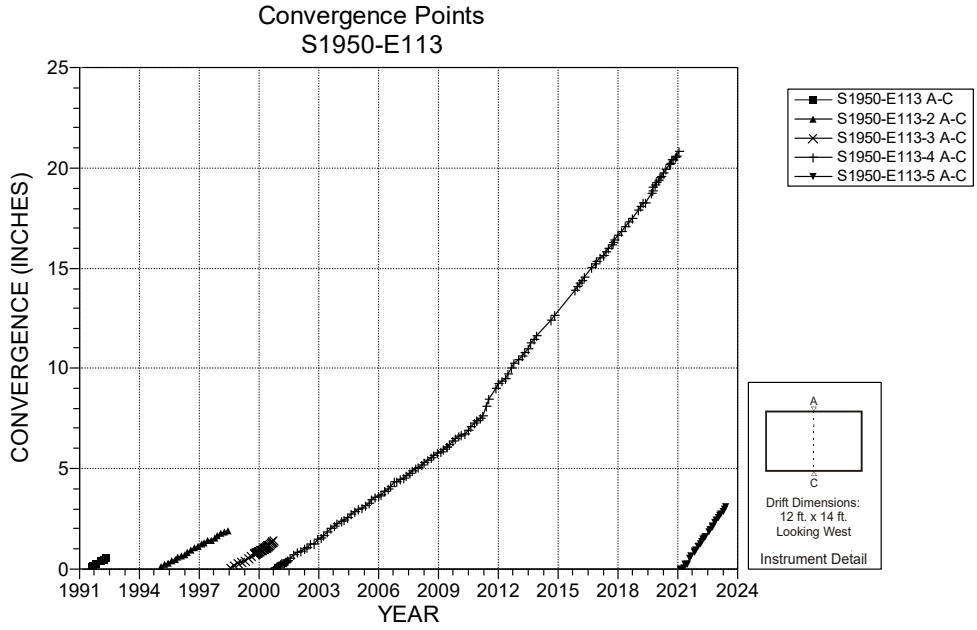
NOTES:
1. Excavation date: September 1985.

Figure 4-223 Convergence Point Array – S1600 E170 – Roof to Floor



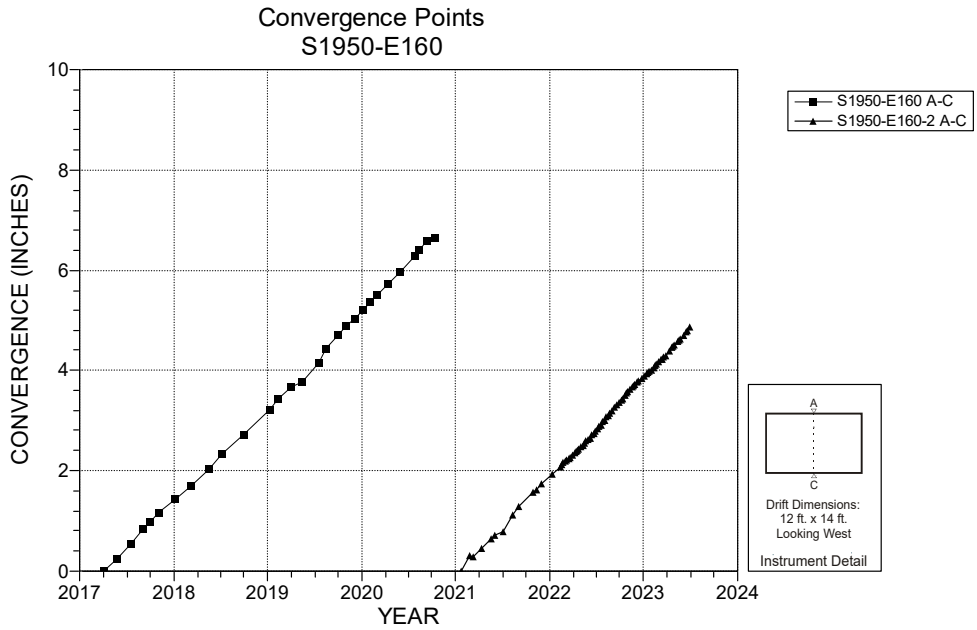
NOTES:
1. Excavation Date: August 1985.

Figure 4-224 Convergence Point Array – S1600 W100 – Roof to Floor



NOTES:
1. Excavation date: January 1986.

Figure 4-225 Convergence Point Array – S1950 E113 – Roof to Floor



NOTES:
1. Excavation date: January 1986.

Figure 4-226 Convergence Point Array – S1950 E160 – Roof to Floor

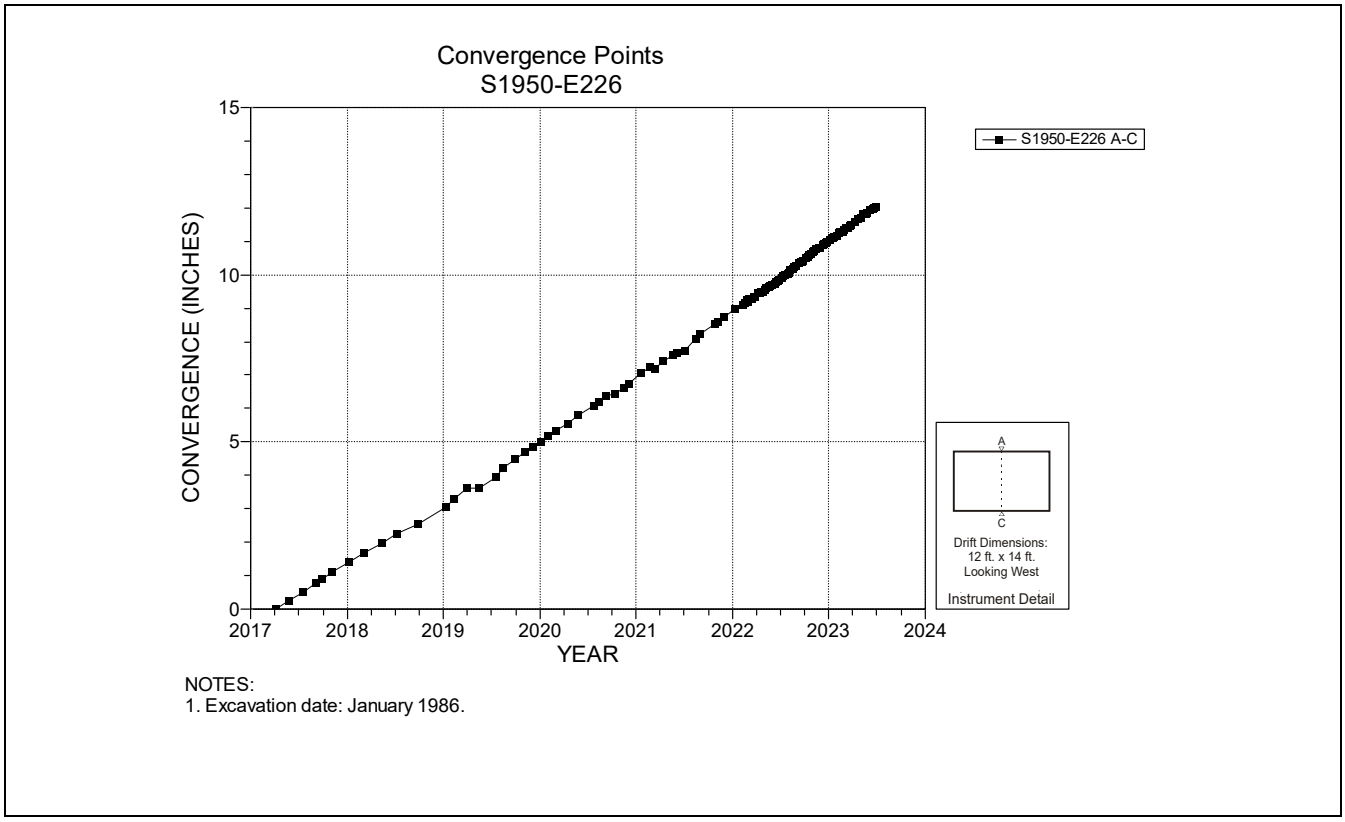


Figure 4-227 Convergence Point Array – S1950 E226 – Roof to Floor

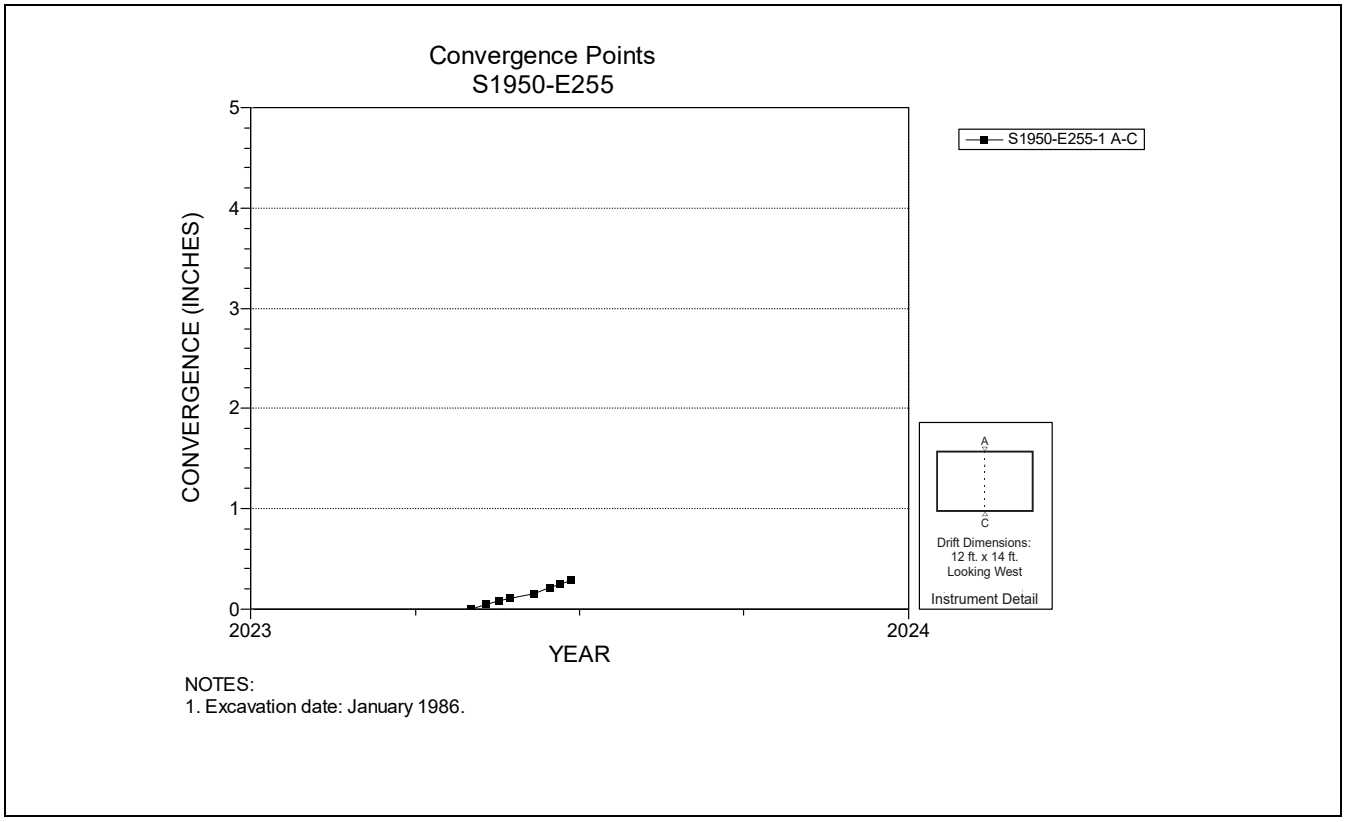
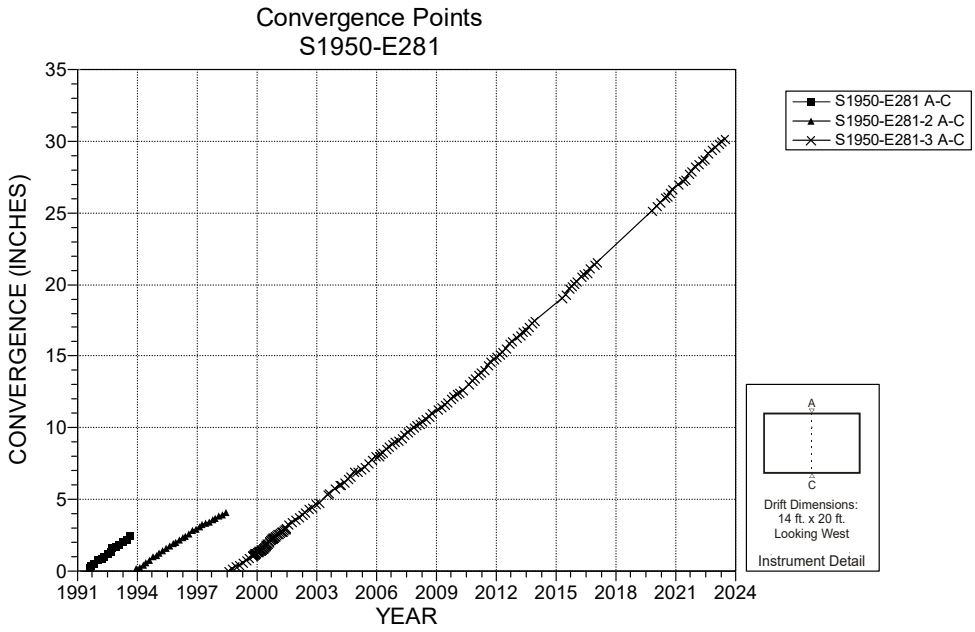
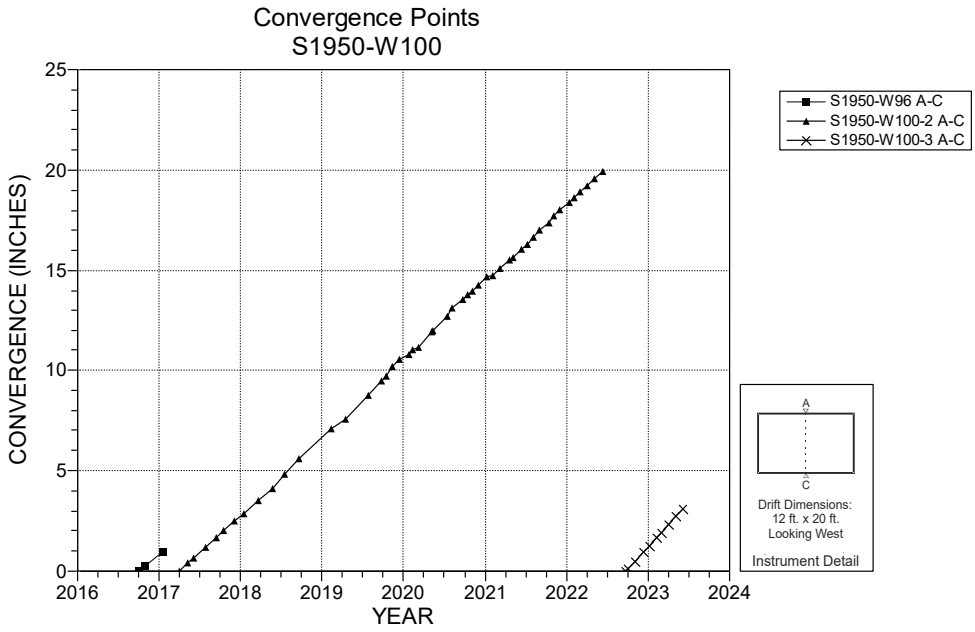


Figure 4-228 Convergence Point Array – S1950 E255 – Roof to Floor



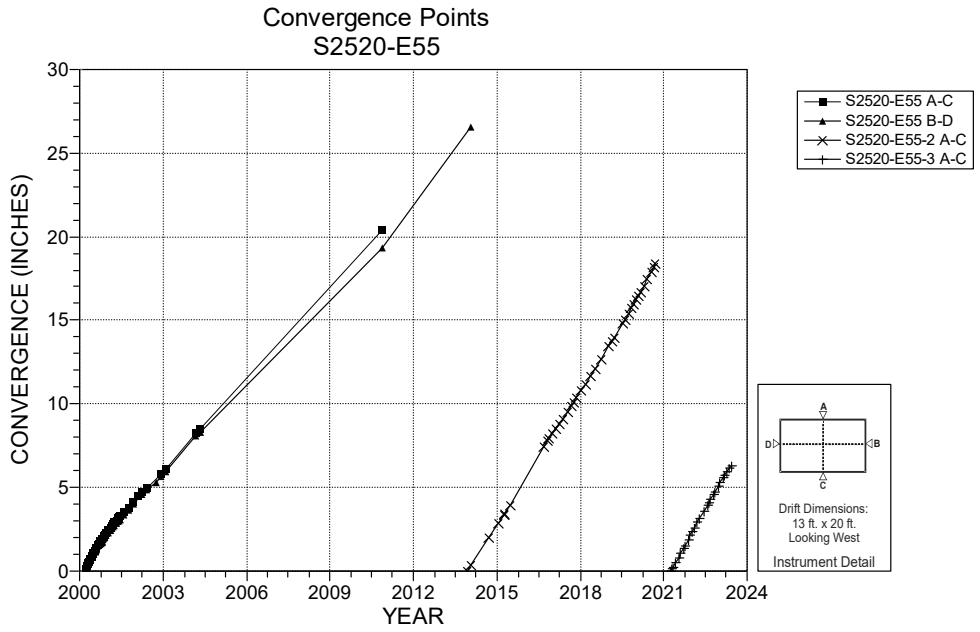
NOTES:
1. Excavation date: November 1985.

Figure 4-229 Convergence Point Array – S1950 E281 – Roof to Floor



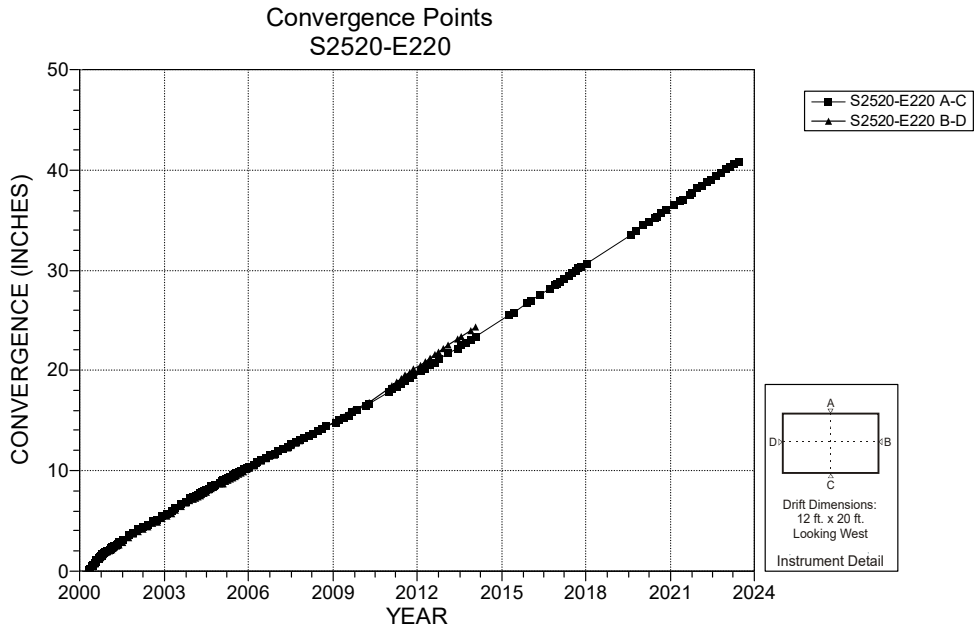
NOTES:
1. Excavation date: March 1986.

Figure 4-230 Convergence Point Array – S1950 W100 – Roof to Floor



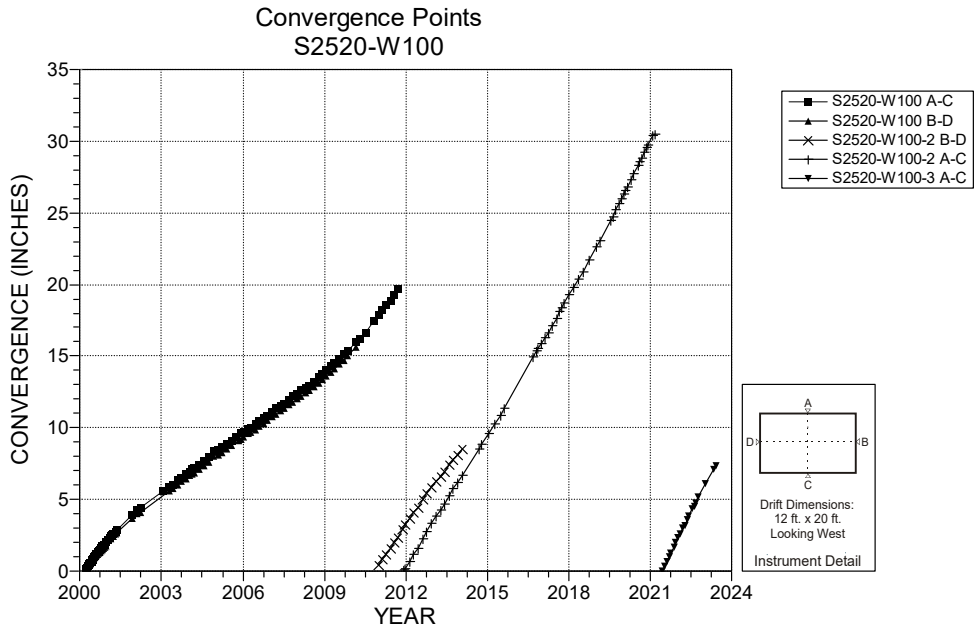
NOTES:
1. Excavation date: February 2000.
2. Blocked by electrical substation.

Figure 4-231 Convergence Point Array – S2520 E55 – All Chords



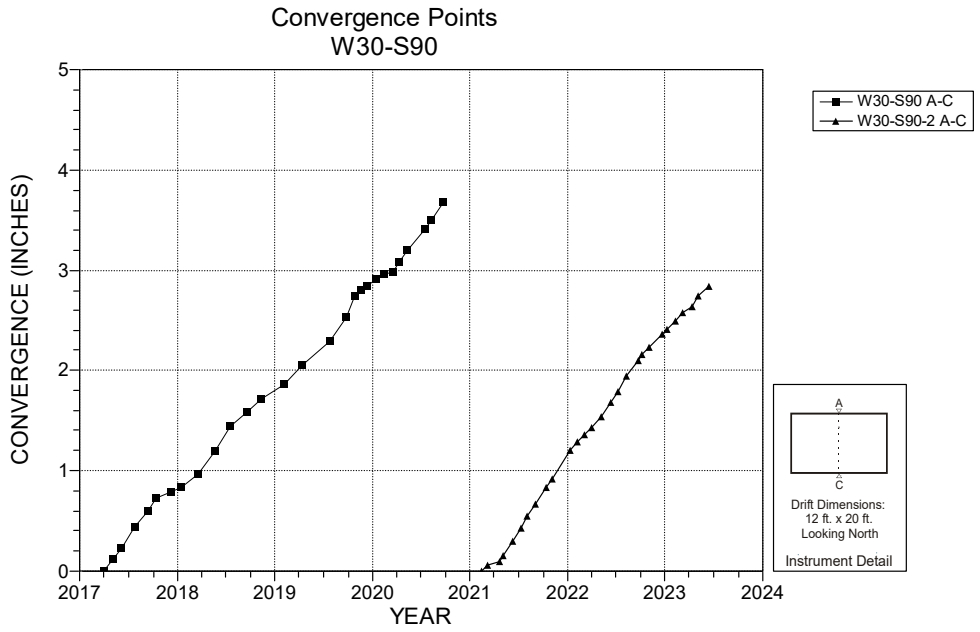
NOTES:
1. Excavation date: December 1999.

Figure 4-232 Convergence Point Array – S2520 E220 – All Chords



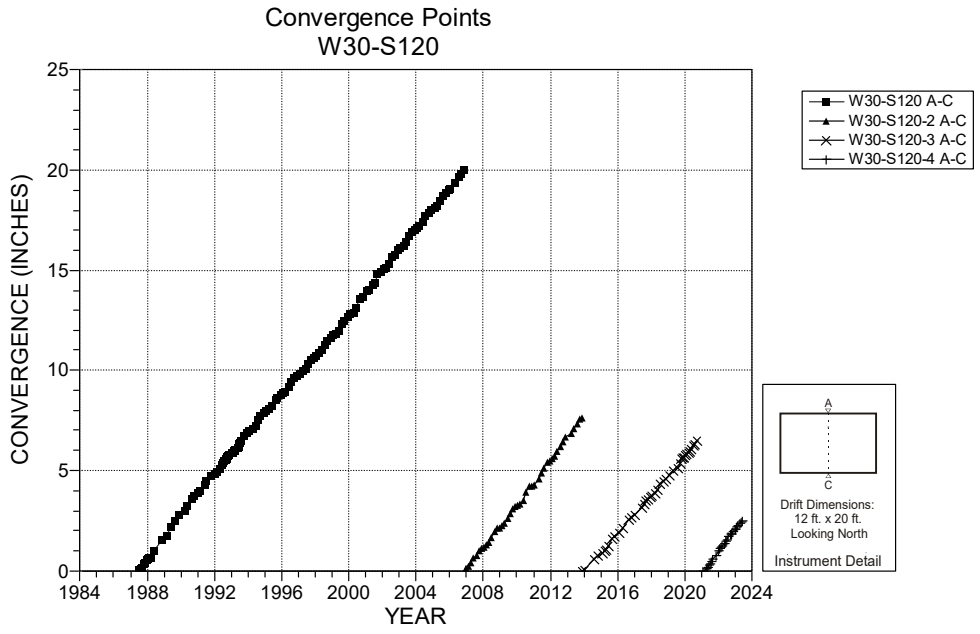
NOTES:
1. Excavation date: December 1999.

Figure 4-233 Convergence Point Array – S2520 W100 – All Chords



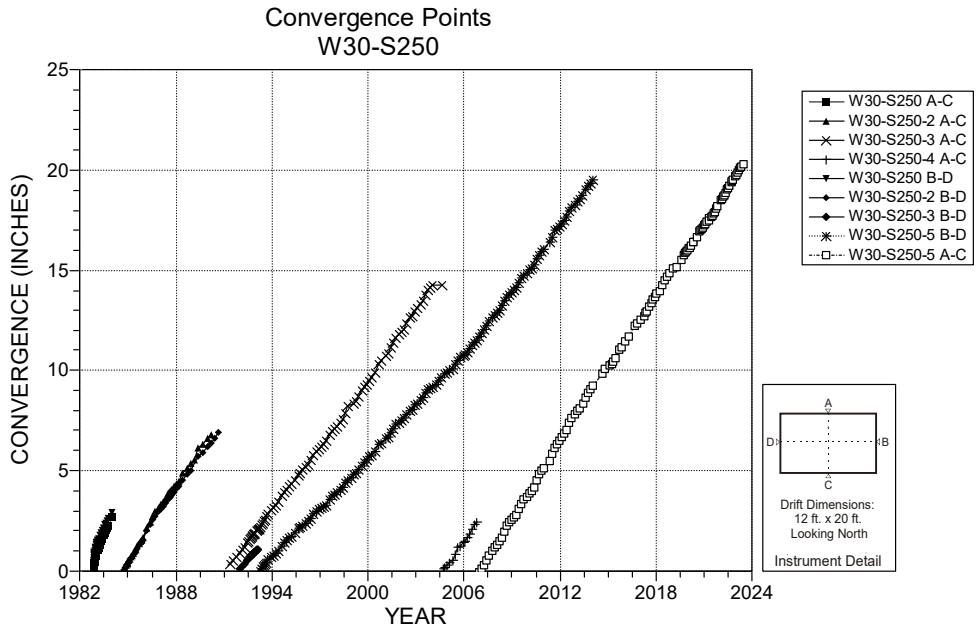
NOTES:
1. Excavation date: January 1982.

Figure 4-234 Convergence Point Array – W30 S90 – Roof to Floor



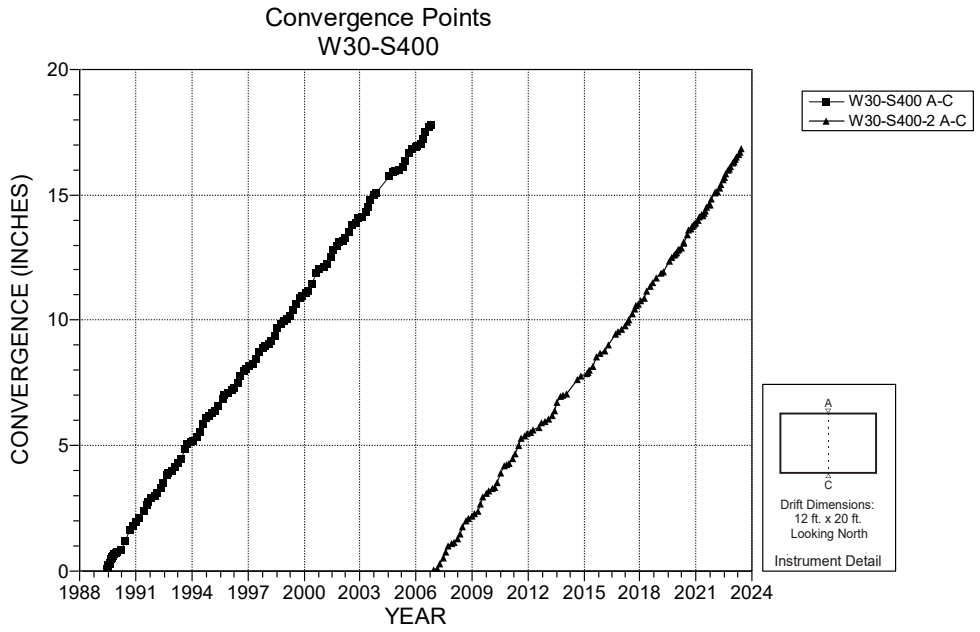
NOTES:
1. Excavation date: October 1982.
2. "C" Point mined out, reinstalled December 2006

Figure 4-235 Convergence Point Array – W30 S120 – Roof to Floor



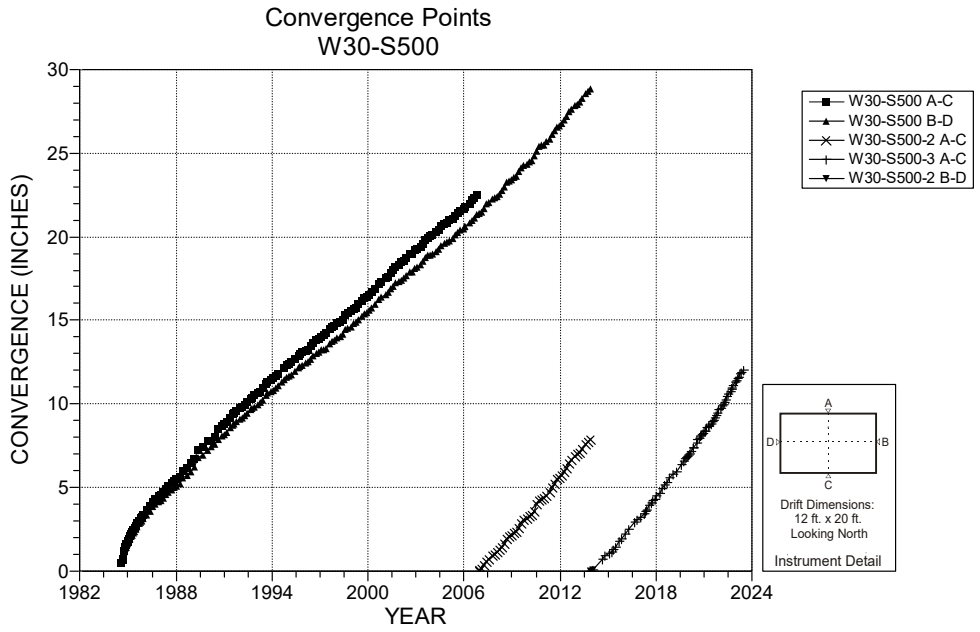
NOTES:
1. Excavation date: October 1982.
2. "C" Point mined out, reinstalled December 2006

Figure 4-236 Convergence Point Array – W30 S250 – All Chords



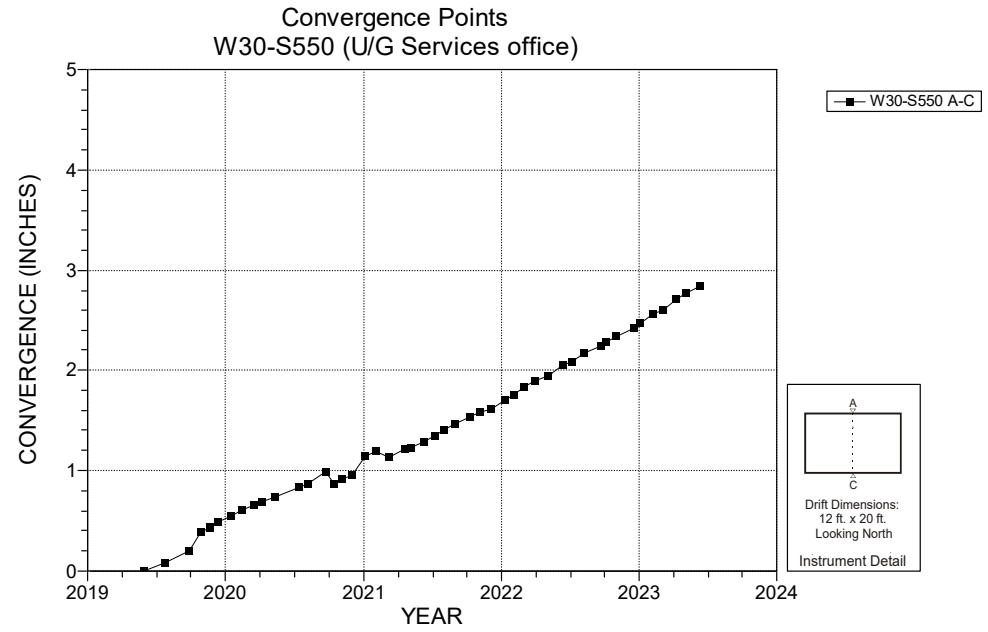
NOTES:
1. Excavation date: October 1982.
2. "C" Point mined out, reinstalled December 2006.

Figure 4-237 Convergence Point Array – W30 S400 – Roof to Floor



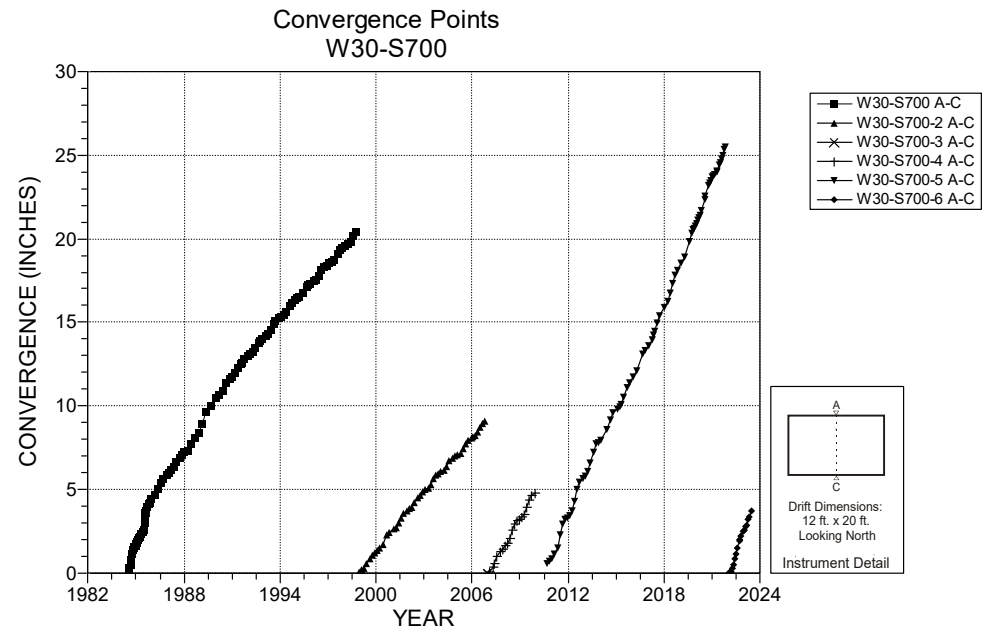
NOTES:
1. Excavation date: August 1984.
2. "C" Point mined out, reinstalled December 2006

Figure 4-238 Convergence Point Array – W30 S500 – All Chords



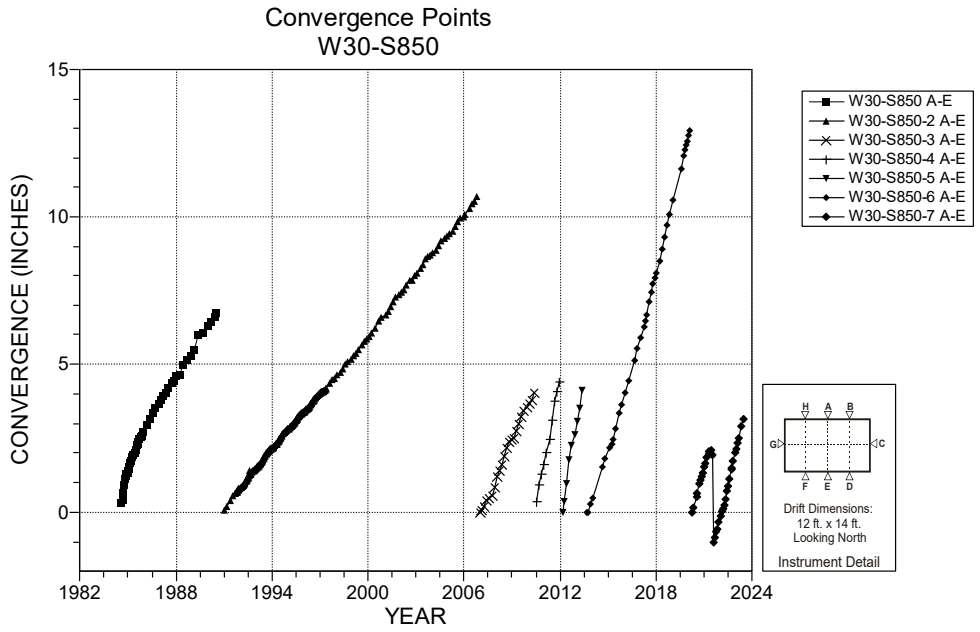
NOTES:
1. Excavation date: August 1984.
2. New installation on 5/29/2019.

Figure 4-239 Convergence Point Array – W30 S550 – Roof to Floor



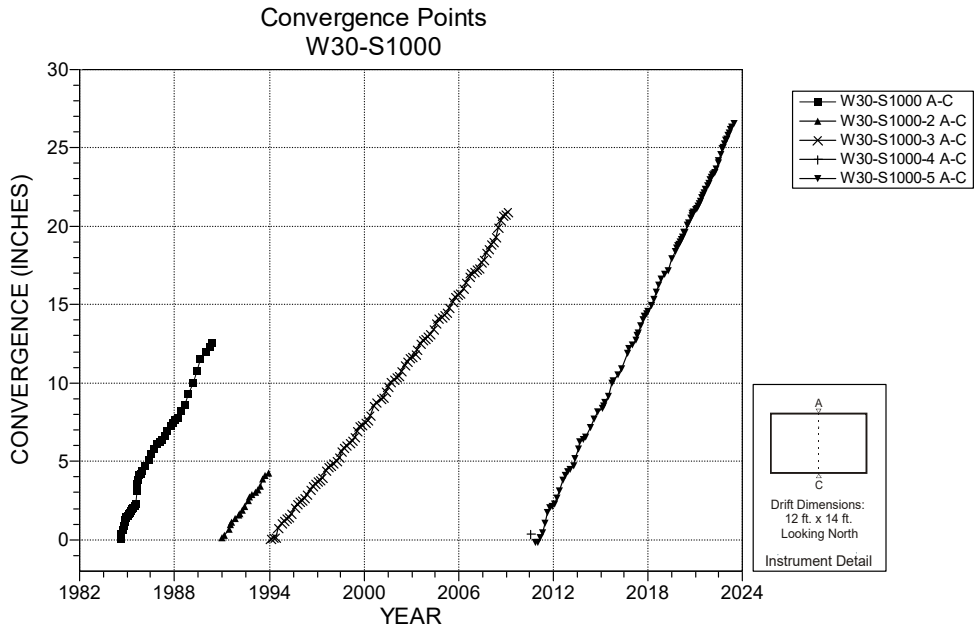
NOTES:
1. Excavation date: August 1984.
2. "C" Point mined out, reinstalled December 2006
3. "C" Point mined out, reinstalled January 2007

Figure 4-240 Convergence Point Array – W30 S700 – Roof to Floor



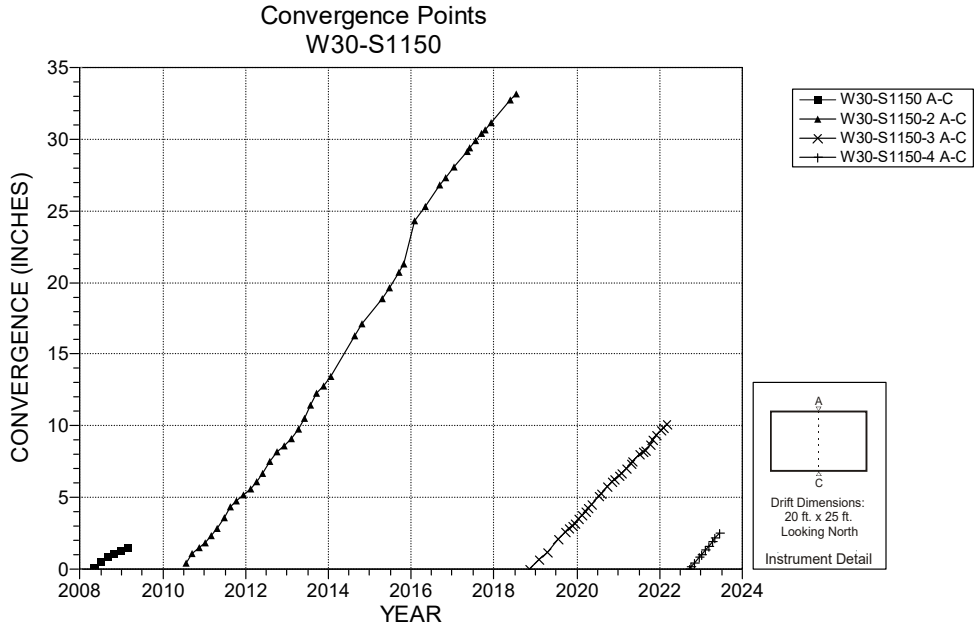
NOTES:
1. Excavation date: August 1984.
2. Rate drop on W30-S850-7 due to suspected floor heave fracturing.

Figure 4-241 Convergence Point Array – W30 S850 – Roof to Floor



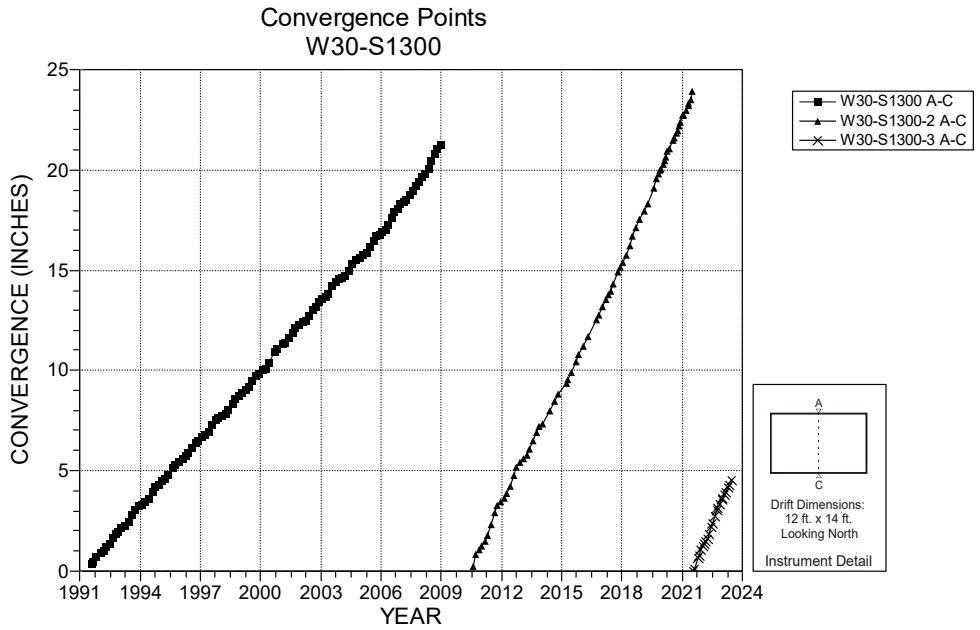
NOTES:
1. Excavation date: August 1984.

Figure 4-242 Convergence Point Array – W30 S1000 – Roof to Floor



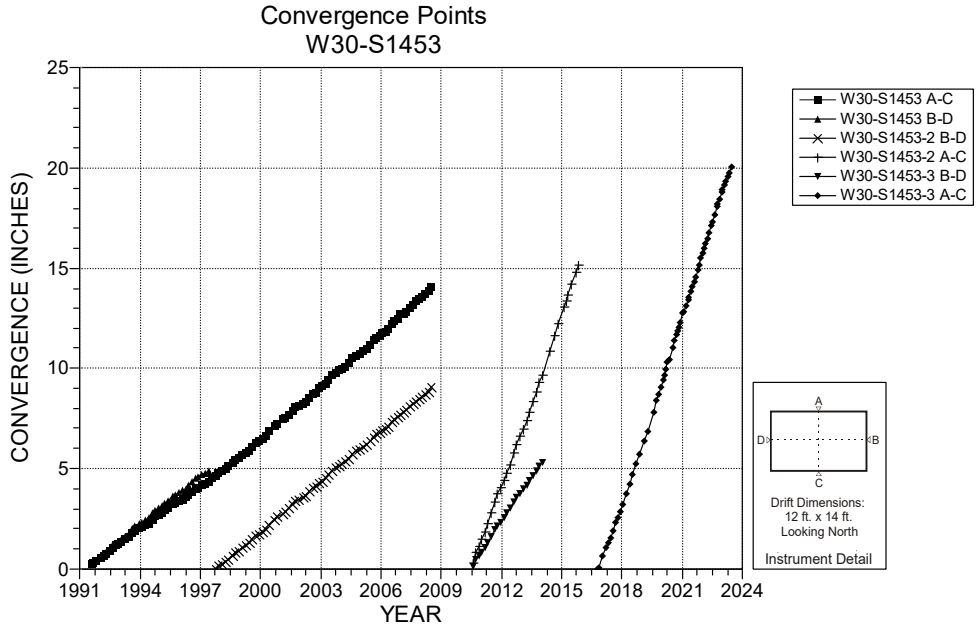
NOTES:
1. Excavation date: August 1984 .

Figure 4-243 Convergence Point Array – W30 S1150 – Roof to Floor



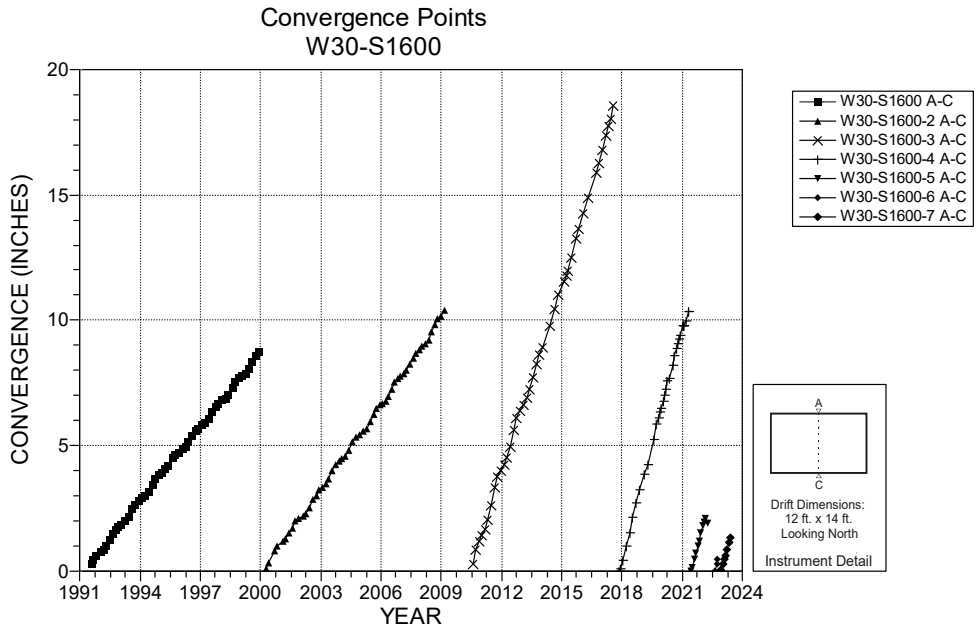
NOTES:
1. Excavation date: August 1984.

Figure 4-244 Convergence Point Array – W30 S1300 – Roof to Floor



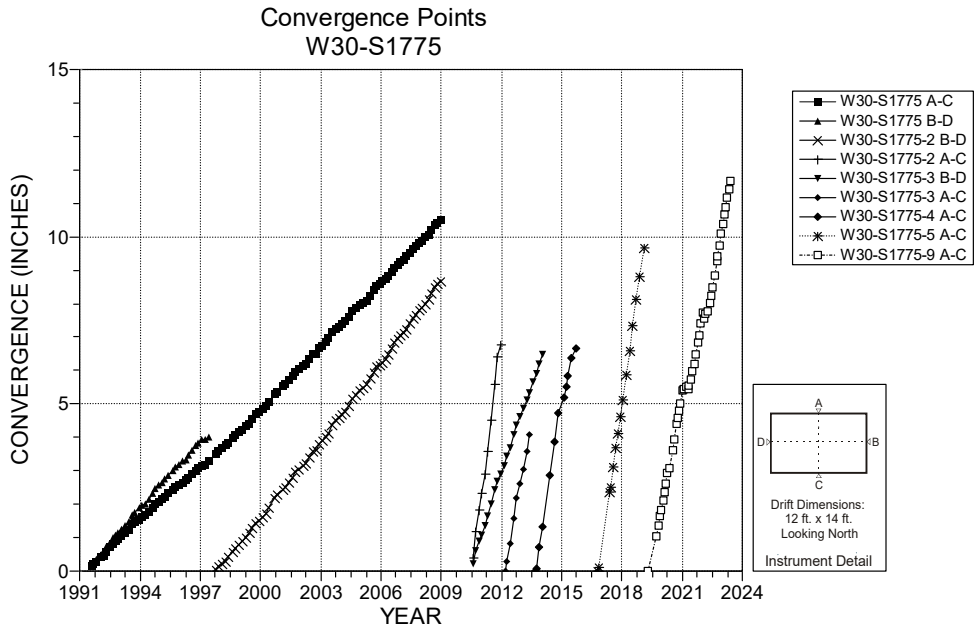
NOTES:
1. Excavation date: August 1984.
2. 'C' anchor mined out, reinstalled October 2016.

Figure 4-245 Convergence Point Array – W30 S1453 – All Chords



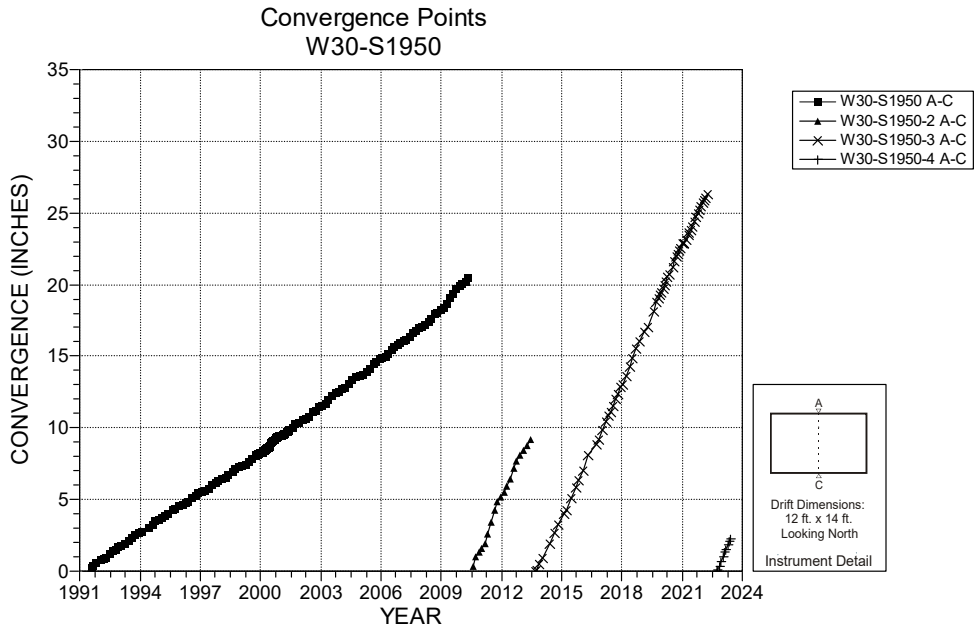
NOTES:
1. Excavation date: September 1984.

Figure 4-246 Convergence Point Array – W30 S1600 – Roof to Floor



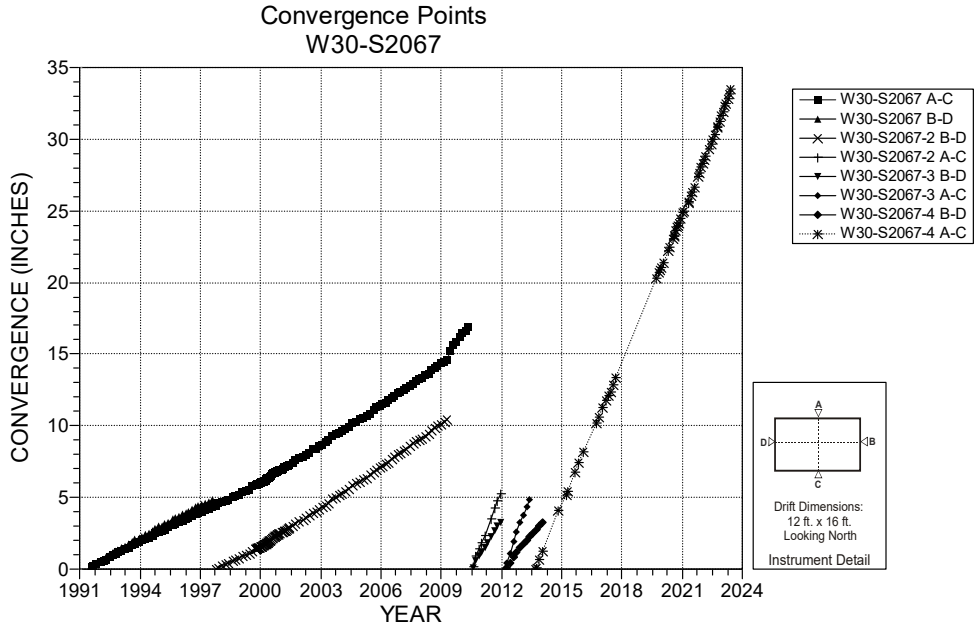
NOTES:
1. Excavation date: February 1986.
2. 'C' anchor mined out, reinstalled October 2016.

Figure 4-247 Convergence Point Array – W30 S1775 – All Chords



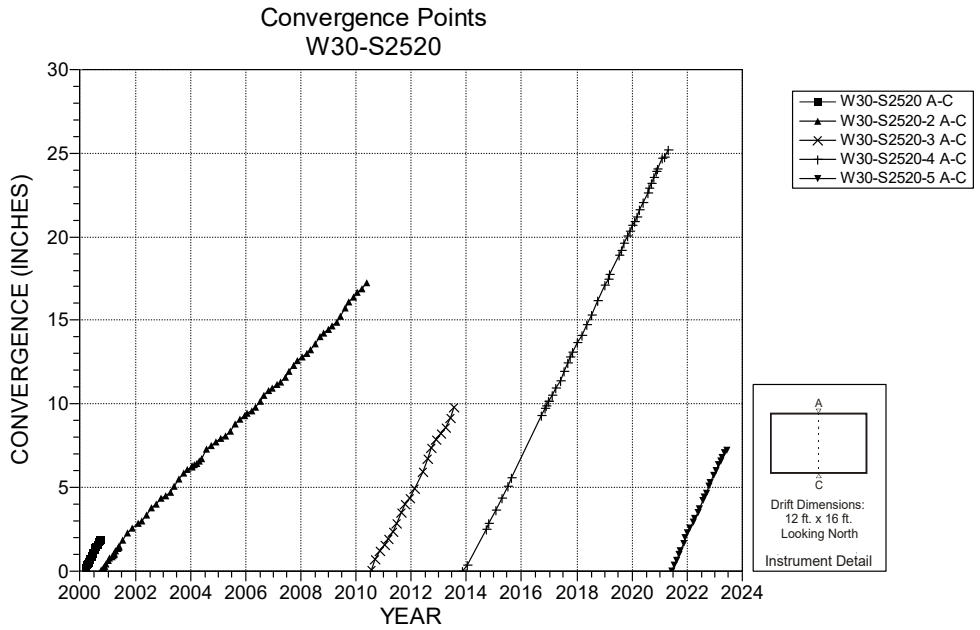
NOTES:
1. Excavation date: February 1986.

Figure 4-248 Convergence Point Array – W30 S1950 – Roof to Floor



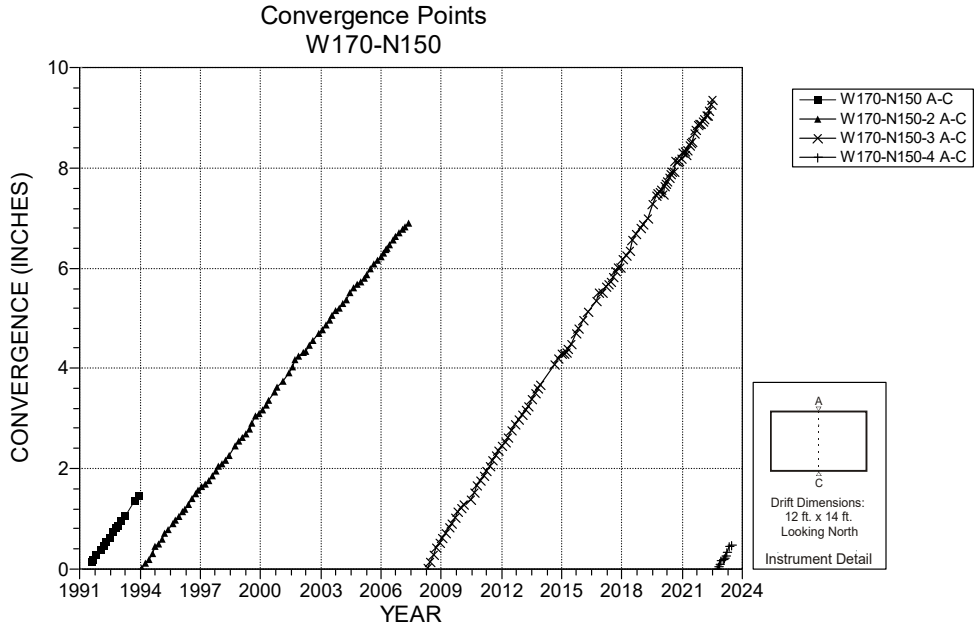
NOTES:
1. Excavation date: July 1988.

Figure 4-249 Convergence Point Array – W30 S2067 – All Chords



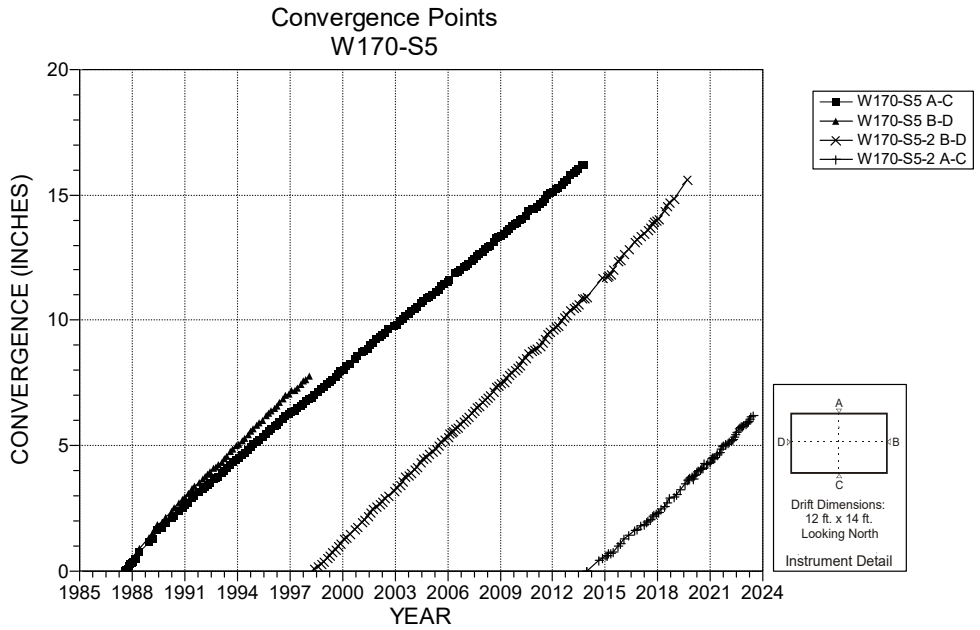
NOTES:
1. Excavation date: November 1999.

Figure 4-250 Convergence Point Array – W30 S2520 – Roof to Floor



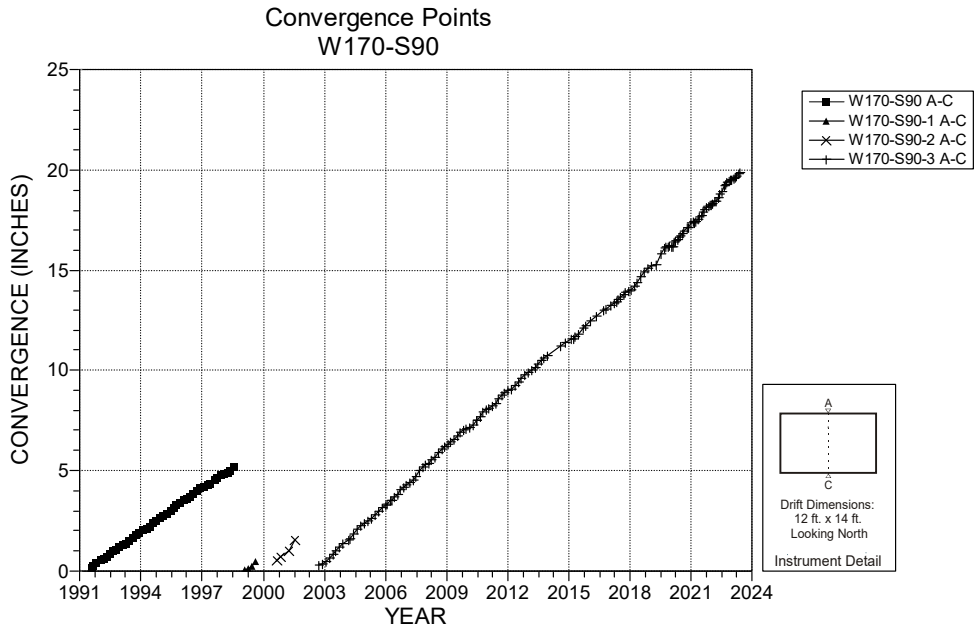
NOTES:
1. Excavation date: July 1984.

Figure 4-251 Convergence Point Array – W170 N150 – Roof to Floor



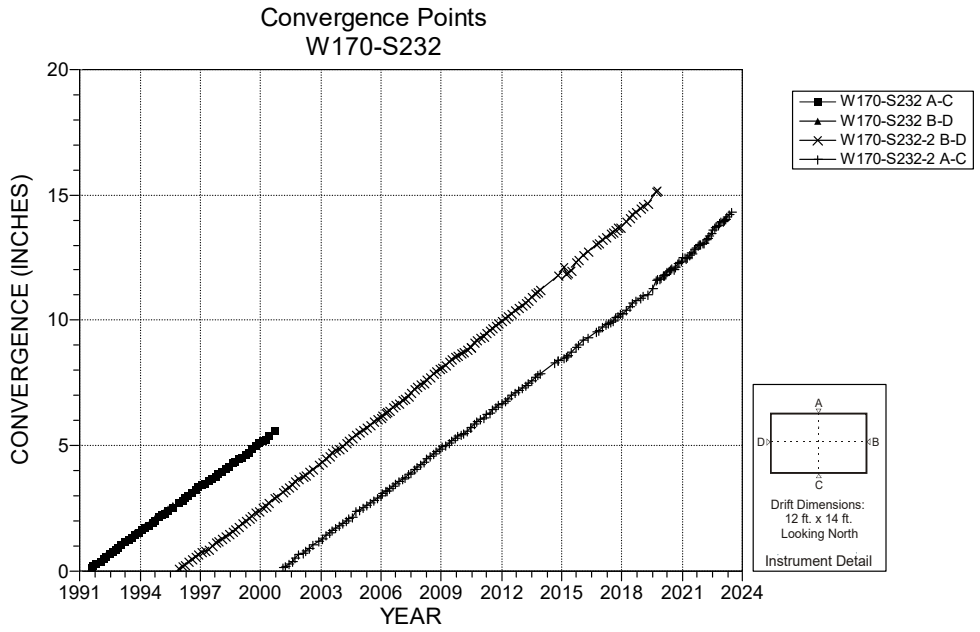
NOTES:
1. Excavation date: August 1984.

Figure 4-252 Convergence Point Array – W170 S5 – All Chords



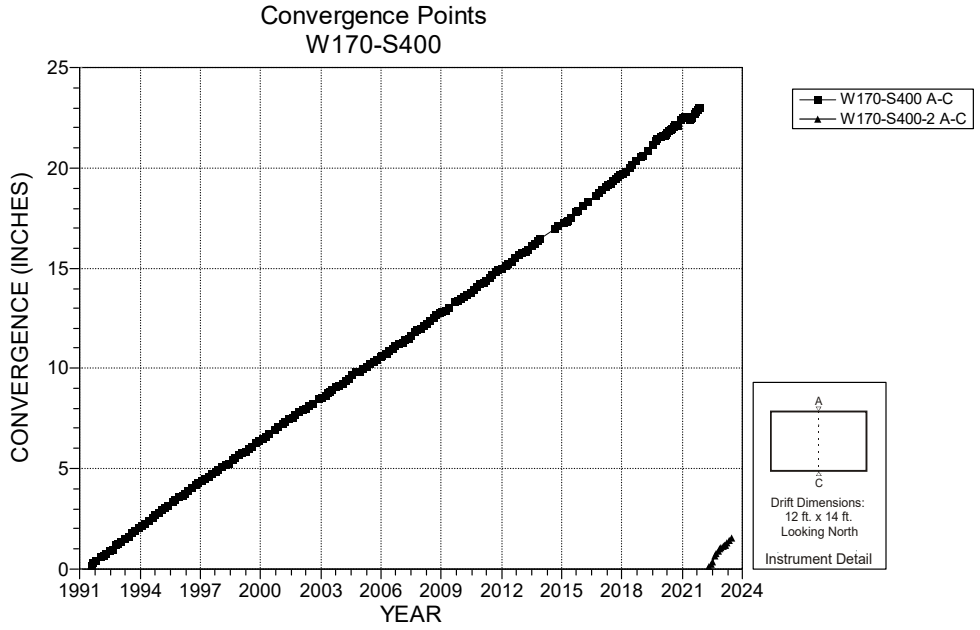
NOTES:
1. Excavation date: August 1984.

Figure 4-253 Convergence Point Array – W170 S90 – Roof to Floor



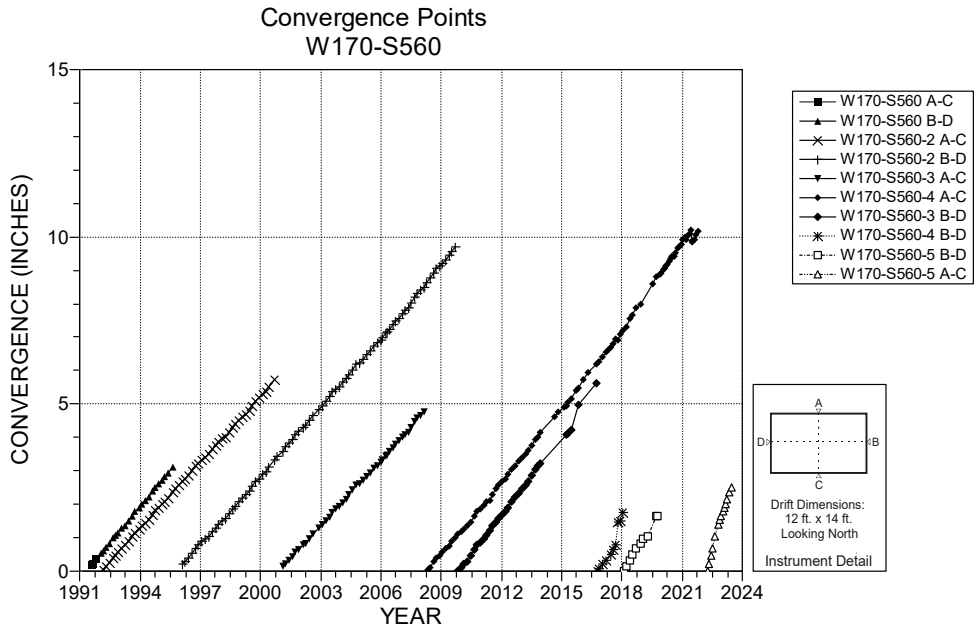
NOTES:
1. Excavation date: August 1984.

Figure 4-254 Convergence Point Array – W170 S232 – All Chords



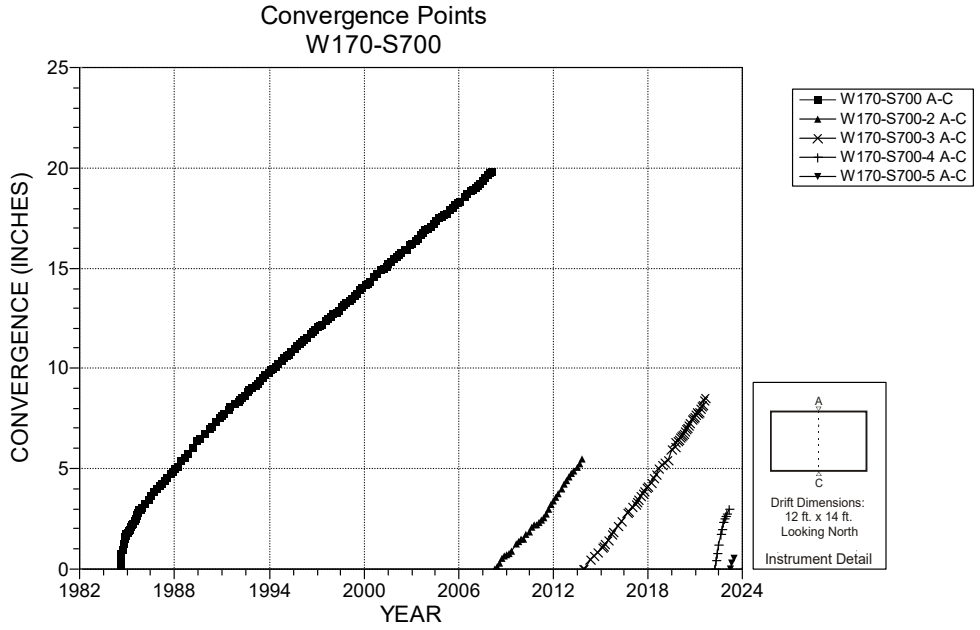
NOTES:
1. Excavation date: August 1984.

Figure 4-255 Convergence Point Array – W170 S400 – Roof to Floor



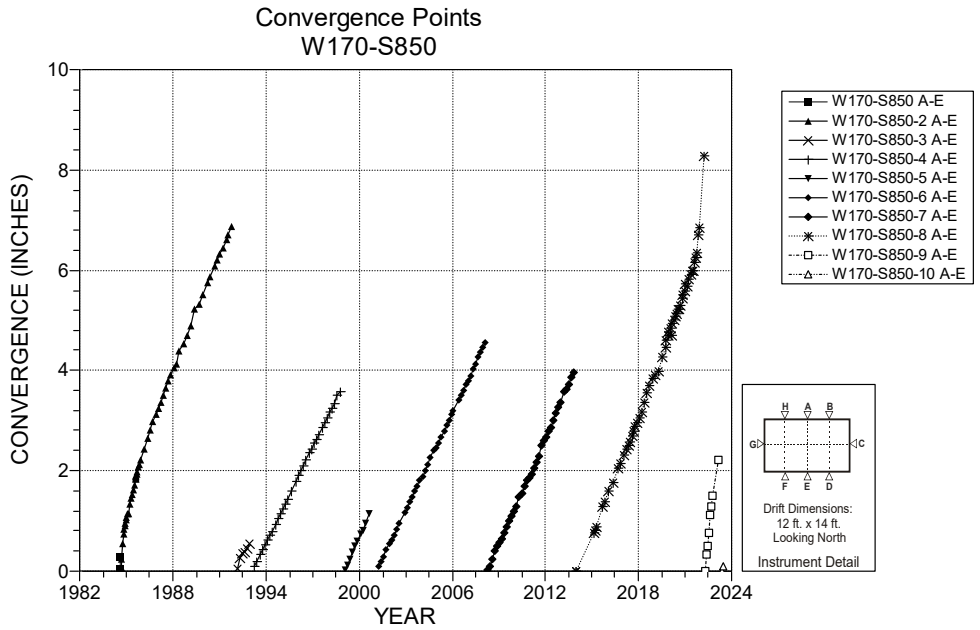
NOTES:
1. Excavation date: August 1984.
2. Reinstalled anchor 'D' due to fracturing of core hole.

Figure 4-256 Convergence Point Array – W170 S560 – All Chords



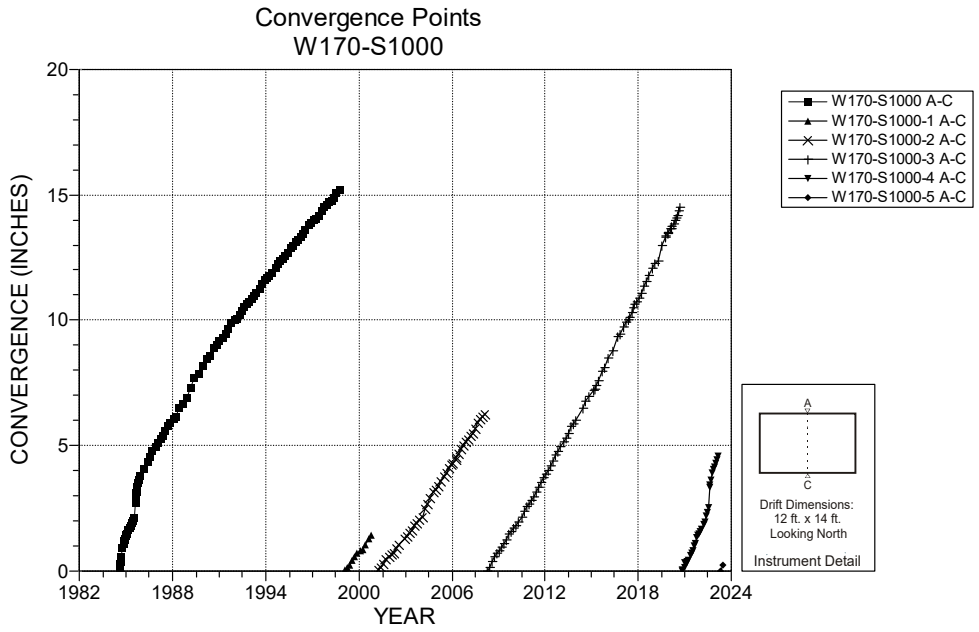
NOTES:
1. Excavation date: August 1984.

Figure 4-257 Convergence Point Array – W170 S700 – Roof to Floor



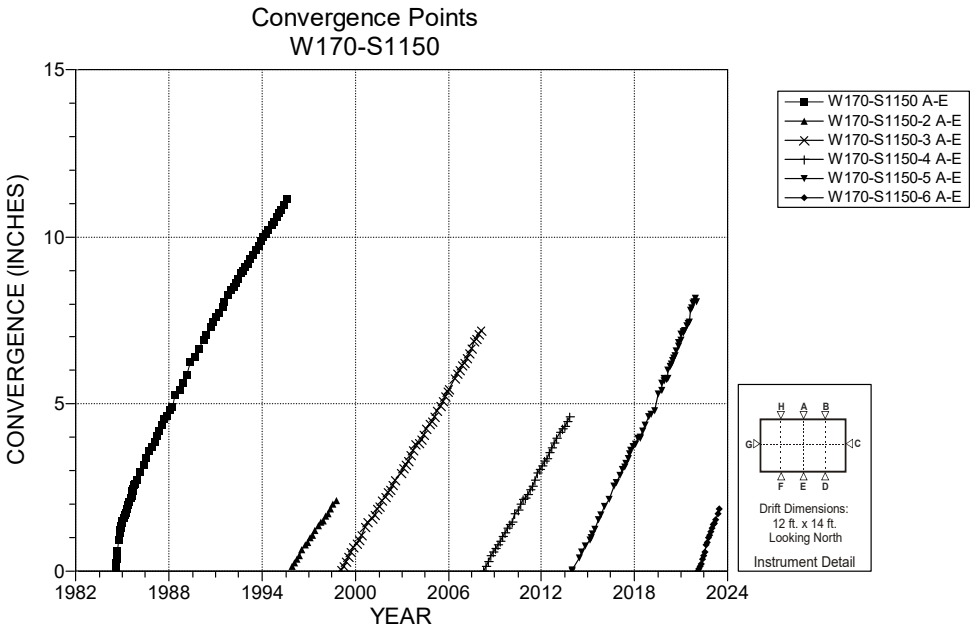
NOTES:
1. Excavation date: August 1984.
2. Chords for this location are on separate plots.

Figure 4-258 Convergence Point Array – W170 S850 – Roof to Floor



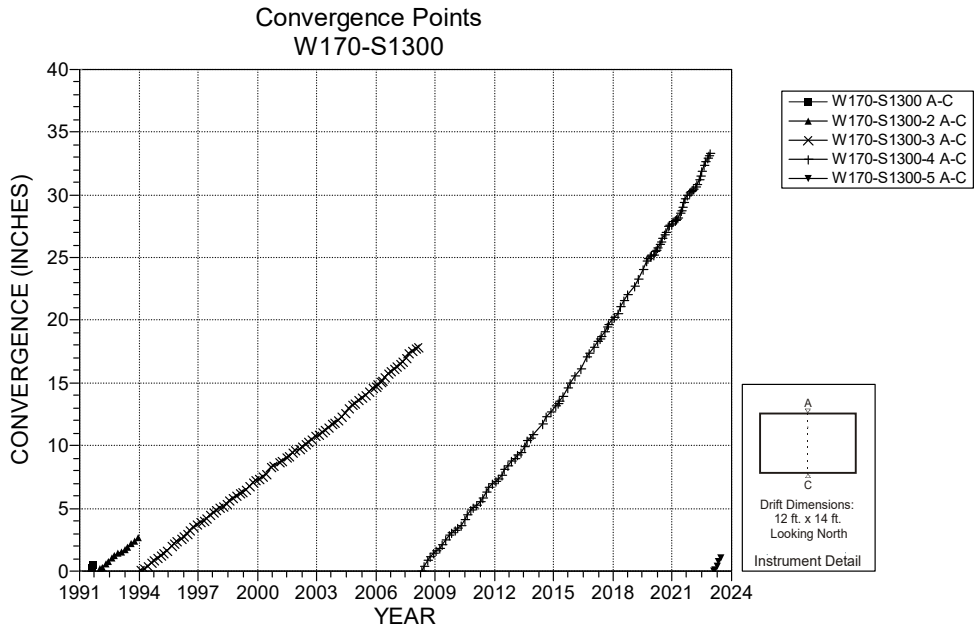
NOTES:
1. Excavation date: August 1984.

Figure 4-259 Convergence Point Array – W170 S1000 – Roof to Floor



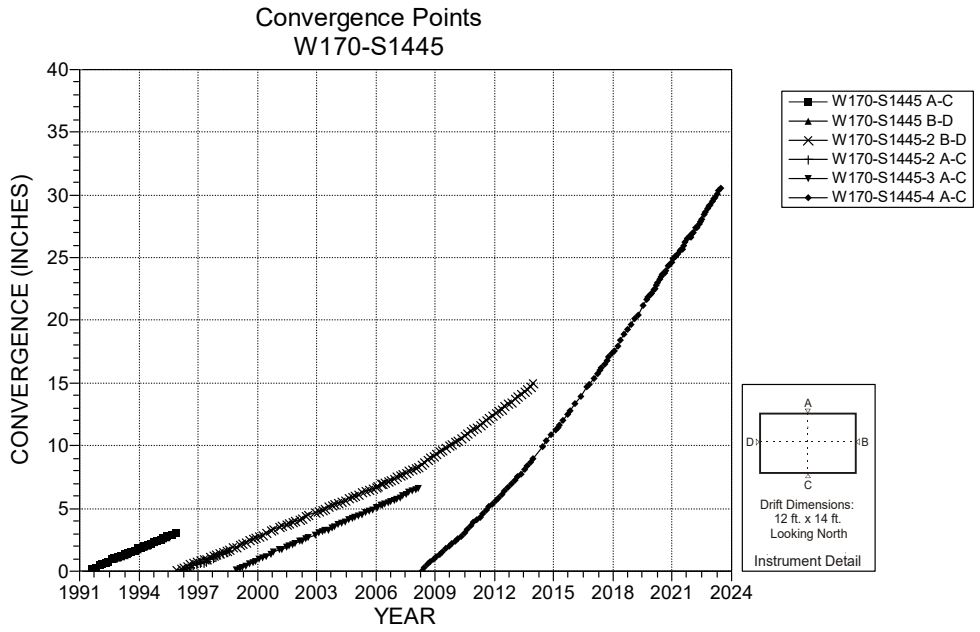
NOTES:
1. Excavation Date: August 1984.

Figure 4-260 Convergence Point Array – W170 S1150 – Roof to Floor



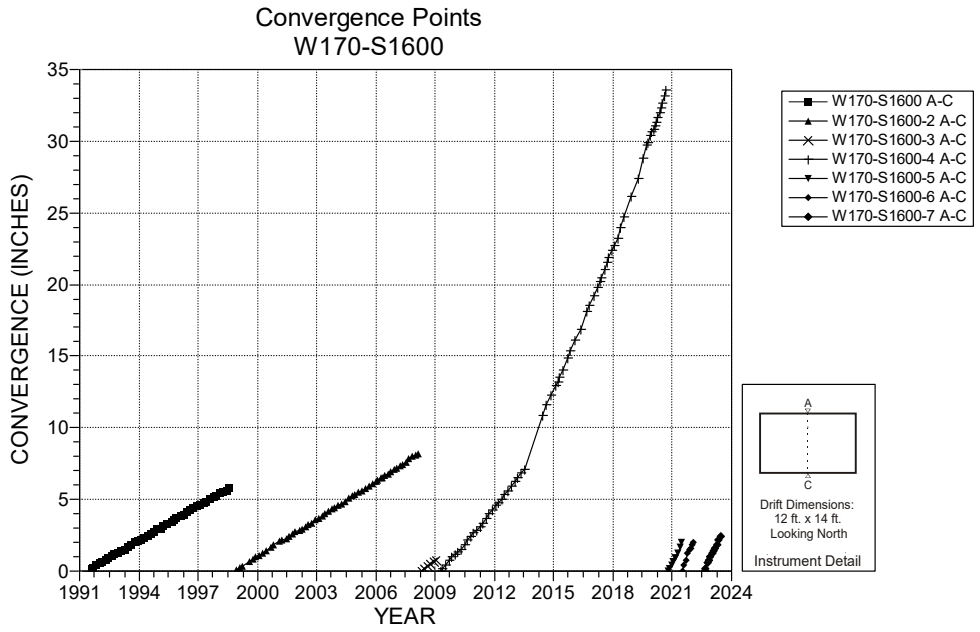
NOTES:
1. Excavation date: August 1984.

Figure 4-261 Convergence Point Array – W170 S1300 – Roof to Floor



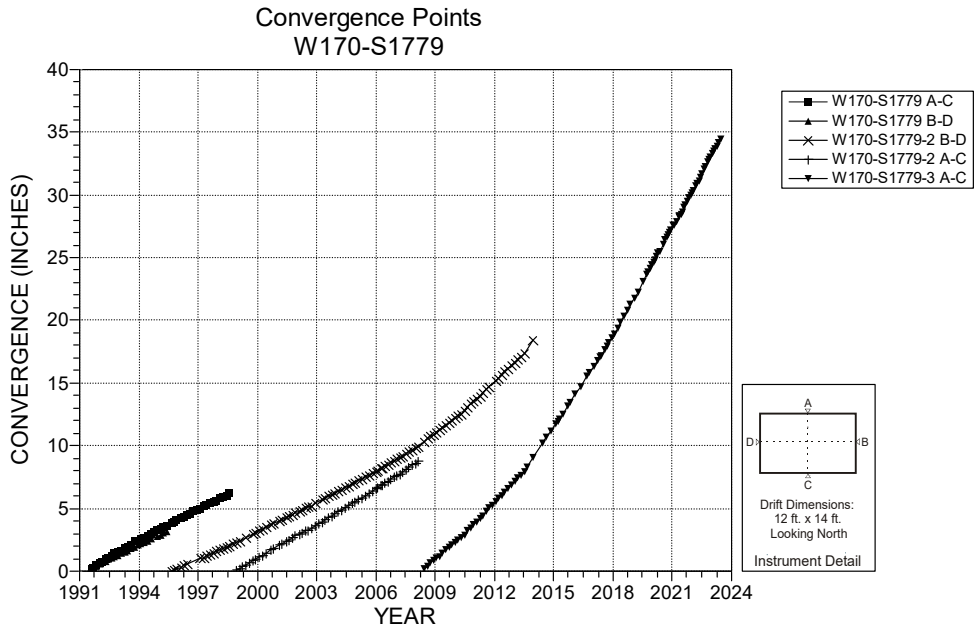
NOTES:
1. Excavation date: August 1984.

Figure 4-262 Convergence Point Array – W170 S1445 – All Chords



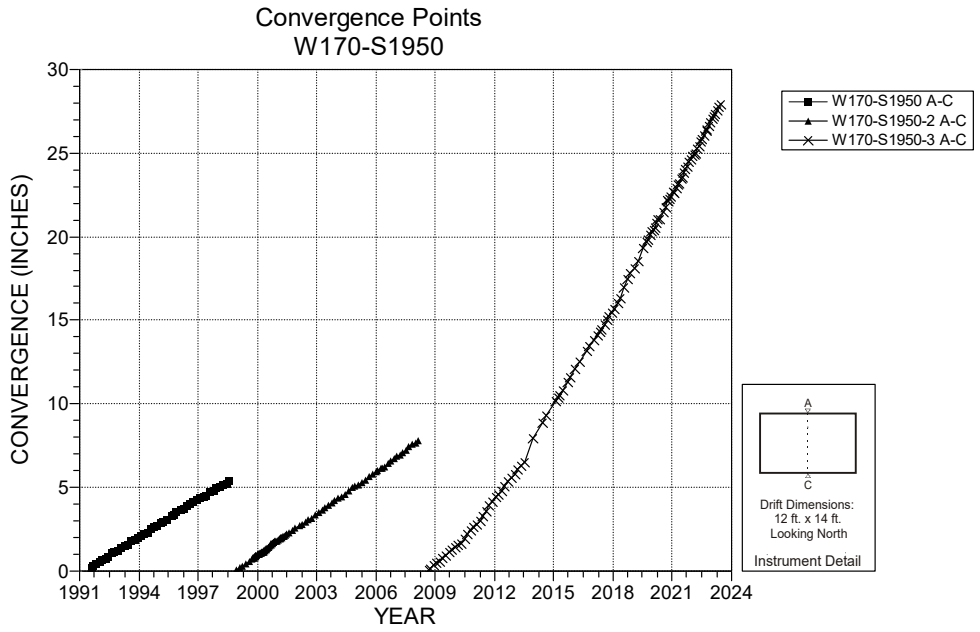
NOTES:
1. Excavation date: September 1984.
2. Backed mined out for overcast from West Mains. No future access to this location.

Figure 4-263 Convergence Point Array – W170 S1600 – Roof to Floor



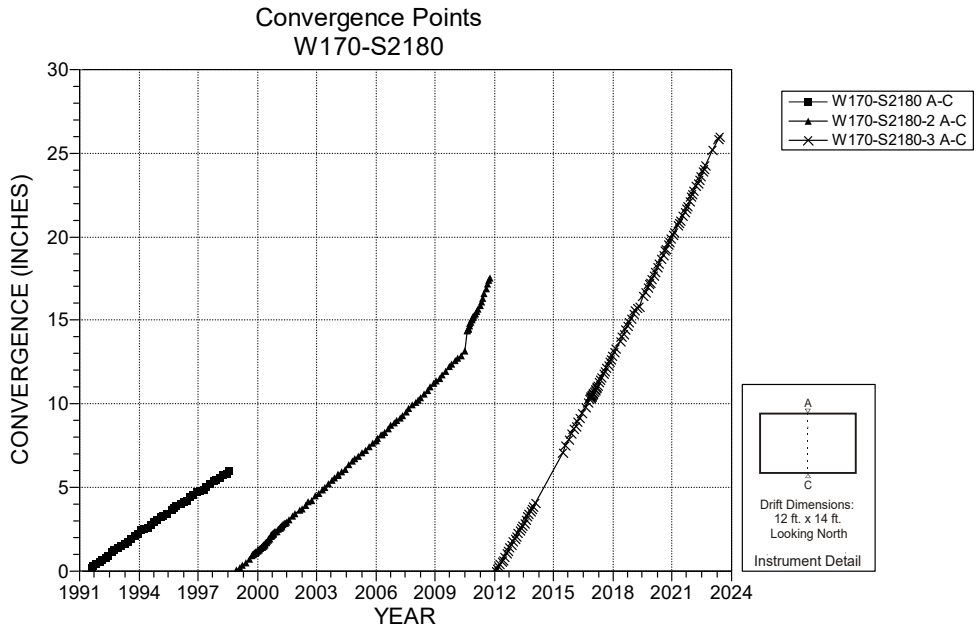
NOTES:
1. Excavation date: December 1985.

Figure 4-264 Convergence Point Array – W170 S1779 – All Chords



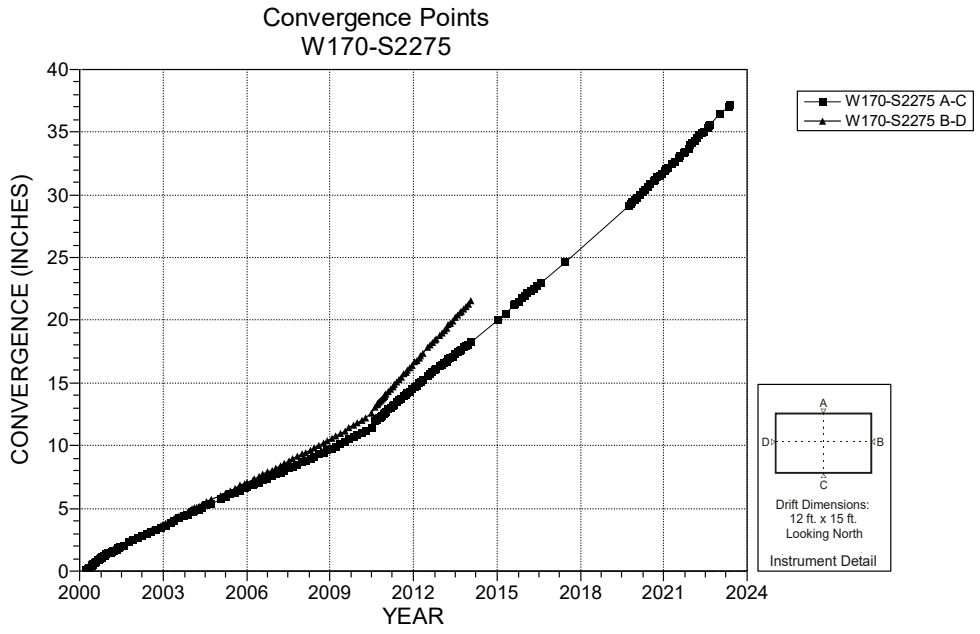
NOTES:
1. Excavation date: December 1985.

Figure 4-265 Convergence Point Array – W170 S1950 – Roof to Floor



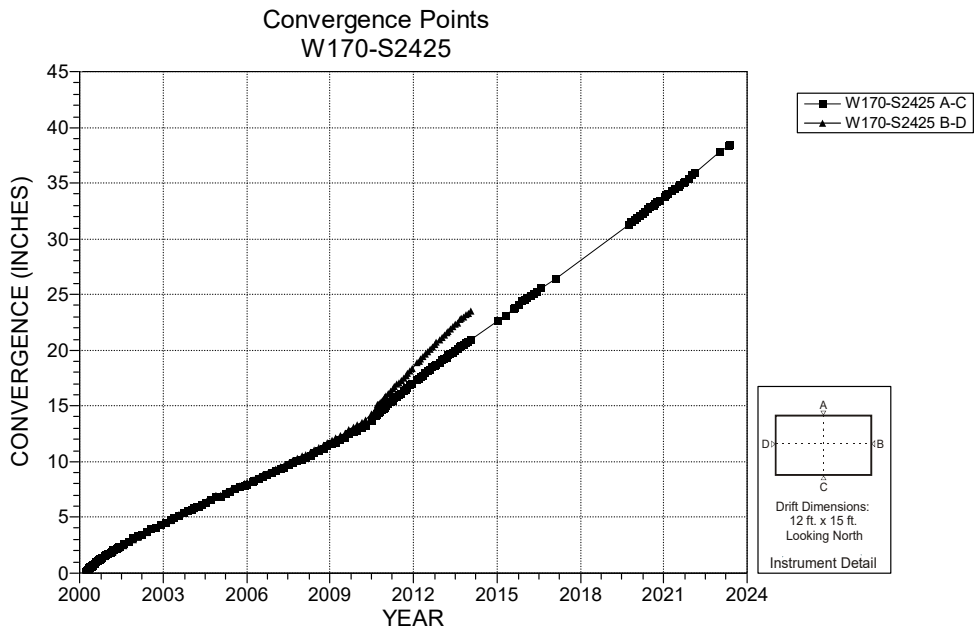
NOTES:
1. Excavation date: August 1988.

Figure 4-266 Convergence Point Array – W170 S2180 – Roof to Floor



NOTES:
1. Excavation date: December 1999.

Figure 4-267 Convergence Point Array – W170 S2275 – All Chords



NOTES:
1. Excavation date: December 1999.

Figure 4-268 Convergence Point Array – W170 S2425 – All Chords

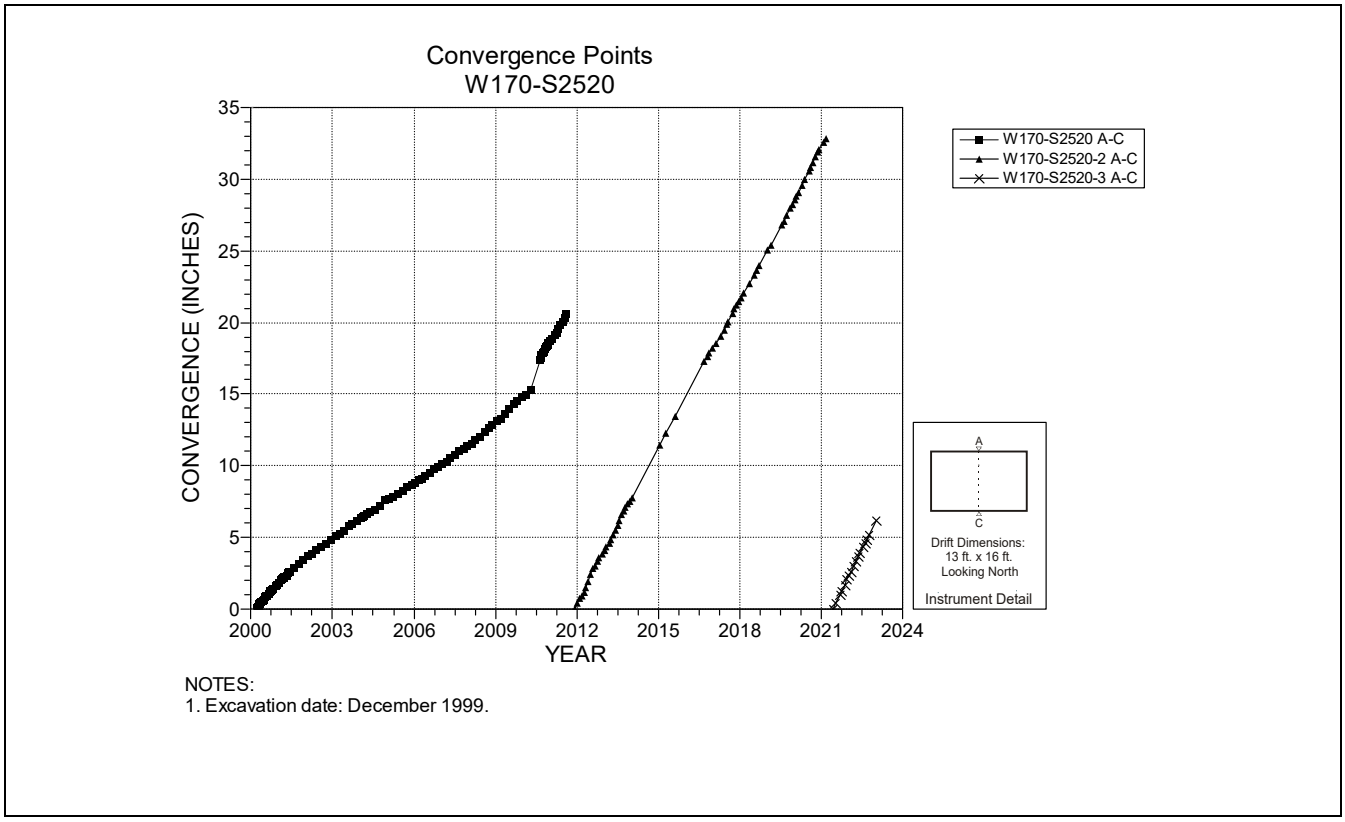


Figure 4-269 Convergence Point Array – W170 S2520 – Roof to Floor

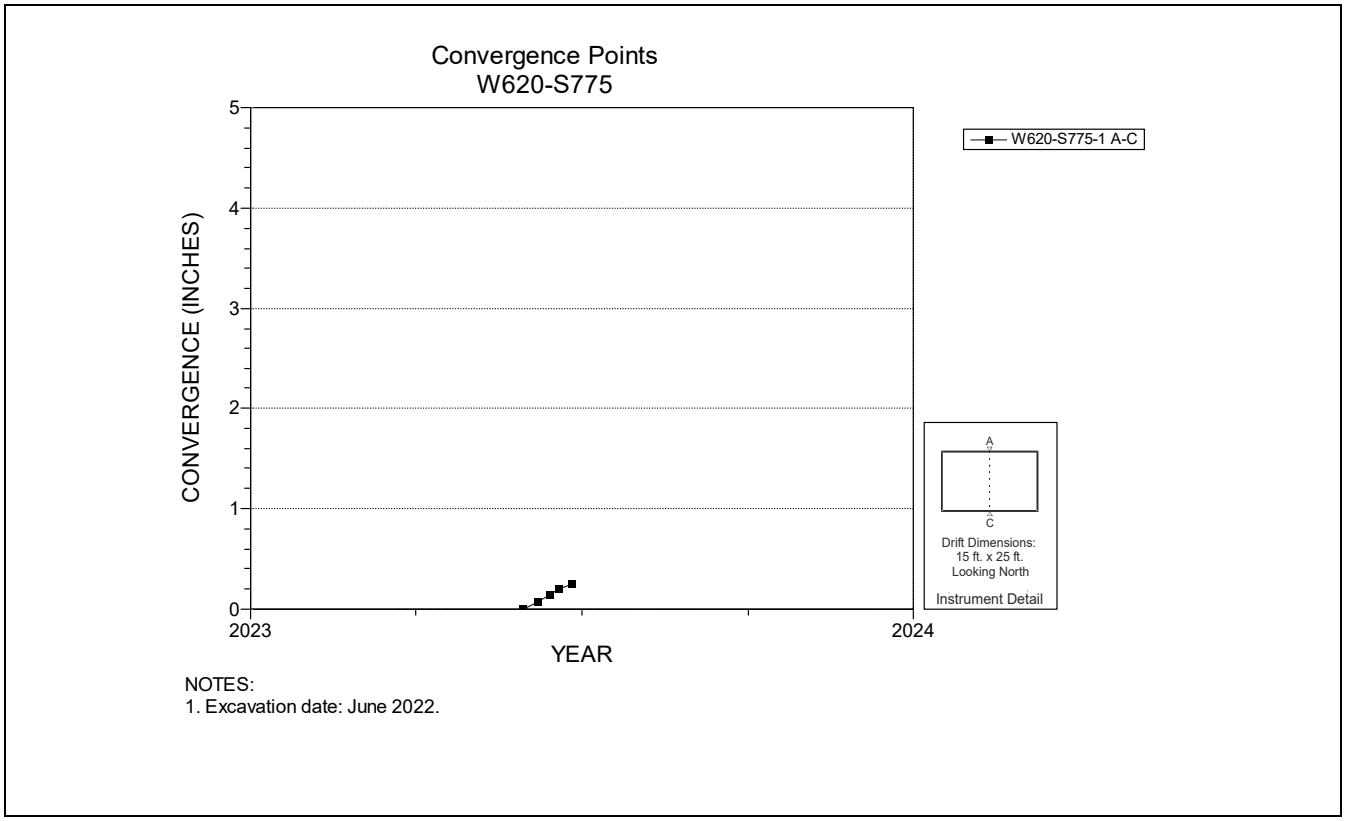
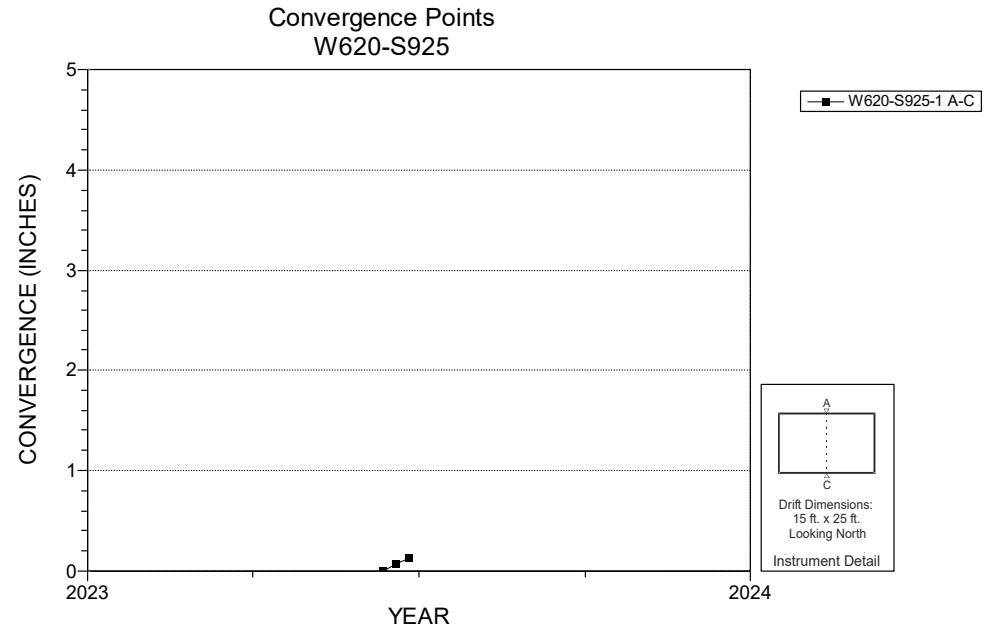
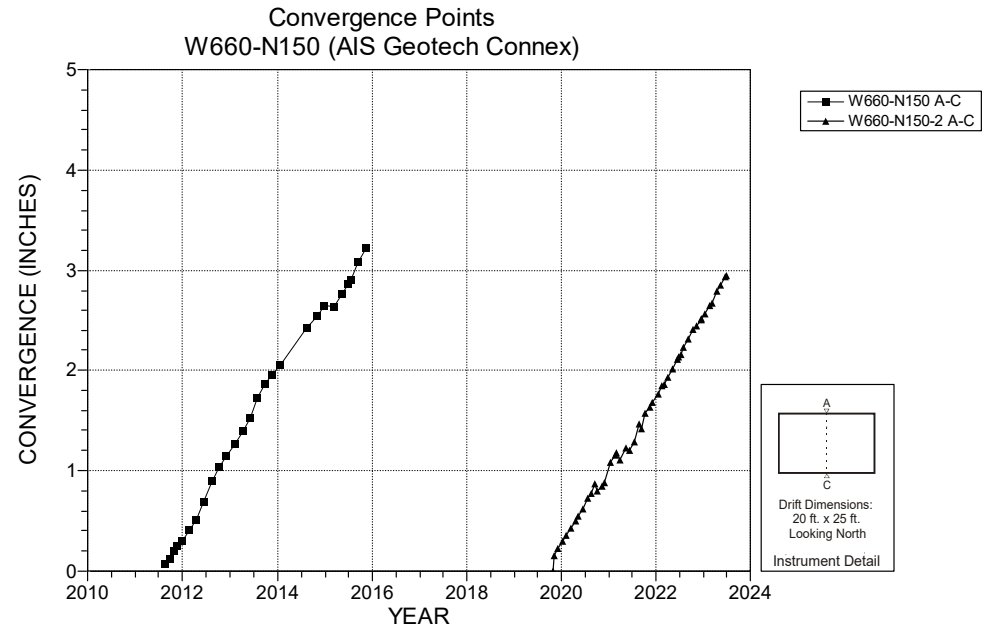


Figure 4-270 Convergence Point Array – W620 S775 – Roof to Floor



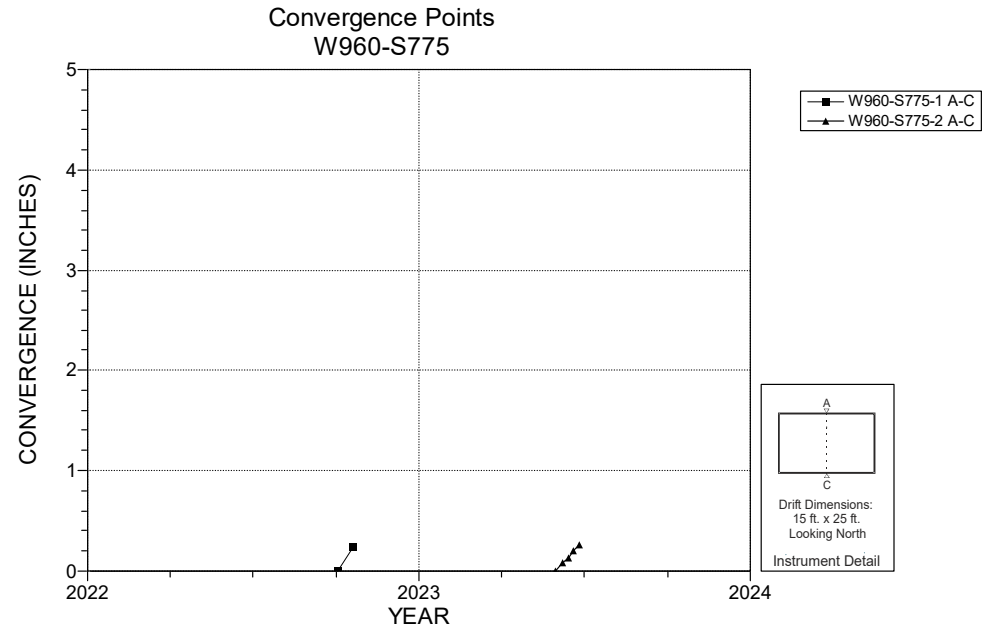
NOTES:
1. Excavation date: June 2022.

Figure 4-271 Convergence Point Array – W620 S925 – Roof to Floor



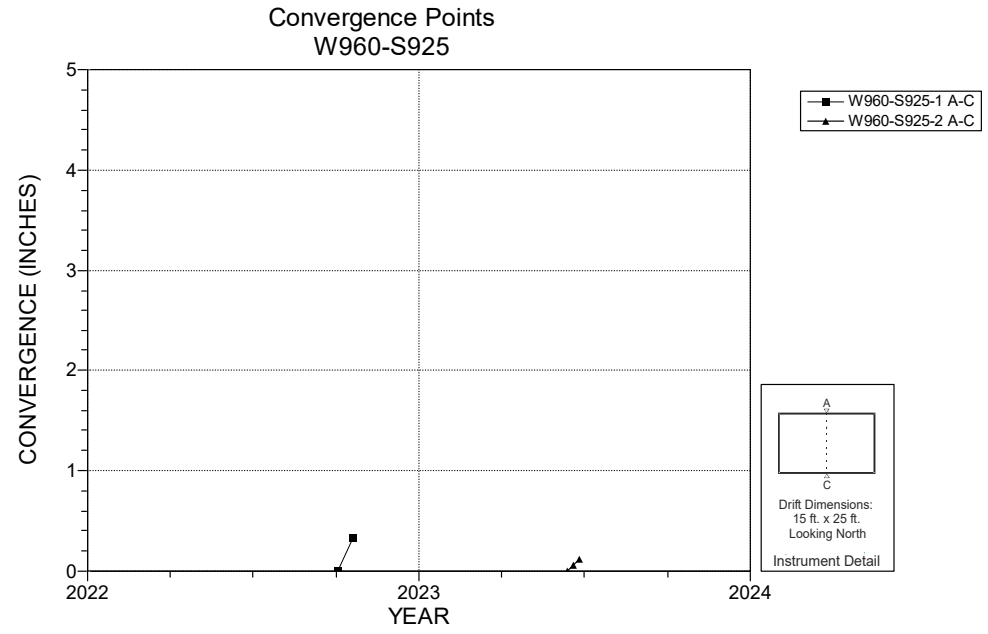
NOTES:
1. Excavation date: January 1988.

Figure 4-272 Convergence Point Array – W660 N150 – Roof to Floor



NOTES:
1. Excavation date: August 2022.

Figure 4-273 Convergence Point Array – W960 S775 – Roof to Floor



NOTES:
1. Excavation date: September 2022.

Figure 4-274 Convergence Point Array – W960 S925 – Roof to Floor

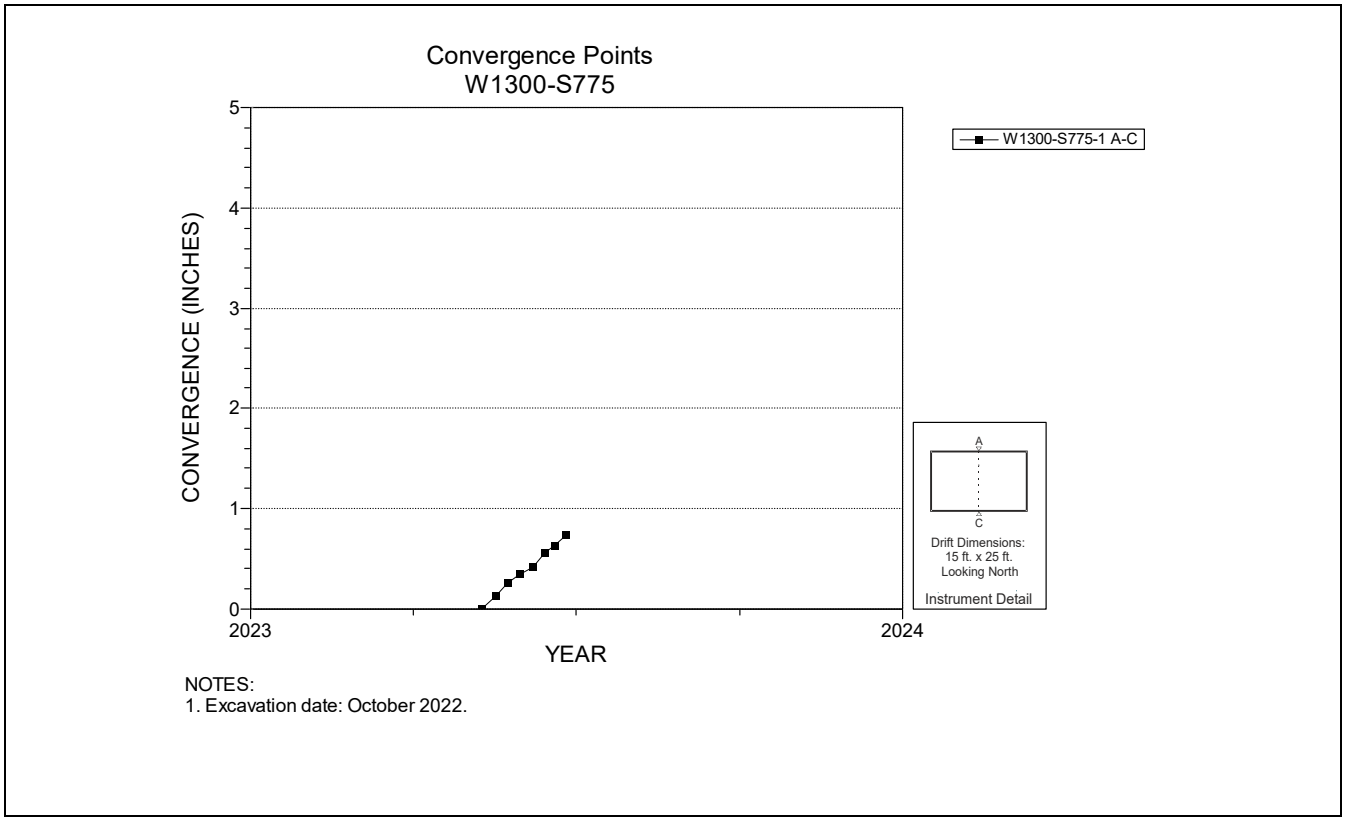


Figure 4-275 Convergence Point Array – W1300 S775 – Roof to Floor

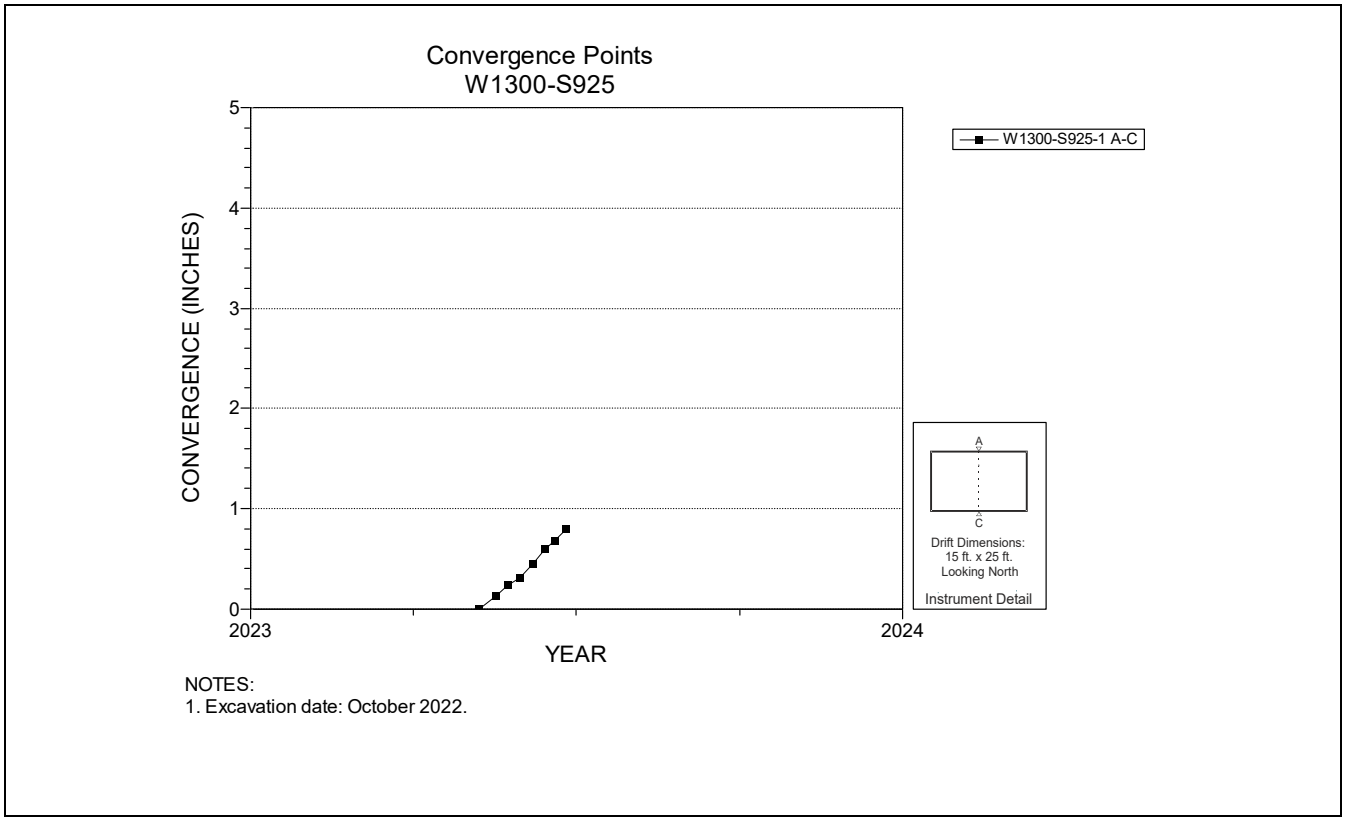
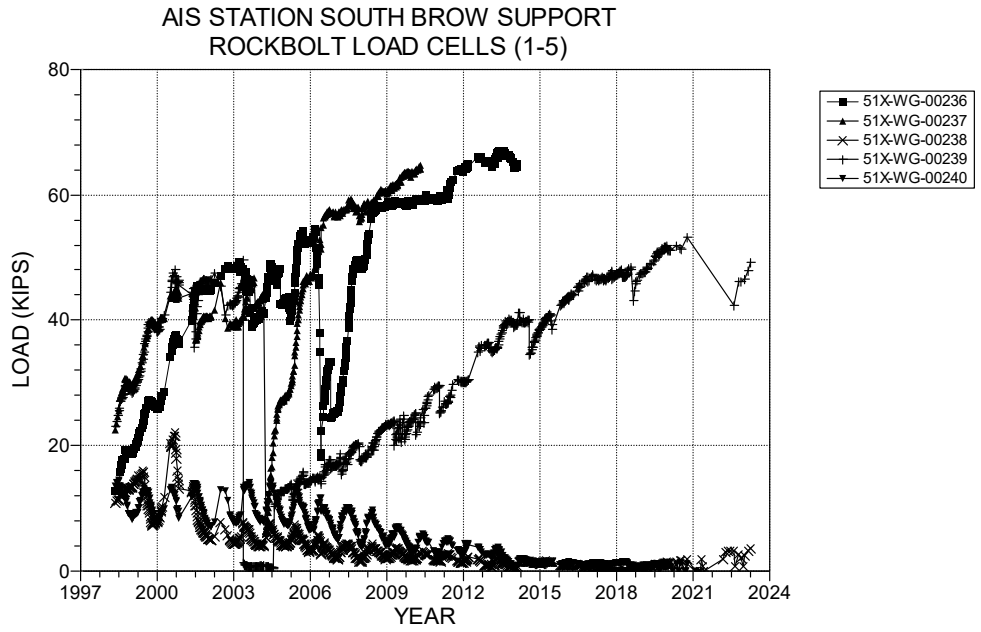
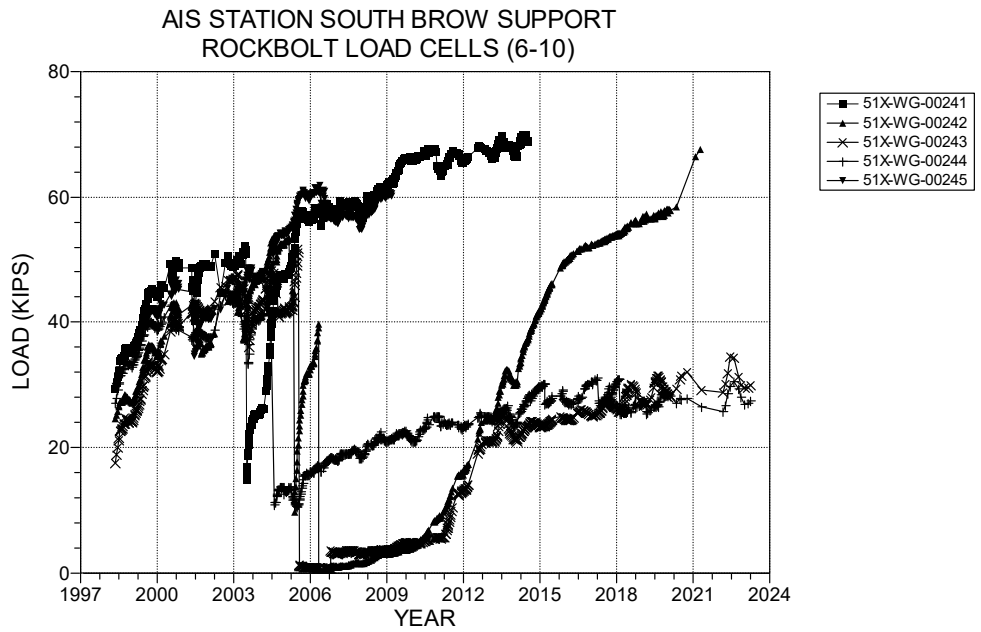


Figure 4-276 Convergence Point Array – W1300 S925 – Roof to Floor



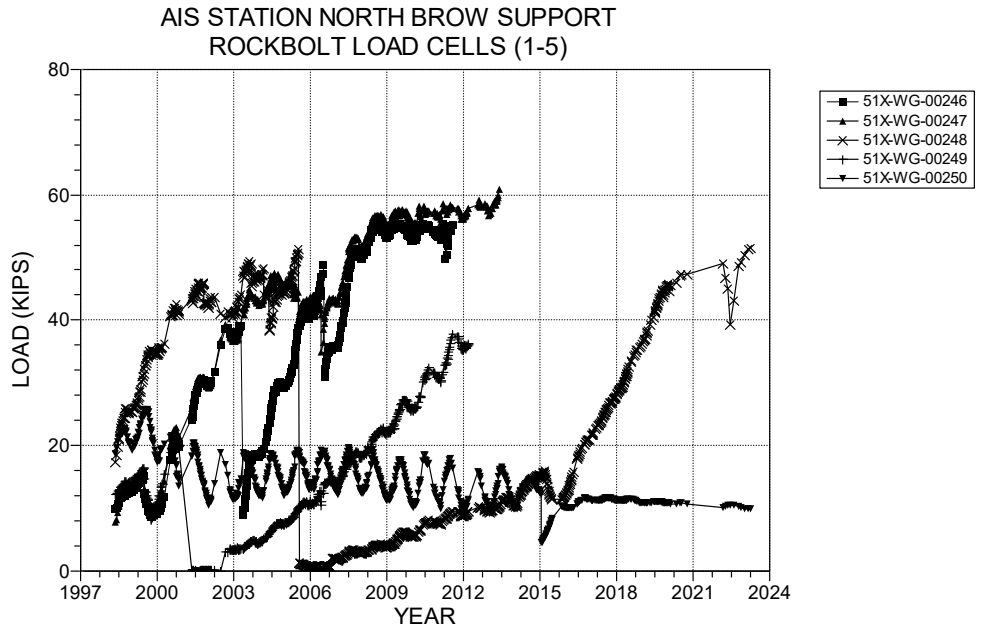
NOTES:
1. Excavation date: January 1988.
2. Load cell 51X-WG-00236 is on the only bolt, of the five instrumented bolts, still intact.

Figure 4-277 Rock Bolt Load Cell 51X-WG-00236 – 51X-WG-00240 – AIS South Brow



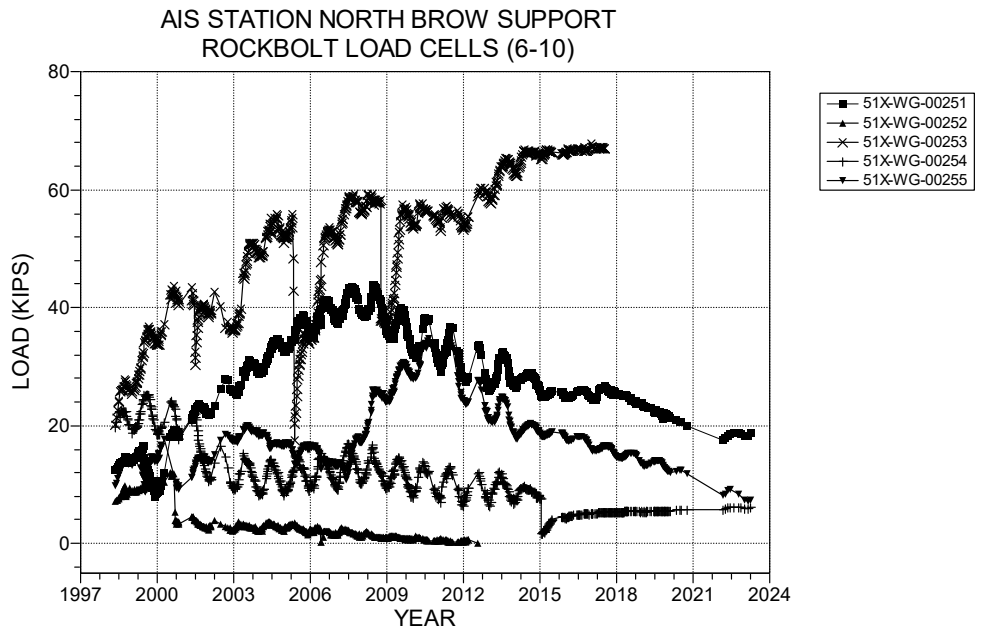
NOTES:
1. The rock bolt that load cell 51X-WG-00242 was on broke in May 2005; the load cell was reinstalled on the replacement bc
2. The bolt that load cell 51X-WG-00245 has failed.

Figure 4-278 Rock Bolt Load Cell 51X-WG-00241– 51X-WG-00245 – AIS South Brow



NOTES:
1. The bolts that load cells 51X-WG-00247 and 51X-WG-00249 are on have failed.

Figure 4-279 Rock Bolt Load Cell 51X-WG-00246 – 51X-WG-00250 – AIS North Brow



NOTES:
1. Load cell 51X-WG-00252 has failed and is no longer read.

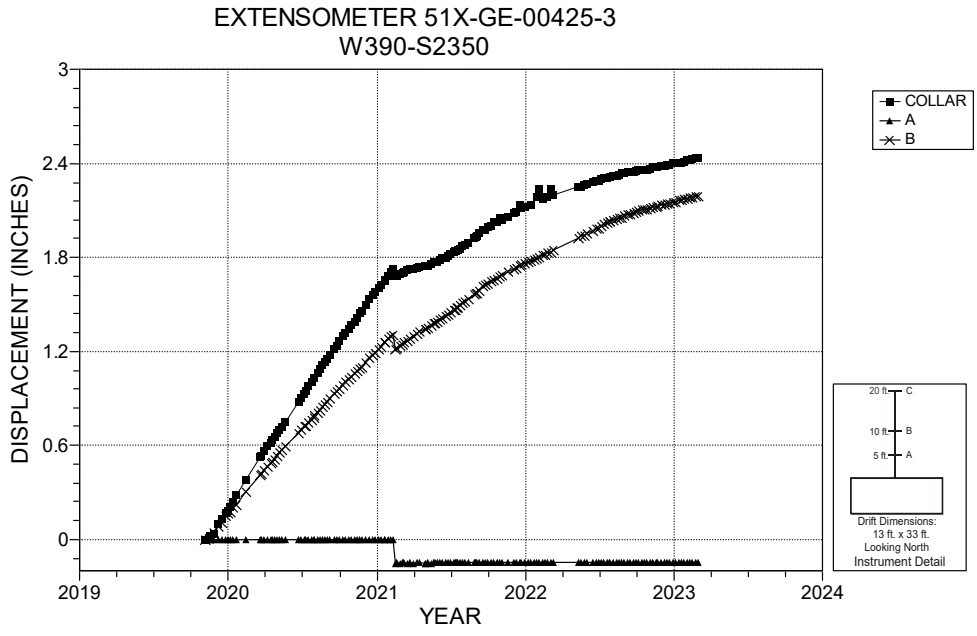
Figure 4-280 Rock Bolt Load Cell 51X-WG-00251 – 51X-WG-00255 – AIS North Brow

5.0 INSTRUMENTATION SUMMARY FOR THE WASTE DISPOSAL AREA

This section presents a summary of the data collected from instruments located in the Waste Disposal Area at the WIPP facility. Table 5-1 presents data and analysis of the instrumentation associated with Panel 7. Plots of the instrument data are presented as Figures 5-1 through 5-3. Table 5-2 presents instrument data from Panel 8. Plots of the instrument data are presented as Figures 5-4 through 5-63.

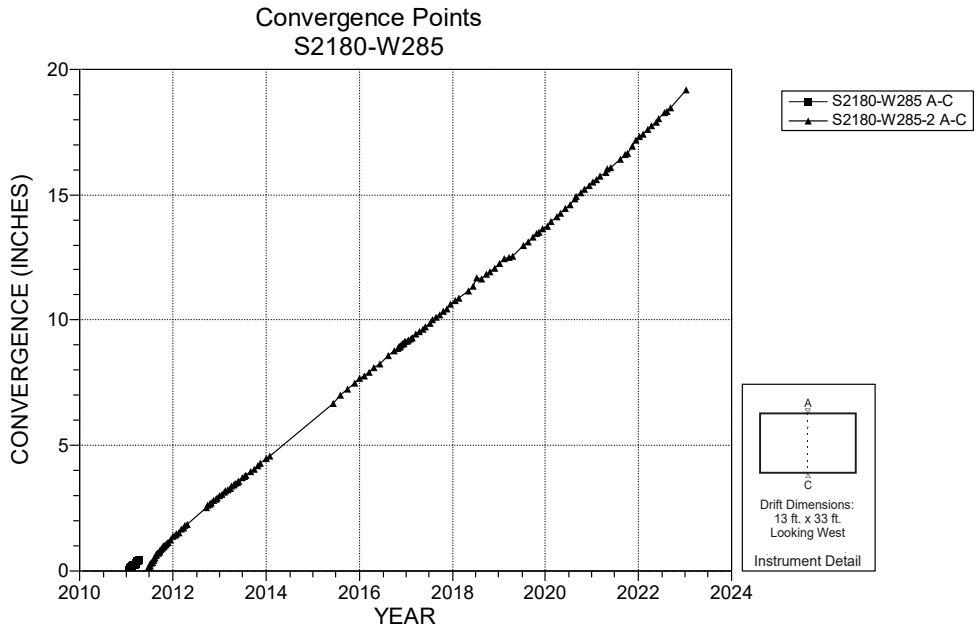
Table 5-1 Panel 7 Data Analysis

Extensometers									
Field Tag	Location	Figure Number	Date of Last Reading	Collar Displacement Relative to Deepest Anchor (inches)	Displacement Rate 2022 to 2023 (in/year)		Displacement Rate 2021 to 2022 (in/year)	Rate Change Percent	Comments
51X-GE-00425-3	W390-S2350	5-1	3/2/2023	2.43	0.2		0.5	-60	Contacted by equipment during '21-'22 report period
Convergence Points									
Field Tag	Location	Figure Number	Last Reading 2022 to 2023		Cumulative Displacement (inches)	Closure Rate 2022 to 2023 (in/year)	Closure Rate 2021 to 2022 (in/year)	Rate Change Percent	Comments
			Date	Inches					
S2180-W285-2 A-C	S2180-W285	5-2	1/11/2023	19.208	19.654	2.0	1.9	5	N/A
S2520-W285-5 A-C	S2520-W285	5-3	1/11/2023	29.276	52.265	5.0	4.9	2	N/A



NOTES:
1. Excavation date: June 2010.
2. WEX Replacement.

Figure 5-1 Extensometer 51X-GE-00425 – W390 S2350 – Roof



NOTES:
1. Excavation date: July 2010.

Figure 5-2 Convergence Point Array – S2180 W285 – Roof to Floor

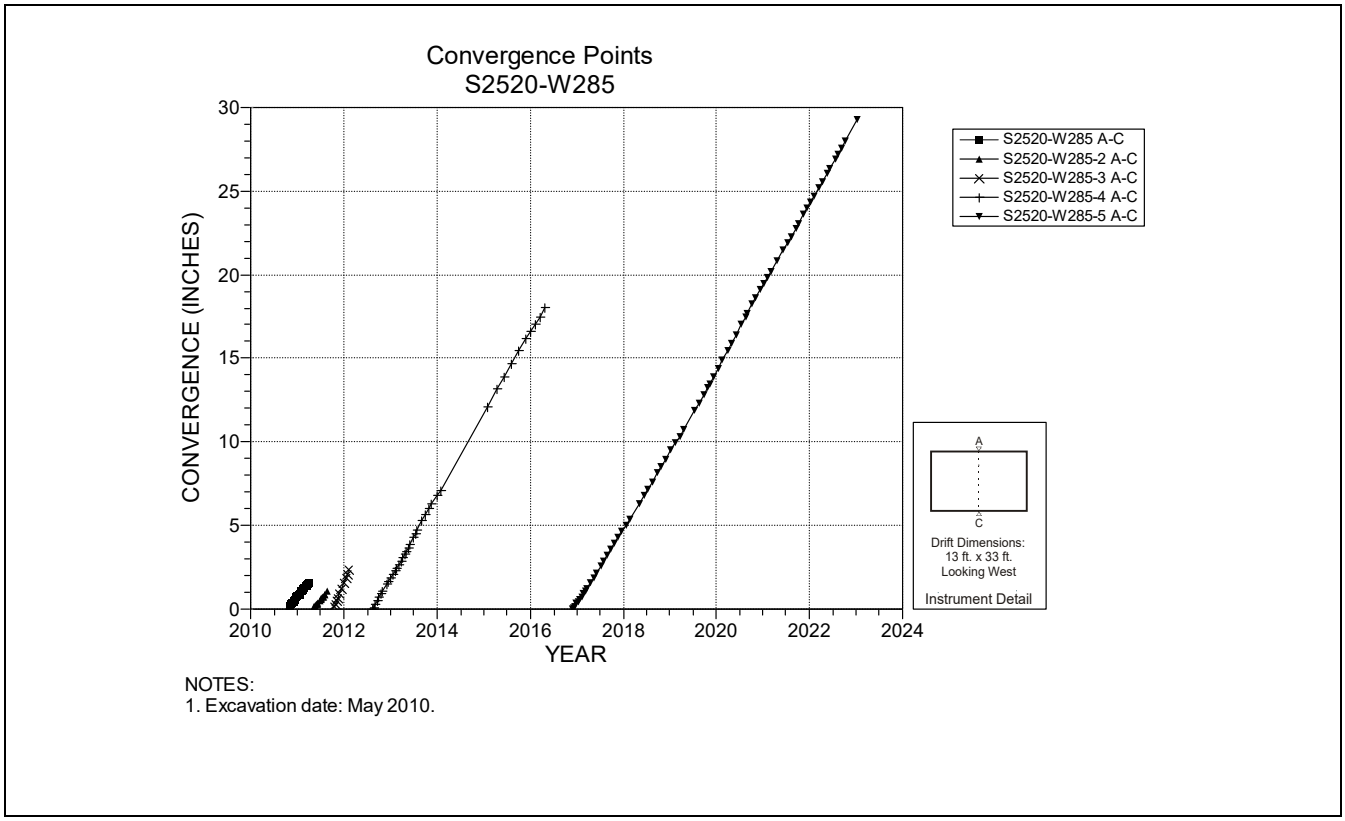


Figure 5-3 Convergence Point Array – S2520 W285 – Roof to Floor

Table 5-2 Panel 8 Data Analysis

Extensometers								
Field Tag	Location	Figure Number	Date of Last Reading	Collar Displacement Relative to Deepest Anchor (inches)	Displacement Rate 2022 to 2023 (in/year)	Displacement Rate[1] 2021 to 2022 (in/year)	Rate Change Percent	Comments
51X-GE-00451	W390-S1775	5-4	6/30/2023	3.40	2.1	1.5	40	Suspected contact with equipment
51X-GE-00452	W520-S1775	5-5	6/30/2023	2.23	1.8	1.8	0	N/A
51X-GE-00453	S1600-W585	5-6	6/30/2023	1.64	1.0	0.8	25	N/A
51X-GE-00454	W660-S1775	5-7	6/30/2023	1.68	1.4	1.5	-7	N/A
51X-GE-00455	W790-S1775	5-8	6/30/2023	1.35	1.1	1.2	-8	N/A
51X-GE-00456	W920-S1775	5-9	6/30/2023	2.08	1.7	1.9	-11	N/A
51X-GE-00457	S1600-W985	5-10	2/10/2023	1.56	0.4	1.1	-64	Noise on anchor C
51X-GE-00458	W1050-S1775	5-11	6/30/2023	1.28	0.8	0.8	0	N/A
51X-GE-00459	W1190-S1775	5-12	5/17/2023	1.63	0.8	0.9	-11	N/A
51X-GE-00460	S1950-W985	5-13	6/30/2023	2.46	0.8	7.4	-89	Comment made on graph
51X-GE-00461	S1950-W585	5-14	6/30/2023	1.92	1.6	1.3	23	N/A

Convergence Points									
Field Tag	Location	Figure Number	Last Reading 2022 to 2023		Cumulative Displacement (inches)	Closure Rate 2022 to 2023 (in/year)	Closure Rate[1] 2021 to 2022 (in/year)	Rate Change Percent[1]	Comments
			Date	Inches					
W390-S1700-2 A-C	W390-S1700	5-15	6/06/2023	7.755	14.944	3.5	3.6	-3	N/A
W390-S1775-2 A-C	W390-S1775	5-16	6/06/2023	10.837	18.837	5.3	4.7	13	N/A
W390-S1850-3 A-C	W390-S1850	5-17	6/06/2023	9.038	9.038	4.2	4.0	5	N/A
W520-S1700-2 A-C	W520-S1700	5-18	6/06/2023	5.663	14.001	3.3	3.4	-3	N/A
W520-S1775-2 A-C	W520-S1775	5-19	6/06/2023	7.659	18.095	4.6	4.4	5	N/A
W520-S1850-2 A-C	W520-S1850	5-20	6/06/2023	7.215	17.357	4.2	4.3	-2	N/A
W660-S1687-2 A-C	W660-S1687	5-21	6/06/2023	6.541	8.193	3.7	4.1	-10	N/A
W660-S1775-2 A-C	W660-S1775	5-22	6/06/2023	6.364	11.620	3.6	4.0	-10	N/A

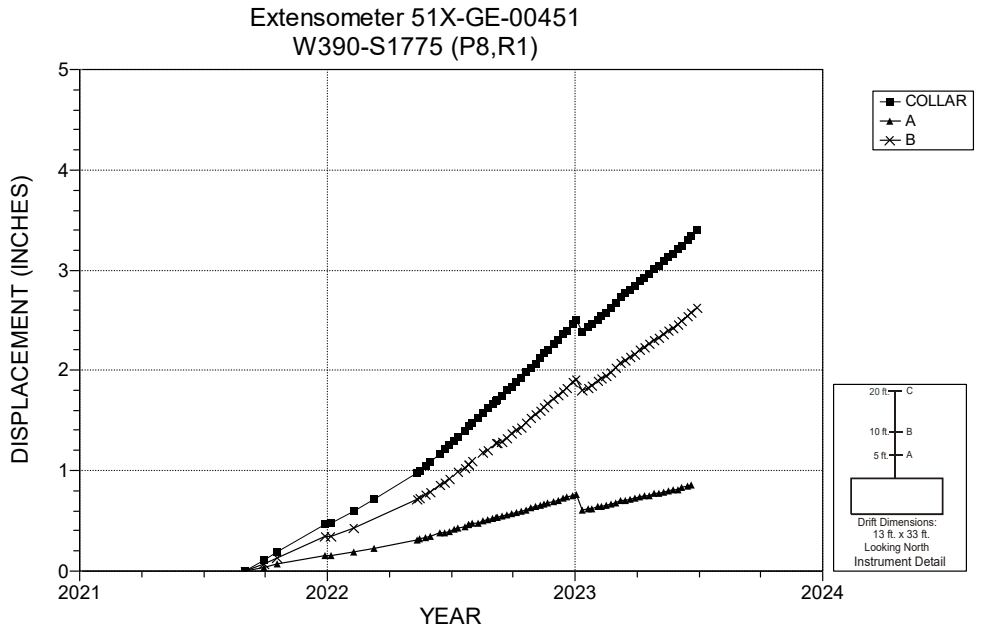
[1] N/A – Insufficient data available to perform the calculation. This is usually due to the inability to read the instruments because of activities such as the removal of an instrument due to floor, rib, or back trimming; locations blocked by equipment or waste disposal; installation timing, access issues, etc.

Convergence Points (continued)									
Field Tag	Location	Figure Number	Last Reading 2022 to 2023		Cumulative Displacement (inches)	Closure Rate 2022 to 2023 (in/year)	Closure Rate[1] 2021 to 2022 (in/year)	Rate Change Percent[1]	Comments
			Date	Inches					
W660-S1862-2 A-C	W660-S1862	5-23	6/06/2023	4.854	9.386	2.5	3.3	-24	N/A
W790-S1687-2 A-C	W790-S1687	5-24	6/06/2023	6.164	10.405	3.0	3.8	-21	N/A
W790-S1775-2 A-C	W790-S1775	5-25	6/06/2023	6.984	11.695	3.4	4.4	-23	N/A
W790-S1862-2 A-C	W790-S1862	5-26	6/06/2023	7.017	10.304	3.3	4.5	-27	N/A
W920-S1687-2 A-C	W920-S1687	5-27	6/06/2023	7.123	10.894	3.4	4.3	-21	N/A
W920-S1775-2 A-C	W920-S1775	5-28	6/06/2023	8.717	13.657	4.1	5.3	-23	N/A
W920-S1862-2 A-C	W920-S1862	5-29	6/06/2023	8.626	13.640	4.1	5.2	-21	N/A
W1050-S1687-2 A-C	W1050-S1687	5-30	6/06/2023	6.694	10.658	2.9	4.0	-28	N/A
W1050-S1775-2 A-C	W1050-S1775	5-31	6/06/2023	7.191	11.169	3.1	4.4	-30	N/A
W1050-S1862-2 A-C	W1050-S1862	5-32	6/06/2023	7.119	11.168	3.0	4.4	-32	N/A
W1190-S1687-2 A-C	W1190-S1687	5-33	4/05/2023	6.805	11.142	3.0	4.0	-25	N/A
W1190-S1775-2 A-C	W1190-S1775	5-34	3/02/2023	7.090	11.551	3.3	4.2	-21	N/A
W1190-S1862-2 A-C	W1190-S1862	5-35	1/12/2023	6.538	10.643	3.1	4.2	-26	N/A
S1600-W285-4 A-C	S1600-W285	5-36	6/06/2023	2.144	13.696	2.8	2.8	0	N/A
S1600-W390-4 A-C	S1600-W390	5-37	6/06/2023	6.517	25.862	3.0	2.9	3	N/A
S1600-W455-3 A-C	S1600-W455	5-38	6/06/2023	8.266	32.888	3.8	3.9	-3	N/A
S1600-W520-4 A-C	S1600-W520	5-39	6/06/2023	8.634	36.377	4.3	4.2	2	N/A
S1600-W585-2 A-C	S1600-W585	5-40	6/06/2023	8.020	14.986	3.9	4.0	-3	N/A
S1600-W660-2 A-C	S1600-W660	5-41	6/06/2023	8.854	16.897	4.2	4.5	-7	N/A
S1600-W725-2 A-C	S1600-W725	5-42	6/06/2023	8.525	12.283	3.8	4.4	-14	N/A
S1600-W790-2 A-C	S1600-W790	5-43	6/06/2023	8.280	11.791	3.5	4.7	-26	N/A
S1600-W855-2 A-C	S1600-W855	5-44	6/06/2023	8.299	12.050	3.6	4.5	-20	N/A
S1600-W920-2 A-C	S1600-W920	5-45	6/06/2023	9.715	14.037	4.0	5.2	-23	N/A

[1] N/A – Insufficient data available to perform the calculation. This is usually due to the inability to read the instruments because of activities such as the removal of an instrument due to floor, rib, or back trimming; locations blocked by equipment or waste disposal; installation timing, access issues, etc.

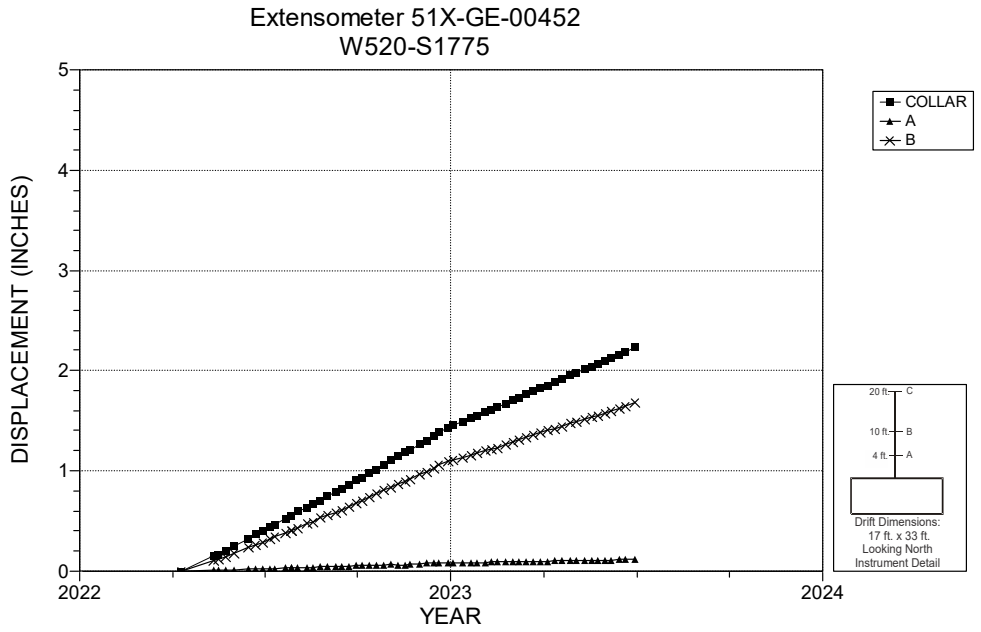
Convergence Points (continued)									
Field Tag	Location	Figure Number	Last Reading 2022 to 2023		Cumulative Displacement (inches)	Closure Rate 2022 to 2023 (in/year)	Closure Rate[1] 2021 to 2022 (in/year)	Rate Change Percent[1]	Comments
			Date	Inches					
S1600-W985-2 A-C	S1600-W985	5-46	6/06/2023	8.204	12.239	3.4	4.5	-24	N/A
S1600-W1050-2 A-C	S1600-W1050	5-47	6/06/2023	8.139	12.058	3.3	4.3	-23	N/A
S1600-W1120-2 A-C	S1600-W1120	5-48	6/06/2023	6.660	10.348	2.8	3.7	-24	N/A
S1600-W1190-2 A-C	S1600-W1190	5-49	4/05/2023	5.093	8.137	2.3	2.9	-21	N/A
S1950-W285-3 A-C	S1950-W285	5-50	6/06/2023	5.266	9.359	2.3	2.3	0	N/A
S1950-W390-3 A-C	S1950-W390	5-51	6/06/2023	8.218	16.004	3.7	3.6	3	N/A
S1950-W455-3 A-C	S1950-W455	5-52	6/06/2023	6.529	15.717	3.8	3.9	-3	N/A
S1950-W520-4 A-C	S1950-W520	5-53	6/06/2023	10.485	17.238	6.2	6.3	-2	N/A
S1950-W585-3 A-C	S1950-W585	5-54	6/06/2023	8.054	19.379	4.4	4.4	0	N/A
S1950-W660-3 A-C	S1950-W660	5-55	6/06/2023	10.134	22.728	5.5	5.6	-2	N/A
S1950-W725-3 A-C	S1950-W725	5-56	6/06/2023	8.231	18.664	4.3	4.7	-9	N/A
S1950-W790-4 A-C	S1950-W790	5-57	6/06/2023	9.431	19.744	4.7	5.7	-18	N/A
S1950-W855-2 A-C	S1950-W855	5-58	6/06/2023	7.276	12.471	3.5	4.5	-22	N/A
S1950-W920-2 A-C	S1950-W920	5-59	6/06/2023	7.476	12.474	3.5	4.7	-26	N/A
S1950-W985-2 A-C	S1950-W985	5-60	6/06/2023	7.211	12.445	3.4	4.5	-24	N/A
S1950-W1050-2 A-C	S1950-W1050	5-61	6/06/2023	7.814	12.817	3.8	4.8	-21	N/A
S1950-W1120-2 A-C	S1950-W1120	5-62	11/16/2022	6.086	10.248	3.3	4.2	-21	N/A
S1950-W1190-2 A-C	S1950-W1190	5-63	12/12/2022	5.038	8.552	2.6	3.4	-24	N/A

[1] N/A – Insufficient data available to perform the calculation. This is usually due to the inability to read the instruments because of activities such as the removal of an instrument due to floor, rib, or back trimming; locations blocked by equipment or waste disposal; installation timing, access issues, etc.



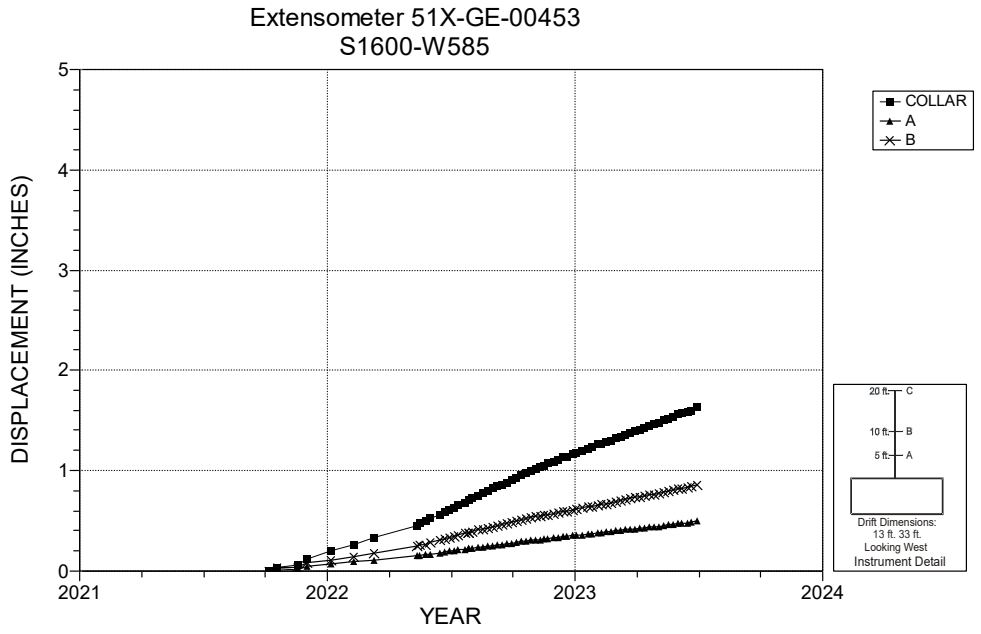
NOTES:
1. Excavation date: October 2013.

Figure 5-4 Extensometer 51X-GE-00451 – W390 S1775



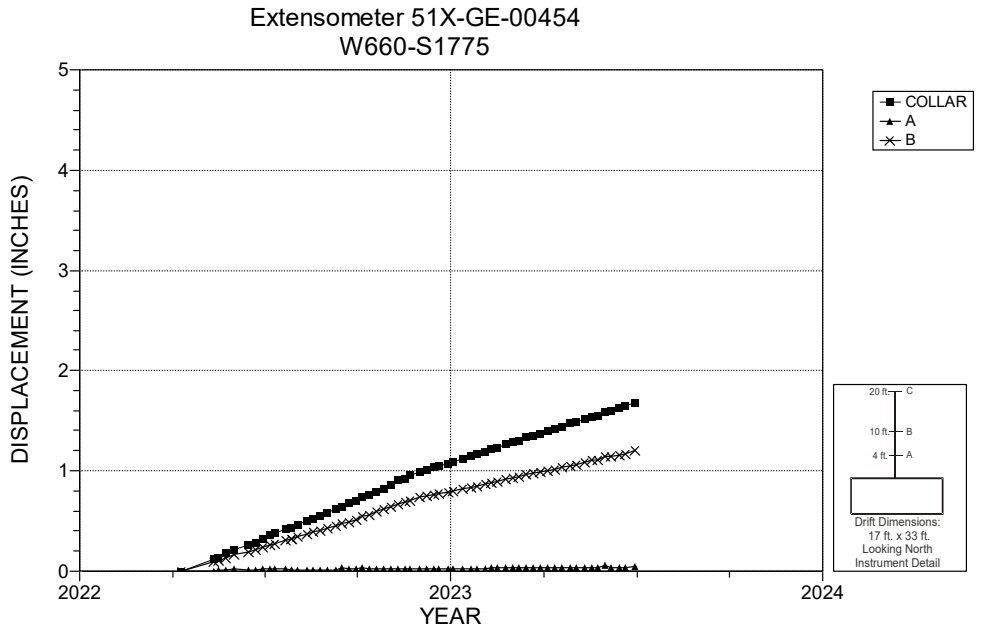
NOTES:
1. Excavation date: January 2020.

Figure 5-5 Extensometer 51X-GE-00452 – W520 S1775



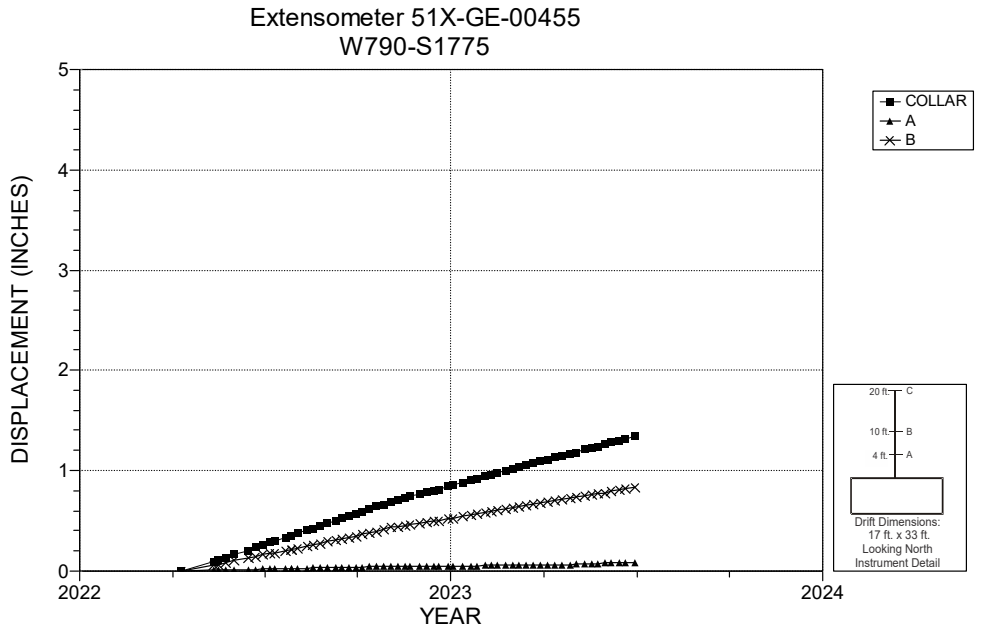
NOTES:
1. Excavation date: January 2014.

Figure 5-6 Extensometer 51X-GE-00453 – S1600 W585



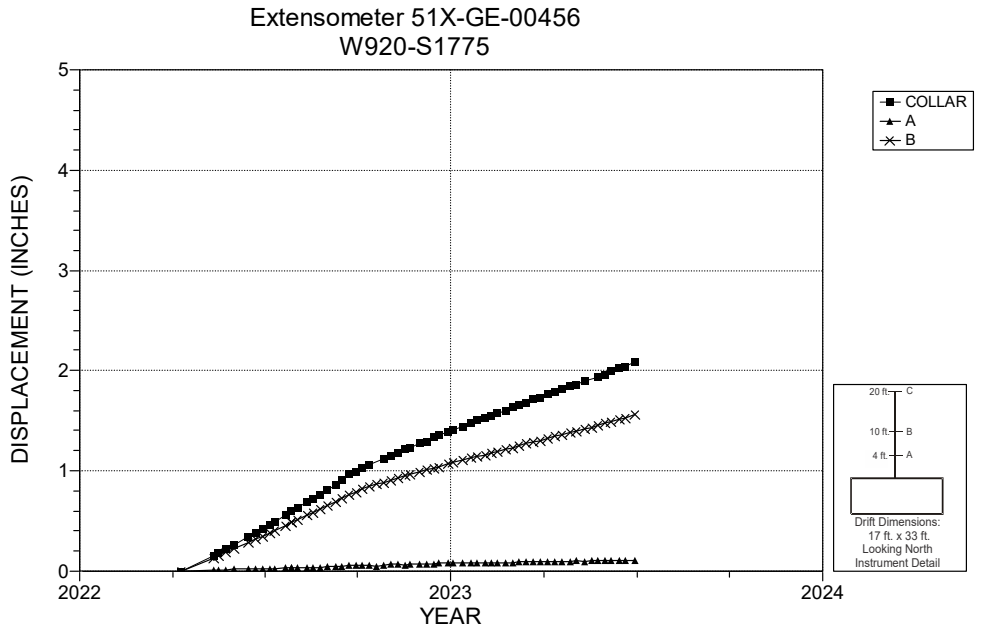
NOTES:
1. Excavation date: January 2020.

Figure 5-7 Extensometer 51X-GE-00454 – W660 S1775



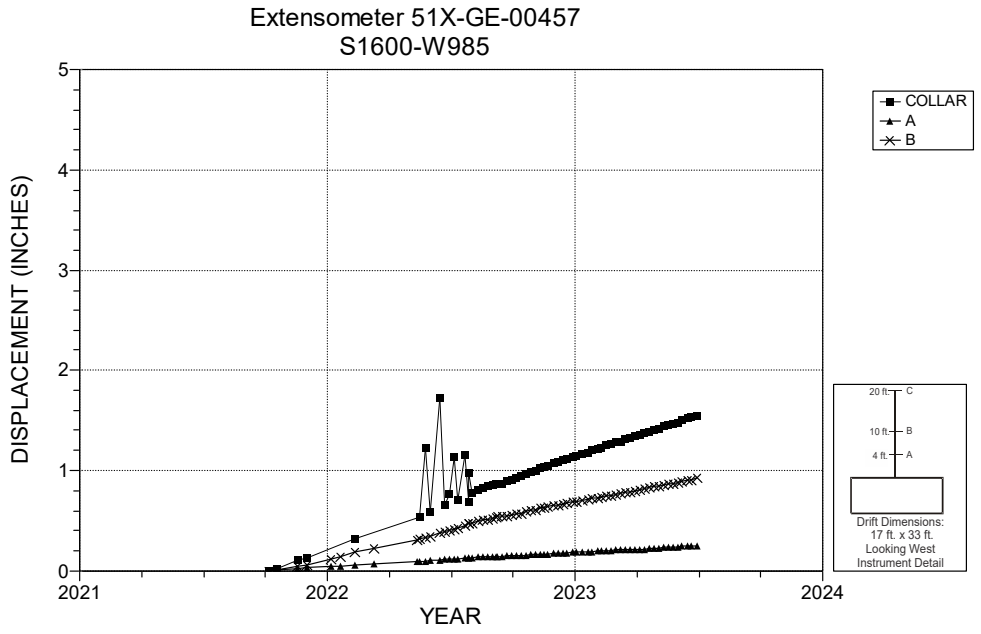
NOTES:
1. Excavation date: January 2020.

Figure 5-8 Extensometer 51X-GE-00455 – W790 S1775



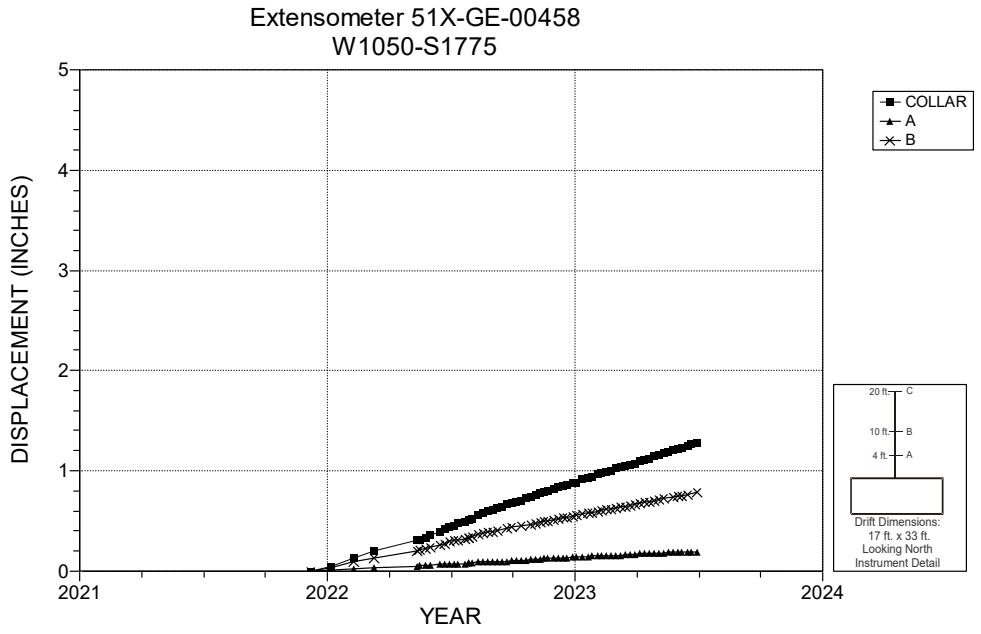
NOTES:
1. Excavation date: January 2020.

Figure 5-9 Extensometer 51X-GE-00456 – W920 S1775



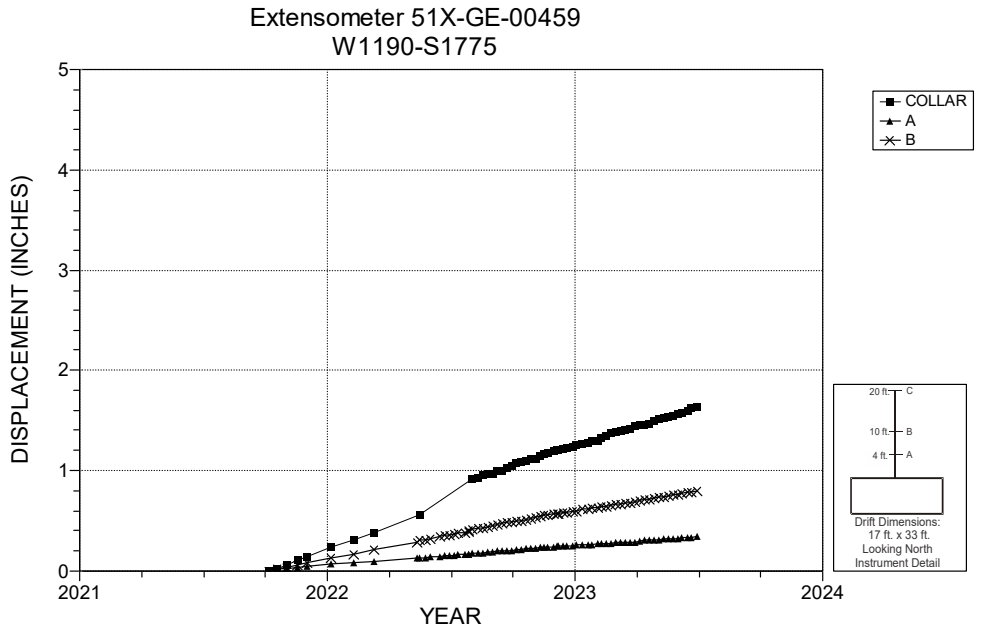
NOTES:
1. Excavation date: July 2019.

Figure 5-10 Extensometer 51X-GE-00457 – S1600 W985



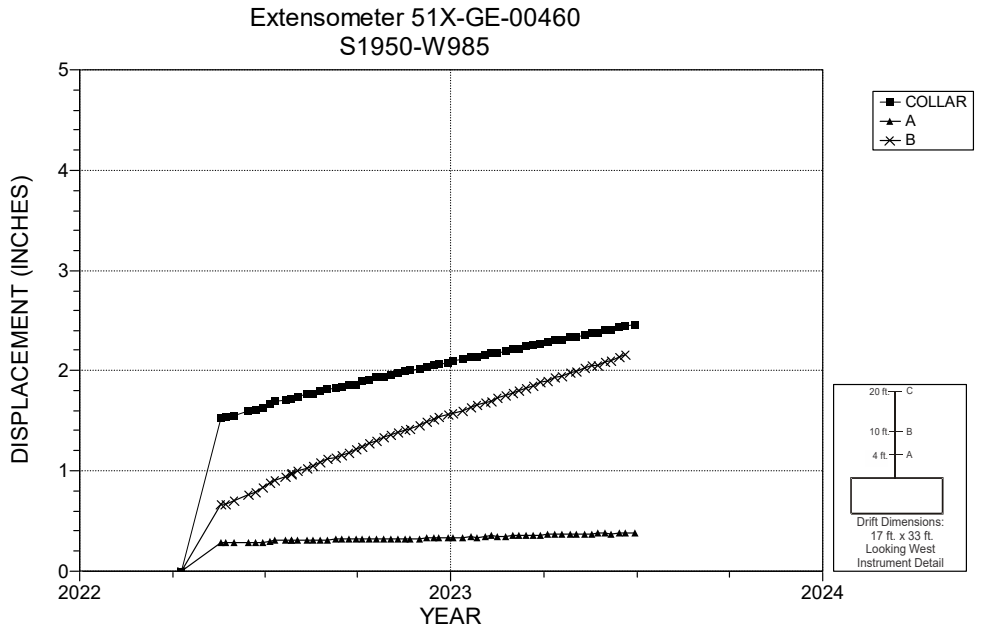
NOTES:
1. Excavation date: January 2020.

Figure 5-11 Extensometer 51X-GE-00458 – W1050 S1775



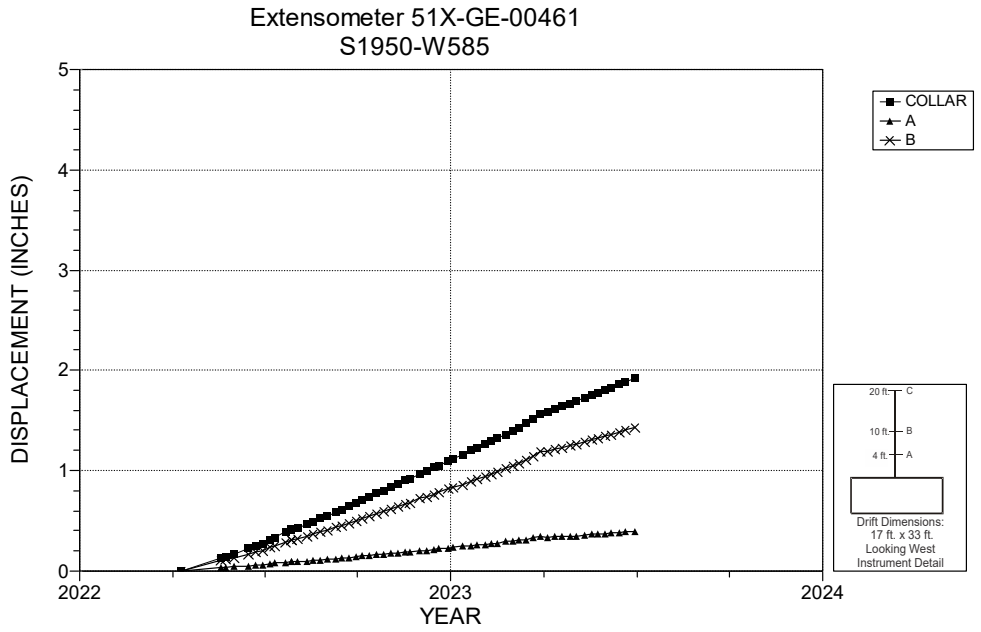
NOTES:
1. Excavation date: January 2020.
2. Anchor 'C' Potentiometer BO. Bad data readings deleted from 5/25/22 - 7/28/22.

Figure 5-12 Extensometer 51X-GE-00459 – W1190 S1775



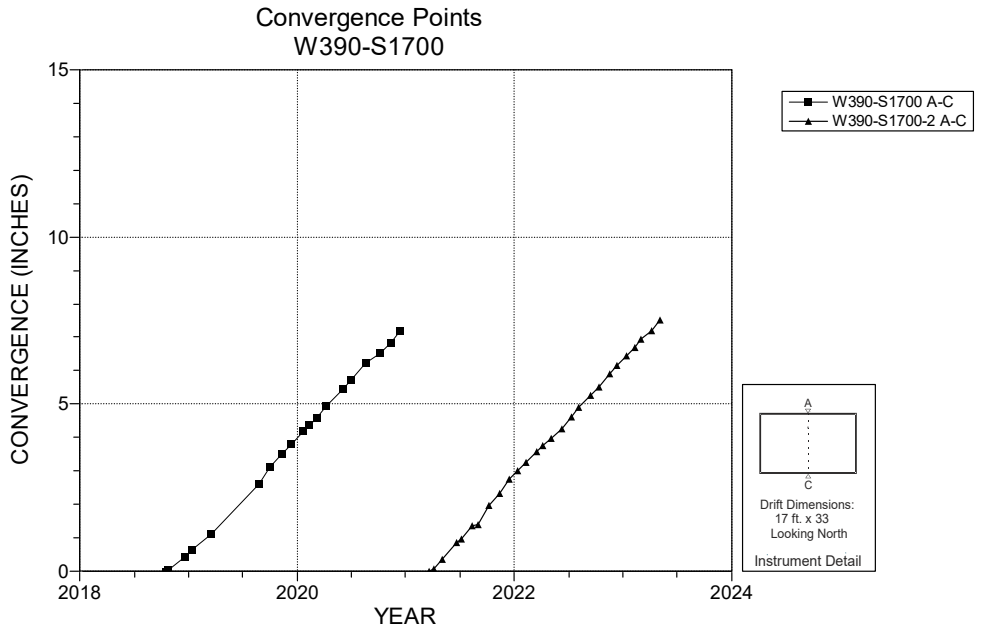
NOTES:
1. Excavation date: January 2020.
2. Initial readings on 4/11/22 and intial rates on 5/20/22 are invalid.
3. Anchor C (collar) and Anchor B data points are swapped.

Figure 5-13 Extensometer 51X-GE-00460 – S1950 W985



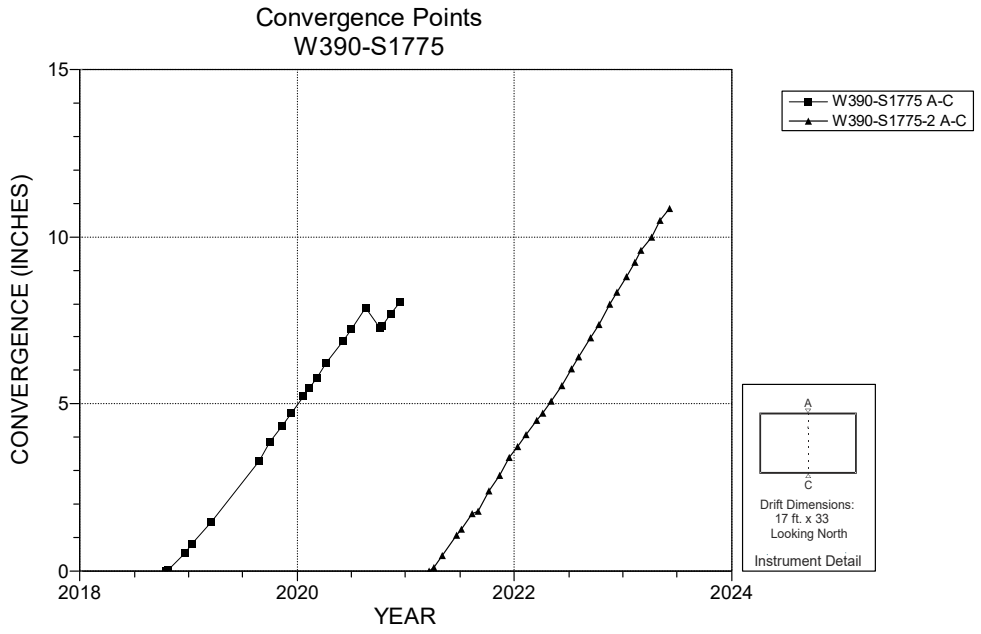
NOTES:
1. Excavation date: January 2020.

Figure 5-14 Extensometer 51X-GE-00461 – S1950 W585



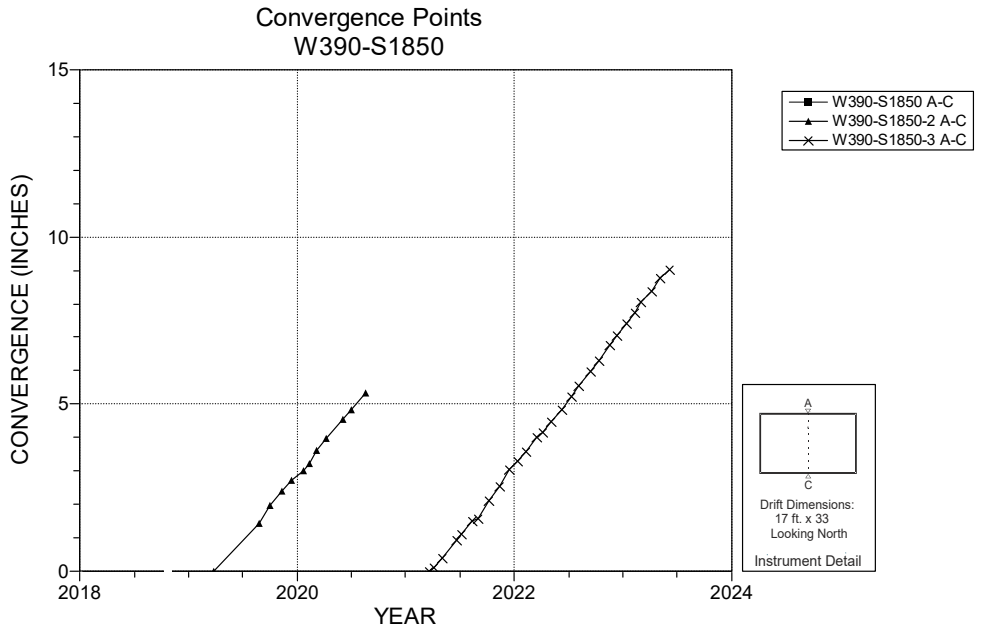
NOTES:
1. Excavation date: October 2013.

Figure 5-15 Convergence Point Array – W390 S1700 – Roof to Floor



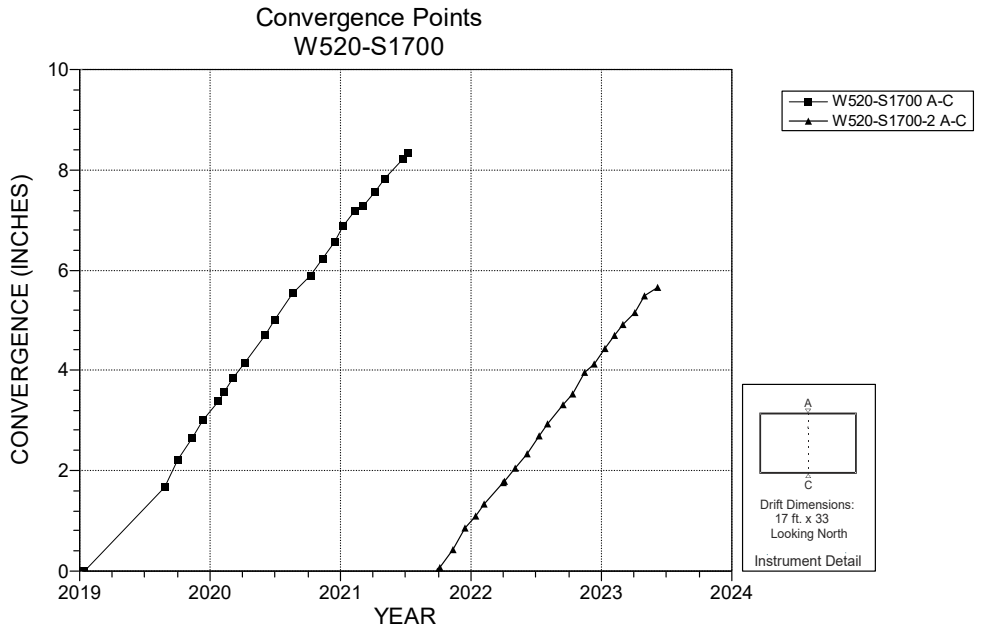
NOTES:
1. Excavation date: October 2013.

Figure 5-16 Convergence Point Array – W390 S1775 – Roof to Floor



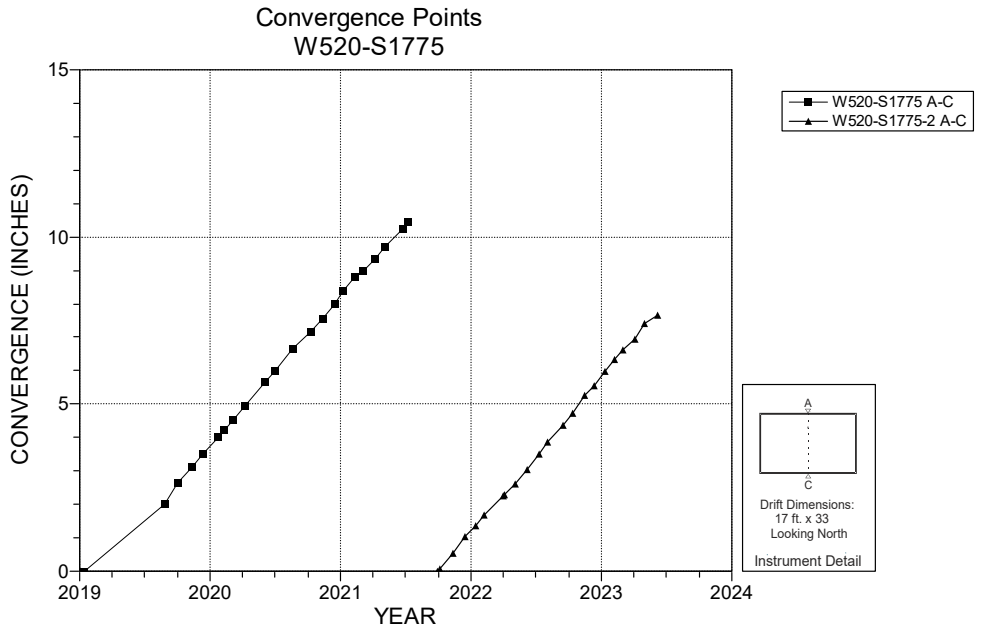
NOTES:
1. Excavation date: October 2013.

Figure 5-17 Convergence Point Array – W390 S1850 – Roof to Floor



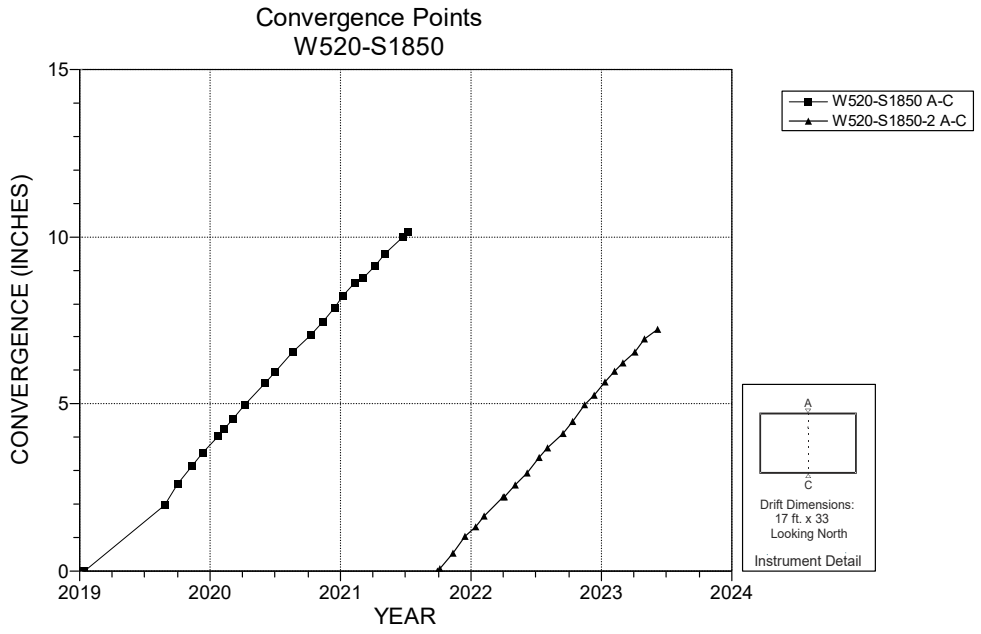
NOTES:
1. Excavation date: October 2013

Figure 5-18 Convergence Point Array – W520 S1700 – Roof to Floor



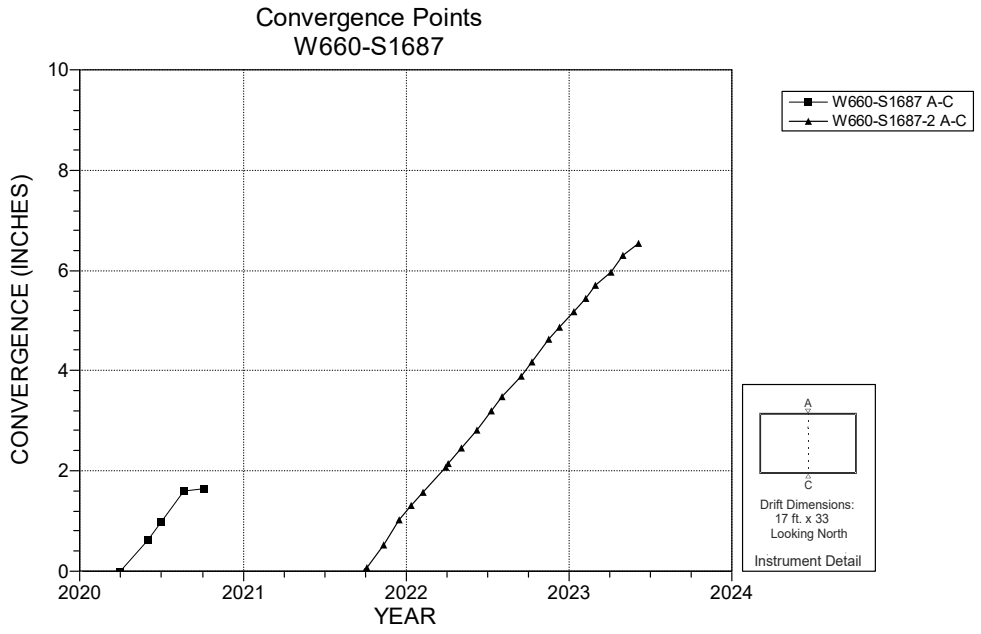
NOTES:
1. Excavation date: October 2013

Figure 5-19 Convergence Point Array – W520 S1775 – Roof to Floor



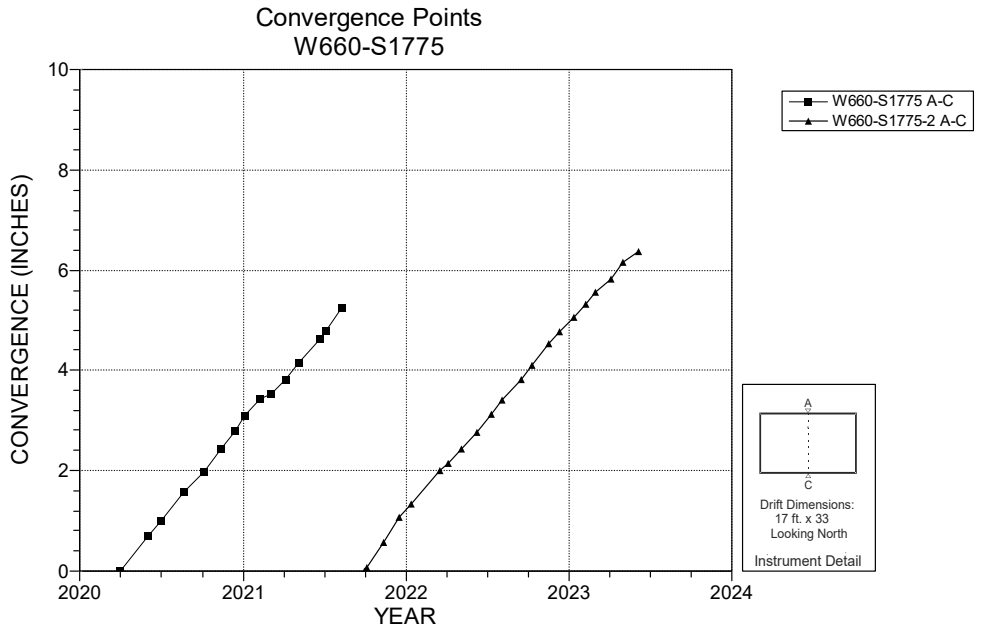
NOTES:
1. Excavation date: October 2013

Figure 5-20 Convergence Point Array – W520 S1850 – Roof to Floor



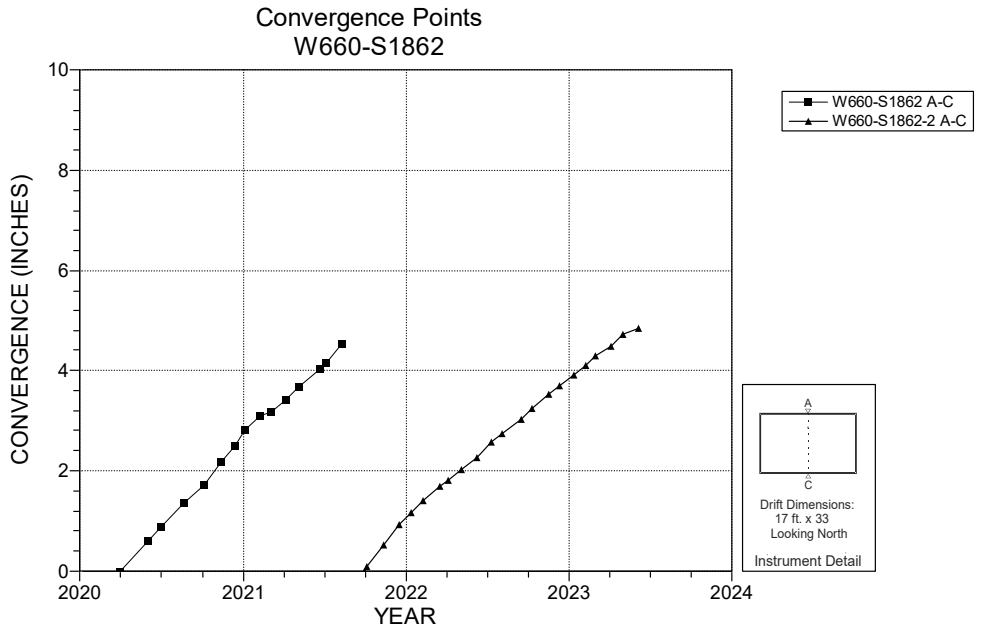
NOTES:
1. Excavation Date: January 2020.

Figure 5-21 Convergence Point Array – W660 S1687 – Roof to Floor



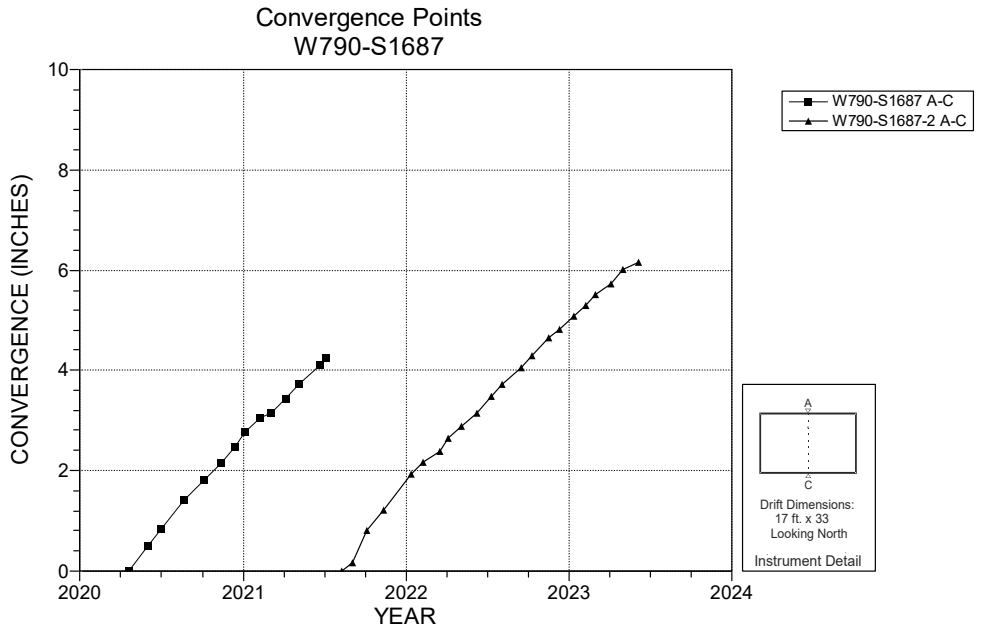
NOTES:
1. Excavation date: January 2020.

Figure 5-22 Convergence Point Array – W660 S1775 – Roof to Floor



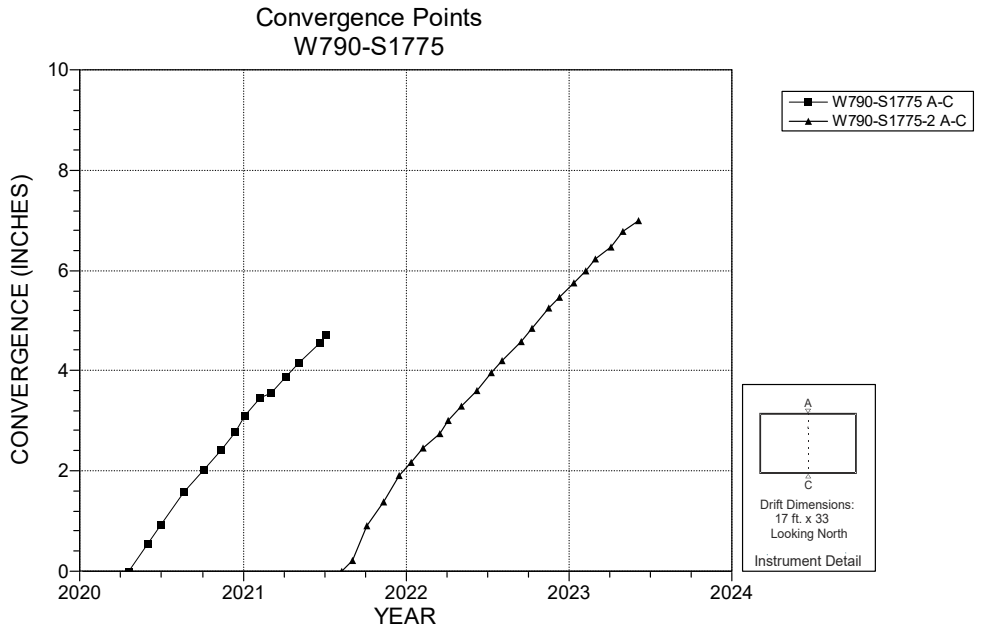
NOTES:
1. Excavation date: January 2020.

Figure 5-23 Convergence Point Array – W660 S1862 – Roof to Floor



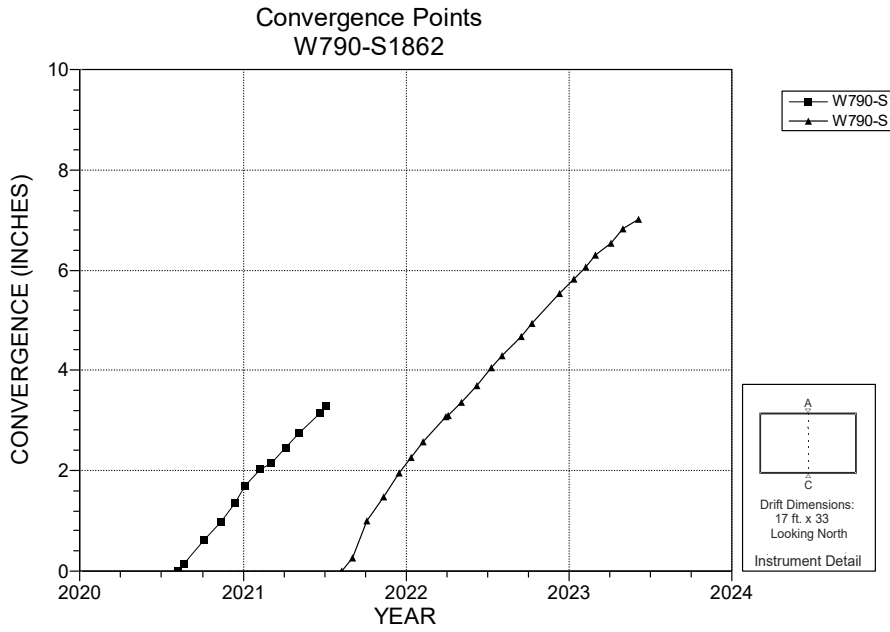
NOTES:
1. Excavation date: Janaury 2020.

Figure 5-24 Convergence Point Array – W790 S1687 – Roof to Floor



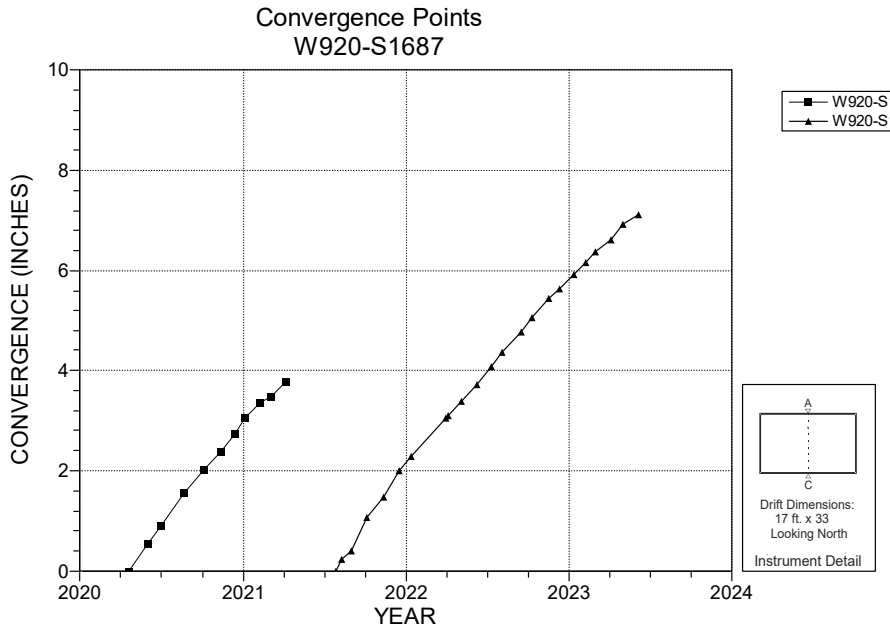
NOTES:
1. Excavation date: Janaury 2020.

Figure 5-25 Convergence Point Array – W790 S1775 – Roof to Floor



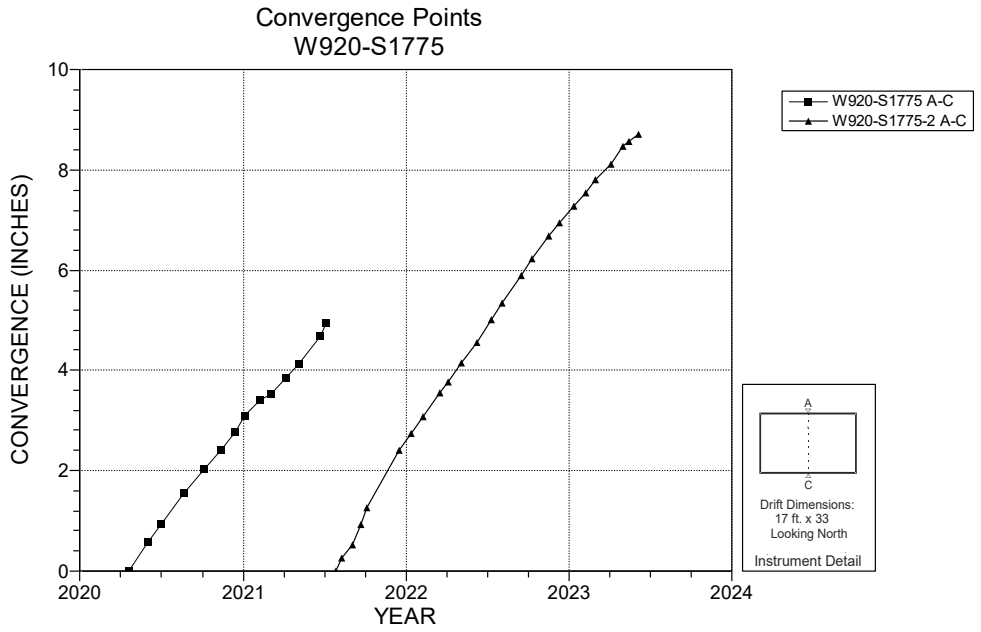
NOTES:
1. Excavation date: Janaury 2020.

Figure 5-26 Convergence Point Array – W790 S1862 – Roof to Floor



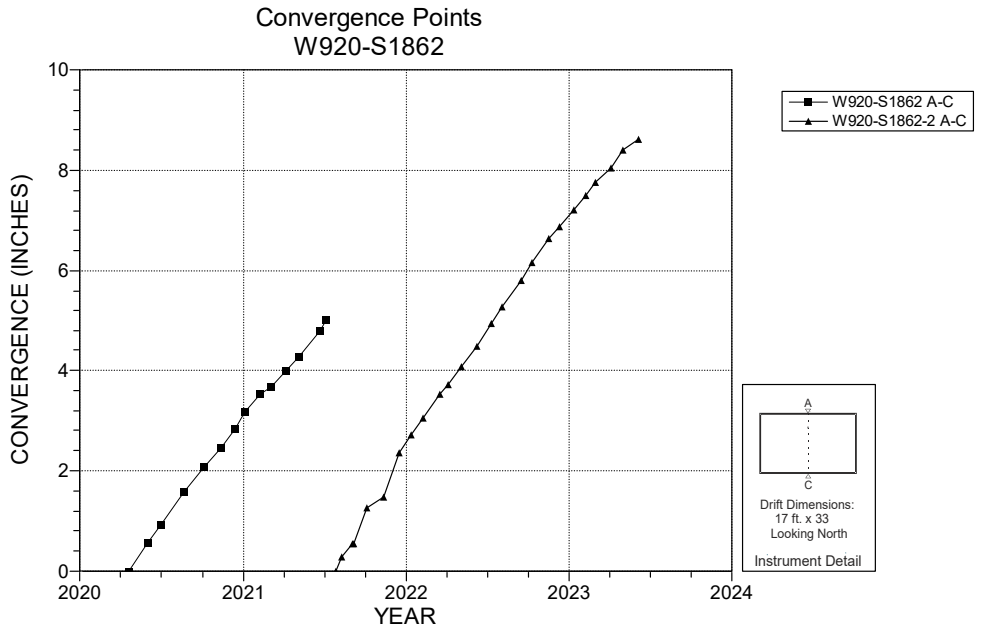
NOTES:
1. Excavation date: Janaury 2020.

Figure 5-27 Convergence Point Array – W920 S1687 – Roof to Floor



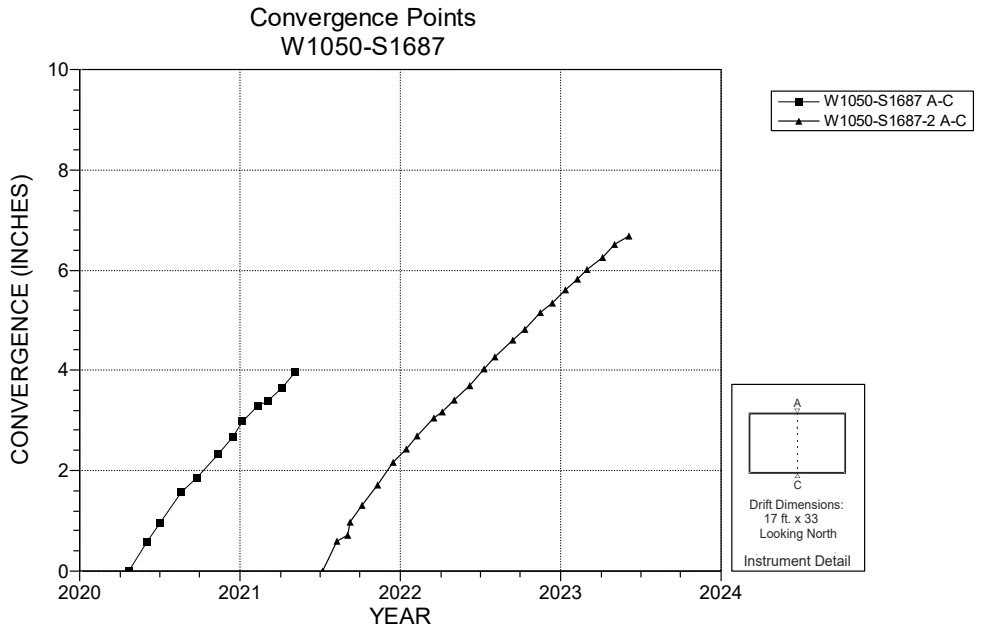
NOTES:
1. Excavation date: Janaury 2020.

Figure 5-28 Convergence Point Array – W920 S1775 – Roof to Floor



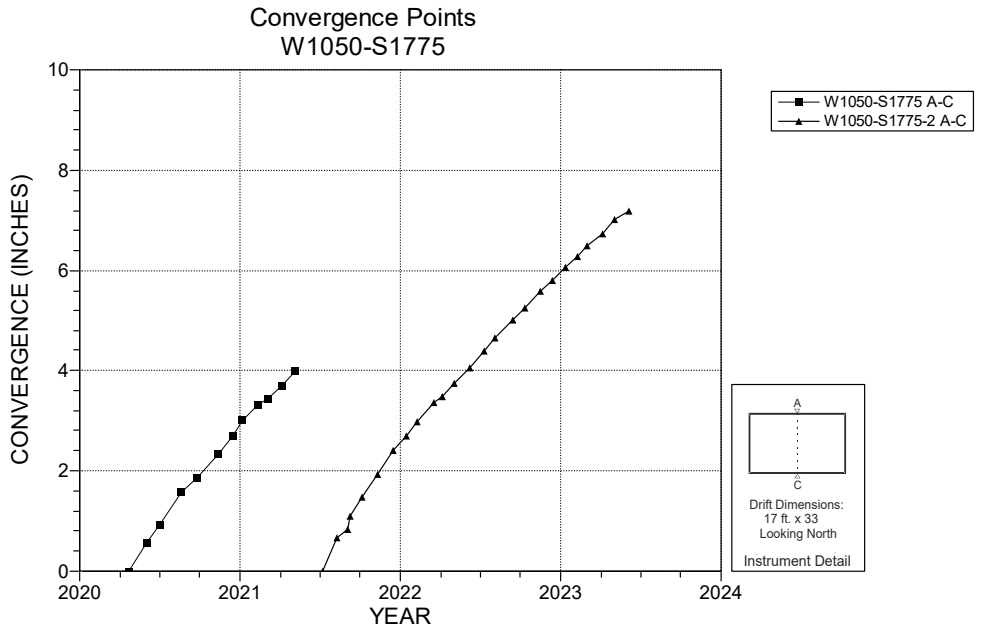
NOTES:
1. Excavation date: Janaury 2020.

Figure 5-29 Convergence Point Array – W920 S1862 – Roof to Floor



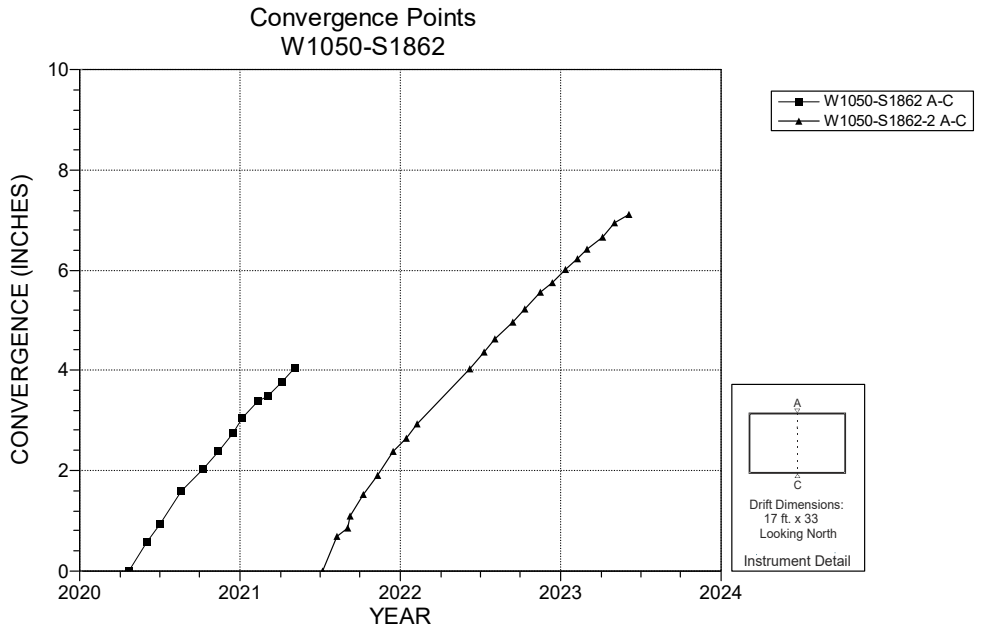
NOTES:
1. Excavation date: Janaury 2020.

Figure 5-30 Convergence Point Array – W1050 S1687 – Roof to Floor



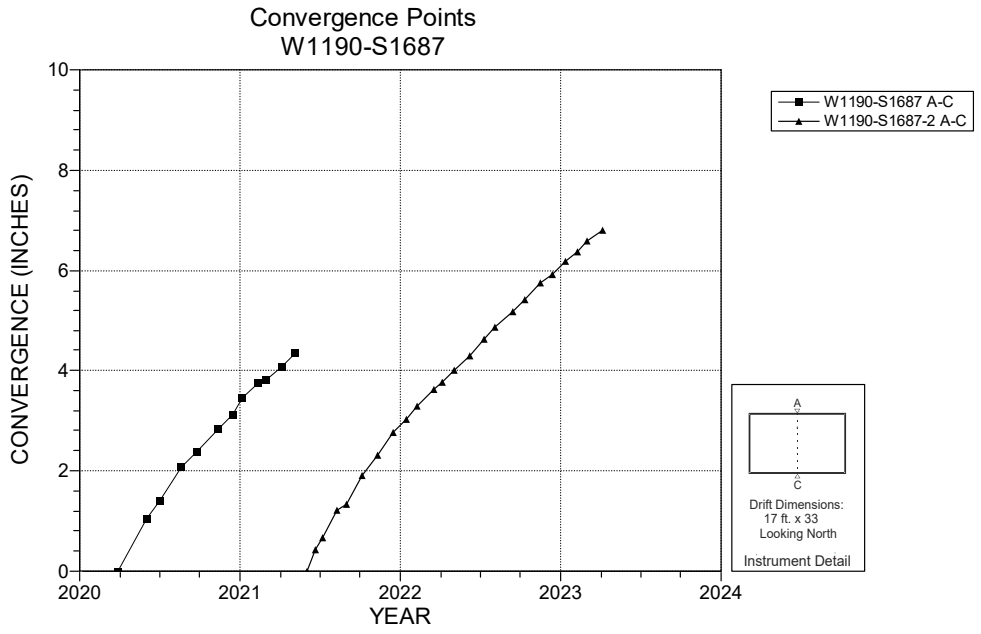
NOTES:
1. Excavation date: Janaury 2020.

Figure 5-31 Convergence Point Array – W1050 S1775 – Roof to Floor



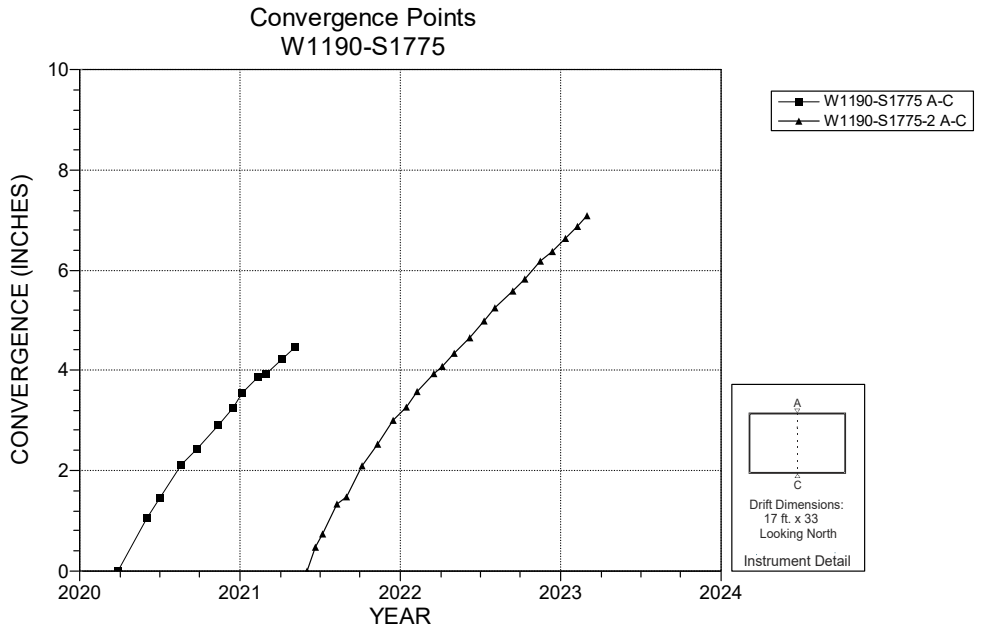
NOTES:
1. Excavation date: Janaury 2020.

Figure 5-32 Convergence Point Array – W1050 S1862 – Roof to Floor



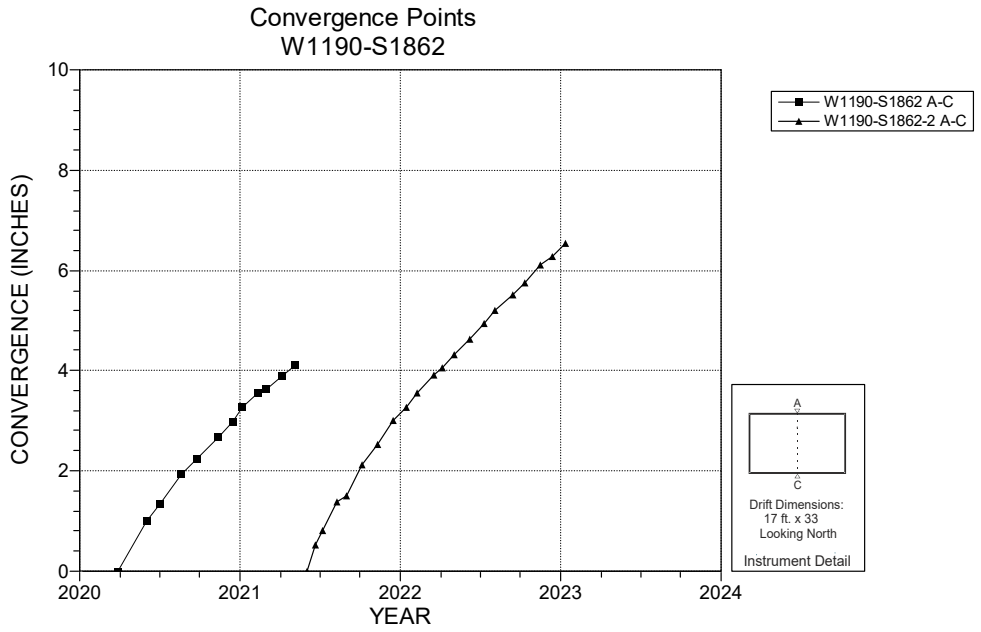
NOTES:
1. Excavation date: January 2020.

Figure 5-33 Convergence Point Array – W1190 S1687 – Roof to Floor



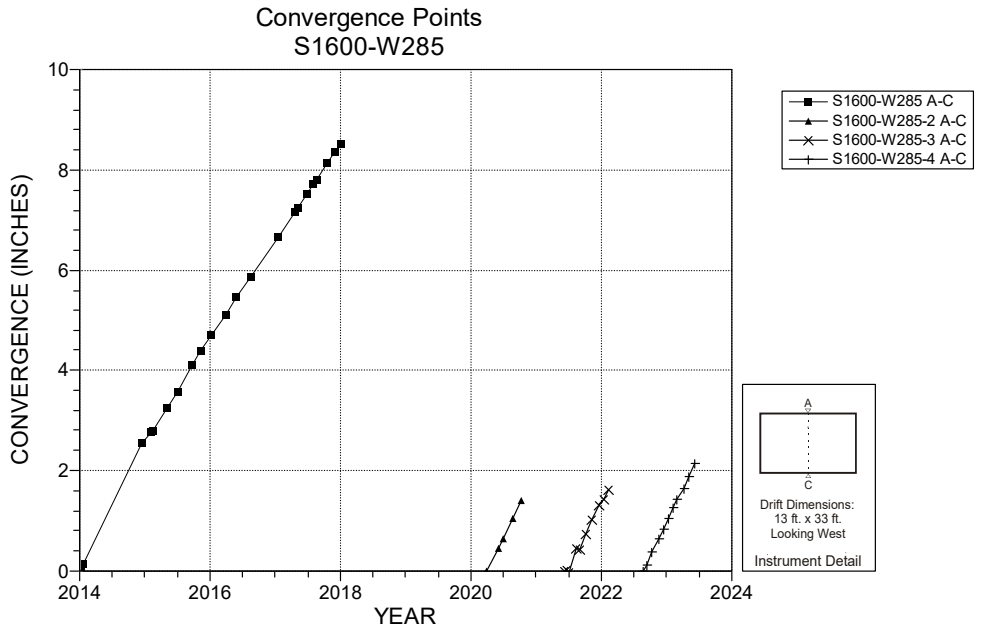
NOTES:
1. Excavation date: January 2020.

Figure 5-34 Convergence Point Array – W1190 S1775 – Roof to Floor



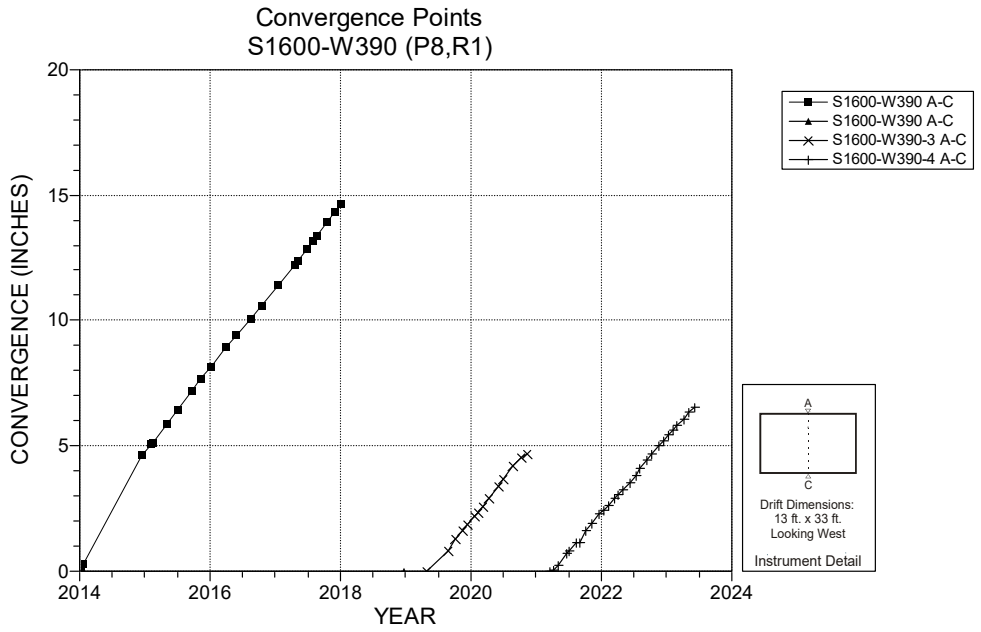
NOTES:
1. Excavation date: January 2020.

Figure 5-35 Convergence Point Array – W1190 S1862 – Roof to Floor



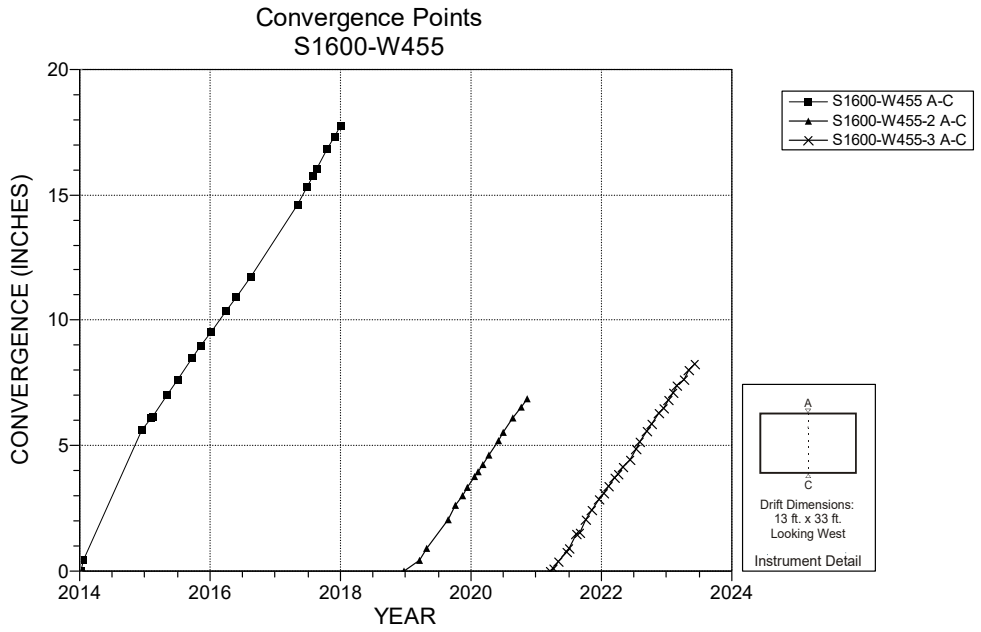
NOTES:
1. Exacavtion Date: October 2013.

Figure 5-36 Convergence Point Array – S1600 W285 – Roof to Floor



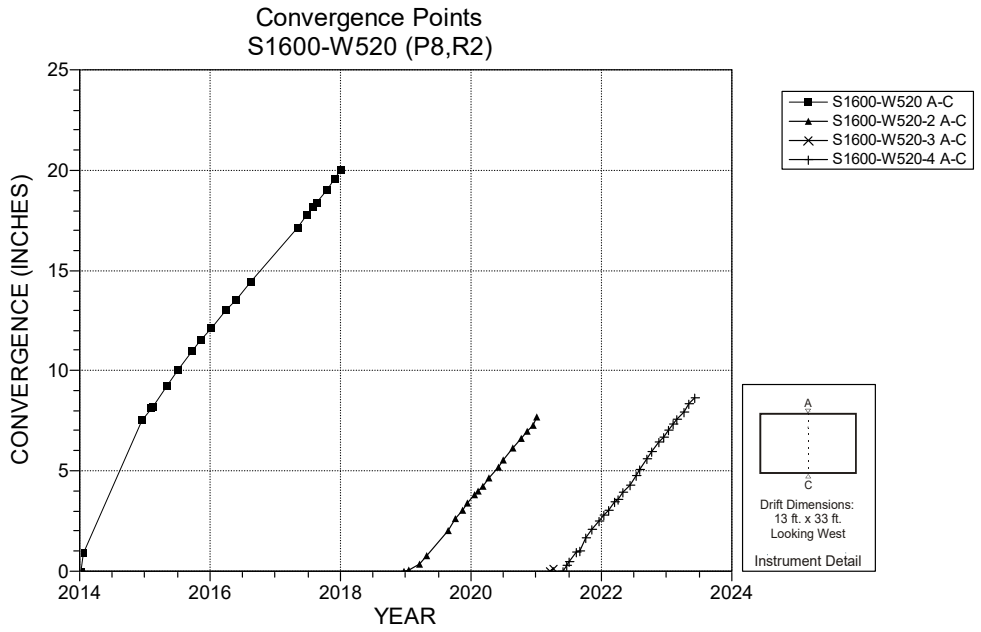
NOTES:
1. Excavation Date: October 2013.

Figure 5-37 Convergence Point Array – S1600 W390 – Roof to Floor



NOTES:
1. Excavation Date: October 2013.

Figure 5-38 Convergence Point Array – S1600 W455 – Roof to Floor



NOTES:
1. Excavation Date: December 2013.

Figure 5-39 Convergence Point Array – S1600 W520 – Roof to Floor

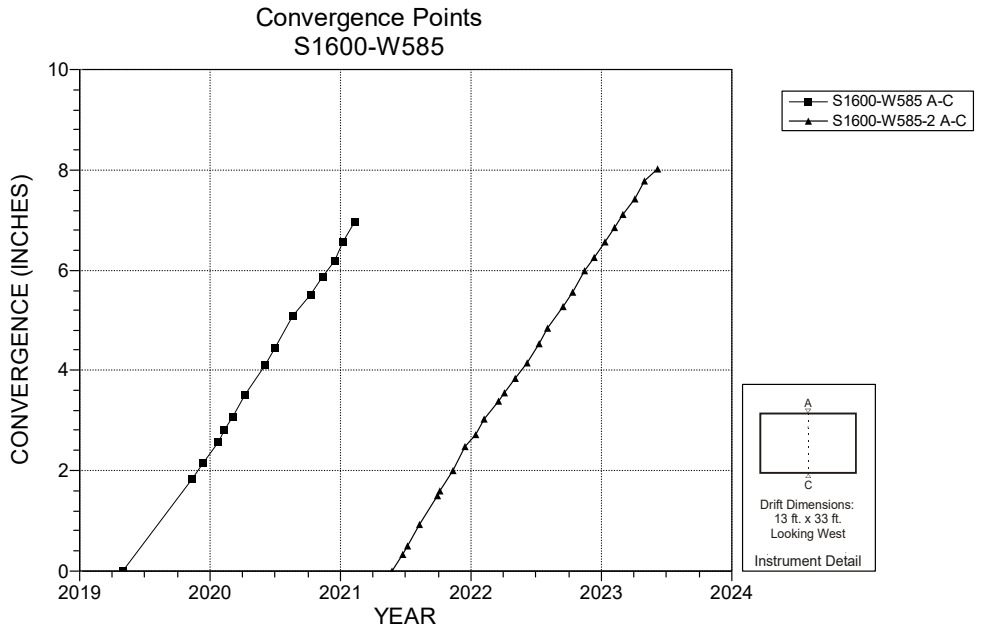


Figure 5-40 Convergence Point Array – S1600 W585 – Roof to Floor

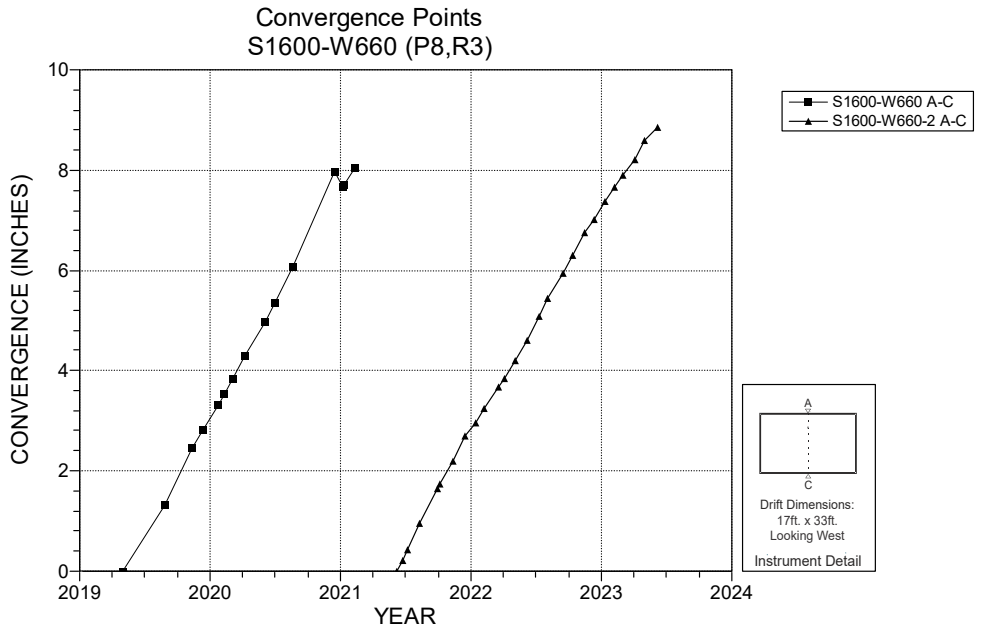
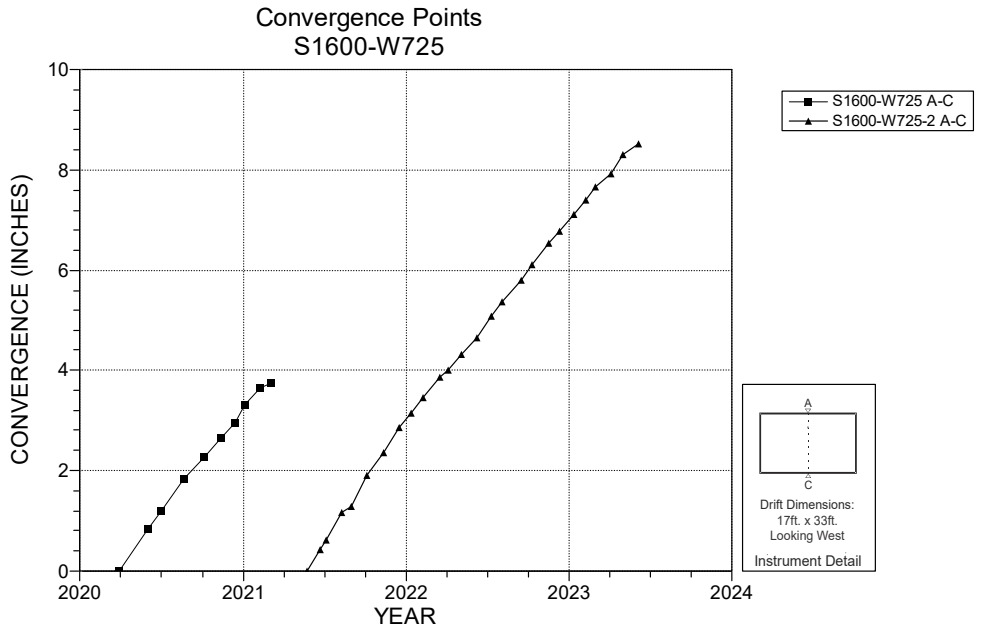
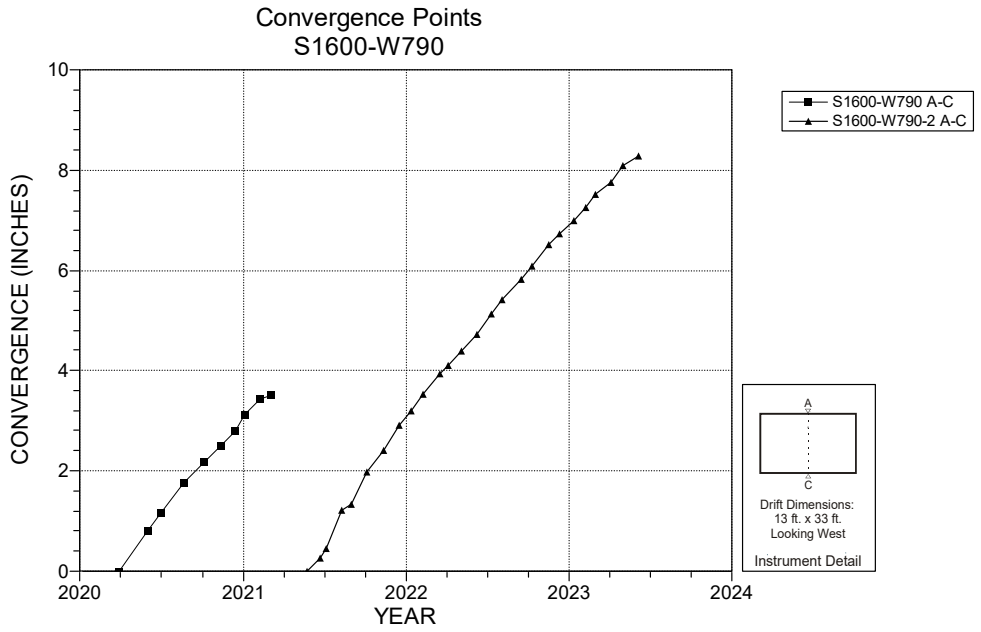


Figure 5-41 Convergence Point Array – S1600 W660 – Roof to Floor



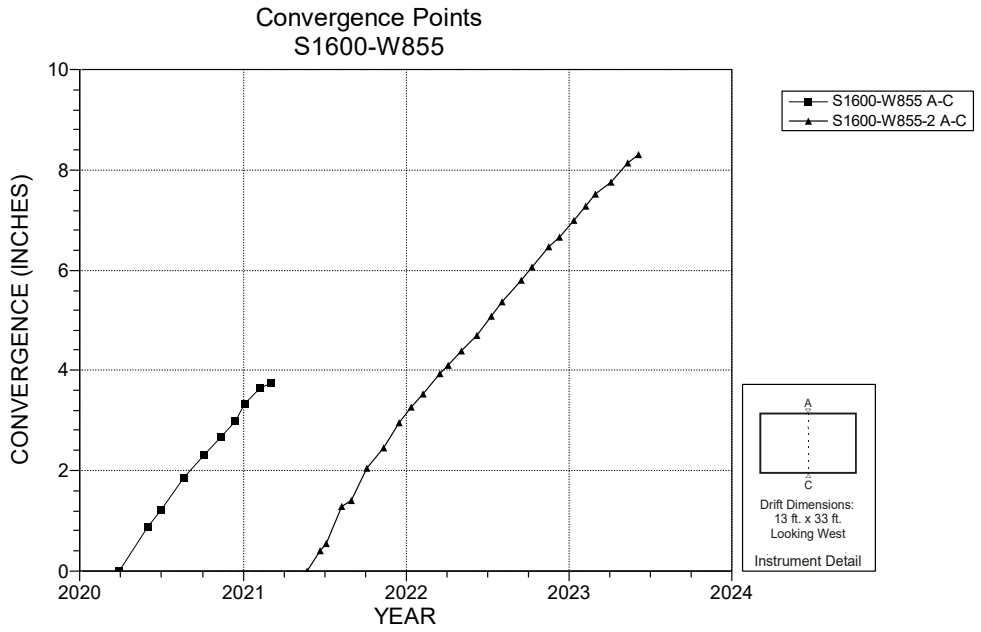
NOTES:
1. Excavation Date: January 2020

Figure 5-42 Convergence Point Array – S1600 W725 – Roof to Floor



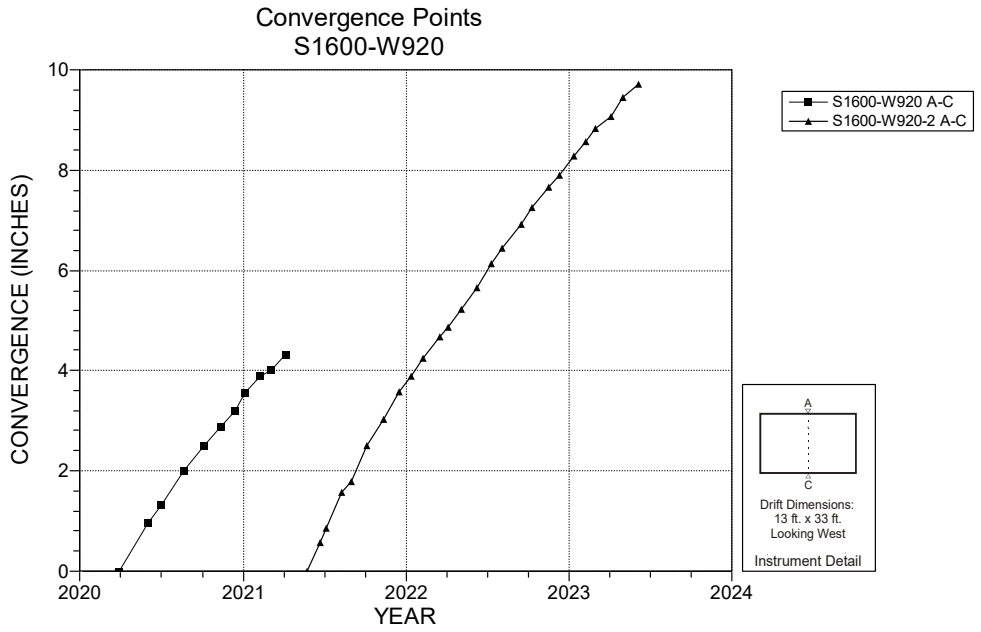
NOTES:
1. Excavation date: January 2020.

Figure 5-43 Convergence Point Array – S1600 W790 – Roof to Floor



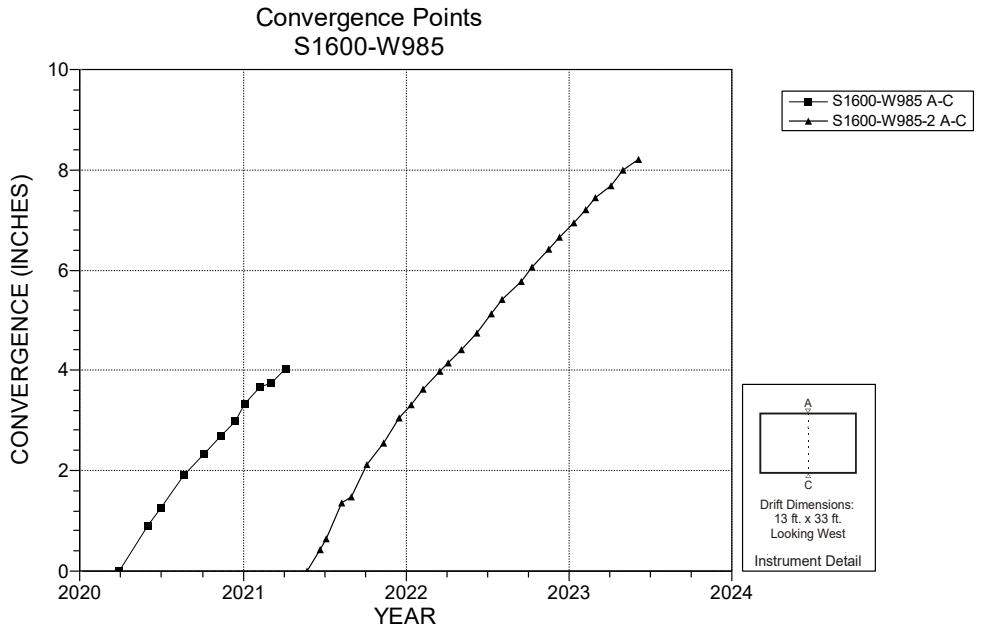
NOTES:
1. Excavation date: January 2020.

Figure 5-44 Convergence Point Array – S1600 W855 – Roof to Floor



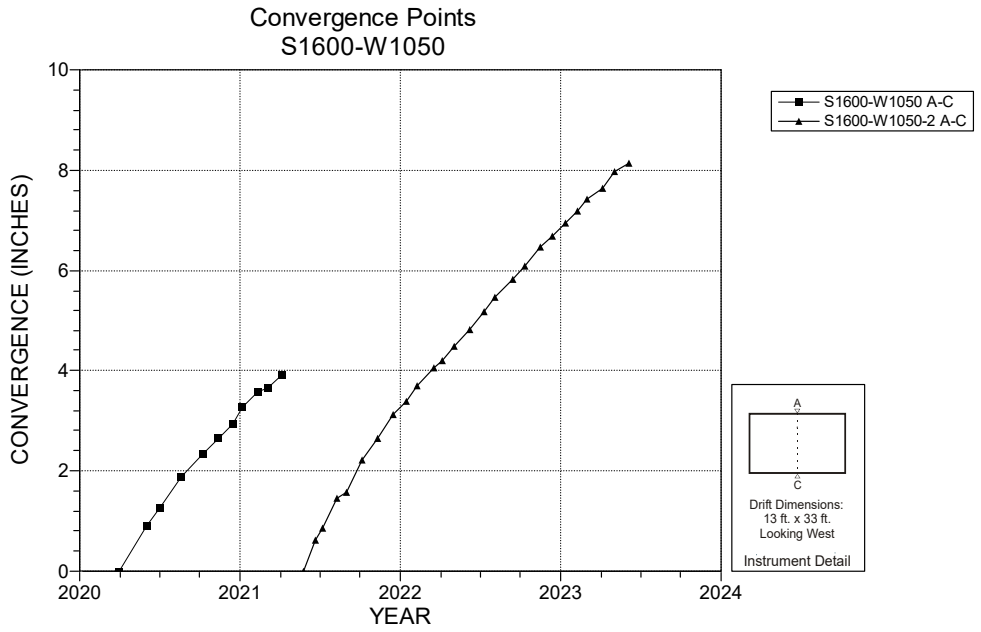
NOTES:
1. Excavation date: January 2020.

Figure 5-45 Convergence Point Array – S1600 W920 – Roof to Floor



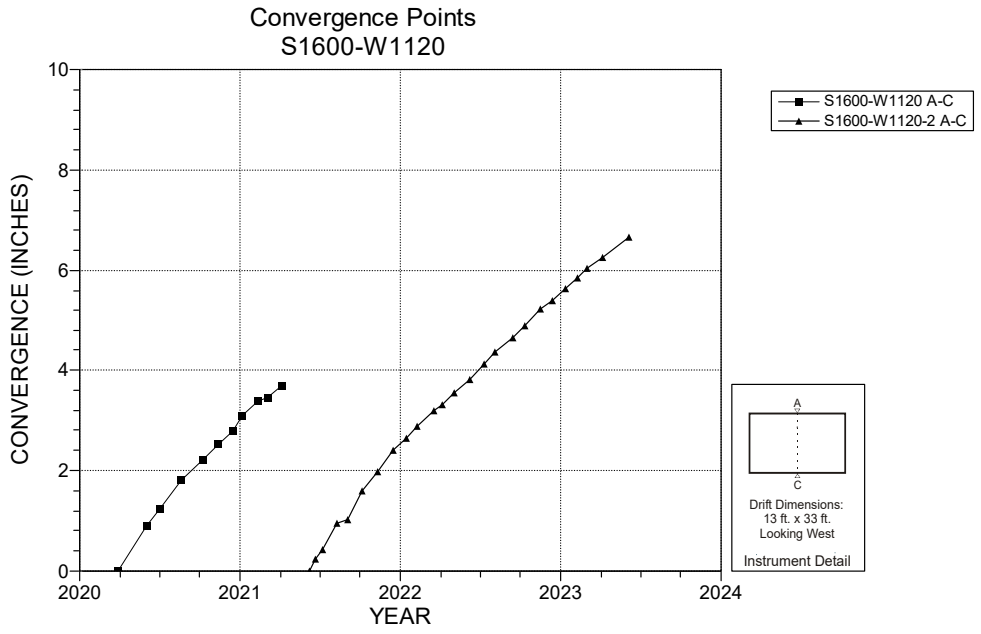
NOTES:
1. Excavation date: January 2020.

Figure 5-46 Convergence Point Array – S1600 W985 – Roof to Floor



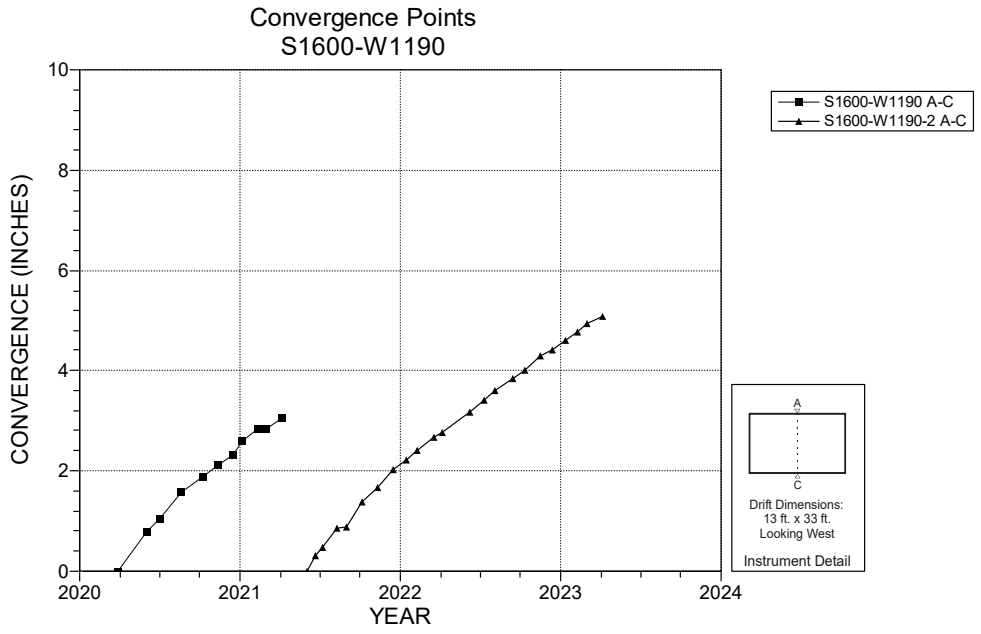
NOTES:
1. Excavation date: January 2020.

Figure 5-47 Convergence Point Array – S1600 W1050– Roof to Floor



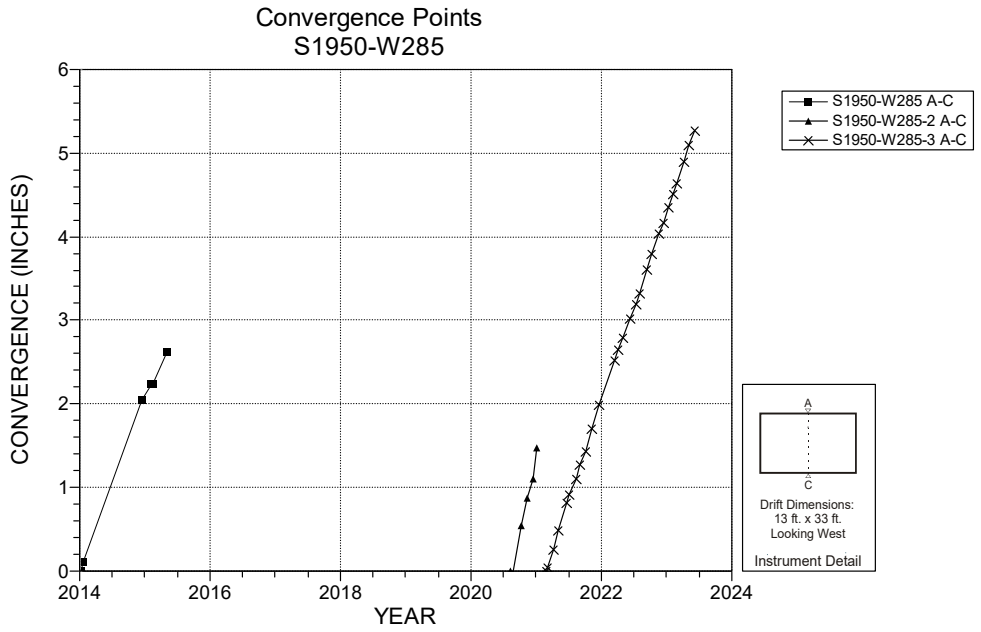
NOTES:
1. Excavation date: January 2020.

Figure 5-48 Convergence Point Array – S1600 W1120 – Roof to Floor



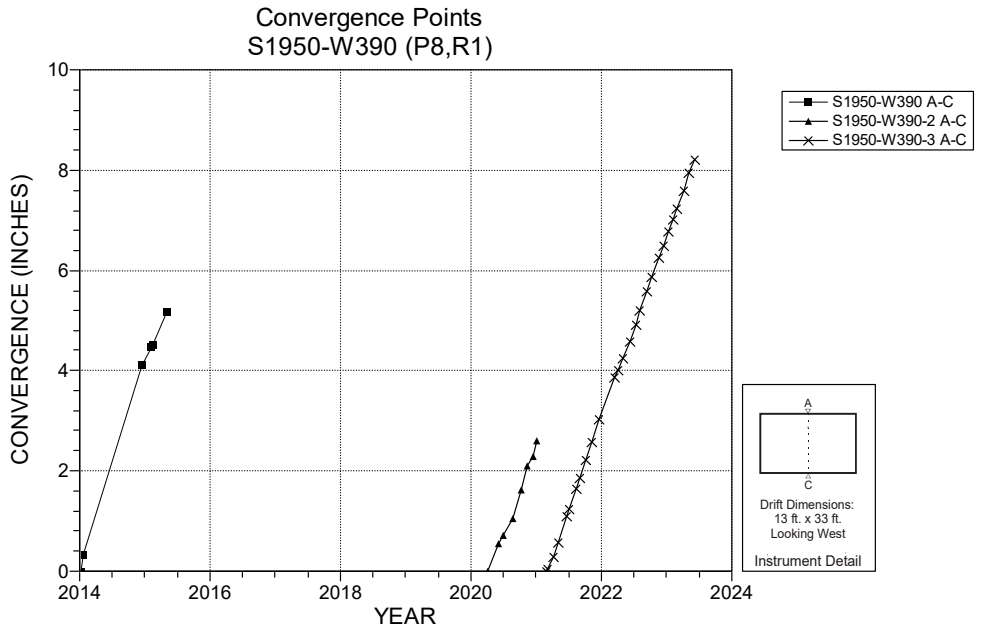
NOTES:
1. Excavation date: January 2020.

Figure 5-49 Convergence Point Array – S1600 W1190 – Roof to Floor



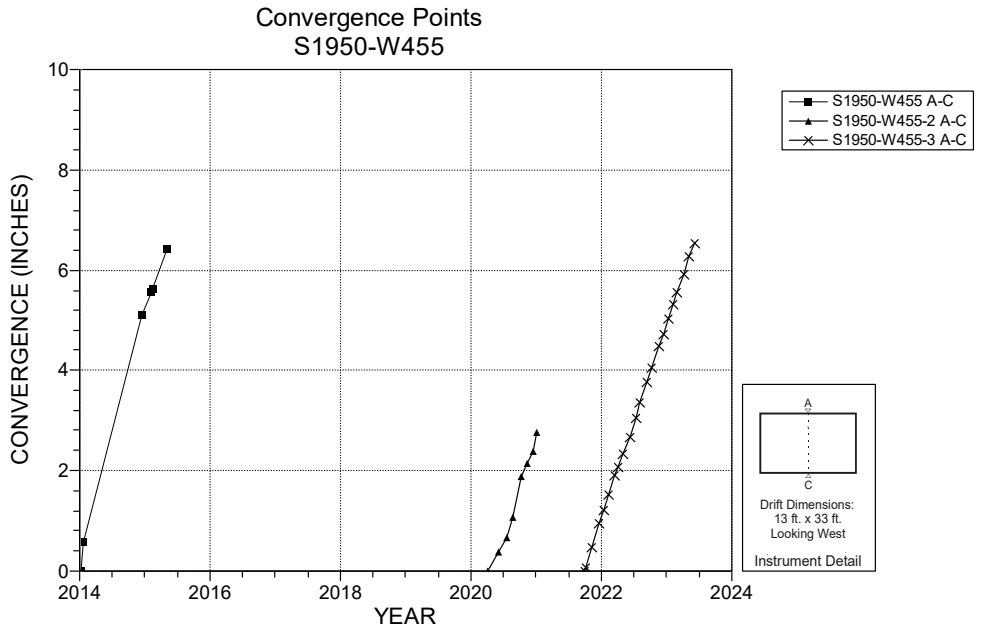
NOTES:
1. Excavation Date: September 2013.

Figure 5-50 Convergence Point Array – S1950 W285 – Roof to Floor



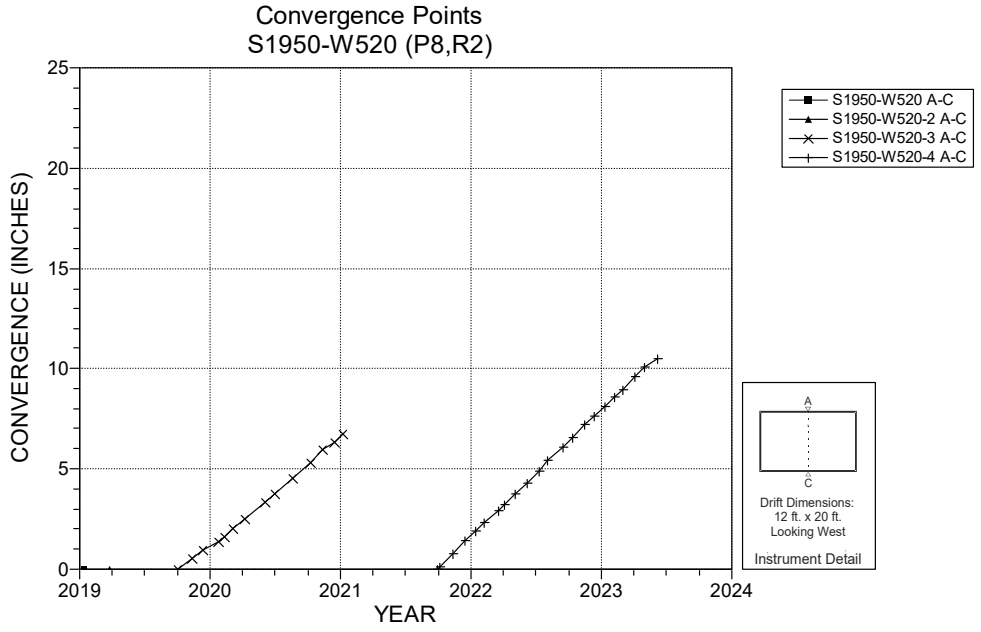
NOTES:
1. Excavation Date: November 2013.

Figure 5-51 Convergence Point Array – S1950 W390 – Roof to Floor



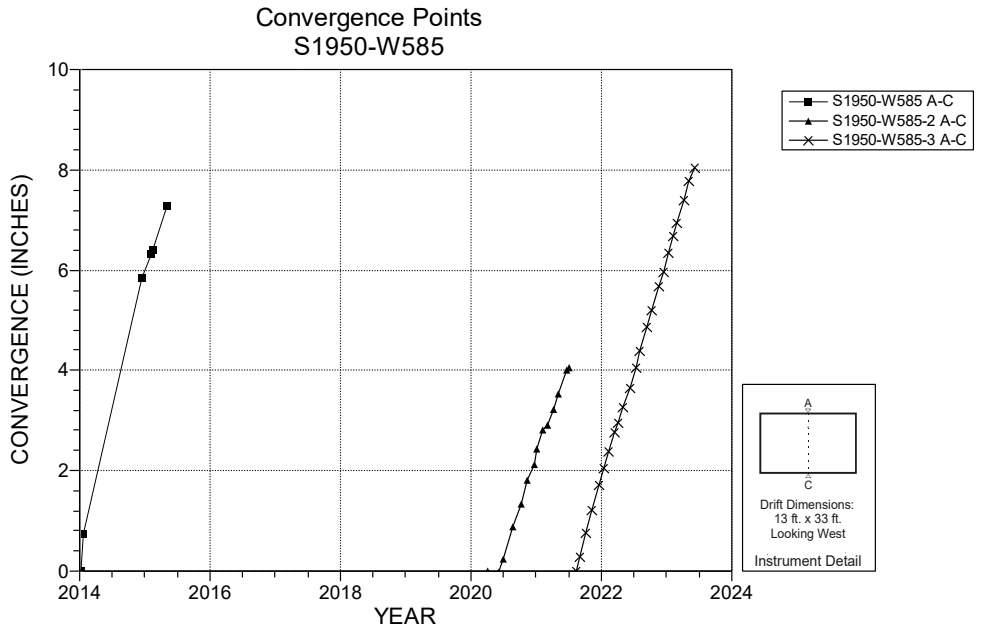
NOTES:
1. Excavation Date: November 2013.

Figure 5-52 Convergence Point Array – S1950 W455 – Roof to Floor



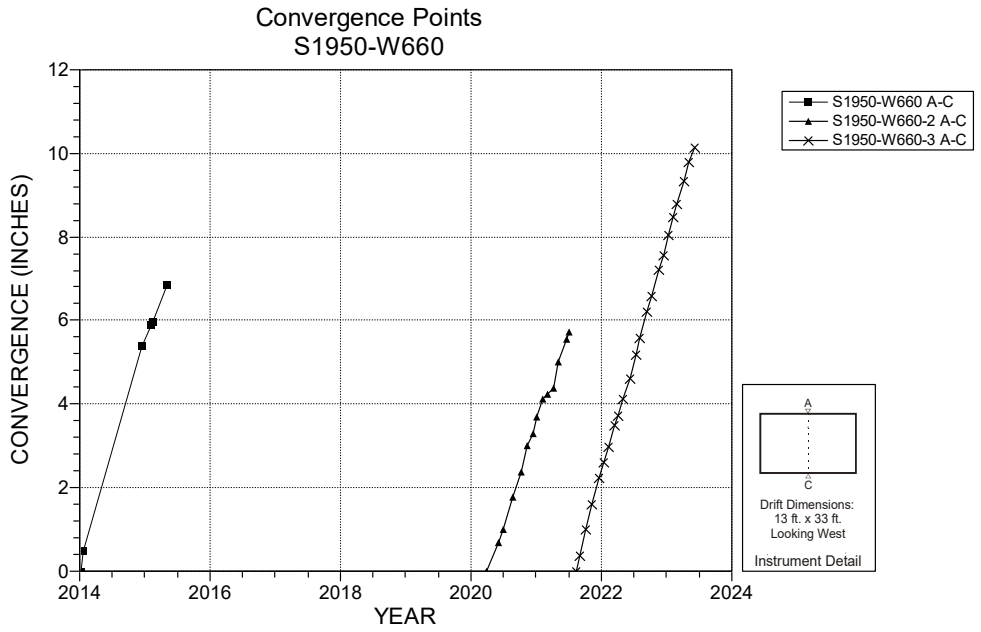
NOTES:
1. Excavation date: October 2013

Figure 5-53 Convergence Point Array – S1950 W520 – Roof to Floor



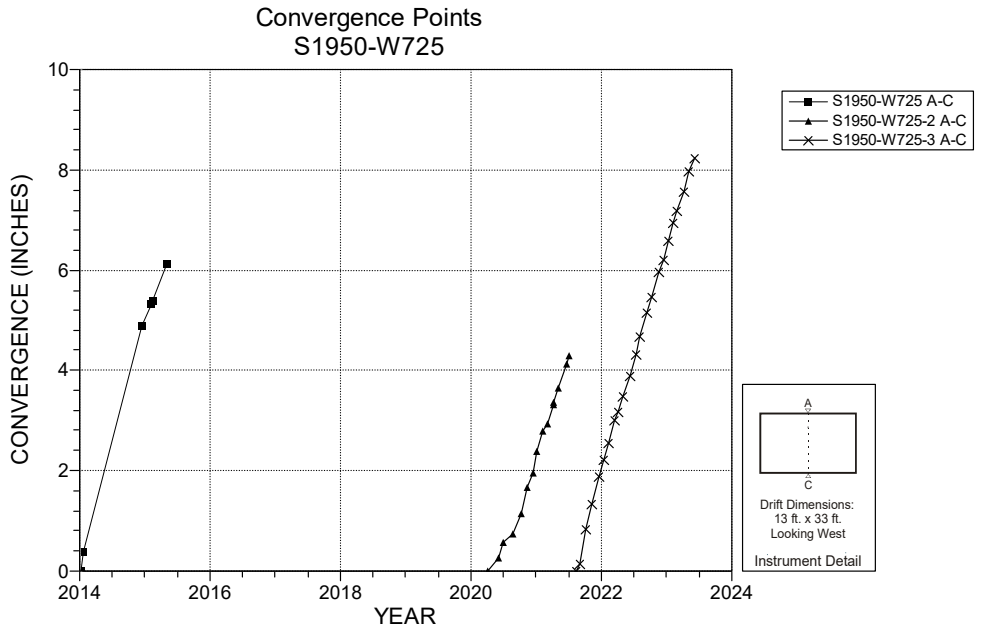
NOTES:
1. Excavation Date: November 2013.

Figure 5-54 Convergence Point Array – S1950 W585 – Roof to Floor



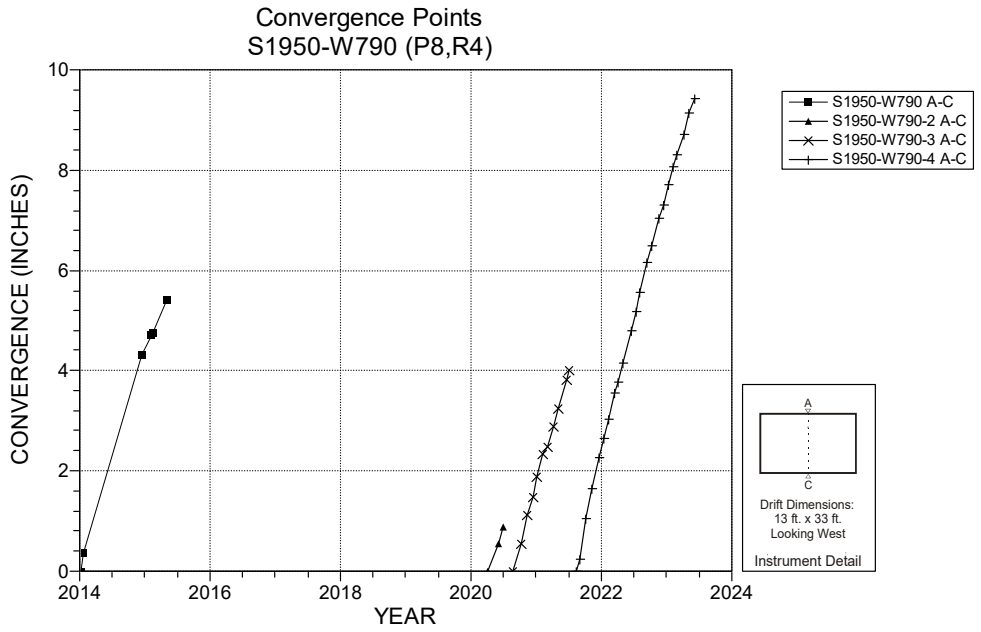
NOTES:
1. Excavation Date: November 2013.

Figure 5-55 Convergence Point Array – S1950 W660 – Roof to Floor



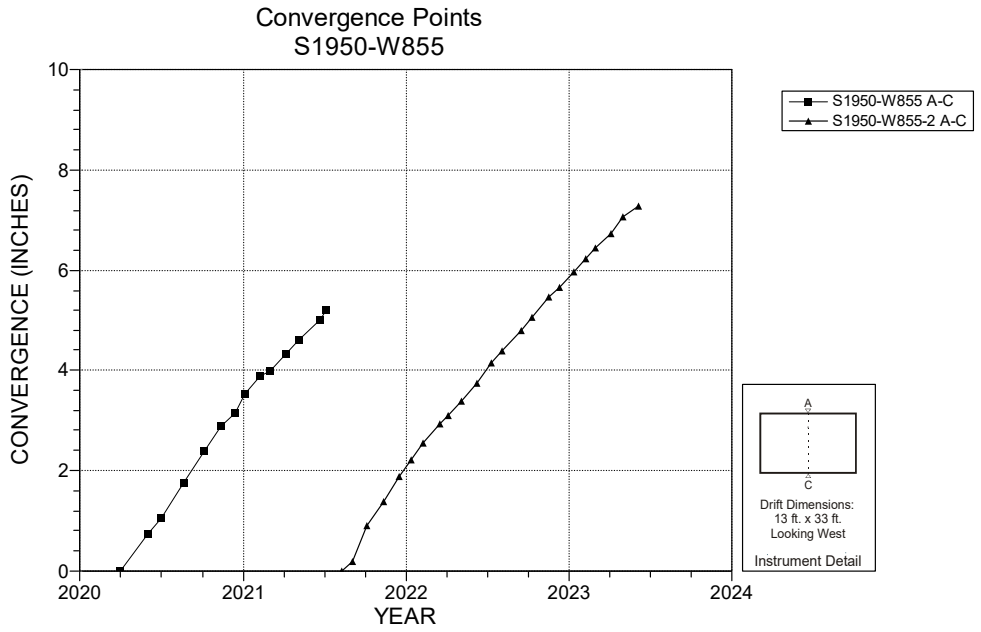
NOTES:
1. Excavation Date: December 2013.

Figure 5-56 Convergence Point Array – S1950 W725 – Roof to Floor



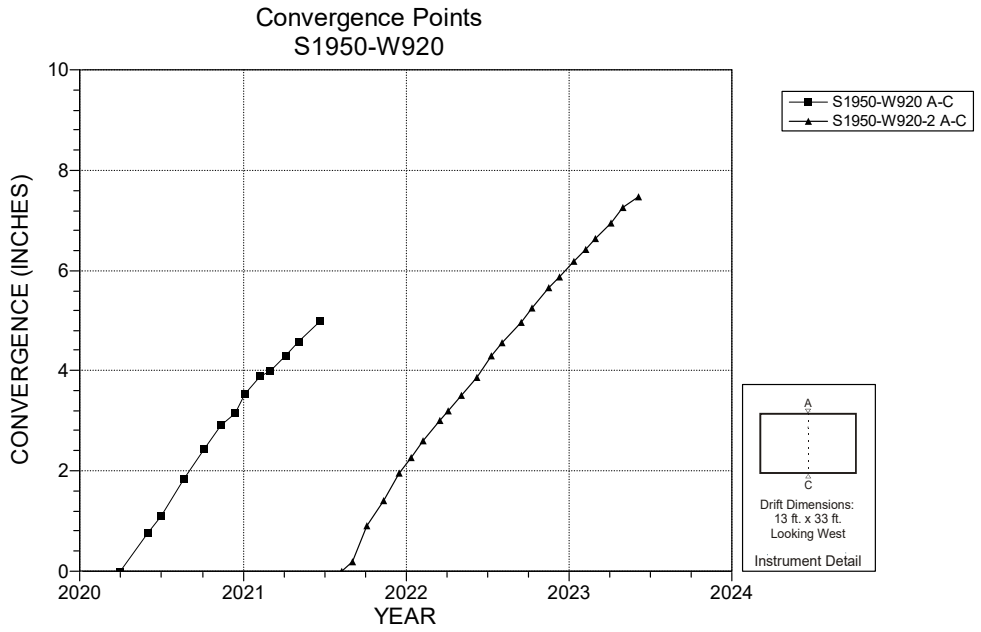
NOTES:
1. Excavation Date: December 2013.

Figure 5-57 Convergence Point Array – S1950 W790 – Roof to Floor



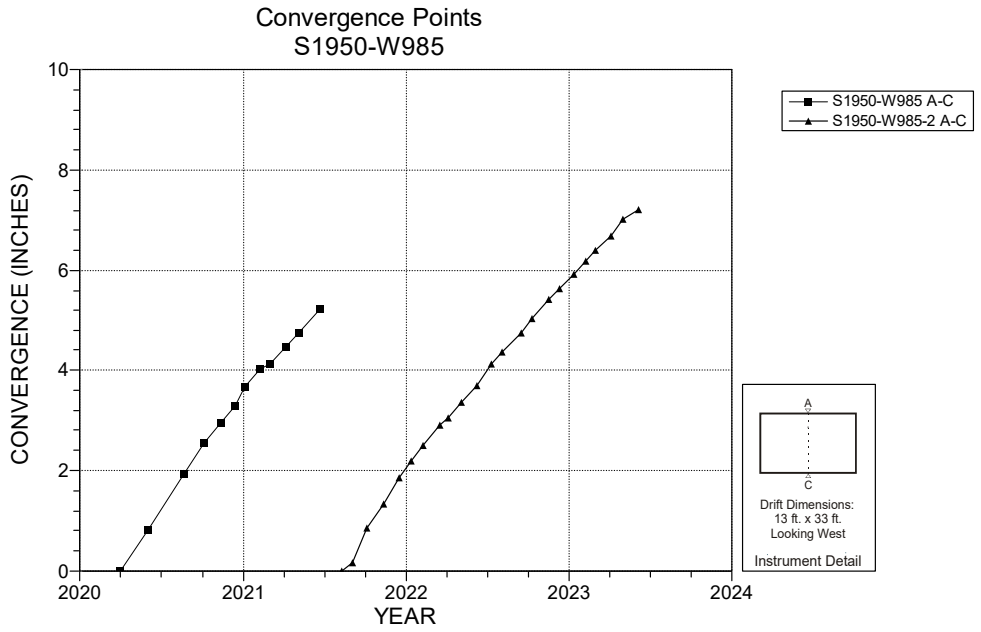
NOTES:
1. Excavation date: January 2020.

Figure 5-58 Convergence Point Array – S1950 W855 – Roof to Floor



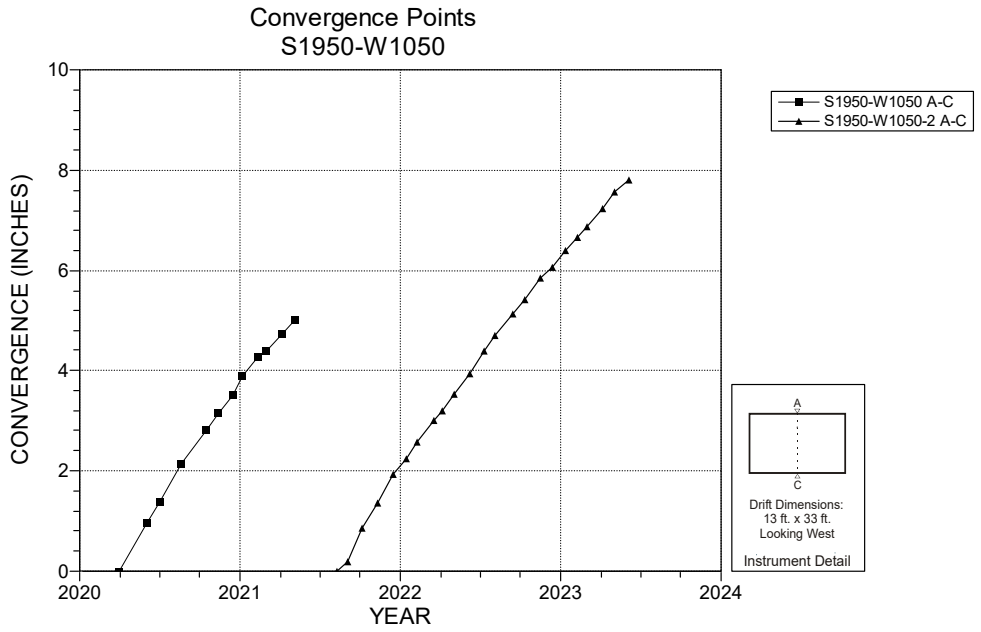
NOTES:
1. Excavation date: January 2020.

Figure 5-59 Convergence Point Array – S1950 W920 – Roof to Floor



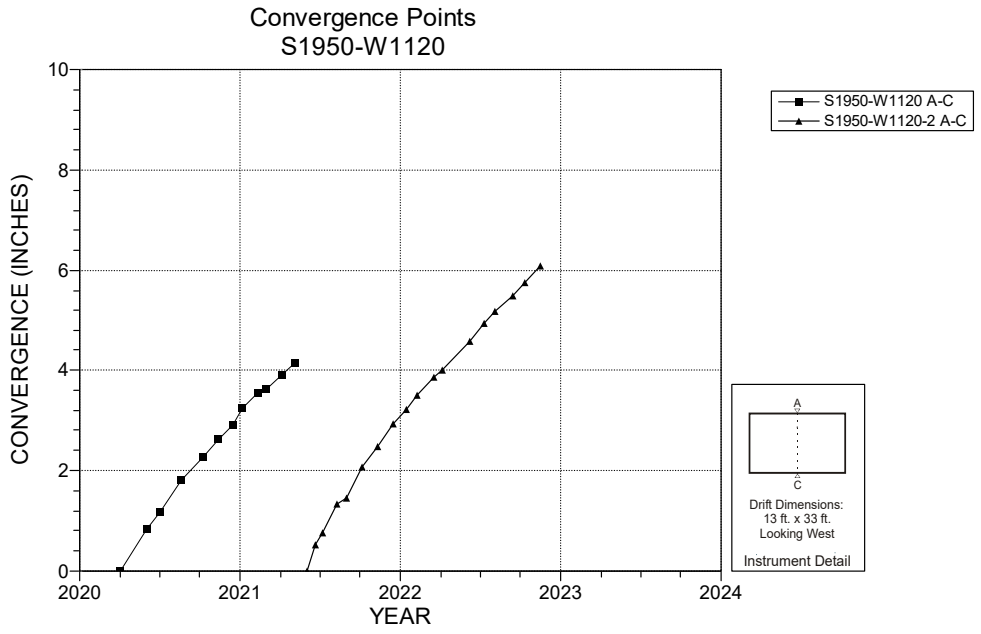
NOTES:
1. Excavation date: January 2020.

Figure 5-60 Convergence Point Array – S1950 W985 – Roof to Floor



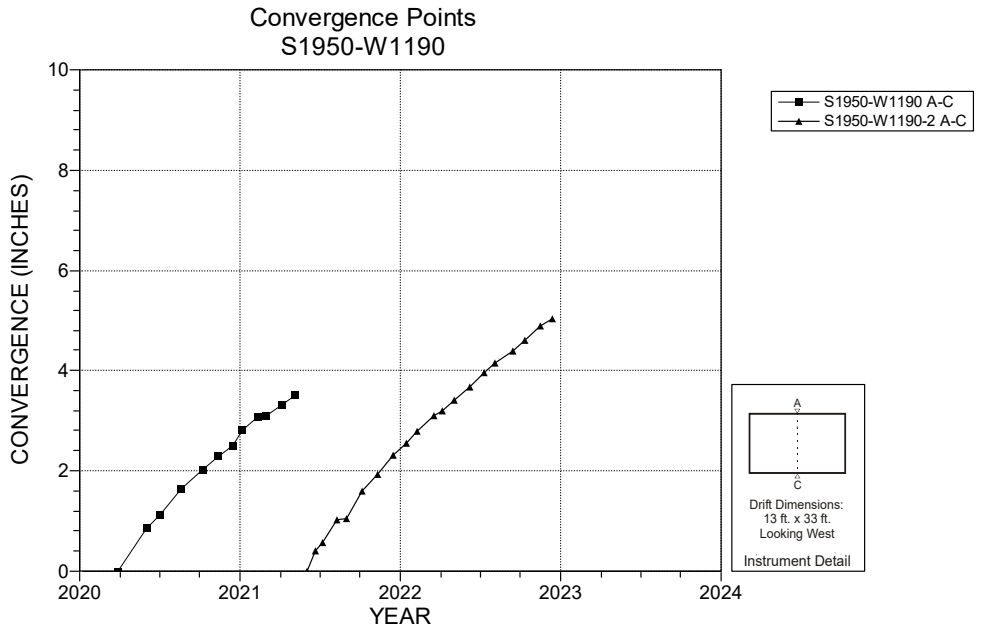
NOTES:
1. Excavation date: January 2020.

Figure 5-61 Convergence Point Array – S1950 W1050 – Roof to Floor



NOTES:
1. Excavation Date: January 2020.

Figure 5-62 Convergence Point Array – S1950 W1120 – Roof to Floor



NOTES:
1. Excavation Date: January 2020.

Figure 5-63 Convergence Point Array – S1950 W1190 – Roof to Floor

6.0 INSTRUMENTATION SUMMARY FOR THE SDI AREA

This section presents a summary of the data collected from the radial convergence stations located in the SDI area at the WIPP facility. A combination of ground control, and to some extent, ventilation challenges, led the Operations Department to continue prohibiting access to a portion of the SDI area during the reporting period in order to allocate resources to other priority areas. As a result, only 35 convergence points out of 55 installed in the SDI were accessible and read during the reporting period. They are captured in the following pages.

Table 6-1 SDI Data Analysis

Convergence Points									
Field Tag	Location	Figure Number	Last Reading 2022 to 2023		Cumulative Displacement (inches)	Closure Rate 2022 to 2023 (in/year)	Closure Rate 2021 to 2022 (in/year)	Rate Change Percent	Comments
			Date	Inches					
E540-N860 A-C	E540-N860	6-1	11/09/2022	14.194	14.194	1.1	1.1	0	N/A
E690-N860-2 A-C	E690-N860	6-2	11/09/2022	9.619	9.841	1.4	1.8	-22	N/A
E1110-N860-1 A-C	E1110-N860	6-3	11/09/2022	1.199	1.199	0.98	1.3	-25	N/A
E1300-N860 A-C	E1300-N860	6-4	5/23/2023	10.525	10.525	0.9	1.0	-10	N/A
N780-E220-5 A-C	N780-E220	6-5	1/25/2023	3.935	38.653	2.2	2.4	-8	N/A
N780-E300-3 A-C	N780-E300	6-6	1/25/2023	19.731	22.360	2.2	2.4	-10	N/A
N780-E420-2 A-C	N780-E420	6-7	11/09/2022	15.984	19.810	1.3	1.8	-28	N/A
N780-E540-2 A-C	N780-E540	6-8	11/09/2022	20.620	25.04	1.8	1.9	-5	N/A
N780-E615-2 A-C	N780-E615	6-9	11/09/2022	16.080	19.298	1.3	1.6	-19	N/A
N780-E690-2 A-C	N780-E690	6-10	11/09/2022	21.298	26.648	1.9	2.0	-5	N/A
N780-E768 A-C	N780-E768	6-11	11/09/2022	17.638	17.638	1.4	1.6	-13	N/A
N780-E845 A-C	N780-E845	6-12	11/09/2022	19.297	19.297	1.5	1.7	-12	N/A
N780-E922 A-C	N780-E922	6-13	11/09/2022	19.573	19.573	1.5	1.8	-17	N/A
N780-E1050 A-C	N780-E1050	6-14	11/09/2022	18.126	18.126	1.2	1.5	-20	N/A
N780-E1100 A-C	N780-E1100	6-15	3/10/2023	18.490	18.490	1.2	1.4	-14	N/A
N780-E1150 A-C	N780-E1150	6-16	3/10/2023	17.410	17.410	1.2	1.4	-14	N/A
N780-E1200 A-C	N780-E1200	6-17	3/10/2023	16.990	16.990	1.2	1.4	-14	N/A
N780-E1250 A-C	N780-E1250	6-18	5/23/2023	14.467	14.467	1.0	1.2	-17	N/A
N780-E1300 A-C	N780-E1300	6-19	5/23/2023	9.582	9.582	0.8	1.0	-20	N/A
N940-E220-2 A-C	N940-E220	6-20	5/23/2023	10.434	11.869	0.8	1.0	-20	N/A
N940-E300-2 A-C	N940-E300	6-21	5/23/2023	12.899	14.665	1.1	1.3	-15	N/A
N940-E420-4 A-C	N940-E420	6-22	5/23/2023	1.746	19.566	3.0	2.6	15	N/A
N940-E540-2 A-C	N940-E540	6-23	5/23/2023	18.279	21.230	1.6	1.8	-11	N/A
N940-E615-2 A-C	N940-E615	6-24	5/23/2023	17.748	20.573	1.5	1.5	0	N/A
N940-E690-3 A-C	N940-E690	6-25	5/23/2023	25.467	27.835	2.0	2.2	-9	N/A
N940-E768-2 A-C	N940-E768	6-26	5/23/2023	18.310	19.145	1.6	1.8	-11	N/A
N940-E845-2 A-C	N940-E845	6-27	5/23/2023	16.178	17.101	1.4	1.6	-13	N/A
N940-E922-2 A-C	N940-E922	6-28	5/23/2023	16.350	17.573	1.3	1.5	-13	N/A
N940-E1000 A-C	N940-E1000	6-29	5/23/2023	18.390	18.390	1.5	1.7	-12	N/A
N940-E1050-2 A-C	N940-E1050	6-30	5/23/2023	15.107	16.624	1.2	1.4	-14	N/A
N940-E1100 A-C	N940-E1100	6-31	5/23/2023	19.133	19.133	1.6	1.8	-11	N/A
N940-E1150 A-C	N940-E1150	6-32	5/23/2023	15.208	15.208	1.3	1.5	-13	N/A
N940-E1200 A-C	N940-E1200	6-33	5/23/2023	15.840	15.840	1.3	1.5	-13	N/A
N940-E1250 A-C	N940-E1250	6-34	5/23/2023	12.215	12.215	1.0	1.2	-17	N/A

Table 6-1 SDI Data Analysis (Continued)

Convergence Points (continued)									
Field Tag	Location	Figure Number	Last Reading 2022 to 2023		Cumulative Displacement (inches)	Closure Rate 2022 to 2023 (in/year)	Closure Rate 2021 to 2022 (in/year)	Rate Change Percent	Comments
			Date	Inches					
N940-E1300 A-C	N940-E1300	6-35	5/23/2023	13.735	13.735	1.1	1.3	-15	N/A

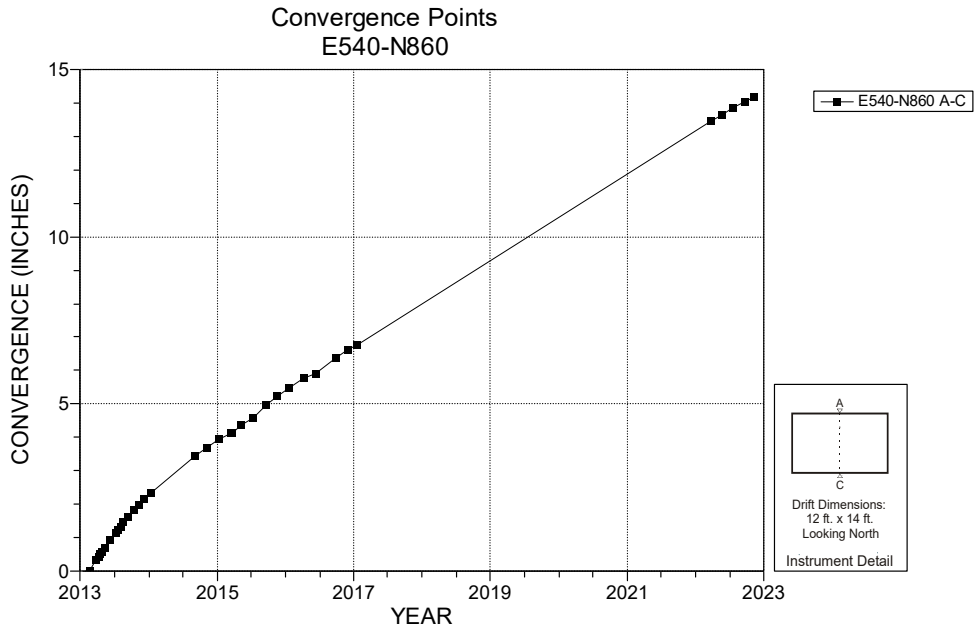


Figure 6-1 Convergence Point Array – E540 N860 – Roof to Floor

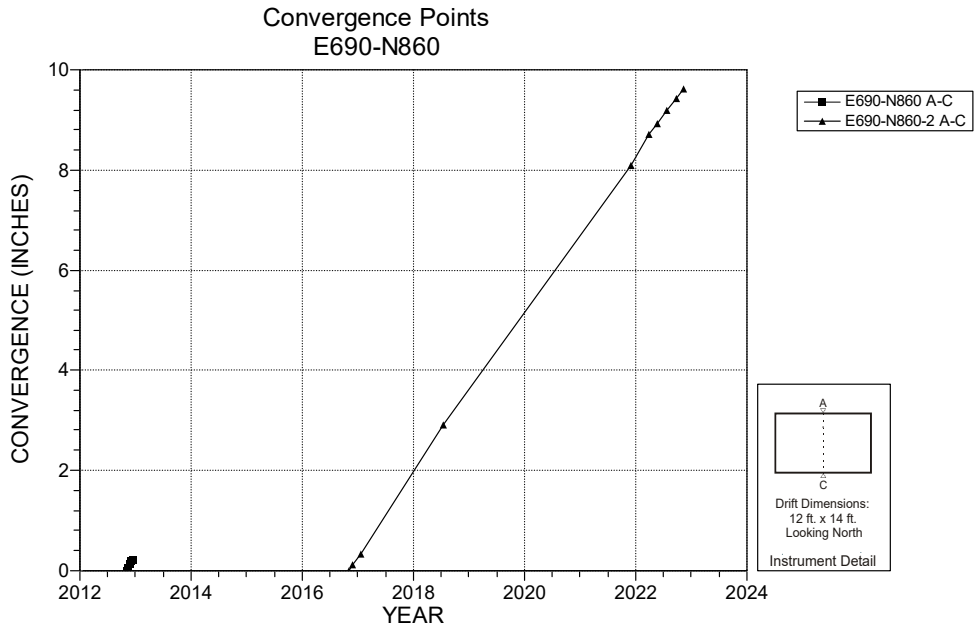
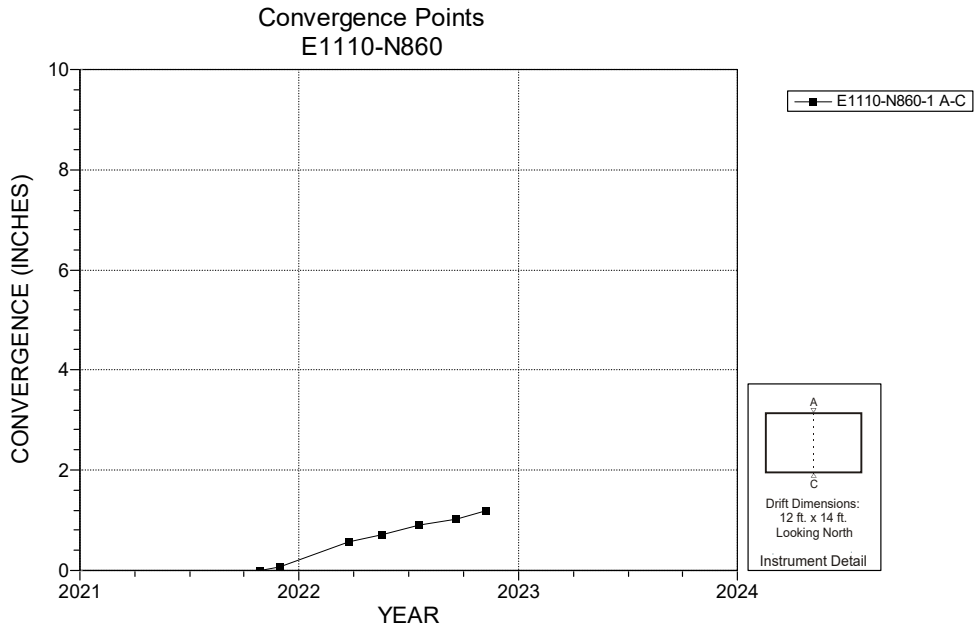
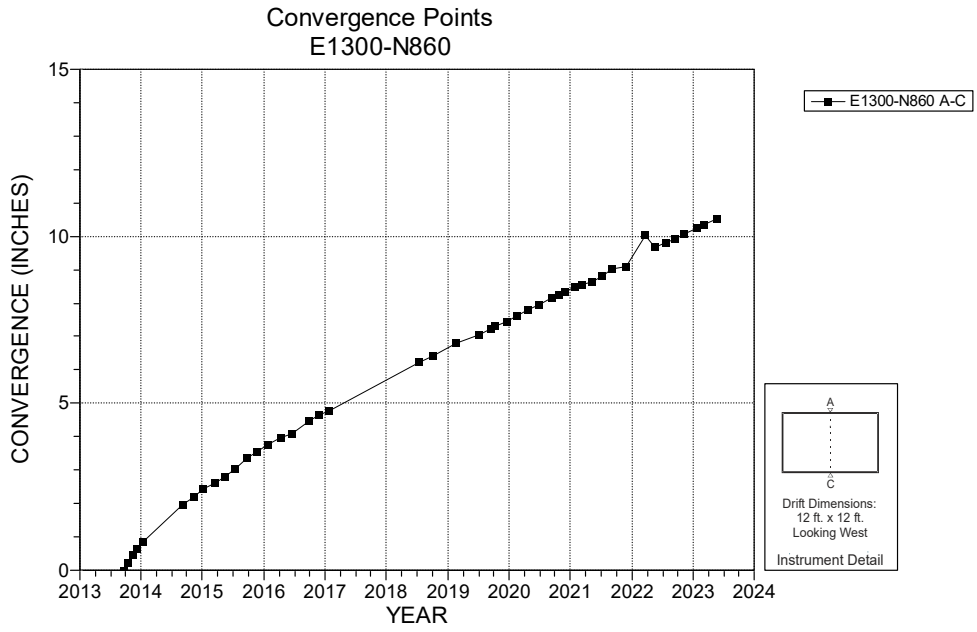


Figure 6-2 Convergence Point Array – E690 N860 – Roof to Floor



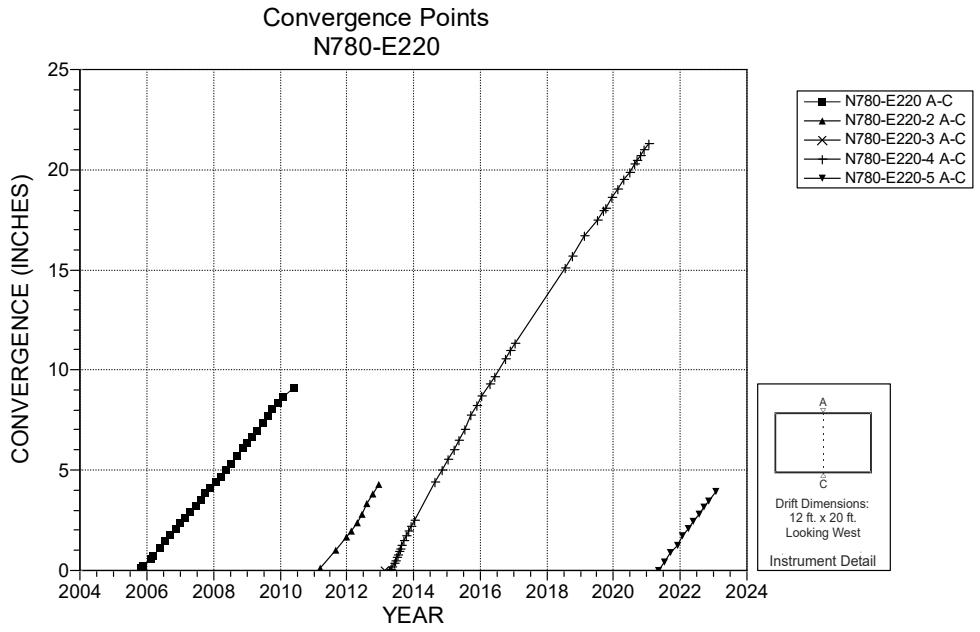
NOTES:
1. Excavation date: June 2012.

Figure 6-3 Convergence Point Array – E1110 N860 – Roof to Floor



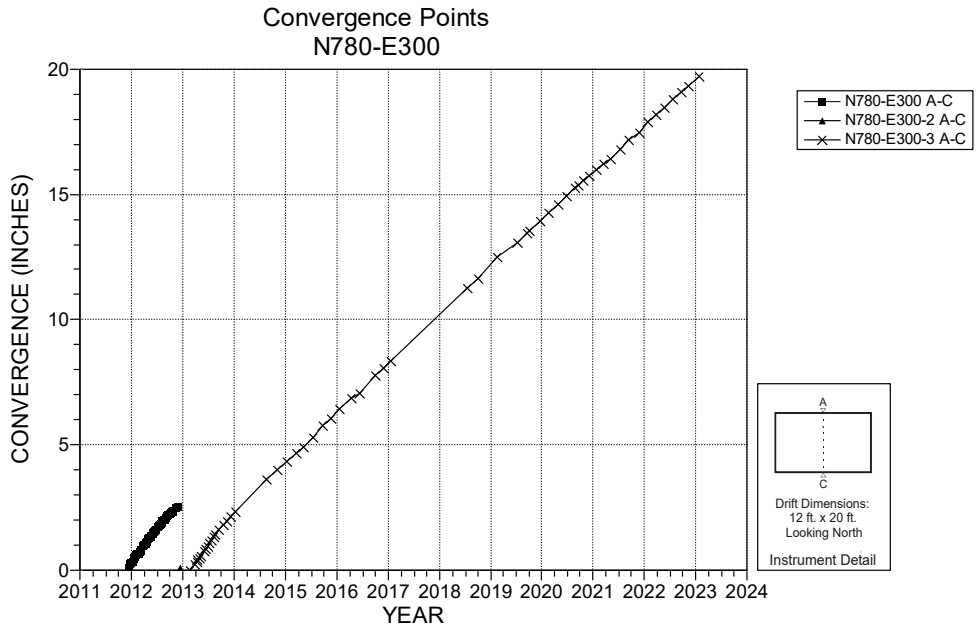
NOTES:
1. Excavation date: July 2013.

Figure 6-4 Convergence Point Array – E1300 N860 – Roof to Floor



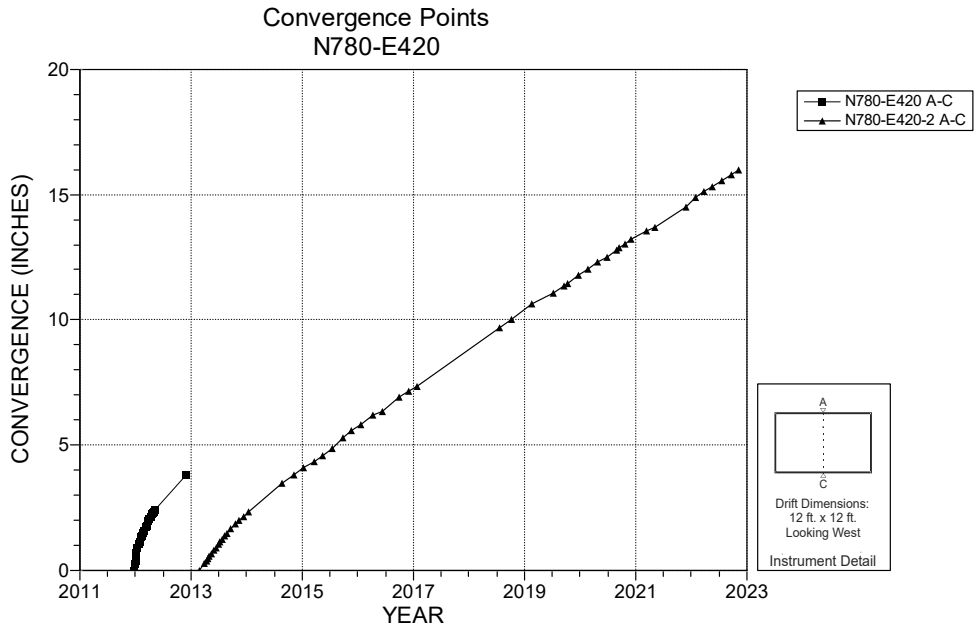
NOTES:
1. Excavation date: February 1983.

Figure 6-5 Convergence Point Array – N780 E220 – Roof to Floor



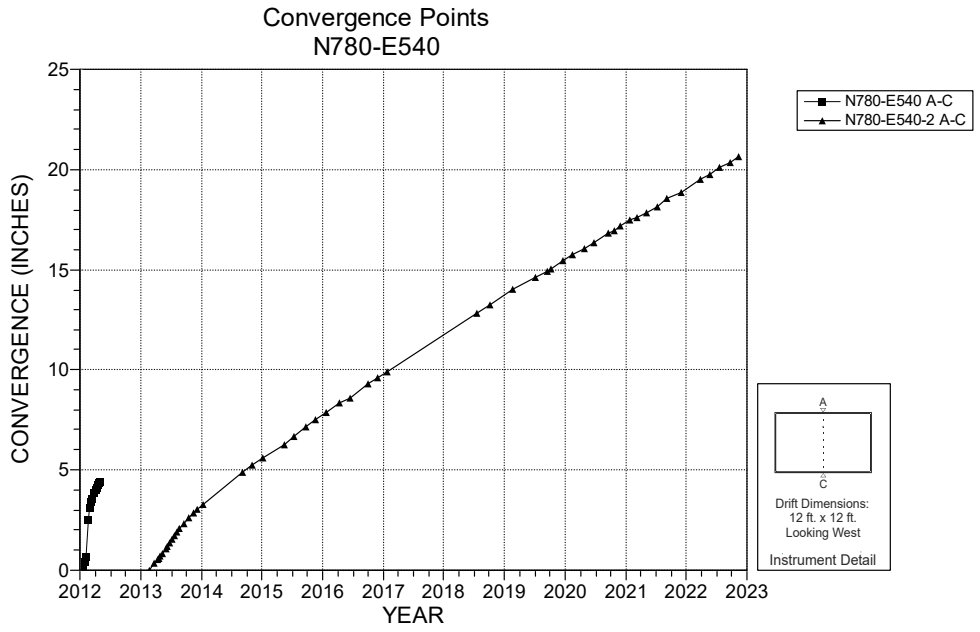
NOTES:
1. Excavation date: December 2011.

Figure 6-6 Convergence Point Array – N780 E300 – Roof to Floor



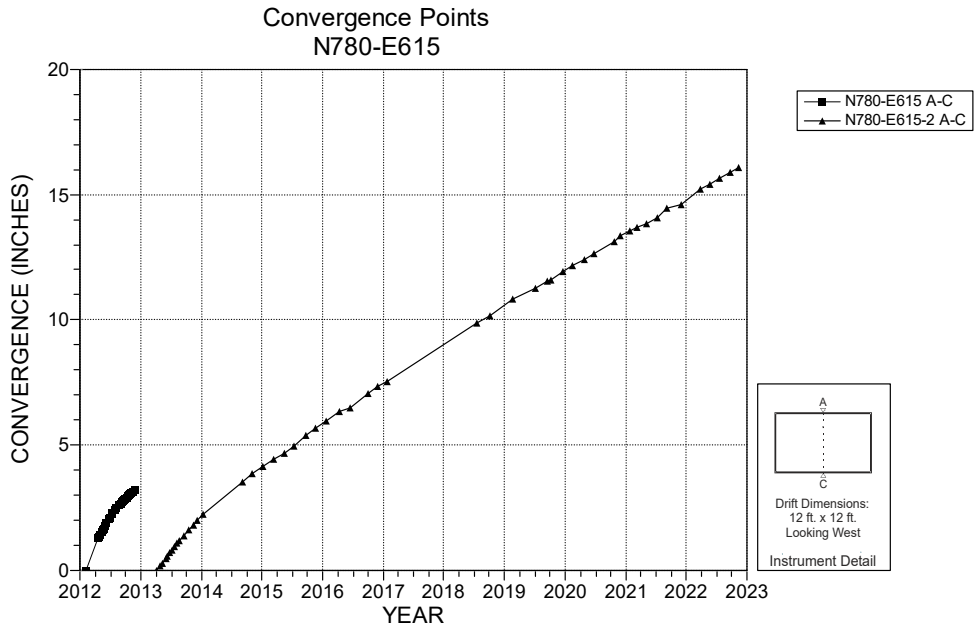
NOTES:
1. Excavation date: December, 2011.

Figure 6-7 Convergence Point Array – N780 E420 – Roof to Floor



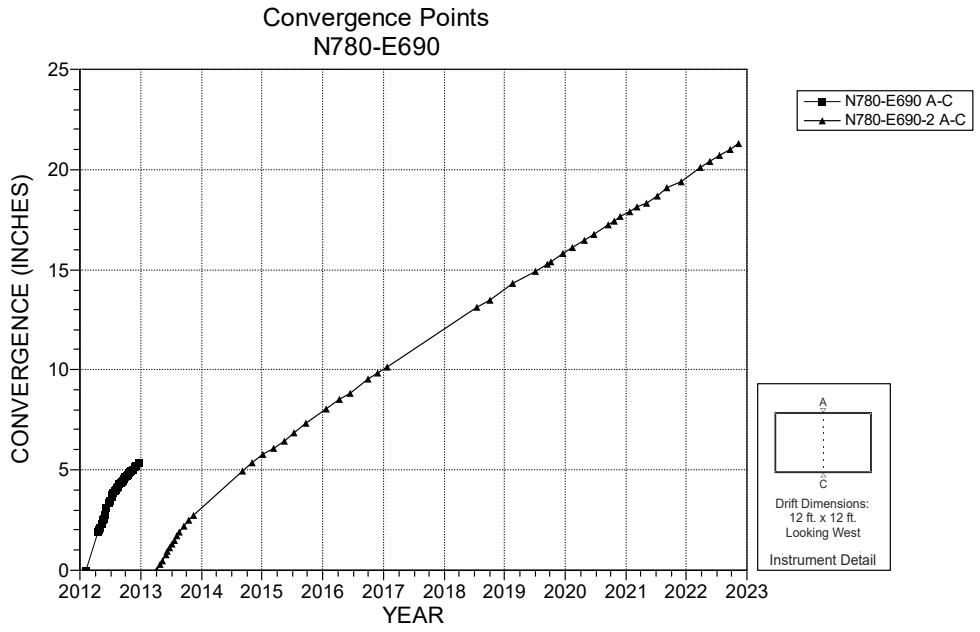
NOTES:
1. Excavation date: January 2012.

Figure 6-8 Convergence Point Array – N780 E540 – Roof to Floor



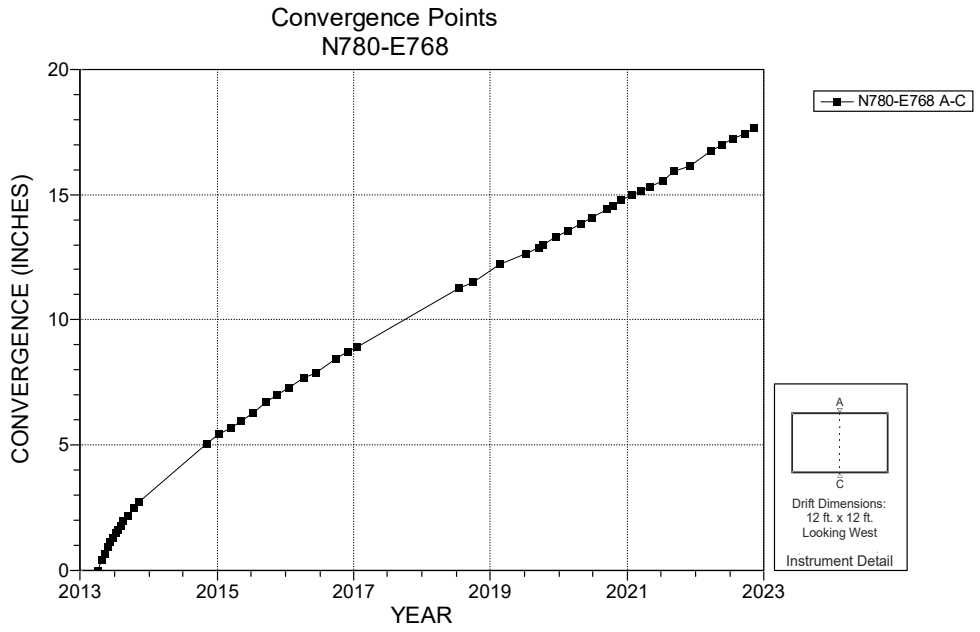
NOTES:
1. Excavation date: January 2012.

Figure 6-9 Convergence Point Array – N780 E615 – Roof to Floor



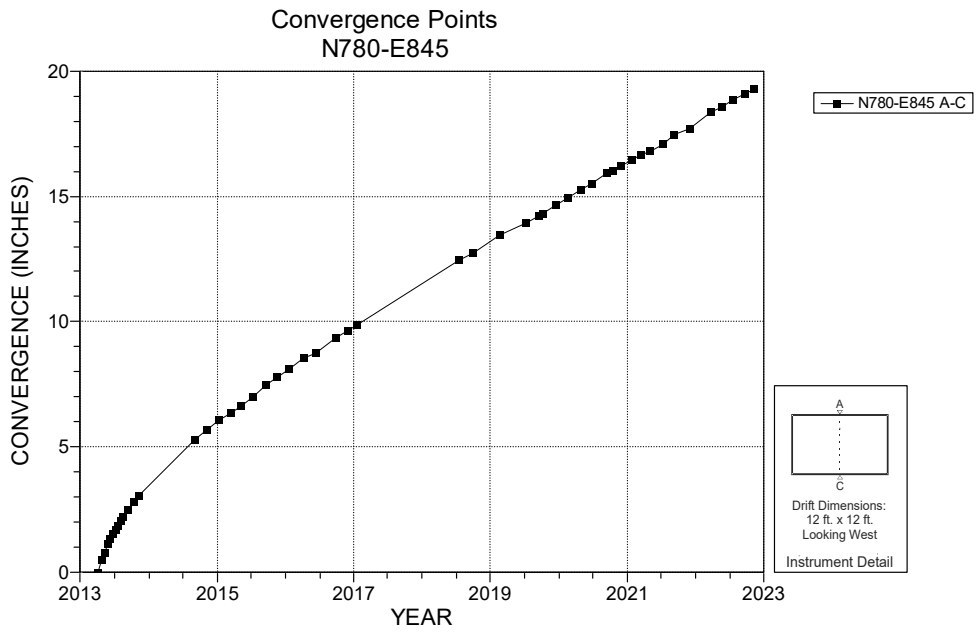
NOTES:
1. Excavation date: January 2012.

Figure 6-10 Convergence Point Array – N780 E690 – Roof to Floor



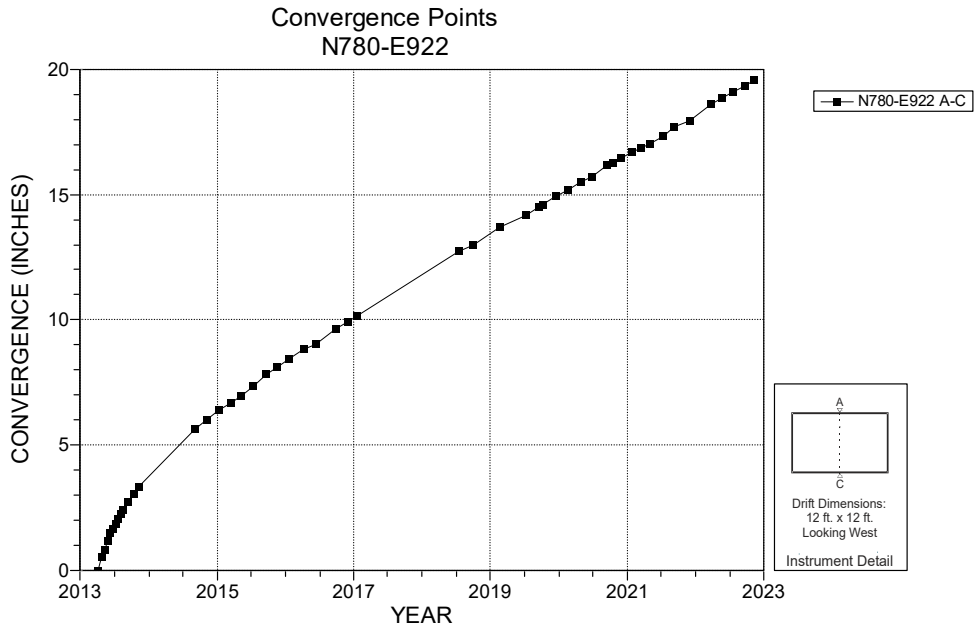
NOTES:
1. Excavation date: February 2013.

Figure 6-11 Convergence Point Array – N780 E768 – Roof to Floor



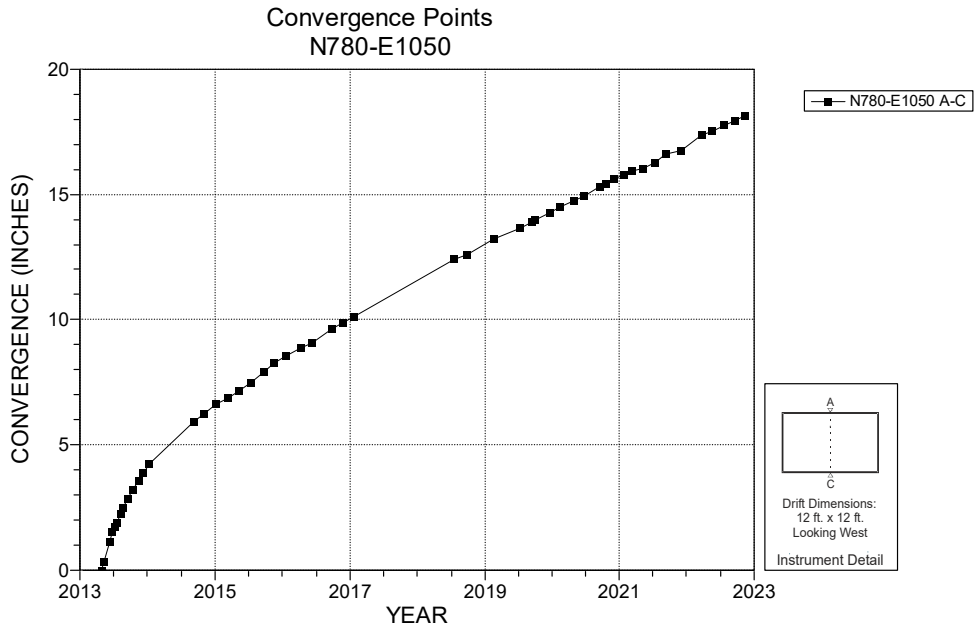
NOTES:
1. Excavation date: February 2013.

Figure 6-12 Convergence Point Array – N780 E845 – Roof to Floor



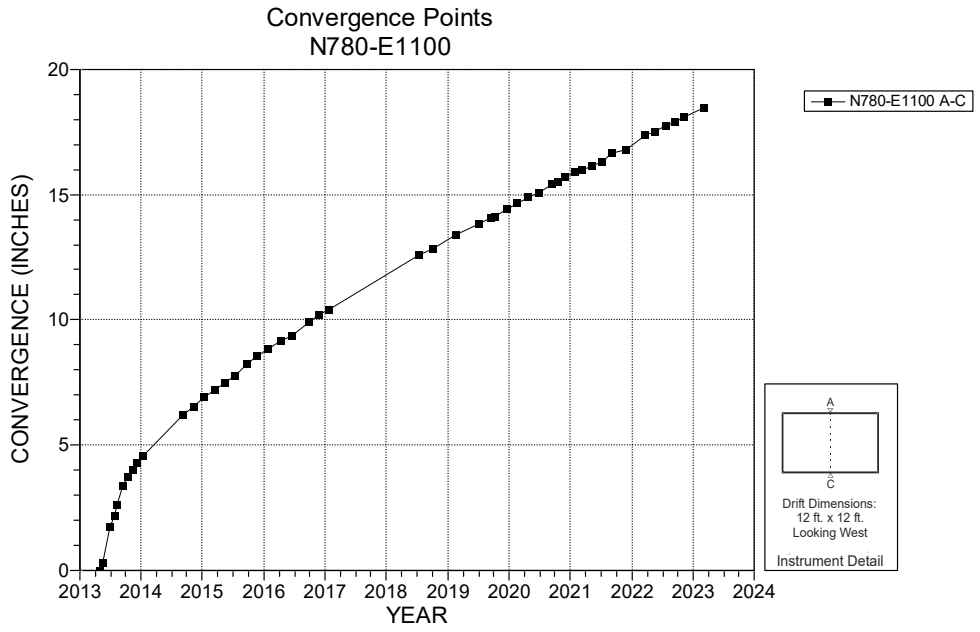
NOTES:
1. Excavation date: February 2013.

Figure 6-13 Convergence Point Array – N780 E922 – Roof to Floor



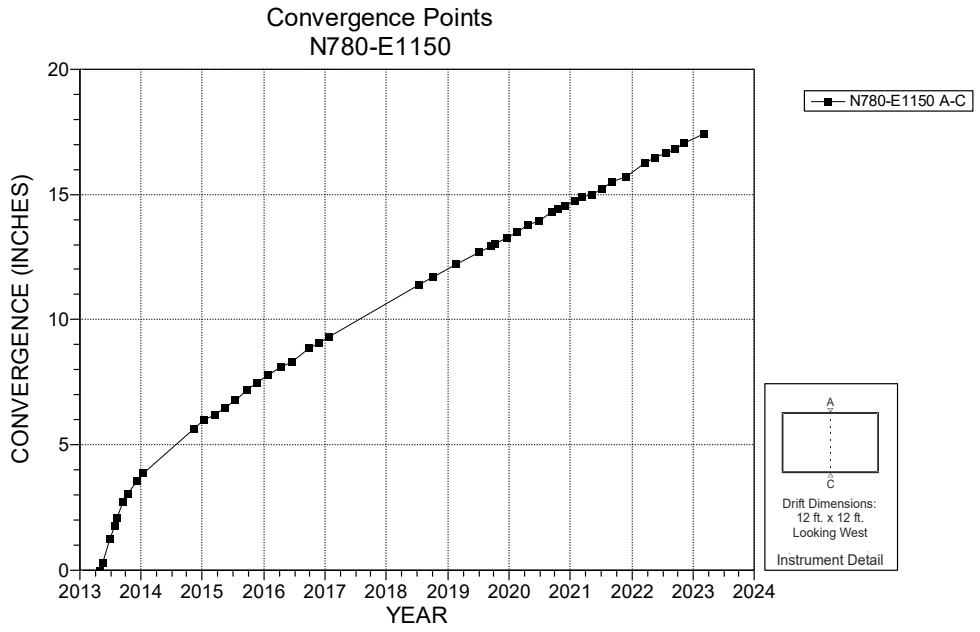
NOTES:
1. Excavation date: March 2013.

Figure 6-14 Convergence Point Array – N780 E1050 – Roof to Floor



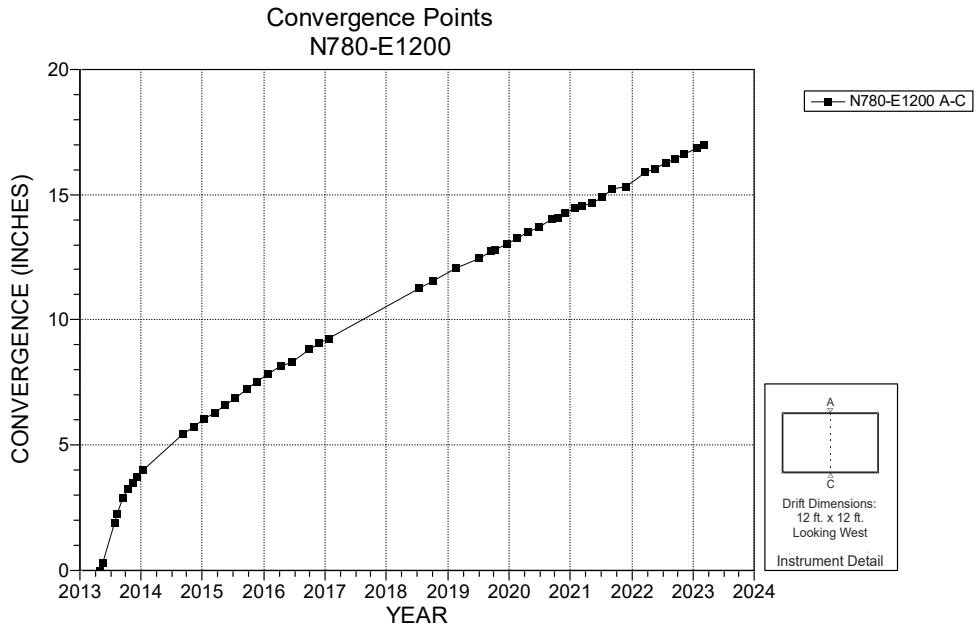
NOTES:
1. Excavation date: March 2013.

Figure 6-15 Convergence Point Array – N780 E1100 – Roof to Floor



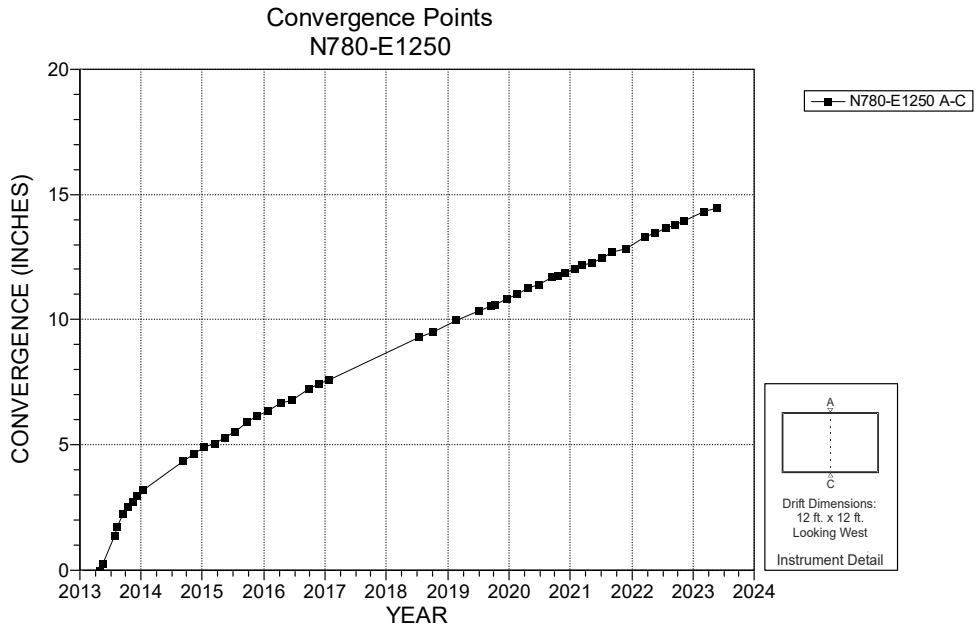
NOTES:
1. Excavation date: March 2013.

Figure 6-16 Convergence Point Array – N780 E1150 – Roof to Floor



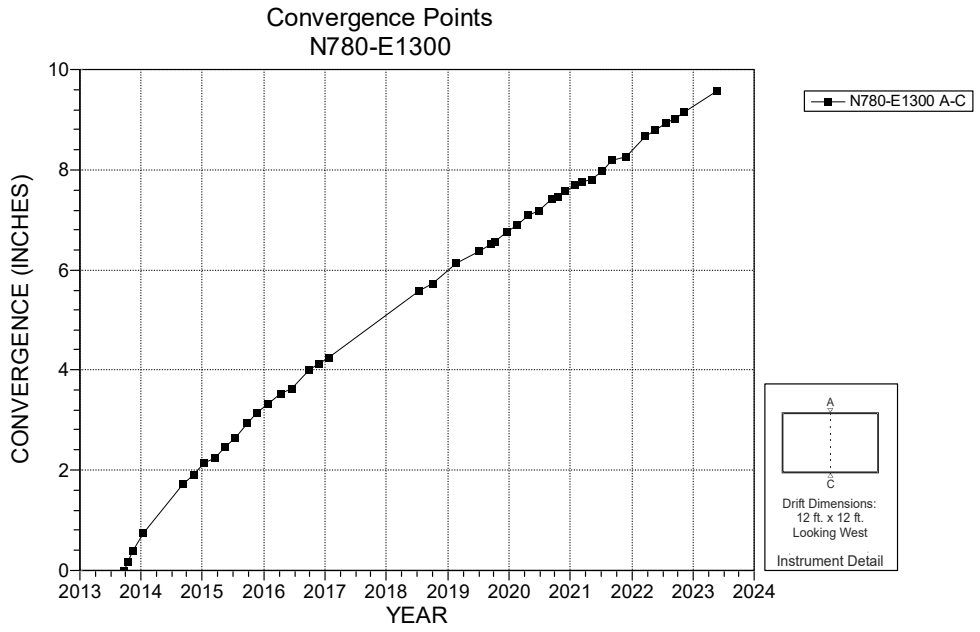
NOTES:
1. Excavation date: March 2013.

Figure 6-17 Convergence Point Array – N780 E1200 – Roof to Floor



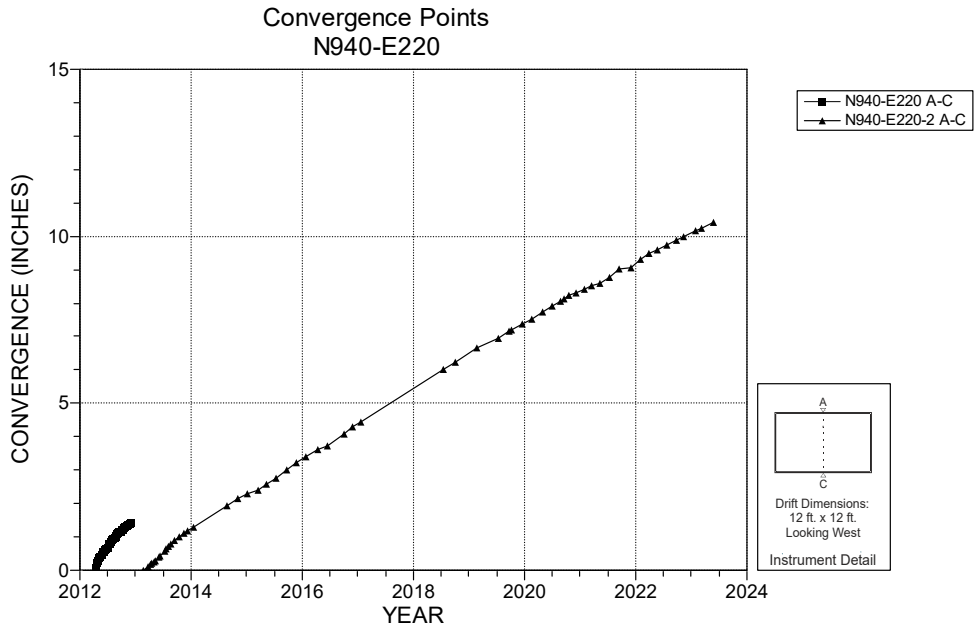
NOTES:
1. Excavation date: April 2013.

Figure 6-18 Convergence Point Array – N780 E1250 – Roof to Floor



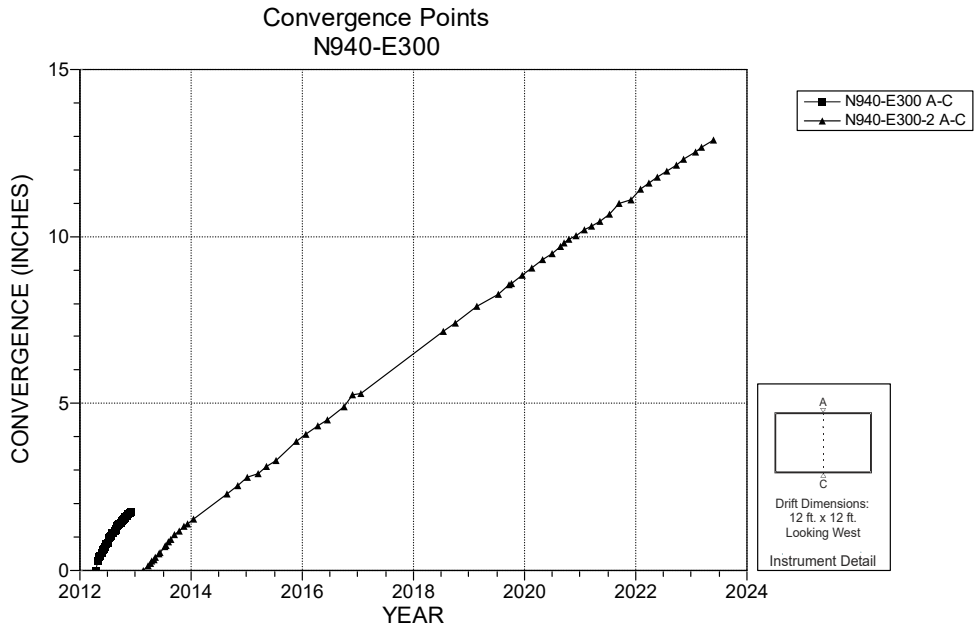
NOTES:
1. Excavation date: April 2013.

Figure 6-19 Convergence Point Array – N780 E1300 – Roof to Floor



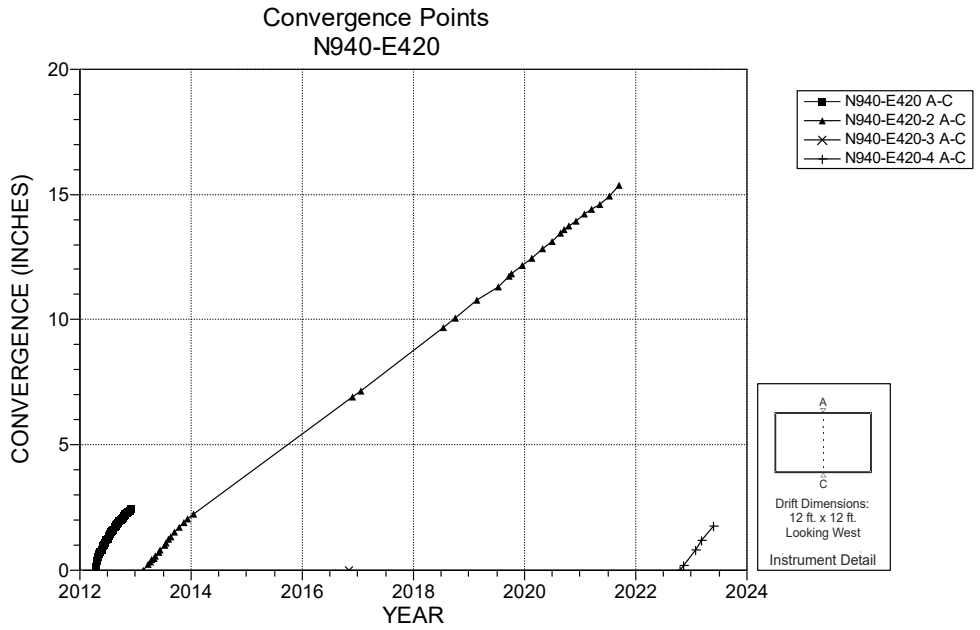
NOTES:
1. Excavation date: March 2012.

Figure 6-20 Convergence Point Array – N940 E220 – Roof to Floor



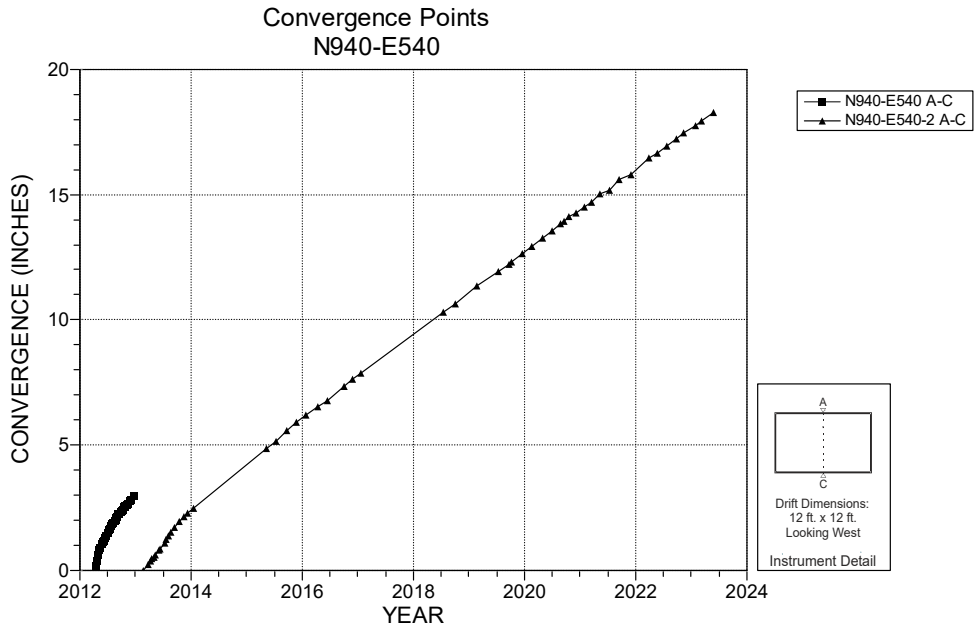
NOTES:
1. Excavation date: March 2012.

Figure 6-21 Convergence Point Array – N940 E300 – Roof to Floor



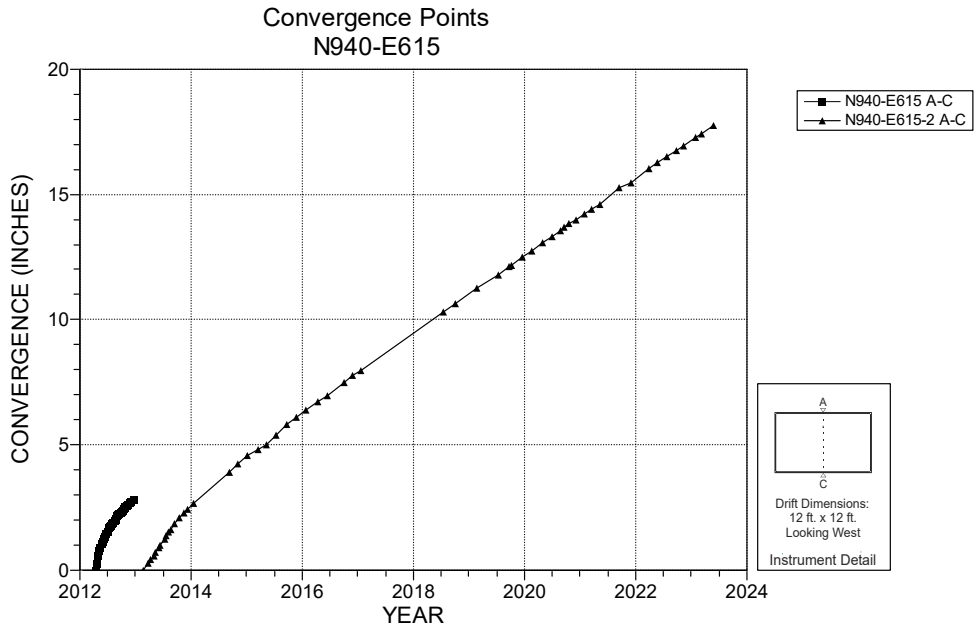
NOTES:
1. Excavation Date: March 2012.

Figure 6-22 Convergence Point Array – N940 E420 – Roof to Floor



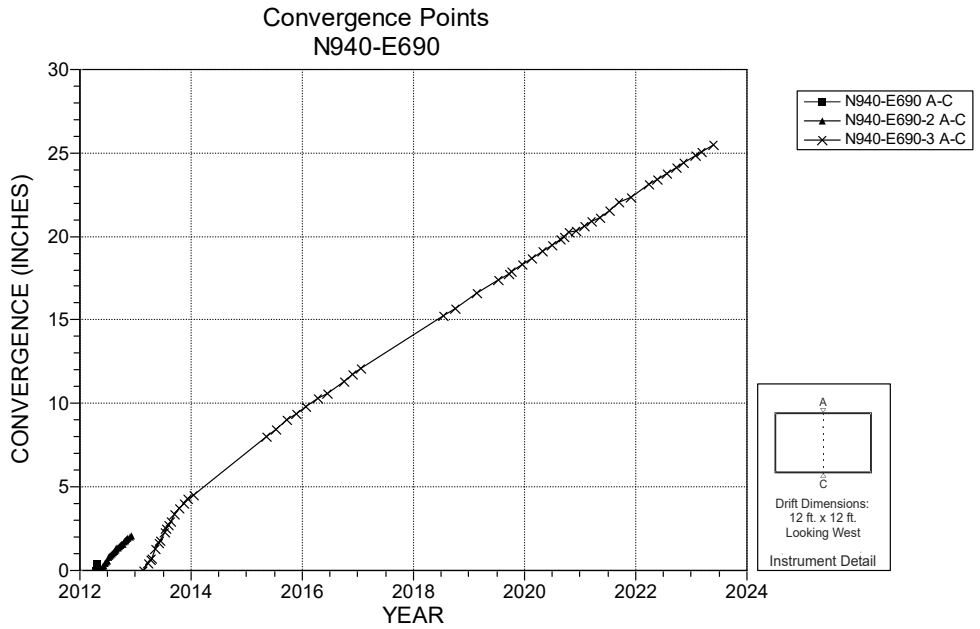
NOTES:
1. Excavation date: March 2012.

Figure 6-23 Convergence Point Array – N940 E540 – Roof to Floor



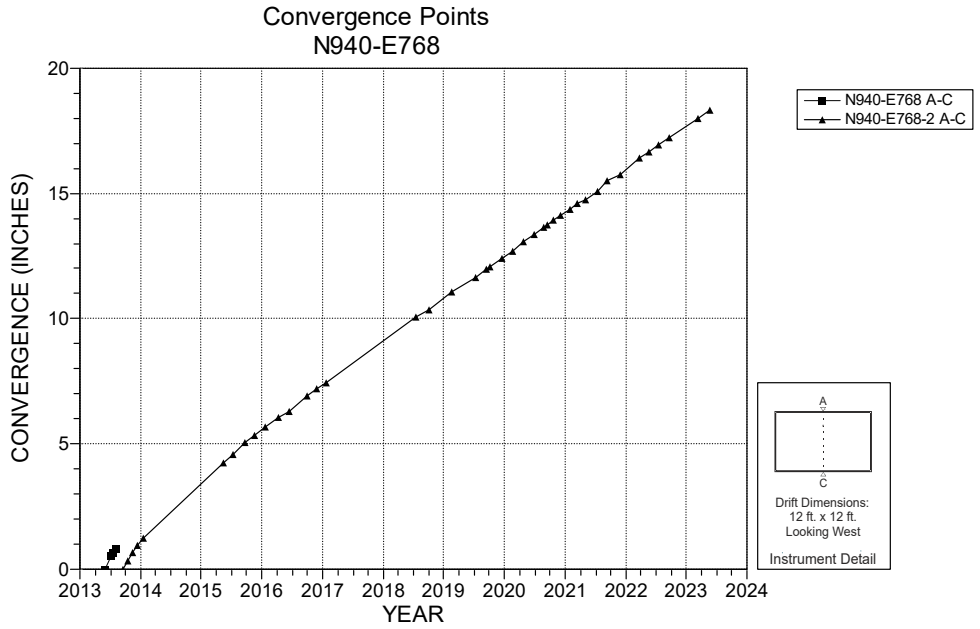
NOTES:
1. Excavation date: March 2012.

Figure 6-24 Convergence Point Array – N940 E615 – Roof to Floor



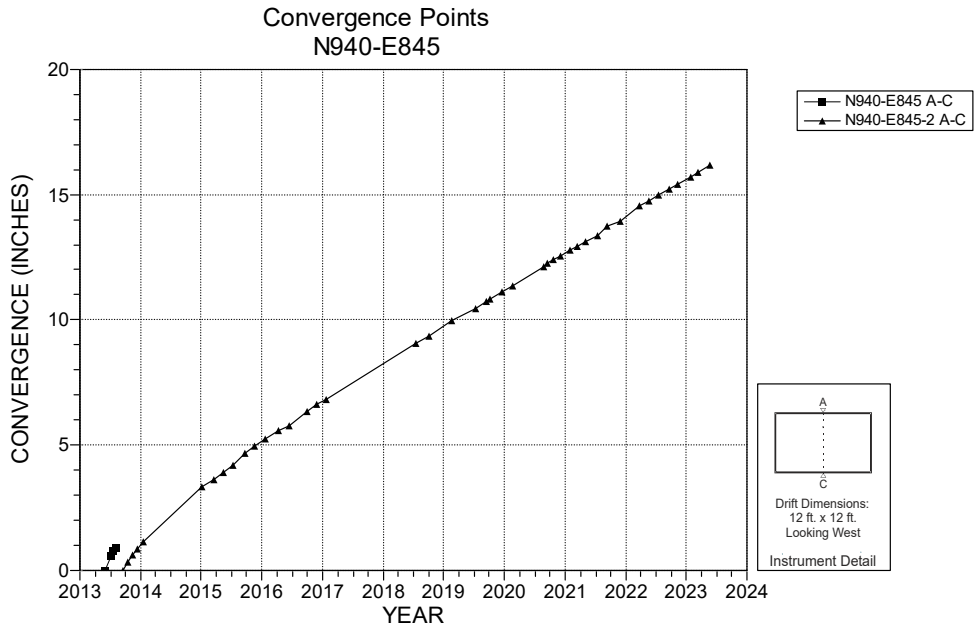
NOTES:
1. Excavation date: March 2012.

Figure 6-25 Convergence Point Array – N940 E690 – Roof to Floor



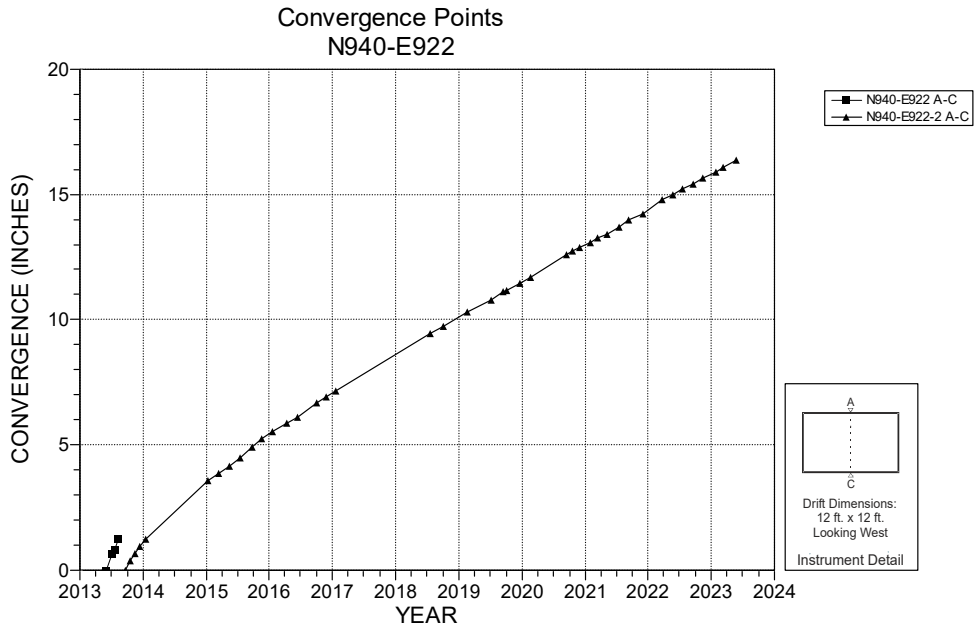
NOTES:
1. Excavation date: April 2013.

Figure 6-26 Convergence Point Array – N940 E768 – Roof to Floor



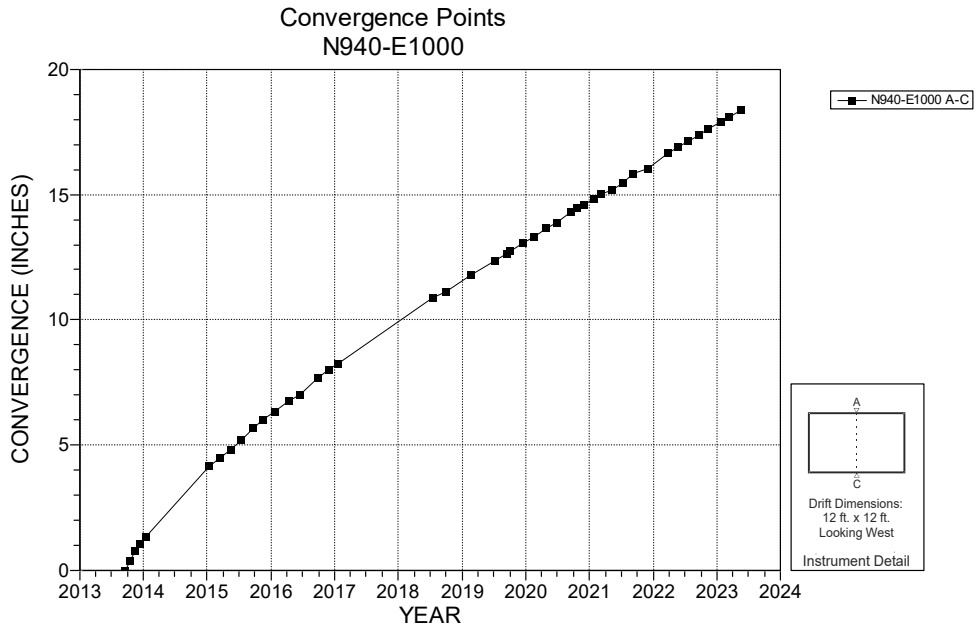
NOTES:
1. Excavation date: May 2013.

Figure 6-27 Convergence Point Array – N940 E845 – Roof to Floor



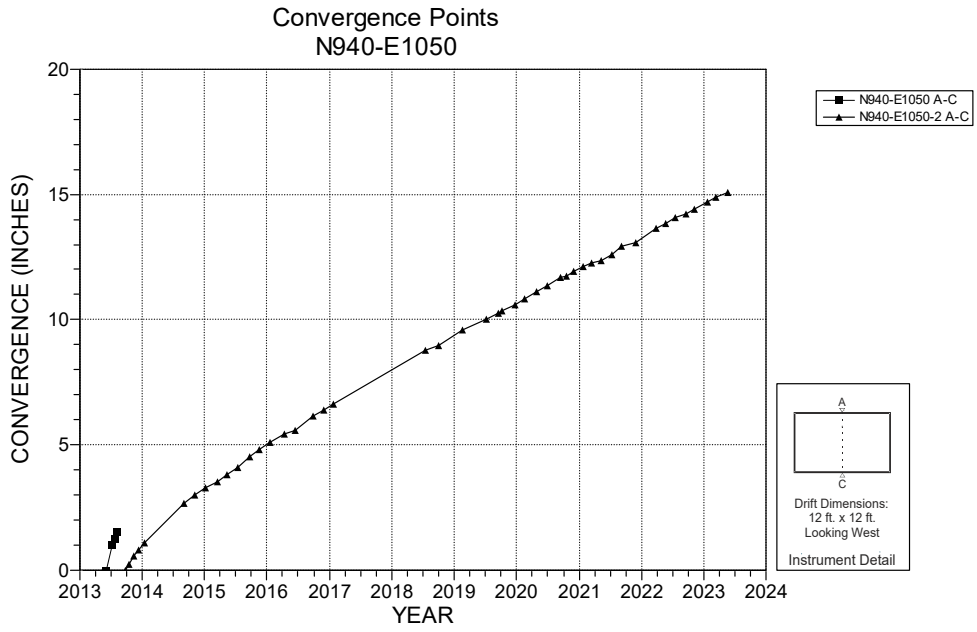
NOTES:
1. Excavation date: May 2013.

Figure 6-28 Convergence Point Array – N940 E922 – Roof to Floor



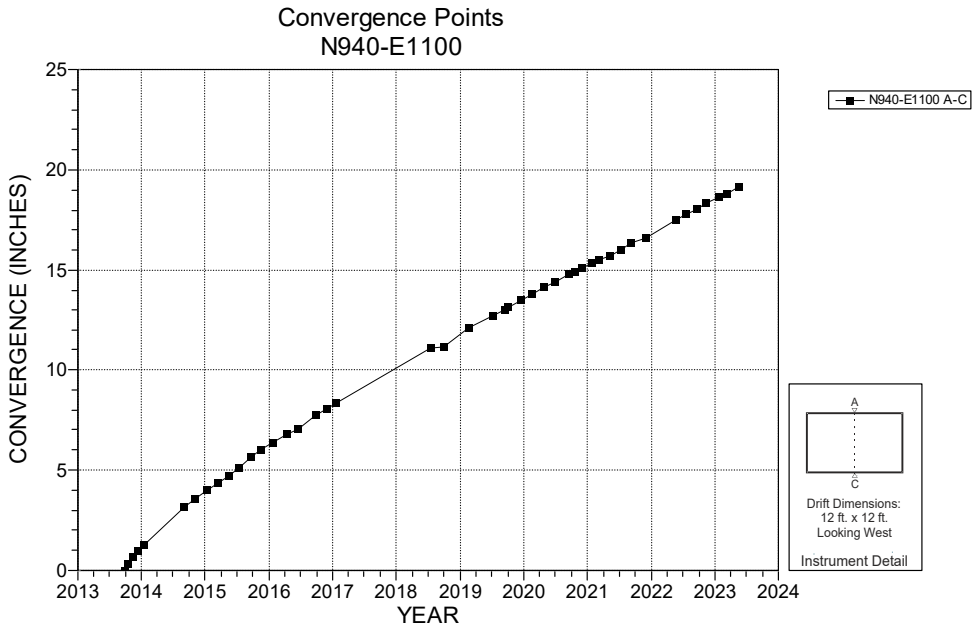
NOTES:
1. Excavation date: May 2013.

Figure 6-29 Convergence Point Array – N940 E1000 – Roof to Floor



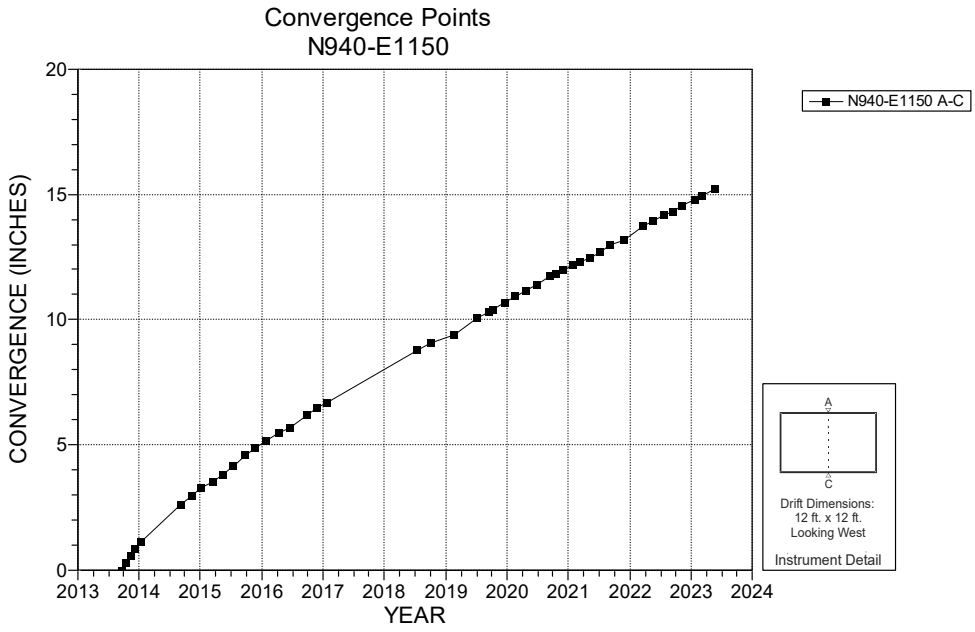
NOTES:
1. Excavation date: May 2013.

Figure 6-30 Convergence Point Array – N940 E1050 – Roof to Floor



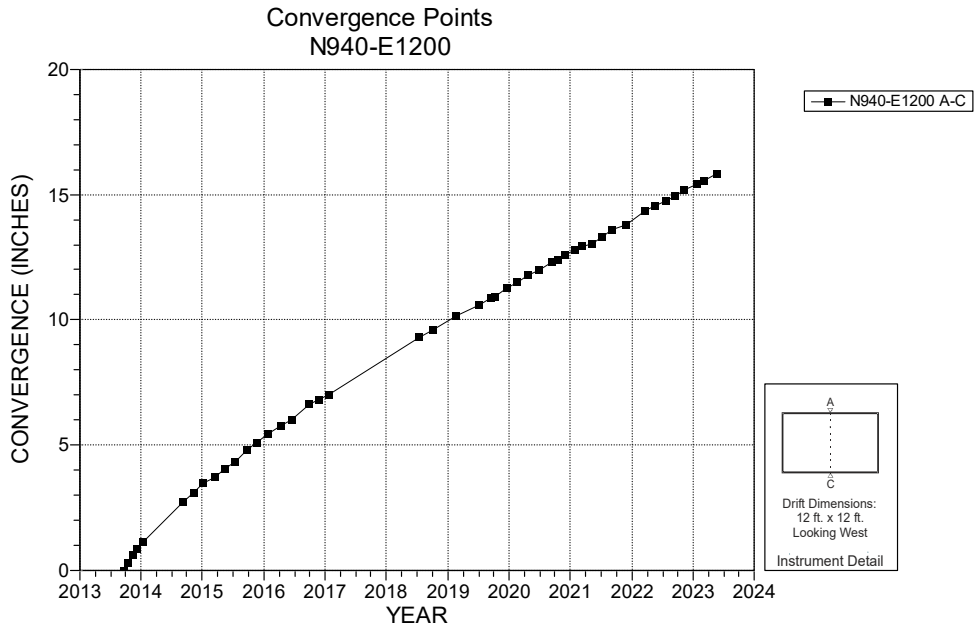
NOTES:
1. Excavation date: June 2013.

Figure 6-31 Convergence Point Array – N940 E1100 – Roof to Floor



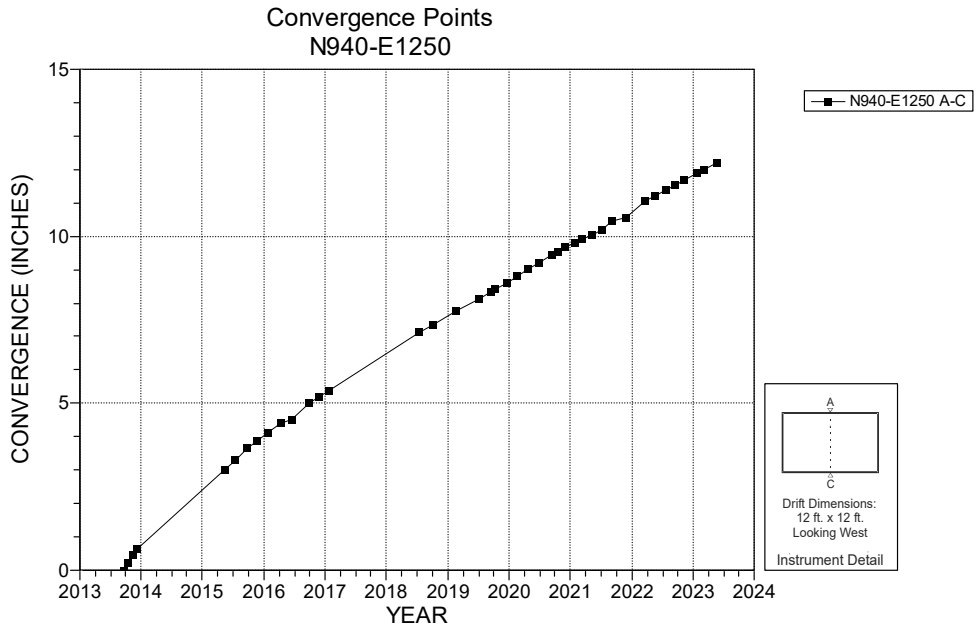
NOTES:
1. Excavation date: June 2013.

Figure 6-32 Convergence Point Array – N940 E1150 – Roof to Floor



NOTES:
1. Excavation date: June 2013.

Figure 6-33 Convergence Point Array – N940 E1200 – Roof to Floor



NOTES:
1. Excavation date: July 2013.

Figure 6-34 Convergence Point Array – N940 E1250 – Roof to Floor

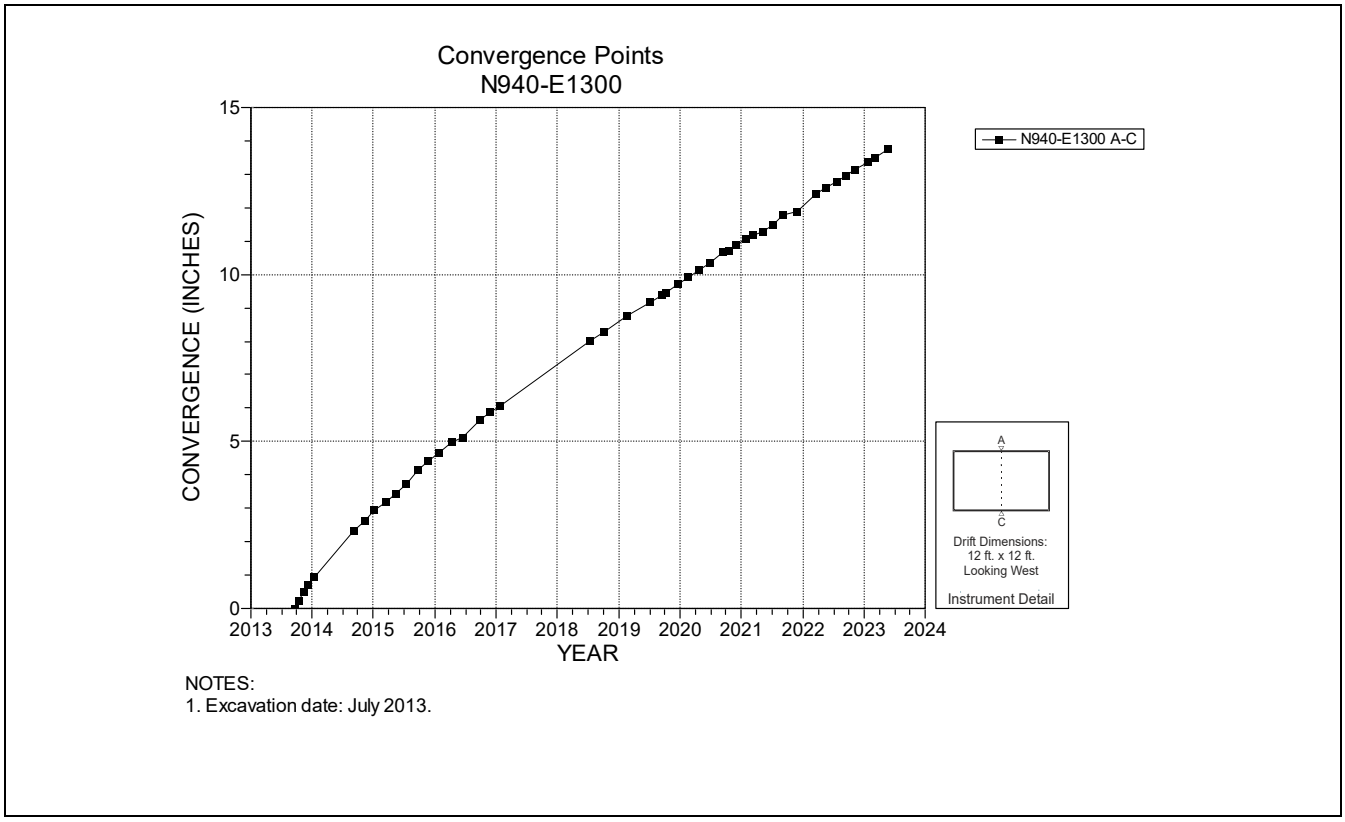


Figure 6-35 Convergence Point Array – N940 E1300 – Roof to Floor

7.0 GEOSCIENCE SUMMARY

This section historically presented data acquired to support the WIPP Geoscience Program. This included fracture maps of excavation surfaces, stratigraphic mapping, and drilling vertical observation holes to monitor clay seam displacements and other significant geological features.

The last reporting period where a full complement of routine geoscience activities (fracture mapping, stratigraphic mapping, and borehole examinations) were performed was during the July 2013 – June 2014 period. With the Geoscience Program getting large updates and staffing support, the activity levels and amount of data collected has greatly increased since the last reporting period. At this point in time the Stratigraphic Mapping and Observation Borehole Inspection programs have been completely updated and Inspection data are included below in Table 7-1, Observation Borehole Inspection Summary. No Stratigraphic Mapping was completed during this reporting period as no new panels have been mined. The Fracture Mapping program is currently being modernized and will be included on future reports.

Unlike broken bolt counts and instrumentation readings accompanied by routine visual inspections, the geoscience program does not necessarily provide an early warning as to near term and imminent ground control problems. Geoscientific borehole inspections are routinely performed either quarterly or biannually, depending on their location.

Occasions do occur when geotechnical engineers want non-routine observation borehole or fracture data. Such as when an accessible area may experience an increase in rates of roof beam expansion or in roof to floor closure. Or possibly when designing a new bolting pattern. These types of “on demand” inspections are completed as requested alongside the regular geoscience program operations.

The elements of the geoscience program have collectively produced a body of information over almost 38 years that has described both typical and atypical characteristics of deformation at the repository horizon currently excavated. For example, low-angle fracturing, a key component to most of the roof falls that have occurred at the WIPP facility, was first identified and mapped in Site Preliminary and Design Validation Room 1 in the early 1990s as part of the geoscience program.

Table 7-1 Observation Borehole Inspection Summary

OBH Number	Easting	Northing	Inspection Date	Feature	Feature Depth (feet)	Feature Thickness (feet)	Feature Thickness (inch)	Offset (inch)	Offset Direction	Comments
BHE140N1400	140	1400	27-Jan-23	Offset	6.75	NA	NA	0.13	SE	NA
	140	1400	27-Jan-23	BOH	16	NA	NA	NA	NA	NA
BHE300N1325	300	1325	27-Jan-23	Offset	1.75	0.0833	1.00	0.08	E	NA
	300	1325	27-Jan-23	BOH	5.5	NA	NA	NA	NA	NA
OH0897	-170	-1600	27-Apr-23	Fracture	7.8	0.0208	0.25	NA	NA	NA
	-170	-1600	27-Apr-23	Fracture	15.9	0.0104	0.13	NA	NA	NA
	-170	-1600	27-Apr-23	BOH	20.9	NA	NA	NA	NA	NA
OH1101-1	-393	-1693	17-Oct-22	Separation	5.1	0.0208	0.25	0.02	E	NA
	-393	-1693	17-Oct-22	BOH	20.3	NA	NA	NA	NA	NA
	-393	-1693	22-Feb-23	Fracture	5	0.0417	0.50	NA	NA	NA
	-393	-1693	22-Feb-23	BOH	20.5	NA	NA	NA	NA	NA
OH1101-2	-392	-1781	17-Oct-22	Separation	5.5	0.0833	1.00	SE	SE	NA
	-392	-1781	17-Oct-22	BOH	20.5	NA	NA	NA	NA	NA
	-392	-1781	23-Feb-23	Separation	4.2	0.0208	0.25	NA	NA	NA
	-392	-1781	23-Feb-23	Separation	4.5	0.0208	0.25	NA	NA	NA
	-392	-1781	23-Feb-23	Separation	4.8	0.0208	0.25	NA	NA	NA
	-392	-1781	23-Feb-23	Offset	5.5	NA	NA	0.08	NE	NA
	-392	-1781	23-Feb-23	Separation	7	0.0208	0.25	NA	NA	NA
	-392	-1781	23-Feb-23	BOH	21	NA	NA	NA	NA	NA
OH1101-3	-392	-1850	17-Oct-22	Separation	5	0.0208	0.25	0.17	E	NA
	-392	-1850	17-Oct-22	Separation	5.9	0.0208	0.25	NA	NA	NA
	-392	-1850	17-Oct-22	Offset	16	NA	NA	0.04	E	NA
	-392	-1850	17-Oct-22	BOH	20.5	NA	NA	NA	NA	NA
	-392	-1850	22-Feb-23	Offset	5	NA	NA	0.17	W	NA
	-392	-1850	22-Feb-23	Offset	16	NA	NA	0.08	W	NA
	-392	-1850	22-Feb-23	BOH	20.75	NA	NA	NA	NA	NA

OBH Number	Easting	Northing	Inspection Date	Feature	Feature Depth (feet)	Feature Thickness (feet)	Feature Thickness (inch)	Offset (inch)	Offset Direction	Comments
OH1102-1	-520	-1700	16-Mar-23	Separation	5	0.0417	0.50	NA	NA	NA
	-520	-1700	16-Mar-23	Separation	5.5	0.0208	0.25	NA	NA	NA
	-520	-1700	16-Mar-23	BOH	20.5	NA	NA	NA	NA	NA
OH1102-4	-520	-1900	16-Mar-23	Separation	5.5	0.0417	0.50	NA	NA	NA
	-520	-1900	16-Mar-23	BOH	20	NA	NA	NA	NA	NA
OH1103-1	-660	-1687	23-Feb-23	Separation	4.8	0.0208	0.25	NA	NA	NA
	-660	-1687	23-Feb-23	Offset	5	0.0417	0.50	0.04	E	NA
	-660	-1687	23-Feb-23	Separation	5.5	0.0625	0.75	NA	NA	NA
	-660	-1687	23-Feb-23	BOH	20.25	NA	NA	NA	NA	NA
	-660	-1862	23-Feb-23	Separation	5	0.0208	0.25	NA	NA	NA
	-660	-1862	23-Feb-23	Offset	5.75	0.0833	1.00	0.04	E	NA
	-660	-1862	23-Feb-23	BOH	20	NA	NA	NA	NA	NA
OH1104-1	-790	-1687	23-Feb-23	Separation	5	0.0417	0.50	NA	NA	NA
	-790	-1687	23-Feb-23	Fracture	6	0.0208	0.25	NA	NA	NA
	-790	-1687	23-Feb-23	BOH	20.75	NA	NA	NA	NA	NA
	-790	-1687	25-Apr-23	Separation	3.7	0.0208	0.25	NA	NA	NA
	-790	-1687	25-Apr-23	Separation	4.6	0.0208	0.25	NA	NA	NA
	-790	-1687	25-Apr-23	Separation	5.3	0.0208	0.25	NA	NA	NA
	-790	-1687	25-Apr-23	Separation	5.5	0.0417	0.50	0.01	E	NA
	-790	-1687	25-Apr-23	Fracture	6	0.0052	0.06	NA	NA	NA
	-790	-1687	25-Apr-23	BOH	20.2	NA	NA	NA	NA	NA
OH1104-2	-790	-1775	23-Feb-23	Separation	6	0.0417	0.50	NA	NA	NA
	-790	-1775	23-Feb-23	BOH	20	NA	NA	NA	NA	NA
	-790	-1775	25-Apr-23	Separation	6	0.0208	0.25	NA	NA	NA
	-790	-1775	25-Apr-23	BOH	20.1	NA	NA	NA	NA	NA
OH1104-3	-790	-1862	23-Feb-23	Fracture	6.25	0.2083	2.50	NA	NA	NA
	-790	-1862	23-Feb-23	BOH	21	NA	NA	NA	NA	NA

OBH Number	Easting	Northing	Inspection Date	Feature	Feature Depth (feet)	Feature Thickness (feet)	Feature Thickness (inch)	Offset (inch)	Offset Direction	Comments
	-920	-1875	23-Feb-23	Offset	5.5	0.1250	1.50	0.08	E	NA
	-920	-1875	23-Feb-23	BOH	20.25	NA	NA	NA	NA	NA
OH1106-1	-1057	-1696	22-Feb-23	Offset	5.5	0.0417	0.50	0.02	NE	NA
	-1057	-1696	22-Feb-23	BOH	20.25	NA	NA	NA	NA	NA
OH1106-2	-1057	-1783	22-Feb-23	Separation	5.75	0.0417	0.50	NA	NA	NA
	-1057	-1783	22-Feb-23	BOH	20	NA	NA	NA	NA	NA
OH1107-1	-1190	-1690	20-Oct-22	Fracture	6	0.0208	0.25	0.02	SE	NA
	-1190	-1690	20-Oct-22	BOH	20.1	NA	NA	NA	NA	NA
OH1107-2	-1190	-1765	20-Oct-22	Separation	4.1	0.0833	1.00	0.02	E	NA
	-1190	-1765	20-Oct-22	Fracture	5.9	0.0104	0.13	0.08	SE	NA
	-1190	-1765	20-Oct-22	BOH	20.3	NA	NA	NA	NA	NA
OH1107-3	-1190	-1870	20-Oct-22	Fracture	5.8	0.0417	0.50	NA	NA	NA
	-1190	-1870	20-Oct-22	BOH	20	NA	NA	NA	NA	NA
OH1116	-1057	-1696	23-Aug-22	Separation	5.25	0.0208	0.25	NA	NA	NA
	-1057	-1696	23-Aug-22	Separation	5.3	0.0417	0.50	NA	NA	NA
	-1057	-1696	23-Aug-22	Fracture	6.67	0.0104	0.13	NA	NA	NA
	-1057	-1696	23-Aug-22	BOH	20	NA	NA	NA	NA	NA
OH1117	-1057	-1783	23-Aug-22	Separation	5.8	0.3750	4.50	NA	NA	NA
	-1057	-1783	23-Aug-22	BOH	20	NA	NA	NA	NA	NA
OH1118	-1057	-1863	23-Aug-22	Separation	5.75	0.0417	0.50	NA	NA	NA
	-1057	-1863	23-Aug-22	BOH	20	NA	NA	NA	NA	NA
OH1134	-1189	-1616	23-Aug-22	Separation	5.67	0.0417	0.50	NA	NA	NA
	-1189	-1616	23-Aug-22	Separation	6	0.0625	0.75	0.21	S	NA
OH1161	140	-1675	11-Aug-22	Fracture	0.8	0.0208	0.25	NA	NA	NA
	140	-1675	11-Aug-22	Fracture	2.8	0.0417	0.50	NA	NA	NA
	140	-1675	11-Aug-22	Separation	4.8	1.7500	21.00	NA	NA	NA
	140	-1675	11-Aug-22	BOH	7.5	NA	NA	NA	NA	NA

OBH Number	Easting	Northing	Inspection Date	Feature	Feature Depth (feet)	Feature Thickness (feet)	Feature Thickness (inch)	Offset (inch)	Offset Direction	Comments
OH1163	140	-1525	11-Aug-22	BOH	0	NA	NA	NA	NA	NA
	140	-1525	11-Aug-22	Fracture	1	0.0417	0.50	NA	NA	NA
	140	-1525	11-Aug-22	Fracture	1.75	0.0417	0.50	NA	NA	NA
	140	-1525	11-Aug-22	Separation	3	0.5000	6.00	NA	NA	NA
	140	-1525	11-Aug-22	Separation	6.8	0.4167	5.00	NA	NA	NA
OH1164-2	140	-1450	11-Oct-22	Separation	1	0.1250	1.50	NA	NA	NA
	140	-1450	11-Oct-22	Separation	1.8	0.3333	4.00	NA	NA	NA
	140	-1450	11-Oct-22	Separation	3	0.3333	4.00	NA	NA	NA
	140	-1450	11-Oct-22	Separation	4.1	0.0833	1.00	NA	NA	NA
	140	-1450	11-Oct-22	Separation	4.2	0.0833	1.00	NA	NA	NA
	140	-1450	11-Oct-22	Separation	4.9	1.6667	20.00	NA	NA	NA
	140	-1450	11-Oct-22	Separation	7.5	0.1667	2.00	NA	NA	NA
	140	-1450	11-Oct-22	Separation	8	0.0833	1.00	NA	NA	NA
	140	-1450	11-Oct-22	Separation	8.8	0.0833	1.00	NA	NA	NA
	140	-1450	11-Oct-22	Separation	9	0.0833	1.00	NA	NA	NA
	140	-1450	11-Oct-22	BOH	20	NA	NA	NA	NA	NA
OH1165-2	140	-1375	11-Oct-22	Separation	1.1	0.0417	0.50	NA	NA	NA
	140	-1375	11-Oct-22	Separation	1.9	0.0833	1.00	NA	NA	NA
	140	-1375	11-Oct-22	Separation	3	0.0833	1.00	NA	NA	NA
	140	-1375	11-Oct-22	Separation	4.4	0.0417	0.50	NA	NA	NA
	140	-1375	11-Oct-22	Separation	5.2	0.4167	5.00	NA	NA	NA
	140	-1375	11-Oct-22	Separation	5.8	0.0833	1.00	NA	NA	NA
	140	-1375	11-Oct-22	Separation	6	0.0833	1.00	NA	NA	NA
	140	-1375	11-Oct-22	Separation	7.2	0.0833	1.00	NA	NA	NA
	140	-1375	11-Oct-22	BOH	20	NA	NA	NA	NA	NA
	140	-1375	13-Apr-23	Separation	1.4	0.0208	0.25	NA	NA	NA
	140	-1375	13-Apr-23	Separation	1.6	0.0208	0.25	NA	NA	NA

OBH Number	Easting	Northing	Inspection Date	Feature	Feature Depth (feet)	Feature Thickness (feet)	Feature Thickness (inch)	Offset (inch)	Offset Direction	Comments
	140	-1375	13-Apr-23	Separation	2.8	0.0138	0.17	NA	NA	NA
	140	-1375	13-Apr-23	Separation	4.3	0.0138	0.17	0.02	NW	NA
	140	-1375	13-Apr-23	Rubble Zone	5.9	0.3000	3.60	NA	NA	Rubbled Zone 5.9' - 5.6'
	140	-1375	13-Apr-23	Separation	6.5	0.0208	0.25	NA	NA	NA
	140	-1375	13-Apr-23	Separation	7.5	0.0138	0.17	NA	NA	NA
	140	-1375	13-Apr-23	BOH	20.2	0.0000	0.00	NA	NA	NA
OH1166	140	-1300	13-Apr-23	Fracture	5.5	0.0104	0.13	NA	NA	NA
	140	-1300	13-Apr-23	Separation	6	0.0208	0.25	NA	NA	NA
	140	-1300	13-Apr-23	BOH	20.4	NA	NA	NA	NA	NA
OH1170	140	-1000	03-Apr-23	Separation	5.5	0.2500	3.00	0.08	E	NA
	140	-1000	03-Apr-23	BOH	20	NA	NA	NA	NA	NA
OH1174	140	-700	03-Apr-23	Separation	5	0.0417	0.50	0.04	W	NA
	140	-700	03-Apr-23	Separation	5.5	0.0417	0.50	0.04	NE	NA
	140	-700	03-Apr-23	Separation	6.1	0.0208	0.25	0.04	N	NA
	140	-700	03-Apr-23	BOH	20	NA	NA	NA	NA	NA
OH1180	-30	-1950	27-Apr-23	Separation	0.5	0.0208	0.25	NA	NA	NA
	-30	-1950	27-Apr-23	Offset	9	NA	NA	0.06	S	NA
	-30	-1950	27-Apr-23	BOH	20.2	NA	NA	NA	NA	NA
OH1185	-30	-1600	27-Apr-23	Separation	0.5	0.0208	0.25	NA	NA	NA
	-30	-1600	27-Apr-23	Offset	8.8	NA	NA	0.08	S	NA
	-30	-1600	27-Apr-23	Separation	9.5	0.0208	0.25	0.08	E	NA
	-30	-1600	27-Apr-23	BOH	20.9	NA	NA	NA	NA	NA
OH1189	-30	-700	16-Nov-22	Separation	9	0.1667	2.00	0.08	NE	NA
	-30	-700	16-Nov-22	BOH	20	NA	NA	NA	NA	NA
	-30	-700	04-Apr-23	Offset	9	NA	NA	0.04	NW	NA
	-30	-700	04-Apr-23	BOH	20	NA	NA	NA	NA	NA
OH1194	0	20	04-Jan-23	Offset	3	NA	NA	0.04	N	NA

OBH Number	Easting	Northing	Inspection Date	Feature	Feature Depth (feet)	Feature Thickness (feet)	Feature Thickness (inch)	Offset (inch)	Offset Direction	Comments
	0	20	04-Jan-23	Offset	3.75	NA	NA	0.04	S	NA
	0	20	04-Jan-23	Separation	4.33	0.0833	1.00	NA	NA	NA
	0	20	04-Jan-23	Separation	4.7	0.2500	3.00	NA	NA	NA
	0	20	04-Jan-23	Separation	5.25	0.2500	3.00	NA	NA	NA
	0	20	04-Jan-23	Separation	5.75	0.0833	1.00	NA	NA	NA
	0	20	04-Jan-23	Offset	7.83	NA	NA	0.13	S	NA
	0	20	04-Jan-23	BOH	20	NA	NA	NA	NA	NA
OH1201	140	-1690	11-Oct-22	Separation	1.5	0.0833	1.00	NA	NA	NA
	140	-1690	11-Oct-22	Separation	2.8	0.3333	4.00	NA	NA	NA
	140	-1690	11-Oct-22	Separation	5	0.1667	2.00	NA	NA	NA
	140	-1690	11-Oct-22	Separation	5.5	0.3333	4.00	NA	NA	NA
	140	-1690	11-Oct-22	Separation	6.8	0.6667	8.00	NA	NA	NA
	140	-1690	11-Oct-22	BOH	20	NA	NA	NA	NA	NA
OH1202	140	-1775	03-Oct-22	Separation	0.8	0.0208	0.25	NA	NA	NA
	140	-1775	03-Oct-22	Separation	1	0.0208	0.25	NA	NA	NA
	140	-1775	03-Oct-22	Separation	1.5	0.0417	0.50	NA	NA	NA
	140	-1775	03-Oct-22	Separation	2.5	0.0417	0.50	NA	NA	NA
	140	-1775	03-Oct-22	Separation	3	0.0417	0.50	NA	NA	NA
	140	-1775	03-Oct-22	Separation	4	0.0417	0.50	NA	NA	NA
	140	-1775	03-Oct-22	Separation	4.75	1.7500	21.00	NA	NA	NA
	140	-1775	03-Oct-22	BOH	6.5	NA	NA	NA	NA	NA
OH1203	140	-1865	11-Oct-22	Separation	1.5	0.0417	0.50	NA	NA	NA
	140	-1865	11-Oct-22	Separation	2.5	0.0833	1.00	NA	NA	NA
	140	-1865	11-Oct-22	Separation	4.5	0.4750	5.70	NA	NA	NA
	140	-1865	11-Oct-22	BOH	20	NA	NA	NA	NA	NA
OH1600-1	-390	-1600	30-Mar-23	Separation	5.58	0.0417	0.50	NA	NA	NA
	-390	-1600	30-Mar-23	Offset	16	NA	NA	0.02	N	NA

OBH Number	Easting	Northing	Inspection Date	Feature	Feature Depth (feet)	Feature Thickness (feet)	Feature Thickness (inch)	Offset (inch)	Offset Direction	Comments
	-390	-1600	30-Mar-23	BOH	20	NA	NA	NA	NA	NA
OH1600-10	-985	-1600	30-Mar-23	Offset	4.25	NA	NA	0.02	N	NA
	-985	-1600	30-Mar-23	Offset	5.5	NA	NA	0.10	N	NA
	-985	-1600	30-Mar-23	BOH	16.83	NA	NA	NA	NA	NA
OH1600-13	-1190	-1600	20-Oct-22	Offset	6	0.0417	0.50	0.13	E	NA
	-1190	-1600	20-Oct-22	Fracture	6.5	0.0417	0.50	NA	NA	NA
	-1190	-1600	20-Oct-22	Offset	16.25	NA	NA	0.08	E	NA
	-1190	-1600	20-Oct-22	BOH	20.1	NA	NA	NA	NA	NA
OH1600-2	-455	-1600	30-Mar-23	Offset	5.5	NA	NA	0.04	N	NA
	-455	-1600	30-Mar-23	BOH	20.25	NA	NA	NA	NA	NA
OH1600-4	-585	-1600	30-Mar-23	Offset	5.5	NA	NA	0.01	N	NA
	-585	-1600	30-Mar-23	BOH	20.25	NA	NA	NA	NA	NA
OH1600-6	-725	-1600	30-Mar-23	Offset	5.8	NA	NA	0.02	N	NA
	-725	-1600	30-Mar-23	Fracture	6.2	0.2500	3.00	NA	NA	NA
	-725	-1600	30-Mar-23	BOH	20.25	NA	NA	NA	NA	NA
OH1600-8	-855	-1600	30-Mar-23	Offset	5.8	NA	NA	0.01	N	NA
	-855	-1600	30-Mar-23	Offset	6	0.1667	2.00	0.04	N	NA
	-855	-1600	30-Mar-23	BOH	20.2	NA	NA	NA	NA	NA
OH1950-1	-392	-1950	26-Oct-22	Separation	5.8	0.0417	0.50	NA	NA	NA
	-392	-1950	26-Oct-22	Separation	6.5	0.0417	0.50	NA	NA	NA
	-392	-1950	26-Oct-22	Offset	16	NA	NA	0.04	NE	NA
	-392	-1950	26-Oct-22	BOH	20	NA	NA	NA	NA	NA
OH1950-10	-985	-1950	26-Oct-22	Separation	5.3	0.0417	0.50	NA	NA	NA
	-985	-1950	26-Oct-22	Separation	5.5	0.0417	0.50	NA	NA	NA
	-985	-1950	26-Oct-22	Separation	6	0.0104	0.13	NA	NA	NA
	-985	-1950	26-Oct-22	BOH	20.5	NA	NA	NA	NA	NA
OH1950-2	-453	-1950	26-Oct-22	Offset	5.3	NA	NA	0.04	N	NA

OBH Number	Easting	Northing	Inspection Date	Feature	Feature Depth (feet)	Feature Thickness (feet)	Feature Thickness (inch)	Offset (inch)	Offset Direction	Comments
	-453	-1950	26-Oct-22	BOH	20	NA	NA	NA	NA	NA
OH1950-3	-520	-1950	26-Oct-22	Separation	4	0.0417	0.50	0.02	N	NA
	-520	-1950	26-Oct-22	Offset	5.6	NA	NA	0.13	N	NA
	-520	-1950	26-Oct-22	Separation	7	0.1667	2.00	NA	NA	NA
	-520	-1950	26-Oct-22	Offset	16	NA	NA	0.08	N	NA
	-520	-1950	26-Oct-22	BOH	20.5	NA	NA	NA	NA	NA
OH1950-4	-585	-1950	26-Oct-22	Offset	5.5	0.0417	0.50	0.04	S	NA
	-585	-1950	26-Oct-22	Fracture	6	0.0208	0.25	NA	NA	NA
	-585	-1950	26-Oct-22	BOH	12.2	NA	NA	NA	NA	NA
OH1950-5	-660	-1950	26-Oct-22	Separation	5.5	0.0833	1.00	0.08	N	NA
	-660	-1950	26-Oct-22	Separation	7	0.0417	0.50	NA	NA	NA
	-660	-1950	26-Oct-22	Offset	16.1	NA	NA	0.08	N	NA
	-660	-1950	26-Oct-22	BOH	20.5	NA	NA	NA	NA	NA
OH1950-6	-725	-1950	26-Oct-22	Separation	5.8	0.0833	1.00	0.04	S	NA
	-725	-1950	26-Oct-22	BOH	12	NA	NA	NA	NA	NA
OH1950-7	-790	-1950	26-Oct-22	Separation	5.5	0.1250	1.50	0.08	N	NA
	-790	-1950	26-Oct-22	Separation	6.5	0.0833	1.00	0.04	N	NA
	-790	-1950	26-Oct-22	Offset	16.5	NA	NA	0.04	N	NA
	-790	-1950	26-Oct-22	BOH	20.5	NA	NA	NA	NA	NA
OH1950-8	-855	-1950	26-Oct-22	Offset	5.5	NA	NA	0.02	S	NA
	-855	-1950	26-Oct-22	Separation	6.1	0.0208	0.25	NA	NA	NA
	-855	-1950	26-Oct-22	BOH	19.7	NA	NA	NA	NA	NA
OH1950-9	-920	-1950	26-Oct-22	Offset	6	NA	NA	0.13	N	NA
	-920	-1950	26-Oct-22	Separation	7	0.0208	0.25	NA	NA	NA
	-920	-1950	26-Oct-22	Offset	16	NA	NA	0.08	N	NA
	-920	-1950	26-Oct-22	BOH	20.5	NA	NA	NA	NA	NA
OHW30S550	-30	-550	16-Nov-22	Separation	9	0.2083	2.50	0.04	W	NA

OBH Number	Easting	Northing	Inspection Date	Feature	Feature Depth (feet)	Feature Thickness (feet)	Feature Thickness (inch)	Offset (inch)	Offset Direction	Comments
	-30	-550	16-Nov-22	Offset	15.3	NA	NA	0.02	W	NA
	-30	-550	16-Nov-22	BOH	20	NA	NA	NA	NA	NA
	-30	-550	04-Apr-23	Offset	4	NA	NA	0.03	SE	NA
	-30	-550	04-Apr-23	Offset	9	NA	NA	0.04	E	NA
	-30	-550	04-Apr-23	BOH	20	NA	NA	NA	NA	NA
OH474-2	140	-2000	13-Apr-23	Separation	1	0.0278	0.33	NA	NA	NA
	140	-2000	13-Apr-23	Fracture	4	0.0104	0.13	NA	NA	NA
	140	-2000	13-Apr-23	Rubble Zone	6.67	0.6667	8.00	NA	NA	Rubbled Zone 6.666' - 6'
	140	-2000	13-Apr-23	BOH	20	NA	NA	NA	NA	NA
OH474-3	140	-2000	03-Oct-22	Separation	1.5	0.0417	0.50	NA	NA	NA
	140	-2000	03-Oct-22	Separation	2.5	0.0208	0.25	NA	NA	NA
	140	-2000	03-Oct-22	Fracture	4.5	0.0104	0.13	NA	NA	NA
	140	-2000	03-Oct-22	Separation	5.8	0.5833	7.00	NA	NA	NA
	140	-2000	03-Oct-22	BOH	20	NA	NA	NA	NA	NA
OH483	140	940	08-Feb-23	Fracture	7.1	0.0104	0.13	NA	NA	NA
	140	940	08-Feb-23	Offset	7.5	0.0208	0.25	0.13	NE	NA
	140	940	08-Feb-23	Offset	7.7	0.0208	0.25	0.17	NE	NA
	140	940	08-Feb-23	Separation	8	0.0208	0.25	NA	NA	NA
	140	940	08-Feb-23	Separation	8.6	0.0417	0.50	NA	NA	NA
	140	940	08-Feb-23	Separation	10	0.0208	0.25	NA	NA	NA
	140	940	08-Feb-23	BOH	20.1	NA	NA	NA	NA	NA
OH484	140	1265	08-Feb-23	Separation	5.5	0.0833	1.00	NA	NA	NA
	140	1265	08-Feb-23	Separation	7.2	0.0833	1.00	NA	NA	NA
	140	1265	08-Feb-23	BOH	20	NA	NA	NA	NA	NA
OH486	0	1400	25-Jan-23	Fracture	2.5	0.0208	0.25	NA	NA	NA
	0	1400	25-Jan-23	BOH	19	NA	NA	NA	NA	NA

OBH Number	Easting	Northing	Inspection Date	Feature	Feature Depth (feet)	Feature Thickness (feet)	Feature Thickness (inch)	Offset (inch)	Offset Direction	Comments
OH488	0	1100	25-Jan-23	Offset	1	0.0208	0.25	0.02	SW	NA
	0	1100	25-Jan-23	Separation	5.25	0.0417	0.50	NA	NA	NA
	0	1100	25-Jan-23	Offset	6.5	0.2500	3.00	0.17	SW	NA
	0	1100	25-Jan-23	BOH	20.5	NA	NA	NA	NA	NA
OH577-2	140	-1075	04-Apr-23	Separation	1.6	0.0208	0.25	NA	NA	NA
	140	-1075	04-Apr-23	Rubble Zone	4.1	NA	NA	0.17	NW	Rubbled zone at 4.1"
	140	-1075	04-Apr-23	Offset	6	0.1667	2.00	0.17	NE	NA
	140	-1075	04-Apr-23	Separation	8.6	0.0833	1.00	0.08	SE	NA
	140	-1075	04-Apr-23	BOH	17	NA	NA	NA	NA	NA
OH582-2	140	-1600	11-Oct-22	Separation	1.5	0.1250	1.50	NA	NA	NA
	140	-1600	11-Oct-22	Separation	2.1	0.0833	1.00	NA	NA	NA
	140	-1600	11-Oct-22	Separation	3.1	0.1667	2.00	NA	NA	NA
	140	-1600	11-Oct-22	Separation	4.9	0.0417	0.50	NA	NA	NA
	140	-1600	11-Oct-22	Separation	5.1	0.5000	6.00	NA	NA	NA
	140	-1600	11-Oct-22	Separation	5.8	0.0833	1.00	NA	NA	NA
	140	-1600	11-Oct-22	Separation	6.5	0.0833	1.00	NA	NA	NA
	140	-1600	11-Oct-22	Separation	6.9	0.0833	1.00	NA	NA	NA
	140	-1600	11-Oct-22	Separation	7	0.0833	1.00	NA	NA	NA
	140	-1600	11-Oct-22	Separation	7.2	0.0833	1.00	NA	NA	NA
	140	-1600	11-Oct-22	Separation	7.5	0.0833	1.00	NA	NA	NA
	140	-1600	11-Oct-22	Separation	7.9	0.0833	1.00	NA	NA	NA
	140	-1600	11-Oct-22	BOH	20	0.0000	0.00	NA	NA	NA
	140	-1600	13-Apr-23	Separation	1.5	0.0208	0.25	NA	NA	NA
	140	-1600	13-Apr-23	Fracture	2	0.0104	0.13	NA	NA	NA
	140	-1600	13-Apr-23	Separation	3	0.0278	0.33	NA	NA	NA
	140	-1600	13-Apr-23	Separation	5.2	0.0104	0.13	NA	NA	NA
	140	-1600	13-Apr-23	Separation	5.9	0.4000	4.80	NA	NA	Separation 5.9' - 5.5'

OBH Number	Easting	Northing	Inspection Date	Feature	Feature Depth (feet)	Feature Thickness (feet)	Feature Thickness (inch)	Offset (inch)	Offset Direction	Comments
	140	-1600	13-Apr-23	Separation	6	0.0208	0.25	NA	NA	0
	140	-1600	13-Apr-23	Fracture	6.5	0.0052	0.06	NA	NA	0
	140	-1600	13-Apr-23	Separation	6.8	0.0104	0.13	NA	NA	0
	140	-1600	13-Apr-23	Rubble Zone	7.5	0.3000	3.60	NA	NA	Rubbled Zone 7.5' - 7.2'
	140	-1600	13-Apr-23	Separation	8	0.0278	0.33	NA	NA	NA
	140	-1600	13-Apr-23	Separation	8.3	0.0208	0.25	NA	NA	NA
	140	-1600	13-Apr-23	BOH	20.5	NA	NA	NA	NA	NA
OH583-2	140	-1950	03-Oct-22	Fracture	2	0.0104	0.13	NA	NA	NA
	140	-1950	03-Oct-22	Separation	3	0.0417	0.50	NA	NA	NA
	140	-1950	03-Oct-22	Fracture	9	0.0104	0.13	NA	NA	NA
	140	-1950	03-Oct-22	Fracture	9.16	0.0104	0.13	NA	NA	NA
	140	-1950	03-Oct-22	BOH	20	NA	NA	NA	NA	NA
	140	-1950	13-Apr-23	Fracture	7.1	0.0052	0.06	NA	NA	NA
	140	-1950	13-Apr-23	BOH	20.4	NA	NA	NA	NA	NA
OH586-3	140	-2359	11-Aug-22	Fracture	0.8	0.0208	0.25	NA	NA	NA
	140	-2359	11-Aug-22	Separation	4.8	0.5000	6.00	NA	NA	NA
	140	-2359	11-Aug-22	Fracture	6.5	0.0208	0.25	NA	NA	NA
	140	-2359	11-Aug-22	Separation	7.25	0.2292	2.75	0.25	E	NA
	140	-2359	11-Aug-22	BOH	7.5	NA	NA	NA	NA	NA
OH884	-30	-1300	16-Nov-22	Separation	4.5	0.0208	0.25	NA	NA	NA
	-30	-1300	16-Nov-22	Offset	8.5	NA	NA	0.08	NE	NA
	-30	-1300	16-Nov-22	Separation	15	0.0208	0.25	NA	NA	NA
	-30	-1300	16-Nov-22	BOH	20	NA	NA	NA	NA	NA
OH885	-30	-1150	16-Nov-22	BOH	20	NA	NA	NA	NA	NA
OH886	-30	-1000	16-Nov-22	Separation	5.75	0.1667	2.00	0.21	N	NA
	-30	-1000	16-Nov-22	Offset	9	0.0208	0.25	0.13	N	NA
	-30	-1000	16-Nov-22	BOH	20	NA	NA	NA	NA	NA

OBH Number	Easting	Northing	Inspection Date	Feature	Feature Depth (feet)	Feature Thickness (feet)	Feature Thickness (inch)	Offset (inch)	Offset Direction	Comments
OH887	-30	-850	16-Nov-22	Offset	8.5	NA	NA	0.02	E	NA
	-30	-850	16-Nov-22	BOH	20	NA	NA	NA	NA	NA
OHE0N1265	0	1265	25-Jan-23	Separation	3	0.0417	0.50	0.00	NA	NA
	0	1265	25-Jan-23	Offset	6.5	0.0417	0.50	0.04	SW	NA
	0	1265	25-Jan-23	Separation	7.5	0.0208	0.25	NA	NA	NA
	0	1265	25-Jan-23	BOH	19	NA	NA	NA	NA	NA
OHE0N620	0	620	25-Jan-23	Separation	6.5	0.1250	1.50	NA	NA	NA
	0	620	25-Jan-23	Separation	7.25	0.0833	1.00	NA	NA	NA
	0	620	25-Jan-23	Separation	7.5	0.0104	0.13	NA	NA	NA
	0	620	25-Jan-23	Separation	9	0.0104	0.13	NA	NA	NA
	0	620	25-Jan-23	BOH	20	NA	NA	NA	NA	NA
OHE0N780	0	780	25-Jan-23	Separation	6.75	0.0417	0.50	NA	NA	NA
	0	780	25-Jan-23	Separation	8.25	0.0104	0.13	NA	NA	NA
	0	780	25-Jan-23	BOH	20	NA	NA	NA	NA	NA
OHE140N370	140	370	08-Feb-23	Fracture	1.5	0.1250	1.50	NA	NA	NA
	140	370	08-Feb-23	Fracture	2.75	0.1667	2.00	NA	NA	NA
	140	370	08-Feb-23	Fracture	7	0.0833	1.00	NA	NA	NA
	140	370	08-Feb-23	BOH	20	NA	NA	NA	NA	NA
OHE140S550	140	-550	03-Apr-23	Offset	5	NA	NA	0.08	SE	NA
	140	-550	03-Apr-23	BOH	20.1	NA	NA	NA	NA	Salt build up from moisture
OHE300N1250	300	1250	27-Jan-23	Offset	5.5	0.0833	1.00	0.13	NW	NA
	300	1250	27-Jan-23	Offset	5.75	0.2500	3.00	0.17	SE	NA
	300	1250	27-Jan-23	Offset	6.75	NA	NA	0.13	SE	NA
	300	1250	27-Jan-23	Separation	8.5	0.0833	1.00	NA	NA	NA
	300	1250	27-Jan-23	Offset	17.5	NA	NA	0.04	SE	NA
	300	1250	27-Jan-23	BOH	21	NA	NA	NA	NA	NA
OHS400E350	350	-400	15-Jun-23	Separation	0.5	0.0208	0.25	NA	NA	NA

OBH Number	Easting	Northing	Inspection Date	Feature	Feature Depth (feet)	Feature Thickness (feet)	Feature Thickness (inch)	Offset (inch)	Offset Direction	Comments
	350	-400	15-Jun-23	BOH	20	NA	NA	NA	NA	NA
OHS400E430	430	-400	15-Jun-23	Separation	0.9	0.0208	0.25	NA	NA	NA
	430	-400	15-Jun-23	BOH	20	NA	NA	NA	NA	NA
OHW30S1735	-30	-1735	27-Apr-23	BOH	20.5	NA	NA	NA	NA	NA
OHW30S475	-30	-475	04-Apr-23	BOH	20	NA	NA	NA	NA	NA

Table 7-2 New Observation Holes Summary

OBH Number	Easting	Northing	Date Drilled	Depth (feet)	Diameter (inch)
OH1202	140	-1775	23-Sep-22	20	1.38
OH1164-2	140	-1450	24-Sep-22	20	1.38
OH1165-2	140	-1375	24-Sep-22	20	1.38
OH1201	140	-1690	24-Sep-22	20	1.38
OH1203	140	-1865	24-Sep-22	20	1.38
OH582-2	140	-1600	24-Sep-22	20	1.38
OHW30S550	-30	-550	11-Nov-22	20	3
OH488	0	1100	07-Jan-23	20.1	3
OHE140S1220	140	-1220	23-Apr-23	20	3
OHE140S860	140	-860	23-Apr-23	20	3
OHE140S1525	140	-1525	24-Apr-23	20	3
OHE140S1684	140	-1684	26-Apr-23	20	3
OHE140S1765	140	-1765	26-Apr-23	20	3
OHE140S1870	140	-1870	26-Apr-23	20	3
OHE140N150	140	150	28-Apr-23	20.5	3
OHE140N460	140	460	28-Apr-23	20	3
OHE140N620	140	620	28-Apr-23	20.5	3
OHE140N780	140	780	28-Apr-23	20.5	3
OH1600-6	-725	-1600	30-Apr-23	20.25	3
OHE140N1100	140	1100	30-Apr-23	20.5	3
OHE140N1400R	140	1400	30-Apr-23	20.5	3
OHE140N25	140	25	02-May-23	20	3
OHE140S400	140	-400	02-May-23	20.3	3
OHE140S90	140	-90	02-May-23	20	3
OHE140S1450	140	-1450	05-May-23	20.5	3
OHS400E350	350	-400	03-Jun-23	20	3
OHS400E430	430	-400	03-Jun-23	20	3