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Geotechnical Analysis Report for July 2002 – June 2003

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Waste Isolation Pilot Plant

Geotechnical Analysis Report for July 2002 – June 2003
DOE/WIPP 04-3177, Vol. 1

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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 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, 2002, to June 30, 2003.

This Geotechnical Analysis Report (GAR) was written to meet the needs of several audiences. This report satisfies the requirements presented in the WIPP Hazardous Waste Permit[1] and the Certification of Compliance[2] with Subparts Band C, Title 40 *Code of Federal Regulations (CFR)* Part 191, "Environmental Radiation Protection for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes." It focuses on the geotechnical performance of the various components of the underground facility, including the shafts, shaft stations, access drifts, and waste disposal areas. The results of investigations of excavation effects and other geologic 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 and the performance history of the instruments. 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 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 Washington TRU Solutions LLC (WTS) for the U.S. Department of Energy (DOE), Carlsbad Field Office (CBFO), Carlsbad, New Mexico. Work was supported by the DOE under Contract No. DE-AC29-01AL66444.

[1] New Mexico Environment Department (NMED), 1999, "Waste Isolation Pilot Plant Hazardous Waste Facility Permit," NM4890139088-TSDF, Santa Fe, New Mexico
[2] Federal Register, Vol. 63, No. 95, pp. 27354, May 18, 1998

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Acronyms and Abbreviations

b.p.	before present
bsc	below shaft collar
CAO	Carlsbad Area Office
CBFO	Carlsbad Field Office
cfi	closure from initial
CFR	Code of Federal Regulations
CH	contact-handled
cm	centimeter(s)
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ft	foot (feet)
GAR	Geotechnical Analysis Report
GIS	geomechanical instrumentation system
in.	inch(es)
kPa	kilopascal(s)
kVA	kilovolt amp(s)
LANL	Los Alamos National Laboratory
lb	pound(s)
m	meter(s)
Ma	million years ago
MB	marker bed
NMED	New Mexico Environment Department
OMB	orange marker bed
psi	pound(s) per square inch
RH	remote-handled
SDD	system design description
SNL/NM	Sandia National Laboratories/New Mexico
SPDV	Site and Preliminary Design Validation
TRU	transuranic
WID	Waste Isolation Division
WIPP	Waste Isolation Pilot Plant
WTS	Washington TRU Solutions LLC
yr(s)	year(s)

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1.0 Introduction

This Geotechnical Analysis Report (GAR) presents and interprets the geotechnical data from the underground excavations at the Waste Isolation Pilot Plant (WIPP). The data, which are obtained as part of a regular monitoring program, are used to characterize conditions, to compare actual performance to the design assumptions, and to evaluate and forecast the performance of the underground excavations.

GARs have been available to the public since 1983. During the Site and Preliminary Design Validation (SPDV) Program, the architect/engineer for the project produced these reports on a quarterly basis to document the geomechanical performance during and immediately after excavation 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 from July 1, 2002, to June 30, 2003. It is divided into ten chapters. Chapter 1 provides background information on WIPP, its mission, and the purpose and scope of the Geomechanical Monitoring Program. Chapter 2 describes the local and regional geology of the WIPP site. Chapters 3 and 4 describe the geomechanical instrumentation located in the shafts and shaft stations, present the data collected by that instrumentation, and provide interpretation of these data. Chapters 5, 6, and 7 present the results of geomechanical monitoring in the three main portions of the WIPP underground facility (the access drifts, the Northern Experimental Area, and the Waste Disposal Area). Chapter 8 discusses the results of the Geoscience Program, which include fracture and stratigraphic mapping and borehole observations. Chapter 9 summarizes the results of the geomechanical monitoring and compares the current excavation performance to the design requirements. Chapter 10 lists the references and bibliography.

1.1 Location and Description

WIPP is located in southeastern New Mexico, 26 miles (42 kilometers [km]) east of Carlsbad (Figure 1-1). The surface facilities were built on the flat to gently rolling hills that are characteristic of the Los Medaños area. The underground facility is being excavated approximately 2,150 feet [ft] (655 meters [m]) beneath the surface in the Salado Formation. Figure 1-2 shows a plan view of the current underground configuration of WIPP.

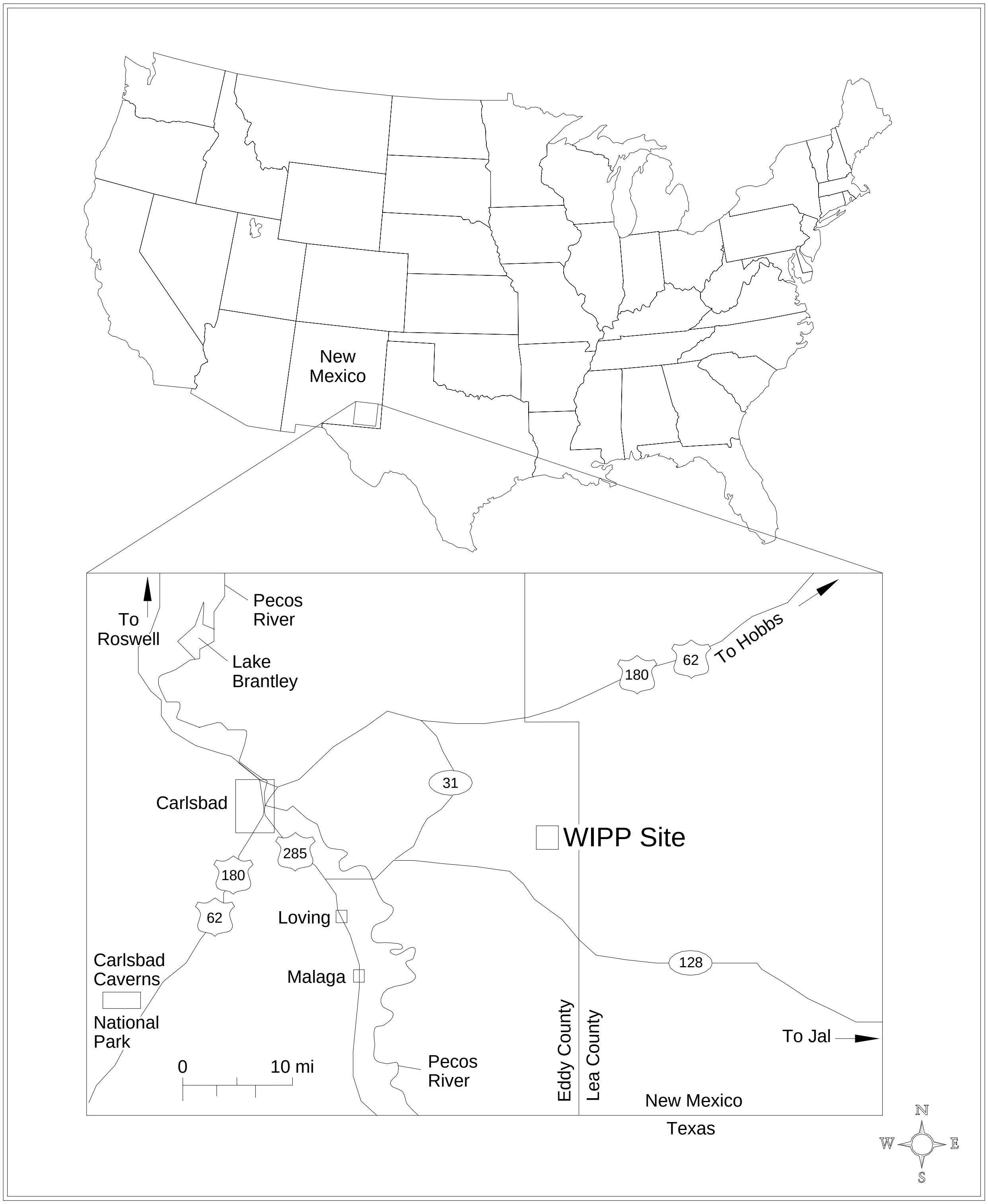

Figure 1-1
WIPP Location

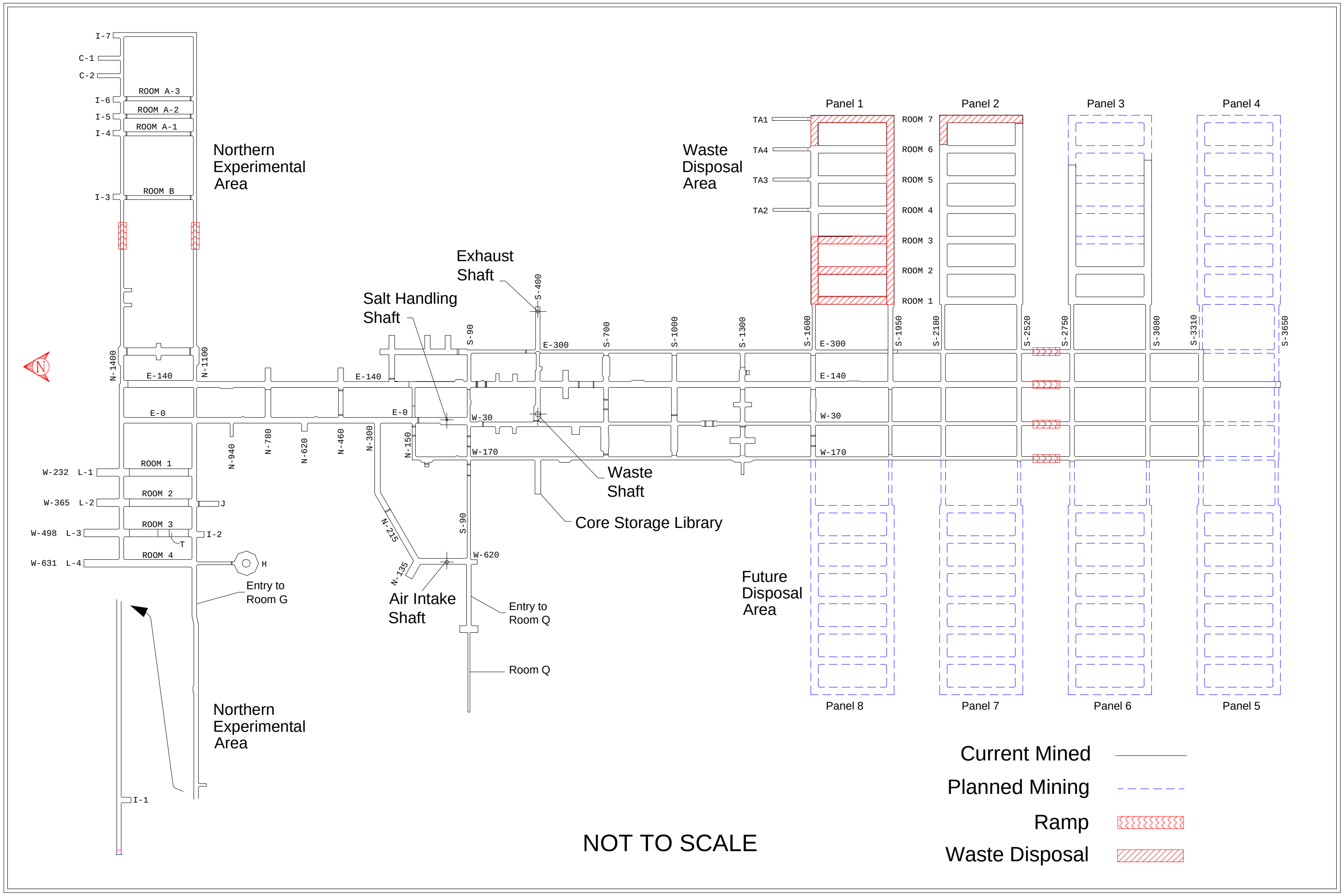

Figure 1-2
Underground Mining and Waste Disposal Configuration as of 6/30/03

1.2 Mission

In 1979 Congress authorized WIPP (Public Law 96-164) 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." WIPP is intended to receive, handle, and permanently dispose of transuranic (TRU) waste and TRU mixed waste. To fulfill this mission, the U.S. Department of Energy (DOE) constructed a full-scale facility to demonstrate both technical and operational principles of the permanent disposal of TRU and TRU mixed wastes. Technical aspects are those concerned with the design, construction, and performance of the subsurface excavations. Operational aspects refer to the receiving, handling, and emplacement of TRU wastes in the facility. The facility was also used for *in situ* studies and experiments without the use of radioactive waste.

1.3 Development Status

To fulfill its mission, the DOE developed 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 the *in situ* conditions were suitable for a permanent disposal facility. During this phase, the Salt Handling 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 Site and Preliminary Design Validation Program” (DOE, 1983).

Based upon the favorable results of the SPDV investigations, additional activities were initiated in 1983. These included the construction of surface structures, conversion of the ventilation shaft for use as the waste shaft, excavation of the Exhaust Shaft, development of additional access drifts to the waste disposal area, excavation of the Air Intake Shaft, and excavation of additional experimental rooms to support research and development activities. Geotechnical data acquired during this phase were used to evaluate the performance of the excavations in the context of established design criteria (DOE, 1984). Results of these evaluations were reported in Geotechnical Field Data Reports (DOE, 1985; DOE, 1986a) and were summarized in the Design Validation Final Report (DOE, 1986b).

The Design Validation Final Report concluded that the facility, including waste disposal areas, could be developed and operated to fulfill the long-term mission of WIPP (DOE, 1986b). However, some modifications to the reference design were proposed so that the requirements could be met for the anticipated life of the waste disposal rooms and the demonstration phase while the waste remained retrievable. The information from these studies validated the design of underground openings to safely accommodate the permanent disposal of waste under routine operating conditions.

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 that was scheduled to start in October 1988. During this reporting period, waste disposal operations in Panel 1 were completed and panel closures were constructed.

In October 1996, the DOE submitted to the U.S. Environmental Protection Agency (EPA) a compliance certification application in accordance with Title 40 CFR Parts 191 and 194, which addressed the long-term (10,000-year) performance criterion for the disposal system. On May 18, 1998, the EPA published final certification that allowed for the receipt of TRU waste at WIPP. Immediately prior to this certification, the DOE Carlsbad Area Office (CAO) completed the WIPP Operational Readiness Review, which was required before the start-up of a nuclear waste repository. As a result of the review, the CAO notified the Energy Secretary on April 1, 1998, that WIPP was operationally ready to receive waste. On October 27, 1999, WIPP received the Hazardous Waste Facility Permit (HWFP). On March 26, 1999, the first shipment of TRU waste was received from Los Alamos National Laboratory (LANL). At the end of June 2003, shipments of TRU waste were received at the WIPP site from LANL, Savannah River Site, Hanford Site, Rocky Flats Environmental Technology Site, Idaho National Engineering and Environmental Laboratory, and Argonne National Lab-East.

Mining of Panel 2 began in September 1999 and was completed in August 2000. The south mains (entry drifts) for Panel 3 were completed in June, 2002. Mining of Panel 3 began on January 31, 2003. As of June 30, 2003, Rooms 1 and 2 are mined and South 2750 and South 3080 drifts are rough cut east of Room 5 of Panel 3.

1.4 Purpose and Scope of Geomechanical Monitoring Program

As specified in the WIPP HWFP (NMED, 1999), 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 established design criteria.

Polling of the geomechanical instrumentation is performed at least monthly. Data taken by the geomechanical instrumentation system (GIS) are evaluated and reported in this GAR. This annual report fulfills the requirements set forth in Section IV.F.1 and Attachment M2, Section M2-5b(2) of the WIPP Hazardous Waste Facility Permit (NMED, 1999), and 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, and displacement of deformation features. Convergence measurements and borehole extensometers provide monitoring data and observations on salt creep closure and stress changes induced by rock excavation. Data on the extent of deformation are generated through borehole extensometers and borehole observations. Fracture mapping of the excavation surface and borehole observations are used to provide data on the initiation of brittle deformation. Displacement of deformation features in the underground facility are monitored by comparing the results of geologic mapping in newly mined areas to the expected stratigraphy.

The GIS provides data that are 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 include convergence points, convergence meters, extensometers, rock bolt load cells, pressure cells, strain gauges, piezometers, and joint meters. Table 1-1 lists a summary of the geomechanical instrumentation specifications.

Table 1-1
Geomechanical Instrumentation System

Instrument Type	Measures	Range[a]	Resolution[a]
Sonic probe borehole extensometer	Cumulative deformation	0–2 in.	0.001 in.
Convergence points (Tape Extensometer)	Cumulative deformation	2–50 ft	0.001 in.
Wire convergence meters	Cumulative deformation	0–3.5 ft	0.001 in.
Sonic probe convergence meters	Cumulative deformation	0–25 ft	0.001 in.
Embedded strain gauges	Cumulative strain	0–3000 μin./in.	1 μin./in.
Spot-welded strain gauges	Cumulative strain	0–2500 μin./in.	1 μin./in.
Rock bolt load cells	Load	0–50 tons	40 lb
Earth pressure cells	Pressure	0–1000 psi	1 psi
Piezometers	Fluid pressure	0–500 psi	0.5 psi
Joint Meters	Cumulative deformation	0–4 in.	0.001 in.
Vibrating wire borehole extensometer	Cumulative deformation	0–4 in.	0.001 in.
Wire borehole extensometer	Cumulative deformation	0–20 in.	0.001 in.
Linear potentiometric borehole extensometer	Cumulative deformation	0–6 in.	0.001 in.

[a] Manual readout boxes for the instruments were manufactured to output measurements in English units. Range and resolution measurement units have not been converted to metric units. Measurements from these instruments have been converted for presentation elsewhere in this report.
ft = foot (feet)
in. = inch(es)
μin. = 10^{-6} inch(es)
psi = pound(s) per square inch
lb = pound(s)

1.4.2 Data Acquisition

The individual geomechanical instruments are read either manually using portable devices or remotely by electronically polling the stations from the surface in accordance with approved operating procedures. Remotely read instruments are connected to one of the data loggers located underground and readings are collected by initiating the appropriate polling routine. Upon completion of a verification process, the data are transferred to a computer database. The manual readout devices are taken to the instrument locations underground. The data are recorded on a data sheet and later entered into an electronic database along with the remotely acquired data.

The underground data acquisition system consists of instruments, polling devices, and a communications network. One or more instruments are connected to a polling device. The polling devices are installed in electrical enclosures near the location of the instrument to facilitate queries of each individual instrument. Polling devices are connected by a datalink to a surface computer.

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 that are used to enter, reduce, and transfer the data to permanent storage files. Additional routines allow access to these permanent storage files for numerical analysis, tabular reporting, and graphical plotting. Copies of the instrumentation database and data plots are available upon request[3].

1.4.3 Data Evaluation

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

Borehole extensometers provide relative displacement data from instrumented rods anchored at various depths in the rock strata. Displacement is measured relative to a fixed point. The deepest anchor is fixed in what is assumed to be undisturbed ground and is used as the reference point. Plots of displacement versus time for individual anchors relative to the reference point are presented. Typically, the plots show greater relative ground movement near the collar (i.e., the opening of the hole). Rate data for the hole collar relative to the deepest anchor are presented in the data analysis.

The annualized closure rate is calculated as follows:

$$rate(inches/year) = (cfi_2 - cfi_1)/(date_2 - date_1) \times 365.25\, days/year$$
$$where\ cfi = the\ change\ from\ the\ initial\ reading\ (inches)$$
$$cfi_1 = cfi\ reading\ closest\ to\ the\ beginning\ of\ the\ reporting\ period$$
$$cfi_2 = cfi\ reading\ closest\ to\ the\ end\ of\ the\ reporting\ period$$

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

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[3] Instrumentation data and data plots are presented in "Geotechnical Analysis Report for July 2002-June 2003 Supporting Data." The document is available upon request from the National Technical Information Service. See the back side of this document's cover sheet for details and addresses.

Earth pressure cells and strain gages are used to determine the stresses and deformations in and around the shaft liners, and data are depicted in time-based plots.

Piezometers used to measure the gage pressure of groundwater are installed in the shafts at varying elevations to monitor the hydraulic head acting on the shaft liners. Data from piezometers are plotted as pressure versus time.

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

1.4.4 Data Errors

As described above, 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, an immediate evaluation of the previous reading is performed, and 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 in the database. If the second reading and subsequent readings remain out of the instrument trend, the ground conditions in the vicinity of the instrument are assessed to determine the reason for the discrepancy. In addition, reading frequency may be increased. This process to correct erroneous readings is documented and filed for future reference.

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2.0 Geology

This chapter provides a summary of the stratigraphy of the WIPP region and the facility stratigraphy. 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 Holt and Powers (1990).

2.1 Regional Stratigraphy

The stratigraphy in the vicinity of the WIPP site includes rocks and sediments of Permian (286 to 245 million years ago [Ma]), Triassic (245 to 208 Ma), and Quaternary (1.6 Ma to present) ages. The generalized descriptions of formations provided in this section are given in order of deposition (oldest to youngest), beginning with the Castile Formation (Figure 2-1).

The Permian system in the United States is divided into four series. The last of these, the Ochoan Series, contains the host rock in which the WIPP facility is located. The Ochoan Series is of mostly marine origin and consists of four formations: three evaporite formations (the Castile, the Salado, and the Rustler) and one redbed 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. Fluvial deposits of the Triassic and Quaternary periods complete the stratigraphic column.

2.1.1 Castile Formation

The Castile Formation, lowermost of the four Ochoan formations, is approximately 1,250 ft (380 m) 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.

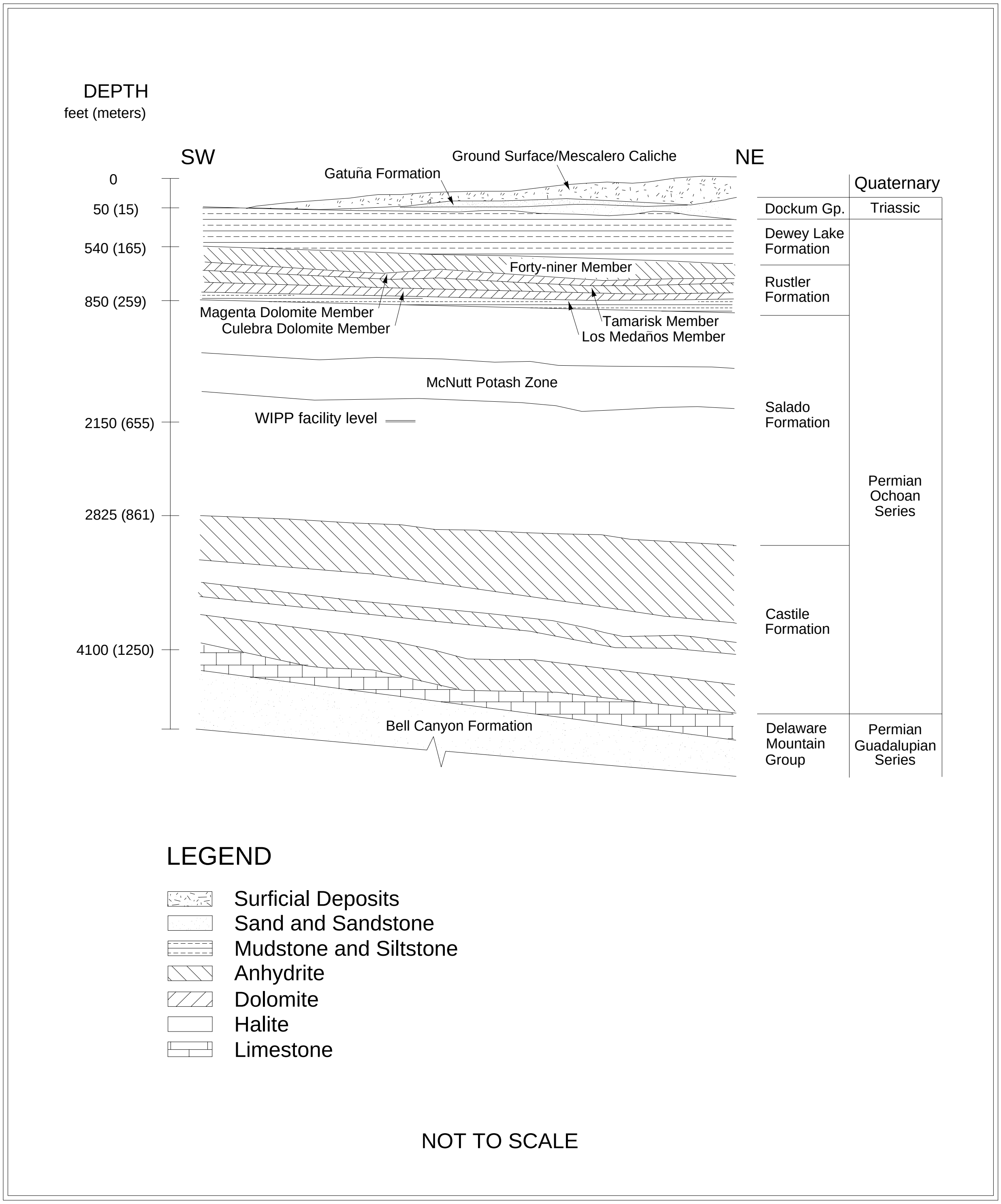

Figure 2-1
Regional Geology

2.1.2 Salado Formation

The Salado Formation comprises nearly 2,000 ft (610 m) 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 on the basis of soluble potassium and magnesium-bearing minerals. The WIPP disposal horizon is located within the unnamed lower member, 2,150 ft (655 m) below the surface.

2.1.3 Rustler Formation

The Rustler Formation is the uppermost of the three Ochoan evaporite formations and contains the largest proportion of clastic material of the three. The Rustler is subdivided into five members as follows (from the 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 (95 m) 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 consists of lower and upper sulfate units separated by a mudstone that displays sedimentary features and bedding. East of the site area, halite correlates with the mudstone. The Culebra and Magenta Dolomite members are persistent and serve as important marker units.

2.1.4 Dewey Lake Redbeds

The Dewey Lake Redbeds are the uppermost of the Ochoan Series formations in the WIPP vicinity. Within the series, the Dewey Lake represents a transition from the lower marine-influenced evaporite deposition to fluvial deposition on a broad, low-relief, fluvial plain. The redbeds, approximately 475 ft (145 m) thick, consist of predominantly reddish-brown interbedded fine-grained sandstone, siltstone, and claystone. The formation is differentiated from other formations by its lithology and distinctive color (both of which are remarkably uniform), and 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.

2.1.5 Dockum Group

The Dockum Group consists of fine-grained floodplain sediments and coarse alluvial debris of the Triassic age. At the WIPP site, the Dockum Group pinches out near the center of the site and thickens eastward as an erosional wedge. Local subdivisions of the Dockum Group are the Santa Rosa Sandstone and the Chinle Formation; however, only the Santa Rosa occurs in the vicinity of the site. The Santa Rosa 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.

2.1.6 Gatuña Formation, Mescalero Caliche, and Surficial Sediments

Quaternary Period deposits include the Gatuña Formation, Mescalero Caliche, and surficial sediments. The Gatuña Formation (ranging in age from approximately 13 Ma to 600,000 years before present [b.p.] [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 approximately 13 ft (4 m) of poorly consolidated sand, gravel, and silty clay. 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 500,000 years b.p.) is approximately 4 ft (1.2 m) thick in the WIPP vicinity. The Mescalero is a hard, resistant soil horizon that lies beneath a cover of wind-blown sand. The horizon is petrocalcic, or very strongly cemented with calcium carbonate. Petrocalcic horizons form slowly beneath a stable landscape at the average depth of infiltration of soil moisture and are an indicator of stability and integrity of the land surface. Many of the surface buildings at 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 330,000 ± 75,000 years ago.

2.2 Underground Facility Stratigraphy

The WIPP disposal horizon lies in the approximate center 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 for numbering the more significant sulfate beds within the Salado designates these beds as marker beds (MB) 100 (near the top of the formation) to MB144 (near the base). The repository is located between MB138 and MB139 (Figure 2-2) within a sequence of laterally continuous depositional cycles as described above. Within this sequence, layers of clay and anhydrite that are locally designated (as shown) can have a significant impact on the geomechanical performance of the excavations. Clay layers provide surfaces along which slip and separation can occur, whereas anhydrite acts as a brittle unit that does not deform plastically.

2.2.1 Disposal Horizon Stratigraphy (Panels 1, 2, 7, and 8)

This disposal horizon contains panels 1, 2, 7, and 8, all the shaft areas, the shop areas, most of the north experimental areas, and all the access drifts to South 2620. The four main entries that extend south ramp-up starting at South 2620 and complete at South 2740.

Most underground excavations are located within this disposal horizon (see Figure 2-2). In this horizon, the Orange Marker Bed (OMB) typically occurs near mid-rib. The OMB is a laterally consistent unit of moderately to light reddish-orange halite, typically about 6 in. (15 cm) thick, that is used as a point of reference for disposal area excavation.

MB139 typically lies approximately 5 ft (1.5 m) below the excavation floor. MB139 is a 20-to-32 in. (50-to-80 cm) thick layer of polyhalitic anhydrite. The top of the anhydrite undulates up to 15 in. (38 cm) while the bottom is subhorizontal and is underlain by clay "E." Above MB139 is a unit of halite that terminates at the base of the OMB. Within this unit, polyhalite is locally abundant and decreases upward, while argillaceous material increases upward.

Above the OMB, a thin sequence of argillaceous halite gives way to a thick sequence of clear halite that becomes increasingly argillaceous upward and is capped by clay "F." Clay "F" occurs as a thin layer occasionally interrupted by partings and breaks and is readily visible in the upper ribs of disposal horizon excavations, usually approxmiately 24 in. (60 cm) below the roof.

Above clay "F," another sequence of halite begins that, as in lower sequences, becomes increasingly argillaceous upward. This sequence terminates at the clay "G"/Anhydrite "b" interface, approximately 6.5 ft (2 m) above the roof of most disposal horizon excavations, forming a roof beam that typically acts as a unit. The roof of some disposal horizon excavations (e.g., East 140 drift between South 1000 and South 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, typically approxmiately 6.5 ft (2 m) above the upper contact of Anhydrite "b."

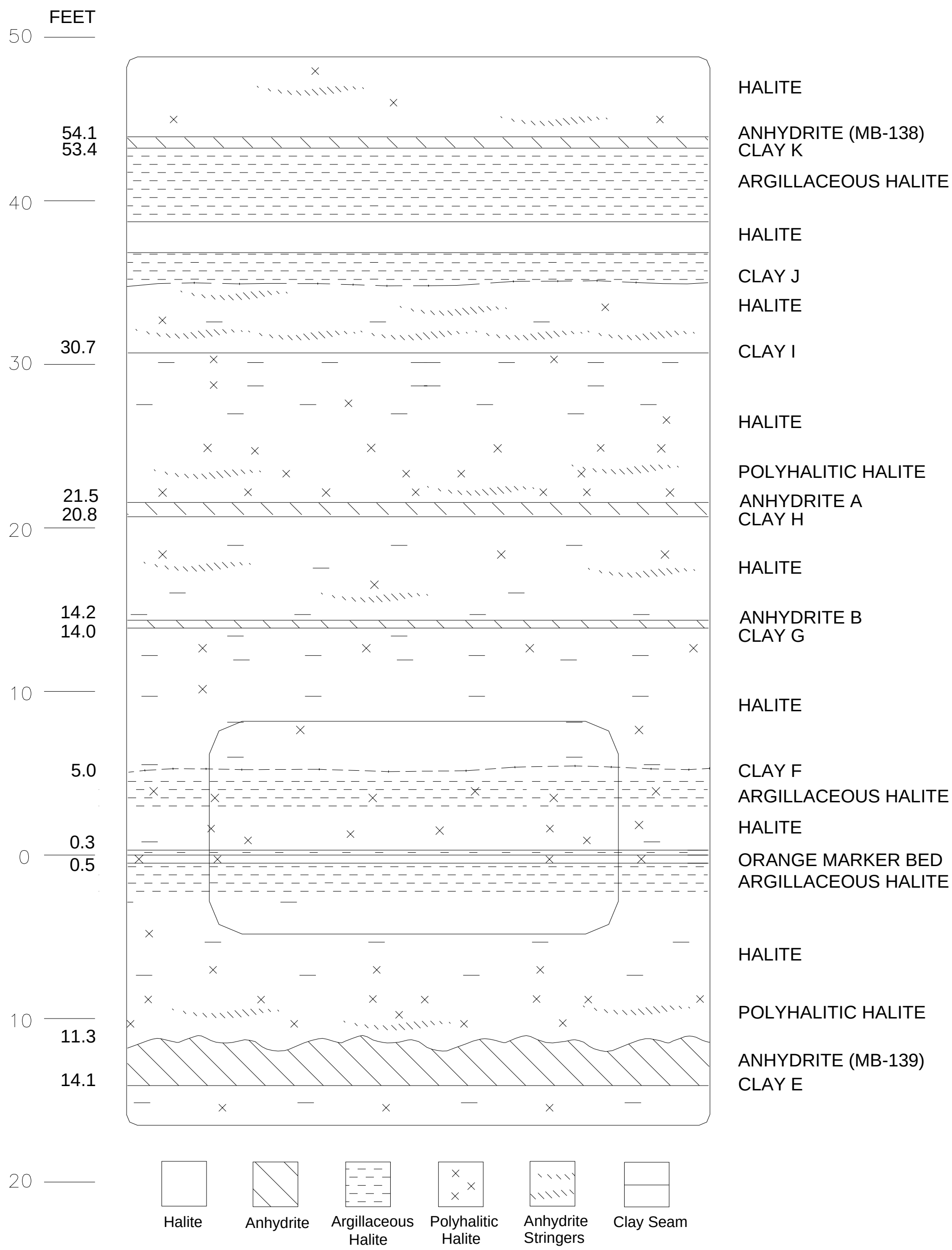

Figure 2-2
Repository Level Stratigraphy (Panels 1, 2, 7, and 8)

2.2.2 Disposal Horizon Stratigraphy (Panels 3, 4, 5, and 6)

This disposal horizon contains panels 3, 4, 5, and 6, all the access drifts south of South 2740. The rise in elevation from South 2620 to South 2740 is approximately 6 ft.

In this horizon (see Figure 2-3), the OMB typically occurs at or below the floor. MB139 typically lies about 12 feet (3.7 m) below the excavation floor. This sequence terminates at the clay "G"/Anhydrite "b" interface. The roof is immediately above Anhydrite "b." Clay "G"/Anhydrite "b" is used as the mining reference at this disposal horizon.

2.2.3 Experimental Area Stratigraphy

Some excavations located in the eastern portion of the Northern Experimental Area (deactivated and closed during this reporting period) lie at a higher stratigraphic level than the disposal excavations. These excavations typically have floors excavated 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. Clay "J," at the top of the first of these intervals, may occur as a distinct seam or merely an argillaceous zone. Clay "K" tops the second interval and is overlain by anhydrite MB138.

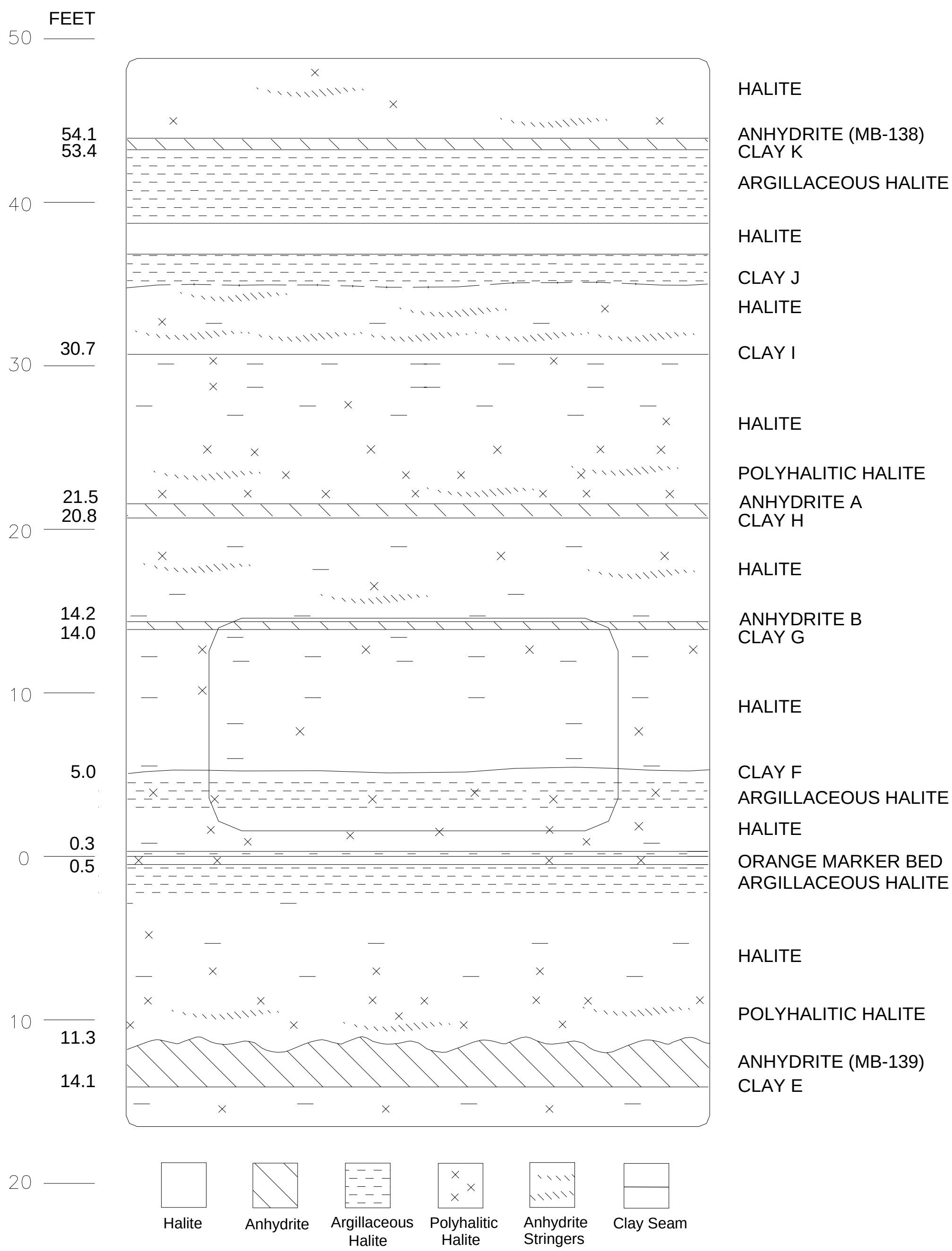

Figure 2-3
Repository Level Stratigraphy (Panels 3, 4, 5, and 6)

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3.0 Performance of Shafts and Keys

Four shafts connect the surface with the WIPP underground facility. The four shafts are: the Salt Handling Shaft, which is primarily used for removing excavated salt from the underground; the Waste Shaft, which is the primary shaft for transporting men and materials and is used for transporting TRU waste to the underground; 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 chapter describes the geomechanical performance of these shafts.

Although through the years some of the shaft instrumentation has failed, there are no plans to replace failed instrumentation installed in any of the shafts. The project currently has a good understanding of the expected movements in the shafts. The monitoring results, up to the point of instrument failure, did not indicate any unusual shaft movements or displacements. Continued periodic visual inspections confirm the expected shaft performance and provide necessary observations to evaluate shaft performance. It is anticipated that replacement of the failed instrumentation will not provide significant additional information.

3.1 Salt Handling Shaft

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

The Salt Handling Shaft is lined with steel casing and has a 10-ft (3-m) inside diameter from the ground surface to a depth of 846 ft (257.9 m). The steel liner has a thickness of 0.62 in. (1.6 cm) at the top, increasing with depth to a thickness of 1.5 in. (3.8 cm), including external stiffener rings, at the key. Cement grout is placed between the liner and rock face. The 10-ft (3-m) diameter extends through the concrete shaft key to a depth of 880 ft (268.2 m). The shaft key is a 37.5-ft (11.4-m) long, reinforced-concrete structure that begins 3.5 ft (1.07 m) above the bottom of the steel liner. The shaft from the key to the bottom of the shaft, at a depth of 2,298 ft (700 m), has a nominal diameter of 12 ft (4 m).

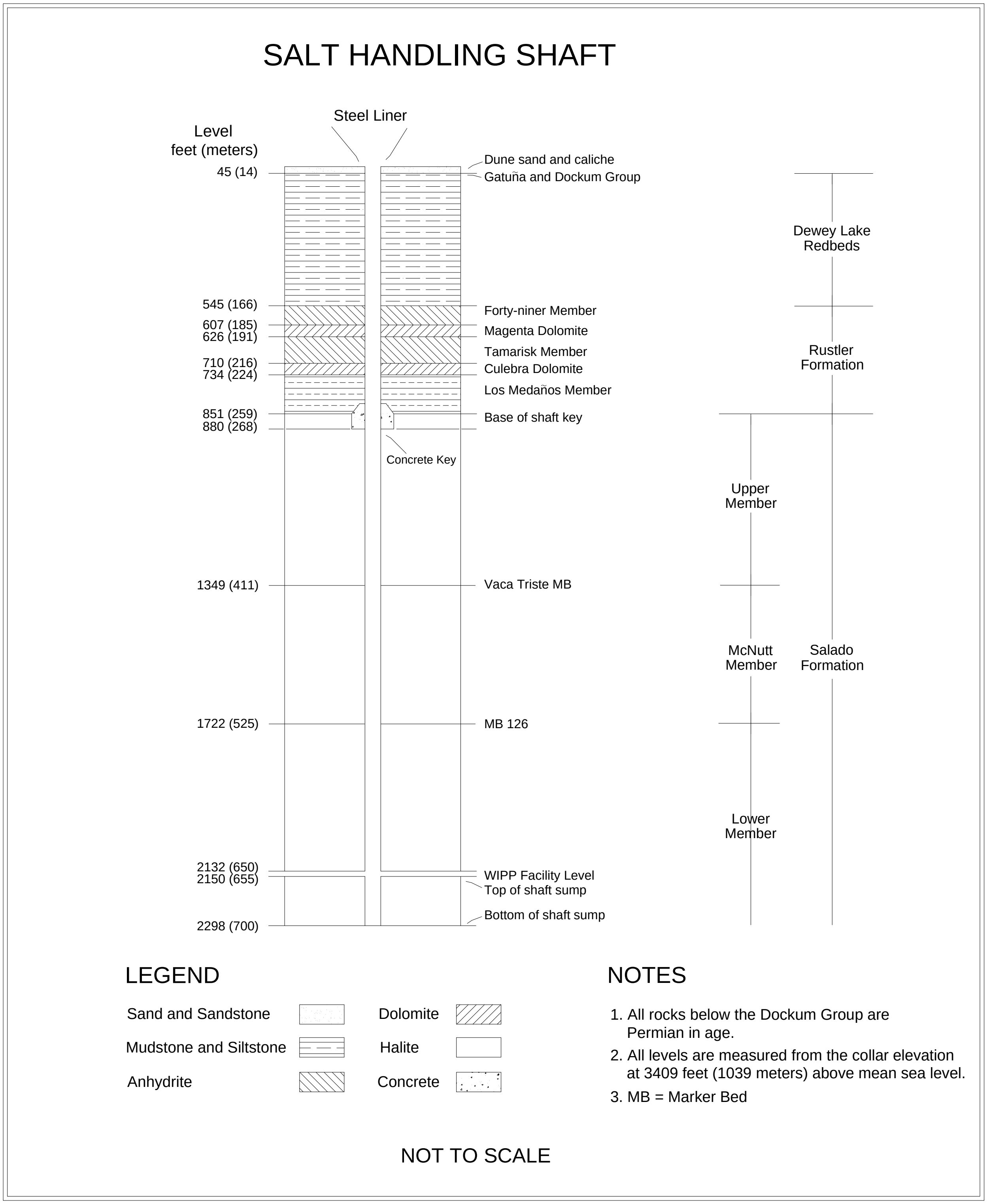


Figure 3-1
Salt Handling Shaft Stratigraphy

Wire mesh anchored by rock bolts is installed in this portion as a safety screen to contain rock fragments that may become detached. The shaft extends approximately 140 ft (43 m) below the facility horizon in order to accommodate the skip loading equipment and to act as a sump.

3.1.1 Shaft Observations

Underground operations personnel conduct weekly visual shaft 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. The visual shaft inspections during this reporting period found that the Salt Handling Shaft was in satisfactory condition. Only routine ground control activities were required in the Salt Handling Shaft during this reporting period.

3.1.2 Instrumentation

Geomechanical instruments (extensometers, piezometers, and radial convergence points) were installed at various levels in the Salt Handling Shaft during April and July of 1982 (Figure 3-2). In the shaft key, instruments included strain gages, pressure cells, and piezometers (Figure 3-3). All of the extensometers in the Salt Handling Shaft are nonfunctional.

All 12 piezometers continue to provide data. The fluid pressures recorded at the end of this reporting period range from approximately 74 pounds per square inch (psi) (510 kilopascals [kPa]) at the 580-ft (177-m) level in the Forty-niner Member to 149 psi (1,027 kPa) at the 691-ft (211-m) level in the Tamarisk Member. The recorded pressure of 90 psi (620 kPa) at the Magenta Dolomite Member represents a 46-psi increase and the recorded pressure of 105 psi (723 kPa) at the Los Medaños Member represents an 11-psi decrease from the recorded pressure in the same location at the end of the previous reporting period. The pressure for the shaft liner will continue to be monitored on a regular basis.

Four earth pressure cells were installed in the key section of the Salt Handling Shaft during concrete emplacement at the 860-ft (262-m) level. These instruments measure the normal stress between the concrete key and the Salado Formation as the creep effects load on the key structure. Three of the four earth pressure cells continue to provide data, although all three indicate negative pressure. These instruments have essentially indicated no contact pressure since their installation (readings resemble instrument drift at a zero pressure).

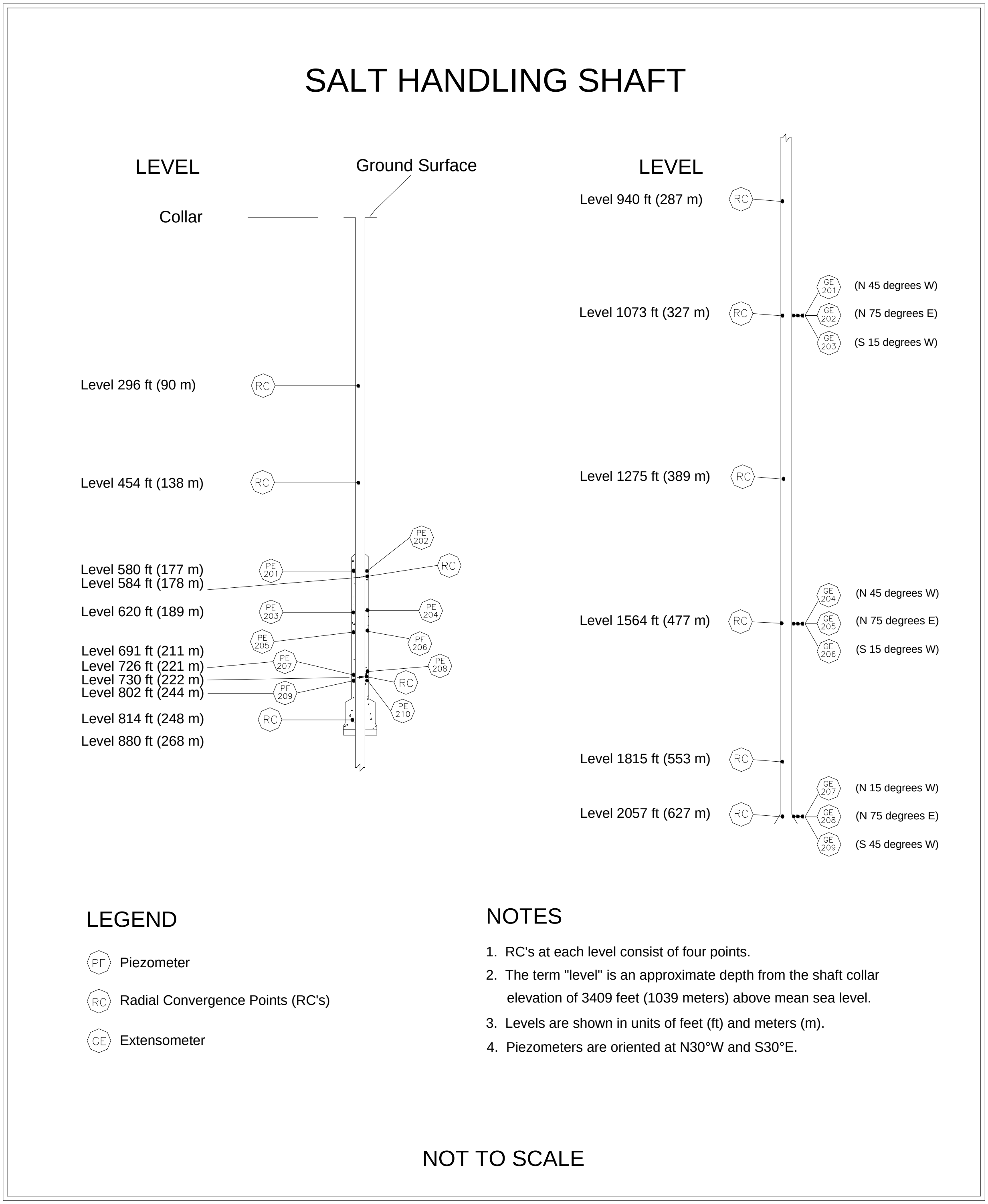


Figure 3-2
Salt Handling Shaft Instrumentation (Without Shaft Key)

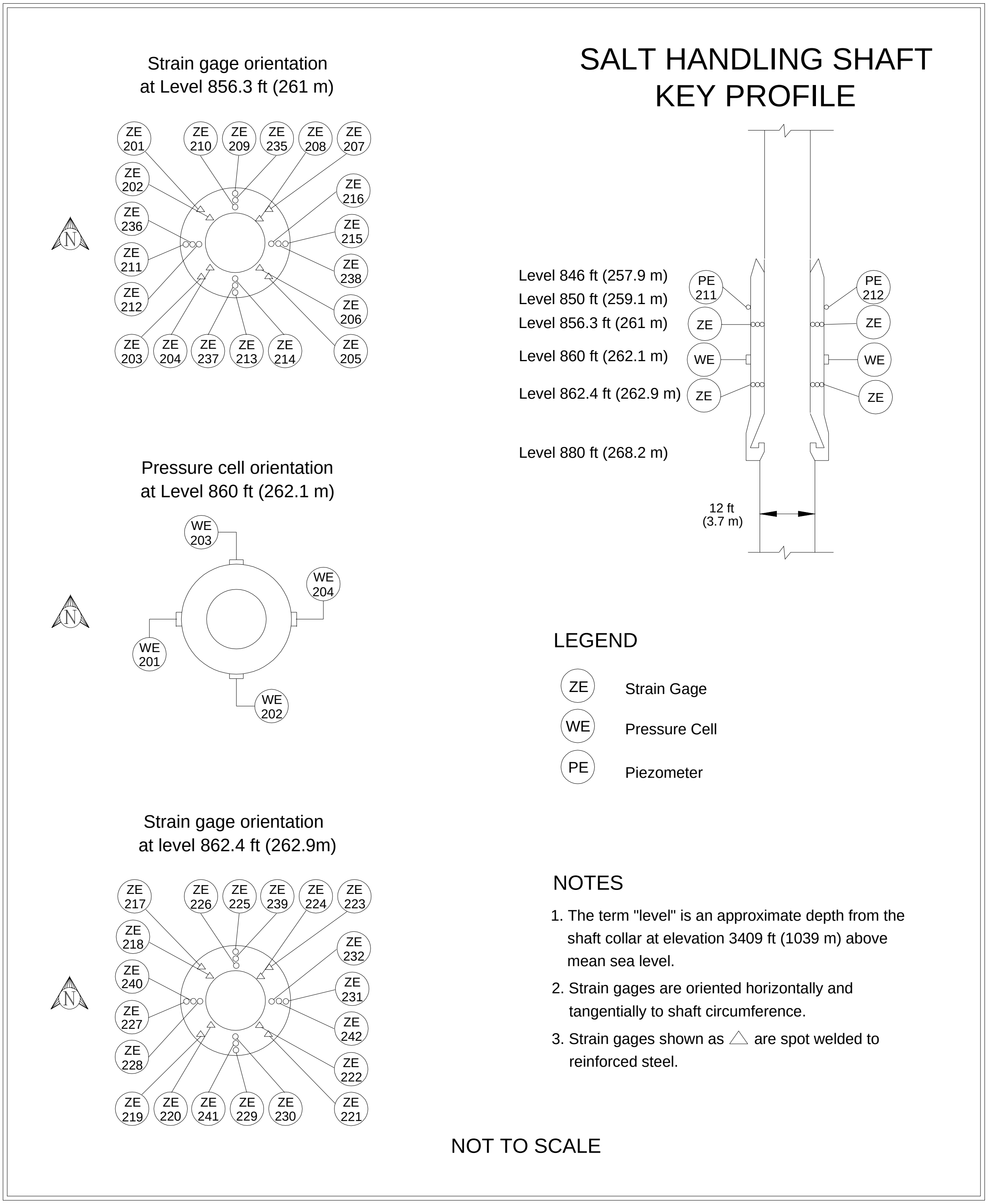


Figure 3-3
Salt Handling Shaft Key Instrumentation

The contact pressures recorded by the instruments for this reporting period ranged from -21.1 to 0.6 psi (-145 to 4 kPa). Sixteen spot-welded and 24 embedment strain gages were installed on and in the shaft key concrete at both the 856.3-ft (261-m) level and at the 862.4-ft (262.9-m) level. There are four functioning spot-welded strain gages located at these levels. The reported strains at the 856.3-ft (261-m) level were 652 and 748 microstrain. The reported strains at the 862.4-ft (262.9-m) level were 507 and 784 microstrain. The strains reported for this reporting period from the 12 embedment strain gages located at the 856.3-ft (261-m) level range from -676 microstrain to 977 microstrain. The strains reported for this reporting period from the two embedment strain gages located at the 862.4-ft (262.9-m) level were 161 microstrain to 297 microstrain. The strains recorded from the spot-welded strain gages and the embedment strain gages are very similar to the recorded strains from these instruments at the end of the previous reporting period.

3.2 Waste Shaft

As part of the SPDV Program, a 6-ft (2-m) diameter ventilation shaft, now referred to as the Waste Shaft, was excavated from December 1981 through February 1982 (see Figure 1-2). This shaft, in combination with the Salt Handling Shaft, provided a two-shaft underground air circulation system. From October 11, 1983, to June 11, 1984, the shaft was enlarged to a diameter of 20 to 23 ft (6 to 7 m) and lined above the key. Stratigraphic mapping (Figure 3-4) was conducted during shaft enlargement from December 9, 1983, to June 5, 1984 (Holt and Powers, 1984).

The Waste Shaft is lined with nonreinforced concrete and has a 19 ft (6 m) inside diameter from the ground surface to the top of the Waste Shaft key at 837 ft (255 m). Liner thickness increases with depth from 10 in. (25 cm) at the surface to 20 in. (51 cm) at the key. The Waste Shaft key is 63 ft (19 m) long and 4.25 ft (1.3 m) thick and is constructed of reinforced concrete. The bottom of the key is 900 ft (274 m) below the surface. The diameter of the shaft is 20 ft (6 m) at the point below the key and increases to 23 ft (7 m) just above the shaft station. The shaft below the key is lined with wire mesh anchored by rock bolts. The diameter of 23 ft (7 m) extends to a depth of approximately 2,286 ft (697 m) with the shaft sump comprising the lower 119 ft (36 m) of that interval.

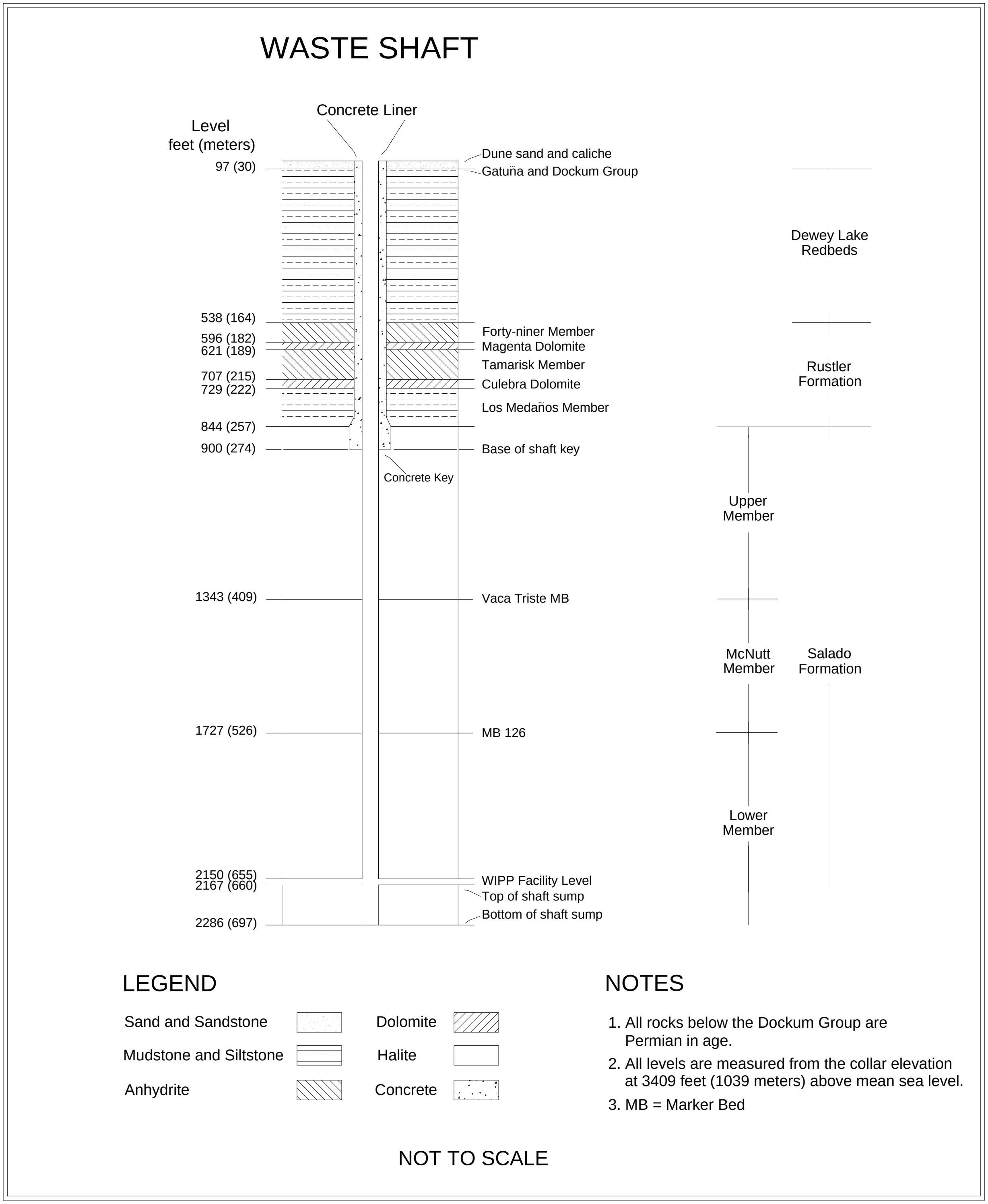


Figure 3-4
Waste Shaft Stratigraphy

3.2.1 Shaft Observations

Underground operations personnel conduct weekly visual shaft inspections. These inspections are performed principally to assess the condition of the hoisting and mechanical systems, but also include observation of the shaft walls for water seepage, loose rock, or sloughing. The visual shaft inspections during this reporting period found that the Waste Shaft was in satisfactory condition. No ground control activities other than routine maintenance were required in the Waste Shaft during this reporting period.

3.2.2 Instrumentation

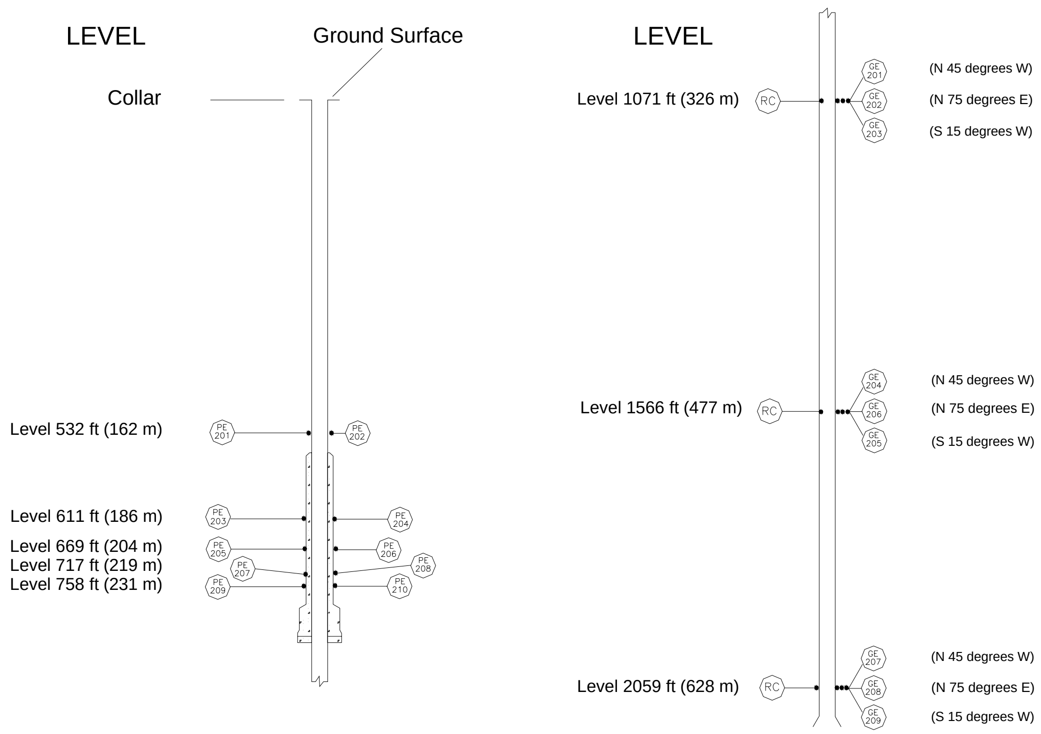
Extensometers, piezometers, earth pressure cells, and radial convergence points were installed in the Waste Shaft between August 27 and September 10, 1984. Figures 3-5 and 3-6 illustrate the instrumentation configurations in the shaft and shaft key.

Nine multiposition borehole extensometers were installed in arrays at 1,071 ft (326 m), 1,566 ft (477 m), and 2,059 ft (628 m) below the surface as shown in Figure 3-5. Each array consists of three extensometers. Currently, six out of nine extensometers remain functional. Table 3-1 summarizes information regarding collar displacement measurements from these extensometers.

Table 3-1
Collar Displacement at Waste Shaft Extensometers

Field Tag	Location Shaft Level	Date of Last Reading	Collar Displacement Relative to Deepest Anchor inches (cm)	Displacement Rate 2002-2003 inches/year (cm/yr)	Displacement Rate 2001-2002 inches/year (cm/yr)	Rate Change Percent %
31X-GE-00203	1071	04/28/03	0.207 (0.526)	0.003 (0.008)	0.002 (0.005)	50%
31X-GE-00204	1566	04/28/03	0.781 (1.984)	0.019 (0.048)	0.018 (0.046)	6%
31X-GE-00205	1566	04/28/03	0.661 (1.679)	0.016 (0.041)	0.016 (0.041)	0%
31X-GE-00206	1566	04/28/03	0.791 (2.009)	0.021 (0.053)	0.021 (0.053)	0%
31X-GE-00208	2059	04/28/03	1.860 (4.724)	0.055 (0.140)	0.047 (0.119)	17%
31X-GE-00209	2059	04/28/03	2.115 (5.372)	0.072 (0.183)	0.067 (0.170)	7%

WASTE SHAFT



LEGEND

- PE Piezometer
- RC Radial Convergence Points (RC's)
- GE Extensometer

NOTES

1. RC's at each level consist of four points.
2. The term "level" is an approximate depth from the shaft collar at elevation of 3409 feet (1039 meters) above mean sea level.
3. Levels are shown in units of feet (ft) and meters (m).
4. Piezometers are oriented at N30°W and S30°E.

NOT TO SCALE

Figure 3-5
Waste Shaft Instrumentation (Without Shaft Key)

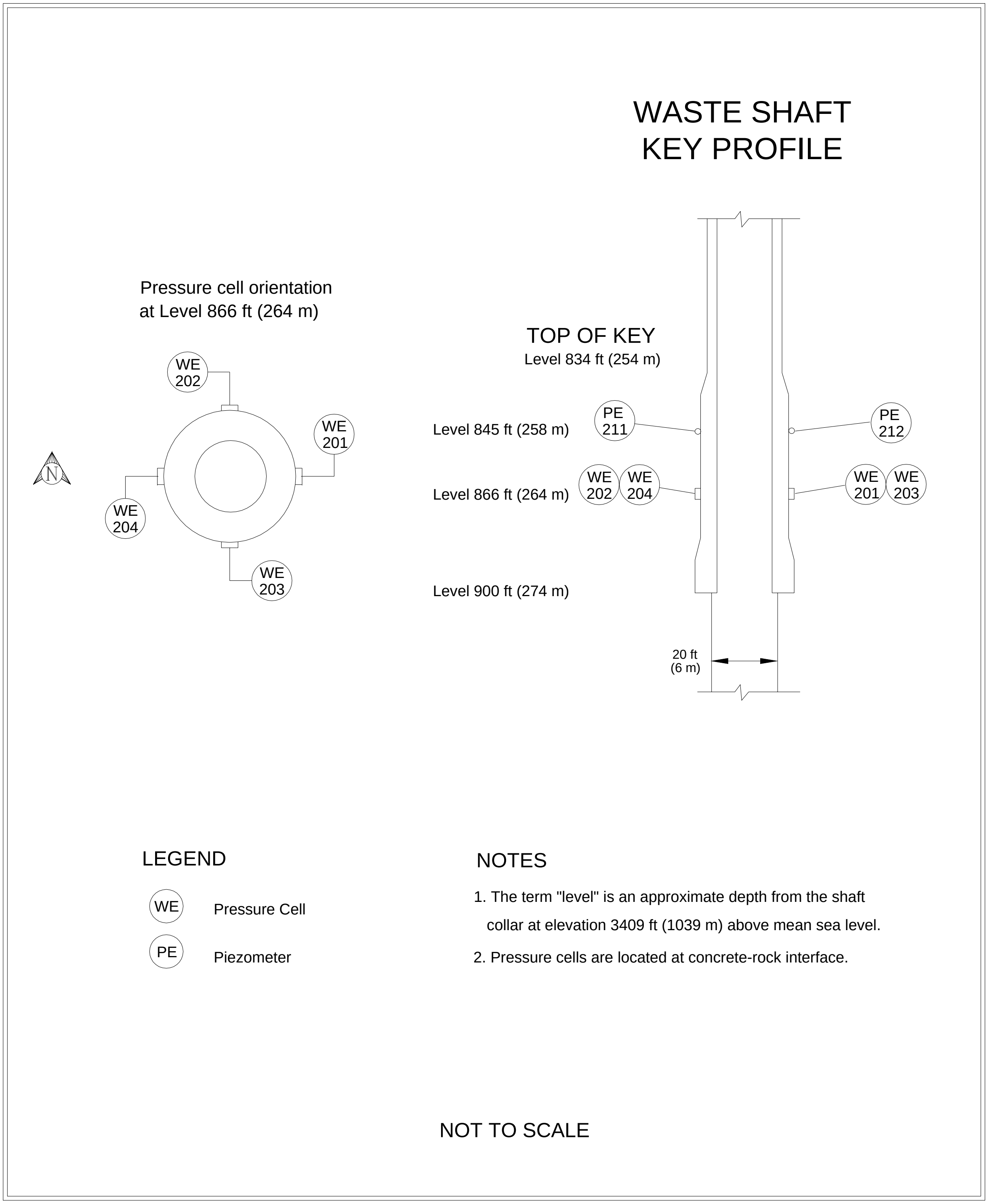


Figure 3-6
Waste Shaft Key Instrumentation

The collar displacement for the one working extensometer at the 1,071-ft (326-m) level indicates virtually no movement. Its annual displacement rate[4] is 0.003 in./yr (0.008 cm/yr). Overall, this displacement rate shows a slight increase over the previous reporting period.

The collar displacement rates at the 1,566-ft (477-m) level have remained similar relative to the rates from the previous reporting period. The annualized displacement rate change for the three extensometers is calculated at 0, 0, and 6 percent. At the 2,059-ft (628-m) level, the collar displacement rate changes varied from 7 to 17 percent. There were no data from the third extensometer because of a instrument failure. Again, these rates are considered acceptable. There is no indication of shaft instability from routine inspections.

Twelve piezometers were installed in the lined section of the Waste Shaft on September 7 and 8, 1984, to monitor pressure behind the shaft liner and key section in the shaft. Data continue to be received from all 12 piezometers, although 5 of the 12 report zero or near zero fluid pressure. The recorded positive fluid pressures from the remaining 7 piezometers at the end of the reporting period range from 34 psi (234 kPa) at the Magenta Dolomite Member (611-ft [186-m] depth) up to greater than 144 psi (992 kPa) at the level where the shaft intersects the Culebra Dolomite Member (717-ft [218.5-m] depth).

Four earth pressure cells were installed in the key section of the Waste Shaft during concrete emplacement between March 23 and April 3, 1984. These instruments measure the normal stress between the concrete key and the Salado Formation as the salt creep loads the key structure. The contact pressure recorded by these four instruments has remained fairly constant over the past five years. The pressures of record during this reporting period are between 74 and 101 psi (510 and 696 kPa).

3.3 Exhaust Shaft

The Exhaust Shaft was drilled from September 22, 1983, to November 29, 1984, to establish a route from the underground facility to the surface for exhaust air (see Figure 1-2). Stratigraphic mapping was conducted from July 16, 1984, to January 18, 1985 (DOE, 1986c). Figure 3-7 illustrates the Exhaust Shaft Stratigraphy.

[4] Annual displacement rates are calculated as the difference in collar displacement readings from the first reading of the previous reporting period to the final reading of this reporting period divided by the time between those two readings, usually approximately one year.

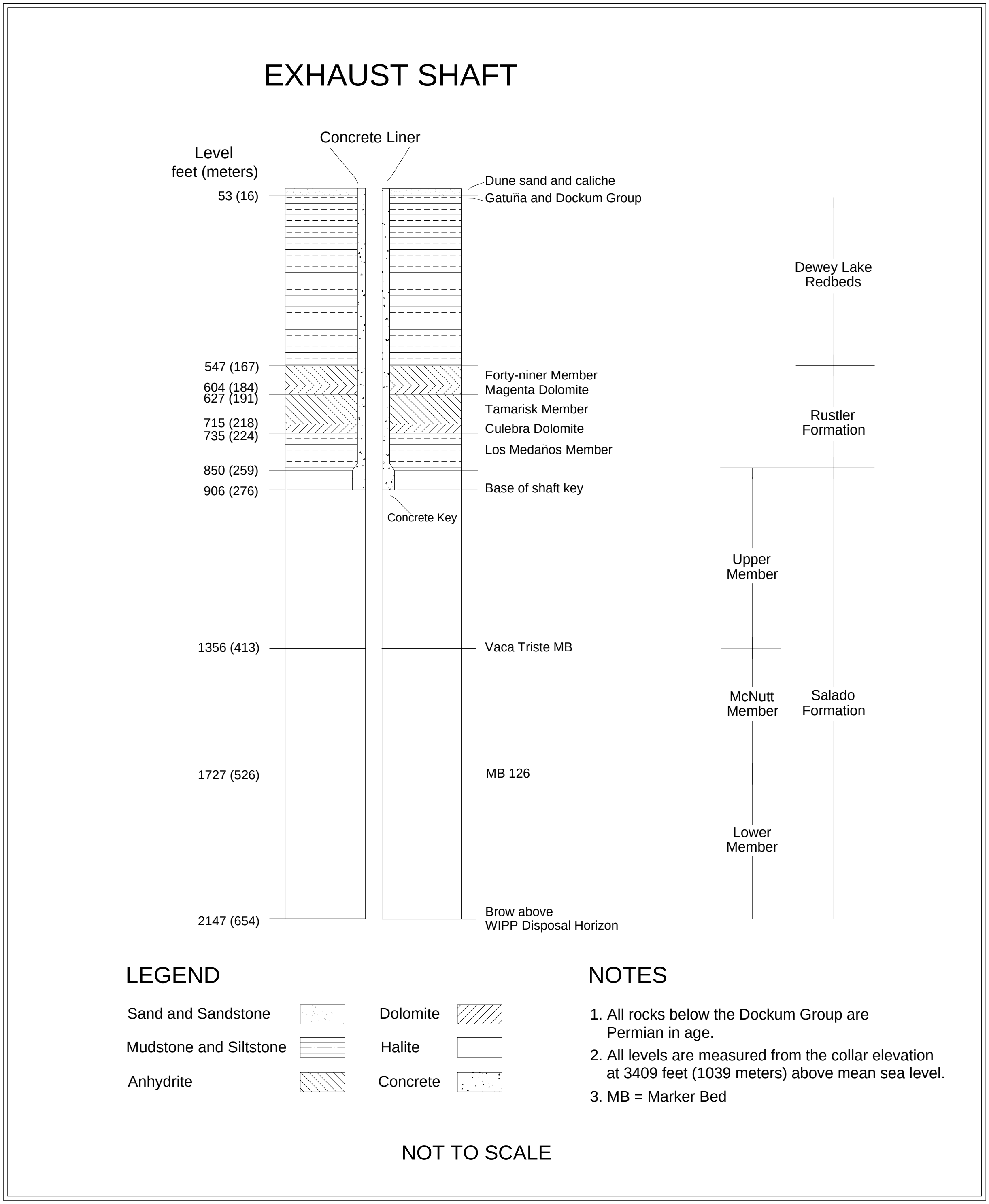


Figure 3-7
Exhaust Shaft Stratigraphy

The Exhaust Shaft is lined with nonreinforced concrete from the surface to the top of the shaft key at a depth of 844 ft (257 m). The liner thickness increases from 10 to 16 in. (25 to 41 cm) over that interval. The Exhaust Shaft key is 63 ft (19 m) long and 3.5 ft (1 m) thick. The shaft diameter below the key is 15 ft (5 m) and the interval below the key is lined with wire mesh anchored by rock bolts. The shaft terminates at the facility horizon, at a depth of approximately 2,150 ft (655 m). There is no excavated shaft sump.

3.3.1 Exhaust Shaft Observations

Quarterly Exhaust Shaft video inspections are conducted following 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, salt buildup, leaks, and debris. In addition, inspections examine the condition of anchors, brackets, and down-hole equipment. Between June 2002 and July 2003, four shaft inspections were conducted. Inspections were conducted on August 15, 2002; November 13, 2002; February 11, 2003; and May 15, 2003.

3.3.1.1 Video Camera

Video inspections of the Exhaust Shaft were conducted by the Washington TRU Solutions LLC (WTS) Geotechnical Engineering Section using a custom-designed vertical-drop camera. The system consists of a color camera with pan, tilt, and zoom capability. The camera is housed in an aerodynamic housing and suspended by a dual-armored cable. The cable consists of five copper conductors and two multimode optical fibers. The cable is reeled out by a winch mounted in a control van. The video inspections are recorded on VHS tape.

3.3.1.2 Shaft Inspection Observations

Quarterly video inspection observations concentrate on four major areas: air monitoring systems, shaft liner, shaft walls, and equipment support and cabling. The air monitoring components consist of one air-velocity and three air-monitoring devices in the Exhaust Shaft, as shown in Figure 3-8. The video inspection includes examination of each device, including the transport assembly, guide tubes, the sample intake, and the support brackets that extend from Station A located above the shaft to the Exhaust Shaft collar. From the Exhaust Shaft collar, the air monitoring components extend down 21 ft and into the shaft.

Video inspections indicate that the air-sampling components may typically accumulate salt buildup of up to several inches.

The Exhaust Shaft liner is examined for cracks, seepage, and general shaft stability. Currently, there are two principal zones of seepage in the shaft. The first is at a depth of about 50 to 55 feet below the shaft collar (bsc). The second is at a depth of about 80 to 85 ft bsc, as shown in Figure 3-9. Monitoring of these seepage horizons dates back prior to 1995. Water entering the shaft through these cracks is believed to originate from a perched anthropogenic water-bearing horizon at the base of the Santa Rosa Formation. The fluid level in the Santa Rosa near the shaft is at about 42 feet below ground surface. Based on examination of the inspection videos the flow rate into the shaft is estimated at about 1 to 3 gallons per minute.

Conditions in the shaft change as a function of several variables, including airflow, humidity, temperature, and underground mining activities (dust). The seepage cracks noted above are confined primarily to the eastern side of the shaft wall. During this reporting period, there did not appear to be any significant change in the quantity of fluid entering the shaft. This is confirmed by comparing annual records of the volume of fluid accumulating in the Exhaust Shaft catch basin at the bottom of the Exhaust Shaft.

When fluid was detected seeping into the Exhaust Shaft in 1995, a catch basin was designed and installed at the base of the Exhaust Shaft to intercept and prevent water from draining into the Waste Shaft Sump. Fluid has been removed on an as-needed basis from the catch basin since March 1996. Table 3-2 presents the volume of fluid removal from the catch basin from July 1997 through June 2003. Between July 2002 and June 2003, the volumes of fluid removed from the catch basin ranged from 55 gallons to 660 gallons (Table 3-2). 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 entering the Exhaust Shaft catch basin, refer to DOE/WIPP 00-2000, "*Brine Generation Study*."

The shaft walls were examined for cracks, moisture, and encrustation, with particular attention paid to three water rings located at the base of the Magenta and Culebra members of the Rustler Formation and the bottom of the shaft key. As noted earlier, the condition of the shaft wall varies depending on the airflow, humidity, temperature, and underground mining activities. During this reporting period, there was significant mining activity in the south main drifts and Panel 3. The only areas in the shaft with significant salt buildup were the three water rings located at the Magenta, the Culebra, and the key.

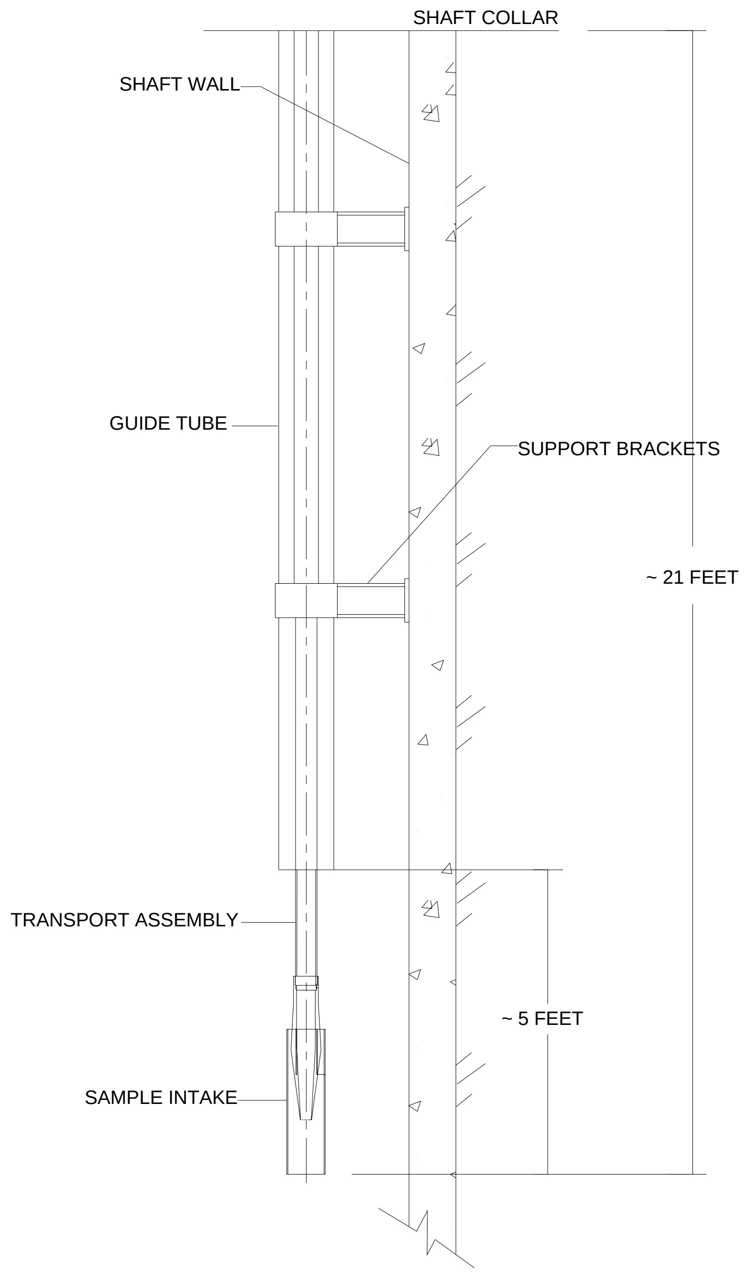


Figure 3-8
Sample Intake Air Monitoring System

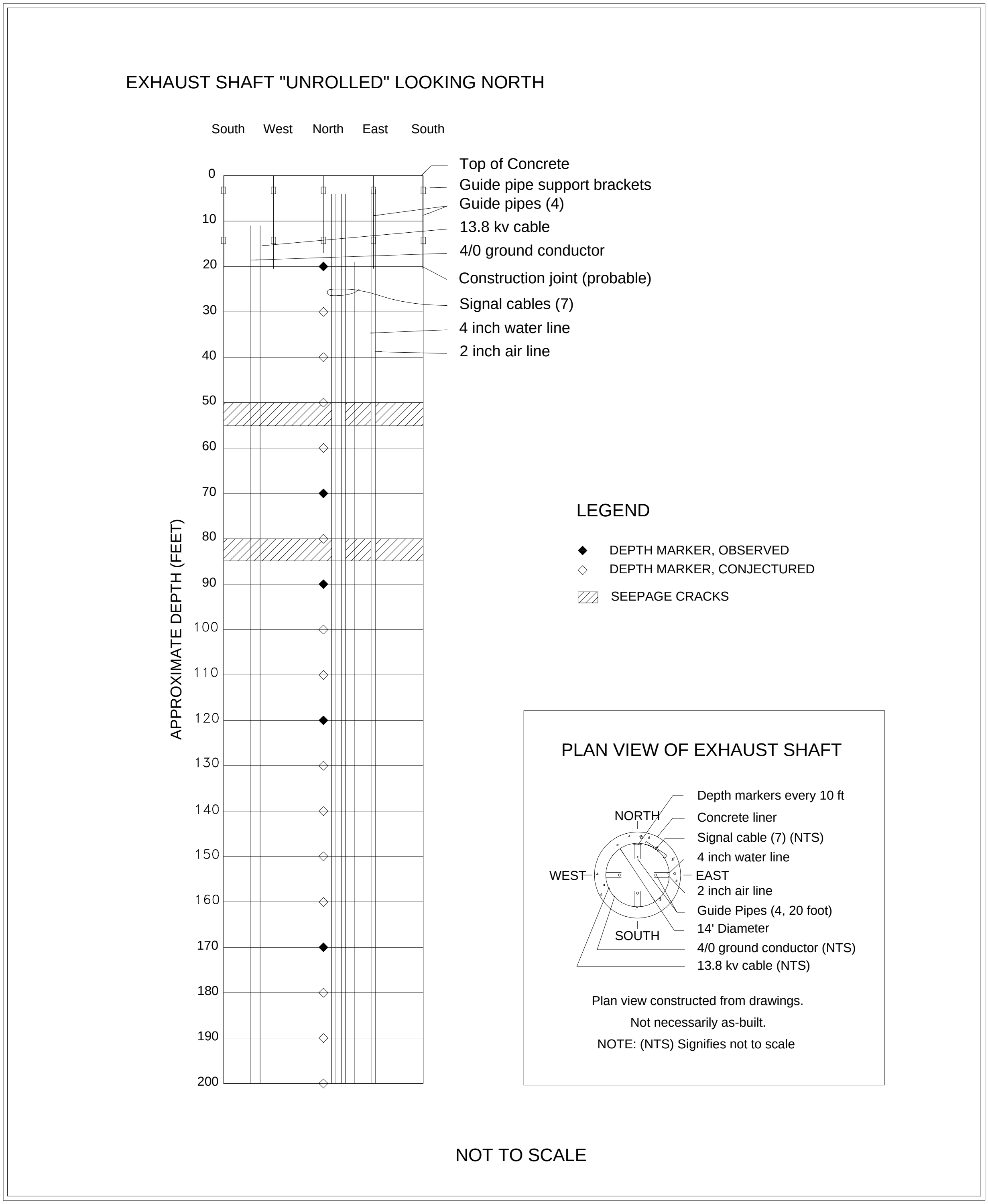


Figure 3-9
Diagram of Exhaust Shaft Fixtures (200 ft Upper Portion)

Though the Magenta and Culebra water rings are encrusted with salt buildup, there does not appear to be any water emanating from the liner or water rings. Most of the seepage was observed along the east face of the shaft wall near the instrumentation cables and the air and waterlines in the upper section of the shaft. Though the presence of water is an inconvenience requiring periodic disposal, at this time it does not appear to have created any hazard or compromised the structural integrity of the shaft. There are no visible signs of dissolution of the salt below the key.

The video inspection also concentrated on the installed utilities and support brackets. This included the 13.8 kilovolt amp (kVA) power cable and the grounding cable located on the west wall of the shaft, the instrumentation cables located on the northeast wall of the shaft, and the 4-in. airline and the 2-in. water line located on the east wall of the shaft. Video inspection of the 13.8 kVA cable and the grounding cable show no visible signs of damage. There is sporadic salt buildup on the cables. Currently, long-term implications of salt buildup on the cables is unknown. The 4-in. compressed air line and the 2-in. water line extend from the ground surface to the bottom of the shaft. At present, neither line is being used. Inspection of the integrity of the brackets holding the air line and water line is difficult to assess because of salt buildup. However, there does not appear to be any indication that the brackets, which hold the air line and water line in place, are broken. Currently broken instrumentation cables were observed at eight locations from about 500 to 1300 ft (152 to 396 m) below the shaft collar. However, only one of the instrumentation cables was in use and therefore should have minimal impact on shaft monitoring or shaft operations.

Table 3-2
Water Removed from the Exhaust Shaft Catch Basin

July 1997 – June 1998		July 1998 – June 1999		July 1999 – June 2000		July 2000 – June 2001		July 2001 – June 2002		July 2002 – June 2003	
Date	**Gallons**	**Date**	**Gallons**	**Date**	**Gallons**	**Date**	**Gallons**	**Date**	**Gallons**	**Date**	**Gallons**
7/18/97	275	7/1/98	770	7/19/99	110	7/3/00	220	7/31/01	165	07/02/2002	165
7/28/97	660	7/7/98	330	12/13/99	165	7/15/00	110	8/21/01	1595	07/08/2002	440
8/1//97	550	7/14/98	220	2/21/00	110	9/18/00	330	9/13/01	330	07/09/2002	495
8/4/97	715	7/16/98	275	5/16/00	715	10/24/00	110	10/15/01	770	07/10/2002	660
8/8/97	770	7/23/98	165	6/7/00	165	3/7/01	110	10/30/01	220	07/30/2002	220
8/11/97	660	7/24/98	220	6/12/00	275	3/21/01	165	4/29/02	275	09/17/2002	165
8/15/97	475	7/27/98	825	6/19/00	440	4/10/01	220	6/11/02	550	09/24/2003	
8/18/97	330	7/28/98	330	6/22/00	330	4/17/01	220	6/22/02	330	Sludge	330
8/22/97	330	8/3/98	495	6/30/00	165	4/24/01	110	**Total**	**4235**	03/25/2003	
8/25/97	1045	8/10/98	1265	**Total**	**2475**	5/22/01	110			Sludge	220
Sludge	110	8/21/98	330			Sludge	440			05/27/2003	55
9/2/97	220	8/24/98	990			6/12/01	1100			06/03/2003	220
9/15/97	605	8/27/98	1155			6/13/01	110			06/25/2003	330
9/22/97	550	9/1/98	330			Sludge	110			**Total**	**3300**
10/13/97	825	10/5/98	385			**Total**	**3465**				
10/20/97	220	10/26/98	660								
11/3/97	275	11/23/98	110								
11/10/97	385	2/1/99	385								
11/17/97	385	2/10/99	110								
11/24/97	330	5/4/99	330								
12/10/97	440	5/11/99	110								
12/12/97	550	5/24/99	605								
1/2/98	220	5/26/99	165								
1/12/98	605	6/1/99	165								
2/2/98	660	6/4/99	165								
2/16/98	605	6/10/99	165								
3/16/98	605	Sludge	165								
5/4/98	660	6/16/99	165								
5/11/98	550	6/21/99	1705								
5/18/98	495	6/23/99	275								
5/20/98	110	6/30/99	605								
6/1/98	330	**Total**	**14135**								
6/10/98	90										
6/15/98	385										
6/22/98	165										
Total	**16185**										

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 multiposition borehole extensometers were installed during November and December 1985. Figures 3-10 and 3-11 illustrate the instrumentation configuration.

The extensometers at the 1,573-ft (480-m) level indicate annual collar displacement rates ranging from 0.016 to 0.019 in/yr. (0.047 to 0.048 cm/yr.) These rates have not significantly changed from the previous reporting periods. At the 2,066-ft (630-m) level, the annualized collar displacement rate was 0.072 in/yr (0.183 cm/yr) from the one functioning extensometer. These displacements indicate continued deformation into the shaft; however, there is no indication of accelerated movement. Table 3-3 summarizes information regarding collar displacement measurements from these extensometers.

Table 3-3
Collar Displacement at the Exhaust Shaft Extensometers

Field Tag	Location Shaft Level	Date Last Reading	Collar Displacement Relative to Deepest Anchor in. (cm)	Displacement Rate 2002 to 2003 in/yr (cm/yr)	Displacement Rate 2001 to 2002 in/yr (cm/yr)	Rate Change Percent	Comments
35X-GE-00204	1573	06/02/03	0.363 (0.922)	0.016 (0.041)	0.019 (0.048)	-16%	
35X-GE-00205	1573	06/02/03	0.380 (0.965)	0.017 (0.043	0.023 (0.058)	-26%	
35X-GE-00206	1573	06/02/03	0.393 (0.998)	0.019 (0.048)	0.024 (0.061)	-21%	
35X-GE-00207	2066	06/02/03	1.754 (4.455)	0.072 (0.183)	0.080 (0.203)	-10%	
35X-GE-00209	2066	07/03/02	1.244 (3.160)	N/A	0.059 (0.150)	N/A	Cable Failure

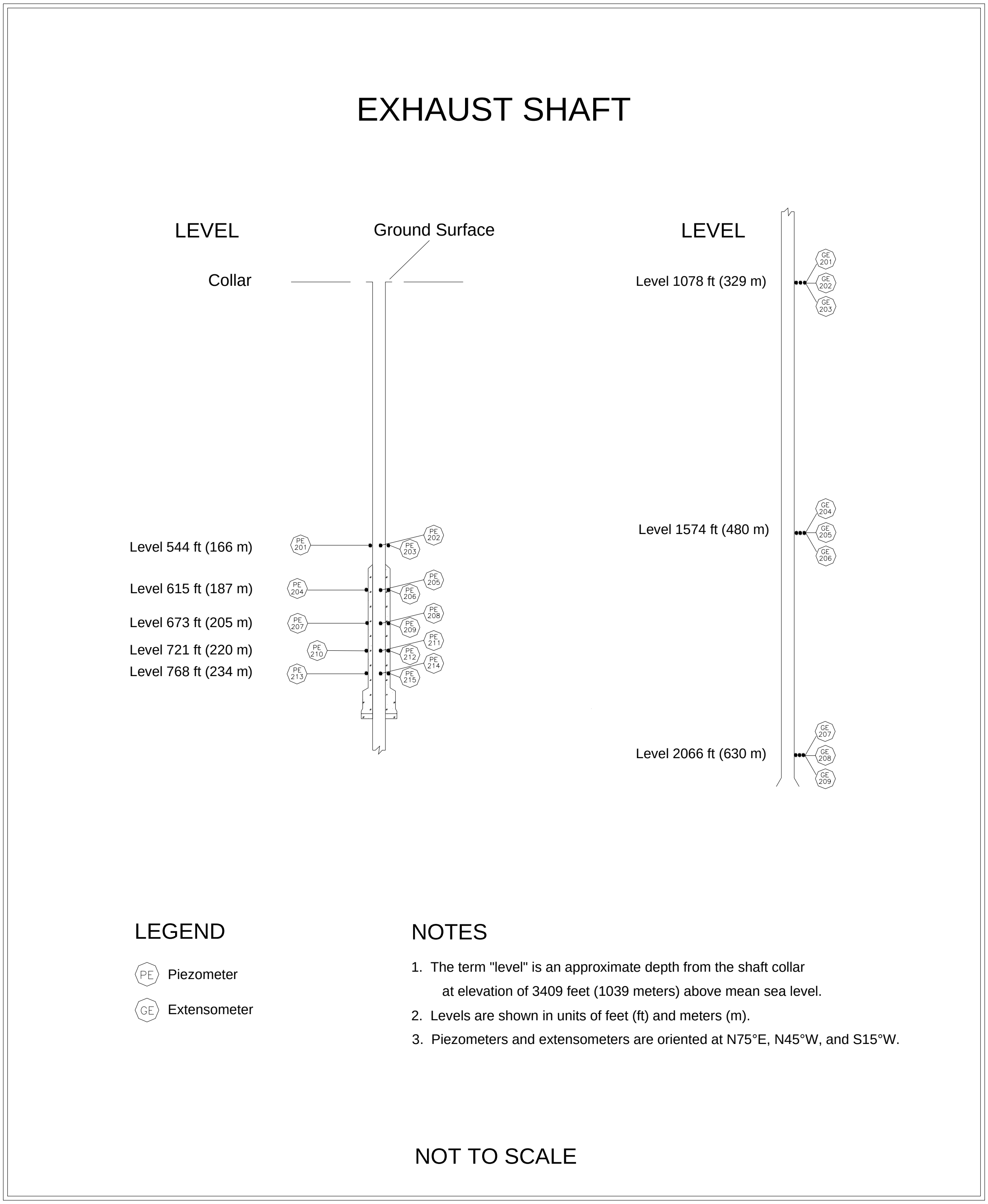
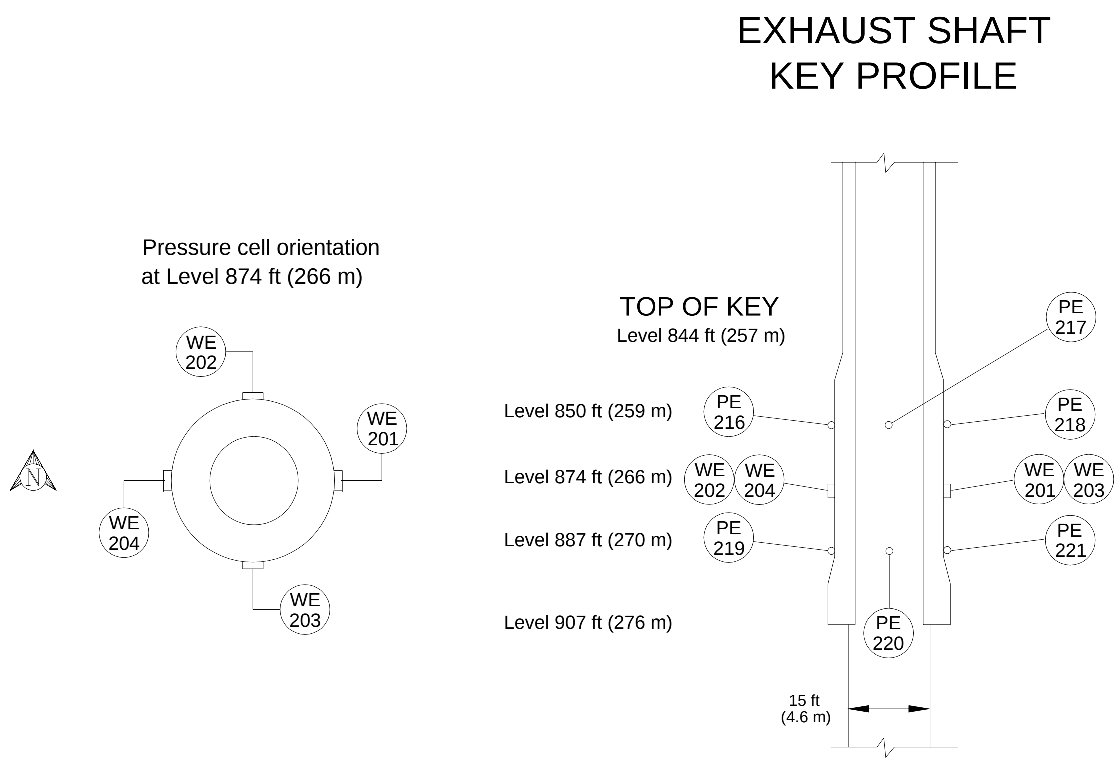


Figure 3-10
Exhaust Shaft Instrumentation (Without Shaft Key)



LEGEND

- WE — Pressure Cell
- PE — Piezometer

NOTES

1. The term "level" is an approximate depth from the shaft collar at elevation 3409 ft (1039 m) above mean sea level.
2. Pressure cells are located at concrete-rock interface and oriented at azimuths of 0°, 90°, 180°, and 270°.
3. Piezometers are oriented at N75°E, N45°W, and S15°W.

NOT TO SCALE

Figure 3-11
Exhaust Shaft Key Instrumentation

Thirteen of the 21 piezometers installed remain in working condition. The fluid pressure readings from the working piezometers at the end of the reporting period range from -3.5 psi (-24.1 kPa) at the 544-ft (165-m) level to 141 psi (971 kPa) at the 721-ft (219-m) level. Maximum pressure readings from the working piezometers during this reporting period were consistent with maximum readings from the previous reporting period with some of the recorded pressures having decreased slightly.

Four earth pressure cells were installed in the key section of the Exhaust Shaft during concrete emplacement. Currently, only two of these earth pressure cells are functional. During this reporting period, the pressure cell readings indicated changes of –0.3 and 0.4 percent. The recorded pressures during this period are 53.2 and 43.6 psi (367 and 300 kPa).

3.4 Air Intake Shaft

The Air Intake Shaft was drilled from December 4, 1987, to August 31, 1988, to establish a primary route for surface air to enter the repository (see Figure 1-2). Stratigraphic mapping was conducted from September 14, 1988, to November 14, 1989 (Holt and Powers, 1990). Figure 3-12 illustrates the Air Intake Shaft stratigraphy.

The Air Intake Shaft is lined with nonreinforced concrete from the surface to the bottom of the shaft key at a depth of 903 ft (275 m). The Air Intake Shaft key is 81 ft (25 m) long with an inside diameter of 16 ft (5 m). The diameter below the shaft key is 20 ft (6 m), and the shaft is unlined below the key to the facility horizon at a depth of 2,150 ft (655 m). The shaft walls are bolted and meshed from just below the key all the way down to the shaft station. The Air Intake 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.

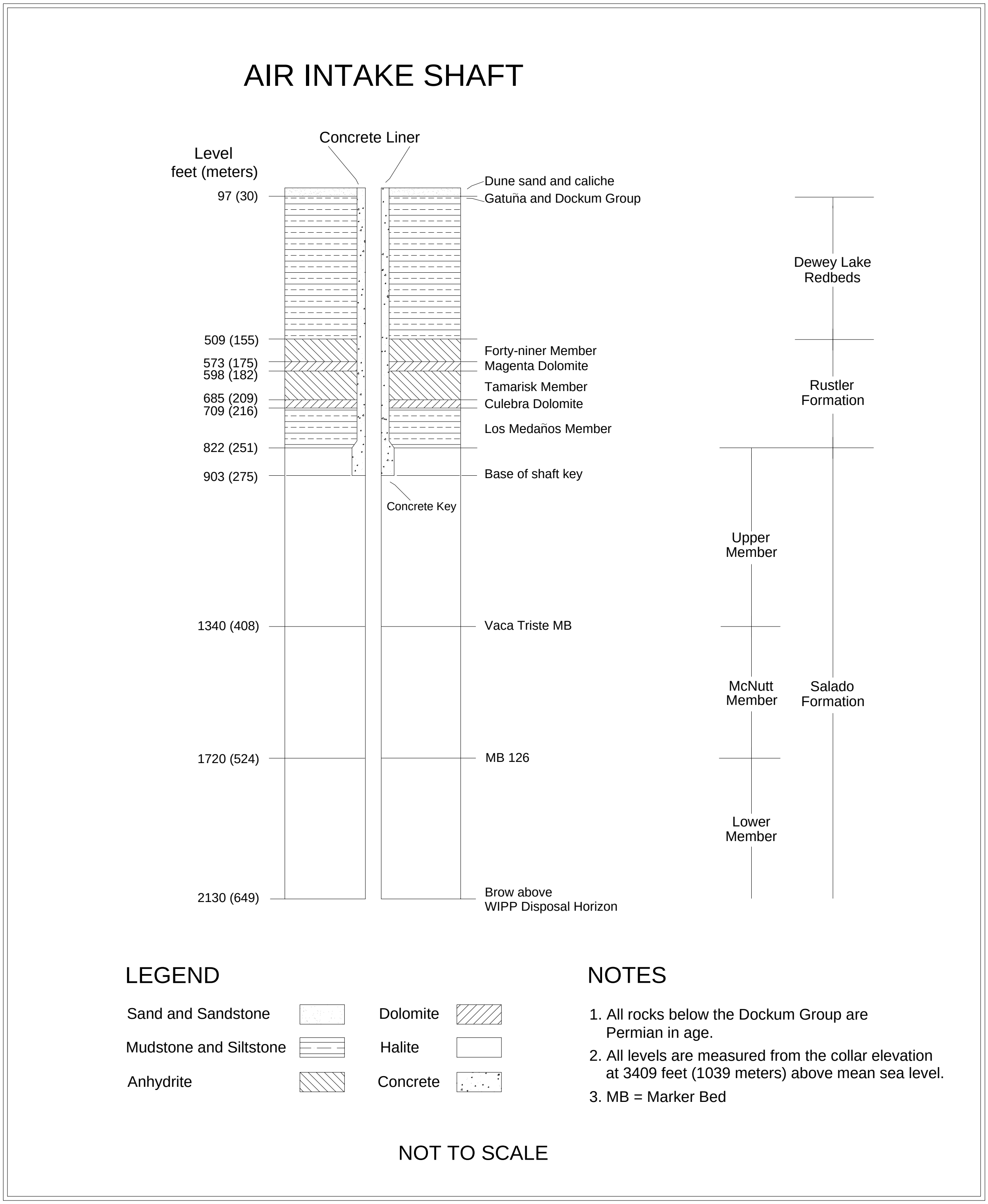


Figure 3-12
Air Intake Shaft Stratigraphy

3.4.2 Instrumentation

Sandia National Laboratories/New Mexico (SNL/NM) installed geomechanical instruments in the Air Intake Shaft in 1988. WTS maintains responsibility for the operation of all of the instruments located in the Air Intake Shaft as well as for data acquisition and instrument maintenance. WTS provides the data to SNL/NM for analysis. Data from these instruments are available from SNL/NM by request.

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4.0 Performance of Shaft Stations

This chapter describes the instrumentation and geomechanical performance of the shaft stations at the base of the Salt Handling Shaft, the Waste Shaft, and the Air Intake Shaft. The Exhaust Shaft does not have an enlarged shaft station and, therefore, is not included in this chapter.

4.1 Salt Handling Shaft Station

The Salt Handling Shaft Station was excavated between May 2 and June 3, 1982, by drilling and blasting. In 1987 the station was enlarged, removing the roof beam up to Anhydrite "b" between South 90 and North 20 using a mechanical scaler. In 1995 the remaining roof beam at the north end of the station was also removed up to Anhydrite "b." The station area south of the shaft is 90 ft (27.5 m) long and 32 to 38 ft (10 to 12 m) wide. The height of the station south of the shaft is 18 ft (5.5 m). The station dimensions north of the shaft are approximately 30 ft (9 m) long, 32 to 35 ft (10 to 11 m) wide, and 18 ft (5.5 m) high. The shaft extends approximately 140 ft (43 m) below the facility horizon to accommodate the skip loading equipment and to act as a sump. Figure 4-1 shows a generalized cross section of the station.

4.1.1 Modifications to Excavation and Ground Control Activities

No major modifications were performed in the Salt Handling Station during this reporting period. Removal of the roof beam immediately north of the station is addressed in Section 5, Performance of Access Drifts. Ground control was performed as routine maintenance.

4.1.2 Instrumentation

Geomechanical instrumentation was installed in the Salt Handling Shaft Station between June 1982 and February 1983, with subsequent reinstallation of extensometers and convergence points as necessary. Figure 4-2 shows the instrument locations after the roof beam was taken down.

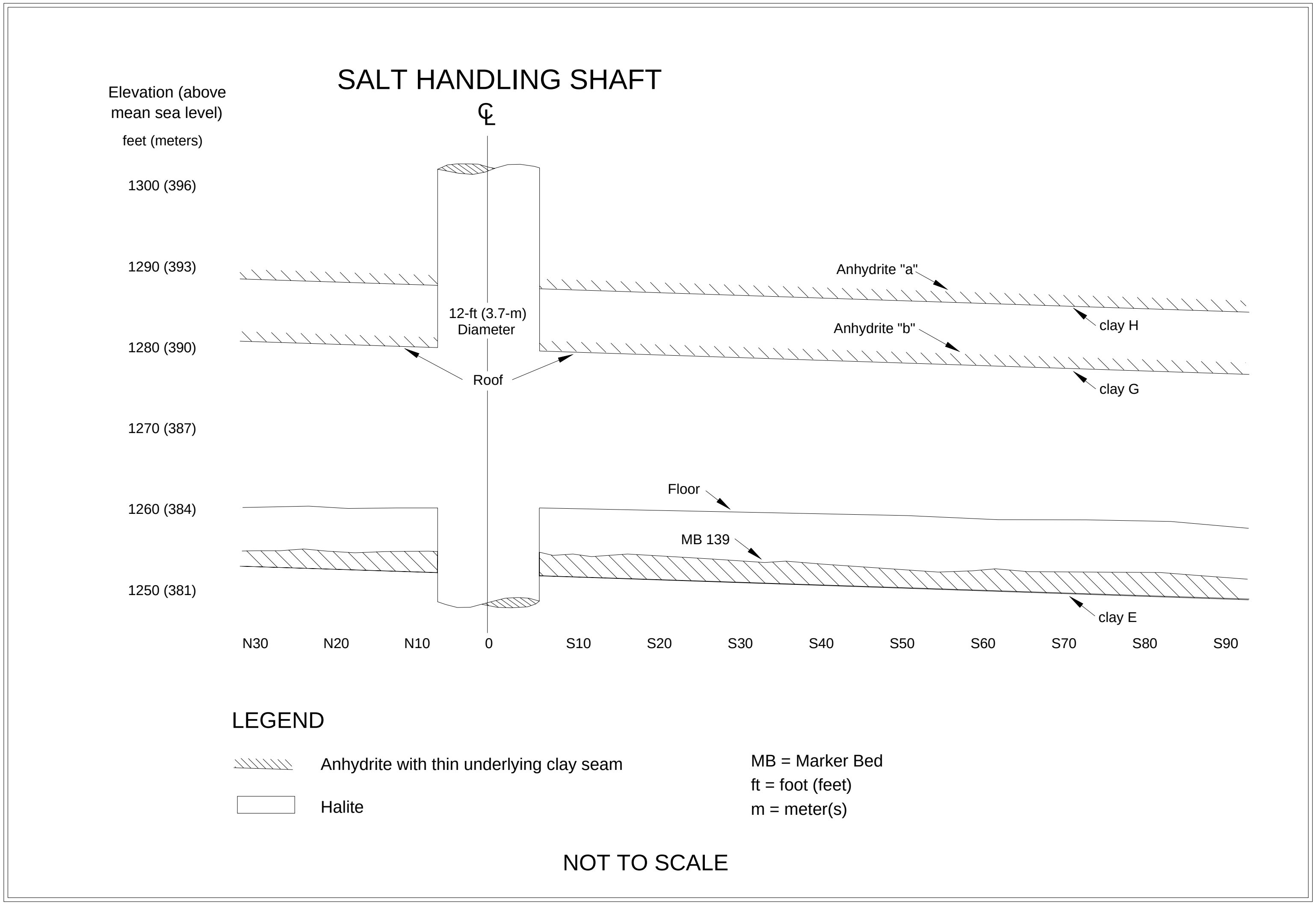

Figure 4-1
Salt Handling Shaft Station Stratigraphy

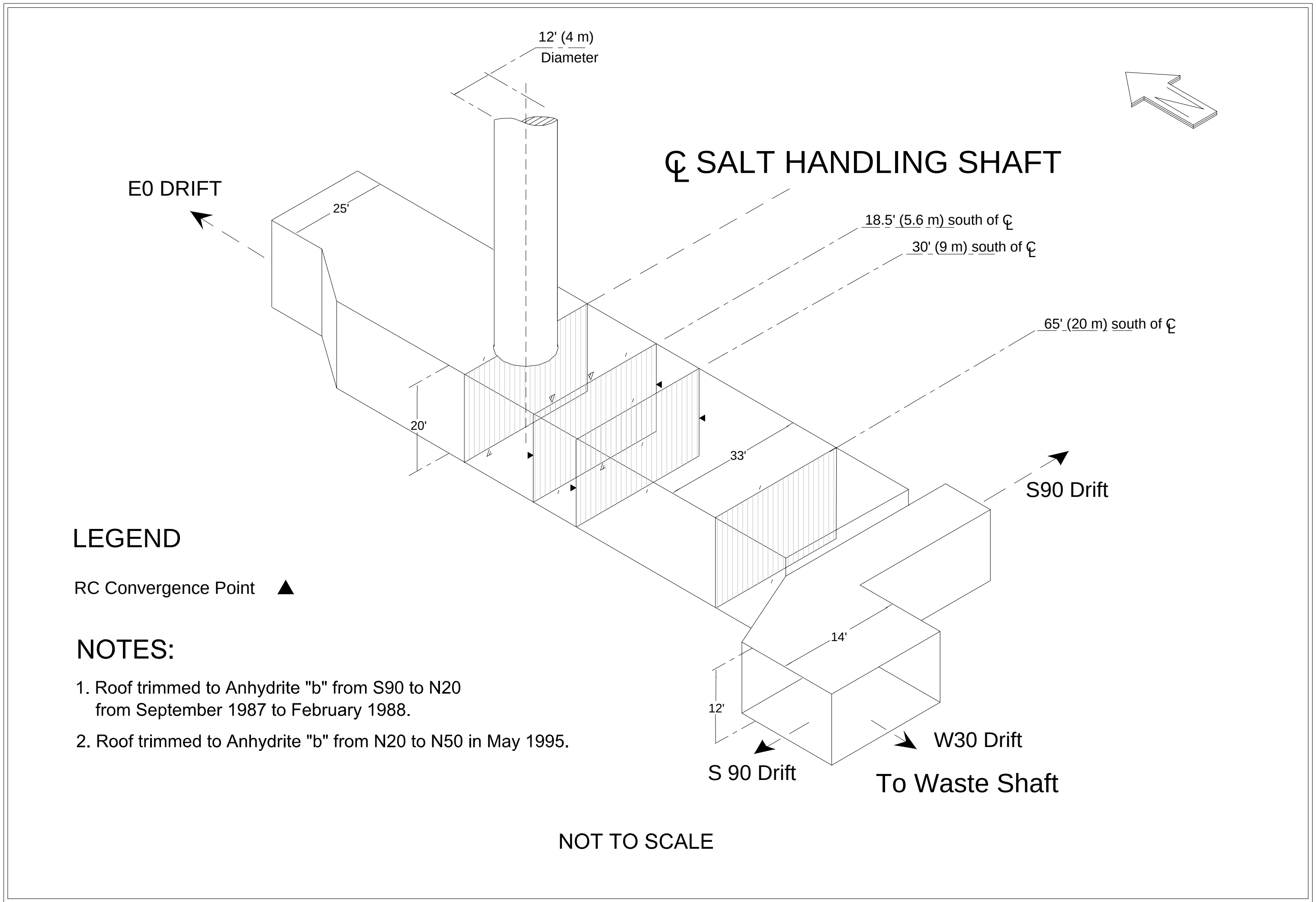

Figure 4-2
Salt Handling Shaft Station Instrumentation After Roof Beam Excavation

There were three extensometers located in the Salt Handling Shaft Station. Due to instrument malfunctions and the removal of one extensometer during roof removal, there are no extensometer data for the Salt Handling Shaft Station for this reporting period; however, historical data are maintained for comparative purposes. Four vertical convergence point arrays and one horizontal convergence chord are currently monitored. Table 4-1 summarizes the vertical closure rates in the Salt Handling Shaft Station from July 2002 through June 2003. Salt Handling Shaft Station vertical closure rates have remained relatively consistent compared to previous reporting periods.

Table 4-1
Vertical Closure Rates in the Salt Handling Shaft Station

Field Tag	Location	Last Reading Date	Cumulative Displacement (inches)	2002-2003 Closure Rate in./yr (cm/yr)	2001-2002 Closure Rate in./yr (cm/yr)	Percent Rate Change
E0-W12-5 A-C	Salt Shaft-W12	06/05/03	16.971	0.832 (2.113)	0.765 (1.943)	9%
E0-S18-6 A-E	E0 Drift-S18	06/05/03	24.632	1.573 (4.000)	1.579 (4.011)	0%
E0-S18-4 B-D	E0 Drift-S18	06/05/03	24.796	1.831 (4.651)	1.596 (4.054)	15%
E0-S18-4 F-H	E0 Drift-S18	06/05/03	15.709	1.103 (2.802)	1.016 (2.581)	9%
E0-S30-5 A-C	E0 Drift-S30	06/05/03	39.043	1.652 (4.201)	1.533 (3.894)	8%
E0-S65-3 A-C	E0 Drift-S65	06/05/03	35.902	1.235 (3.137)	1.201 (3.051)	3%

in./yr = inch(es) per year.
cm/yr = centimeter(s) per year.

4.2 Waste Shaft Station

The Waste Shaft Station was initially excavated with a continuous miner as a ventilation connection to a 6-ft (2-m) diameter exhaust shaft in November 1982. In 1984, the station was enlarged to a height of 15 to 20 ft (4.5 to 6 m) and a width of 20 to 30 ft (6 to 9 m). The station is approximately 150 ft (46 m) long. In 1988, the station walls were trimmed and concrete was placed on the floor. Since 1988, the Waste Shaft Station has undergone three major floor renovations. A 53-ft (16-m)-long section of the reinforced concrete was removed in February 1991, in 1995 an additional 30-ft (9-m) section was removed, and in 2000 the most recent floor maintenance included trimming of the floor and reinstallation of the rails supported by segmented concrete panels on a crushed rock backfill. Figure 4-3 shows a cross section of the Waste Shaft Station.

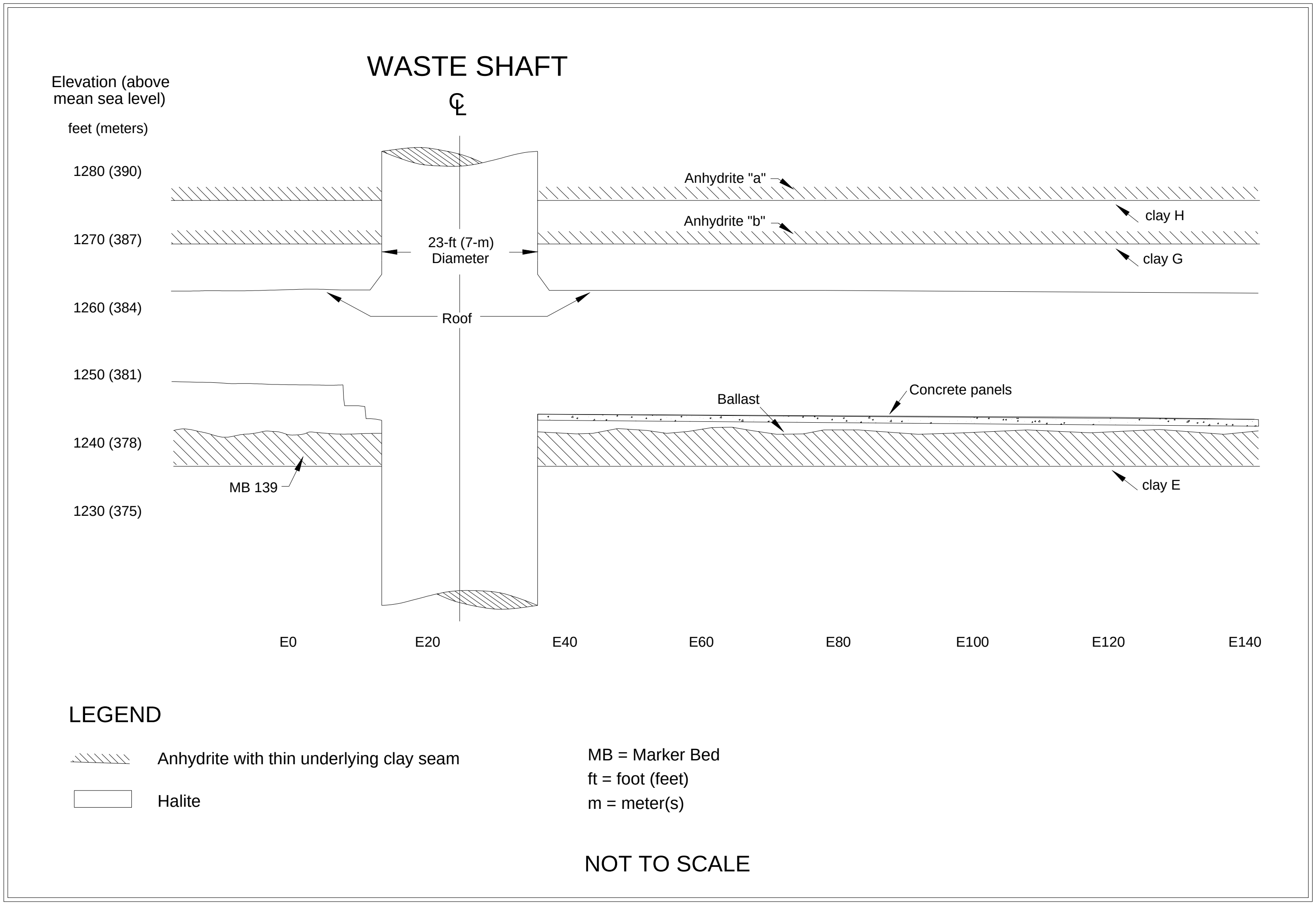

Figure 4-3
Waste Shaft Station Stratigraphy

4.2.1 Modifications to Excavation and Ground Control Activities

Ground control activities performed in the Waste Shaft Station during this reporting period consisted of routine rib maintenance and the routine replacement of failed rock bolts.

4.2.2 Instrumentation

Instruments were initially installed in the Waste Shaft Station between November 12 and December 2, 1982. Figure 4-4 illustrates the locations after enlargement. There are two extensometers in the roof of the Waste Shaft Station (located at West 30 and East 140) that are currently being monitored. In addition, horizontal convergence is being monitored at East 30 and East 90.

Table 4-2 summarizes the history of the roof extensometers in the Waste Shaft Station. The extensometers, 51X-GE-00268 (West 30) and 51X-GE-00279 (East 140), remain in good working condition and the data indicate a relatively steady displacement rate. Extensometers 51X-GE-00277 (East 35) and 51X-GE-00278 (East 90) are no longer functional due to damage. The annual displacement rate calculated for extensometer 51X-GE-00279, located in South 400 drift at East 140, is -19.0 percent lower than the rate calculated for the previous reporting period. The data trend at this installation is consistent with historic displacement rates for this instrument.

Table 4-3 summarizes the annual horizontal closure rates calculated from convergence point data for this reporting period. The data indicate a slight decrease in horizontal closure rates at East 30 and East 90 of -7.0 and -1.0 percent, respectively, relative to the previous annual closure rates.

Sixteen rock bolt load cells are installed in the roof and brow of the Waste Shaft Station. The loads on these rock bolts are monitored regularly.

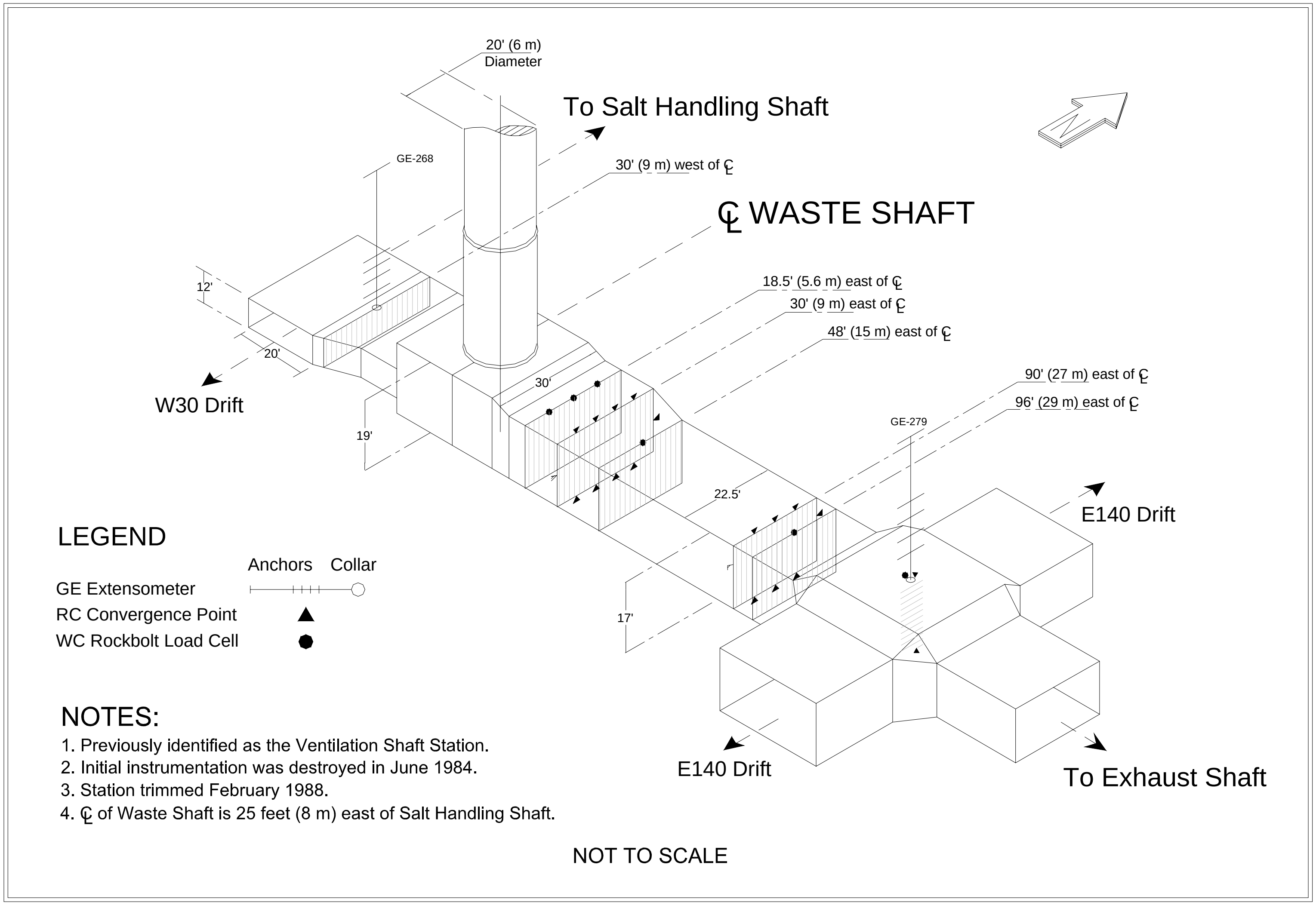

Figure 4-4
Waste Shaft Station Instrumentation After Wall Trimming

Table 4-2
Historical Summary of Roof Extensometers in Waste Shaft Station

Instrument	Location	Date Installed	Date of Last Reading	Collar Displacement Relative to Deepest Anchor in. (cm)	Displacement Rate 2002 to 2003 in./yr (cm/yr)	Displacement Rate 2001 to 2000 in./yr (cm/yr)	Rate Change Percent
51X-GE-00268	S400-W30	10/24/1984	6/02/2003	7.928 (20.137)	0.254 (0.645)	0.243 (0.617)	5%
51X-GE-00279	S400-E140	11/29/1988	5/12/2003	10.212 (25.939)	0.662 (1.682)	0.820 (2.083)	-19%

cm = centimeter(s)
in. = inch(es)

Table 4-3
Horizontal Closure Rates in the Waste Shaft Station

Location Date of Last	Date of Last Reading	Last Reading in. (cm)	Cumulative Displacement in. (cm)	2002 to 2003 Closure Rate in./yr (cm/yr)	2001 to 2002 Closure Rate in./yr (cm/yr)	Percent Rate Change
S400-E30	6/04/2003	15.753 (40.010)	15.826 (40.198)	0.856 (2.174)	0.920 (2.337)	-7%
S400-E90	6/04/2003	17.920 (45.517)	18.111 (46.002)	0.958 (2.433)	0.968 (2.459)	-1%

cm/yr = centimeter(s) per year.
in./yr = inch(es) per year.

4.3 Air Intake Shaft Station

The Air Intake Shaft Station was excavated in late 1987 and early 1988 using a continuous miner. The Air Intake Shaft typically is not used to transport personnel or materials between the surface and the underground, but does have a work platform that can be raised and lowered in the shaft to perform routine ground maintenance. There is minimal operational activity at the Air Intake Shaft Station.

4.3.1 Modifications to Excavation and Ground Control Activities

Bolts and mesh around the shaft brow were installed during this reporting period. Routine maintenance and inspections were also performed at the Air Intake Shaft Station during this reporting period.

4.3.2 Instrumentation

Convergence point and extensometer instrumentation located near the Air Intake Shaft Station is presented in Chapter 5.0 as part of the discussion on the performance of the access drifts. Twenty rock bolt load cells installed in the Air Intake Shaft Station area are monitored regularly.

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5.0 Performance of Access Drifts

This chapter describes the geomechanical performance of the central underground access drifts. The Northern Experimental Area and the Waste Disposal Area are discussed later in Chapters 6.0 and 7.0, respectively. There are four major north-south drifts in the WIPP underground, intersected by shorter east-west cross-drifts. These drift dimensions range from 8 ft (2.4 m) to 21 ft (6.4 m) in height and from 14 ft (4.3 m) to 33 ft (9.2 m) in width.

5.1 Modifications to Excavation and Ground Control Activities

The four major north-south access drifts were extended towards the south during this reporting period. Trimming, scaling, and floor milling activities were performed as necessary in many areas throughout the WIPP underground. Table 5-1 summarizes these activities. Table 5-1 also summarizes ground control activities (e.g., rock bolting and installing wire mesh) performed in various locations in the access drifts. The roof was removed to above Anhydrite “b” in the two major north-south access drifts, East 0 and East 140, north to North 1400 and in East 140, South 1900 to South 2600.

5.2 Instrumentation

This section discusses instrumentation details and locations for each instrumentation type.

5.2.1 Borehole Extensometers

Sixteen new extensometers were installed during this reporting period. All of these borehole extensometers were installed in the north and south mains with the exception of one installation in Panel 3, Room 1. All operating underground extensometers continue to be monitored. Twenty-four borehole extensometers were damaged or mined out during this reporting period. Fifty borehole extensometers continue to be monitored.

5.2.2 Convergence Points

Figure 5-1 shows typical convergence point array configurations. Instrumentation installed during this reporting period was limited to the installation and replacement of convergence point arrays and the installation of new monitoring arrays in the newly mined areas. Ninety-six new convergence points were reinstalled in various locations throughout the WIPP underground where rib, roof, or floor trimming activities had been performed during this and the previous reporting periods. Horizontal and vertical convergence point arrays were installed at various locations in the West 170, West 30, East 140, and East 300 drifts.

Convergence points within the access drifts are read manually at least every two months, with more frequent monitoring in some areas. Table 5-2 lists the new and replacement convergence points that were installed during this reporting period.

Table 5-1
Summary of Modifications and Ground Control Activities in the Access Drifts
July 1, 2002, through June 30, 2003

Location	Work Performed
E300/S2750 to S3310	Cut to final
E300/S3110 to S3380	Rough cut
E140/S2750 to S3310	Cut to final
E140/S3100 to S3496	Rough cut
W30/S2750 to S3310	Cut to final
W30/S3110 to S3366	Rough cut
W170/S2750 to S3310	Cut to final
W170/S3110 to S3347	Rough cut
S3080/W170 to E300	Cut to final
S3310/W170 to E300	Cut to final and rough cut
E300/S1600, S2180, S2750, and S3080	Cut overcasts
E140/S1920 to S2600	Roof removal cut final to clay G
Entire accessible underground	Annual ground survey
E140/S2520 to S3080	Installed mechanical bolts and chainlink mesh
W30/S2520 to S3080	Installed mechanical bolts and chainlink mesh
E140/S1500 to S1700, S1800 to S1900	Installed 12’ rock bolts and mats
N780/E0 to E140	Installed mechanical bolts and chainlink mesh
E300/S1600 Intersection	Installed mechanical bolts and chainlink mesh
E140/S1950 Intersection	Installed mechanical bolts and chainlink mesh
S2520/W30 to E140	Installed mechanical bolts and chainlink mesh
E300/S3080 Intersection brows	Installed mechanical bolts and chainlink mesh
Air Intake Shaft station	Installed 13’ rock bolts
N300 drift and Core Storage drift	Replaced broken mechanical rock bolts
E0/N910 to N1100	Roof removal rough cut
E140/N780 to N1100	Roof removal rough cut

Table 5-2
New and Replaced Convergence Points Installed in the Access Drifts
July 1, 2002, through June 30, 2003

Location	N/R	Field Tag*	Chord#	Date Installed
E0 DRIFT-N562	N	E0-N562	A-C (Vertical)	04/28/2003
E0 DRIFT-N562	N	E0-N562	B-D (Horizontal)	04/28/2003
E0 DRIFT-N626	R	E0-N626-4	A-C (Vertical)	04/28/2003
E0 DRIFT-N686	N	E0-N686	A-C (Vertical)	04/28/2003
E0 DRIFT-N686	N	E0-N686	B-D (Horizontal)	04/28/2003
E140 DRIFT-N562	R	E140-N562-2	A-C (Vertical)	03/25/2003
E140 DRIFT-N562	R	E140-N562-2	B-D (Horizontal)	03/25/2003
E140 DRIFT-N626	R	E140-N626-3	A-C (Vertical)	03/25/2003
E140 DRIFT-N626	R	E140-N626-4	B-D (Horizontal)	03/25/2003
E140 DRIFT-N686	R	E140-N686-2	A-C (Vertical)	03/26/2003
E140 DRIFT-N686	R	E140-N686-2	B-D (Horizontal)	03/26/2003
E140 DRIFT-N780	R	E140-N780-2	A-C (Vertical)	03/26/2003
E140 DRIFT-S1950	R	E140-S1950-5	A-C (Vertical)	03/12/2003
E140 DRIFT-S2007	R	E140-S2007-3	A-C (Vertical)	03/12/2003
E140 DRIFT-S2065	R	E140-S2065-2	B-D (Horizontal)	03/12/2003
E140 DRIFT-S2065	R	E140-S2065-3	A-C (Vertical)	03/12/2003
E140 DRIFT-S2122	R	E140-S2122-3	A-C (Vertical)	03/12/2003
E140 DRIFT-S2180	R	E140-S2180-4	A-C (Vertical)	03/12/2003
E140 DRIFT-S2275	R	E140-S2275-2	A-C (Vertical)	03/12/2003
E140 DRIFT-S2350	R	E140-S2350-3	A-C (Vertical)	03/12/2003
E140 DRIFT-S2425	R	E140-S2425-2	A-C (Vertical)	03/12/2003
E140 DRIFT-S2520	R	E140-S2520-2	A-C (Vertical)	03/12/2003
E140 DRIFT-S2634	N	E140-S2634	A-C (Vertical)	03/18/2003
E140 DRIFT-S2634	N	E140-S2634	B-D (Horizontal)	03/18/2003
E140 DRIFT-S2750	N	E140-S2750	A-C (Vertical)	12/30/2002
E140 DRIFT-S2833	N	E140-S2833	A-C (Vertical)	12/19/2002
E140 DRIFT-S2833	N	E140-S2833	B-D (Horizontal)	12/19/2002
E140 DRIFT-S2915	N	E140-S2915	A-C (Vertical)	12/23/2002
E140 DRIFT-S2915	N	E140-S2915	B-D (Horizontal)	12/23/2002
E140 DRIFT-S2998	N	E140-S2998	A-C (Vertical)	12/23/2002
E140 DRIFT-S2998	N	E140-S2998	B-D (Horizontal)	12/23/2002
E140 DRIFT-S3080	N	E140-S3080	A-C (Vertical)	02/20/2003
E140 DRIFT-S3195	N	E140-S3195	A-C (Vertical)	02/20/2003
E140 DRIFT-S3195	N	E140-S3195	B-D (Horizontal)	02/20/2003
E140 DRIFT-S3310	N	E140-S3310	A-C (Vertical)	02/20/2003
E300 DRIFT-S2634	N	E300-S2634	A-C (Vertical)	01/29/2003
E300 DRIFT-S2634	N	E300-S2634	B-D (Horizontal)	01/29/2003
E300 DRIFT-S2833	N	E300-S2833	A-C (Vertical)	01/29/2003
E300 DRIFT-S2833	N	E300-S2833	B-D (Horizontal)	01/29/2003
E300 DRIFT-S2916	N	E300-S2916	A-C (Vertical)	01/29/2003
E300 DRIFT-S2916	N	E300-S2916	B-D (Horizontal)	01/29/2003
E300 DRIFT-S2998	N	E300-S2998	A-C (Vertical)	02/24/2003
E300 DRIFT-S2998	N	E300-S2998	B-D (Horizontal)	02/24/2003
E300 DRIFT-S3195	N	E300-S3195	A-C (Vertical)	02/20/2003
E300 DRIFT-S3195	N	E300-S3195	B-D (Horizontal)	02/20/2003
E660 DRIFT-S2275	R	E660-S2275-3	A-C (Vertical)	07/03/2002

N = New installation.

R = Replacement installation (i.e., instrument replaces older instrument that has failed or has been mined out).
*Field tag chords are defined in "Geotechnical Analysis Report for July 2002–June 2003 Supporting Data.
#Chord configuration is defined in "Geotechnical Analysis Report for July 2002–June 2003 Supporting Data."

Table 5-2 (continued)

Location	N/R	Field Tag*	Chord#	Date Installed
E660 DRIFT-S2350	R	E660-S2350-4	A-C (Vertical)	07/10/2002
E660 DRIFT-S2425	R	E660-S2425-3	A-C (Vertical)	07/03/2002
N780 DRIFT-E70	N	N780-E70	A-C (Vertical)	04/30/2003
N780 DRIFT-E70	N	N780-E70	B-D (Horizontal)	04/30/2003
S2520 DRIFT-E660	R	S2520-E660-2	A-C (Vertical)	07/03/2002
S2750 DRIFT-E220	N	S2750-E220	A-C (Vertical)	01/28/2003
S2750 DRIFT-E220	N	S2750-E220	B-D (Horizontal)	01/28/2003
S2750 DRIFT-E55	N	S2750-E55	A-C (Vertical)	12/19/2002
S2750 DRIFT-E55	N	S2750-E55	B-D (Horizontal)	12/19/2002
S2750 DRIFT-W93	N	S2750-W93	A-C (Vertical)	01/13/2003
S2750 DRIFT-W93	N	S2750-W93	B-D (Horizontal)	01/13/2003
S3080 DRIFT-E220	N	S3080-E220	A-C (Vertical)	02/24/2003
S3080 DRIFT-E220	N	S3080-E220	B-D (Horizontal)	02/24/2003
S3080 DRIFT-E55	N	S3080-E55	A-C (Vertical)	01/22/2003
S3080 DRIFT-E55	N	S3080-E55	B-D (Horizontal)	01/22/2003
S3080 DRIFT-W100	N	S3080-W100	A-C (Vertical)	01/21/2003
S3080 DRIFT-W100	N	S3080-W100	B-D (Horizontal)	01/21/2003
S3310 DRIFT-E220	N	S3310-E220	A-C (Vertical)	02/20/2003
S3310 DRIFT-E220	N	S3310-E220	B-D (Horizontal)	02/20/2003
S3310 DRIFT-E55	N	S3310-E55	A-C (Vertical)	03/07/2003
S3310 DRIFT-E55	N	S3310-E55	B-D (Horizontal)	03/07/2003
S3310 DRIFT-W100	N	S3310-W100	A-C (Vertical)	03/07/2003
S3310 DRIFT-W100	N	S3310-W100	B-D (Horizontal)	04/30/2003
W170 DRIFT-S2750	N	W170-S2750	A-C (Vertical)	11/20/2002
W170 DRIFT-S2833	N	W170-S2833	A-C (Vertical)	01/16/2003
W170 DRIFT-S2833	N	W170-S2833	B-D (Horizontal)	01/16/2003
W170 DRIFT-S2916	N	W170-S2916	A-C (Vertical)	01/16/2003
W170 DRIFT-S2916	N	W170-S2916	B-D (Horizontal)	04/30/2003
W170 DRIFT-S2998	N	W170-S2998	A-C (Vertical)	01/16/2003
W170 DRIFT-S2998	N	W170-S2998	B-D (Horizontal)	01/16/2003
W170 DRIFT-S3080	N	W170-S3080	A-C (Vertical)	01/16/2003
W170 DRIFT-S3195	N	W170-S3195	A-C (Vertical)	01/21/2003
W170 DRIFT-S3195	N	W170-S3195	B-D (Horizontal)	01/21/2003
W170 DRIFT-S3310	N	W170-S3310	A-C (Vertical)	03/07/2003
W170 DRIFT-S90	R	W170-S90-3	A-C (Vertical)	08/09/2002
W30 DRIFT-S2750	N	W30-S2750	A-C (Vertical)	12/30/2002
W30 DRIFT-S2833	N	W30-S2833	A-C (Vertical)	01/23/2003
W30 DRIFT-S2833	N	W30-S2833	B-D (Horizontal)	01/23/2003
W30 DRIFT-S2916	N	W30-S2916	A-C (Vertical)	02/24/2003
W30 DRIFT-S2916	N	W30-S2916	B-D (Horizontal)	02/24/2003
W30 DRIFT-S2998	N	W30-S2998	A-C (Vertical)	01/23/2003
W30 DRIFT-S2998	N	W30-S2998	B-D (Horizontal)	01/23/2003
W30 DRIFT-S3080	N	W30-S3080	A-C (Vertical)	01/22/2003
W30 DRIFT-S3195	N	W30-S3195	A-C (Vertical)	01/22/2003
W30 DRIFT-S3195	N	W30-S3195	B-D (Horizontal)	01/22/2003
W30 DRIFT-S3310	N	W30-S3310	A-C (Vertical)	03/07/2003

N = New installation.

R = Replacement installation (i.e., instrument replaces older instrument that has failed or has been mined out).

*Field tag chords are defined in “Geotechnical Analysis Report for July 2002–June 2003 Supporting Data.

#Chord configuration is defined in “Geotechnical Analysis Report for July 2002–June 2003 Supporting Data.”

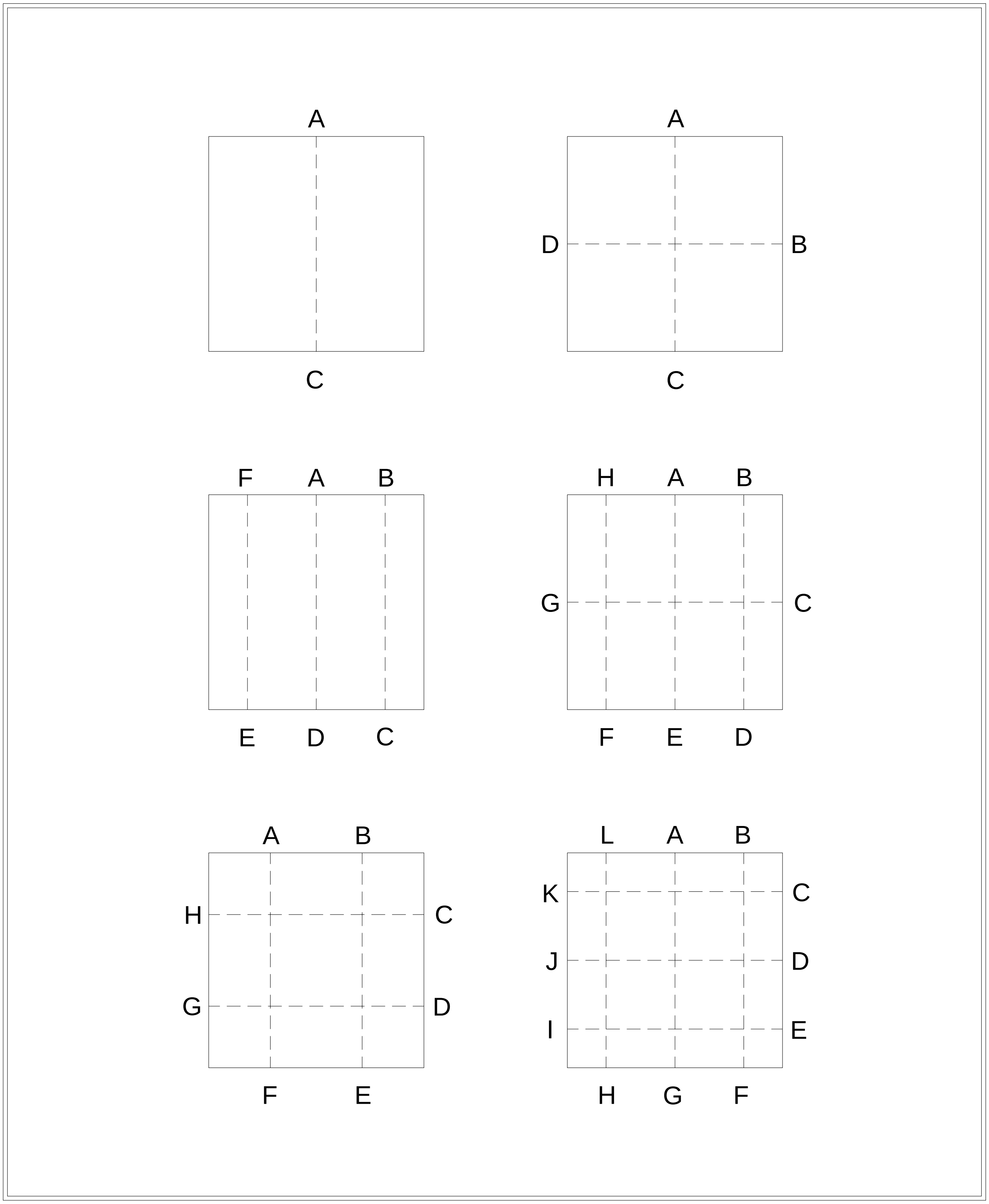

Figure 5-1
Typical Convergence Point Array Configurations

5.3 Analysis of Convergence Point and Extensometer Data

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. Extensometer data are obtained by measuring the displacement from the reference head anchor (collar) to each fixed anchor of the extensometer. These measurements are made, at a minimum, every two months throughout the WIPP underground, with the exception of when convergence points are not accessible. Convergence rates and extensometer displacement rates and indicate how an excavation is performing; rates that decrease or are relatively constant typify stable excavations, whereas increasing rates may indicate some type of developing instability.

Where possible, annual closure rates were calculated from convergence point array data from the access drifts. A complete tabulation of these convergence point data and calculated closure rates are presented in the supporting data document for this report[5]. Locations with increases in annual vertical and horizontal closure rates of greater than 10 percent are listed in Table 5-3.

Routinely, extensometer displacement rates and convergence rates are plotted against time, and comparisons are made through time to identify any acceleration. Annual convergence rates are calculated by determining the difference between the first and last readings of the reporting period and dividing that difference by the time between the two readings (in years). Instruments that indicate acceleration are analyzed to determine the significance of the acceleration. Factors that are considered during the analysis include the magnitude of the respective rates, percentage increase, convergence history, and any recent excavation in the vicinity.

There are 50 active borehole extensometers being monitored at various locations in the access drifts. Of the 50 extensometers, 25 are in the southern East 140 drift to monitor the waste transport route. Where data are available, annual displacement rates were calculated for each of the active extensometers and compared to the annual displacement rates from the previous reporting period. Many of the extensometers in this area show increased rates; in some cases, this is attributed to lateral displacement. The increased movement in the

[5] Instrumentation data and data plots are presented in "Geotechnical Analysis Report for July 2002–June 2003 Supporting Data." The document is available upon request from the National Technical Information Service. See the back side of this documents cover sheet for details and addresses.

East 140 roof rates may also be attributed to localized fracturing and a clay stringer separation approximately 12 to 18 in. above the roof.

Table 5-3

Increases in Annual Vertical Convergence Rates Greater than 10 Percent in the Access Drifts

Location	Chord*	Last Reading 2002 to 2003 Date	Closure Rate 2002 to 2003 in./yr	Closure Rate 2001 to 2002 in./yr	Rate Change Percent [a]	Comments
E140-S2275-2	A-C	06/03/2003	11.037	3.768	193%	Mining Excavation and instrument re-installation.
E140-S2180-4	A-C	06/03/2003	3.739	2.072	80%	Mining Excavation and instrument re-installation.
E140-S2350-3	A-C	06/03/2003	4.489	2.994	50%	Mining Excavation and instrument re-installation.
E140-S2425-2	A-C	06/03/2003	4.449	2.791	59%	Mining Excavation and instrument re-installation.
E140-S2065-3	A-C	06/03/2003	3.599	2.480	45%	Mining Excavation and instrument re-installation.
E140-S2520-2	A-C	06/03/2003	3.805	2.674	42%	Mining Excavation and instrument re-installation.
S1000-E120-2	A-C	06/03/2003	1.108	0.788	41%	Clay stringer separation.
E140-S1950-5	A-C	06/03/2003	3.092	2.338	32%	Mining Excavation and instrument re-installation.
E140-N780-2	A-C	06/05/2003	3.613	2.905	24%	Instrument re-installation.
E300-S1300	A-C	06/10/2003	0.700	0.574	22%	
E140-S2007-3	A-C	06/03/2003	3.115	2.567	21%	Mining Excavation and instrument re-installation.
E140-S2122-3	A-C	06/03/2003	3.626	3.032	20%	Mining Excavation and instrument re-installation.
E140-S1862-2	A-E	06/03/2003	2.944	2.493	18%	Clay stringer separation.
E140-N686-2	A-C	06/05/2003	2.478	2.131	16%	Instrument re-installation.
E140-S1534-2	H-F	06/03/2003	2.986	2.573	16%	Clay stringer separation.
E140-N626-3	A-C	06/05/2003	2.844	2.478	15%	Instrument re-installation.
E300-N45	H-F	06/04/2003	1.533	1.349	14%	Instrument re-installation.
S90-W400	A-C	06/02/2003	0.765	0.671	14%	
S90-W920-2	A-C	06/02/2003	1.226	1.073	14%	
E140-S1534-2	A-E	06/03/2003	5.592	4.936	13%	Clay stringer separation.
S1950-E113-4	A-C	06/03/2003	0.712	0.642	11%	
E140-N562-2	A-C	06/05/2003	2.211	2.012	10%	Instrument re-installation.

[a] Increase in convergence rate is calculated from the difference between the 2001–2002 rate and the 2002–2003 rate.

*Chord is defined in "Geotechnical Analysis Report for July 2002–June 2003 Supporting Data."

in./yr = inch(es) per year.

Further analysis of these accelerations has shown many of them to be relatively insignificant. Others, such as the southern areas of the access drifts, had closure rate increases that can be directly attributed to the effects of mining Panel 3 and the associated access drifts. In the south half of Panel 2 and Panel 3 and the Panel 3 access drifts, increased closure rates will continue due to the continued mining of Panel 3 and the Panel 4 access drifts and redistribution of stress effects in those areas.

The rates in East 0 and East 140, north of North 460 and from South 1900 to South 2600, where the roof has been mined to Clay "G," show an increase in the closure rates. These rates are expected to decrease over time as the roof beam removal effect subsides. Convergence measurements in East 140 between South 1534 and South 1862 show an increasing trend over the long-term median convergence rate. This is due to a separation caused by a clay stringer approximately 12 in. to 18 in. above the roof and localized fracturing. A supplemental ground control system was installed in this area to address the separation.

5.4 Excavation Performance

Over 490 readings are collected and assessed on a regular basis from convergence point pairs located throughout the WIPP underground. Convergence rates continue to seasonally vary, typically increasing during the warmer summer months and decreasing during the cooler winter months.

The performance of the access drift excavations during this reporting period was within acceptable criteria. "Acceptable criteria" is when the drift remains accessible and the ground can be controlled by routine maintenance. Standard remedial ground control maintenance in some areas was required to maintain the performance of the excavations. The drifts remain stable and controlled. The majority of the annualized rates remain steady indicating stability. In some locations where the rates are high, nearby mining activities are most likely the cause. In other locations where necessary, additional ground control measures have been or will be installed.

6.0 Northern Experimental Area

This area includes all excavations north of the North 1100. Access to this area was blocked in August and September 1996 by the construction of barriers in the East 0 and East 140 drifts at North 800 and the area was deactivated. In October and November 1999, members of the Geotechnical Engineering Section and Underground Operations made a reentry and the area was reopened. Since that time, some areas have been renovated.

6.1 Modifications to Excavation and Ground Control Activities

Roof removal in East 0, East 140, and East 300 from the North 1100 to North 1400 was performed during this reporting period. Table 6-1 summarizes these activities. The Experimental Area was spot-bolted, replacing failed bolts and addressing drummy areas after roof removal. Muck disposal/backfilling operations have filled all areas west of the East 0 drift. All remote and manually read instruments of this area are no longer being read. As access to these areas is reestablished, it is anticipated that some instrumentation will be reinstalled, including both remote and manually read instruments.

Table 6-1
Summary of Modifications and Ground Control Activities
in the Northern Experimental Area
July 1, 2002, through June 30, 2003

Location	Work Performed
E0/N1100 to N1400	Roof removal rough cut
E140/N1100 to N1400	Roof removal rough cut
N1100/W70 to E343	Roof removal rough cut
N1400/W50 to E325	Roof removal rough cut
E300/N1100 to N1400	Roof removal rough cut
N1100/W570 to W70	Backfilled
N1400/W515 to W50	Backfilled

6.2 Deactivated Areas in the Northern Experimental Area

The Northern Experimental Area, including the SPDV rooms and associated access drifts, is no longer accessible and readings were temporarily discontinued in June 2002 to facilitate removal of the roof beam. Remote monitoring of instrumentation east of the East 300 shop was discontinued due to mining activities in North 1100 drift that required removal of the data logger. There are no instrument data results from this area during this reporting period.

6.3 Northern Experimental Area Condition

A reentry into previously closed sections of North 1100 and North 1400 drifts was performed on March 13, 2003. The purpose of the reentry was to evaluate this area for future operational use. This reentry documented the condition of installed ground support, opening geometry, and observed geotechnical conditions.

<u>North 1100</u>

Entry in North 1100 drift started at the barricade located just east of the East 300 intersection and progressed towards the east. Conditions in North 1100 drift varied with location along the drift. Minor and discontinuous low-angle fracturing was observed between the East 300 intersection to the ramp, which starts at approximately East 675 and ends at East 835. There were minor areas of drummy ground, generally near the rib line. The installed ground control was mostly intact with isolated roof bolt failures. The floor through this area was competent and in generally good condition.

The ramp area exhibited increasing deterioration as the roof beam thickness was reduced. The occurrence of low-angle fracturing increased along both ribs, ending at the brows. The brows were bolted and meshed; however, there was noticeable bulging of the mesh and localized bolt failures. The magnitude of floor heave increases as the ramp approaches the brow locations. Significant lateral rib movement was observed along the clay seam underlying the anhydrite layers. Small blocks of anhydrite formed by this rib movement were easily addressed by hand scaling.

This section between the ramp and Room D displayed generally good conditions. The roof was generally sounded with minor drummy areas observed. The ground control system was mostly intact and did not indicate excessive loading or stress. This section of North 1100 exhibited significant floor heave in localized areas. Significant lateral rib movement was observed along the clay seam underlying the anhydrite layers. Small blocks of anhydrite formed by this rib movement were easily addressed by hand scaling. The wooden cribs installed at the experimental room brow locations were intact and did not show excessive deformation.

Room D

Entry into Room D started from the North 1100 drift intersection and progressed north to approximately 125 feet into the room. Visual observations indicated a significant change in found conditions near the room center. A 25 to 30 ft section south of the room center exhibited significant roof deformation and rock bolt failures. The Tensar mesh continues to provide some containment, however, the rock bolt pattern supporting this area has mostly failed. Approximately one dozen bolts had failed and fallen to the ground. Visual observations indicated that these bolts had failed at approximately 4.5 to 5 ft into the roof and exhibited tensile failure characteristics. The ground support installed in Room D consists of resin-grouted threaded bar bolts with a plate and slip nut. A full load nut was installed on the bottom of the bolt to limit the amount of yield.

With the exception of the area near the room center, the remaining ground conditions were good. Excessive deformations of ground support failures were not observed.

North 1400

Entry in the North 1400 drift started at the barricade located just east of the East 300 intersection and progressed eastward. Conditions in North 1400 drift varied with location along the drift. Minor and discontinuous low angle fracturing was observed between the East 300 intersection to the ramp. There were minor areas of drummy ground, generally near the rib line. The installed ground control was mostly intact, with isolated roof bolt failures. The floor though this area was competent and in generally good condition. The alcoves are bolted and meshed and are in generally good condition, with the installed ground support mostly intact.

The ramp area exhibited increasing deterioration as the roof beam thickness was reduced. The occurrence of low angle fracturing increased along both ribs ending at the brows. The brows were bolted and meshed; however, there was noticeable bulging of the mesh and localized bolt failures. The magnitude of floor heave increases as the ramp approaches the brow locations. Significant lateral rib movement was observed along the clay seam underlying the anhydrite layers. Small blocks of anhydrite formed by this rib movement were easily addressed by hand scaling.

Entry east of the ramp progressed to approximately 100 feet from the intersection with Room B. Ground condition deterioration increased towards the east. Low angle fracturing in the roof increased in magnitude and continuity along both rib lines. Vertical fracturing along the centerline was observed running parallel to the axis of the drift. The ground support in this area has been greatly reduced due to significant roof bolt failures.

7.0 Performance of Waste Disposal Area

The Waste Disposal Area as of June 30, 2003, consist of Panels 1, 2 and 3. Panel 1 is closed. Panel 2 is currently being used for waste disposal, with Room 7 filled. Panel 3 is currently being mined as shown in Figure 1-2.

Excavation of the Panel 1 waste disposal area began in May 1986 with the mining of access entries to Panel 1. Initially, the disposal rooms and drifts were developed as pilot drifts that were later excavated to nominal operational dimensions of 13 ft (4 m) high, 33 ft (10 m) wide, and 300 ft (91 m) long. Room 1 was completed to these dimensions in August 1986, and pilot drifts for Rooms 2 and 3 were excavated in January and February 1987. Rooms 2 and 3 were completed in February and March 1988 and Rooms 4 through 7 were completed in May 1988. Short access drifts designed to lead to smaller test alcoves were excavated north off of the S1600 drift in June 1989. Only the access drifts to the alcoves were completed; the alcoves were not excavated. During this reporting period, waste emplacement in Panel 1 was completed and the panel is closed to all access.

Excavation of the Panel 2 waste disposal area began in September 1999 with the mining of access entries to Panel 2. Initially, the disposal rooms and drifts were developed as pilot drifts that 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 Rooms 4 through 6 in April 2000. The pilot drift for Room 7 was excavated in May 2000. All the rooms were excavated to final dimensions by August 2000.

Excavation of the Panel 3 waste disposal area began in January 2003 with the mining of access entries to Panel 3. As of June 30, 2003, South 2750 and South 3080 (the Panel 3 ventilation drifts) are rough cut from the east rib of Room 1 to the east of Room 5. The Panel 3 entries and Room 1 are mined to final dimensions. Room 2 is rough cut only (see Figure 1.2). Rooms 3 through 7 have not yet been mined.

7.1 Modifications to Excavations and Ground Control Activities

In Panel 1, excavations were made at East 460 in South 1600 and South 1950 drifts as part of the panel closure construction. No new excavations were mined in Panel 2 during the reporting period of July 2002 through June 2003. Panel 3 mining began in January 2003, with South 2750 and South 3080 being mined just east of Room 5. Panel 3, Room 1 was mined to final dimensions and Room 2 was rough cut. Routine maintenance and ground control activities in the form of trimming, scaling, rock bolt replacement, and installing wire mesh were performed on ribs, floor, and roof throughout accessible areas in Panels 1 and 2. During this reporting period, Panel 2, Rooms 2, 3, 4, 5, and parts of South 2520 were fully wire meshed and bolted. Table 7-1 summarizes the ground control activities performed in Panels 1, 2, and 3 during this reporting period.

7.2 Instrumentation

No extensometers or convergence points were installed or replaced in Panel 1 during this reporting period. Because of floor trimming, there were three convergence points replaced in Room 2 and one convergence point replaced in South 2520 at the intersection of Room 2, Panel 2 during this reporting period. Table 7-2 lists the convergence points replaced in Panel 2. Figure 7-1 shows the location of the various types of geotechnical instruments in Panel 1 of the Waste Disposal Area. During this reporting period, waste emplacement operations were completed and Panel 1 was closed. Remote monitoring of the extensometers was discontinued and the convergence points are no longer accessible in these rooms. Figure 7-2 shows the location of the various types of geotechnical instruments in Panel 2 of the Waste Disposal Area.

Table 7-1
Summary of Modifications and Ground Control Activities
in the Waste Disposal Area July 1, 2002, through June 30, 2003

Location	Work Performed
Panel 3, Room 1	Cut to final
Panel 3, Rooms 1 and 2	Rough cut
Panel 3, S2750/E330 to E1046	Rough cut
Panel 3, S2750/E330 to E520	Cut to final
Panel 3, S3080/E330 to E1092	Rough cut
Panel 3, S3080/E300 to E520	Cut to final
E460/S1600 and S1950	Excavation for Panel Closure Wall.
Panel 1, Rooms 1 and 2	Replaced broken channel bolts
S2520/Panel 2, rooms 5 to 7	Installed bolts and mesh
Panel 1, Rooms 1 and 2/Ribs	Installed bolts and mesh
Panel 3, Room 1	Installed bolts
Panel 2, Rooms 2, 3, 4, 5 and 6	Installed bolts and mesh

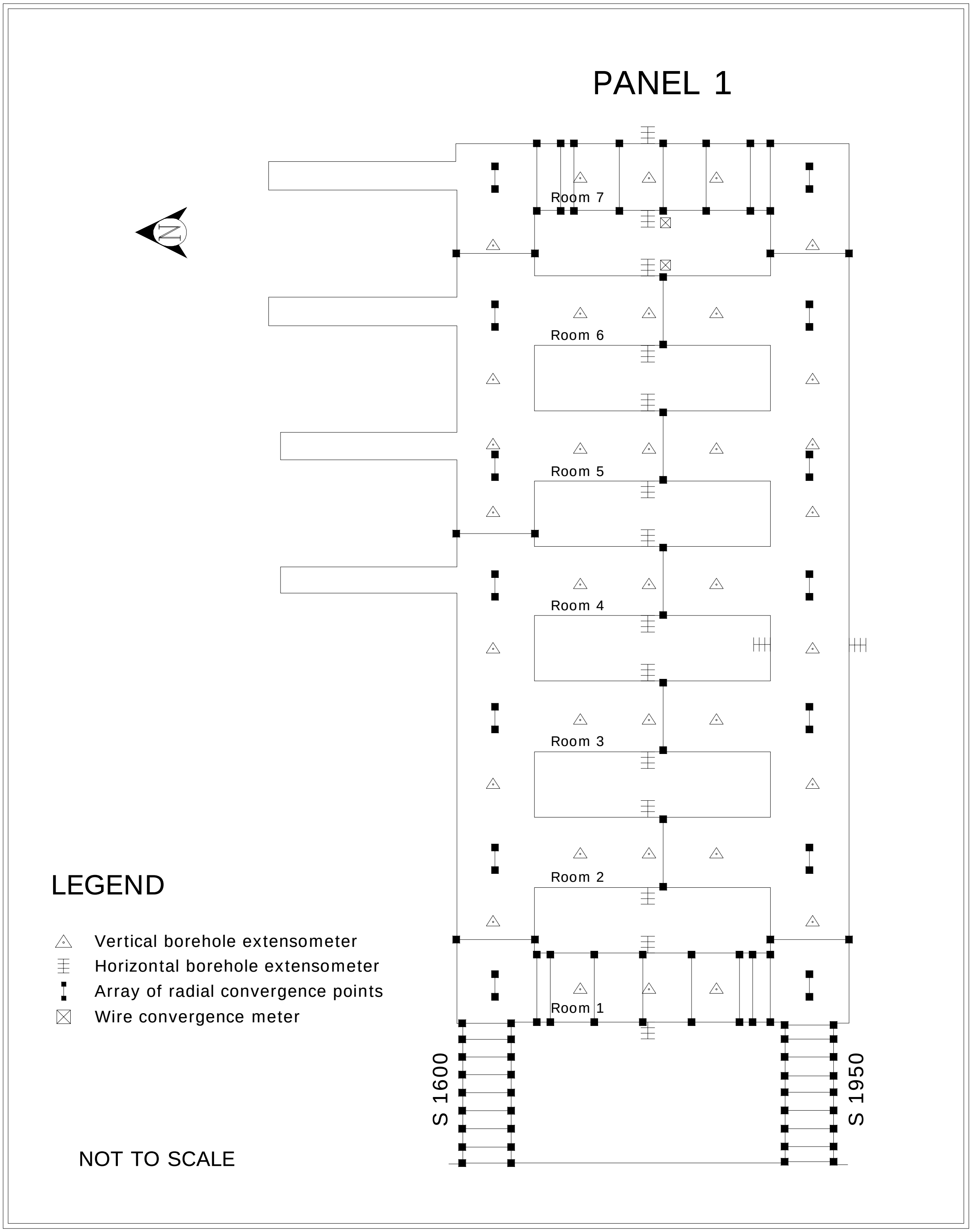

Figure 7-1
Location of Panel 1 Geotechnical Instruments

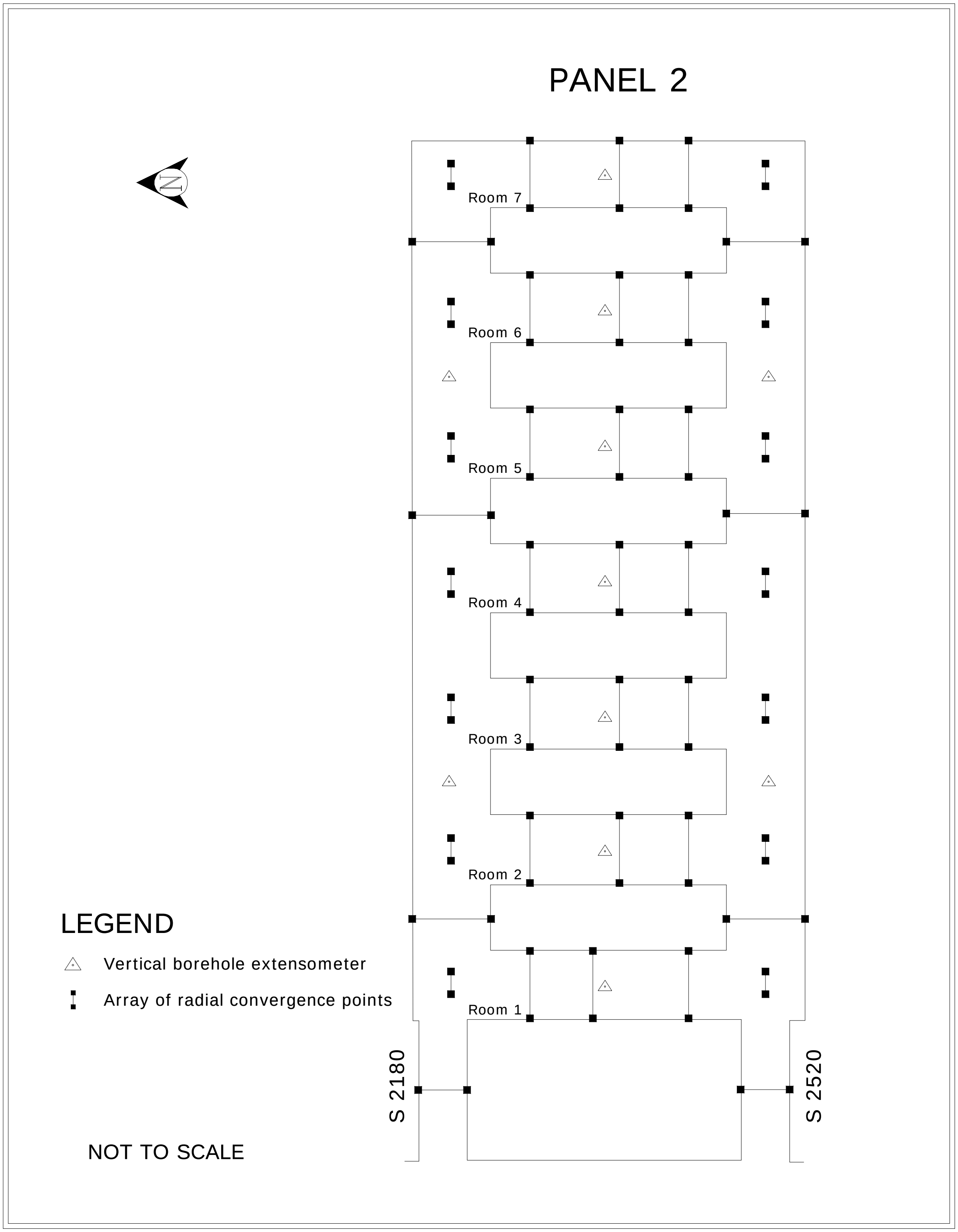

Figure 7-2
Location of Panel 2 Geotechnical Instruments

Table 7-2
New and Replaced Instruments in the Waste Disposal Area
July 1, 2002, through June 30, 2003

Instrument Type	N/R	Field Tag*	Chord#	Location	Date Installed
Convergence Point	R	E660-S2275-3	A-C (Vertical)	E660 DRIFT-S2275	07/03/2002
Convergence Point	R	E660-S2425-3	A-C (Vertical)	E660 DRIFT-S2425	07/03/2002
Convergence Point	R	S2520-E660-2	A-C (Vertical)	S2520 DRIFT-E660	07/03/2002
Convergence Point	R	E660-S2350-4	A-C (Vertical)	E660 DRIFT-S2350	07/10/2002

N = New installation.
R = Replacement installation (i.e., instrument replaces older instrument that has failed or has been mined out).
*Field tag chords is defined in "Geotechnical Analysis Report for July 2002–June 2003 Supporting Data.
#Chord configuration is defined in "Geotechnical Analysis Report for July 2002–June 2003 Supporting Data."

7.3 Excavation Performance

Horizontal and vertical convergence rates have been calculated at the center of each of the rooms in Panel 1 for this and the previous reporting period. Tables 7-3 and 7-4 present these convergence rates. The vertical and horizontal convergence rates in Room 2, Panel 1, increased, while Room 1 rates decreased during the current reporting period relative to the previous reporting period. The increases in Room 2 are probably caused in response to floor trimming in Room 2.

Horizontal and vertical convergence rates have been calculated at the center of each of the rooms in Panel 2 for this and the previous reporting period. Tables 7-5 and 7-6 present these convergence rates. The vertical and horizontal convergence rates at the center of each room in Panel 2 have all decreased.

Panel 3, Rooms 1 and 2, were mined as of June 30, 2003. There were no extensometer or convergence point data for Panel 3 during this reporting period. Based on visual observations, these two rooms are performing very similar to the same rooms at the same age in Panels 1 and 2.

Table 7-3
Annual Vertical Convergence Rates at the Center of Panel 1 Disposal Rooms*

Location		Fieldtag	Total Cumulative Displacement in. (cm)	Convergence Rate 2002-2003 in./yr (cm/yr)	Convergence Rate 2001-2002 in./yr (cm/yr)	Rate Change Percent	Comments
Room 1	Centerline	E520-S1802-7 A-E	55.015 (139.738)	2.608 (6.624)	3.047 (7.739)	-14%	Room filled in March 2003
Room 2	Centerline	E660-S1775-6 A-C	40.158 (102.000)	2.574 (6.538)	2.214 (5.624)	16%	Room filled in November 2002

*Room 3-7 closed – unable to obtain readings.
cm/yr = centimeter(s) per year
in./yr = inch(es) per year

Table 7-4
Annual Horizontal Convergence Rates at the Center of Panel 1 Disposal Rooms*

Location		Fieldtag	Total Cumulative Displacement in. (cm)	Convergence Rate 2002-2003 in./yr (cm/yr)	Convergence Rate 2001-2002 in./yr (cm/yr)	Rate Change Percent	Comments
Room 1	Rib center	E520-S1802-3 C-G	23.999 (60.976)	1.485 (3.772)	1.650 (4.191)	-10%	Room filled in March 2003
Room 2	Rib center	E660-S1775-5 B-D	25.993 (66.022)	2.105 (5.347)	1.790 (4.547)	18%	Room filled in November 2002

*Room 3-7 closed – unable to obtain readings.
cm/yr = centimeter(s) per year
in./yr = inch(es) per year

Table 7-5
Annual Vertical Convergence Rates at the Center of Panel 2 Disposal Rooms

Location		Fieldtag	Total Cumulative Displacement in. (cm)	Convergence Rate 2002-2003 in./yr (cm/yr)	Convergence Rate 2001-2002 in./yr (cm/yr)	Rate Change Percent
Room 1	Centerline	E520-S2350-2 A-C	13.343 (33.891)	3.384 (8.595)	3.579 (9.091)	-5%
Room 2	Centerline	E660-S2350-3 A-C	13.454 (34.173)	3.309 (8.405)	3.656 (9.286)	-9%
Room 3	Centerline	E790-S2350-2 A-C	12.759 (32.408)	2.920 (7.417)	3.167 (8.044)	-8%
Room 4	Centerline	E920-S2350-2 A-C	15.566 (39.538)	3.195 (8.115)	3.591 (9.121)	-11%
Room 5	Centerline	E1050-S2350-2 A-C	15.008 (31.120)	2.923 (7.424)	3.279 (8.329)	-11%
Room 6	Centerline	E1190-S2350-3 A-C	13.469 (34.211)	2.872 (7.295)	3.322 (8.438)	-14%
Room 7	Centerline	E1320-S2350-3 A-C	11.837 (30.066)	3.050 (7.747)	3.550 (9.017)	-14%

cm/yr = centimeter(s) per year
in./yr = inch(es) per year

Table 7-6
Annual Horizontal Convergence Rates at the Center of Panel 2 Disposal Rooms

Location		Fieldtag	Total Cumulative Displacement in. (cm)	Convergence Rate 2002-2003 in./yr (cm/yr)	Convergence Rate 2001-2002 in./yr (cm/yr)	Rate Change Percent
Room 1	Rib center	E520-S2350 B-D	8.668 (22.017)	2.287 (5.809)	2.377 (6.038)	-4%
Room 2	Rib center	E660-S2350 B-D	8.775 (22.289)	2.100 (5.334)	2.268 (5.761)	-7%
Room 3	Rib center	E790-S2350 B-D	7.891 (20.043)	1.985 (5.042)	2.176 (5.527)	-9%
Room 4	Rib center	E920-S2350 B-D	8.619 (21.892)	2.083 (5.291)	2.360 (5.994)	-12%
Room 5	Rib center	E1050-S2350 B-D	7.380 (18.750)	1.785 (4.534)	2.031 (5.159)	-12%
Room 6	Rib center	E1190-S2350 B-D	7.186 (18.252)	1.654 (4.201)	1.960 (4.978)	-16%
Room 7	Rib center	E1320-S2425 B-D	6.691 (16.995)	1.584 (4.023)	1.748 (4.440)	-9%

cm/yr = centimeter(s) per year
in./yr = inch(es) per year

7.4 Analysis of Extensometer and Convergence Point Data

There were 36 monitored extensometers installed in the roofs and ribs of Panel 1, with most being located in the disposal rooms. Twenty-one of the 36 extensometers showed a displacement rate decrease. The extensometers with the greatest rate decreases are generally located in the northern half of the panel which is furthest from Panel 2. The other 15 extensometers showed an increase. These extensometers are generally located on the southern half of the panel, which is closest to Panel 2. The instrument data indicate that the rates have become steady since the increase in response to the mining of Panel 2.

During this reporting period, vertical convergence rates were read in Rooms 1 and 2 of Panel 1. All the readings from these rooms were decreasing, with the exception of one point located at South 1775 in Room 2, which showed a 16 percent increase. This increase was probably caused by floor milling for waste emplacement.

The closure rates in Panel 2 are generally decreasing with exception of the South 2520 drift, which are responding to the initial mining of Panel 3. At South 2520/East 586 the closure rate increase was the highest at 9 percent. The convergence rates in South 2520 and the southernmost points in the rooms of Panel 2 are expected to be affected due to Panel 3 mining, which will continue with an scheduled completion date in 2004.

There were no extensometer or convergence point data for Panel 3 during this reporting period.

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8.0 Geoscience Program

The Geoscience Program confirms the suitability of the site through the collection of various geologic data and excavation characteristics from the underground facility. These include the inspection of open boreholes for fractures (separations) and offsets (lateral displacements) in roof beams, the mapping of fracture development on roof (back) surfaces, and the documentation of stratigraphic features on wall (rib) surfaces.

Data collected through these activities support the design and evaluation of ground support systems (Westinghouse WID, 1999).

During this reporting period, the following activities were performed:

- Borehole Inspections
- Fracture Mapping
- Stratigraphic Mapping

8.1 Borehole Inspections

Geotechnical observation boreholes are drilled at various locations throughout the underground facility. A location may contain one or several boreholes arranged in an array. These holes are drilled to depths that allow the monitoring of fracture development and offsetting and are inspected for the development of those features. Roof observation holes usually intersect clays "G" and "H" (Figure 8-1).

The clay seams nearest the excavation surfaces define the immediate roof beam. Clay "G" defines the roof beam in most of the access drifts and Panels 1 and 2. Some areas, such as the Salt Handling Shaft Station, portions of the East 0 and East 140 drifts, the south mains south of South 2620 and Panel 3 are excavated to clay "G" and so have roof beams bounded by clay "H."

The offset in a borehole is determined by visually estimating the degree of borehole 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 moves toward the center of the excavation (Figure 8-2). Based on previous observations in the underground, the magnitude of offset is usually greater in boreholes located near ribs than in those located along excavation centerlines. Offsetting along the clay layers is

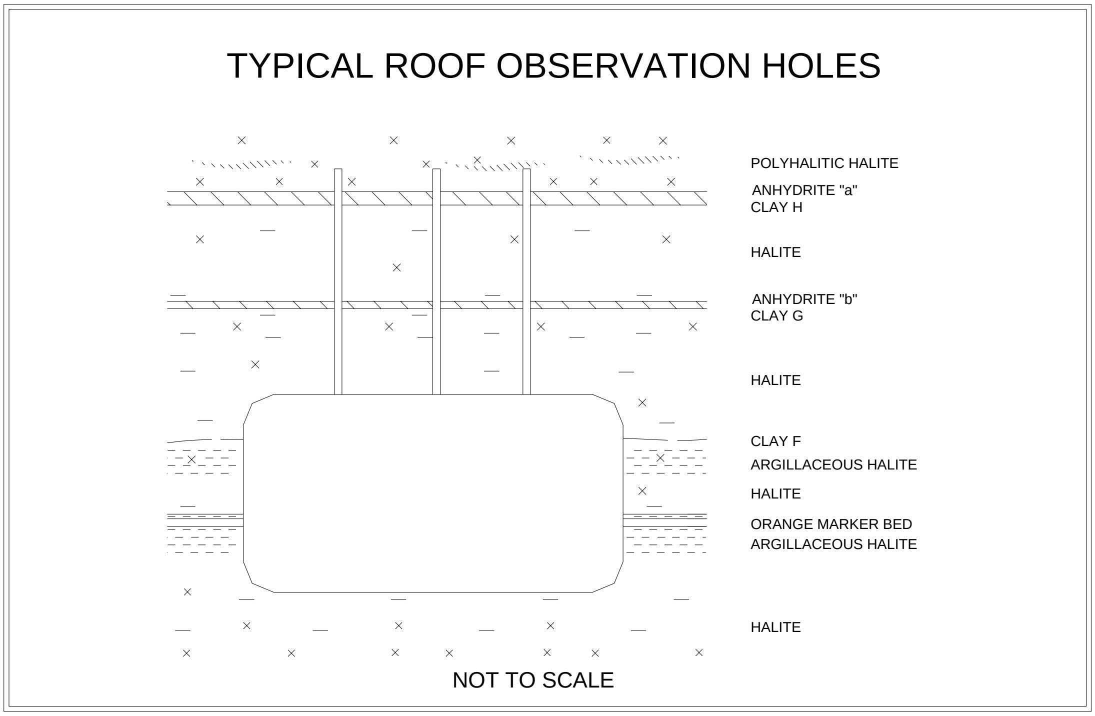

Figure 8-1
Examples of Observation Borehole Layouts

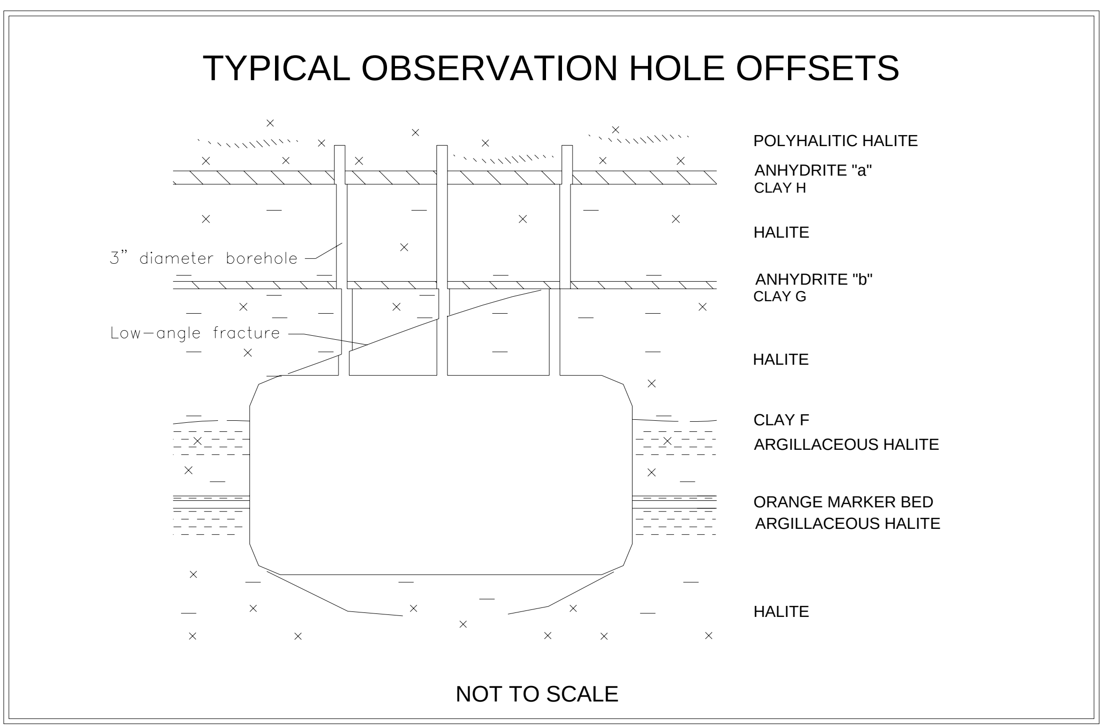

Figure 8-2
Generalized Fracture Pattern at Lower Horizon

observable until the total borehole offset is reached or visibility is obstructed by intervening offsets at other clay seams or fractures. Boreholes are inspected for fractures using an aluminum rod with a flattened steel wire probe attached to one end perpendicular to the rod (referred to as a “scratcher rod”). Fractures and clay seams are located by moving the probe along the sides of the borehole until it is snagged in one of these features. Depth to each feature is recorded, as is the magnitude of separations encountered.

The separation and offset data observed at clay “G” and clay “H” in accessible boreholes during this reporting period are presented in Table 7-1 of the supporting data document for this report.[6] Nineteen of the 28 observation holes in Panel 2 show some offset (compared to 17 holes the previous year). Most offsets are minor, with the exception of two holes in South 2180 which are 75 percent closed at clay “G” (compared to about 50 percent closure during the last reporting period).

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 on an annual basis, and the fracture maps are recorded on Mylar sheets or updated as AutoCAD files. The fracture maps facilitate the analysis of strain in the immediate roof-beam as they document the propagation of fractures through time. Figures 7-1 through 7-16 of the supporting data document contain fracture maps for Panels 1 and 2. For this reporting period only, Rooms 1 and 2 and a limited portion of South 1950 have been accessible in Panel 1. Some low angle fracturing along the southern end of the east ribs in the two rooms and along the south rib of South 1950 is all that has developed in Panel 1. As indicated on the map legends for Panel 2, the features documented are mainly surficial “onionskin” features. No notable fracturing has developed in Panel 2.

[6] Instrumentation data and data plots are available in “Geotechnical Analysis Report for July 2002-June 2003 Supporting Data.” This document is available upon request from Washington TRU Solutions. Refer to Foreword and Acknowledgments for details and address.

8.3 Stratigraphic Mapping

The four south mains were ramped up between South 2520 and South 2750 to establish a new mining horizon for Panel 3 and future Panels 4, 5, 6, and 9. Figures 7-17 and 7-18 of the supporting data document are the stratigraphic maps of the east wall along East 140 where the excavation level ramps up to the new horizon. These maps are representative of the other three south mains. The geology at the upper horizon is as expected—a layer of halite capped by clay "G."

9.0 Summary

At the inception of the WIPP Project, criteria were developed that address the requirements for the design of WIPP (DOE, 1984). These criteria, in the form of design requirements, pertain to all aspects of the mined facility and its operation as a pilot plant for the demonstration of technical and operational methods for permanent disposal of contact-handled (CH) and remote-handled (RH) TRU waste. In 1994, as WIPP developed and the 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 (SDDs). Table 9-1 shows the comparison of these design requirements with conditions actually observed in the underground from July 2002 through June 2003.

Fracture development in the roof is primarily caused by the concentration of compressive stresses in the roof beam and is influenced by the size and shape of the excavation and the stratigraphy in the immediate vicinity of the opening. Pillar deformations 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 boreholes and is indicated 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. This scenario of roof deterioration, combining compressive stresses, horizontal offsetting, and large strains associated with lateral movements, is substantiated by field observations.

Normal drift and room maintenance continued during this reporting period with rib, roof, and floor scaling and trimming in various locations, and rock bolting and wire mesh installation as needed. Supplemental ground control systems consisting of resin anchored bolts and roof mats were installed in sections of E140 drift and Panel 1.

New geomechanical instrumentations were installed in the access drifts to Panel 3 and in various locations throughout the repository to replace mined-out instruments. Remote convergence monitoring no longer continues in non-accessible areas north of the North 1100 drift. All accessible areas of the underground are connected to data loggers or are monitored manually.

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

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."	Geomechanical data from the Waste Shaft indicate that the shaft key is minimally loaded and is structurally stable. 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 and instrumentation show no indication of instability due to salt dissolution.
"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 and storage space. Ground control maintenance is performed as necessary to maintain access.
"The underground waste disposal facilities shall be designed to provide the capability of retrieving the emplaced CH and RH TRU waste."	(Retrievability is not presently a requirement in the waste disposal program.)
"Entries and sub-entries to the underground disposal area and the experimental areas shall be provided and sized for personnel safety, adequate air flow, and space for equipment."	Deformation of excavation remains within the required limits. Normal periodic maintenance consisting of rock bolting, wire meshing, trimming, and scaling continue throughout the repository.
"Geomechanical instrumentation shall be provided to measure the cumulative deformation of the rock mass surrounding mined drifts. . . ."	Geotechnical instrumentation is operated and maintained to meet this requirement. This annual report acts to provide a summary and analysis of the geomechanical data.

The *in situ* performance of the excavations generally continues to satisfy the appropriate design criteria, although specific areas are being identified where deterioration resulting from aging must be addressed through routine maintenance and implementation of engineered systems. This deterioration has been identified through the analysis of data acquired from geomechanical instrumentation and the Geoscience Program. If the planned life of some of the openings needs to be extended, redesigning the geometry of the access drifts (e.g., changing the horizontal and vertical dimensions) or additional ground control (e.g., roof removal, installing bolts, mesh, or straps) may be necessary. The ground conditions in the Waste Disposal Area and associated waste transport routes continue to slowly deteriorate; however, routine ground control installations and maintenance continue to allow safe access in the underground facility.

In addition to underground instrumentation, qualitative assessments of fracture development are documented through mapping the underground repository and inspecting the observation boreholes. The information acquired from these programs provides early detection of ground deterioration, contributes to the understanding of the dynamic geomechanical processes in the WIPP underground, and aids in the design of effective ground control and support systems.

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DOE/WIPP-04-3177
Volume 2

Geotechnical Analysis Report for July 2002 - June 2003

Supporting Data

March 2004

Waste Isolation Pilot Plant

FOREWORD AND ACKNOWLEDGMENTS

This Supporting Data Document to the Geotechnical Analysis Report (GAR) presents the data that were used to assess the geotechnical status of the Waste Isolation Pilot Plant (WIPP). This report presents data for the underground facility including the shafts, shaft stations, access drifts, Northern Experimental Area, and the Waste Disposal Area. The data are presented as both tables and plots in order to meet the needs of several audiences. This report presents the data collected through June 30, 2003. This data can be provided in its original format upon written request to the U.S. Department of Energy (DOE) at the following address:

U.S. Department of Energy
Carlsbad Field Office
P.O. Box 3090
Carlsbad, NM 88221-3090

The Geotechnical Analysis Report is a multi-author report that was prepared by Washington TRU Solutions for the DOE, Carlsbad Field Office, Carlsbad, New Mexico. Work was supported by the DOE under Contract No. DE-AC29-01AL66444.

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Figure	Title	Page No.

Waste Disposal Area Panel 1

Figure **Title** **Page No.**

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Figure **Title** **Page No.**

1.0 Introduction

This report is a compilation of geotechnical data presented as plots for each active instrument installed in the underground at the Waste Isolation Pilot Plant (WIPP) through June 30, 2003. A summary of the geotechnical analyses that were performed using the enclosed data is provided in Volume 1 of the Geotechnical Analysis Report (GAR).

1.1 Instrumentation

Geomechanical data included in this report reflect the measurements of the geomechanical response from instruments installed in the underground and shafts. These instruments consist of convergence points, borehole extensometers, rockbolt load cells, pressure cells, strain gages, 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 for 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. With these instruments, rods or wires are placed 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 here. As part of the post-processing of acquired extensometer data a *relative displacement* value is calculated. The deepest anchor is assumed to be fixed in undisturbed ground and a displacement for the remaining anchors relative to the deepest anchor is calculated. Annual rates of collar displacement are calculated for each extensometer and are compared with the annual displacement rate reported during the previous reporting period.

Rockbolt load cells are used to determine the ground loading and the effectiveness of rockbolts. Plots consist of load versus time for each instrumented bolt.

Earth pressure cells and strain gages are used in and around the shaft liners to determine their loads. These are also depicted in time-based plots. Monitoring of these instruments indicates whether there is any stress buildup in the shaft lining systems.

Piezometers are used to measure the gage 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 any changes in separation of the crack which may occur over time.

1.2 Data Plot Explanation

Data are presented in graphical form for ease in interpretation. Time-based plots are used in this report. Each plot generally consists of 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 “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 indicate that the convergence point was lost due to normal mine maintenance activities and later reinstalled.

1.3 Report Organization

Chapter 1.0 provides an introduction to this Supporting Data volume of the GAR. Chapter 2.0 provides instrument data analysis for the Salt Handling Shaft, Waste Shaft, and Exhaust Shaft followed by data plots for the extensometers, piezometers, earth pressure cells, spot welded strain gages, and embedment strain gages installed in the shafts. Chapter 3.0 provides instrument data analysis for the Salt Handling Shaft Station and Waste Shaft Station, an instrument data summary only for the area immediately surrounding the Air Intake Shaft, and data plots for extensometers, convergence points, and rockbolt load cells for all three locations. Chapter 4.0 provides instrument data analysis for the access drifts followed by data plots for the extensometers, convergence points and joint meters. Chapter 5.0: the Northern Experimental Area including the SPDV rooms and associated access drifts are no longer accessible and readings have been discontinued. Instrumentation data for this area has been presented in previous Geotechnical Annual Reports. Chapter 6.0 provides instrument data analysis for the Waste Disposal Area followed by data plots for the extensometers and convergence points.

Chapter 7.0 provides geologic data collected through the mapping of fractures and stratigraphic features on excavation surfaces and the observation of clay seam displacements in vertical boreholes.

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2.0 Instrumentation Summary for Shafts

Instrumentation data analysis for three of the four shafts at the WIPP follows. Table 2-1 presents data and analysis of the Salt Shaft. Plots of the instrument data are presented as Figures 2-1 through 2-13. Table 2-2 presents data and analysis of the Waste Shaft. Plots of the instrument data are presented as Figures 2-14 through 2-27. Table 2-3 presents data and analysis of the Exhaust Shaft. Plots of the instrument data are presented as Figures 2-28 through 2-40. Instrumentation and measurements for the Air Intake Shaft are collected by Washington TRU Solutions and then provided to Sandia National Laboratories/New Mexico for analysis and reporting. The data are not presented here.

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Table 2-1
Salt Handling Shaft Data Analysis

PIEZOMETERS

Field Tag	Level feet	Figure Number	Date of 2002-2003 Max. Reading	2002-2003 Maximum Pressure Readings (psi)	Date of 2001-2002 Max. Reading	2001-2002 Maximum Pressure Readings (psi)	Change in Maximum Pressure From Previous Year (psi)	Comments
37X-PE-00201	580	2-1	06/10/03	73.8	12/12/01	64.2	9.6	
37X-PE-00202	580	2-1	06/10/03	79.3	12/12/01	67	12.3	
37X-PE-00203	620	2-2	06/10/03	90.4	12/12/01	44	46.4	
37X-PE-00204	620	2-2	06/10/03	120.5	12/12/01	90.4	30.1	
37X-PE-00205	691	2-3	06/10/03	149.2	11/07/01	108.9	40.3	
37X-PE-00206	691	2-3	05/21/03	144.8	02/11/02	108.3	36.5	
37X-PE-00207	726	2-4	05/21/03	142.3	02/11/02	144.9	-2.6	
37X-PE-00208	726	2-4	05/21/03	141.9	12/12/01	142.5	-0.6	
37X-PE-00209	802	2-5	06/10/03	104.5	11/07/01	115	-10.5	
37X-PE-00210	802	2-5	06/10/03	105	11/07/01	113.9	-8.9	
37X-PE-00211	850	2-6	05/21/03	113.7	11/07/01	78.7	35	
37X-PE-00212	850	2-6	05/21/03	111.6	11/07/01	79	32.6	

EARTH PRESSURE CELLS

Field Tag	Level feet	Figure Number	Date of 2002-2003 Max. Reading	2002-2003 Maximum Pressure Readings (psi)	Date of 2001-2002 Max. Reading	2001-2002 Maximum Pressure Readings (psi)	Change in Maximum Pressure From Previous Year (psi)	Comments
37X- WE-00201	860	2-7	06/10/03	-7	11/07/01	-9.5	2.5	
37X- WE-00202	860	2-7	06/10/03	-21.1	02/11/02	-25.2	4.1	
37X- WE-00203	860	2-7	06/10/03	0.6	11/07/01	-30.2	30.8	

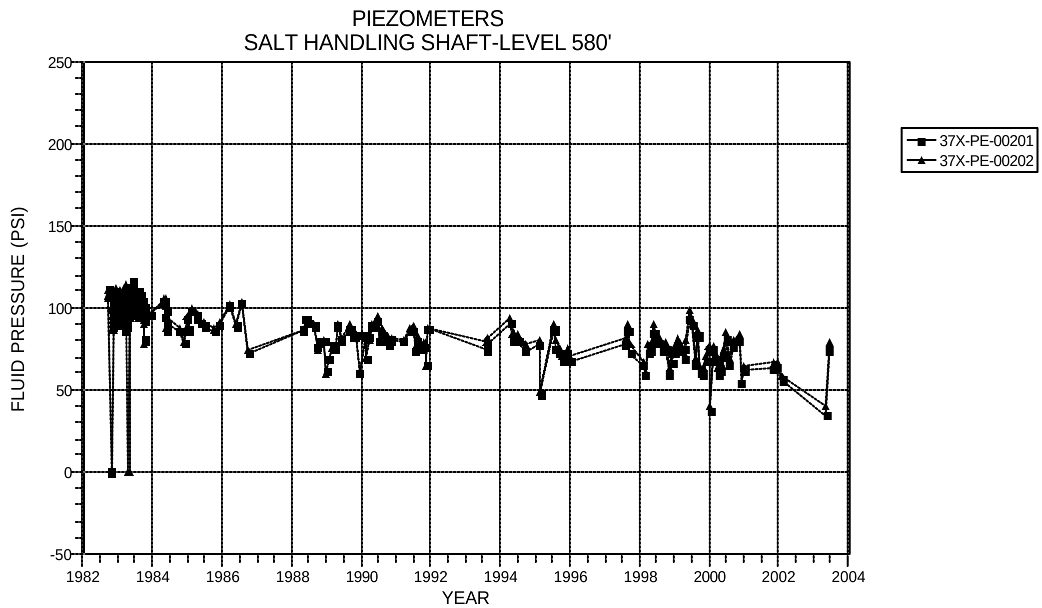
Table 2-1 (Continued)
Salt Handling Shaft Data Analysis

SPOT WELDED STRAIN GAGES

Field Tag	Level feet	Figure Number	Date of 2002-2003 Max. Reading	2002-2003 Maximum Total microstrain	Date of 2001-2002 Max. Reading	2001-2002 Maximum Total microstrain	Change in Maximum Strain From Previous Year	Comments
37X-ZE-00201	856.3	2-8	05/21/03	748	11/07/01	727	21	
37X-ZE-00206	856.3	2-8	06/11/03	652	11/07/01	589	63	
37X-ZE-00220	862.4	2-9	06/11/03	784	11/07/01	807	-23	
37X-ZE-00223	862.4	2-9	05/22/03	507	02/11/02	440	67	

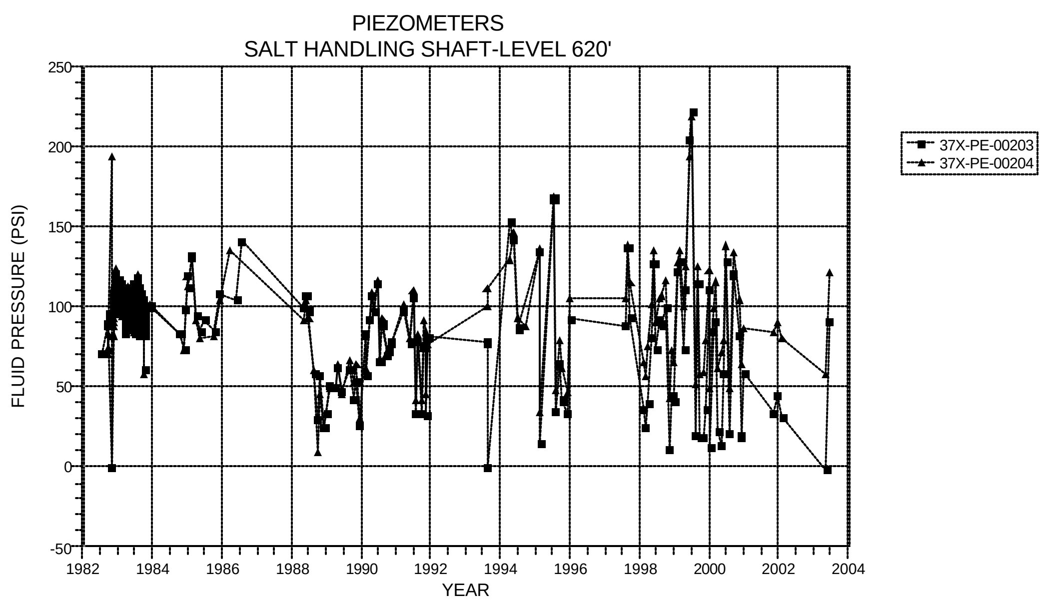
EMBEDMENT STRAIN GAGES

Field Tag	Level feet	Figure Number	Date of 2002-2003 Max. Reading	2002-2003 Maximum Total microstrain	Date of 2001-2002 Max. Reading	2001-2002 Maximum Total microstrain	Change in Maximum Strain From Previous Year	Comments
37X-ZE-00209	856.3	2-10	06/10/03	-513	12/12/01	-549	36	
37X-ZE-00210	856.3	2-10	06/10/03	977	11/07/01	950	27	
37X-ZE-00211	856.3	2-10	06/10/03	318	11/07/01	298	20	
37X-ZE-00212	856.3	2-10	06/10/03	-676	02/11/02	-914	238	
37X-ZE-00213	856.3	2-10	06/10/03	304	11/07/01	240	64	
37X-ZE-00214	856.3	2-10	06/10/03	-40	02/11/02	-189	149	
37X-ZE-00215	856.3	2-10	06/10/03	70	11/07/01	46	24	
37X-ZE-00216	856.3	2-10	06/10/03	555	11/07/01	497	58	
37X-ZE-00225	862.4	2-11	06/10/03	161	11/07/01	391	-230	Possible gage malfunction.
37X-ZE-00235	856.3	2-12	06/10/03	-378	02/11/02	-424	46	
37X-ZE-00236	856.3	2-12	06/10/03	58	02/11/02	-146	204	
37X-ZE-00237	856.3	2-12	06/10/03	52	02/11/02	-47	99	
37X-ZE-00238	856.3	2-12	06/10/03	463	11/07/01	422	41	
37X-ZE-00239	862.4	2-13	06/10/03	297	02/11/02	-386	683	Possible gage malfunction.



NOTES:
1. Steel liner was installed in late 1981.

Figure 2-1 Piezometers 37X-PE- 00201 and 37X-PE-00202
Salt Handling Shaft – Level 580 at the Forty-niner Member



NOTES:
1. Steel liner was installed in late 1981.

Figure 2-2 Piezometers 37X-PE-00203 and 37X-PE-00204
Salt Handling Shaft – Level 620 at the Magenta Dolomite Member

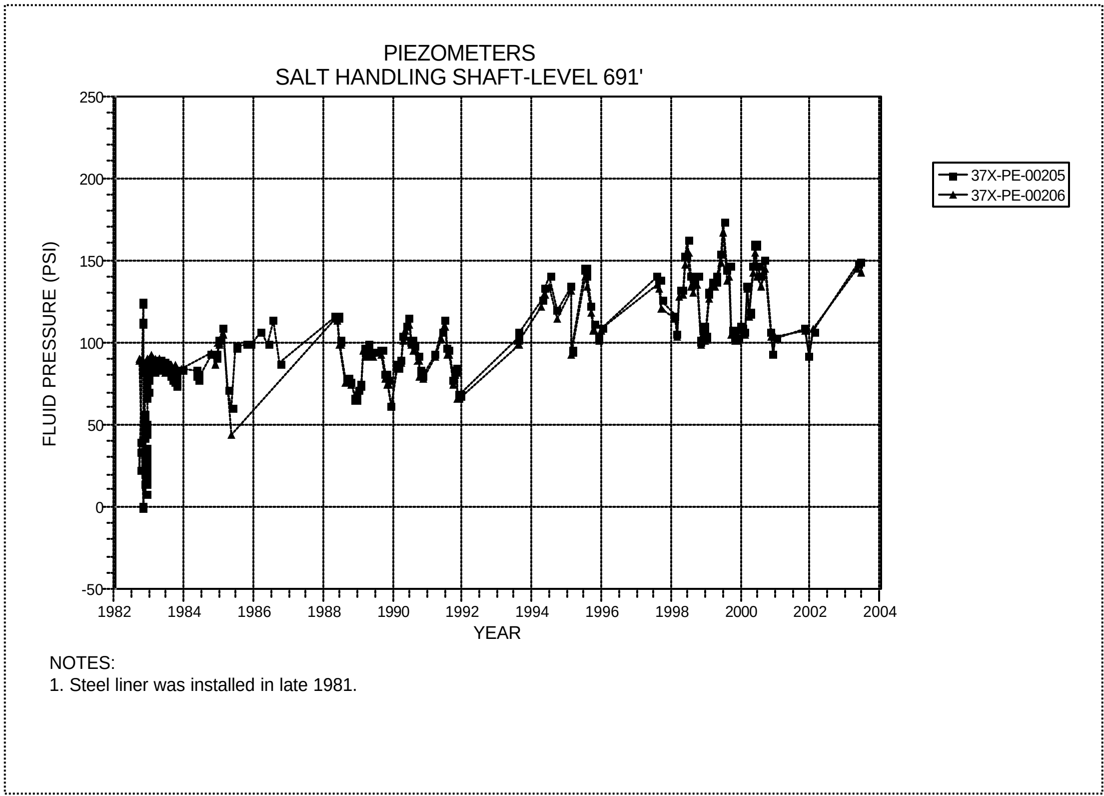


Figure 2-3 Piezometers 37X-PE-00205 and 37X-PE-00206
Salt Handling Shaft – Level 691 at the Tamarisk Member

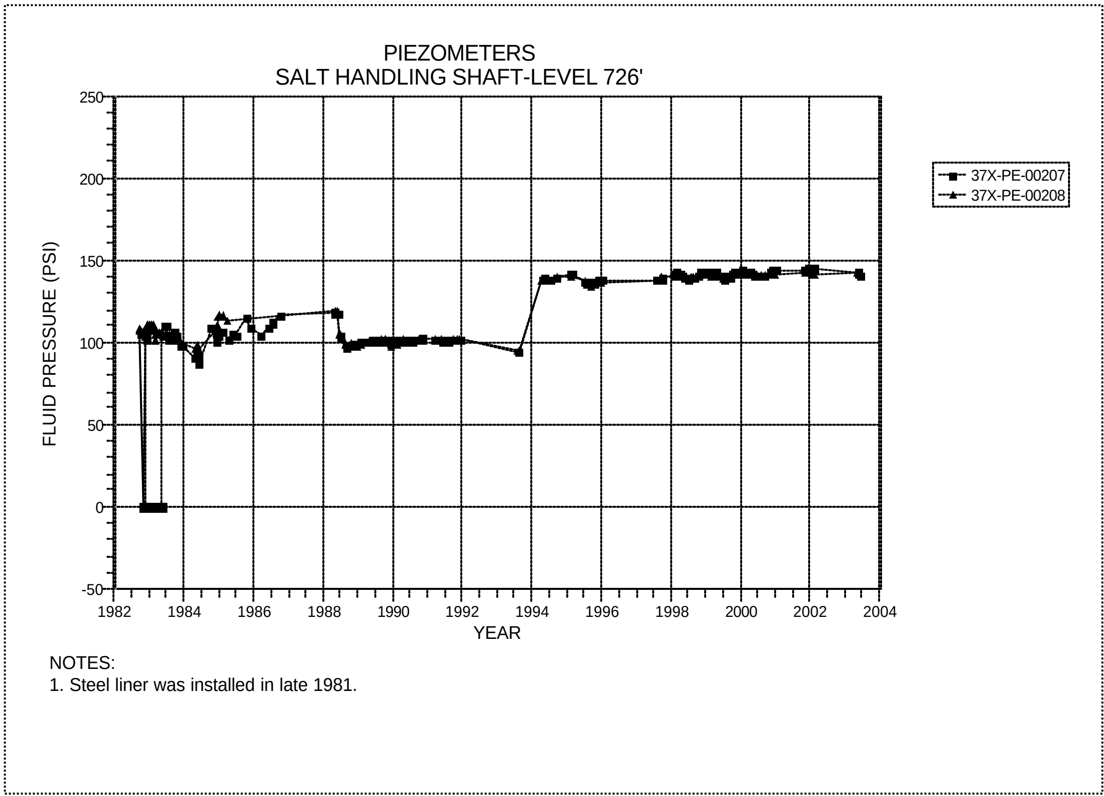
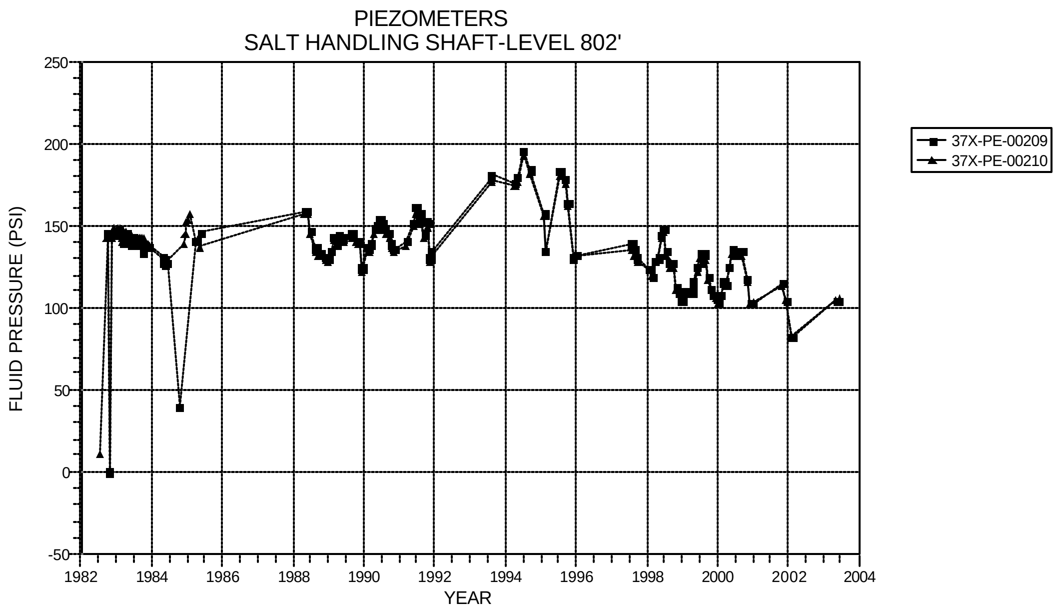
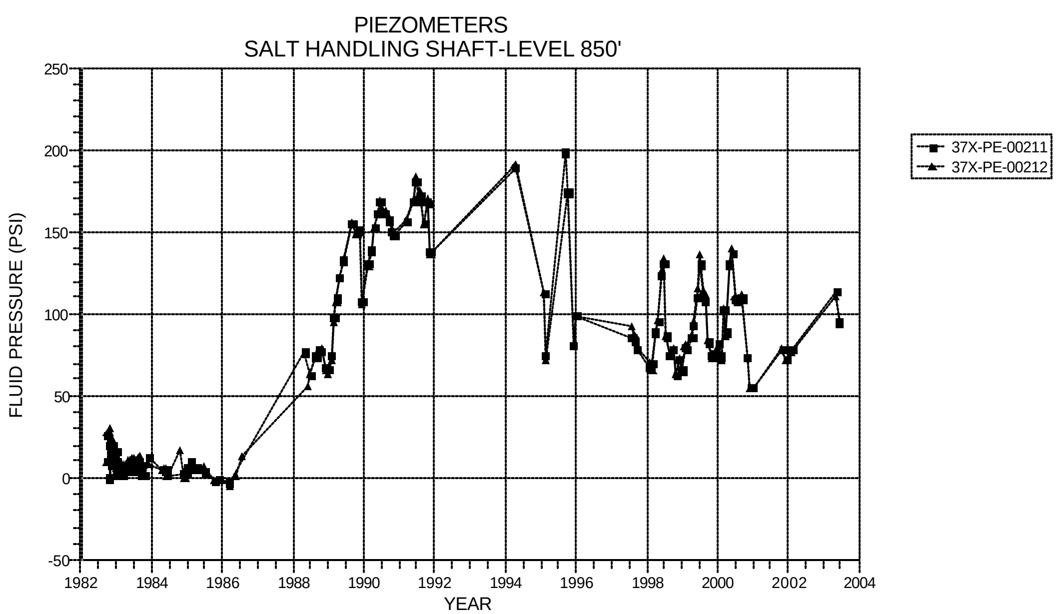


Figure 2-4 Piezometers 37X-PE-00207 and 37X-PE-00208
Salt Handling Shaft – Level 726 at the Culebra Dolomite Member



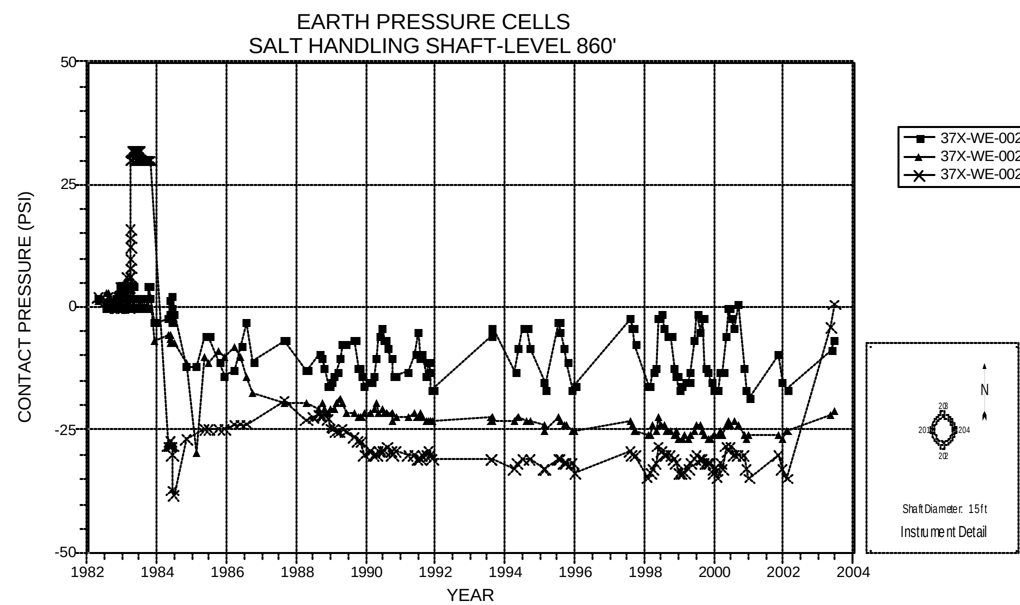
NOTES:
1. Steel liner was installed in late 1981.

Figure 2-5 Piezometers 37X-PE-00209 and 37X-PE-00210
Salt Handling Shaft – Level 802 at the Unnamed Lower Member



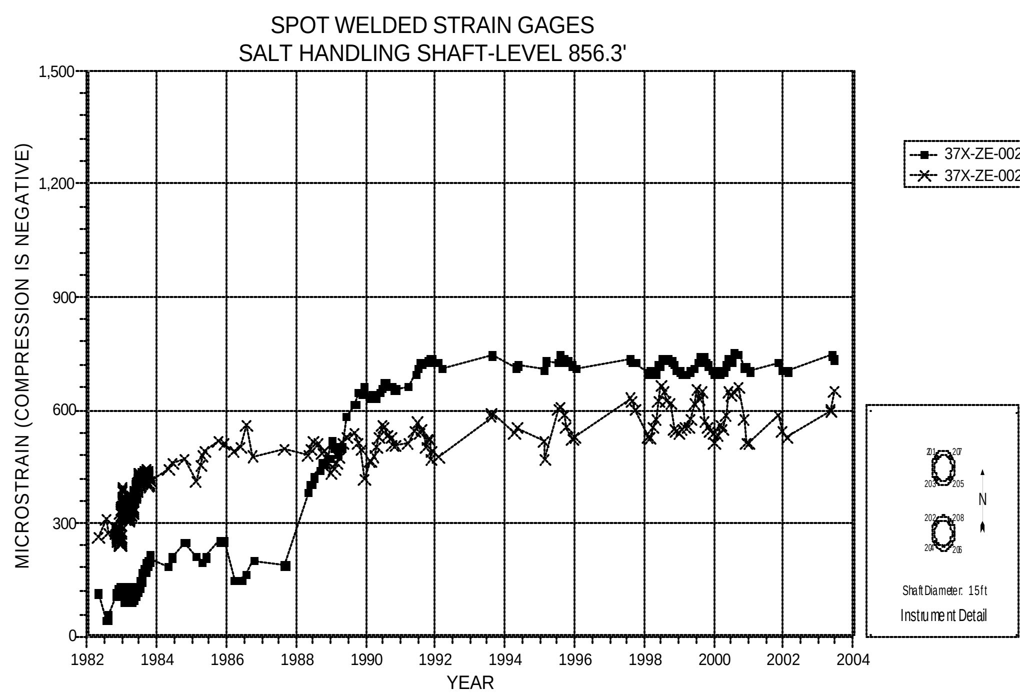
NOTES:
1. Concrete for key was placed in April 1982.

Figure 2-6 Piezometers 37X-PE-00211 and 37X-PE-00212
Salt Handling Shaft – Level 850 at the Rustler-Salado Contact



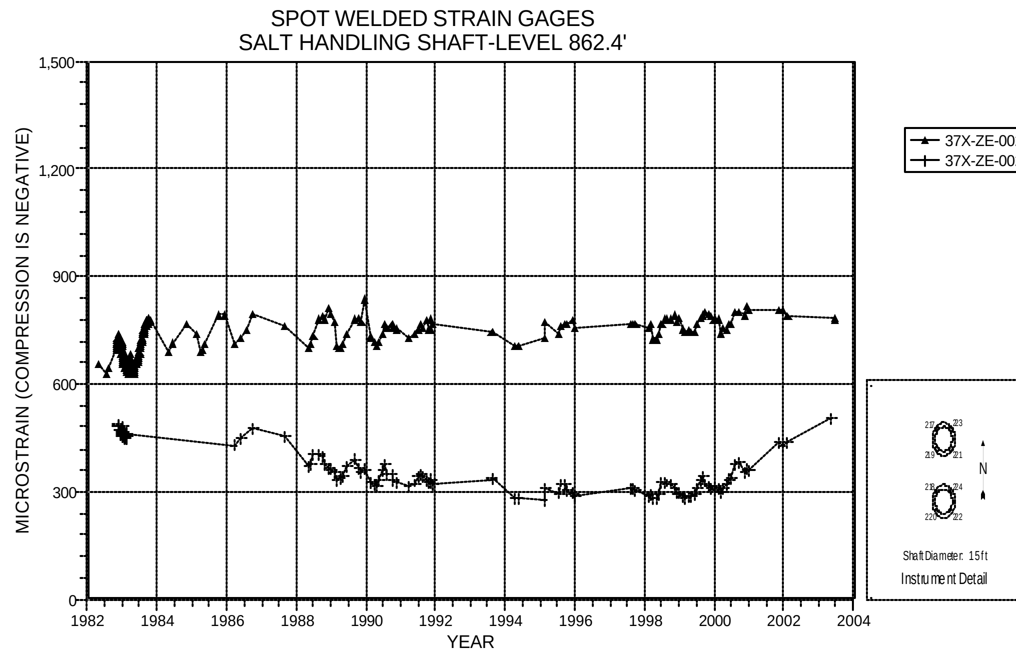
NOTES:
1. Concrete for key was placed in April 1982.

Figure 2-7 Earth Pressure Cells Behind Shaft Key
Salt Handling Shaft Key – Level 860



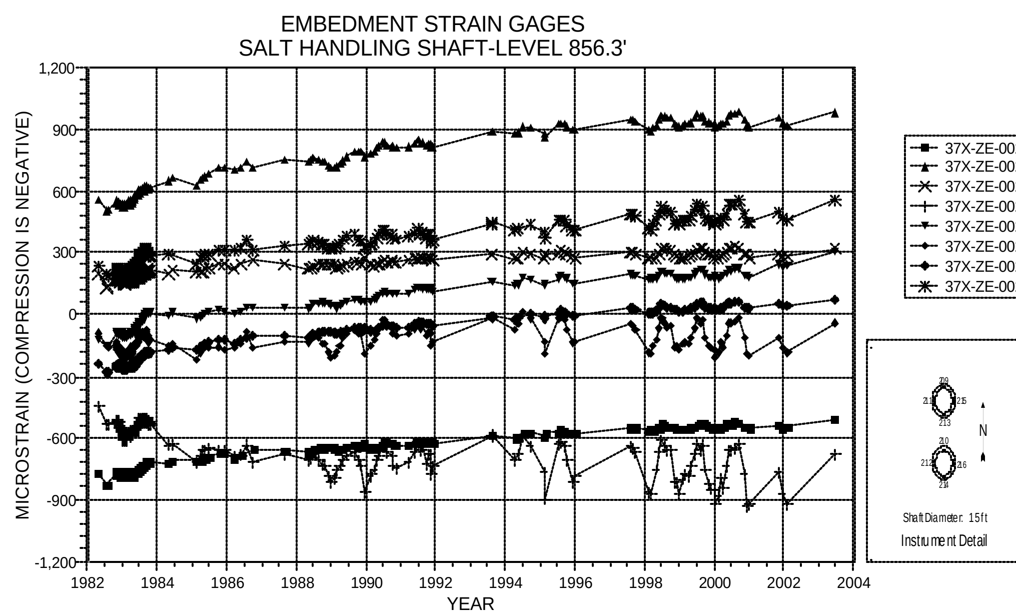
NOTES:
1. Concrete for key was placed in April 1982.

Figure 2-8 Spot Welded Strain Gages
Salt Handling Shaft Key – Level 856.3



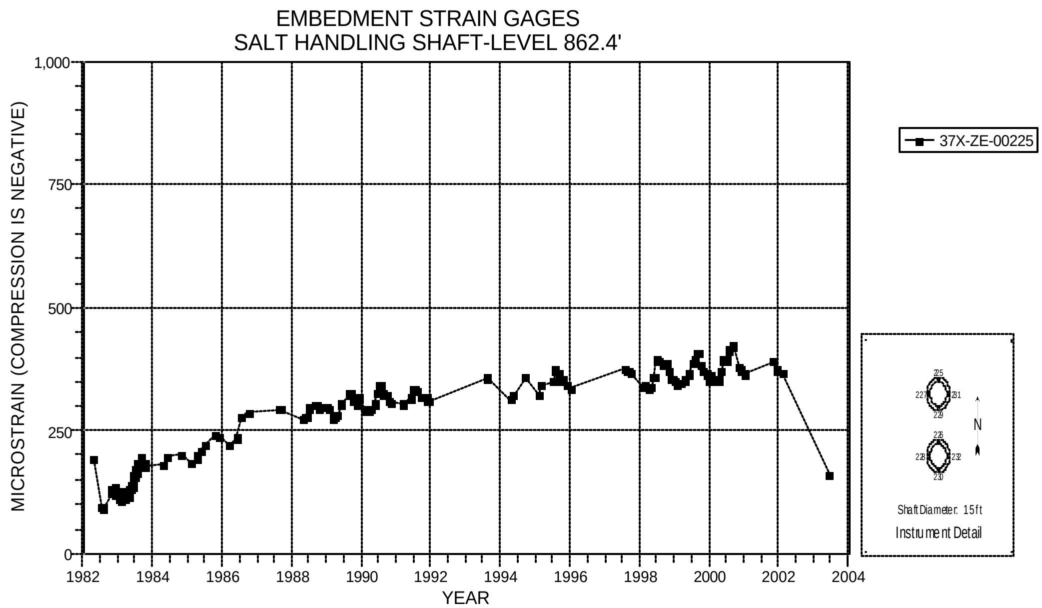
NOTES:
1. Concrete for key was placed in April 1982.

Figure 2-9 Spot Welded Strain Gages
Salt Handling Shaft Key – Level 862.4



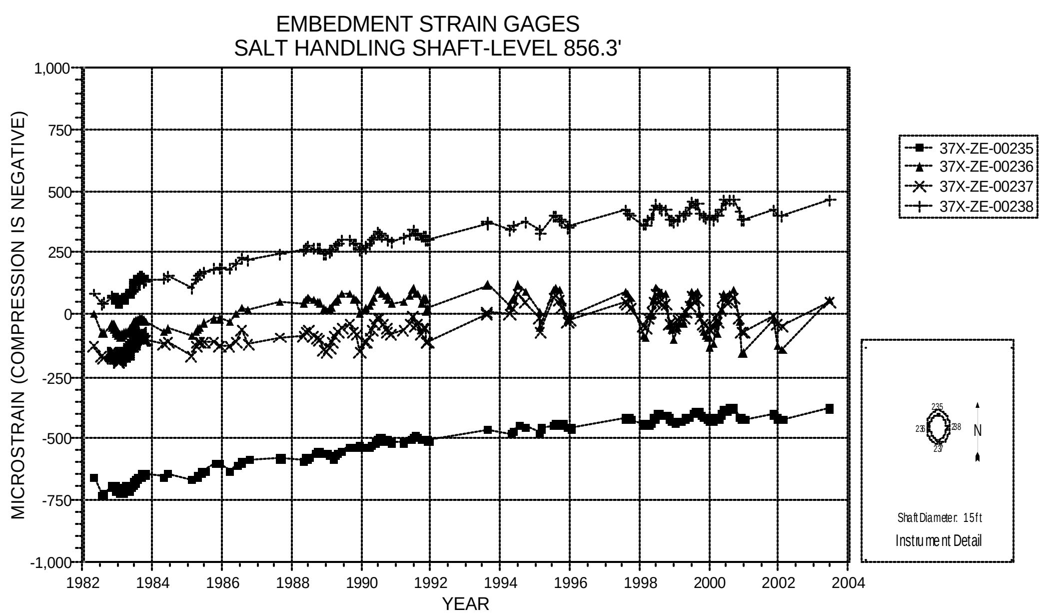
NOTES:
1. Concrete for key was placed in April 1982.

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



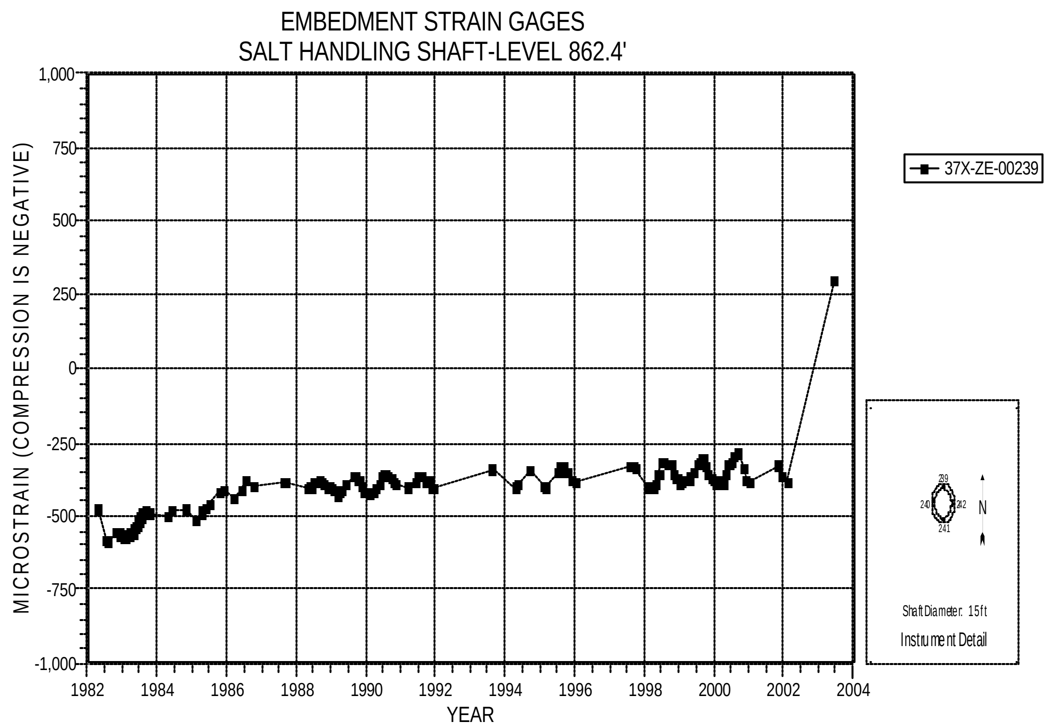
NOTES:
1. Concrete for key was placed in April 1982.
2. Possible gage malfunction.

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



NOTES:
1. Concrete for key was placed in April 1982.

Figure 2-12 Embedment Strain Gages
Salt Handling Shaft Key Level 856.3



NOTES:
1. Concrete for key was placed in April 1982.
2. Possible gage malfunction.

Figure 2-13 Embedment Strain Gages
Salt Handling Shaft Key – Level 862.4

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Table 2-2
Waste Shaft Data Analysis

EXTENSOMETERS

Field Tag	Location	Level feet	Figure Number	Date of Last Reading	Collar Displacement Relative to Deepest Anchor (inches)	Displacement Rate 2002 to 2003 in/year	Displacement Rate 2001 to 2002 in/year	Rate Change Percent [A]	Comments
31X-GE-00203	WASTE SHAFT	1071	2-14	04/28/03	0.207	0.003	0.002	50%	
31X-GE-00204	WASTE SHAFT	1566	2-15	04/28/03	0.781	0.019	0.018	6%	
31X-GE-00205	WASTE SHAFT	1566	2-16	04/28/03	0.661	0.016	0.016	0%	
31X-GE-00206	WASTE SHAFT	1566	2-17	04/28/03	0.791	0.021	0.021	0%	
31X-GE-00207	WASTE SHAFT	2059	2-18	07/10/02	1.945	N/A	0.060	N/A	Not readable.
31X-GE-00208	WASTE SHAFT	2059	2-19	04/28/03	1.860	0.055	0.047	17%	
31X-GE-00209	WASTE SHAFT	2059	2-20	04/28/03	2.115	0.072	0.067	7%	

[A] N/A indicates insufficient data to calculate

PIEZOMETERS

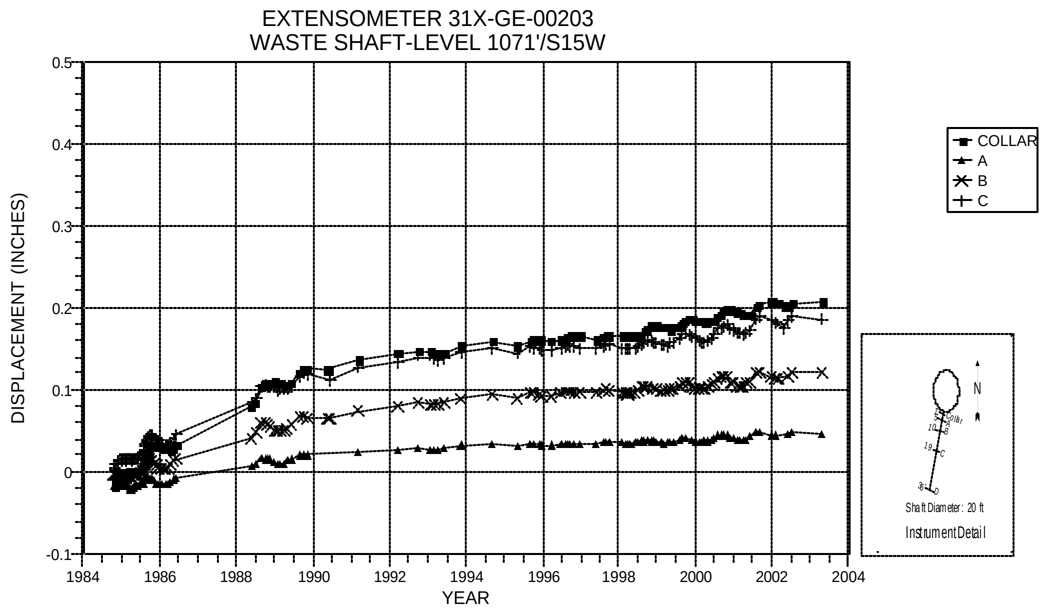
Field Tag	Level feet	Figure Number	Date of 2002-2003 Max. Reading	2002-2003 Maximum Pressure Readings (psi)	Date of 2001-2002 Max. Reading	2001-2002 Maximum Pressure Readings (psi)	Change in Maximum Pressure From Previous Year (psi)	Comments
31X-PE-00201	532	2-21	04/28/03	0.0	03/04/02	-3.2	3.2	
31X-PE-00202	532	2-21	07/10/02	-4.4	10/01/01	-3.6	-0.8	
31X-PE-00203	611	2-22	07/03/02	39.2	09/04/01	41.8	-2.6	
31X-PE-00204	611	2-22	07/03/02	34.4	08/09/01	33.2	1.2	
31X-PE-00205	669	2-23	07/10/02	-0.5	03/04/02	0.0	-0.5	
31X-PE-00206	669	2-23	07/10/02	-0.7	06/05/02	-0.7	0	
31X-PE-00208	717	2-24	07/03/02	144.3	08/09/01	146.3	-2	
31X-PE-00209	758	2-25	07/10/02	43.2	06/05/02	42.5	0.7	
31X-PE-00210 [B]	758	2-25	04/28/03	-0.6	05/03/02	0.0	-0.6	
31X-PE-00211	845	2-26	07/10/02	75.1	10/01/01	79.3	-4.2	
31X-PE-00212	845	2-26	07/10/02	80.1	06/05/02	75.6	4.5	

[B] Probable Instrument Failure.

Table 2-2 (Continued)
Waste Shaft Data Analysis

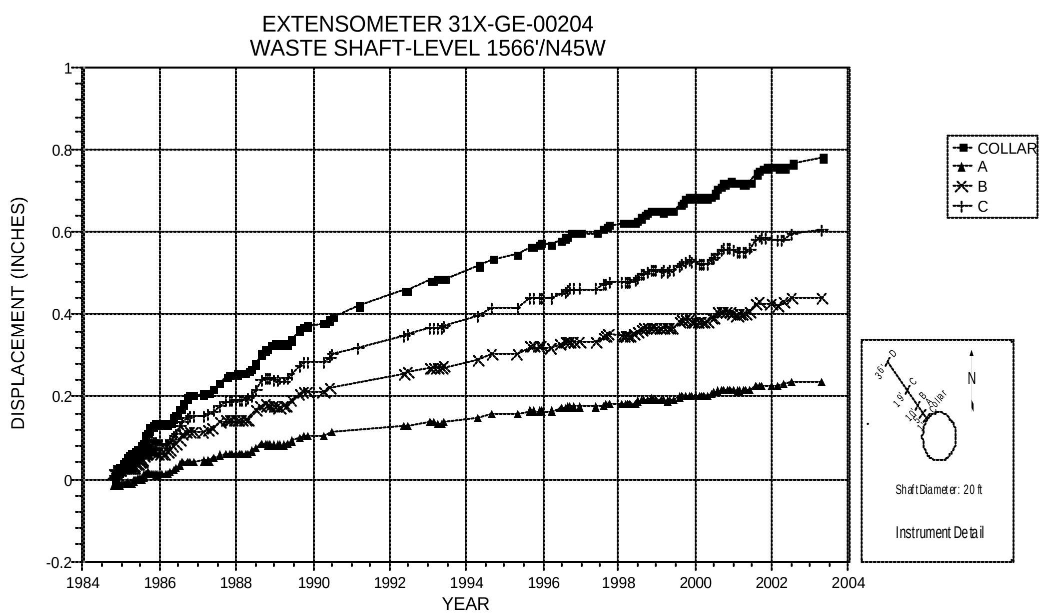
EARTH PRESSURE CELLS

Field Tag	Level feet	Figure Number	Date of 2002-2003 Max. Reading	2002-2003 Maximum Pressure Readings (psi)	Date of 2001-2002 Max. Reading	2001-2002 Maximum Pressure Readings (psi)	Change in Maximum Pressure From Previous Year (psi)	Comments
31X- WE-00201	866	2-27	07/10/02	74.0	11/06/01	77.5	-3.5	
31X- WE-00202	866	2-27	07/10/02	80.9	09/04/01	88.4	-7.5	
31X- WE-00203	866	2-27	07/03/02	100.1	08/09/01	102.9	-2.8	
31X- WE-00204	866	2-27	07/03/02	101.0	08/09/01	104.2	-3.2	



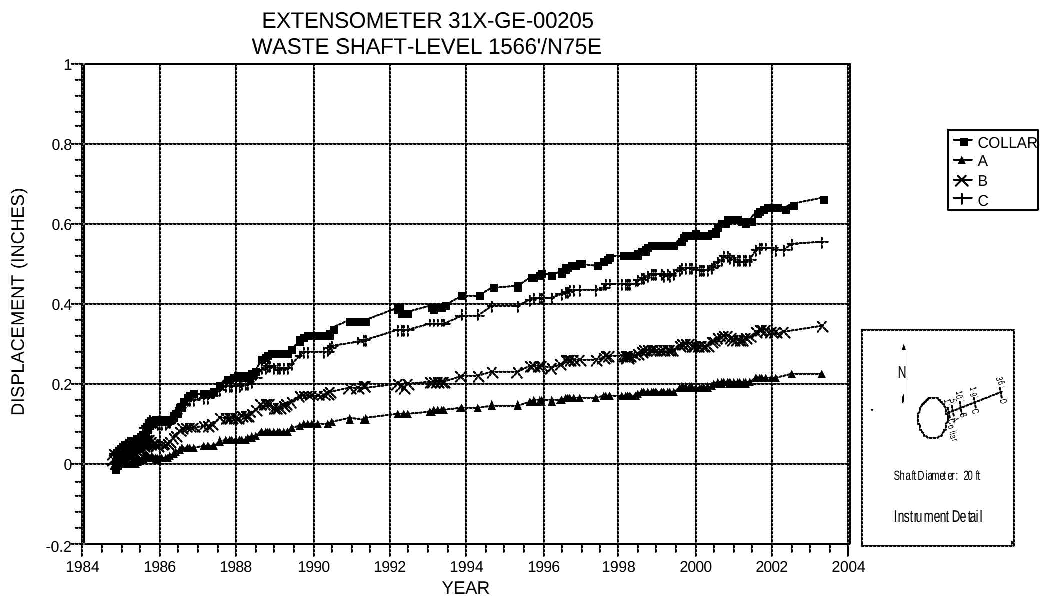
NOTES:
1. Excavation date: April 1984.

Figure 2-14 Extensometer 31X-GE-00203
Waste Shaft – Level 1071 / S15W



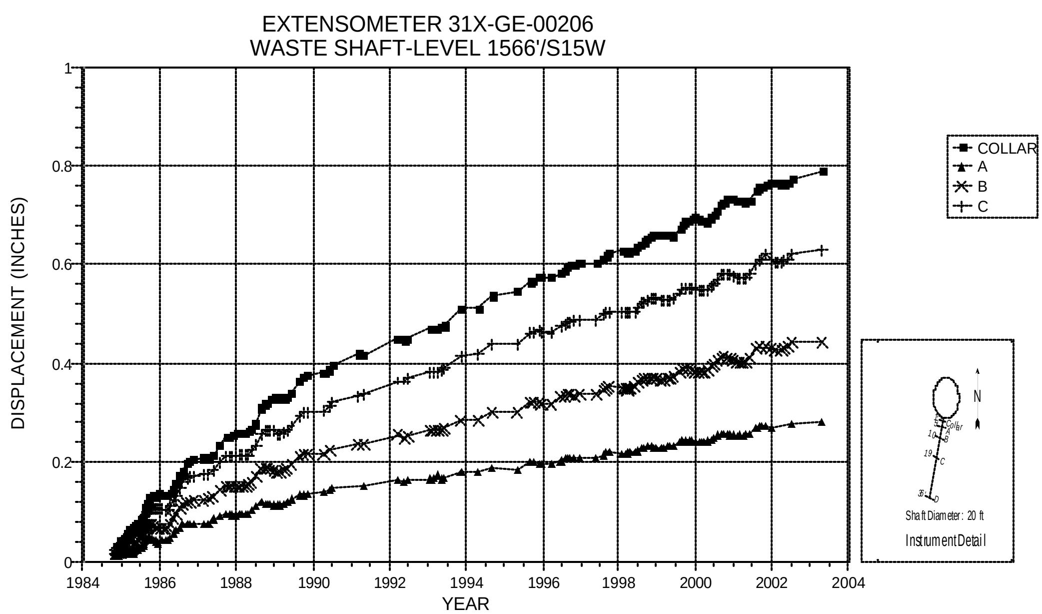
NOTES:
1. Excavation date: May 1984.

Figure 2-15 Extensometer 31X-GE-00204
Waste Shaft – Level 1566 / N45W



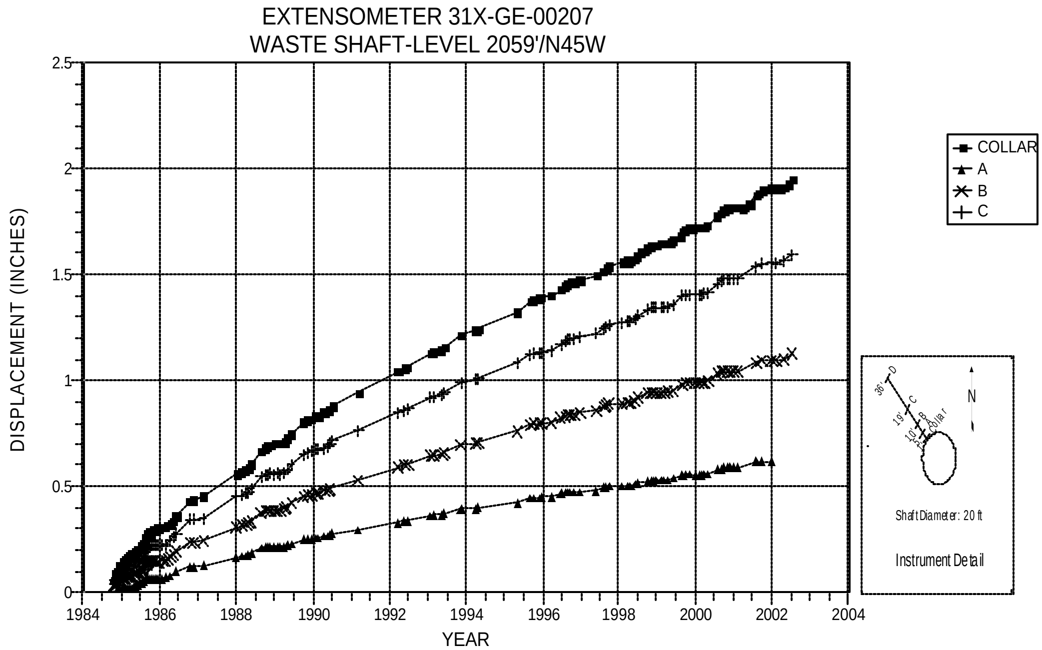
NOTES:
1. Excavation date: May 1984.

Figure 2-16 Extensometer 31X-GE-00205
Waste Shaft – Level 1566 / N75E



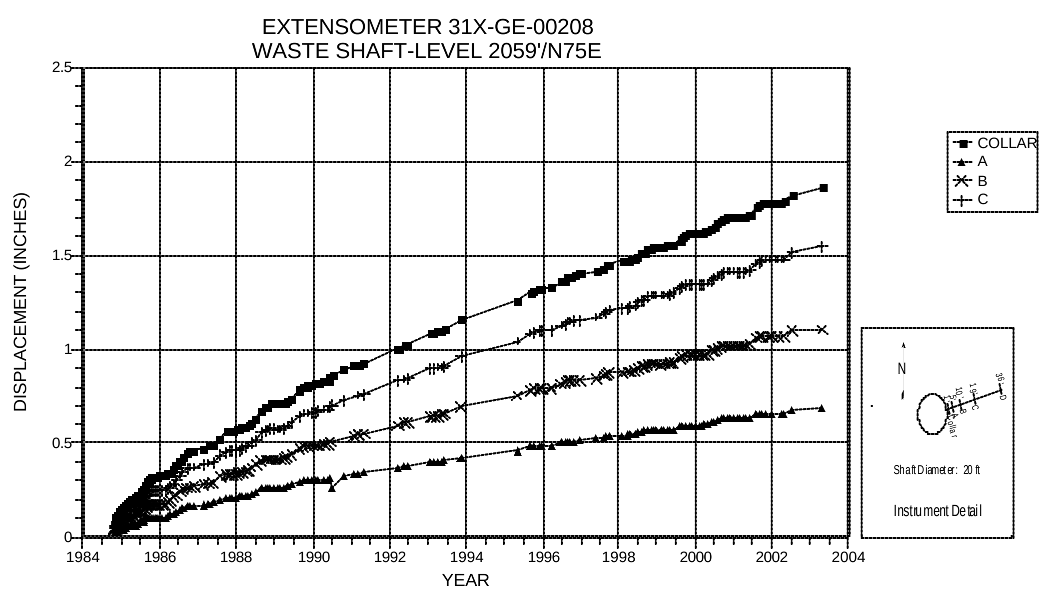
NOTES:
1. Excavation date: May 1984.

Figure 2-17 Extensometer 31X-GE-00206
Waste Shaft – Level 1566 / S15W



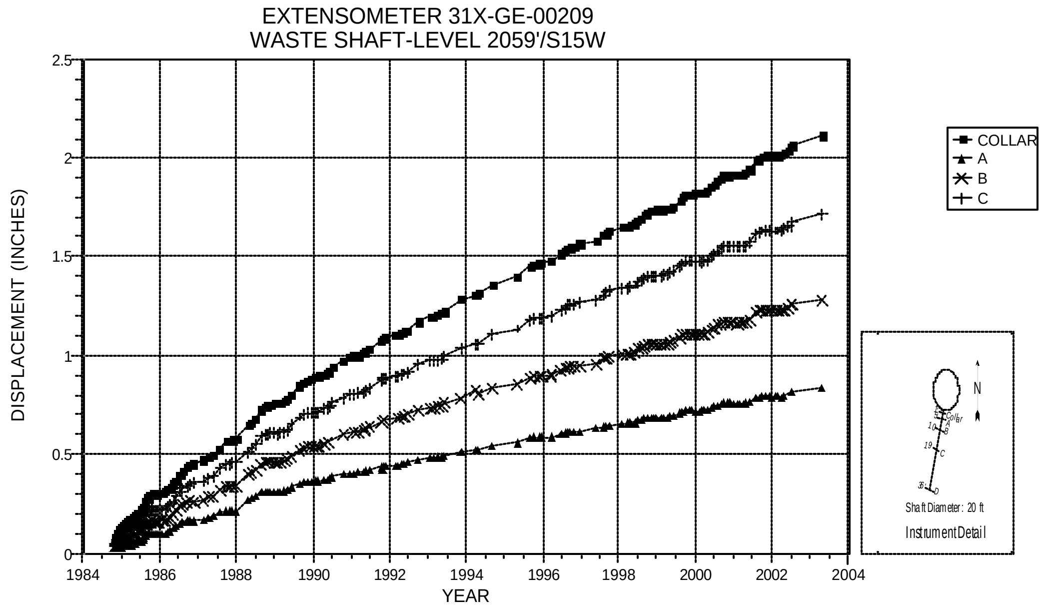
NOTES:
1. Excavation date: June 1984.

Figure 2-18 Extensometer 31X-GE-00207
Waste Shaft – Level 2059 / N45W



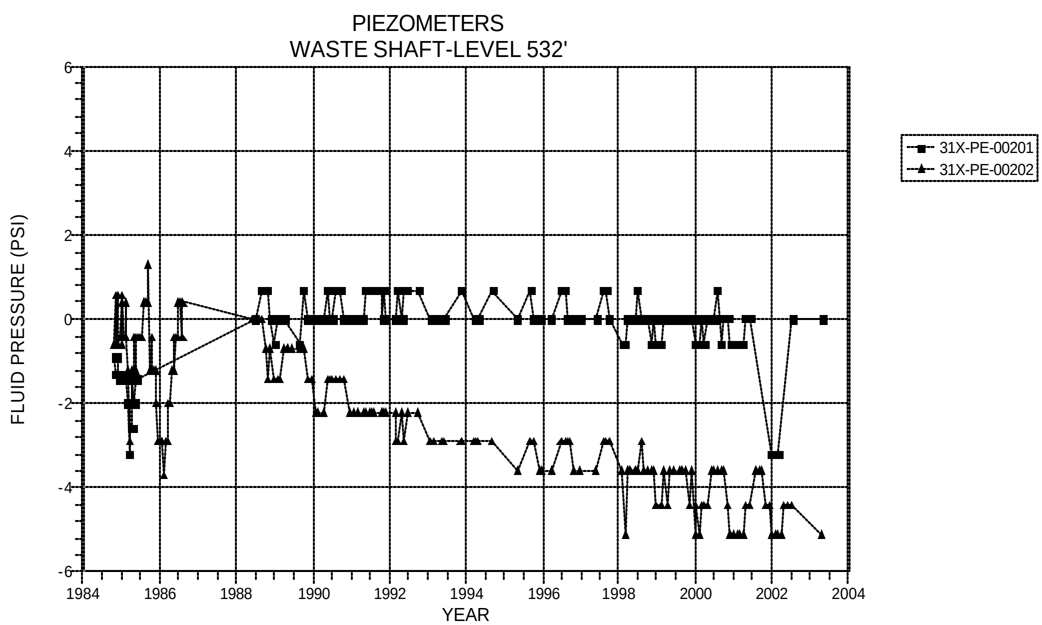
NOTES:
1. Excavation date: June 1984.

Figure 2-19 Extensometer 31X-GE-00208
Waste Shaft – Level 2059 / N75E



NOTES:
1. Excavation date: June 1984.

Figure 2-20 Extensometer 31X-GE-00209
Waste Shaft – Level 2059 / S15W



NOTES:
1. Excavation date: February 1984.

Figure 2-21 Piezometers 31X-PE-00201 and 31X-PE-00202
Waste Shaft – Level 532 at the Base of Dewey Lake Redbeds

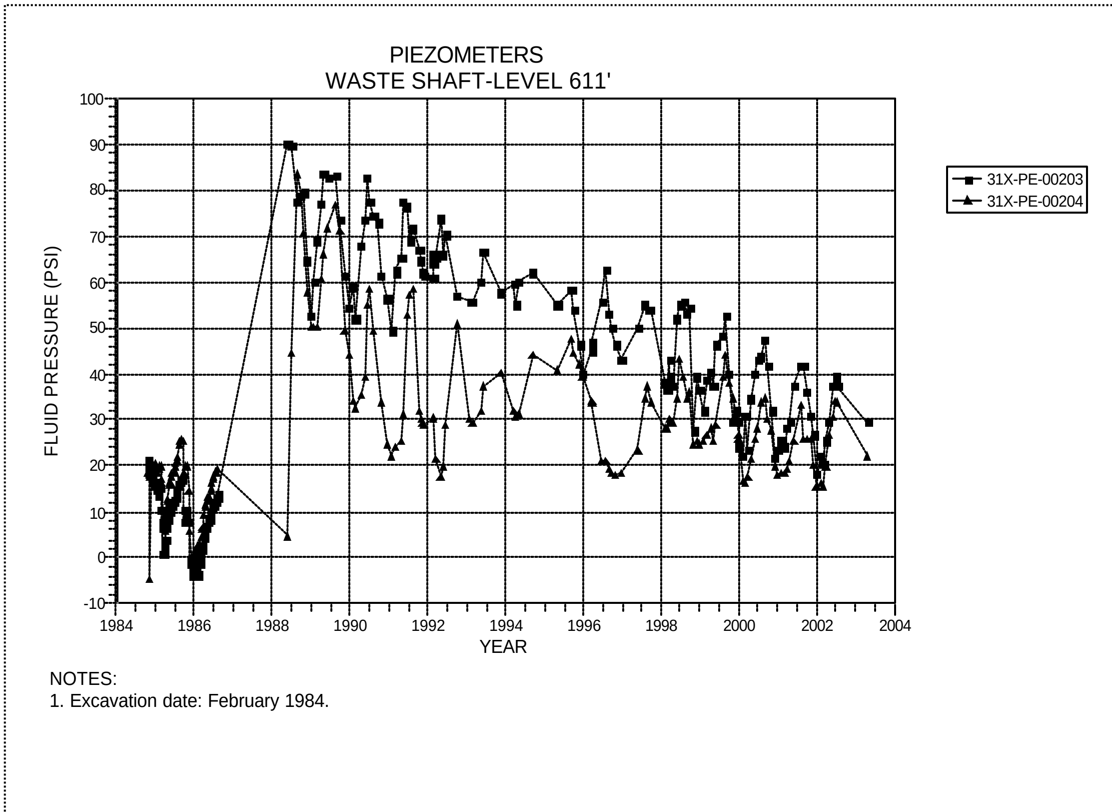


Figure 2-22 Piezometers 31X-PE-00203 and 31X-PE-00204
Waste Shaft – Level 611 at the Magenta Dolomite Member

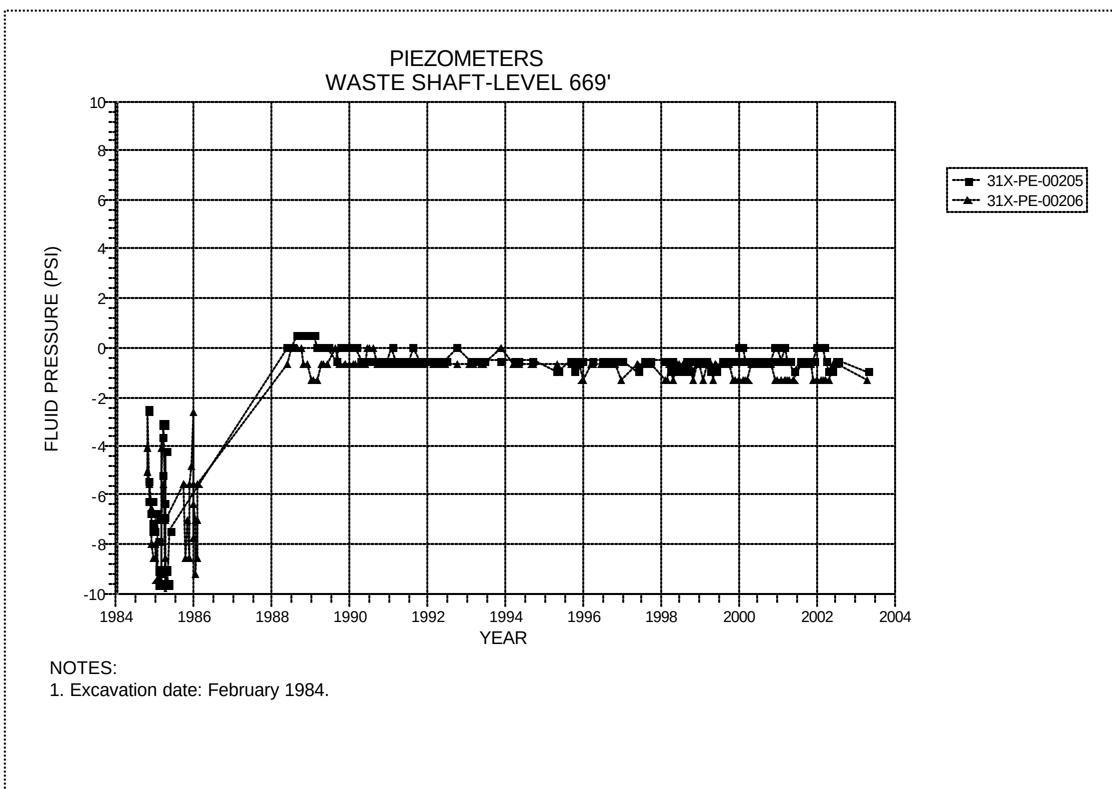
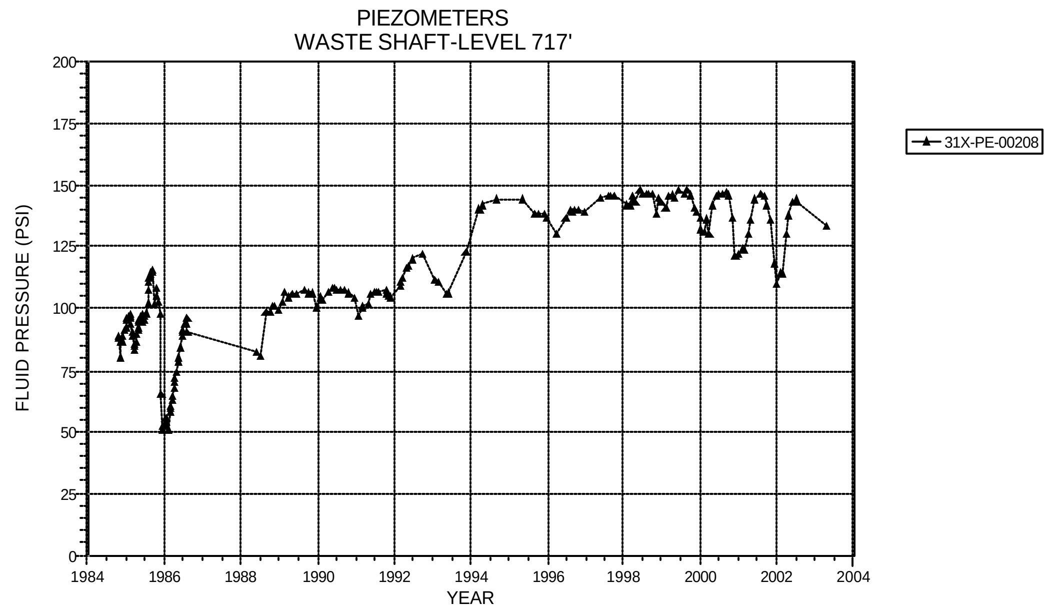
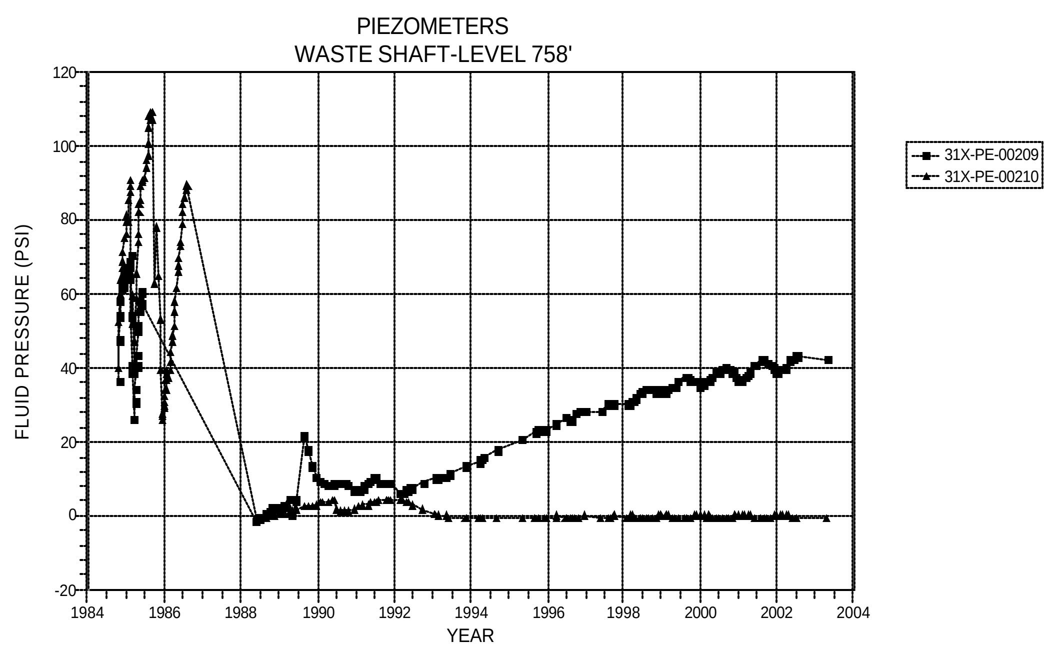


Figure 2-23 Piezometers 31X-PE-00205 and 31X-PE-00206
Waste Shaft – Level 669 at the Tamarisk Member



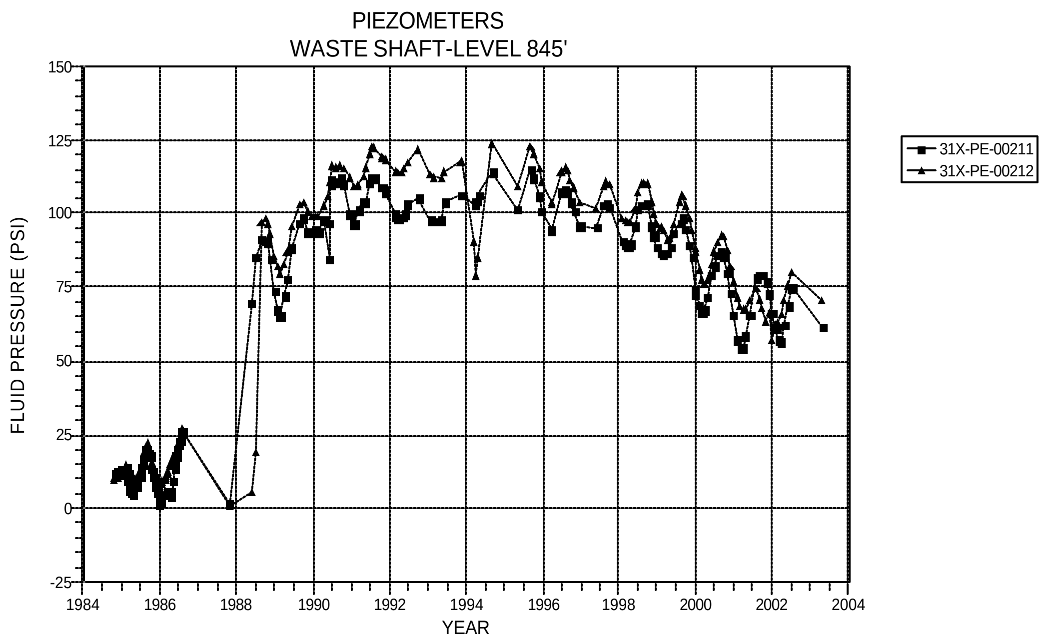
NOTES:
1. Excavation date: February 1984.

Figure 2-24 Piezometers 31X-PE-00208
Waste Shaft – Level 717 at the Culebra Dolomite Member



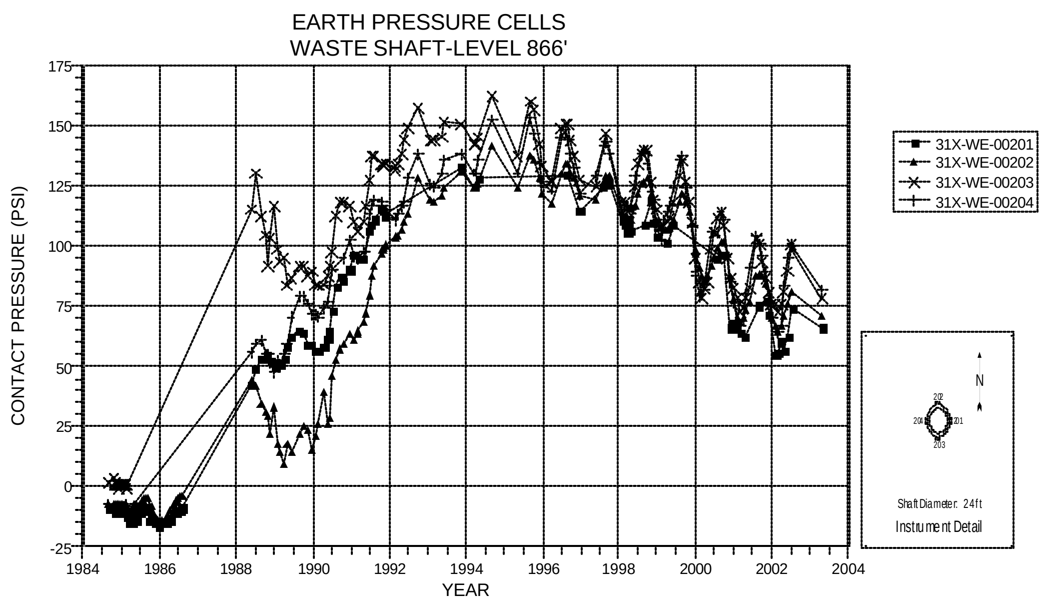
NOTES:
1. Excavation date: March 1984.
2. Suspected malfunction 31X-PE-00210 .

Figure 2-25 Piezometers 31X-PE-00209 and 31X-PE-00210
Waste Shaft – Level 758 at the Los Medaños Member



NOTES:
1. Excavation date: March 1984.
2. Pressure released on PE-211 during maintenance on June 6, 1990.

Figure 2-26 Piezometers 31X-PE-00211 and 31X-PE-00212
Waste Shaft – Level 845 at the Rustler-Salado Contact



NOTES:
1. Excavation date: March 1984.

Figure 2-27 Earth Pressure Cells
Waste Shaft Key – Level 866

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Table 2-3
Exhaust Shaft Data Analysis

EXTENSOMETERS

Field Tag	Location	Level feet	Figure Number	Date of Last Reading	Collar Displacement Relative to Deepest Anchor (inches)	Displacement Rate 2002 to 2003 in/year	Displacement Rate 2001 to 2002 in/year	Rate Change Percent [A]	Comments
35X-GE-00204	EXHAUST SHAFT	1573	2-28	06/02/03	0.363	0.016	0.019	-16%	
35X-GE-00205	EXHAUST SHAFT	1573	2-29	06/02/03	0.380	0.017	0.023	-26%	
35X-GE-00206	EXHAUST SHAFT	1573	2-30	06/02/03	0.393	0.019	0.024	-21%	
35X-GE-00207	EXHAUST SHAFT	2066	2-31	06/02/03	1.754	0.072	0.080	-10%	
35X-GE-00209	EXHAUST SHAFT	2066	2-32	07/03/02	1.244	N/A	0.059	N/A	Not readable.

[A] N/A indicates insufficient data to calculate

PIEZOMETERS

Field Tag	Level feet	Figure Number	Date of 2002-2003 Max. Reading	2002-2003 Maximum Pressure Readings (psi)	Date of 2001-2002 Max. Reading	2001-2002 Maximum Pressure Readings (psi)	Change in Maximum Pressure From Previous Year (psi)	Comments
35X-PE-00201	544	2-33	07/03/02	-3.5	09/04/01	-3.1	-0.4	
35X-PE-00202	544	2-33	09/04/02	-1.8	09/04/01	-1.9	0.1	
35X-PE-00204	615	2-34	09/04/02	126.2	09/04/01	126.7	-0.5	
35X-PE-00205	615	2-34	09/04/02	137.0	09/04/01	138.0	-1	
35X-PE-00208	673	2-35	09/04/02	6.3	09/04/01	6.7	-0.4	
35X-PE-00210	721	2-36	09/04/02	140.7	10/01/01	140.4	0.3	
35X-PE-00211	721	2-36	08/05/02	131.6	02/04/02	132.1	-0.5	
35X-PE-00213	768	2-37	09/04/02	10.8	07/30/01	11.9	-1.1	
35X-PE-00214	768	2-37	09/04/02	9.1	09/04/01	9.5	-0.4	
35X-PE-00216	850	2-38	10/02/02	90.6	09/04/01	93.4	-2.8	
35X-PE-00218	850	2-38	08/05/02	15.1	09/04/01	15.6	-0.5	
35X-PE-00219	887	2-39	10/02/02	26.7	12/04/01	23.6	3.1	
35X-PE-00220	887	2-39	10/02/02	27.3	10/01/01	26.9	0.4	

Table 2-3 (Continued)
Exhaust Shaft Data Analysis

EARTH PRESSURE CELLS

Field Tag	Level feet	Figure Number	Date of 2002-2003 Max. Reading	2002-2003 Maximum Pressure Readings (psi)	Date of 2001-2002 Max. Reading	2001-2002 Maximum Pressure Readings (psi)	Change in Maximum Pressure From Previous Year (psi)	Comments
35X-WE-00201	874	2-40	12/02/02	43.6	12/04/01	43.9	-0.3	
35X-WE-00202	874	2-40	06/02/03	53.2	09/04/01	52.8	0.4	

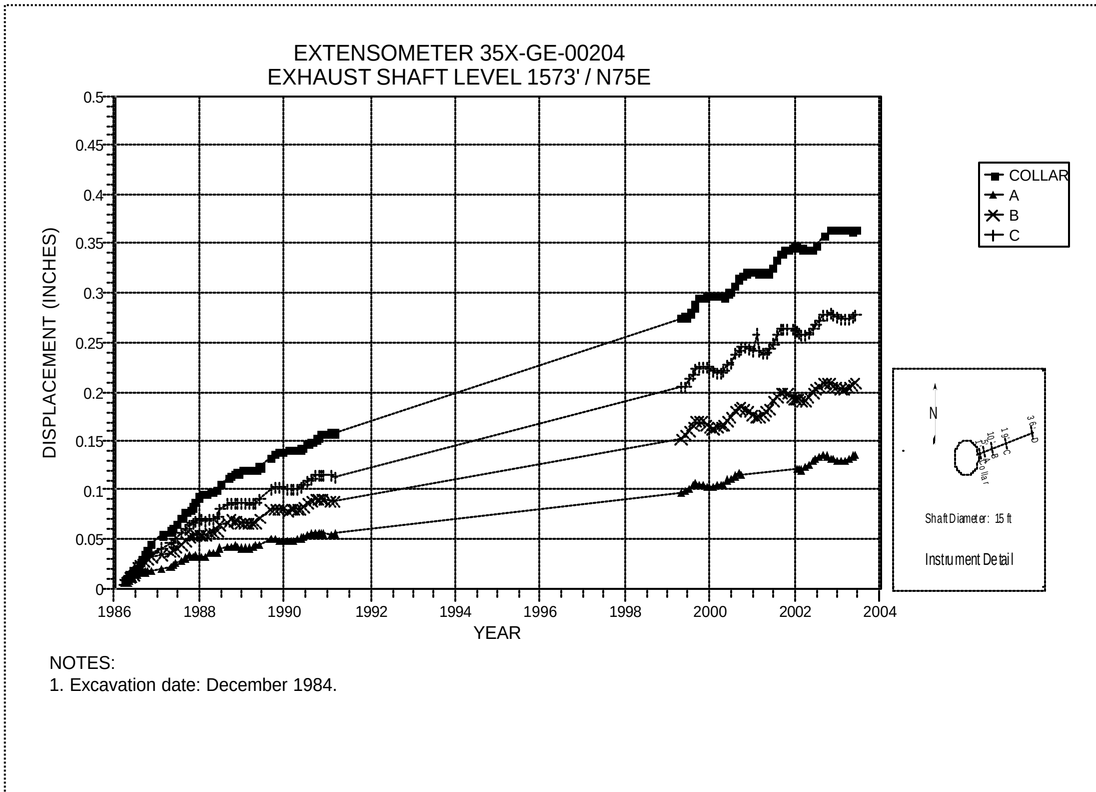


Figure 2-28 Extensometer 35X-GE-00204
Exhaust Shaft – Level 1573 / N75E

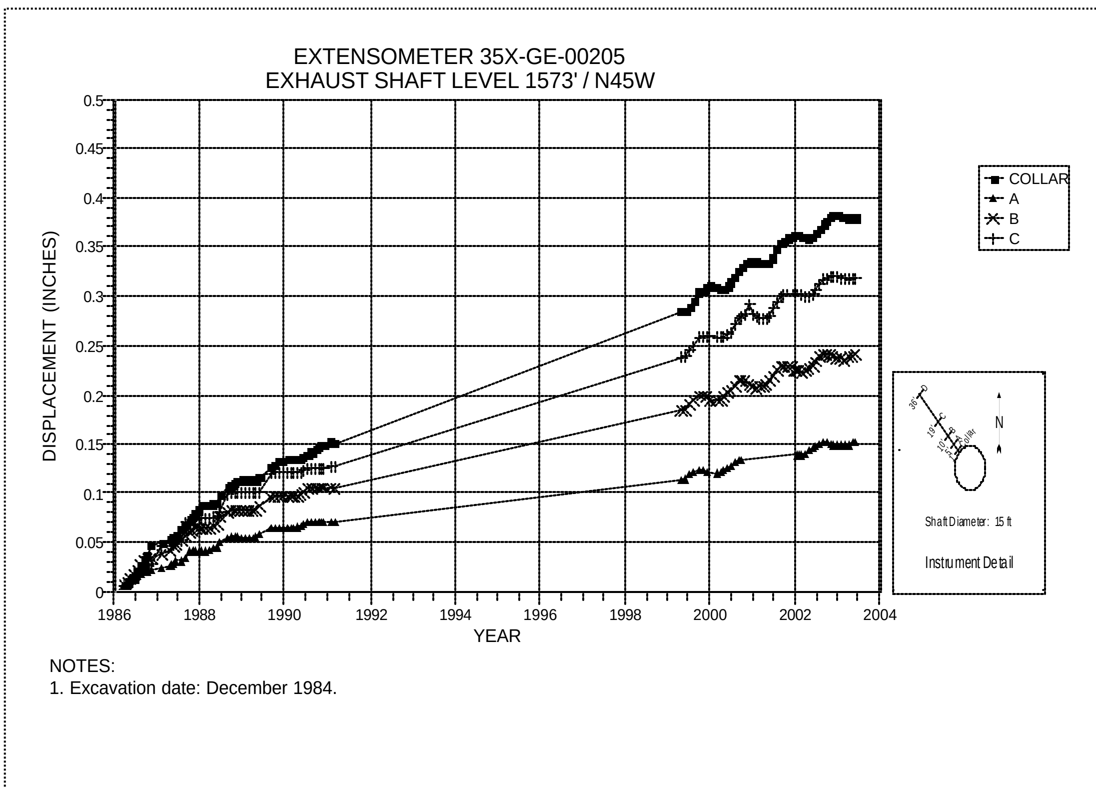
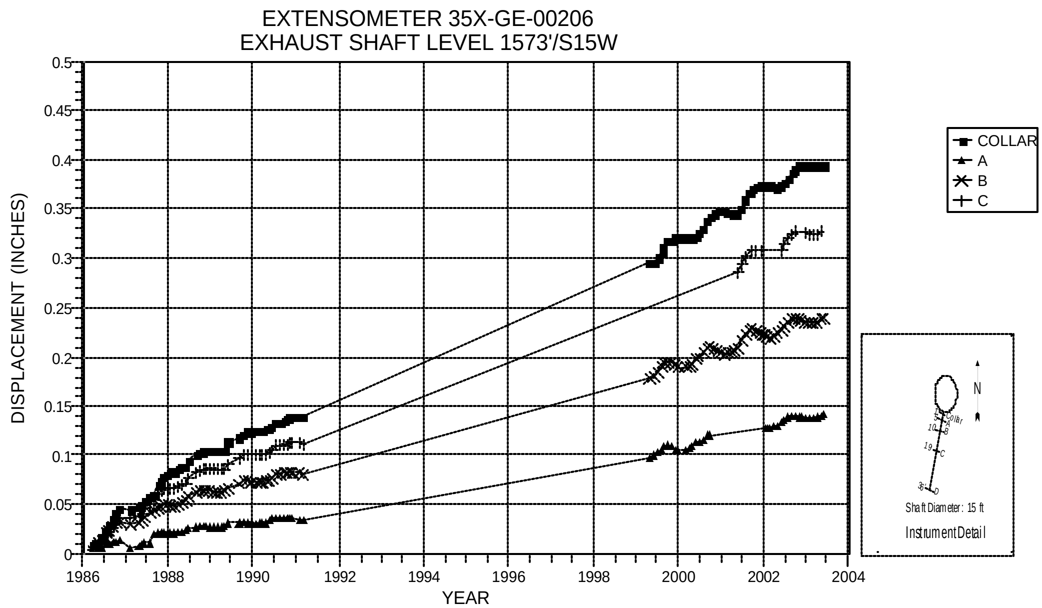
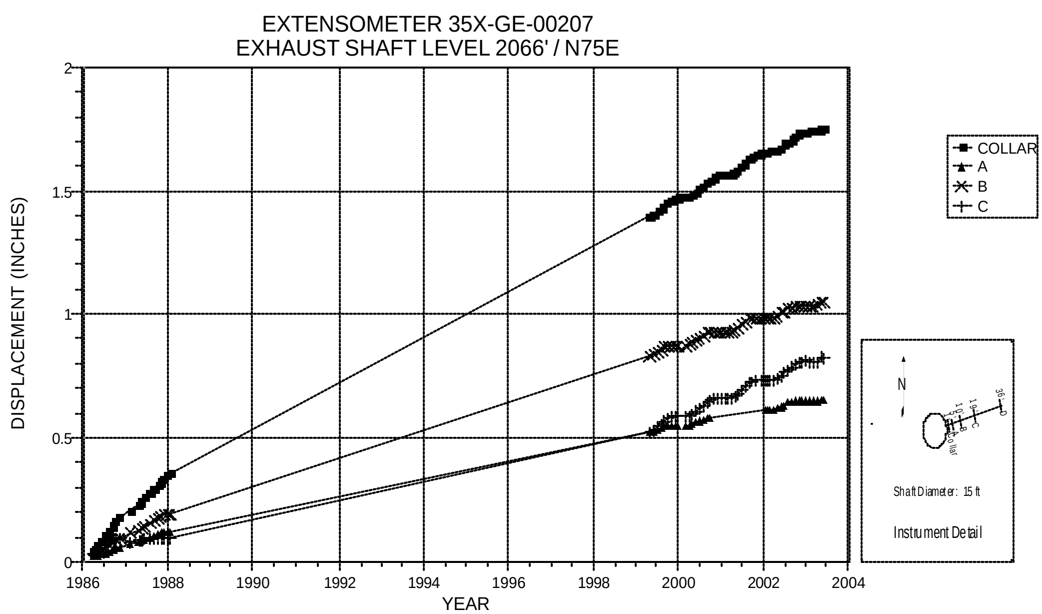


Figure 2-29 Extensometer 35X-GE-00205
Exhaust Shaft – Level 1573 / N45W



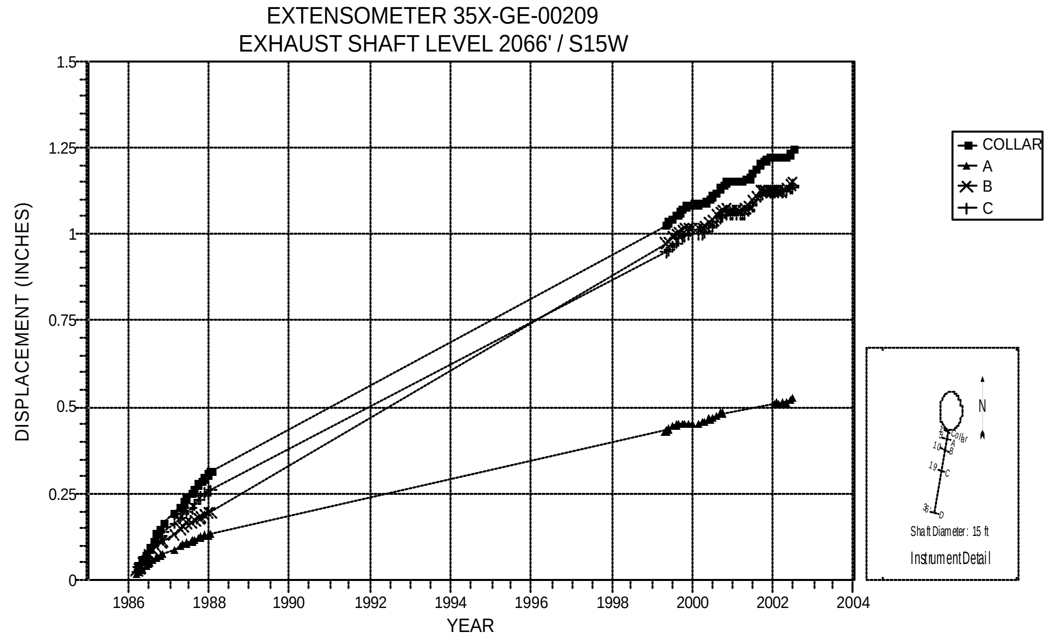
NOTES:
1. Excavation date: December 1984.

Figure 2-30 Extensometer 35X-GE-00206
Exhaust Shaft – Level 1573 / S15W



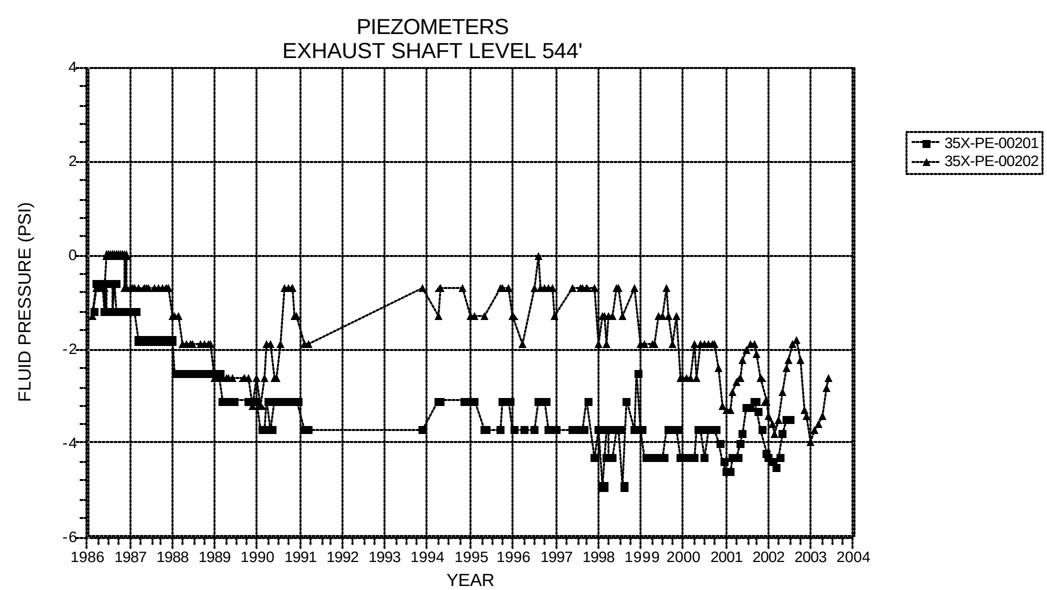
NOTES:
1. Excavation date: December 1984.

Figure 2-31 Extensometer 35X-GE-00207
Exhaust Shaft – Level 2066 / N75E



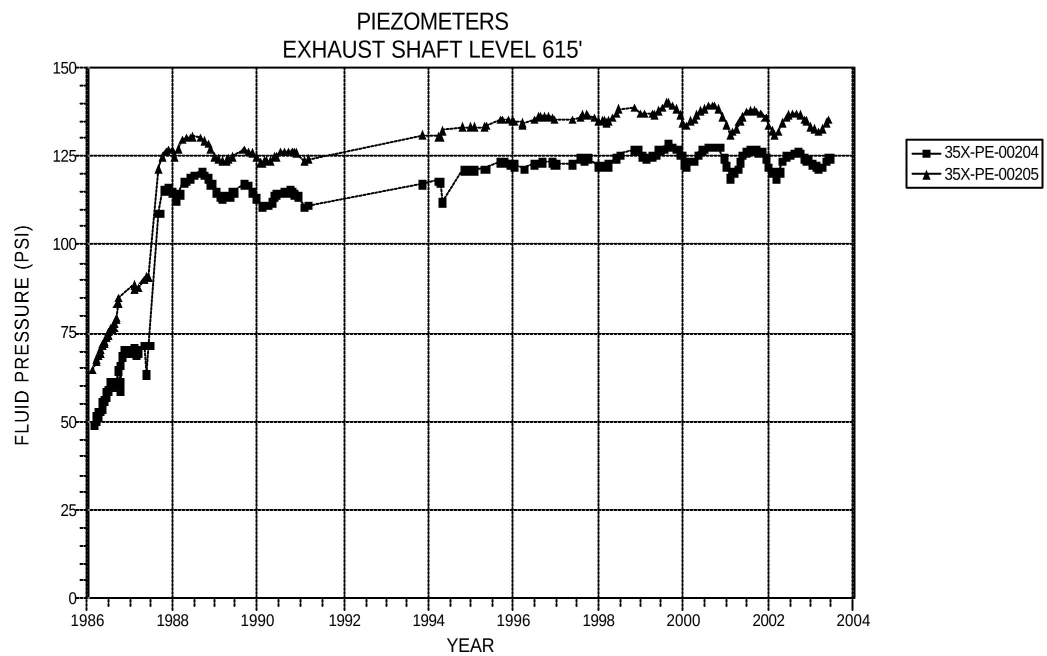
NOTES:
1. Excavation date: December 1984.
2. Not readable after 7/3/02.

Figure 2-32 Extensometer 35X-GE-00209
Exhaust Shaft – Level 2066 / S15W



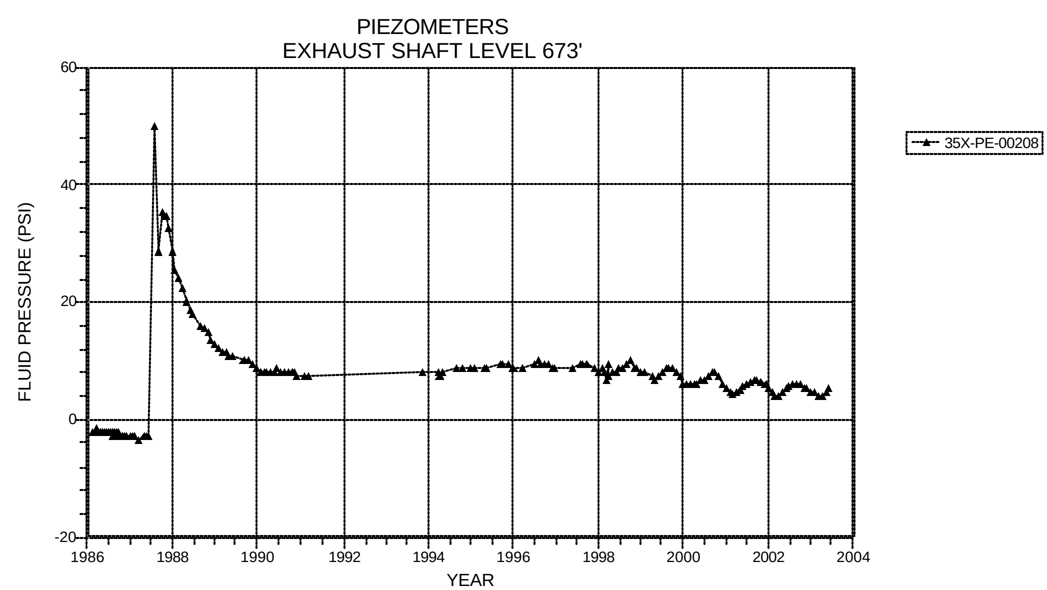
NOTES:
1. Excavation date: October 1984.
2. Instrumentation malfunction 35X-PE-00201 after 7/3/2002.

Figure 2-33 Piezometers 35X-PE-00201and 35X-PE-00202
Exhaust Shaft – Level 544 at the Base of Dewey Lake Redbeds



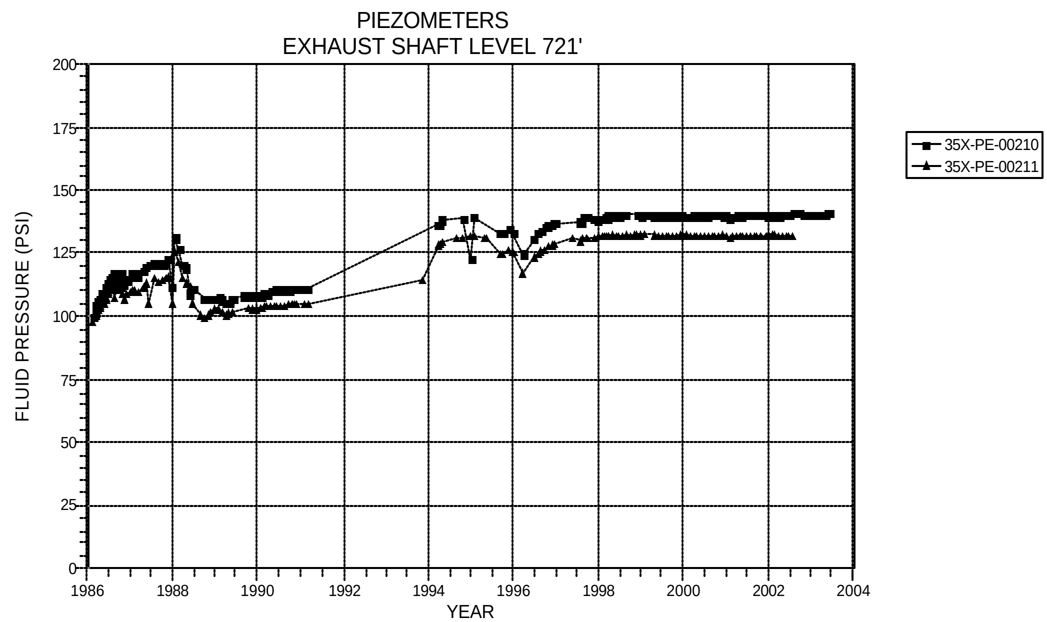
NOTES:
1. Excavation date: October 1984.

Figure 2-34 Piezometers 35X-PE-00204 and 35X-PE-00205
Exhaust Shaft – Level 615 at the Magenta Dolomite Member



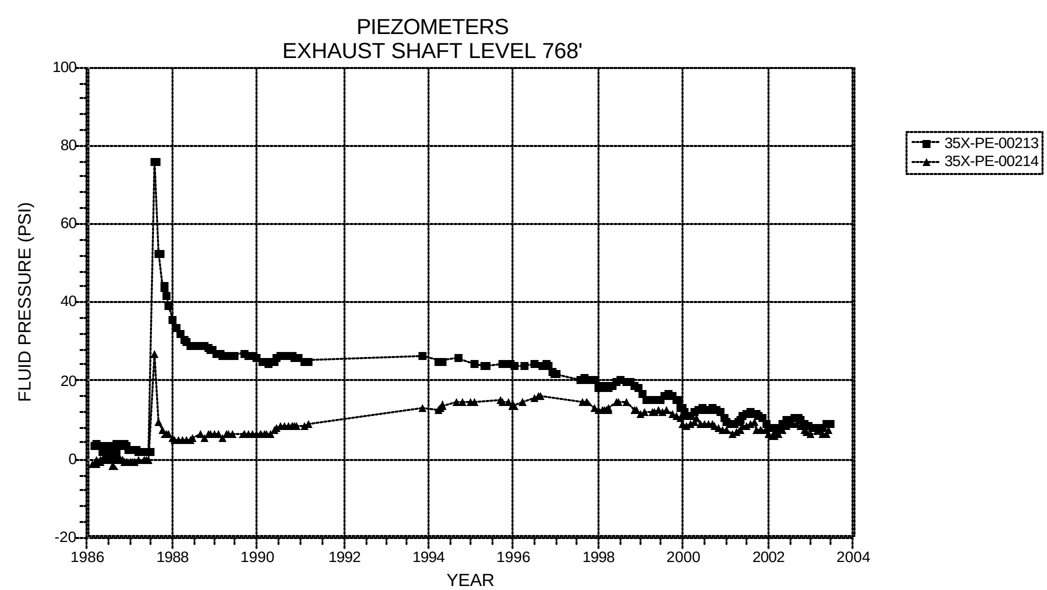
NOTES:
1. Excavation date: October 1984.

Figure 2-35 Piezometers 35X-PE-00208
Exhaust Shaft – Level 673 at the Tamarisk Member



NOTES:
1. Excavation date: October 1984.
2. Instrumentation malfunction 35X-PE-00211 after 8/5/2002..

Figure 2-36 Piezometers 35X-PE-00210 and 35X-PE-00211
Exhaust Shaft – Level 721 at the Culebra Dolomite Member



NOTES:
1. Excavation date: November 1984.

Figure 2-37 Piezometers 35X-PE-00213 and 35X-PE-00214
Exhaust Shaft – Level 768 at the Los Medaños Member

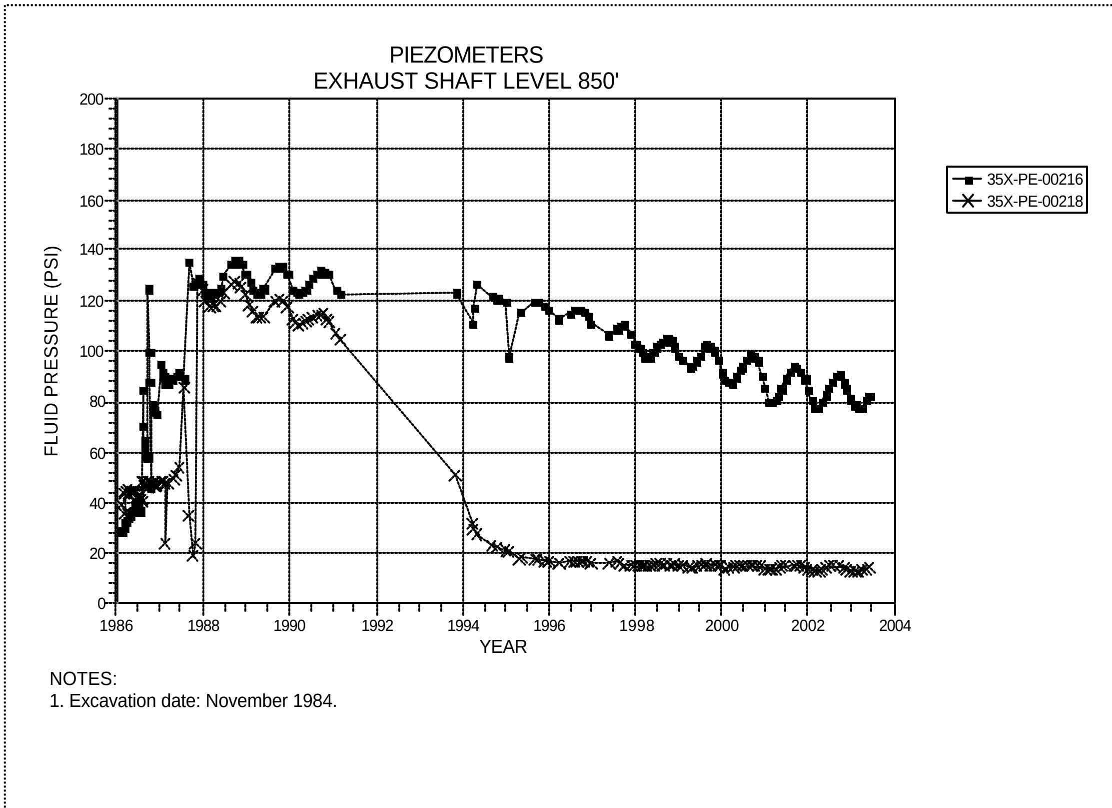


Figure 2-38 Piezometers 35X-PE-00216 and 35X-PE-00218
Exhaust Shaft – Level 850 at the Rustler-Salado Contact

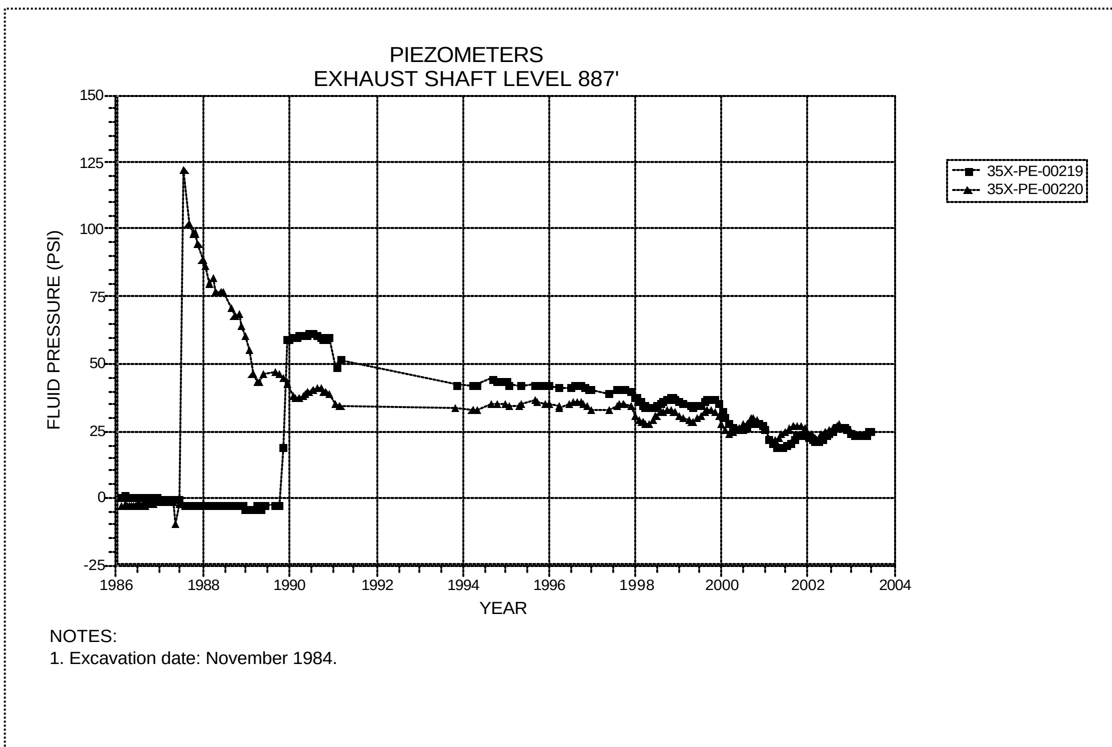


Figure 2-39 Piezometers 35X-PE-00219 and 35X-PE-00220
Exhaust Shaft – Level 887 below the Lower Chemical Seal

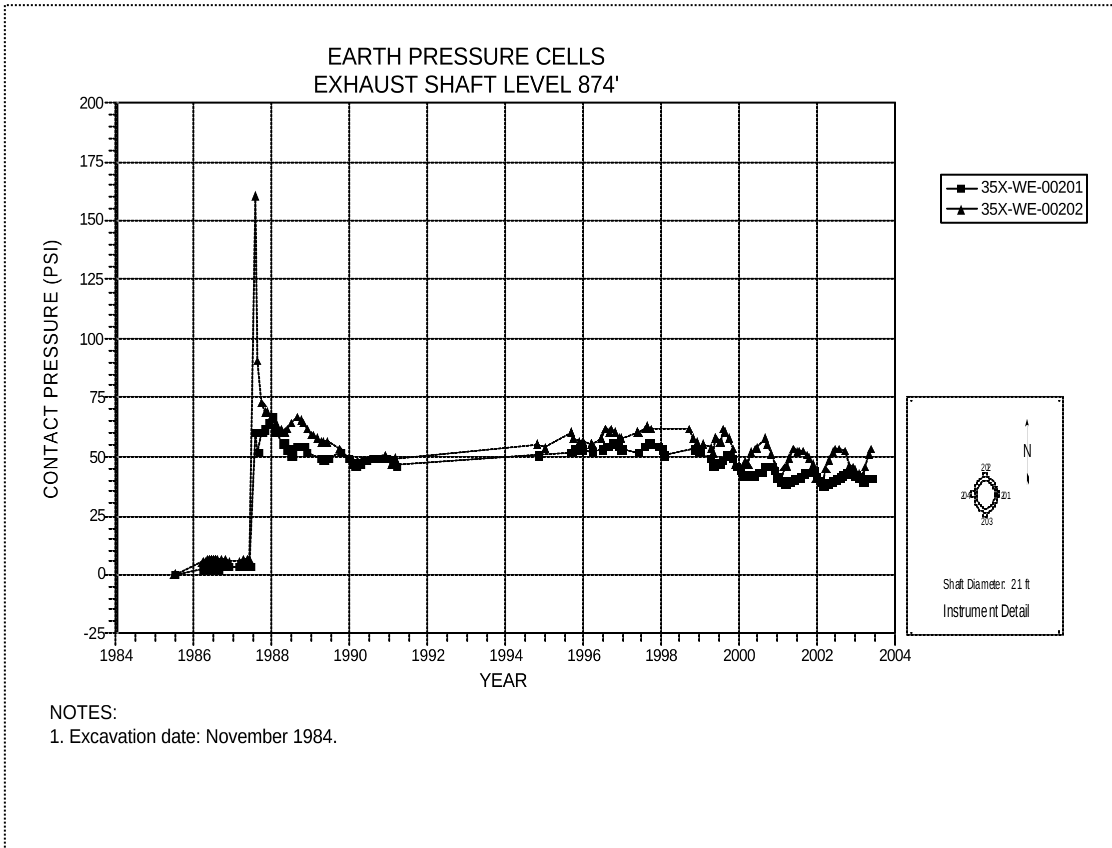


Figure 2-40 Earth Pressure Cells 35X-WE-00201 and 35X-WE-00202
Exhaust Shaft Key – Level 874

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3.0 Instrumentation Summary for Shaft Stations

Instrumentation data analysis for the Salt Handling Shaft Station, Waste Shaft Station, and the area around the Air Intake Shaft follow. Table 3-1 presents data analyses for each of the Salt Handling Shaft Station instruments. Figures 3-1 through 3-4 present plots of the instrumentation data for the Salt Handling Shaft Station. Tables 3-2 presents data and analysis for the Waste Shaft Station. Plots from the instrumentation in the Waste Shaft Station are presented as Figures 3-5 through 3-10. Table 3-3 and Figures 3-11 through 3-14 present the data from rock bolt load cells located in the immediate area around the Air Intake Shaft.

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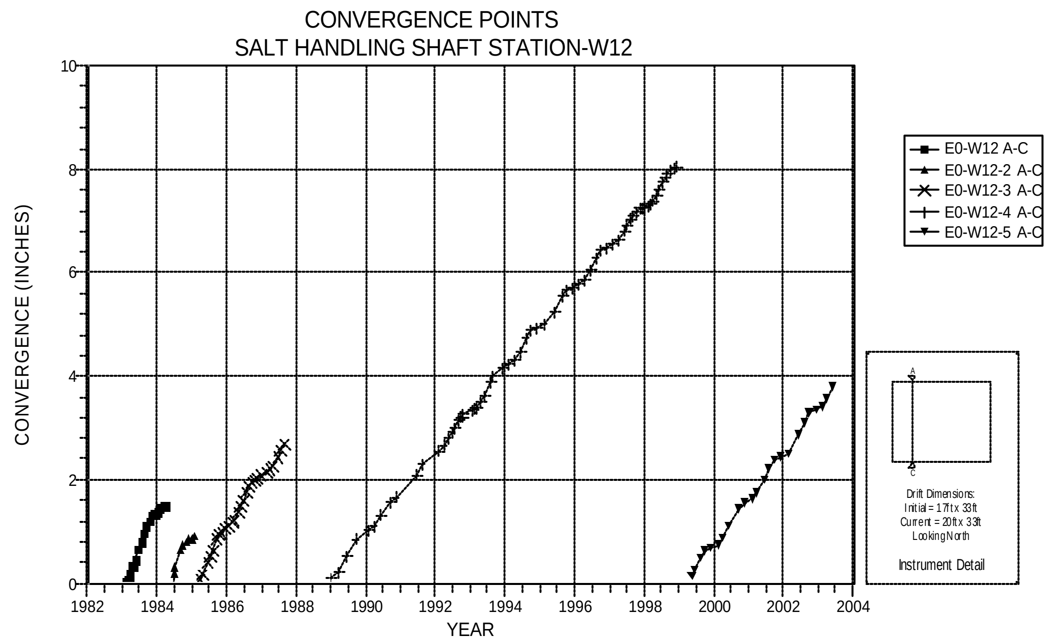
Table 3-1
Salt Handling Shaft Station Data Analysis

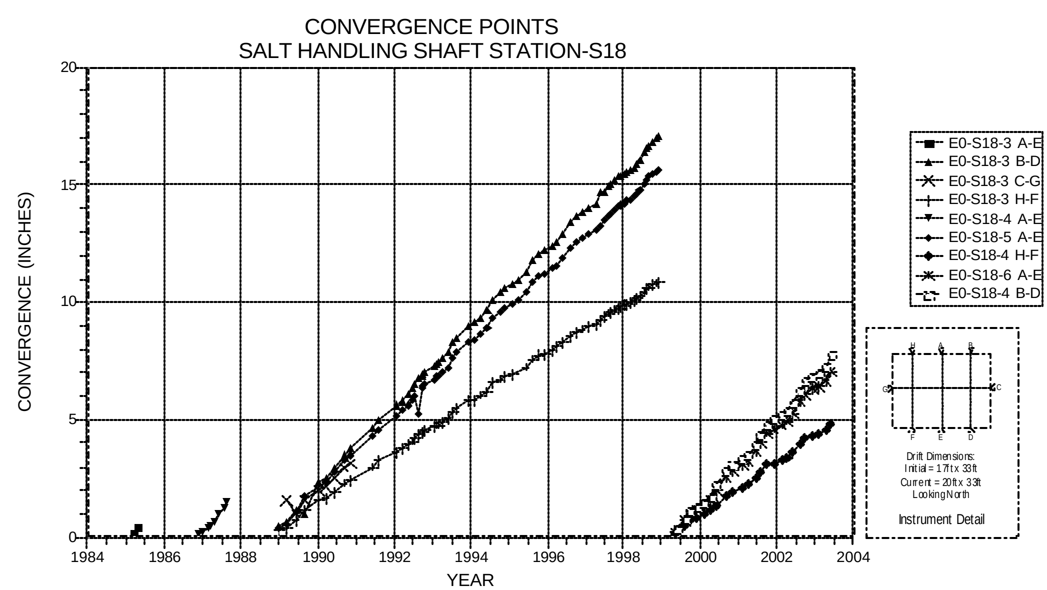
CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading Date	Last Reading Inches	Cumulative Displacement Inches	Closure Rate 2002 to 2003 in/year	Closure Rate 2001 to 2002 in/year	Rate Change Percent	Comments
E0-W12-5 A-C	Salt Shaft-W12	3-1	06/05/03	3.802	16.971	0.832	0.765	9%	
E0-S18-6 A-E	E0 Drift-S18	3-2	06/05/03	7.076	24.632	1.573	1.579	0%	
E0-S18-4 B-D	E0 Drift-S18	3-2	06/05/03	7.738	24.796	1.831	1.596	15%	
E0-S18-4 F-H	E0 Drift-S18	3-2	06/05/03	4.853	15.709	1.103	1.016	9%	
E0-S30-5 A-C	E0 Drift-S30	3-3	06/05/03	7.436	39.043	1.652	1.533	8%	
E0-S65-3 A-C	E0 Drift-S65	3-4	06/05/03	5.551	35.902	1.235	1.201	3%	



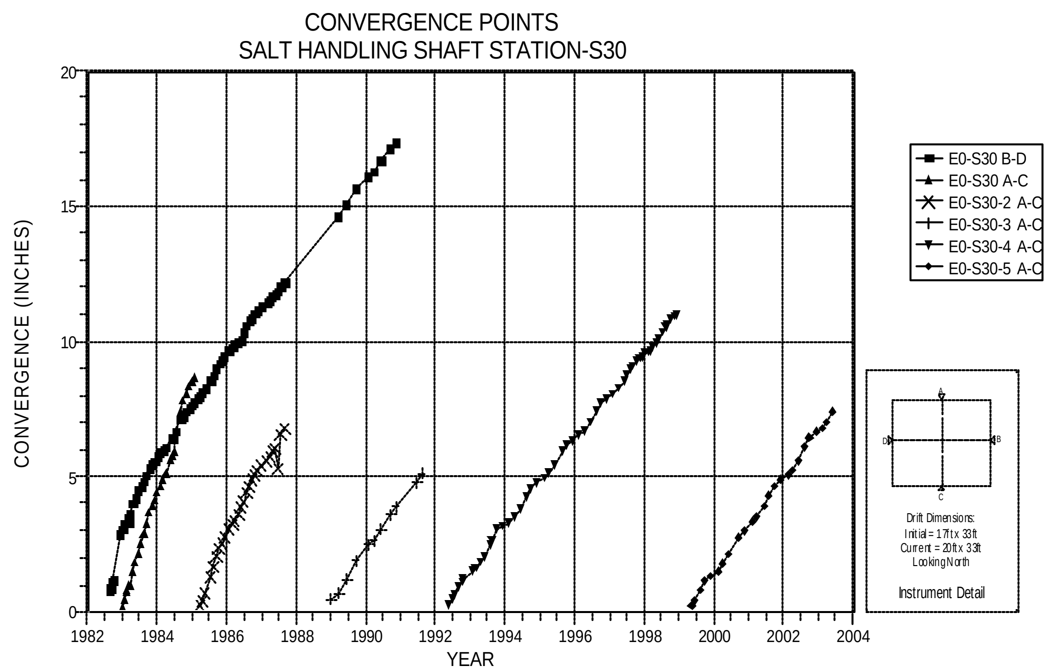
NOTES:
1. Excavation date: May 1982.

Figure 3-1 Convergence Point Array
Salt Handling Shaft Station 12 Feet West of Shaft – Roof to Floor



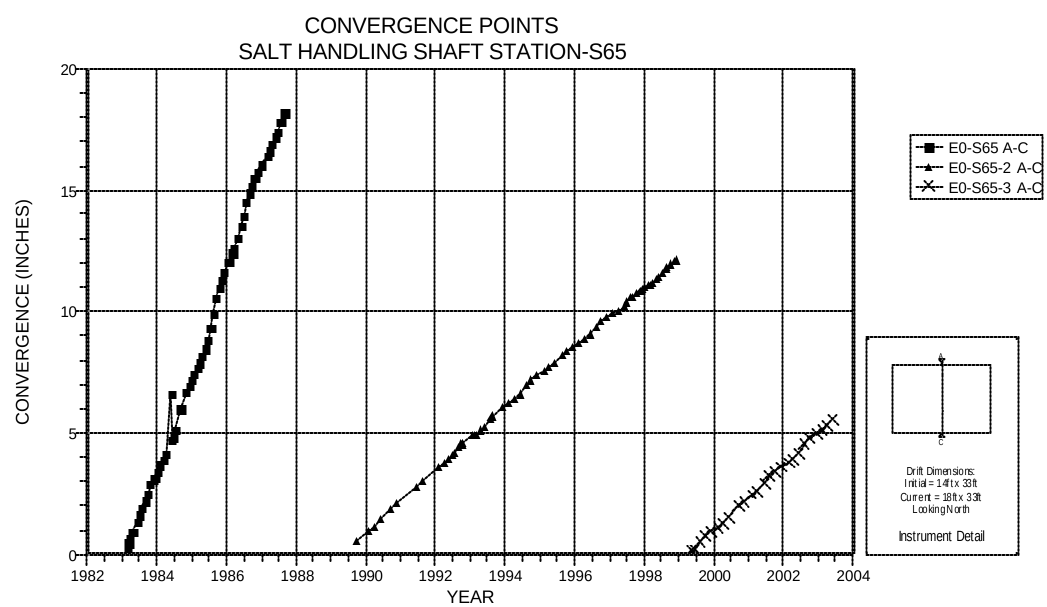
NOTES:
1. Excavation date: May 1982.

Figure 3-2 Convergence Point Array
Salt Handling Shaft Station at South 18 – All Chords



NOTES:
1. Excavation date: May 1982.

Figure 3-3 Convergence Point Array
Salt Handling Shaft Station at South 30 – All Chords



NOTES:
1. Excavation date: May 1982.

Figure 3-4 Convergence Point Array
Salt Handling Shaft Station at South 65 – Roof to Floor

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Table 3-2
Waste Shaft Station Data Analysis

EXTENSOMETERS

Field Tag	Location		Figure Number	Date of Last Reading	Collar Displacement Relative to Deepest Anchor (inches)	Displacement Rate 2002 to 2003 in/year	Displacement Rate 2001 to 2002 in/year	Rate Change Percent	Comments
51X-GE-00268	W30 Drift-S400	Roof	3-5	06/02/03	7.928	0.254	0.243	5%	
51X-GE-00279	S400 Drift-E140	Roof	3-6	05/12/03	10.212	0.662	0.82	-19%	

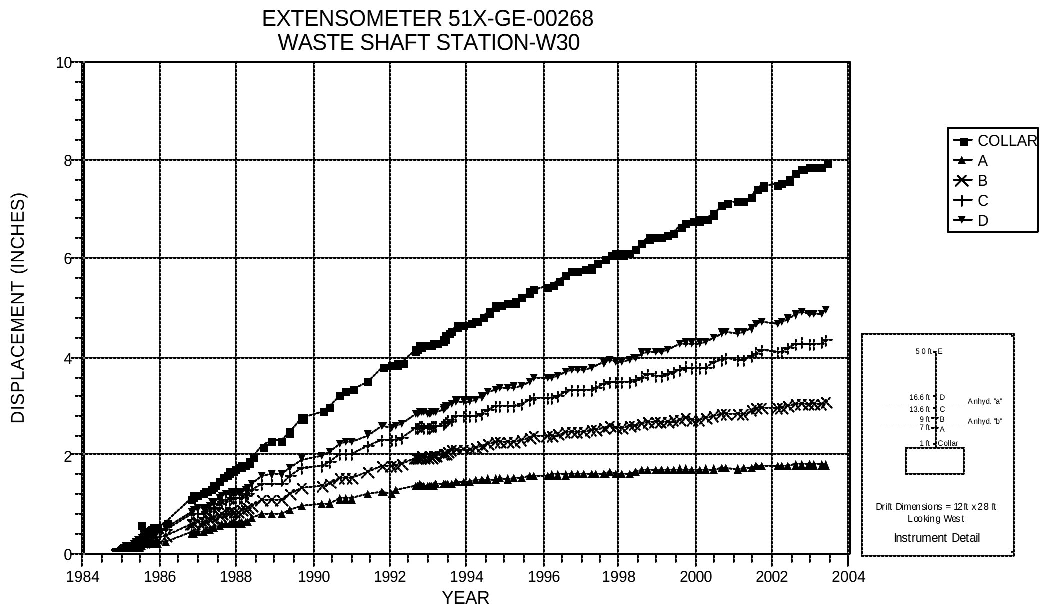
CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading		Cumulative Displacement Inches	Closure Rate 2002 to 2003 in/year	Closure Rate 2001 to 2002 in/year	Rate Change Percent	Comments
			Date	Inches					
S400-E30-2 C-H	S400 Drift-E30	3-7	06/04/03	15.753	15.826	0.856	0.92	-7%	
S400-E90-2 C-G	S400 Drift-E90	3-8	06/04/03	17.92	18.111	0.958	0.968	-1%	

Table 3-2 (Continued)
Waste Shaft Station Data Analysis

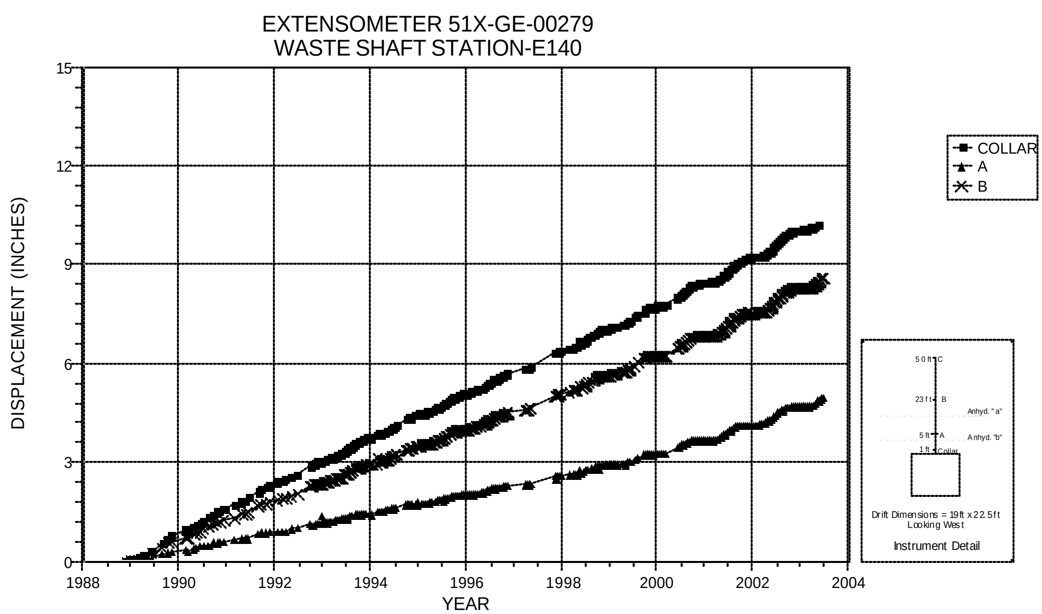
ROCKBOLT LOAD CELLS

Field Tag	Location	Figure Number	Date of Initial Reading	Date of Last Reading	Load (kips)	Comments
51X WG-00226	Waste Shaft Station Brow	3-9	07/15/92	06/23/03	42.460	
51X WG-00227	Waste Shaft Station Brow	3-9	07/15/92	06/23/03	35.445	
51X WG-00228	Waste Shaft Station Brow	3-9	03/20/96	06/23/03	39.607	
51X WG-00229	Waste Shaft Station Brow	3-9	03/20/96	06/23/03	38.528	
51X WG-00230	Waste Shaft Station Brow	3-9	03/20/96	06/23/03	51.171	
51X WG-00231	Waste Shaft Station Brow	3-10	03/20/96	06/23/03	28.336	
51X WG-00232	Waste Shaft Station Brow	3-10	07/15/92	06/23/03	35.919	
51X WG-00233	Waste Shaft Station Brow	3-10	07/15/92	06/23/03	2.370	Probable broken bolt.
51X WG-00234	Waste Shaft Station Brow	3-10	07/15/92	06/23/03	62.620	
51X WG-00235	Waste Shaft Station Brow	3-10	03/20/96	06/23/03	34.824	



NOTES:
1. Excavation date: November 1982.

Figure 3-5 Extensometer 51X-GE-00268
Waste Shaft Station at West 30 – Roof



NOTES:
1. Excavation date: November 1982.

Figure 3-6 Extensometer 51X-GE-00279
Waste Shaft Station at East 140 – Roof

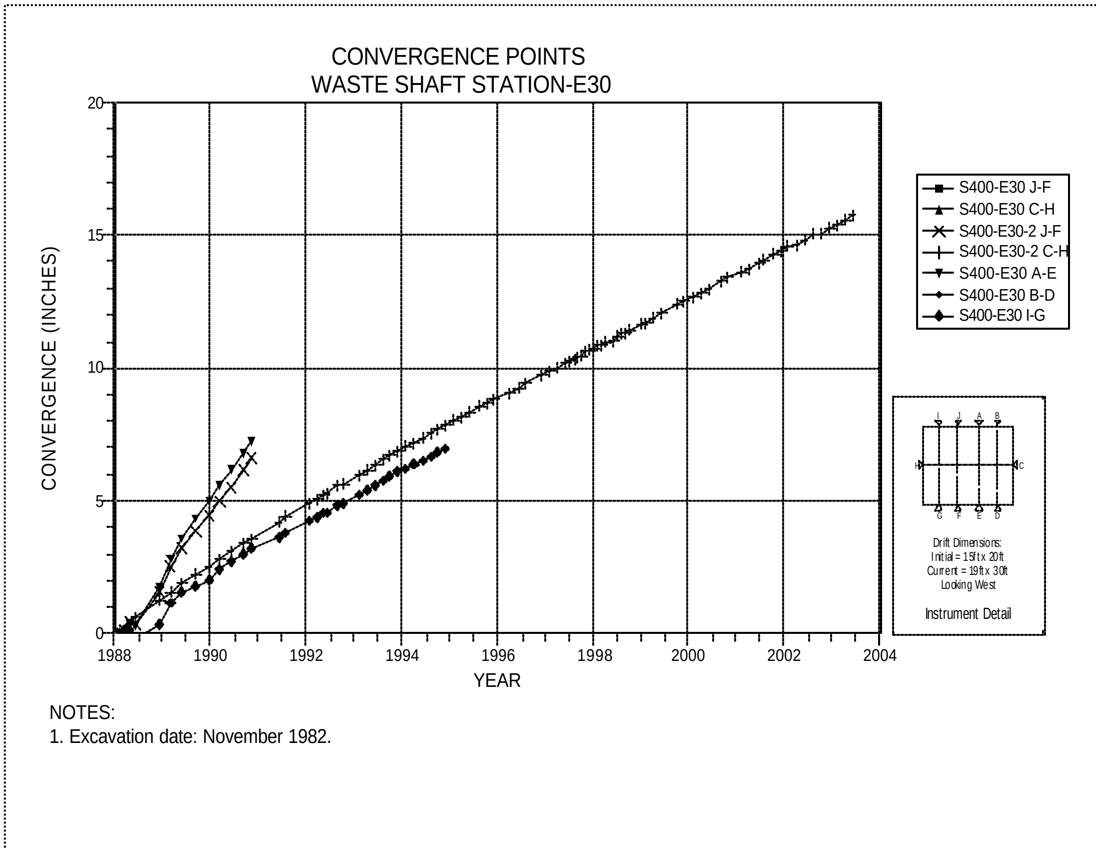


Figure 3-7 Convergence Point Array
Waste Shaft Station at East 30 – All Chords

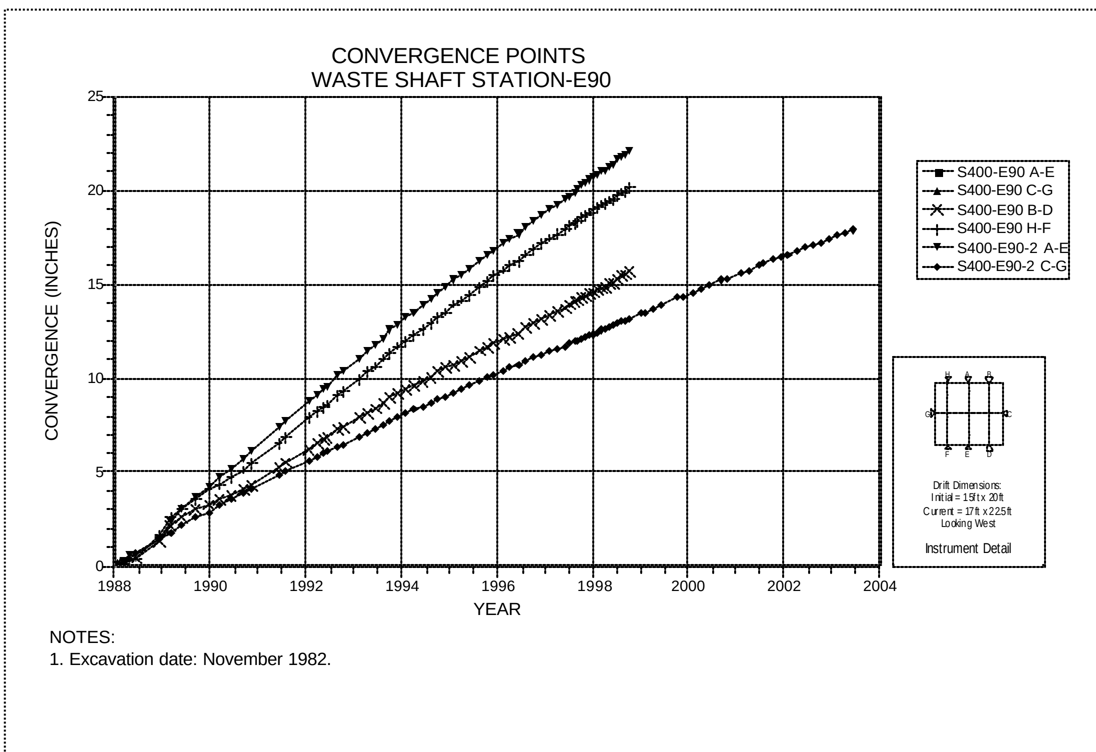


Figure 3-8 Convergence Point Array
Waste Shaft Station at East 90 – All Chords

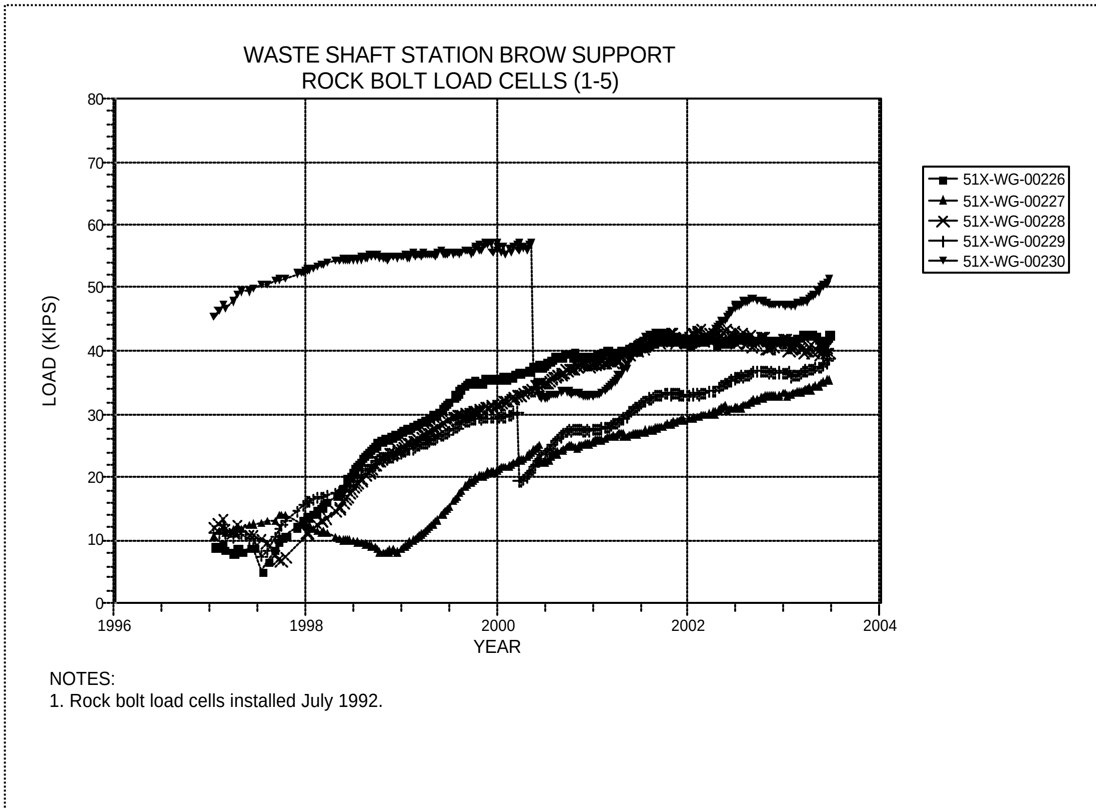


Figure 3-9 Rock Bolt Load Cells
Waste Shaft Station Brow – Roof Bolts Set 1

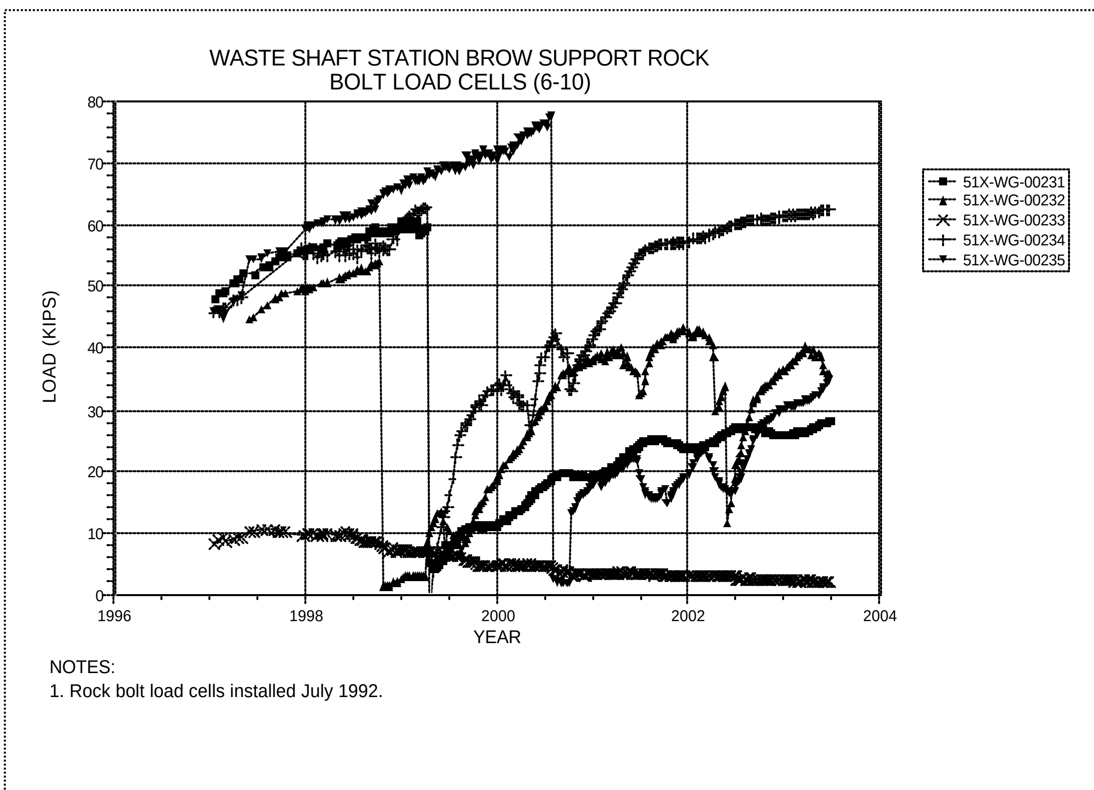


Figure 3-10 Rock Bolt Load Cells
Waste Shaft Station Brow – Roof Bolts Set 2

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Table 3-3
Air Intake Shaft Station Data Analysis

ROCKBOLT LOAD CELLS

Field Tag	Location	Figure Number	Date of Initial Reading	Date of Last Reading	Load (kips)	Comments
51X-WG-00236	AIS Station Brow - South	3-11	01/19/93	06/23/03	44.757	
51X-WG-00237	AIS Station Brow - South	3-11	01/19/93	06/23/03	43.037	
51X-WG-00238	AIS Station Brow - South	3-11	01/19/93	06/23/03	7.108	
51X-WG-00239	AIS Station Brow - South	3-11	01/19/93	06/23/03	0.900	Broken bolt.
51X-WG-00240	AIS Station Brow - South	3-11	01/19/93	06/23/03	13.628	
51X-WG-00241	AIS Station Brow - South	3-12	01/19/93	06/23/03	50.962	
51X-WG-00242	AIS Station Brow - South	3-12	01/19/93	06/23/03	38.988	
51X-WG-00243	AIS Station Brow - South	3-12	01/19/93	06/23/03	41.890	
51X-WG-00244	AIS Station Brow - South	3-12	12/24/94	06/23/03	38.640	
51X-WG-00245	AIS Station Brow - South	3-12	01/19/93	06/23/03	46.749	
51X-WG-00246	AIS Station Brow - North	3-13	01/19/93	06/23/03	12.902	
51X-WG-00247	AIS Station Brow - North	3-13	01/19/93	06/23/03	42.014	
51X-WG-00248	AIS Station Brow - North	3-13	01/19/93	06/23/03	47.844	
51X-WG-00249	AIS Station Brow - North	3-13	01/19/93	06/23/03	3.934	
51X-WG-00250	AIS Station Brow - North	3-13	12/24/94	06/23/03	18.738	
51X-WG-00251	AIS Station Brow - North	3-14	01/19/93	06/23/03	29.554	
51X-WG-00252	AIS Station Brow - North	3-14	01/19/93	06/23/03	3.094	
51X-WG-00253	AIS Station Brow - North	3-14	01/19/93	06/23/03	47.302	
51X-WG-00254	AIS Station Brow - North	3-14	01/19/93	06/23/03	14.146	
51X-WG-00255	AIS Station Brow - North	3-14	01/19/93	06/23/03	19.830	

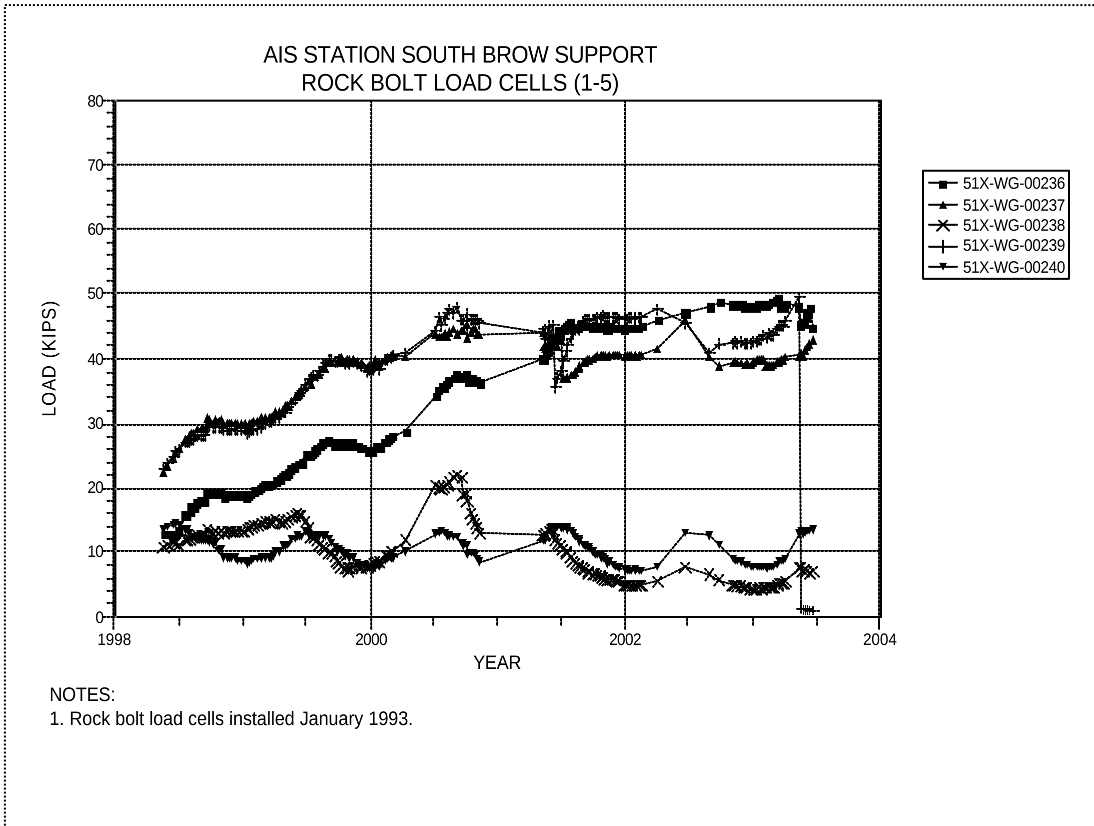


Figure 3-11 Rock Bolt Load Cells
Air Intake Shaft Station Brow – South Side Roof Bolts Set 1

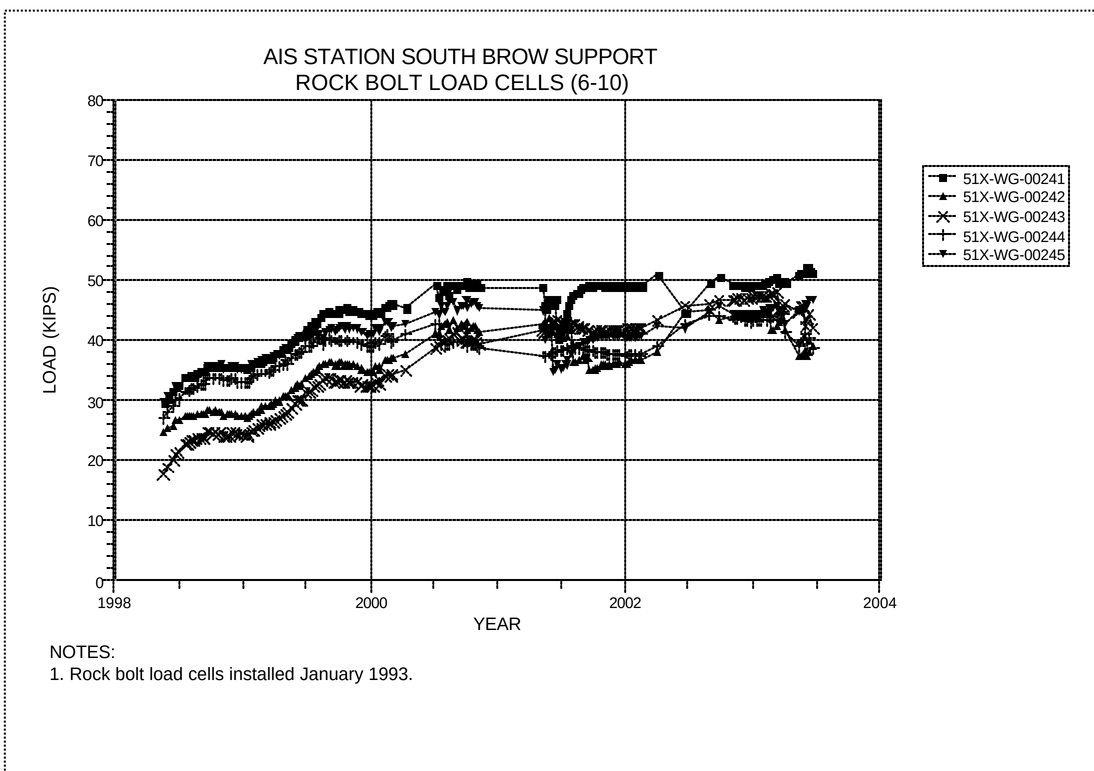
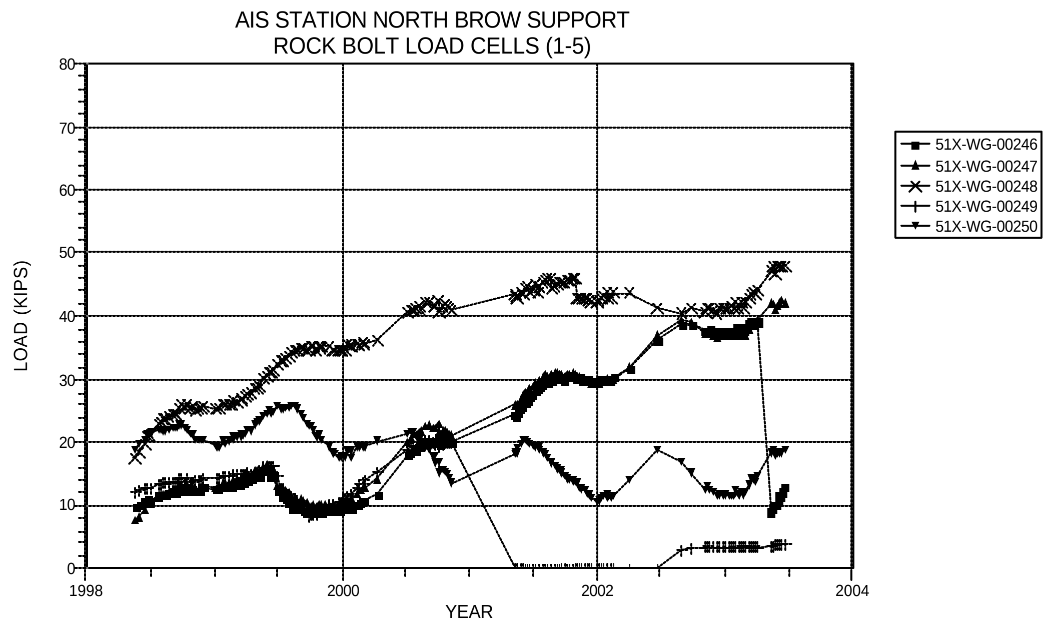
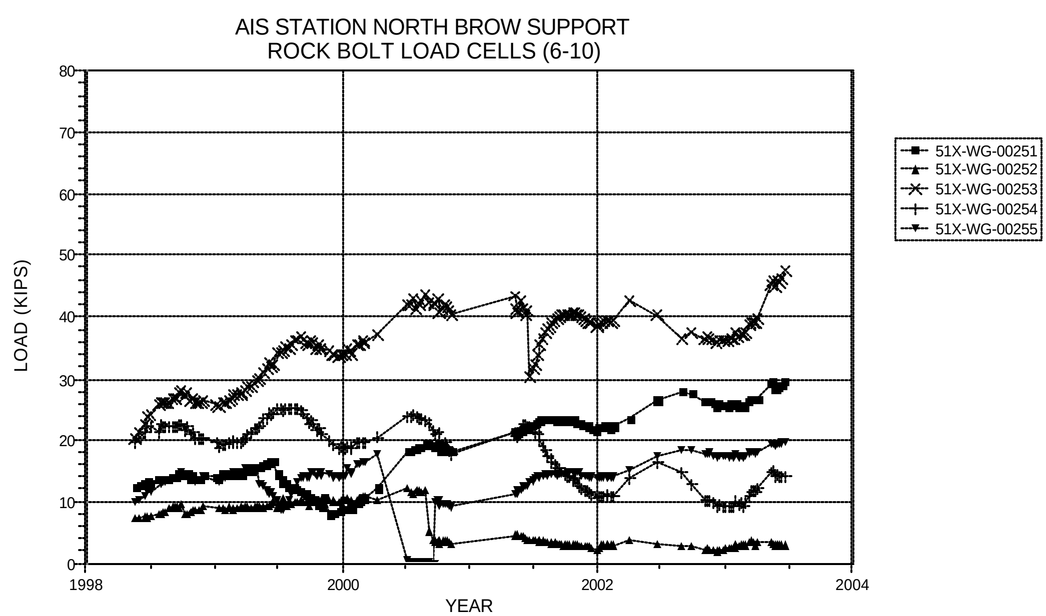


Figure 3-12 Rock Bolt Load Cells
Air Intake Shaft Station Brow – South Side Roof Bolts Set 2



NOTES:
1. Rock bolt load cells installed January 1993.

Figure 3-13 Rock Bolt Load Cells
Air Intake Shaft Station Brow – North Side Roof Bolts Set 1



NOTES:
1. Rock bolt load cells installed January 1993.

Figure 3-14 Rock Bolt Load Cells
Air Intake Shaft Station Brow – North Side Roof Bolts Set 2

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4.0 Instrumentation Summary for the Access Drifts

This chapter 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 calculated annual displacement and convergence rates. Figures 4-1 through 4-49 present data from borehole extensometers installed in the access drifts while Figures 4-50 through 4-231 present the convergence point data. Figure 4-232 presents data from joint meters installed in the S1950/E300 overcast.

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Table 4-1
Access Drifts Data Analysis

EXTENSOMETERS

Field Tag	Location		Figure Number	Date of Last Reading	Collar Displacement Relative to Deepest Anchor (inches)	Displacement Rate 2002 to 2003 in/year	Displacement Rate 2001 to 2002 in/year	Rate Change Percent [A]	Comments
51X-GE-00265	S700 Drift-E220	Roof	4-1	06/23/03	10.896	0.532	0.523	2%	
41X-GE-00106	E140 Drift-N250	Roof	4-2	04/10/03	2.695	0.298	0.357	-17%	
51X-GE-00105-3	E140 Drift-N150	Roof	4-3	04/10/03	0.363	0.153	0.425	-64%	Electronically noisy.
51X-GE-00276	E140 Drift-S700	Roof	4-4	04/21/03	8.663	0.513	0.563	-9%	
51X-GE-00299	E140 Drift-S800	Roof	4-5	04/21/03	5.150	0.265	0.230	15%	
51X-GE-00300	E140 Drift-S900	Roof	4-6	04/24/03	9.195	1.881	0.363	418%	Anchor D malfunction.
51X-GE-00474	E120/S1000	Roof	4-7	06/03/03	0.645	0.075	0.066	14%	
51X-GE-00472	E140 Drift-S1000	Roof	4-8	06/03/03	2.881	0.249	0.280	-11%	
51X-GE-00473	E160/S1000	Roof	4-9	06/03/03	0.542	0.035	0.051	-31%	
51X-GE-00464	E140 Drift-S1025	Roof	4-10	06/03/03	3.082	0.235	0.263	-11%	
51X-GE-00459	E140 Drift-S1075	Roof	4-11	06/03/03	1.674	0.226	0.225	0%	
51X-GE-00333	E140 Drift-S1075	Roof	4-12	06/23/03	2.417	0.436	0.450	-3%	
51X-GE-00460	E140 Drift-S1150	Roof	4-13	10/04/02	2.118	0.532	0.372	43%	Localized roof fracturing.
51X-GE-00460-2	E140 Drift-S1150	Roof	4-13	06/03/03	0.260	0.503	N/A	N/A	Installed 10/02.
41X-GE-00103	E140 Drift-S1150	Roof	4-14	06/23/03	3.219	0.676	0.622	9%	
51X-GE-00461	E140 Drift-S1225	Roof	4-15	06/03/03	1.761	0.273	0.252	8%	
51X-GE-00334	E140 Drift-S1225	Roof	4-16	06/23/03	2.546	0.491	0.479	3%	
51X-GE-00462	E120/S1300	Roof	4-17	06/03/03	0.337	0.036	0.032	12%	
51X-GE-00465	E140 Drift-S1300	Roof	4-18	06/03/03	1.239	0.138	0.129	7%	
51X-GE-00335	E140 Drift-S1300	Roof	4-19	06/16/03	1.867	0.330	0.334	-1%	
51X-GE-00463	E160/S1300	Roof	4-20	06/03/03	1.693	0.231	0.234	-1%	
51X-GE-00409	E140 Drift-S1375	Roof	4-21	10/01/02	1.763	0.385	0.232	66%	Localized roof fracturing.
51X-GE-00336	E140 Drift-S1375	Roof	4-22	06/23/03	3.519	0.439	1.042	-58%	Electronically noisy.
51X-GE-00410	E140 Drift-S1450	Roof	4-23	04/08/03	3.885	0.798	0.770	4%	
41X-GE-00102-2	E140 Drift-S1450	Roof	4-24	06/23/03	2.252	1.478	1.262	17%	
51X-GE-00442	E120/S1600	Roof	4-25	06/03/03	0.531	0.055	0.070	-21%	
51X-GE-00446	E140 Drift-S1600	Roof	4-26	06/03/03	1.653	0.189	0.201	-6%	

[A] NA indicates insufficient data to calculate.

Table 4-1 (Continued)
Access Drifts Data Analysis

EXTENSOMETERS (Continued)

Field Tag	Location		Figure Number	Date of Last Reading	Collar Displacement Relative to Deepest Anchor (inches)	Displacement Rate 2002 to 2003 in/year	Displacement Rate 2001 to 2002 in/year	Rate Change Percent [A]	Comments
51X-GE-00338-2	E140 Drift-S1600	Roof	4-27	06/23/03	0.174	-0.009	0.381	-102%	Electronically noisy.
51X-GE-00441	E160/S1600	Roof	4-28	06/03/03	1.385	0.183	0.223	-18%	
51X-GE-00443	E140 Drift-S1685	Roof	4-29	06/03/03	2.465	0.274	0.275	0%	
51X-GE-00339-2	E140 Drift-S1685	Roof	4-30	06/23/03	1.528	1.009	1.016	-1%	
51X-GE-00444	E140 Drift-S1775	Roof	4-31	12/10/02	6.992	2.632	2.356	12%	
41X-GE-00101-2	E140 Drift-S1775	Roof	4-32	06/23/03	4.069	2.582	3.139	-18%	
51X-GE-00445	E140 Drift-S1863	Roof	4-33	06/03/03	7.139	2.323	1.214	91%	Localized roof fracturing.
51X-GE-00492	E140 Drift-S2750	Roof	4-34	06/09/03	0.204	0.817	N/A	N/A	Installed 3/03.
51X-GE-00493	E140 Drift-S2916	Roof	4-35	06/09/03	0.779	3.052	N/A	N/A	Installed 3/03.
51X-GE-00352	E0 Drift-N940	Roof	4-36	06/26/03	0.125	0.947	N/A	N/A	Installed 5/03.
51X-GE-00353	E0 Drift-N626	Roof	4-37	06/26/03	0.158	1.001	N/A	N/A	Installed 5/03.
51X-GE-00481	N300 Drift-W10	Roof	4-38	06/16/03	0.470	0.278	0.189	47%	
41X-GE-00127	N300 Drift-W110	Roof	4-39	06/16/03	4.241	0.709	0.640	11%	
41X-GE-00126	N300 Drift-W212	Roof	4-40	06/16/03	5.000	0.862	0.613	41%	
41X-GE-00125	N215 Drift-W417	Roof	4-41	06/09/03	2.915	0.591	0.353	67%	
41X-GE-00124	N215 Drift-W519	Roof	4-42	06/09/03	2.824	0.591	0.354	67%	
41X-GE-00123	W620 Drift-N93	Roof	4-43	06/23/03	2.423	0.303	0.400	-24%	
41X-GE-00122	W620 Drift-S65	Roof	4-44	06/23/03	1.849	0.211	0.295	-28%	
51X-GE-00494	E300 Drift-S2892	Roof	4-45	06/09/03	0.206	0.848	N/A	N/A	Installed 3/03.
51X-GE-00490	W30 Drift-S2750	Roof	4-46	05/20/03	0.140	0.691	N/A	N/A	Installed 3/03.
51X-GE-00491	W30 Drift-S2916	Roof	4-47	06/09/03	0.119	0.578	N/A	N/A	Installed 3/03.
51X-GE-00489	W30 Drift-S3080	Roof	4-48	06/09/03	0.664	2.561	N/A	N/A	Installed 3/03.
51X-GE-00495	W170 Drift-S2634	Roof	4-49	06/09/03	0.174	0.722	N/A	N/A	Installed 3/03.

[A] NA indicates insufficient data to calculate.

Table 4-1 (Continued)
Access Drifts Data Analysis

CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading 2002 to 2003 Date	Last Reading 2002 to 2003 Inches	Cumulative Displacement Inches	Closure Rate 2002 to 2003 in/year	Closure Rate 2001 to 2002 in/year	Rate Change Percent	Comments
E300-N250-2 A-C	E300 Drift-N250	4-50	06/04/03	9.928	24.281	1.880	1.779	6%	
E300-N170 A-E	E300 Drift-N170	4-51	06/04/03	17.899	17.899	1.479	1.428	4%	
E300-N170 H-F	E300 Drift-N170	4-51	06/04/03	15.845	15.845	1.351	1.271	6%	
E300-N170 C-G	E300 Drift-N170	4-51	06/04/03	14.110	14.110	1.115	1.183	-6%	
E300-N45 A-E	E300 Drift-N45	4-52	06/04/03	18.431	18.431	1.551	1.512	3%	
E300-N45 H-F	E300 Drift-N45	4-52	06/04/03	15.444	15.444	1.533	1.349	14%	
E300-N45 C-G	E300 Drift-N45	4-52	06/04/03	13.450	13.450	1.133	1.167	-3%	
E300-S45-2 A-E	E300 Drift-S45	4-53	06/04/03	15.002	15.002	1.241	1.272	-2%	
E300-S45-2 B-D	E300 Drift-S45	4-53	06/04/03	11.950	11.950	0.976	0.914	7%	
E300-S45-2 H-F	E300 Drift-S45	4-53	06/04/03	12.885	12.885	1.153	1.149	0%	
E300-S45 C-G	E300 Drift-S45	4-53	06/04/03	11.885	11.885	0.930	0.885	5%	
E300-S90 A-C	E300 Drift-S90	4-54	06/10/03	11.993	11.993	0.729	0.765	-5%	
E300-S250-2 A-C	E300 Drift-S250	4-55	06/10/03	3.542	7.952	0.643	0.648	-1%	
E300-S250-2 B-D	E300 Drift-S250	4-55	06/10/03	3.947	8.020	0.642	0.629	2%	
E300-S700 A-C	E300 Drift-S700	4-56	06/10/03	15.116	15.116	0.626	0.616	2%	
E300-S850 A-E	E300 Drift-S850	4-57	06/10/03	11.656	11.656	0.471	0.475	-1%	
E300-S850 B-D	E300 Drift-S850	4-57	06/10/03	8.739	8.739	0.369	0.369	0%	
E300-S850 H-F	E300 Drift-S850	4-57	06/10/03	7.965	7.965	0.346	0.366	-5%	
E300-S850-2 C-G	E300 Drift-S850	4-57	06/10/03	3.641	12.919	0.517	0.548	-6%	
E300-S1000 A-C	E300 Drift-S1000	4-58	06/10/03	15.133	15.133	0.539	0.585	-8%	
E300-S1150-3 A-E	E300 Drift-S1150	4-59	06/10/03	7.420	12.910	0.558	0.570	-2%	
E300-S1150-3 B-D	E300 Drift-S1150	4-59	06/10/03	5.178	9.237	0.398	0.398	0%	
E300-S1150-3 H-F	E300 Drift-S1150	4-59	06/10/03	5.137	8.757	0.408	0.416	-2%	
E300-S1150-2 C-G	E300 Drift-S1150	4-60	06/10/03	4.256	14.712	0.575	0.661	-13%	
E300-S1300 A-C	E300 Drift-S1300	4-61	06/10/03	8.270	8.270	0.700	0.574	22%	

Table 4-1 (Continued)
Access Drifts Data Analysis

CONVERGENCE POINTS (Continued)

Field Tag	Location	Figure Number	Last Reading 2002 to 2003 Date	Last Reading 2002 to 2003 Inches	Cumulative Displacement Inches	Closure Rate 2002 to 2003 in/year	Closure Rate 2001 to 2002 in/year	Rate Change Percent [A]	Comments
E300-S1450 A-C	E300 Drift-S1450	4-62	06/10/03	3.901	3.901	0.684	0.682	0%	
E300-S1450 B-D	E300 Drift-S1450	4-62	06/10/03	4.362	4.362	0.737	0.798	-8%	
E300-S1687 A-C	E300 Drift-S1687	4-63	06/10/03	3.817	3.817	0.727	0.693	5%	
E300-S1687 B-D	E300 Drift-S1687	4-63	06/10/03	4.249	4.249	0.793	0.797	-1%	
E300-S1775 A-C	E300 Drift-S1775	4-64	06/10/03	3.596	3.596	0.657	0.707	-7%	
E300-S1775 B-D	E300 Drift-S1775	4-64	06/10/03	4.277	4.277	0.788	0.798	-1%	
E300-S1862 A-C	E300 Drift-S1862	4-65	06/10/03	3.711	3.711	0.751	0.730	3%	
E300-S1862 B-D	E300 Drift-S1862	4-65	06/10/03	4.571	4.571	0.886	0.843	5%	
E300-S2065 A-C	E300 Drift-S2065	4-66	06/24/03	4.420	4.420	0.839	0.956	-12%	
E300-S2065 B-D	E300 Drift-S2065	4-66	06/24/03	5.661	5.661	1.097	1.114	-2%	
E300-S2180-1 A-C	E300 Drift-S2180	4-67	11/12/02	4.580	9.930	1.265	1.366	-7%	Mined out.
E300-S2275 A-C	E300 Drift-S2275	4-68	06/24/03	4.917	4.917	1.200	1.255	-4%	
E300-S2275 B-D	E300 Drift-S2275	4-68	06/24/03	5.859	5.859	1.503	1.620	-7%	
E300-S2350 A-C	E300 Drift-S2350	4-69	06/24/03	5.741	5.741	1.404	1.463	-4%	
E300-S2350 B-D	E300 Drift-S2350	4-69	06/24/03	6.209	6.209	1.570	1.613	-3%	
E300-S2425 A-C	E300 Drift-S2425	4-70	06/24/03	5.745	5.745	1.403	1.593	-12%	
E300-S2425 B-D	E300 Drift-S2425	4-70	06/24/03	6.309	6.309	1.589	1.617	-2%	
E300-S2634 A-C	E300 Drift-S2634	4-71	06/23/03	0.907	0.907	2.229	N/A	N/A	New installation 1/03.
E300-S2634 B-D	E300 Drift-S2634	4-71	06/23/03	0.987	0.987	2.484	N/A	N/A	New installation 1/03.
E300-S2833 A-C	E300 Drift-S2833	4-72	03/17/03	0.341	0.341	2.857	N/A	N/A	New installation 1/03.
E300-S2833 B-D	E300 Drift-S2833	4-72	03/17/03	0.358	0.358	2.844	N/A	N/A	New installation 1/03.
E300-S2916 A-C	E300 Drift-S2916	4-73	06/23/03	1.499	1.499	3.882	N/A	N/A	New installation 1/03.
E300-S2916 B-D	E300 Drift-S2916	4-73	06/23/03	1.272	1.272	3.206	N/A	N/A	New installation 1/03.
E300-S2998 A-C	E300 Drift-S2998	4-74	06/23/03	1.796	1.796	5.575	N/A	N/A	New installation 2/03.
E300-S2998 B-D	E300 Drift-S2998	4-74	06/23/03	1.158	1.158	3.513	N/A	N/A	New installation 2/03.
E300-S3195 A-C	E300 Drift-S3195	4-75	06/23/03	1.179	1.179	3.400	N/A	N/A	New installation 2/03.

[A] NA indicates insufficient data to calculate.

Table 4-1 (Continued)
Access Drifts Data Analysis

CONVERGENCE POINTS (Continued)

Field Tag	Location	Figure Number	Last Reading 2002 to 2003 Date	Last Reading 2002 to 2003 Inches	Cumulative Displacement Inches	Closure Rate 2002 to 2003 in/year	Closure Rate 2001 to 2002 in/year	Rate Change Percent [A]	Comments
E300-S3195 B-D	E300 Drift-S3195	4-75	06/23/03	1.310	1.310	3.726	N/A	N/A	New installation 2/03.
E140-N780-2 A-C	E140 Drift-N780	4-76	06/05/03	0.708	32.486	3.613	2.905	24%	Reinstalled 3/03.
E140-N686-2 A-C	E140 Drift-N686	4-77	06/05/03	0.506	13.668	2.478	2.131	16%	Reinstalled 3/03.
E140-N686-2 B-D	E140 Drift-N686	4-77	06/05/03	0.403	11.446	2.041	1.878	9%	Reinstalled 3/03.
E140-N626-3 A-C	E140 Drift-N626	4-78	06/05/03	0.589	33.183	2.844	2.478	15%	Reinstalled 3/03.
E140-N626-4 B-D	E140 Drift-N626	4-78	06/05/03	0.406	21.766	1.898	1.458	30%	Reinstalled 3/03.
E140-N562-2 A-C	E140 Drift-N562	4-79	06/05/03	0.477	12.318	2.211	2.012	10%	Reinstalled 3/03.
E140-N562-2 B-D	E140 Drift-N562	4-79	06/05/03	0.411	8.713	1.794	1.307	37%	Reinstalled 3/03.
E140-N460-3 A-C	E140 Drift-N460	4-80	06/05/03	3.211	24.107	1.927	1.845	4%	
E140-N355 A-C	E140 Drift-N355	4-81	06/05/03	3.436	3.436	1.730	1.998	-13%	
E140-N355 B-D	E140 Drift-N355	4-81	06/05/03	3.075	3.075	1.545	1.672	-8%	
E140-N220 A-C	E140 Drift-N220	4-82	06/04/03	21.137	21.137	1.627	1.722	-6%	
E140-N150 A-C	E140 Drift-N150	4-83	06/04/03	15.902	15.902	1.125	1.098	2%	
E140-N5-4 A-C	E140 Drift-N5	4-84	06/04/03	6.495	28.201	1.210	1.187	2%	
E140-N5-3 B-D	E140 Drift-N5	4-84	06/04/03	7.116	22.357	0.983	0.898	9%	
E140-S90-3 A-C	E140 Drift-S90	4-85	06/04/03	6.385	13.765	1.177	1.082	9%	
E140-S262-3 A-C	E140 Drift-S262	4-86	06/04/03	15.497	18.513	1.594	1.579	1%	
E140-S262-3 B-D	E140 Drift-S262	4-86	06/04/03	10.718	12.071	1.031	0.989	4%	
E140-S460-4 A-C	E140 Drift-S460	4-87	06/04/03	11.066	36.777	2.050	1.977	4%	
E140-S460-2 B-D	E140 Drift-S460	4-87	06/04/03	17.433	23.377	0.978	0.977	0%	
E140-S550-4 A-C	E140 Drift-S550	4-88	06/04/03	7.078	31.195	1.255	1.291	-3%	
E140-S550-4 B-D	E140 Drift-S550	4-88	06/04/03	18.113	26.755	1.009	1.013	0%	
E140-S700-5 A-D	E140 Drift-S700	4-89	06/03/03	3.118	19.301	1.194	1.253	-5%	
E140-S700-4 B-C	E140 Drift-S700	4-90	06/03/03	6.878	18.839	1.189	1.225	-3%	
E140-S700-4 E-F	E140 Drift-S700	4-90	06/03/03	4.988	13.804	0.854	0.929	-8%	
E140-S850-7 A-C	E140 Drift-S850	4-91	06/03/03	9.582	36.102	1.795	1.702	5%	

[A] NA indicates insufficient data to calculate.

Table 4-1 (Continued)
Access Drifts Data Analysis

CONVERGENCE POINTS (Continued)

Field Tag	Location	Figure Number	Last Reading 2002 to 2003 Date	Last Reading 2002 to 2003 Inches	Cumulative Displacement Inches	Closure Rate 2002 to 2003 in/year	Closure Rate 2001 to 2002 in/year	Rate Change Percent	Comments
E140-S850-4 B-D	E140 Drift-S850	4-92	06/03/03	8.906	24.853	0.999	1.047	-5%	
E140-S1000 A-C	E140 Drift-S1000	4-93	06/03/03	24.585	24.585	1.278	1.377	-7%	
E140-S1025-2 A-C	E140 Drift-S1025	4-94	06/03/03	8.078	10.624	1.279	1.371	-7%	
E140-S1075-2 A-E	E140 Drift-S1075	4-95	06/03/03	8.258	10.005	1.501	1.675	-10%	
E140-S1075-2 B-D	E140 Drift-S1075	4-95	06/03/03	8.004	9.666	1.479	1.520	-3%	
E140-S1075-2 F-H	E140 Drift-S1075	4-95	06/03/03	6.891	8.471	1.235	1.258	-2%	
E140-S1075-2 C-G	E140 Drift-S1075	4-95	06/03/03	6.787	7.661	1.141	1.163	-2%	
E140-S1150-2 A-G	E140 Drift-S1150	4-96	06/03/03	9.483	38.630	1.865	1.838	1%	
E140-S1150-2 B-F	E140 Drift-S1150	4-96	06/03/03	9.555	11.067	1.810	1.848	-2%	
E140-S1150-3 L-H	E140 Drift-S1150	4-96	06/03/03	7.066	8.709	1.420	1.407	1%	
E140-S1150 C-K	E140 Drift-S1150	4-97	06/03/03	7.712	7.712	1.085	1.142	-5%	
E140-S1150-2 D-J	E140 Drift-S1150	4-97	06/03/03	7.313	27.184	1.221	1.221	0%	
E140-S1150-2 E-I	E140 Drift-S1150	4-97	06/03/03	6.664	7.574	1.104	1.182	-7%	
E140-S1225-2 A-E	E140 Drift-S1225	4-98	06/03/03	9.498	11.523	1.894	1.928	-2%	
E140-S1225-2 B-D	E140 Drift-S1225	4-98	06/03/03	10.037	12.147	1.878	1.975	-5%	
E140-S1225-2 H-F	E140 Drift-S1225	4-98	06/03/03	7.204	8.803	1.432	1.337	7%	
E140-S1225-2 C-G	E140 Drift-S1225	4-98	06/03/03	8.003	8.960	1.408	1.413	0%	
E140-S1300-4 A-C	E140 Drift-S1300	4-99	06/03/03	7.005	23.628	1.218	1.261	-3%	
E140-S1378-2 A-E	E140 Drift-S1378	4-100	06/03/03	9.341	20.179	1.776	1.842	-4%	
E140-S1378-2 B-D	E140 Drift-S1378	4-100	06/03/03	6.347	16.051	1.181	1.248	-5%	
E140-S1378-2 H-F	E140 Drift-S1378	4-100	06/03/03	10.907	22.185	2.070	2.149	-4%	
E140-S1378 C-G	E140 Drift-S1378	4-101	06/03/03	9.040	13.210	1.250	1.257	-1%	
E140-S1456-4 A-G	E140 Drift-S1456	4-102	06/03/03	9.747	44.816	2.698	2.520	7%	
E140-S1456-2 B-F	E140 Drift-S1456	4-103	06/03/03	11.486	21.654	2.253	2.307	-2%	
E140-S1456-2 L-H	E140 Drift-S1456	4-103	06/03/03	8.444	17.214	1.745	1.708	2%	
E140-S1456-2 D-J	E140 Drift-S1456	4-104	06/03/03	8.350	29.698	1.483	1.475	1%	

Table 4-1 (Continued)
Access Drifts Data Analysis

CONVERGENCE POINTS (Continued)

Field Tag	Location	Figure Number	Last Reading 2002 to 2003 Date	Last Reading 2002 to 2003 Inches	Cumulative Displacement Inches	Closure Rate 2002 to 2003 in/year	Closure Rate 2001 to 2002 in/year	Rate Change Percent	Comments
E140-S1456 K-C	E140 Drift-S1456	4-105	06/03/03	8.778	8.778	1.262	1.181	7%	
E140-S1456-2 I-E	E140 Drift-S1456	4-105	06/03/03	7.045	8.655	1.233	1.252	-2%	
E140-S1534-2 A-E	E140 Drift-S1534	4-106	06/03/03	21.261	24.422	5.592	4.936	13%	
E140-S1534-2 B-D	E140 Drift-S1534	4-106	02/05/03	11.169	13.444	3.555	2.881	23%	Point blocked by roof mat.
E140-S1534-2 H-F	E140 Drift-S1534	4-106	06/03/03	13.041	16.111	2.986	2.573	16%	
E140-S1534-2 C-G	E140 Drift-S1534	4-106	06/03/03	7.572	9.095	1.391	1.359	2%	
E140-S1600-5 A-C	E140 Drift-S1600	4-107	06/03/03	7.896	24.741	1.467	1.482	-1%	
E140-S1687-2 A-E	E140 Drift-S1687	4-108	06/03/03	11.587	14.545	2.575	2.465	4%	
E140-S1687-2 B-D	E140 Drift-S1687	4-108	06/03/03	10.290	13.174	2.077	2.124	-2%	
E140-S1687-2 H-F	E140 Drift-S1687	4-108	06/03/03	8.986	11.582	1.823	1.831	0%	
E140-S1687 C-G	E140 Drift-S1687	4-108	06/03/03	8.770	8.770	1.285	1.319	-3%	
E140-S1775-2 A-G	E140 Drift-S1775	4-109	06/23/03	21.506	24.733	6.695	6.195	8%	
E140-S1775-2 B-F	E140 Drift-S1775	4-109	06/23/03	19.023	22.473	5.145	4.853	6%	
E140-S1775-2 L-H	E140 Drift-S1775	4-109	06/23/03	9.649	11.835	2.366	2.436	-3%	
E140-S1775 C-K	E140 Drift-S1775	4-110	02/05/03	8.324	8.324	1.243	1.318	-6%	Temporarily blocked.
E140-S1775-2 D-J	E140 Drift-S1775	4-110	02/05/03	7.181	8.491	1.363	1.402	-3%	Temporarily blocked.
E140-S1775-2 I-E	E140 Drift-S1775	4-110	12/10/02	6.719	8.260	1.194	1.417	-16%	Temporarily blocked.
E140-S1862-2 A-E	E140 Drift-S1862	4-111	06/03/03	11.368	13.974	2.944	2.493	18%	
E140-S1862-2 B-D	E140 Drift-S1862	4-111	06/03/03	11.087	14.003	2.406	2.281	5%	
E140-S1862-2 H-F	E140 Drift-S1862	4-111	06/03/03	6.839	8.670	1.519	1.430	6%	
E140-S1862-3 C-G	E140 Drift-S1862	4-111	06/03/03	2.131	8.536	1.309	1.240	6%	
E140-S1917-3 A-C	E140 Drift-S1917	4-112	02/04/03	8.775	12.670	1.076	1.597	-33%	Mined out.
E140-S1950-5 A-C	E140 Drift-S1950	4-113	06/03/03	0.675	30.785	3.092	2.338	32%	"Roof beam removed" Reinstalled 3/03.
E140-S2007-3 A-C	E140 Drift-S2007	4-114	06/03/03	0.736	14.307	3.115	2.567	21%	"Roof beam removed" Reinstalled 3/03.
E140-S2065-3 A-C	E140 Drift-S2065	4-115	06/03/03	0.866	12.976	3.599	2.480	45%	"Roof beam removed" Reinstalled 3/03.
E140-S2065-2 B-D	E140 Drift-S2065	4-115	06/03/03	0.582	7.282	2.444	1.377	77%	"Roof beam removed" Reinstalled 3/03.
E140-S2122-3 A-C	E140 Drift-S2122	4-116	06/03/03	0.856	14.406	3.626	3.032	20%	"Roof beam removed" Reinstalled 3/03.

Table 4-1 (Continued)
Access Drifts Data Analysis

CONVERGENCE POINTS (Continued)

Field Tag	Location	Figure Number	Last Reading 2002 to 2003		Cumulative Displacement Inches	Closure Rate 2002 to 2003 in/year	Closure Rate 2001 to 2002 in/year	Rate Change Percent [A]	Comments
			Date	Inches					
E140-S2180-4 A-C	E140 Drift-S2180	4-117	06/03/03	0.842	18.926	3.739	2.072	80%	"Roof beam removed" Reinstalled 3/03.
E140-S2275-2 A-C	E140 Drift-S2275	4-118	06/03/03	2.197	13.977	11.037	3.768	193%	"Roof beam removed" Reinstalled 3/03.
E140-S2275 B-D	E140 Drift-S2275	4-118	06/03/03	6.442	6.442	2.266	1.619	40%	
E140-S2350-3 A-C	E140 Drift-S2350	4-119	06/03/03	1.042	27.208	4.489	2.994	50%	"Roof beam removed" Reinstalled 3/03.
E140-S2350-2 B-D	E140 Drift-S2350	4-119	06/03/03	6.740	13.631	2.540	1.703	49%	
E140-S2425-2 A-C	E140 Drift-S2425	4-120	06/03/03	0.994	9.844	4.449	2.791	59%	"Roof beam removed" Reinstalled 3/03.
E140-S2425 B-D	E140 Drift-S2425	4-120	06/03/03	6.724	6.724	2.507	1.645	52%	
E140-S2520-2 A-C	E140 Drift-S2520	4-121	06/03/03	0.851	9.501	3.805	2.674	42%	"Roof beam removed" Reinstalled 3/03.
E140-S2634 A-C	E140 Drift-S2634	4-122	06/23/03	2.311	2.311	9.014	N/A	N/A	New installation 3/03.
E140-S2634 B-D	E140 Drift-S2634	4-122	06/23/03	0.799	0.799	2.791	N/A	N/A	New installation 3/03.
E140-S2750 A-C	E140 Drift-S2750	4-123	06/23/03	1.261	1.261	2.705	N/A	N/A	New installation 12/02.
E140-S2833 A-C	E140 Drift-S2833	4-124	06/23/03	1.759	1.759	3.414	N/A	N/A	New installation 12/02.
E140-S2833 B-D	E140 Drift-S2833	4-124	06/23/03	1.262	1.262	2.418	N/A	N/A	New installation 12/02.
E140-S2915 A-C	E140 Drift-S2915	4-125	06/23/03	2.732	2.732	5.525	N/A	N/A	New installation 12/02.
E140-S2915 B-D	E140 Drift-S2915	4-125	06/23/03	1.415	1.415	2.690	N/A	N/A	New installation 12/02.
E140-S2998 A-C	E140 Drift-S2998	4-126	06/23/03	2.834	2.834	5.681	N/A	N/A	New installation 12/02.
E140-S2998 B-D	E140 Drift-S2998	4-126	06/23/03	1.377	1.377	2.695	N/A	N/A	New installation 12/02.
E140-S3080 A-C	E140 Drift-S3080	4-127	06/23/03	1.246	1.246	3.646	N/A	N/A	New installation 2/03.
E140-S3195 A-C	E140 Drift-S3195	4-128	06/23/03	1.592	1.592	4.582	N/A	N/A	New installation 2/03.
E140-S3195 B-D	E140 Drift-S3195	4-128	06/23/03	1.235	1.235	3.354	N/A	N/A	New installation 2/03.
E140-S3310 A-C	E140 Drift-S3310	4-129	06/23/03	1.387	1.387	3.975	N/A	N/A	New installation 2/03.
E0-N686 A-C	E0 Drift-N686	4-130	06/05/03	0.343	0.343	N/A	N/A	N/A	New installation 4/03.
E0-N686 B-D	E0 Drift-N686	4-130	06/05/03	0.261	0.261	N/A	N/A	N/A	New installation 4/03.
E0-N626-4 A-C	E0 Drift-N626	4-131	06/05/03	0.359	41.337	N/A	N/A	N/A	Reinstalled 4/03.
E0-N562 A-C	E0 Drift-N562	4-132	06/05/03	0.096	0.096	N/A	N/A	N/A	New installation 4/03.
E0-N562 B-D	E0 Drift-N562	4-132	06/05/03	0.269	0.269	N/A	N/A	N/A	New installation 4/03.

[A] NA indicates insufficient data to calculate.

Table 4-1 (Continued)
Access Drifts Data Analysis

CONVERGENCE POINTS (Continued)

Field Tag	Location	Figure Number	Last Reading 2002 to 2003 Date	Last Reading 2002 to 2003 Inches	Cumulative Displacement Inches	Closure Rate 2002 to 2003 in/year	Closure Rate 2001 to 2002 in/year	Rate Change Percent [A]	Comments
E0-N460-3 A-C	E0 Drift-N460	4-133	06/05/03	3.419	23.566	2.053	1.978	4%	
E0-N300-4 A-C	E0 Drift-N300	4-134	06/05/03	3.779	38.506	1.800	1.944	-7%	
E0-N225-2 A-C	E0 Drift-N225	4-135	06/05/03	2.995	3.086	1.809	1.892	-4%	
E0-N225 B-D	E0 Drift-N225	4-135	06/05/03	3.102	3.102	1.511	1.682	-10%	
E0-N75 A-C	E0 Drift-N75	4-136	06/05/03	2.573	19.593	2.200	N/A	N/A	
E0-N75 B-D	E0 Drift-N75	4-136	06/05/03	1.916	1.916	1.614	N/A	N/A	
W30-S120 A-C	W30 Drift-S120	4-137	06/02/03	16.455	16.455	0.960	1.161	-17%	
W30-S250-3 A-C	W30 Drift-S250	4-138	06/02/03	13.518	23.030	1.061	1.085	-2%	
W30-S250-5 B-D	W30 Drift-S250	4-138	06/02/03	8.704	19.658	0.773	0.838	-8%	
W30-S400 A-C	W30 Drift-S400	4-139	06/02/03	14.514	14.514	0.830	0.870	-5%	
W30-S500 A-C	W30 Drift-S500	4-140	06/02/03	19.596	19.596	0.772	0.830	-7%	
W30-S500 B-D	W30 Drift-S500	4-140	06/02/03	18.559	18.559	0.743	0.751	-1%	
W30-S700-2 A-C	W30 Drift-S700	4-141	06/02/03	5.344	25.785	0.979	1.040	-6%	
W30-S850-2 A-E	W30 Drift-S850	4-142	06/02/03	8.400	15.153	0.621	0.672	-8%	
W30-S850-2 B-D	W30 Drift-S850	4-142	06/02/03	5.778	10.340	0.450	0.466	-3%	
W30-S850 H-F	W30 Drift-S850	4-142	06/02/03	11.261	11.261	0.460	0.489	-6%	
W30-S850 C-G	W30 Drift-S850	4-142	06/02/03	16.890	16.890	0.717	0.744	-4%	
W30-S1000-3 A-C	W30 Drift-S1000	4-143	06/02/03	12.126	28.993	1.160	1.189	-2%	
W30-S1100 A-C	W30 Drift-S1100	4-144	06/02/03	7.145	7.145	0.899	0.879	2%	
W30-S1200 A-C	W30 Drift-S1200	4-145	06/02/03	7.195	7.195	0.817	0.894	-9%	
W30-S1300 A-C	W30 Drift-S1300	4-146	06/02/03	13.887	13.887	1.011	0.988	2%	
W30-S1453 A-C	W30 Drift-S1453	4-147	06/02/03	9.447	9.447	0.834	0.814	2%	
W30-S1453-2 B-D	W30 Drift-S1453	4-147	06/02/03	4.721	9.644	0.775	0.778	0%	
W30-S1600-1 A-C	W30 Drift-S1600	4-148	06/02/03	3.702	12.444	0.994	0.974	2%	
W30-S1775 A-C	W30 Drift-S1775	4-149	06/02/03	6.997	6.997	0.601	0.589	2%	
W30-S1775-2 B-D	W30 Drift-S1775	4-149	06/02/03	4.161	8.201	0.670	0.726	-8%	

[A] NA indicates insufficient data to calculate.

Table 4-1 (Continued)
Access Drifts Data Analysis

CONVERGENCE POINTS (Continued)

Field Tag	Location	Figure Number	Last Reading 2002 to 2003 Date	Last Reading 2002 to 2003 Inches	Cumulative Displacement Inches	Closure Rate 2002 to 2003 in/year	Closure Rate 2001 to 2002 in/year	Rate Change Percent [A]	Comments
W30-S1950 A-C	W30 Drift-S1950	4-150	06/02/03	11.926	11.926	0.974	0.942	3%	
W30-S2067 A-C	W30 Drift-S2067	4-151	06/02/03	9.063	9.063	0.855	0.838	2%	
W30-S2067-2 B-D	W30 Drift-S2067	4-151	06/02/03	4.658	9.567	0.828	0.919	-10%	
W30-S2180 A-C	W30 Drift-S2180	4-152	06/02/03	14.659	14.659	1.173	1.216	-4%	
W30-S2275-2 A-C	W30 Drift-S2275	4-153	06/02/03	2.767	3.606	0.987	1.004	-2%	
W30-S2275 B-D	W30 Drift-S2275	4-153	06/02/03	4.227	4.227	1.109	1.172	-5%	
W30-S2350-2 A-C	W30 Drift-S2350	4-154	06/02/03	3.129	4.217	1.074	1.127	-5%	
W30-S2350 B-D	W30 Drift-S2350	4-154	06/02/03	4.877	4.877	1.252	1.314	-5%	
W30-S2425-2 A-C	W30 Drift-S2425	4-155	06/02/03	3.399	4.388	1.105	1.246	-11%	
W30-S2425 B-D	W30 Drift-S2425	4-155	06/02/03	5.010	5.010	1.303	1.405	-7%	
W30-S2520-2 A-C	W30 Drift-S2520	4-156	06/02/03	5.089	7.010	1.575	1.755	-10%	
W30-S2685-2 A-C	W30 Drift-S2685	4-157	06/23/03	2.935	5.069	1.929	2.122	-9%	
W30-S2685-2 B-D	W30 Drift-S2685	4-157	06/23/03	2.689	4.869	1.673	1.940	-14%	
W30-S2750 A-C	W30 Drift-S2750	4-158	06/23/03	0.912	0.912	1.897	N/A	N/A	New installation 12/02.
W30-S2833 A-C	W30 Drift-S2833	4-159	06/23/03	0.775	0.775	1.819	N/A	N/A	New installation 1/03.
W30-S2833 B-D	W30 Drift-S2833	4-159	06/23/03	0.849	0.849	1.941	N/A	N/A	New installation 1/03.
W30-S2916 A-C	W30 Drift-S2916	4-160	06/23/03	0.816	0.816	2.457	N/A	N/A	New installation 2/03.
W30-S2916 B-D	W30 Drift-S2916	4-160	06/23/03	0.699	0.699	2.049	N/A	N/A	New installation 2/03.
W30-S2998 A-C	W30 Drift-S2998	4-161	06/09/03	0.821	0.821	2.090	N/A	N/A	New installation 1/03.
W30-S2998 B-D	W30 Drift-S2998	4-161	06/09/03	0.835	0.835	2.093	N/A	N/A	New installation 1/03.
W30-S3080 A-C	W30 Drift-S3080	4-162	06/23/03	1.891	1.891	4.256	N/A	N/A	New installation 1/03.
W30-S3195 A-C	W30 Drift-S3195	4-163	06/23/03	1.197	1.197	2.780	N/A	N/A	New installation 1/03.
W30-S3195 B-D	W30 Drift-S3195	4-163	06/23/03	1.192	1.192	2.691	N/A	N/A	New installation 1/03.
W30-S3310 A-C	W30 Drift-S3310	4-164	06/23/03	1.040	1.040	3.295	N/A	N/A	New installation 3/03.
W170-N150-2 A-C	W170 Drift-N150	4-165	06/04/03	4.990	6.436	0.494	0.502	-2%	
W170-S5 A-C	W170 Drift-S5	4-166	06/04/03	10.080	10.080	0.529	0.561	-6%	

[A] NA indicates insufficient data to calculate.

Table 4-1 (Continued)
Access Drifts Data Analysis

CONVERGENCE POINTS (Continued)

Field Tag	Location	Figure Number	Last Reading 2002 to 2003 Date	Last Reading 2002 to 2003 Inches	Cumulative Displacement Inches	Closure Rate 2002 to 2003 in/year	Closure Rate 2001 to 2002 in/year	Rate Change Percent [A]	Comments
W170-S5-2 B-D	W170 Drift-S5	4-166	06/04/03	3.604	11.396	0.664	0.671	-1%	
W170-S90-3 A-C	W170 Drift-S90	4-167	06/04/03	0.836	8.106	0.772	N/A	N/A	Reinstalled 8/02.
W170-S232-2 A-C	W170 Drift-S232	4-168	06/04/03	1.551	7.163	0.598	0.626	-4%	
W170-S232-2 B-D	W170 Drift-S232	4-168	06/04/03	4.627	7.269	0.641	0.617	4%	
W170-S400 A-C	W170 Drift-S400	4-169	06/05/03	8.825	8.825	0.674	0.661	2%	
W170-S560-3 A-C	W170 Drift-S560	4-170	06/04/03	1.643	7.738	0.623	0.655	-5%	
W170-S560-2 B-D	W170 Drift-S560	4-170	06/04/03	5.236	8.368	0.683	0.693	-1%	
W170-S700 A-C	W170 Drift-S700	4-171	06/04/03	16.486	16.486	0.674	0.675	0%	
W170-S850-6 A-E	W170 Drift-S850	4-172	06/04/03	1.506	13.995	0.633	0.634	0%	
W170-S850-5 B-D	W170 Drift-S850	4-173	06/04/03	1.332	10.331	0.493	0.500	-1%	
W170-S850-6 H-F	W170 Drift-S850	4-173	06/04/03	1.200	9.580	0.463	0.460	1%	
W170-S850-3 C-G	W170 Drift-S850	4-174	06/04/03	5.168	15.981	0.686	0.693	-1%	
W170-S1000-2 A-C	W170 Drift-S1000	4-175	06/04/03	1.659	18.343	0.700	0.722	-3%	
W170-S1150-3 A-E	W170 Drift-S1150	4-176	06/04/03	3.323	16.595	0.703	0.741	-5%	
W170-S1150-3 B-D	W170 Drift-S1150	4-176	06/04/03	2.403	11.641	0.520	0.521	0%	
W170-S1150-2 C-G	W170 Drift-S1150	4-176	06/04/03	5.661	17.238	0.727	0.719	1%	
W170-S1150 H-F	W170 Drift-S1150	4-176	06/04/03	10.912	10.912	0.530	0.551	-4%	
W170-S1300-3 A-C	W170 Drift-S1300	4-177	06/04/03	11.273	14.353	1.098	1.066	3%	
W170-S1445-3 A-C	W170 Drift-S1445	4-178	06/04/03	3.259	7.994	0.674	0.665	1%	
W170-S1445-2 B-D	W170 Drift-S1445	4-178	06/04/03	5.034	7.692	0.636	0.665	-4%	
W170-S1600-2 A-C	W170 Drift-S1600	4-179	06/04/03	4.000	9.798	0.834	0.819	2%	
W170-S1779-2 A-C	W170 Drift-S1779	4-180	06/04/03	4.117	10.348	0.987	0.883	12%	
W170-S1779-2 B-D	W170 Drift-S1779	4-180	06/04/03	5.871	9.006	0.786	0.778	1%	
W170-S1950-2 A-C	W170 Drift-S1950	4-181	06/04/03	3.793	9.216	0.799	0.772	3%	
W170-S2060-2 A-C	W170 Drift-S2060	4-182	06/04/03	3.916	9.474	0.868	0.812	7%	
W170-S2060-2 B-D	W170 Drift-S2060	4-182	06/04/03	6.122	9.446	0.851	0.853	0%	

[A] NA indicates insufficient data to calculate.

Table 4-1 (Continued)
Access Drifts Data Analysis

CONVERGENCE POINTS (Continued)

Field Tag	Location	Figure Number	Last Reading 2002 to 2003 Date	Last Reading 2002 to 2003 Inches	Cumulative Displacement Inches	Closure Rate 2002 to 2003 in/year	Closure Rate 2001 to 2002 in/year	Rate Change Percent [A]	Comments
W170-S2180-2 A-C	W170 Drift-S2180	4-183	06/02/03	5.046	11.061	1.051	1.020	3%	
W170-S2275 A-C	W170 Drift-S2275	4-184	06/02/03	4.033	4.033	1.029	1.080	-5%	
W170-S2275 B-D	W170 Drift-S2275	4-184	06/02/03	4.210	4.210	1.086	1.135	-4%	
W170-S2350 A-C	W170 Drift-S2350	4-185	06/02/03	5.338	5.338	1.321	1.425	-7%	
W170-S2350 B-D	W170 Drift-S2350	4-185	06/02/03	4.546	4.546	1.124	1.197	-6%	
W170-S2425 A-C	W170 Drift-S2425	4-186	06/02/03	4.937	4.937	1.201	1.321	-9%	
W170-S2425 B-D	W170 Drift-S2425	4-186	06/02/03	4.989	4.989	1.246	1.379	-10%	
W170-S2520 A-C	W170 Drift-S2520	4-187	06/02/03	5.486	5.486	1.320	1.456	-9%	
W170-S2685-2 A-C	W170 Drift-S2685	4-188	06/23/03	2.714	4.580	1.769	1.973	-10%	
W170-S2685-2 B-D	W170 Drift-S2685	4-188	06/23/03	2.522	4.418	1.553	1.893	-18%	
W170-S2750 A-C	W170 Drift-S2750	4-189	06/23/03	1.001	1.001	1.681	N/A	N/A	New installation 11/02.
W170-S2833 A-C	W170 Drift-S2833	4-190	06/23/03	0.813	0.813	1.804	N/A	N/A	New installation 1/03.
W170-S2833 B-D	W170 Drift-S2833	4-190	06/23/03	0.789	0.789	1.727	N/A	N/A	New installation 1/03.
W170-S2916 A-C	W170 Drift-S2916	4-191	06/23/03	1.791	1.791	4.082	N/A	N/A	New installation 1/03.
W170-S2916 B-D	W170 Drift-S2916	4-191	06/23/03	0.355	0.355	1.938	N/A	N/A	New installation 4/03.
W170-S2998 A-C	W170 Drift-S2998	4-192	06/23/03	0.980	0.980	2.179	N/A	N/A	New installation 1/03.
W170-S2998 B-D	W170 Drift-S2998	4-192	06/23/03	0.925	0.925	2.045	N/A	N/A	New installation 1/03.
W170-S3080 A-C	W170 Drift-S3080	4-193	06/23/03	0.928	0.928	2.057	N/A	N/A	New installation 1/03.
W170-S3195 A-C	W170 Drift-S3195	4-194	06/23/03	1.241	1.241	2.838	N/A	N/A	New installation 1/03.
W170-S3195 B-D	W170 Drift-S3195	4-194	06/23/03	1.139	1.139	2.497	N/A	N/A	New installation 1/03.
W170-S3310 A-C	W170 Drift-S3310	4-195	06/23/03	0.790	0.790	2.482	N/A	N/A	New installation 3/03.
N460-E70-3 A-C	N460 Drift-E70	4-196	06/05/03	2.702	19.214	1.465	1.485	-1%	
N460-E70-2 B-D	N460 Drift-E70	4-196	06/05/03	3.228	14.976	1.632	1.722	-5%	
N250-E220 A-E	N250 Drift-E220	4-197	06/04/03	18.911	18.911	1.613	1.533	5%	
N250-E220 B-D	N250 Drift-E220	4-197	06/04/03	19.471	19.471	1.708	1.613	6%	
N250-E220 H-F	N250 Drift-E220	4-197	06/04/03	14.711	14.711	1.242	1.203	3%	

[A] NA indicates insufficient data to calculate.

Table 4-1 (Continued)
Access Drifts Data Analysis

CONVERGENCE POINTS (Continued)

Field Tag	Location	Figure Number	Last Reading 2002 to 2003 Date	Last Reading 2002 to 2003 Inches	Cumulative Displacement Inches	Closure Rate 2002 to 2003 in/year	Closure Rate 2001 to 2002 in/year	Rate Change Percent	Comments
N250-E220 C-G	N250 Drift-E220	4-197	06/04/03	14.246	14.246	1.107	1.101	1%	
N300-W170 A-C	N300 Drift-W170	4-198	06/04/03	21.201	21.201	1.560	1.554	0%	
N300-W170-1 B-D	N300 Drift-W170	4-198	06/04/03	5.220	13.465	1.154	1.036	11%	
N215-W500 A-C	N215 Drift-W500	4-199	06/04/03	17.403	17.403	1.343	1.356	-1%	
N215-W500-2 B-D	N215 Drift-W500	4-199	06/04/03	4.526	11.396	0.871	0.829	5%	
N215-W620 A-C	N215 Drift-W620	4-200	06/04/03	15.337	15.337	1.025	1.044	-2%	
N140-E90 A-C	N140 Drift-E90	4-201	06/04/03	11.314	11.314	0.701	0.749	-6%	
N140-E90 B-D	N140 Drift-E90	4-201	06/04/03	11.666	11.666	0.760	0.721	5%	
N140-W50-2 B-D	N140 Drift-W50	4-202	06/04/03	5.403	17.609	1.167	1.160	1%	
S90-W120 A-C	S90 Drift-W120	4-203	06/04/03	2.223	2.223	0.650	0.680	-4%	
S90-W120 B-D	S90 Drift-W120	4-203	06/04/03	2.325	2.325	0.680	0.740	-8%	
S90-W400 A-C	S90 Drift-W400	4-204	06/02/03	12.263	12.263	0.765	0.671	14%	
S90-W400-2 B-D	S90 Drift-W400	4-204	06/02/03	3.867	11.790	0.630	0.632	0%	
S90-W590 A-C	S90 Drift-W590	4-205	06/02/03	8.314	8.314	0.610	0.629	-3%	
S90-W590-2 B-D	S90 Drift-W590	4-205	06/02/03	3.750	7.587	0.528	0.561	-6%	
S90-W620 A-C	S90 Drift-W620	4-206	06/02/03	15.308	15.308	1.016	1.018	0%	
S90-W770 A-C	S90 Drift-W770	4-207	06/02/03	10.295	10.295	0.772	0.895	-14%	
S90-W770-2 B-D	S90 Drift-W770	4-207	06/02/03	3.571	9.258	0.716	0.689	4%	
S90-W920-2 A-C	S90 Drift-W920	4-208	06/02/03	2.361	16.017	1.226	1.073	14%	
CORE-W10 A-C	CORE STORAGE W10	4-209	06/02/03	14.891	14.891	0.828	0.827	0%	
CORE-W20 A-C	CORE STORAGE W20	4-209	06/02/03	13.789	13.789	0.828	0.817	1%	
CORE-W30 A-C	CORE STORAGE W30	4-209	06/02/03	14.335	14.335	0.876	0.878	0%	
CORE-W51 A-C	CORE STORAGE W51	4-209	06/02/03	15.950	15.950	1.000	0.970	3%	
CORE-W62 A-C	CORE STORAGE W62	4-209	06/02/03	16.533	16.533	1.033	1.040	-1%	
CORE-W73 A-C	CORE STORAGE W73	4-209	06/02/03	16.650	16.650	1.068	1.053	1%	
CORE-W101 A-C	CORE STORAGE W101	4-209	06/02/03	16.401	16.401	1.010	0.991	2%	

Table 4-1 (Continued)
Access Drifts Data Analysis

CONVERGENCE POINTS (Continued)

Field Tag	Location	Figure Number	Last Reading 2002 to 2003 Date	Last Reading 2002 to 2003 Inches	Cumulative Displacement Inches	Closure Rate 2002 to 2003 in/year	Closure Rate 2001 to 2002 in/year	Rate Change Percent	Comments
CORE-W117 A-C	CORE STORAGE W117	4-209	06/02/03	14.991	14.991	0.902	0.873	3%	
CORE-W133 A-C	CORE STORAGE W133	4-209	06/02/03	12.926	12.926	0.740	0.721	3%	
S700-E205-2 A-C	S700 Drift-E205	4-210	06/03/03	13.083	16.025	1.351	1.347	0%	
S700-E205 B-D	S700 Drift-E205	4-210	06/03/03	24.424	24.424	1.023	0.969	6%	
S700-E58 A-C	S700 Drift-E58	4-211	06/02/03	12.271	12.271	1.222	1.274	-4%	
S1000-E160 A-C	S1000 Drift-E160	4-212	06/03/03	5.089	5.089	0.695	0.752	-8%	
S1000-E120-2 A-C	S1000 Drift-E120	4-213	06/03/03	1.242	6.319	1.108	0.788	41%	Shorter "Previous" reading interval.
S1000-E58-3 A-C	S1000 Drift-E58	4-214	06/03/03	10.761	13.723	1.080	1.122	-4%	
S1000-E58-2 B-D	S1000 Drift-E58	4-214	06/03/03	9.348	10.892	0.900	0.838	7%	
S1000-W98 A-C	S1000 Drift-W98	4-215	06/02/03	17.688	17.688	1.468	1.480	-1%	
S1000-W98 B-D	S1000 Drift-W98	4-215	06/02/03	12.308	12.308	1.056	1.035	2%	
S1300-E160 A-C	S1300 Drift-E160	4-216	06/03/03	8.925	8.925	1.177	1.199	-2%	
S1300-E120 A-C	S1300 Drift-E120	4-217	06/03/03	6.606	6.606	0.863	0.885	-2%	
S1300-E24 A-C	S1300 Drift-E24	4-218	06/02/03	12.548	12.548	0.985	0.956	3%	
S1300-W55 A-C	S1300 Drift-W55	4-219	06/02/03	9.359	9.359	1.065	1.096	-3%	
S1300-W100-2 A-C	S1300 Drift-W100	4-220	06/02/03	13.564	20.084	1.503	1.539	-2%	
S1600-E170 A-C	S1600 Drift-E170	4-221	06/03/03	7.872	7.872	0.948	1.027	-8%	
S1600-E110 A-C	S1600 Drift-E110	4-222	06/03/03	7.127	7.127	0.871	0.882	-1%	
S1950-E113-4 A-C	S1950 Drift-E113	4-223	06/03/03	1.852	5.779	0.712	0.642	11%	
S1950-E281-3 A-C	S1950 Drift-E281	4-224	02/04/03	4.829	11.398	0.904	1.041	-13%	
S1950-E284-3 A-C	S1950 Drift-E284	4-225	02/04/03	4.832	11.471	0.926	1.047	-12%	
S2180-E55-2 A-C	S2180 Drift-E55	4-226	06/02/03	3.384	3.704	1.306	1.213	8%	
S2180-E55 B-D	S2180 Drift-E55	4-226	06/02/03	2.933	2.933	0.993	0.978	2%	
S2180-E220 A-C	S2180 Drift-E220	4-227	06/03/03	3.607	3.607	1.284	1.254	2%	
S2180-E220 B-D	S2180 Drift-E220	4-227	06/03/03	3.648	3.648	1.303	1.199	9%	
S2180-W100-2 A-C	S2180 Drift-W100	4-228	06/02/03	4.405	4.554	1.507	1.516	-1%	
S2180-W100-2 B-D	S2180 Drift-W100	4-228	06/02/03	2.956	3.142	0.966	1.001	-3%	
S2520-E55 A-C	S2520 Drift-E55	4-229	02/07/03	6.092	6.092	1.692	1.744	-3%	Temporarily blocked.
S2520-E55 B-D	S2520 Drift-E55	4-229	02/07/03	5.975	5.975	1.954	1.747	12%	Temporarily blocked.
S2520-E220 A-C	S2520 Drift-E220	4-230	06/03/03	6.335	6.335	1.605	1.733	-7%	
S2520-E220 B-D	S2520 Drift-E220	4-230	06/03/03	6.103	6.103	1.568	1.801	-13%	
S2520-W100 A-C	S2520 Drift-W100	4-231	06/02/03	6.062	6.062	1.394	1.452	-4%	
S2520-W100 B-D	S2520 Drift-W100	4-231	06/02/03	5.789	5.789	1.327	1.315	1%	

Table 4-1 (Continued)
Access Drifts Data Analysis

JOINT METERS

Field Tag	Location	Figure Number	Date of Last Reading	Cumulative Displacement Inches	Closure Rate 2002 to 2003 in/year	Closure Rate 2001 to 2002 in/year	Rate Change Percent	Comments
51X-CG-02703	S1950-E300 Overcast-NE	4-232	06/23/03	0.518	0.023	0.029	-21%	
51X-CG-02706	S1950-E300 Overcast-SW	4-232	06/23/03	0.993	0.069	0.062	11%	
51X-CG-02707	S1950-E300 Overcast-NW	4-232	06/23/03	1.015	0.070	0.069	1%	
51X-CG-02708	S1950-E300 Overcast-SE	4-232	06/23/03	0.574	0.035	0.039	-10%	

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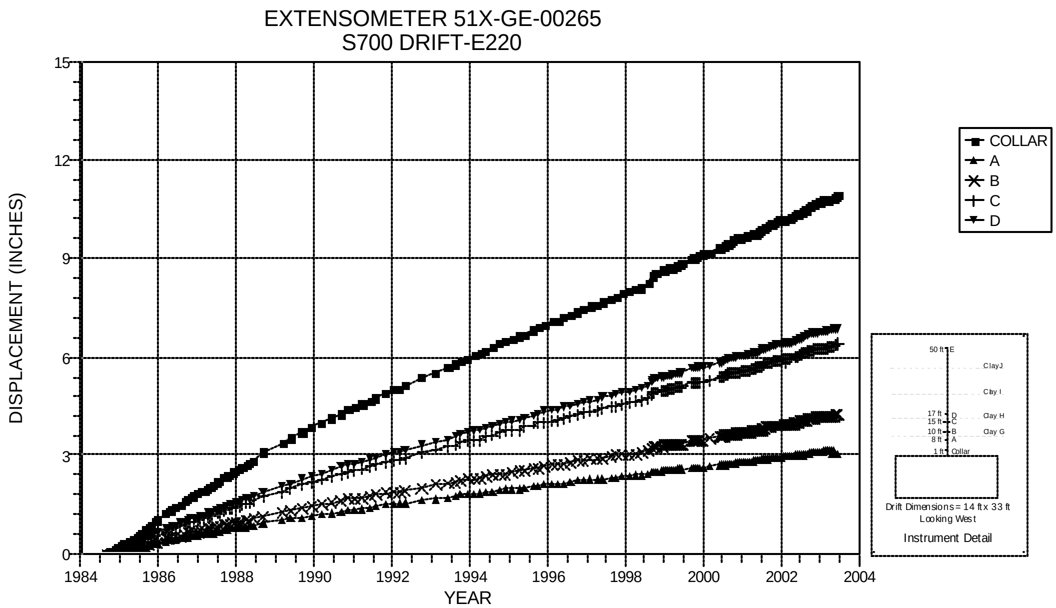
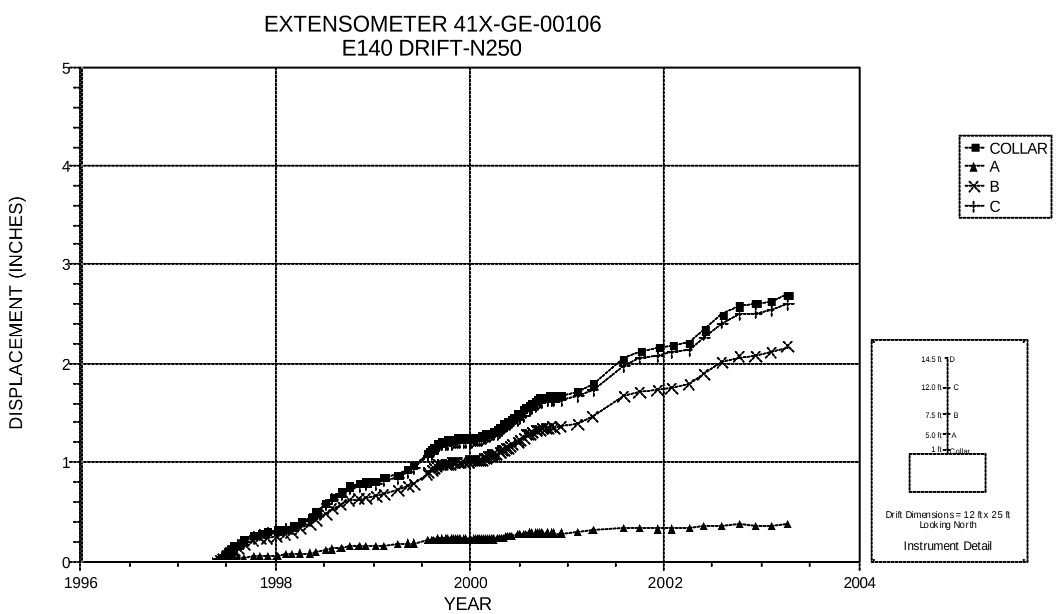


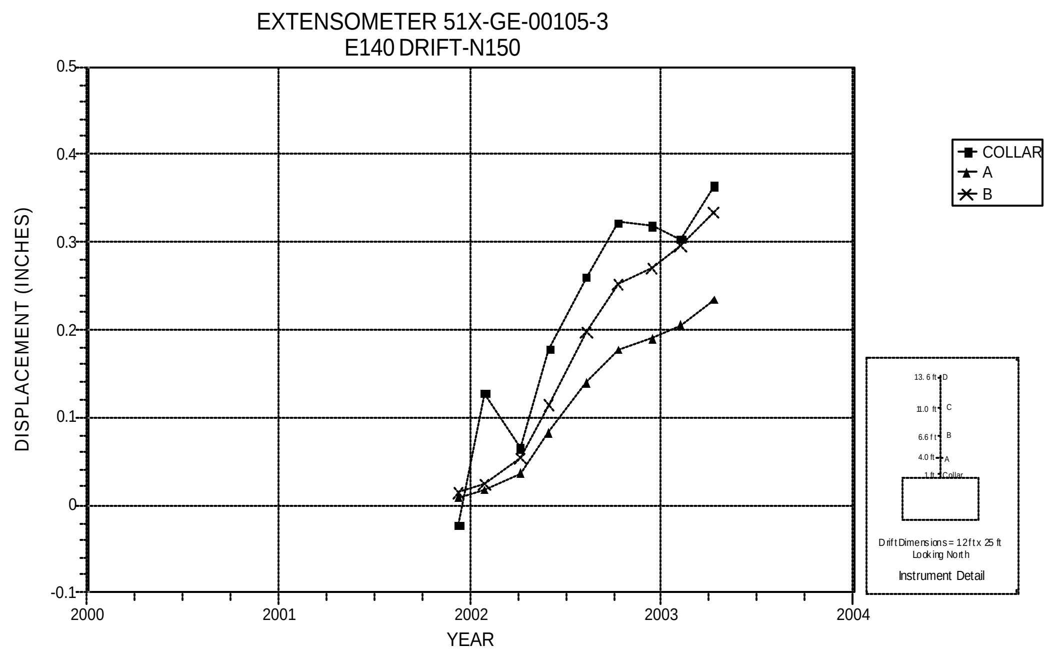
NOTES:
1. Excavation date: May 1984.

Figure 4-1 Extensometer 51X-GE-00265
S700 Drift at E220 – Roof



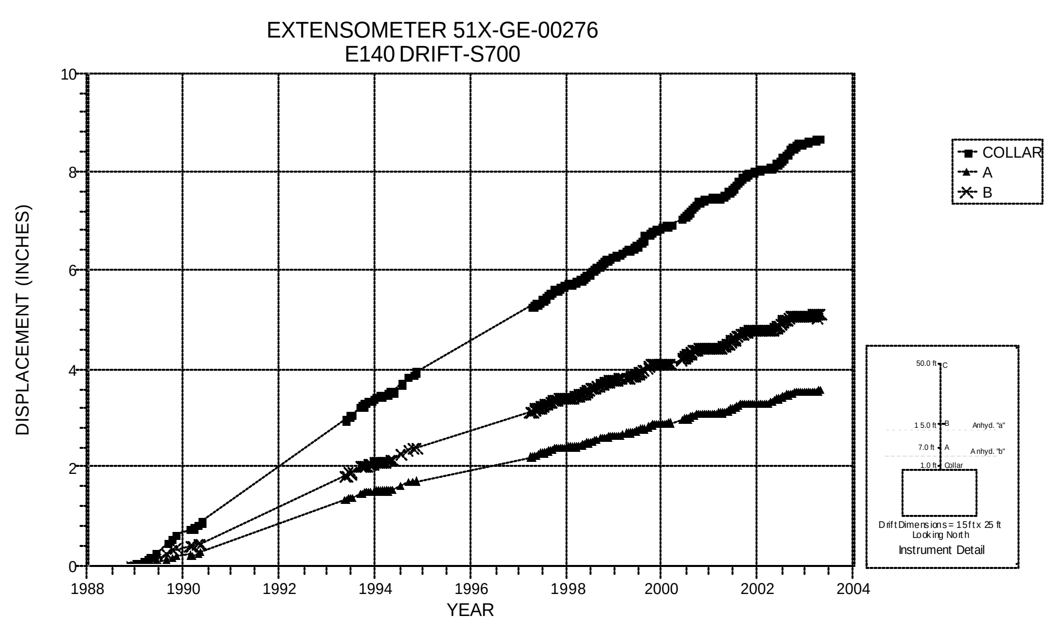
NOTES:
1. Excavation date: November 1982.

Figure 4-2 Extensometer 41X-GE-00106
E140 Drift at N250 – Roof



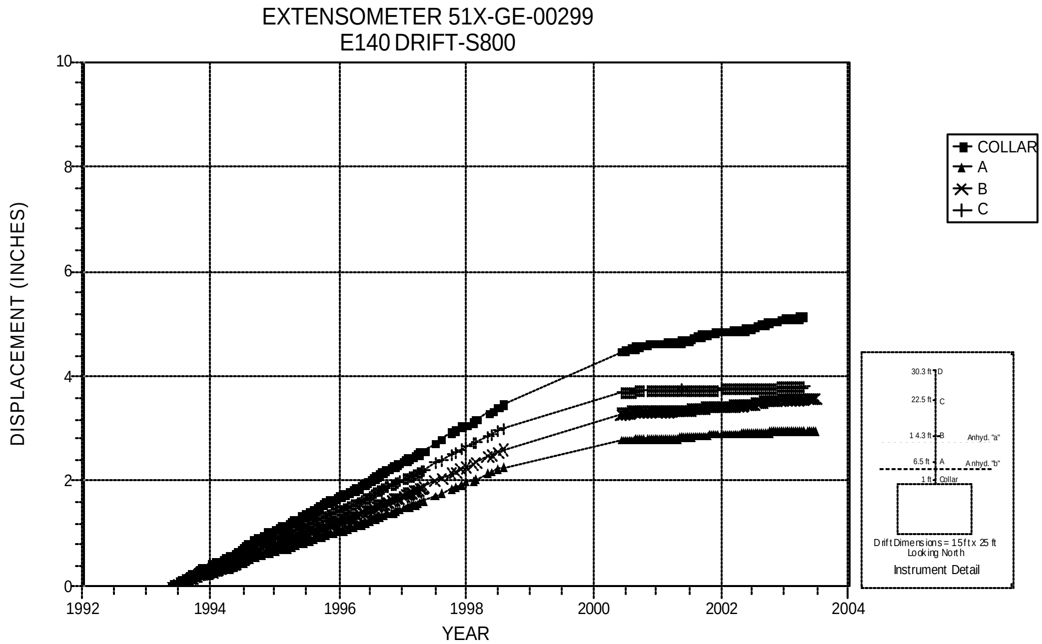
NOTES:
1. Excavation date: November 1982.
2. Replaced head July. 26, 1999
3. Replaced head October. 18, 2001

Figure 4-3 Extensometer 51X-GE-00105-3
E140 Drift at N150 – Roof



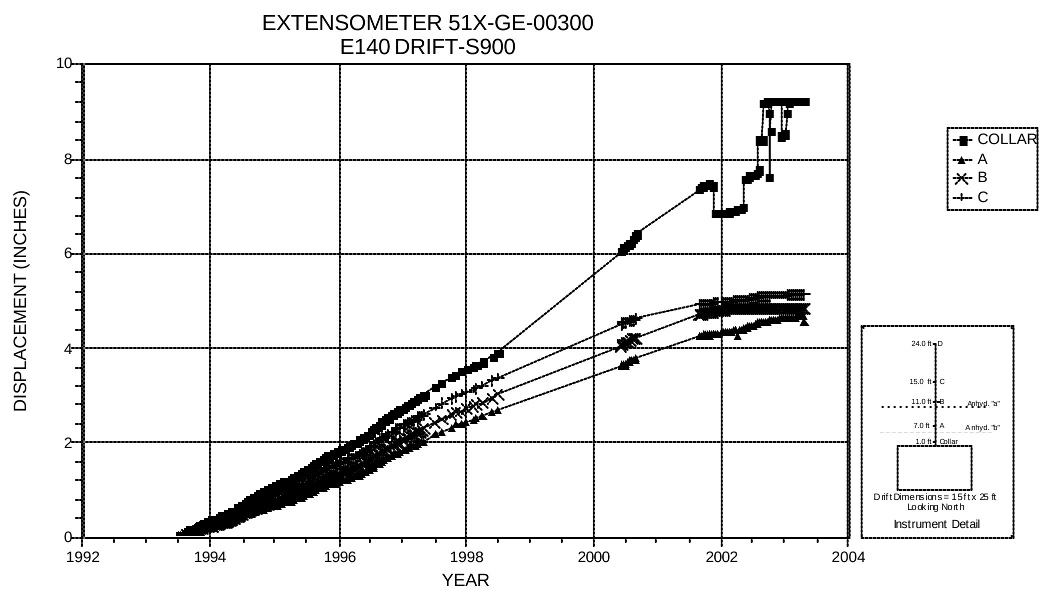
NOTES:
1. Excavation date: December 1982.

Figure 4-4 Extensometer 51X-GE-00276
E140 Drift at S700 Drift Intersection – Roof



NOTES:
1. Excavation date: December 1982.

Figure 4-5 Extensometer 51X-GE-00299
E140 Drift at S800 – Roof



NOTES:
1. Excavation date: December 1982.
2. Probable instrument malfunction.

Figure 4-6 Extensometer 51X-GE-00300
E140 Drift at S900 – Roof

Figure 4-7 Extensometer 51X-GE-00474
E120 at S1000 – Roof

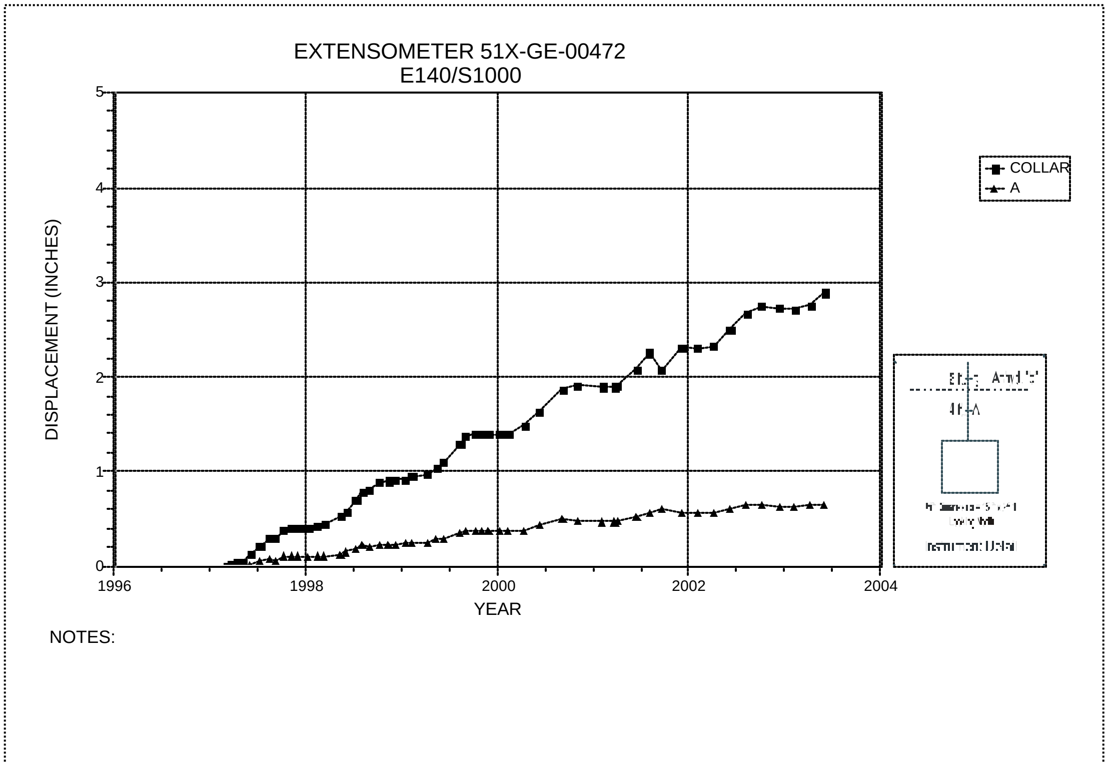
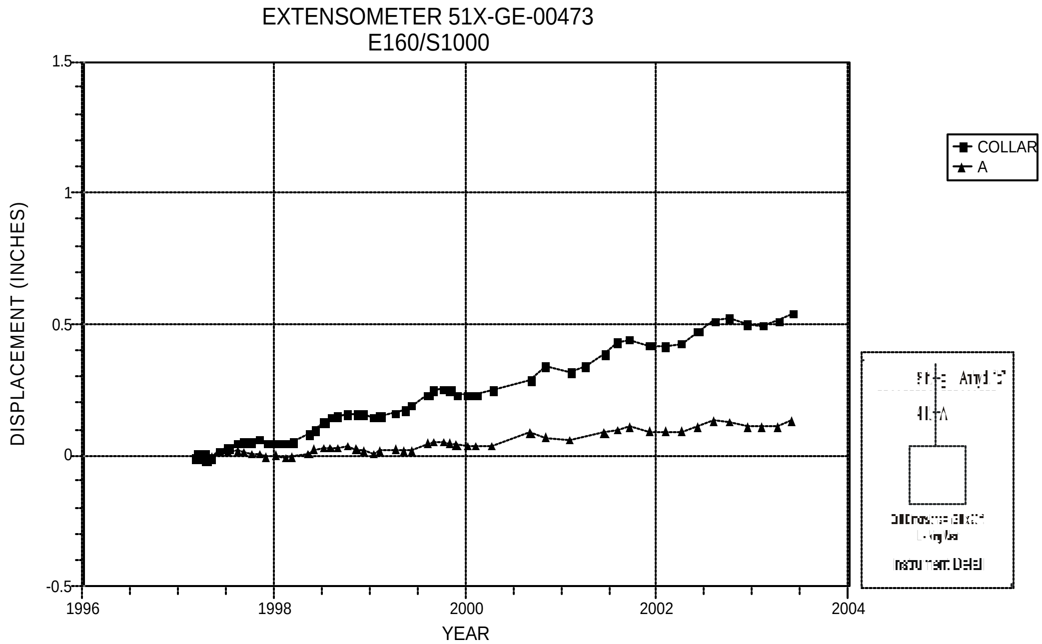
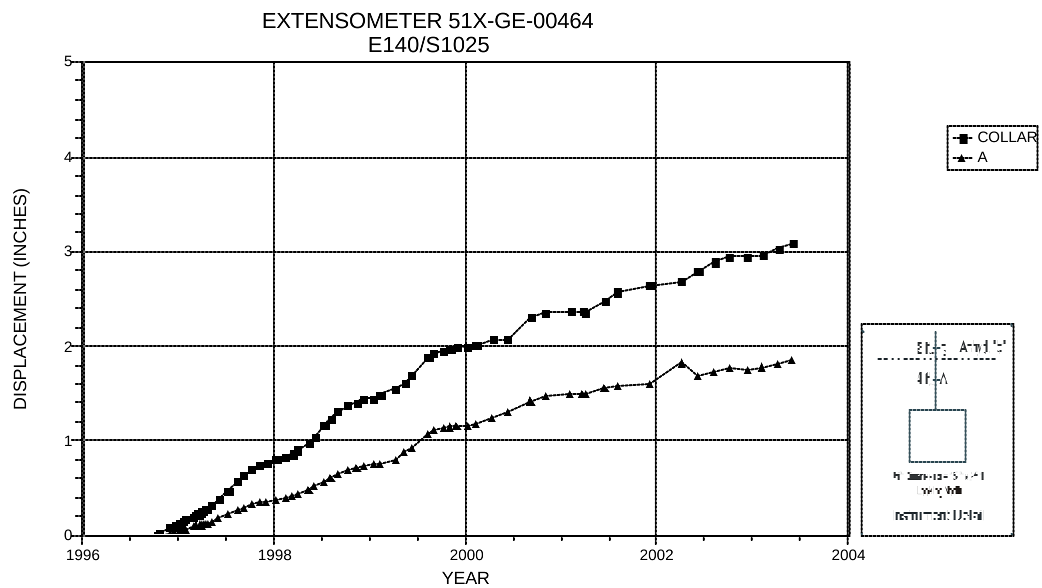


Figure 4-8 Extensometer 51X-GE-00472
E140 Drift at S1000 – Roof



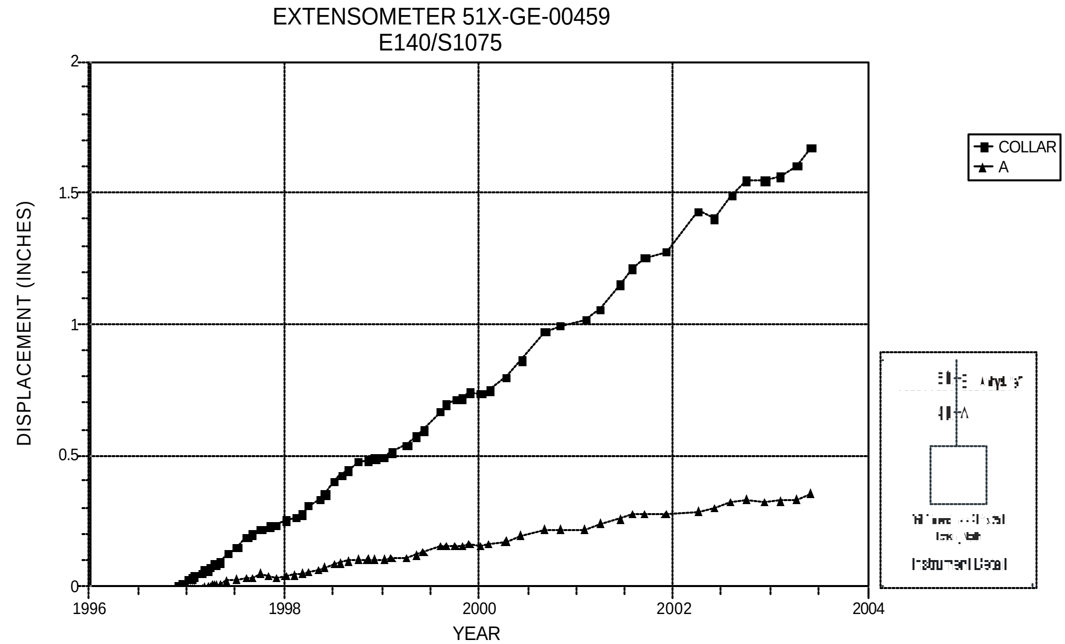
NOTES:

Figure 4-9 Extensometer 51X-GE-00473
E160 Drift at S1000 – Roof



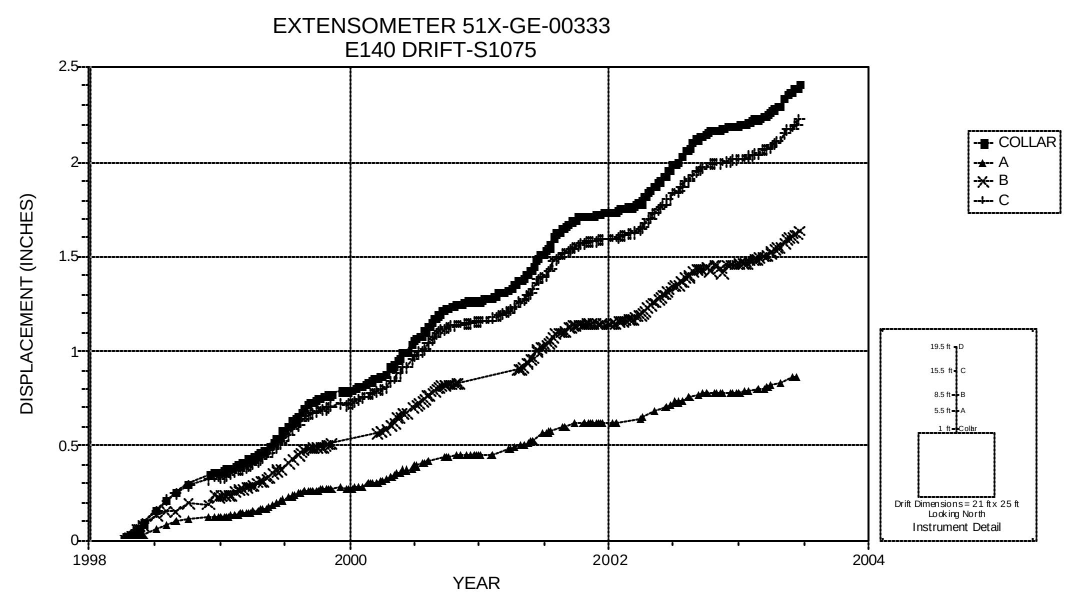
NOTES:

Figure 4-10 Extensometer 51X-GE-00464
E140 Drift at S1025 – Roof



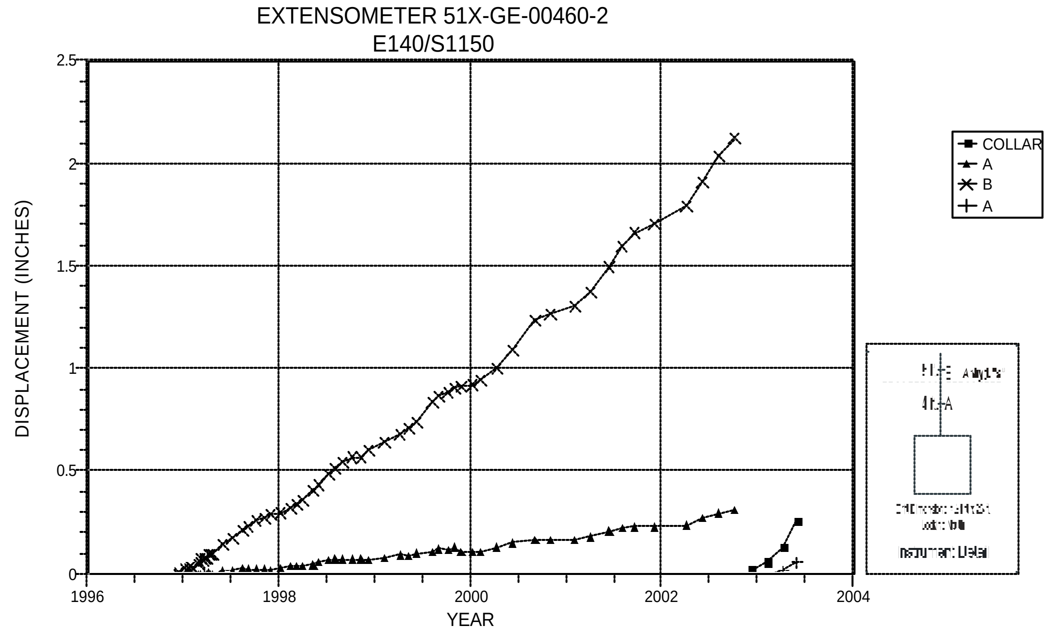
NOTES:

Figure 4-11 Extensometer 51X-GE-00459
E140 Drift at S1075 – Roof



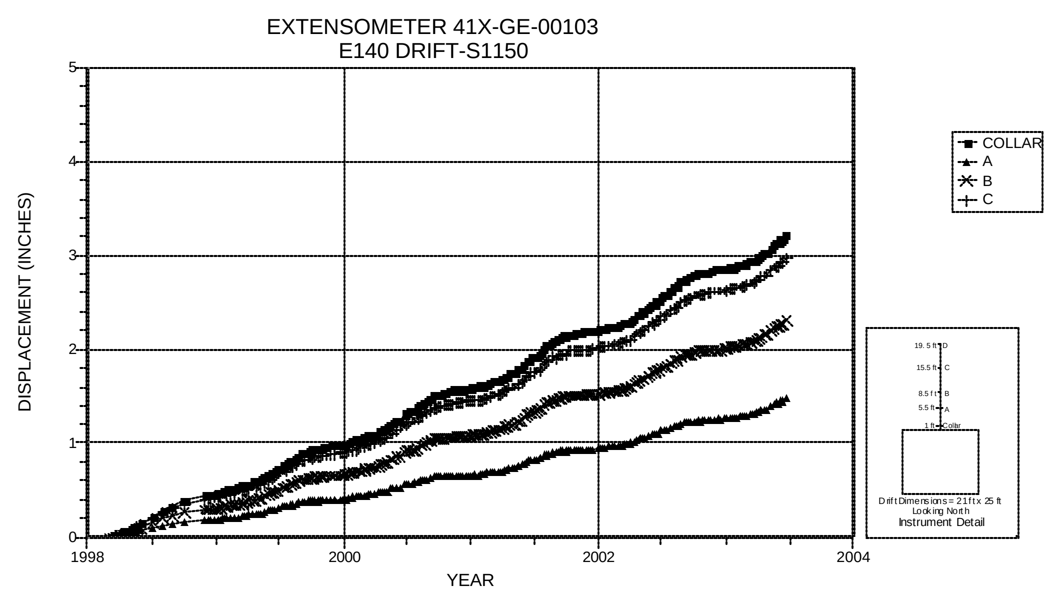
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b".

Figure 4-12 Extensometer 51X-GE-00333
E140 Drift at S1075 – Roof



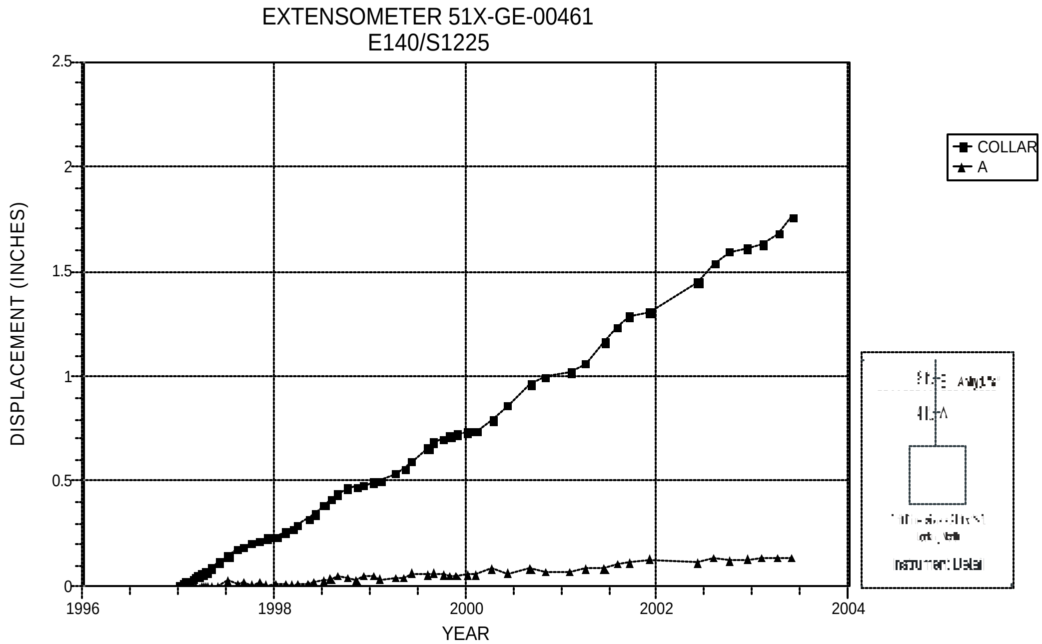
NOTES:
1. Instrument replaced October 2002.

Figure 4-13 Extensometer 51X-GE-00460-2
E140 Drift at S1150 – Roof



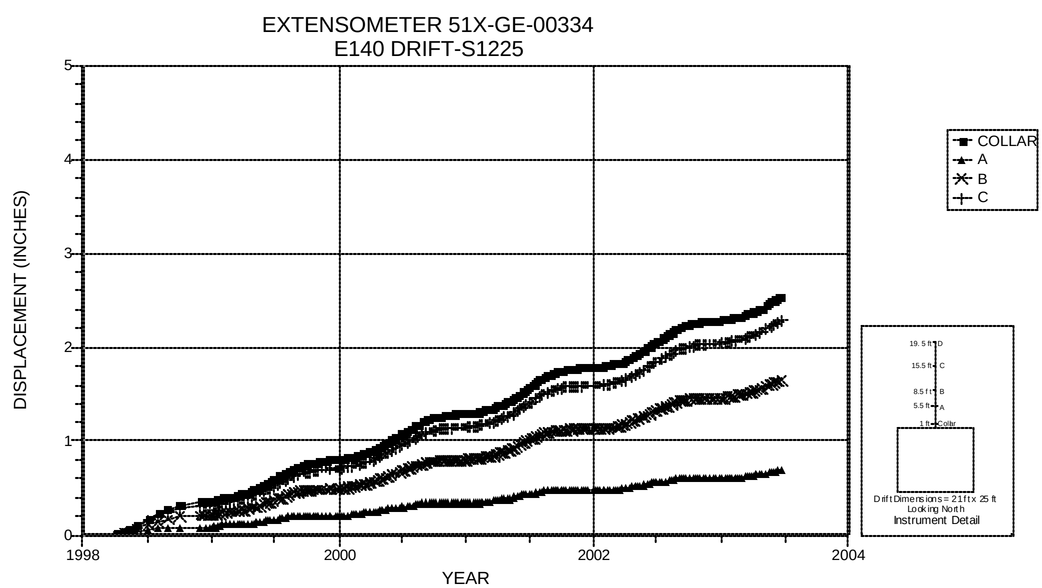
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b".

Figure 4-14 Extensometer 41X-GE-00103
E140 Drift at S1150 – Roof



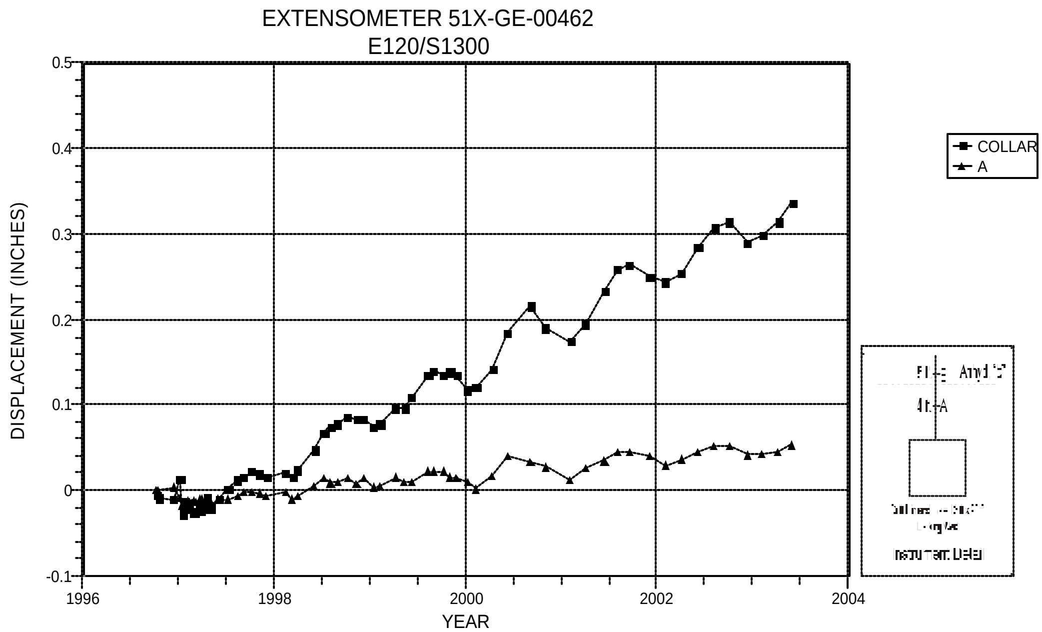
NOTES:

Figure 4-15 Extensometer 51X-GE-00461
E140 Drift at S1225 – Roof



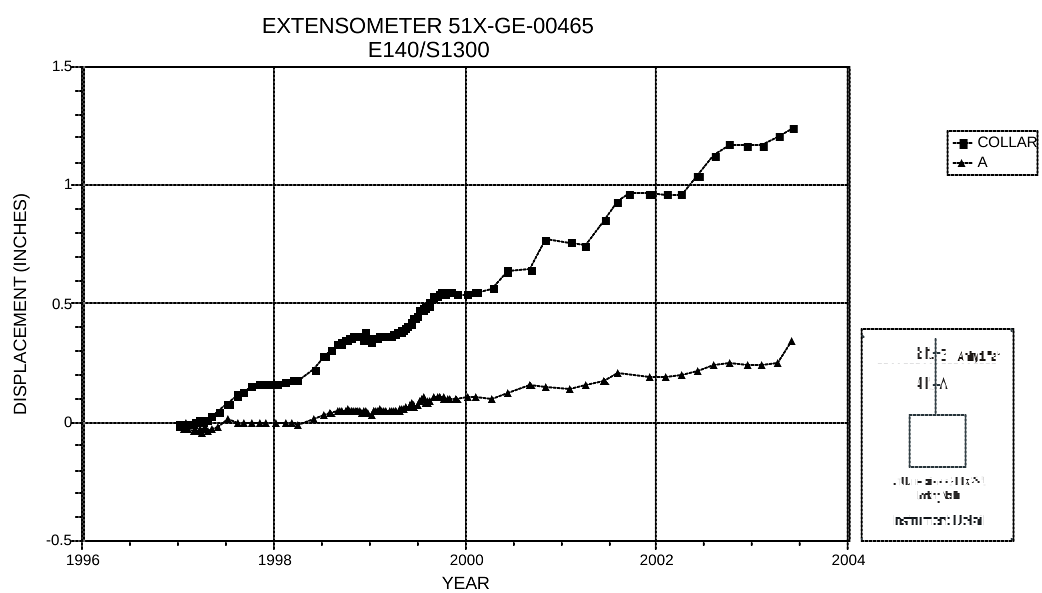
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b".

Figure 4-16 Extensometer 51X-GE-00334
E140 Drift at S1225 – Roof



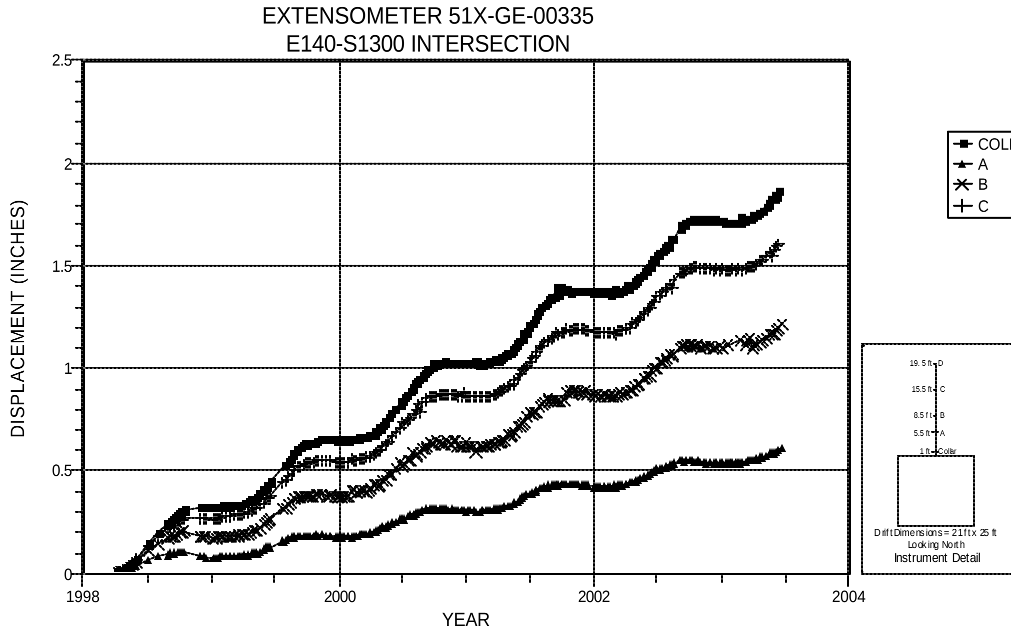
NOTES:

Figure 4-17 Extensometer 51X-GE-00462
E120 at S1300 – Roof



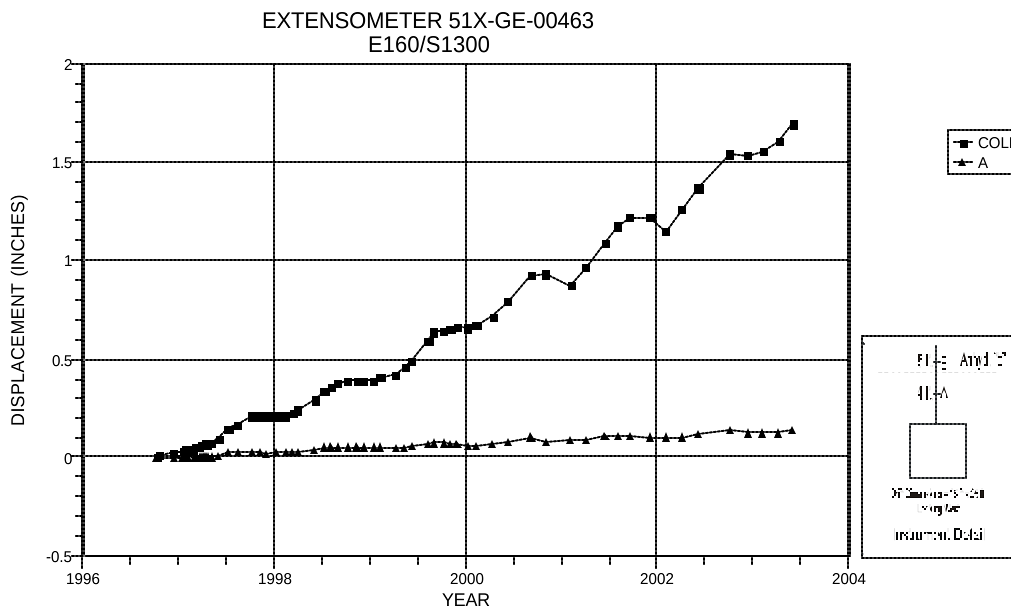
NOTES:

Figure 4-18 Extensometer 51X-GE-00465
E140 Drift at S1300 – Roof



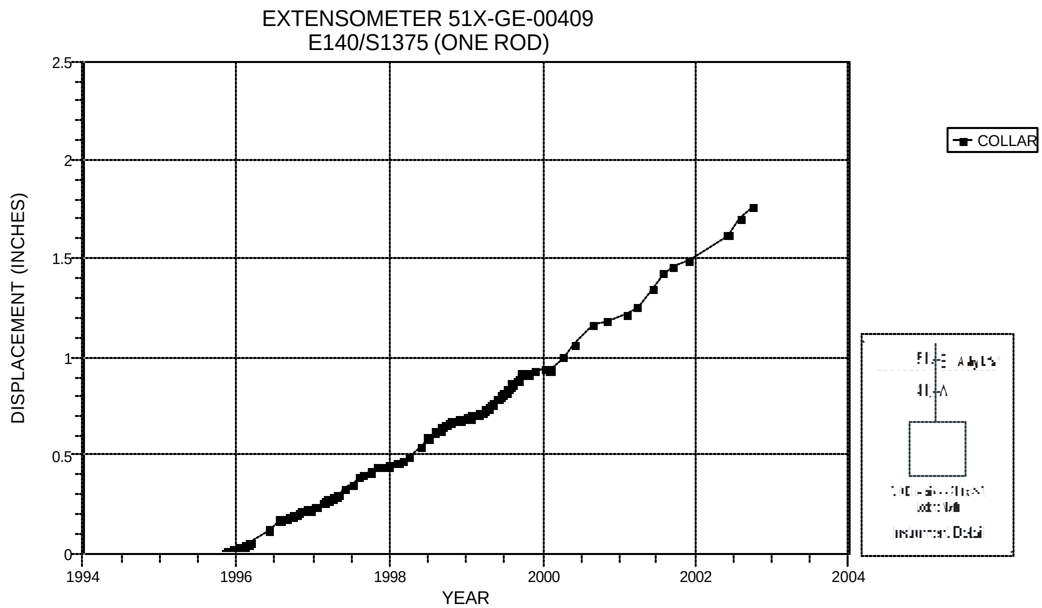
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b".

Figure 4-19 Extensometer 51X-GE-00335
E140 Drift at S1300 Drift Intersection – Roof



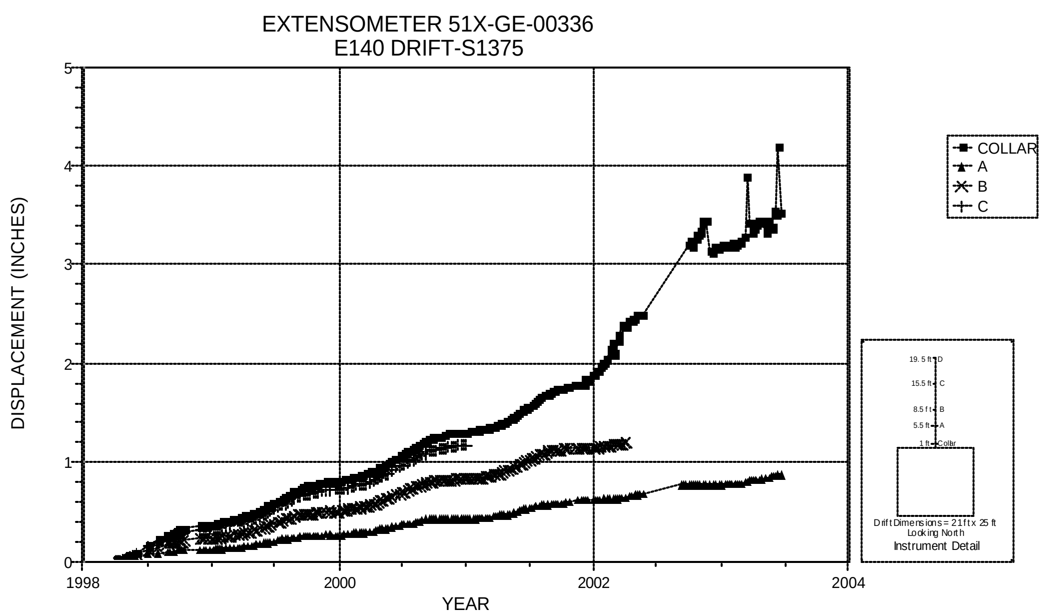
NOTES:

Figure 4-20 Extensometer 51X-GE-00463
E160 at S1300 – Roof



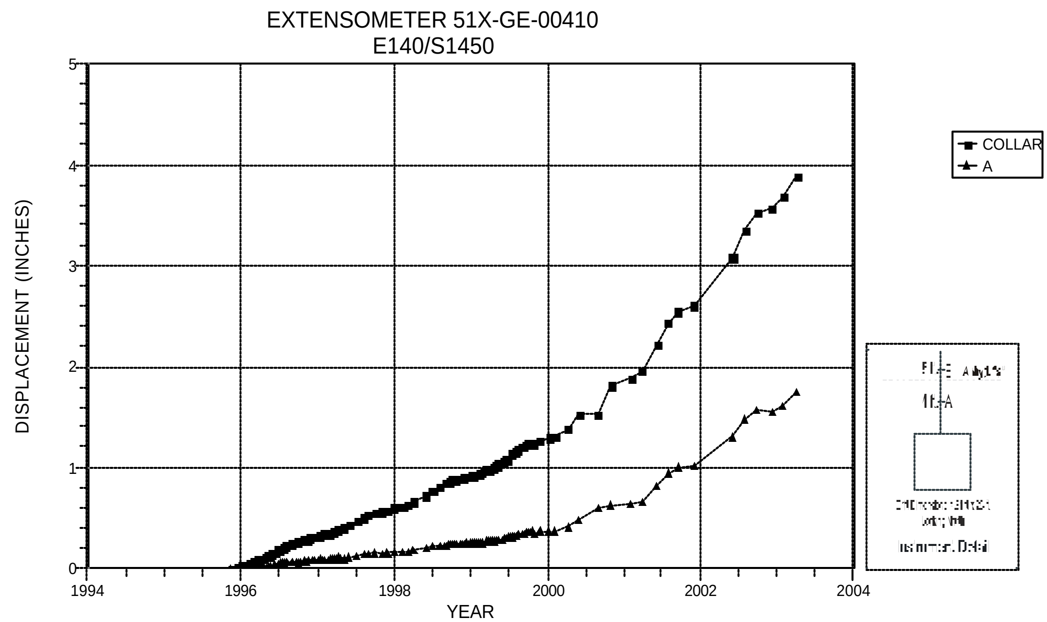
NOTES:

Figure 4-21 Extensometer 51X-GE-00409
E140 Drift at S1375 – Roof



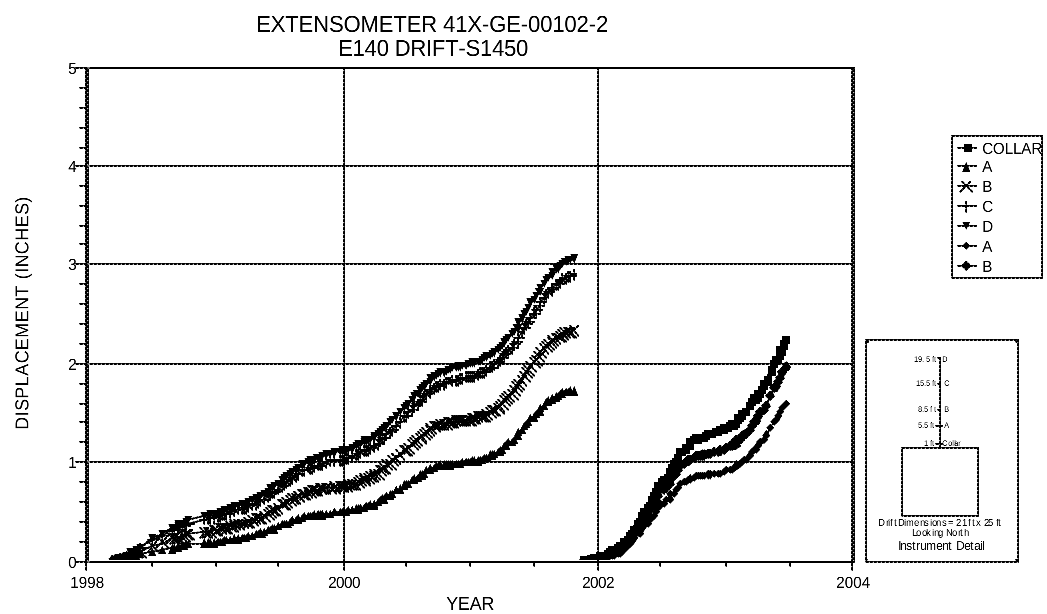
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b".
3. Malfunction with Anchor "B" and "C".
4. Instrument electrically noisy.

Figure 4-22 Extensometer 51X-GE-00336
E140 Drift at S1375 – Roof



NOTES:

Figure 4-23 Extensometer 51X-GE-00410
E140 Drift at S1450 – Roof



NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b".
3. Instrument repaired November 2001.
4. Rod C broken.

Figure 4-24 Extensometer 41X-GE-00102-2
E140 Drift at S1450 – Roof

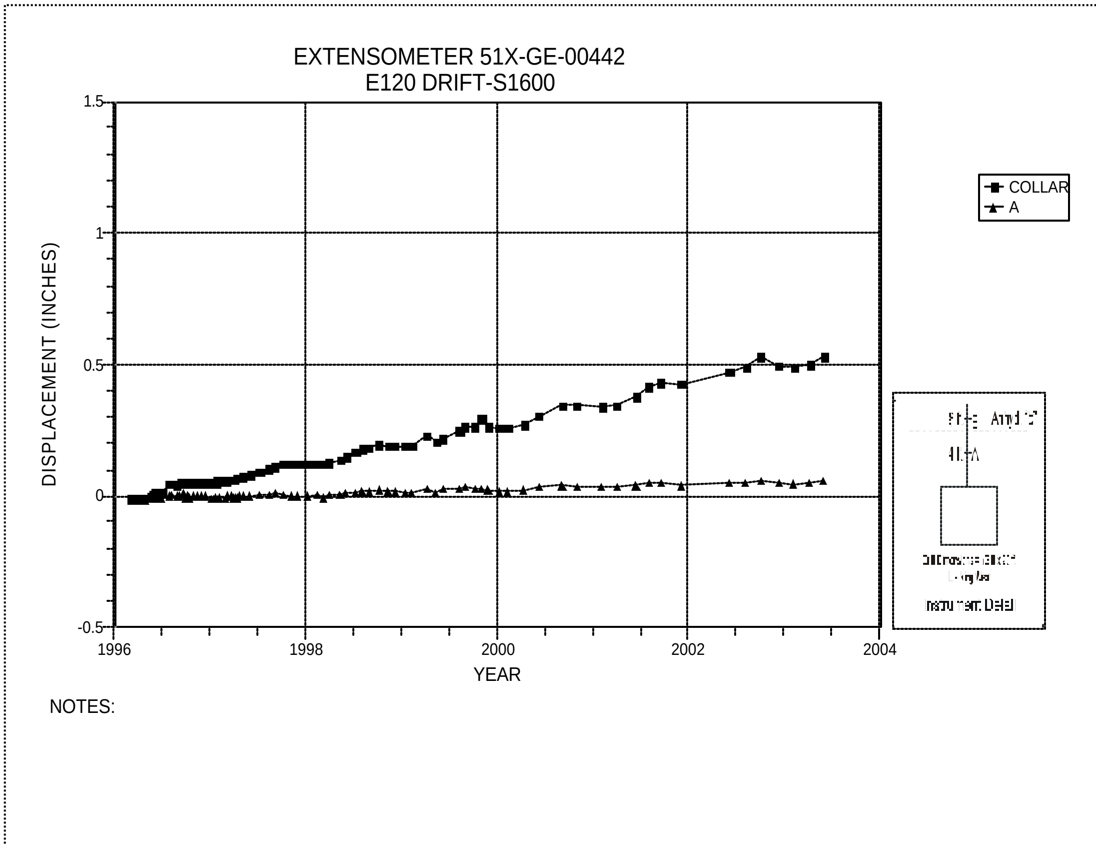


Figure 4-25 Extensometer 51X-GE-00442
E120 at S1600 – Roof

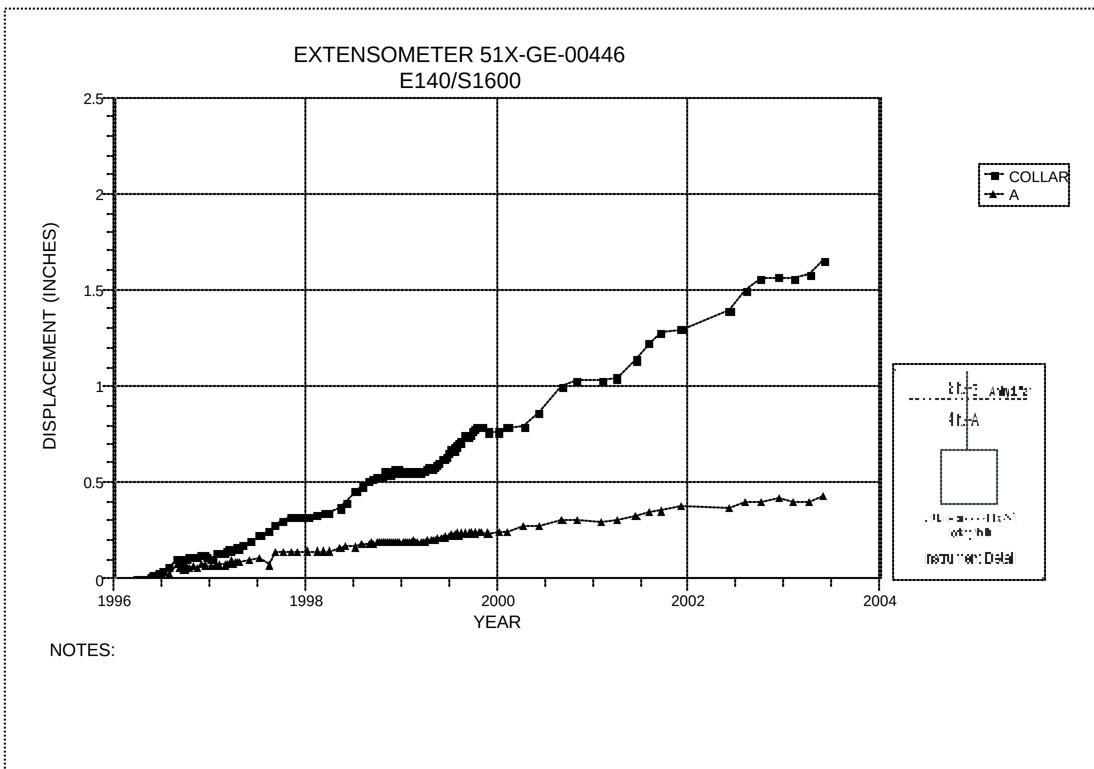
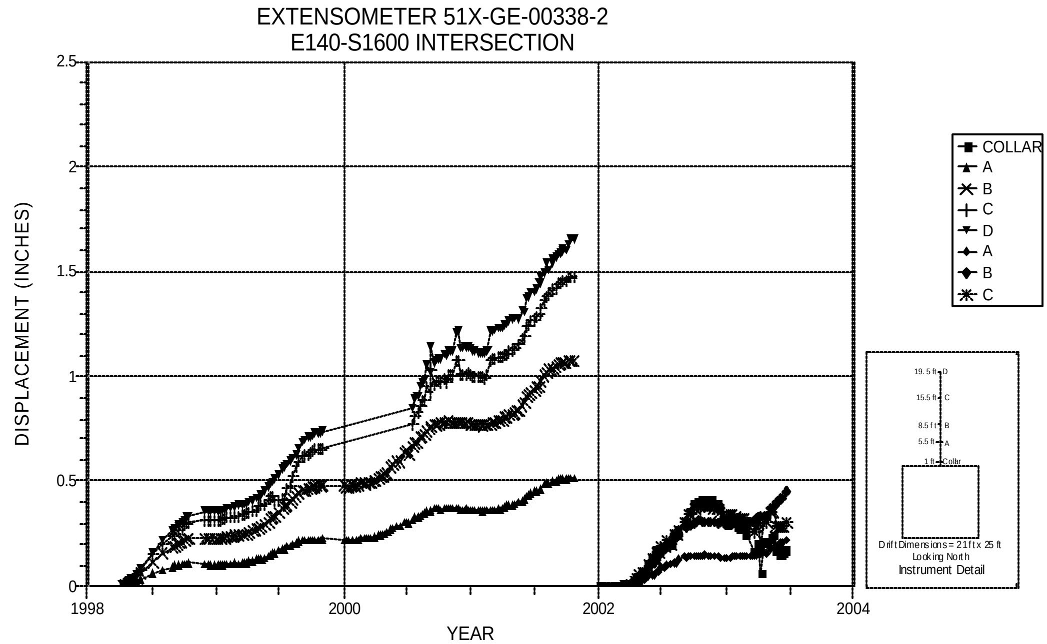
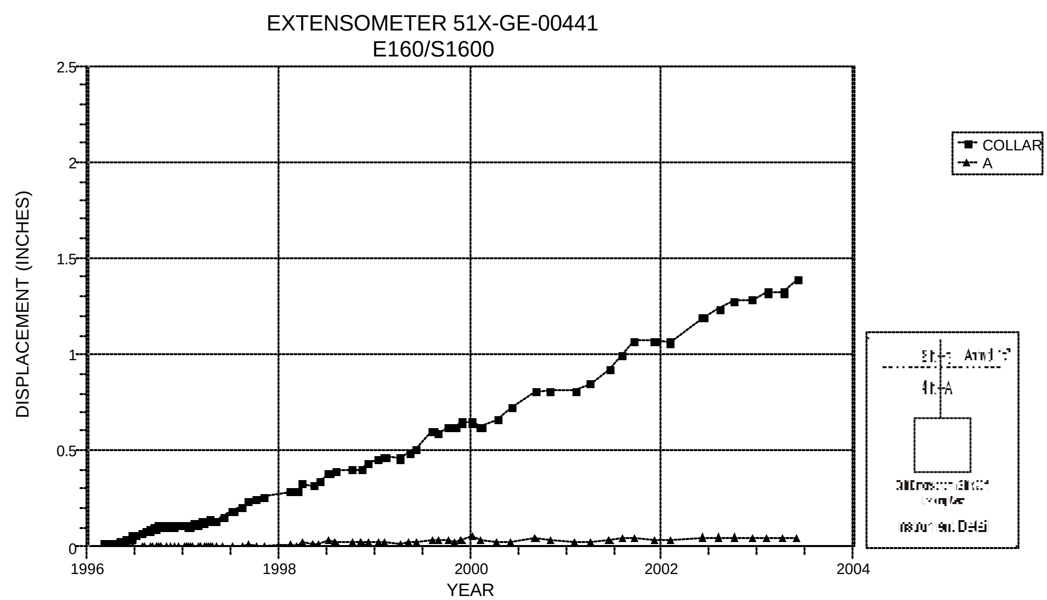


Figure 4-26 Extensometer 51X-GE-00446
E140 Drift at S1600 – Roof



NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b".
3. Instrument repaired January 2002.
4. Instrument electrically noisy.

Figure 4-27 Extensometer 51X-GE-00338-2
E140 Drift at S1600 Drift Intersection – Roof



NOTES:

Figure 4-28 Extensometer 51X-GE-00441
E160 at S1600 – Roof

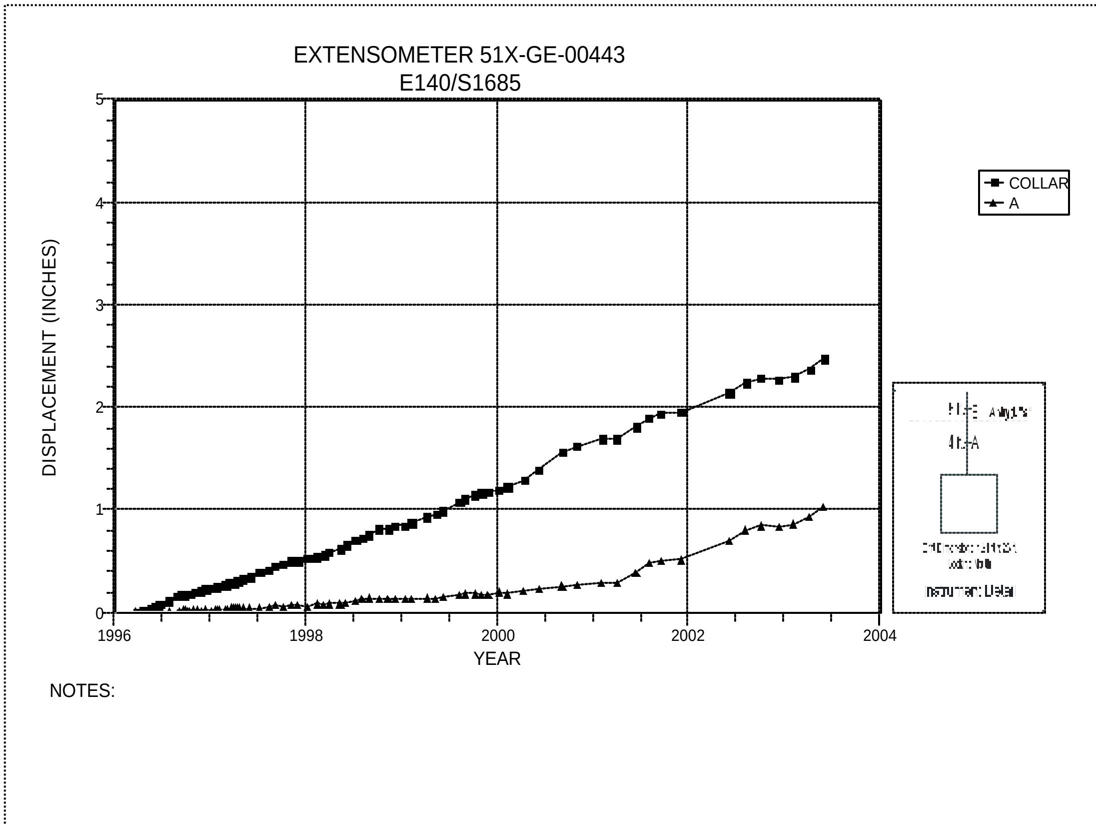


Figure 4-29 Extensometer 51X-GE-00443
E140 Drift at S1685 – Roof

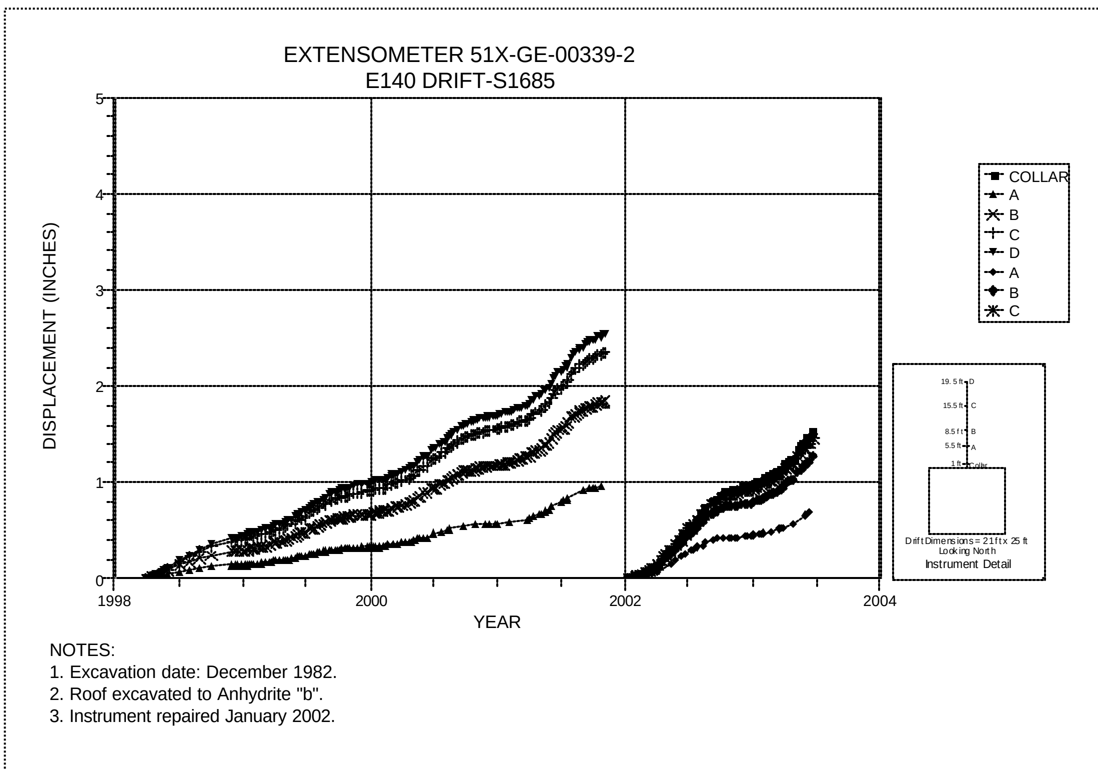
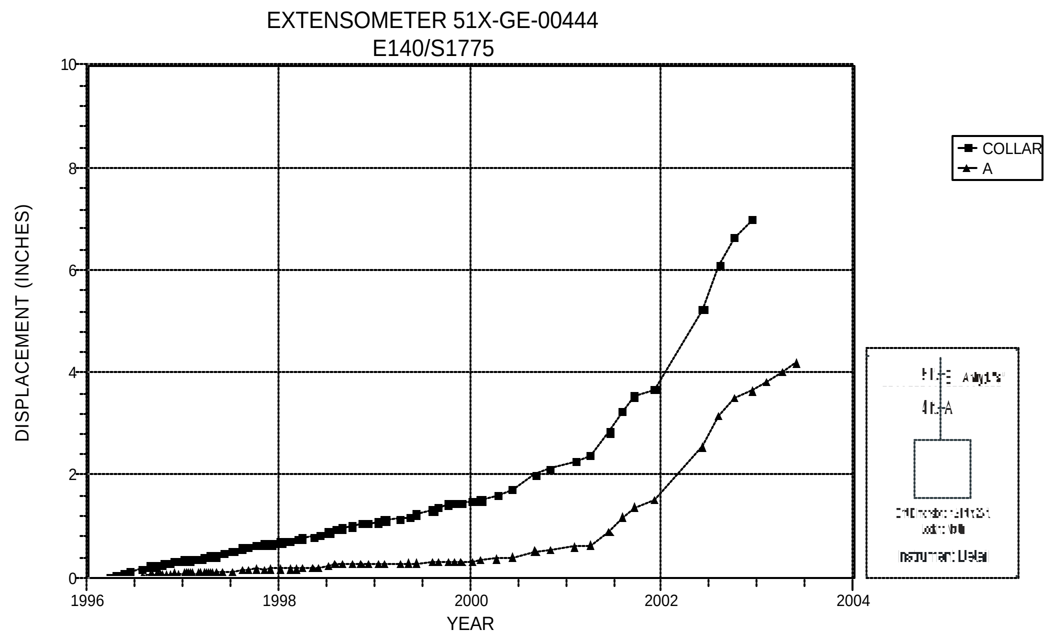
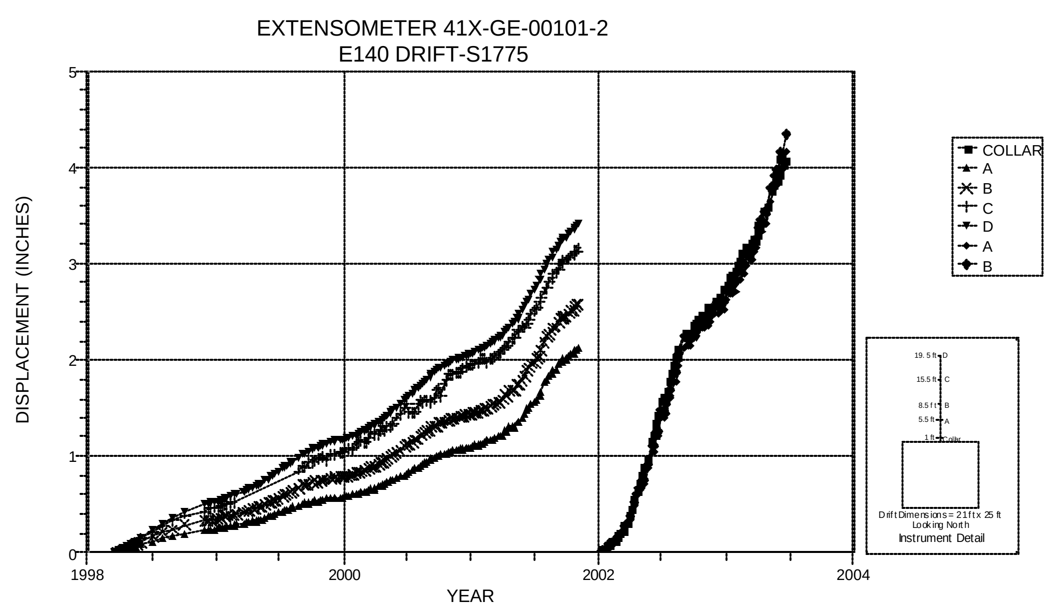


Figure 4-39 Extensometer 51X-GE-00339-2
E140 Drift at S1685 – Roof



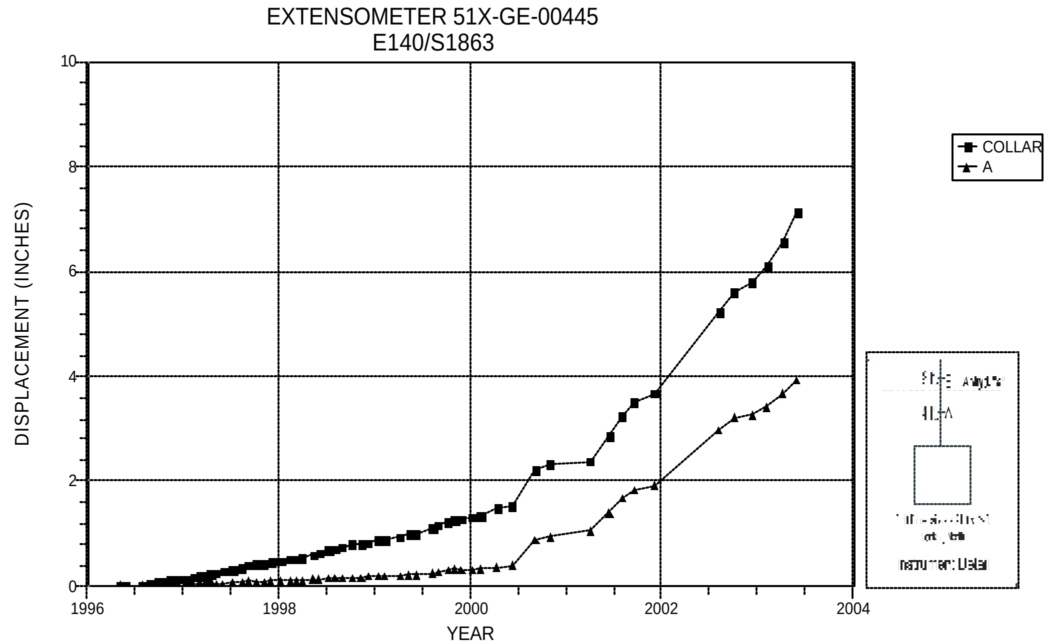
NOTES:

Figure 4-31 Extensometer 51X-GE-00444
E140 Drift at S1775 – Roof



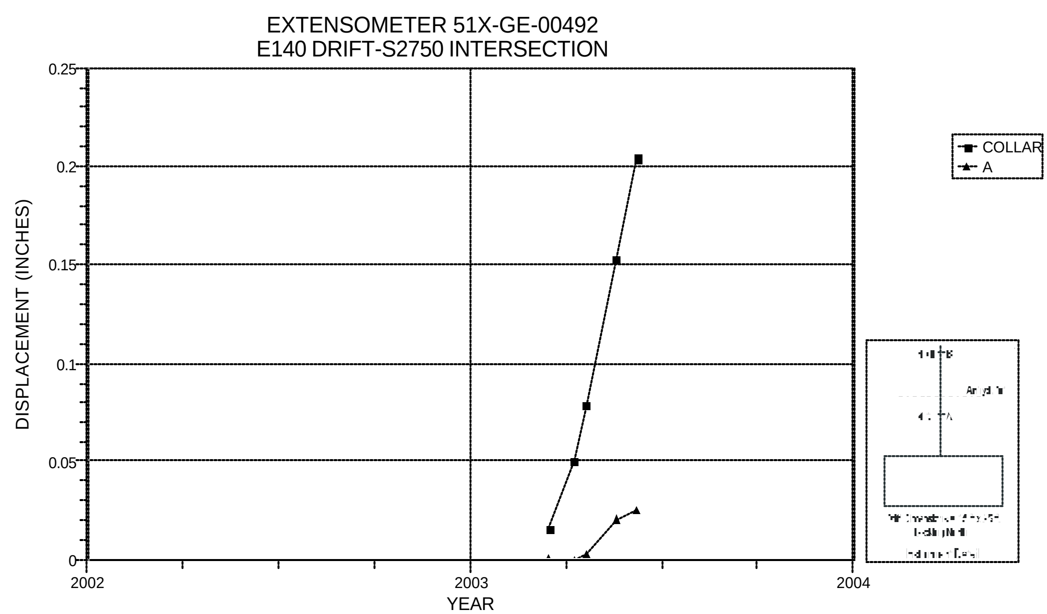
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b".
3. Instrument repaired January 2002.
4. Rod C broken.

Figure 4-32 Extensometer 41X-GE-00101-2
E140 Drift at S1775 – Roof



NOTES:

Figure 4-33 Extensometer 51X-GE-00445
E140 Drift at S1863 – Roof



NOTES:
1. Installed date: March 2003.

Figure 4-34 Extensometer 51X-GE-00492
E140 Drift at S2750 Drift Intersection – Roof

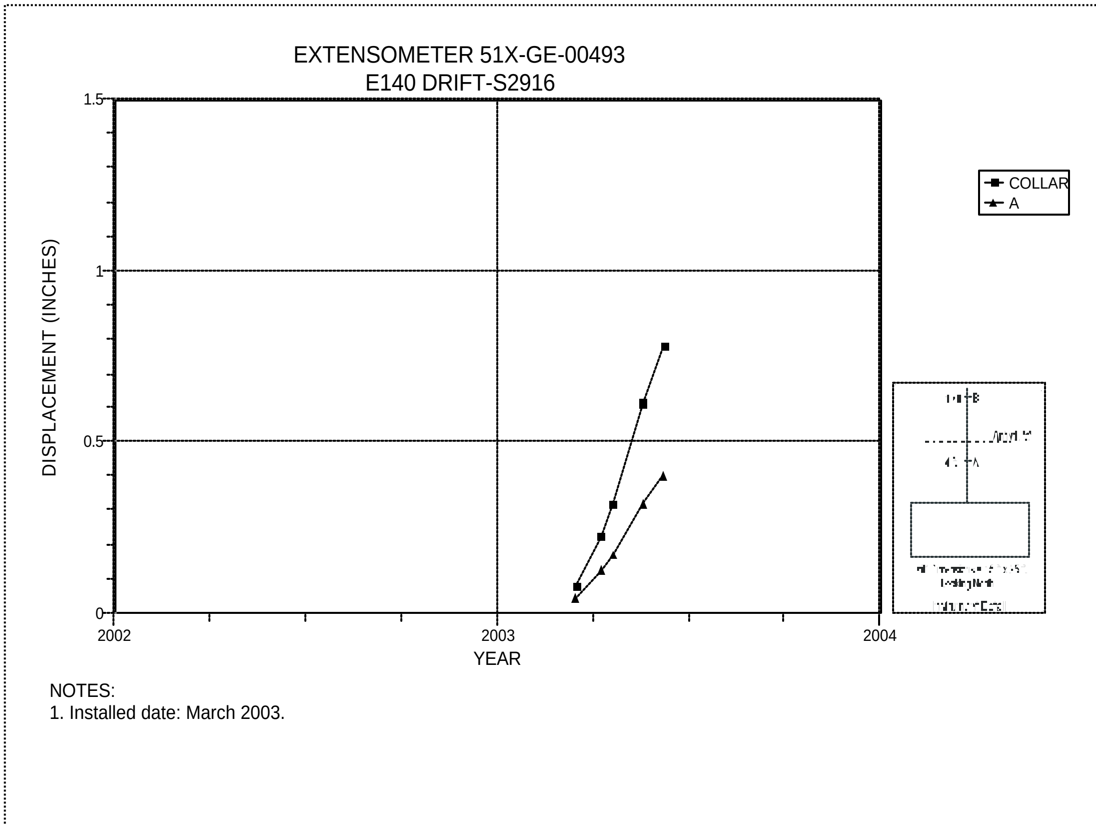


Figure 4-35 Extensometer 51X-GE-00493
E140 Drift at S2916 – Roof

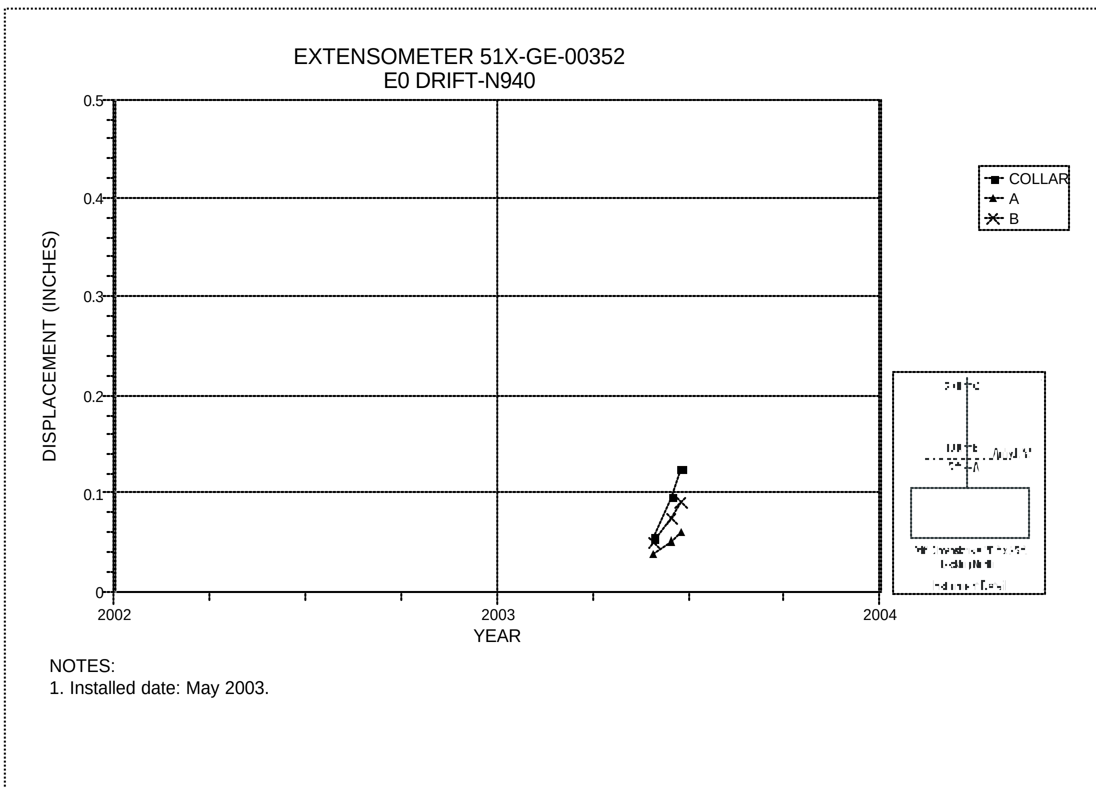


Figure 4-36 Extensometer 51X-GE-00352
E0 Drift at N940 – Roof

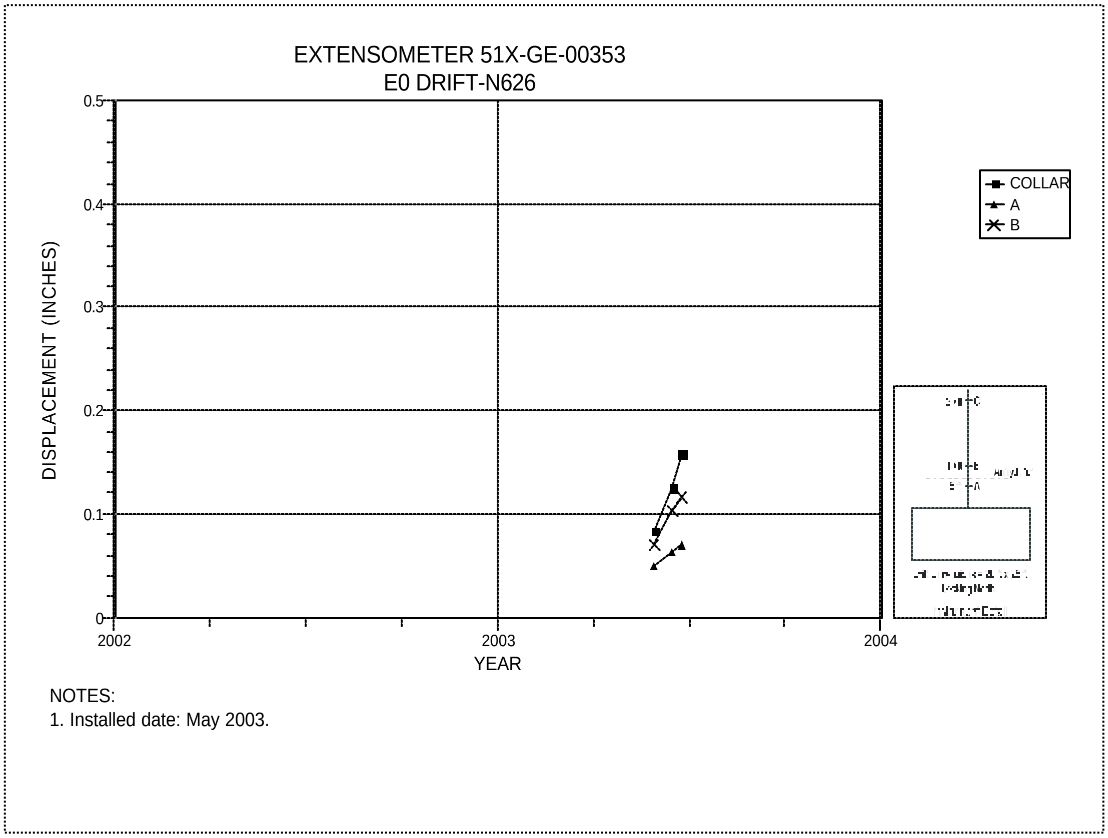


Figure 4-37 Extensometer 51X-GE-00353
E0 Drift at N626 – Roof

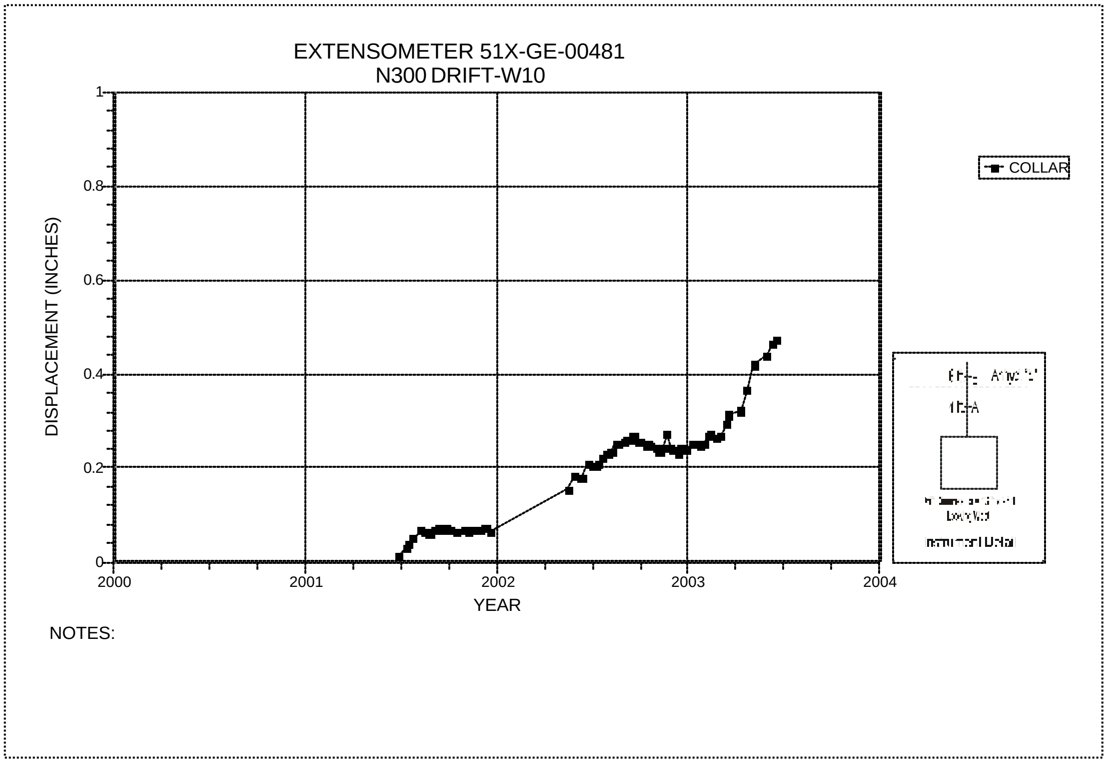
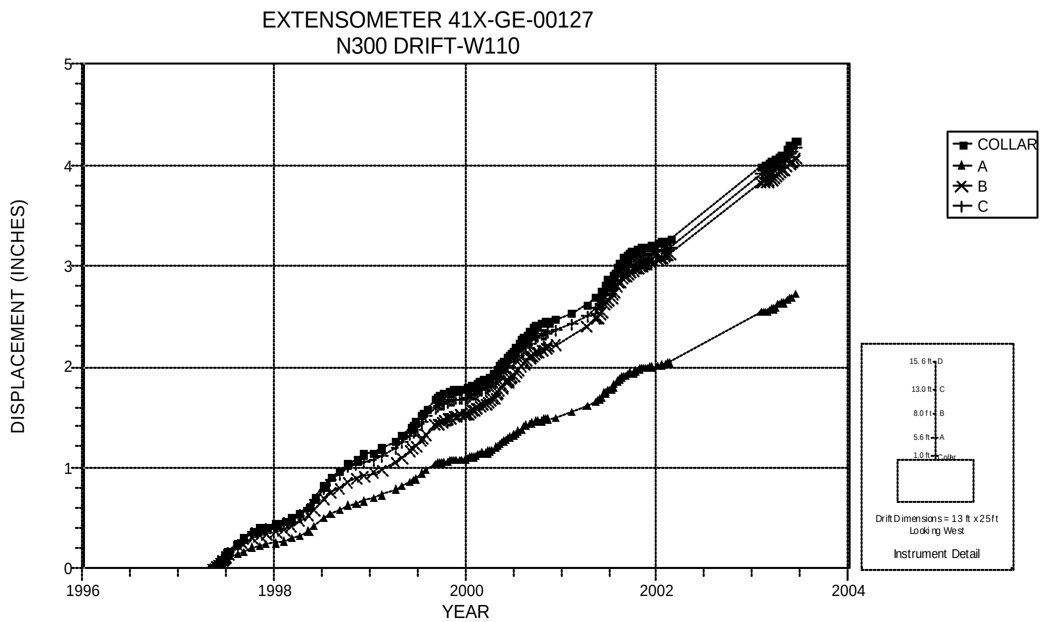
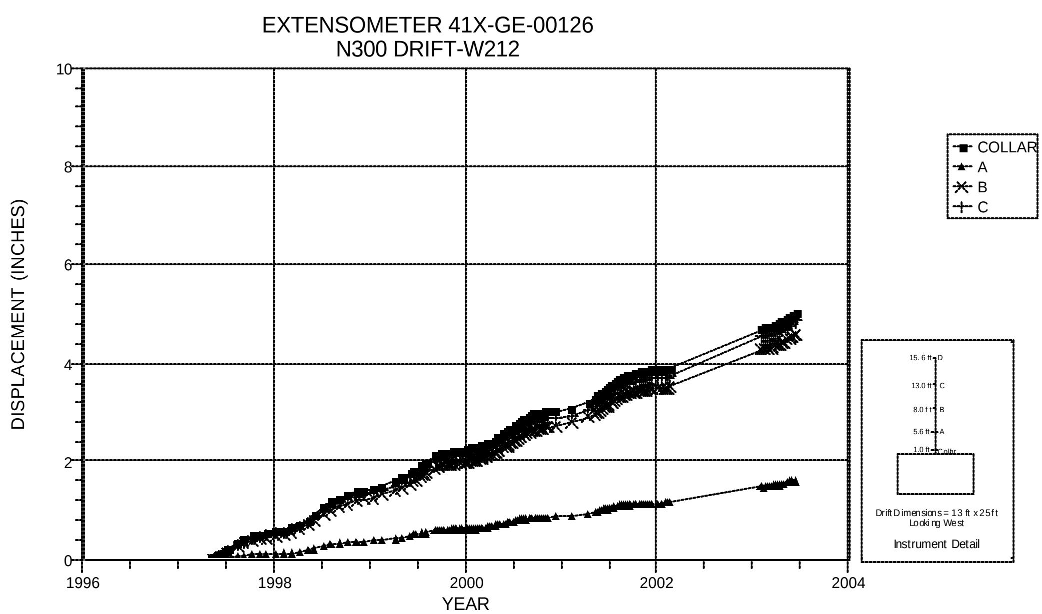


Figure 4-38 Extensometer 51X-GE-00481
N300 Drift at W10 – Roof



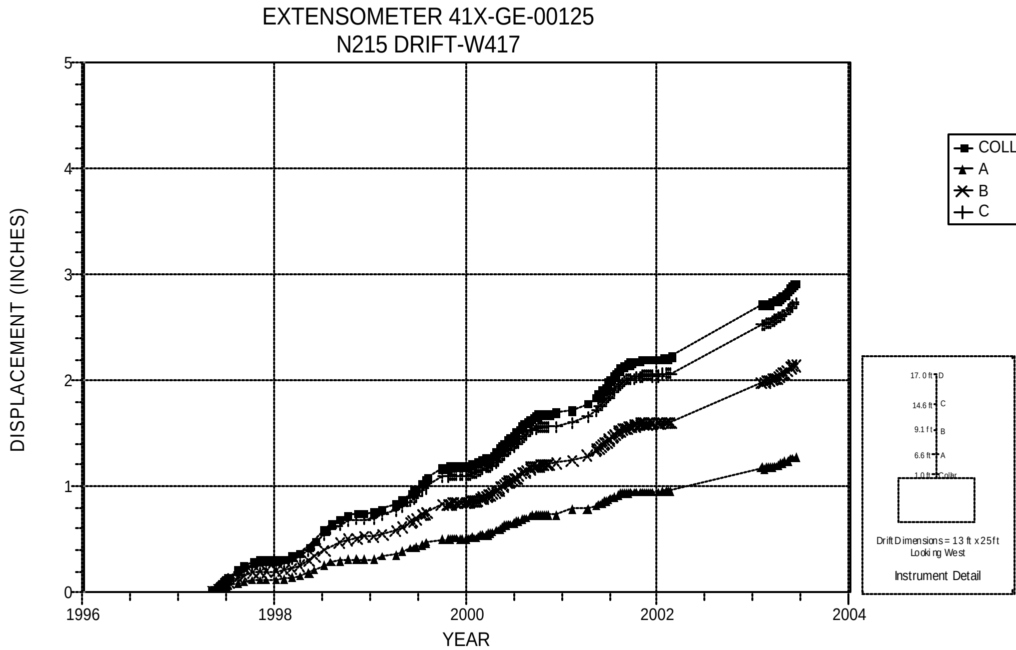
NOTES:
1. Excavation date: December 1987.

Figure 4-39 Extensometer 41X-GE-00127
N300 Drift at W110 – Roof



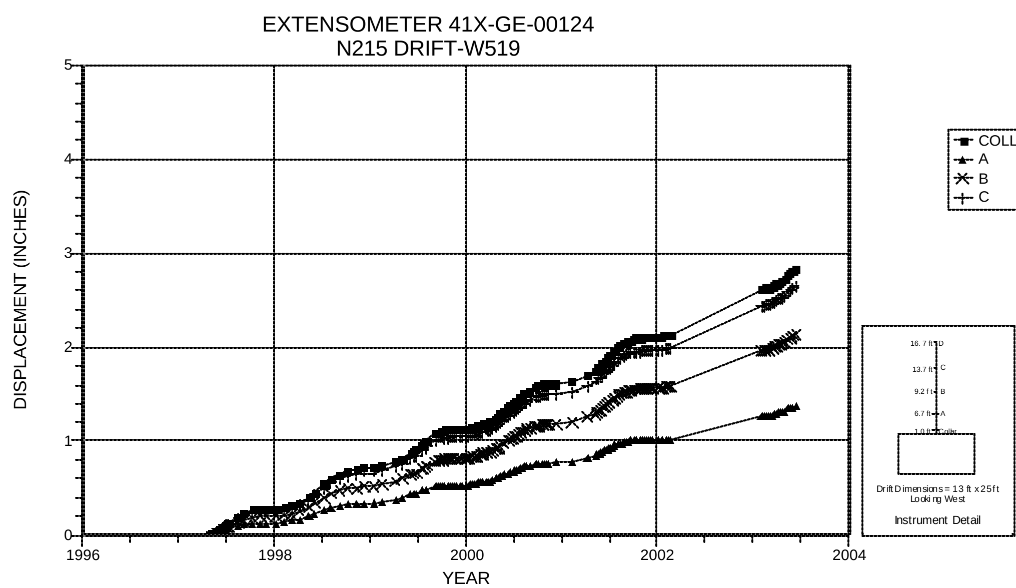
NOTES:
1. Excavation date: December 1987.

Figure 4-40 Extensometer 41X-GE-00126
N300 Drift at W212 – Roof



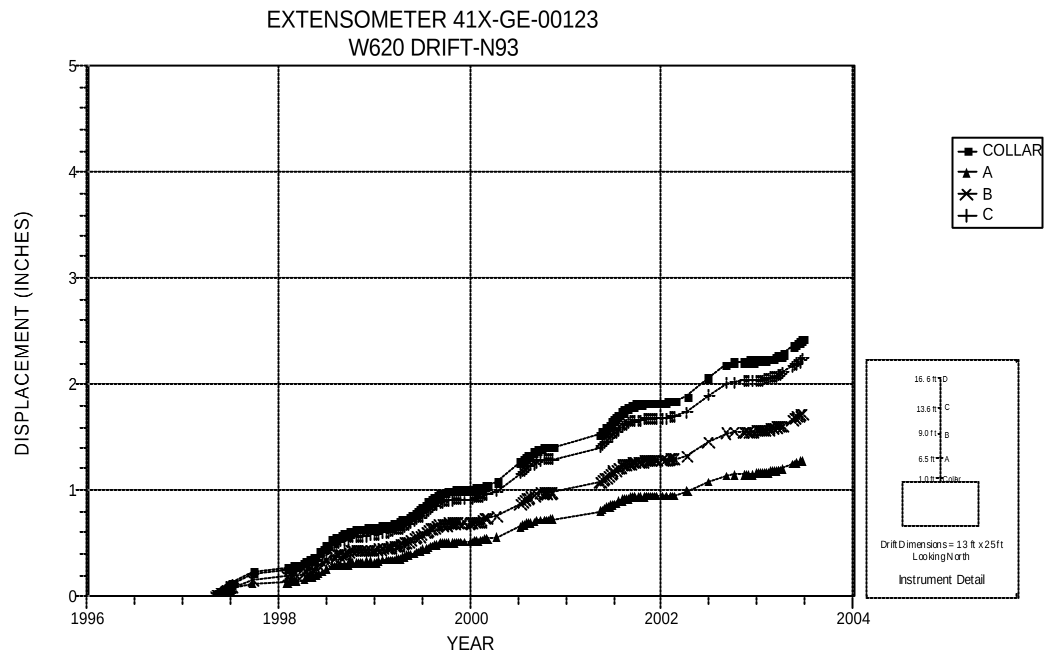
NOTES:
1. Excavation date: December 1987.

Figure 4-41 Extensometer 41X-GE-00125
N215 Drift at W417 – Roof



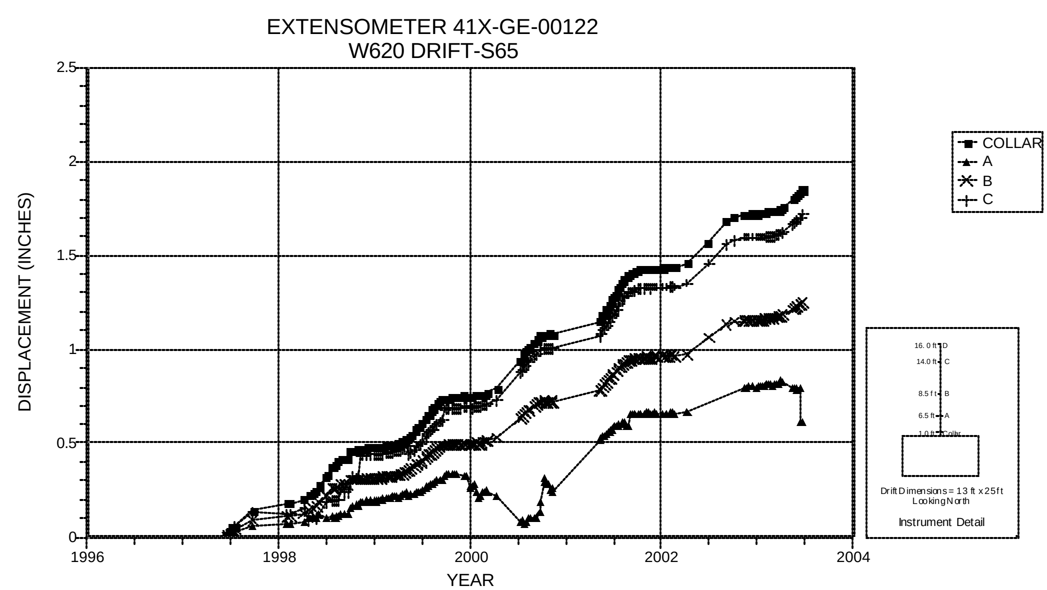
NOTES:
1. Excavation date: January 1988.

Figure 4-42 Extensometer 41X-GE-00124
N215 Drift at W519 – Roof



NOTES:
1. Excavation date: January 1988.

Figure 4-43 Extensometer 41X-GE-00123
W620 Drift at N93 – Roof



NOTES:
1. Excavation date: January 1988.
2. Anchor "A" noisy.

Figure 4-44 Extensometer 41X-GE-00122
W620 Drift at S65 – Roof

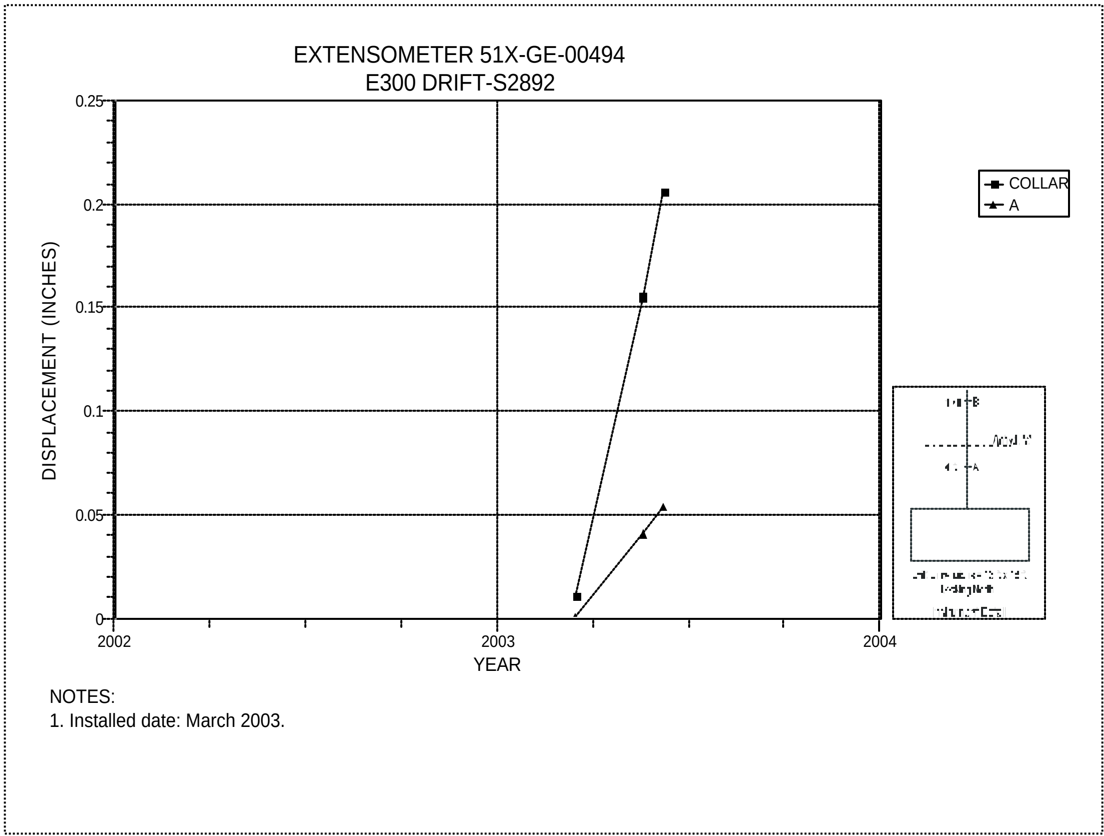


Figure 4-45 Extensometer 51X-GE-00494
E300 Drift at S2892 – Roof

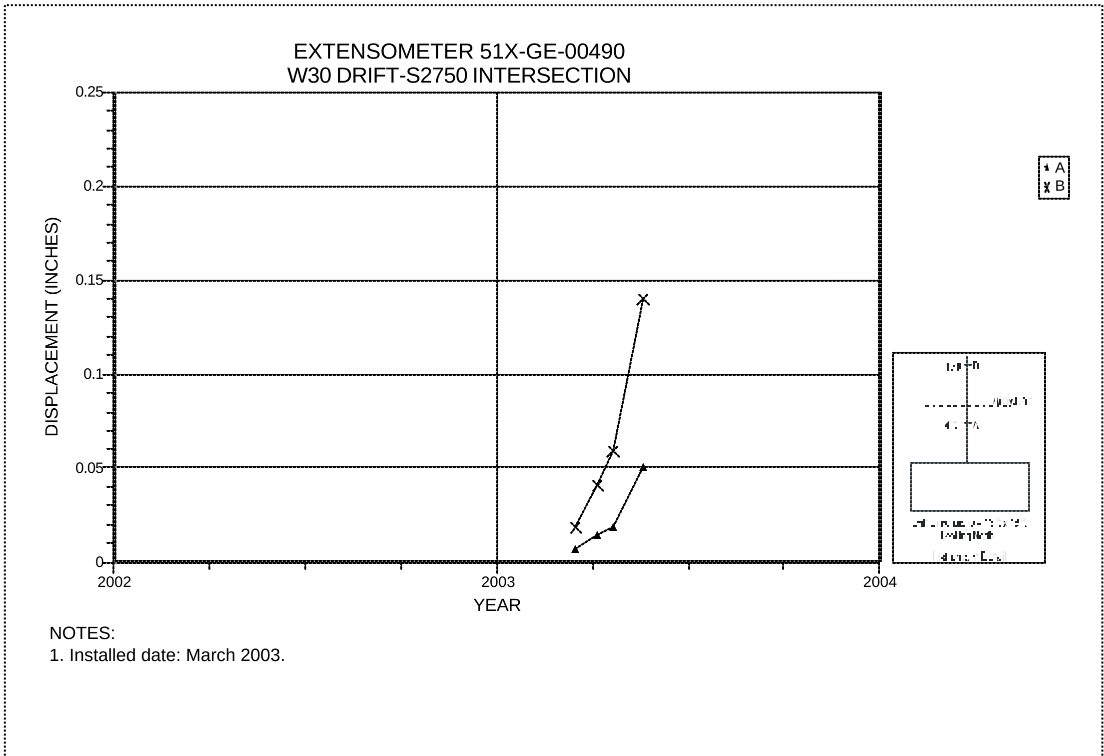


Figure 4-46 Extensometer 51X-GE-00490
W30 Drift at S2750 Drift Intersection – Roof

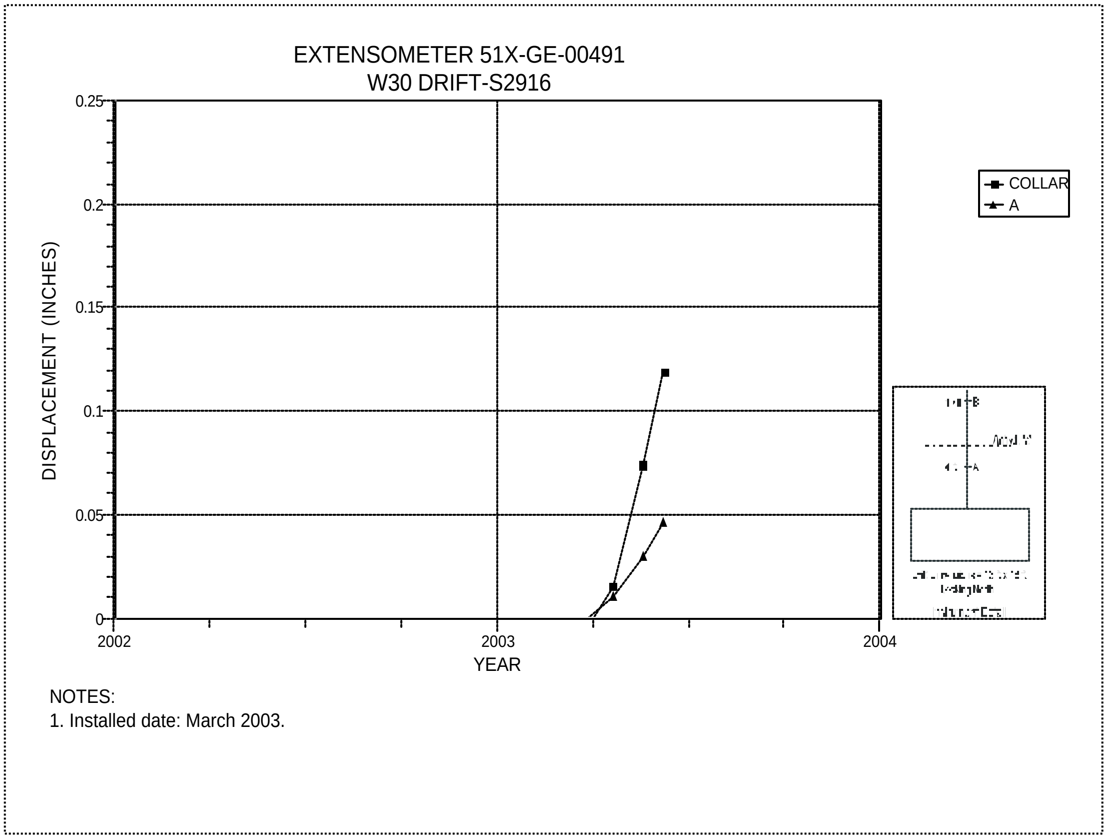


Figure 4-47 Extensometer 51X-GE-00491
W30 Drift at S2916 – Roof

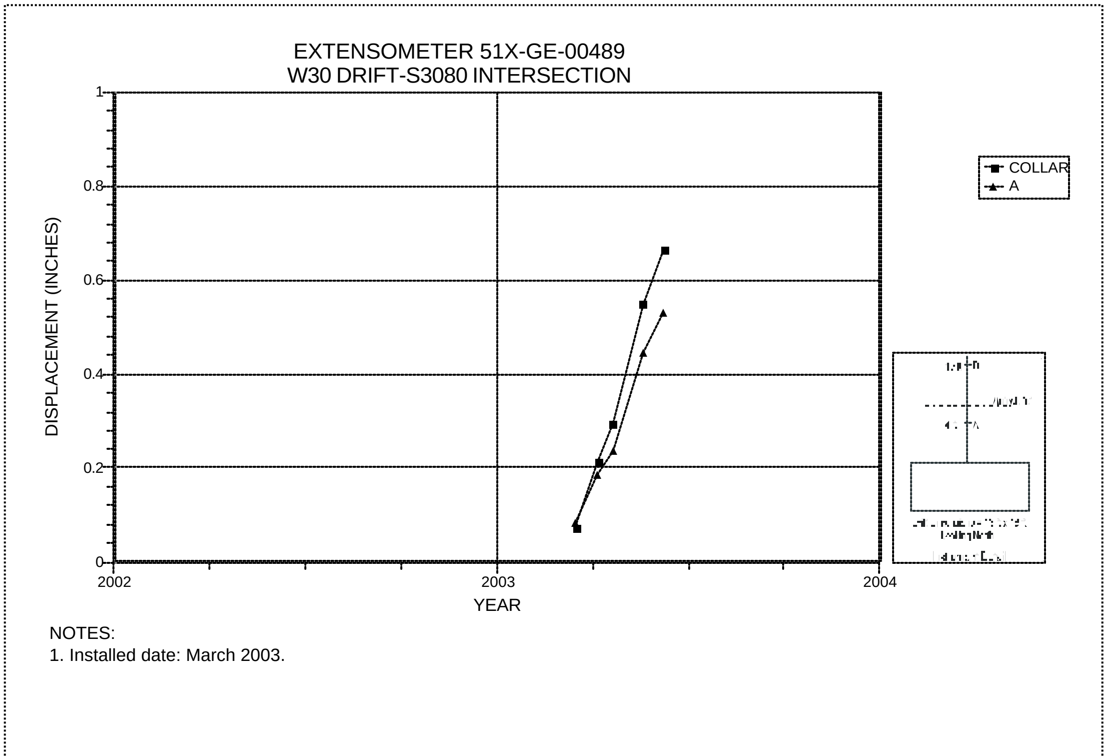


Figure 4-48 Extensometer 51X-GE-00489
W30 Drift at S3080 Drift Intersection – Roof

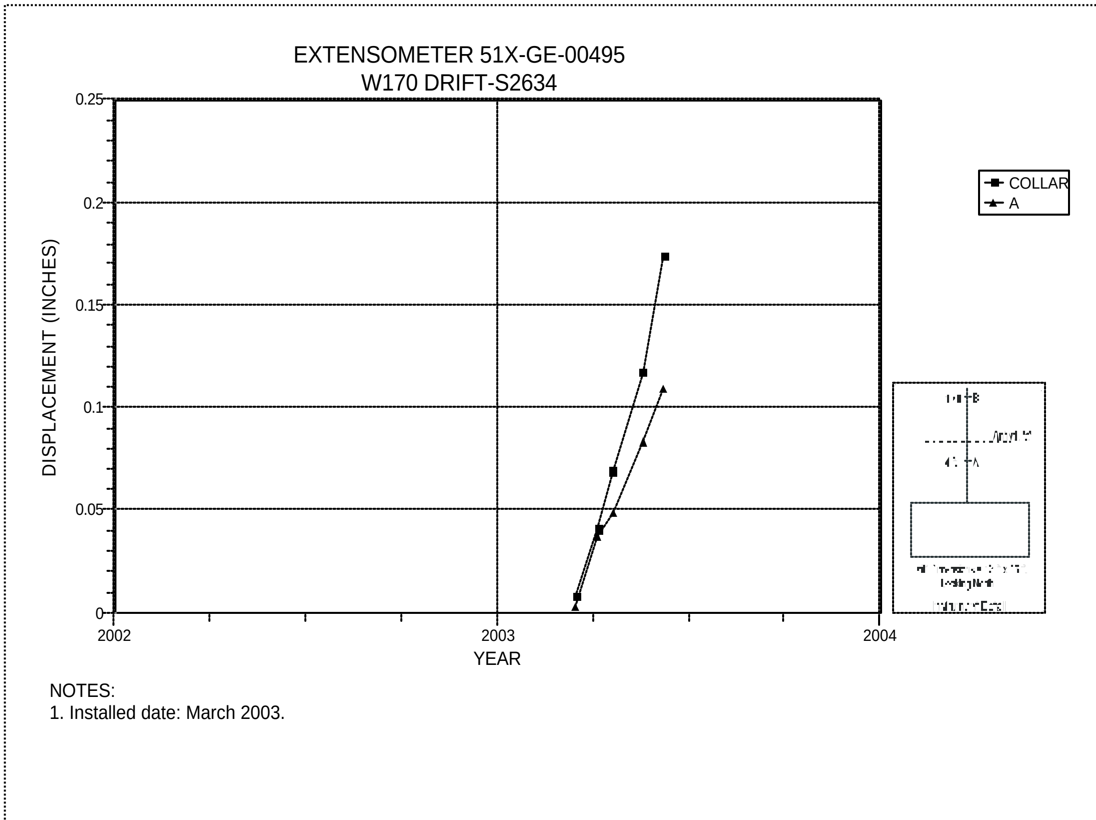


Figure 4-49 Extensometer 51X-GE-00495
W170 Drift at S2634 – Roof

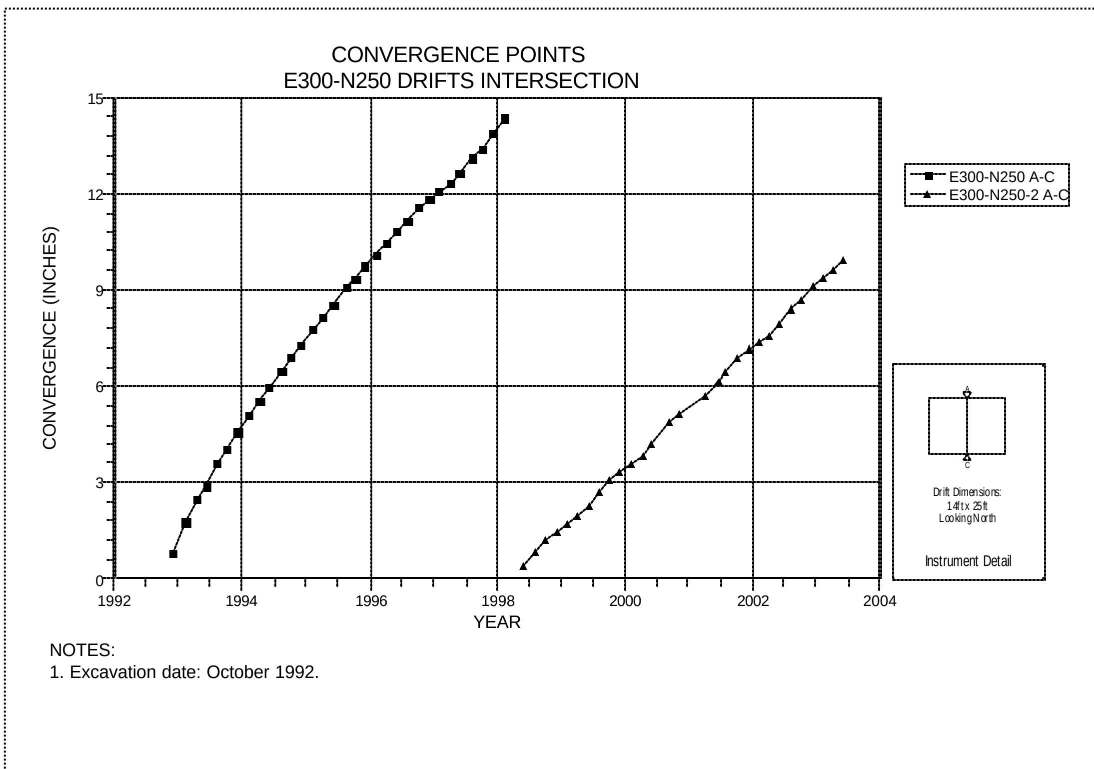
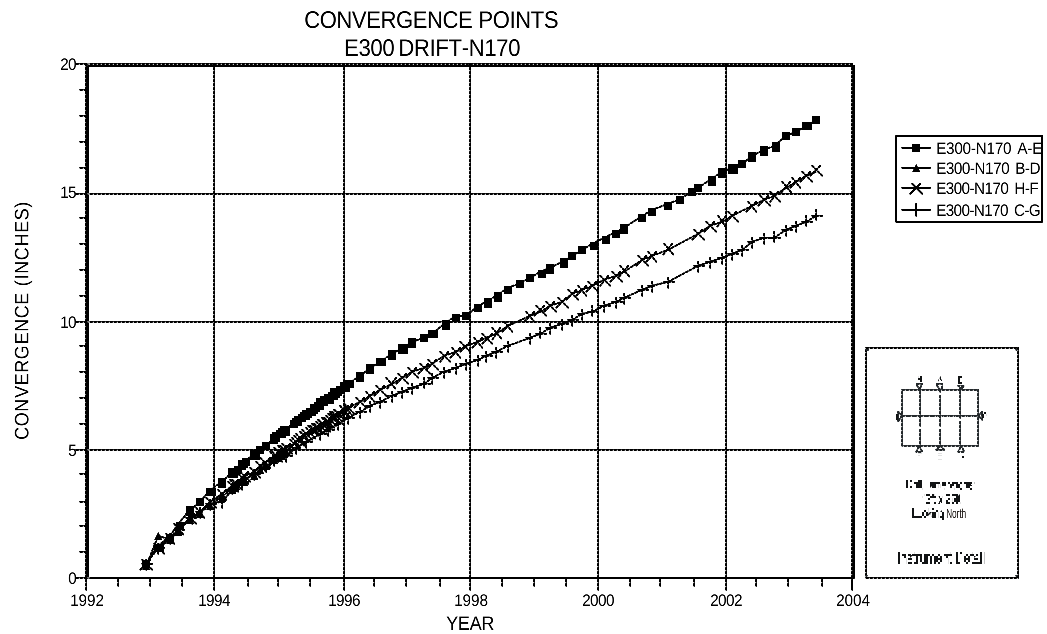
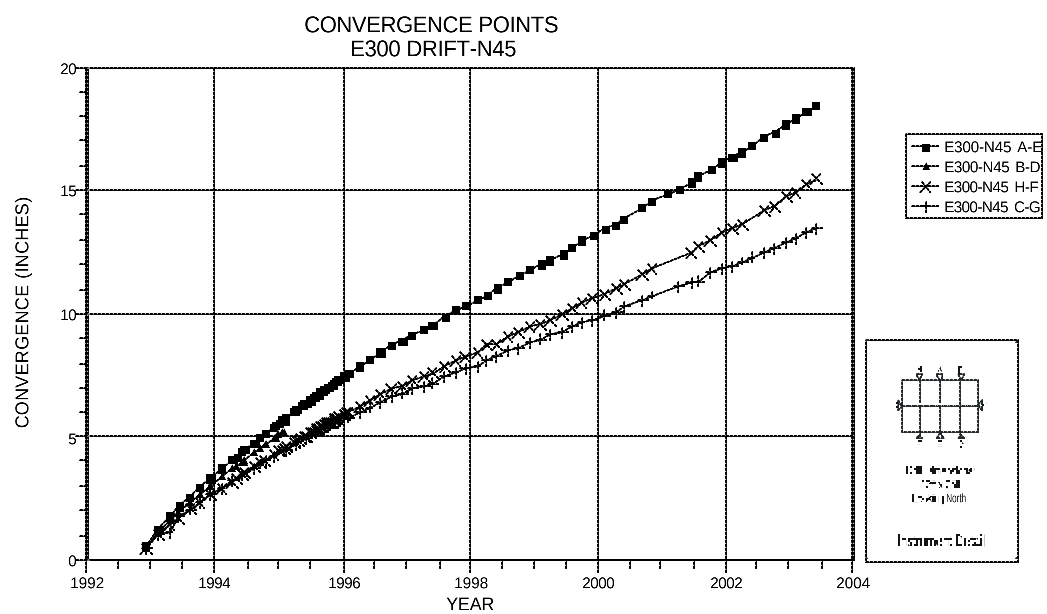


Figure 4-50 Convergence Point Array
E300 Shop – E300 Drift at N250 – Roof to Floor



NOTES:
1. Excavation date: October 1992.

Figure 4-51 Convergence Point Array
E300 Shop – E300 Drift at N170 – All Chords



NOTES:
1. Excavation date: October 1992.

Figure 4-52 Convergence Point Array
E300 Shop – E300 Drift at N45 – All Chords

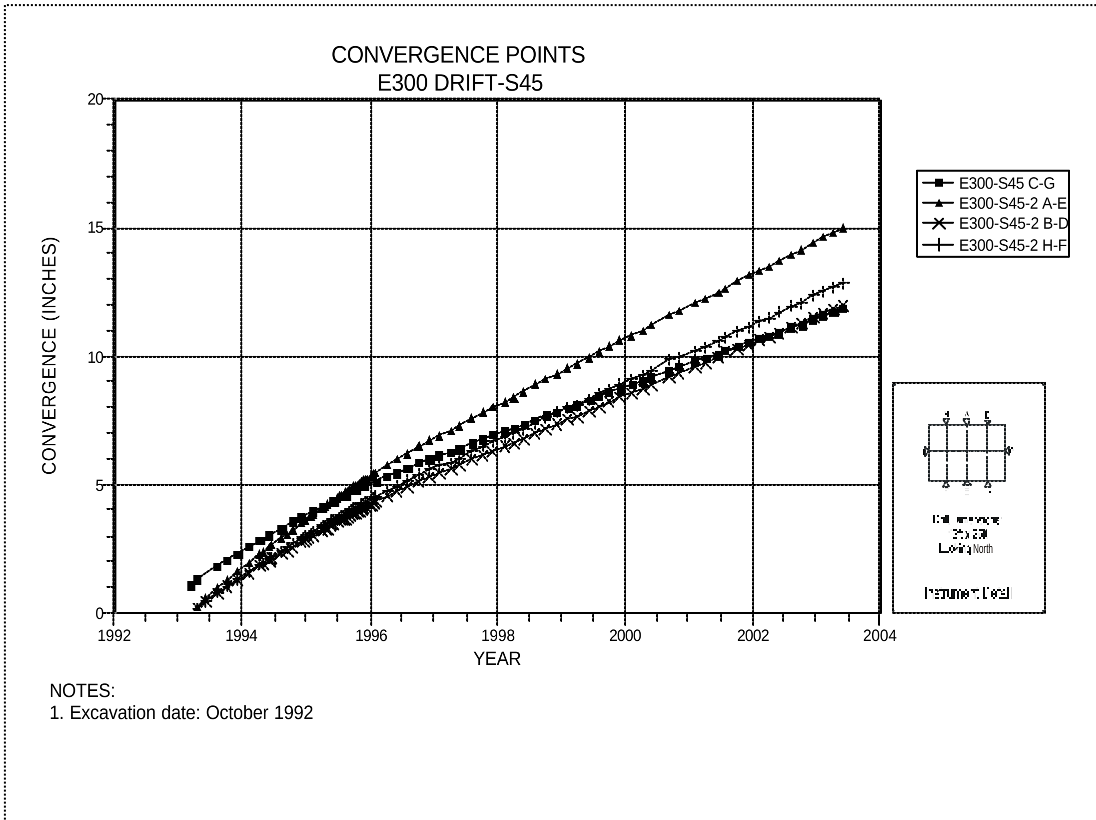


Figure 4-53 Convergence Point Array
E300 Shop – E300 Drift at S45 – All Chords

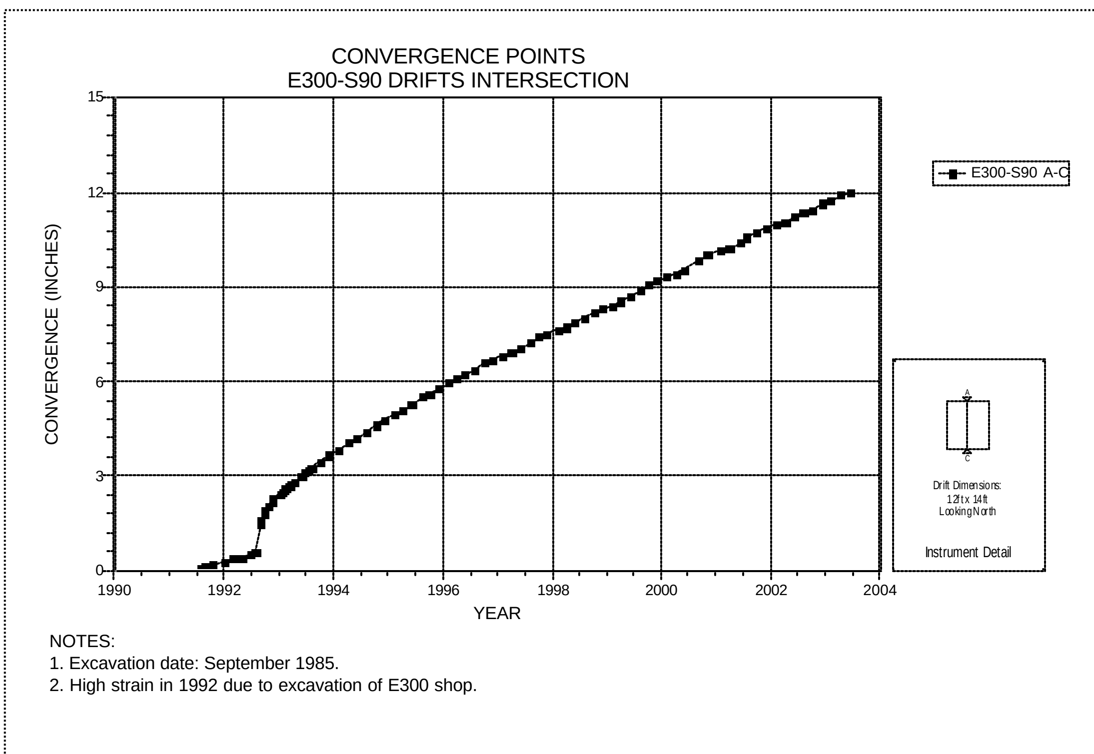


Figure 4-54 Convergence Point Array
E300 Drift at S90 Drift Intersection – Roof to Floor

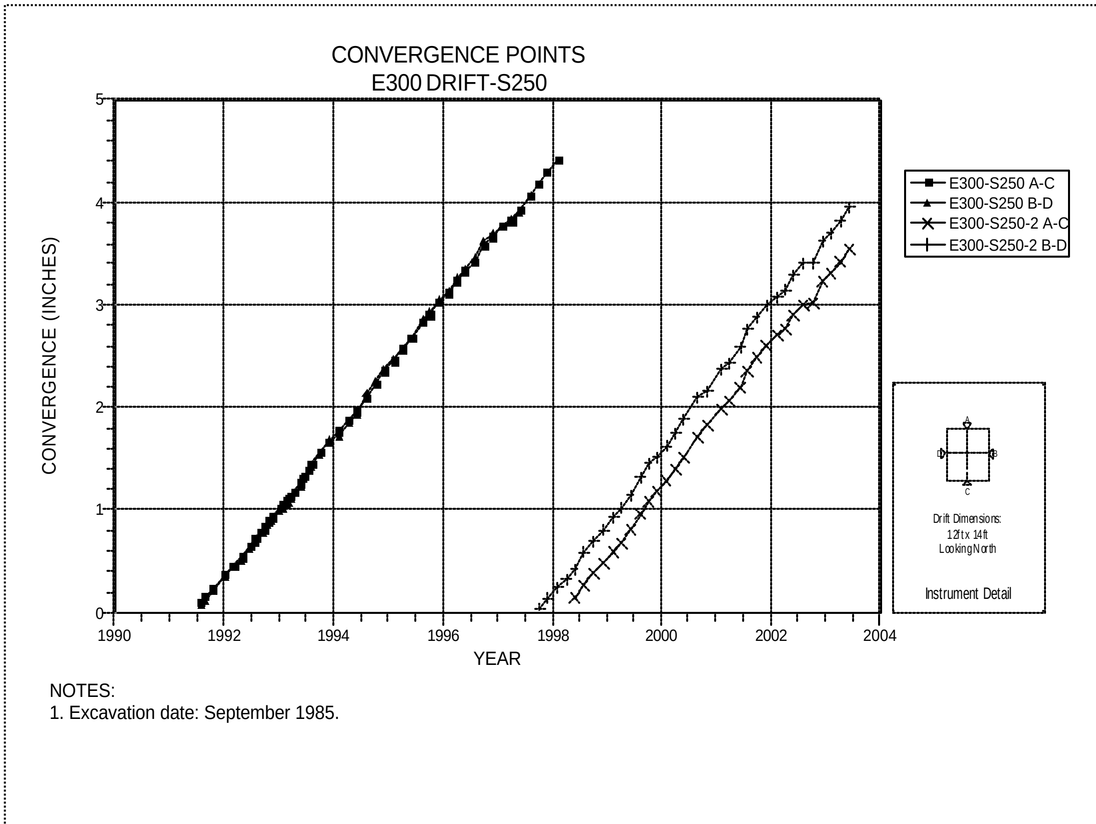


Figure 4-55 Convergence Point Array
E300 Drift at S250 – All Chords

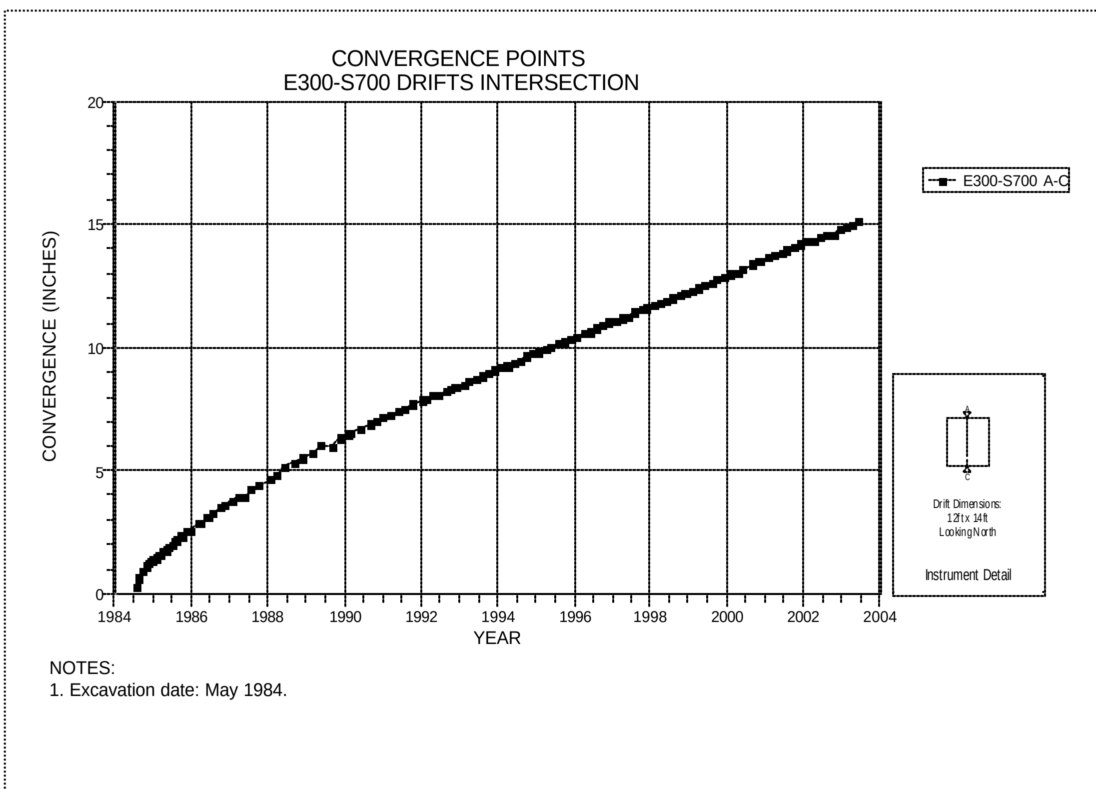


Figure 4-56 Convergence Point Array
E300 Drift at S700 Drift Intersection – Roof to Floor

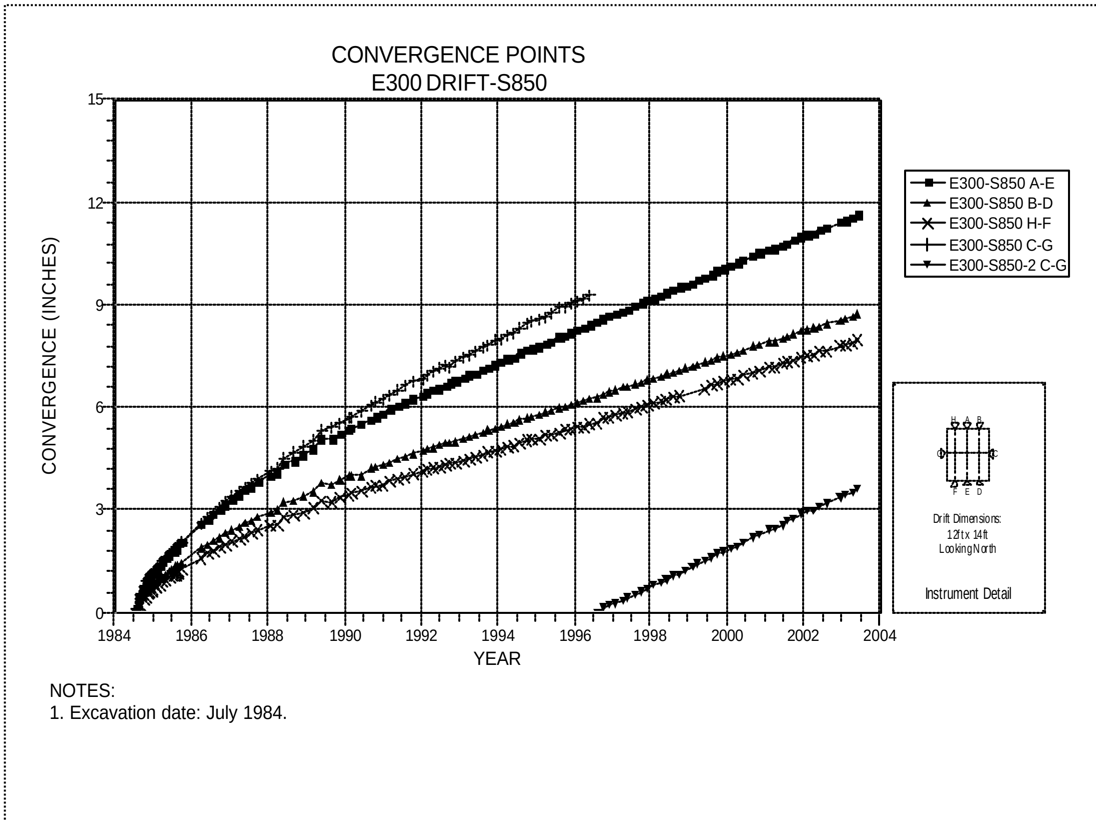


Figure 4-57 Convergence Point Array
E300 Drift at S850 – All Chords

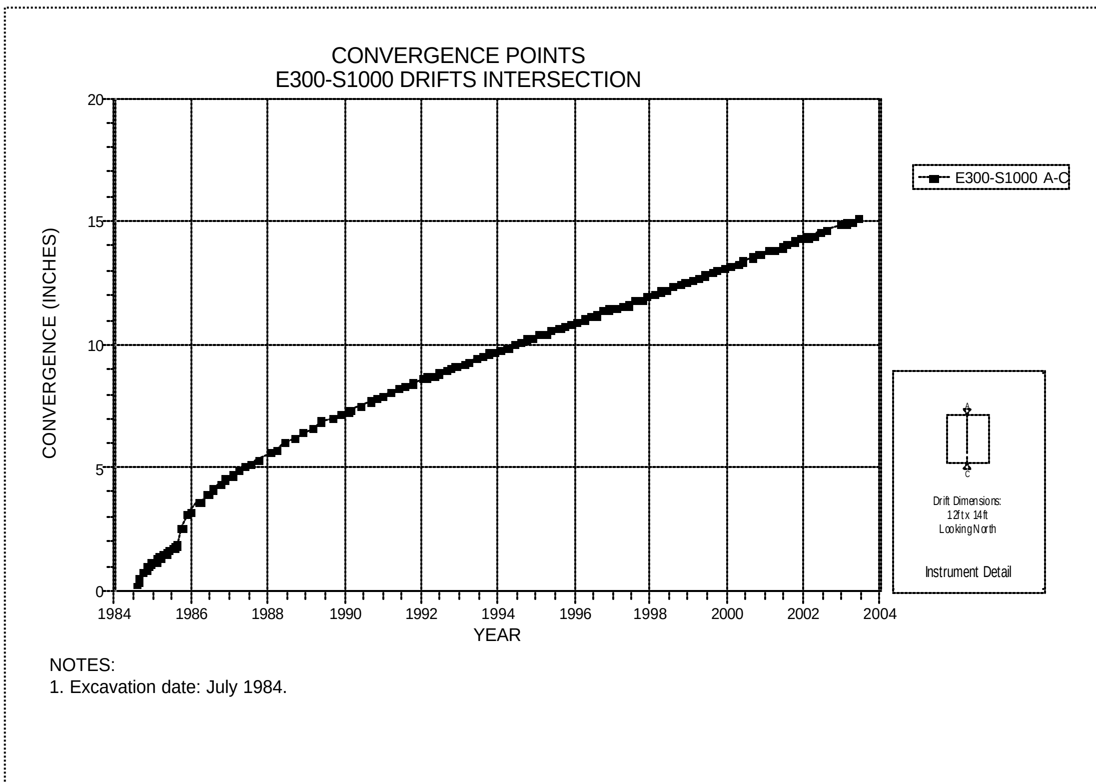


Figure 4-58 Convergence Point Array
E300 Drift at S1000 Drift Intersection – Roof to Floor

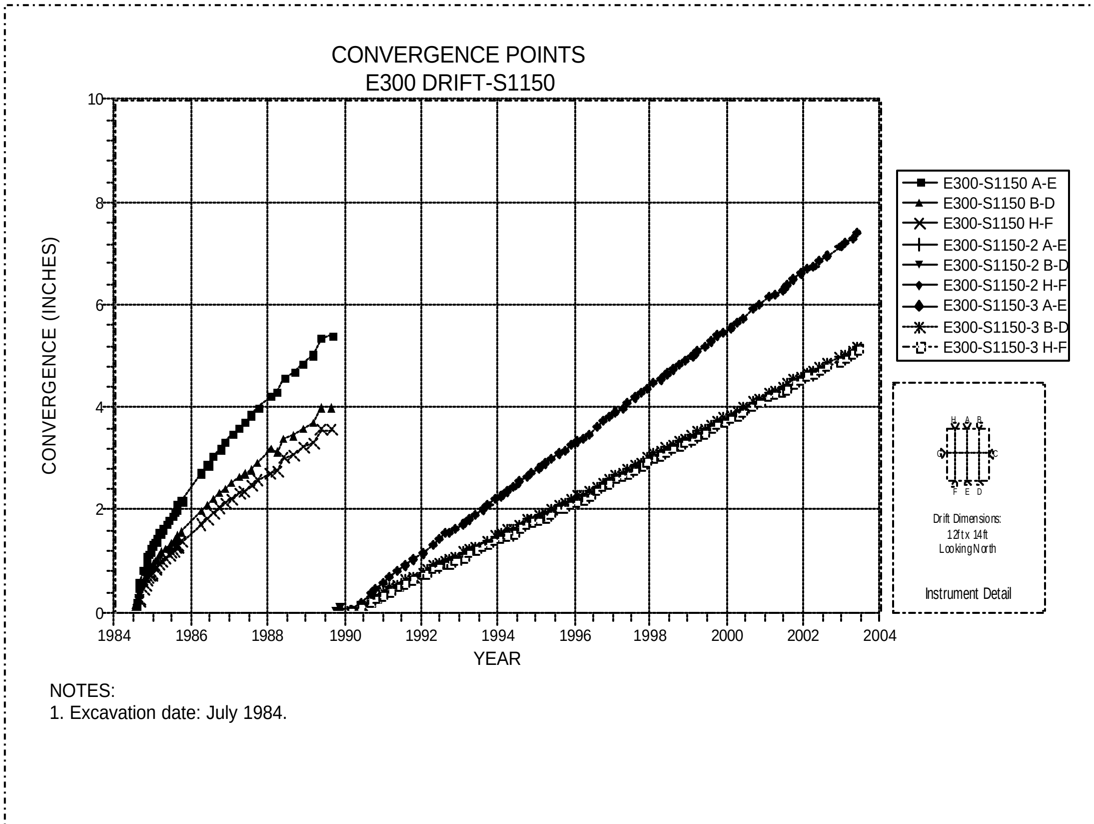


Figure 4-59 Convergence Point Array
E300 Drift at S1150 – Roof to Floor

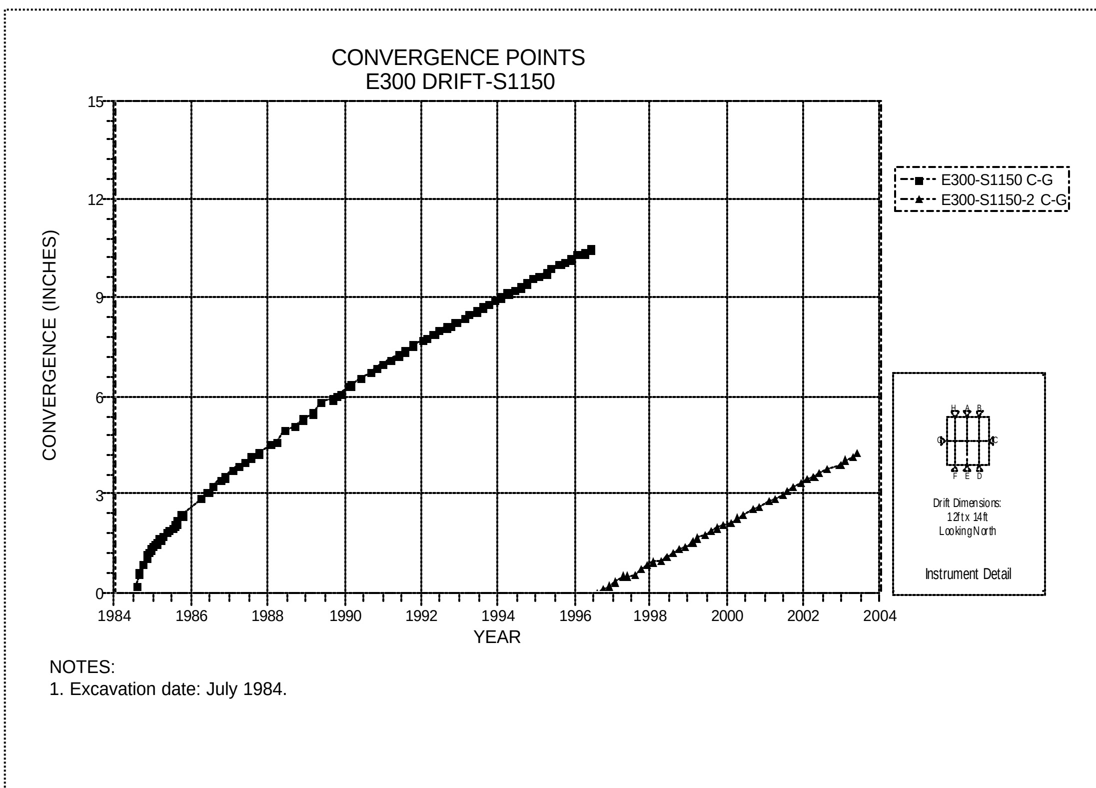
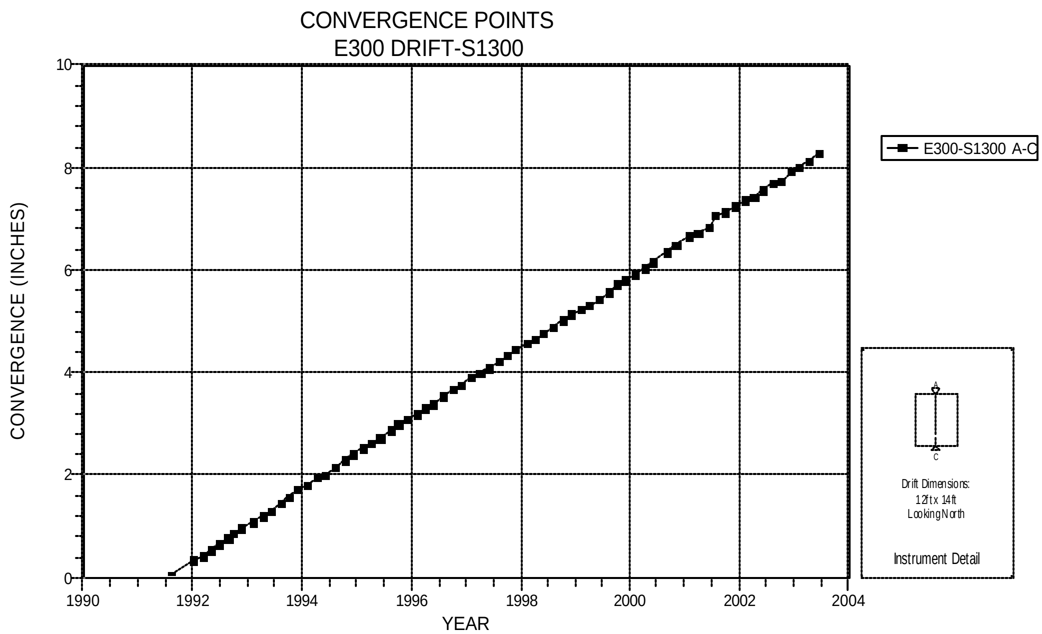
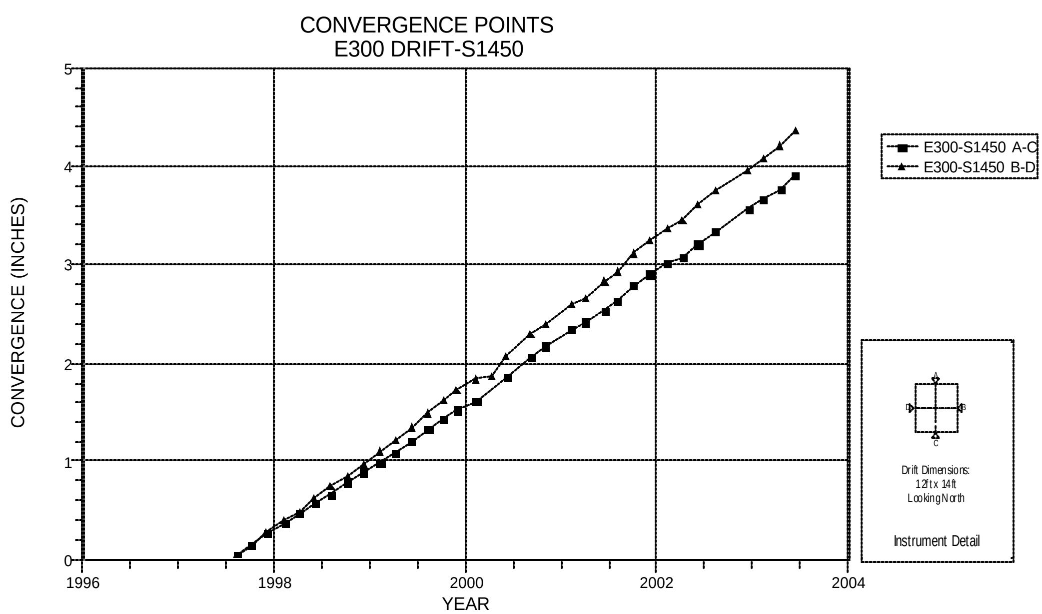


Figure 4-60 Convergence Point Array
E300 Drift at S1150 – Rib to Rib



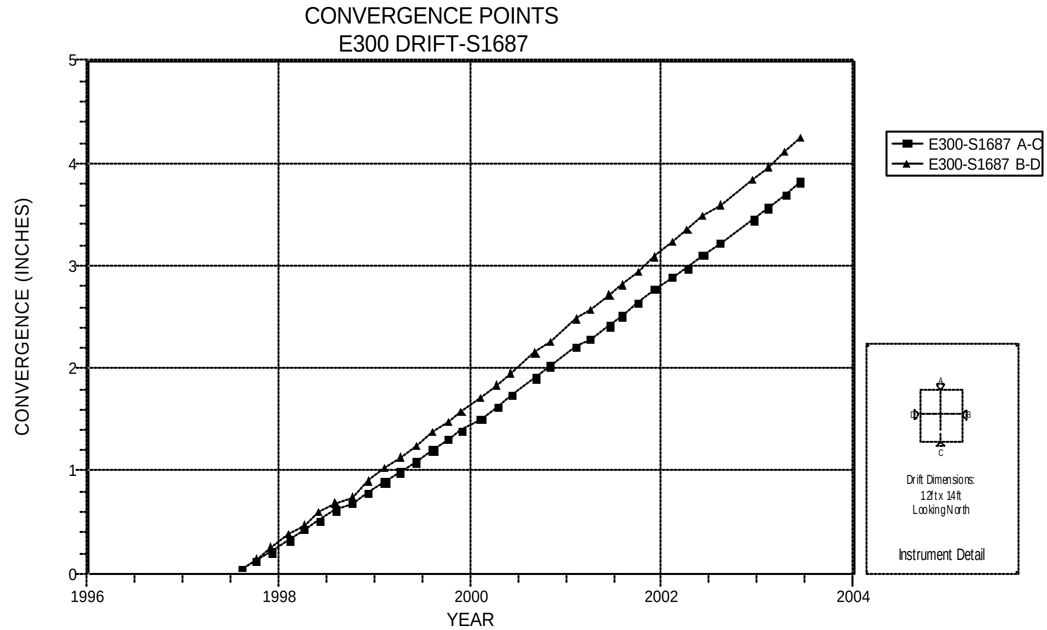
NOTES:
1. Excavation date: July 1984.

Figure 4-61 Convergence Point Array
E300 Drift at S1300 Drift Intersection – Roof to Floor



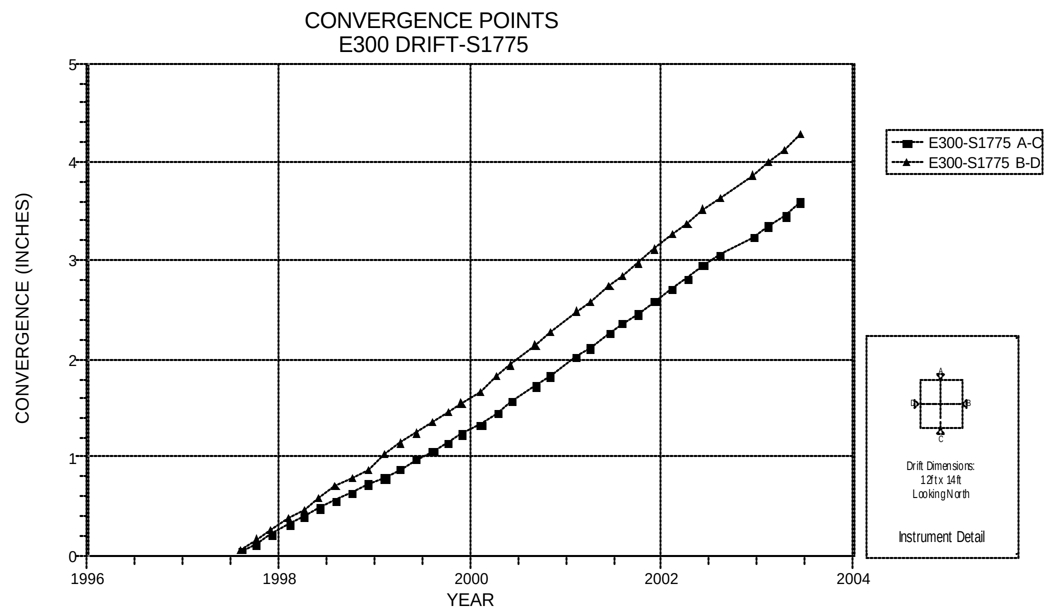
NOTES:
1. Excavation date: October 1985.

Figure 4-62 Convergence Point Array
E300 Drift at S1450 – All Chords



NOTES:
1. Excavation date: October 1985.

Figure 4-63 Convergence Point Array
E300 Drift at S1687 – All Chords



NOTES:
1. Excavation date: October 1985.

Figure 4-64 Convergence Point Array
E300 Drift at S1775 – All Chords

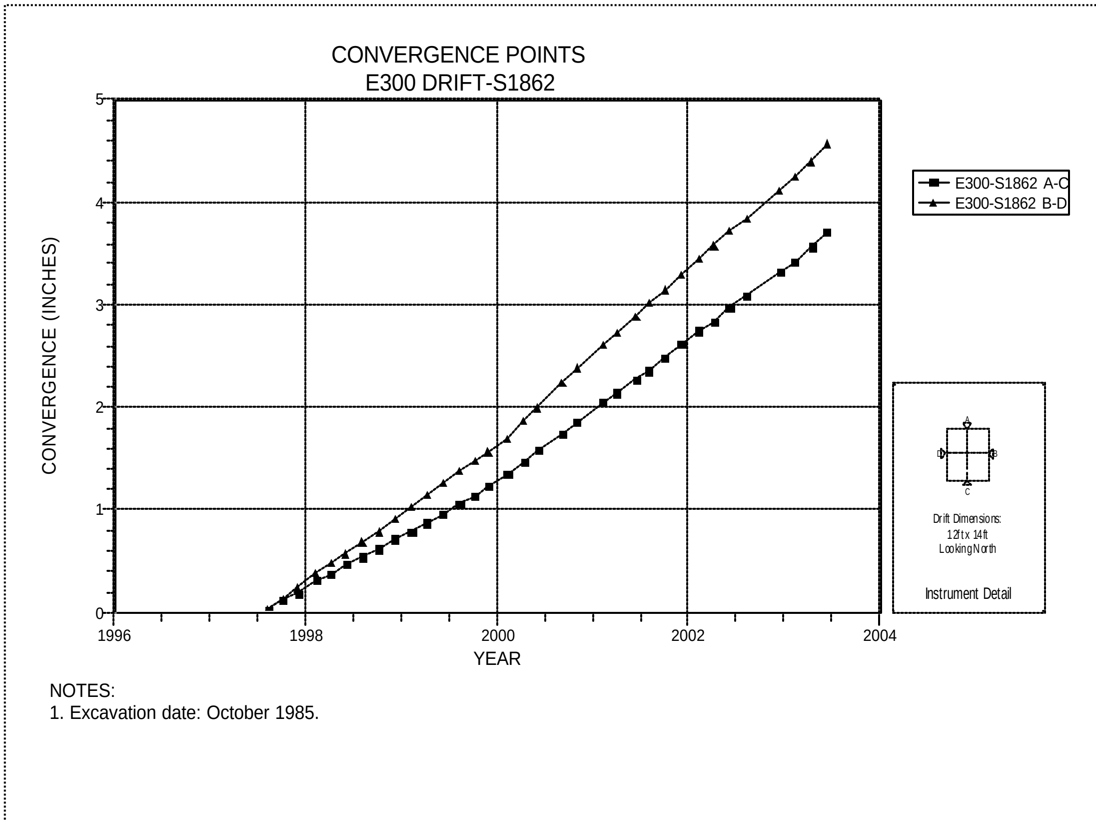


Figure 4-65 Convergence Point Array
E300 Drift at S1862 – All Chords

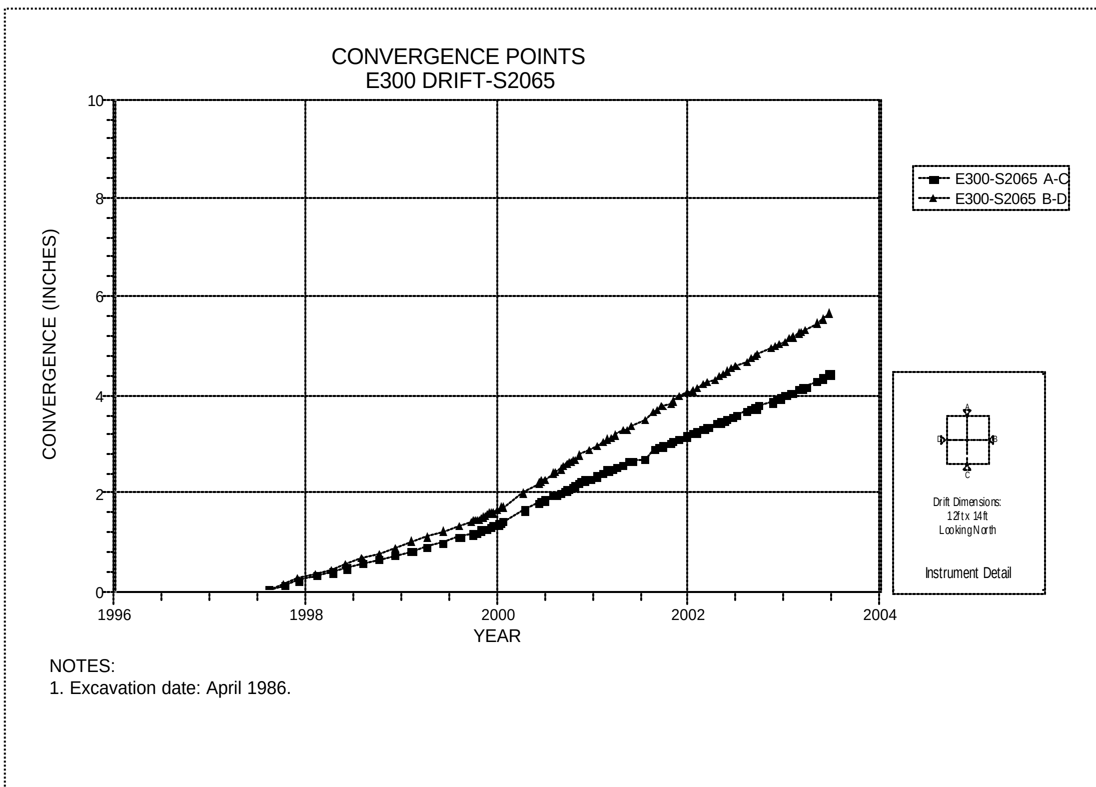
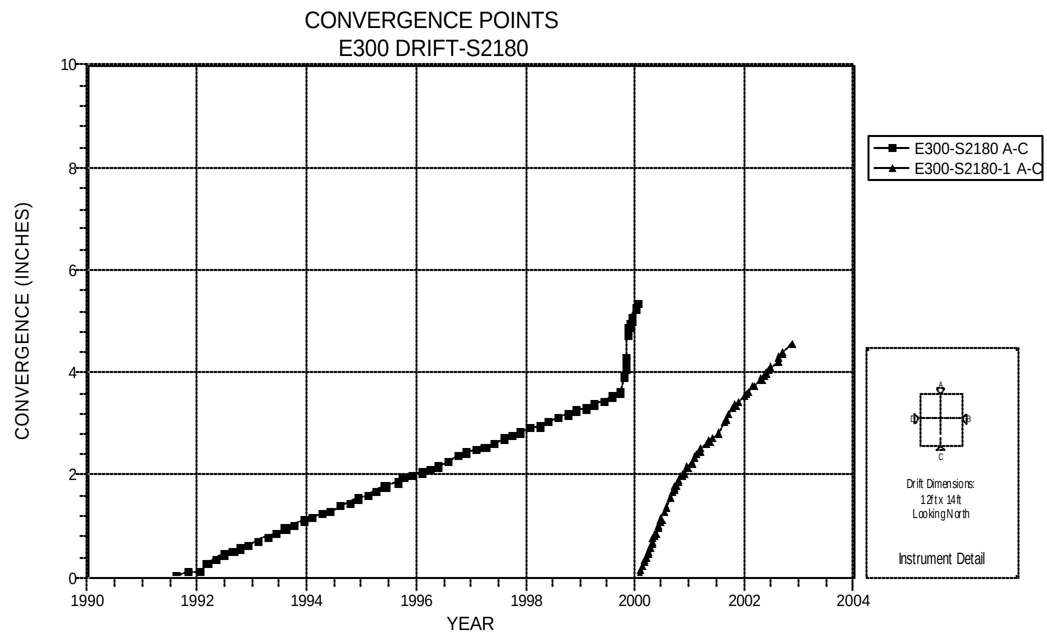
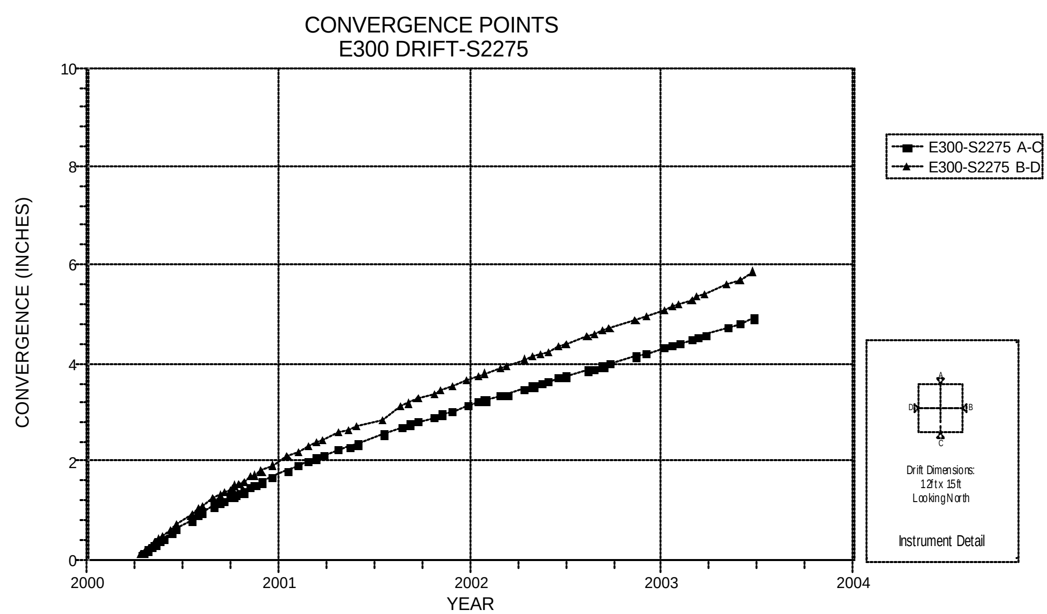


Figure 4-66 Convergence Point Array
E300 Drift at S2065 – All Chords



NOTES:
1. Excavation date: April 1986.

Figure 4-67 Convergence Point Array
E300 Drift at S2180 Drift Intersection – Roof to Floor



NOTES:
1. Excavation date: November 1999.

Figure 4-68 Convergence Point Array
E300 Drift at S2275 – All Chords

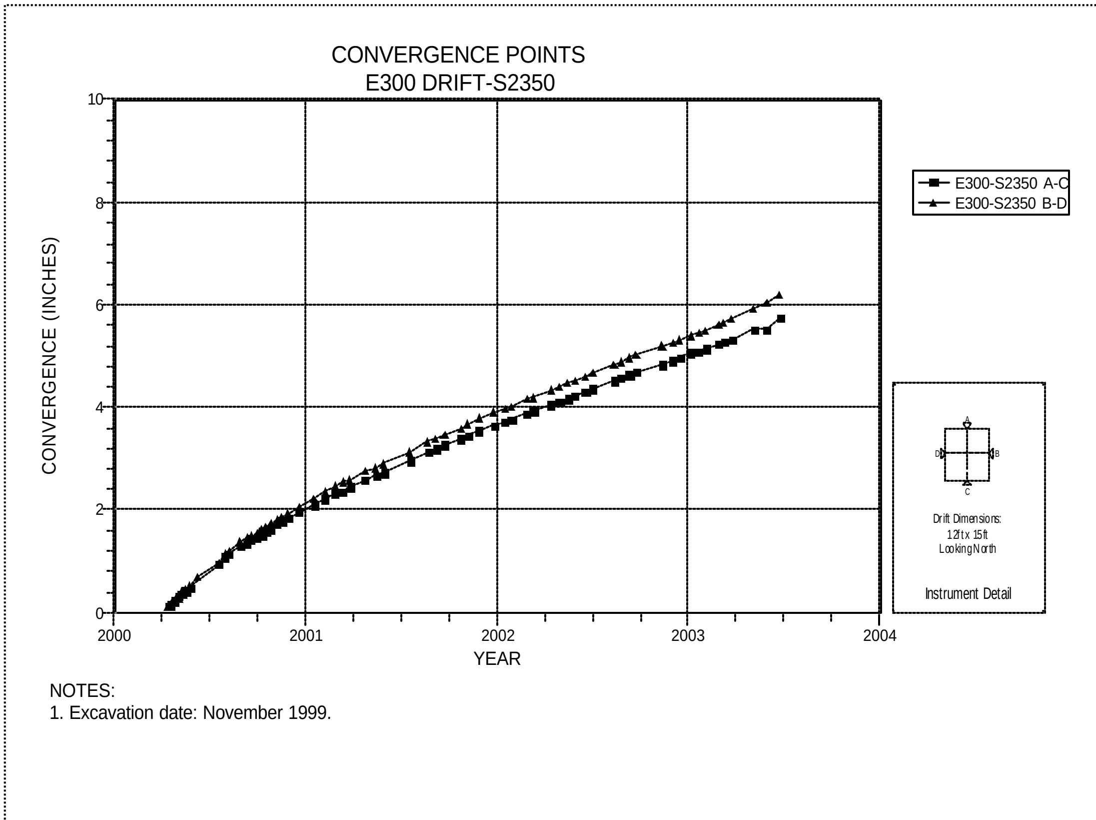


Figure 4-69 Convergence Point Array
E300 Drift at S2350 – All Chords

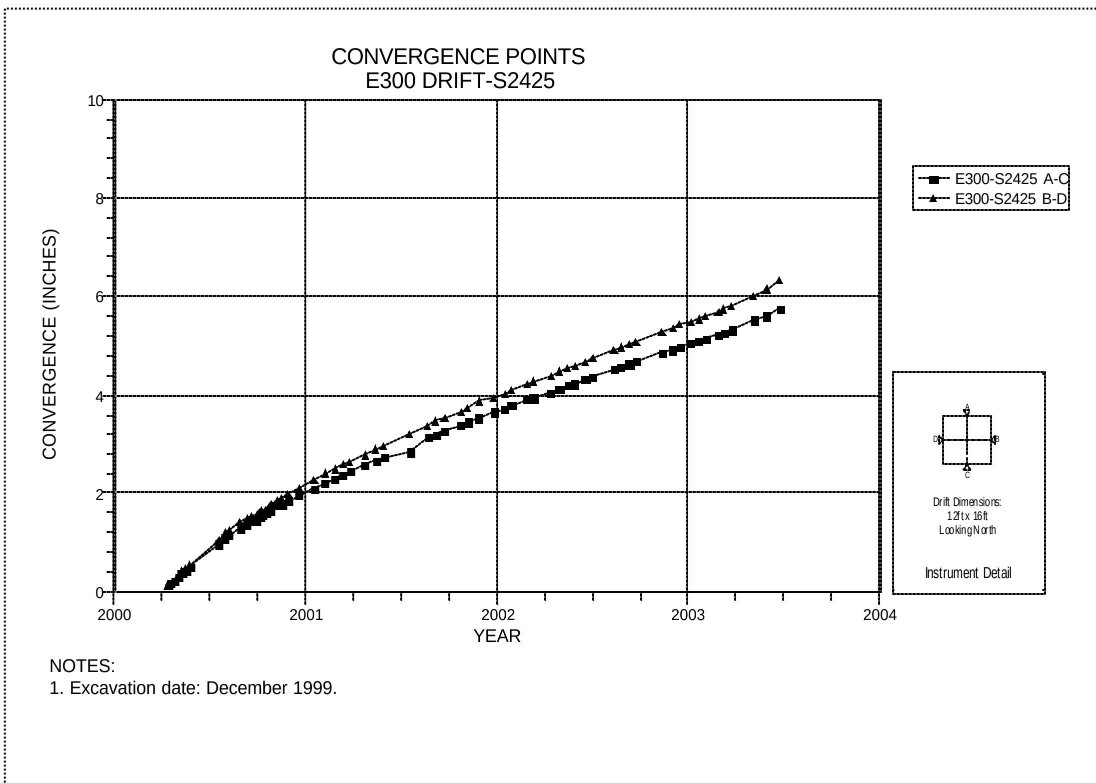
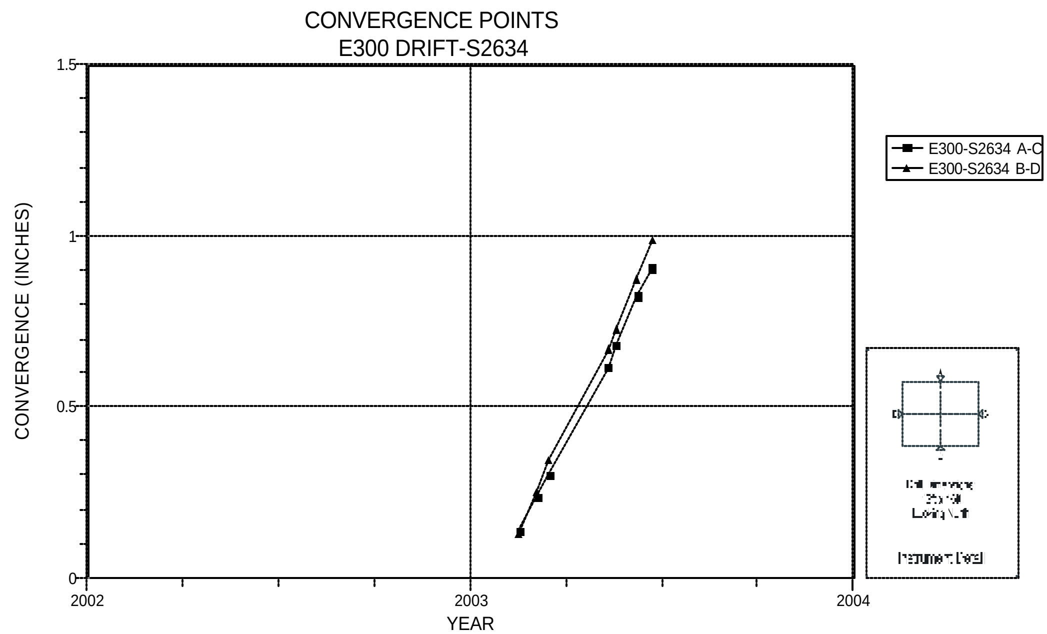
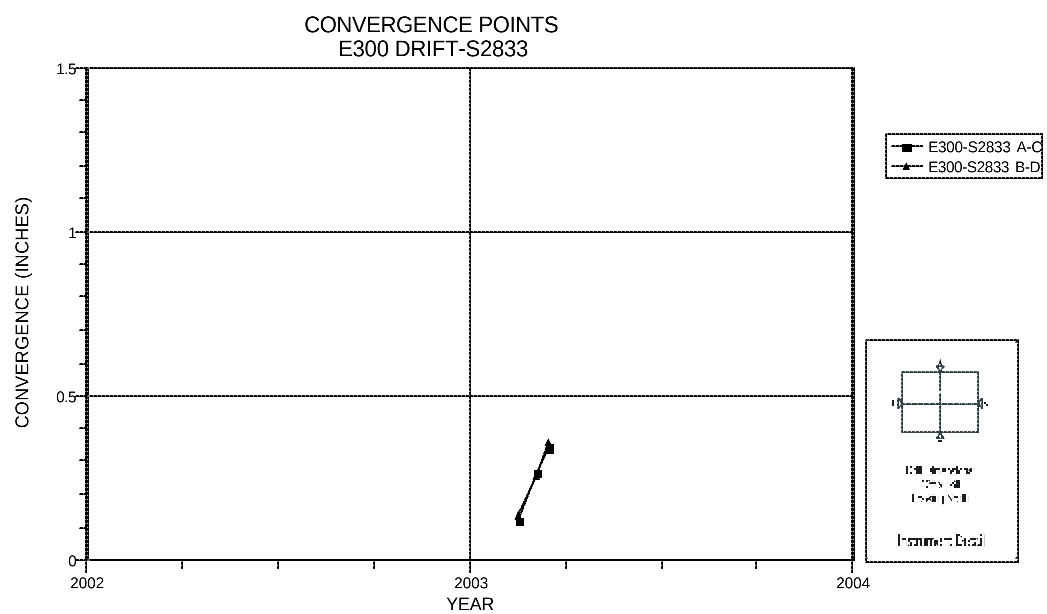


Figure 4-70 Convergence Point Array
E300 Drift at S2425 – All Chords



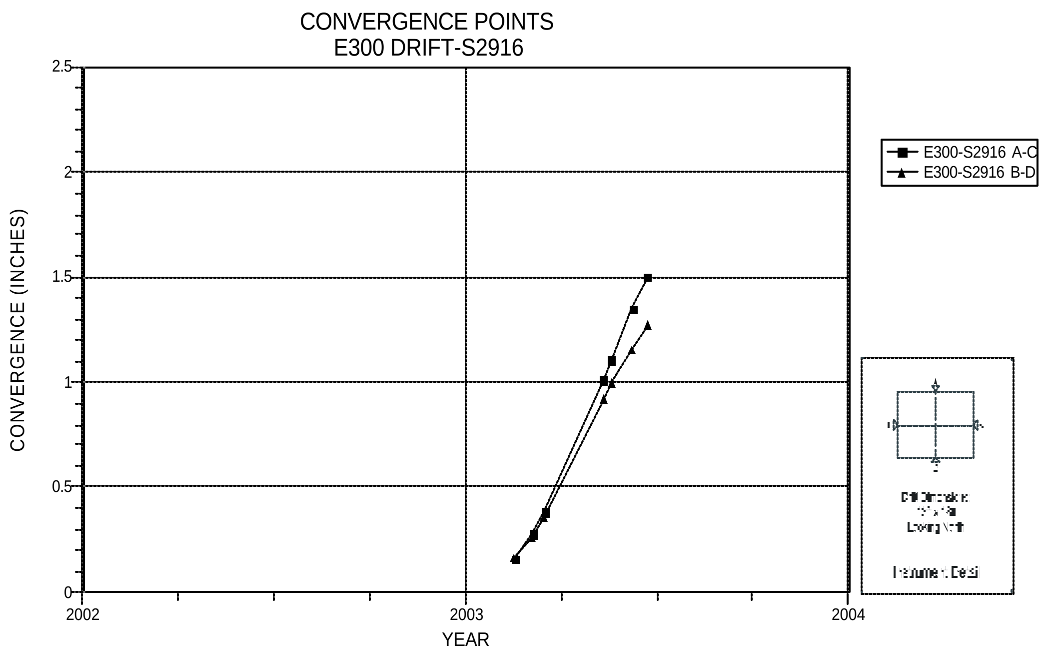
NOTES:
1. Installed date: January 2003.

Figure 4-71 Convergence Point Array
E300 Drift at S2634 – All Chords



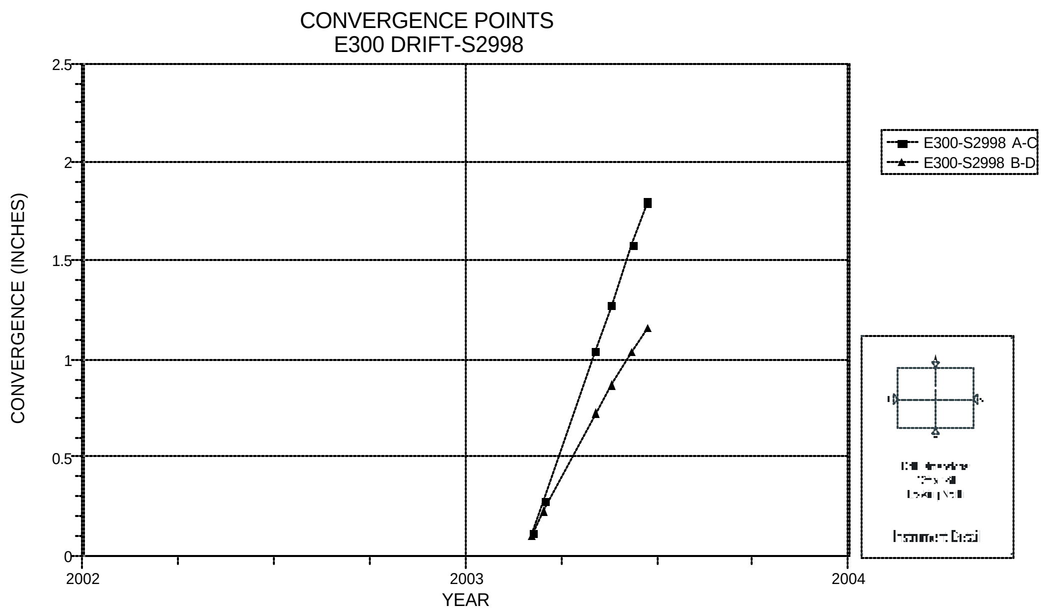
NOTES:
1. Installed date: January 2003.

Figure 4-72 Convergence Point Array
E300 Drift at S2833 – All Chords



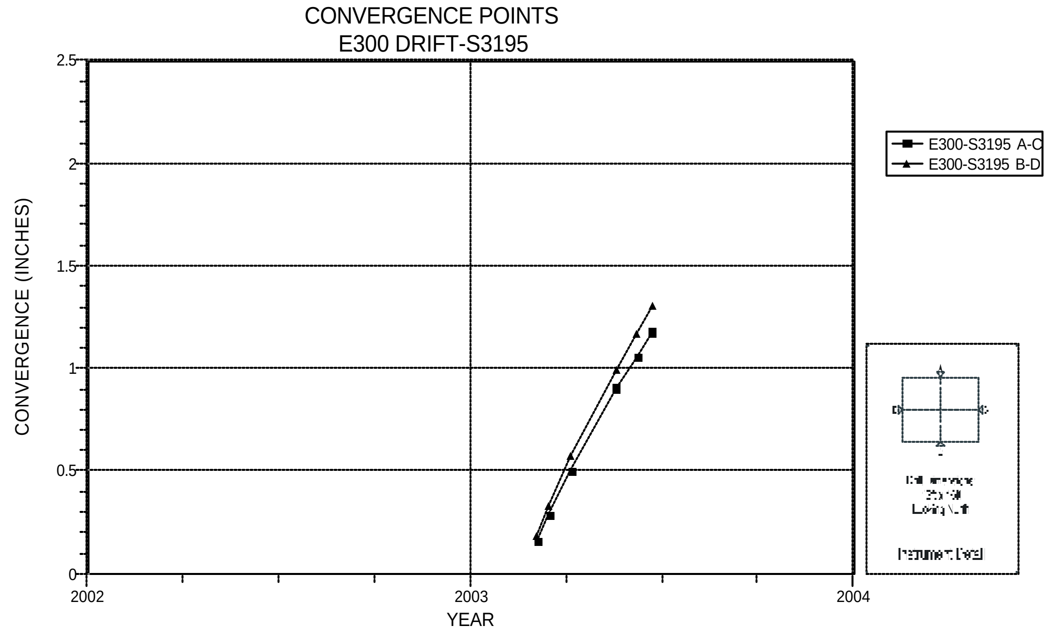
NOTES:
1. Installed date: January 2003.

Figure 4-73 Convergence Point Array
E300 Drift at S2916 – All Chords



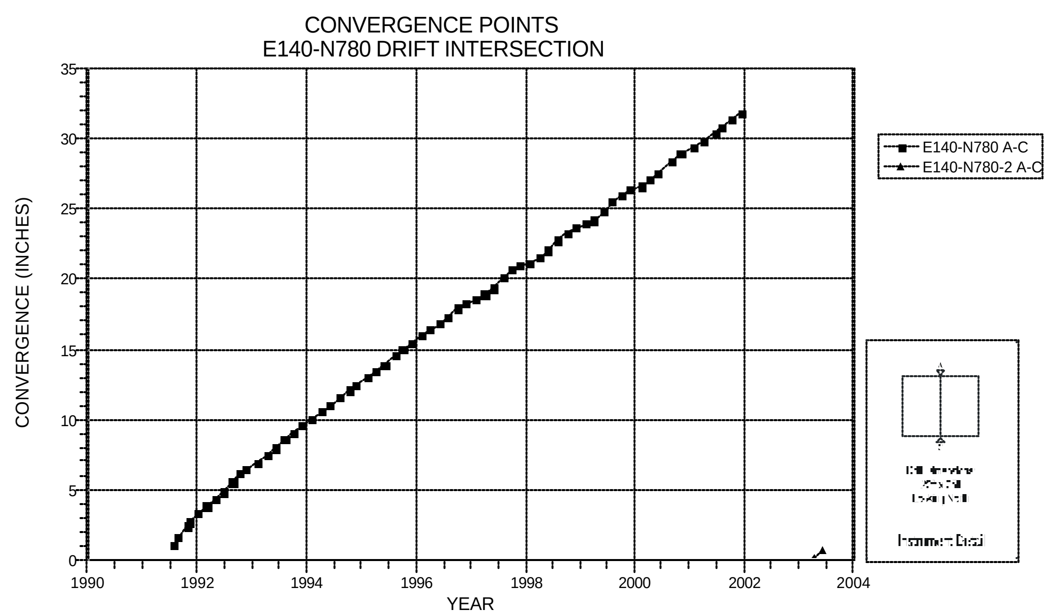
NOTES:
1. Installed date: February 2003.

Figure 4-74 Convergence Point Array
E300 Drift at S2998 – All Chords



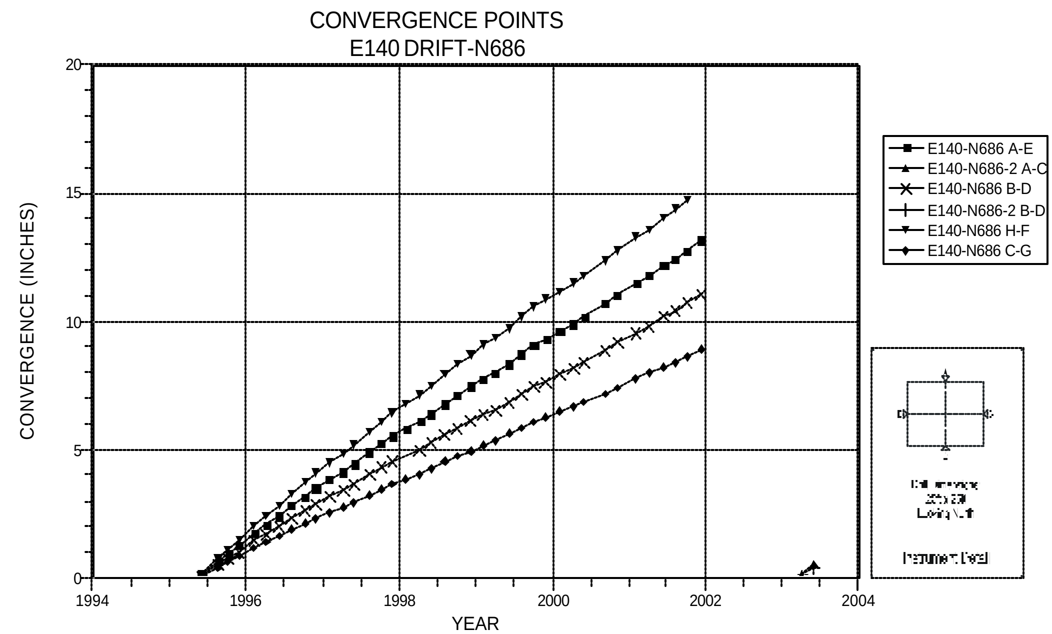
NOTES:
1. Installed date: February 2003.

Figure 4-75 Convergence Point Array
E300 Drift at S3195 – All Chords



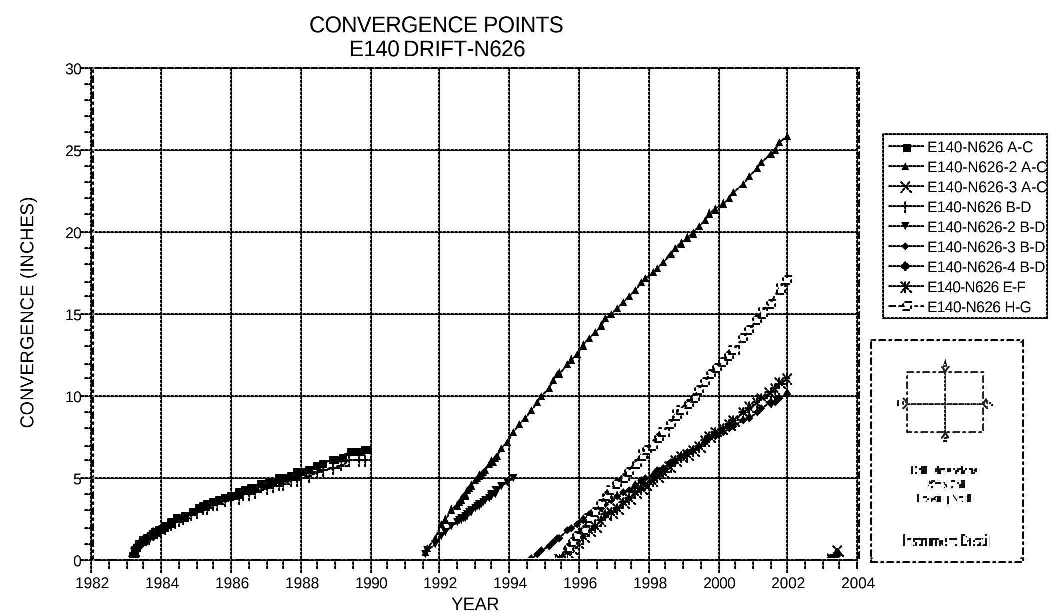
NOTES:
1. Excavation date: February 1983.
2. Roof excavated to Anhydrite "b" in early 2002.

Figure 4-76 Convergence Point Array
E140 Drift at N780 Drift Intersection – Roof to Floor



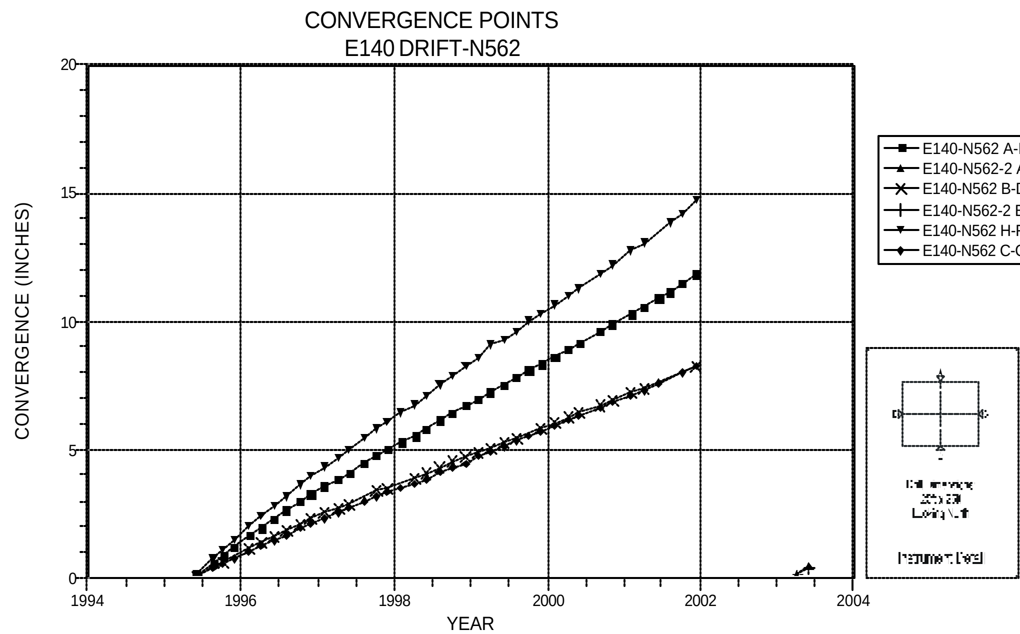
NOTES:
1. Excavation date: February 1983.
2. Enlarged from 8ft x 14ft in February 1990.
3. Roof excavated to Anhydrite "b" in early 2002.

Figure 4-77 Convergence Point Array
E140 Drift at N686 – All Chords



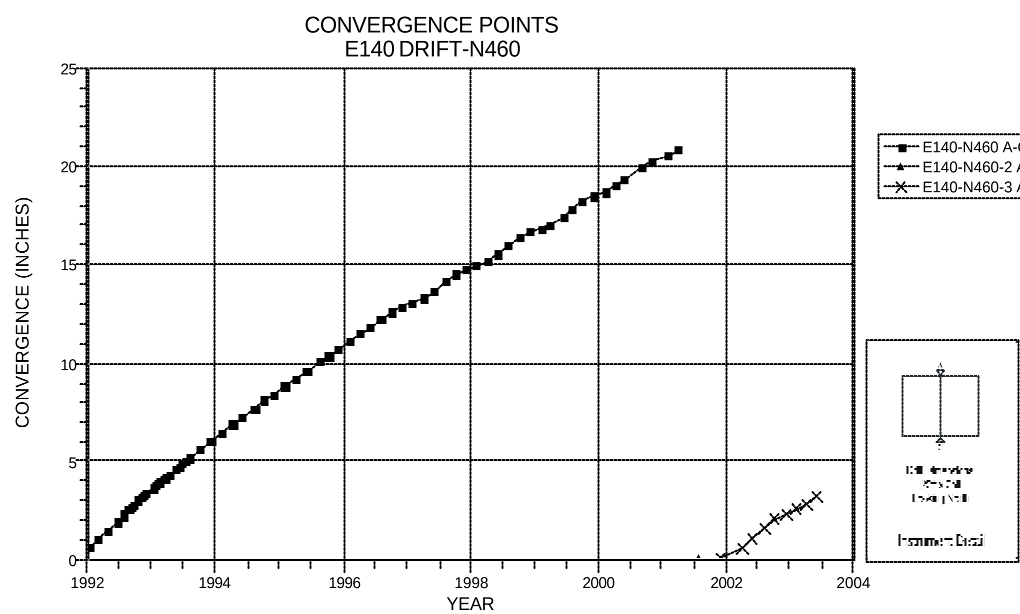
NOTES:
1. Excavation date: February 1983.
2. Enlarged from 8ft x 14ft in January 1990.
3. Roof excavated to Anhydrite "b" in early 2002.

Figure 4-78 Convergence Point Array
E140 Drift at N626 – All Chords



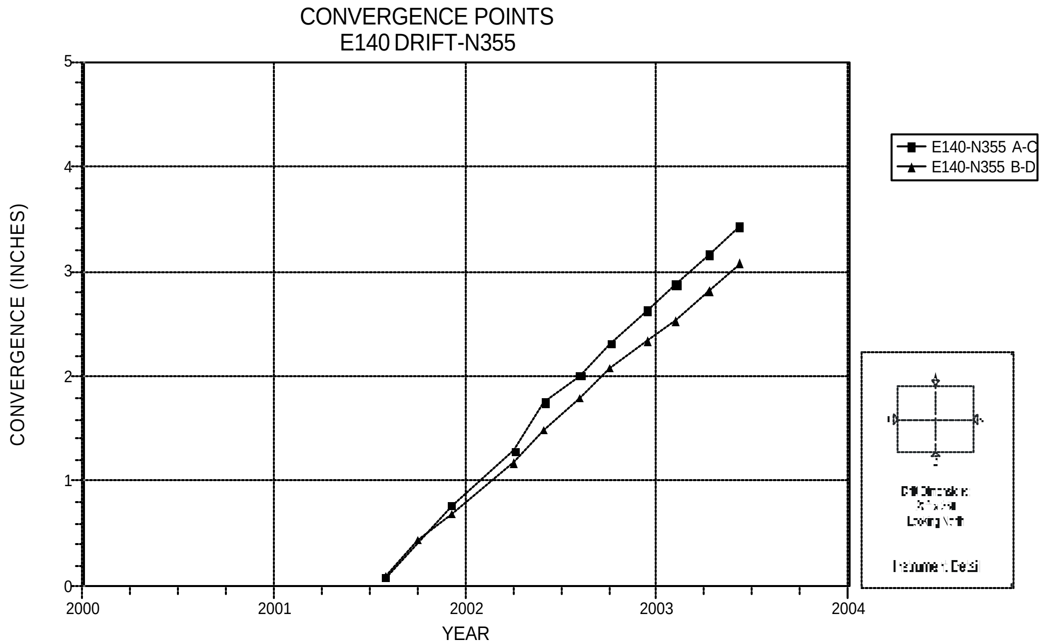
NOTES:
1. Excavation date: February 1983.
2. Enlarged from 8ft x 14ft in February 1990.
3. Roof excavated to Anhydrite "b" in early 2002.

Figure 4-79 Convergence Point Array
E140 Drift at N562 – All Chords



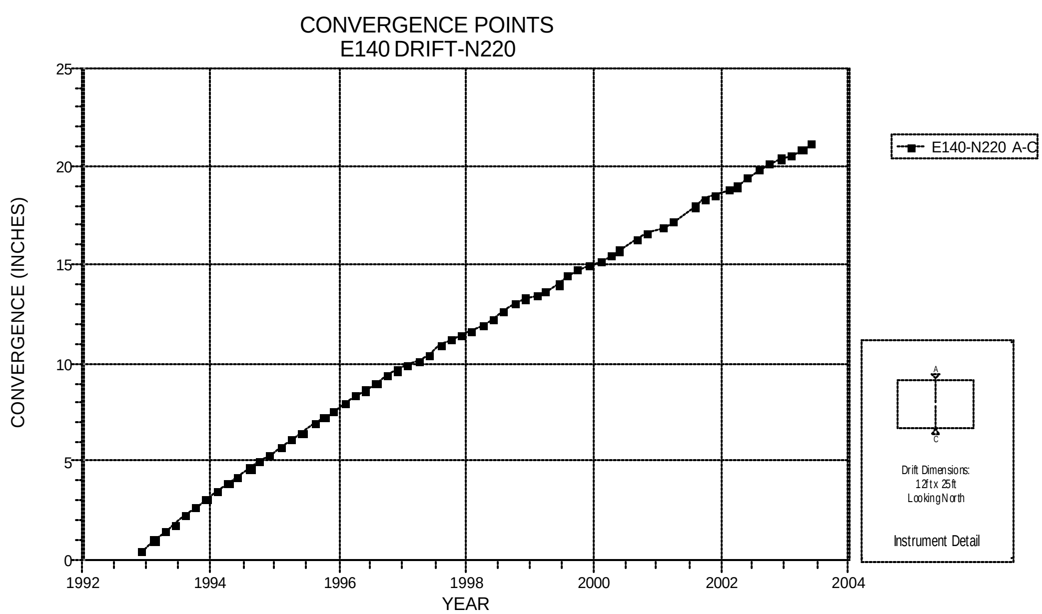
NOTES:
1. Excavation date: February 1983.
2. Roof excavated to Anhydrite "b" in mid 2001.

Figure 4-80 Convergence Point Array
E140 Drift at N460 Drift Intersection – Roof to Floor



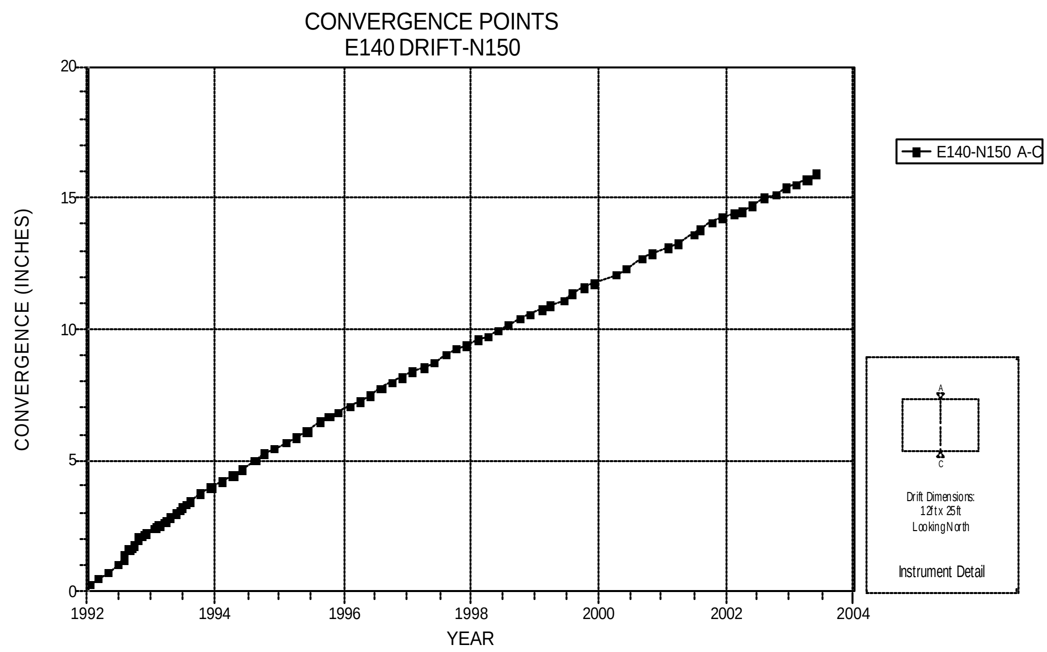
NOTES:
1. E140-N355 replaced E140-N300.
2. Roof excavated to Anhydrite "b" in mid 2001.

Figure 4-81 Convergence Point Array
E140 Drift at N355 – All Chords



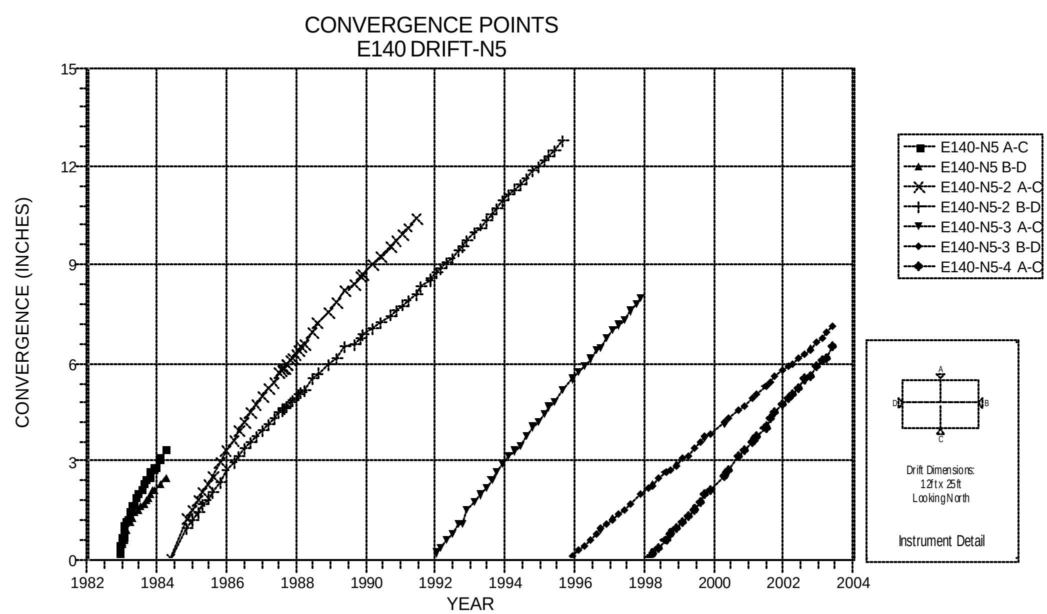
NOTES:
1. Excavation date: November 1982.

Figure 4-82 Convergence Point Array
E140 Drift at N220 – Roof to Floor



NOTES:
1. Excavation date: November 1982.

Figure 4-83 Convergence Point Array
E140 Drift at N150 Drift Intersection – Roof to Floor



NOTES:
1. Excavation date: November 1982.

Figure 4-84 Convergence Point Array
E140 Drift at N5 – All Chords

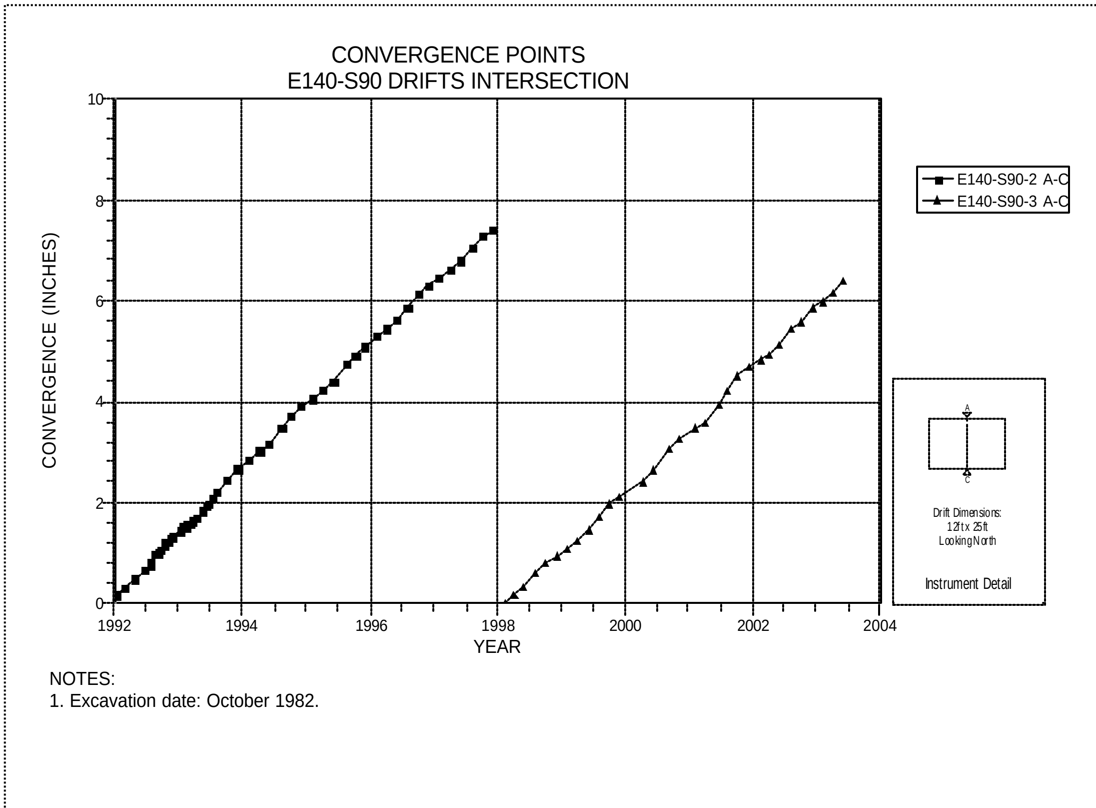


Figure 4-85 Convergence Point Array
E140 Drift at S90 Drift Intersection – Roof to Floor

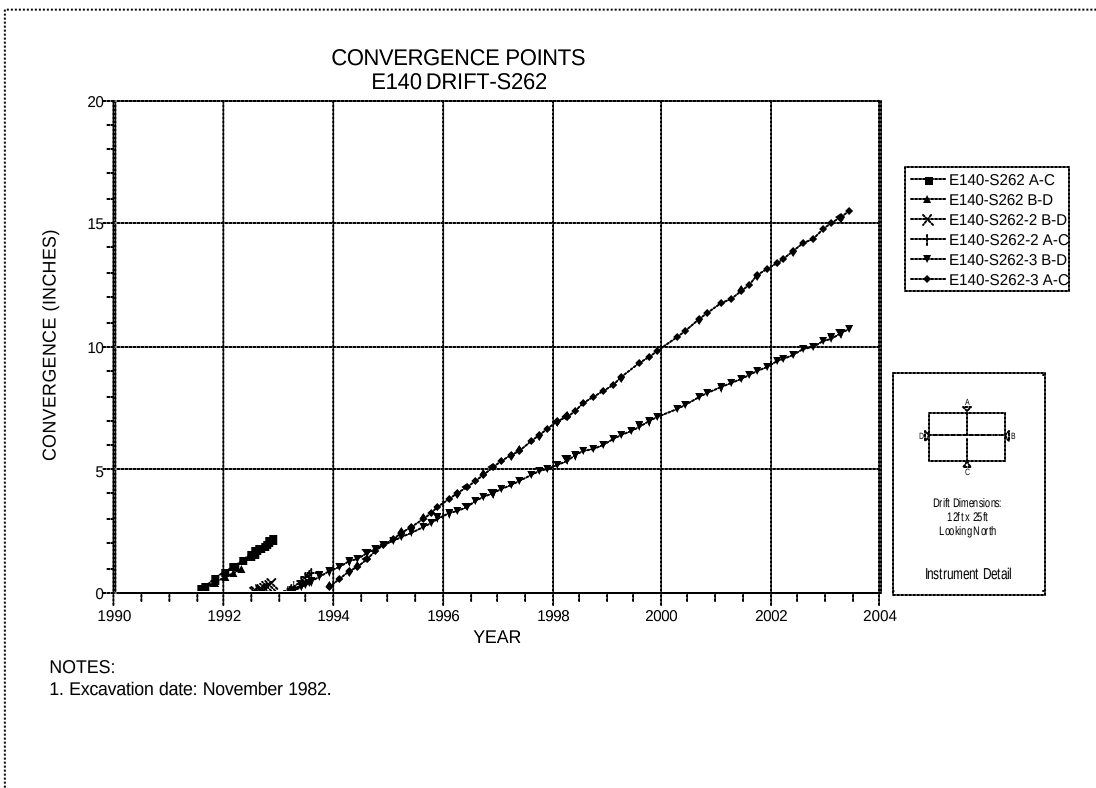
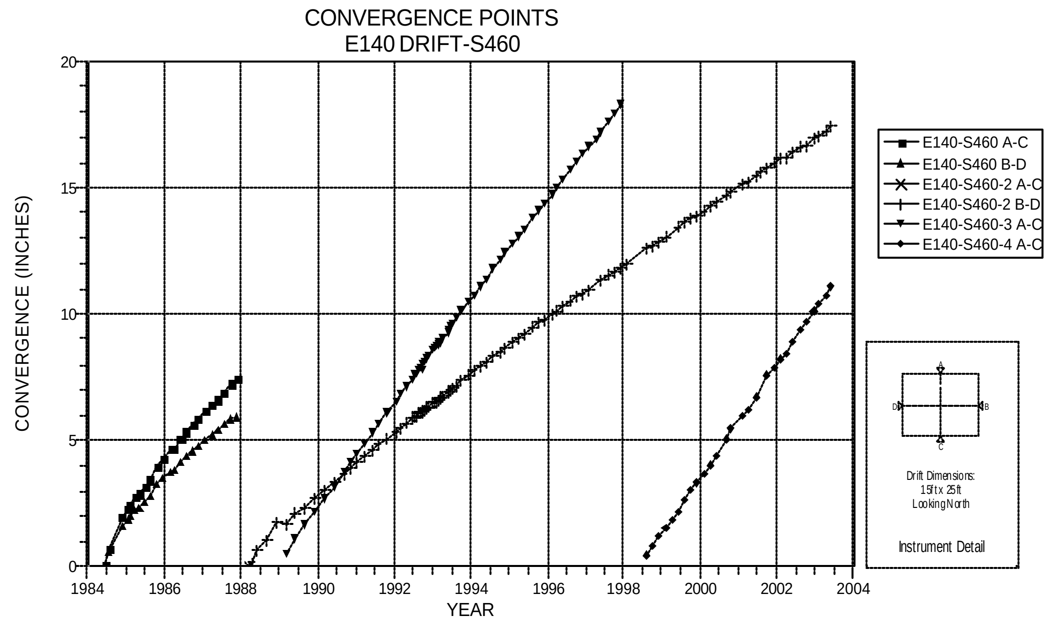
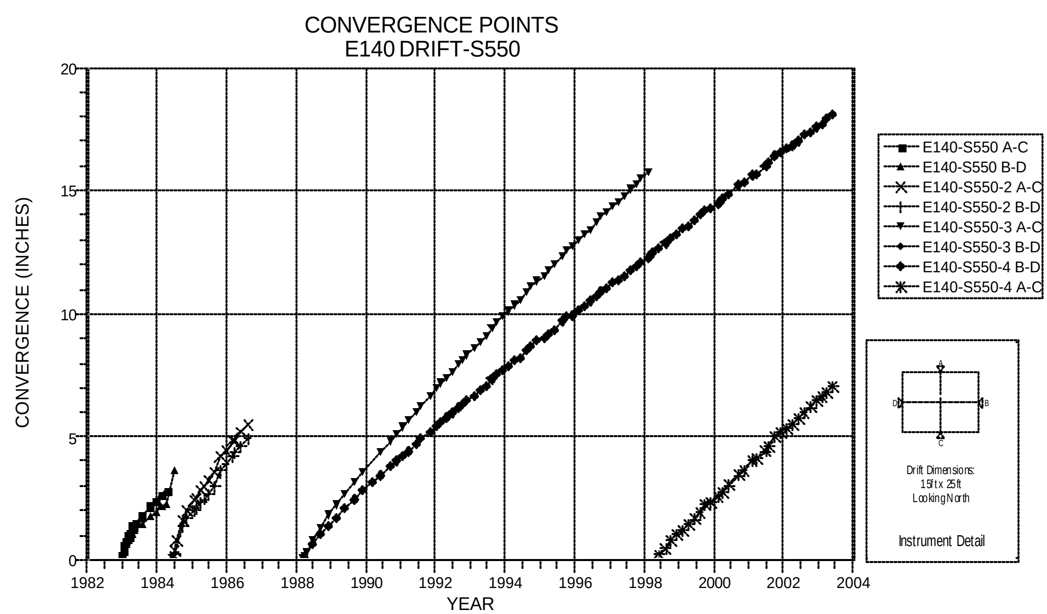


Figure 4-86 Convergence Point Array
E140 Drift at S262 – All Chords



NOTES:
1. Excavation date: December 1982.

Figure 4-87 Convergence Point Array
E140 Drift at S460 – All Chords



NOTES:
1. Excavation date: December 1982.

Figure 4-88 Convergence Point Array
E140 Drift at S550 – All Chords

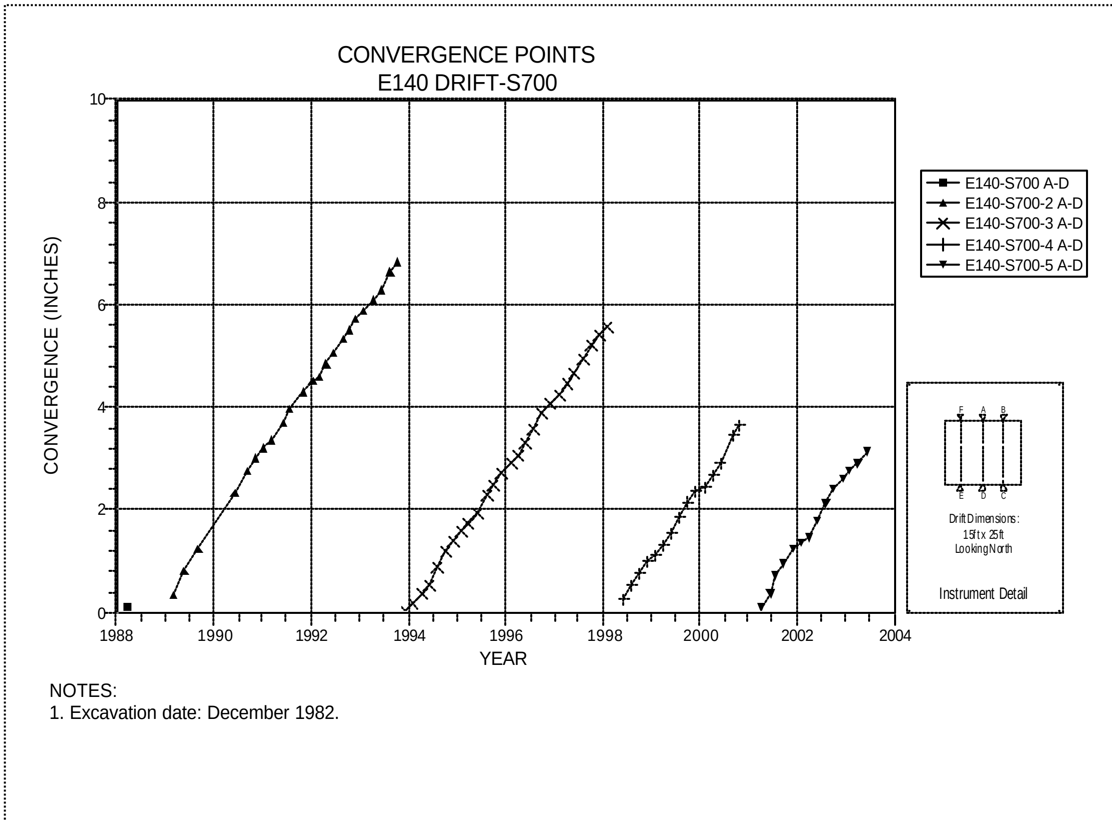


Figure 4-89 Convergence Point Array
E140 Drift at S700 Drift Intersection – Roof to Floor Centerline

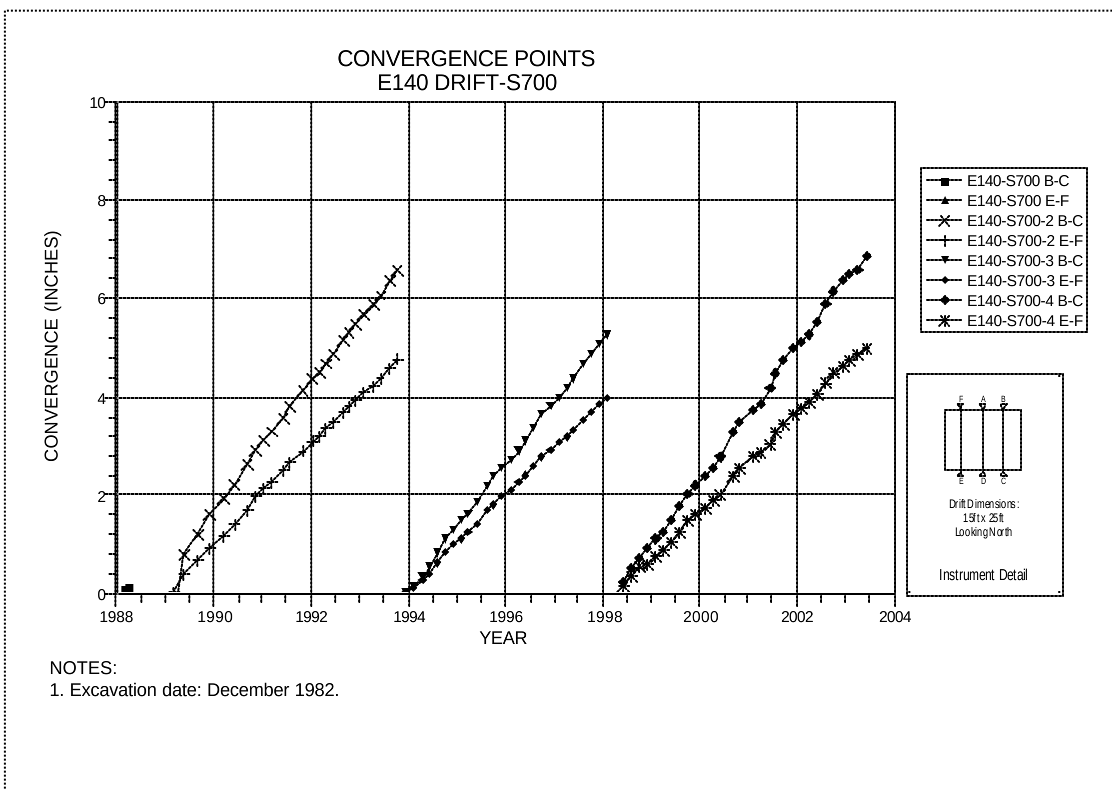
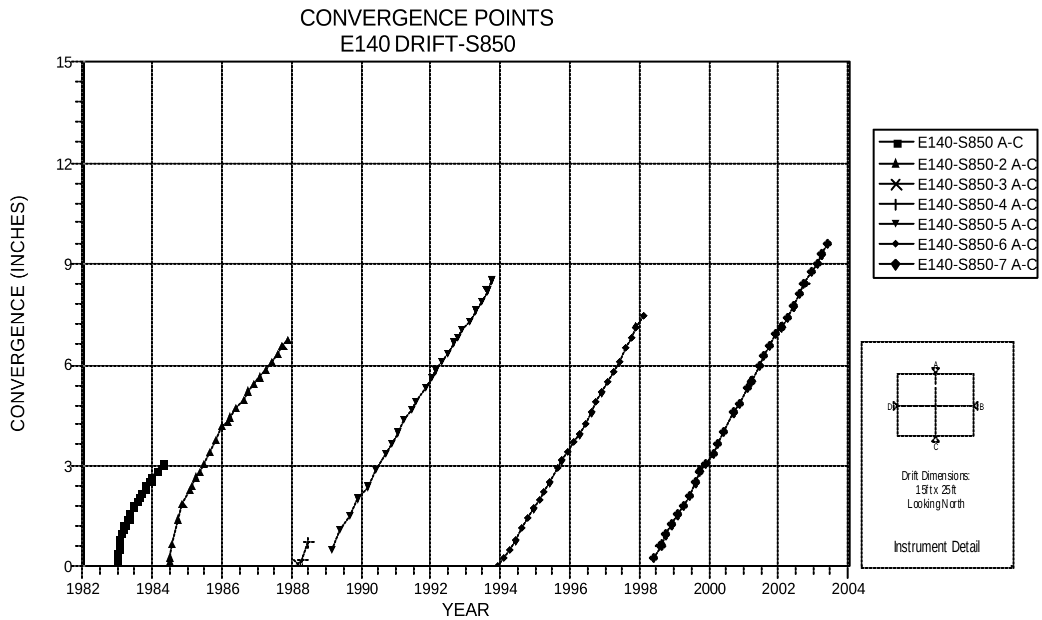
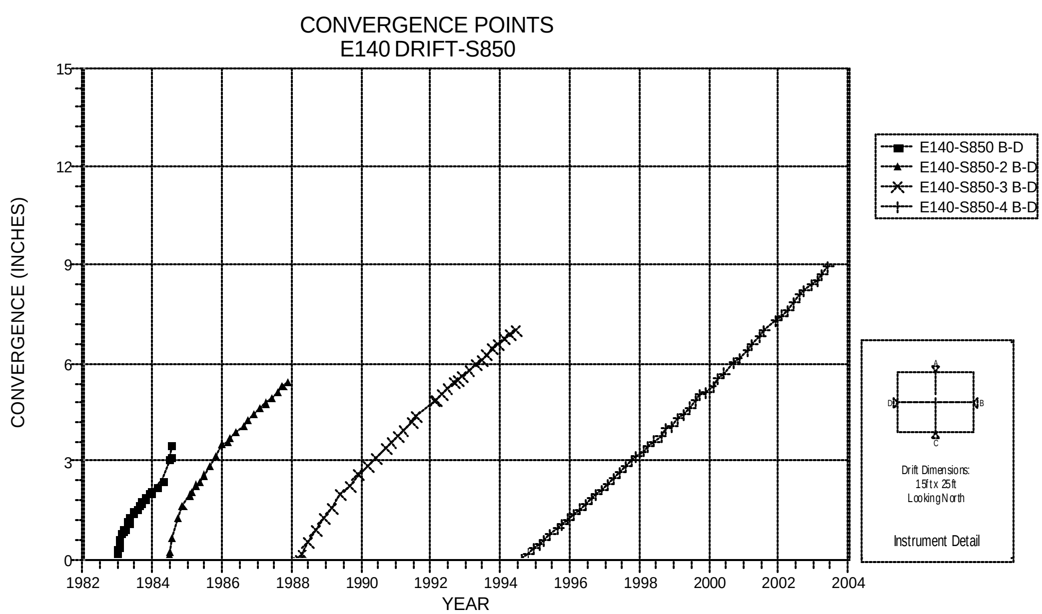


Figure 4-90 Convergence Point Array
E140 Drift at S700 Drift Intersection – Roof to Floor Quarter Points



NOTES:
1. Excavation date: December 1982.

Figure 4-91 Convergence Point Array
E140 Drift at S850 – Roof to Floor



NOTES:
1. Excavation date: December 1982.

Figure 4-92 Convergence Point Array
E140 Drift at S850 – Rib to Rib

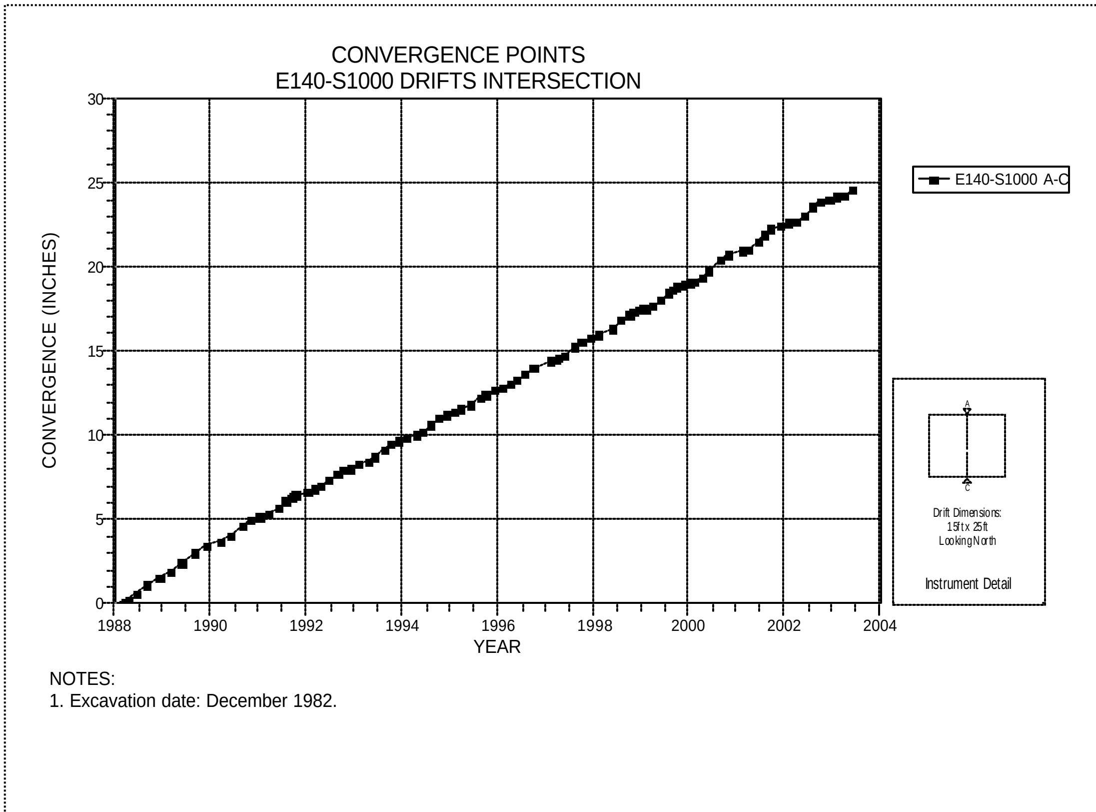


Figure 4-93 Convergence Point Array
E140 Drift at S1000 Drift Intersection – Roof to Floor

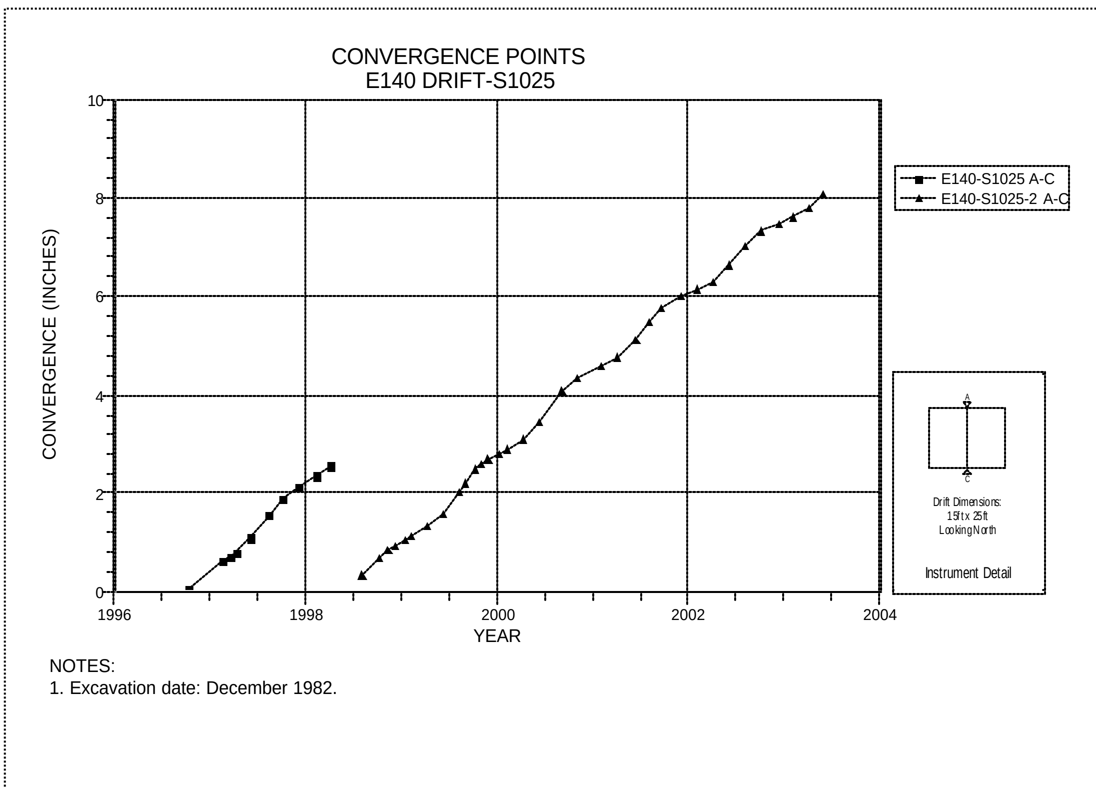
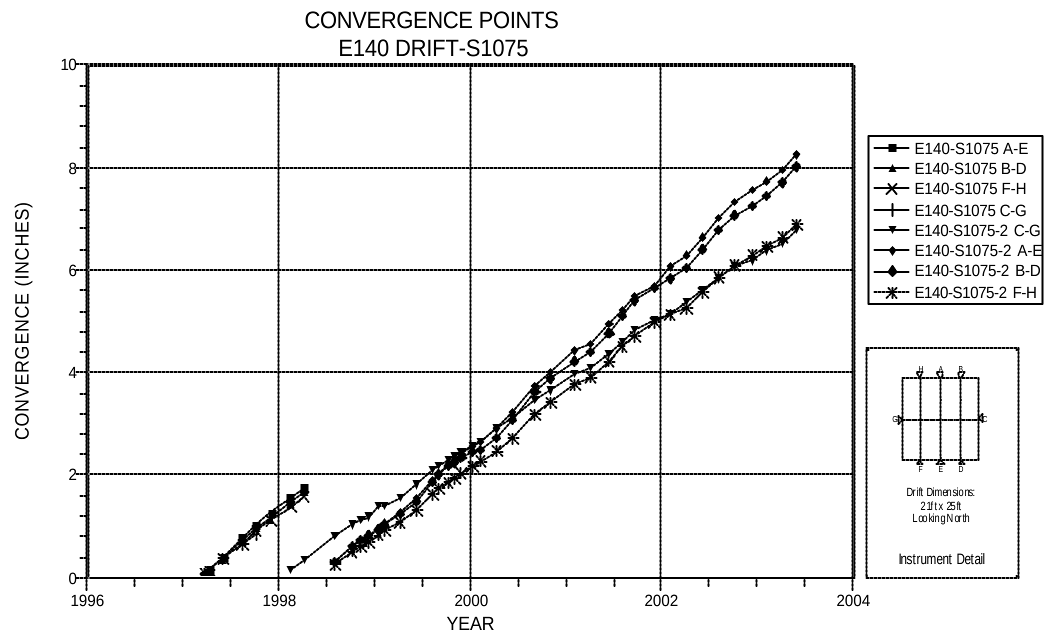
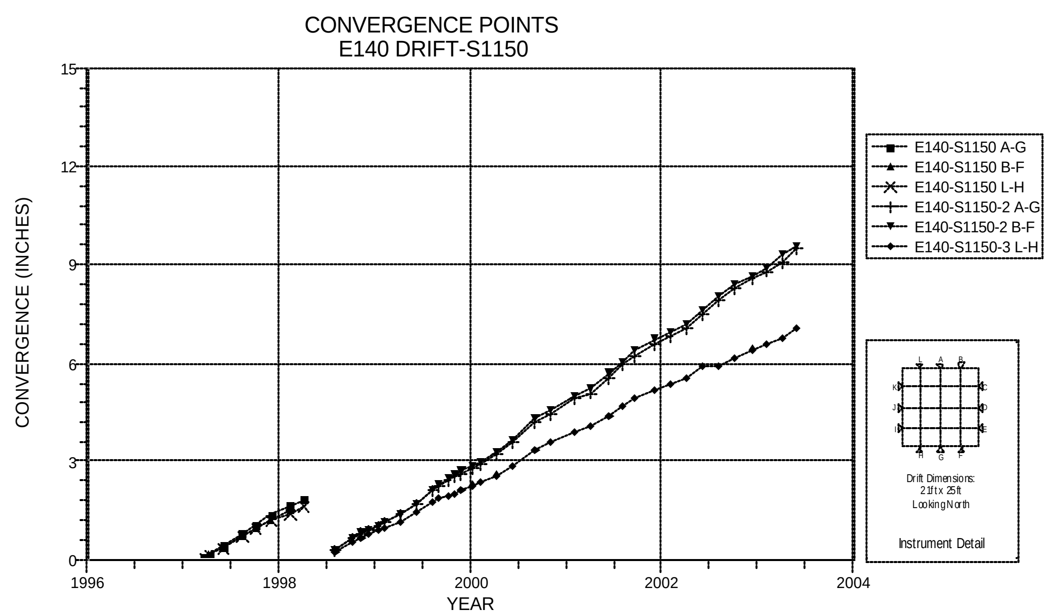


Figure 4-94 Convergence Point Array
E140 Drift at S1025 – Roof to Floor



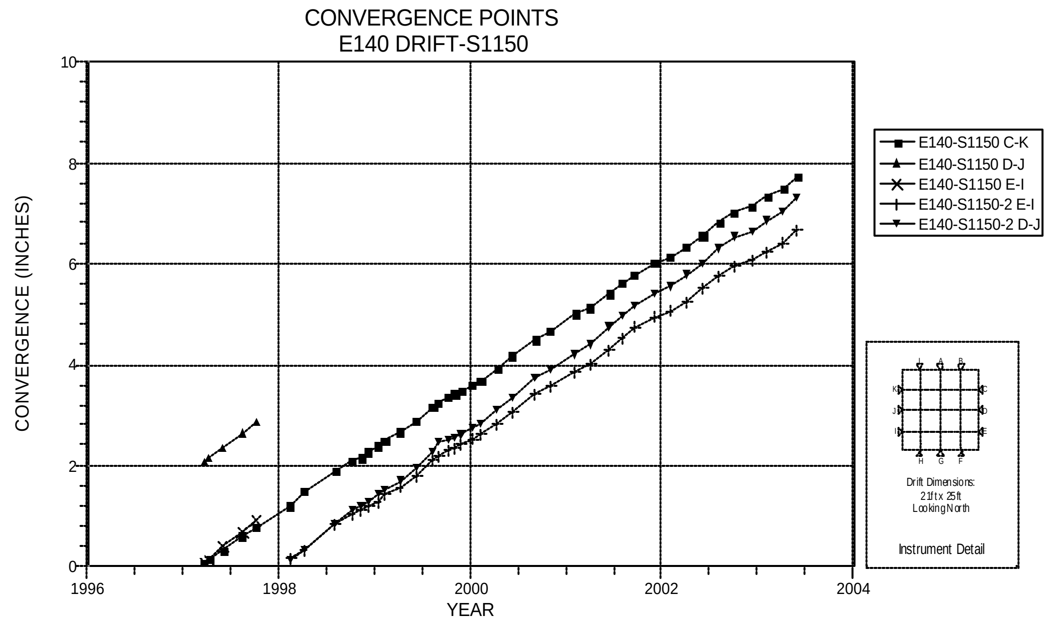
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b", November 1996.

Figure 4-95 Convergence Point Array
E140 Drift at S1075 – All Chords



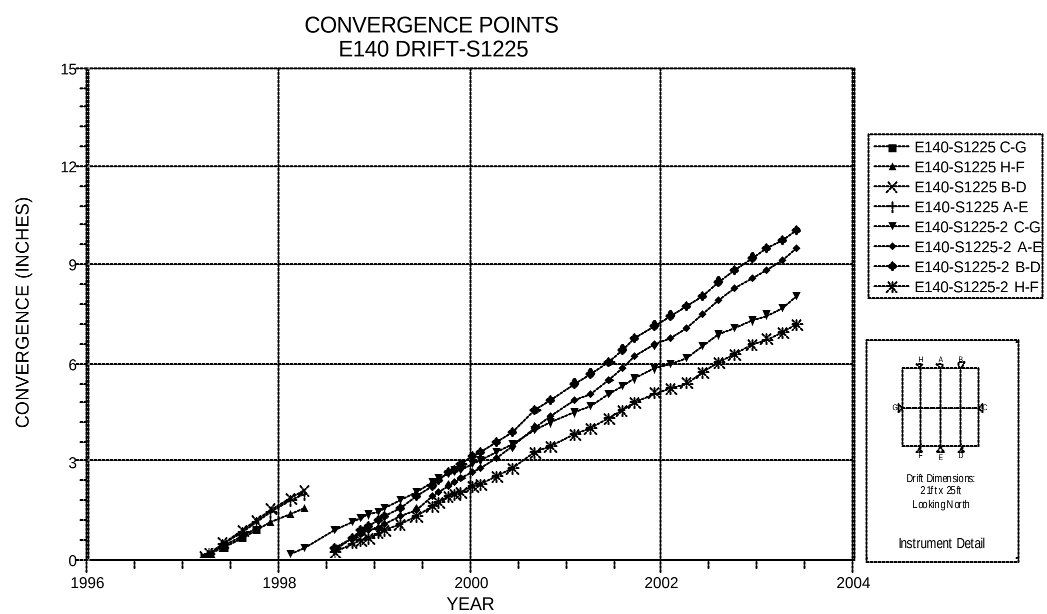
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b", November 1996.

Figure 4-96 Convergence Point Array
E140 Drift at S1150 – Roof to Floor



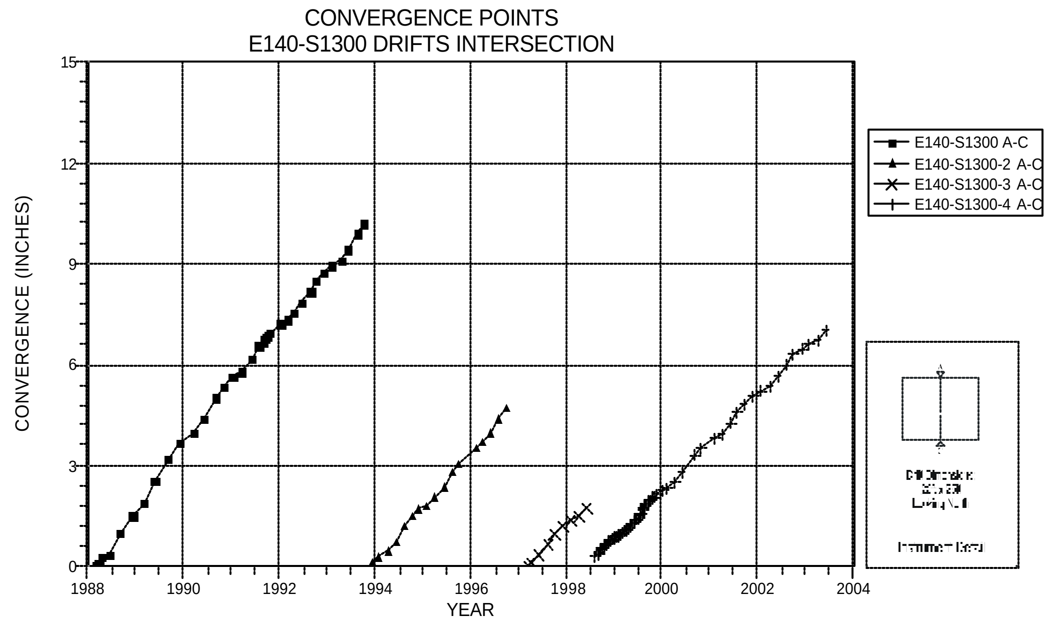
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b", November 1996.

Figure 4-97 Convergence Point Array
E140 Drift at S1150 – Rib to Rib



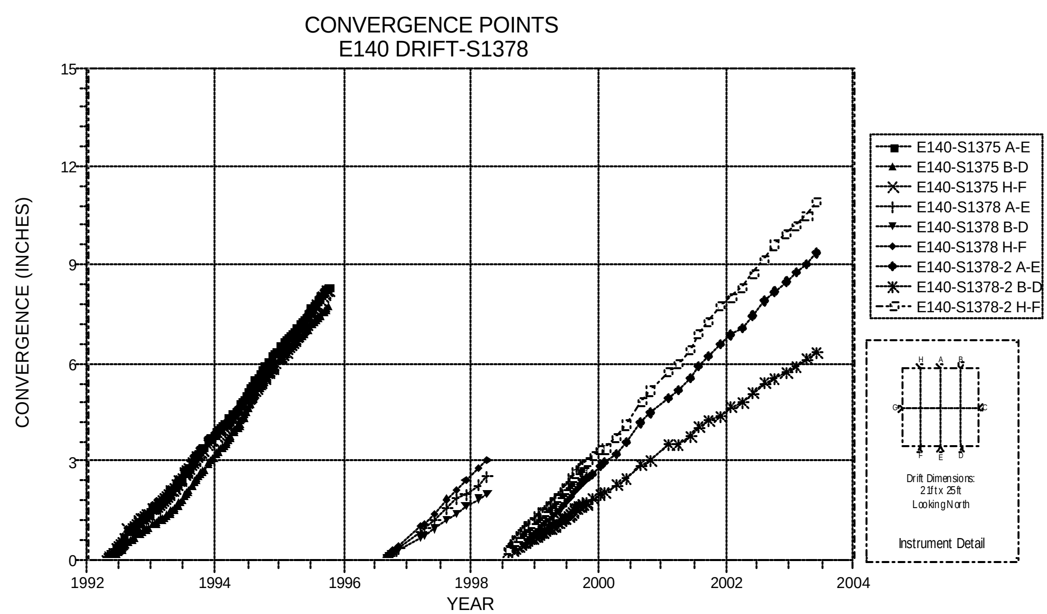
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b", November 1996.

Figure 4-98 Convergence Point Array
E140 Drift at S1225 – All Chords



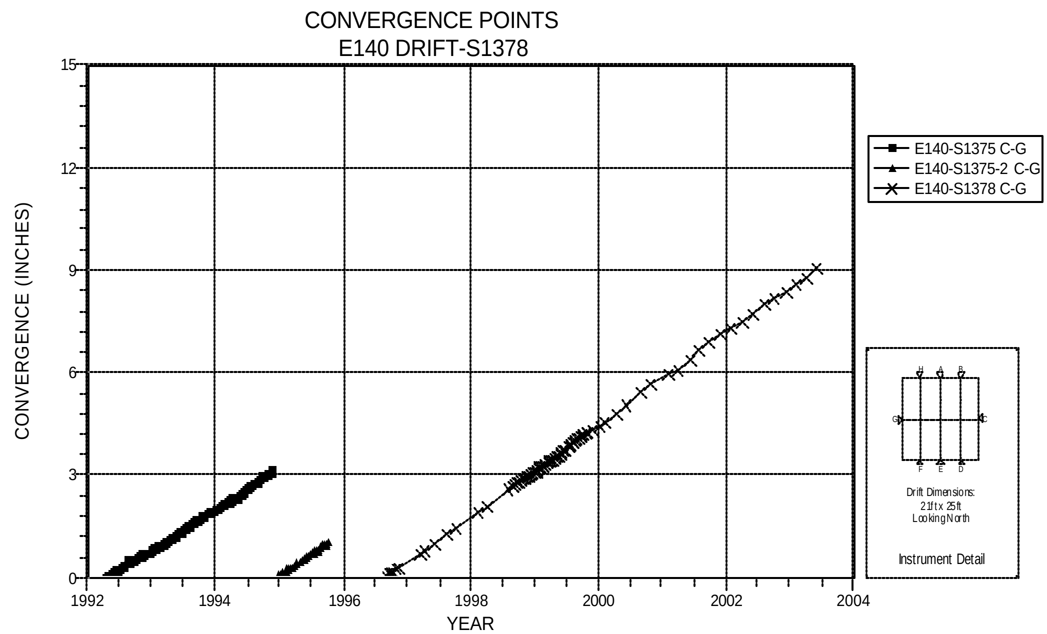
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b" in December 1996.
3. Current drift dimensions are 20ft x 25ft.

Figure 4-99 Convergence Point Array
E140 Drift at S1300 Drift Intersection – Roof to Floor



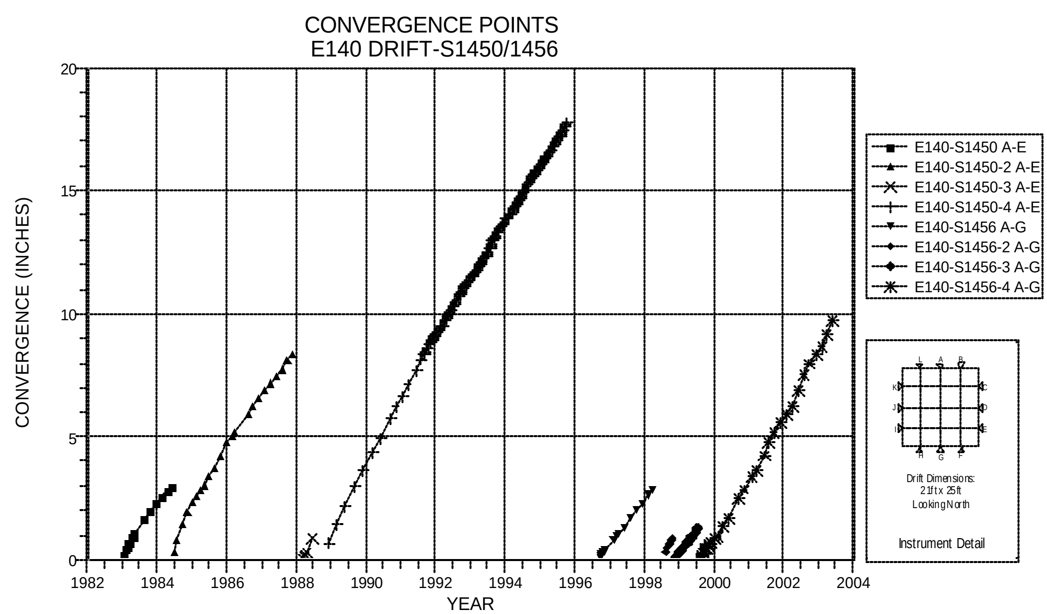
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b" in December 1995.
3. Current drift dimensions are 21ft x 25ft.

Figure 4-100 Convergence Point Array
E140 Drift at S1378 – Roof to Floor



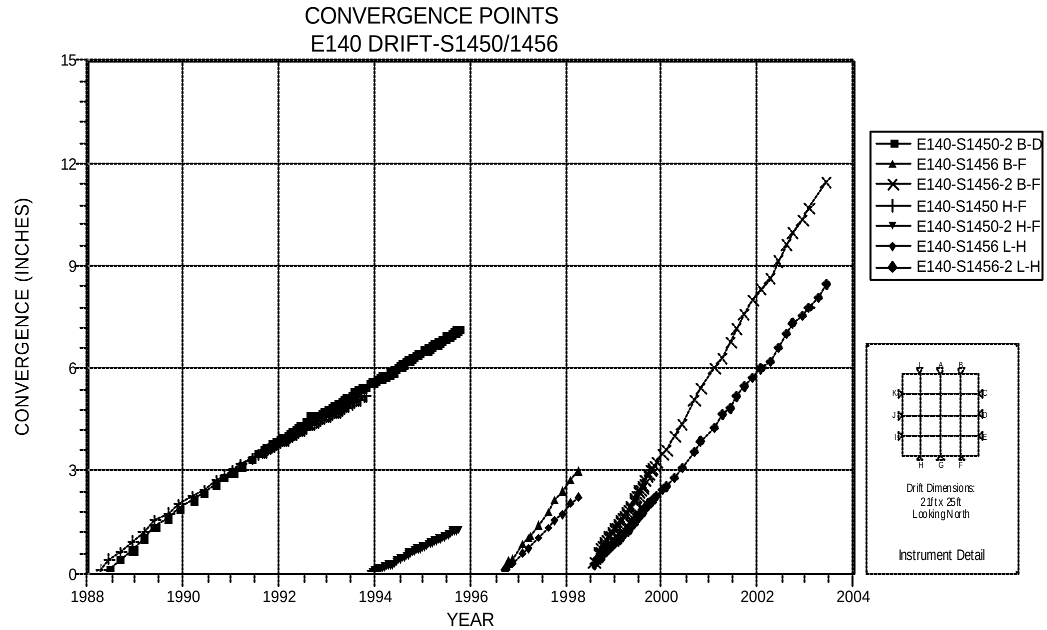
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Clay G, December 1995.
3. Current drift dimensions are 21ft x 25ft.

Figure 4-101 Convergence Point Array
E140 Drift at S1378 – Rib to Rib



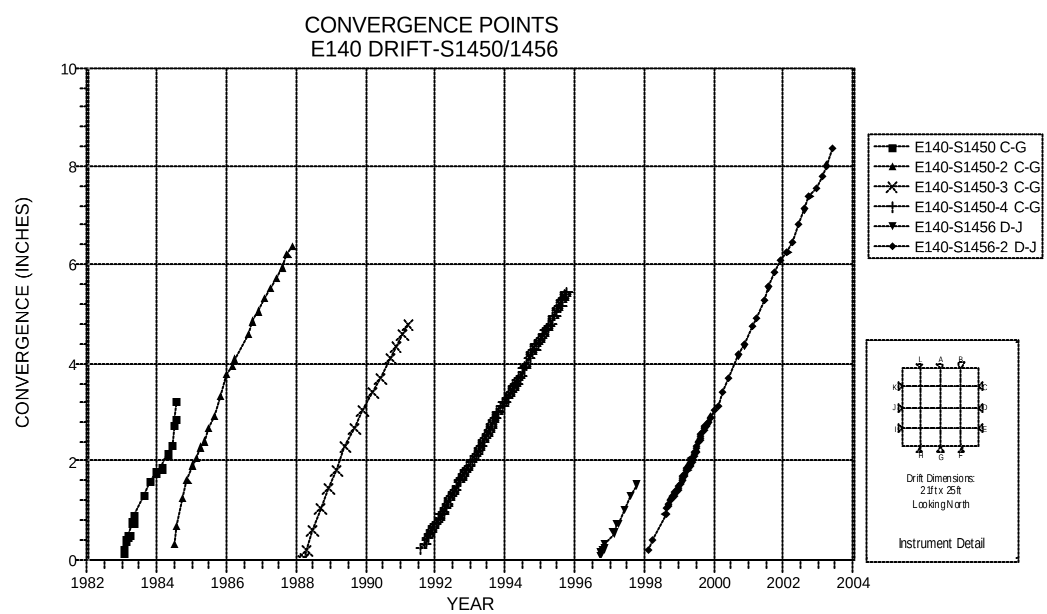
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b" in December 1995.
3. E140-S1450 was replaced by E140-S1456

Figure 4-102 Convergence Point Array
E140 Drift at S1450/S1456 – Roof to Floor – Centerline



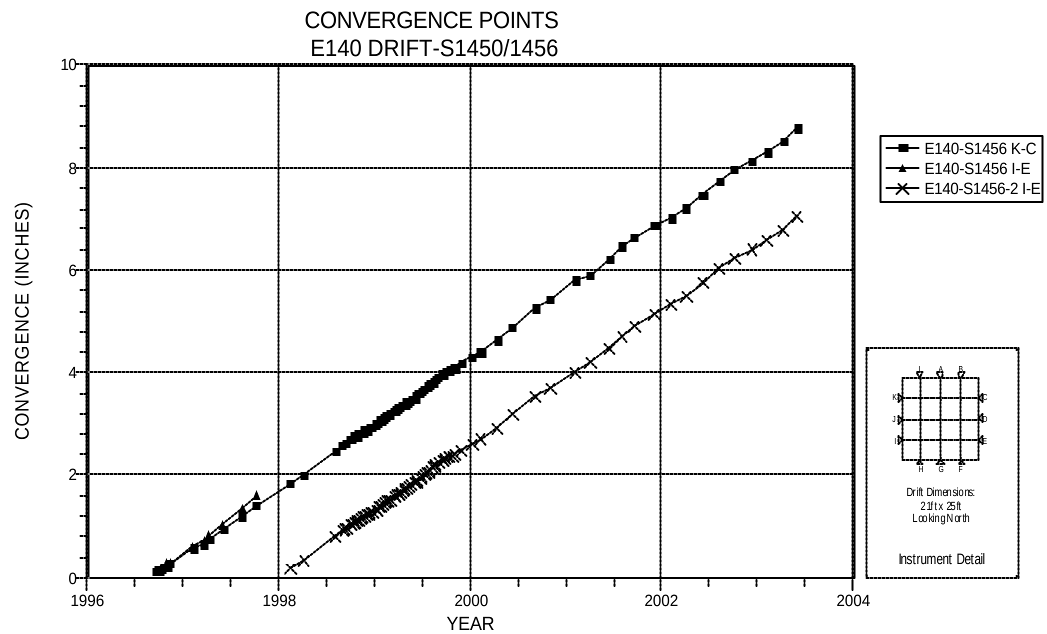
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b" in December 1995.
3. E140-S1450 was replaced by E140-S1456

Figure 4-103 Convergence Point Array
E140 Drift at S1450/S1456 – Roof to Floor – Quarter Points



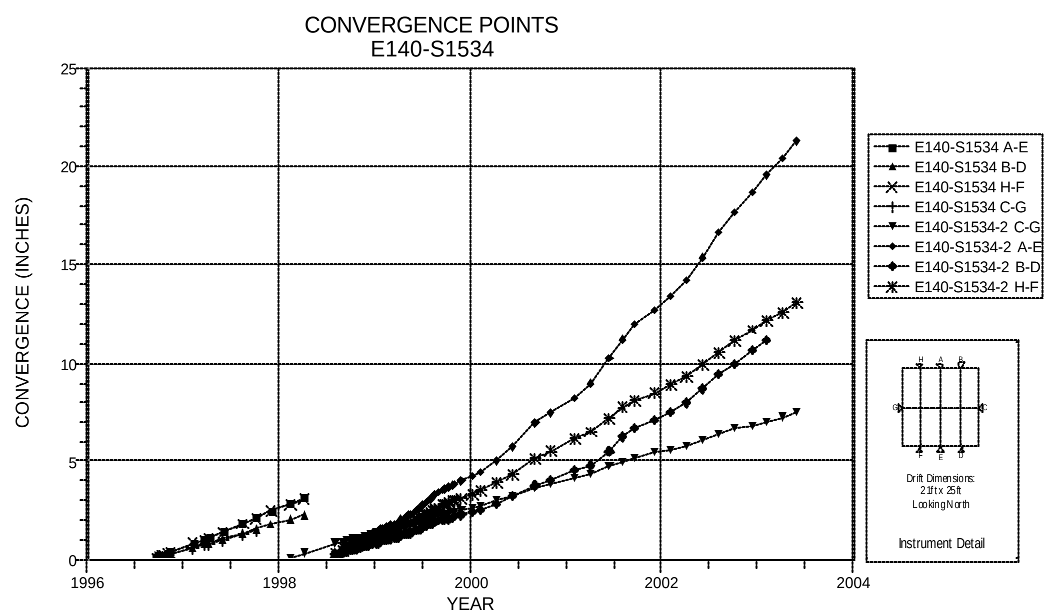
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b" in December 1995.
3. E140-S1450 was replaced by E140-S1456

Figure 4-104 Convergence Point Array
E140 Drift at S1450/S1456 – Rib to Rib – Midheight



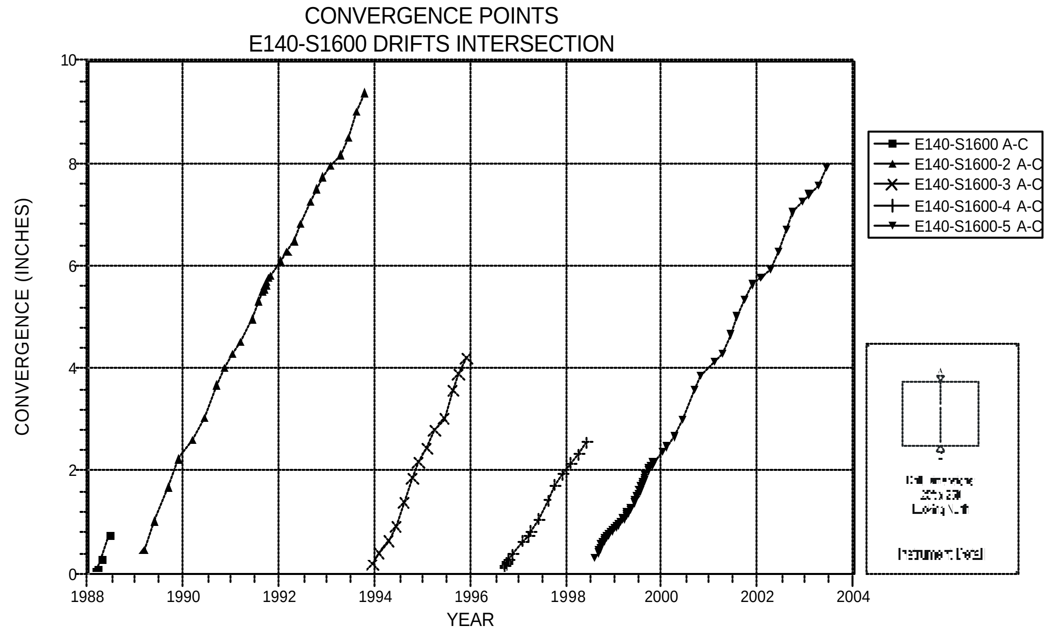
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b" in December 1995.
3. E140-S1450 was replaced by E140-S1456

Figure 4-105 Convergence Point Array
E140 Drift at S1450/S1456 – Rib to Rib – Quarter Points



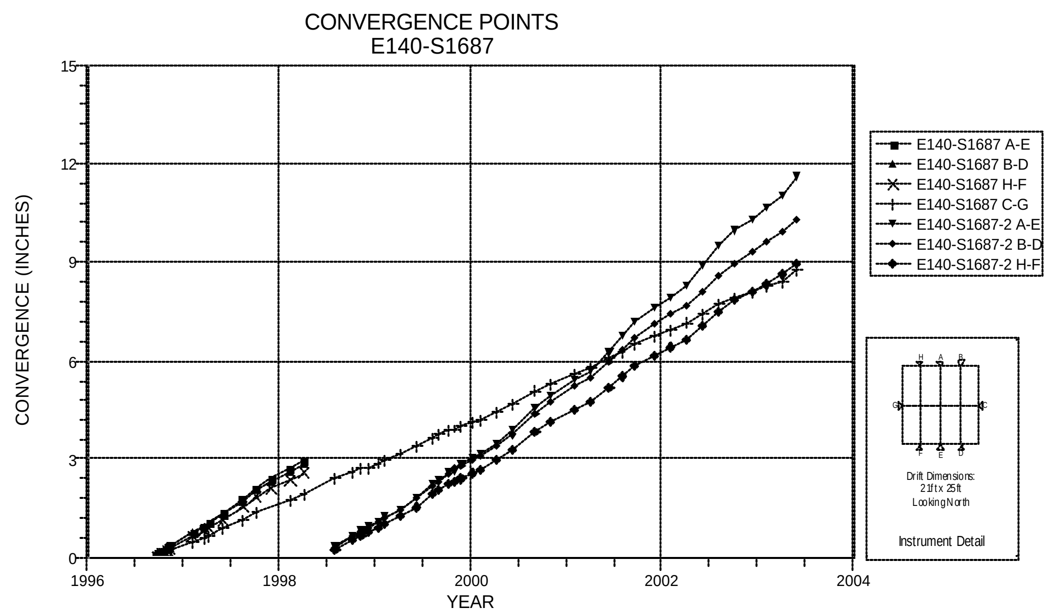
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b" in late 1995.

Figure 4-106 Convergence Point Array
E140 Drift at S1534 – All Chords



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

Figure 4-107 Convergence Point Array
E140 Drift at S1600 Drift Intersection – Roof to Floor



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

Figure 4-108 Convergence Point Array
E140 Drift at S1687 – All Chords

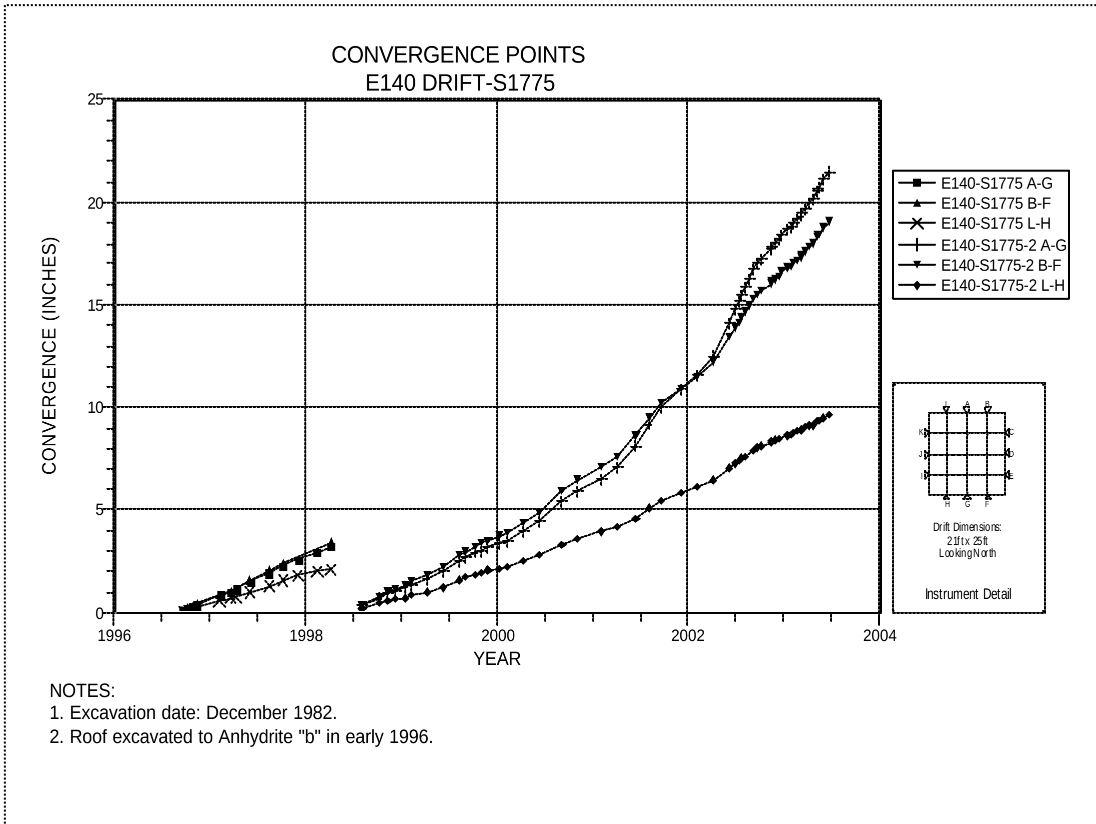


Figure 4-109 Convergence Point Array
E140 Drift at S1775 – Roof to Floor

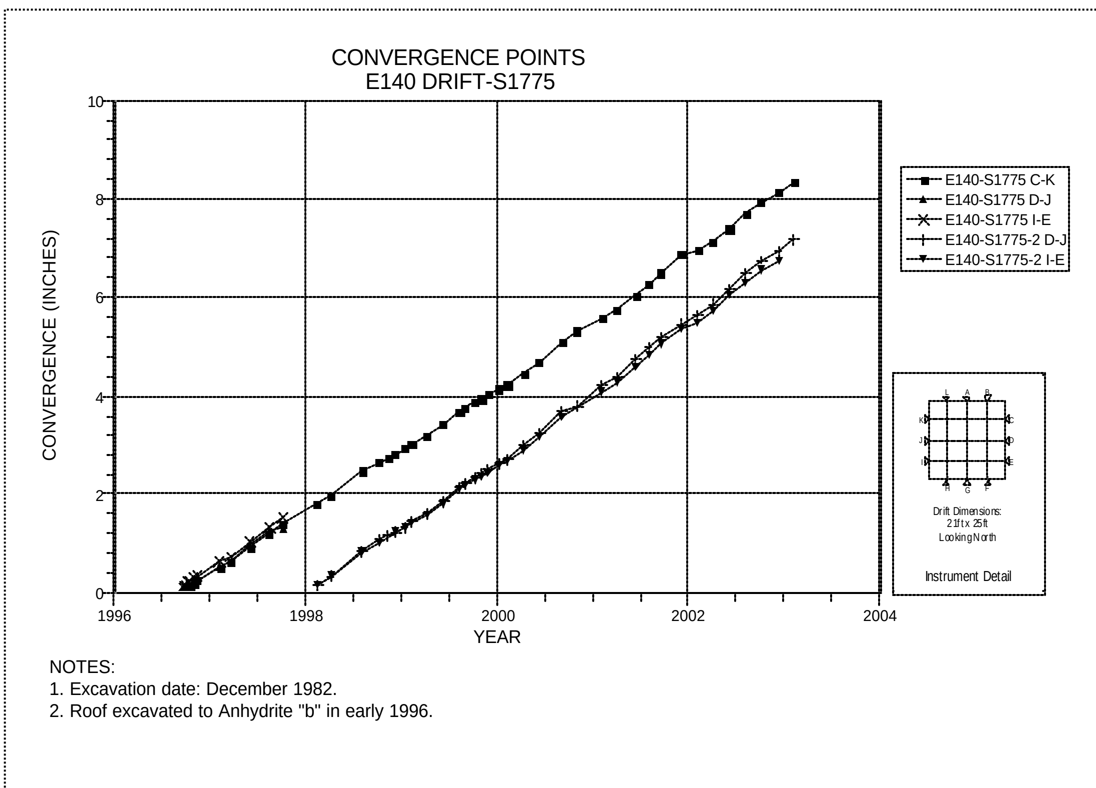
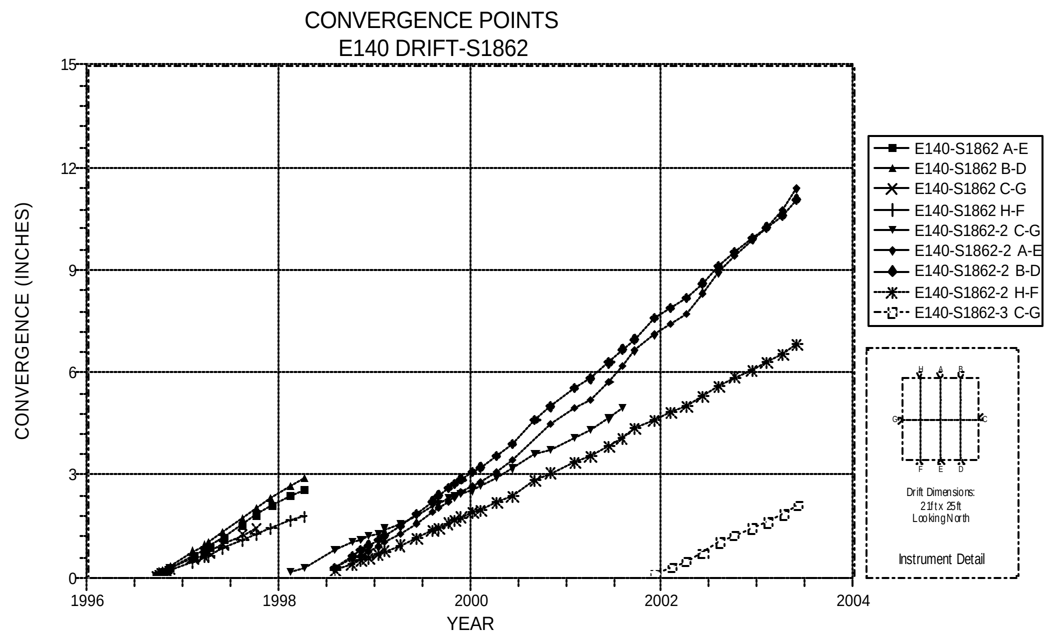
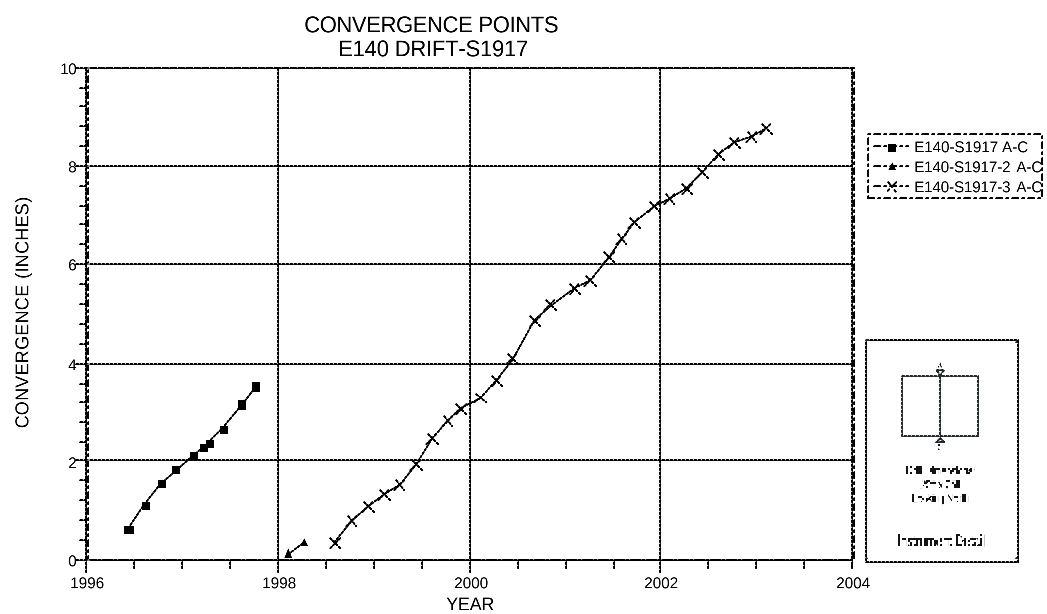


Figure 4-110 Convergence Point Array
E140 Drift at S1775 – Rib to Rib



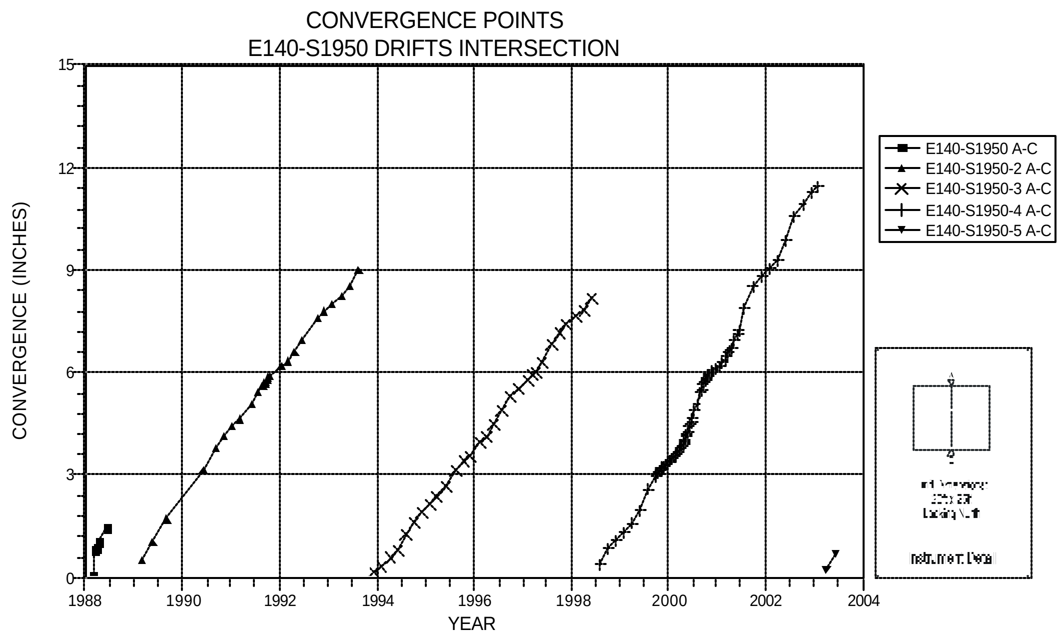
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b" in early 1996.

Figure 4-111 Convergence Point Array
E140 Drift at S1862 – All Chords



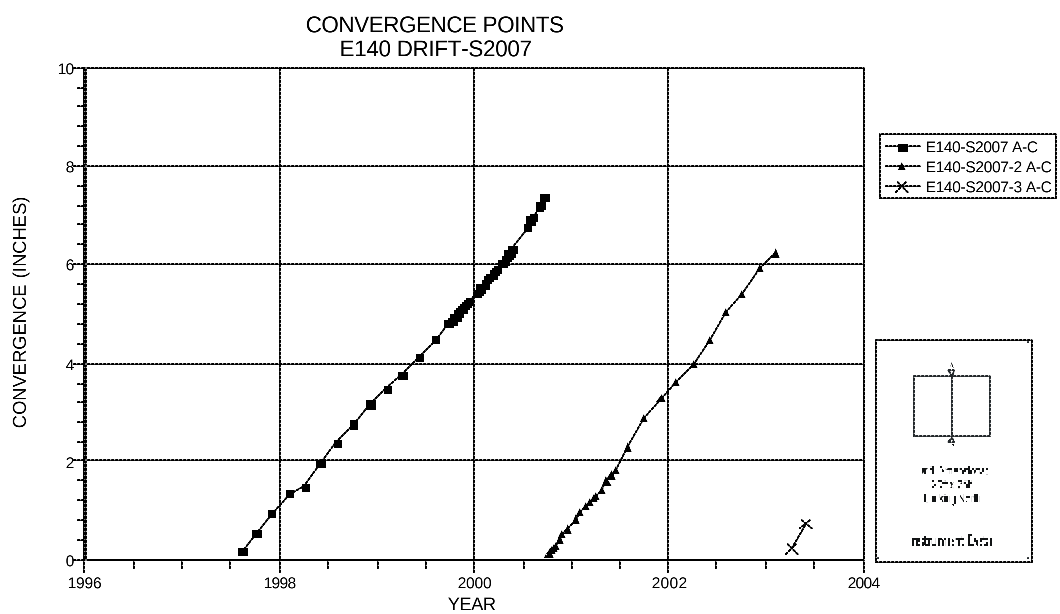
NOTES:
1. Excavation date: December 1982.
2. Mined out.

Figure 4-112 Convergence Point Array
E140 Drift at S1917 – Roof to Floor



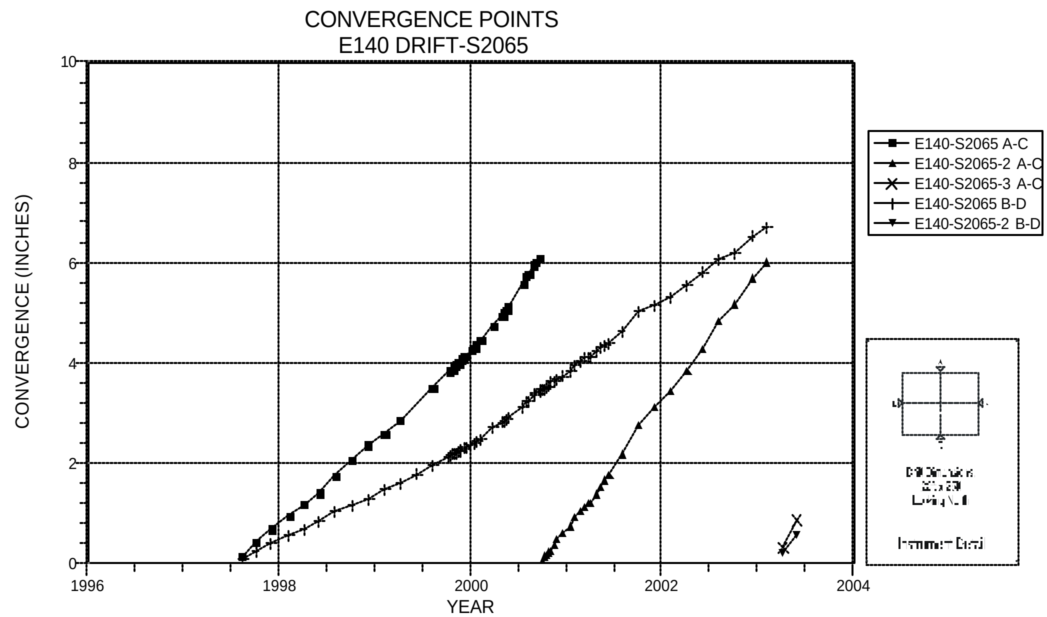
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b", March 2003.

Figure 4-113 Convergence Point Array
E140 Drift at S1950 Drift Intersection – Roof to Floor



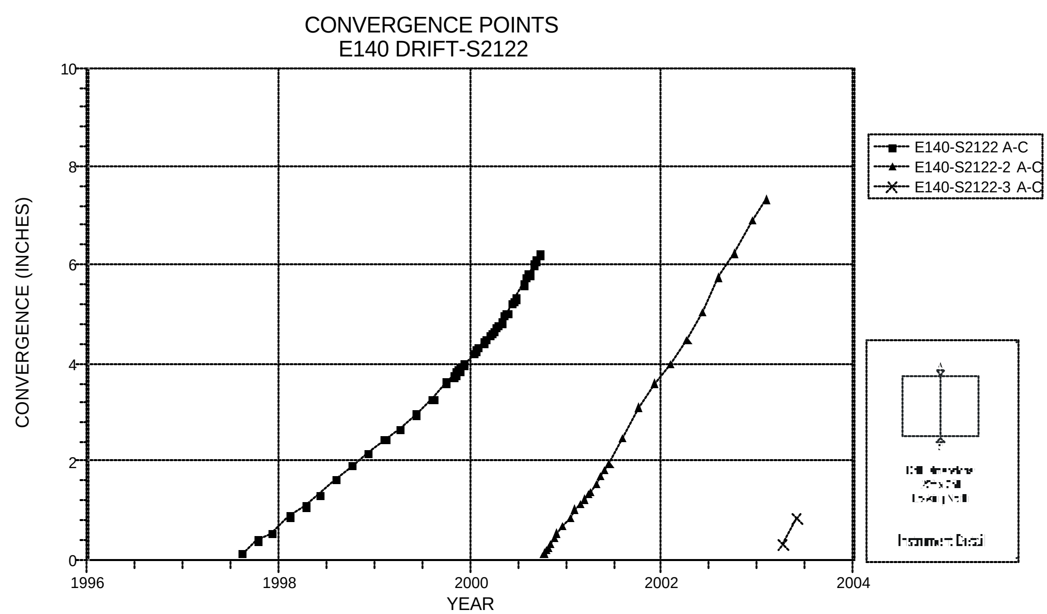
NOTES:
1. Excavation date: January 1993.
2. Roof excavated to Anhydrite "b", March 2003.

Figure 4-114 Convergence Point Array
E140 Drift at S2007 – Roof to Floor



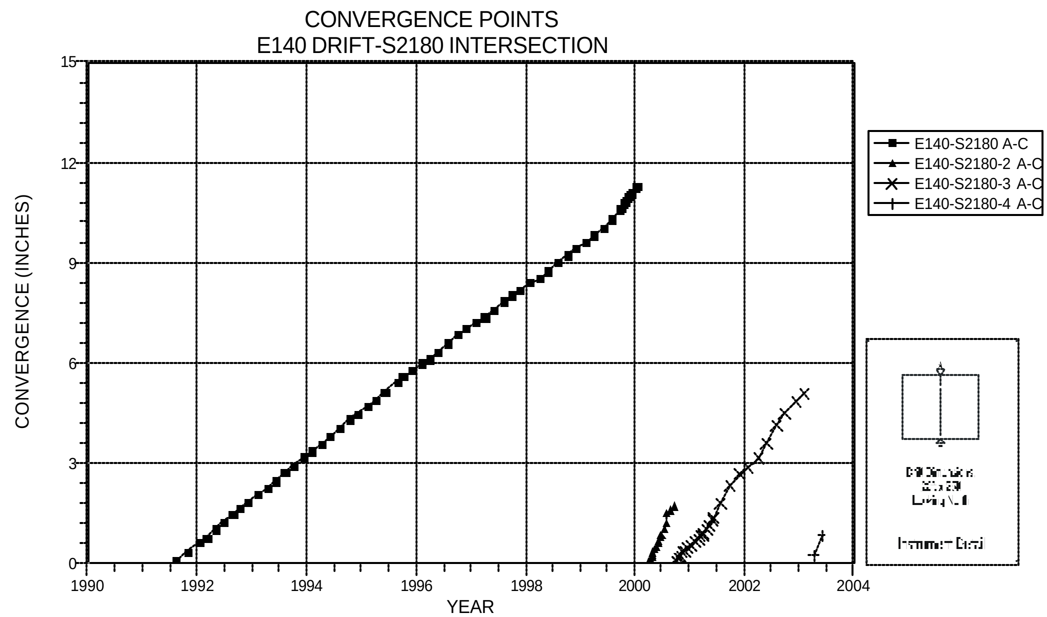
NOTES:
1. Excavation date: January 1993.
2. Roof excavated to Anhydrite "b", March 2003.

Figure 4-115 Convergence Point Array
E140 Drift at S2065 – All Chords



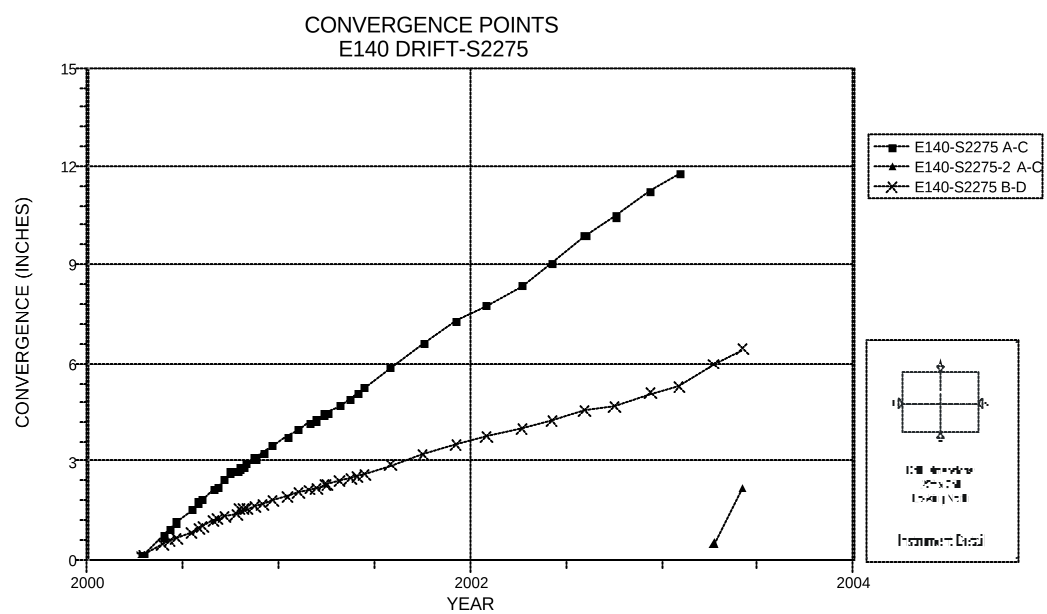
NOTES:
1. Excavation date: January 1993.
2. Roof excavated to Anhydrite "b", March 2003.

Figure 4-116 Convergence Point Array
E140 Drift at S2122 – Roof to Floor



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

Figure 4-117 Convergence Point Array
E140 Drift at S2180 Drift Intersection – Roof to Floor



NOTES:
1. Excavation date: October 1999.
2. Roof excavated to Anhydrite "b", March 2003.

Figure 4-118 Convergence Point Array
E140 Drift at S2275 – All Chords

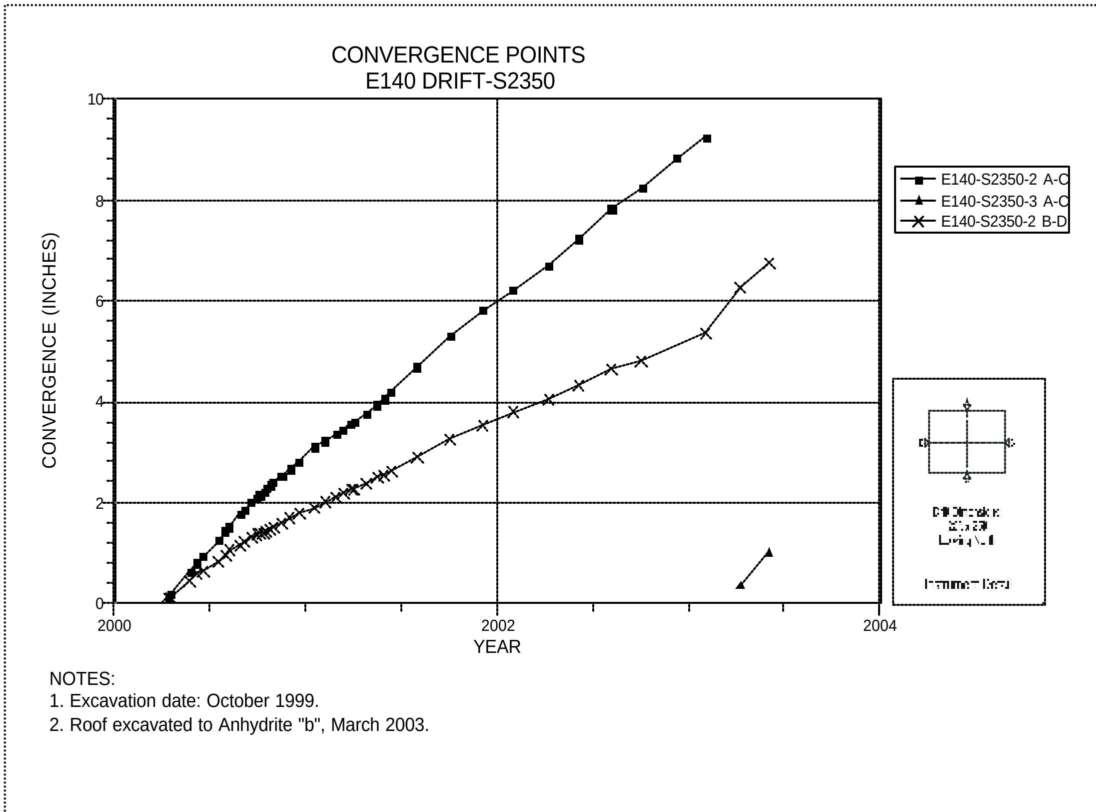


Figure 4-119 Convergence Point Array
E140 Drift at S2350 – All Chords

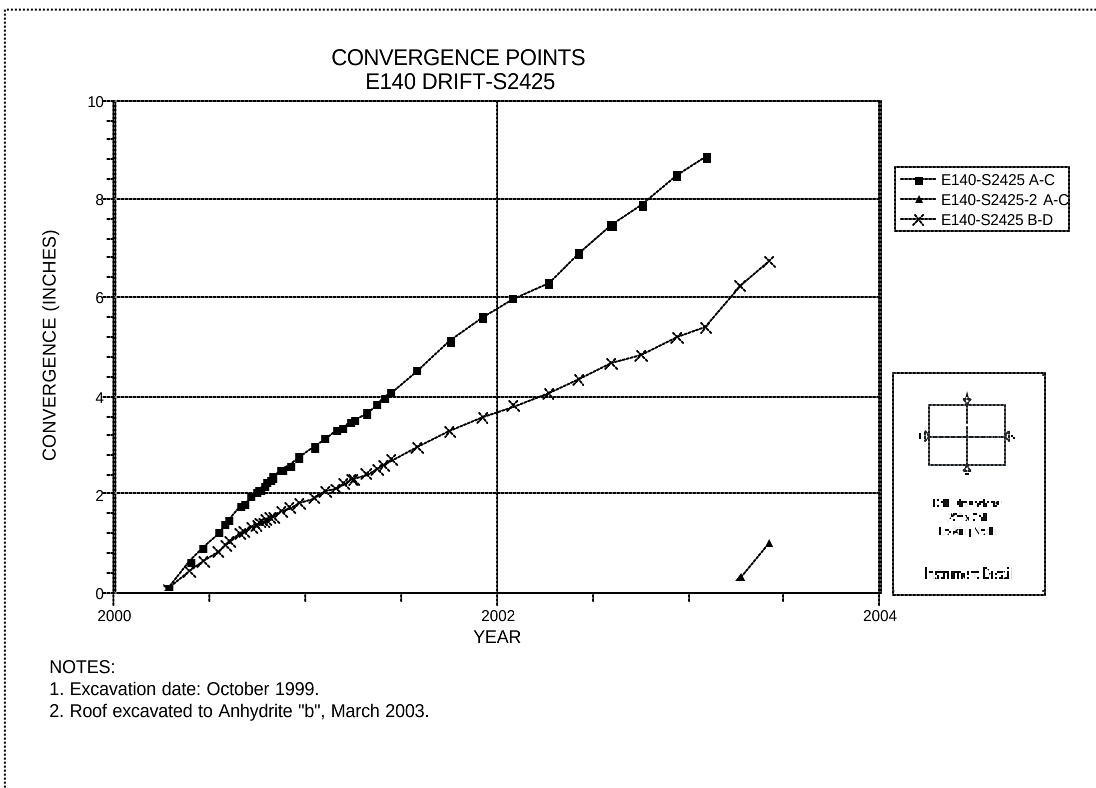
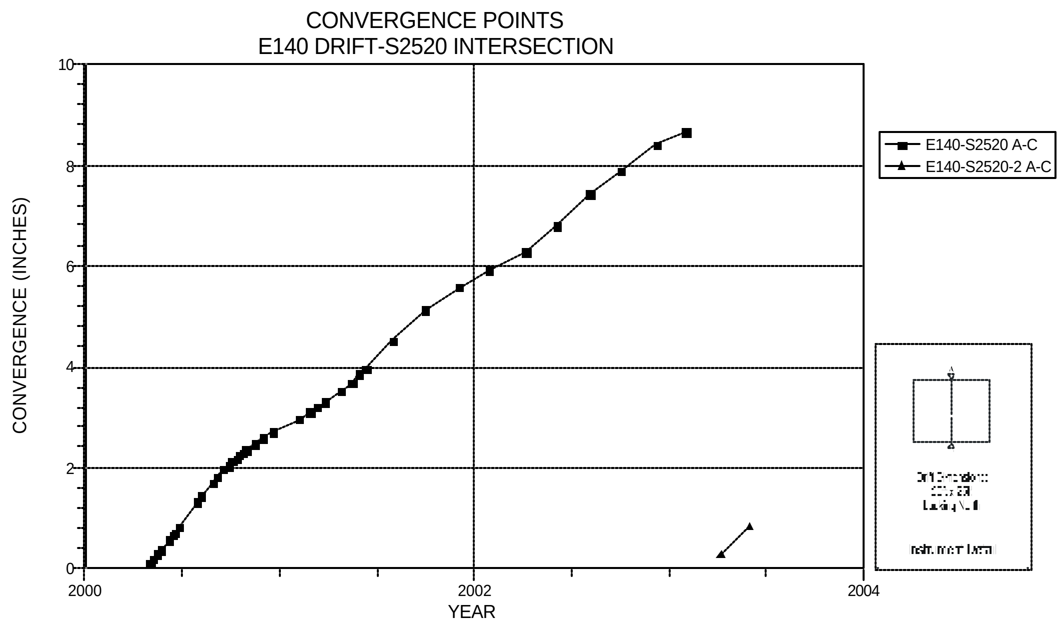
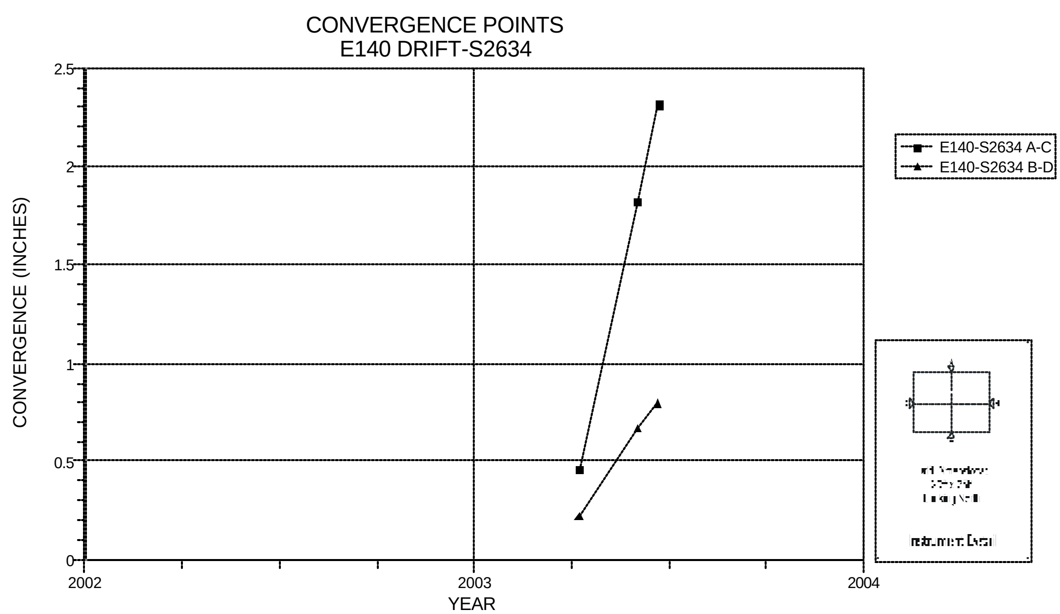


Figure 4-120 Convergence Point Array
E140 Drift at S2425 – All Chords



NOTES:
1. Excavation date: November 1999.
2. Roof excavated to Anhydrite "b", March 2003.

Figure 4-121 Convergence Point Array
E140 Drift at S2520 Drift Intersection – Roof to Floor



NOTES:
1. Installed date: March 2003.

Figure 4-122 Convergence Point Array
E140 Drift at S2634 – All Chords

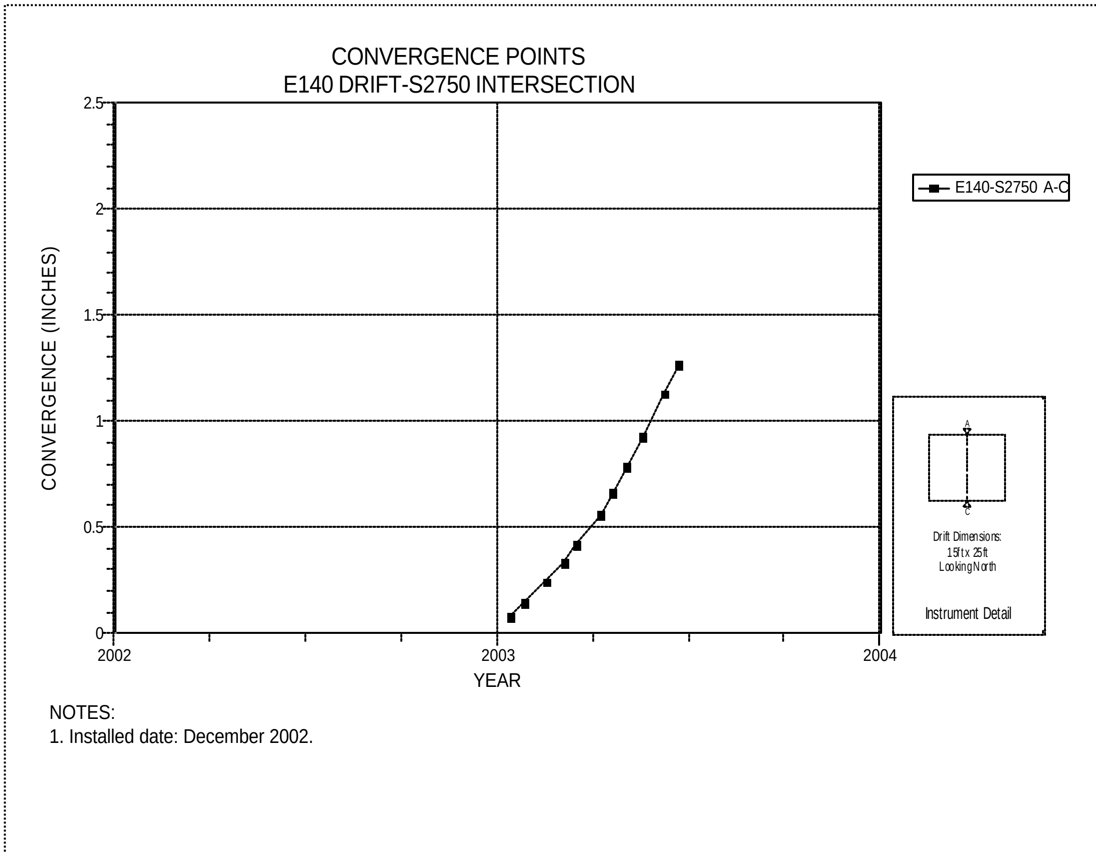


Figure 4-123 Convergence Point Array
E140 Drift at S2750 Drift Intersection – Roof to Floor

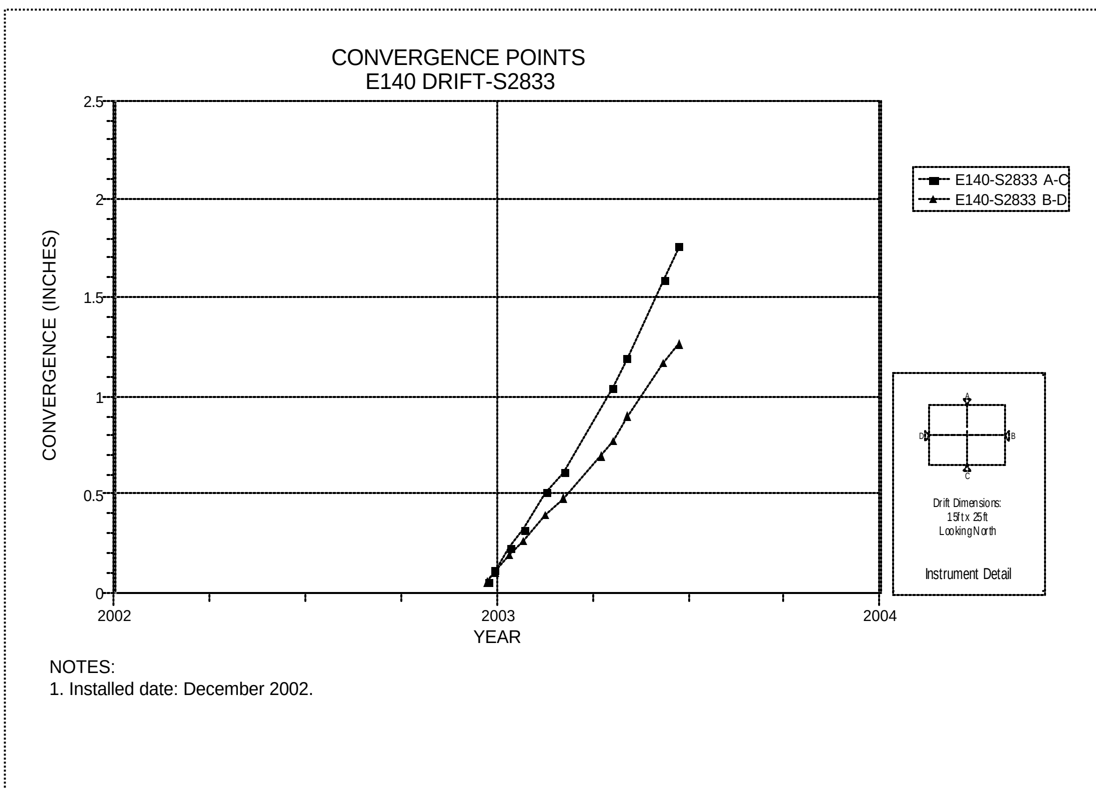
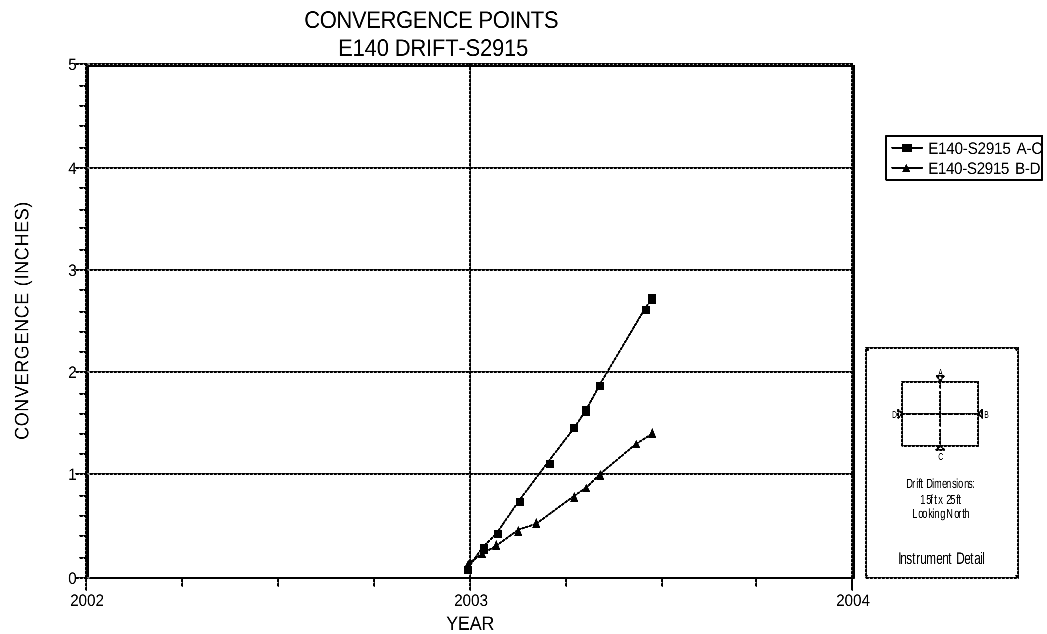
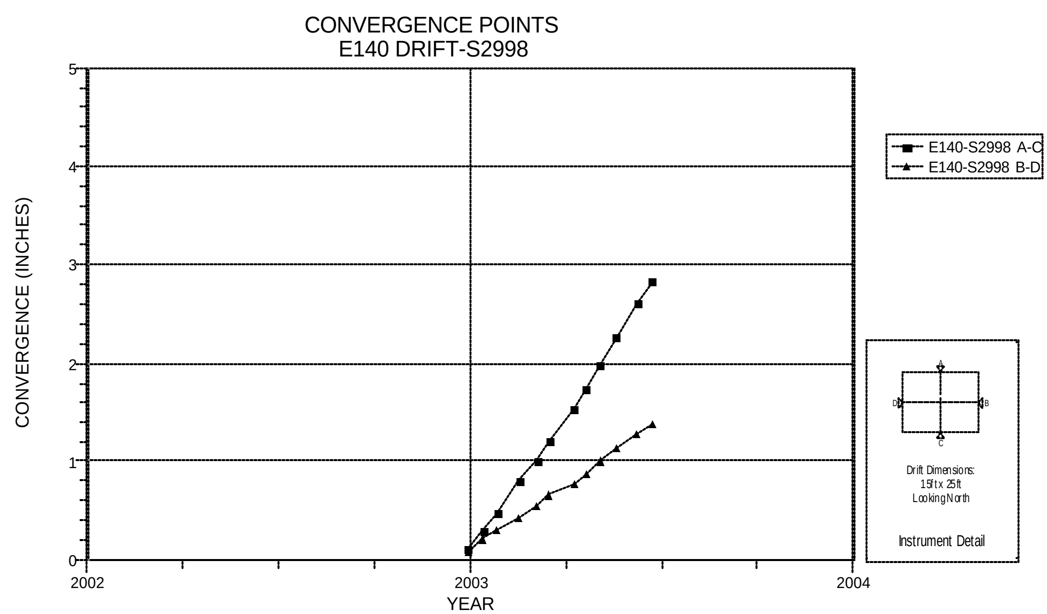


Figure 4-124 Convergence Point Array
E140 Drift at S2833 – All Chords



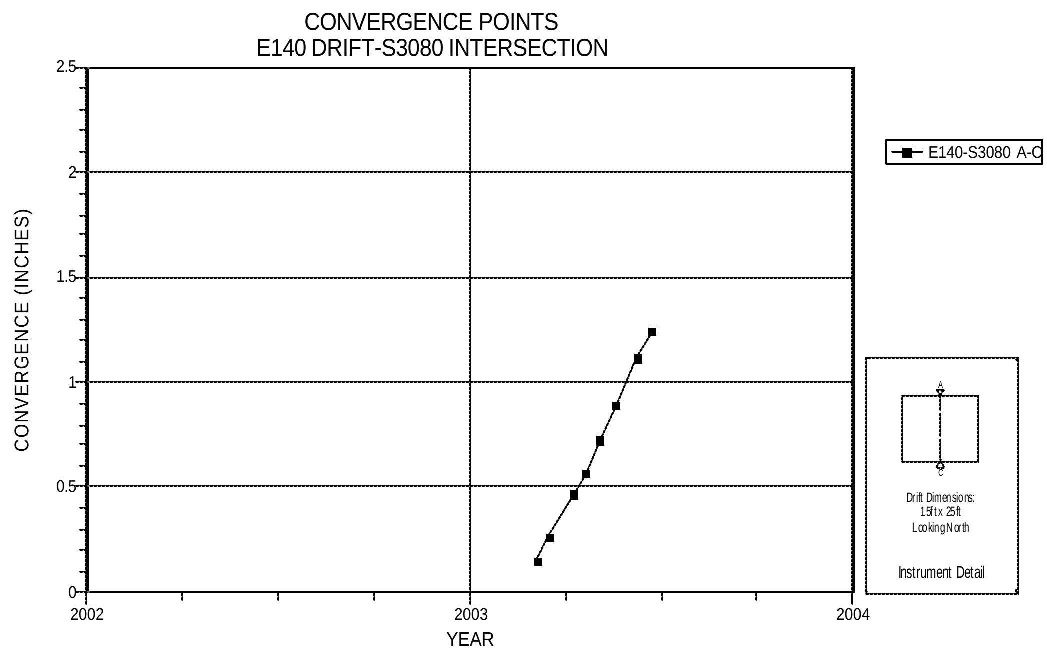
NOTES:
1. Installed date: December 2002.

Figure 4-125 Convergence Point Array
E140 Drift at S2915 – All Chords



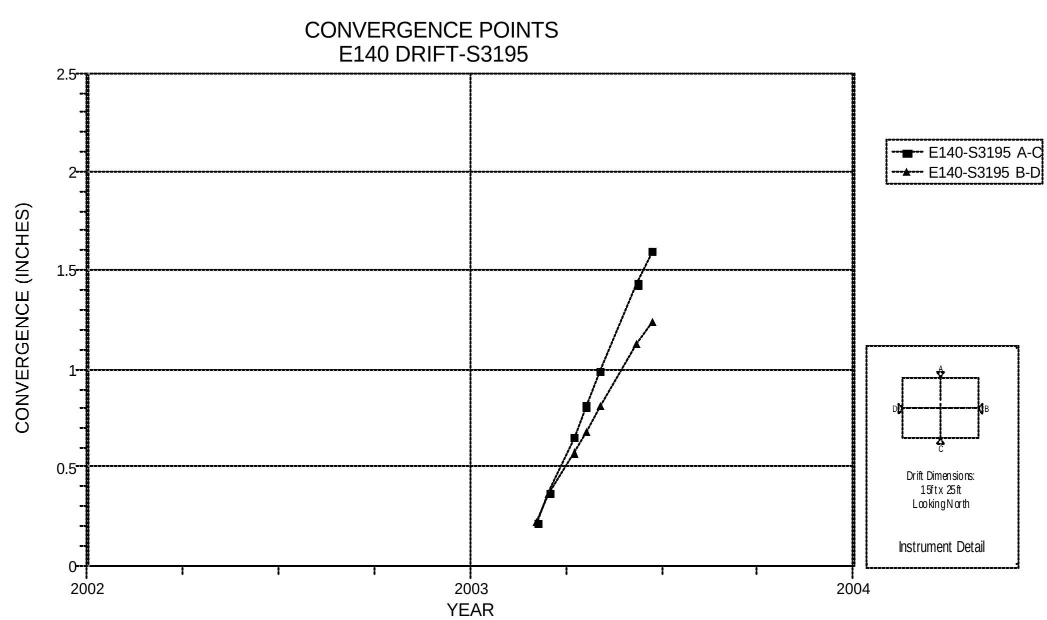
NOTES:
1. Installed date: December 2002.

Figure 4-126 Convergence Point Array
E140 Drift at S2998 – All Chords



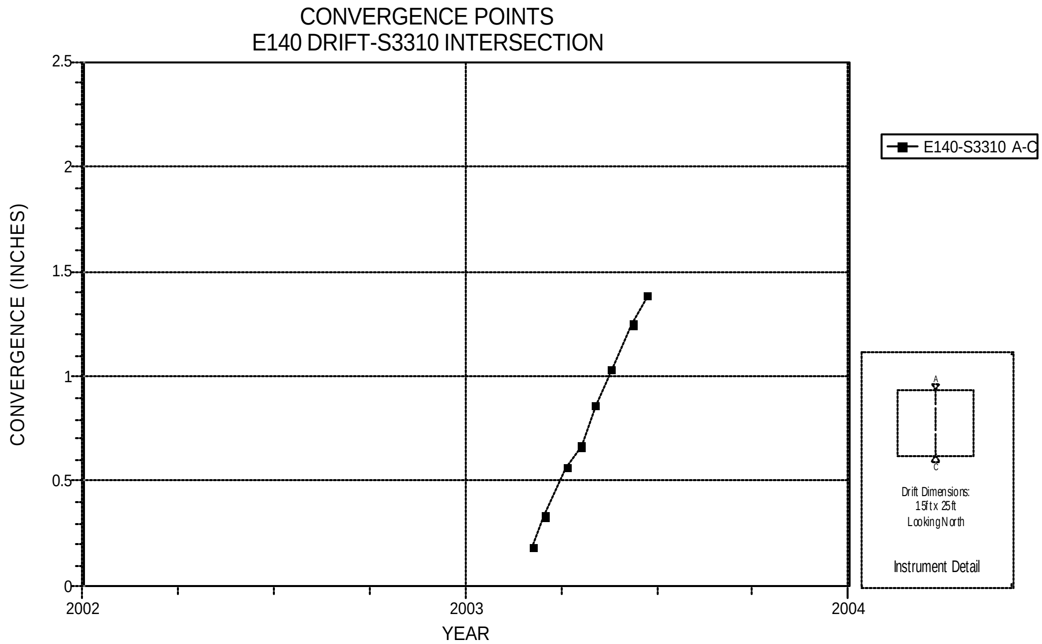
NOTES:
1. Installed date: February 2003.

Figure 4-127 Convergence Point Array
E140 Drift at S3080 Drift Intersection – Roof to Floor



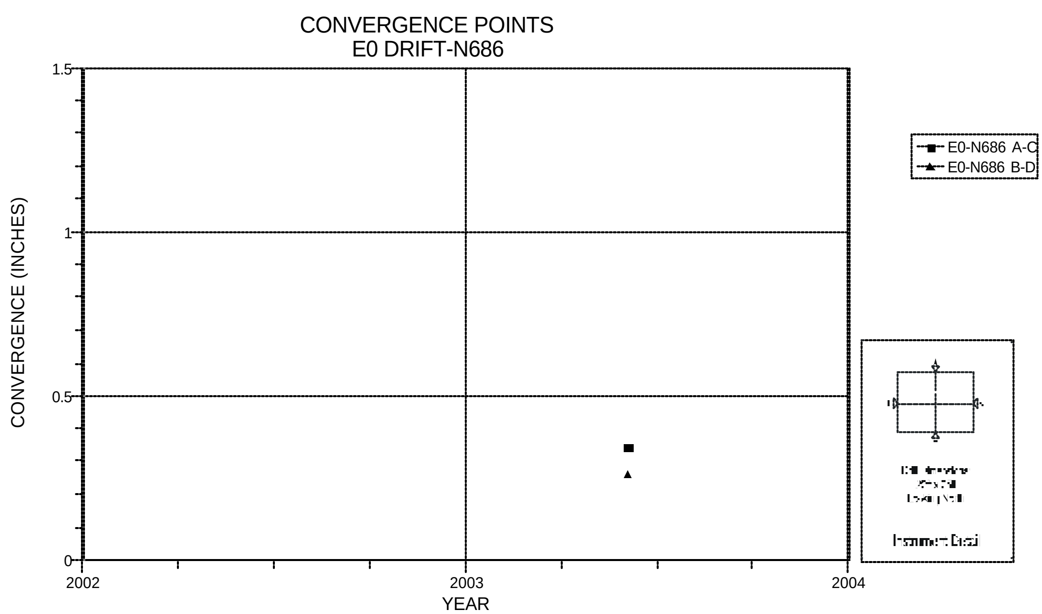
NOTES:
1. Installed date: February 2003.

Figure 4-128 Convergence Point Array
E140 Drift at S3195 – All Chords



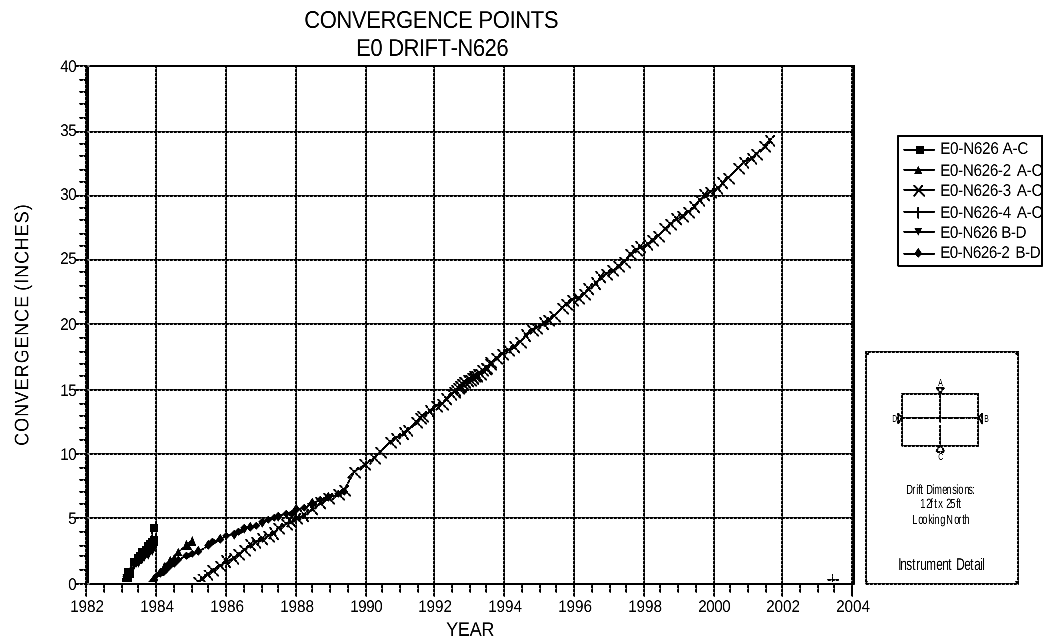
NOTES:
1. Installed date: February 2003.

Figure 4-129 Convergence Point Array
E140 Drift at S3310 Drift Intersection – Roof to Floor



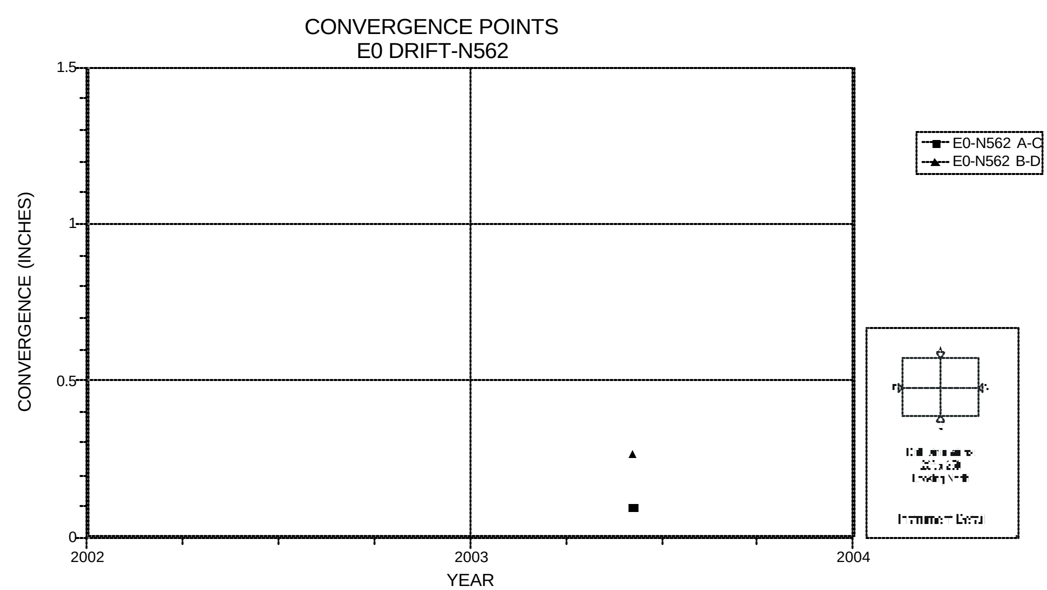
NOTES:
1. Installed date: April 2003.

Figure 4-130 Convergence Point Array
E0 Drift at N686 – All Chords



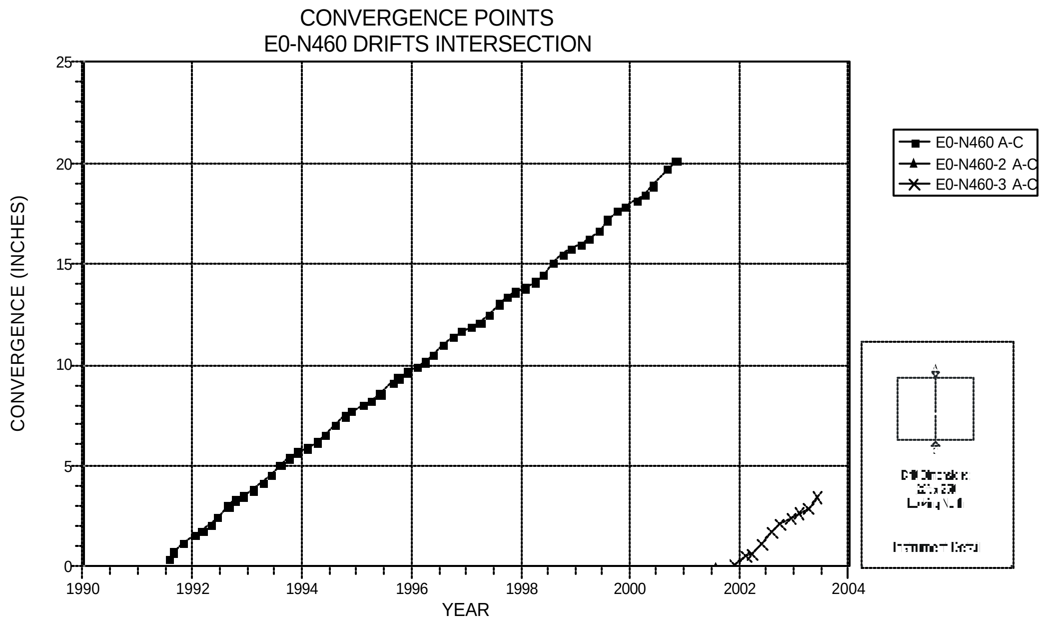
NOTES:
1. Excavation date: February 1983.
2. Roof excavated to Anhydrite "b".

Figure 4-131 Convergence Point Array
E0 Drift at N626 – All Chords



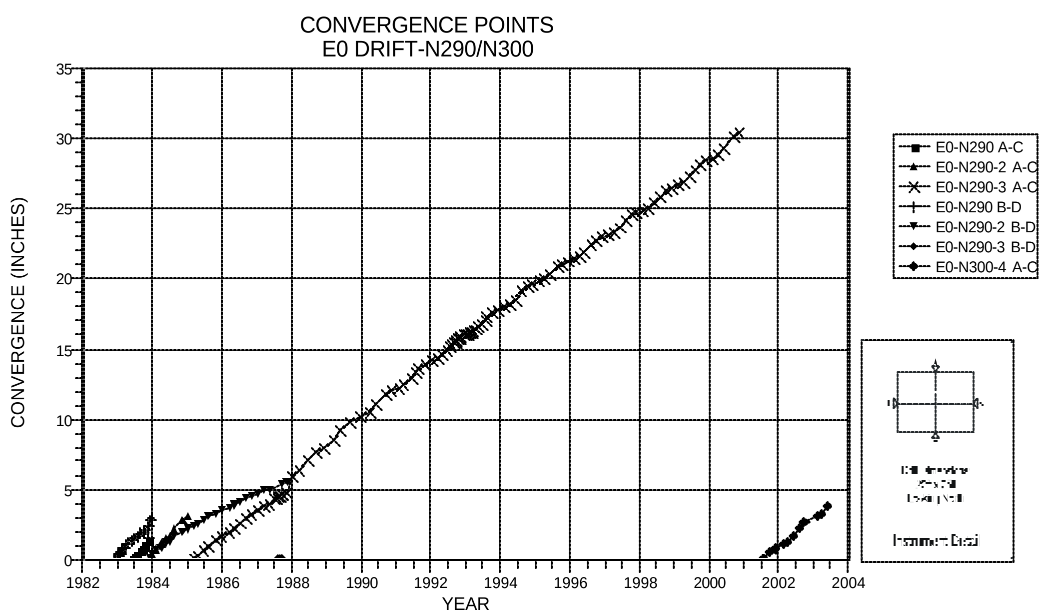
NOTES:
1. Installed date: April 2003.

Figure 4-132 Convergence Point Array
E0 Drift at N562 – All Chords



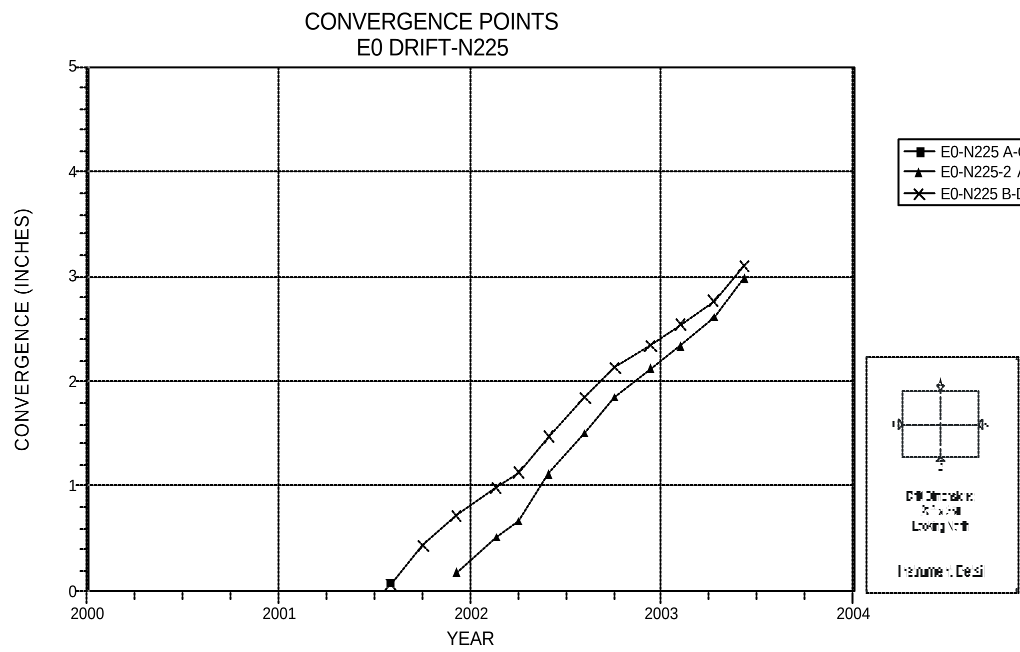
NOTES:
1. Excavation date: January 1983.
2. Roof excavated to Anhydrite "b".

Figure 4-133 Convergence Point Array
E0 Drift at N460 Drift Intersection – Roof to Floor



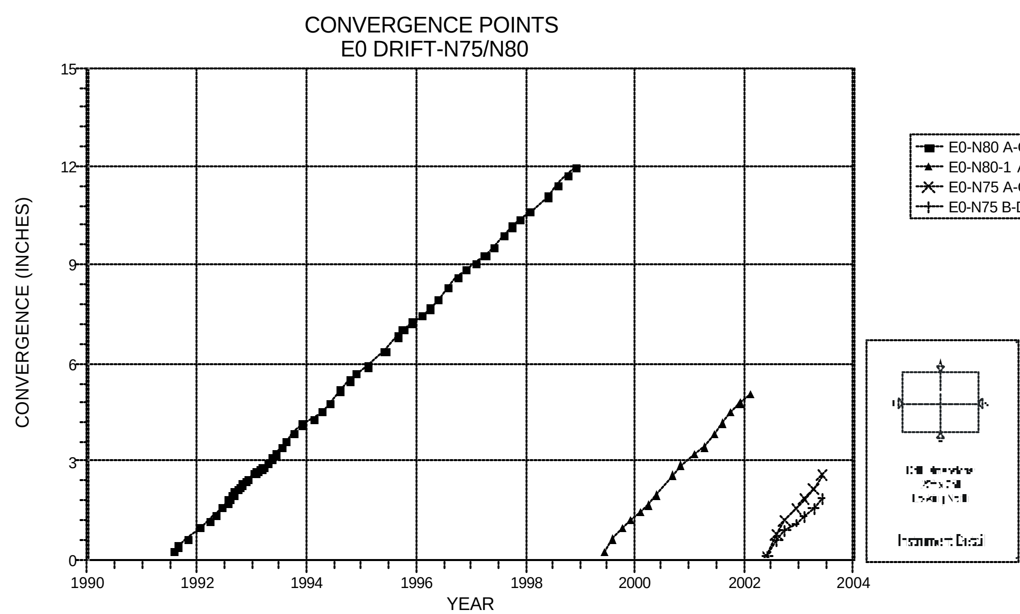
NOTES:
1. Excavation date: December 1982.
2. Chord B-D removed as a result of N300 drift.
3. E0-N290 was replaced by E0-N300.
4. Roof excavated to Anhydrite "b".

Figure 4-134 Convergence Point Array
E0 Drift at N300 – All Chords



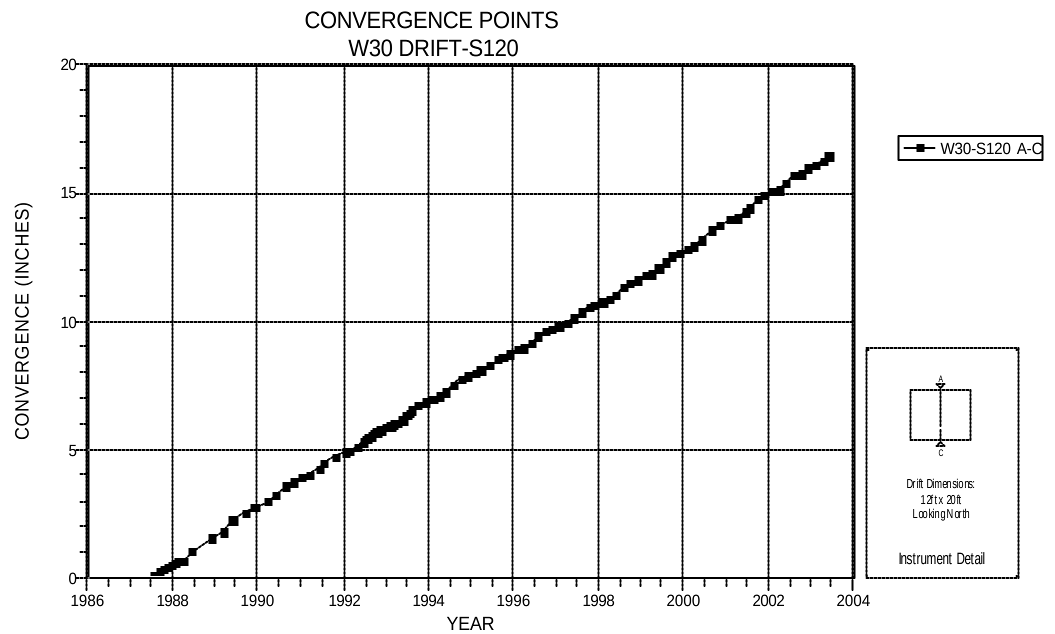
NOTES:
1. E0-N225 replaced E0-N200.
2. Roof excavated to Anhydrite "b".

Figure 4-135 Convergence Point Array
E0 Drift at N225 – All Chords



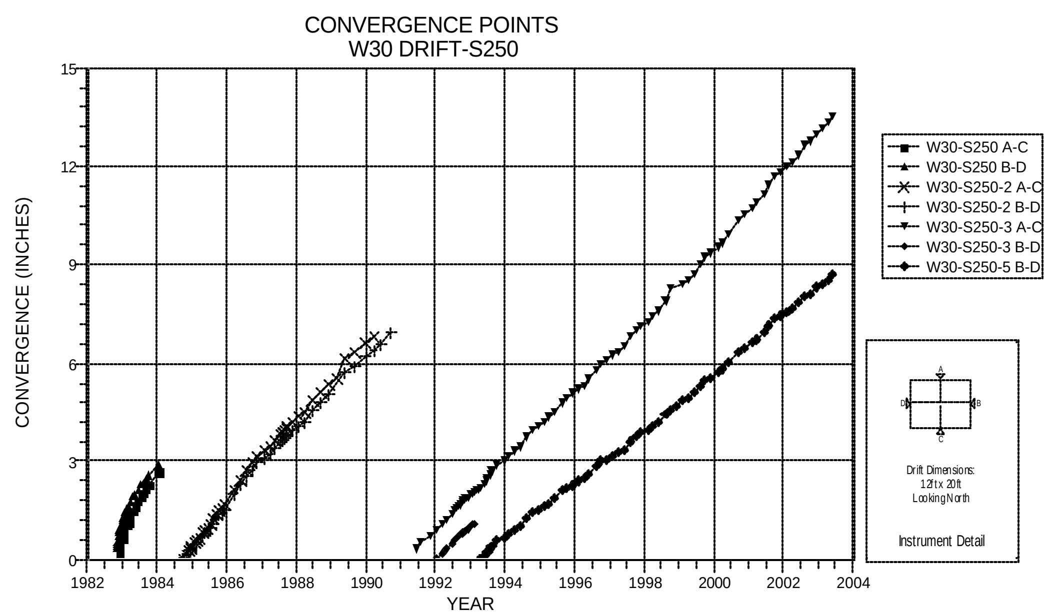
NOTES:
1. Excavation date: October 1982.
2. Formerly designated as E0-N80.
3. Roof excavated to Anhydrite "b".

Figure 4-136 Convergence Point Array
E0 Drift at N75 – All Chords



NOTES:
1. Excavation date: October 1982.

Figure 4-137 Convergence Point Array
W30 Drift at S120 – Roof to Floor



NOTES:
1. Excavation date: October 1982.

Figure 4-138 Convergence Point Array
W30 Drift at S250 – All Chords

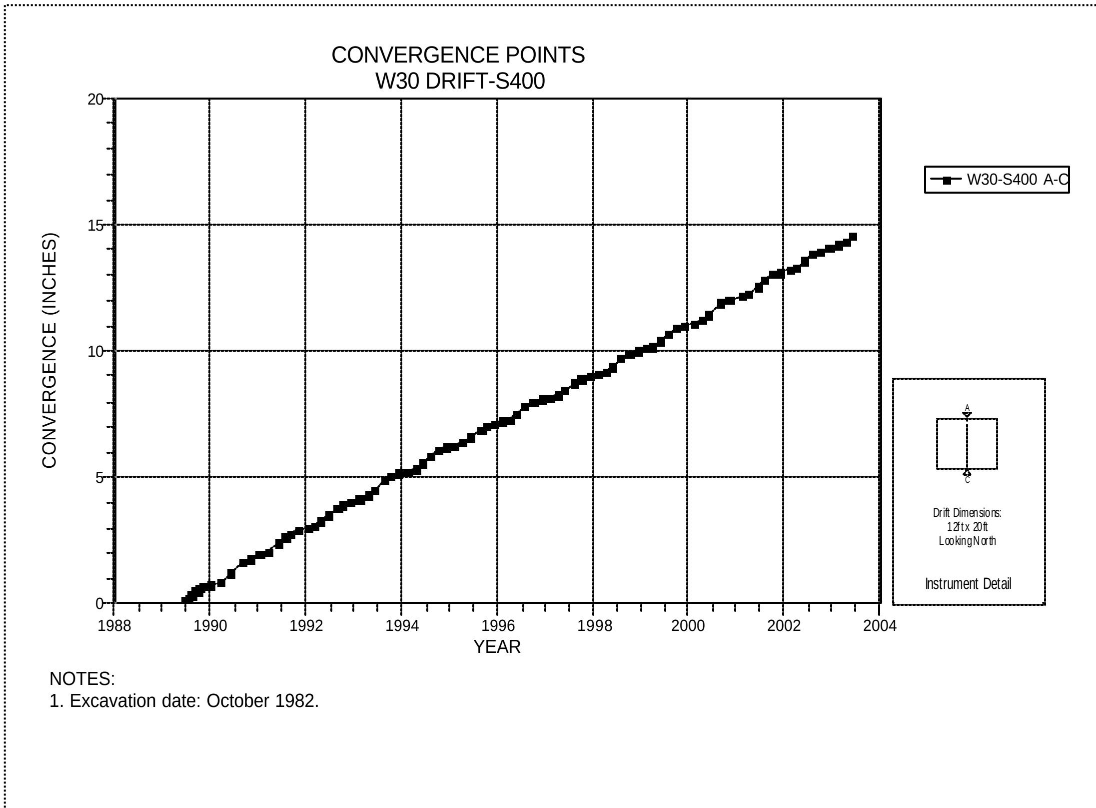


Figure 4-139 Convergence Point Array
W30 Drift at S400 Drift Intersection – Roof to Floor

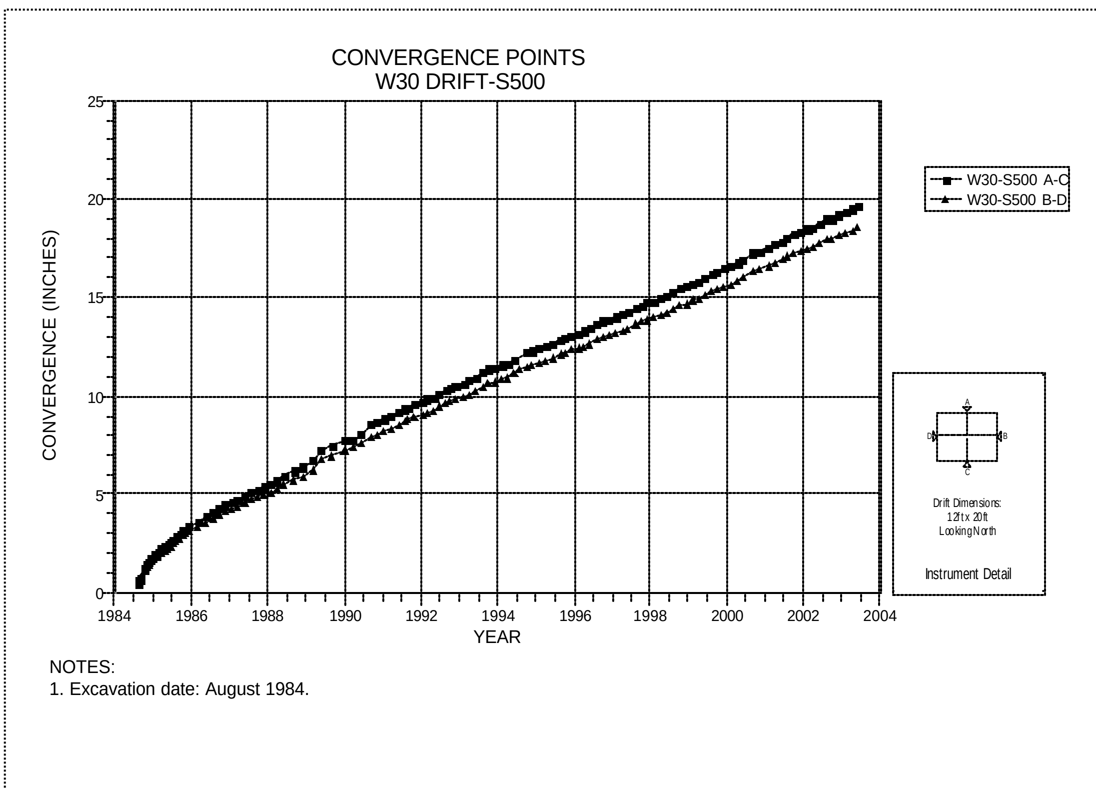


Figure 4-140 Convergence Point Array
W30 Drift at S500 – All Chords

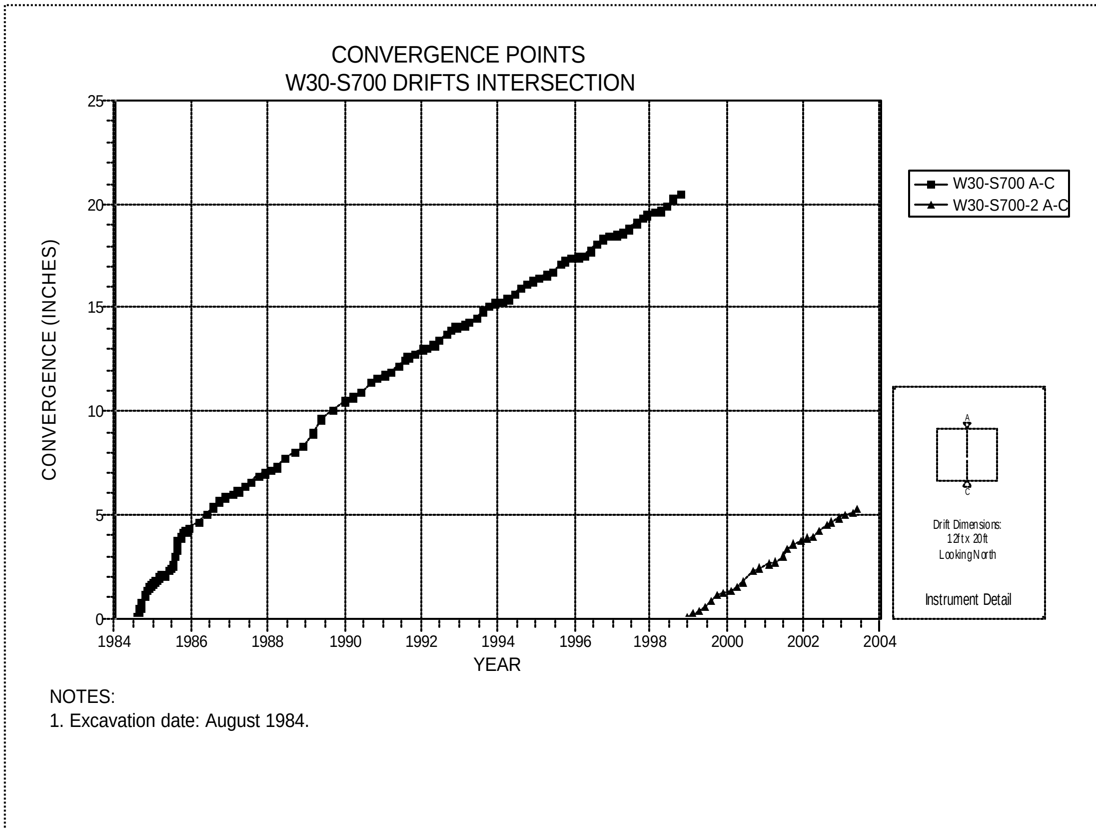


Figure 4-141 Convergence Point Array
W30 Drift at S700 Drift Intersection – Roof to Floor

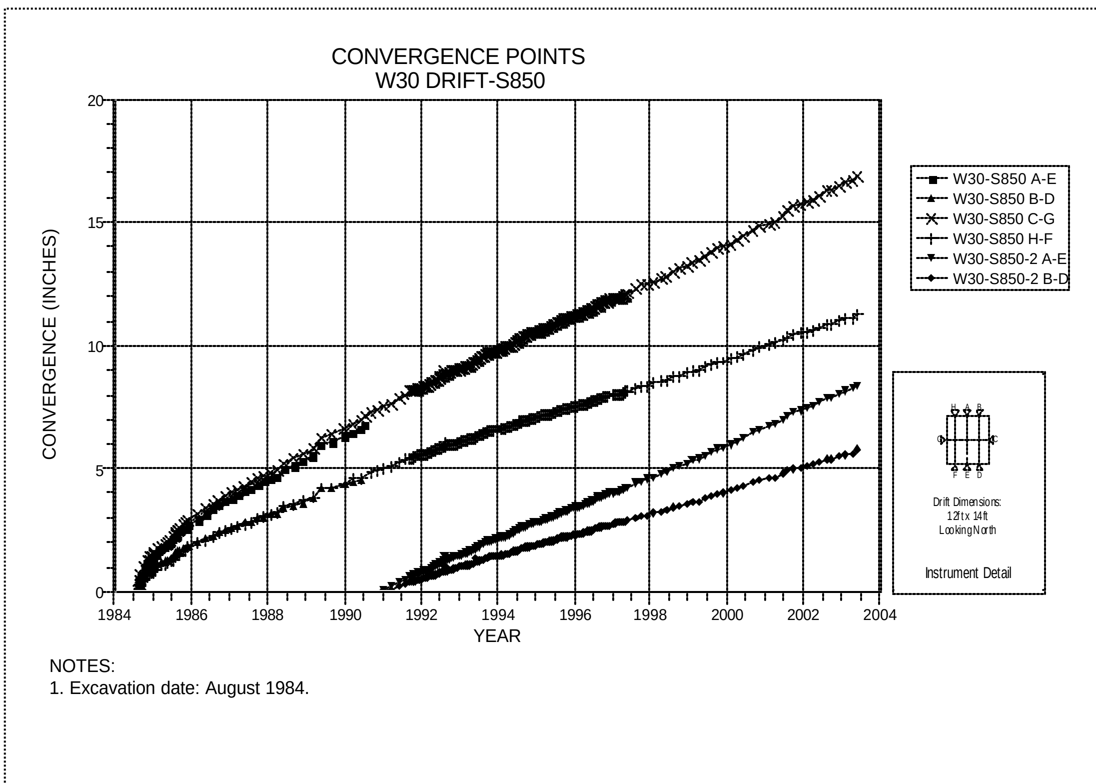
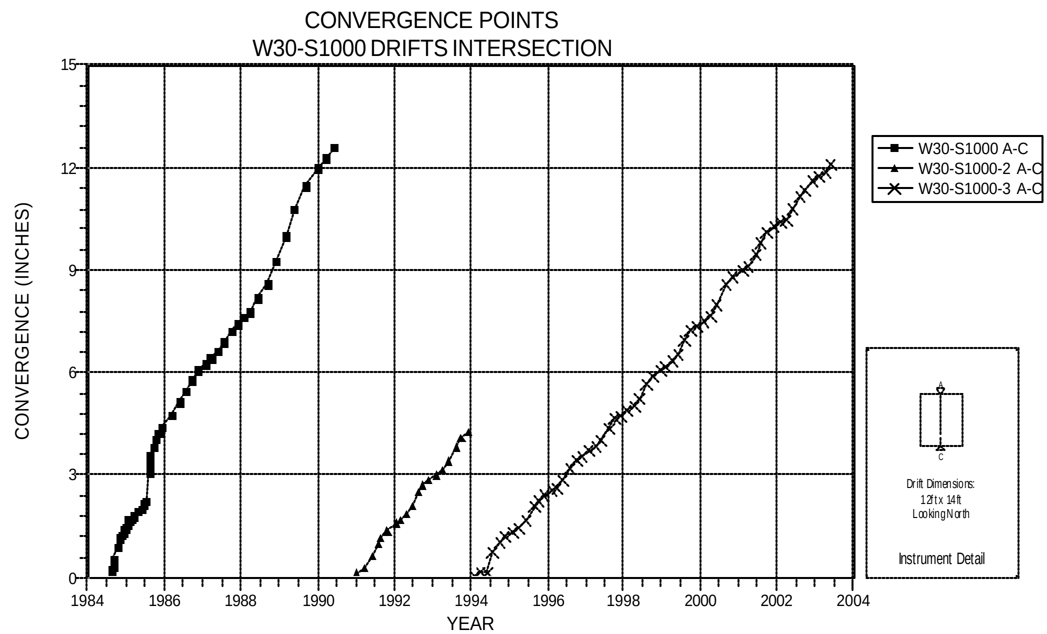
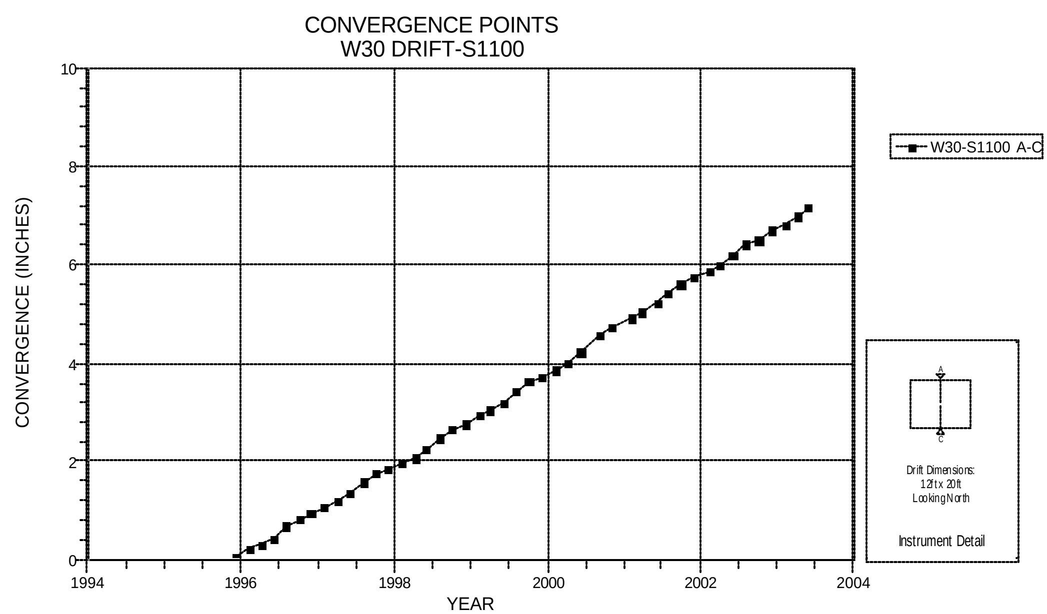


Figure 4-142 Convergence Point Array
W30 Drift at S850 – All Chords



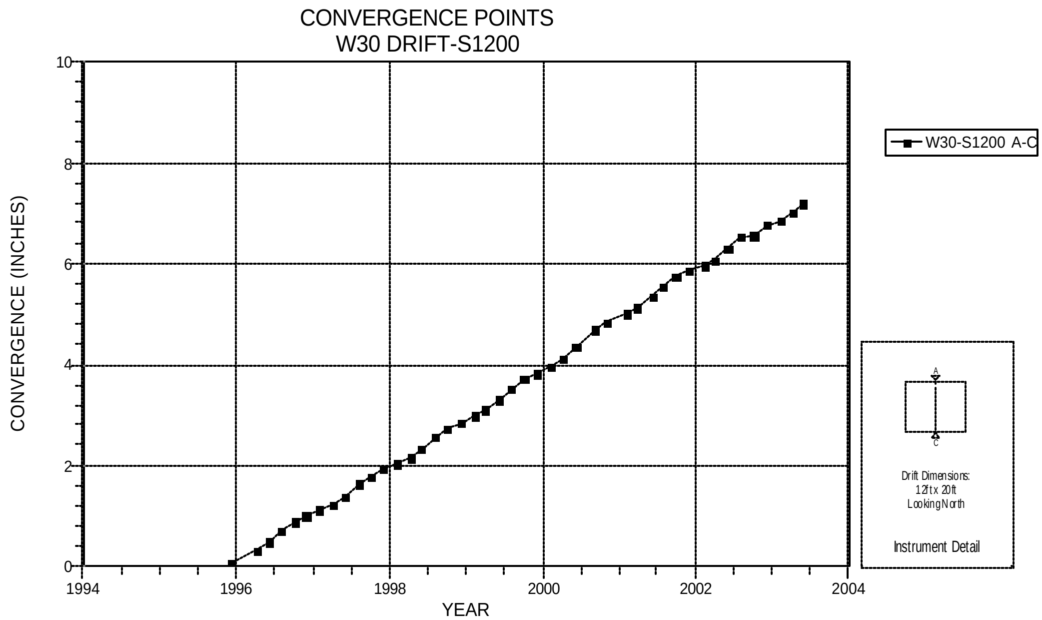
NOTES:
1. Excavation date: August 1984.

Figure 4-143 Convergence Point Array
W30 Drift at S1000 Drift Intersection – Roof to Floor



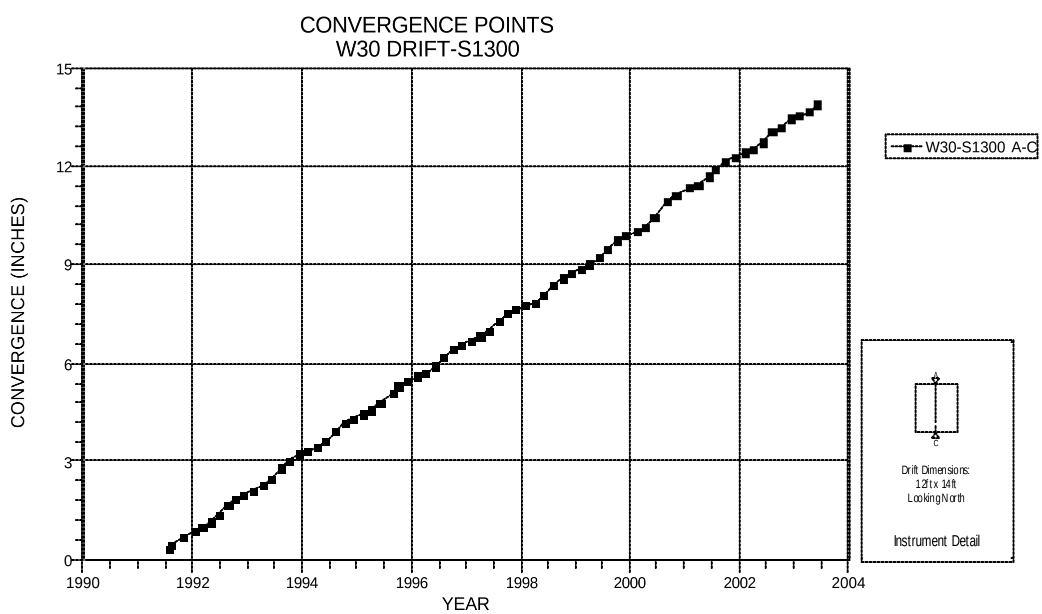
NOTES:
1. Excavation date: October 1982.

Figure 4-144 Convergence Point Array
W30 Drift at S1100 – Roof to Floor



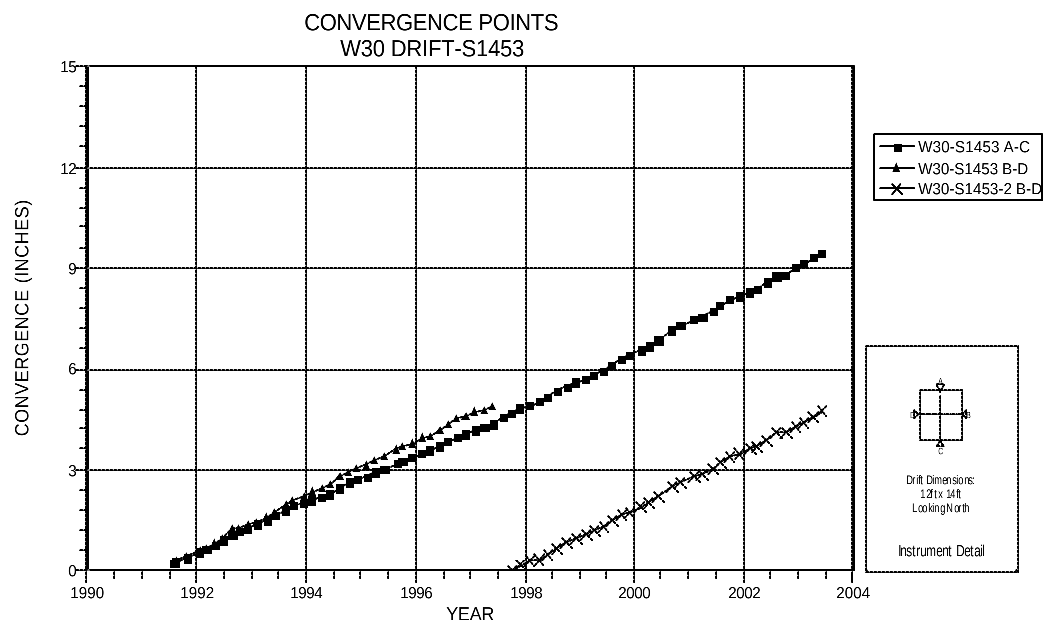
NOTES:
1. Excavation date: October 1982.

Figure 4-145 Convergence Point Array
W30 Drift at S1200 – Roof to Floor



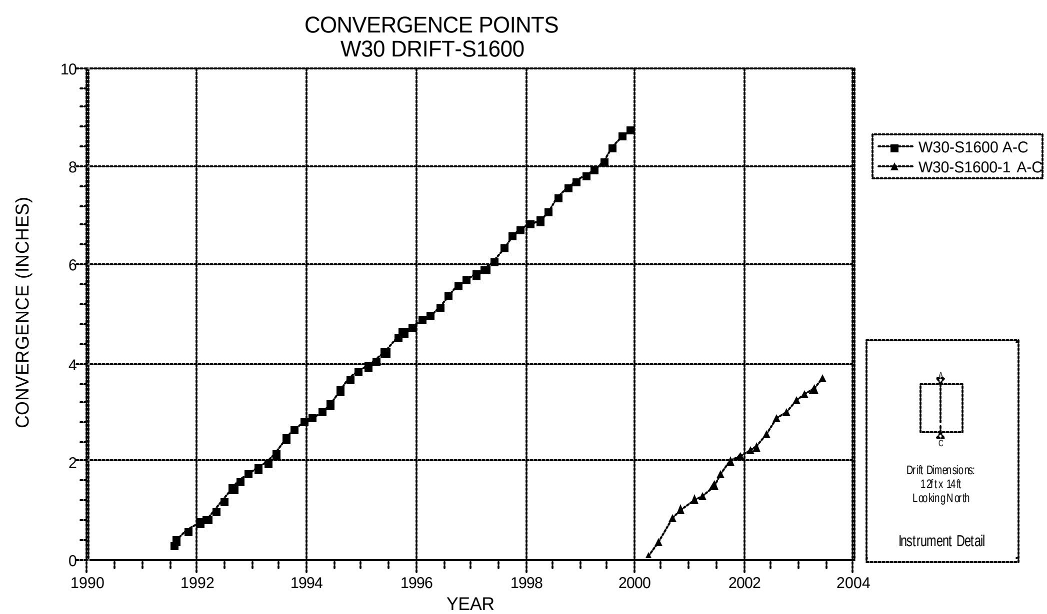
NOTES:
1. Excavation date: August 1984.

Figure 4-146 Convergence Point Array
W30 Drift at S1300 Drift Intersection – Roof to Floor



NOTES:
1. Excavation date: August 1984.

Figure 4-147 Convergence Point Array
W30 Drift at S1453 – All Chords



NOTES:
1. Excavation date: September 1984.

Figure 4-148 Convergence Point Array
W30 Drift at S1600 Drift Intersection – Roof to Floor

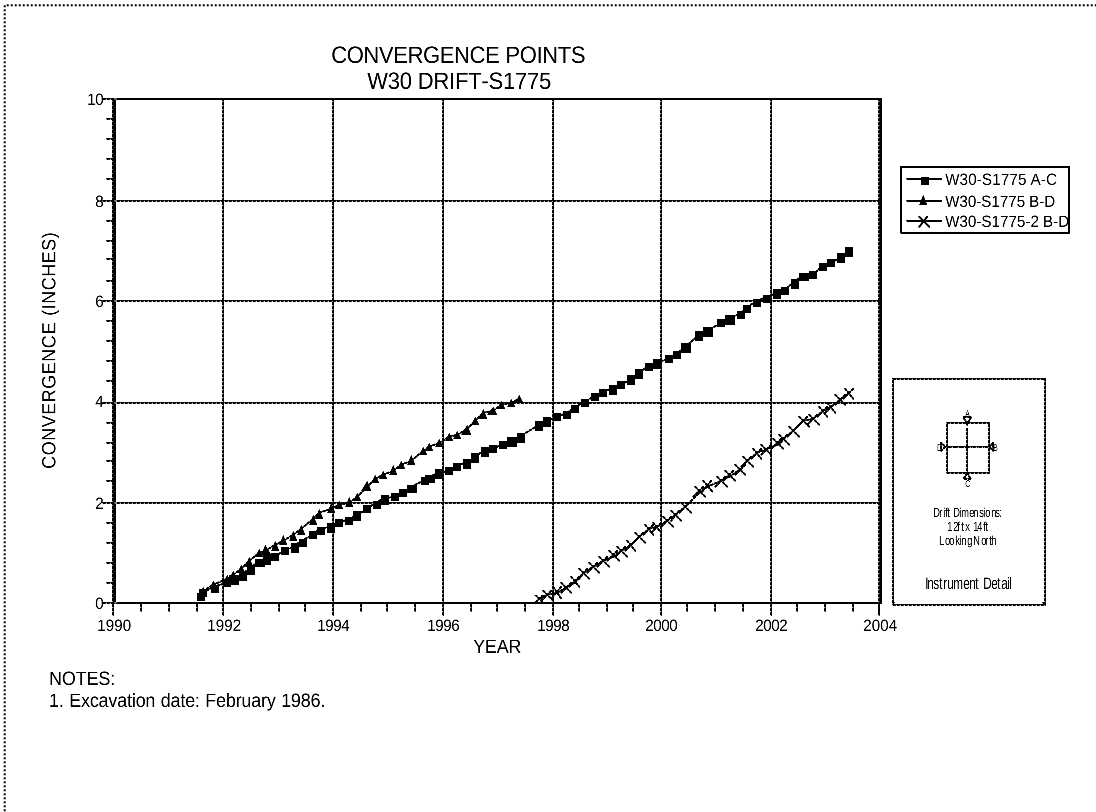


Figure 4-149 Convergence Point Array
W30 Drift at S1775 – All Chords

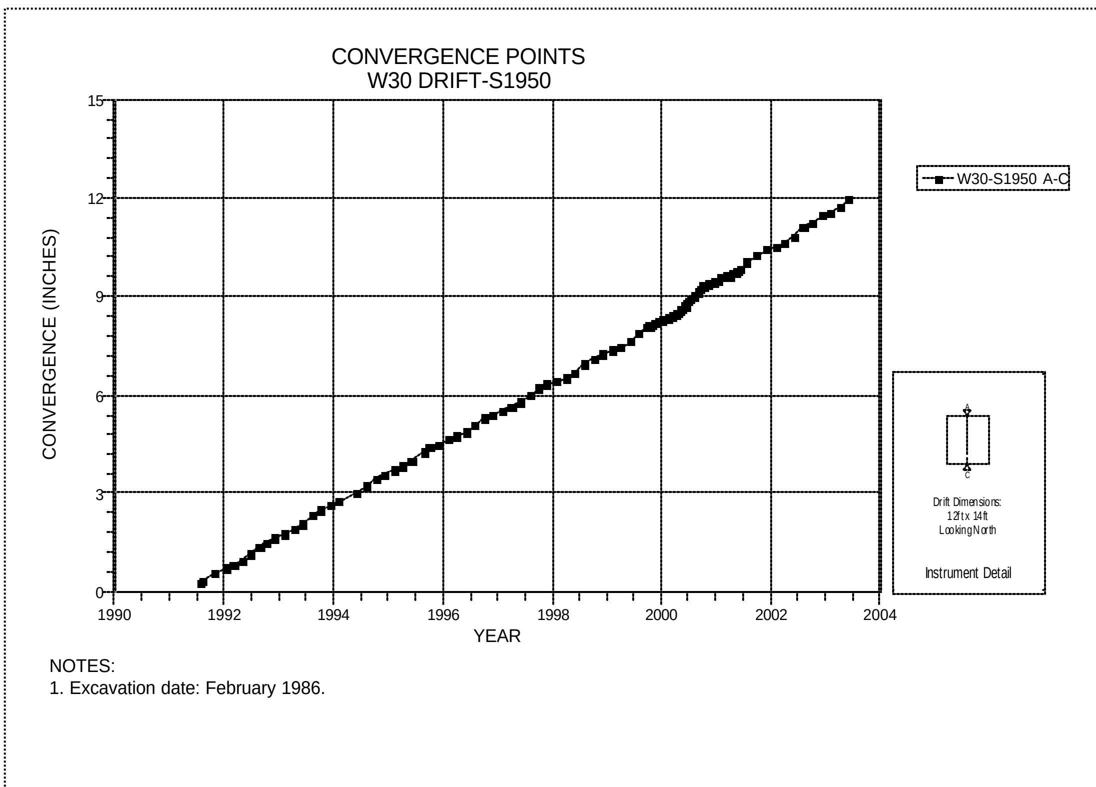


Figure 4-150 Convergence Point Array
W30 Drift at S1950 Drift Intersection – Roof to Floor

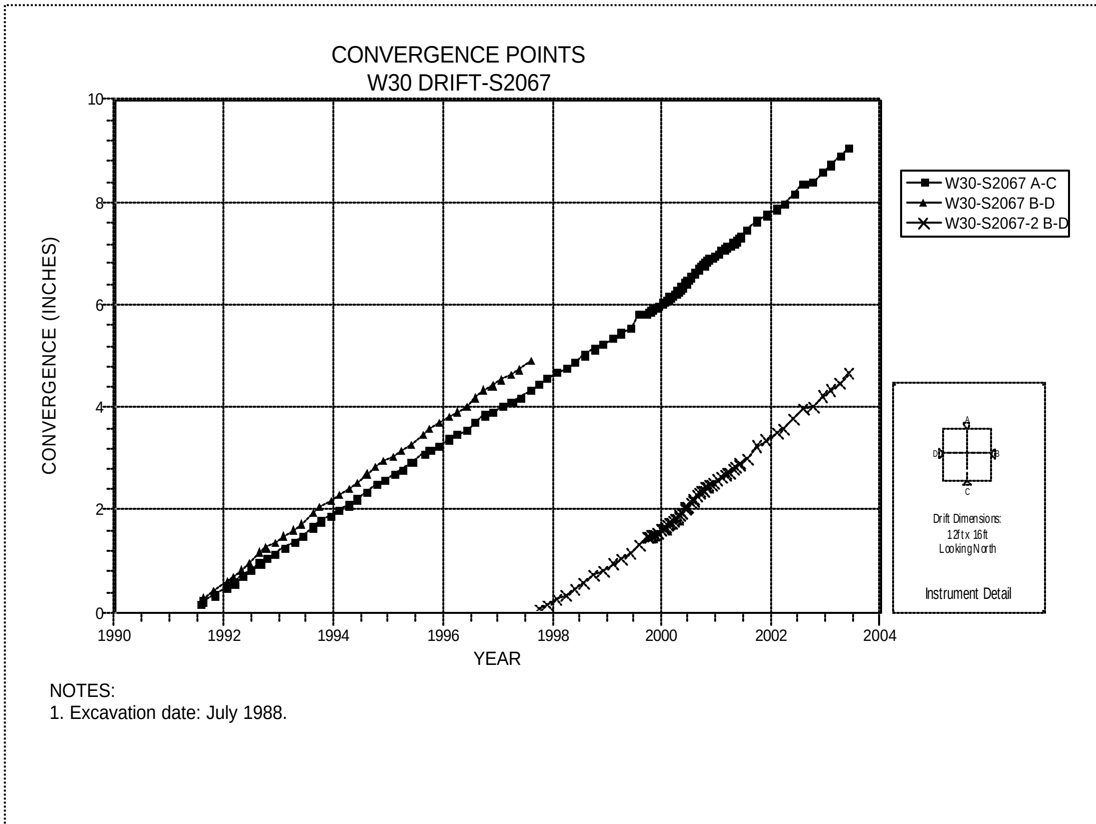


Figure 4-151 Convergence Point Array
W30 Drift at S2067 – All Chords

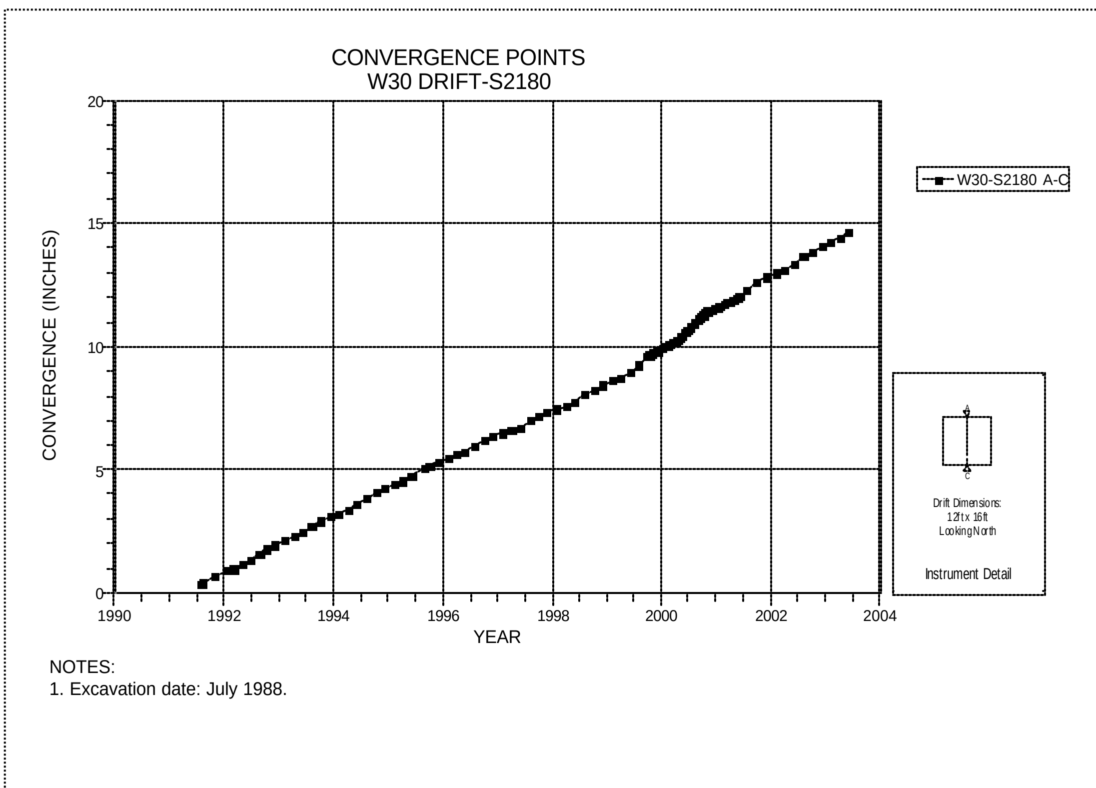


Figure 4-152 Convergence Point Array
W30 Drift at S2180 Drift Intersection – Roof to Floor

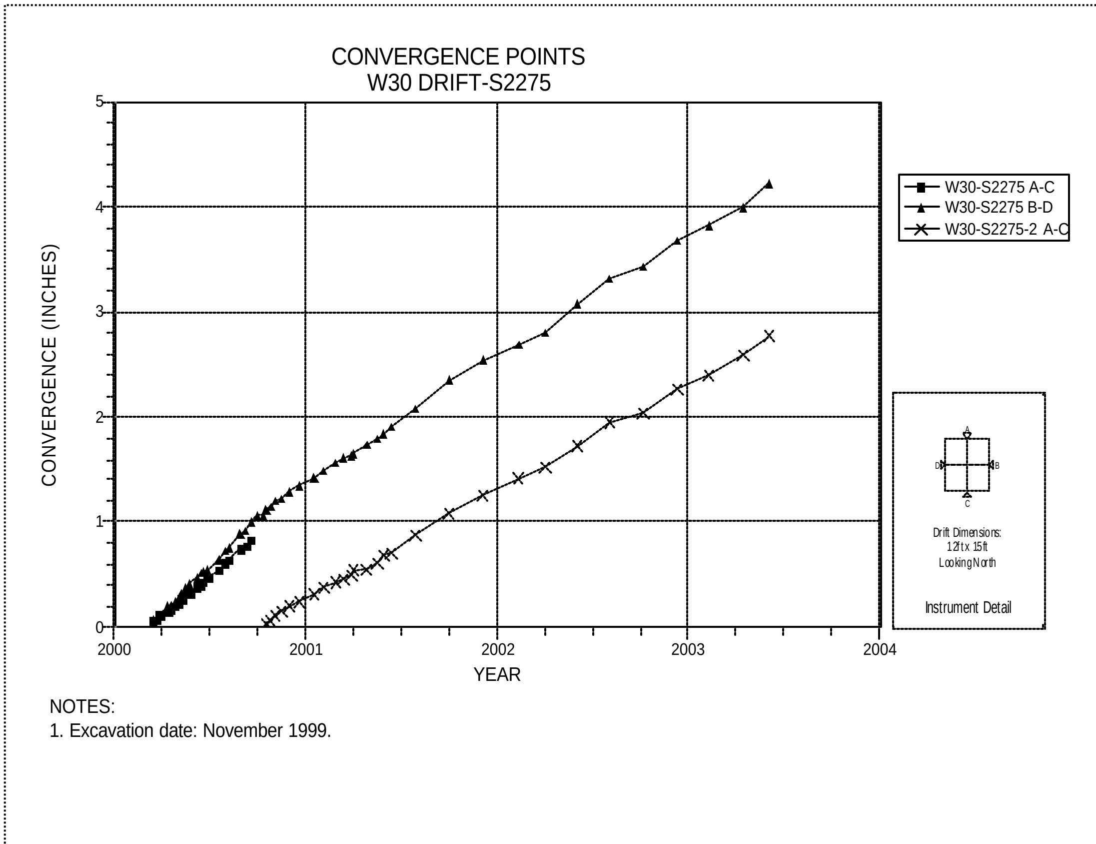


Figure 4-153 Convergence Point Array
W30 Drift at S2275 – All Chords

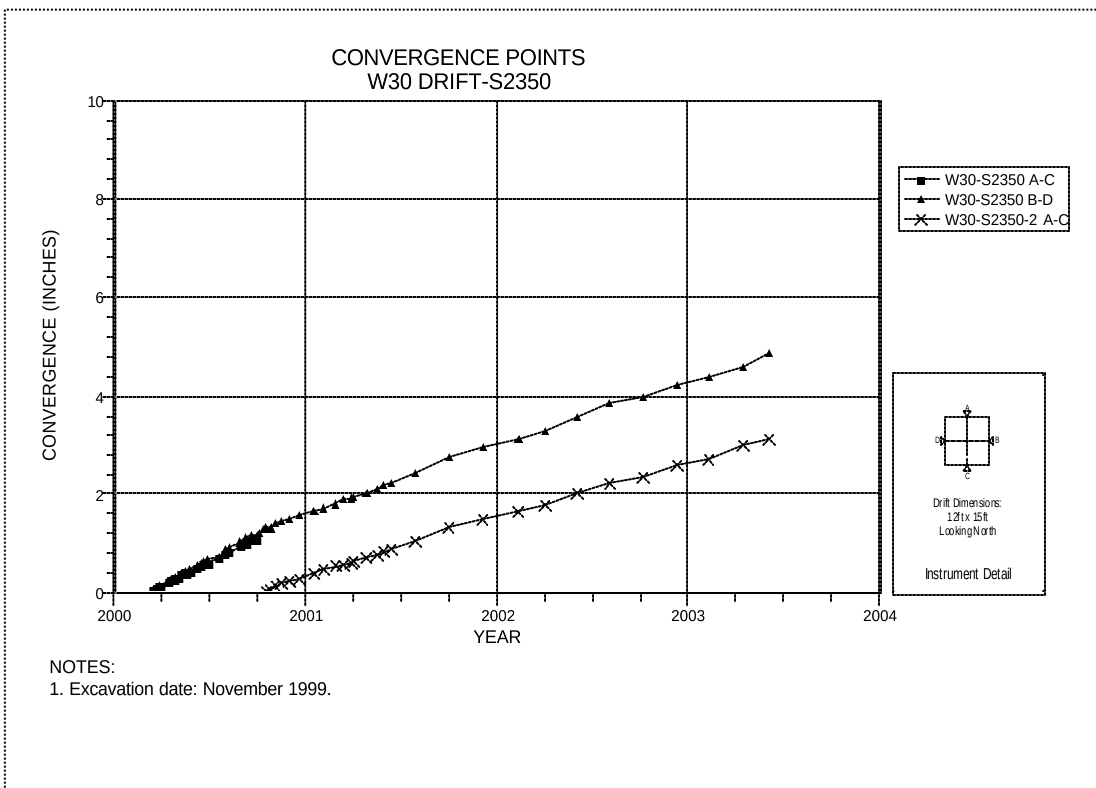


Figure 4-154 Convergence Point Array
W30 Drift at S2350 – All Chords

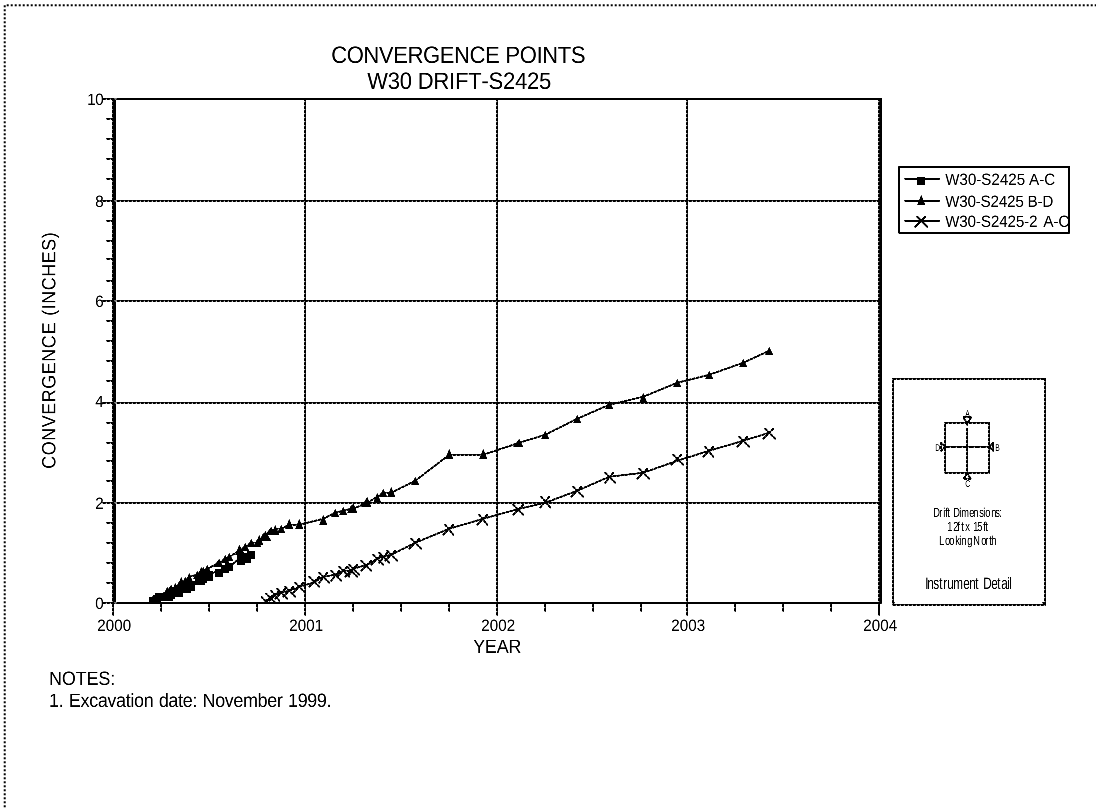


Figure 4-155 Convergence Point Array
W30 Drift at S2425 – All Chords

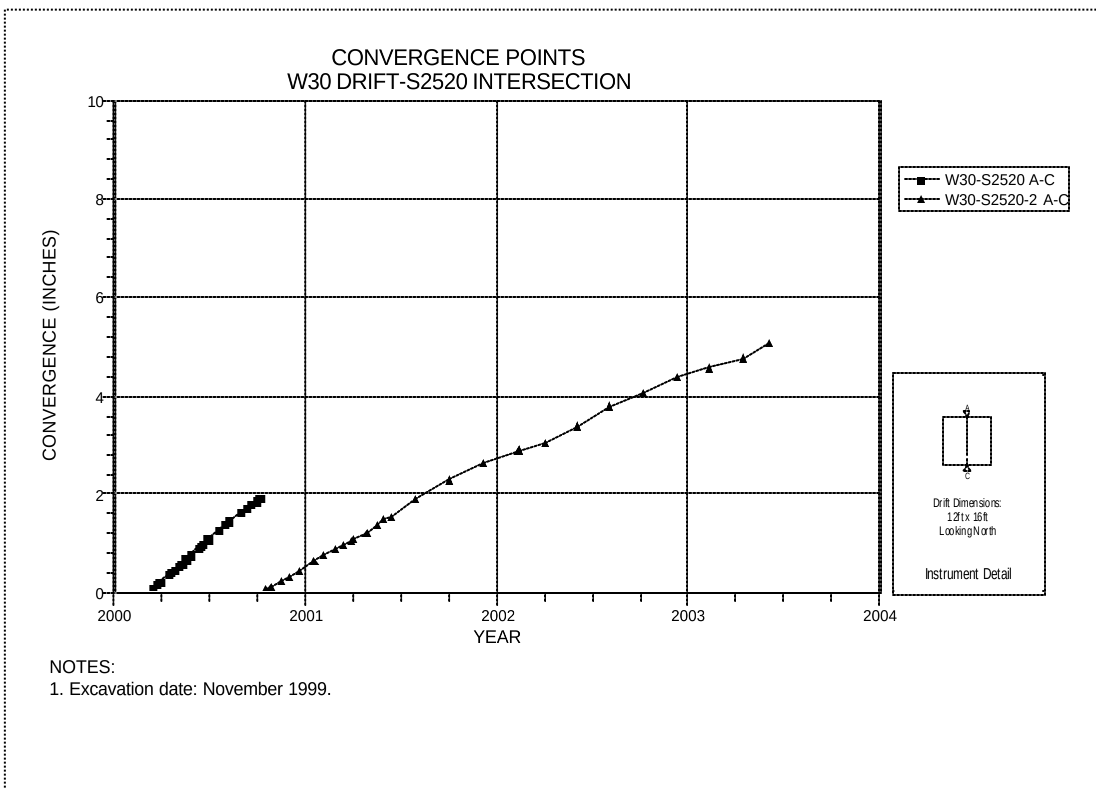


Figure 4-156 Convergence Point Array
W30 Drift at S2520 Drift Intersection – Roof to Floor

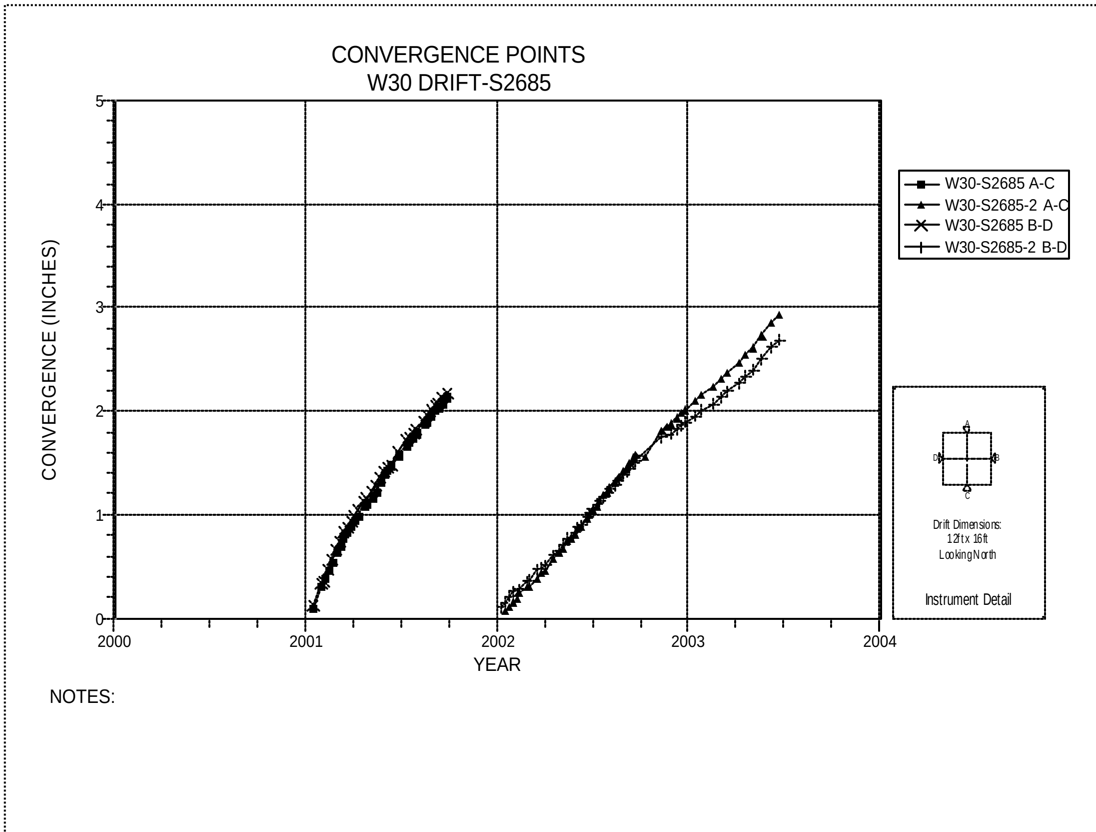


Figure 4-157 Convergence Point Array
W30 Drift at S2685 – All Chords

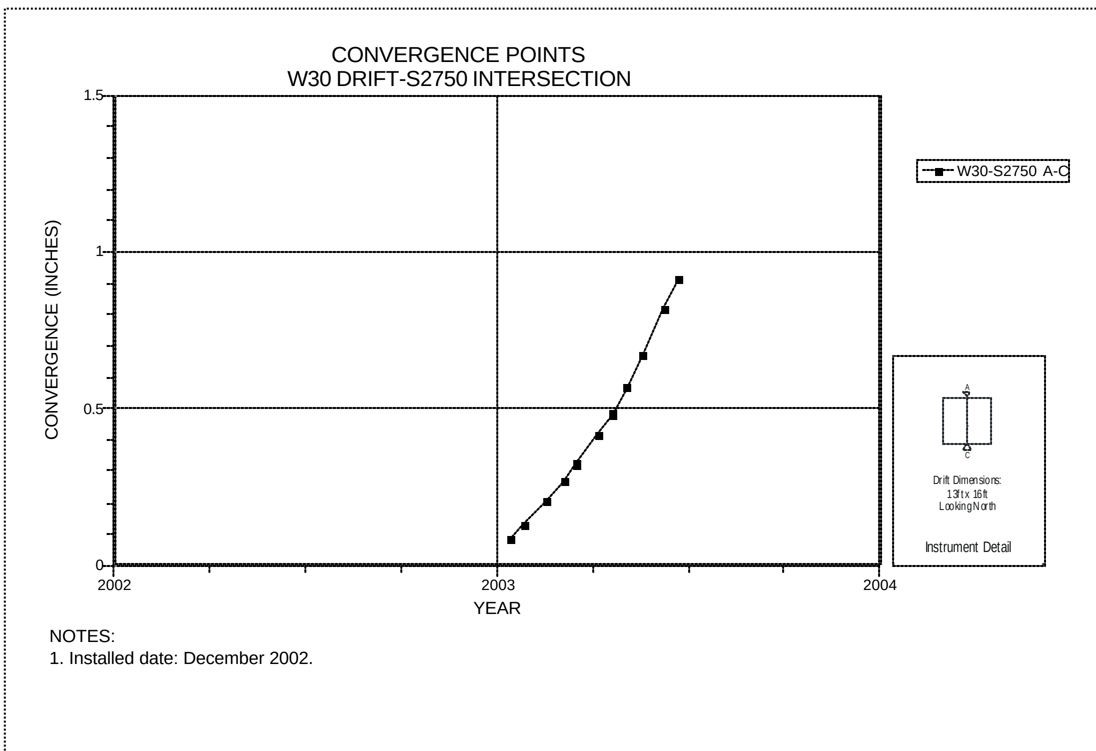


Figure 4-158 Convergence Point Array
W30 Drift at S2750 Drift Intersection – Roof to Floor

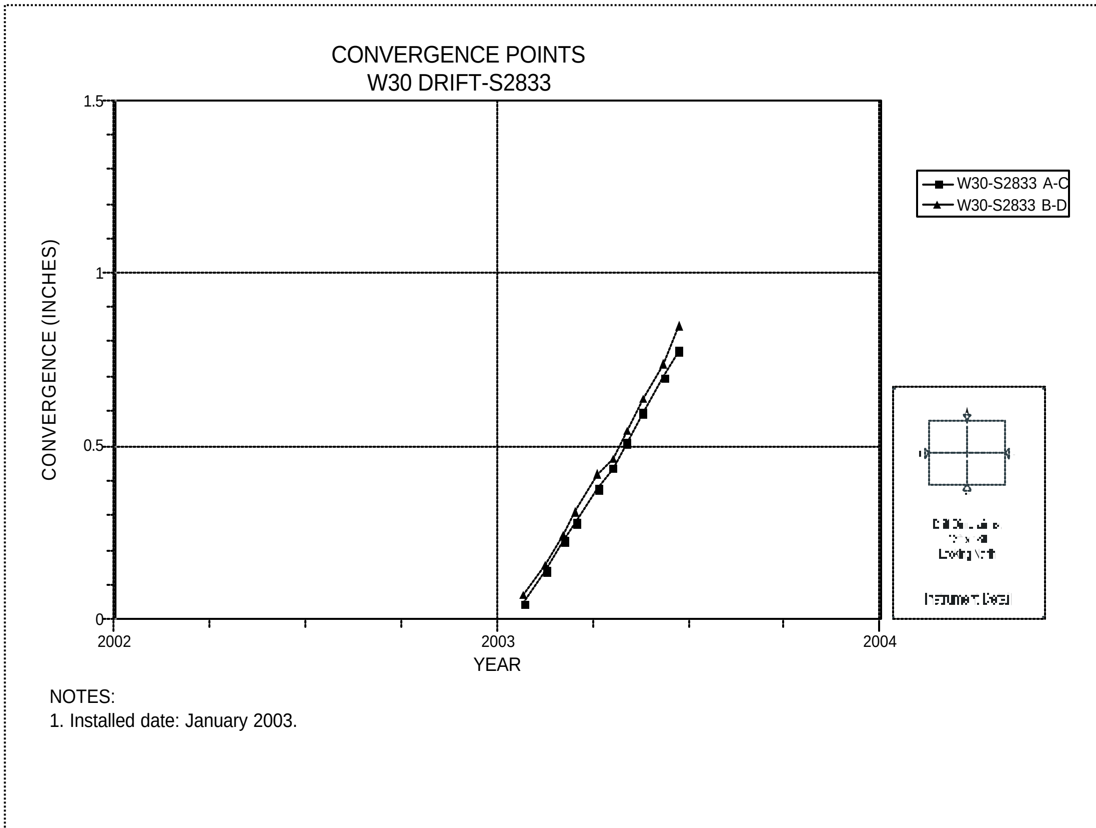


Figure 4-159 Convergence Point Array
W30 Drift at S2833 – All Chords

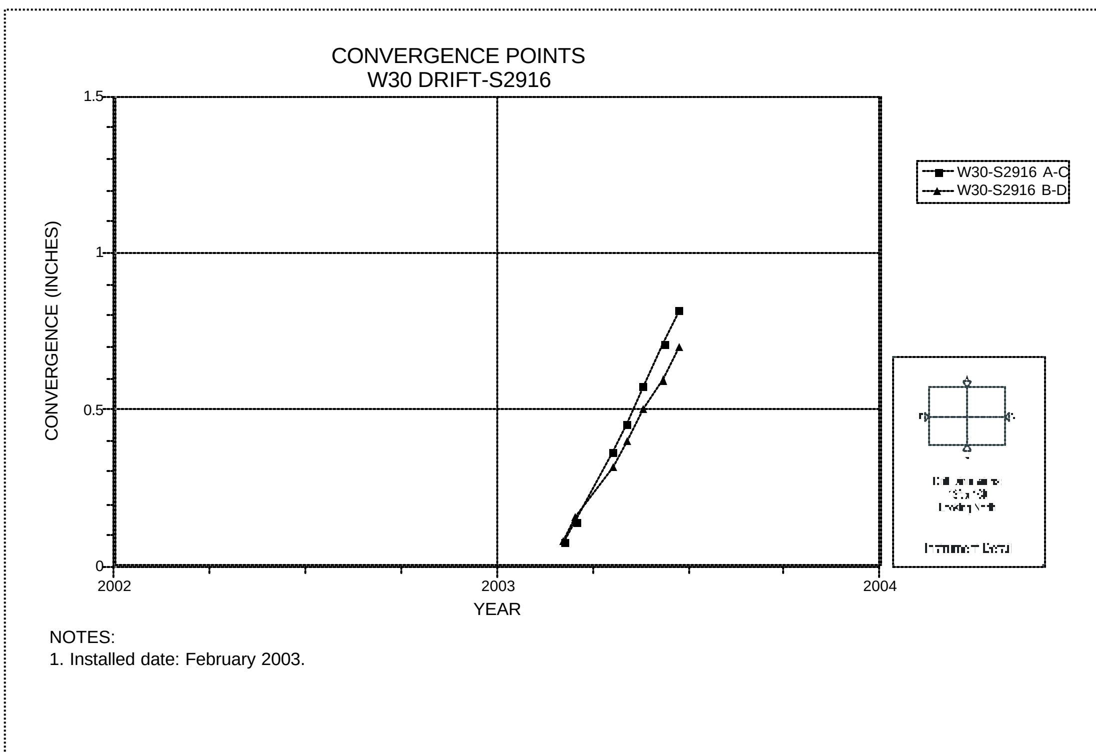


Figure 4-160 Convergence Point Array
W30 Drift at S2916 – All Chords

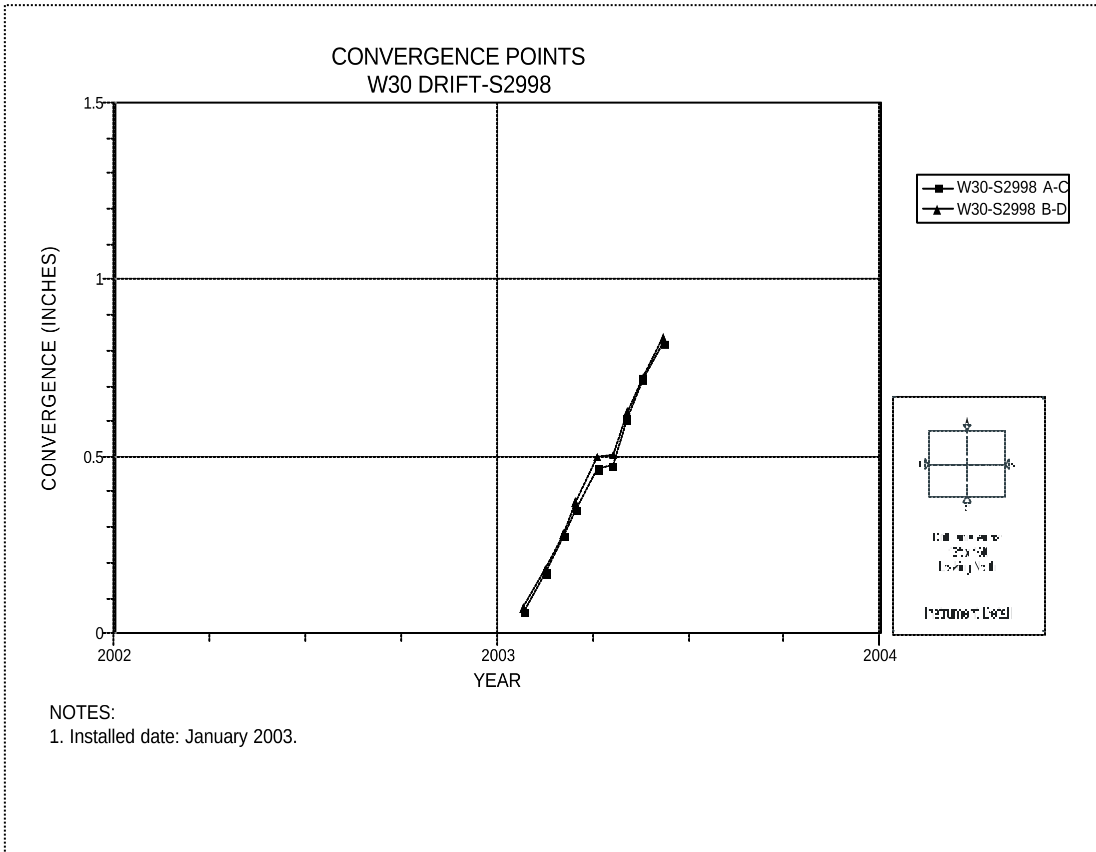


Figure 4-161 Convergence Point Array
W30 Drift at S2998 – All Chords

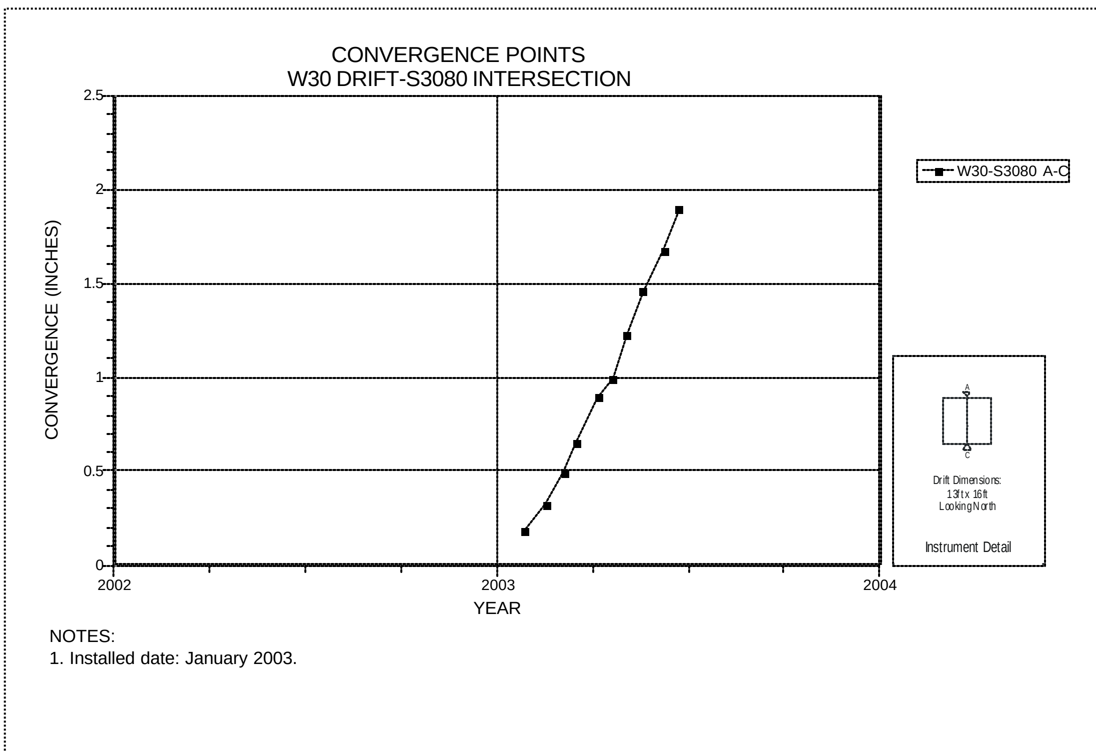
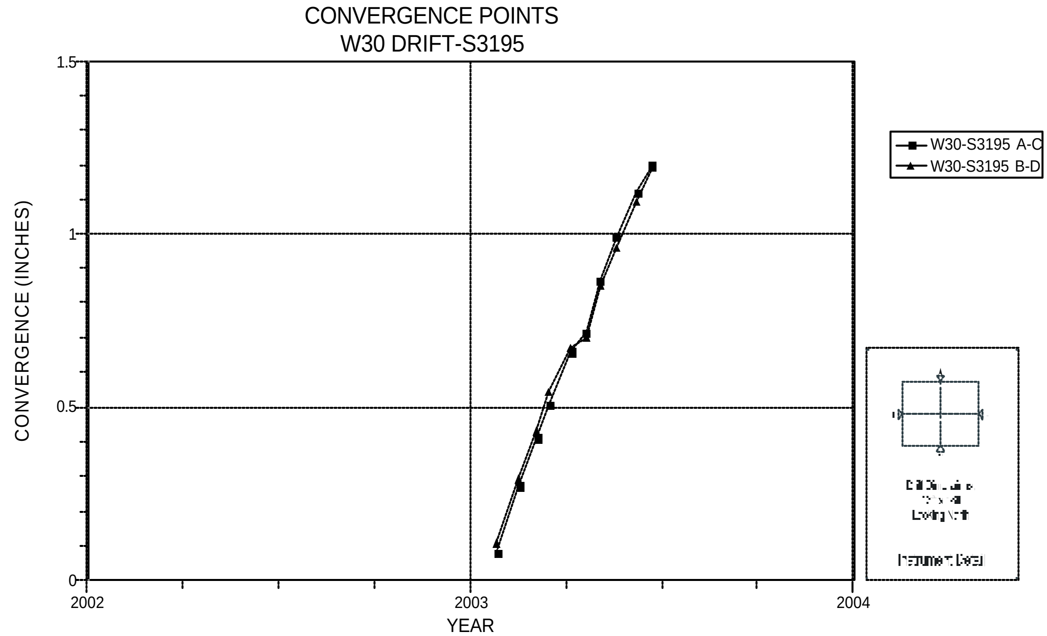
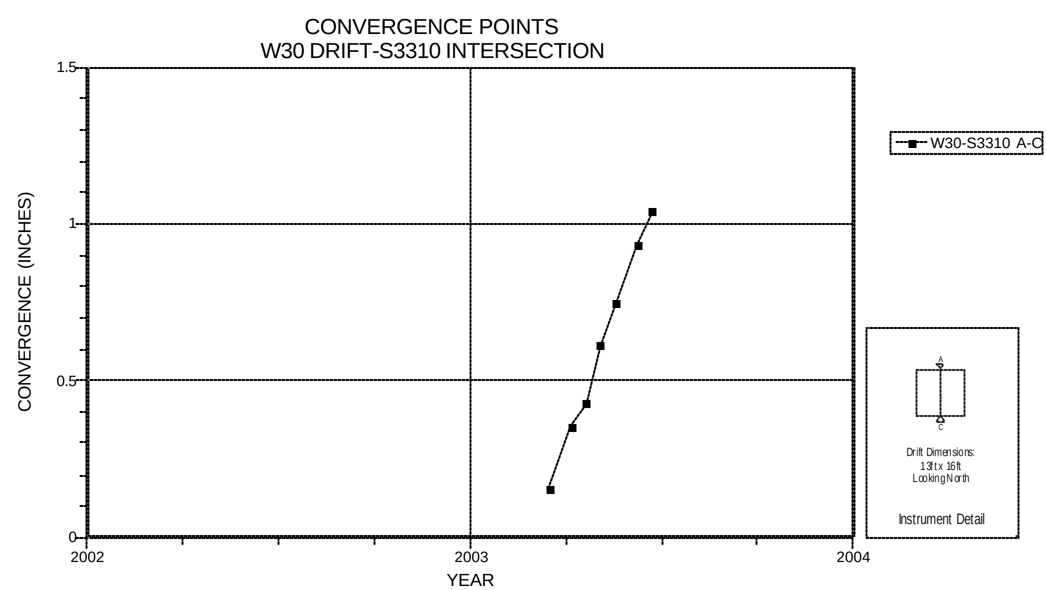


Figure 4-162 Convergence Point Array
W30 Drift at S3080 Drift Intersection – Roof to Floor



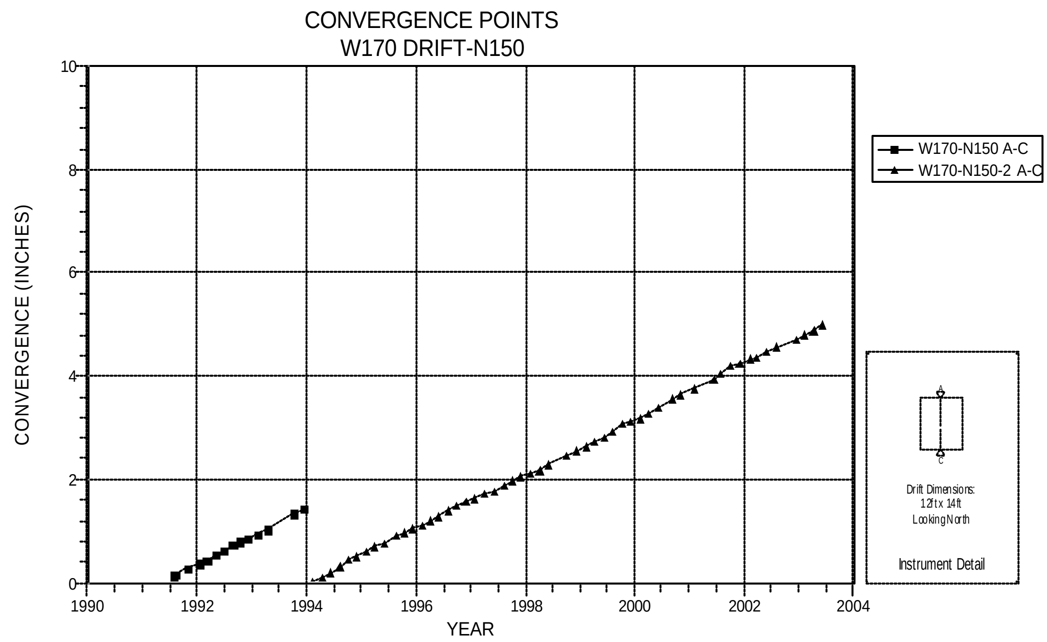
NOTES:
1. Installed date: January 2003.

Figure 4-163 Convergence Point Array
W30 Drift at S3195 – All Chords



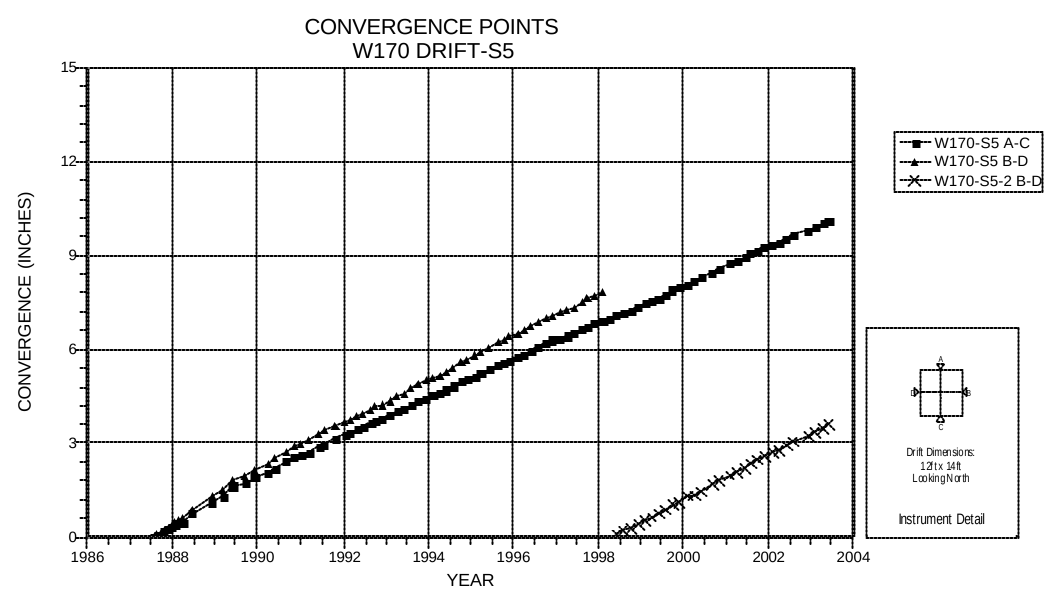
NOTES:
1. Installed date: March 2003.

Figure 4-164 Convergence Point Array
W30 Drift at S3310 Drift Intersection – Roof to Floor



NOTES:
1. Excavation date: July 1984.

Figure 4-165 Convergence Point Array
W170 Drift at N150 Drift Intersection – Roof to Floor



NOTES:
1. Excavation date: August 1984.

Figure 4-166 Convergence Point Array
W170 Drift at S5 – All Chords

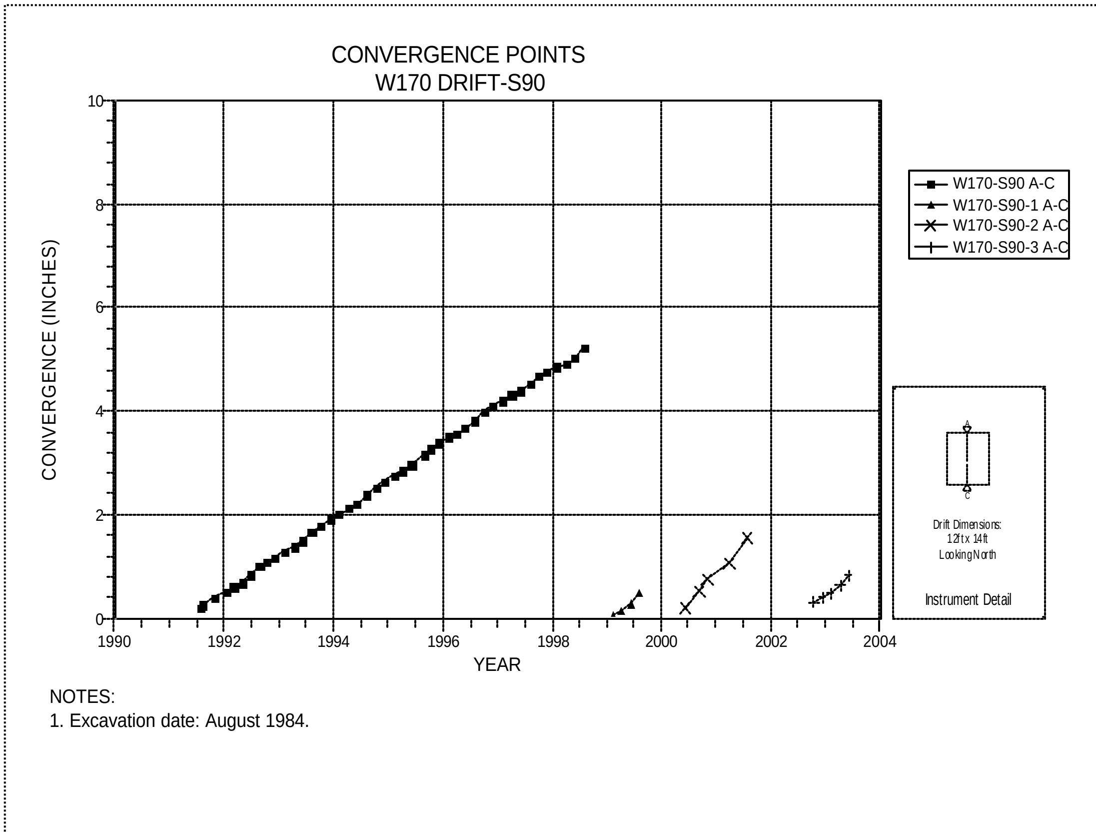


Figure 4-167 Convergence Point Array
W170 Drift at S90 – Roof to Floor

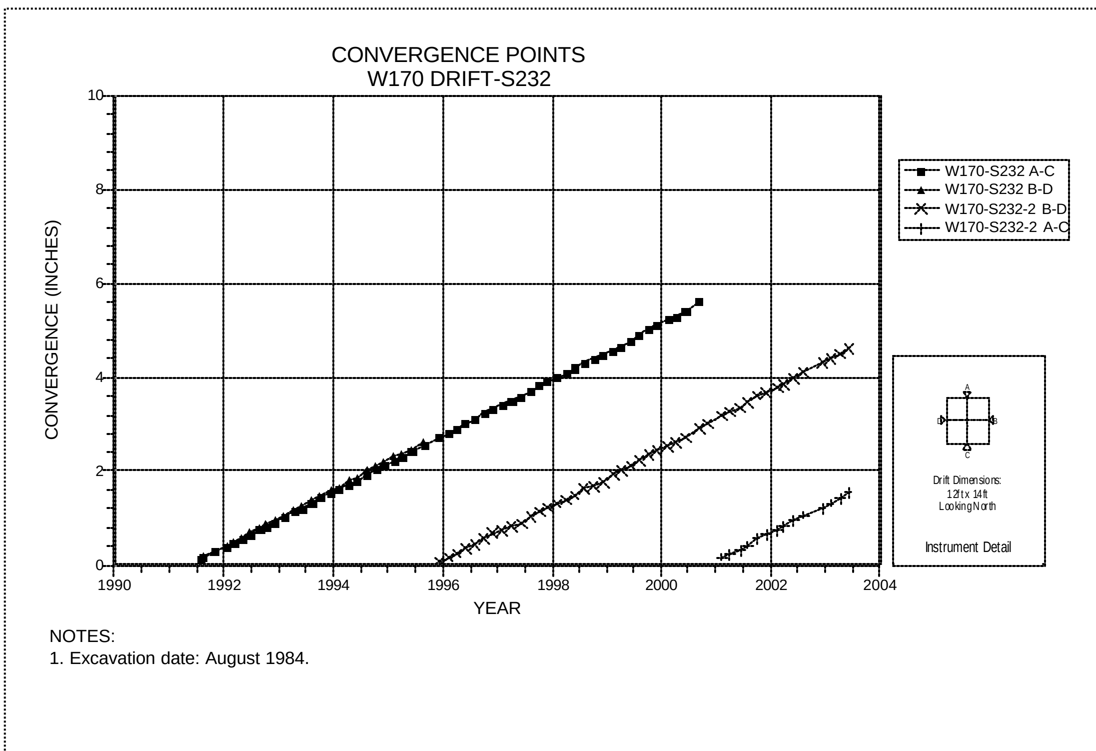


Figure 4-168 Convergence Point Array
W170 Drift at S232 – All Chords

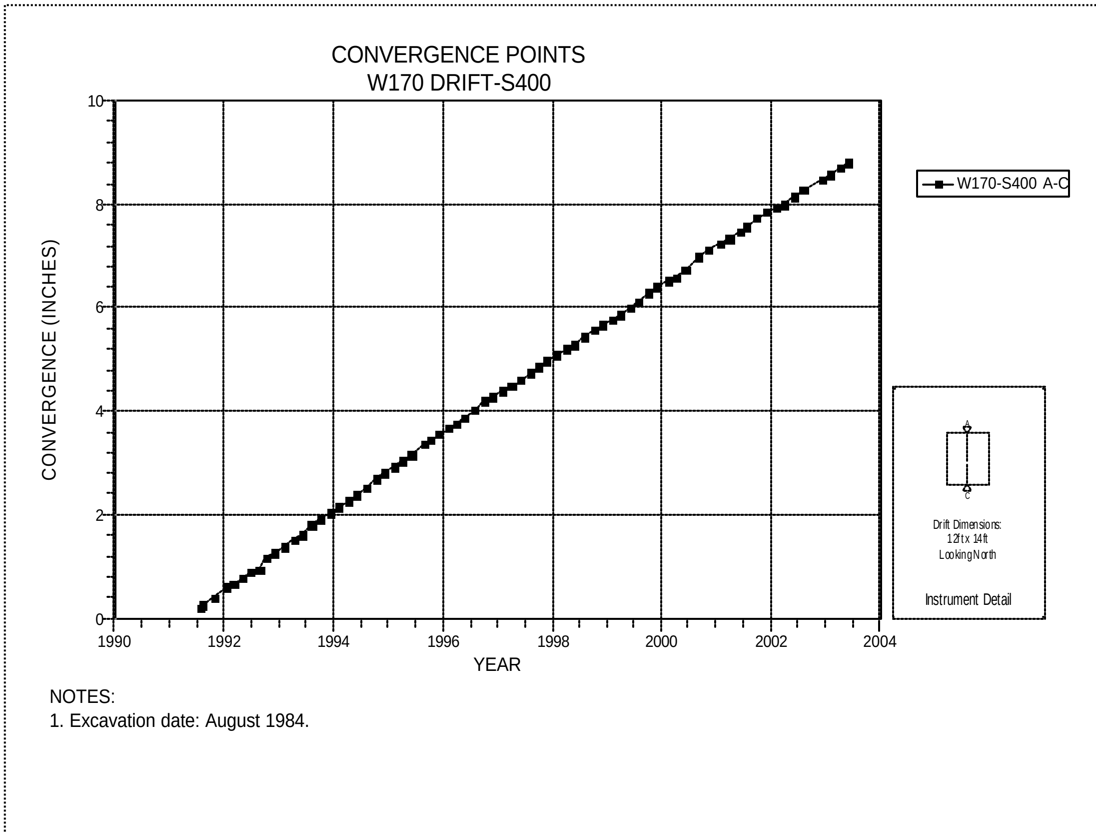


Figure 4-169 Convergence Point Array
W170 Drift at S400 Drift Intersection – Roof to Floor

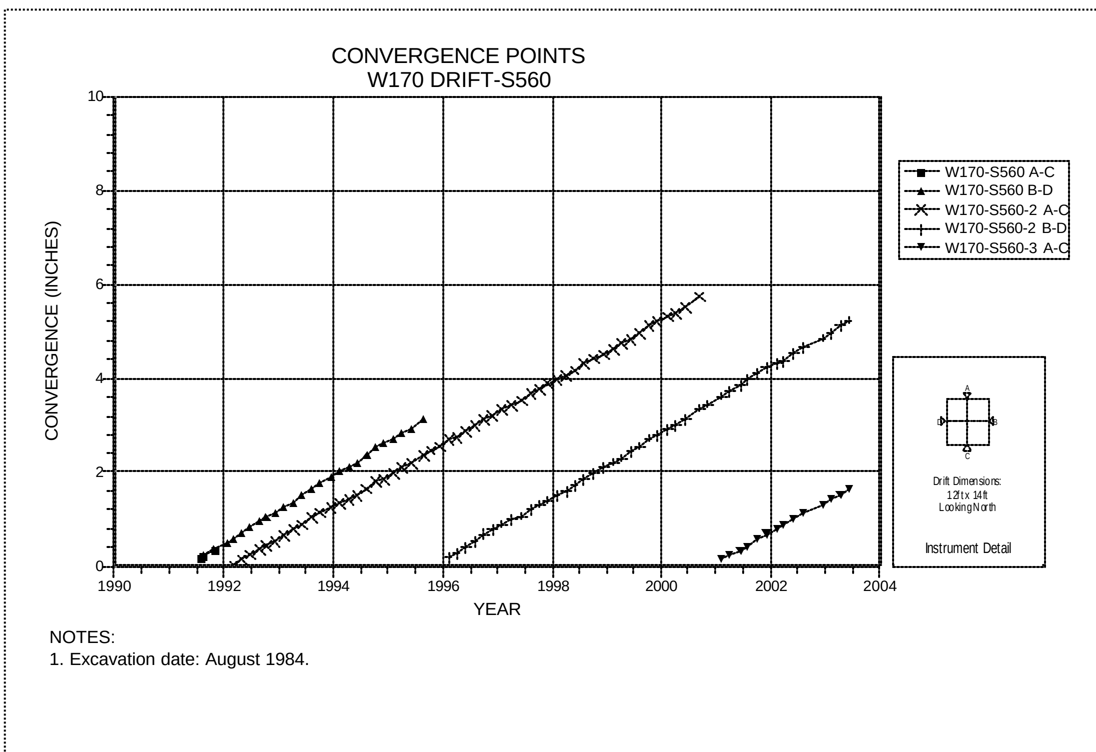
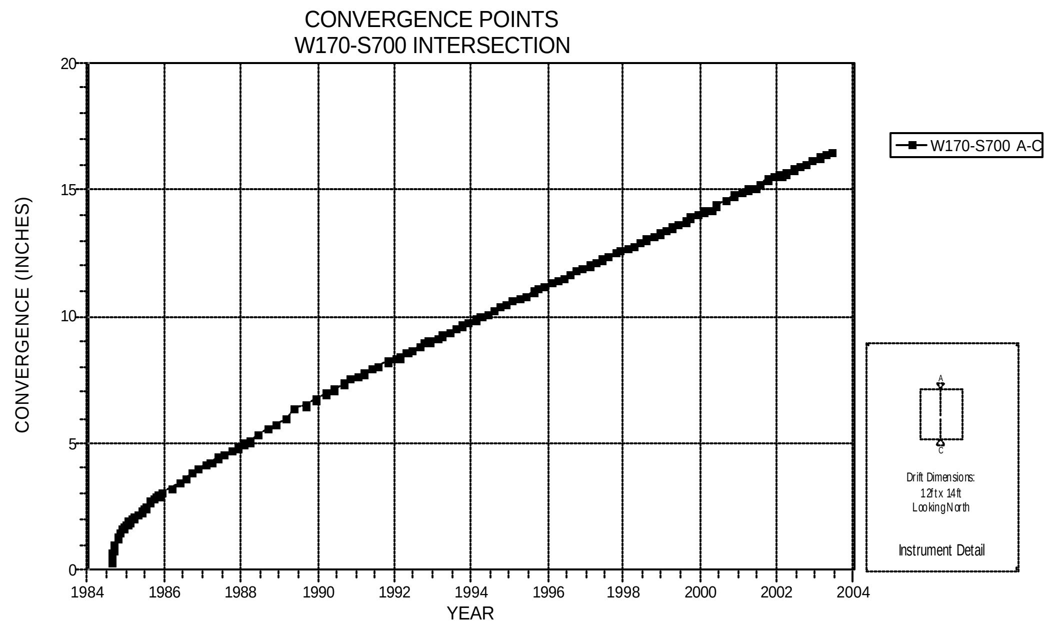
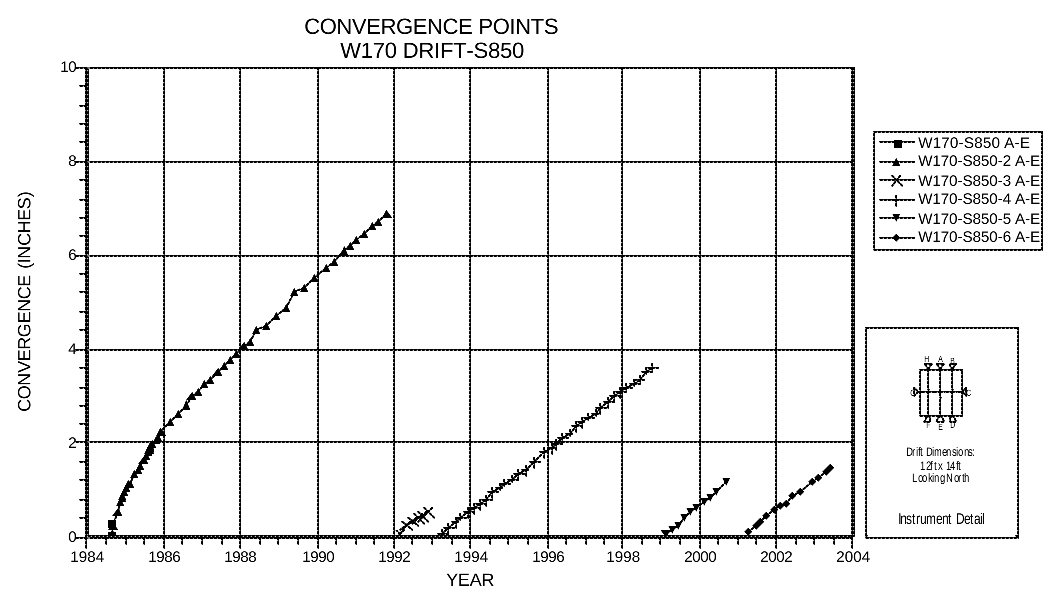


Figure 4-170 Convergence Point Array
W170 Drift at S560 – All Chords



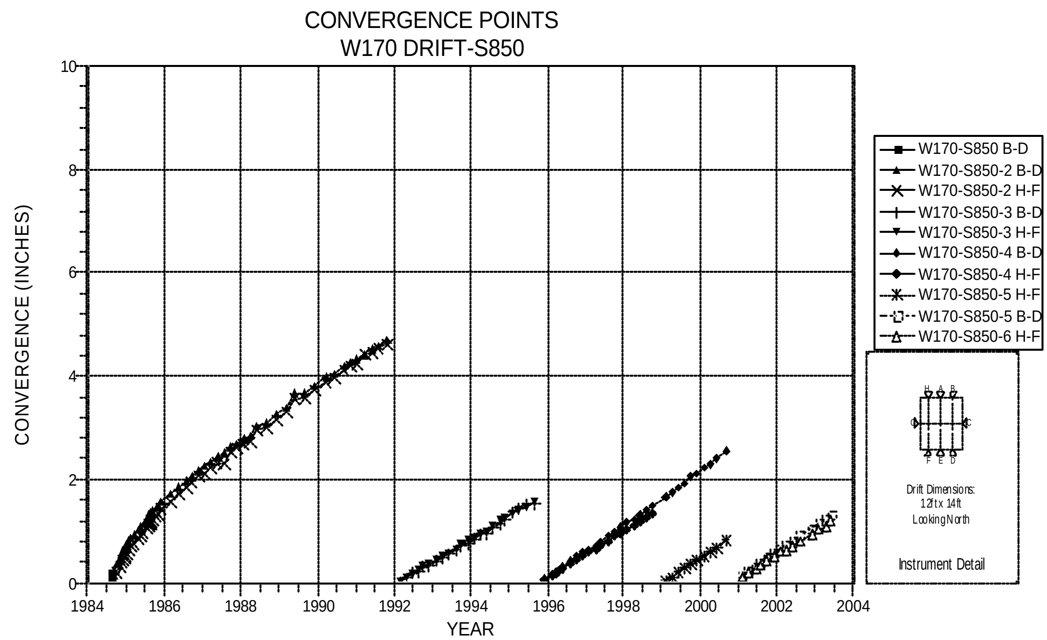
NOTES:
1. Excavation date: August 1984.

Figure 4-171 Convergence Point Array
W170 Drift at S700 Drift Intersection – Roof to Floor



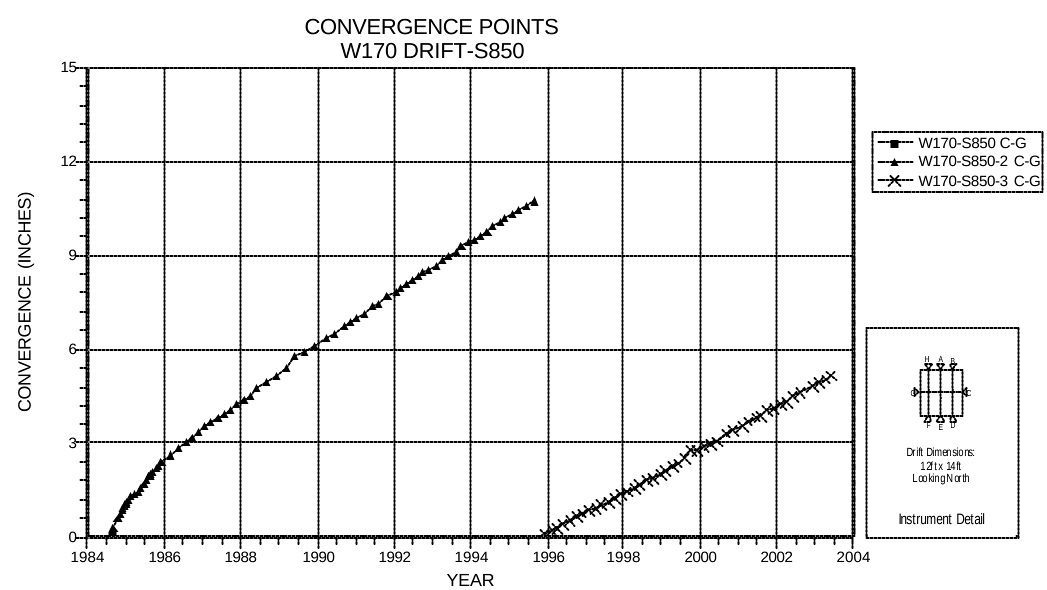
NOTES:
1. Excavation date: August 1984.

Figure 4-172 Convergence Point Array
W170 Drift at S850 – Roof to Floor – Centerline



NOTES:
1. Excavation date: August 1984.

Figure 4-173 Convergence Point Array
W170 Drift at S850 – Roof to Floor – Quarter Points



NOTES:
1. Excavation date: August 1984.

Figure 4-174 Convergence Point Array
W170 Drift at S850 – Rib to Rib

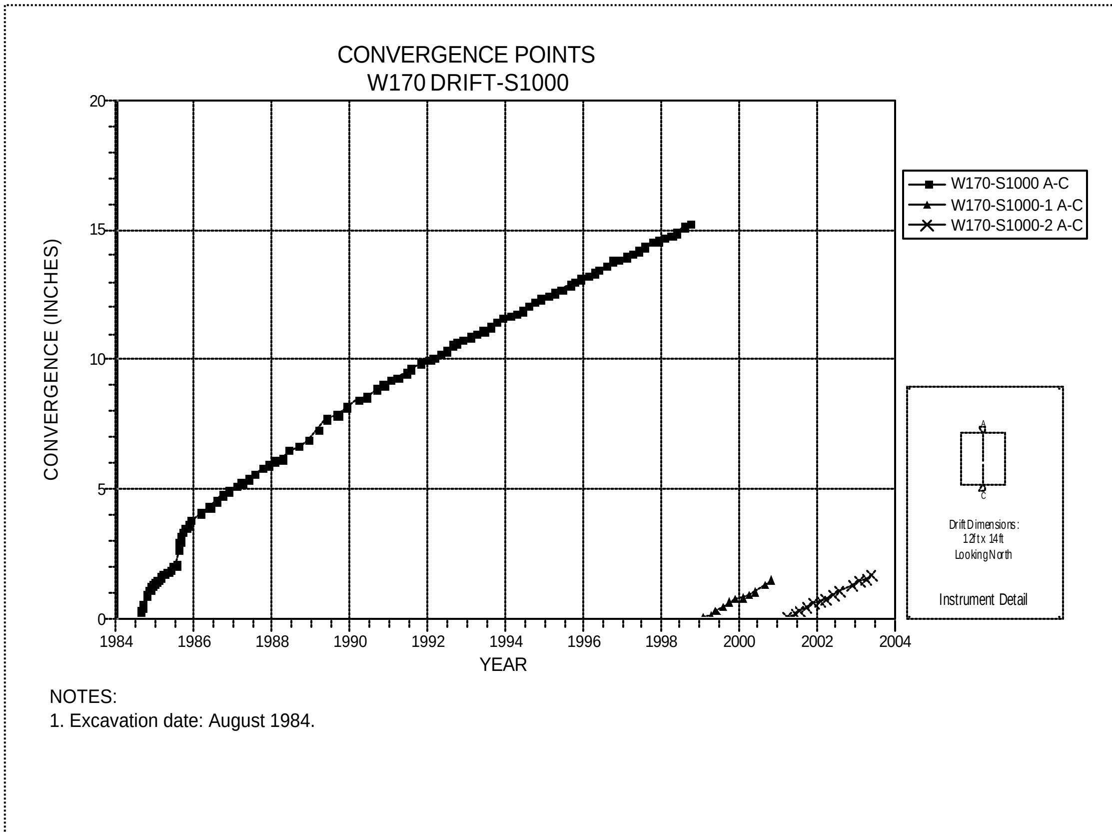


Figure 4-175 Convergence Point Array
W170 Drift at S1000 – Roof to Floor

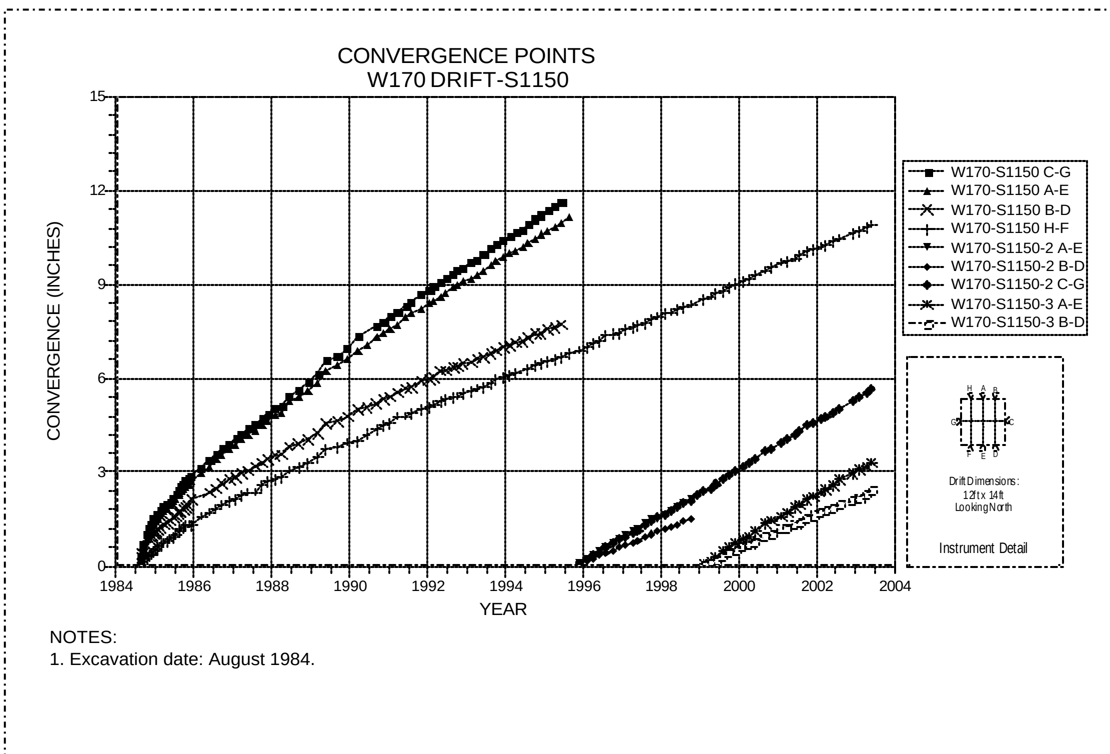
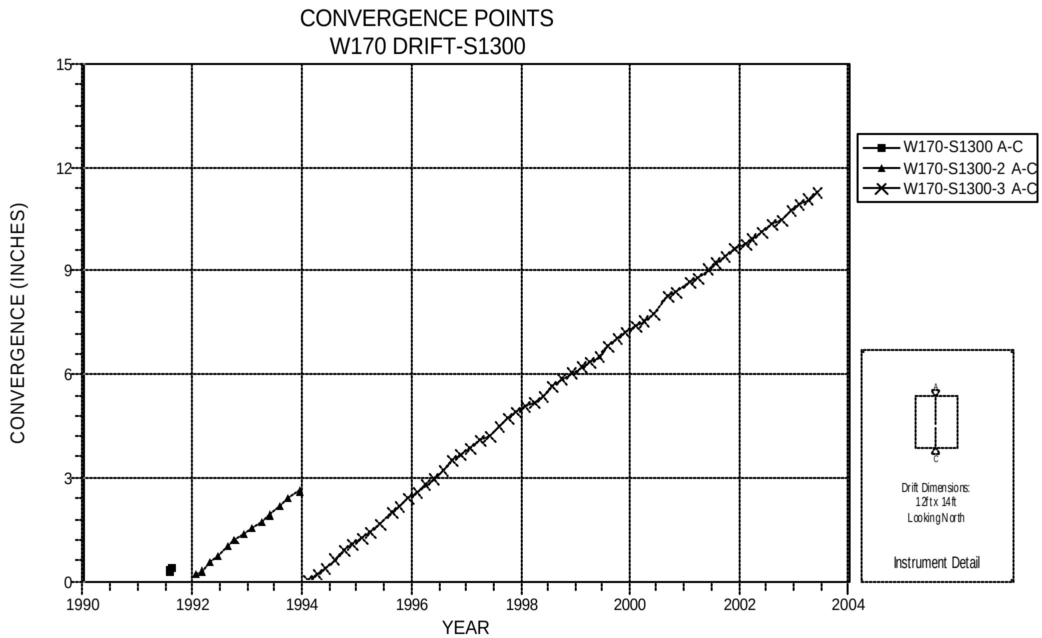
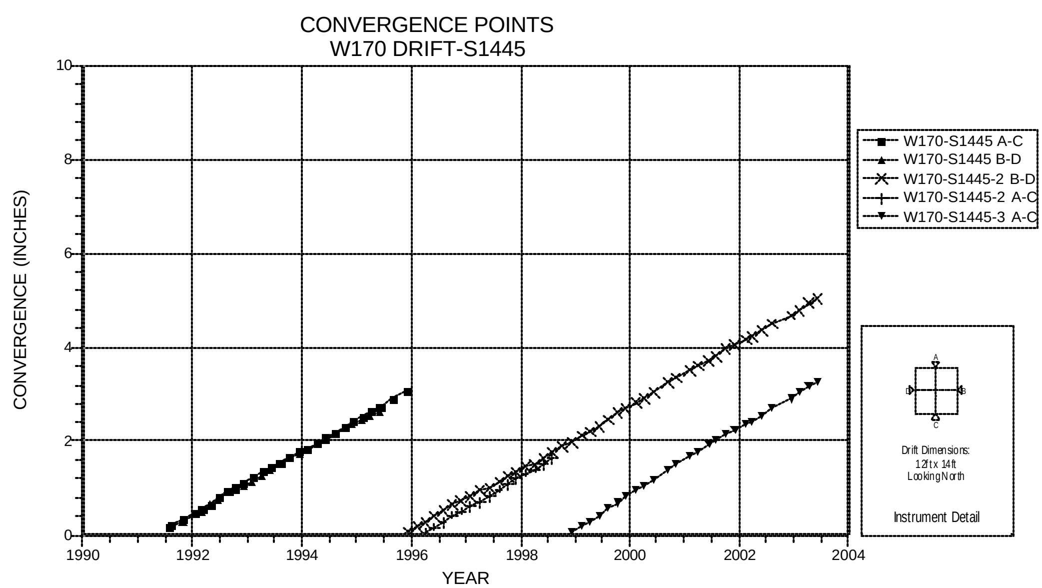


Figure 4-176 Convergence Point Array
W170 Drift at S1150 – All Chords



NOTES:
1. Excavation date: August 1984.

Figure 4-177 Convergence Point Array
W170 Drift at S1300 Drift Intersection – Roof to Floor



NOTES:
1. Excavation date: August 1984.

Figure 4-178 Convergence Point Array
W170 Drift at S1445 – All Chords

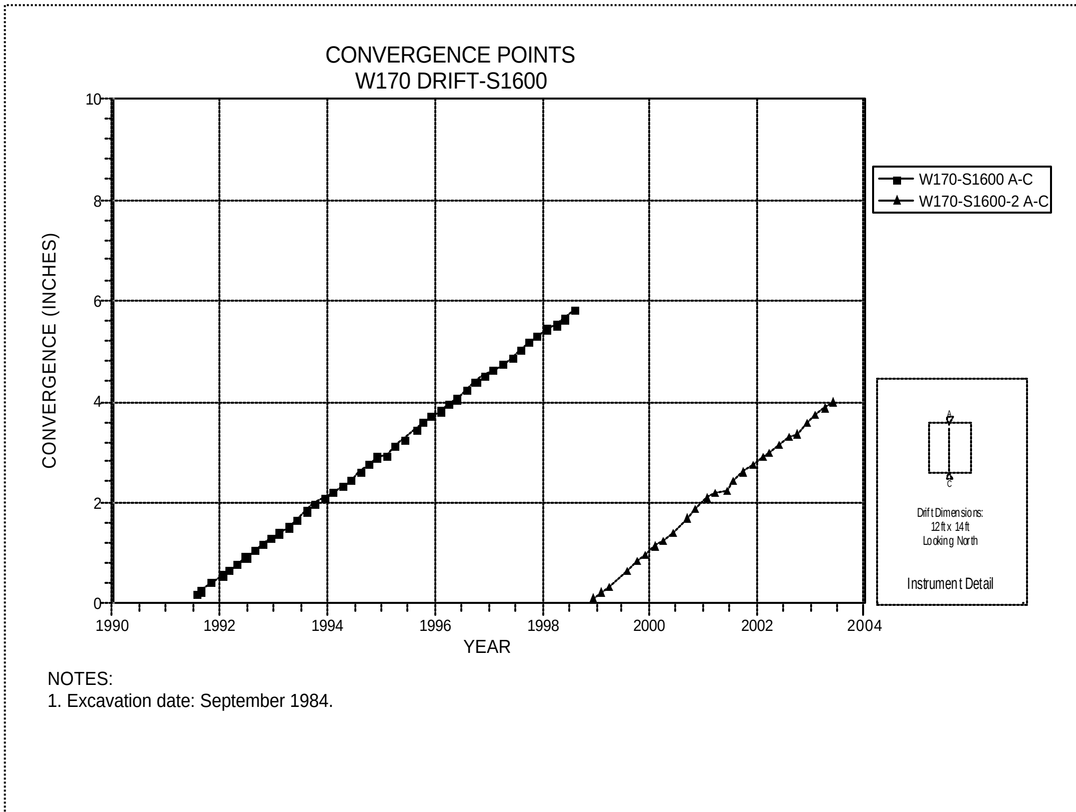


Figure 4-179 Convergence Point Array
W170 Drift at S1600 Drift Intersection – Roof to Floor

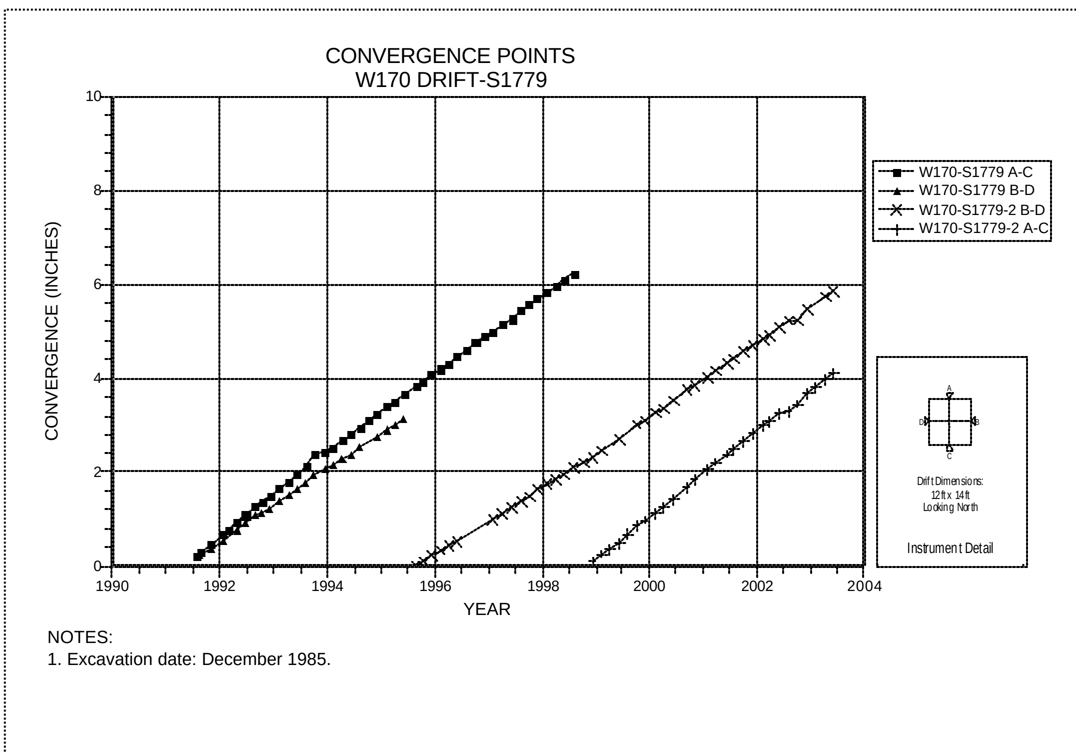
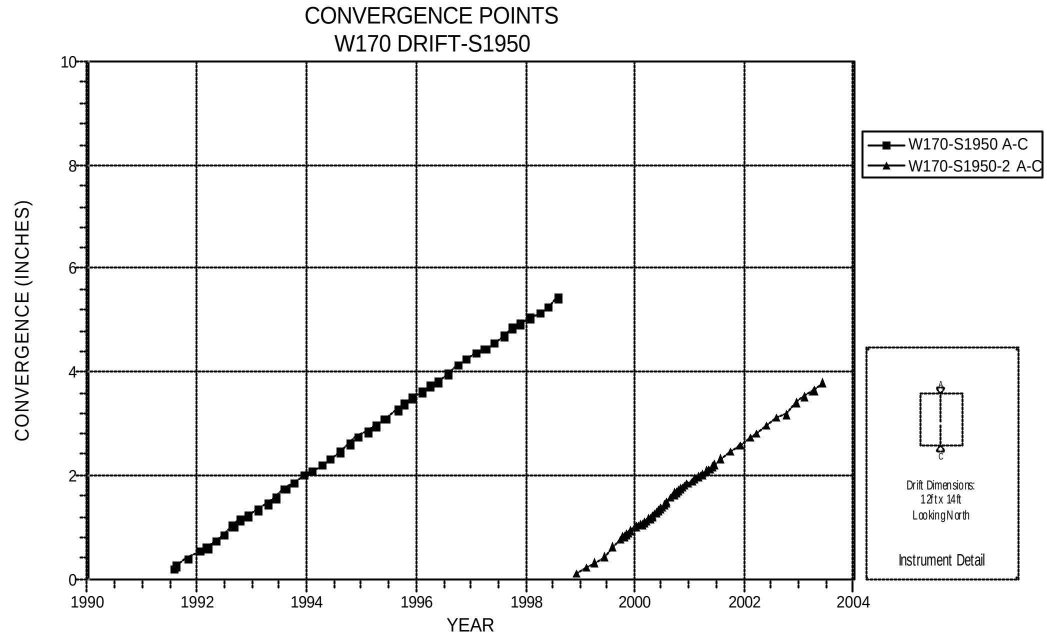
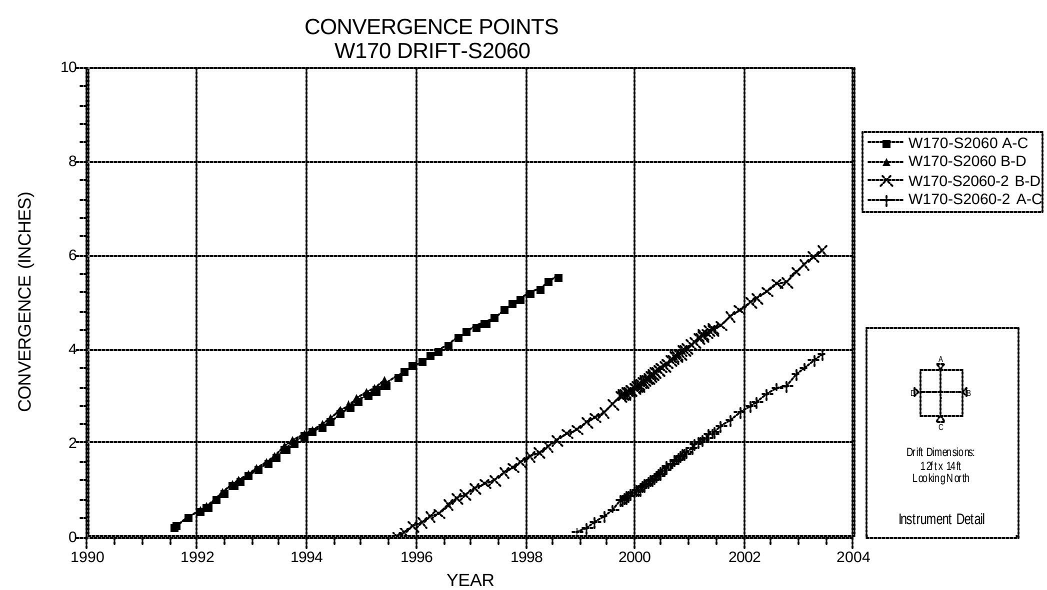


Figure 4-180 Convergence Point Array
W170 Drift at S1779 – All Chords



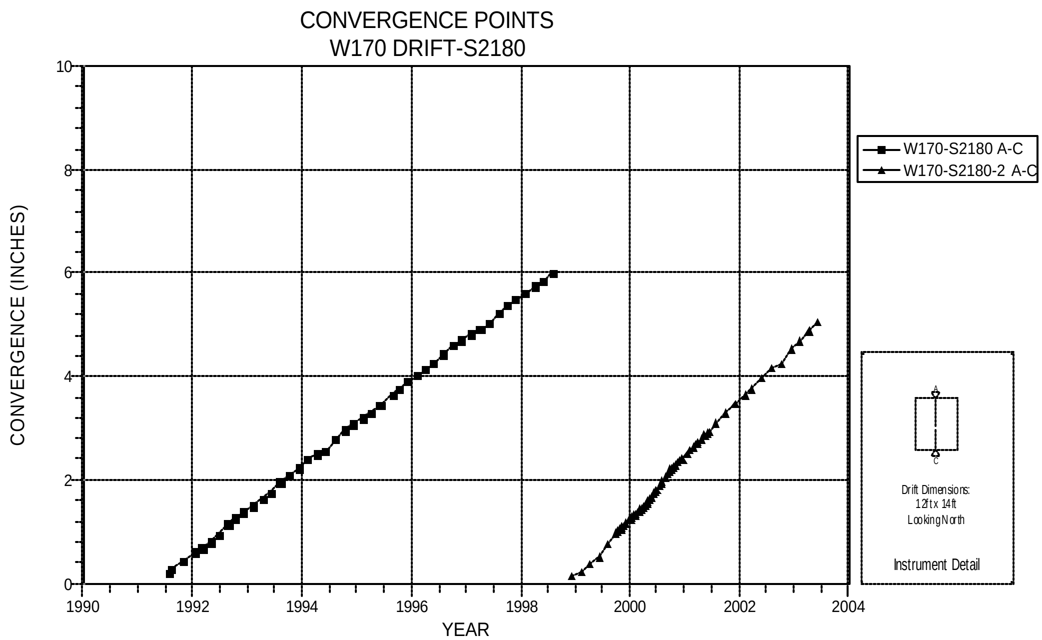
NOTES:
1. Excavation date: December 1985.

Figure 4-181 Convergence Point Array
W170 Drift at S1950 Drift Intersection – Roof to Floor



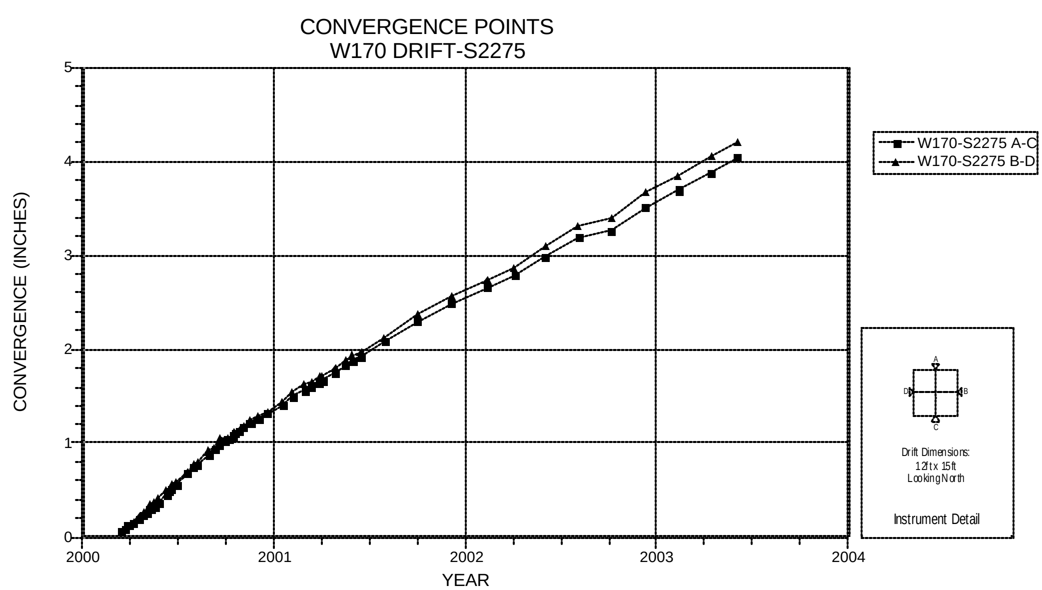
NOTES:
1. Excavation date: July 1988.

Figure 4-182 Convergence Point Array
W170 Drift at S2060 – All Chords



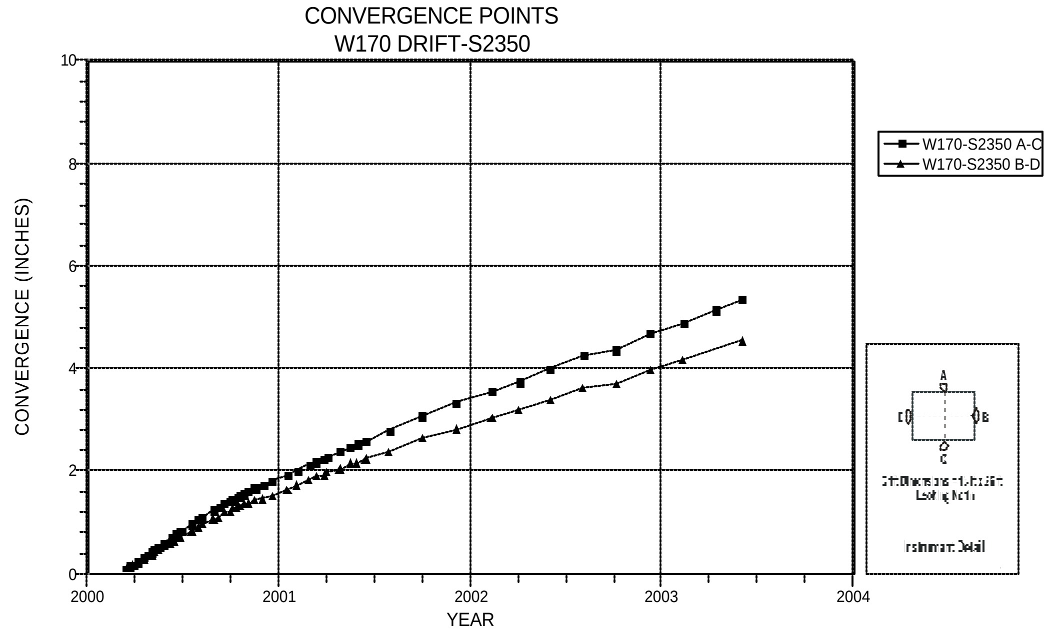
NOTES:
1. Excavation date: August 1988.

Figure 4-183 Convergence Point Array
W170 Drift at S2180 Drift Intersection – Roof to Floor



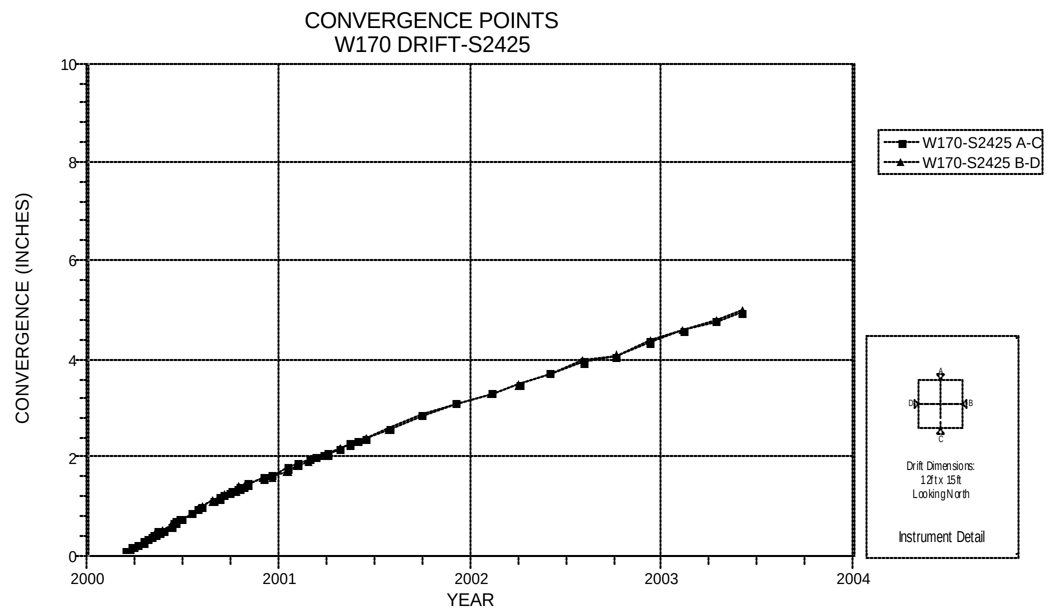
NOTES:
1. Excavation date: December 1999.

Figure 4-184 Convergence Point Array
W170 Drift at S2275 – All Chords



NOTES:
1. Excavation date: December 1999.

Figure 4-185 Convergence Point Array
W170 Drift at S2350 – All Chords



NOTES:
1. Excavation date: December 1999.

Figure 4-186 Convergence Point Array
W170 Drift at S2425 – All Chords

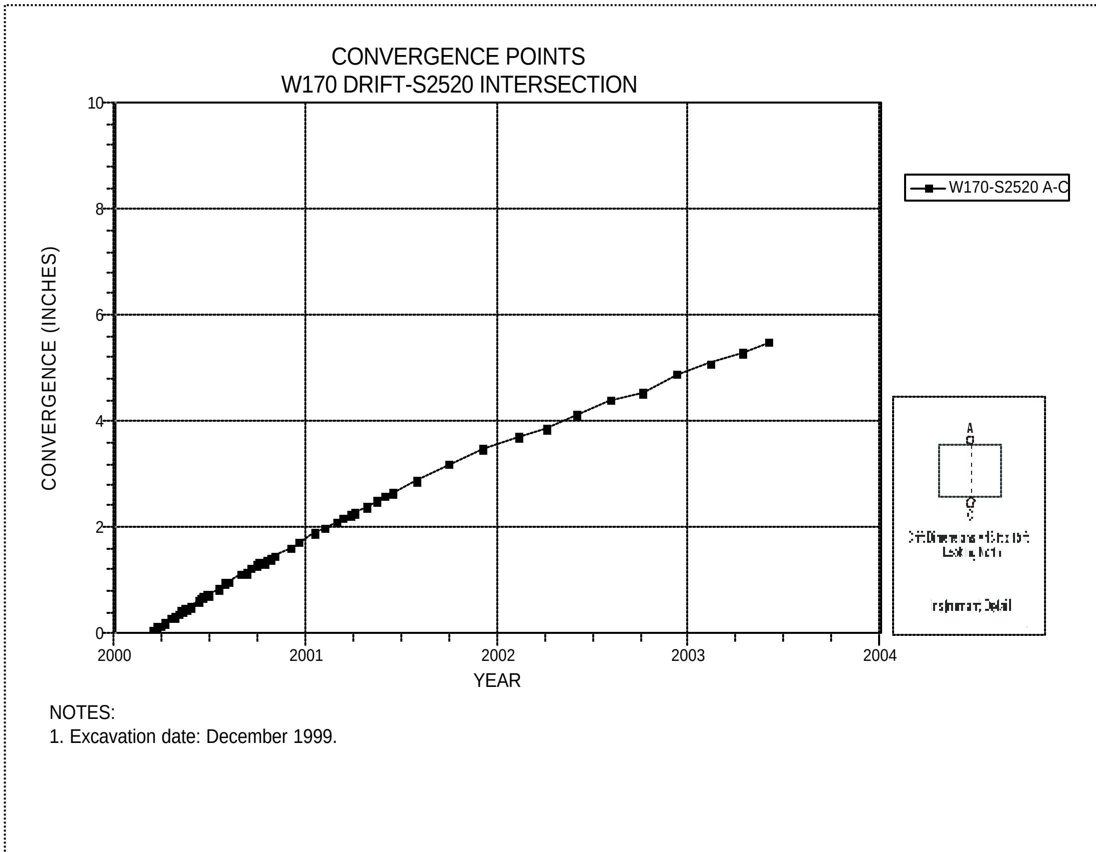


Figure 4-187 Convergence Point Array
W170 Drift at S2520 Drift Intersection – Roof to Floor

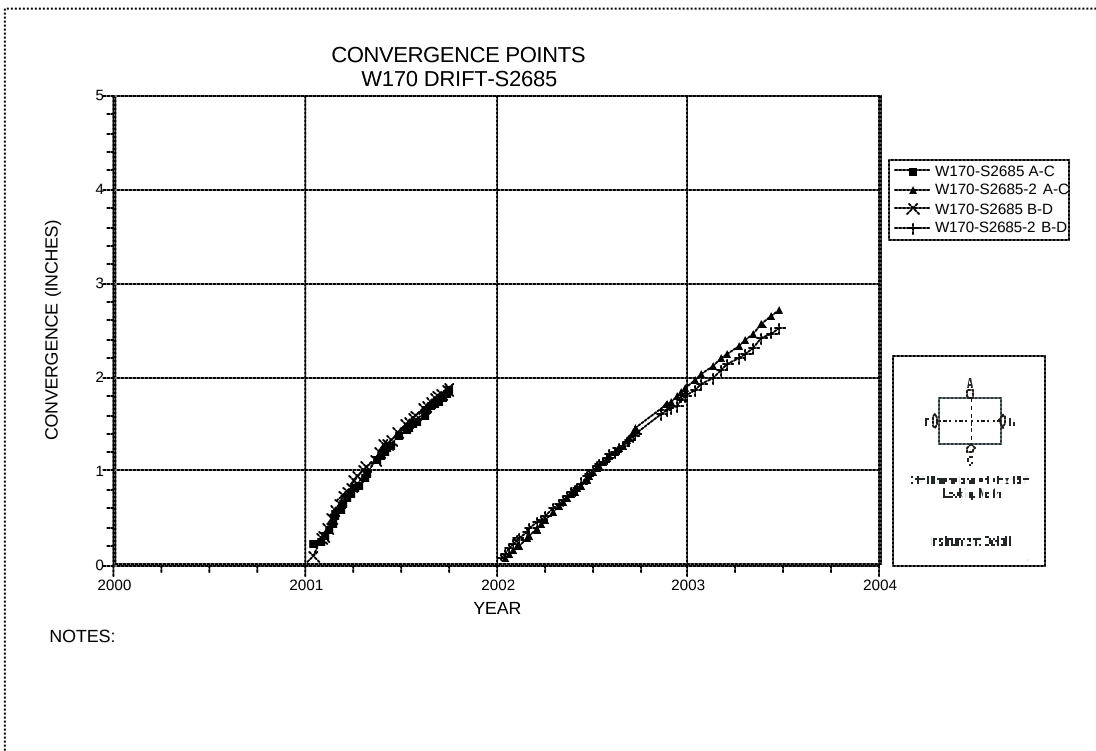


Figure 4-188 Convergence Point Array
W170 Drift at S2685 – All Chords

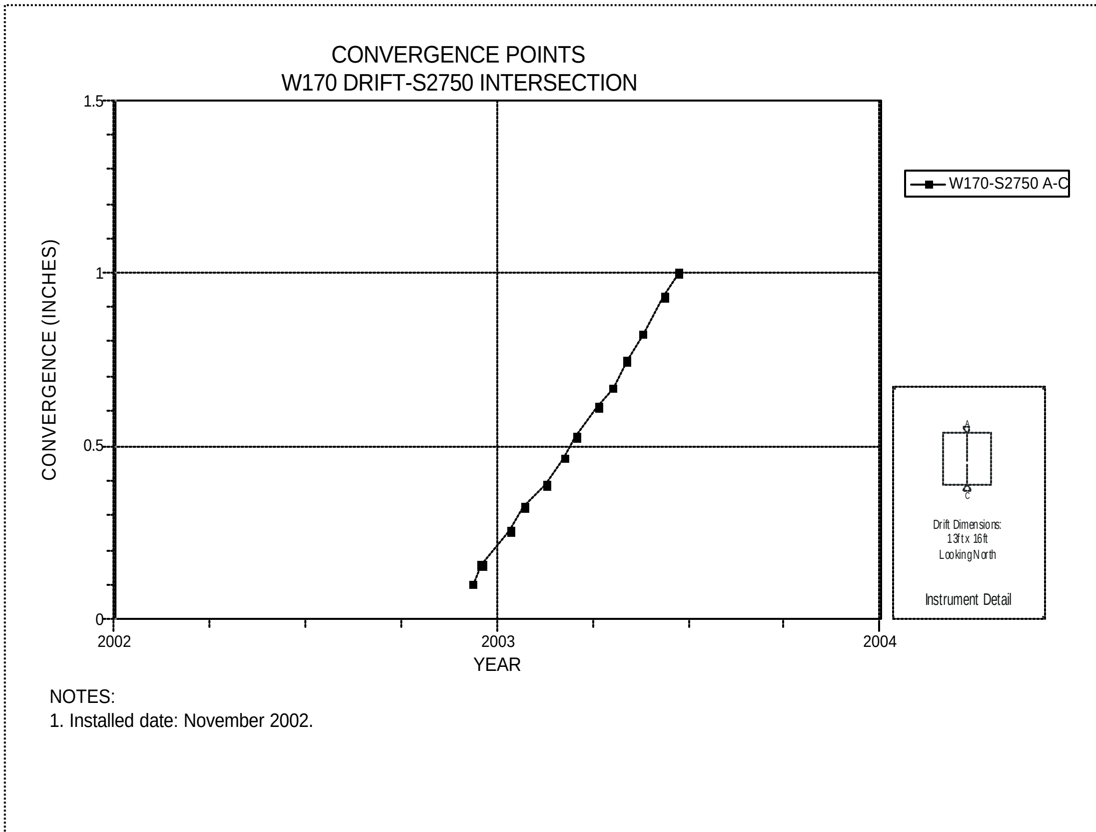


Figure 4-189 Convergence Point Array
W170 Drift at S2750 Drift Intersection – Roof to Floor

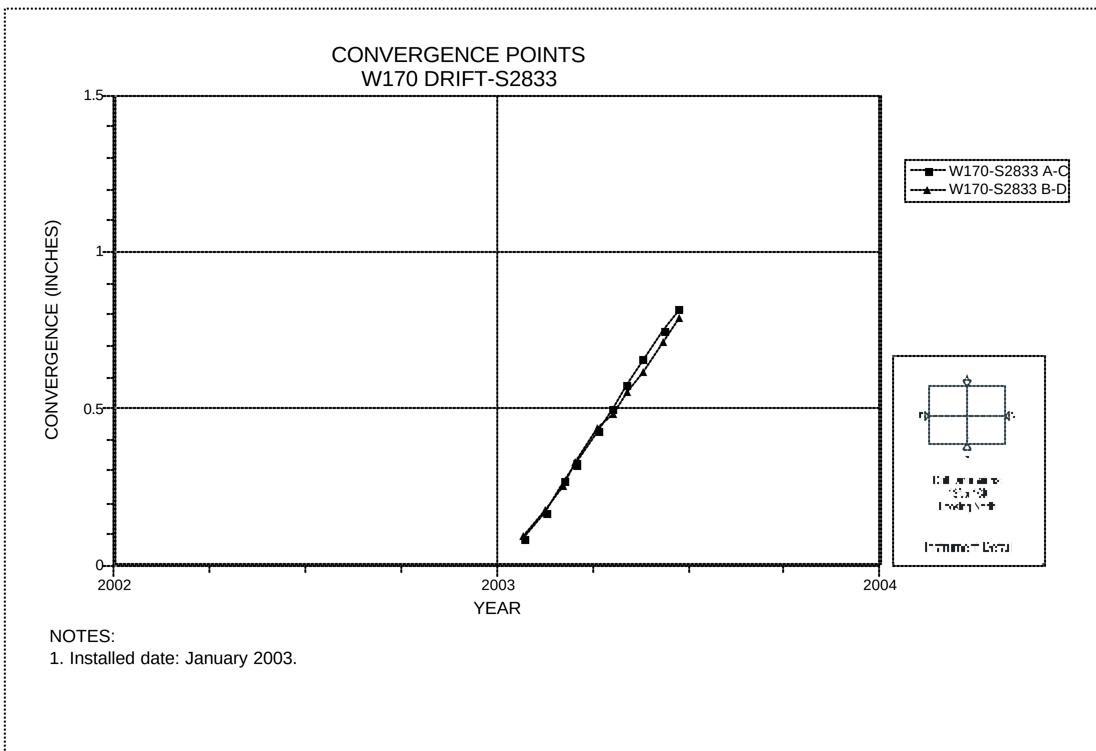
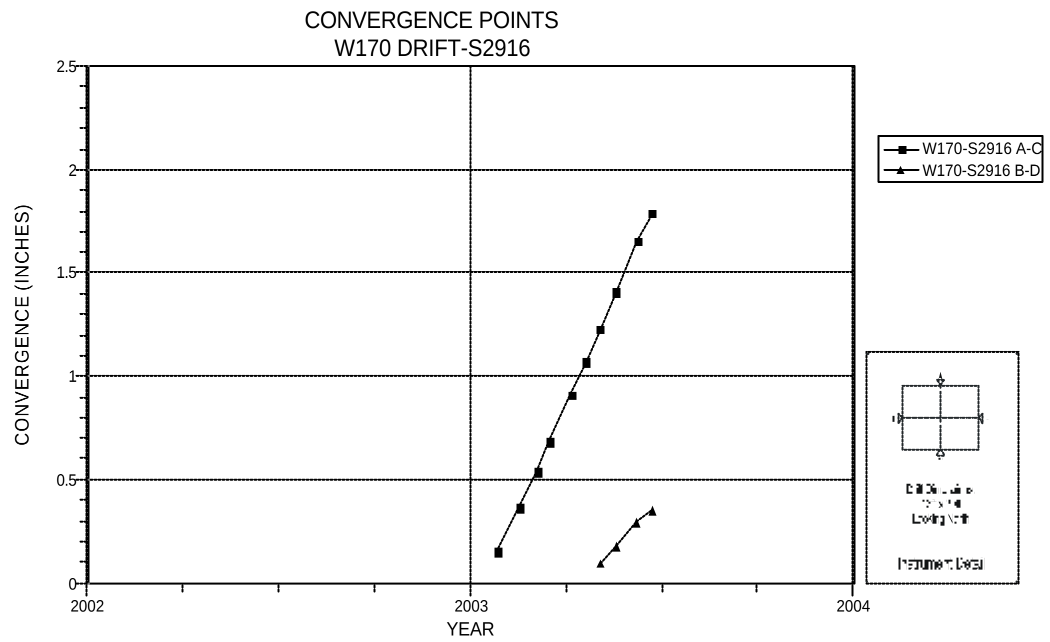
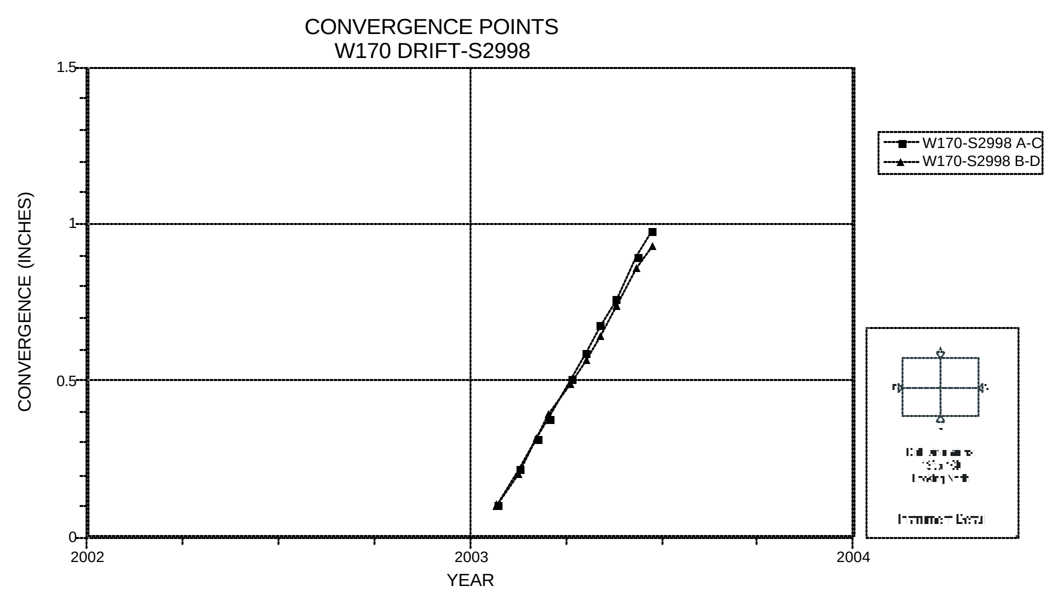


Figure 4-190 Convergence Point Array
W170 Drift at S2833 – All Chords



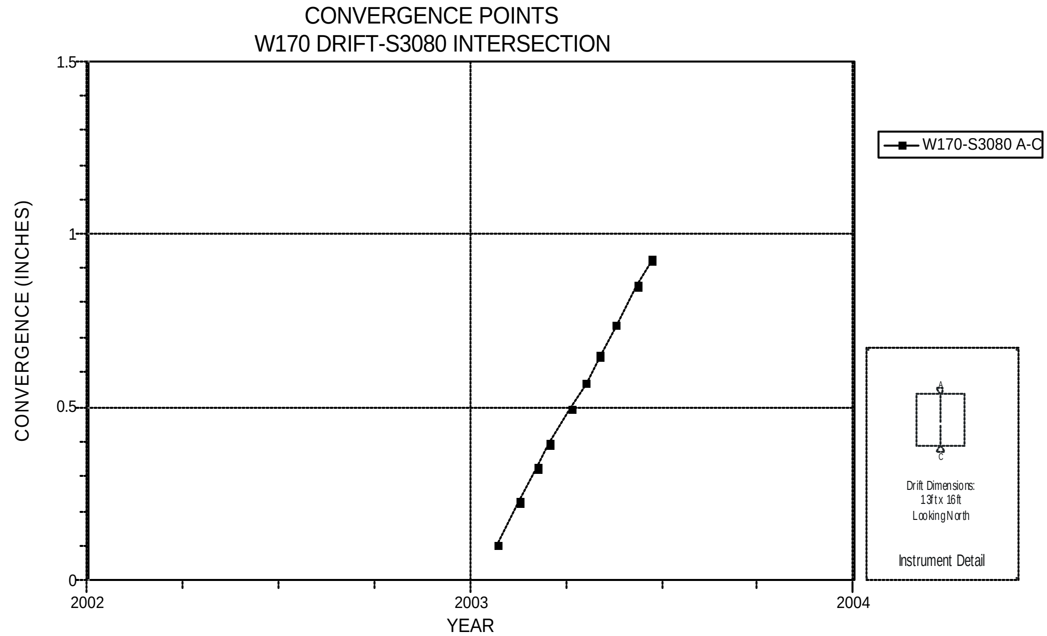
NOTES:
1. Installed date: January 2003.

Figure 4-191 Convergence Point Array
W170 Drift at S2916 – All Chords



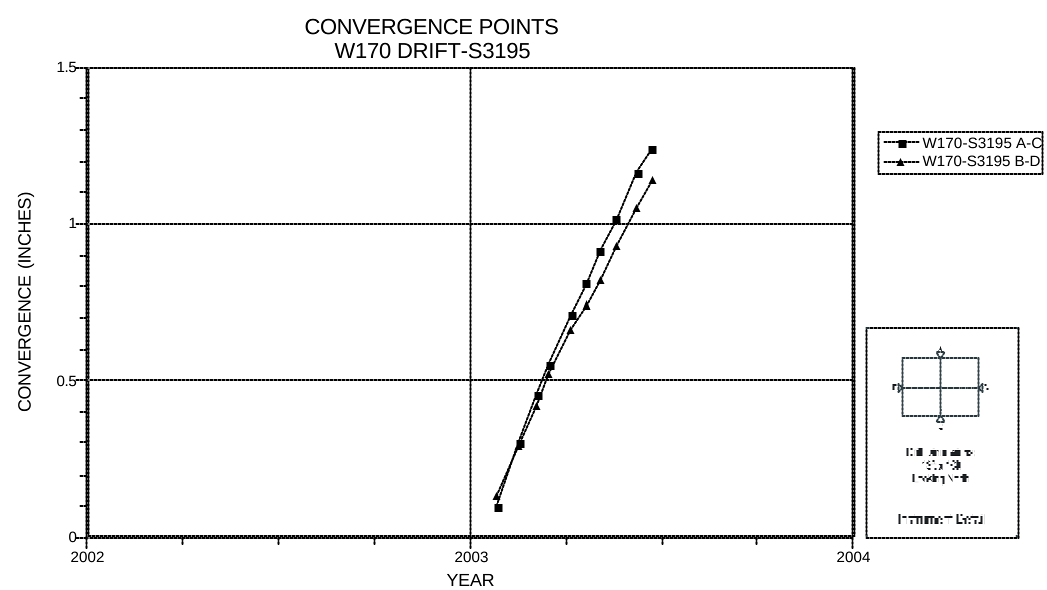
NOTES:
1. Installed date: January 2003.

Figure 4-192 Convergence Point Array
W170 Drift at S2998 – All Chords



NOTES:
1. Installed date: January 2003.

Figure 4-193 Convergence Point Array
W170 Drift at S3080 Drift Intersection – Roof to Floor



NOTES:
1. Installed date: January 2003.

Figure 4-194 Convergence Point Array
W170 Drift at S3195 – All Chords

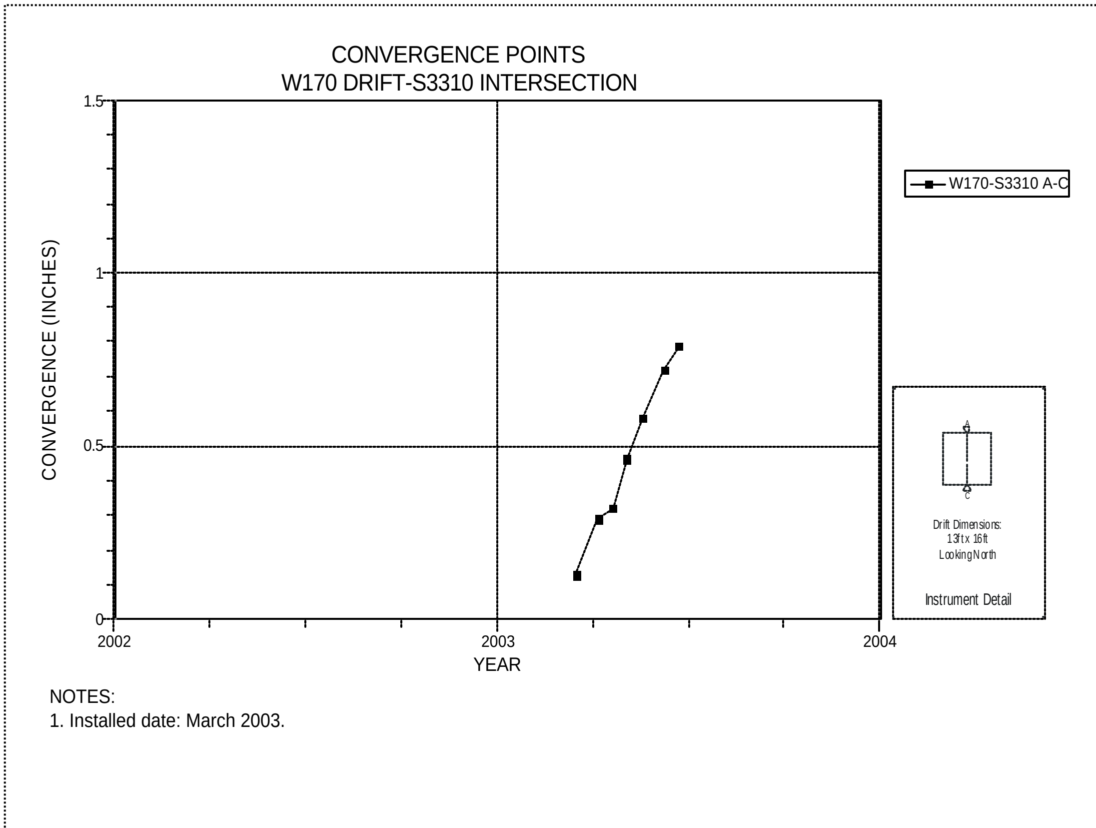


Figure 4-195 Convergence Point Array
W170 Drift at S3310 Drift Intersection – Roof to Floor

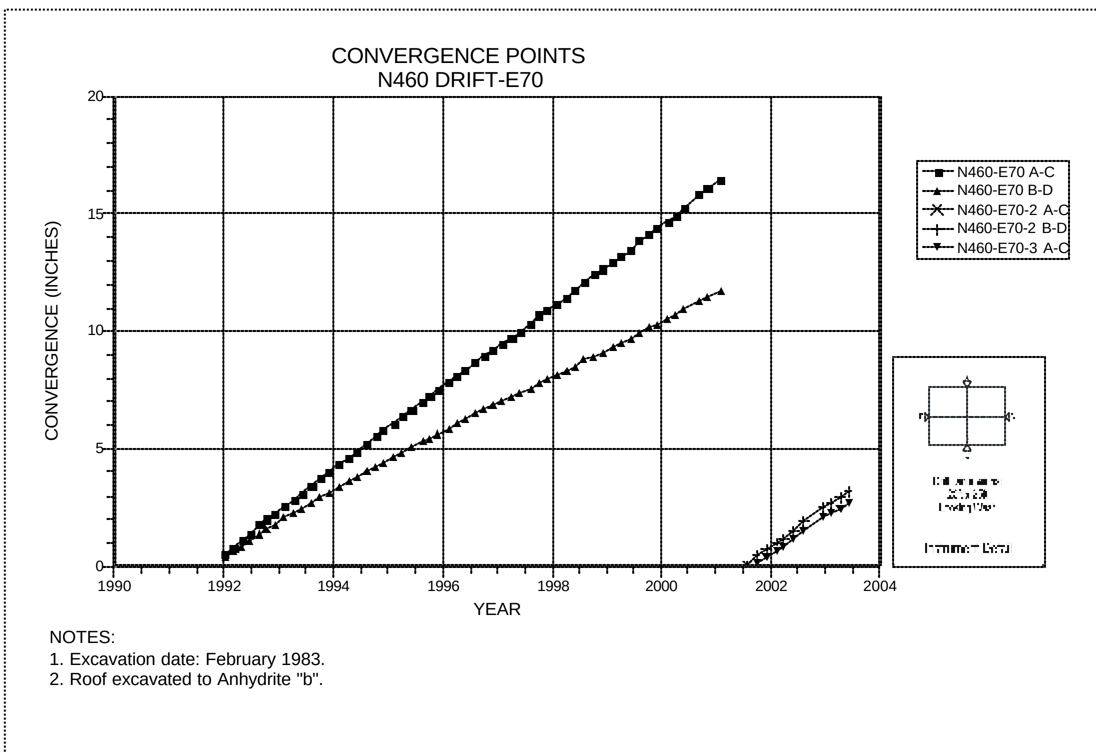
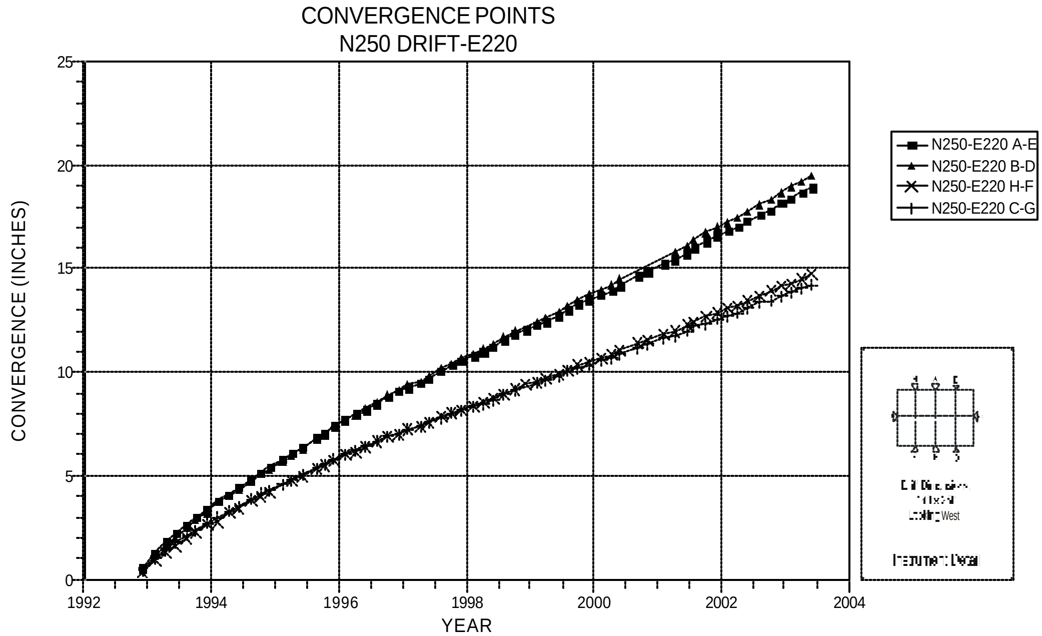
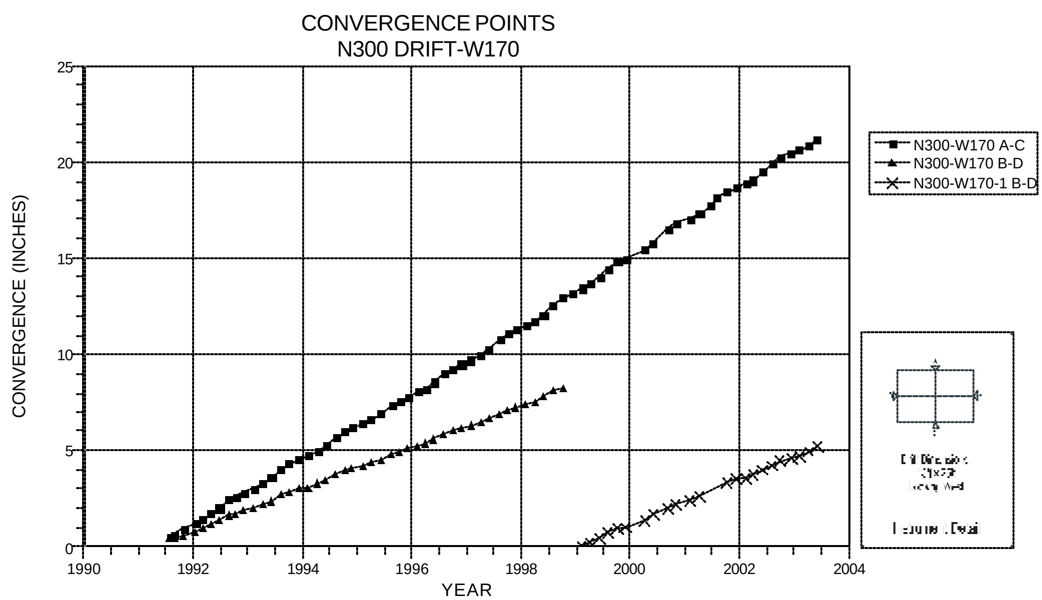


Figure 4-196 Convergence Point Array
N460 Drift at E70 – All Chords



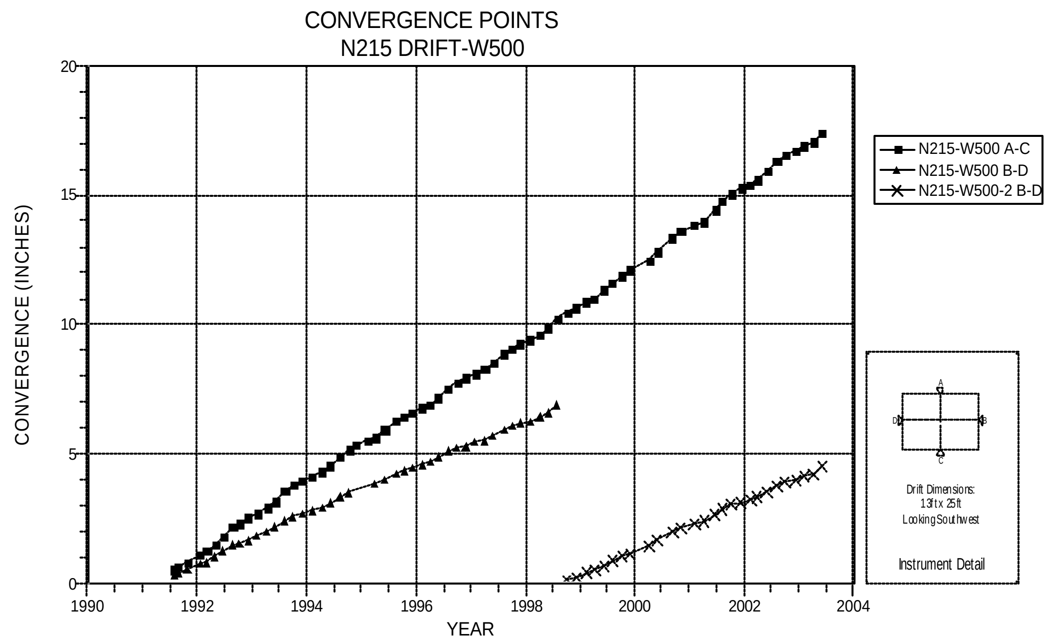
NOTES:
1. Excavation date: October 1992.

Figure 4-197 Convergence Point Array
N250 Drift at E220 – All Chords



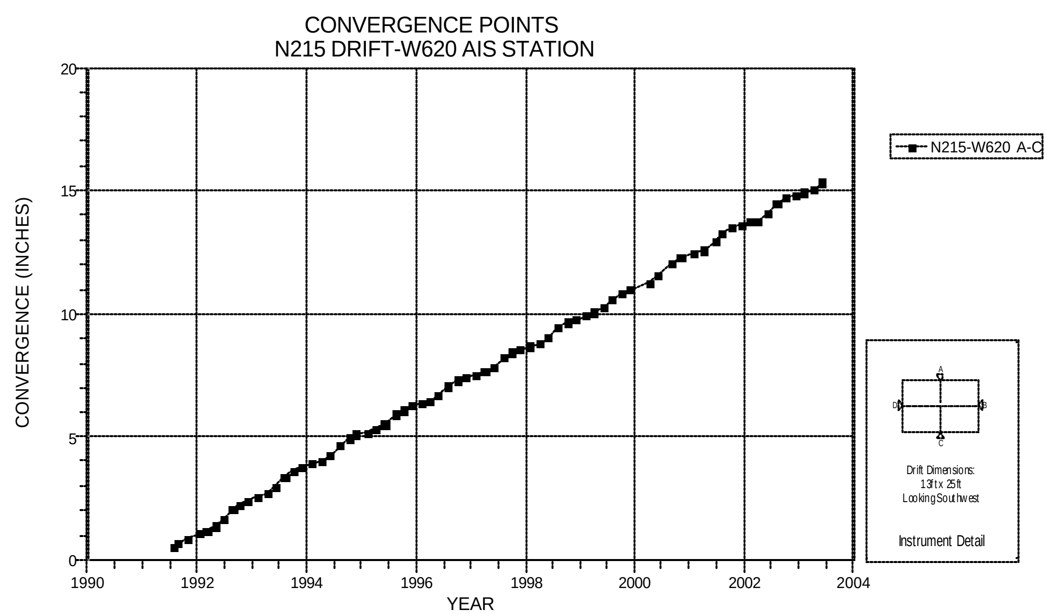
NOTES:
1. Excavation date: October 1988.

Figure 4-198 Convergence Point Array
N300 Drift at W170 – All Chords



NOTES:
1. Excavation date: December 1987.

Figure 4-199 Convergence Point Array
N215 Drift at W500 – All Chords



NOTES:
1. Excavation date: January 1988.

Figure 4-200 Convergence Point Array
N215 Drift at W620 at Air Intake Shaft – Roof to Floor

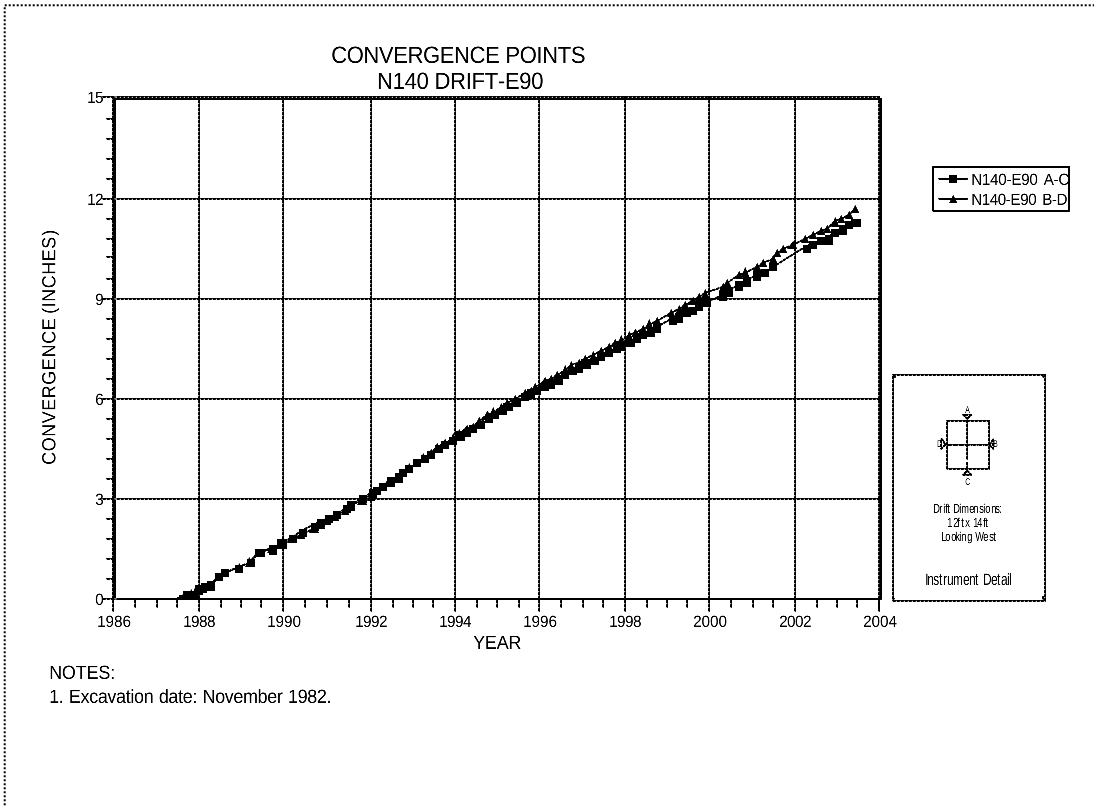


Figure 4-201 Convergence Point Array
N140 Drift at E90 – All Chords

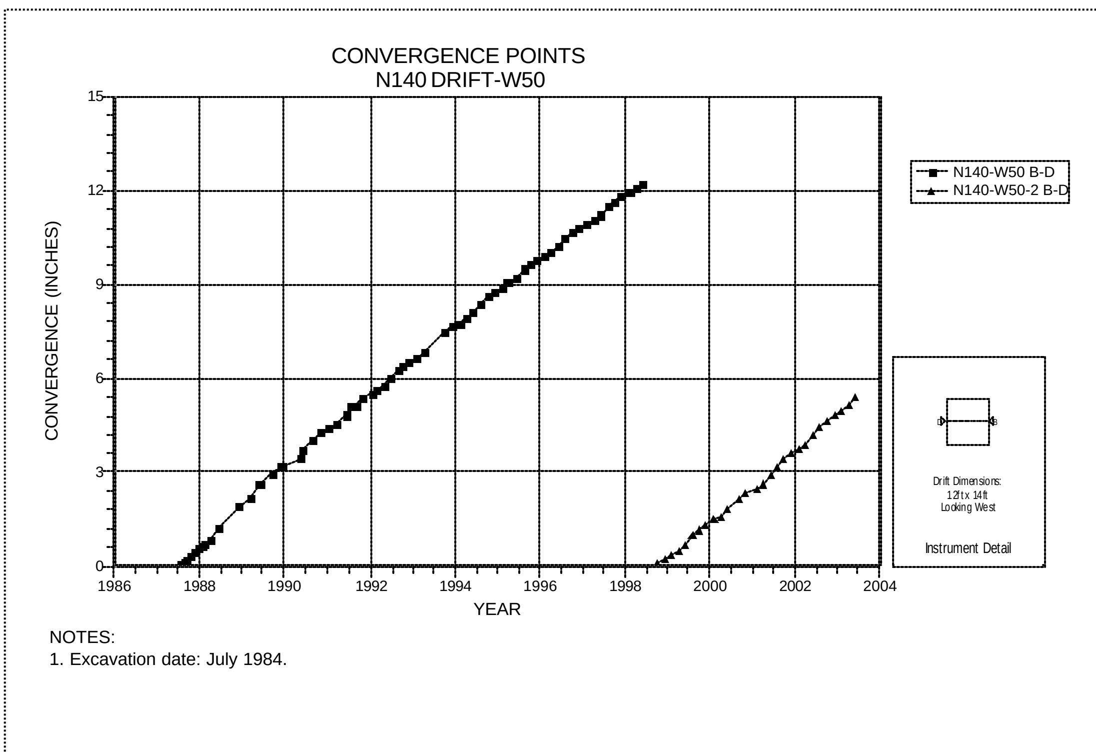


Figure 4-202 Convergence Point Array
N140 Drift at W50 – Rib to Rib

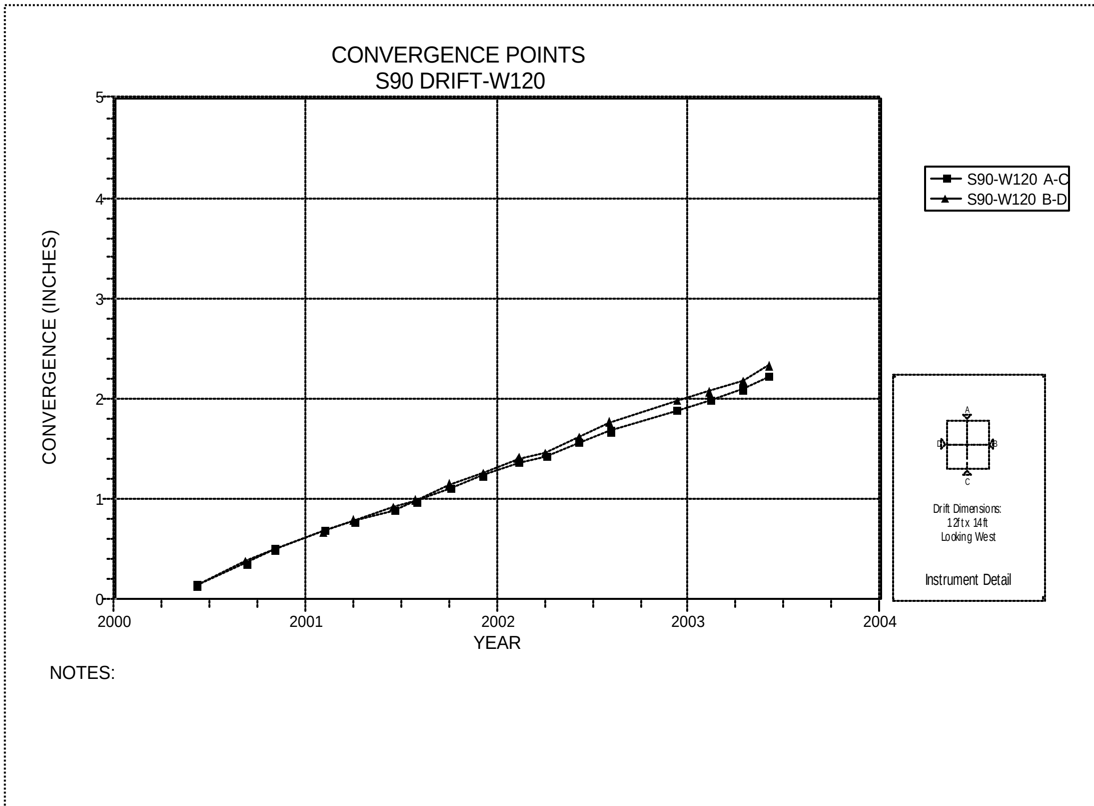


Figure 4-203 Convergence Point Array
S90 Drift at W120 – All Chords

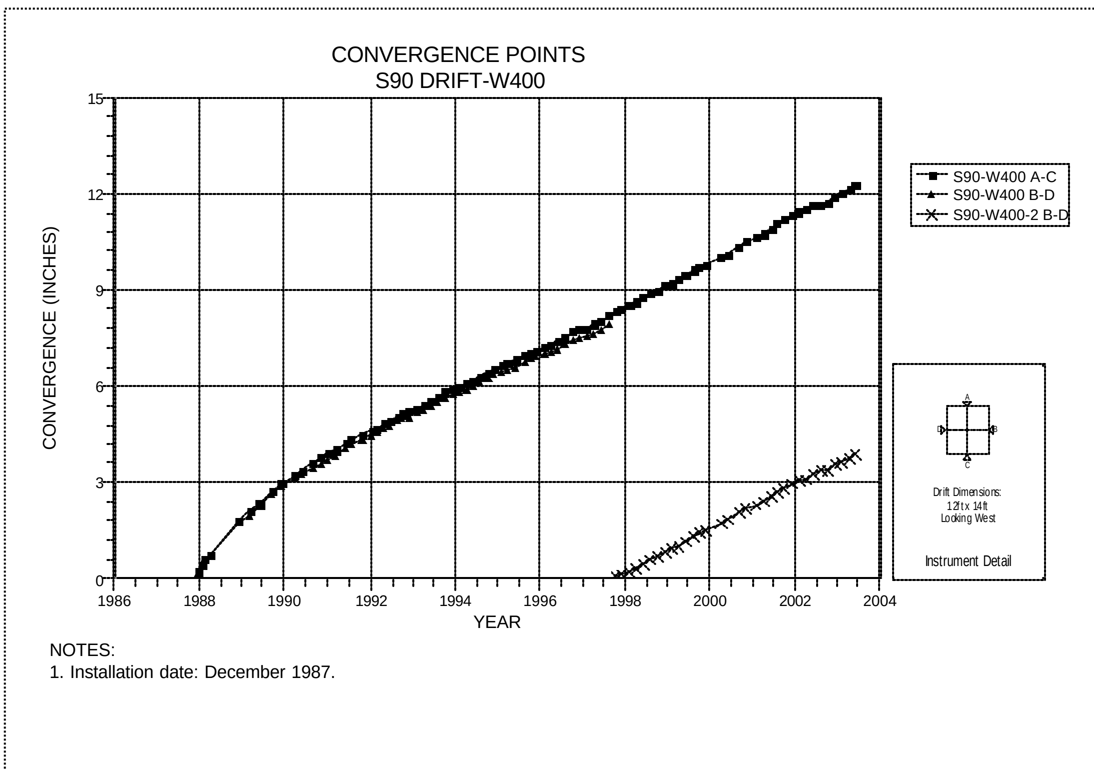


Figure 4-204 Convergence Point Array
S90 Drift at W400 – All Chords

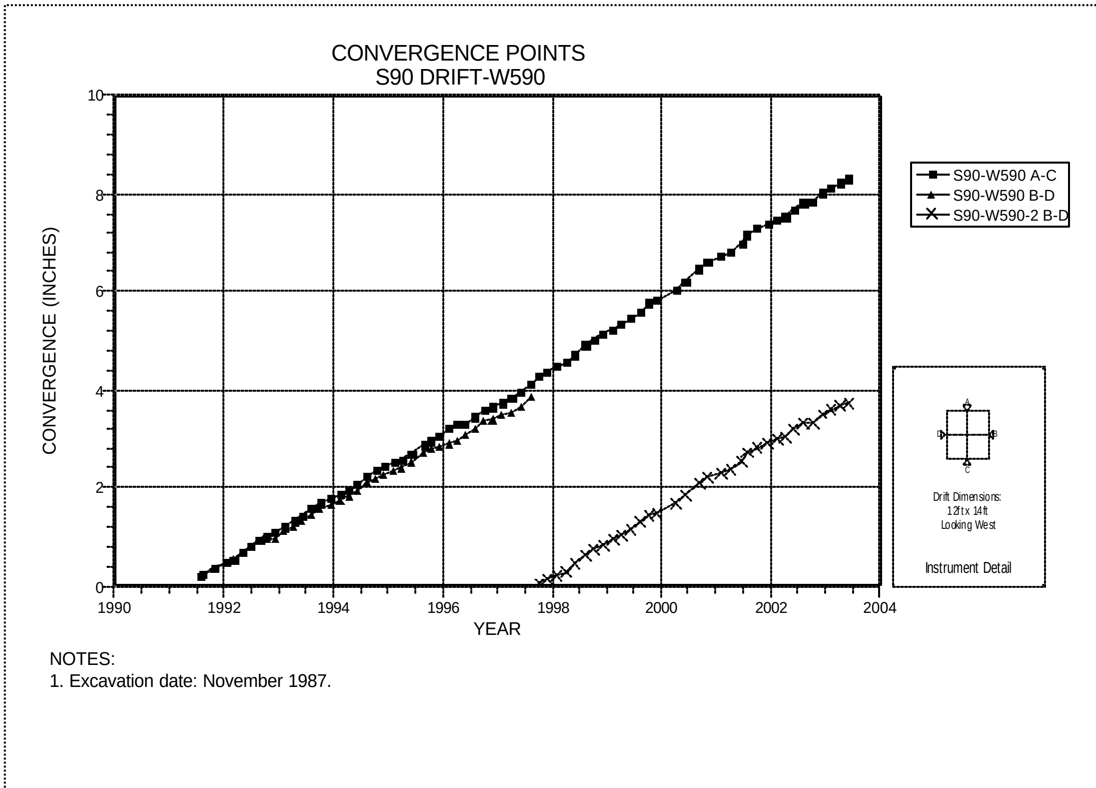


Figure 4-205 Convergence Point Array
S90 Drift at W590 – All Chords

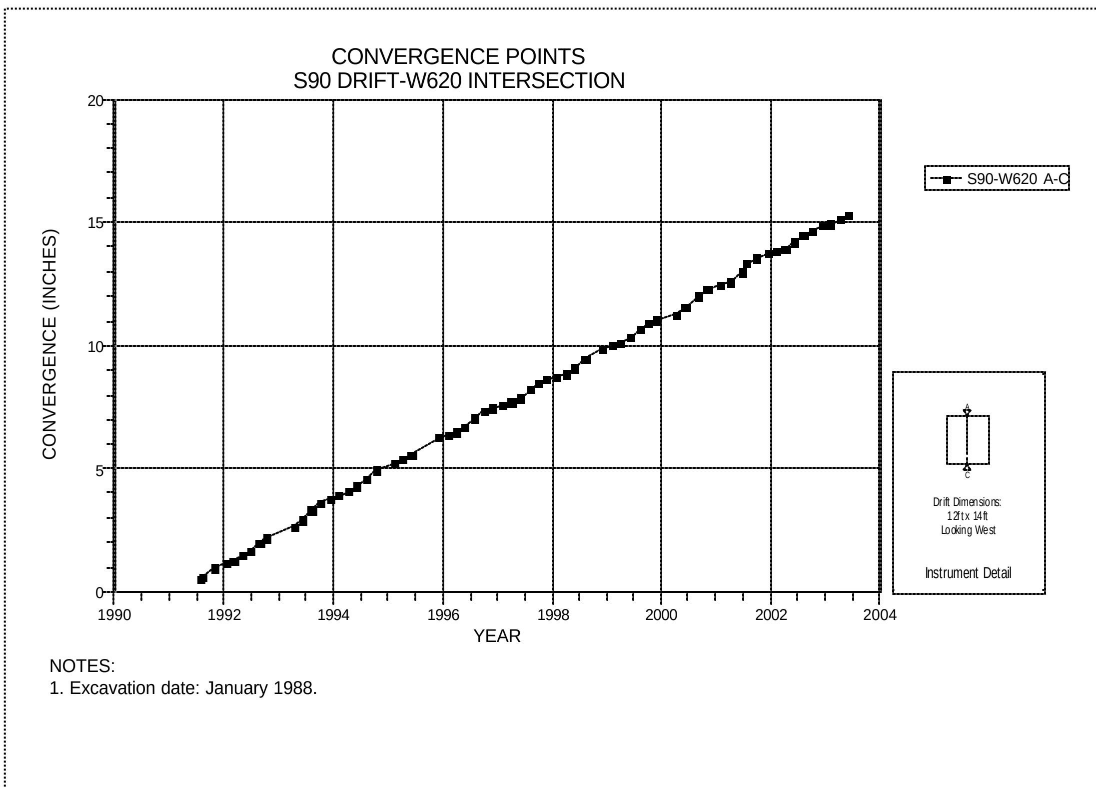


Figure 4-206 Convergence Point Array
S90 Drift at W620 – Roof to Floor

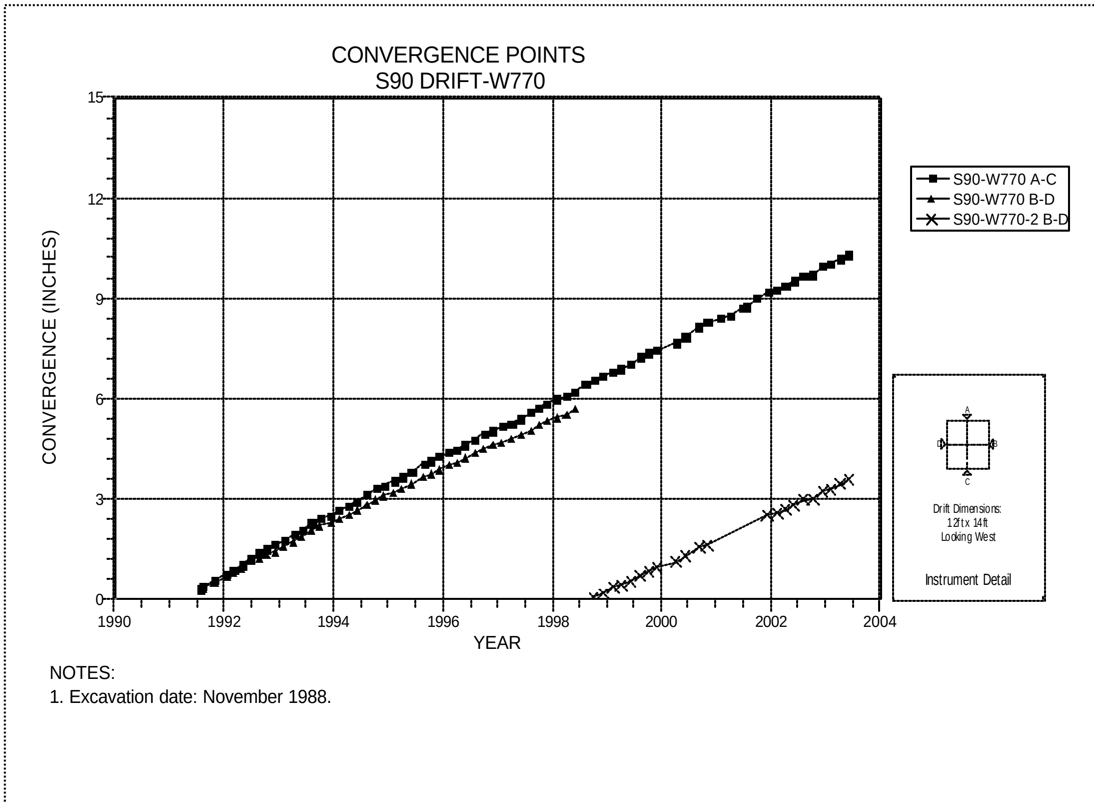


Figure 4-207 Convergence Point Array
S90 Drift at W770 – All Chords

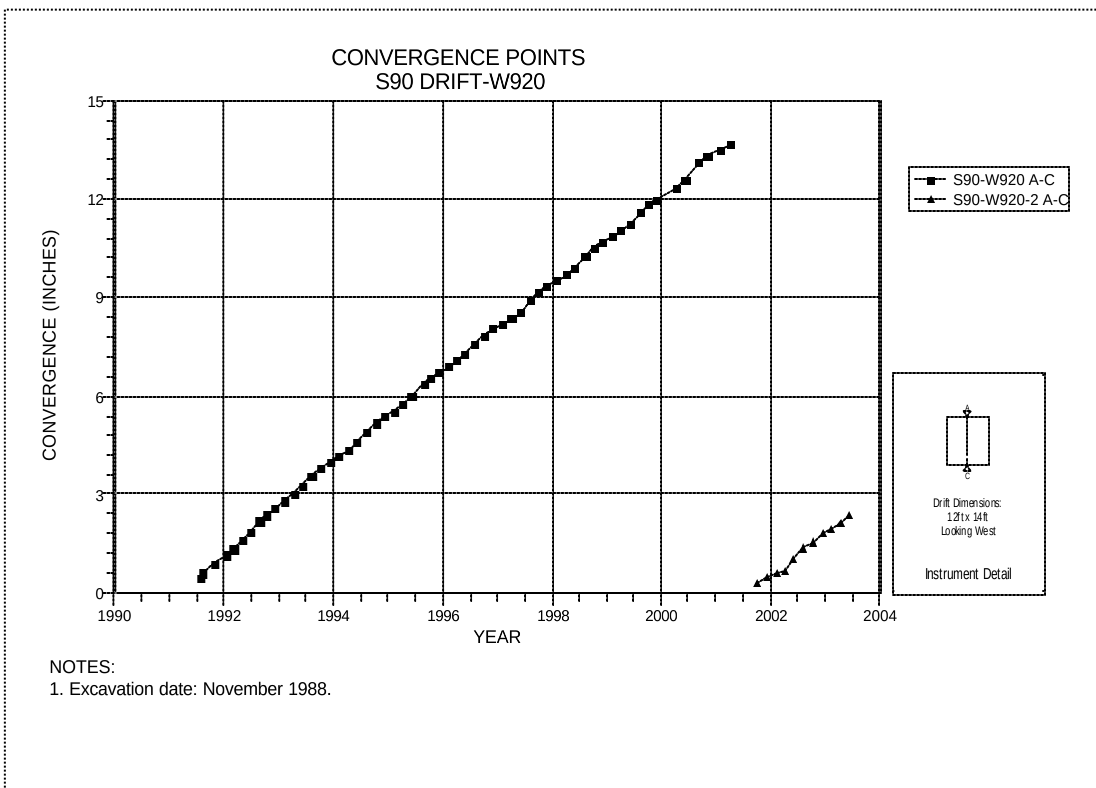


Figure 4-208 Convergence Point Array
S90 Drift at W920 – Roof to Floor

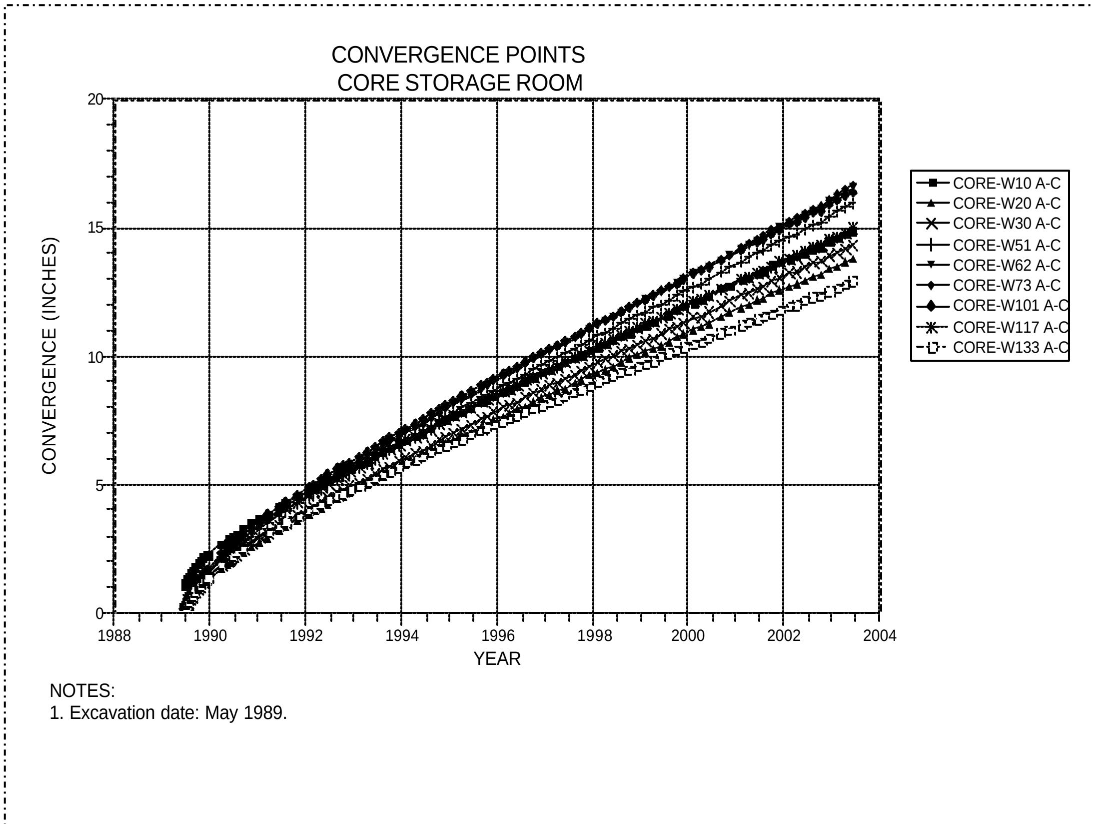


Figure 4-209 Convergence Point Array
S400 Core Storage Library – All Chords

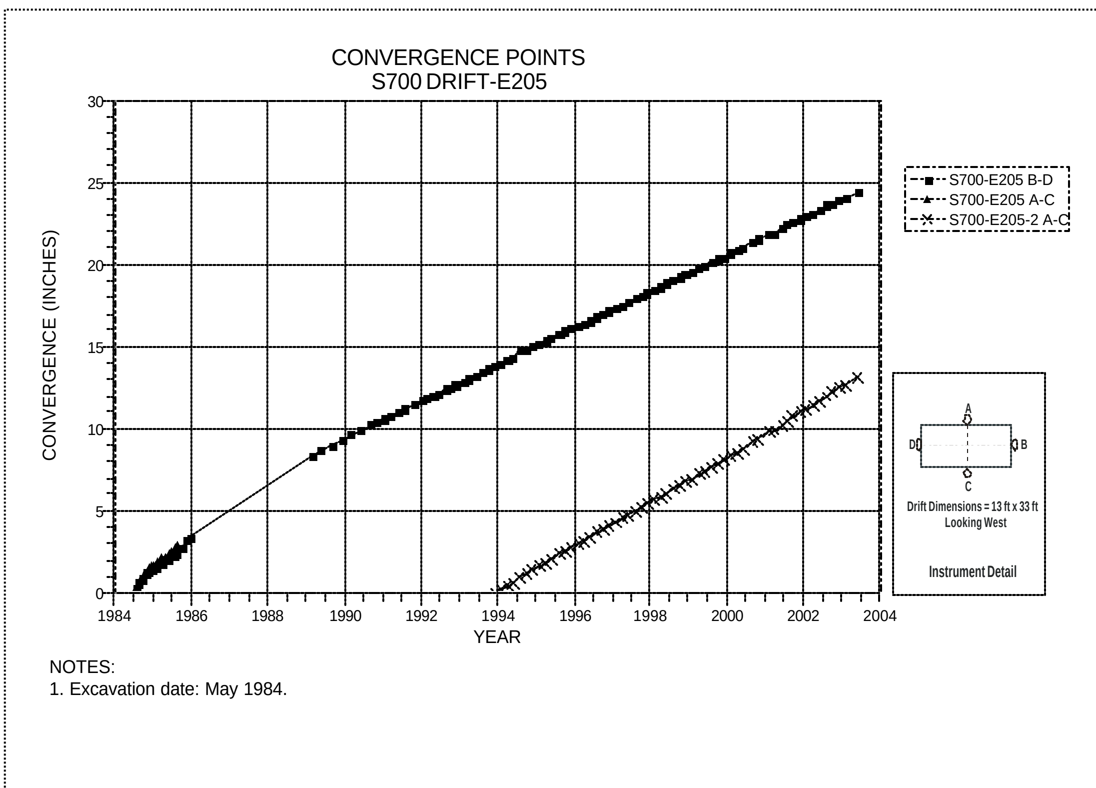
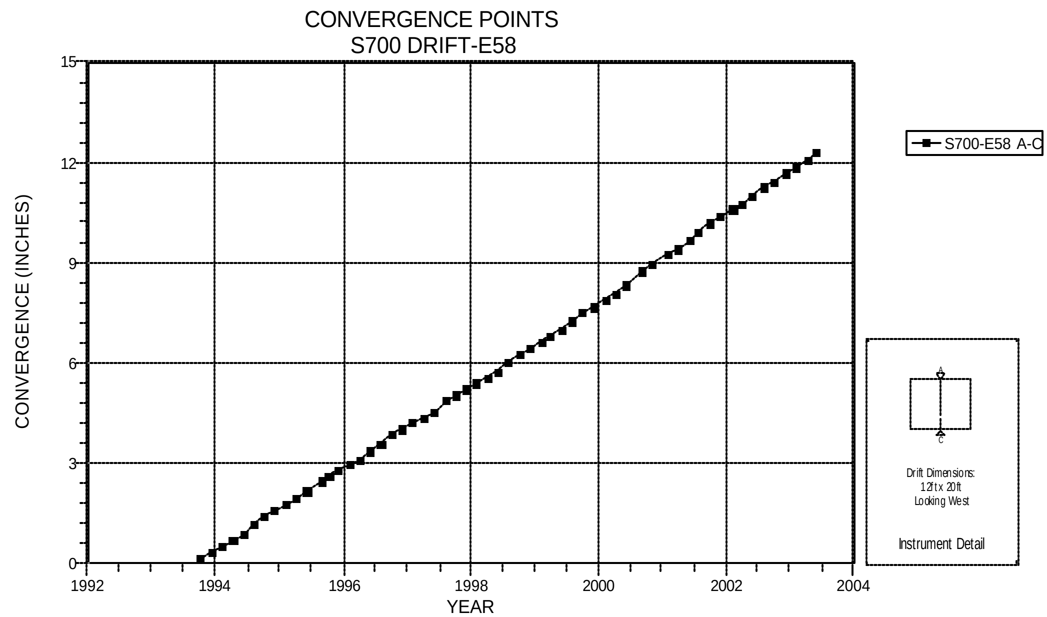
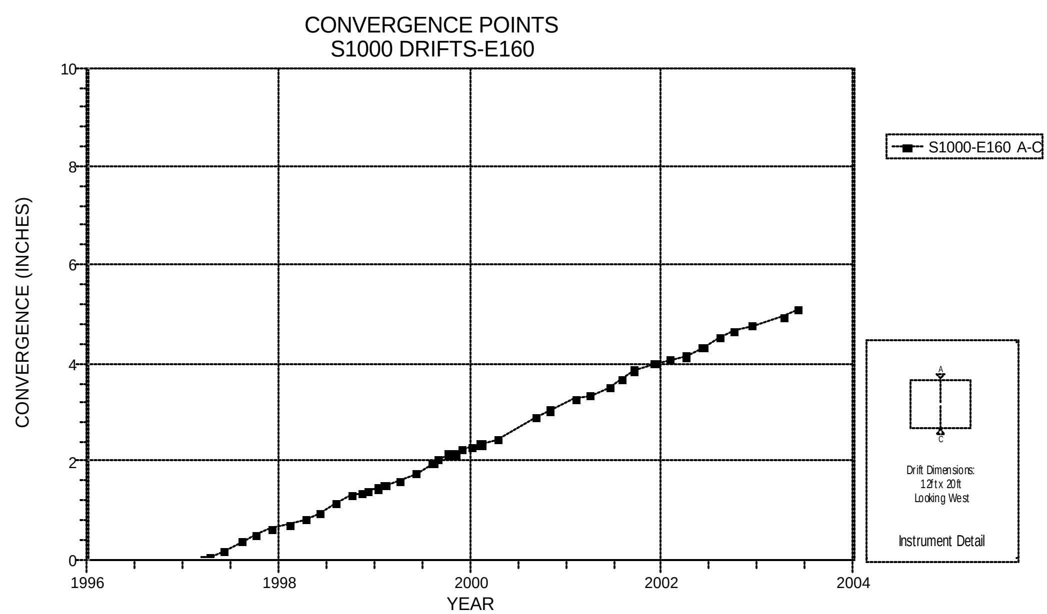


Figure 4-210 Convergence Point Array
S700 Drift at E205 – All Chords



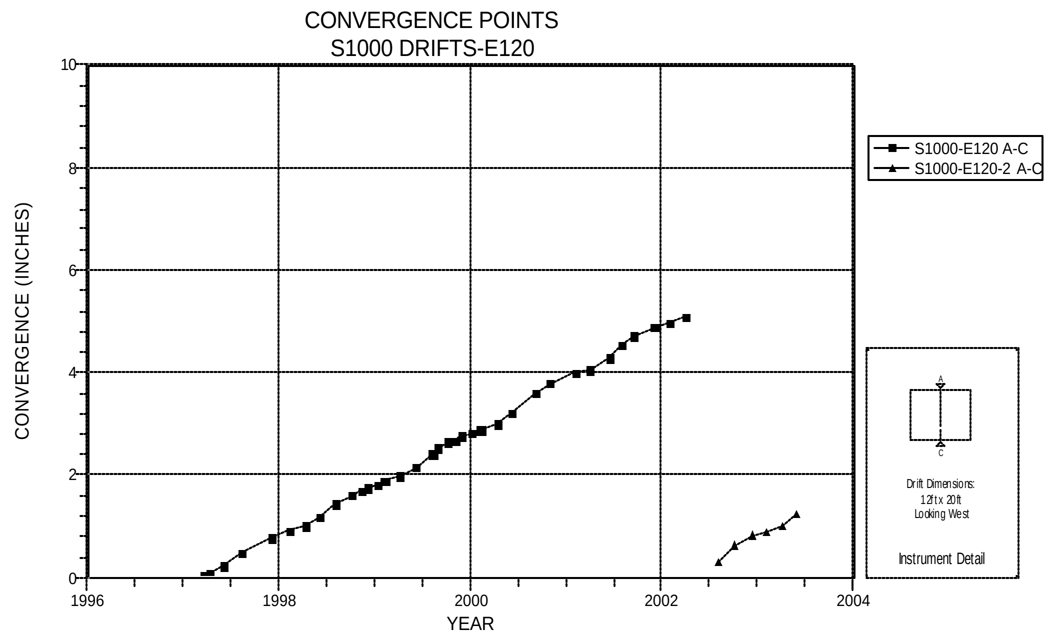
NOTES:
1. Excavation date: July 1985.

Figure 4-211 Convergence Point Array
S700 Drift at E58 – Roof to Floor



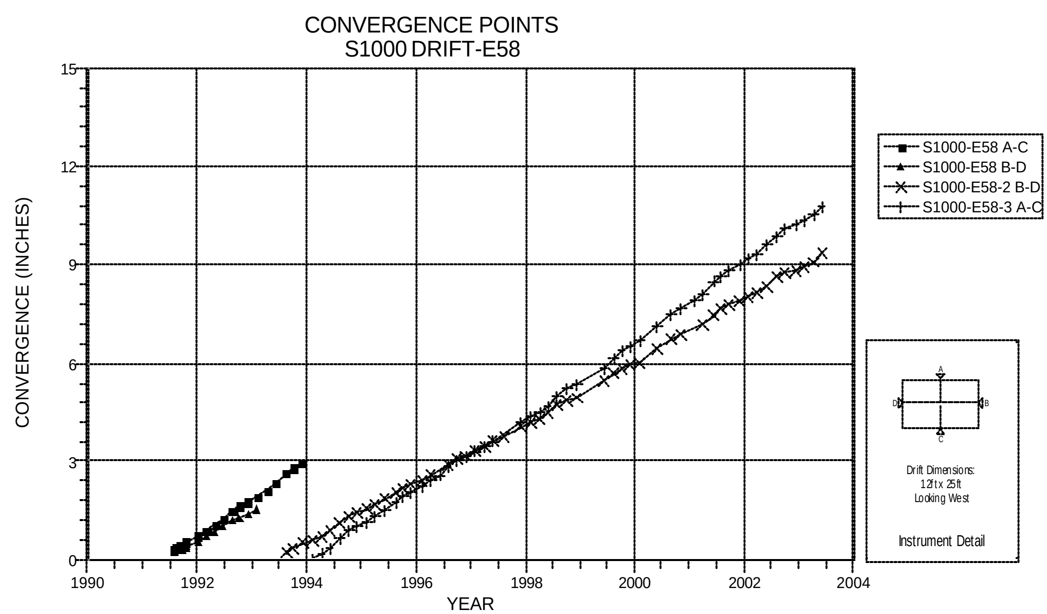
NOTES:
1. Excavation date: September 1985.

Figure 4-212 Convergence Point Array
S1000 Drift at E160 – Roof to Floor



NOTES:
1. Excavation date: July 1984.

Figure 4-213 Convergence Point Array
S1000 Drift at E120 – Roof to Floor



NOTES:
1. Excavation date: July 1984.

Figure 4-214 Convergence Point Array
S1000 Drift at E58 – Roof to Floor

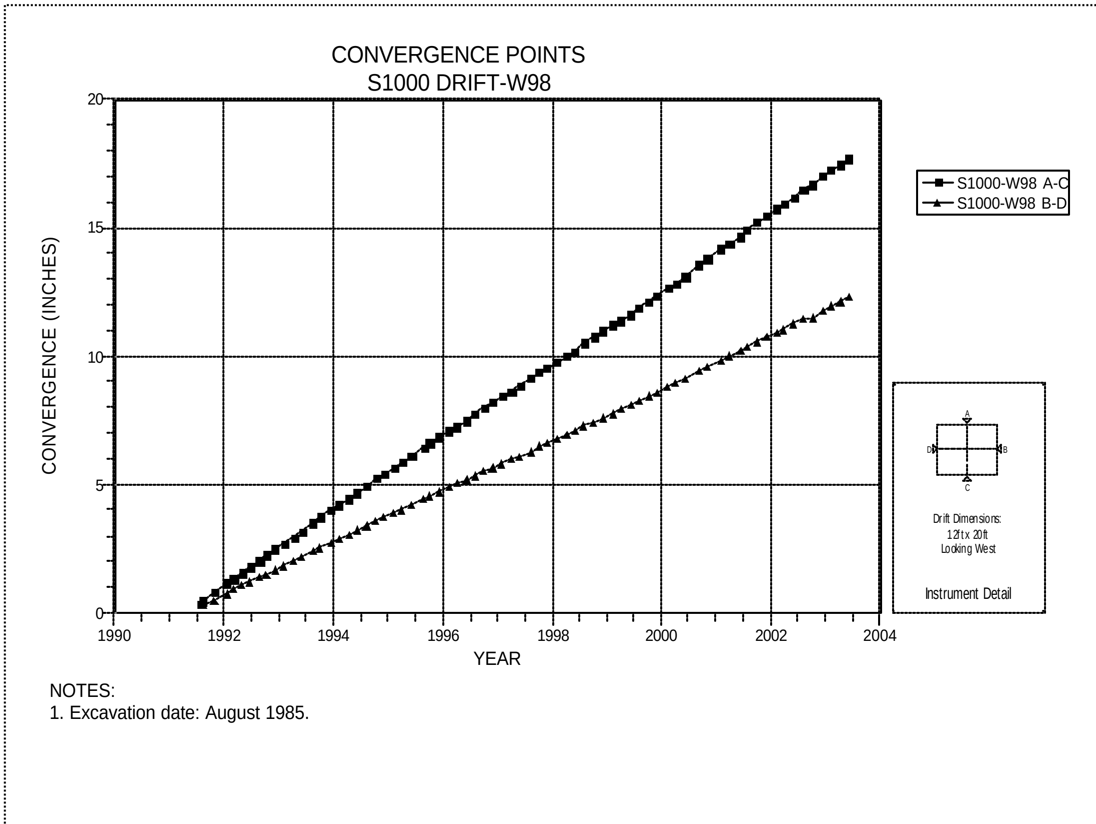


Figure 4-215 Convergence Point Array
S1000 Drift at W98 – All Chords

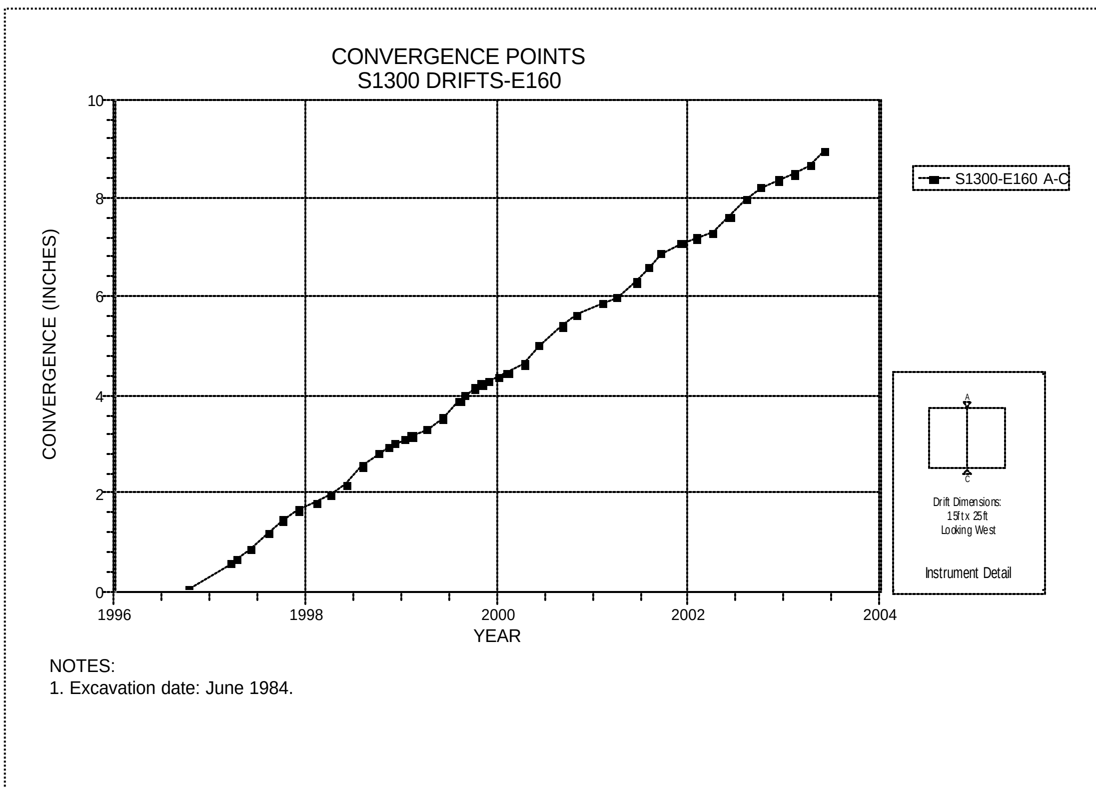


Figure 4-216 Convergence Point Array
S1300 Drift at E160 – Roof to Floor

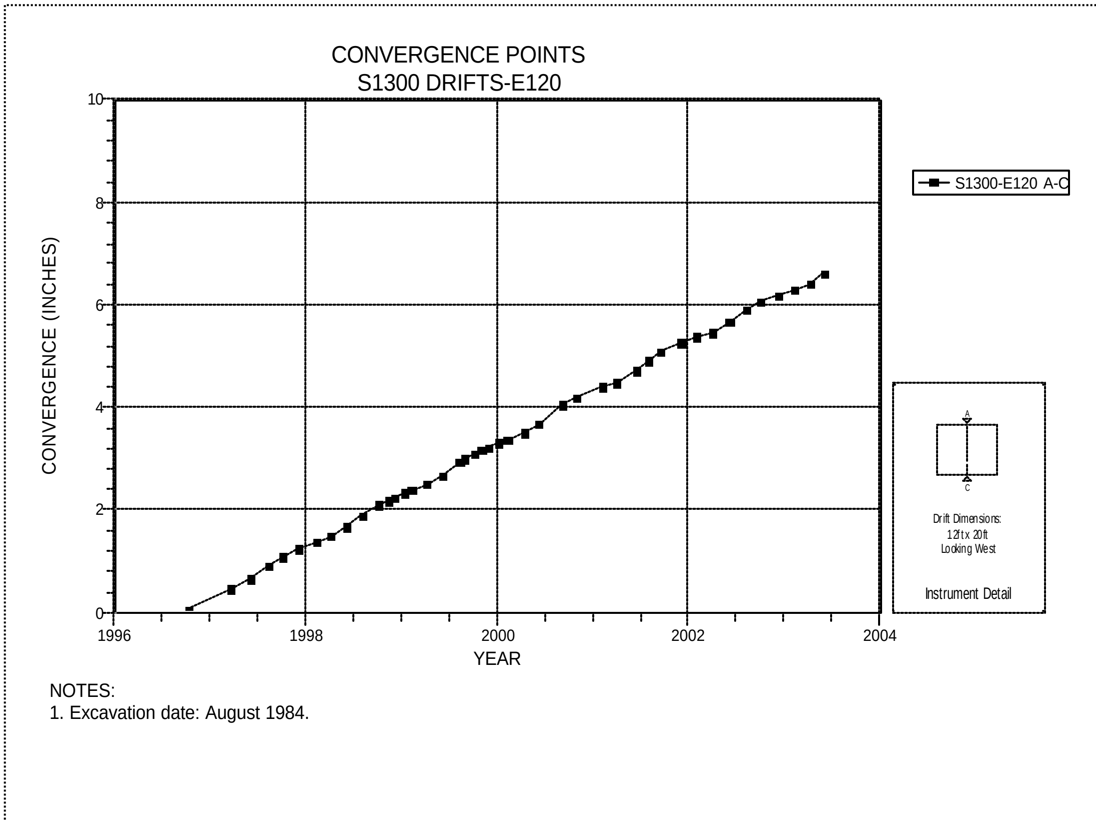


Figure 4-217 Convergence Point Array
S1300 Drift at E120 – Roof to Floor

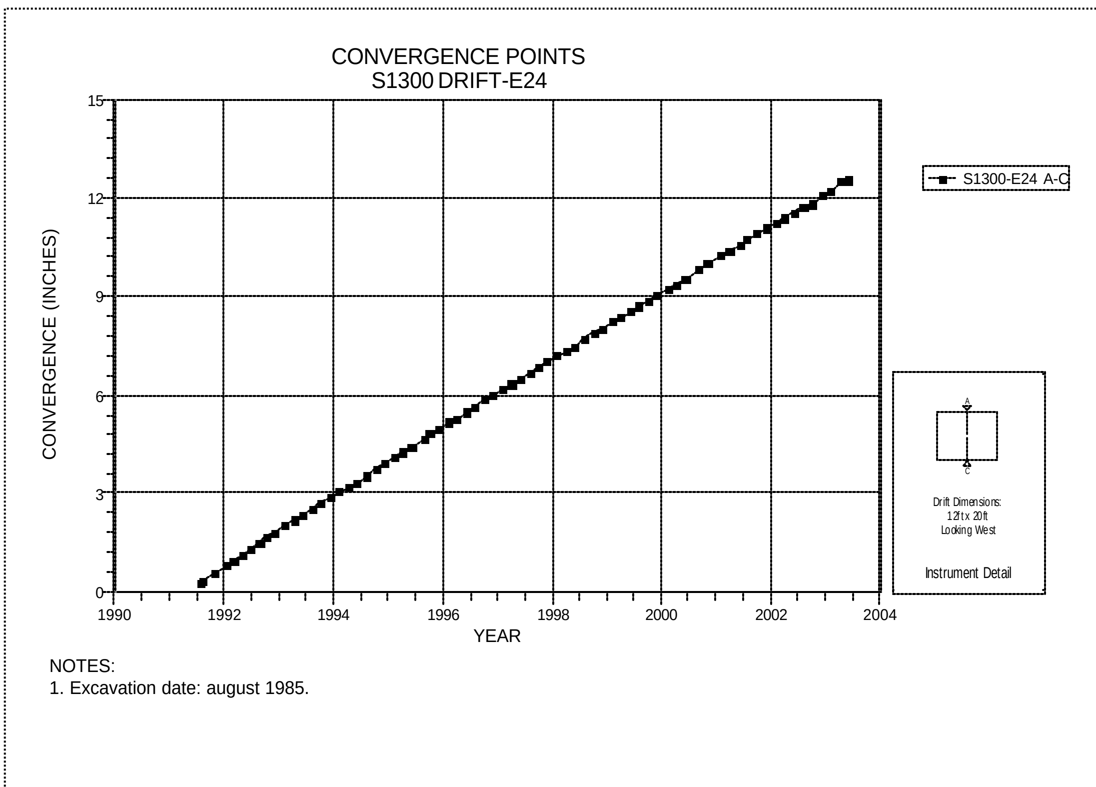


Figure 4-218 Convergence Point Array
S1300 Drift at E24 – Roof to Floor

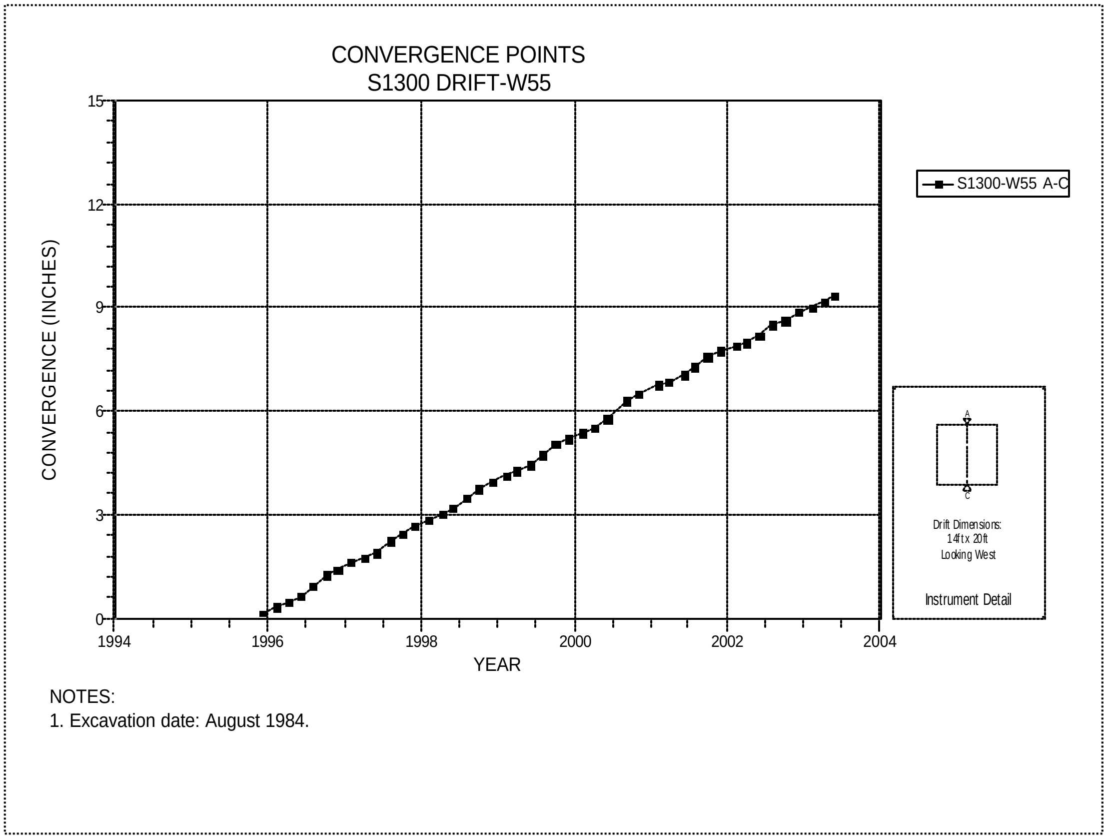


Figure 4-219 Convergence Point Array
S1300 Drift at W55 – Roof to Floor

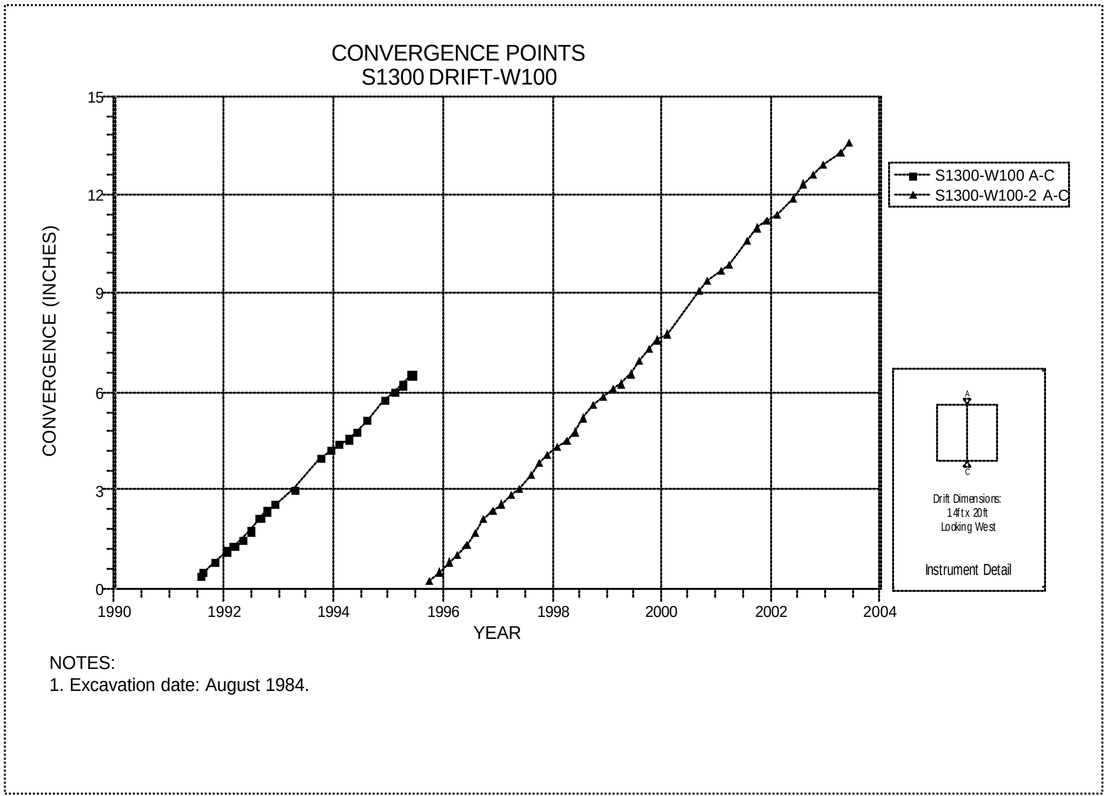
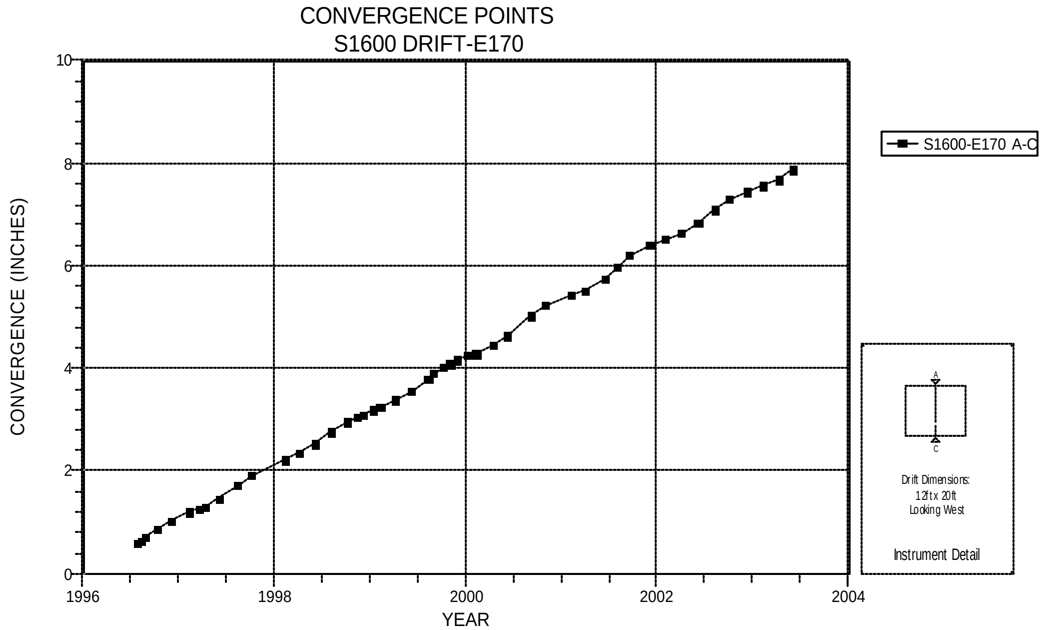
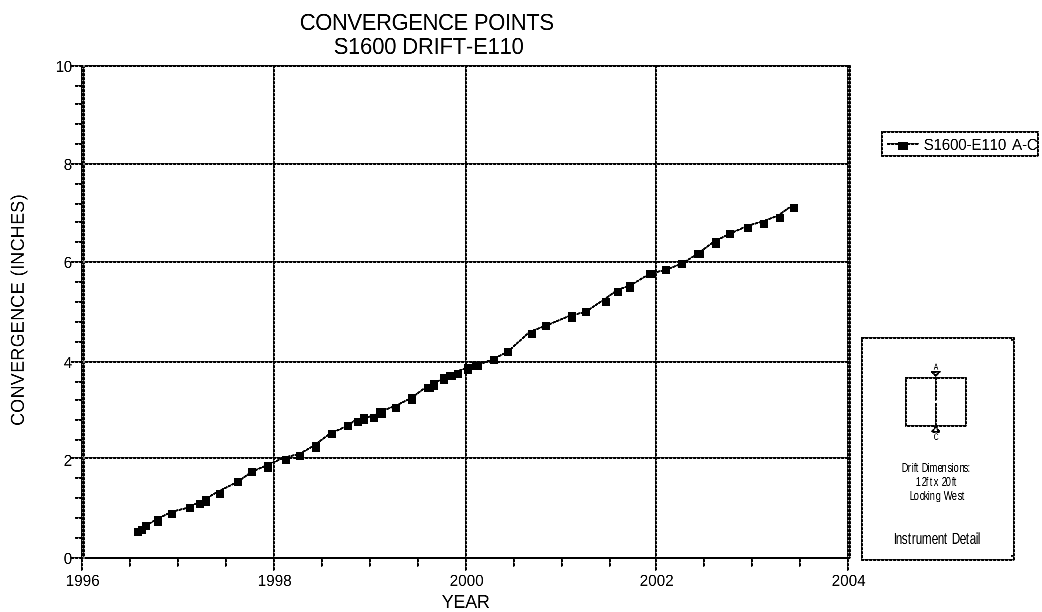


Figure 4-220 Convergence Point Array
S1300 Drift at W100 – Roof to Floor



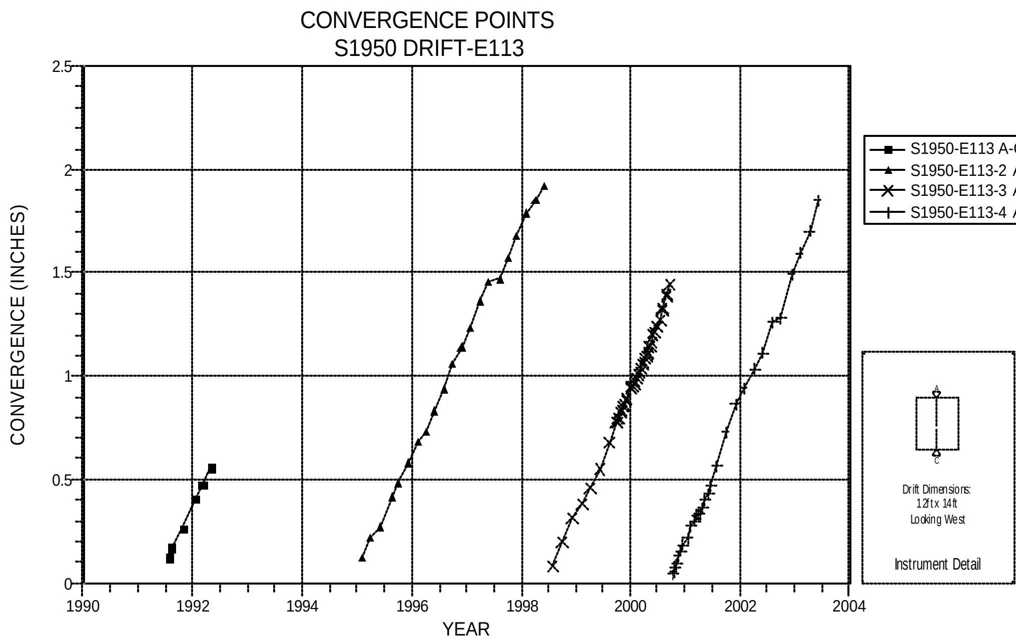
NOTES:
1. Excavation date: September 1985.

Figure 4-221 Convergence Point Array
S1600 Drift at E170 – Roof to Floor



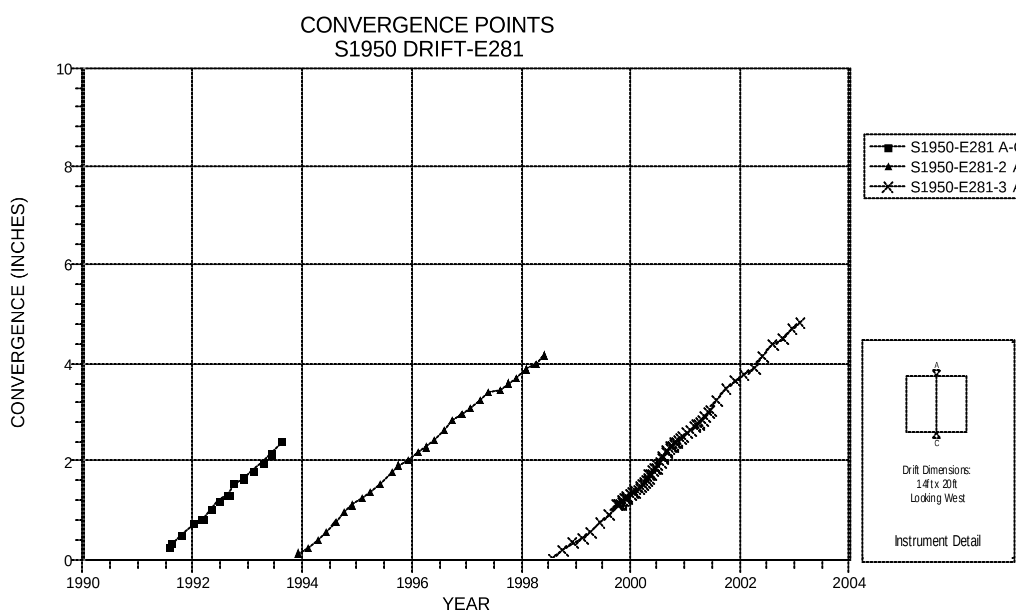
NOTES:
1. Excavation date: June 1984.

Figure 4-222 Convergence Point Array
S1600 Drift at E110 – Roof to Floor



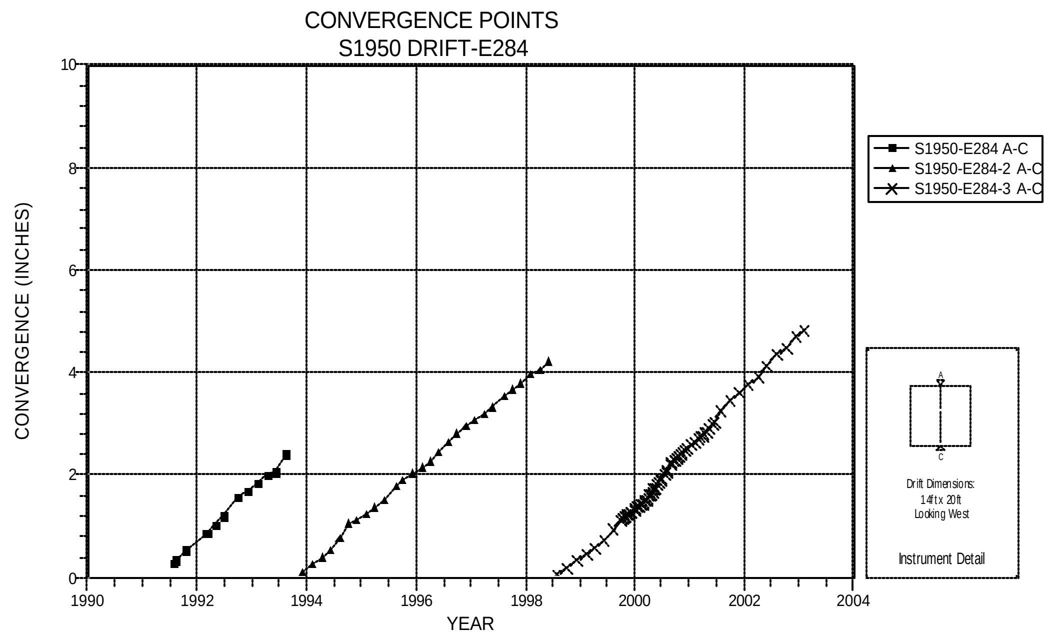
NOTES:
1. Excavation date: January 1986.

Figure 4-223 Convergence Point Array
S1950 Drift at E113 – Roof to Floor



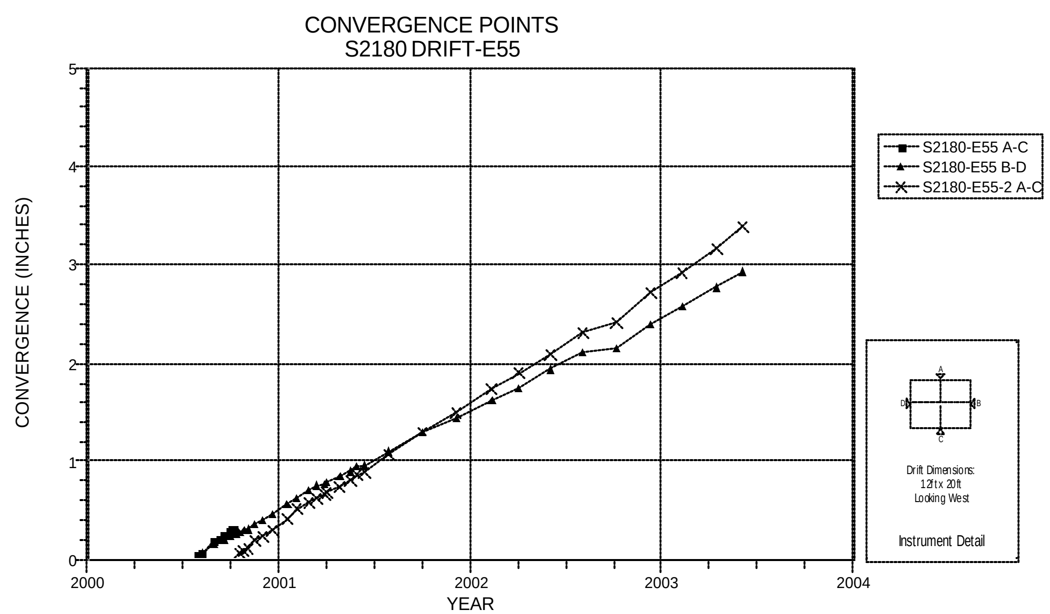
NOTES:
1. Excavation date: November 1985.

Figure 4-224 Convergence Point Array
S1950 Drift at E281 – Roof to Floor



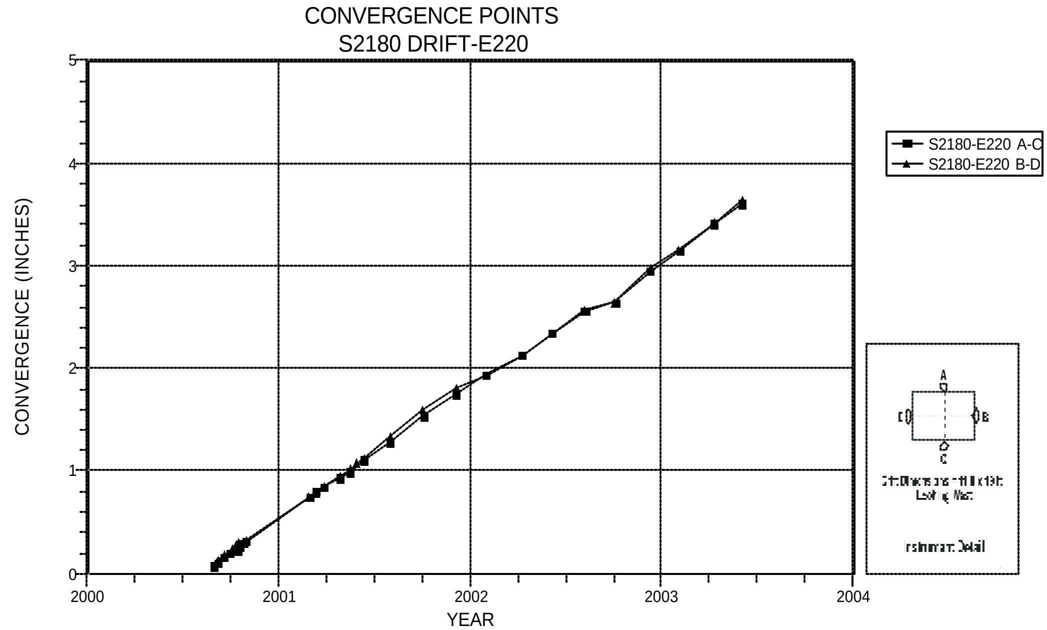
NOTES:
1. Excavation date: November 1985.

Figure 4-225 Convergence Point Array
S1950 Drift at E284 – Roof to Floor



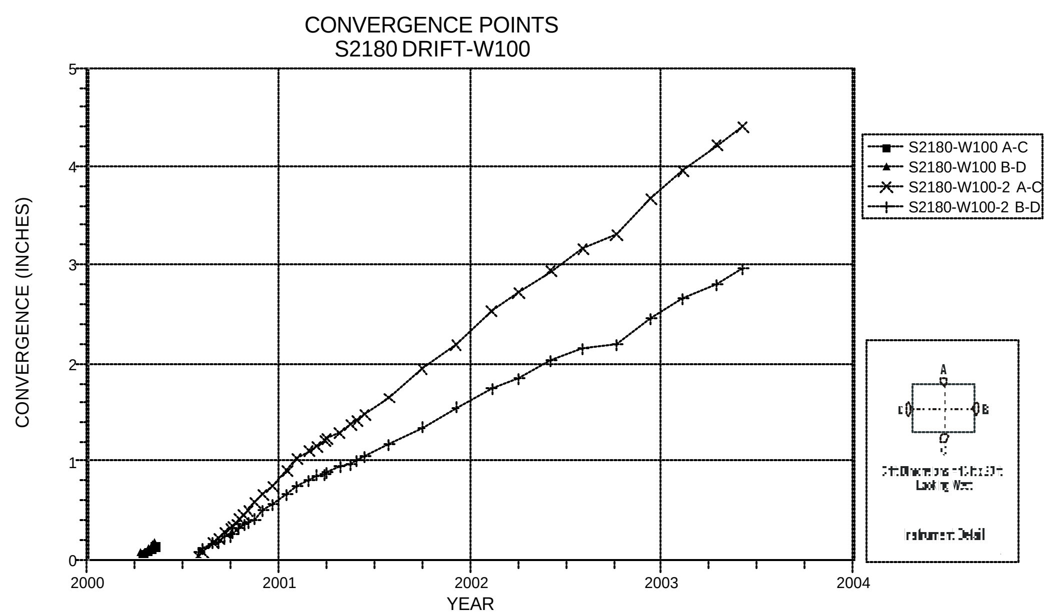
NOTES:
1. Excavation date: July 1986.

Figure 4-226 Convergence Point Array
S2180 Drift at E55 – All Chords



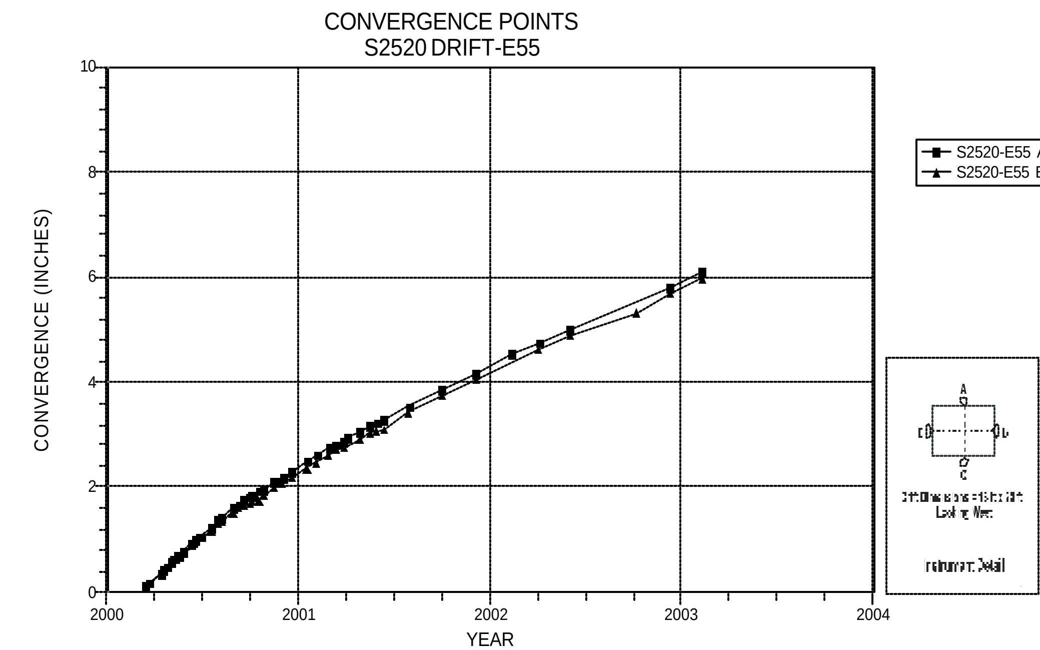
NOTES:
1. Excavation date: March 1986.

Figure 4-227 Convergence Point Array
S2180 Drift at E220 – All Chords



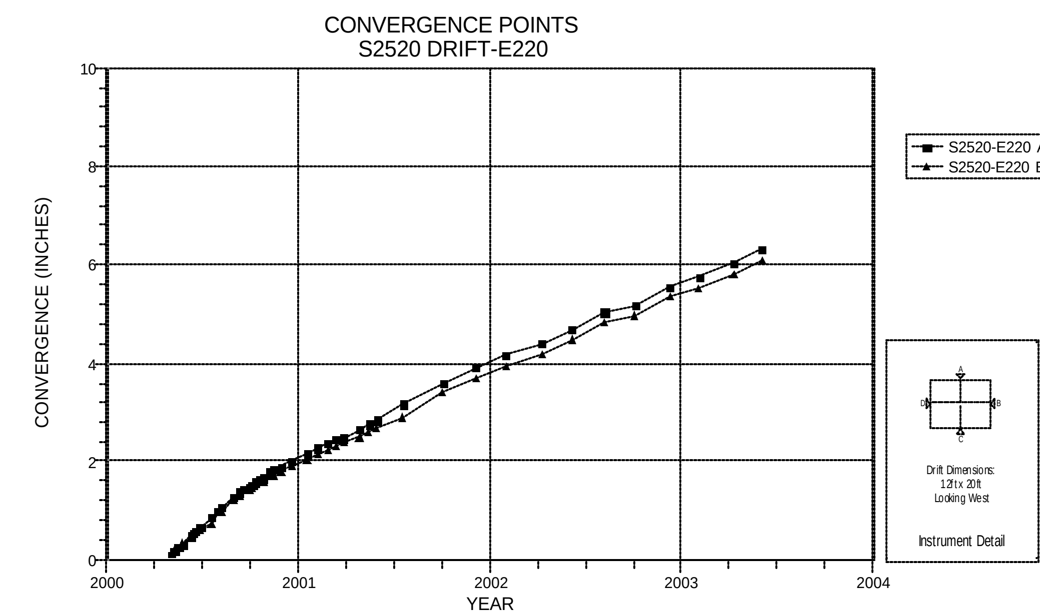
NOTES:
1. Excavation date: July 1986.

Figure 4-228 Convergence Point Array
S2180 Drift at W100 – All Chords



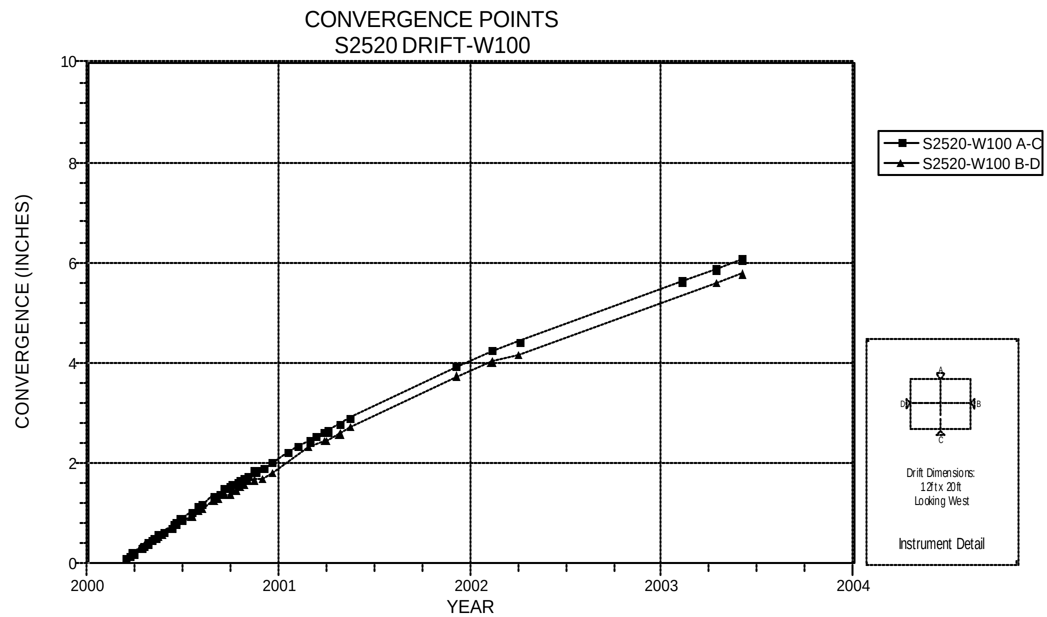
NOTES:
1. Excavation date: February 2000.

Figure 4-229 Convergence Point Array
S2520 Drift at E55 – All Chords



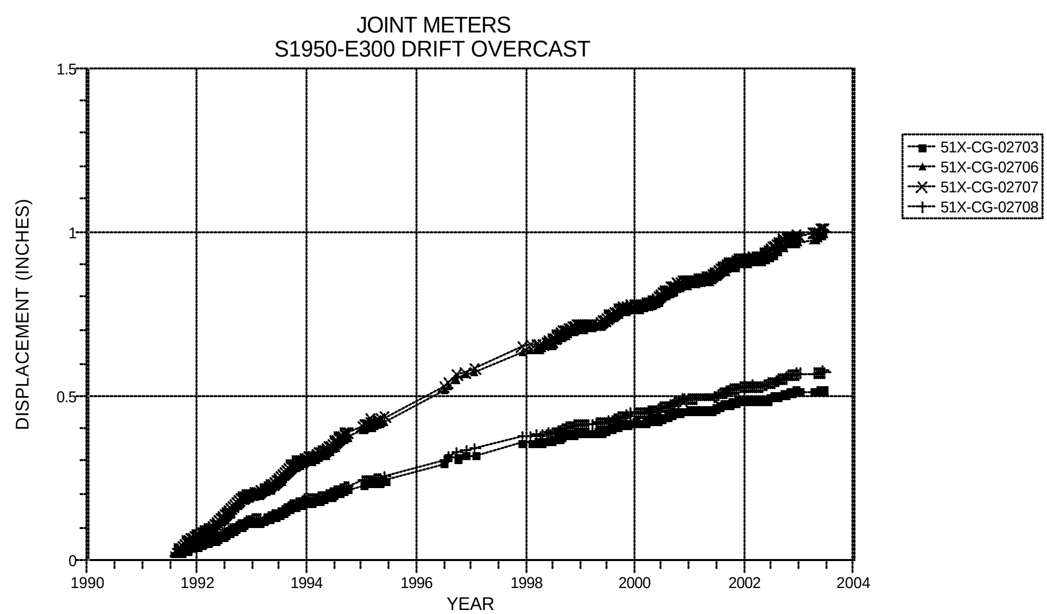
NOTES:
1. Excavation date: December 1999.

Figure 4-230 Convergence Point Array
S2520 Drift at E220 – All Chords



NOTES:
1. Excavation date: December 1999.

Figure 4-231 Convergence Point Array
S2520 Drift at W100 – All Chords



NOTES:
1. Excavation date: March 1985.

Figure 4-232 Joint Meters
S1950 Drift at E300 – Drift Overcast

5.0 Instrumentation Summary for the Northern Experimental Area

The Northern Experimental Area including the SPDV rooms and associated access drifts are no longer accessible and readings were discontinued in June 2002. There are no instrument data results from this area during this reporting period. Remote monitoring of instrumentation east of the E300 shop was discontinued due to mining activities in N1100 drift that required removal of the data logger. Access to this instrumentation is currently not available and there are no plans to reactivate remote monitoring in this area.

A re-entry into previously closed sections of N1100 and N1420 drifts was performed on March 13, 2003. The purpose of the re-entry was to evaluate this area for future operational use. This re-entry documented the conditions of installed ground support, opening geometry, and observed geotechnical conditions.

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6.0 Instrumentation Summary for the Waste Disposal Area

This chapter presents a summary of the data collected from instruments located in Panel 1 and Panel 2 of the Waste Disposal Area. Table 6-1 and Table 6-2 presents the results of analyses performed on the instrument data including extensometer displacement rates and convergence rates compared to previous reporting period rates. Figures 6-1 through 6-40 present plots of the data from borehole extensometers located in Panel 1. Panel 1 convergence point data plots are presented as Figures 6-41 through 6-69. Figures 6-70 through 6-80 present plots of the data from borehole extensometers located in Panel 2. Panel 2 convergence point data plots are presented as Figures 6-81 through 6-123.

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Table 6-1
Panel 1 Data Analysis

EXTENSOMETERS

Field Tag	Location		Figure Number	Date of Last Reading	Collar Displacement Relative to Deepest Anchor (inches)	Displacement Rate 2002 to 2003 in/year	Displacement Rate 2001 to 2002 in/year	Rate Change Percent [A]	Comments
51X-GE-01001	Room 1, Panel 1	E Rib	6-1	02/10/03	9.191	0.696	0.747	-7%	
51X-GE-01002	Room 1, Panel 1	W Rib	6-2	02/10/03	8.616	0.627	0.665	-6%	
51X-GE-00312	Room 1, Panel 1	Roof	6-3	01/06/03	8.075	2.059	2.139	-4%	
51X-GE-00458	Room 1, Panel 1	Roof	6-4	11/07/02	3.443	-0.004	-0.061	-93%	
51X-GE-00313	Room 1, Panel 1	Roof	6-5	01/06/03	5.392	1.147	0.653	76%	
51X-GE-00457	Room 1, Panel 1	Roof	6-6	11/07/02	5.234	0.746	0.984	-24%	
51X-GE-00314	Room 1, Panel 1	Roof	6-7	01/06/03	4.122	1.285	0.749	72%	
51X-GE-00456	Room 1, Panel 1	Roof	6-8	11/07/02	4.422	0.973	0.789	23%	
51X-GE-01003	Room 2, Panel 1	E Rib	6-9	02/10/03	8.547	0.426	0.370	15%	
51X-GE-01004	Room 2, Panel 1	W Rib	6-10	02/10/03	8.764	0.798	0.790	1%	
51X-GE-00315	Room 2, Panel 1	Roof	6-11	01/06/03	6.292	1.615	1.854	-13%	
51X-GE-00428	Room 2, Panel 1	Roof	6-12	08/20/02	5.119	N/A	0.919	N/A	
51X-GE-00316	Room 2, Panel 1	Roof	6-13	01/06/03	5.573	1.342	1.272	6%	
51X-GE-00427	Room 2, Panel 1	Roof	6-14	08/20/02	4.739	N/A	0.557	N/A	
51X-GE-00317	Room 2, Panel 1	Roof	6-15	01/06/03	4.361	1.064	0.889	20%	
51X-GE-00426	Room 2, Panel 1	Roof	6-16	08/20/02	5.346	N/A	0.562	N/A	
51X-GE-00318	Room 3, Panel 1	Roof	6-17	01/06/03	5.364	1.170	1.451	-19%	
51X-GE-00319	Room 3, Panel 1	Roof	6-18	01/06/03	4.726	1.014	1.102	-8%	
51X-GE-00320	Room 3, Panel 1	Roof	6-19	01/06/03	3.980	0.906	0.973	-7%	
51X-GE-01007	Room 4, Panel 1	E Rib	6-20	02/10/03	10.155	N/A	0.864	N/A	Instrument malfunction.
51X-GE-01008	Room 4, Panel 1	W Rib	6-21	02/10/03	10.725	0.819	0.880	-7%	
51X-GE-00321	Room 4, Panel 1	Roof	6-22	01/06/03	3.632	0.732	0.923	-21%	
51X-GE-00322	Room 4, Panel 1	Roof	6-23	01/06/03	6.785	1.897	1.776	7%	
51X-GE-00323	Room 4, Panel 1	Roof	6-24	01/06/03	3.027	0.662	0.559	18%	
51X-GE-01009	Room 5, Panel 1	E Rib	6-25	01/20/03	9.849	0.696	0.765	-9%	
51X-GE-00325	Room 5, Panel 1	Roof	6-26	01/06/03	6.543	1.410	1.283	10%	
51X-GE-00326	Room 5, Panel 1	Roof	6-27	01/06/03	4.335	0.953	0.958	-1%	
51X-GE-01011	Room 6, Panel 1	E Rib	6-28	02/10/03	8.177	0.597	0.607	-2%	
51X-GE-01012	Room 6, Panel 1	W Rib	6-29	02/10/03	8.439	0.624	0.662	-6%	

[A] NA indicates insufficient data to calculate.

Table 6-1 (Continued)
Panel 1 Data Analysis

EXTENSOMETERS (Continued)

Field Tag	Location		Figure Number	Date of Last Reading	Collar Displacement Relative to Deepest Anchor (inches)	Displacement Rate 2002 to 2003 in/year	Displacement Rate 2001 to 2002 in/year	Rate Change Percent	Comments
51X-GE-00327	Room 6, Panel 1	Roof	6-30	01/06/03	7.427	1.961	1.644	19%	
51X-GE-00328	Room 6, Panel 1	Roof	6-31	01/06/03	4.947	1.330	1.271	5%	
51X-GE-00329	Room 6, Panel 1	Roof	6-32	01/06/03	4.907	1.094	1.148	-5%	
51X-GE-01013	Room 7, Panel 1	E Rib	6-33	02/10/03	7.734	0.472	0.489	-3%	
51X-GE-01023	Room 7, Panel 1	W Rib	6-34	02/10/03	2.646	0.421	0.443	-5%	
51X-GE-00330	Room 7, Panel 1	Roof	6-35	01/06/03	5.030	0.857	0.854	0%	
51X-GE-00331	Room 7, Panel 1	Roof	6-36	01/06/03	4.318	0.885	0.810	9%	
51X-GE-00332	Room 7, Panel 1	Roof	6-37	01/06/03	3.802	0.830	0.748	11%	
51X-GE-00412	S1950 Drift-E582	Roof	6-38	09/16/02	5.753	0.676	0.686	-1%	
51X-GE-01015	S1950 Drift-E856	S Rib	6-39	02/10/03	10.767	1.078	1.247	-14%	
51X-GE-01016	S1950 Drift-E856	N Rib	6-40	02/10/03	7.493	0.630	0.567	11%	

Table 6-1 (Continued)
Panel 1 Data Analysis

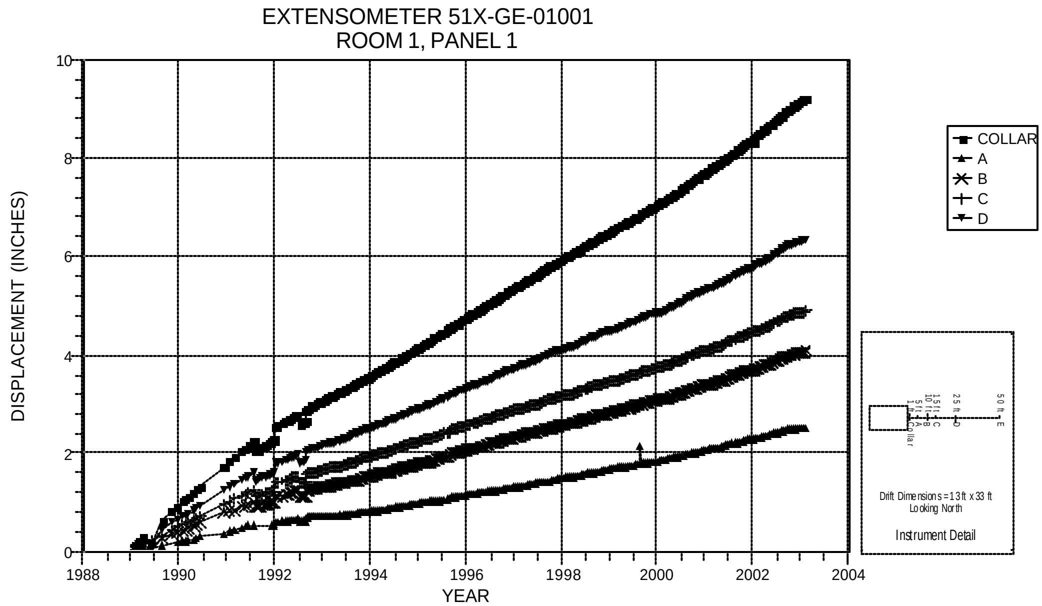
CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading 2002 to 2003 Date	Last Reading 2002 to 2003 Inches	Cumulative Displacement Inches	Closure Rate 2002 to 2003 in/year	Closure Rate 2001 to 2002 in/year	Rate Change Percent	Comments
S1600-E311-2 A-C	S1600 Drift-E311	6-41	02/10/03	9.345	14.792	0.765	0.612	25%	
S1600-E311-5 B-D	S1600 Drift-E311	6-41	02/10/03	3.865	13.108	0.595	0.684	-13%	
S1600-E332-3 A-C	S1600 Drift-E332	6-42	02/10/03	8.192	12.619	0.676	0.739	-9%	
S1600-E357-2 A-C	S1600 Drift-E357	6-43	02/10/03	9.417	14.815	0.745	0.779	-4%	
S1600-E357-2 B-D	S1600 Drift-E357	6-43	02/10/03	7.827	16.574	0.787	0.830	-5%	
S1600-E382-2 A-C	S1600 Drift-E382	6-44	02/10/03	9.538	14.918	0.722	0.752	-4%	
S1600-E382 B-D	S1600 Drift-E382	6-44	02/10/03	15.903	15.903	0.775	0.794	-2%	
S1600-E407-3 C-K	S1600 Drift-E407	6-45	02/10/03	6.067	18.081	0.871	0.991	-12%	
S1600-E407-2 D-J	S1600 Drift-E407	6-45	02/10/03	8.537	17.492	0.799	0.918	-13%	
S1600-E407-2 E-I	S1600 Drift-E407	6-45	02/10/03	7.893	16.495	0.749	0.810	-8%	
S1600-E407-2 A-G	S1600 Drift-E407	6-46	02/10/03	10.225	15.667	0.739	0.833	-11%	
S1600-E407-2 B-F	S1600 Drift-E407	6-46	02/10/03	9.315	14.321	0.684	0.751	-9%	
S1600-E407-2 H-L	S1600 Drift-E407	6-46	02/10/03	9.902	14.967	0.757	0.785	-4%	
S1600-E432-2 A-C	S1600 Drift-E432	6-47	02/10/03	11.675	18.434	0.931	0.989	-6%	
S1600-E432-2 B-D	S1600 Drift-E432	6-47	02/10/03	7.963	17.101	0.745	0.812	-8%	
S1600-E457-2 A-C	S1600 Drift-E457	6-48	10/08/02	10.242	16.321	0.199	0.848	-77%	
S1600-E457-3 B-D	S1600 Drift-E457	6-48	10/08/02	5.062	16.783	0.232	0.871	-73%	
S1600-E482-3 A-C	S1600 Drift-E482	6-49	10/08/02	0.850	17.226	0.405	0.952	-57%	No longer accessible.
S1600-E482-2 B-D	S1600 Drift-E482	6-49	10/08/02	9.294	19.705	0.345	1.225	-72%	No longer accessible.
S1600-E507-3 A-C	S1600 Drift-E507	6-50	10/08/02	1.313	18.101	0.956	1.397	-32%	No longer accessible.
S1950-E311-5 A-C	S1950 Drift-E311	6-51	10/08/02	1.732	21.961	0.601	1.152	-48%	No longer accessible.
S1950-E311-3 B-D	S1950 Drift-E311	6-51	02/04/03	5.470	18.513	0.866	1.084	-20%	No longer accessible.
S1950-E332-4 A-C	S1950 Drift-E332	6-52	02/04/03	6.460	25.119	1.281	1.587	-19%	No longer accessible.
S1950-E332-4 B-D	S1950 Drift-E332	6-52	02/04/03	2.612	20.599	0.983	1.181	-17%	No longer accessible.
S1950-E357-7 A-C	S1950 Drift-E357	6-53	02/04/03	8.103	28.345	1.598	2.089	-24%	No longer accessible.
S1950-E357-4 B-D	S1950 Drift-E357	6-53	02/04/03	2.855	21.355	1.140	1.280	-11%	No longer accessible.
S1950-E382-5 A-C	S1950 Drift-E382	6-54	02/04/03	9.898	28.583	1.739	2.374	-27%	No longer accessible.
S1950-E382-3 B-D	S1950 Drift-E382	6-54	02/04/03	8.786	23.168	1.207	1.420	-15%	No longer accessible.

Table 6-1 (Continued)
Panel 1 Data Analysis

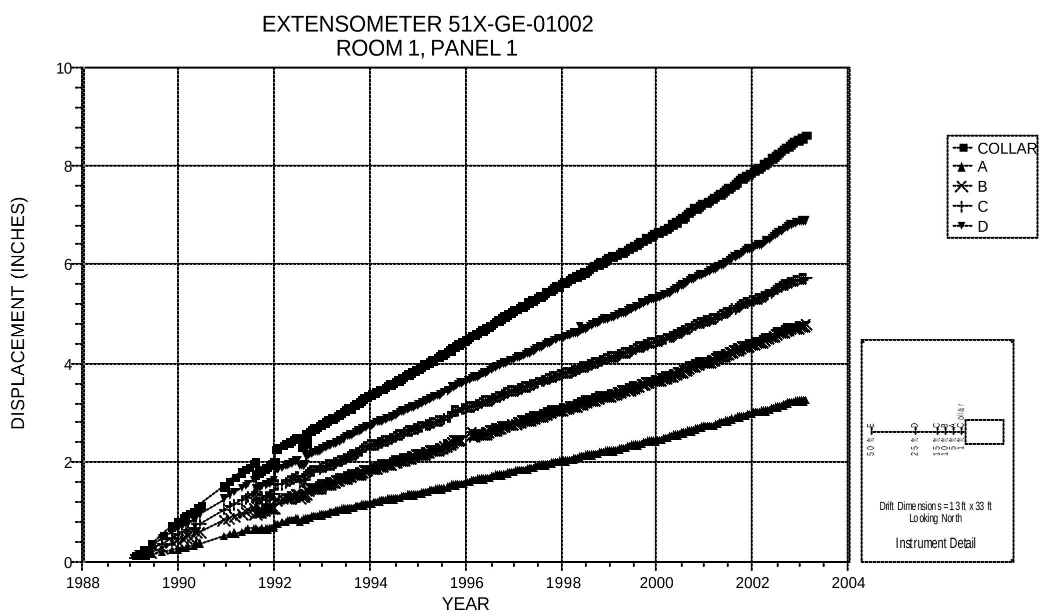
CONVERGENCE POINTS (Continued)

Field Tag	Location	Figure Number	Last Reading 2002 to 2003 Date	Last Reading 2002 to 2003 Inches	Cumulative Displacement Inches	Closure Rate 2002 to 2003 in/year	Closure Rate 2001 to 2002 in/year	Rate Change Percent	Comments
S1950-E407-4 A-G	S1950 Drift-E407	6-55	02/04/03	9.067	30.943	1.951	2.608	-25%	
S1950-E407-3 B-F	S1950 Drift-E407	6-55	02/04/03	8.991	26.376	1.915	2.330	-18%	
S1950-E407-3 H-L	S1950 Drift-E407	6-55	02/04/03	10.456	31.213	1.796	2.463	-27%	
S1950-E407-3 C-K	S1950 Drift-E407	6-56	02/04/03	8.485	21.462	1.207	1.423	-15%	
S1950-E407-3 D-J	S1950 Drift-E407	6-56	02/04/03	9.291	23.468	1.336	1.547	-14%	
S1950-E407-4 E-I	S1950 Drift-E407	6-56	02/04/03	3.931	21.919	1.078	1.272	-15%	
S1950-E432-3 A-C	S1950 Drift-E432	6-57	02/04/03	9.524	31.345	2.004	2.385	-16%	
S1950-E432-3 B-D	S1950 Drift-E432	6-57	02/04/03	8.809	23.210	1.257	1.456	-14%	
S1950-E457-4 A-C	S1950 Drift-E457	6-58	02/04/03	7.543	32.346	2.081	2.158	-4%	
S1950-E457-4 B-D	S1950 Drift-E457	6-58	02/04/03	8.279	23.571	1.178	1.318	-11%	
S1950-E482-7 A-C	S1950 Drift-E482	6-59	02/04/03	8.072	30.688	2.206	2.240	-2%	No longer accessible.
S1950-E482-3 B-D	S1950 Drift-E482	6-59	02/04/03	9.232	25.501	1.185	1.401	-15%	No longer accessible.
S1950-E503-7 A-C	S1950 Drift-E503	6-60	02/04/03	2.915	38.910	2.581	3.795	-32%	No longer accessible.
S1950-E523-4 A-C	S1950 Drift-E523	6-61	12/11/02	10.039	44.617	2.602	2.831	-8%	No longer accessible.
S1950-E586-9 A-C	S1950 Drift-E586	6-62	09/16/02	2.050	36.306	3.912	3.785	3%	No longer accessible.
S1950-E586-3 B-D	S1950 Drift-E586	6-63	08/20/02	10.956	23.058	2.087	1.945	7%	No longer accessible.
S1950-E660-4 A-C	S1950 Drift-E660	6-64	08/20/02	5.556	27.581	4.122	4.110	0%	No longer accessible.
E520-S1717-2 B-D	E520 Drift-S1717	6-65	11/22/02	1.240	39.668	1.270	2.145	-41%	No longer accessible.
E520-S1717-2 C-G	E520 Drift-S1717	6-65	11/22/02	1.308	24.966	1.464	1.959	-25%	No longer accessible.
E520-S1717-2 H-F	E520 Drift-S1717	6-65	11/22/02	1.419	21.911	1.789	2.084	-14%	No longer accessible.
E520-S1802-7 A-E	E520 Drift-S1802	6-66	10/10/02	1.732	55.015	2.608	3.047	-14%	No longer accessible.
E520-S1802-2 B-D	E520 Drift-S1802	6-66	11/22/02	1.790	38.451	2.243	2.721	-18%	No longer accessible.
E520-S1802-2 H-F	E520 Drift-S1802	6-66	11/07/02	1.728	24.303	2.342	2.700	-13%	No longer accessible.
E520-S1802-3 C-G	E520 Drift-S1802	6-67	11/22/02	23.999	23.999	1.485	1.650	-10%	No longer accessible.
E520-S1884-2 A-E	E520 Drift-S1884	6-68	11/22/02	2.129	28.090	2.815	3.087	-9%	No longer accessible.
E520-S1884-2 B-D	E520 Drift-S1884	6-68	11/07/02	1.754	32.256	2.172	3.152	-31%	No longer accessible.
E520-S1884-4 C-G	E520 Drift-S1884	6-68	11/22/02	3.151	15.091	1.469	1.617	-9%	No longer accessible.
E520-S1884-2 H-F	E520 Drift-S1884	6-68	11/07/02	1.190	18.822	1.681	1.762	-5%	No longer accessible.
E660-S1775-6 A-C	E660 Drift-S1775	6-69	08/20/02	1.860	40.158	2.574	2.214	16%	No longer accessible.
E660-S1775-5 B-D	E660 Drift-S1775	6-69	08/20/02	22.461	25.993	2.105	1.790	18%	No longer accessible.



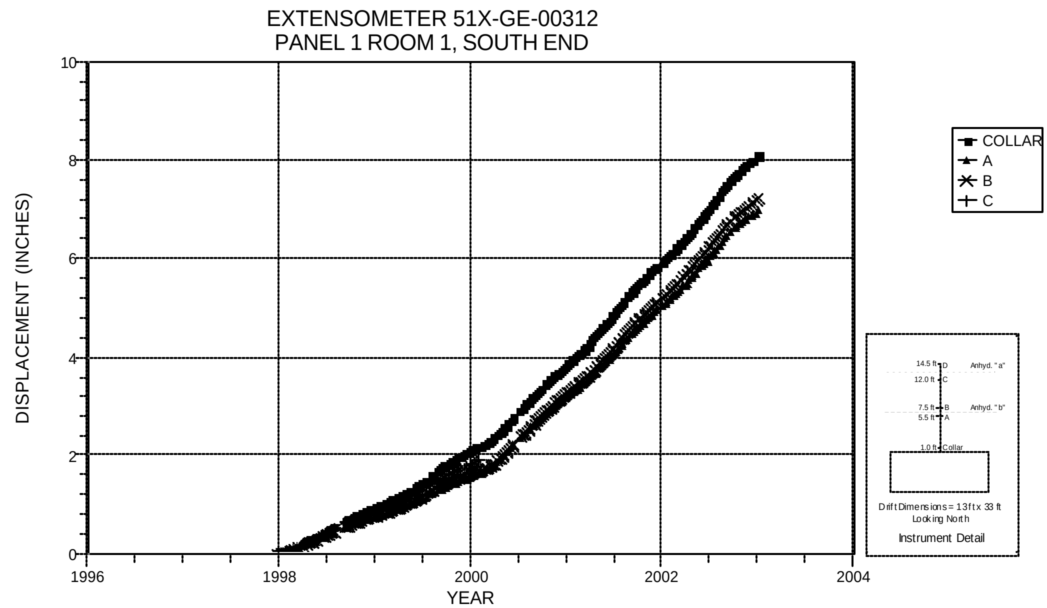
NOTES:
1. Excavation date: May 1986.

Figure 6-1 Extensometer 51X-GE-01001
Room 1, Panel 1 – Room Center – East Rib



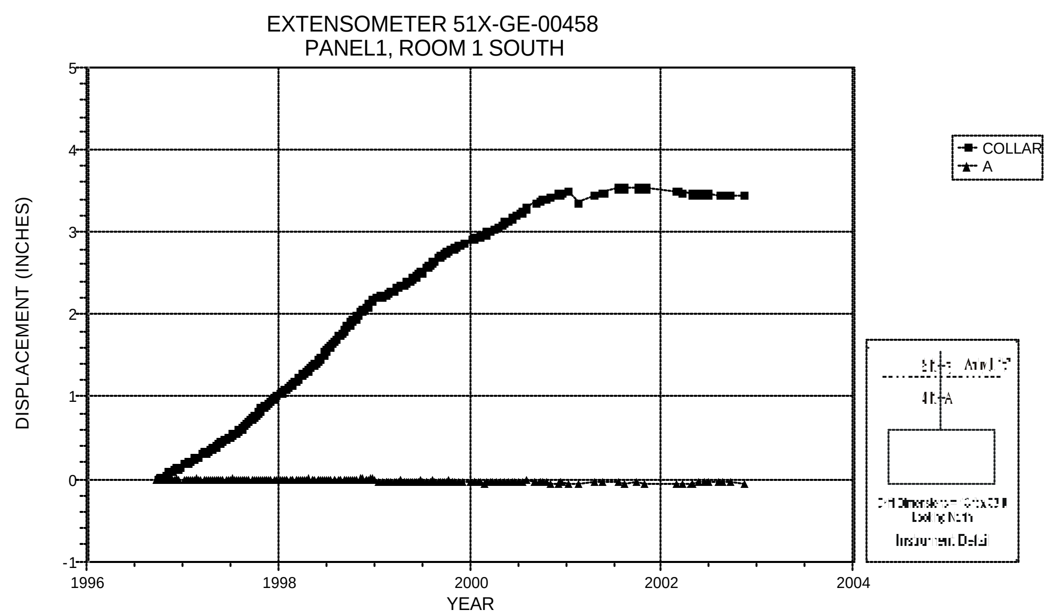
NOTES:
1. Excavation date: May 1986.

Figure 6-2 Extensometer 51X-GE-01002
Room 1, Panel 1 – Room Center – West Rib



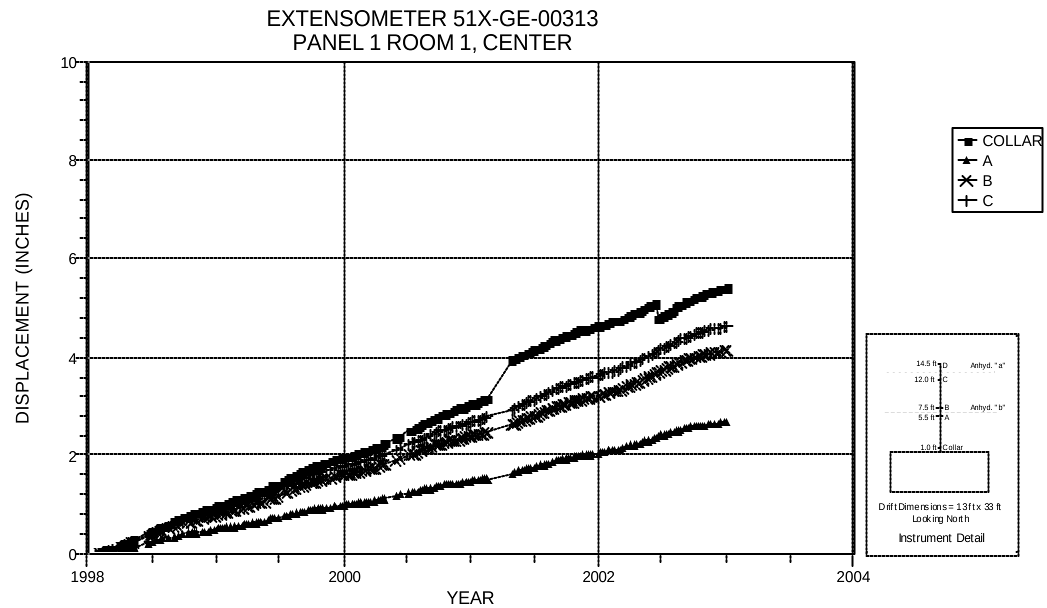
NOTES:
1. Excavation date: May 1986.
2. Replaces 51X-GE-01017.
3. Anchor C defective after 2/2/00.

Figure 6-3 Extensometer 51X-GE-00312
Room 1, Panel 1 – South End – Roof



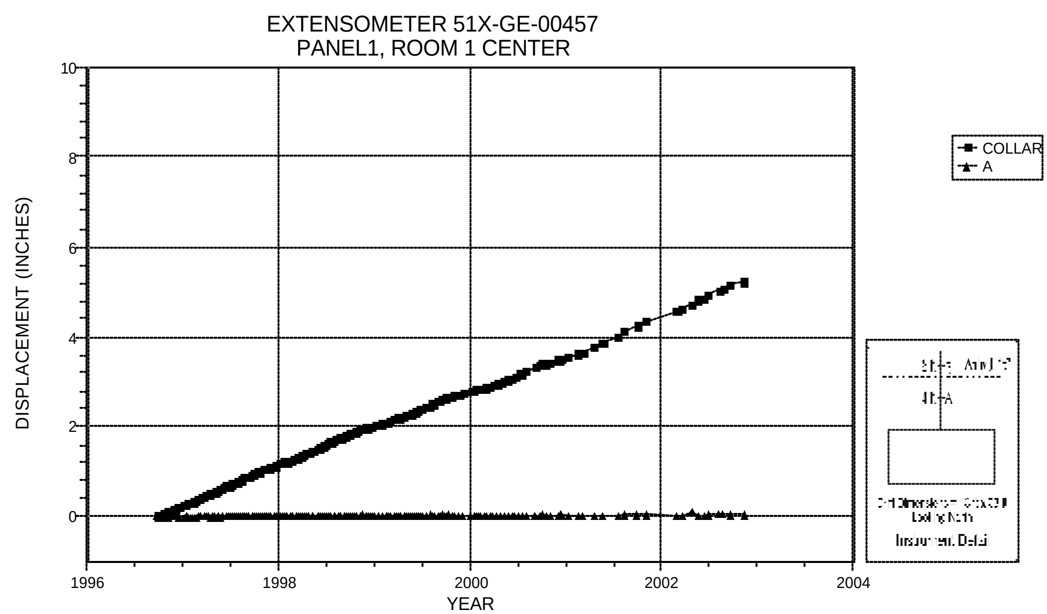
NOTES:

Figure 6-4 Extensometer 51X-GE-00458
Room 1, Panel 1 – South End – Roof



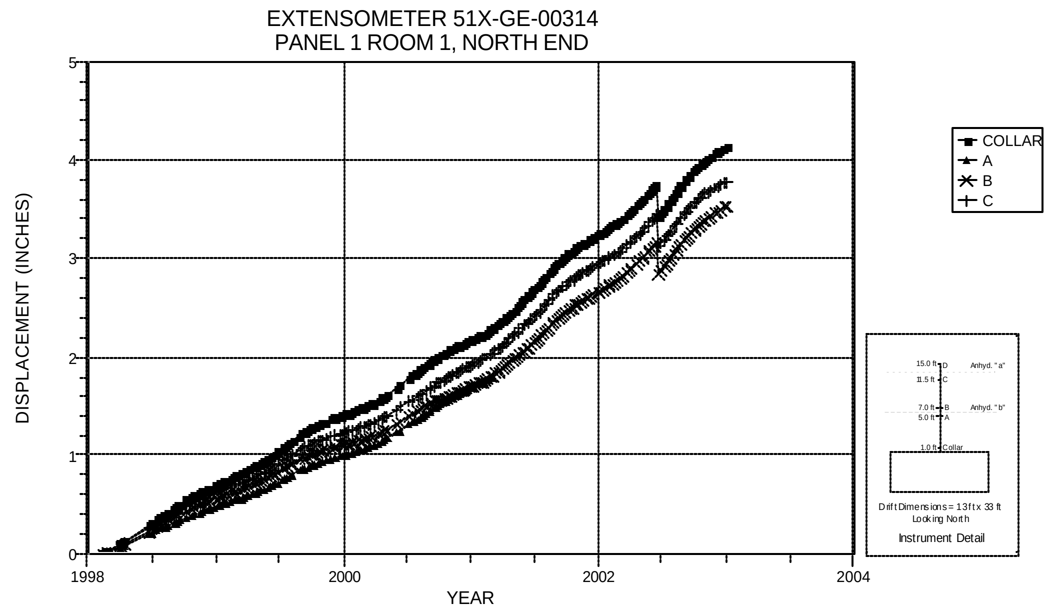
NOTES:
1. Excavation date: May 1986.
2. Rod D broken, relative displacement plot invalid.

Figure 6-5 Extensometer 51X-GE-00313
Room 1, Panel 1 – Room Center – Roof



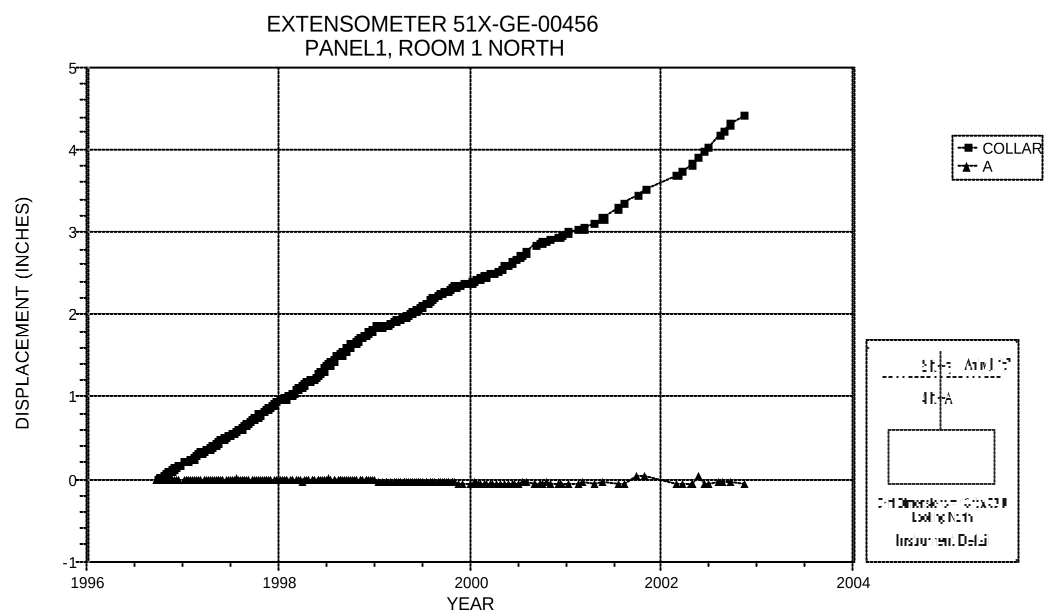
NOTES:

Figure 6-6 Extensometer 51X-GE-00457
Room 1, Panel 1 – Room Center – Roof



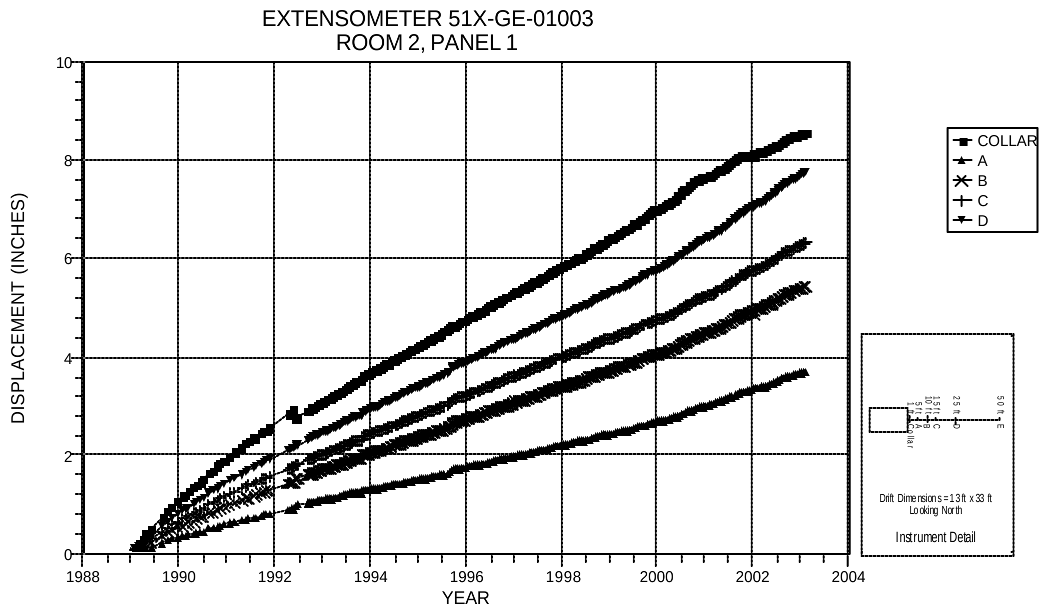
NOTES:
1. Excavation date: June 1986.
2. Replaces 51X-GE-01019.
3. Reference anchor bumped 06/02.

Figure 6-7 Extensometer 51X-GE-00314
Room 1, Panel 1 – North End – Roof



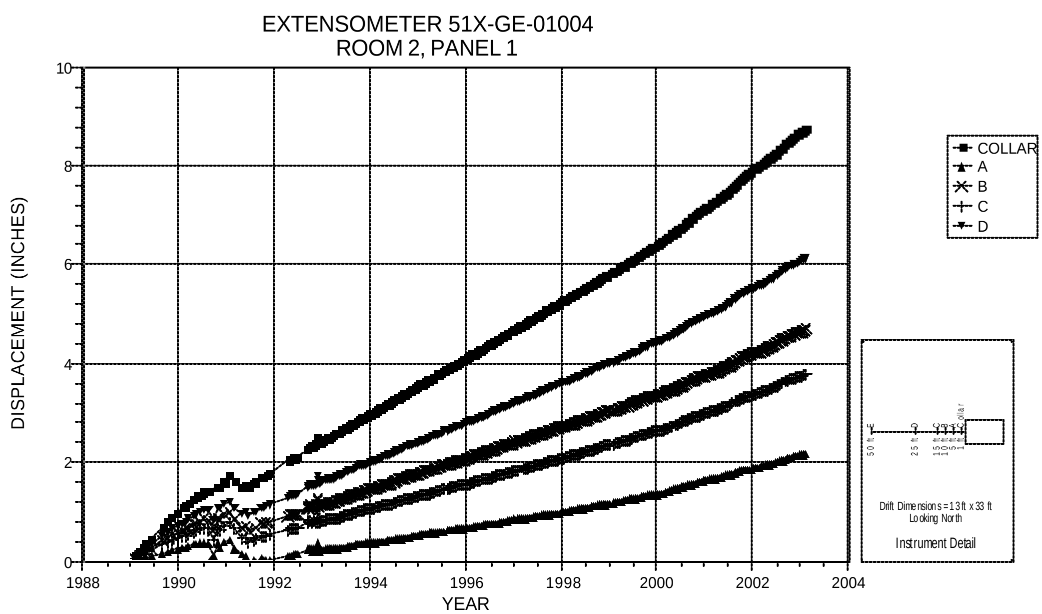
NOTES:

Figure 6-8 Extensometer 51X-GE-00456
Room 1, Panel 1 – North End – Roof



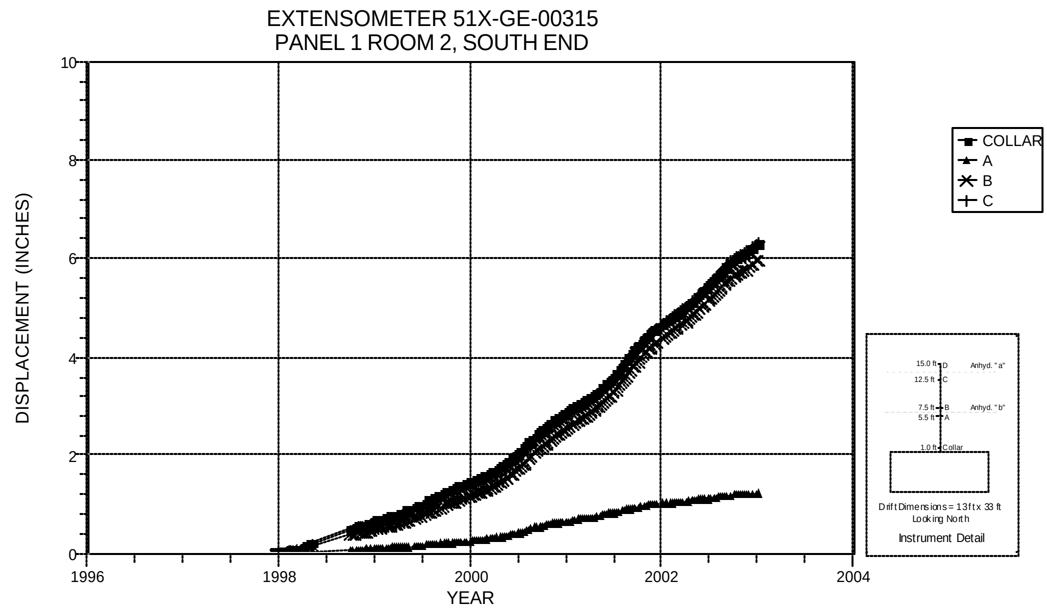
NOTES:
1. Excavation date: January 1987.

Figure 6-9 Extensometer 51X-GE-01003
Room 2, Panel 1 – Room Center – East Rib



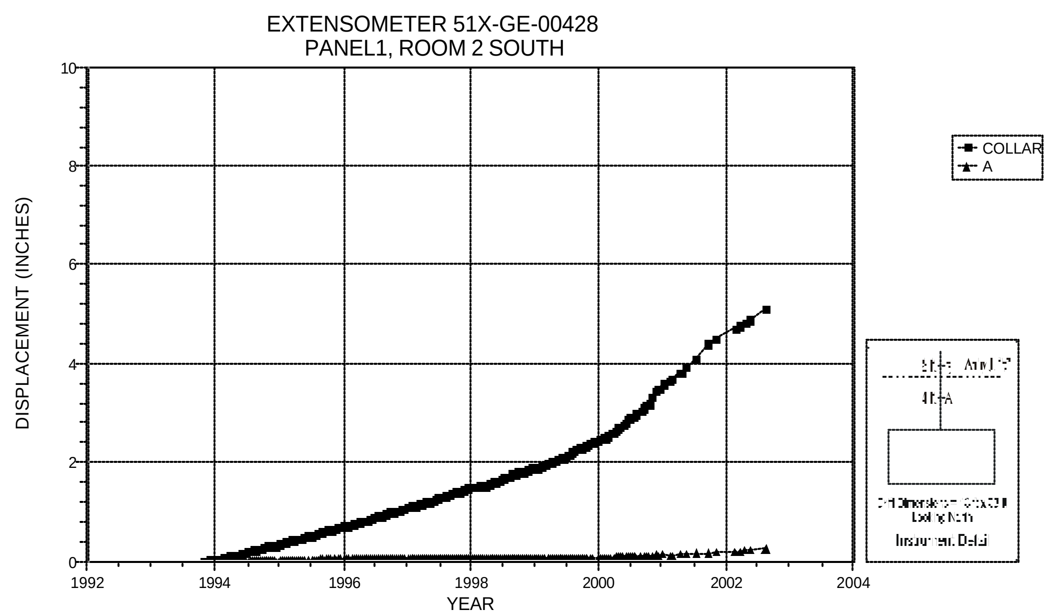
NOTES:
1. Excavation date: January 1987.

Figure 6-10 Extensometer 51X-GE-01004
Room 2, Panel 1 – Room Center – West Rib



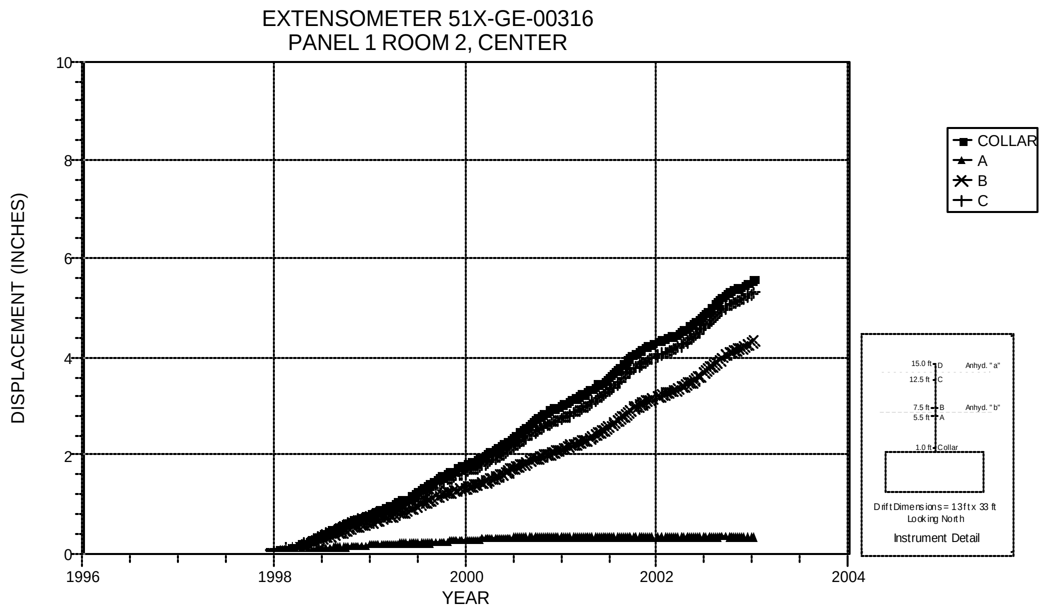
NOTES:
1. Excavation date: January 1987.

Figure 6-11 Extensometer 51X-GE-00315
Room 2, Panel 1 – South End – Roof



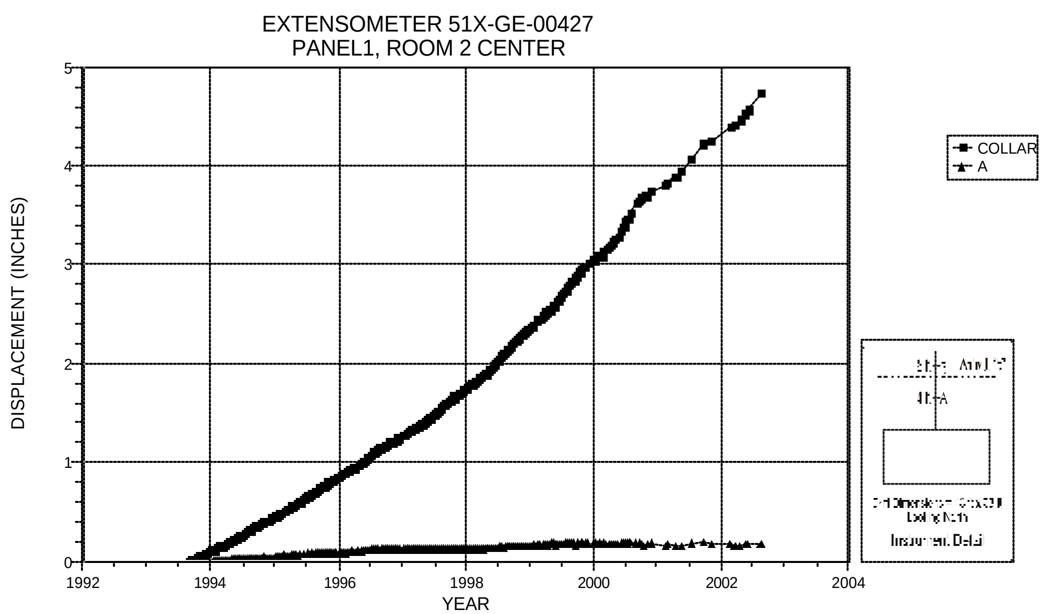
NOTES:

Figure 6-12 Extensometer 51X-GE-00428
Room 2, Panel 1 – South End – Roof



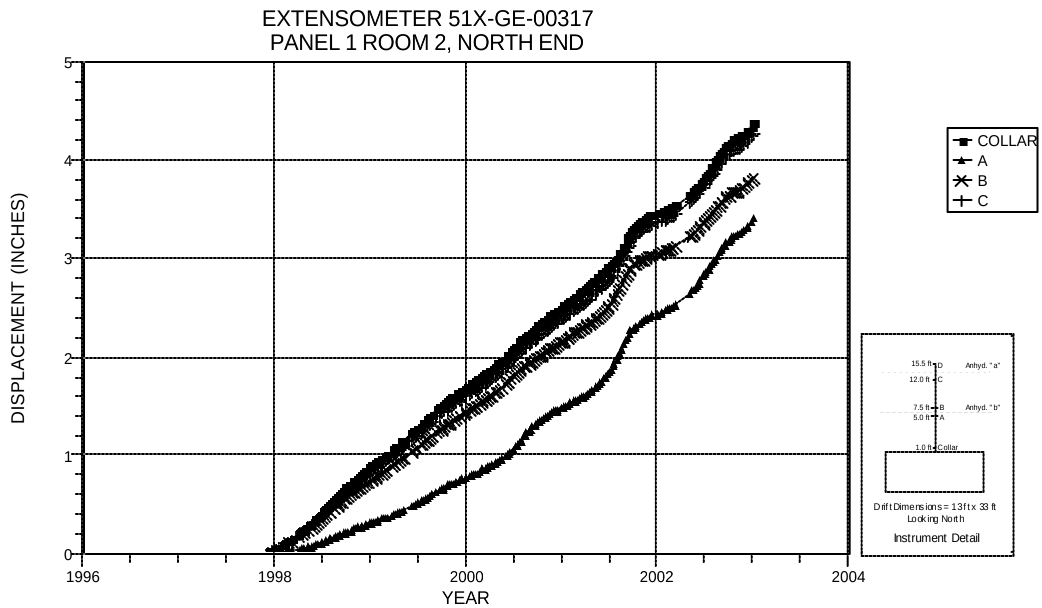
NOTES:
1. Excavation date: January 1987.

Figure 6-13 Extensometer 51X-GE-00316
Room 2, Panel 1 – Room Center – Roof



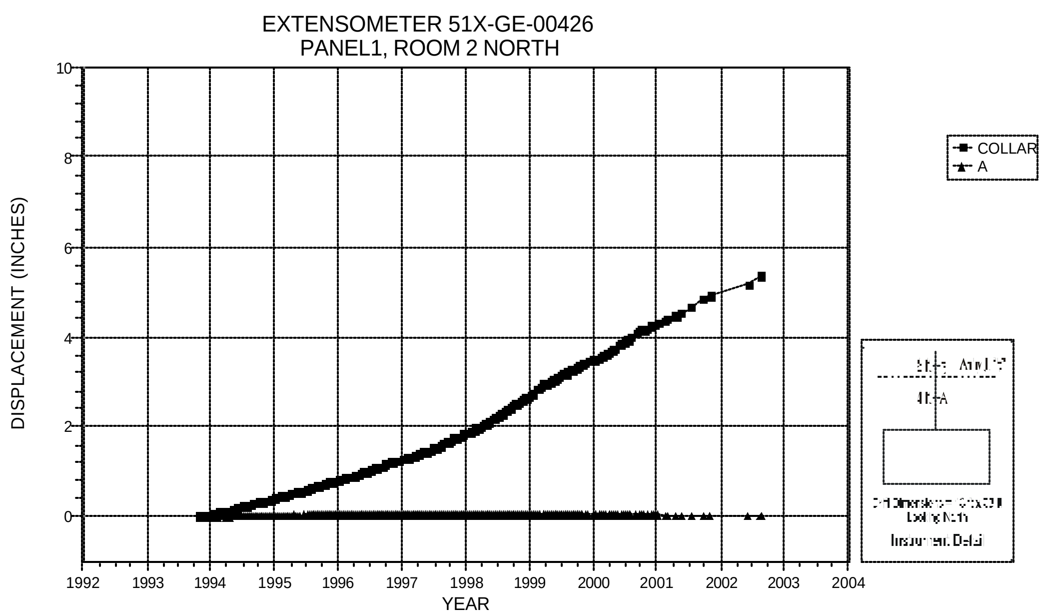
NOTES:

Figure 6-14 Extensometer 51X-GE-00427
Room 2, Panel 1 – Room Center – Roof



NOTES:
1. Excavation date: January 1987.

Figure 6-15 Extensometer 51X-GE-00317
Room 2, Panel 1 – North End – Roof



NOTES:

Figure 6-16 Extensometer 51X-GE-00426
Room 2, Panel 1 – North End – Roof

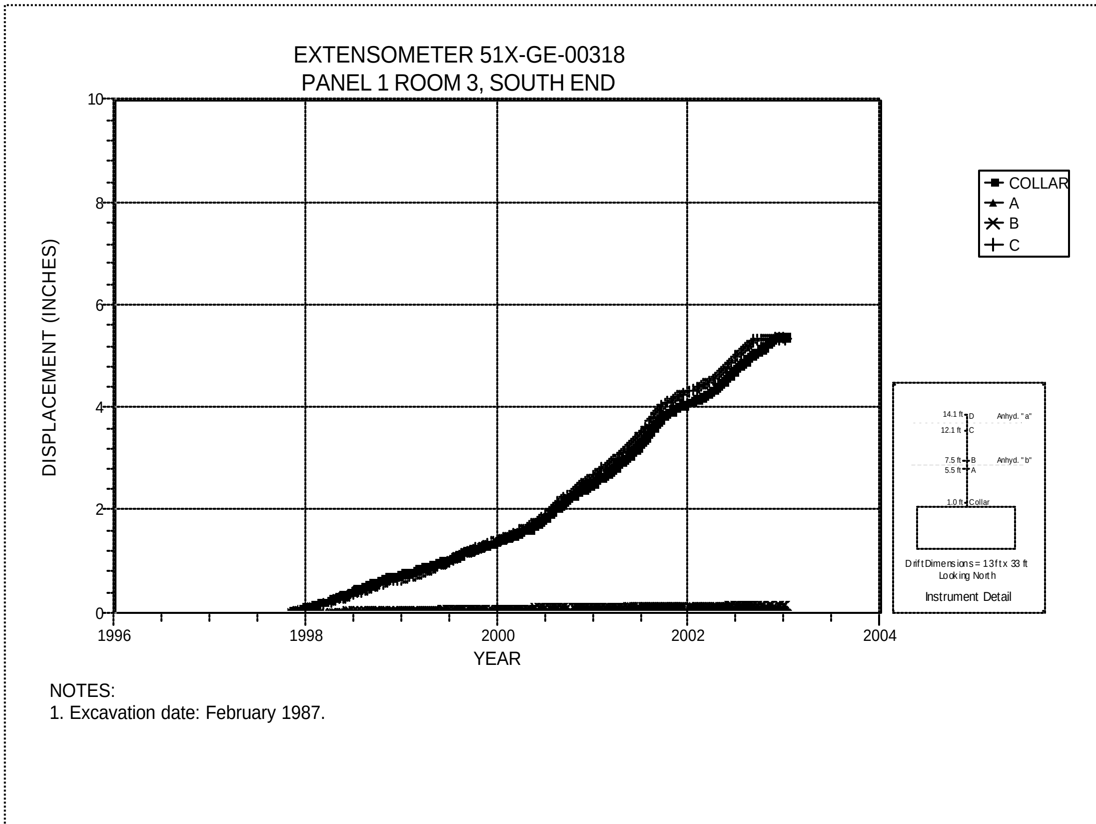


Figure 6-17 Extensometer 51X-GE-00318
Room 3, Panel 1 – South End – Roof

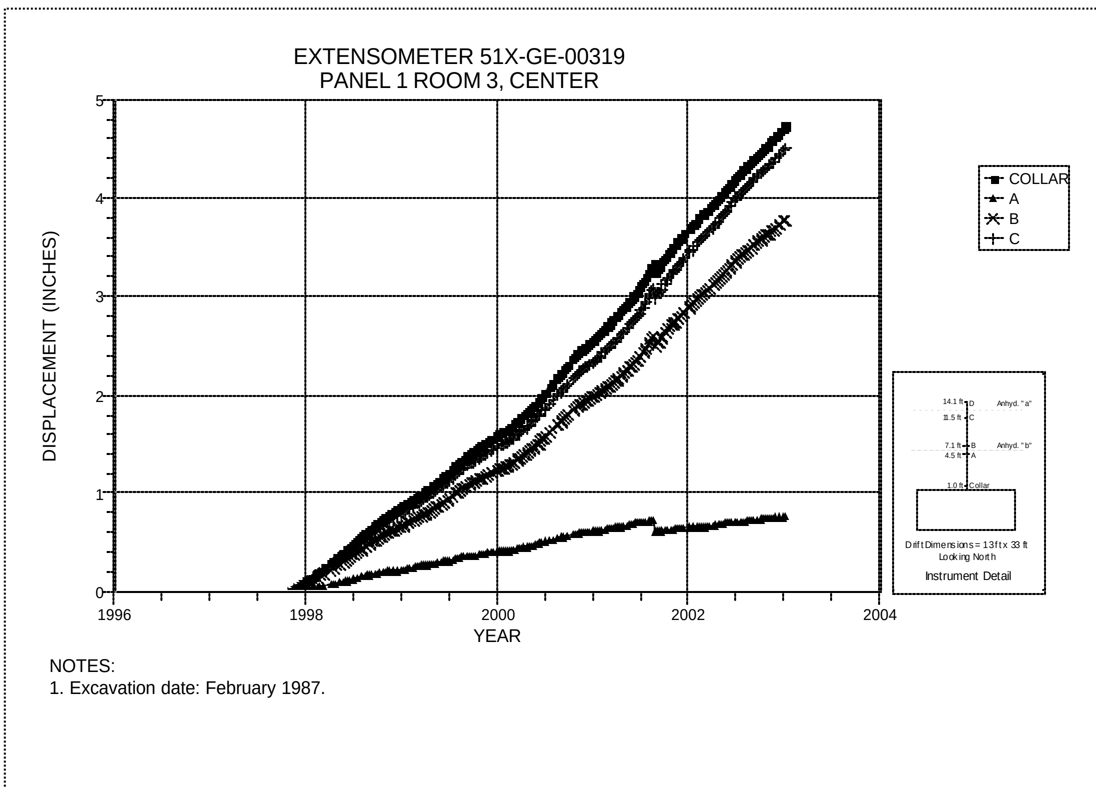
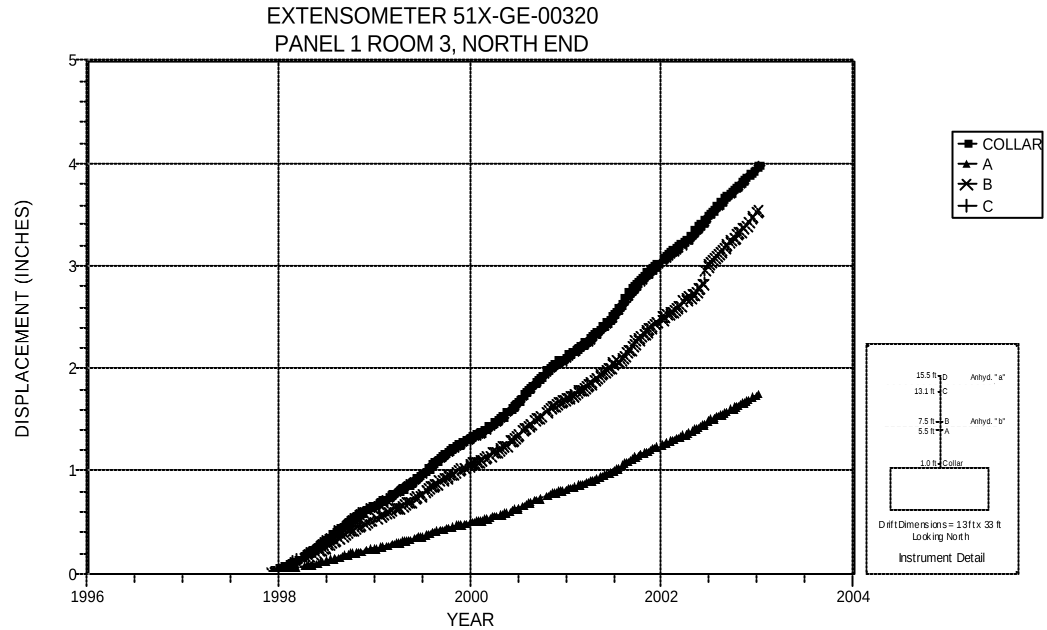
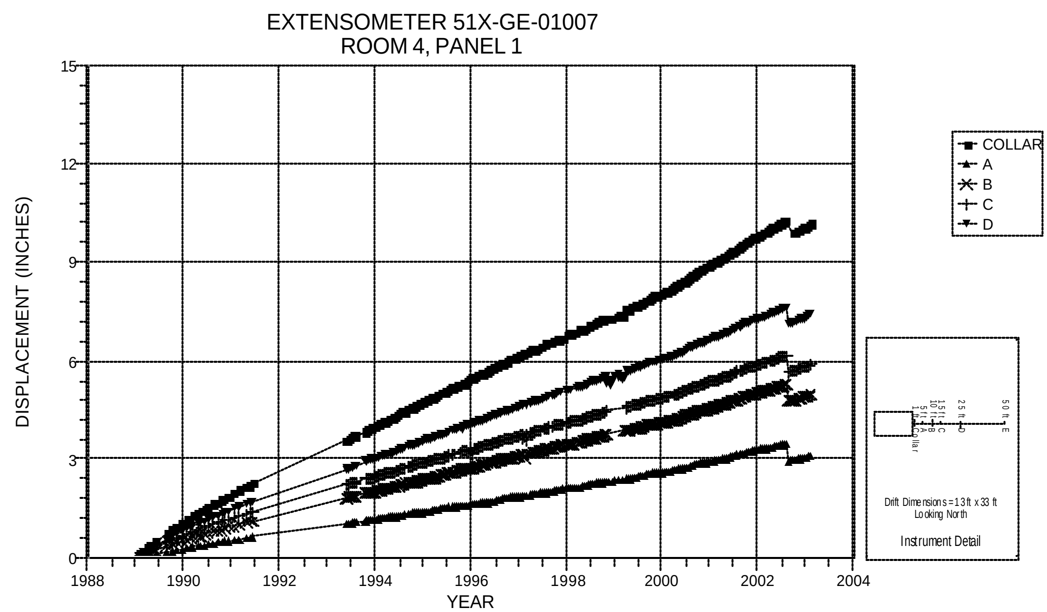


Figure 6-18 Extensometer 51X-GE-00319
Room 3, Panel 1 – Room Center – Roof



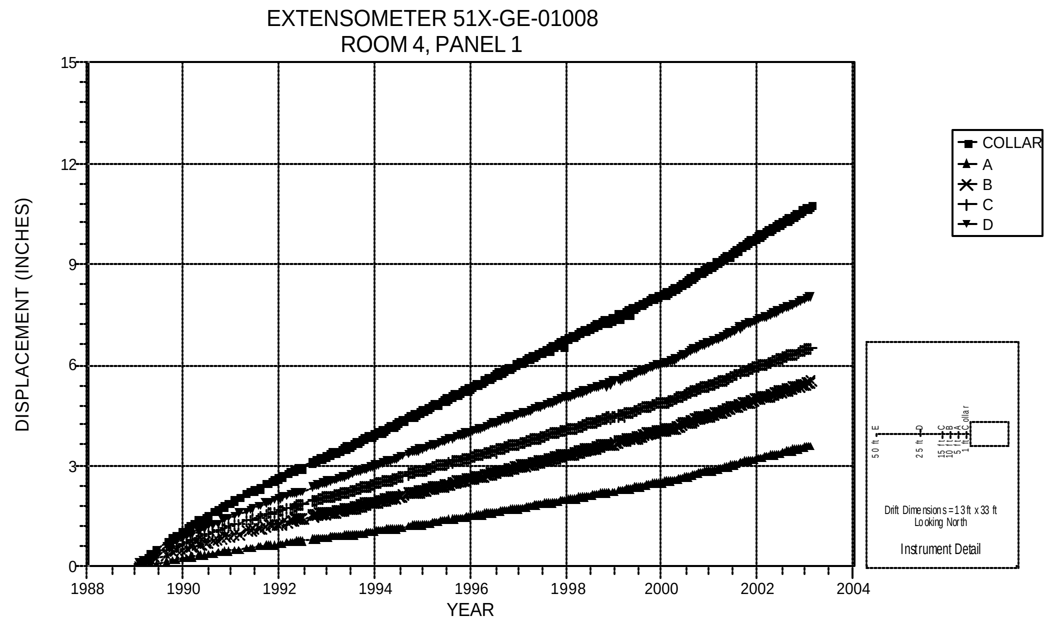
NOTES:
1. Excavation date: February 1987.

Figure 6-19 Extensometer 51X-GE-00320
Room 3, Panel 1 – North End – Roof



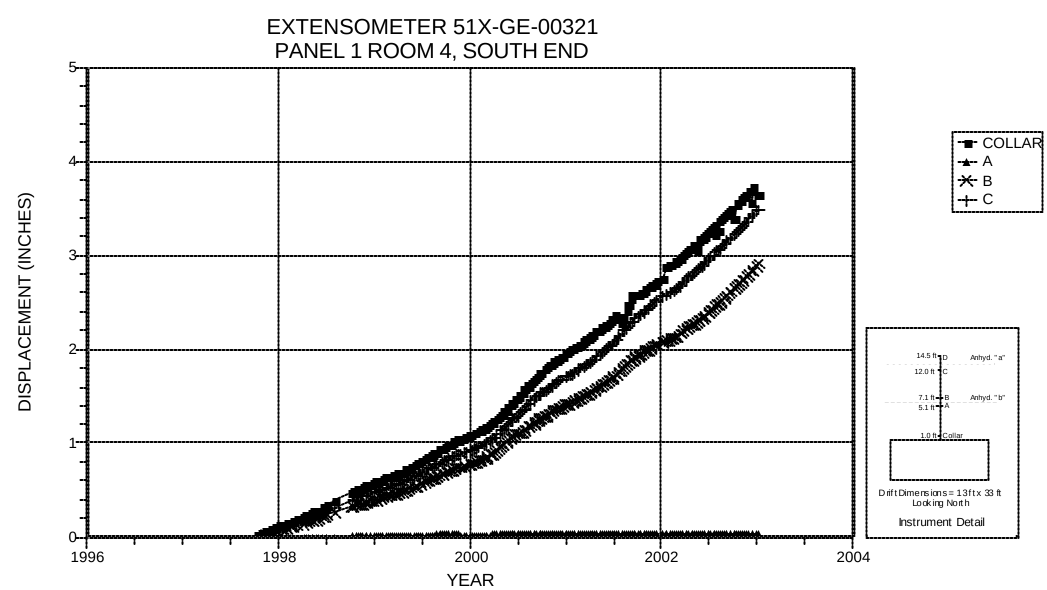
NOTES:
1. Excavation date: February 1988.
2. Instrument malfunction.

Figure 6-20 Extensometer 51X-GE-01007
Room 4, Panel 1 – Room Center – East Rib



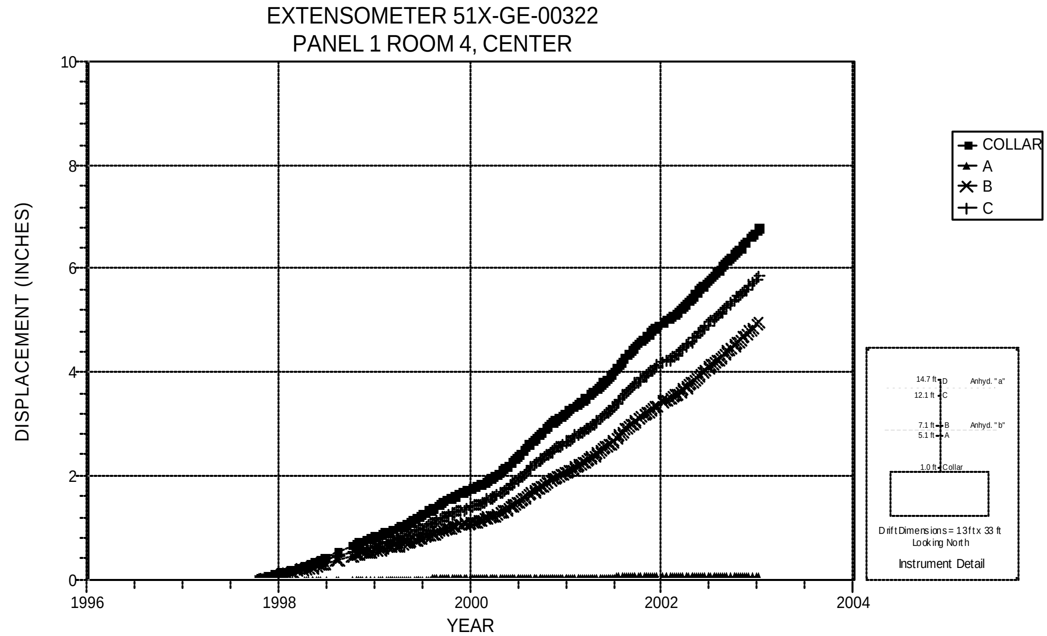
NOTES:
1. Excavation date: February 1988.

Figure 6-21 Extensometer 51X-GE-01008
Room 4, Panel 1 – Room Center – West Rib



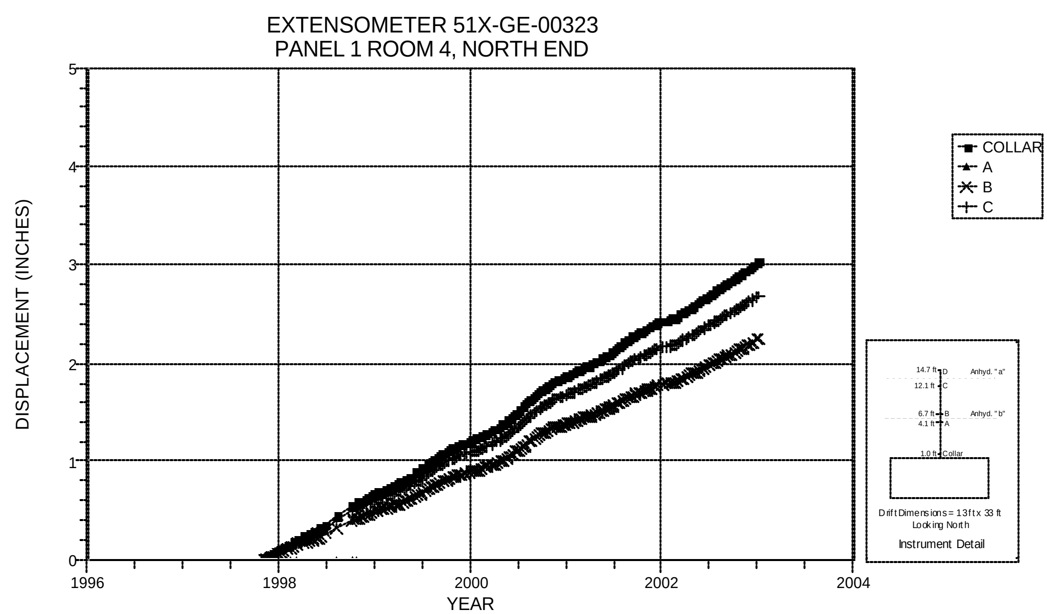
NOTES:
1. Excavation date: February 1988.

Figure 6-22 Extensometer 51X-GE-00321
Room 4, Panel 1 – South End – Roof



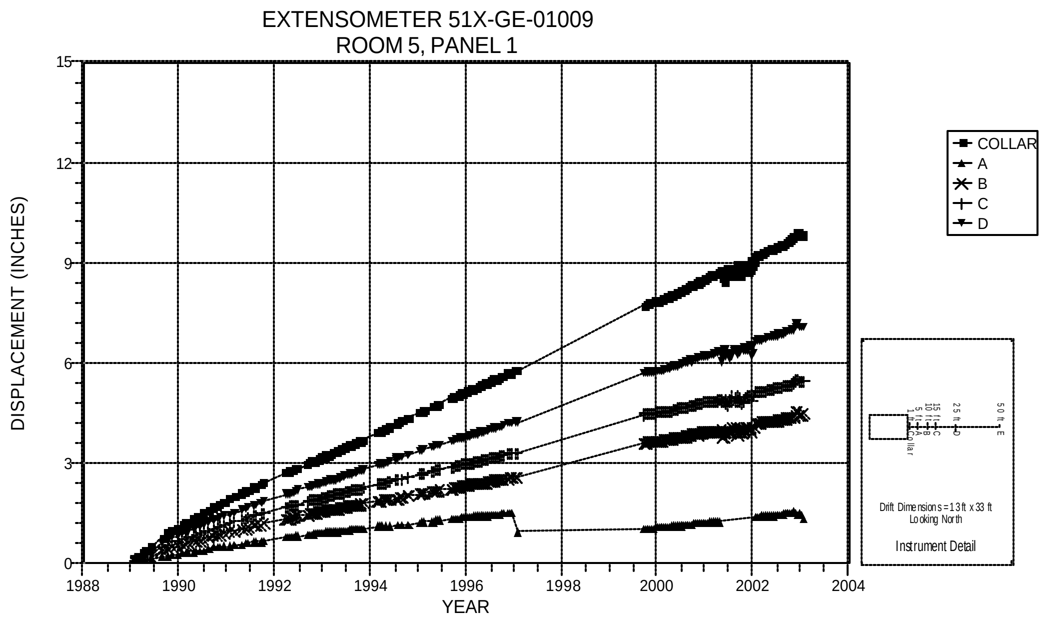
NOTES:
1. Excavation date: February 1988.

Figure 6-23 Extensometer 51X-GE-00322
Room 4, Panel 1 – Room Center – Roof



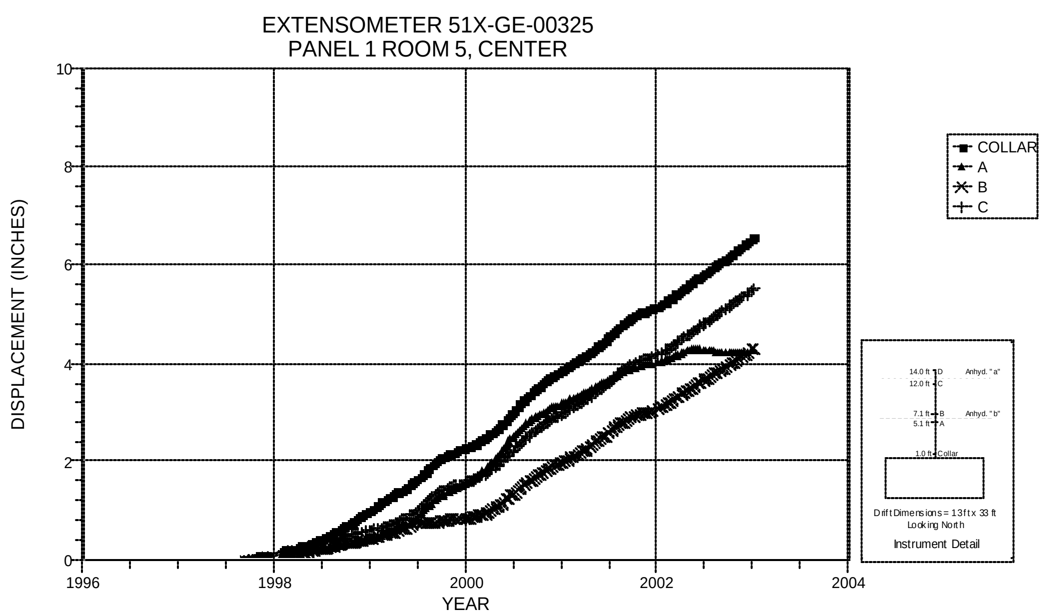
NOTES:
1. Excavation date: February 1988.

Figure 6-24 Extensometer 51X-GE-00323
Room 4, Panel 1 – North End – East Roof



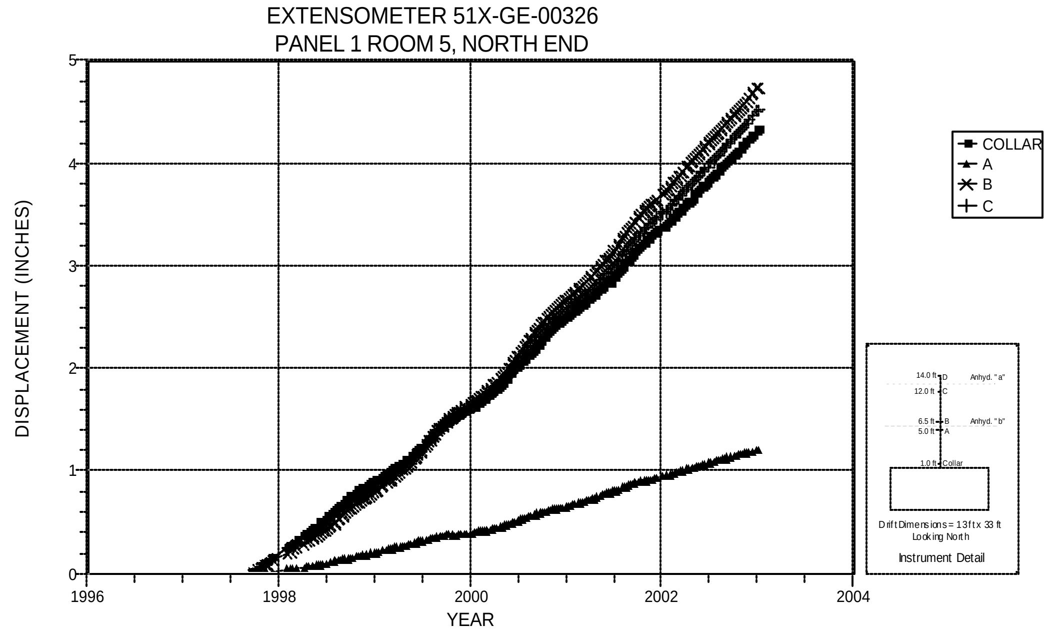
NOTES:
1. Excavation date: February 1988.
2. Electronic offset on rod "A" after 1/97.

Figure 6-25 Extensometer 51X-GE-01009
Room 5, Panel 1 – Room Center – East Rib



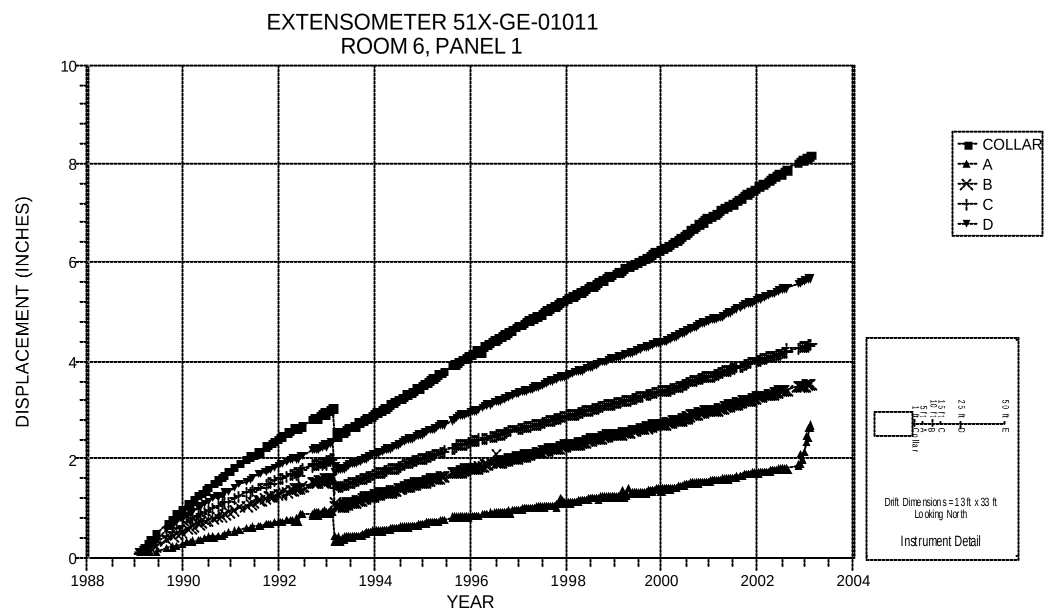
NOTES:
1. Excavation date: February 1988.

Figure 6-26 Extensometer 51X-GE-00325
Room 5, Panel 1 – Room Center – Roof



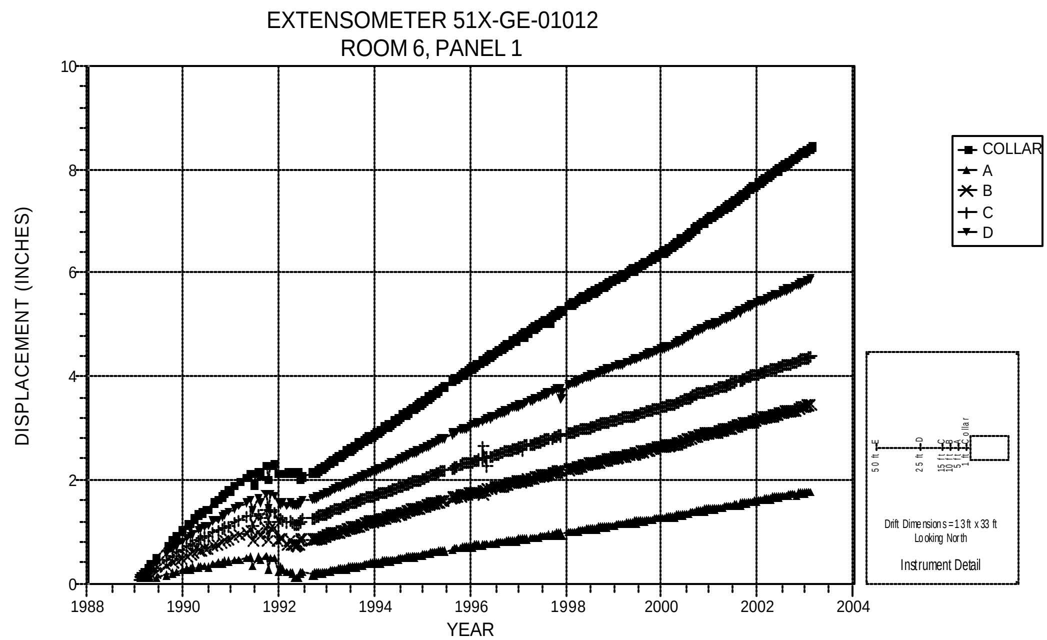
NOTES:
1. Excavation date: February 1988.

Figure 6-27 Extensometer 51X-GE-00326
Room 5, Panel 1 – North End – Roof



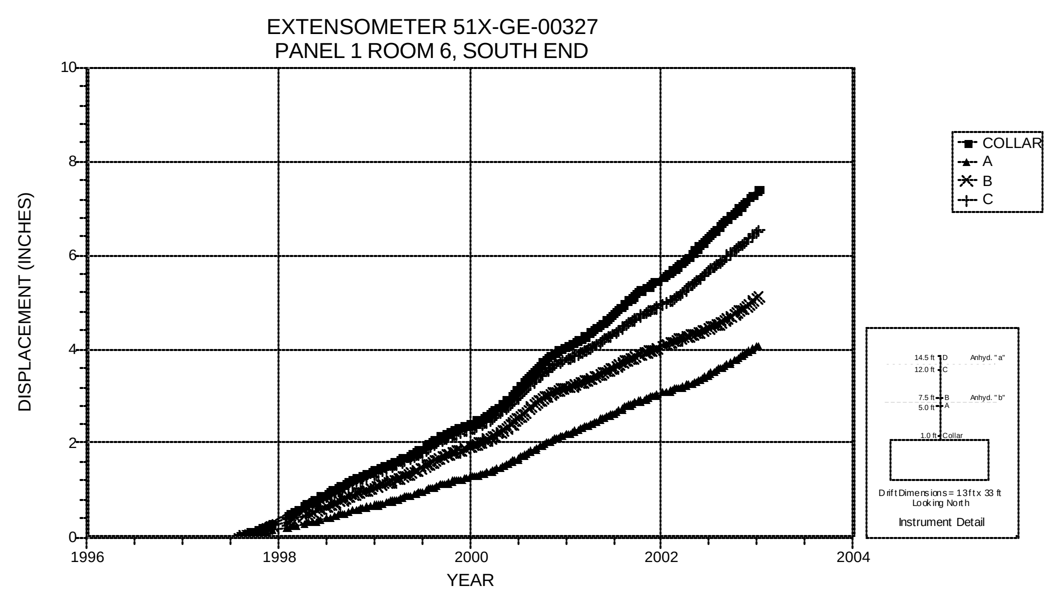
NOTES:
1. Excavation date: February 1988.

Figure 6-28 Extensometer 51X-GE-01011
Room 6, Panel 1 – Room Center – East Rib



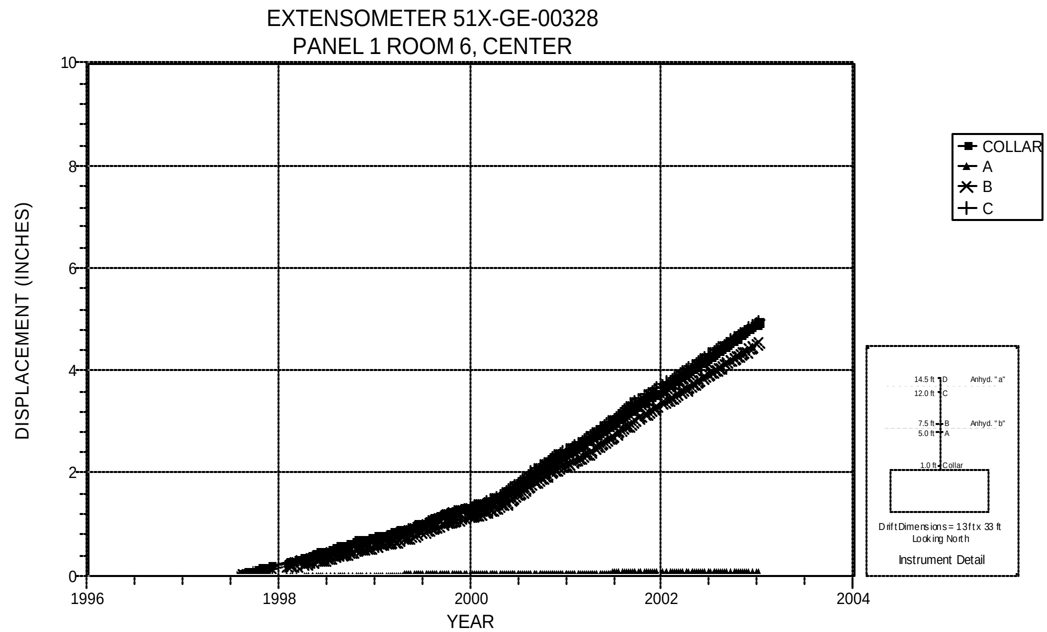
NOTES:
1. Excavation date: February 1988.

Figure 6-29 Extensometer 51X-GE-01012
Room 6, Panel 1 – Room Center – West Rib



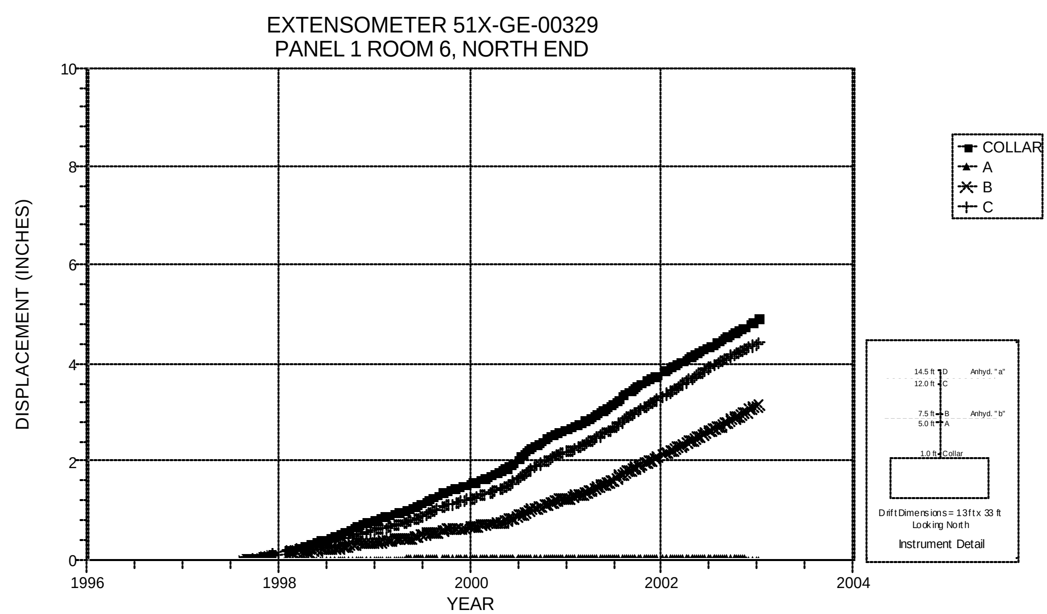
NOTES:
1. Excavation date: February 1988.

Figure 6-30 Extensometer 51X-GE-00327
Room 6, Panel 1 – South End – Roof



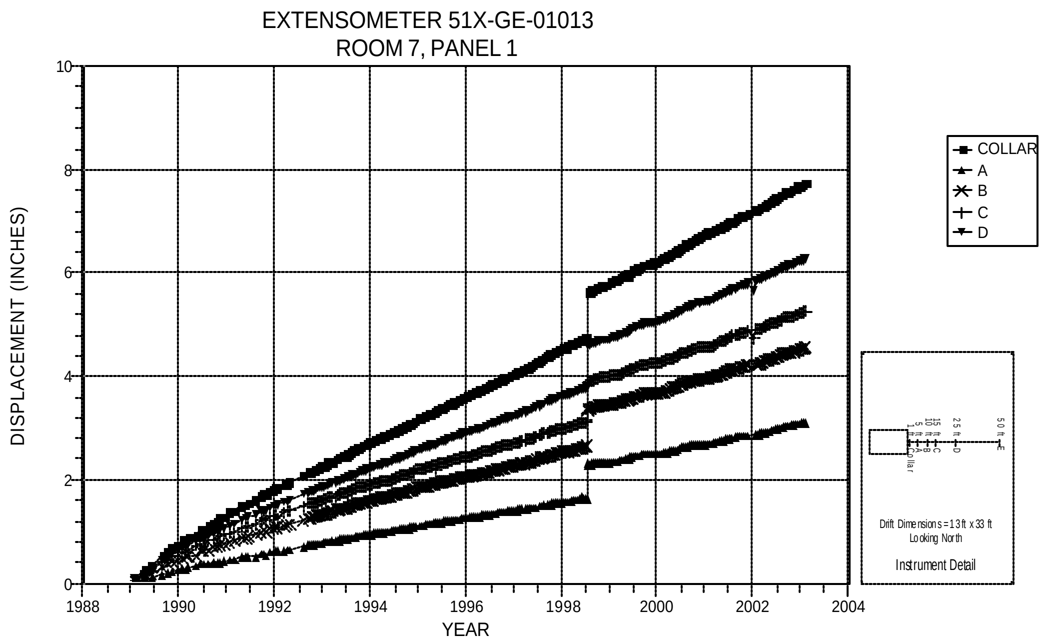
NOTES:
1. Excavation date: February 1988.

Figure 6-31 Extensometer 51X-GE-00328
Room 6, Panel 1 – Room Center – Roof



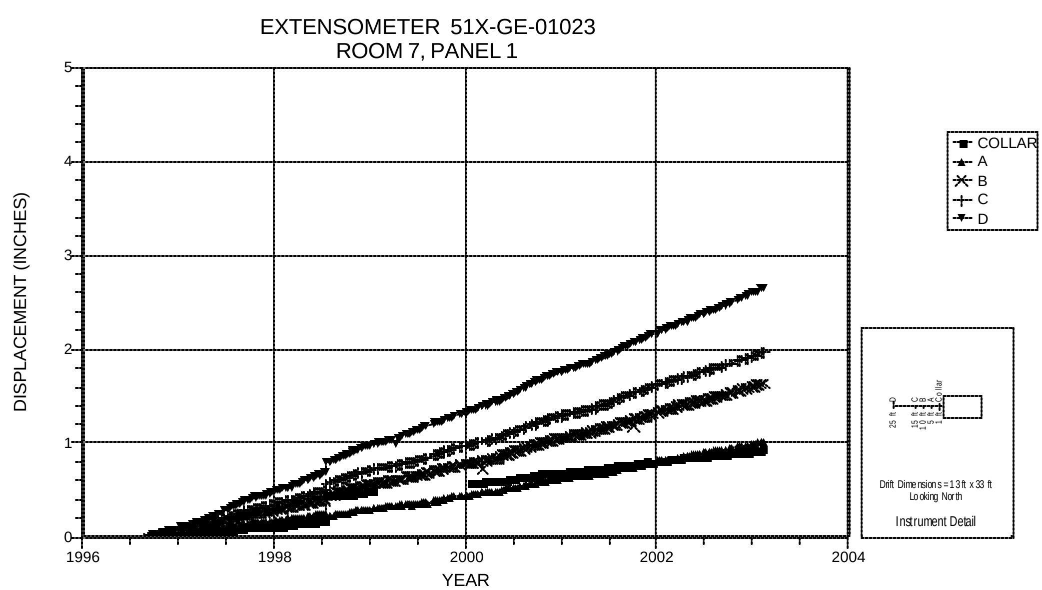
NOTES:
1. Excavation date: February 1988.

Figure 6-32 Extensometer 51X-GE-00329
Room 6, Panel 1 – North End – Roof



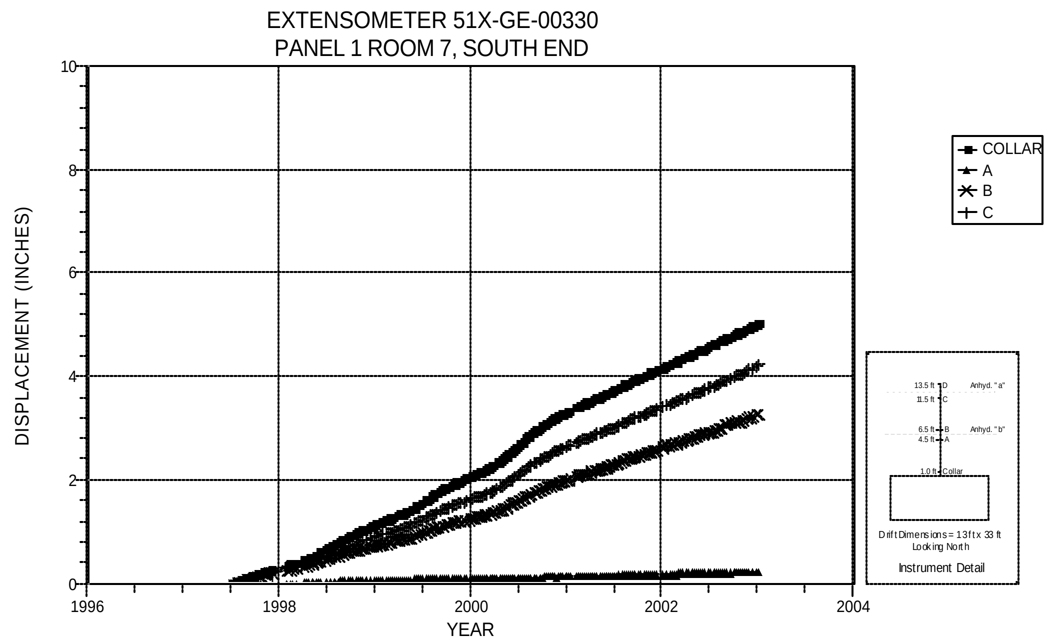
NOTES:
1. Excavation date: March 1988.
2. Offsets in the second half of 1998 due to electronic activities.

Figure 6-33 Extensometer 51X-GE-01013
Room 7, Panel 1 – Room Center – East Rib



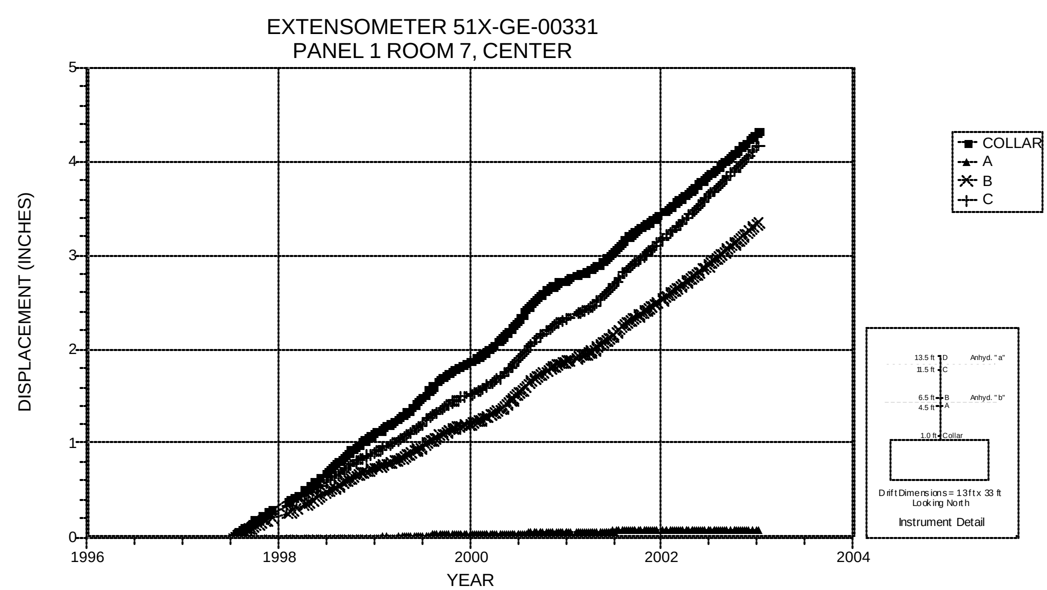
NOTES:
1. Excavation date: March 1988.
2. Replaces 51X-GE-01014.
3. Offsets in mid 1998 due to electronic activities.

Figure 6-34 Extensometer 51X-GE-01023
Room 7, Panel 1 – Room Center – West Rib



NOTES:
1. Excavation date: March 1988.

Figure 6-35 Extensometer 51X-GE-00330
Room 7, Panel 1 – South End – Roof



NOTES:
1. Excavation date: March 1988.

Figure 6-36 Extensometer 51X-GE-00331
Room 7, Panel 1 – Room Center – Roof

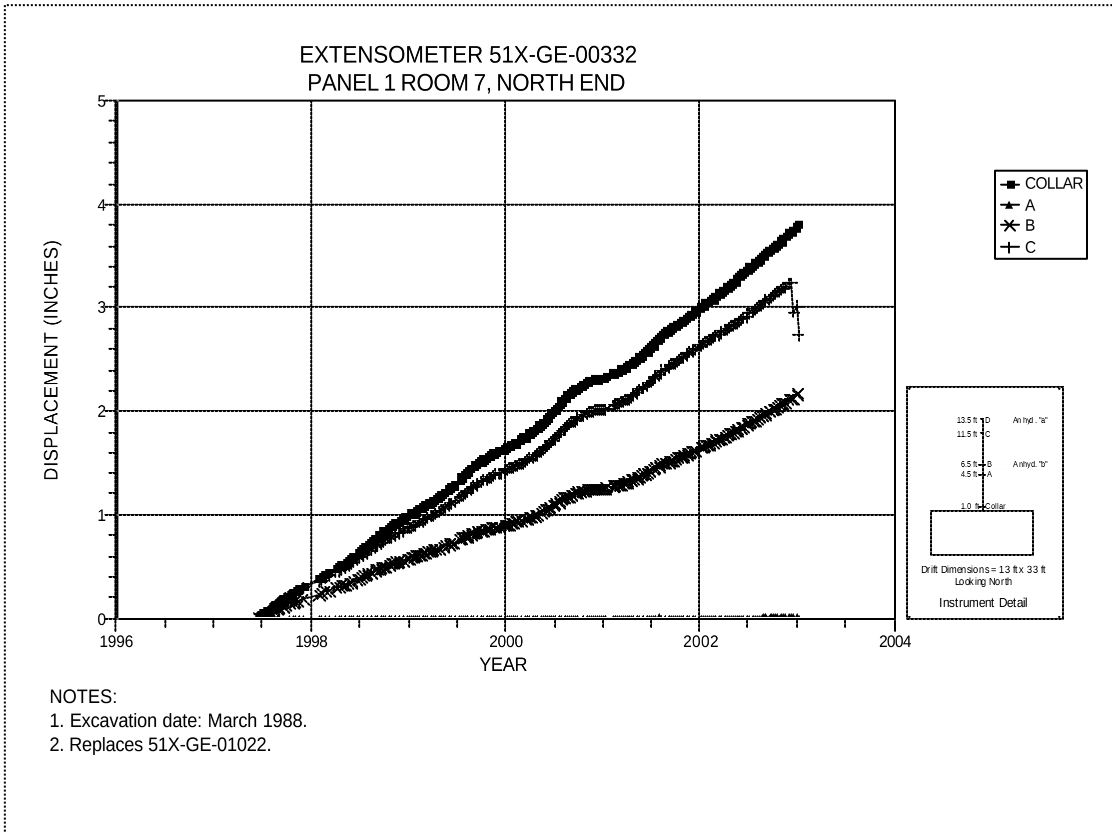


Figure 6-37 Extensometer 51X-GE-00332
Room 7, Panel 1 – North End – Roof

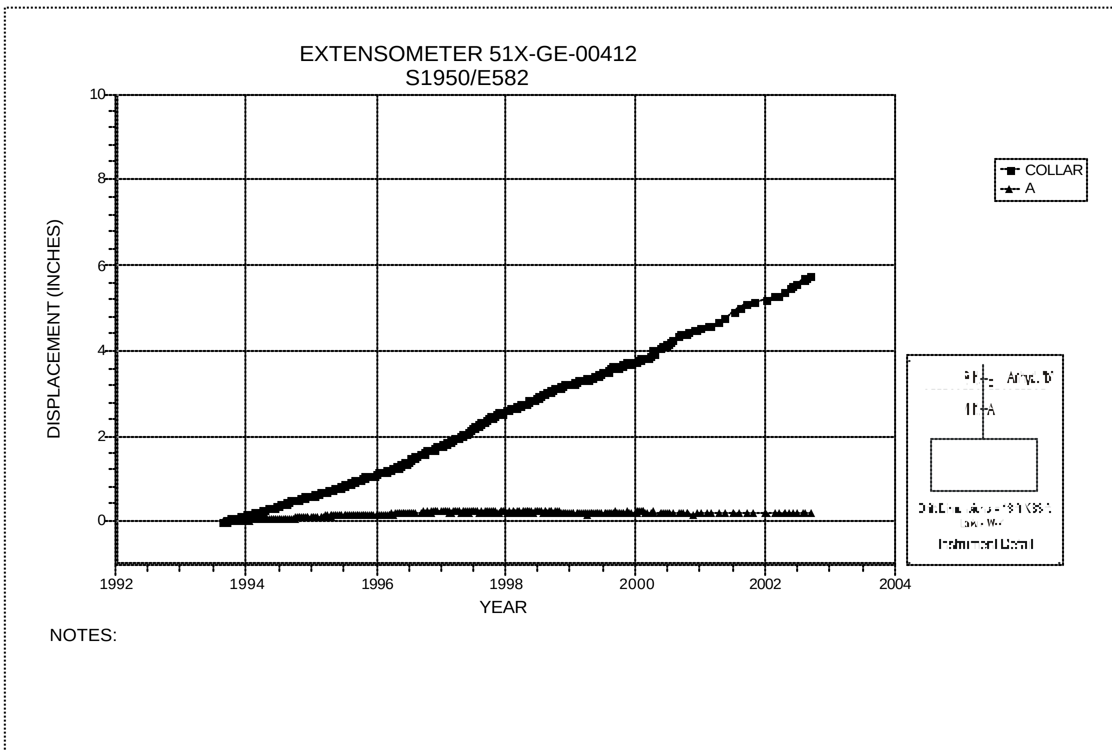


Figure 6-38 Extensometer 51X-GE-00412
S1950 Drift at E582 – Roof

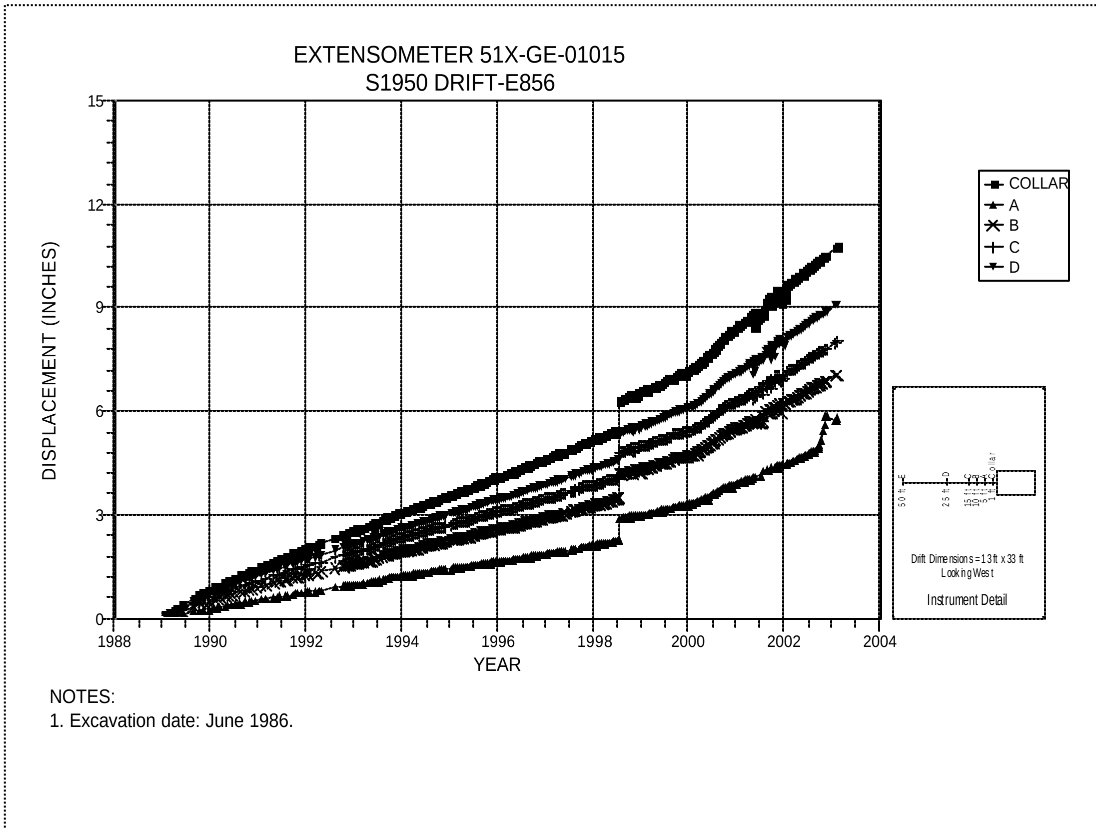


Figure 6-39 Extensometer 51X-GE-01015
South 1950 Drift at E856 – Mid Panel – South Rib

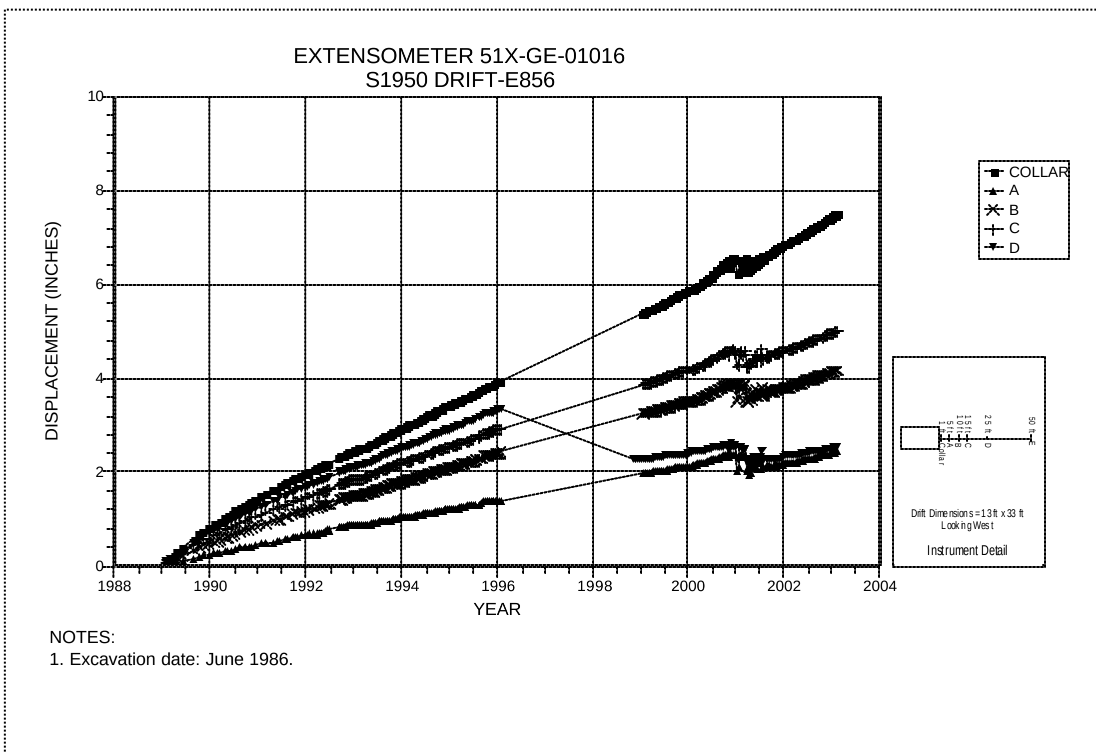
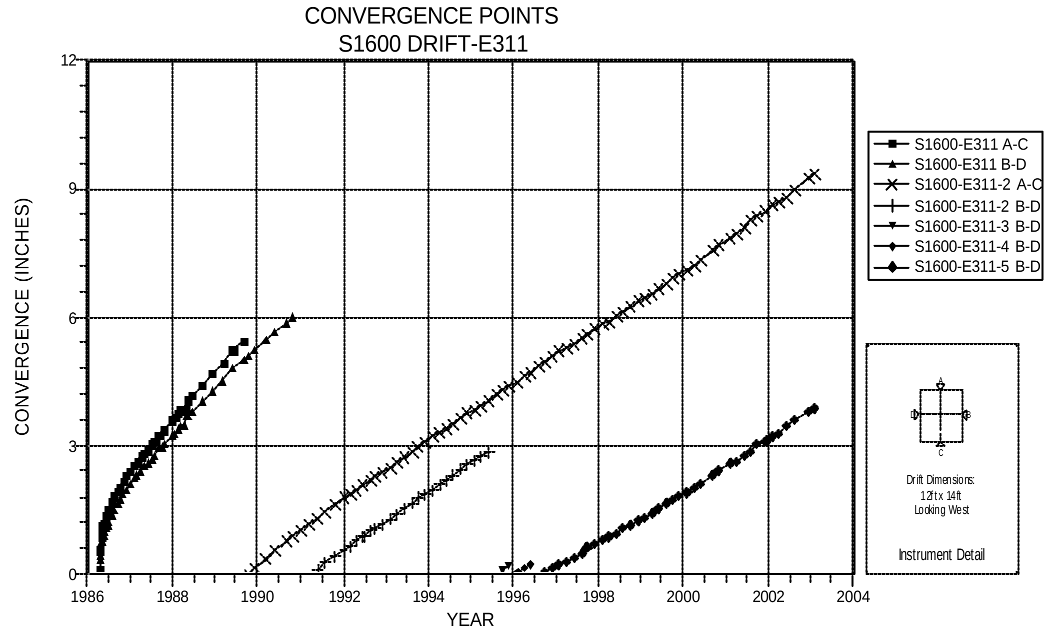
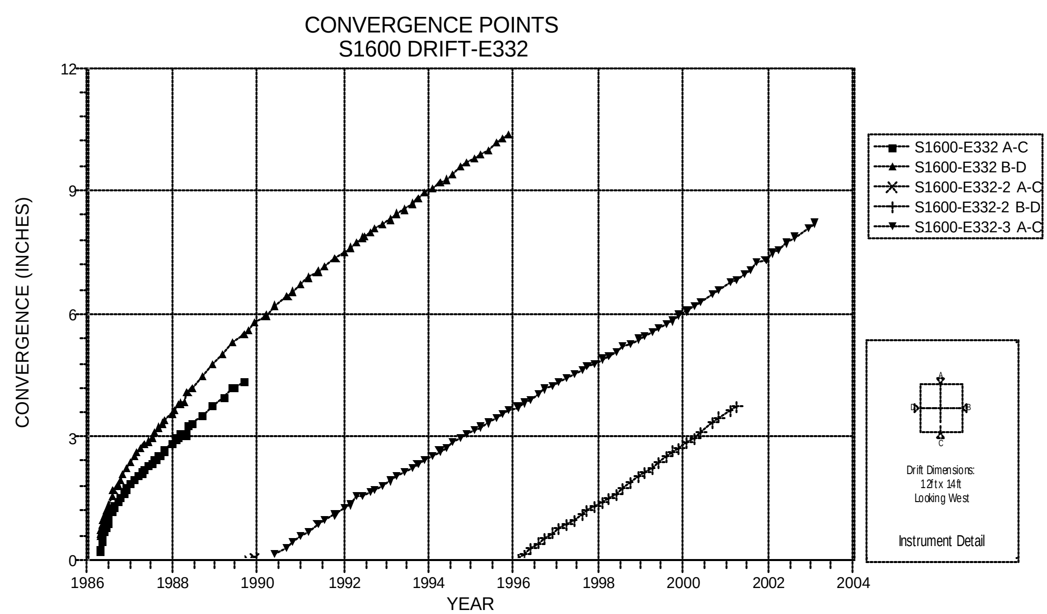


Figure 6-40 Extensometer 51X-GE-01016
South 1950 Drift at E856 – Mid Panel – North Rib



NOTES:
1. Excavation date: April 1986.

Figure 6-41 Convergence Point Array
S1600 Drift at E311 – All Chords



NOTES:
1. Excavation date: April 1986.
2. Chord B-D removed due to air monitoring equipment cutout.

Figure 6-42 Convergence Point Array
S1600 Drift at E332 – All Chords

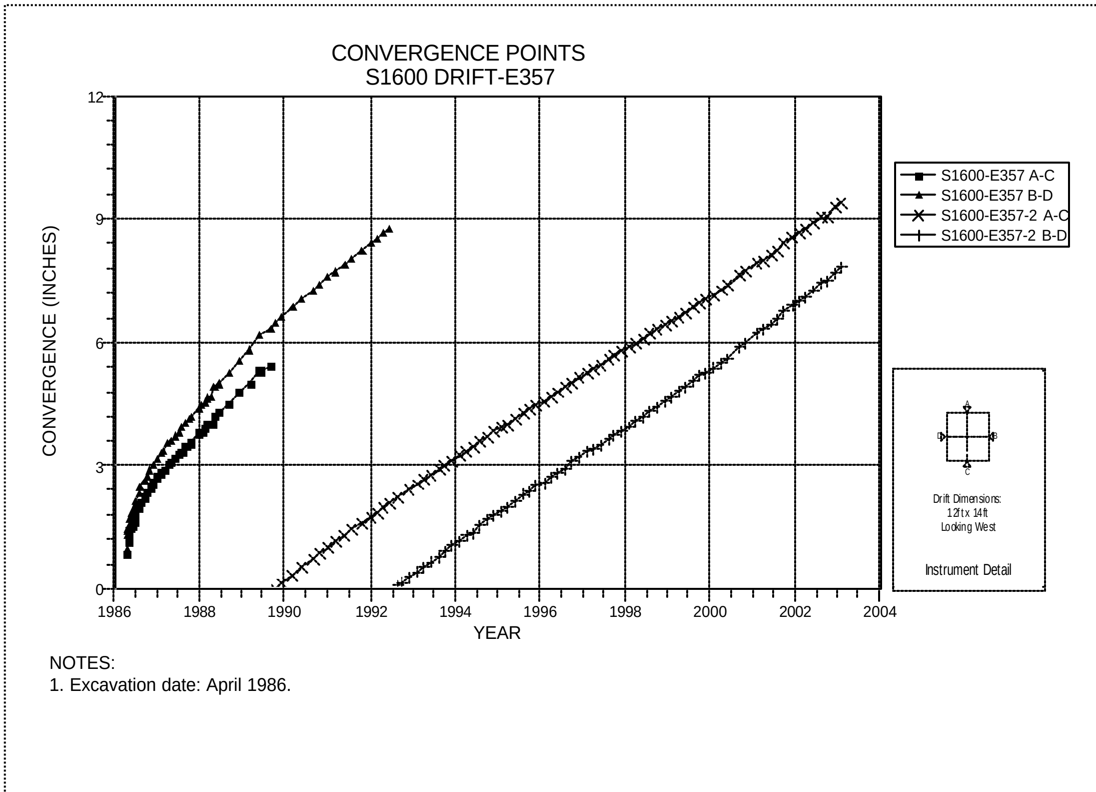


Figure 6-43 Convergence Point Array
S1600 Drift at E357 – All Chords

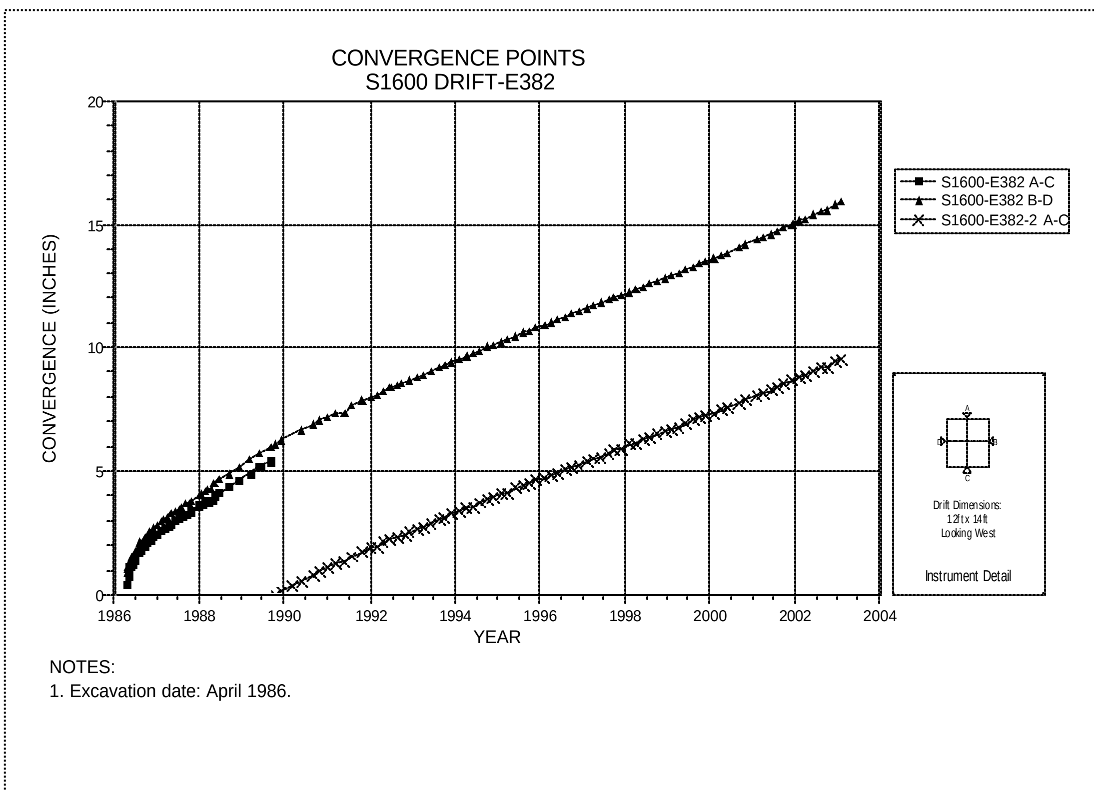
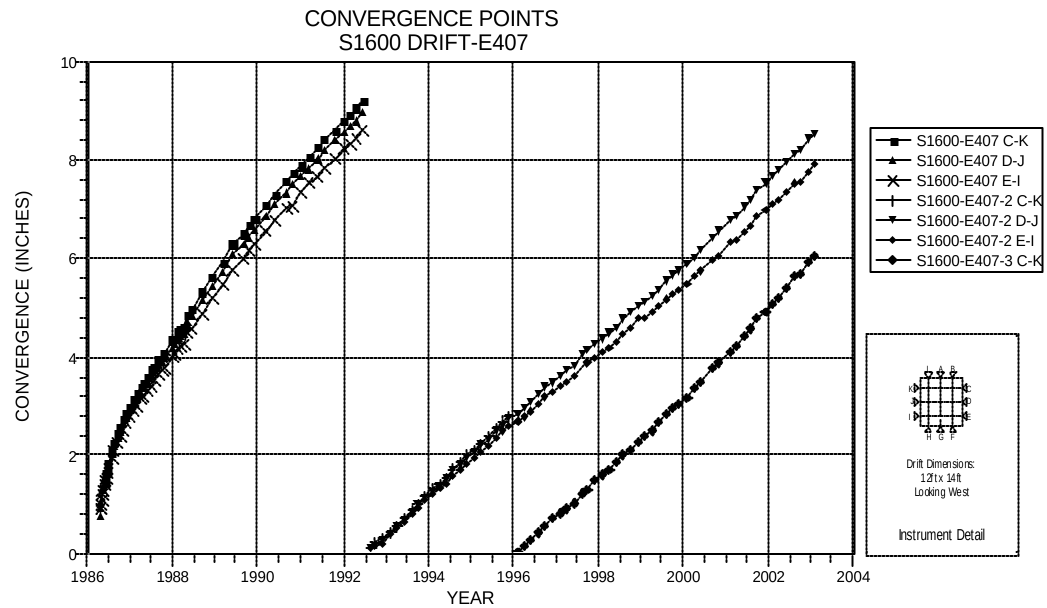
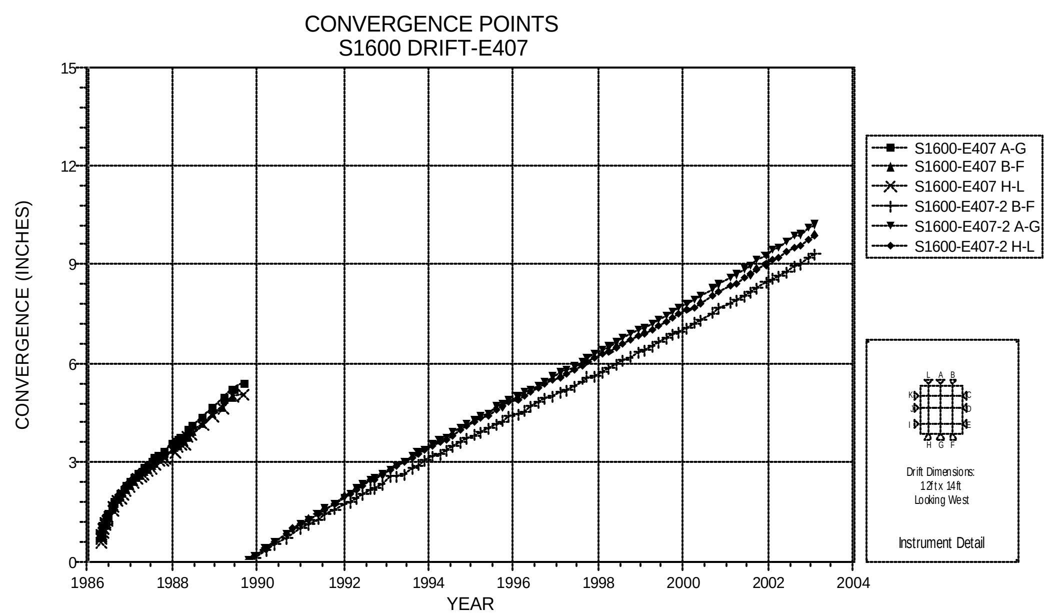


Figure 6-44 Convergence Point Array
S1600 Drift at E382 – All Chords



NOTES:
1. Excavation date: April 1986.

Figure 6-45 Convergence Point Array
S1600 Drift at E407 – Rib to Rib



NOTES:
1. Excavation date: April 1986.

Figure 6-46 Convergence Point Array
S1600 Drift at E407 – Roof to Floor

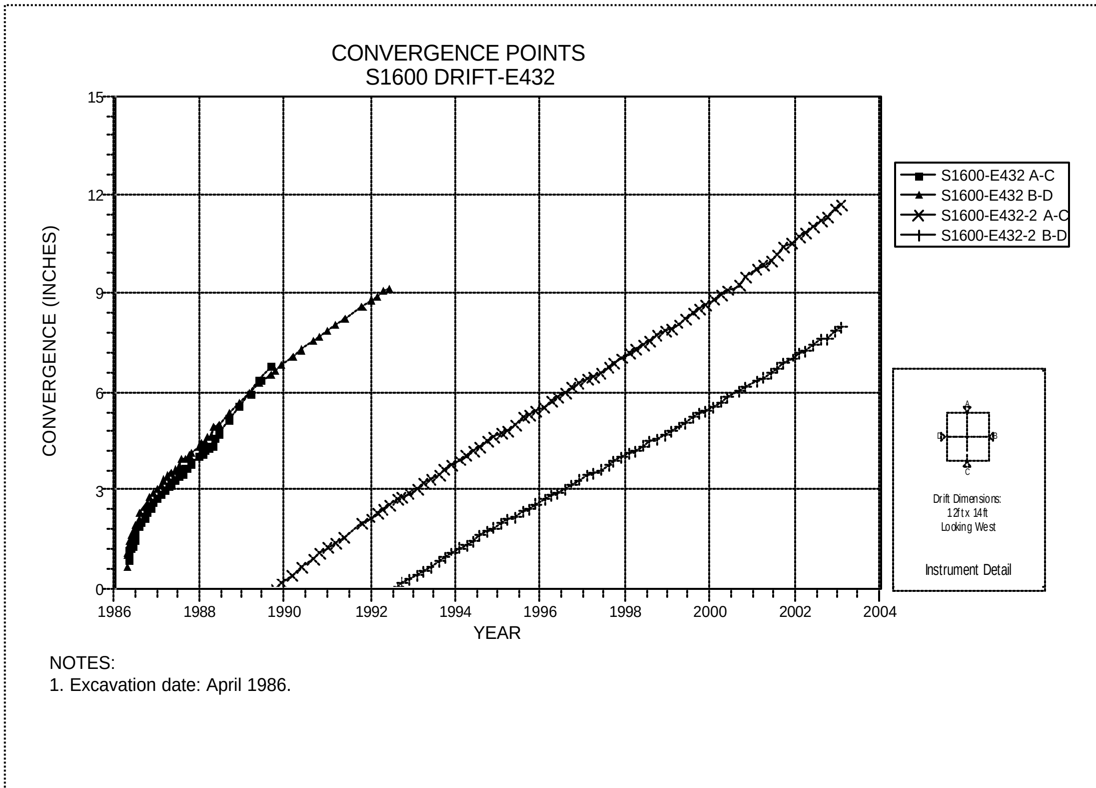


Figure 6-47 Convergence Point Array
S1600 Drift at E432 – All Chords

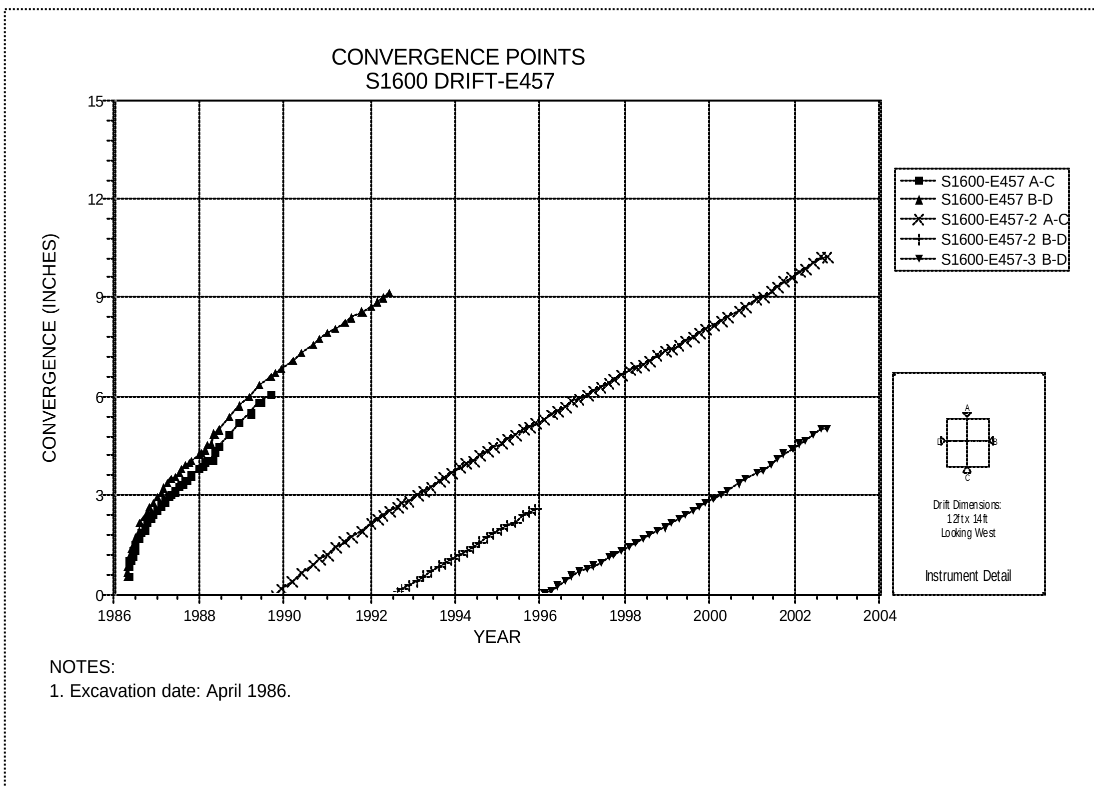
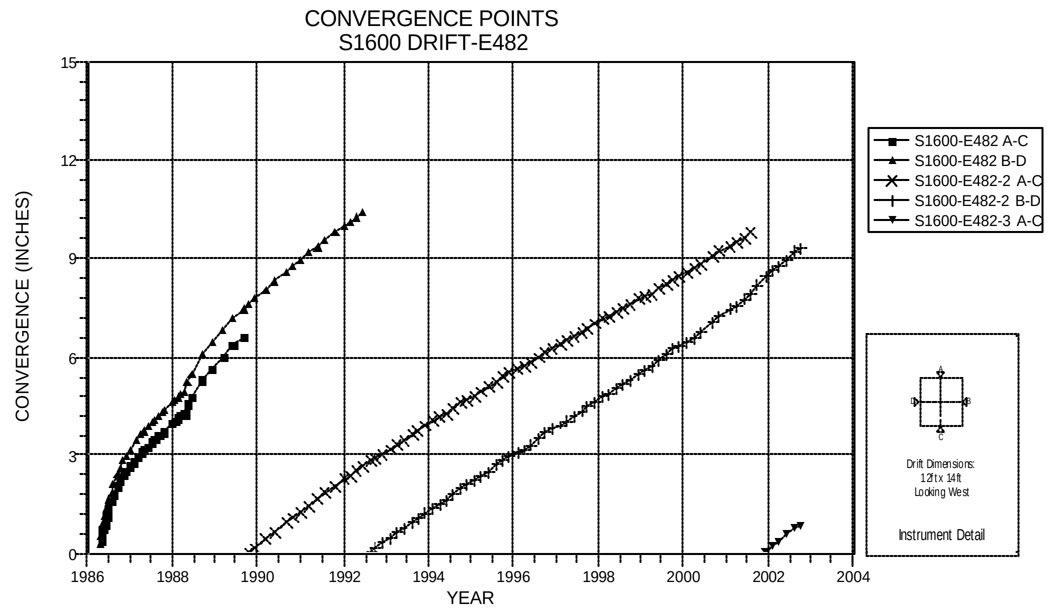
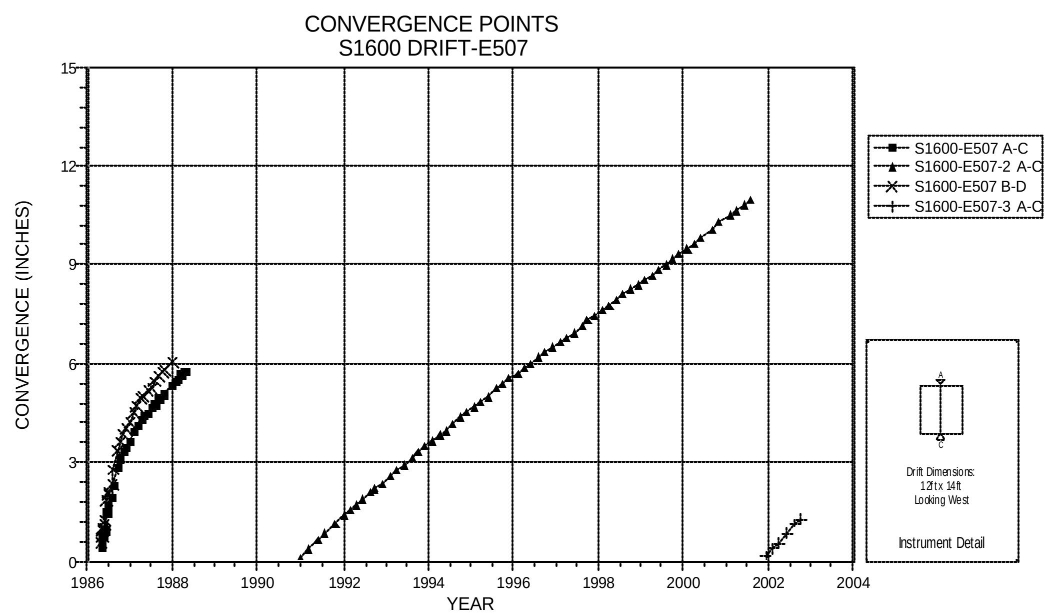


Figure 6-48 Convergence Point Array
S1600 Drift at E457 – All Chords



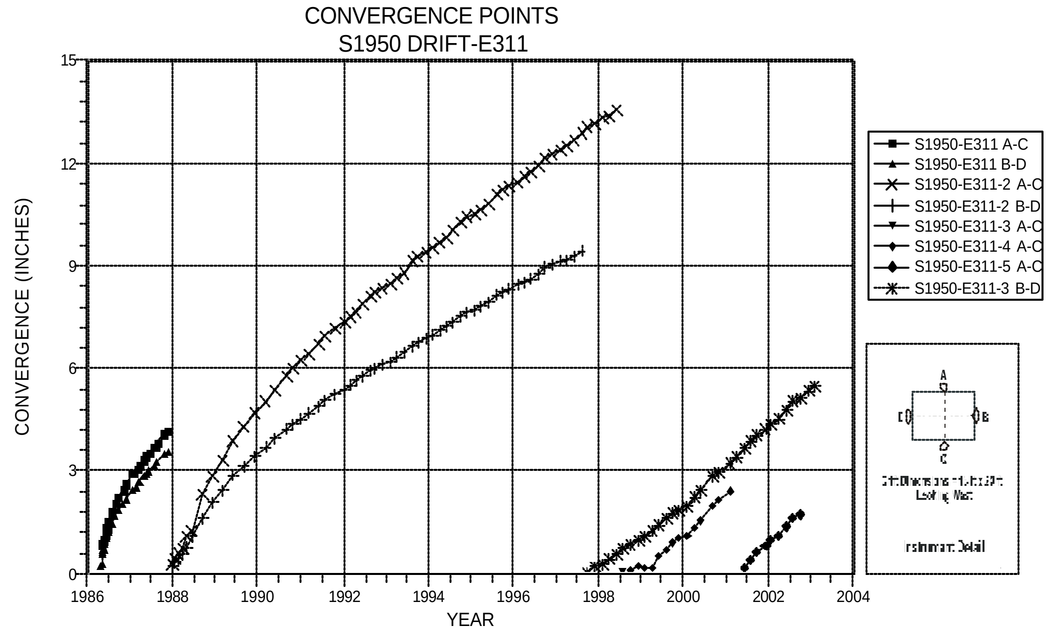
NOTES:
1. Excavation date: April 1986.

Figure 6-49 Convergence Point Array
S1600 Drift at E482 – All Chords



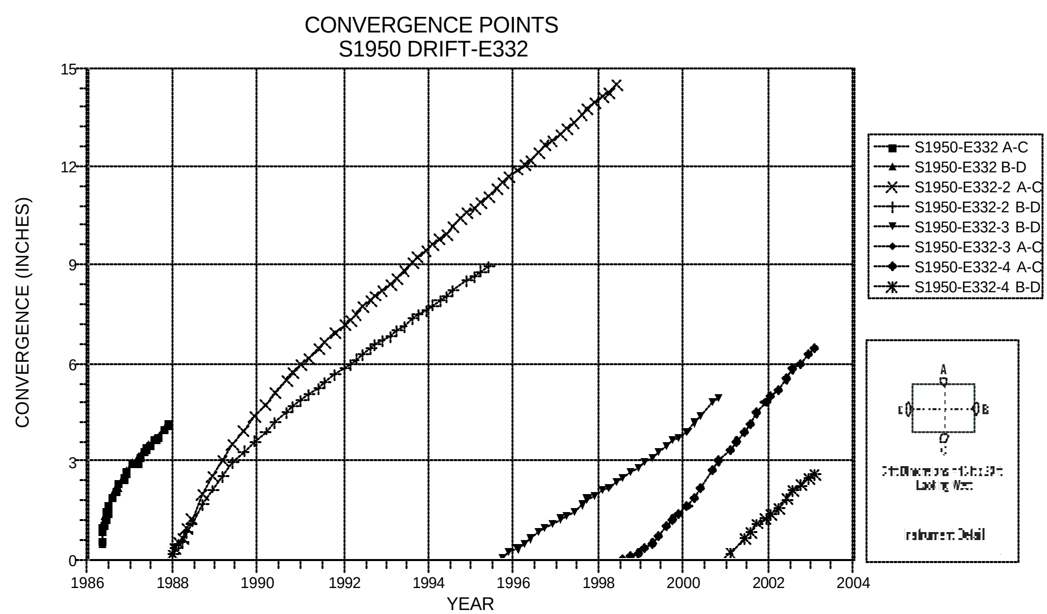
NOTES:
1. Excavation date: April 1986.
2. Chord B-D mined-out, area now an intersection.

Figure 6-50 Convergence Point Array
S1600 Drift at E507 – Roof to Floor



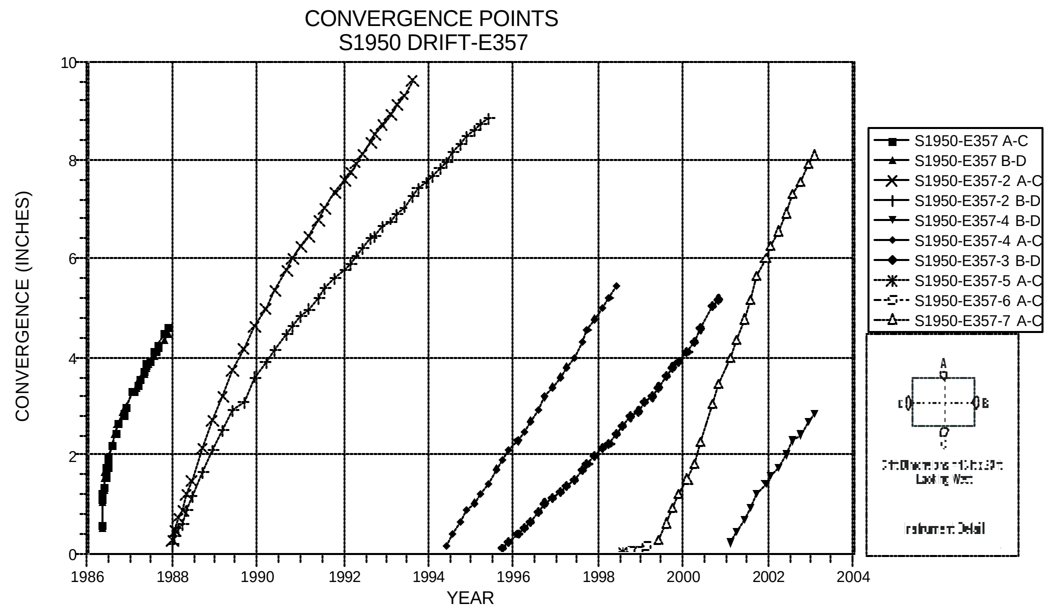
NOTES:
1. Excavation date: May 1986.

Figure 6-51 Convergence Point Array
S1950 Drift at E311 – All Chords



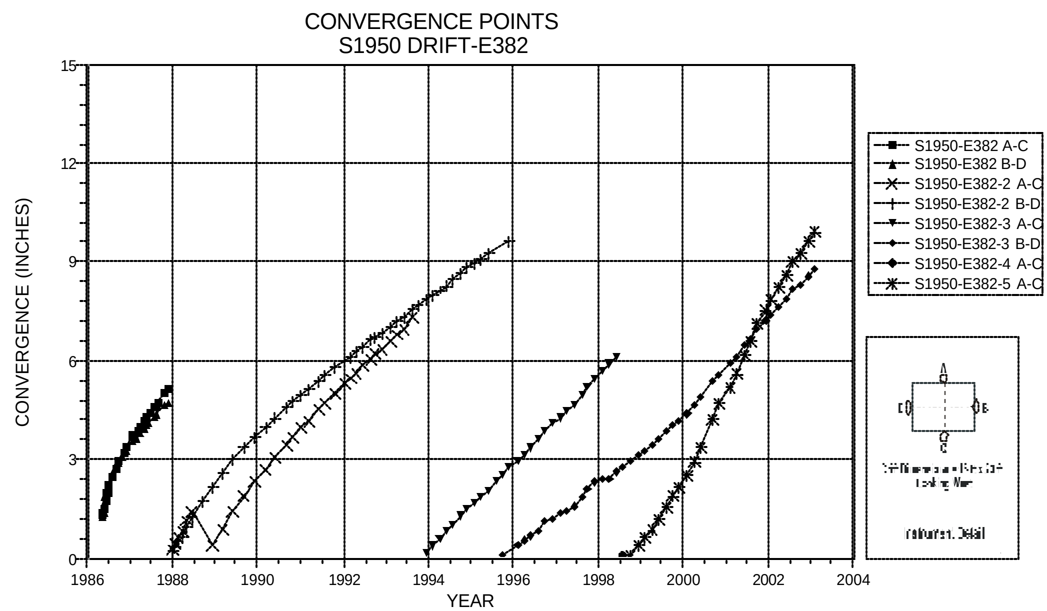
NOTES:
1. Excavation date: May 1986.

Figure 6-52 Convergence Point Array
S1950 Drift at E332 – All Chords



NOTES:
1. Excavation date: May 1986.

Figure 6-53 Convergence Point Array
S1950 Drift at E357 – All Chords



NOTES:
1. Excavation date: May 1986.

Figure 6-54 Convergence Point Array
S1950 Drift at E382 – All Chords

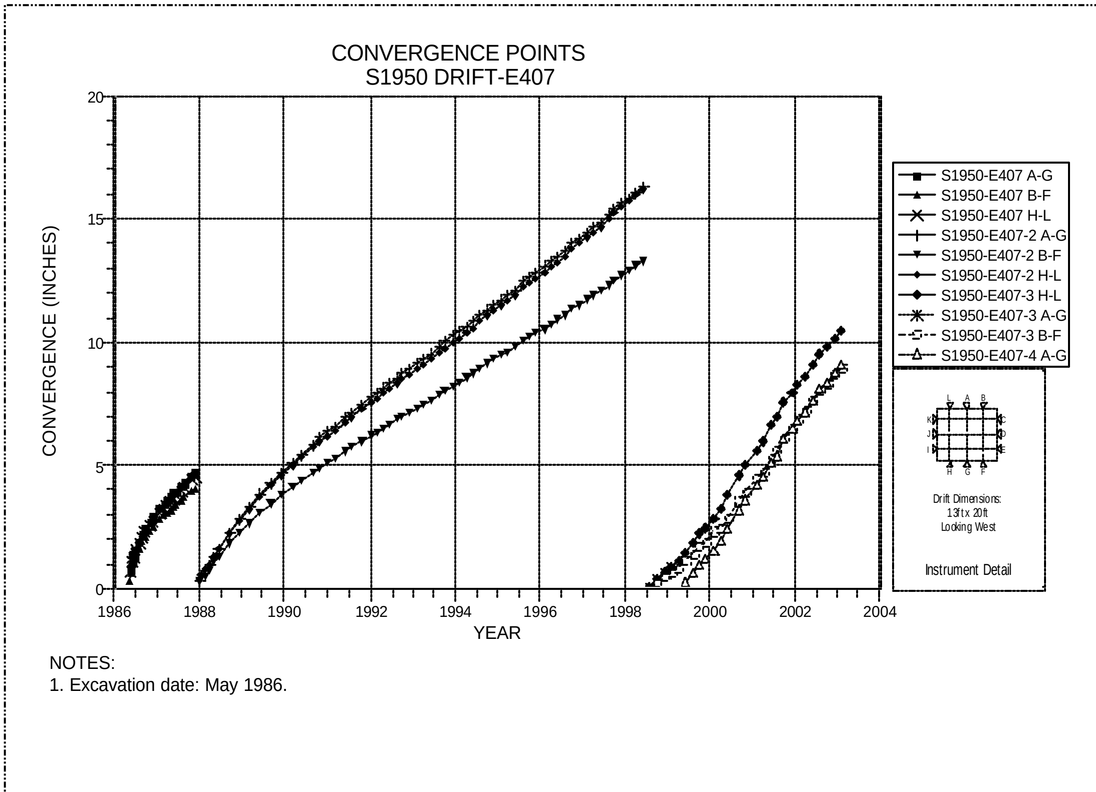


Figure 6-55 Convergence Point Array
S1950 Drift at E407 – Roof to Floor

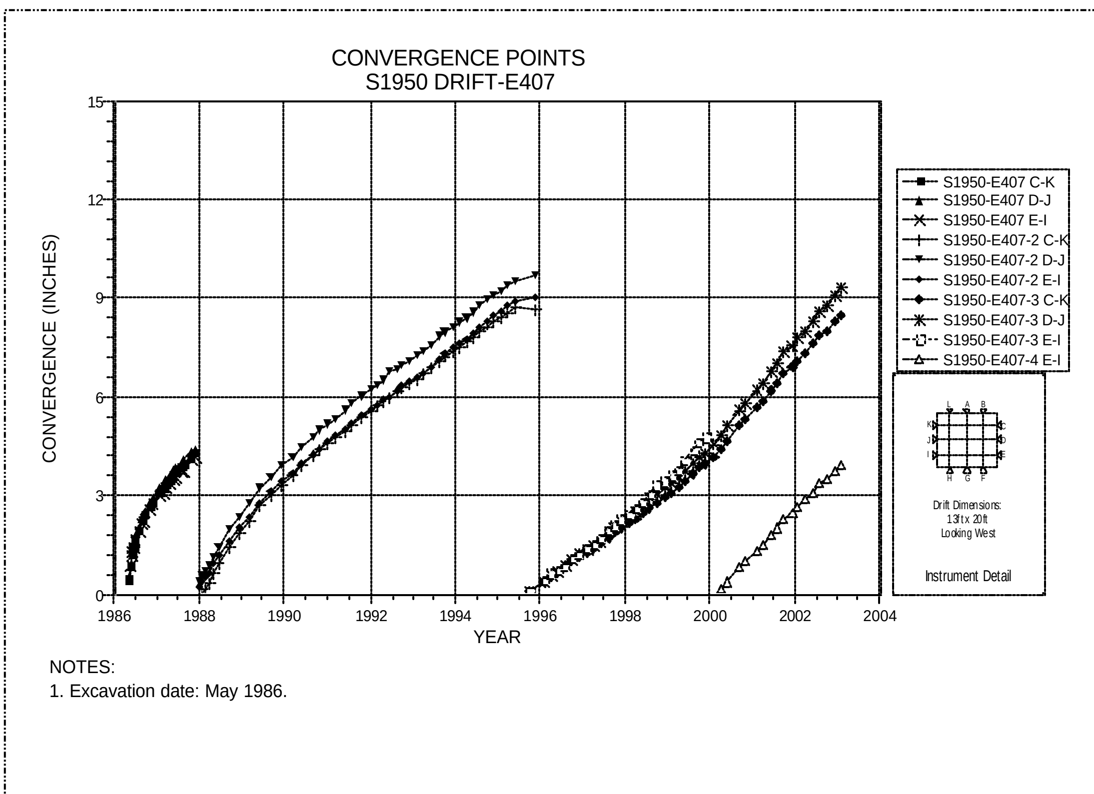


Figure 6-56 Convergence Point Array
S1950 Drift at E407 – Rib to Rib

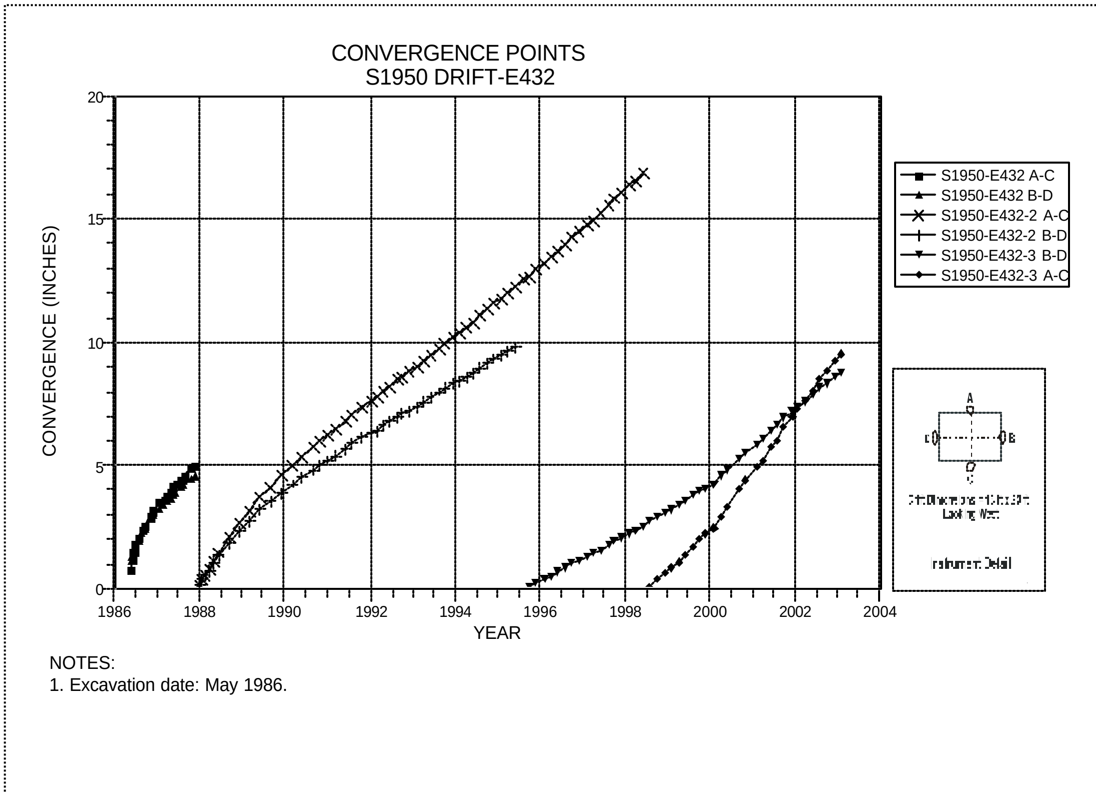


Figure 6-57 Convergence Point Array
S1950 Drift at E432 – All Chords

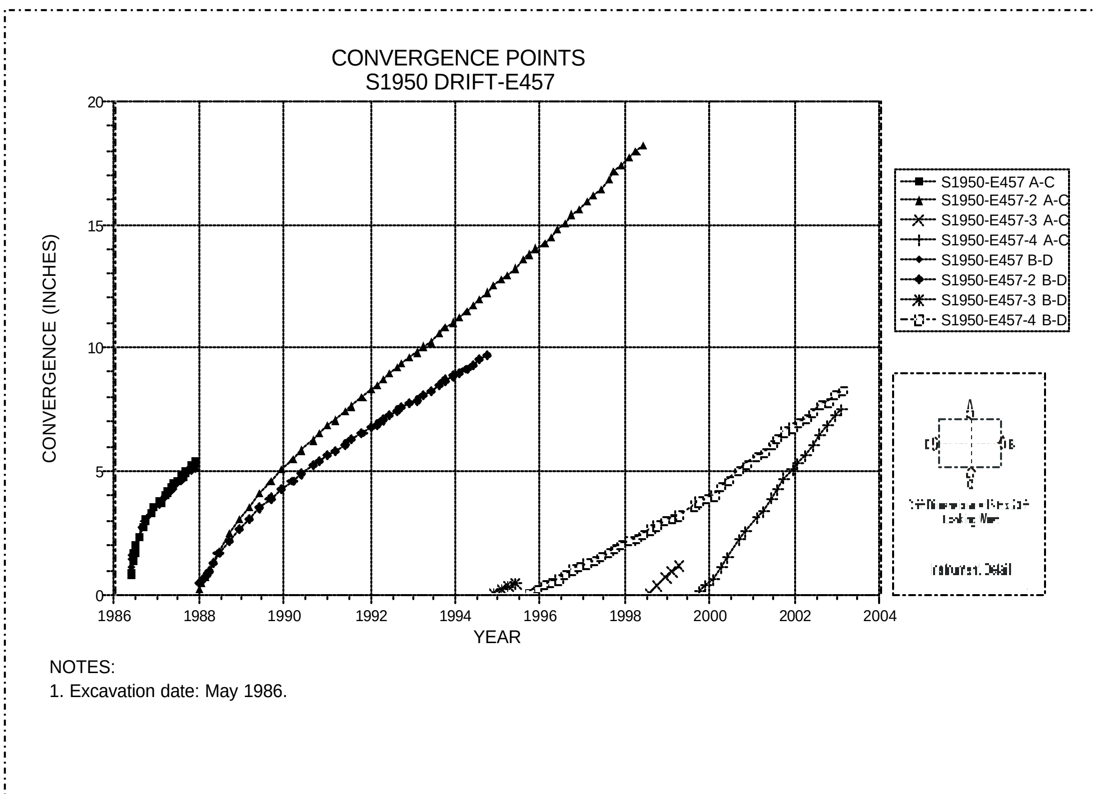
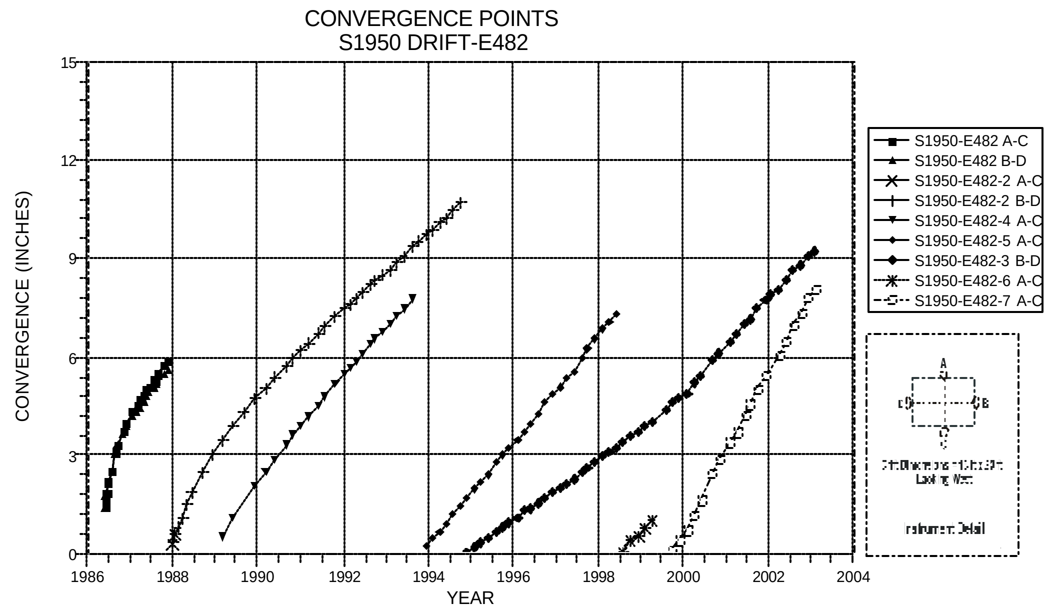
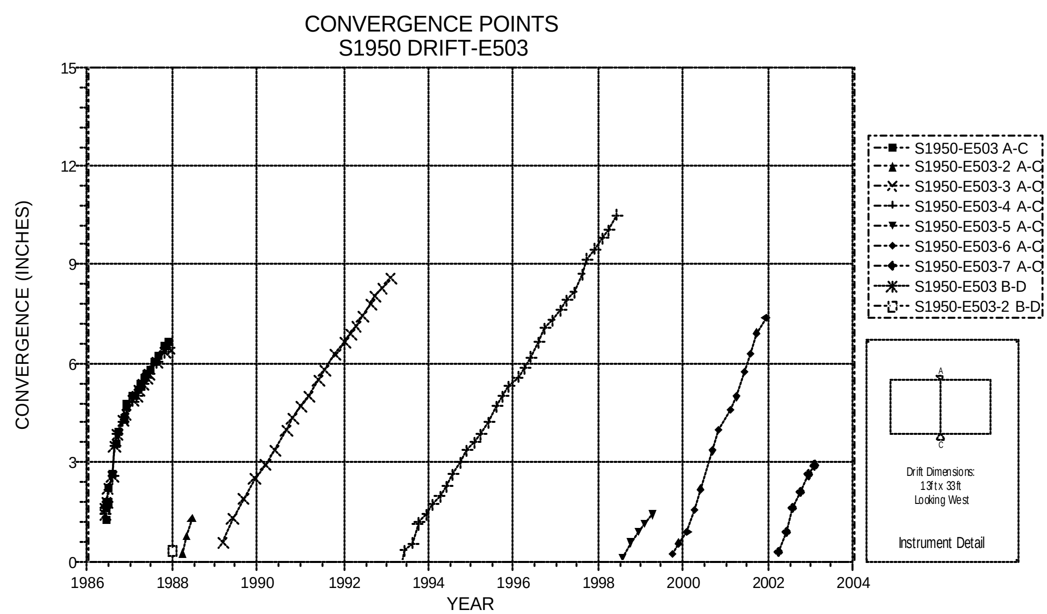


Figure 6-58 Convergence Point Array
S1950 Drift at E457 – All Chords



NOTES:
1. Excavation date: May 1986.

Figure 6-59 Convergence Point Array
S1950 Drift at E482 – All Chords



NOTES:
1. Excavation date: May 1986.
2. Chord B-D mined-out, area now an intersection.

Figure 6-60 Convergence Point Array
S1950 Drift at E503 – Roof to Floor

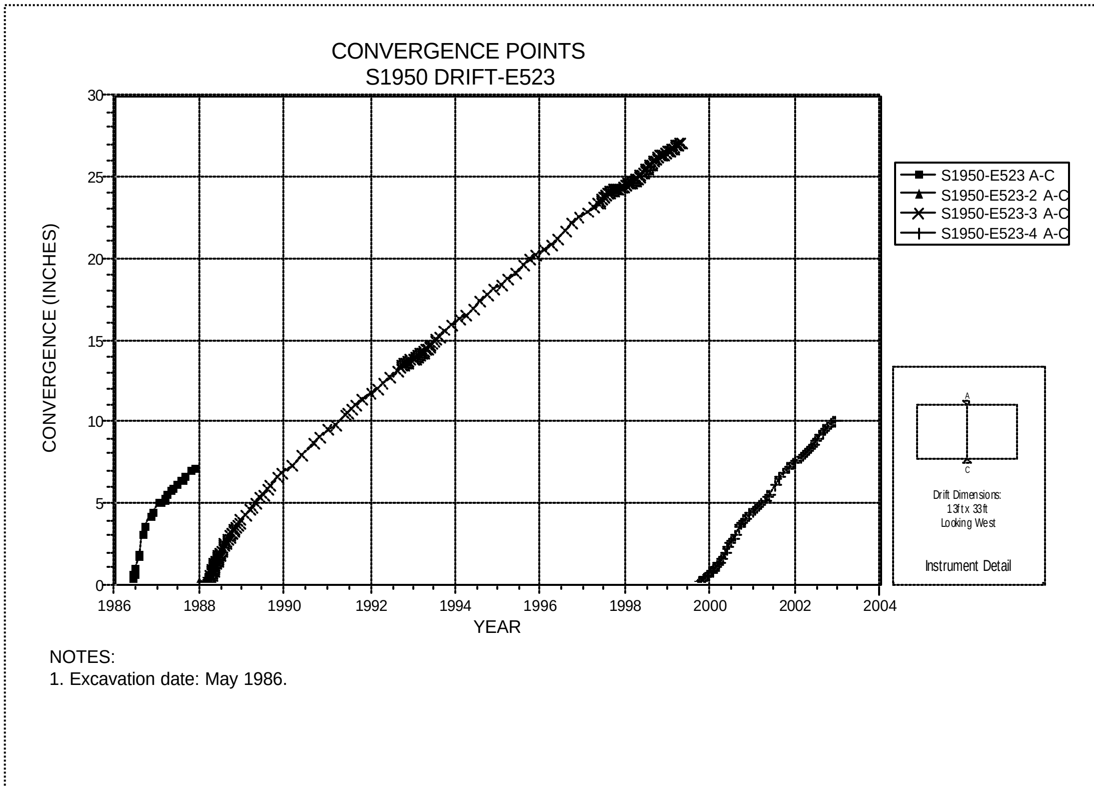


Figure 6-61 Convergence Point Array
S1950 Drift at E523 Drift Intersection (Room 1, Panel 1) – Roof to Floor

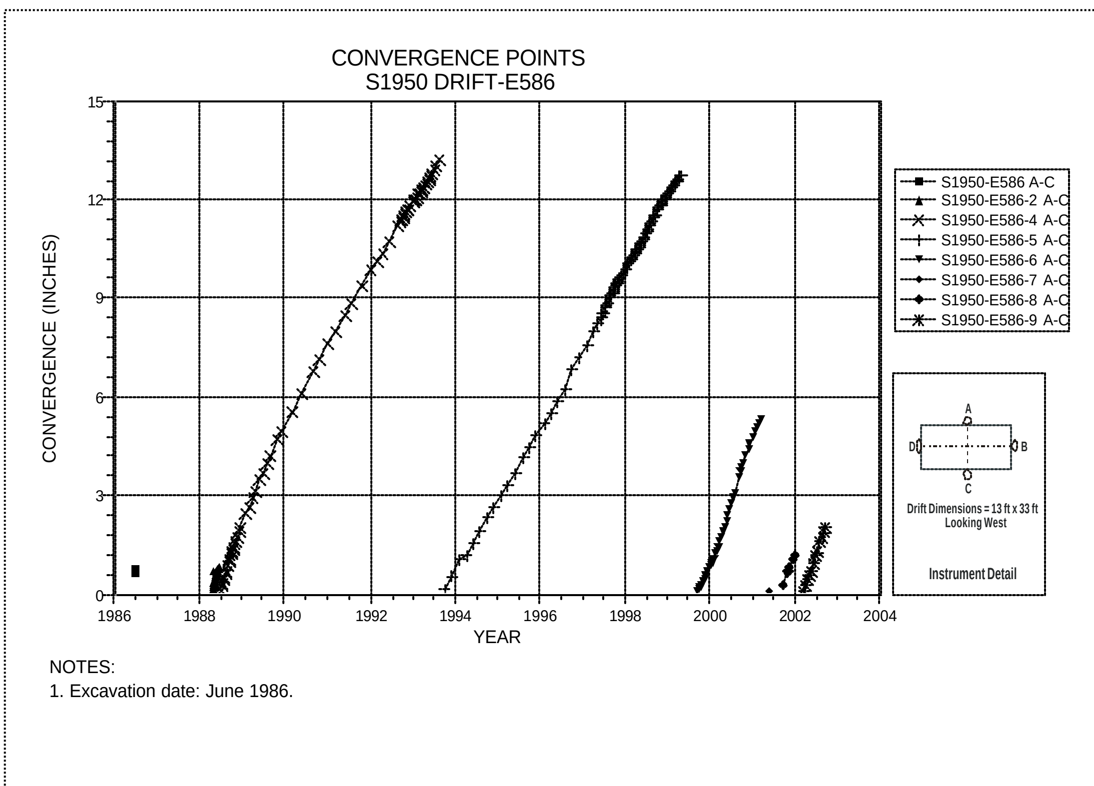


Figure 6-62 Convergence Point Array
S1950 Drift at E586 – Roof to Floor

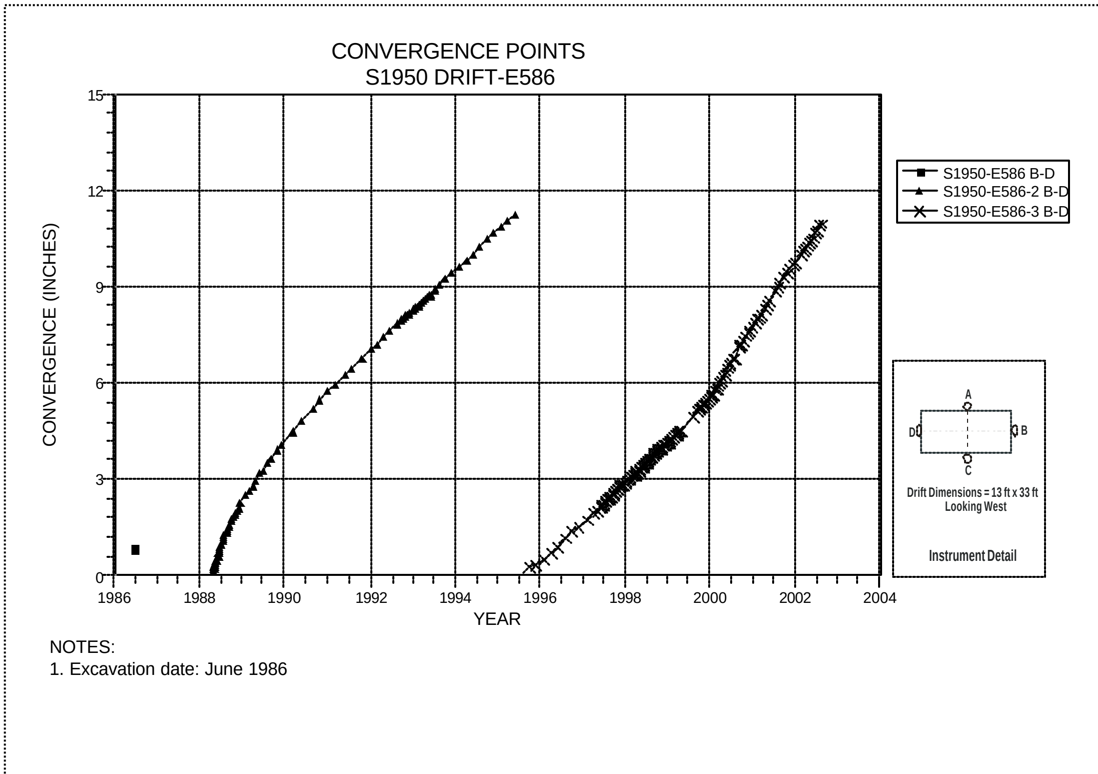


Figure 6-63 Convergence Point Array
S1950 Drift at E586 – Rib to Rib

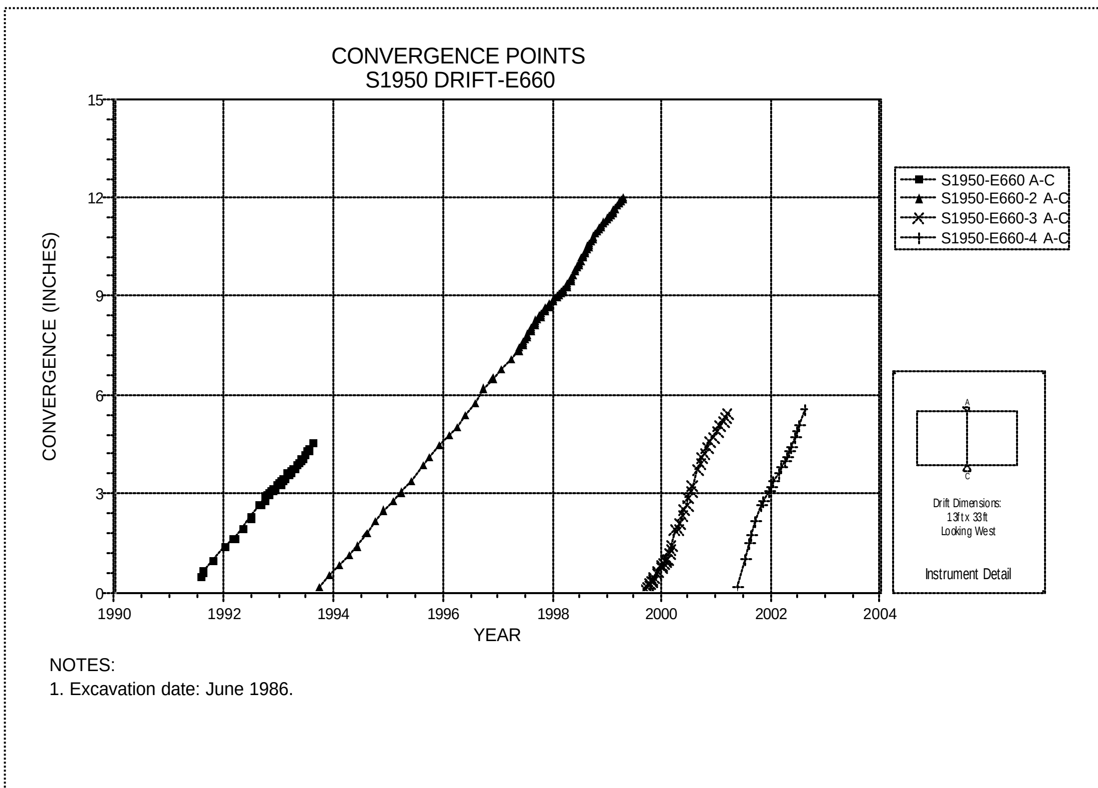
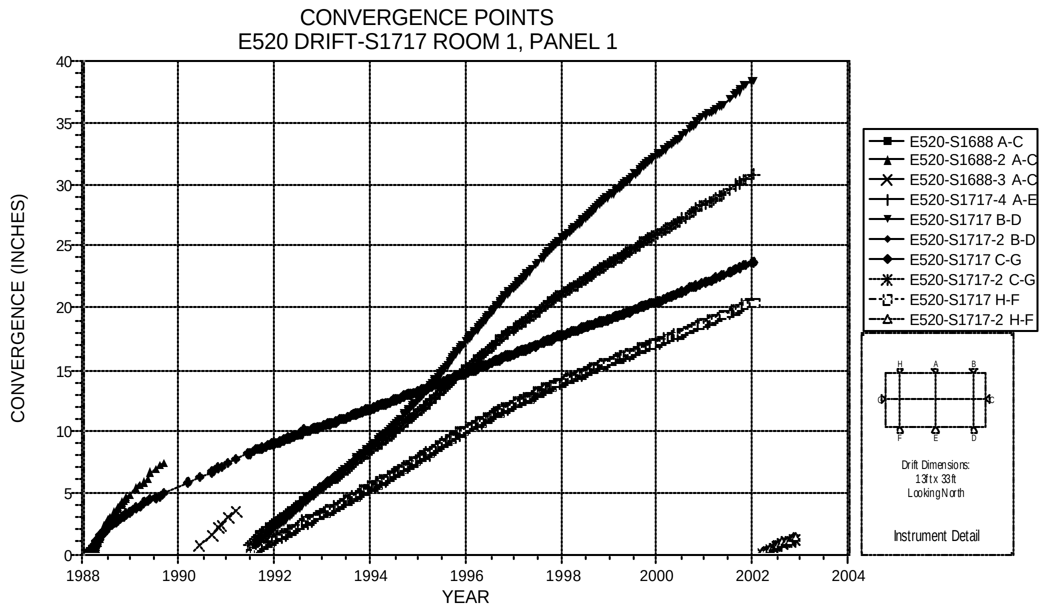
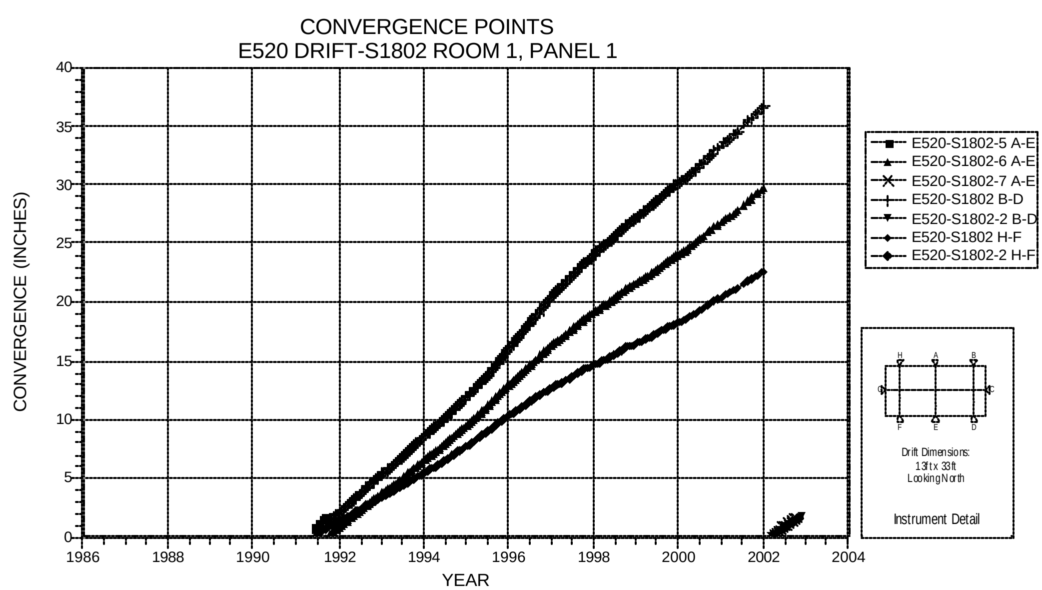


Figure 6-64 Convergence Point Array
S1950 Drift at E660 Drift Intersection (Room 2, Panel 1) – Roof to Floor



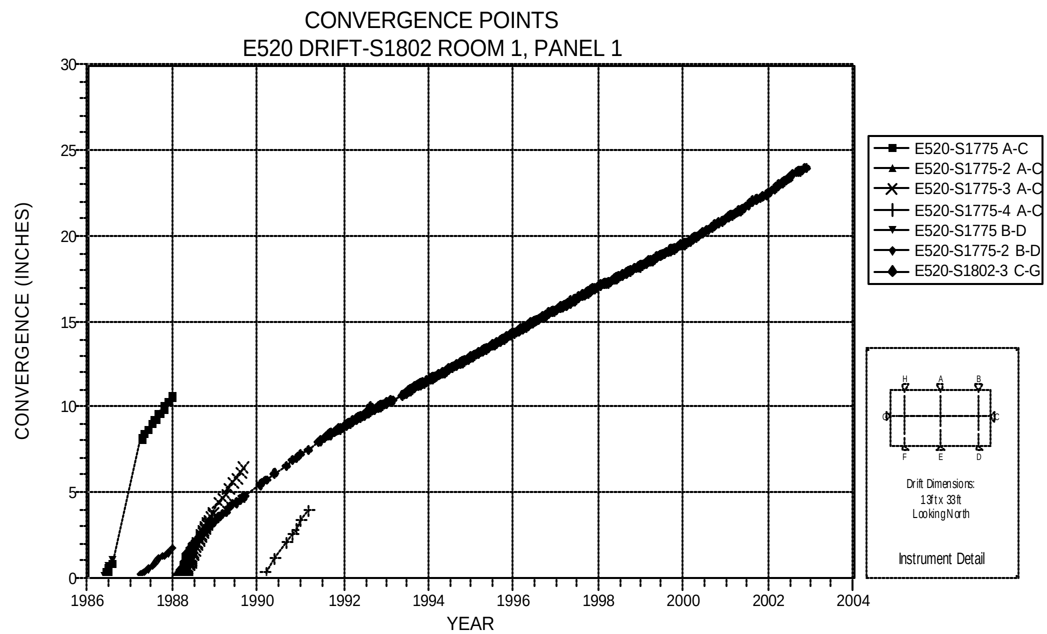
NOTES:
1. Excavation date: June 1986.
2. Location originally designated as E520-S1688.
3. E520-S1688 A-C chord now an A-E chord.
4. E520-S1688 B-D chord now a C-G chord.

Figure 6-65 Convergence Point Array
Room 1, Panel 1 at S1717 – All Chords



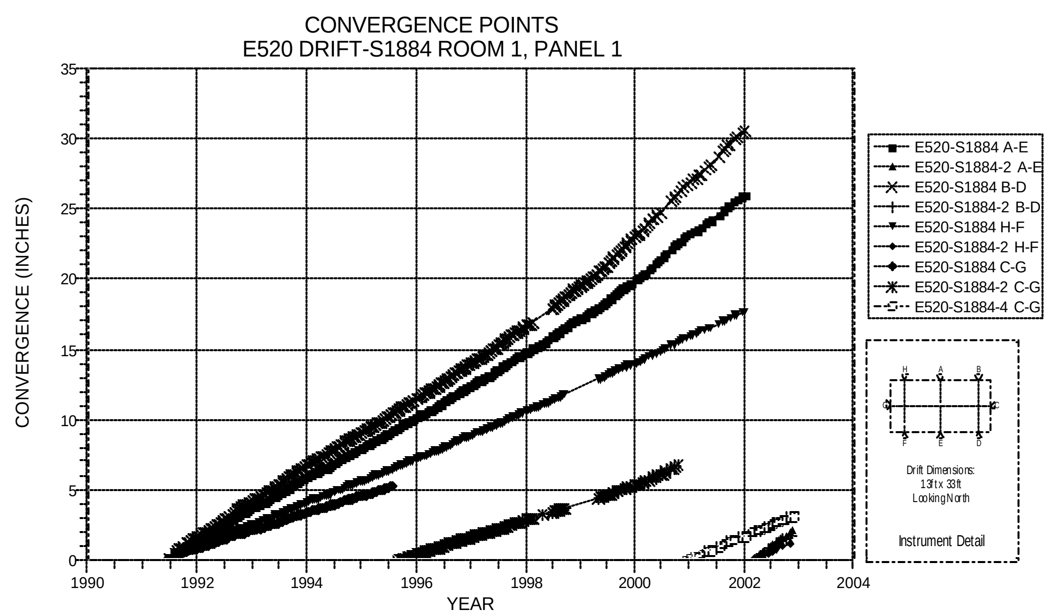
NOTES:
1. Excavation date: May 1986.
2. Location originally designated as E520-S1775.

Figure 6-66 Convergence Point Array
Room 1, Panel 1 at S1802 – Roof to Floor



NOTES:
1. Excavation date: May 1986.
2. Location originally designated as E520-S1775.
3. E520-S1775 B-D chord now E520-S1802 C-G chord.

Figure 6-67 Convergence Point Array
Room 1, Panel 1 at S1802 – Rib to Rib



NOTES:
1. Excavation date: May 1986.

Figure 6-68 Convergence Point Array
Room 1, Panel 1 at S1884 – All Chords

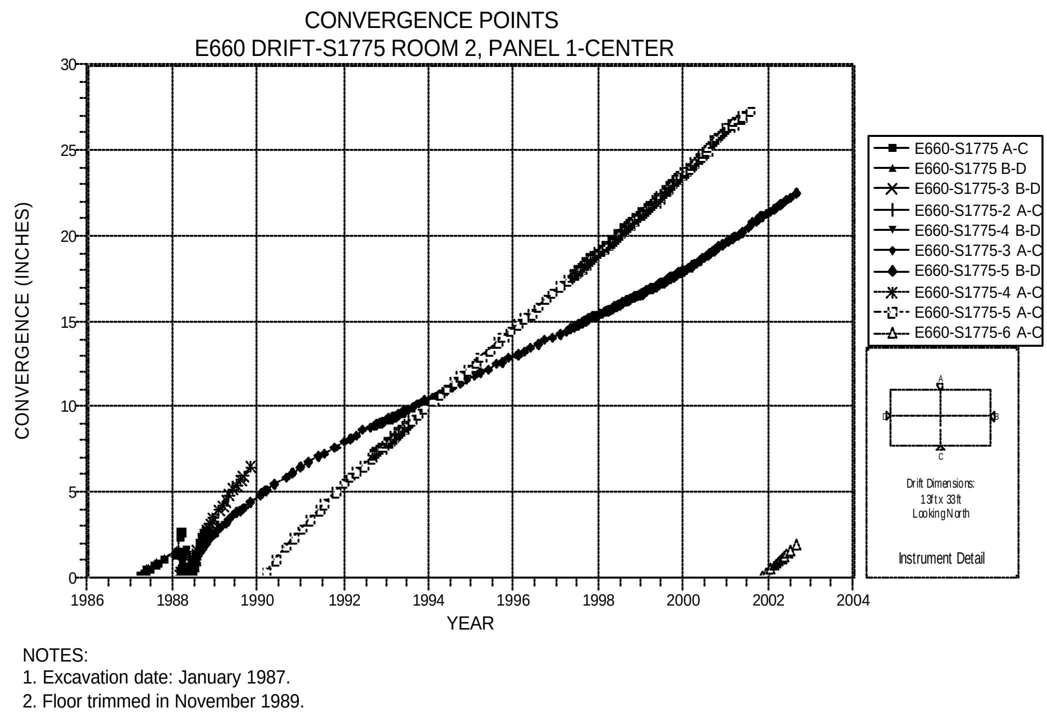


Figure 6-69 Convergence Point Array
Room 2, Panel 1 at S1775 – Room Center – All Chords

Table 6-2
Panel 2 Data Analysis

EXTENSOMETERS

Field Tag	Location		Figure Number	Date of Last Reading	Collar Displacement Relative to Deepest Anchor (inches)	Displacement Rate 2002 to 2003 in/year	Displacement Rate 2001 to 2002 in/year	Rate Change Percent	Comments
51X-GE-00341	PANEL 2 ROOM 1	CENTER ROOF	6-70	06/23/03	3.294	1.072	1.121	-4%	
51X-GE-00342	PANEL 2 ROOM 2	CENTER ROOF	6-71	06/23/03	2.551	0.829	0.712	16%	
51X-GE-00343	PANEL 2 ROOM 3	CENTER ROOF	6-72	06/23/03	3.350	1.059	1.064	0%	
51X-GE-00344	PANEL 2 ROOM 4	CENTER ROOF	6-73	06/23/03	2.986	0.804	0.975	-18%	
51X-GE-00345	PANEL 2 ROOM 5	CENTER ROOF	6-74	06/23/03	3.022	0.820	1.001	-18%	
51X-GE-00346	PANEL 2 ROOM 6	CENTER ROOF	6-75	06/23/03	2.543	0.725	0.851	-15%	
51X-GE-00347	PANEL 2 ROOM 7	CENTER ROOF	6-76	06/23/03	3.006	0.790	1.023	-23%	
51X-GE-00348	S2180 DRIFT - E725	ROOF	6-77	06/23/03	3.448	1.003	1.121	-11%	
51X-GE-00351	S2180 DRIFT - E1120	ROOF	6-78	06/23/03	2.540	0.714	0.810	-12%	
51X-GE-00350	S2520 DRIFT - E735	ROOF	6-79	06/23/03	3.350	1.156	1.054	10%	
51X-GE-00349	S2520 DRIFT - E1120	ROOF	6-80	06/23/03	3.433	1.020	1.102	-7%	

Table 6-2 (Continued)
Panel 2 Data Analysis

CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading 2002 to 2003 Date	Last Reading 2002 to 2003 Inches	Cumulative Displacement Inches	Closure Rate 2002 to 2003 in/year	Closure Rate 2001 to 2002 in/year	Rate Change Percent	Comments
S2180-E410 A-C	S2180 Drift-E410	6-81	06/24/03	4.264	4.264	1.217	1.516	-20%	
S2180-E410 B-D	S2180 Drift-E410	6-81	06/24/03	4.583	4.583	1.374	1.616	-15%	
S2180-E520 A-C	S2180 Drift-E520	6-82	06/24/03	7.856	7.856	2.161	2.615	-17%	
S2180-E586 A-C	S2180 Drift-E586	6-83	06/24/03	10.236	10.236	2.887	3.335	-13%	
S2180-E586-2 B-D	S2180 Drift-E586	6-83	06/24/03	2.878	6.359	1.840	2.004	-8%	
S2180-E660 A-C	S2180 Drift-E660	6-84	06/24/03	10.048	10.048	2.824	3.117	-9%	
S2180-E790 A-C	S2180 Drift-E790	6-85	06/24/03	11.156	11.156	3.066	3.591	-15%	
S2180-E920 A-C	S2180 Drift-E920	6-86	06/24/03	12.316	12.316	3.362	3.943	-15%	
S2180-E986 A-C	S2180 Drift-E986	6-87	06/24/03	11.253	11.253	3.079	3.636	-15%	
S2180-E986 B-D	S2180 Drift-E986	6-87	06/24/03	7.507	7.507	1.973	2.328	-15%	
S2180-E1050-2 A-C	S2180 Drift-E1050	6-88	06/24/03	9.964	9.964	2.911	3.394	-14%	
S2180-E1190 A-C	S2180 Drift-E1190	6-89	06/24/03	10.450	10.450	2.996	3.230	-7%	
S2180-E1265-2 A-C	S2180 Drift-E1265	6-90	03/10/03	8.196	9.780	2.636	3.055	-14%	No longer accessible.
S2180-E1265 B-D	S2180 Drift-E1265	6-90	03/10/03	6.183	6.183	1.536	1.837	-16%	No longer accessible.
S2180-E1320-2 A-C	S2180 Drift-E1320	6-91	03/10/03	6.085	6.879	1.912	2.173	-12%	No longer accessible.
S2520-E410-2 A-C	S2520 Drift-E410	6-92	06/03/03	6.257	7.187	2.139	2.200	-3%	
S2520-E410 B-D	S2520 Drift-E410	6-92	06/03/03	7.196	7.196	1.995	1.980	1%	
S2520-E520-2 A-C	S2520 Drift-E520	6-93	06/24/03	10.584	12.284	3.493	3.324	5%	
S2520-E660-2 A-C	S2520 Drift-E660	6-94	06/24/03	3.505	13.721	3.626	3.534	3%	Reinstalled 7/02.
S2520-E586 A-C	S2520 Drift-E586	6-95	06/24/03	12.596	12.596	3.489	3.214	9%	
S2520-E586 B-D	S2520 Drift-E586	6-95	06/24/03	7.834	7.834	2.027	1.940	4%	
S2520-E790 A-C	S2520 Drift-E790	6-96	06/24/03	11.560	11.560	3.177	3.142	1%	
S2520-E920 A-C	S2520 Drift-E920	6-97	06/24/03	10.645	10.645	2.900	3.016	-4%	
S2520-E985 A-C	S2520 Drift-E985	6-98	06/24/03	11.174	11.174	2.968	3.157	-6%	

Table 6-2 (Continued)
Panel 2 Data Analysis

CONVERGENCE POINTS (Continued)

Field Tag	Location	Figure Number	Last Reading 2002 to 2003 Date	Last Reading 2002 to 2003 Inches	Cumulative Displacement Inches	Closure Rate 2002 to 2003 in/year	Closure Rate 2001 to 2002 in/year	Rate Change Percent	Comments
S2520-E985 B-D	S2520 Drift-E985	6-98	06/24/03	7.717	7.717	1.951	2.114	-8%	
S2520-E1050 A-C	S2520 Drift-E1050	6-99	06/24/03	10.881	10.881	2.800	3.066	-9%	
S2520-E1190-2 A-C	S2520 Drift-E1190	6-100	06/24/03	10.558	12.055	3.213	3.509	-8%	
S2520-E1265-2 A-C	S2520 Drift-E1265	6-101	05/29/03	7.796	9.091	2.287	2.702	-15%	No longer accessible.
S2520-E1265 B-D	S2520 Drift-E1265	6-101	05/06/03	6.164	6.164	1.446	1.731	-16%	No longer accessible.
S2520-E1320 A-C	E2520 Drift-E1320	6-102	05/29/03	8.487	8.487	2.145	2.510	-15%	No longer accessible.
E520-S2275 A-C	E520 Drift-S2275	6-103	06/24/03	12.101	12.101	3.044	3.485	-13%	
E520-S2275 B-D	E520 Drift-S2275	6-103	06/24/03	7.421	7.421	1.840	2.046	-10%	
E520-S2350-2 A-C	E520 Drift-S2350	6-104	06/24/03	12.919	13.343	3.384	3.579	-5%	
E520-S2350 B-D	E520 Drift-S2350	6-104	06/24/03	8.668	8.668	2.287	2.377	-4%	
E520-S2425 A-C	E520 Drift-S2425	6-105	06/24/03	11.629	11.629	3.055	3.201	-5%	
E520-S2425 B-D	E520 Drift-S2425	6-105	06/24/03	8.022	8.022	2.126	2.188	-3%	
E660-S2275-3 A-C	E660 Drift-S2275	6-106	06/24/03	3.045	9.185	3.049	3.054	0%	Reinstalled 7/02.
E660-S2275 B-D	E660 Drift-S2275	6-106	06/24/03	8.393	8.393	1.929	2.117	-9%	
E660-S2350-4 A-C	E660 Drift-S2350	6-107	06/24/03	3.168	13.454	3.309	3.656	-9%	Reinstalled 7/02.
E660-S2350 B-D	E660 Drift-S2350	6-107	06/24/03	8.775	8.775	2.100	2.268	-7%	
E660-S2425-3 A-C	E660 Drift-S2425	6-108	06/24/03	3.819	13.059	3.844	3.778	2%	Reinstalled 7/02.
E660-S2425 B-D	E660 Drift-S2425	6-108	06/24/03	8.731	8.731	2.096	2.149	-2%	
E790-S2275 A-C	E790 Drift-S2275	6-109	06/24/03	9.897	9.897	2.441	2.779	-12%	
E790-S2275 B-D	E790 Drift-S2275	6-109	06/24/03	7.292	7.292	1.752	1.997	-12%	
E790-S2350-2 A-C	E790 Drift-S2350	6-110	06/24/03	11.039	12.759	2.920	3.167	-8%	
E790-S2350 B-D	E790 Drift-S2350	6-110	06/24/03	7.891	7.891	1.985	2.176	-9%	
E790-S2425 A-C	E790 Drift-S2425	6-111	06/24/03	10.869	10.869	2.786	3.102	-10%	
E790-S2425 B-D	E790 Drift-S2425	6-111	06/24/03	8.084	8.084	2.075	2.248	-8%	

Table 6-2 (Continued)
Panel 2 Data Analysis

CONVERGENCE POINTS (Continued)

Field Tag	Location	Figure Number	Last Reading 2002 to 2003 Date	Last Reading 2002 to 2003 Inches	Cumulative Displacement Inches	Closure Rate 2002 to 2003 in/year	Closure Rate 2001 to 2002 in/year	Rate Change Percent [A]	Comments
E920-S2275 A-C	E920 Drift-S2275	6-112	06/24/03	11.294	11.294	2.800	3.054	-8%	
E920-S2275 B-D	E920 Drift-S2275	6-112	06/24/03	8.230	8.230	1.998	2.205	-9%	
E920-S2350-2 A-C	E920 Drift-S2350	6-113	06/24/03	12.606	15.566	3.195	3.591	-11%	
E920-S2350 B-D	E920 Drift-S2350	6-113	06/24/03	8.619	8.619	2.083	2.360	-12%	
E920-S2425 A-C	E920 Drift-S2425	6-114	06/24/03	11.949	11.949	3.102	3.271	-5%	
E920-S2425 B-D	E920 Drift-S2425	6-114	06/24/03	7.911	7.911	1.887	N/A	N/A	
E1050-S2275 A-C	E1050 Drift-S2275	6-115	06/24/03	10.045	10.045	2.505	2.865	-13%	
E1050-S2275 B-D	E1050 Drift-S2275	6-115	06/24/03	7.271	7.271	1.744	2.044	-15%	
E1050-S2350-2 A-C	E1050 Drift-S2350	6-116	06/24/03	11.591	15.008	2.923	3.279	-11%	
E1050-S2350 B-D	E1050 Drift-S2350	6-116	06/24/03	7.380	7.380	1.785	2.031	-12%	
E1050-S2425 A-C	E1050 Drift-S2425	6-117	06/24/03	9.989	9.989	2.449	2.852	-14%	
E1050-S2425 B-D	E1050 Drift-S2425	6-117	06/24/03	7.432	7.432	1.811	1.952	-7%	
E1190-S2275-2 A-C	E1190 Drift-S2275	6-118	06/24/03	8.660	10.086	2.466	2.921	-16%	
E1190-S2275 B-D	E1190 Drift-S2275	6-118	06/24/03	7.239	7.239	1.677	1.982	-15%	
E1190-S2350-3 A-C	E1190 Drift-S2350	6-119	06/24/03	10.046	13.469	2.872	3.322	-14%	
E1190-S2350 B-D	E1190 Drift-S2350	6-119	06/24/03	7.186	7.186	1.654	1.960	-16%	
E1190-S2425-2 A-C	E1190 Drift-S2425	6-120	06/24/03	9.851	10.980	2.788	3.271	-15%	
E1190-S2425 B-D	E1190 Drift-S2425	6-120	05/29/03	7.406	7.406	1.725	2.072	-17%	No longer accessible.
E1320-S2275-2 A-C	E1320 Drift-S2275	6-121	04/17/03	9.455	10.564	2.970	3.435	-14%	No longer accessible.
E1320-S2275 B-D	E1320 Drift-S2275	6-121	04/17/03	6.248	6.248	1.519	1.827	-17%	No longer accessible.
E1320-S2350-3 A-C	E1320 Drift-S2350	6-122	05/06/03	9.989	11.837	3.050	3.550	-14%	No longer accessible.
E1320-S2350 B-D	E1320 Drift-S2350	6-122	03/24/03	6.735	6.735	1.686	1.998	-16%	No longer accessible.
E1320-S2425-2 A-C	E1320 Drift-S2425	6-123	05/29/03	10.859	12.091	3.267	3.802	-14%	No longer accessible.
E1320-S2425 B-D	E1320 Drift-S2425	6-123	05/29/03	6.691	6.691	1.584	1.748	-9%	No longer accessible.

[A] NA Indicates insufficient data to calculate.

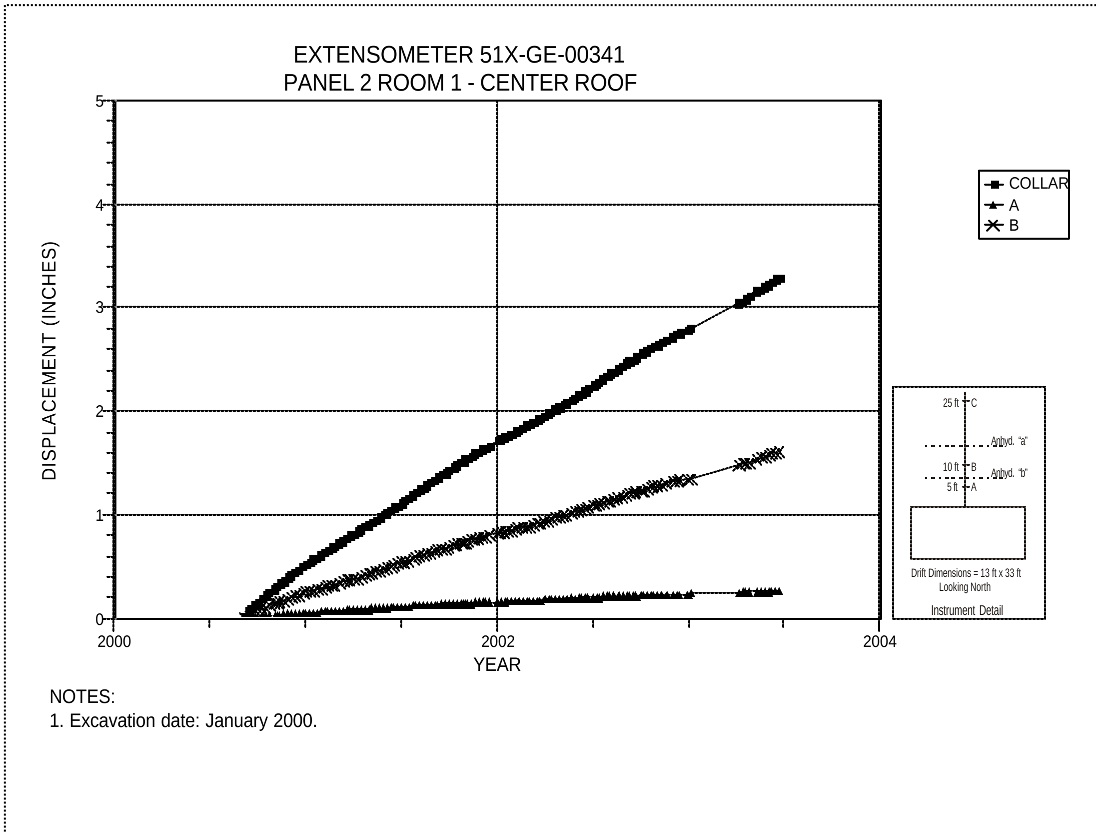


Figure 6-70 Extensometer 51X-GE-00341
Room 1, Panel 2 – Room Center – Roof

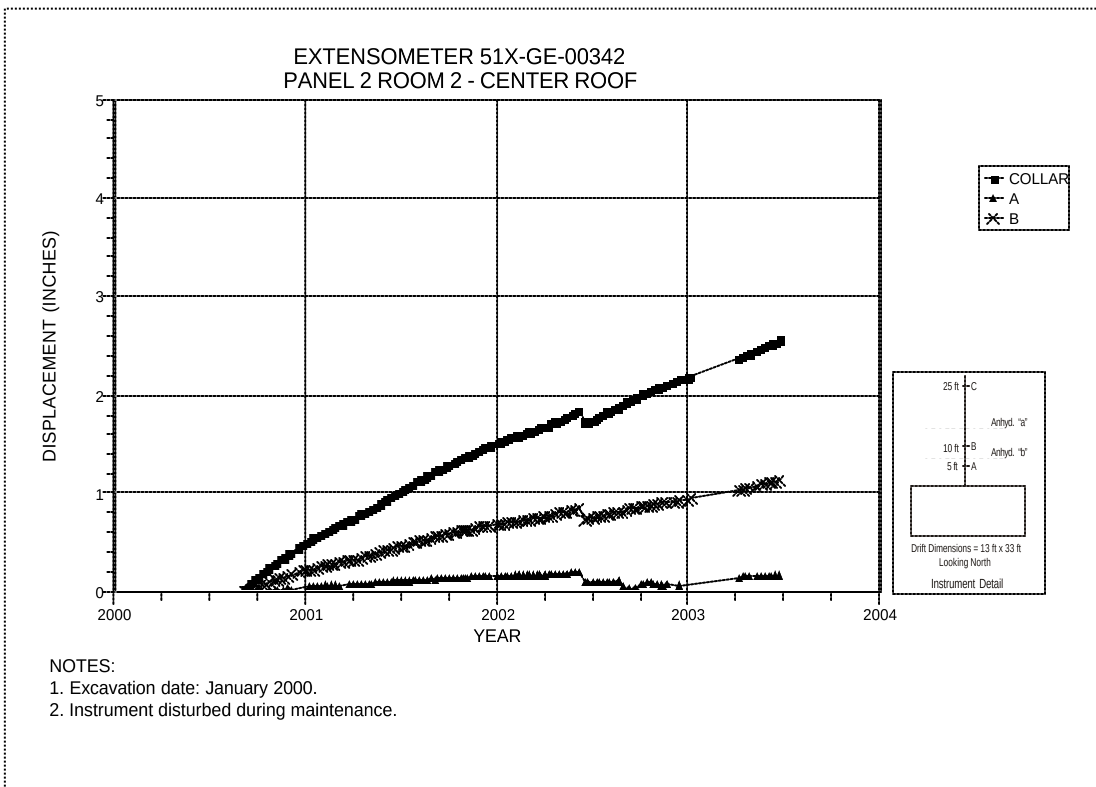


Figure 6-71 Extensometer 51X-GE-00342
Room 2, Panel 2 – Room Center – Roof

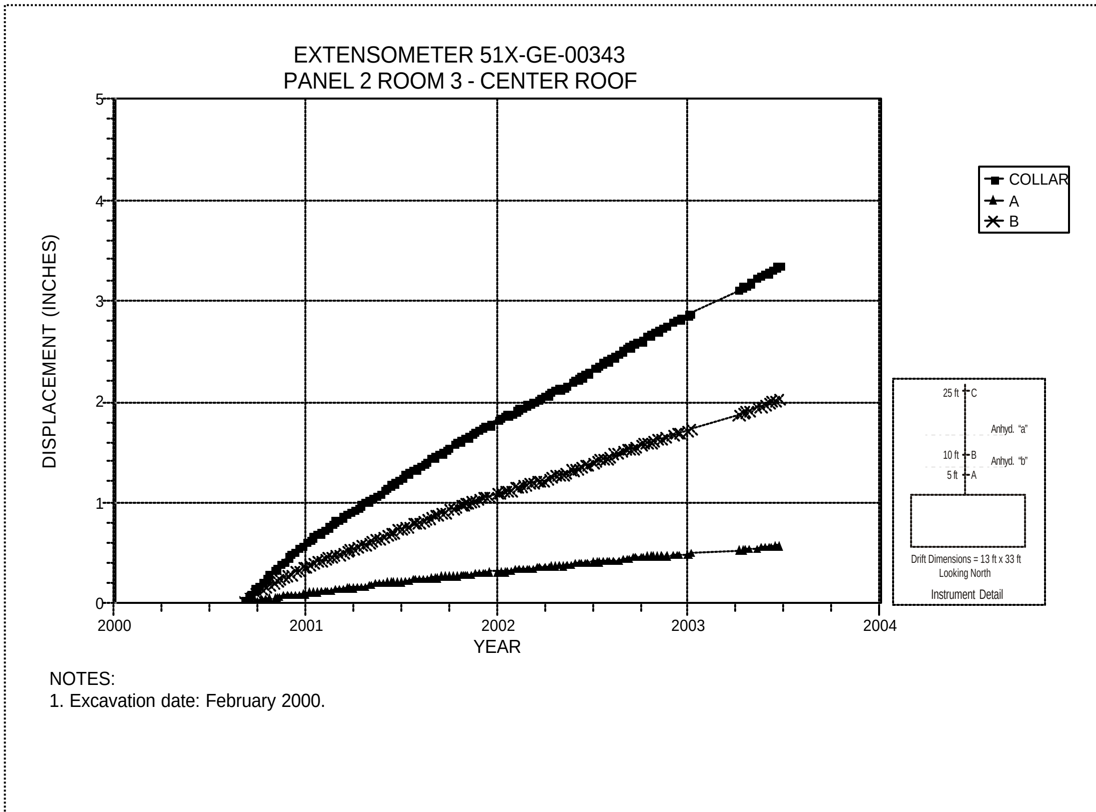


Figure 6-72 Extensometer 51X-GE-00343
Room 3, Panel 2 – Room Center – Roof

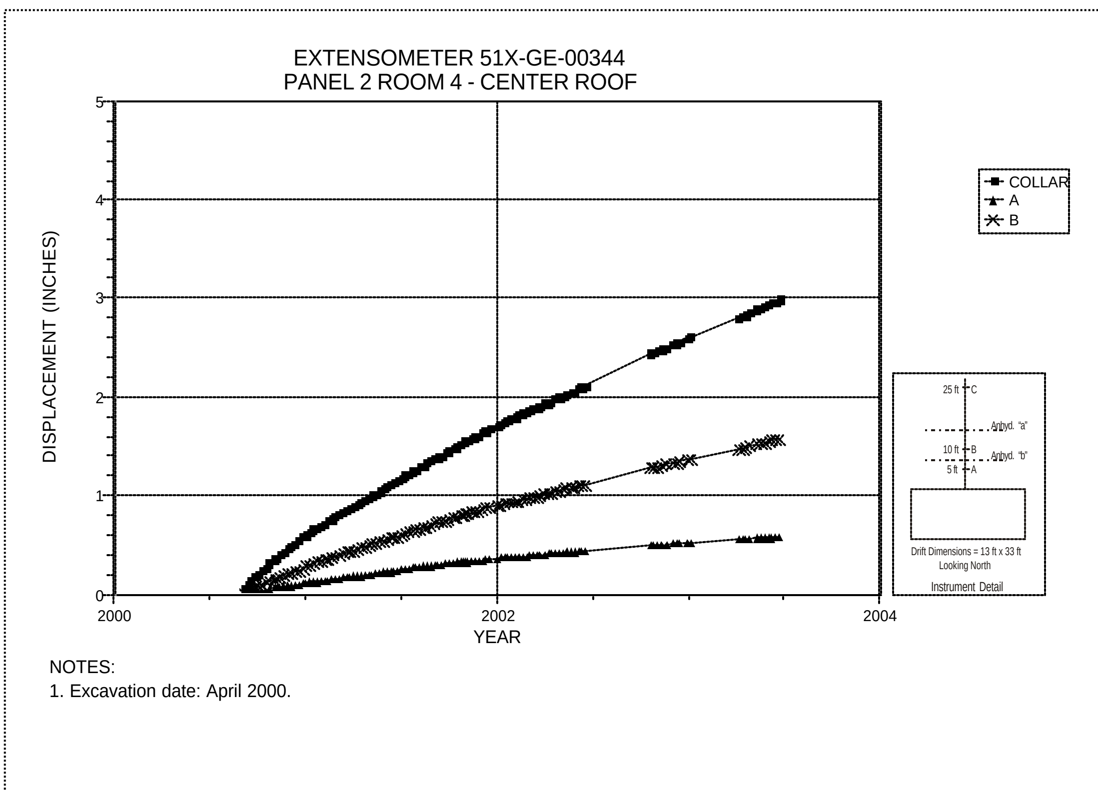
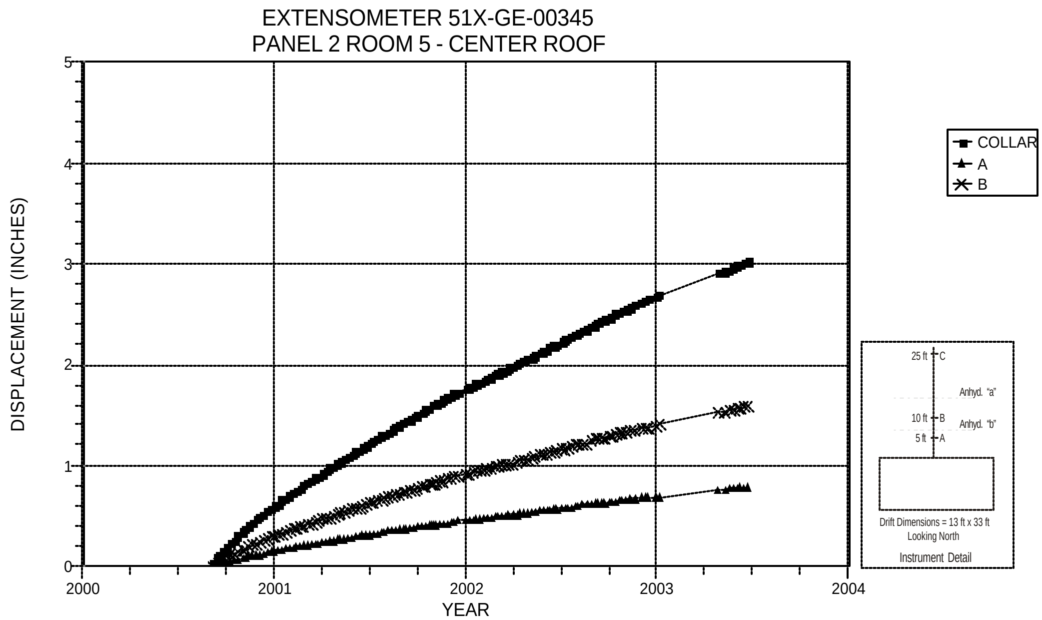
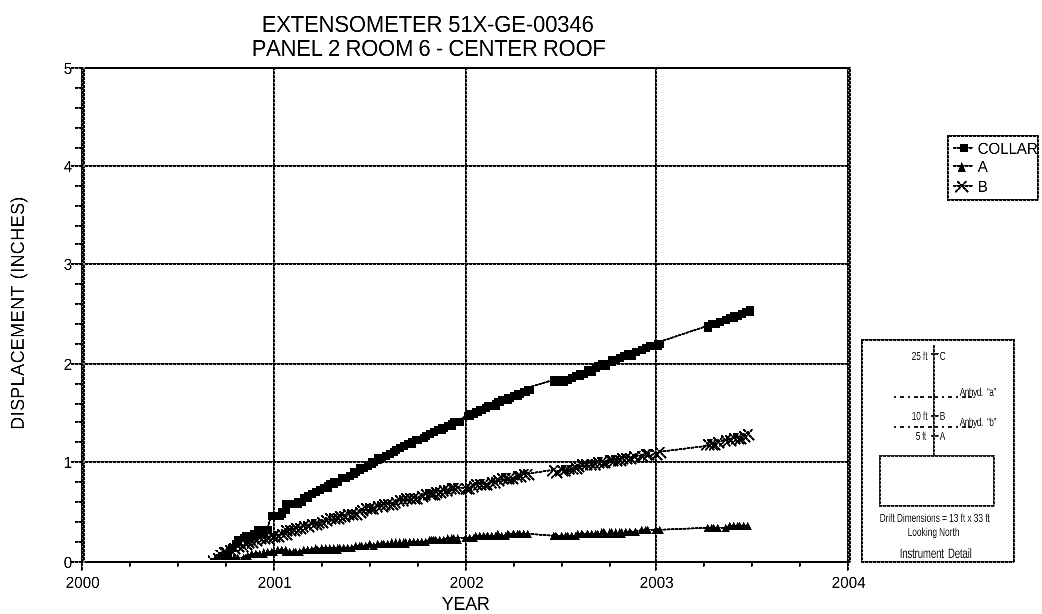


Figure 6-73 Extensometer 51X-GE-00344
Room 4, Panel 2 – Room Center – Roof



NOTES:
1. Excavation date: April 2000.

Figure 6-74 Extensometer 51X-GE-00345
Room 5, Panel 2 – Room Center – Roof



NOTES:
1. Excavation date: April 2000.

Figure 6-75 Extensometer 51X-GE-00346
Room 6, Panel 2 – Room Center – Roof

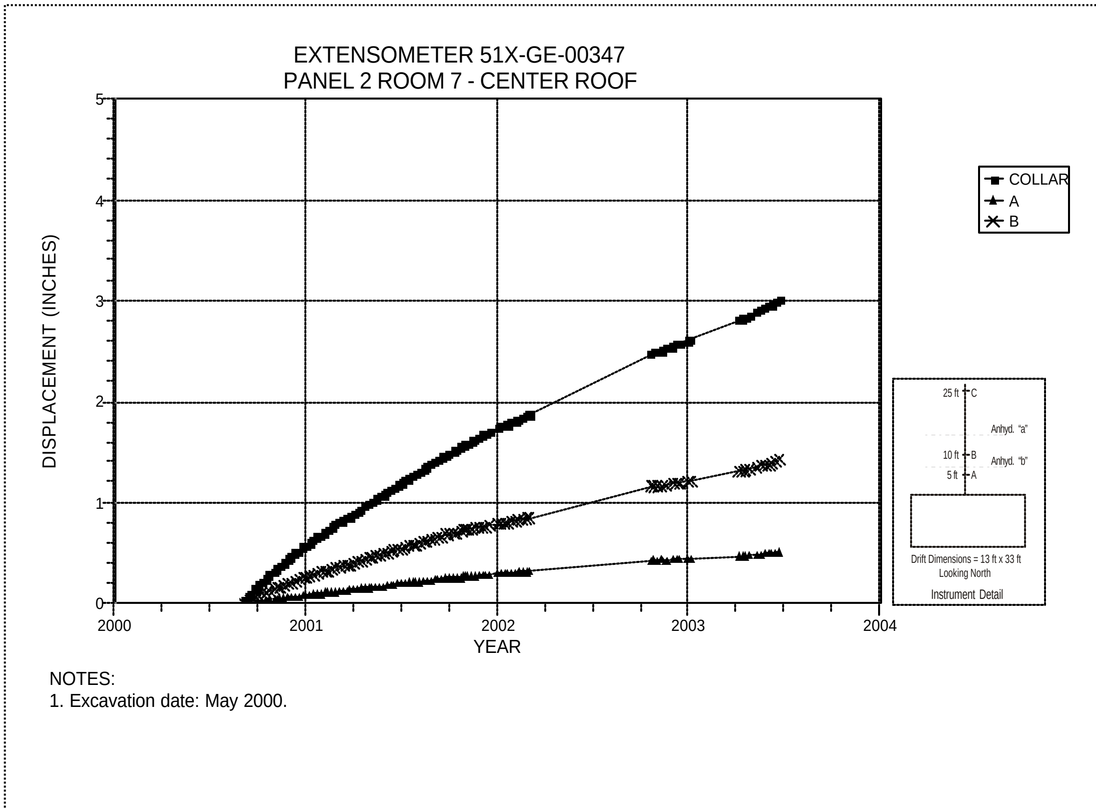


Figure 6-76 Extensometer 51X-GE-00347
Room 7, Panel 2 – Room Center – Roof

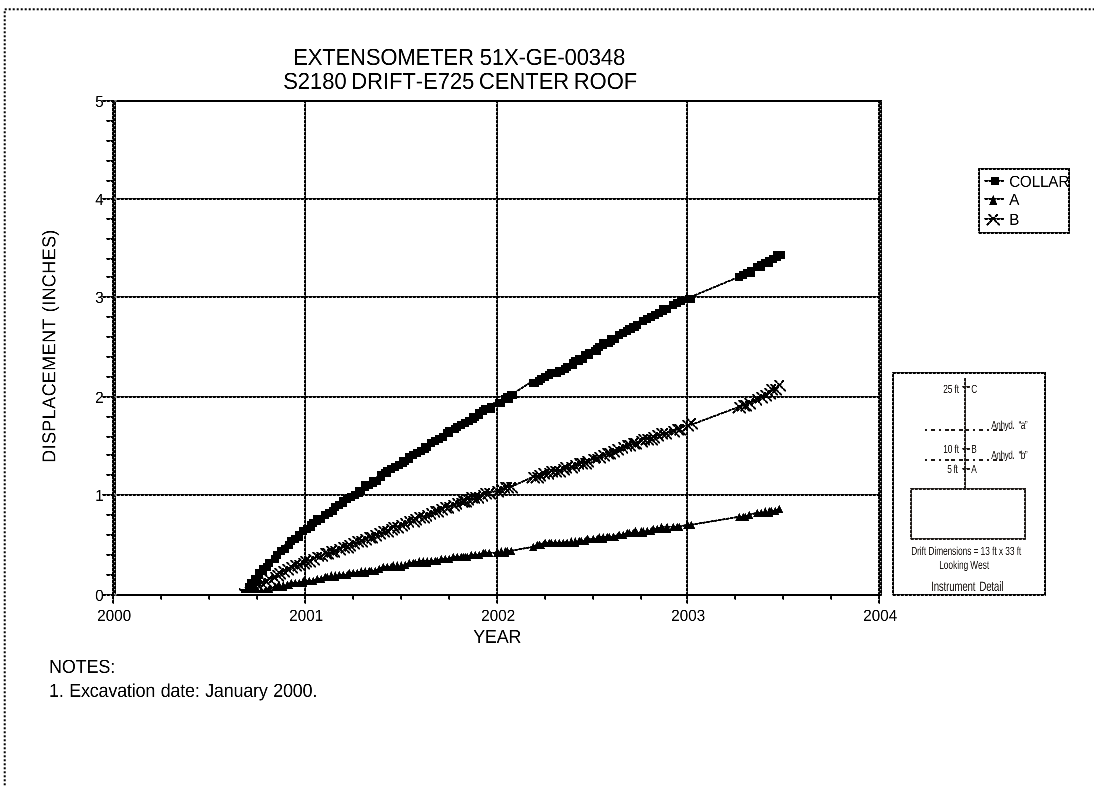


Figure 6-77 Extensometer 51X-GE-00348
S2180 Drift at E725 – Roof

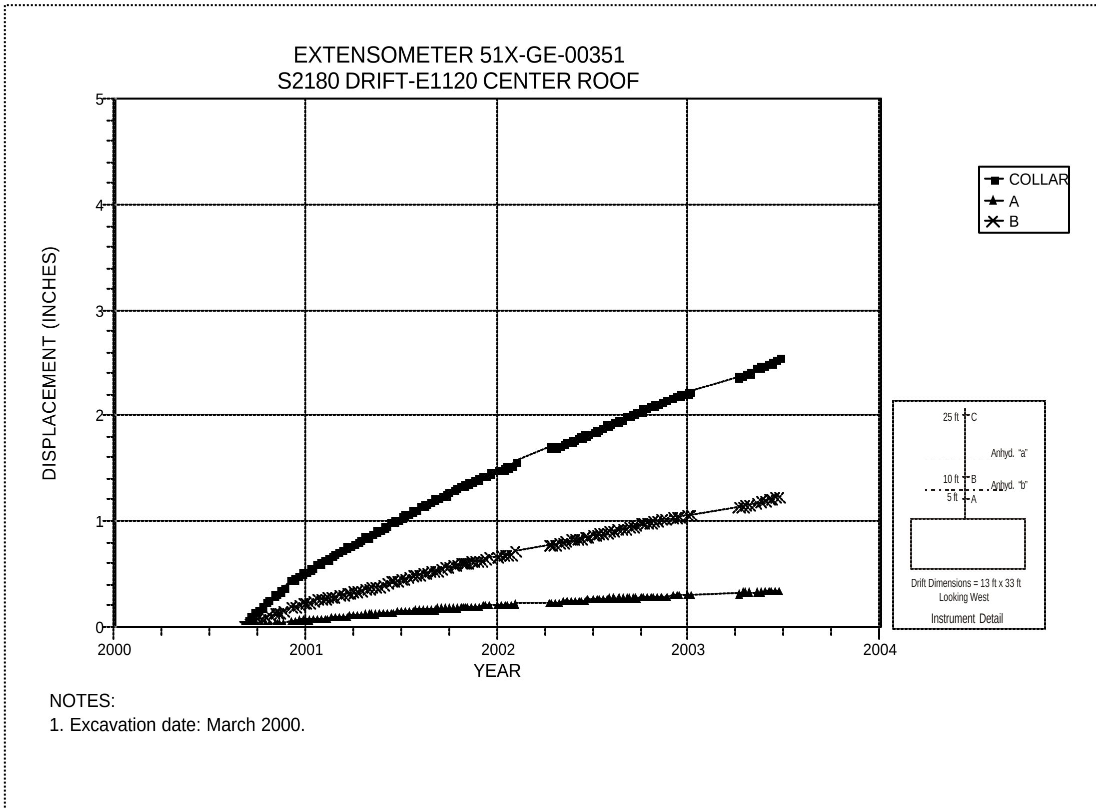


Figure 6-78 Extensometer 51X-GE-00351
S2180 Drift at E1120 – Roof

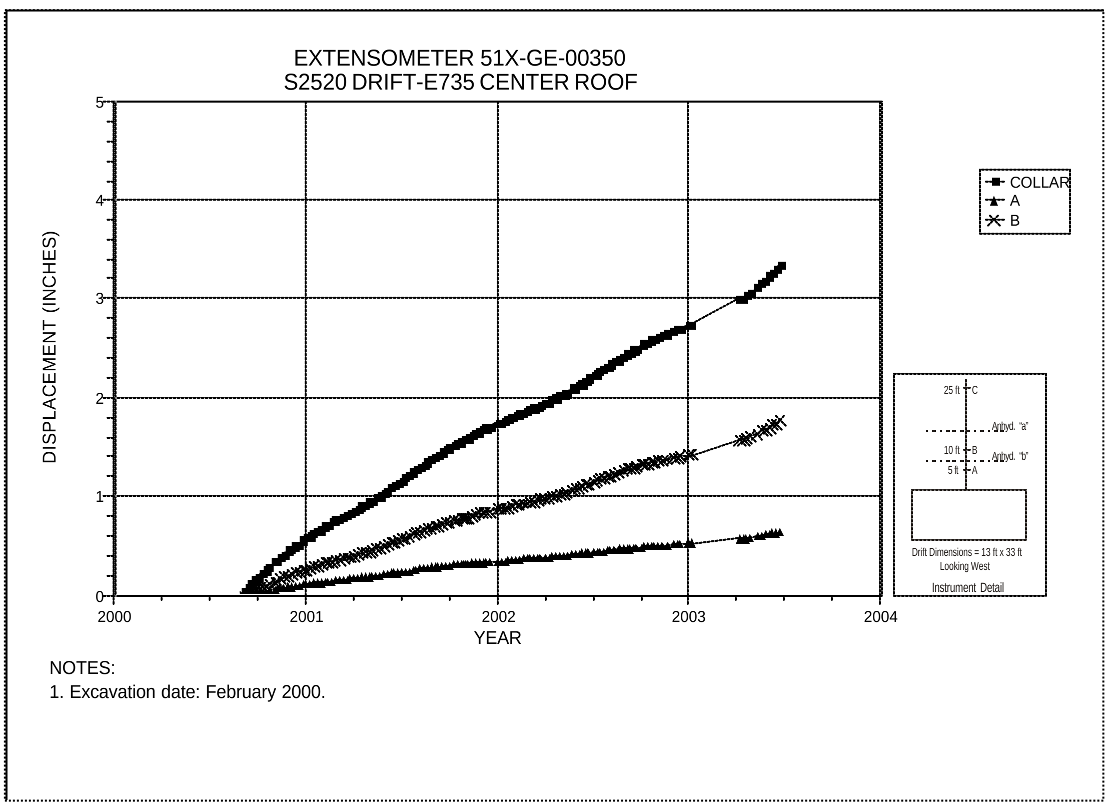


Figure 6-79 Extensometer 51X-GE-00350
S2520 Drift at E735 – Roof

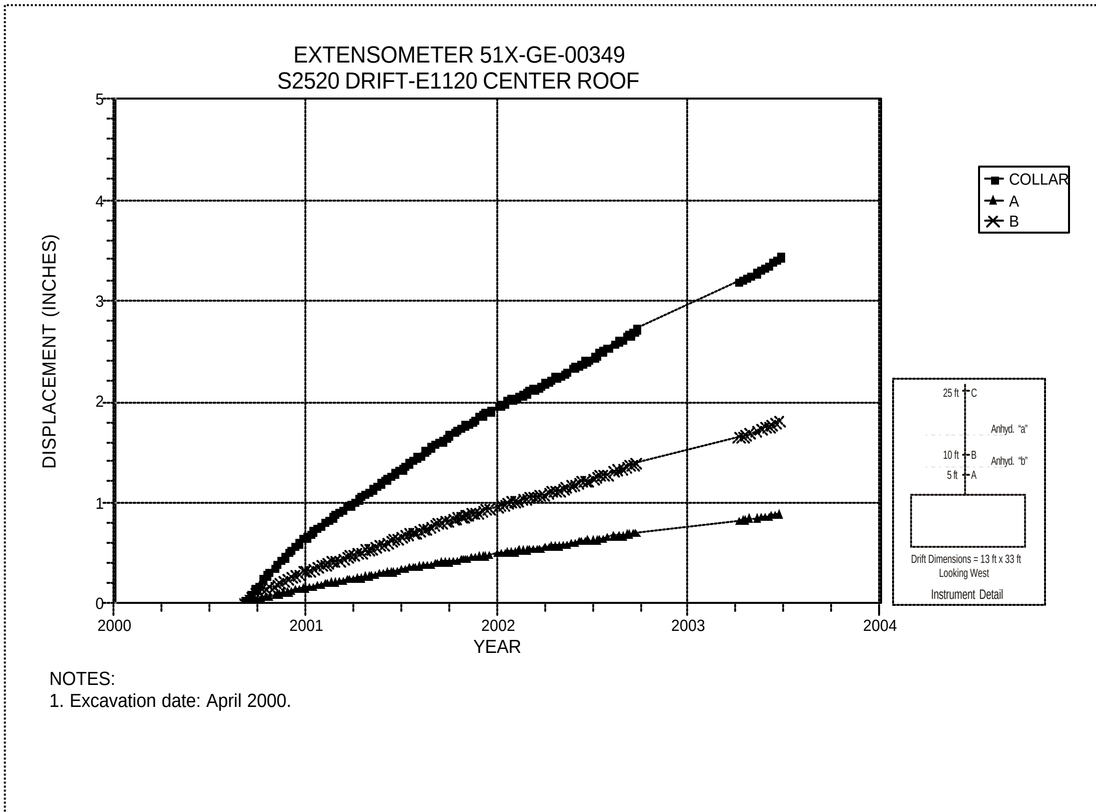


Figure 6-80 Extensometer 51X-GE-00349
S2520 Drift at E1120 – Roof

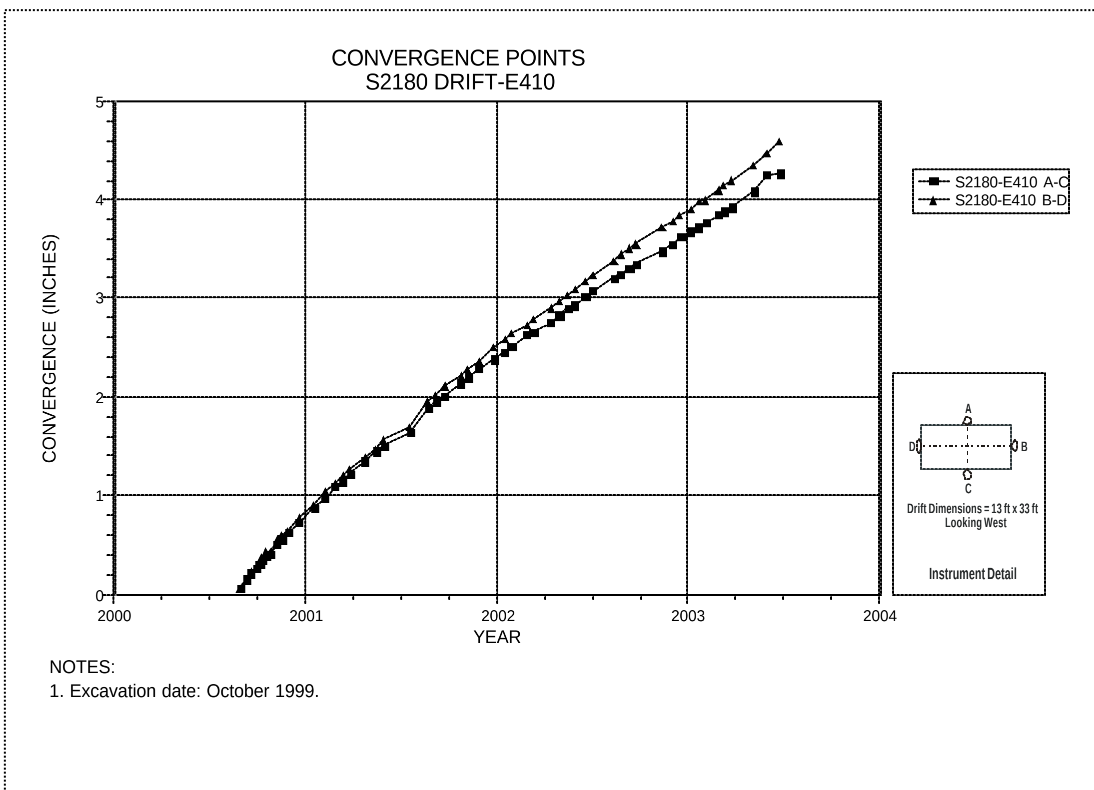
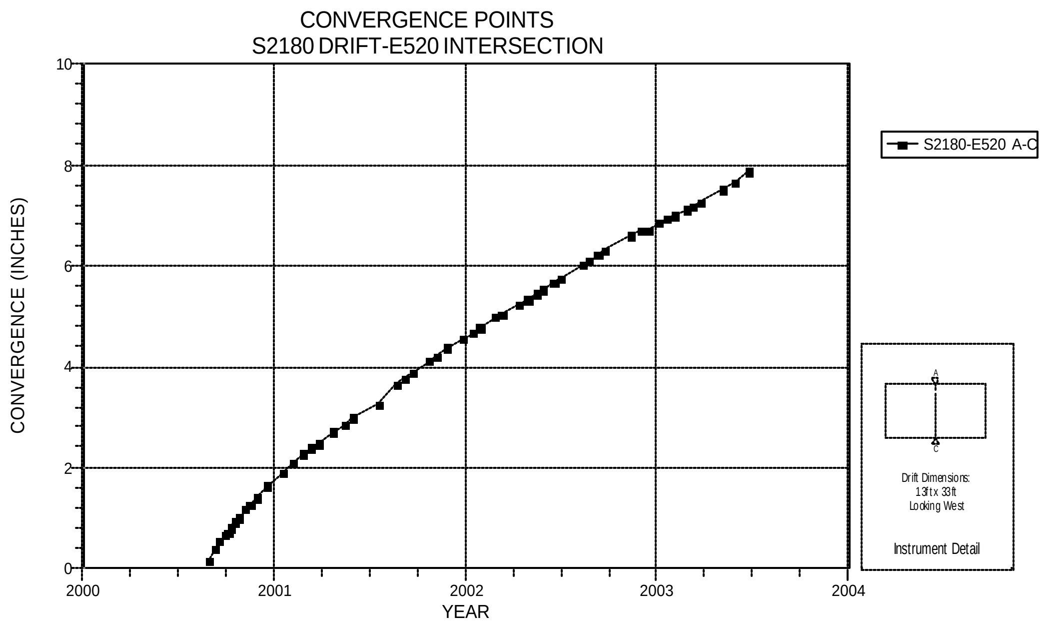
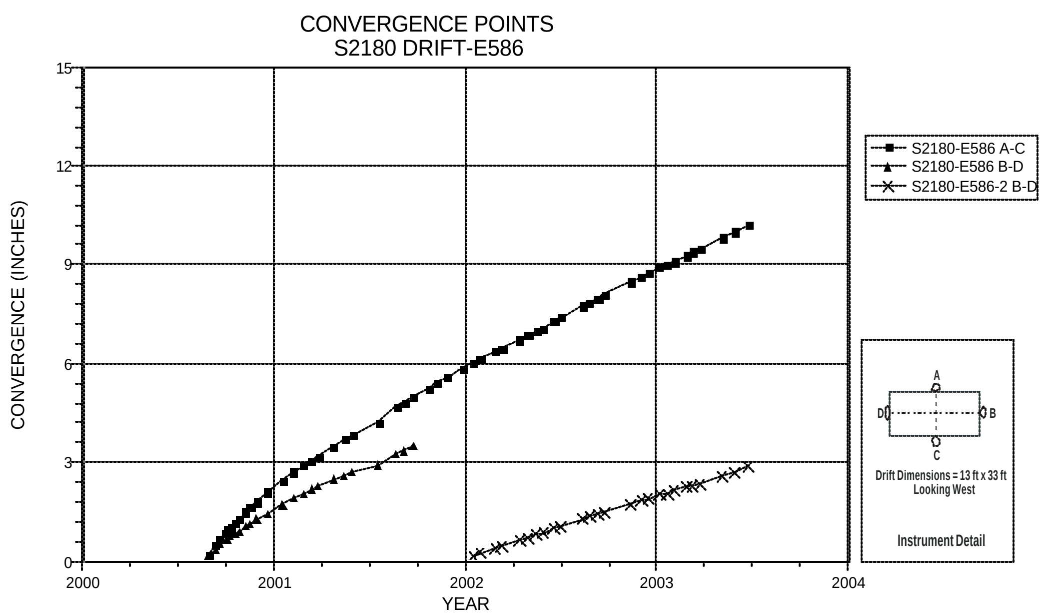


Figure 6-81 Convergence Point Array
S2180 Drift at E410 – All Chords



NOTES:
1. Excavation date: November 1999.

Figure 6-82 Convergence Point Array
S2180 Drift at E520 Drift Intersection (Room 1, Panel 2) – Roof to Floor



NOTES:
1. Excavation date: November 1999.

Figure 6-83 Convergence Point Array
S2180 Drift at E586 – All Chords

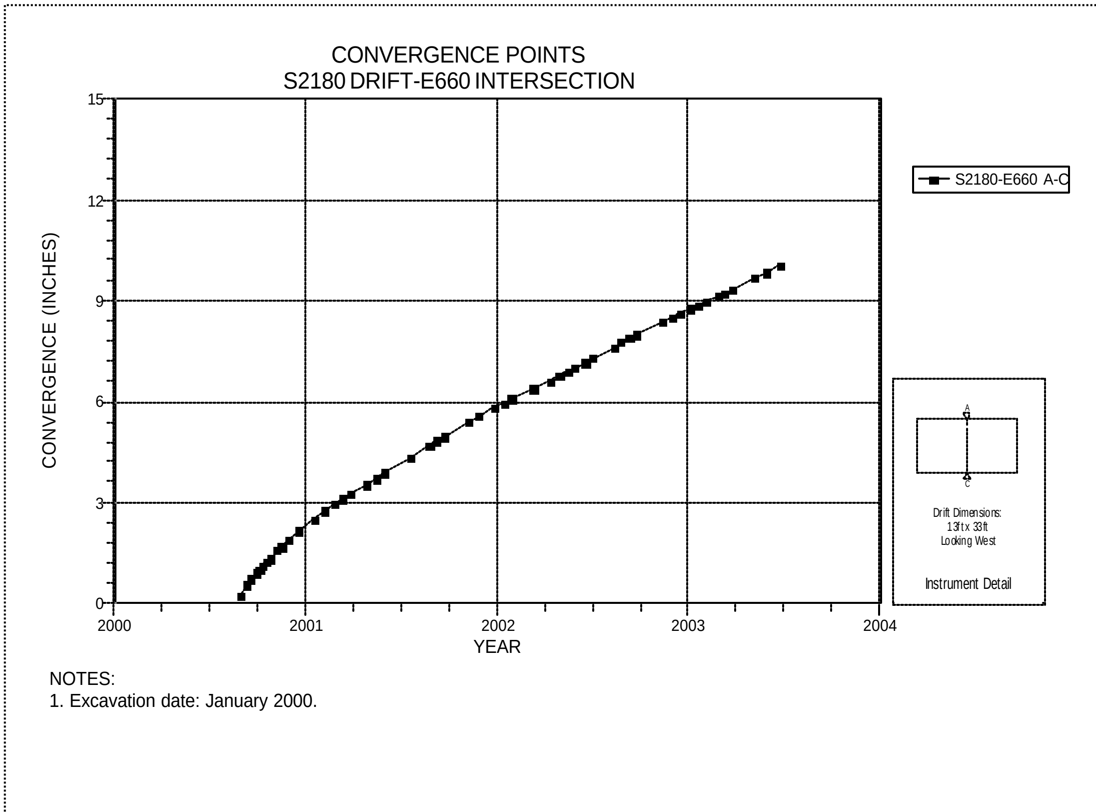


Figure 6-84 Convergence Point Array
S2180 Drift at E660 Drift Intersection (Room 2, Panel 2) – Roof to Floor

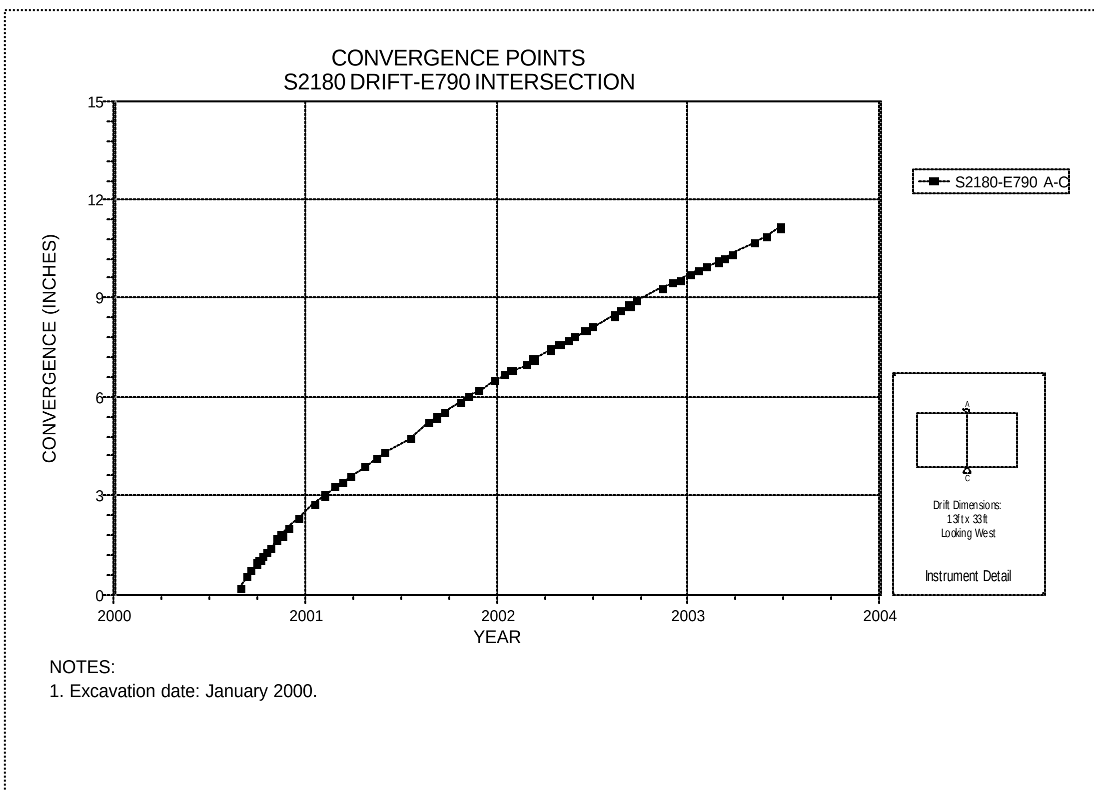


Figure 6-85 Convergence Point Array
S2180 Drift at E790 Drift Intersection (Room 3, Panel 2) – Roof to Floor

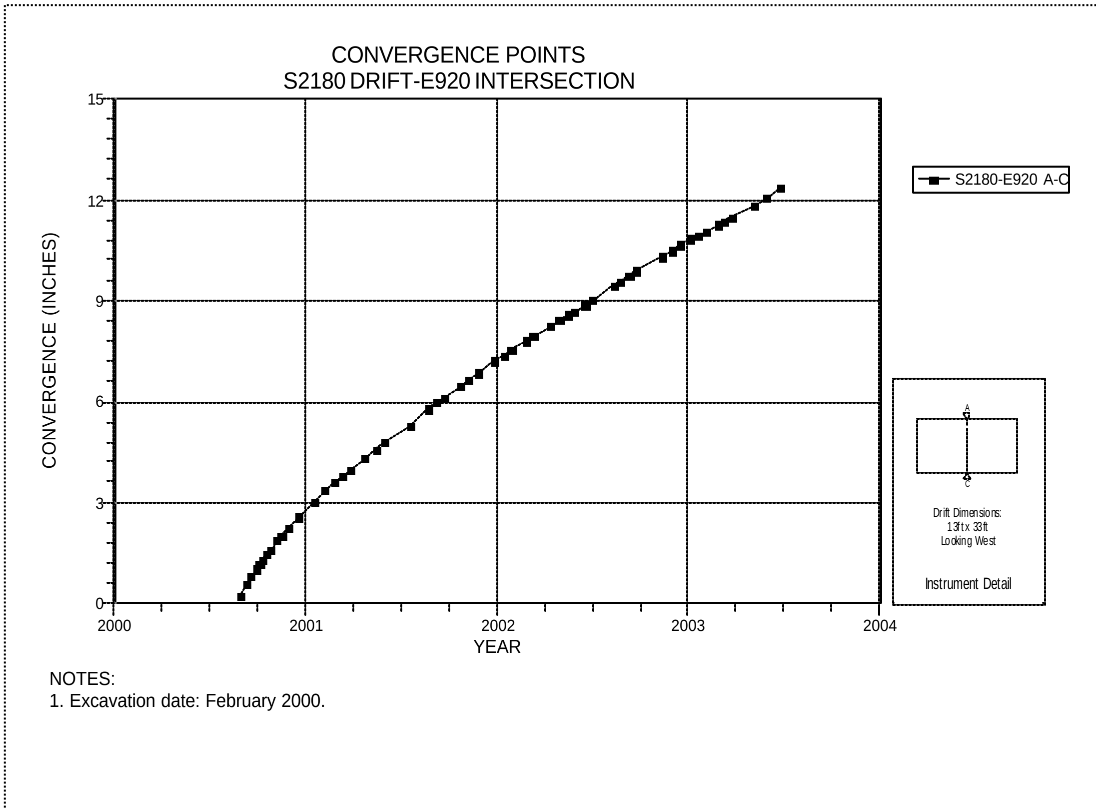


Figure 6-86 Convergence Point Array
S2180 Drift at E920 Drift Intersection (Room 4, Panel 2) – Roof to Floor

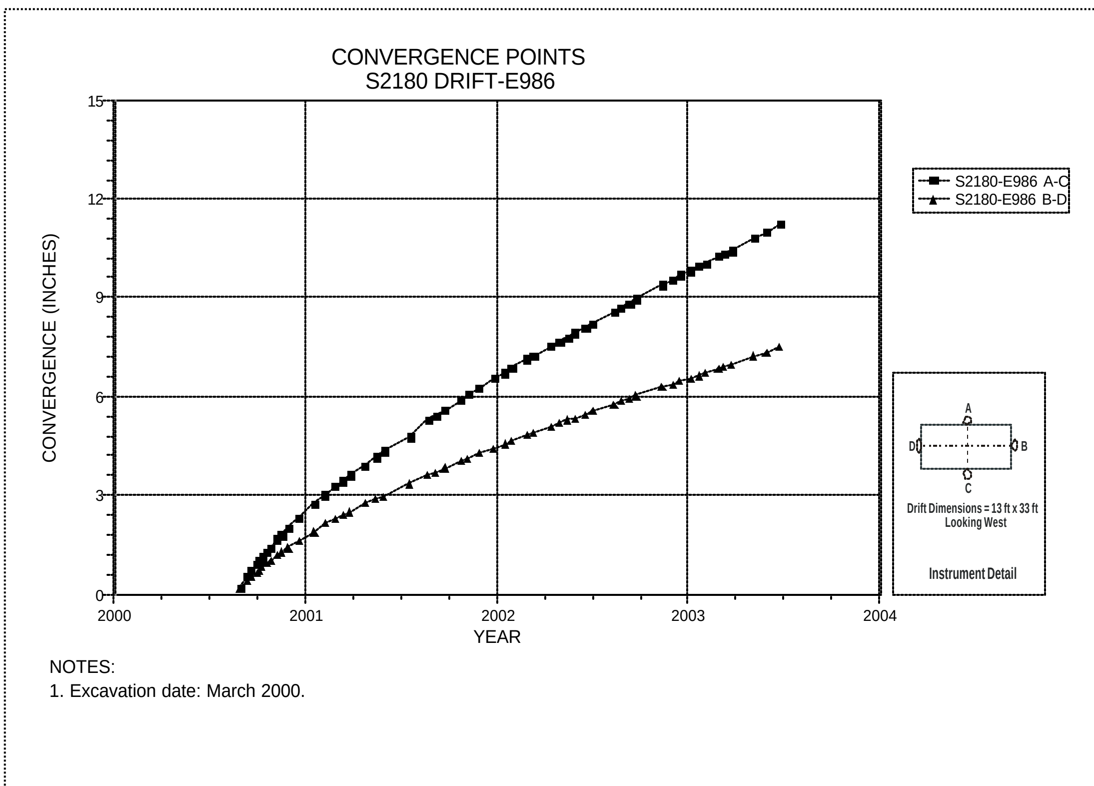


Figure 6-87 Convergence Point Array
S2180 Drift at E986 – All Chords

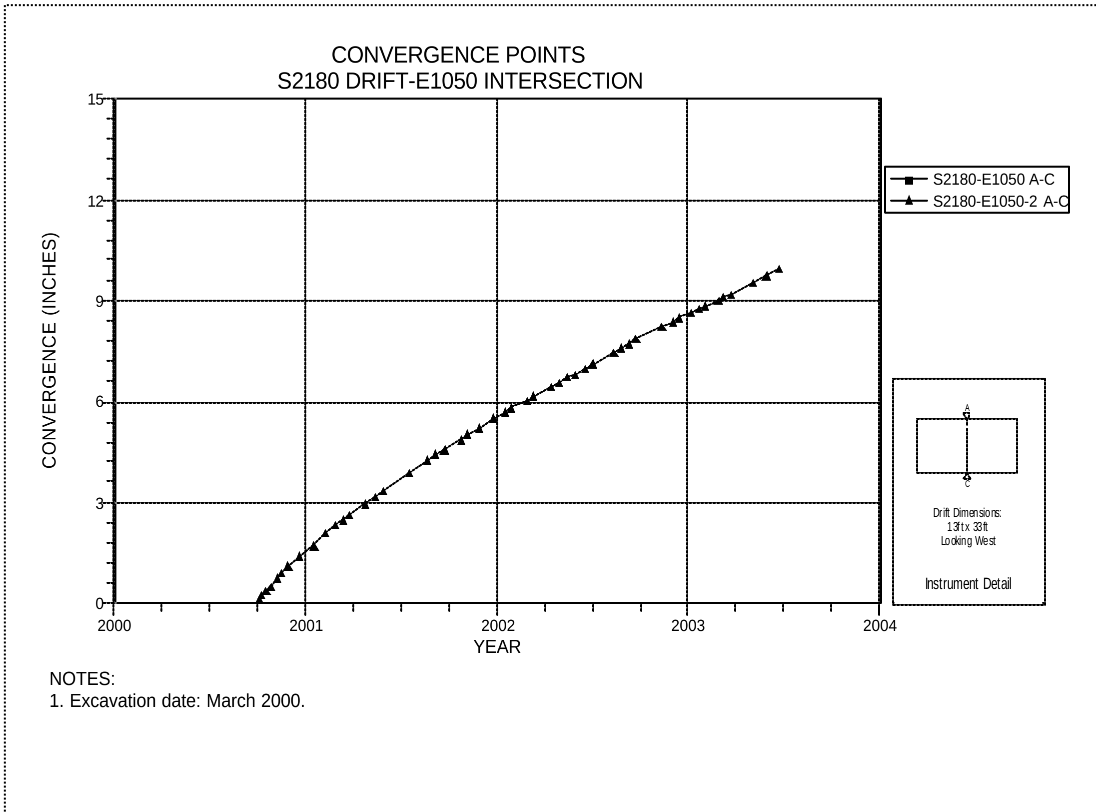


Figure 6-88 Convergence Point Array
S2180 Drift at E1050 Drift Intersection (Room 5, Panel 2) – Roof to Floor

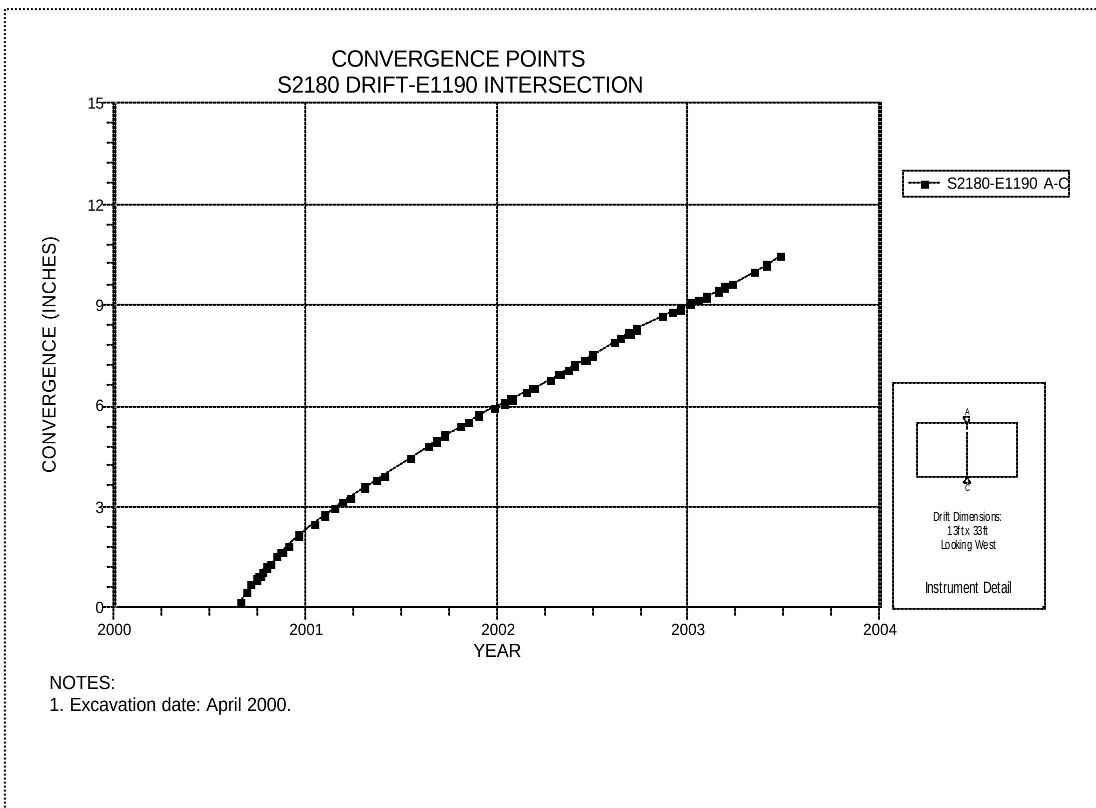


Figure 6-89 Convergence Point Array
S2180 Drift at E1190 Drift Intersection (Room 6, Panel 2) – Roof to Floor

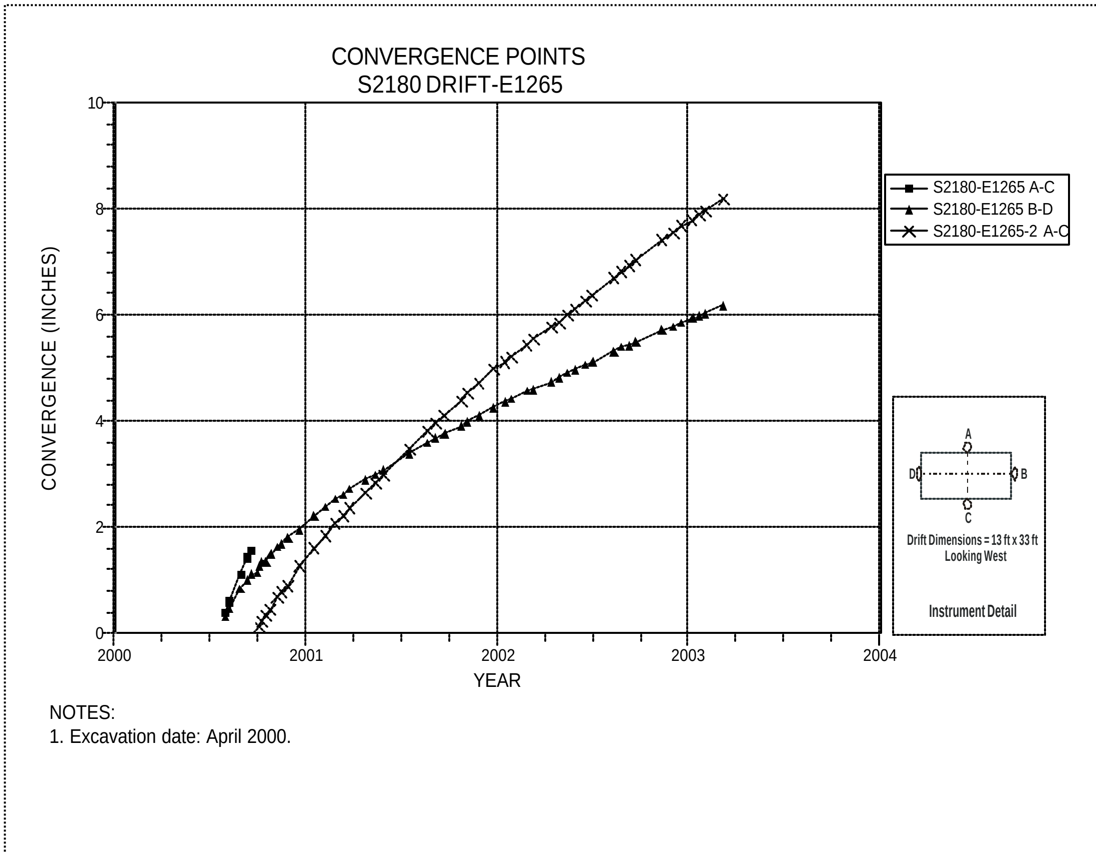


Figure 6-90 Convergence Point Array
S2180 Drift at E1265 – All Chords

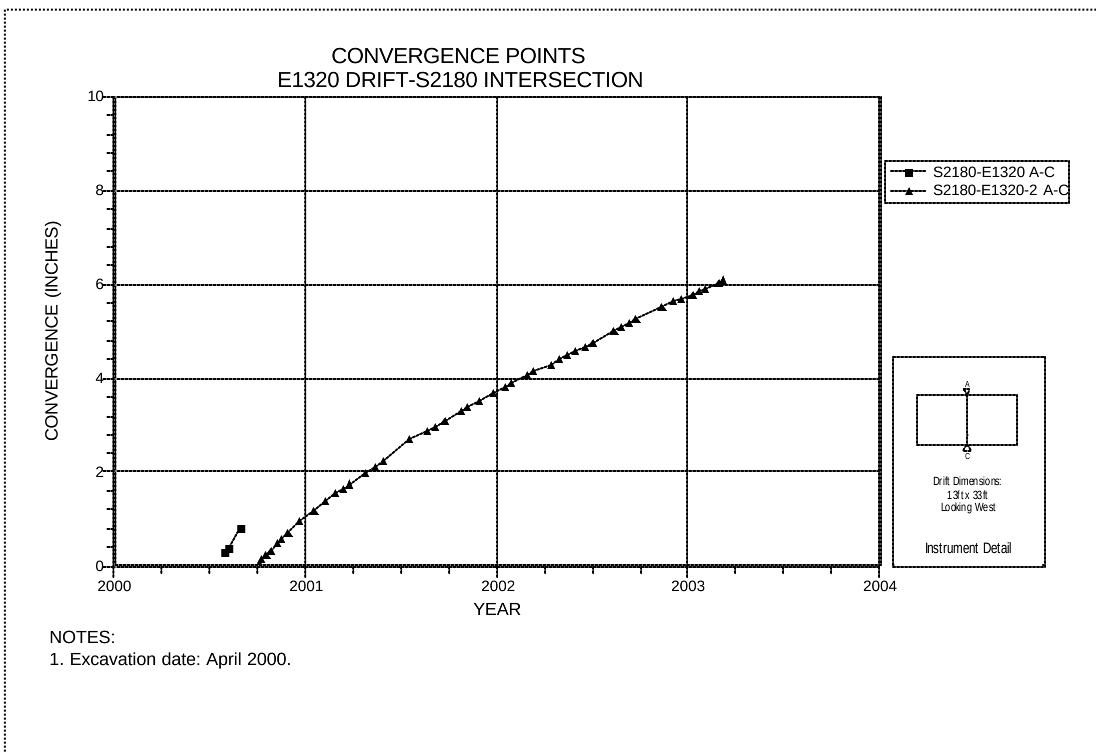
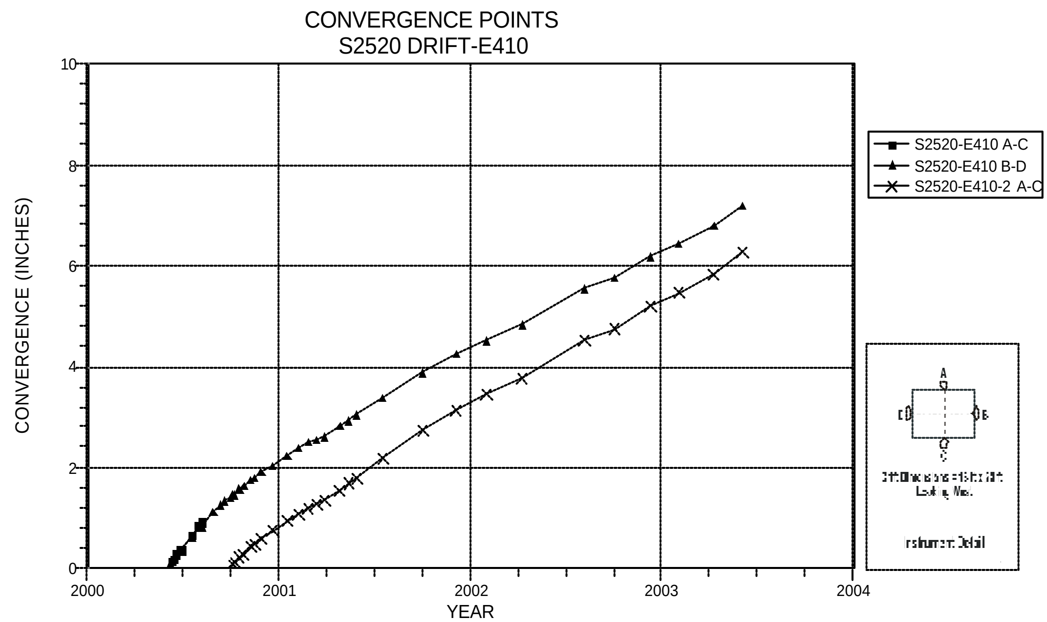
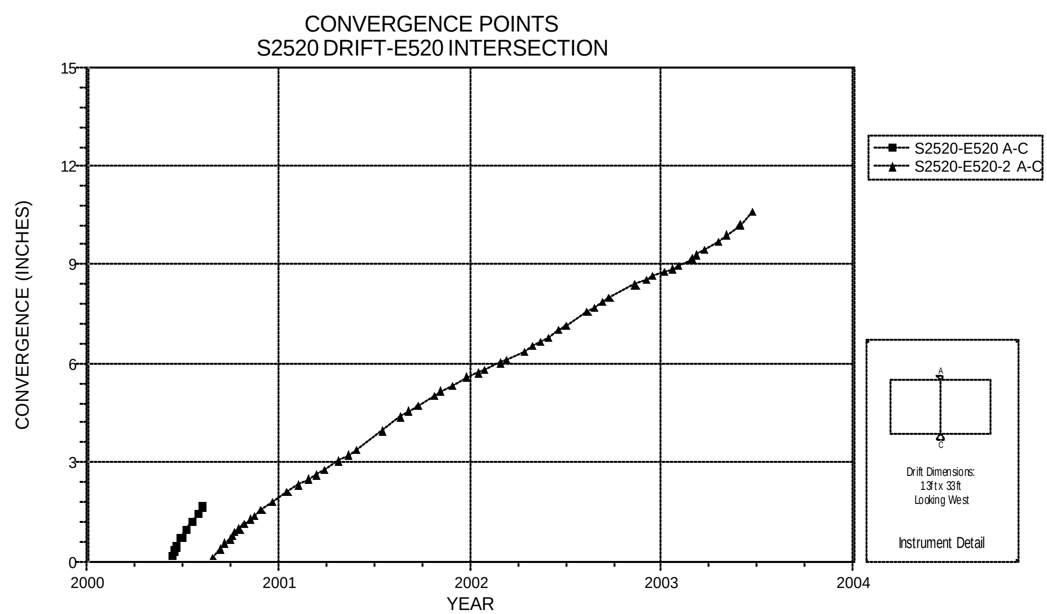


Figure 6-91 Convergence Point Array
S2180 Drift at E1320 Drift Intersection (Room 7, Panel 2) – Roof to Floor



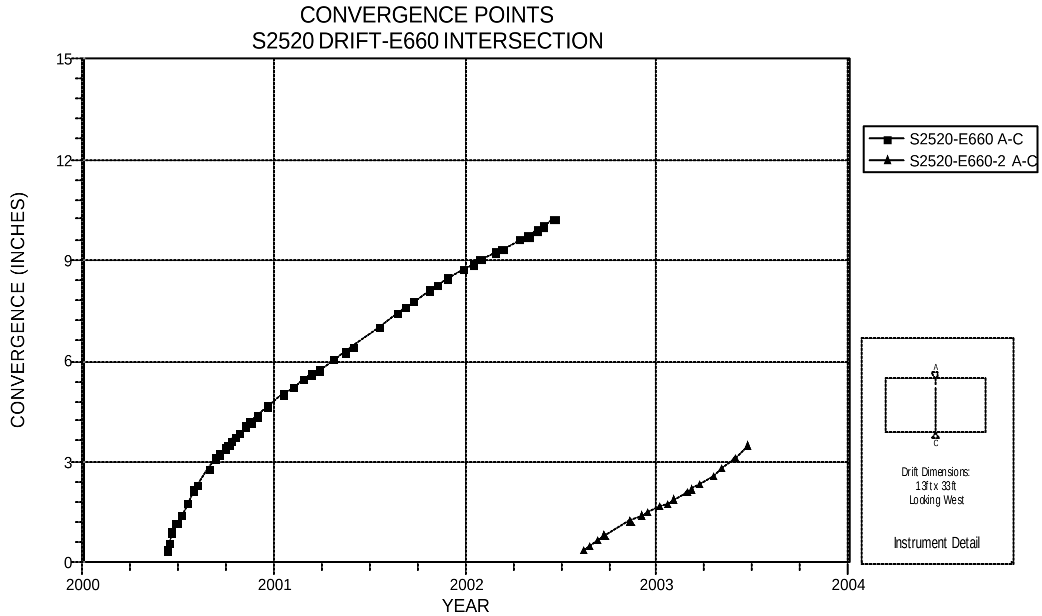
NOTES:
1. Excavation date: December 1999.

Figure 6-92 Convergence Point Array
S2520 Drift at E410 – All Chords



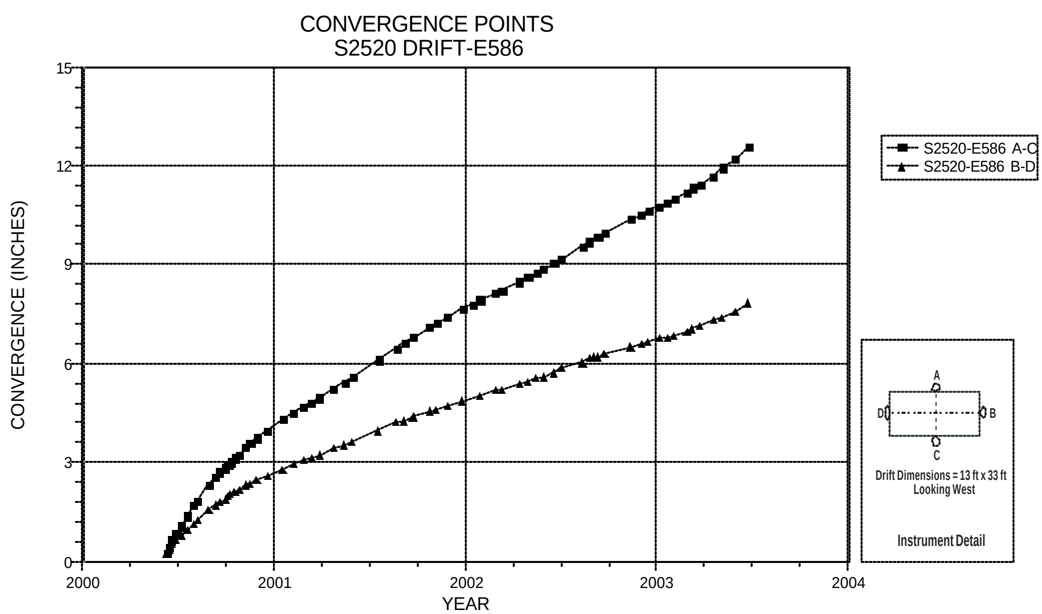
NOTES:
1. Excavation date: December 1999.

Figure 6-93 Convergence Point Array
S2520 Drift at E520 Drift Intersection (Room 1, Panel 2) – Roof to Floor



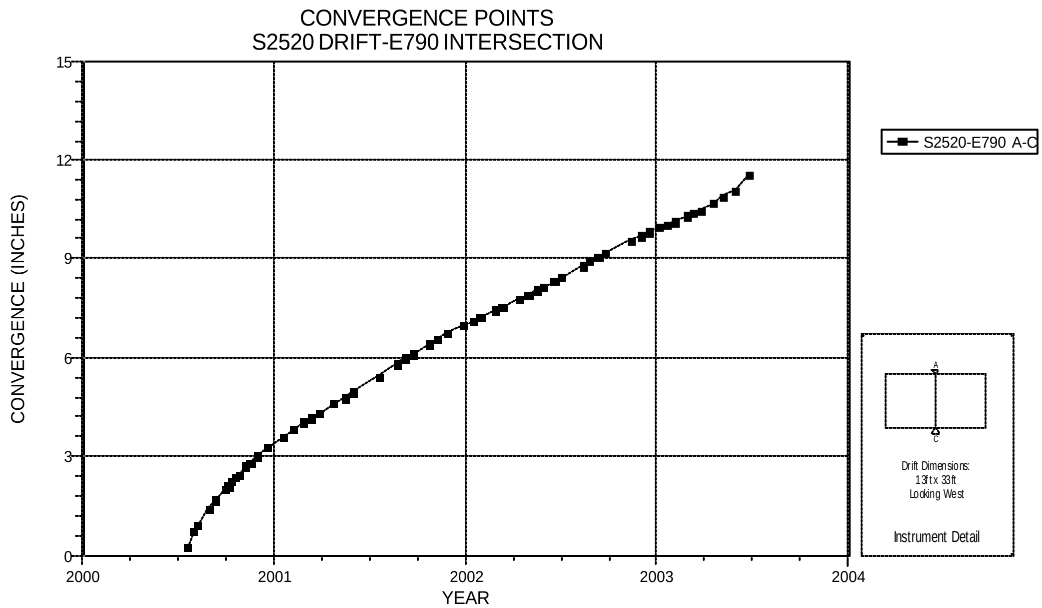
NOTES:
1. Excavation date: January 2000.

Figure 6-94 Convergence Point Array
S2520 Drift at E660 Drift Intersection (Room 2, Panel 2) – Roof to Floor



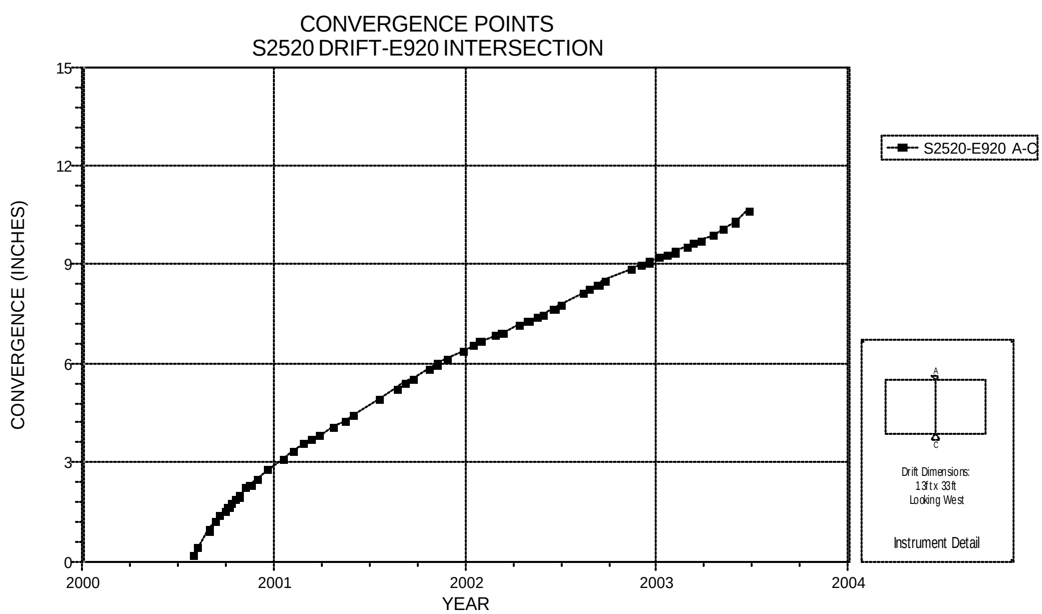
NOTES:
1. Excavation date: January 2000.

Figure 6-95 Convergence Point Array
S2520 Drift at E586 – All Chords



NOTES:
1. Excavation date: February 2000.

Figure 6-96 Convergence Point Array
S2520 Drift at E790 Drift Intersection (Room 3, Panel 2) – Roof to Floor



NOTES:
1. Excavation date: March 2000.

Figure 6-97 Convergence Point Array
S2520 Drift at E920 Drift Intersection (Room 4, Panel 2) – Roof to Floor

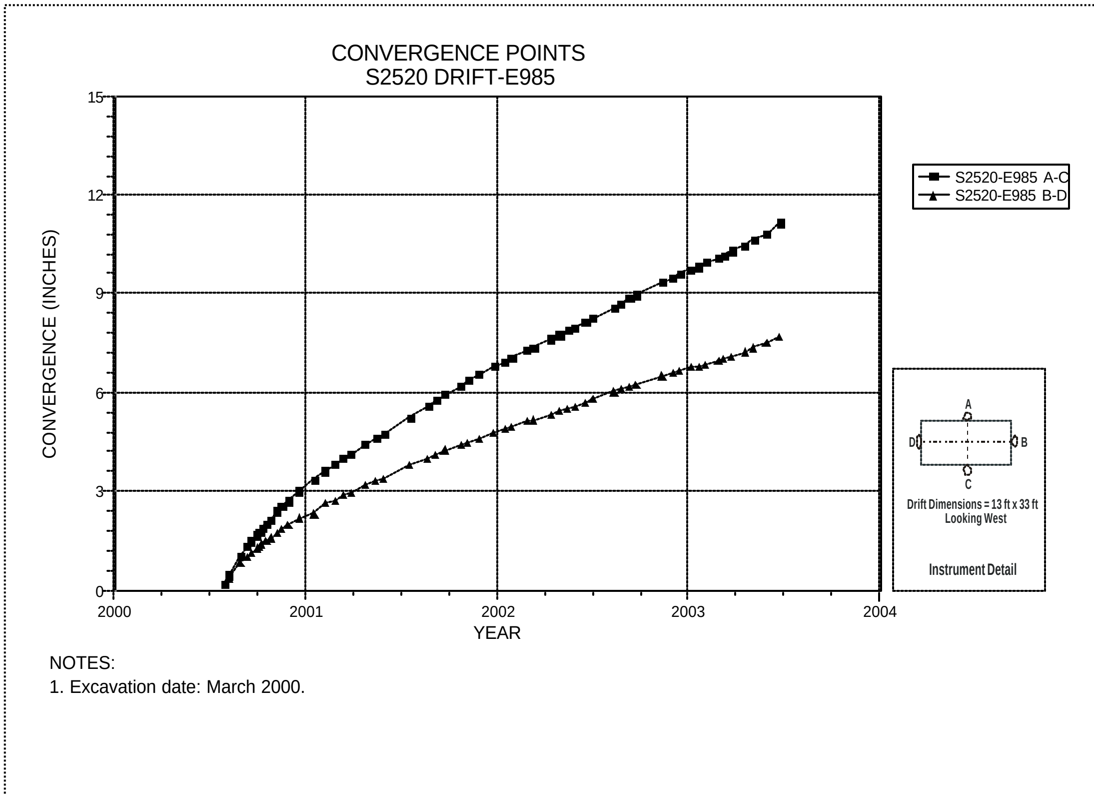


Figure 6-98 Convergence Point Array
S2520 Drift at E985 – All Chords

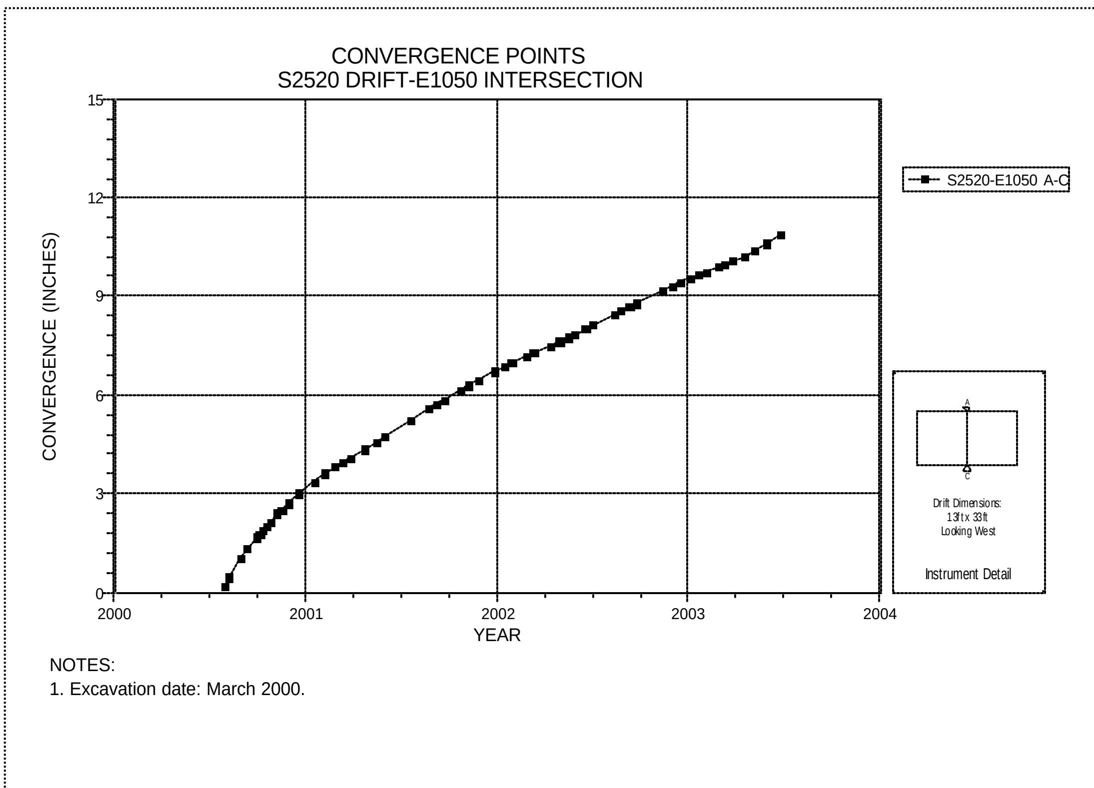


Figure 6-99 Convergence Point Array
S2520 Drift at E1050 Drift Intersection (Room 5, Panel 2) – Roof to Floor

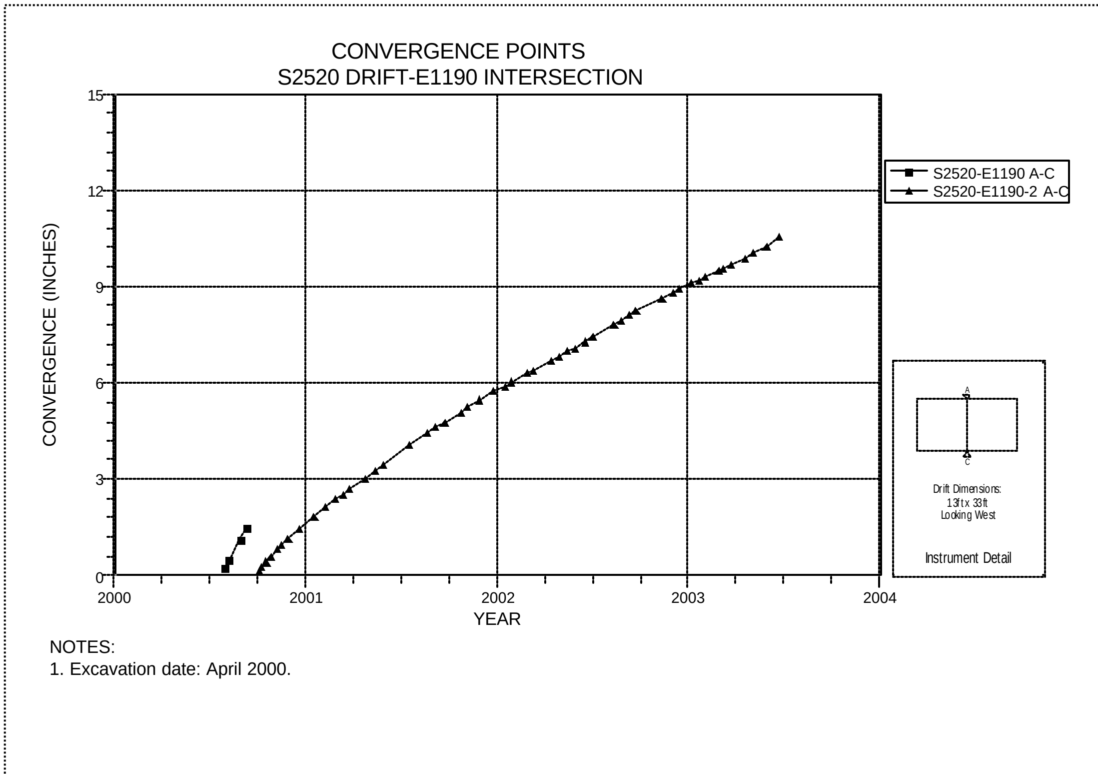


Figure 6-100 Convergence Point Array
S2520 Drift at E1190 Drift Intersection (Room 6, Panel 2) – Roof to Floor

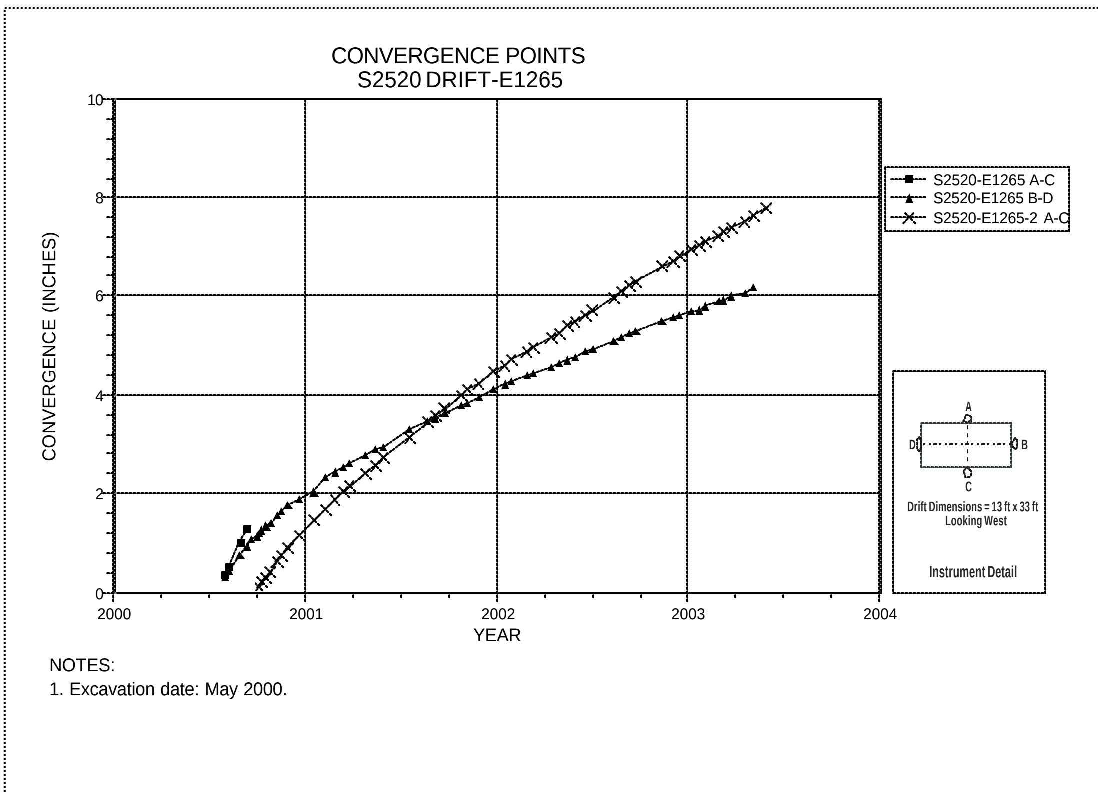
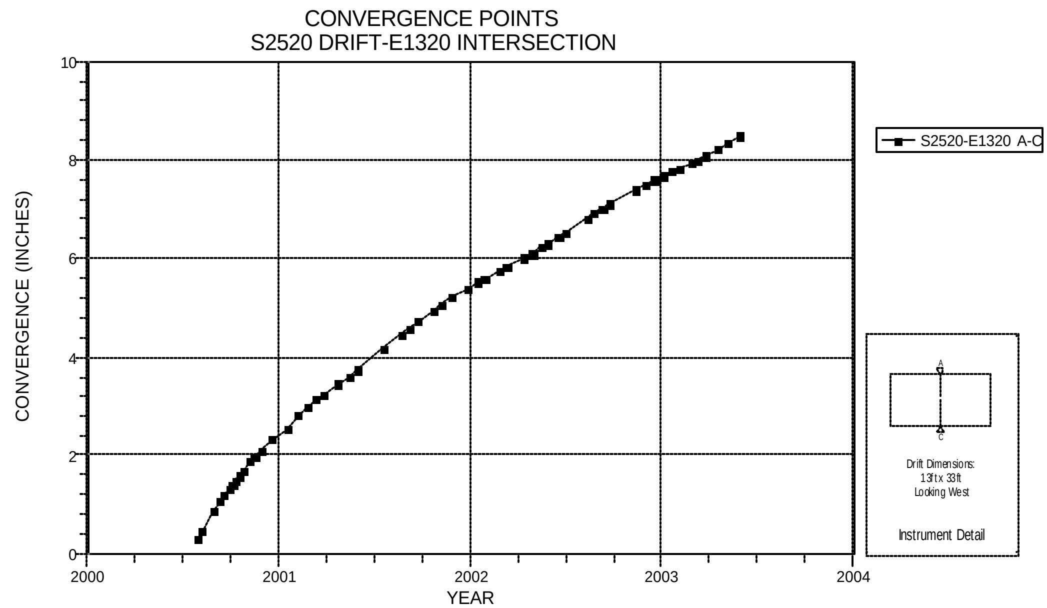
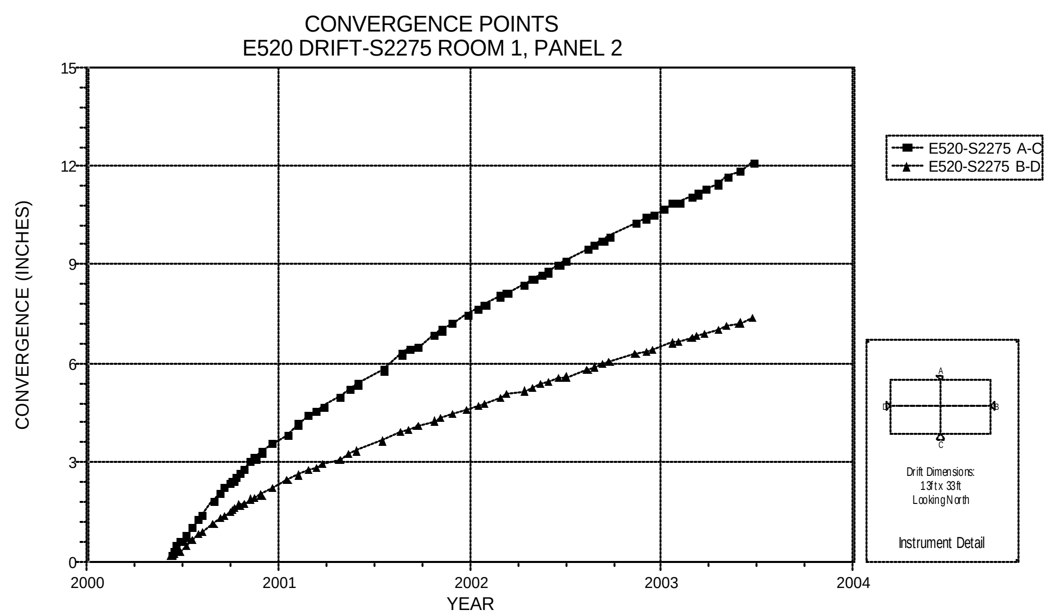


Figure 6-101 Convergence Point Array
S2520 Drift at E1265 – All Chords



NOTES:
1. Excavation date: May 2000.

Figure 6-102 Convergence Point Array
S2520 Drift at E1320 Drift Intersection (Room 7, Panel 2) – Roof to Floor



NOTES:
1. Excavation date: January 2000.

Figure 6-103 Convergence Point Array
Room 1, Panel 2 at S2275 – All Chords

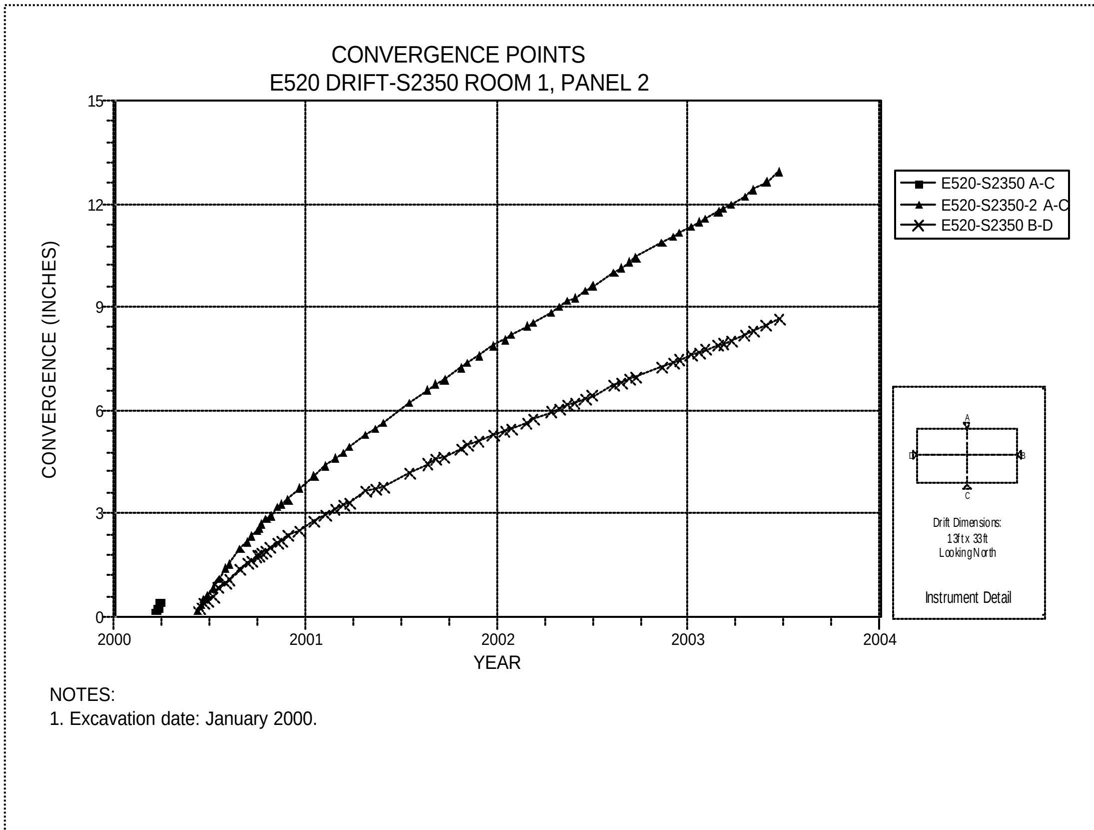


Figure 6-104 Convergence Point Array
Room 1, Panel 2 at S2350 – Room Center – All Chords

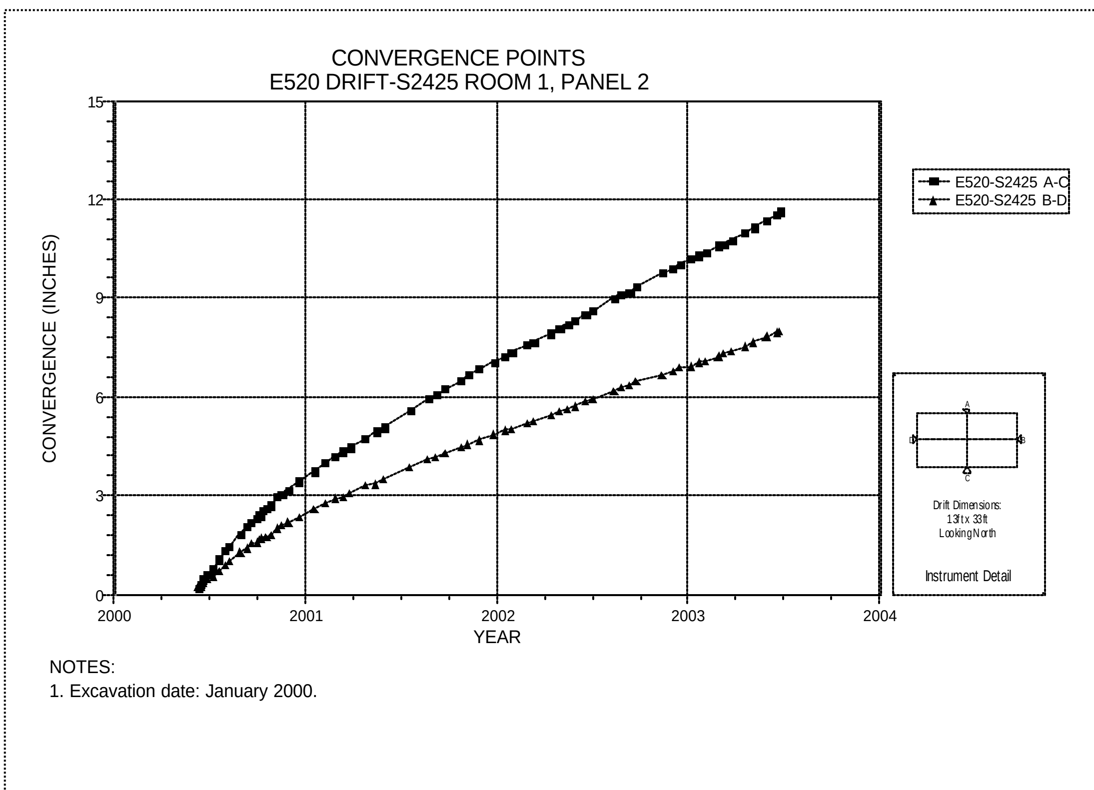
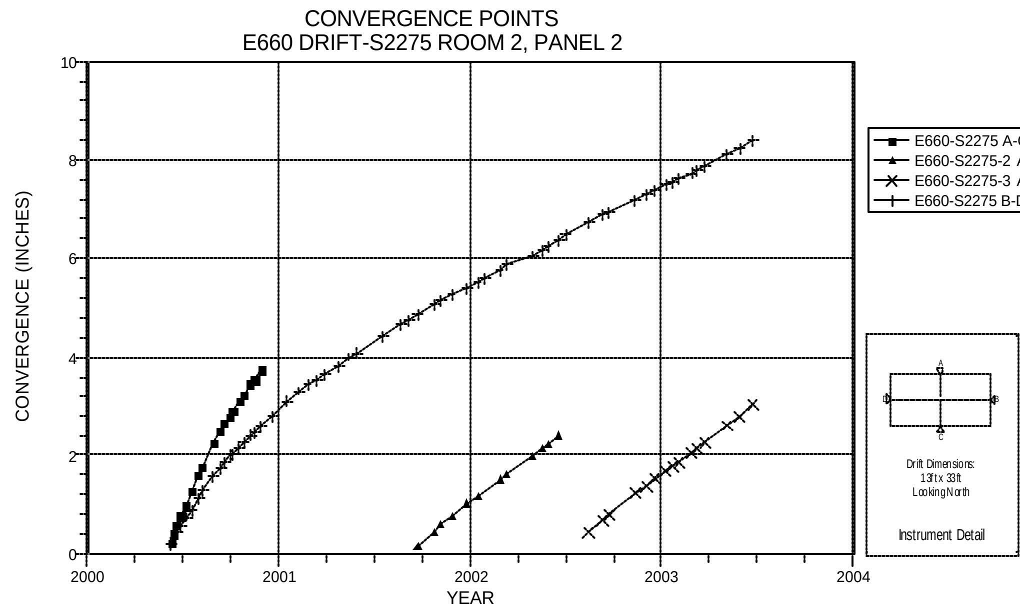
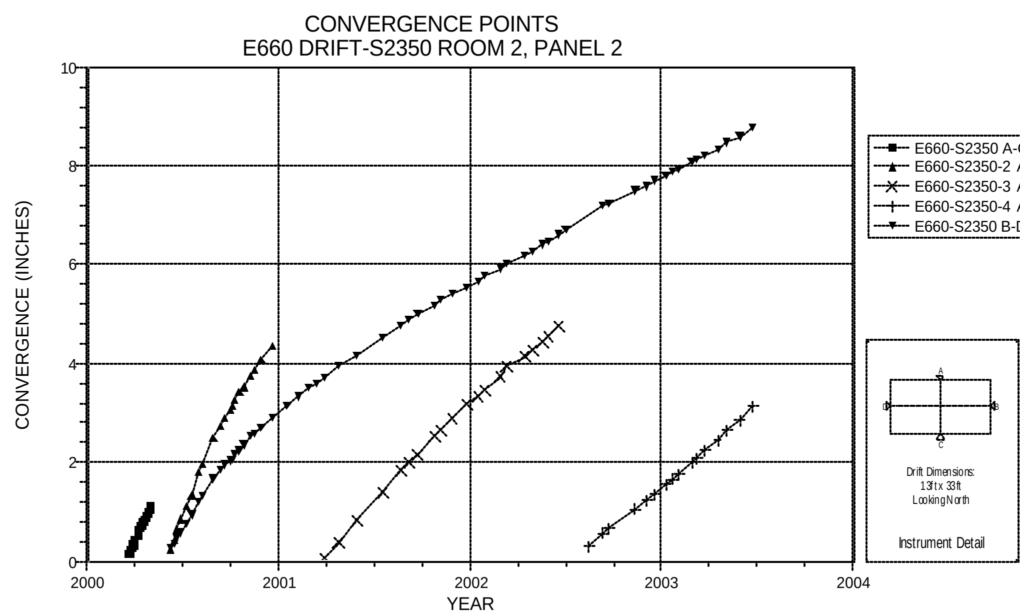


Figure 6-105 Convergence Point Array
Room 1, Panel 2 at S2425 – All Chords



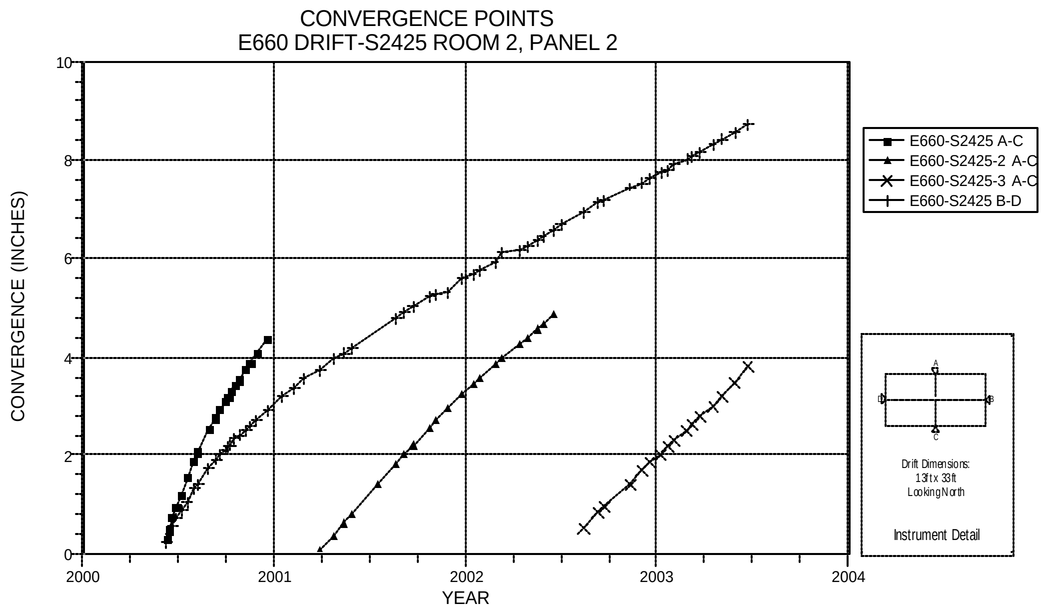
NOTES:
1. Excavation date: February 2000.

Figure 6-106 Convergence Point Array
Room 2, Panel 2 at S2275 – All Chords



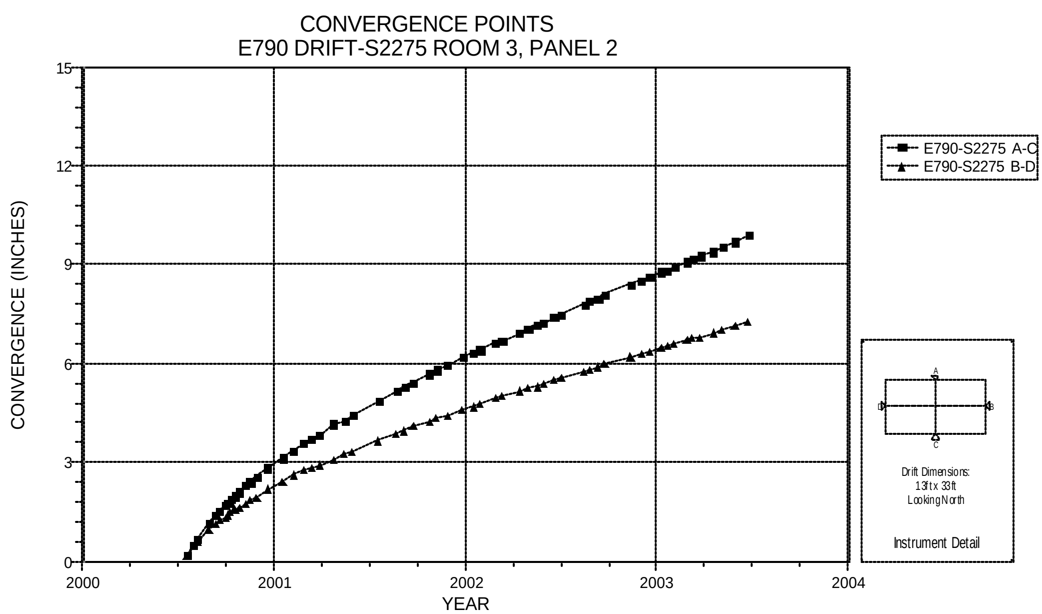
NOTES:
1. Excavation date: February 2000.

Figure 6-107 Convergence Point Array
Room 2, Panel 2 at S2350 – Room Center – All Chords



NOTES:
1. Excavation date: February 2000.

Figure 6-108 Convergence Point Array
Room 2, Panel 2 at S2425 – All Chords



NOTES:
1. Excavation date: March 2000.

Figure 6-109 Convergence Point Array
Room 3, Panel 2 at S2275 – All Chords

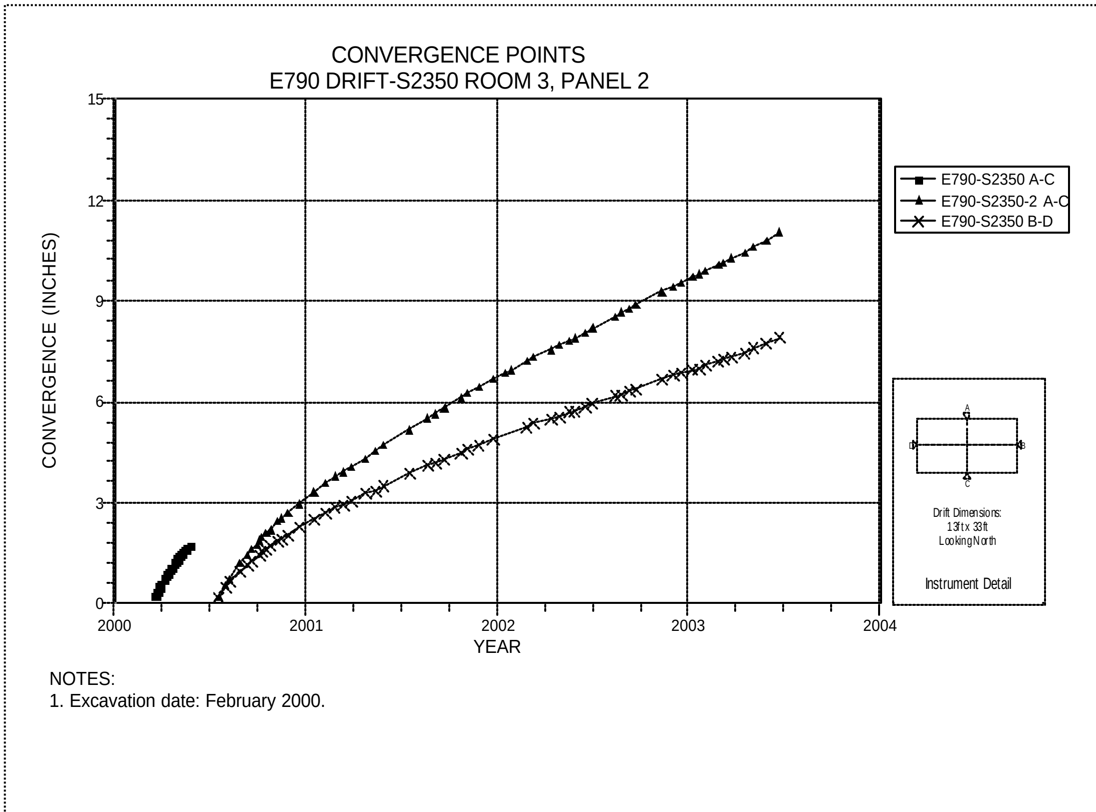


Figure 6-110 Convergence Point Array
Room 3, Panel 2 at S2350 – Room Center – All Chords

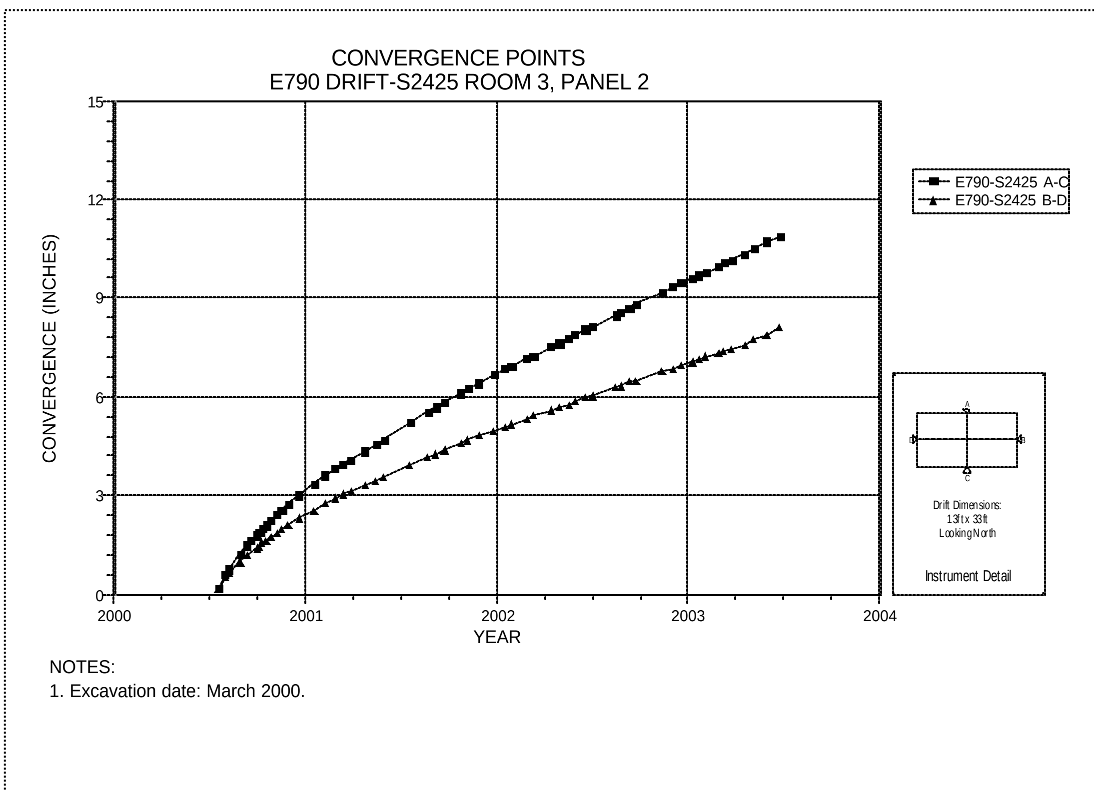
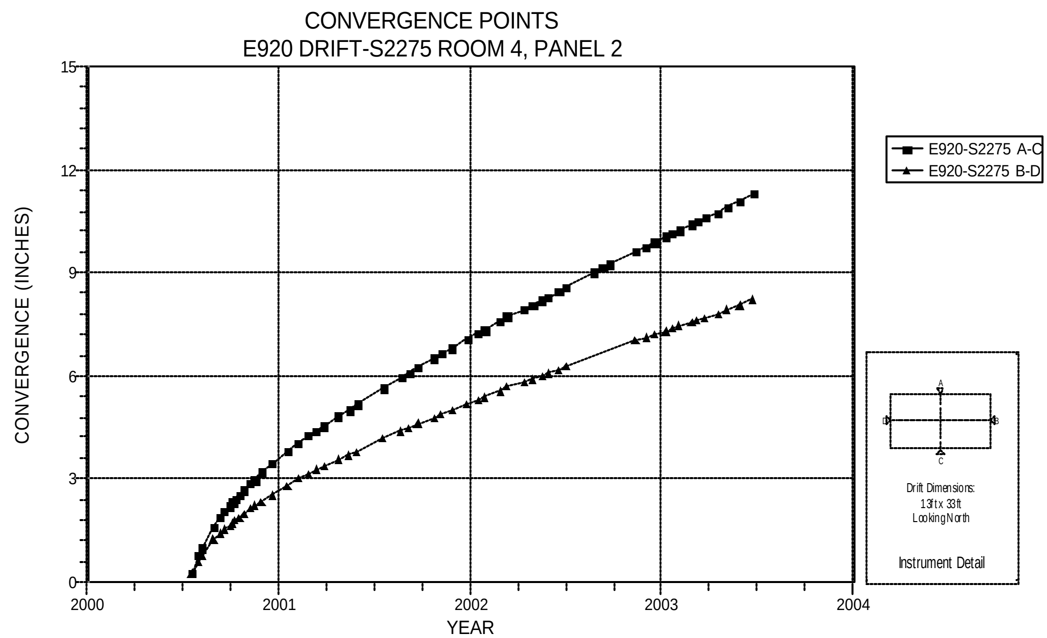
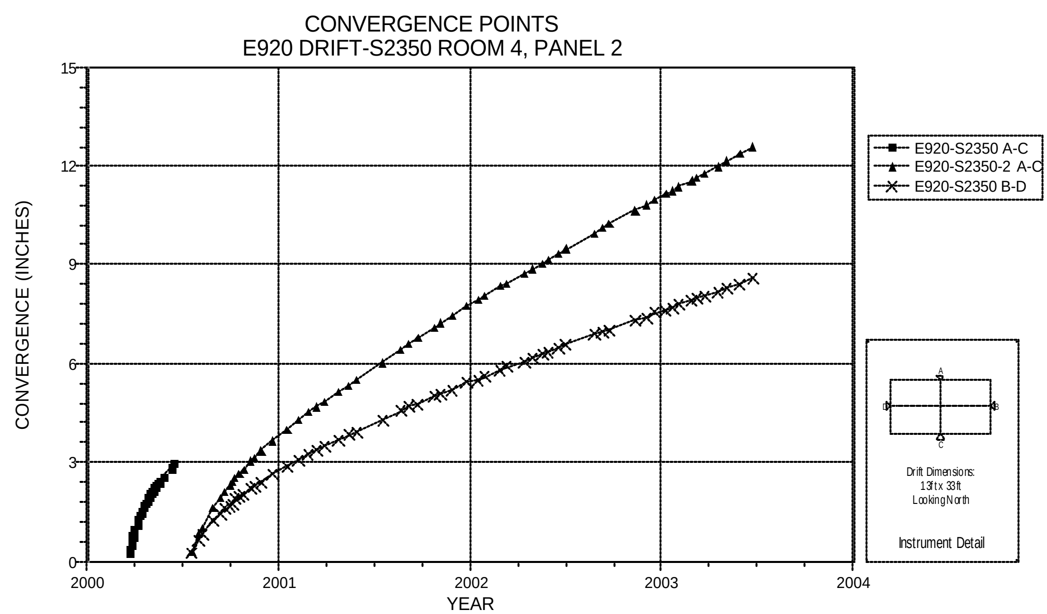


Figure 6-111 Convergence Point Array
Room 3, Panel 2 at S2425 – All Chords



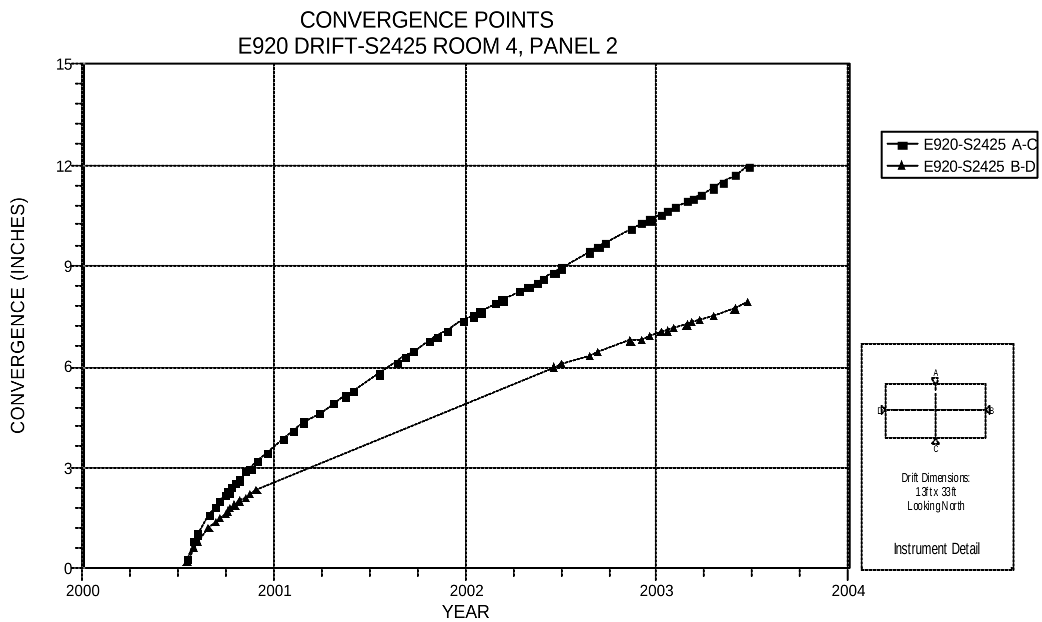
NOTES:
1. Excavation date: April 2000.

Figure 6-112 Convergence Point Array
Room 4, Panel 2 at S2275 – All Chords



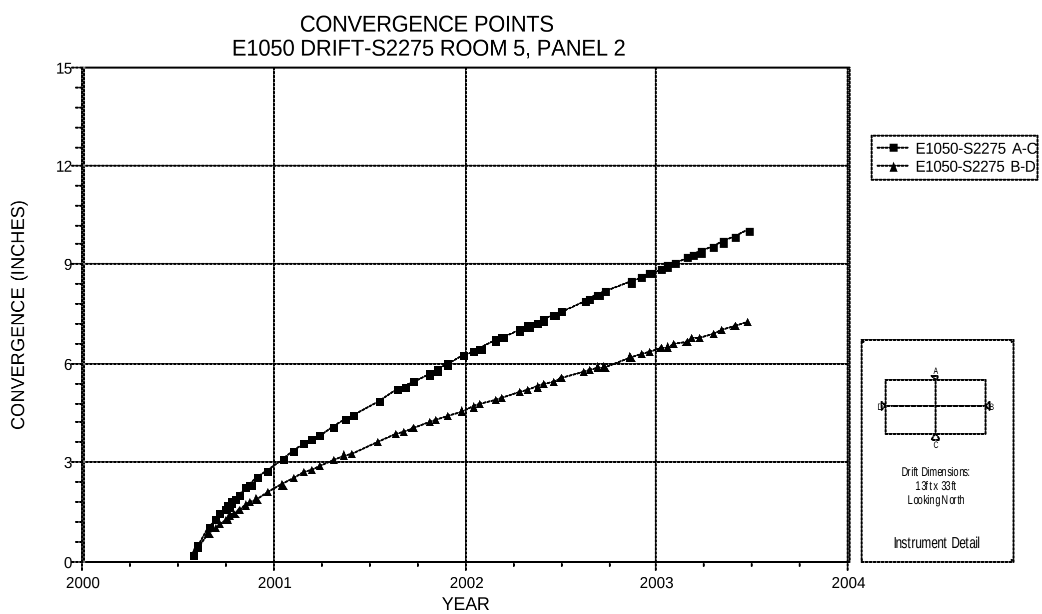
NOTES:
1. Excavation date: April 2000.

Figure 6-113 Convergence Point Array
Room 4, Panel 2 at S2350 – Room Center – All Chords



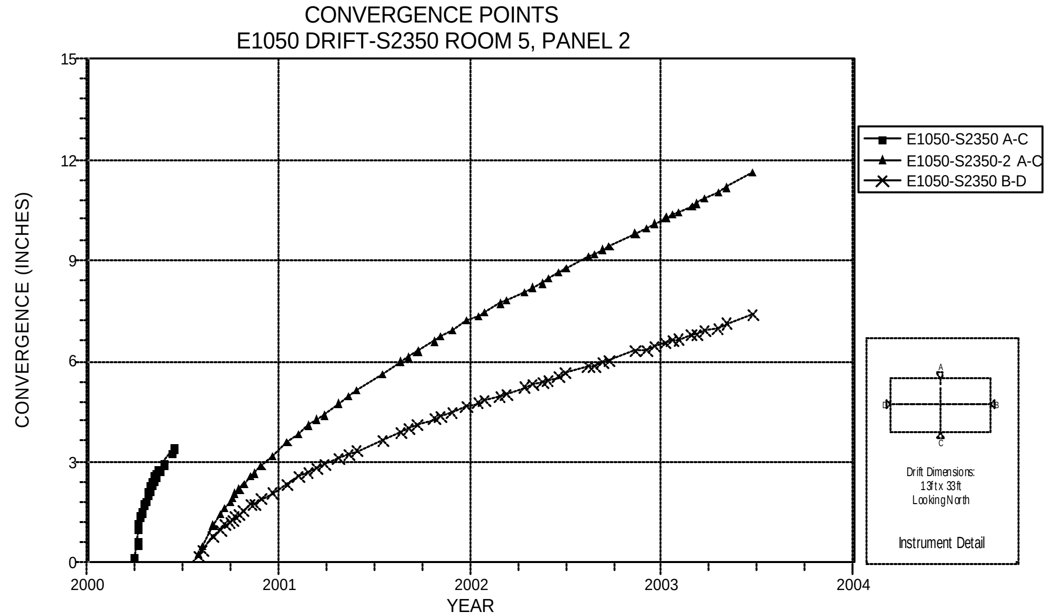
NOTES:
1. Excavation date: April 2000.

Figure 6-114 Convergence Point Array
Room 4, Panel 2 at S2425 – All Chords



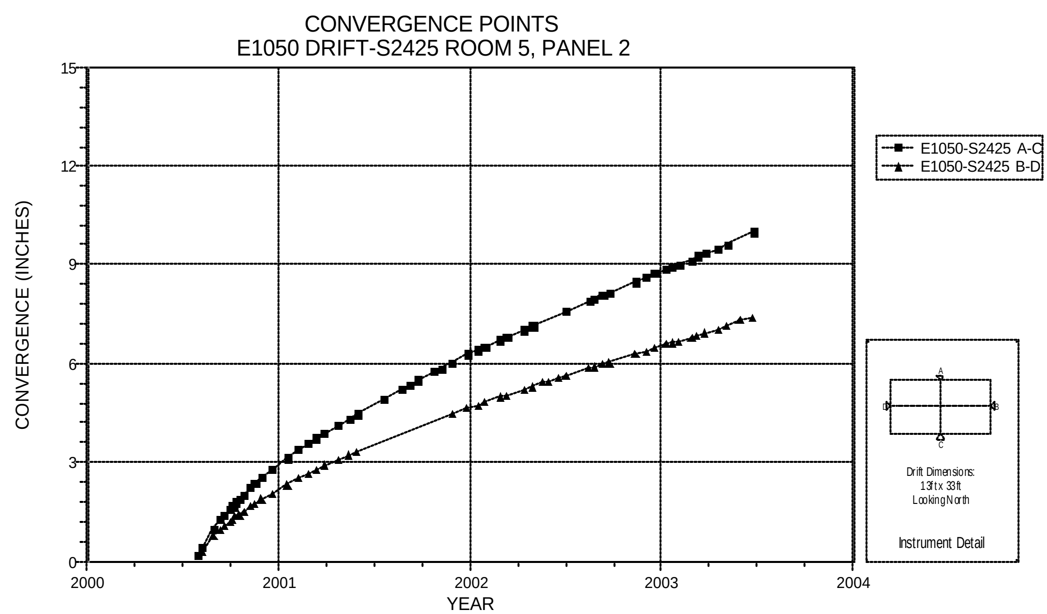
NOTES:
1. Excavation date: April 2000.

Figure 6-115 Convergence Point Array
Room 5, Panel 2 at S2275 – All Chords



NOTES:
1. Excavation date: April 2000.

Figure 6-116 Convergence Point Array
Room 5, Panel 2 at S2350 – Room Center – All Chords



NOTES:
1. Excavation date: April 2000.

Figure 6-117 Convergence Point Array
Room 5, Panel 2 at S2425 – All Chords

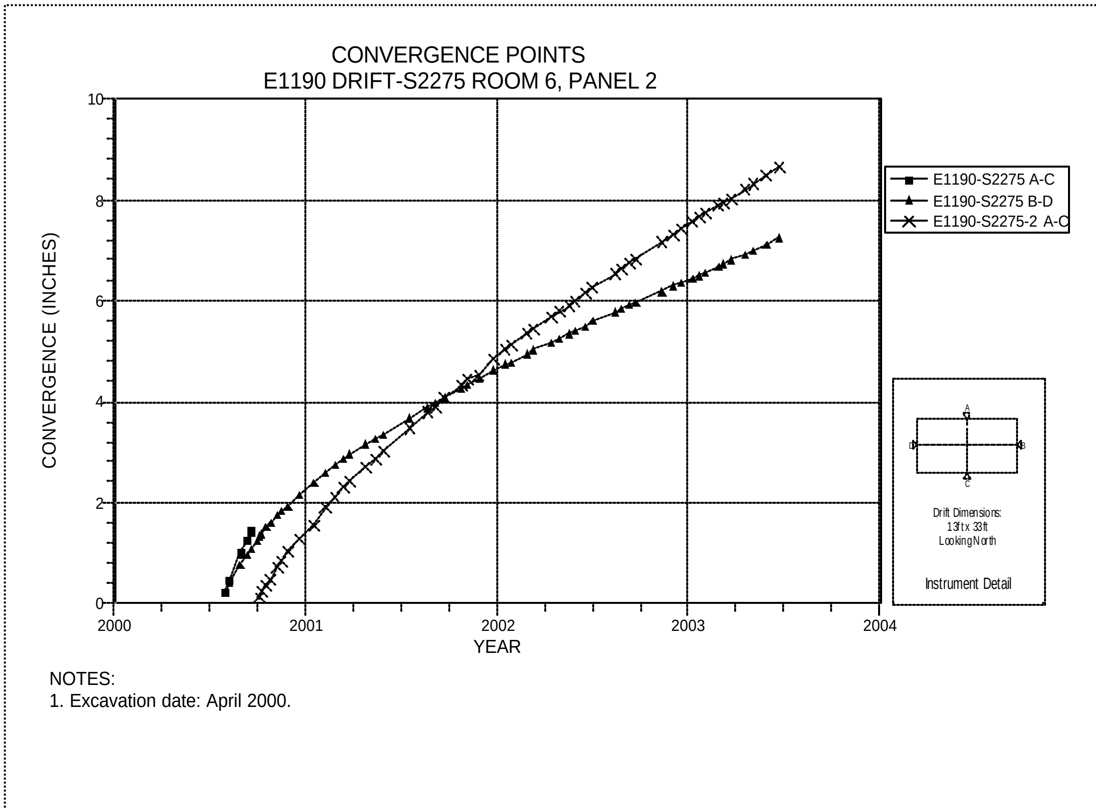


Figure 6-118 Convergence Point Array
Room 6, Panel 2 at S2275 – All Chords

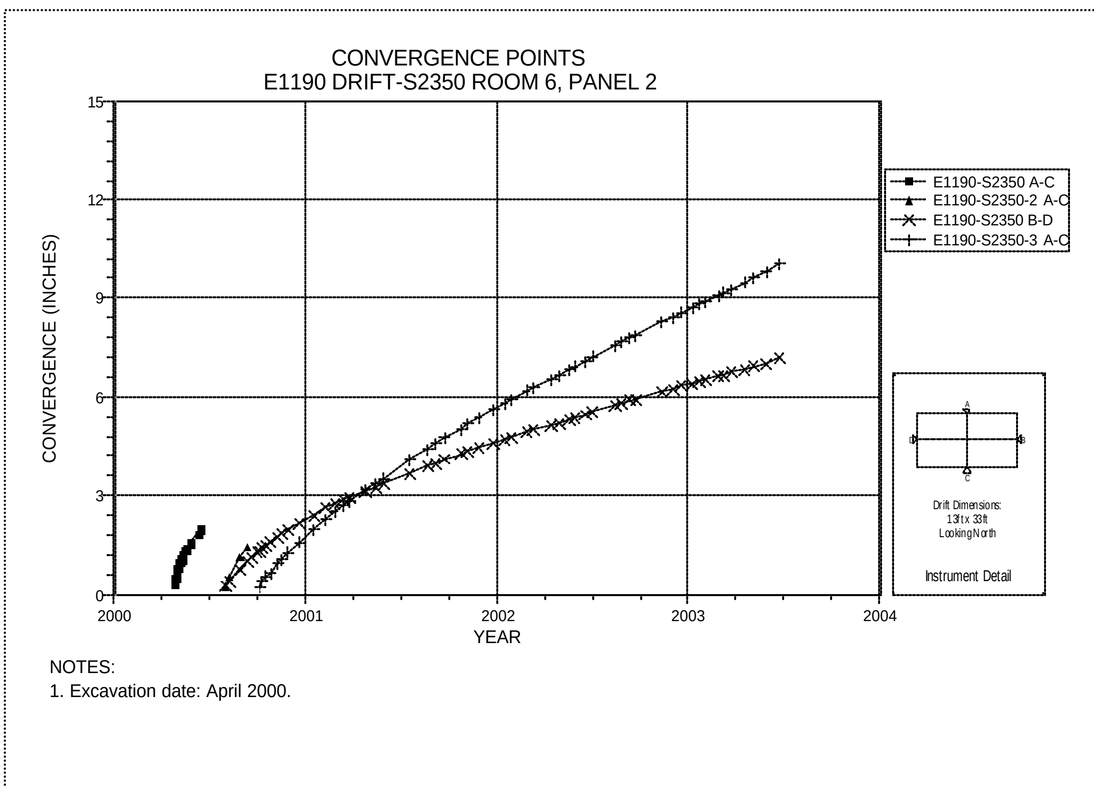


Figure 6-119 Convergence Point Array
Room 6, Panel 2 at S2350 – Room Center – All Chords

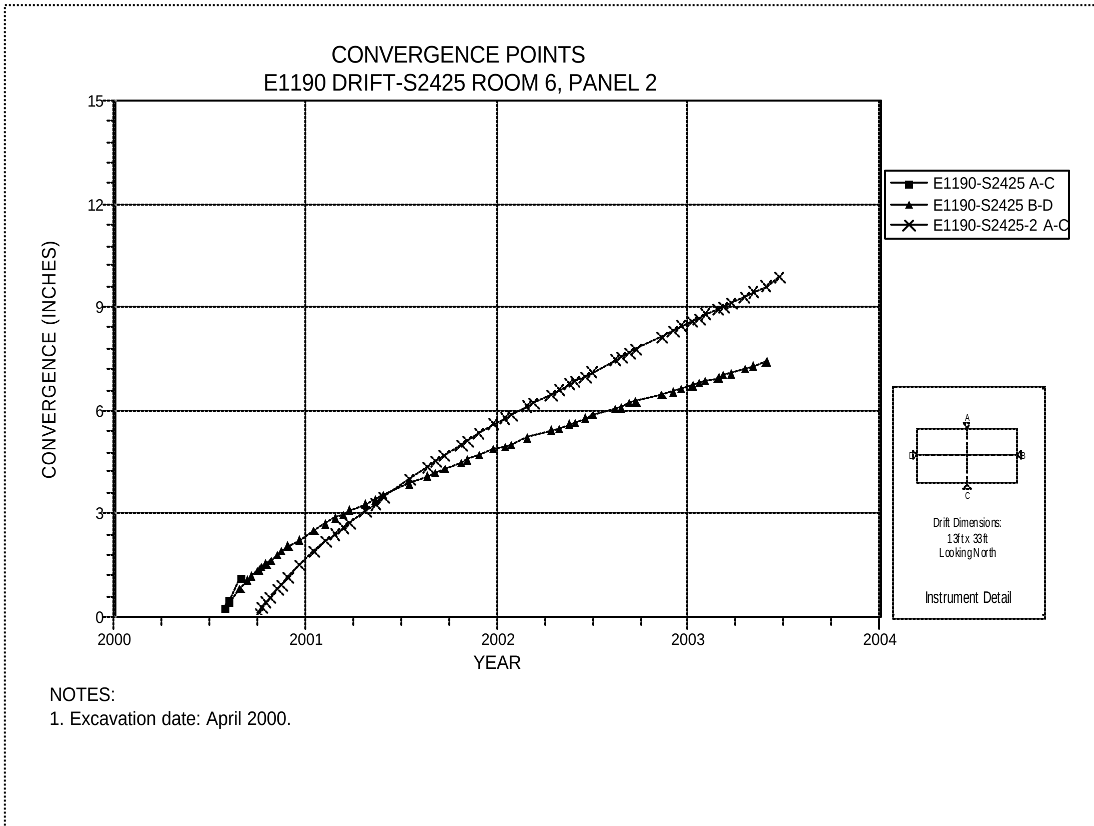


Figure 6-120 Convergence Point Array
Room 6, Panel 2 at S2425 – All Chords

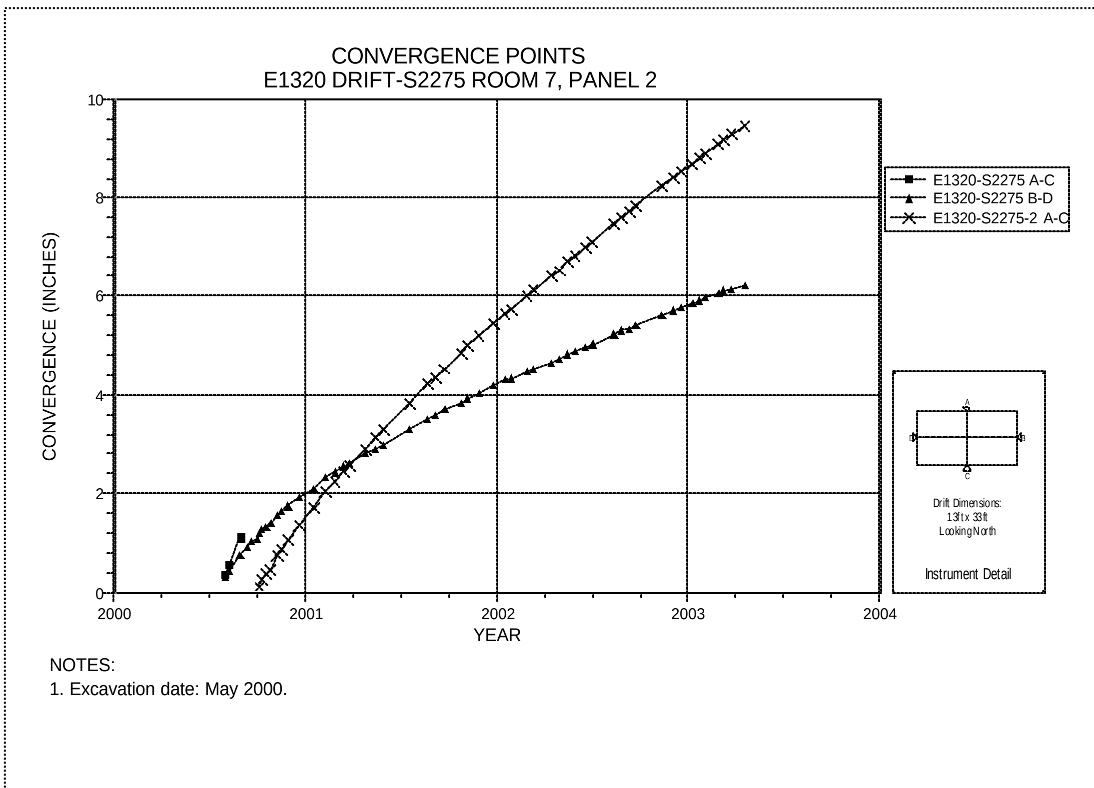


Figure 6-121 Convergence Point Array
Room 7, Panel 2 at S2275 – All Chords

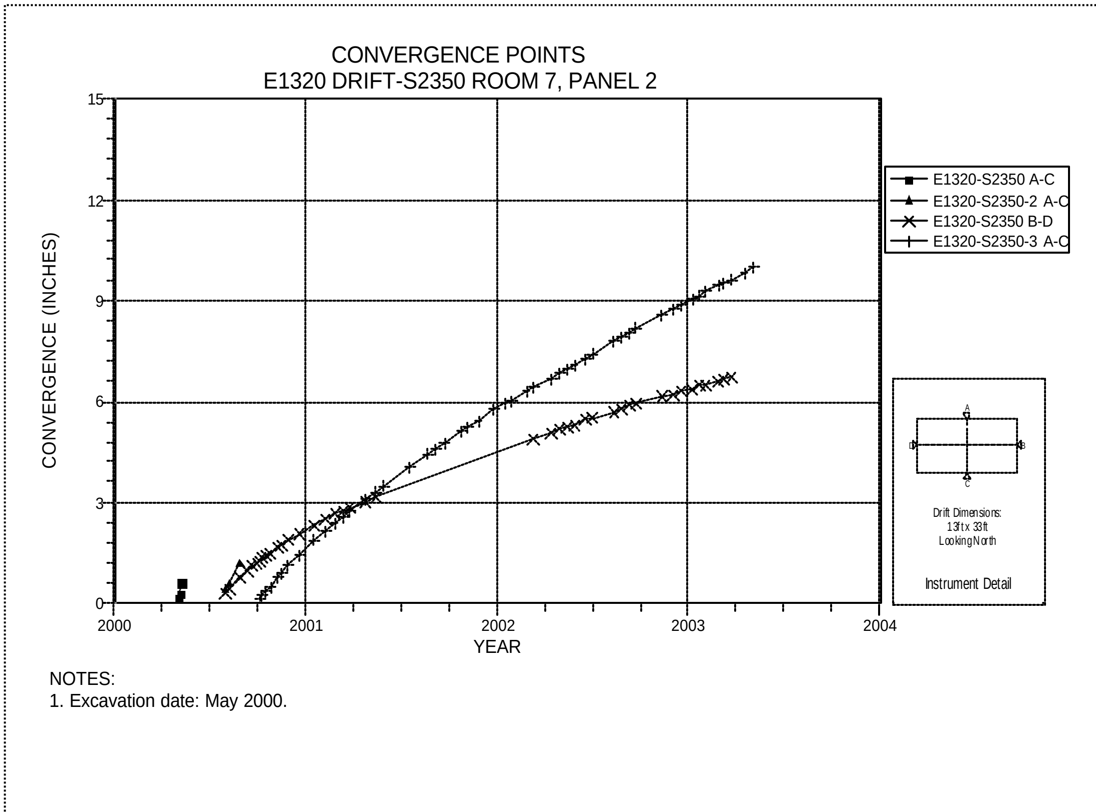


Figure 6-122 Convergence Point Array
Room 7, Panel 2 at S2350 – Room Center – All Chords

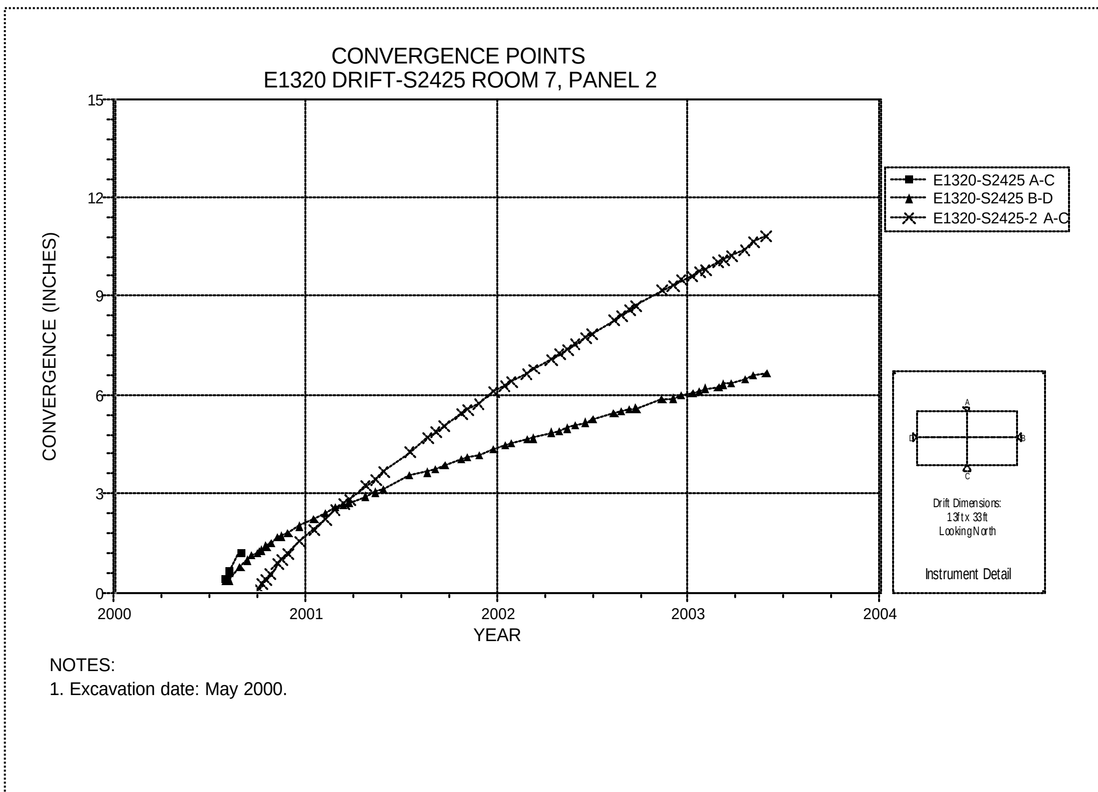


Figure 6-123 Convergence Point Array
Room 7, Panel 2 at S2425 – All Chords

7.0 Geoscience Program Supporting Data

This chapter presents supporting data acquired as part of the Geoscience Program. It includes observations of clay seam displacements and other features in vertical observation holes, fracture maps of excavation surfaces, and stratigraphic maps of excavation surfaces.

7.1 Bore Hole Inspections

This section presents a summary of the clay seam displacements (offsets) and fracture densities measured in observation boreholes located through the WIPP underground facility. Relative lateral displacement of rock strata above and below a clay layer is measured as offset within a borehole. Fracture density is a calculated parameter based on the number of fractures and fracture zones observed in an observation borehole. Fracture density is equal to the number of fractures plus twice the number of fracture zones in a roof beam divided by the thickness of the beam (in feet). Table 7-1 presents the observed offset data for boreholes intersecting Clay G and Clay H, the number of observed fractures and fracture zones, and the calculated fracture densities.

7.2 Fracture Mapping

This section presents graphical results of the fracture mapping done in Panels 1 and 2 of the Waste Disposal Area. Figures 7-1 through 7-16 are plan view fracture maps for the roof (back) in these panels.

7.3 Stratigraphic Mapping

This section presents the graphical results of the geological mapping done in East 140 from South 2520 to South 2750. Figures 7-17 and 7-18 are the stratigraphic maps of the east wall along East 140 where the excavation level ramps up to the new horizon .

Table 7-1
Observation Borehole Fractures and Offset Data Summary

Observation Hole	Location Northing		Location Easting		Initial Reading	Inspection Date	Fr [1]	FZ [2]	Beam Height (ft)	Feature	Fracture Density [3]	Feature Depth (ft)	Feature Magnitude (in)	Hole Diameter (in)	Hole Closure (%)	Offset Rate (in/yr)
Panel 2 Room 1																
OH 359	S	2271	E	524	7/24/00	4/2/03				hangup	N/A	7.2	0.06	3.00	N/A	N/A
							6	0	7.0	sep'n Clay G	0.86	7.0	0.25	3.00	8.33	0.09
										hangup	N/A	6.8	0.06	3.00	N/A	N/A
										hangup	N/A	6.4	0.06	3.00	N/A	N/A
										hangup	N/A	6.0	0.06	3.00	N/A	N/A
										hangup	N/A	5.8	0.06	3.00	N/A	N/A
										hangup	N/A	5.5	0.06	3.00	N/A	N/A
										offset	N/A	1.8	0.12	3.00	N/A	N/A
										separation	N/A	1.8	0.25	3.00	N/A	N/A
OH 360	S	2350	E	523	7/24/00	4/2/03	1	0	7.4	hangup Clay G	0.14	7.4	0.05	3.00	1.67	0.02
										offset	N/A	5.4	0.12	3.00	N/A	N/A
										separation	N/A	5.4	0.12	3.00	N/A	N/A
OH 361	S	2422	E	523	7/24/00	4/2/03	0	0	7.2	offset Clay G	0.00	7.2	0.25	3.00	8.33	0.09
										separation	N/A	7.2	0.18	3.00	N/A	N/A
Panel 2 Room 2																
OH 362	S	2275	E	655	7/24/00	5/29/03				offset Clay H	N/A	14.0	0.01	3.00	N/A	N/A
										offset	N/A	7.8	0.12	3.00	N/A	N/A
							0	0	6.7	separation	0.00	6.7	0.12	3.00	4.00	0.04
OH 363	S	2347	E	656	7/24/00	4/22/03	0	0	8.2	hangup	0.00	8.2	0.05	3.00	1.67	0.02
OH 364	S	2422	E	656	7/24/00	5/29/03				hangup Clay H	N/A	14.2	0.05	3.00	N/A	N/A
							0	0	6.0	separation	0.00	6.0	0.12	3.00	4.00	0.04
Panel 2 Room 3																
OH 365	S	2277	E	789	7/24/00	5/29/03	0	0	6.8	separation	0.00	6.8	0.12	3.00	4.00	0.04
OH 366	S	2351	E	790	7/24/00	5/29/03	3	0	7.0	offset Clay G	0.43	7.0	0.50	3.00	16.67	0.18
										separation	N/A	7.0	0.50	3.00	N/A	N/A
										separation	N/A	6.8	0.25	3.00	N/A	N/A
										separation	N/A	6.1	0.12	3.00	N/A	N/A
										separation	N/A	6.0	0.25	3.00	N/A	N/A
OH 367	S	2421	E	789	7/24/00	5/29/03	1	0	6.6	separation	0.15	6.6	0.12	3.00	4.00	0.04
										separation	N/A	6.2	0.12	3.00	N/A	N/A

[1] Fr = Number of fractures in immediate roof beam
[2] FZ = Number of fracture zones in immediate roof beam
[3] Fracture Density = (Fr + 2FZ) / Beam Height

Table 7-1 (Continued)
Observation Borehole Fractures and Offset Data Summary

Observation Hole	Location Northing		Location Easting		Initial Reading	Inspection Date	Fr [1]	FZ [2]	Beam Height (ft)	Feature	Fracture Density [3]	Feature Depth (ft)	Feature Magnitude (in)	Hole Diameter (in)	Hole Closure (%)	Offset Rate (in/yr)
Panel 2 Room 4																
OH 368	S	2270	E	922	7/24/00	3/25/03	0	0	7.0	no features	0.00	7.0	0.0	3.00	0.00	0.00
OH 369	S	2344	E	922	7/24/00	5/29/03	0	0	7.0	no features	0.00	7.0	0.0	3.00	0.00	0.00
OH 370	S	2427	E	922	7/24/00	3/25/03				offset Clay H		13.8	0.12	3.00	N/A	N/A
							1	0	7.2	offset	0.14	7.2	0.12	3.00	4.00	0.04
										separation		6.6	0.12	3.00	N/A	N/A
Panel 2 Room 5																
OH 371	S	2276	E	1054	1/17/01	3/25/03	0	0	6.8	hangup	0.00	6.8	0.05	3.00	1.67	0.02
OH 372	S	2351	E	1054	1/17/01	3/25/03	0	0	6.4	separation	0.00	6.4	0.18	3.00	6.00	0.08
OH 373	S	2426	E	1055	1/17/01	3/25/03	0	0	6.7	sep'n Clay G	0.00	6.7	0.18	3.00	6.00	0.08
Panel 2 Room 6																
OH 374	S	2275	E	1188	1/17/01	4/15/03	0	0	7.0	no features	0.00	7.0	0.0	3.00	0.00	0.00
OH 375	S	2348	E	1189	1/17/01	4/15/03				hangup Clay H		14.0	0.05	3.00	N/A	N/A
							0	0	7.3	offset Clay G	0.00	7.3	0.12	3.00	4.00	0.05
										separation		7.3	0.25	3.00	N/A	N/A
OH 376	S	2423	E	1189	1/17/01	4/15/03	0	0	6.5	separation	0.00	6.5	0.12	3.00	4.00	0.05
Panel 2 Room 7																
OH 377	S	2421	E	1320	1/11/01	4/15/03	0	0	7.2	offset	0.00	7.2	0.25	3.00	8.33	0.11
										separation		7.2	0.12	3.00	N/A	N/A
OH 378	S	2345	E	1321	1/11/01	4/15/03	0	0	7.3	offset	0.00	7.3	0.12	3.00	4.00	0.05
										separation		7.3	0.12	3.00	N/A	N/A
OH 379	S	2270	E	1321	1/11/01	4/15/03	0	0	6.3	offset	0.00	6.3	0.12	3.00	4.00	0.05
										separation		6.3	0.12	3.00	N/A	N/A
South 2180 (Panel)																
OH 380	S	2181	E	726	1/18/01	4/22/03				offset		12.5	0.04	3.00	N/A	N/A
										sep'n Clay H		12.5	0.12	3.00	N/A	N/A
							0	0	5.6	offset	0.00	5.6	2.25	3.00	75.00	1.00
										separation		5.6	0.50	3.00	N/A	N/A
OH 381	S	2181	E	921	1/17/01	4/22/03				offset		14.2	3.00	3.00	N/A	N/A
							0	0	7.4	offset	0.00	7.4	2.25	3.00	75.00	1.00
										separation		7.4	0.50	3.00	N/A	N/A
OH 382	S	2183	E	1120	1/17/01	4/22/03	0	0	7.7	offset	0.00	7.7	0.12	3.00	4.00	0.05

[1] Fr = Number of fractures in immediate roof beam
[2] FZ = Number of fracture zones in immediate roof beam
[3] Fracture Density = (Fr + 2FZ) / Beam Height

Table 7-1 (Continued)
Observation Borehole Fractures and Offset Data Summary

Observation Hole	Location Northing	Location Easting	Initial Reading	Inspection Date	Fr [1]	FZ [2]	Beam Height (ft)	Feature	Fracture Density [3]	Feature Depth (ft)	Feature Magnitude (in)	Hole Diameter (in)	Hole Closure (%)	Offset Rate (in/yr)
South 2520 (Panel)														
OH 383	S 2515	E 718	1/11/01	4/17/03	1	0	6.1	offset	0.16	6.1	0.12	3.00	4.00	0.05
								separation		6.1	0.12	3.00	N/A	N/A
								offset		5.2	0.12	3.00	N/A	N/A
								separation		5.2	0.12	3.00	N/A	N/A
OH 384	S 2517	E 921	1/11/01	4/17/03				offset Clay H		13.0	0.50	3.00	N/A	N/A
					0	0	6.5	offset	0.00	6.5	0.75	3.00	25.00	0.33
								separation		6.5	0.12	3.00	N/A	N/A
OH 385	S 2514	E 1133	1/11/01	4/17/03				hangup Clay H		12.5	0.05	3.00	N/A	N/A
					0	0	5.8	offset	0.00	5.8	1.00	3.00	33.33	0.44
								separation		5.8	0.12	3.00	N/A	N/A
OH 387	S 2517	E 1326	8/1/01	4/15/03				offset Clay H		12.6	0.25	3.00	N/A	N/A
					0	0	6.5	offset Clay G	0.00	6.5	0.50	3.00	16.67	0.29
East 140 (S1700 to S1850)														
OH139-1	S 1730	E 147	5/8/92	6/25/03	1	0	6.1	offset	0.16	6.1	3.00	3.00	100.00	0.27
								offset		1.5	0.50	3.00	N/A	N/A
								separation		1.5	0.50	3.00	N/A	N/A
OH140-1	S 1732	E 154	5/8/92	6/25/03				offset		9.3	3.00	3.00	N/A	N/A
								separation		2.7	0.25	3.00	N/A	N/A
OH141-1	S 1731	E 164	5/8/92	6/25/03	2	0	6.5	offset	0.31	6.5	3.00	3.00	100.00	0.27
								offset		1.3	0.50	3.00	N/A	N/A
								separation		1.3	0.50	3.00	N/A	N/A
								offset		1.1	0.12	3.00	N/A	N/A
								separation		1.1	0.12	3.00	N/A	N/A
OH142-1	S 1780	E 147	5/8/92	6/25/03	3	0	6.4	offset	0.47	6.4	3.00	3.00	100.00	0.27
								offset		2.7	1.75	3.00	N/A	N/A
								separation		2.7	2.00	3.00	N/A	N/A
								offset		1.6	1.60	3.00	N/A	N/A
								separation		1.6	1.00	3.00	N/A	N/A
								offset		1.0	1.50	3.00	N/A	N/A
								separation		1.0	0.50	3.00	N/A	N/A

[1] Fr = Number of fractures in immediate roof beam
[2] FZ = Number of fracture zones in immediate roof beam
[3] Fracture Density = (Fr + 2FZ) / Beam Height

Table 7-1 (Continued)
Observation Borehole Fractures and Offset Data Summary

Observation Hole	Location Northing		Location Easting		Initial Reading	Inspection Date	Fr [1]	FZ [2]	Beam Height (ft)	Feature	Fracture Density [3]	Feature Depth (ft)	Feature Magnitude (in)	Hole Diameter (in)	Hole Closure (%)	Offset Rate (in/yr)
East 140 (S1700 to S1850) - Continued																
OH143-1	S	1781	E	154	5/8/92	6/25/03				offset		10.1	3.00	3.00	N/A	N/A
										FZ Top		6.5	9.00	3.00	N/A	N/A
							9	1	5.8	FZ Bottom	1.90	5.8	1.70	3.00	56.67	0.15
										separation		5.7	0.50	3.00	N/A	N/A
										offset		5.5	1.60	3.00	N/A	N/A
										separation		5.5	2.00	3.00	N/A	N/A
										separation		5.2	0.12	3.00	N/A	N/A
										separation		5.0	0.25	3.00	N/A	N/A
										separation		4.9	0.12	3.00	N/A	N/A
										separation		4.5	0.12	3.00	N/A	N/A
										offset		2.9	0.37	3.00	N/A	N/A
										offset		1.6	0.25	3.00	N/A	N/A
										separation		1.6	1.00	3.00	N/A	N/A
										offset		1.1	0.12	3.00	N/A	N/A
										separation		1.1	1.00	3.00	N/A	N/A
OH145-1	S	1831	E	146	5/8/92	6/25/03	3	0	6.2	offset	0.48	6.2	3.00	3.00	100.00	0.27
										offset		2.5	2.40	3.00	N/A	N/A
										separation		2.5	0.50	3.00	N/A	N/A
										separation		1.6	0.75	3.00	N/A	N/A
										offset		0.5	2.20	3.00	N/A	N/A
										separation		0.5	0.75	3.00	N/A	N/A

[1] Fr = Number of fractures in immediate roof beam
[2] FZ = Number of fracture zones in immediate roof beam
[3] Fracture Density = (Fr + 2FZ) / Beam Height

Table 7-1 (Continued)
Observation Borehole Fractures and Offset Data Summary

Observation Hole	Location				Initial Reading	Inspection Date	Fr [1]	FZ [2]	Beam Height (ft)	Feature	Fracture Density [3]	Feature Depth (ft)	Feature Magnitude (in)	Hole Diameter (in)	Hole Closure (%)	Offset Rate (in/yr)
	Northing		Easting													
East 140 (S1700 to S1850) - Continued																
OH146-1	S	1830	E	152	5/8/92	6/25/03				offset		10.8	3.00	3.00	N/A	N/A
							7	0	5.7	separation	1.23	5.7	0.25	3.00	8.33	0.02
										offset		5.4	1.40	3.00	N/A	N/A
										separation		5.4	1.50	3.00	N/A	N/A
										separation		4.7	0.75	3.00	N/A	N/A
										separation		4.3	0.12	3.00	N/A	N/A
										separation		3.8	0.75	3.00	N/A	N/A
										offset		2.4	0.25	3.00	N/A	N/A
										separation		2.4	1.00	3.00	N/A	N/A
										offset		1.3	0.75	3.00	N/A	N/A
										separation		1.3	1.75	3.00	N/A	N/A
										offset		0.8	0.25	3.00	N/A	N/A
										separation		0.8	0.12	3.00	N/A	N/A
OH147-1	S	1830	E	159	5/8/92	6/25/03	2	0	6.0	offset	0.33	6.0	3.00	3.00	100.00	0.27
										separation		2.2	0.25	3.00	N/A	N/A
										offset		1.4	2.00	3.00	N/A	N/A
										separation		1.4	0.25	3.00	N/A	N/A

[1] Fr = Number of fractures in immediate roof beam
[2] FZ = Number of fracture zones in immediate roof beam
[3] Fracture Density = (Fr + 2FZ) / Beam Height

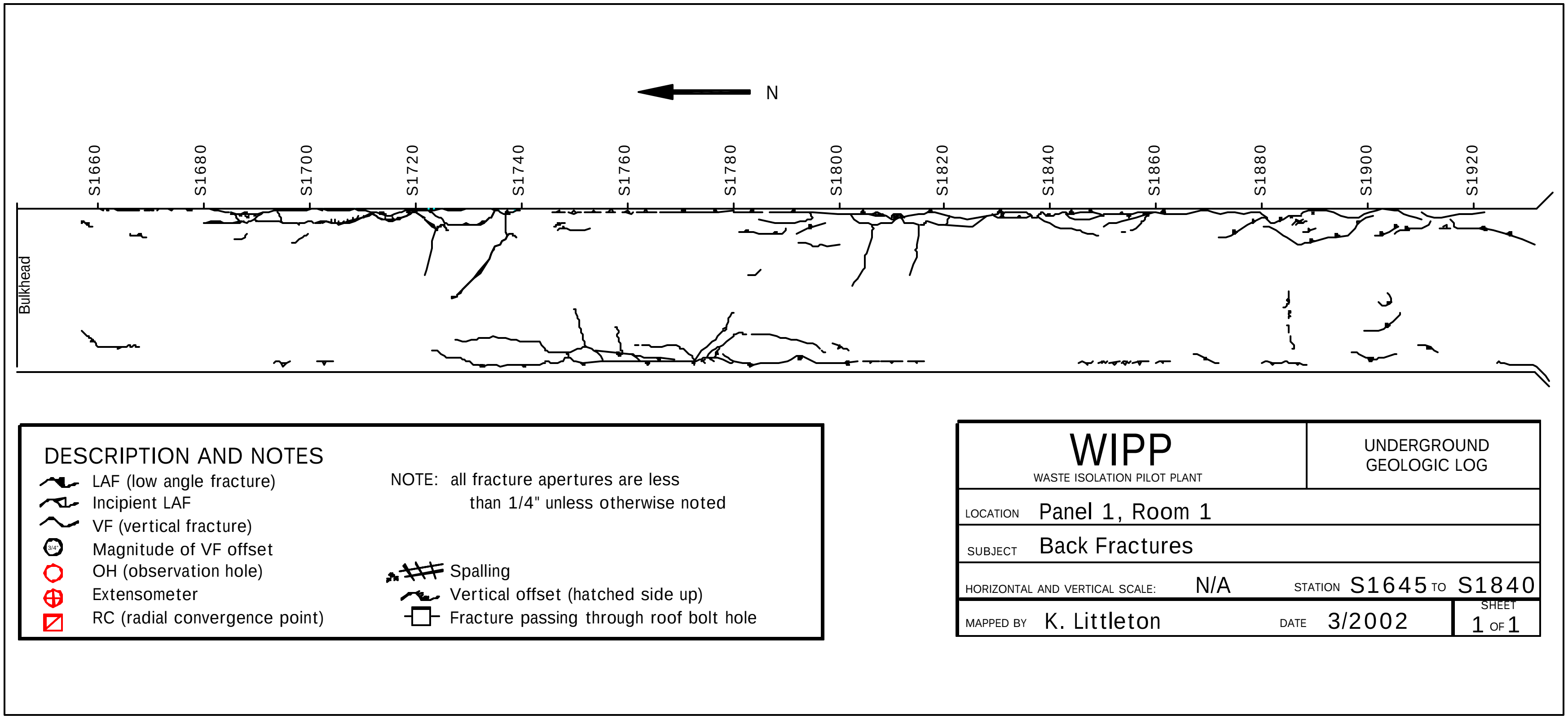


Figure 7-1
Panel 1 Room 1 Back Fractures

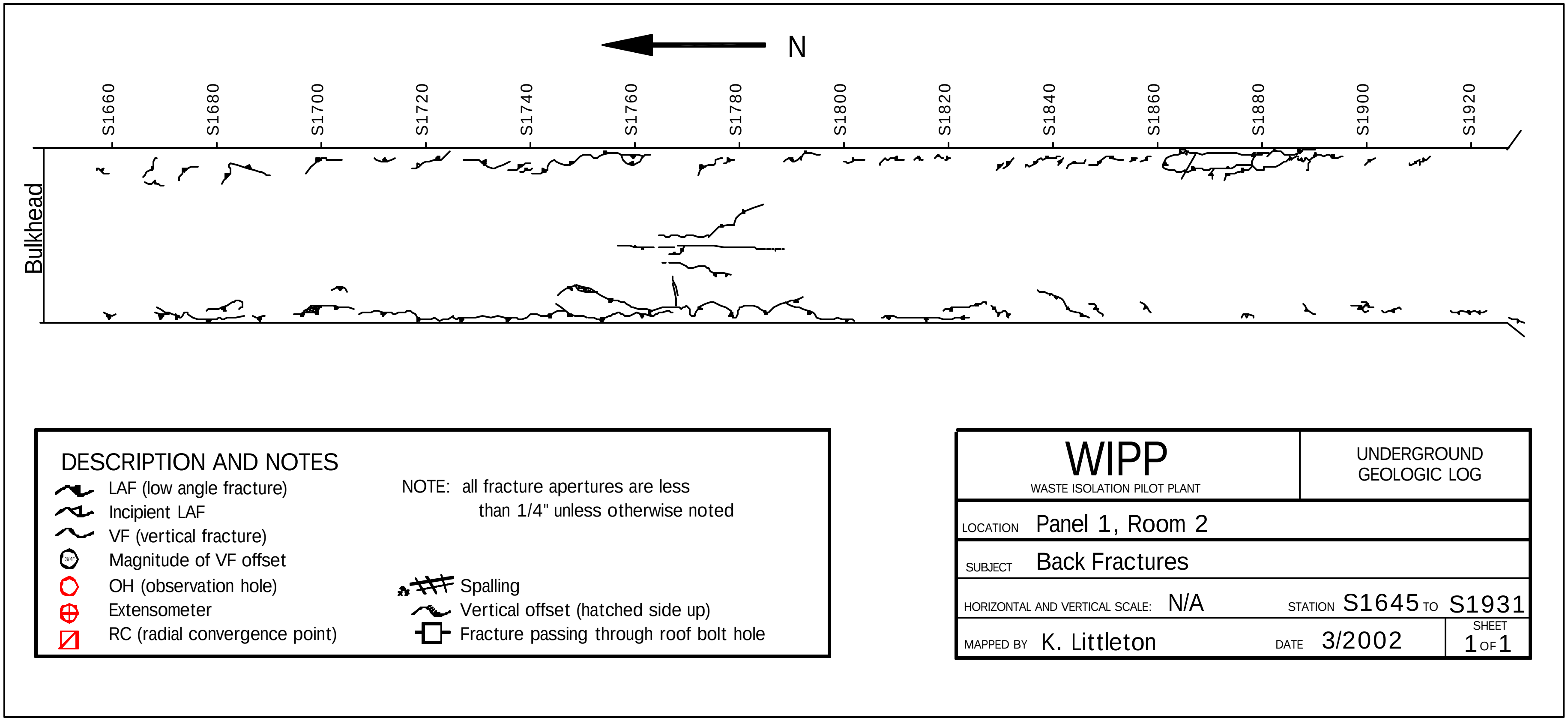


Figure 7-2
Panel 1 Room 2 Back Fractures

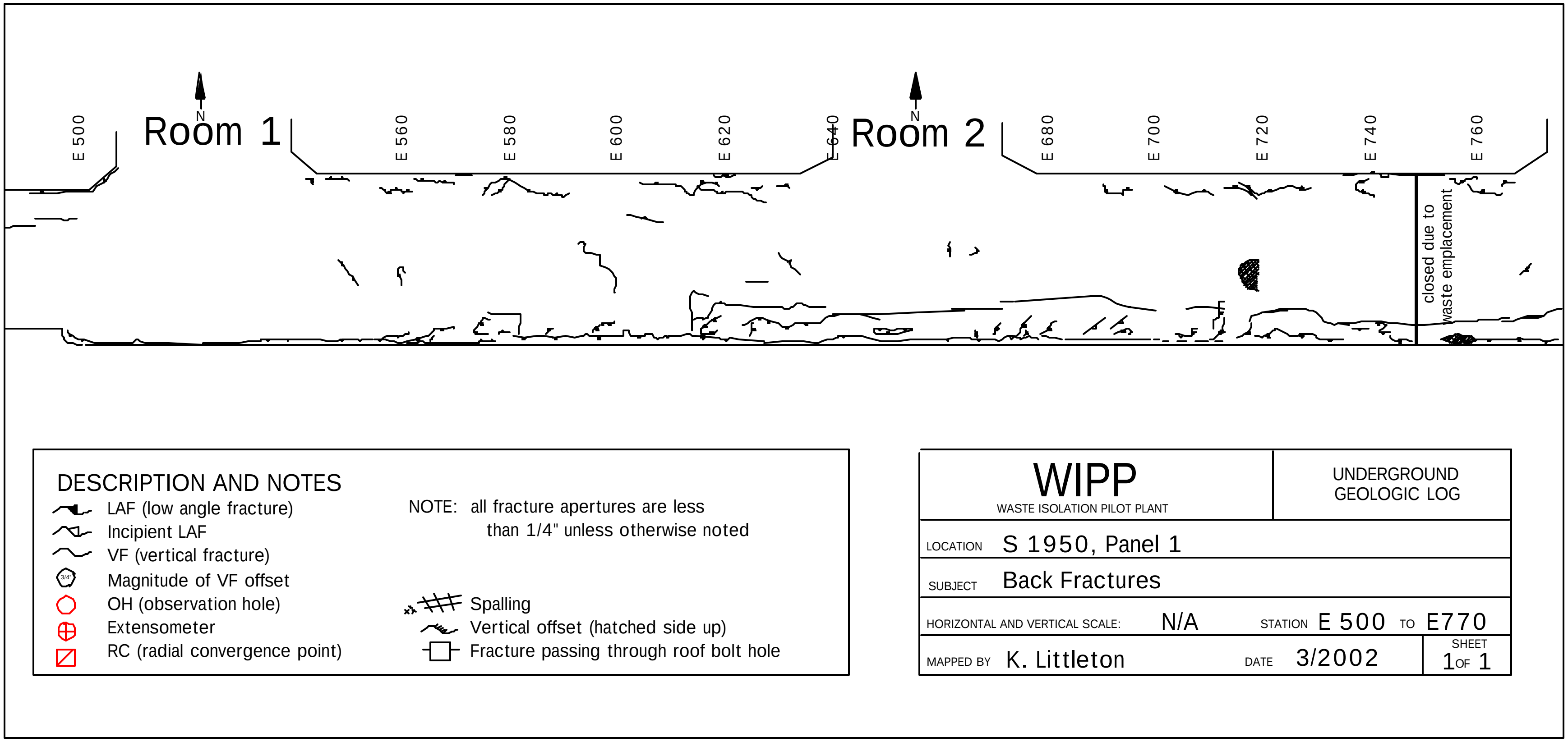


Figure 7-3
Panel 1 South 1950, E500 to E770, Back Fractures

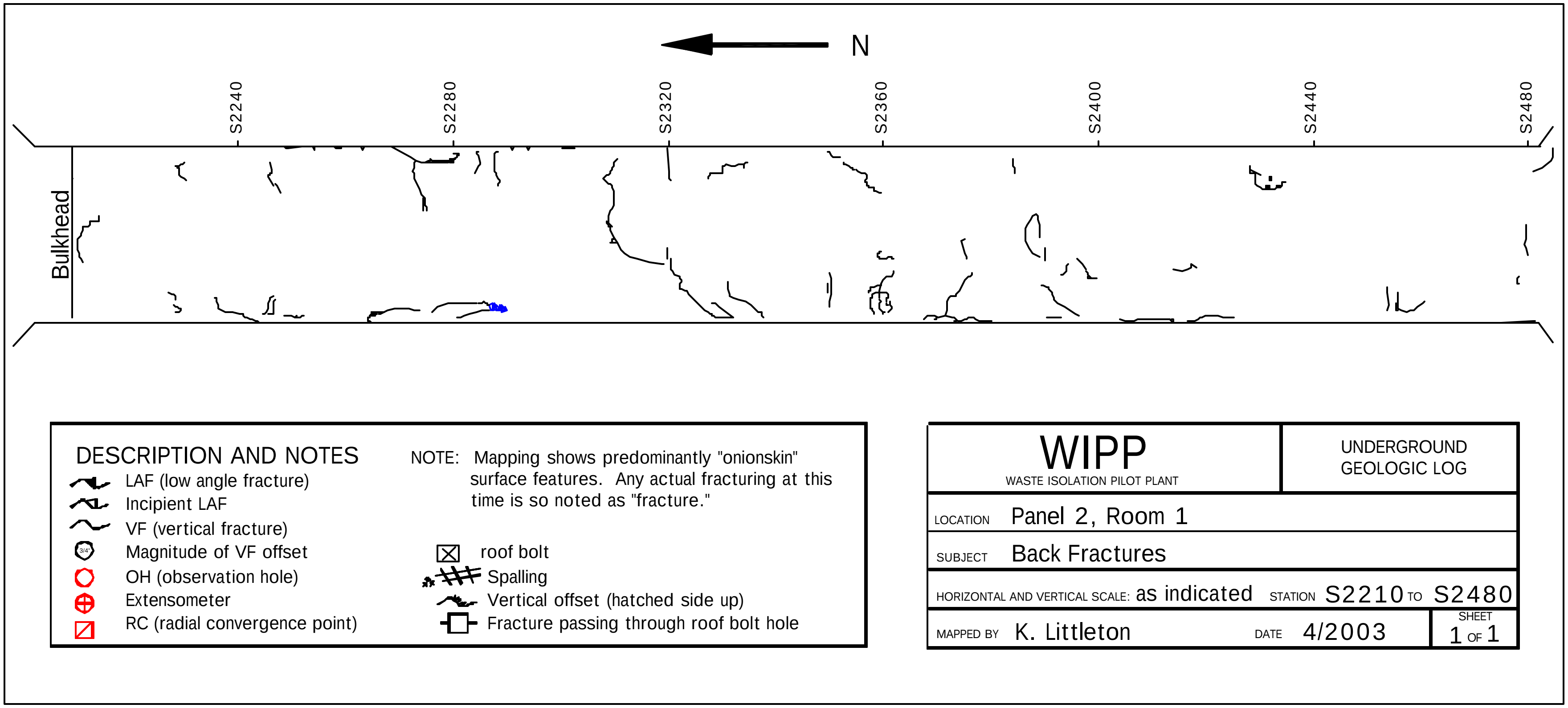


Figure 7-4
Panel 2 Room 1 Back Fractures

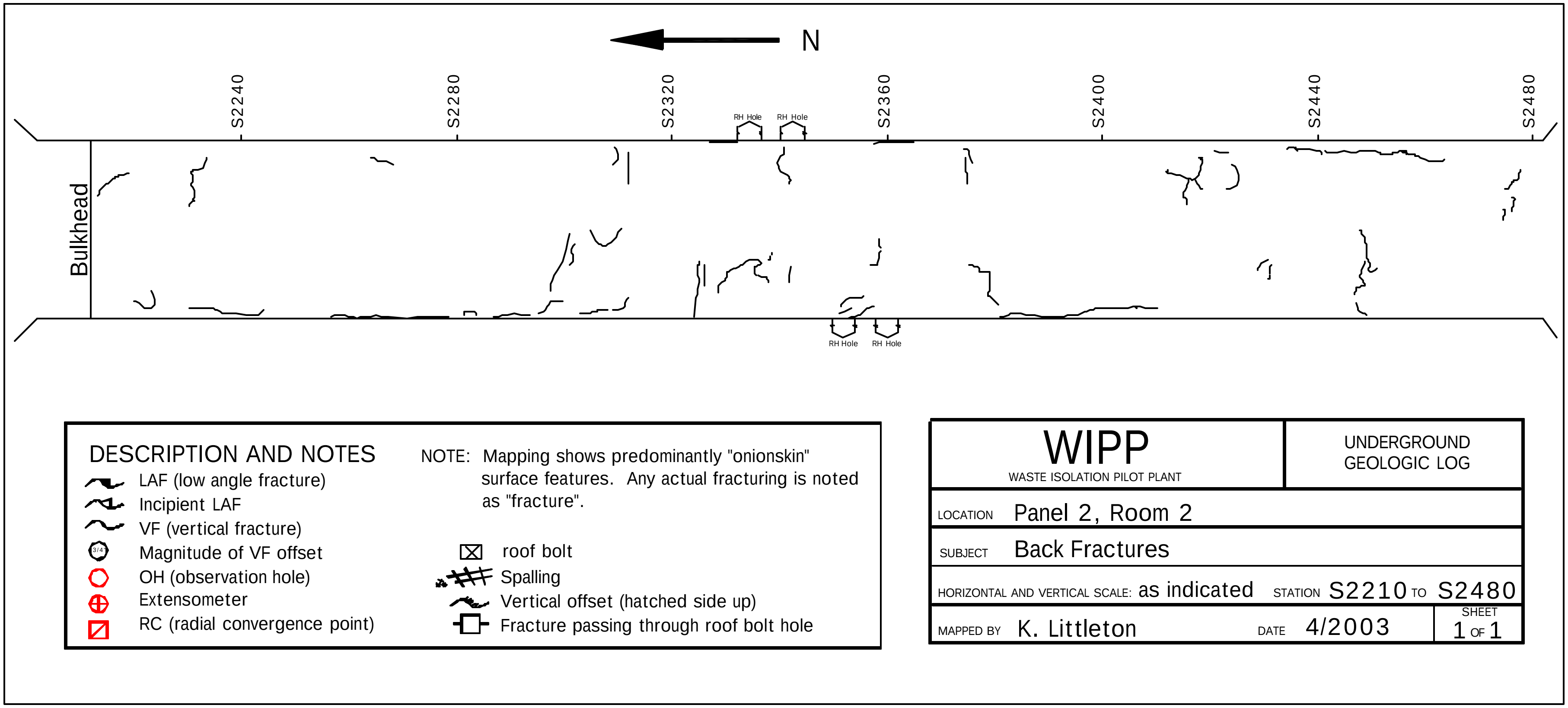


Figure 7-5
Panel 2 Room 2 Back Fractures

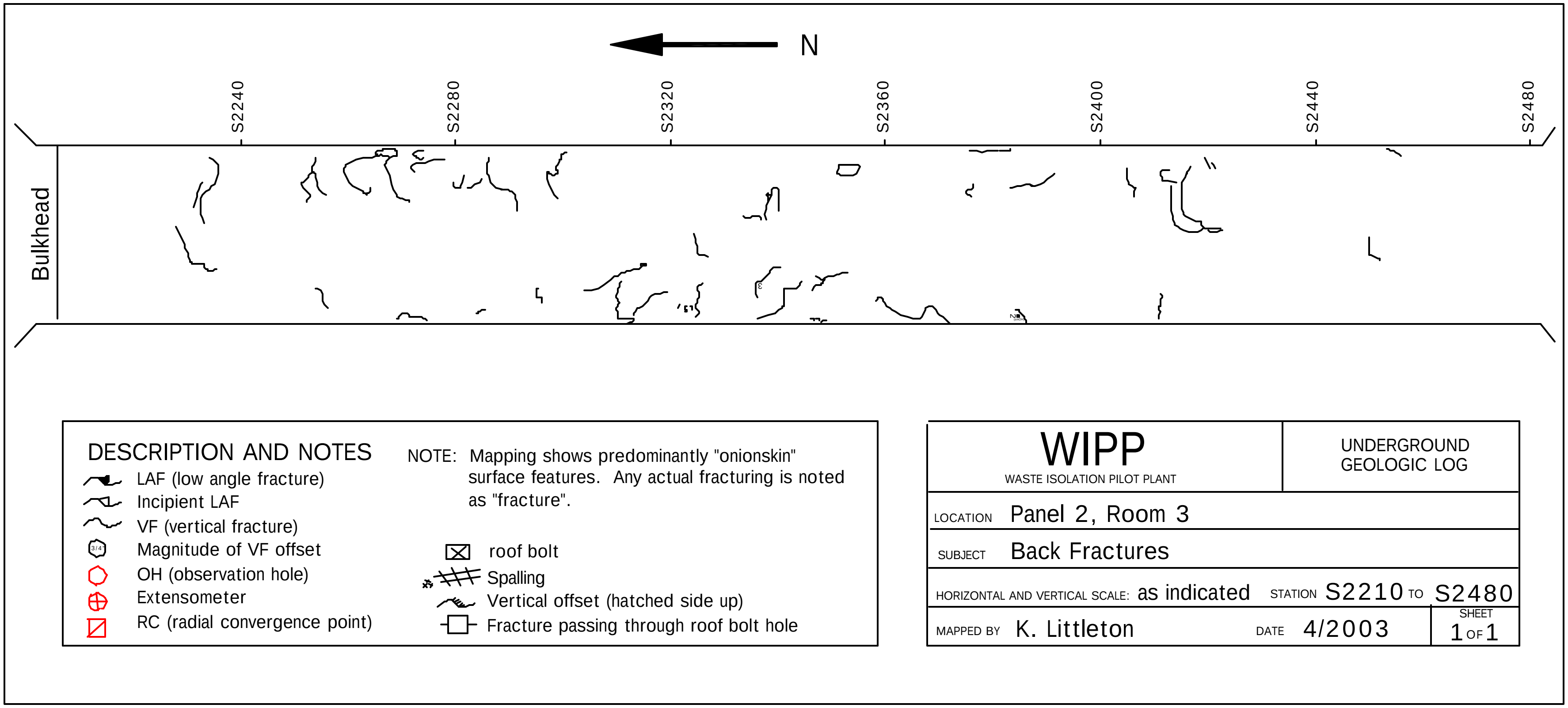


Figure 7-6
Panel 2 Room 3 Back Fractures

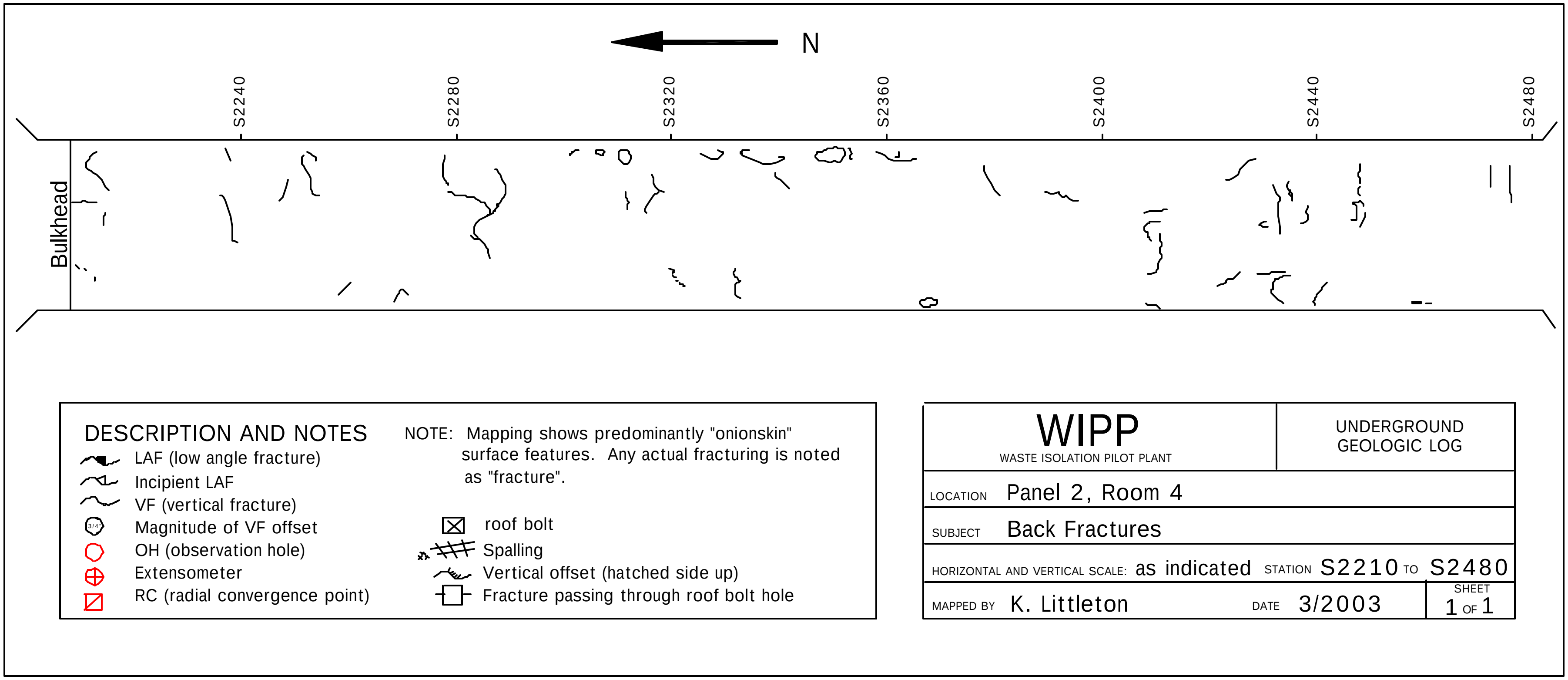


Figure 7-7
Panel 2 Room 4 Back Fractrures

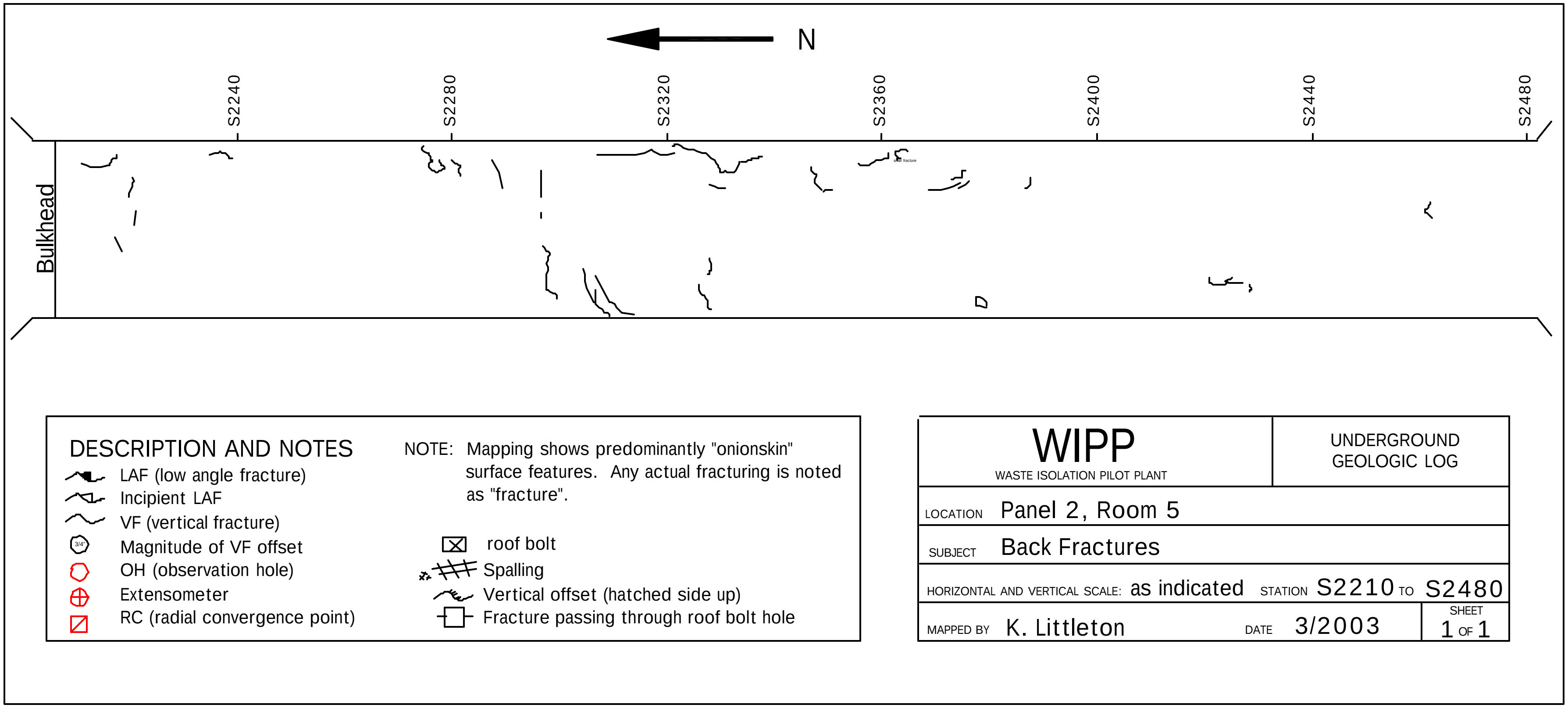


Figure 7-8
Panel 2 Room 5 Back Fractures

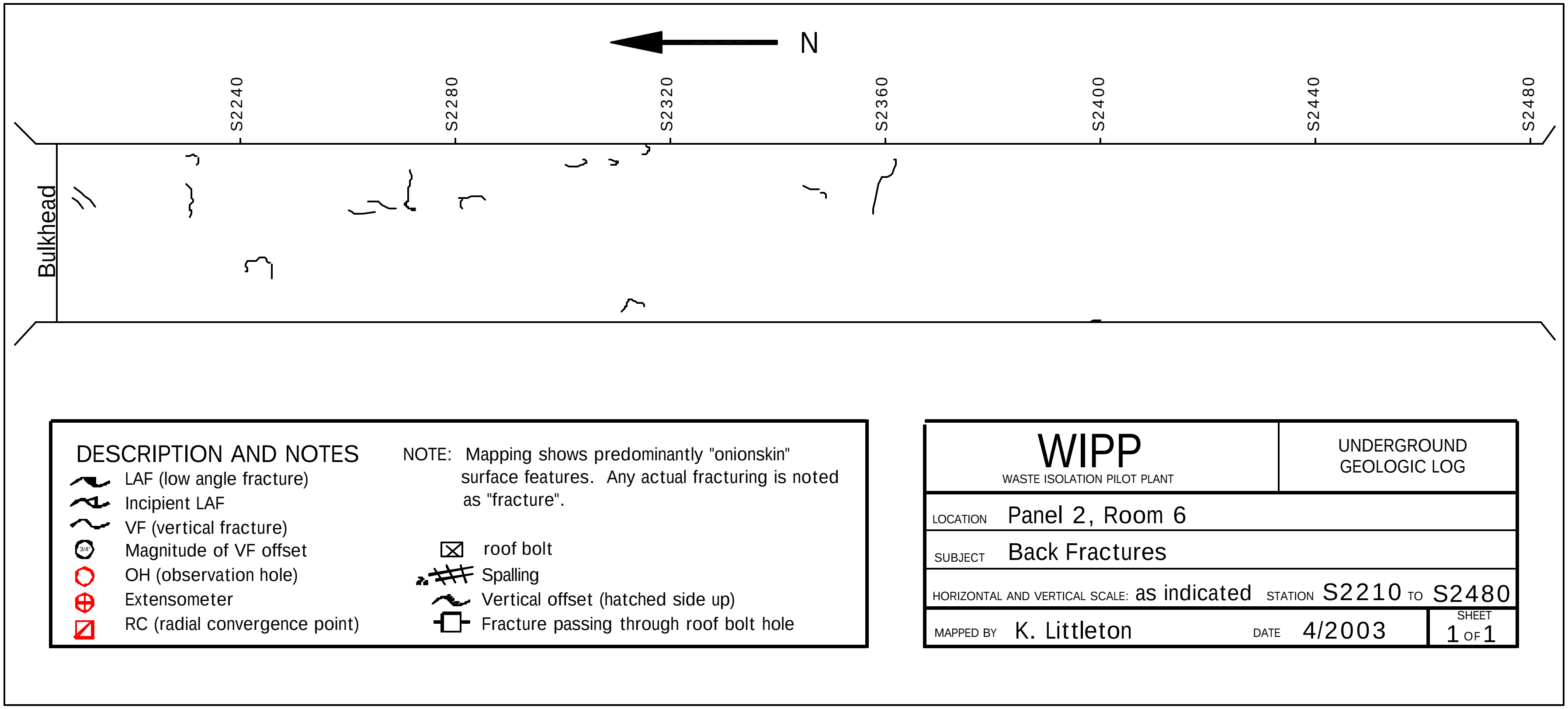


Figure 7-9
Panel 2 Room 6 Back Fractures

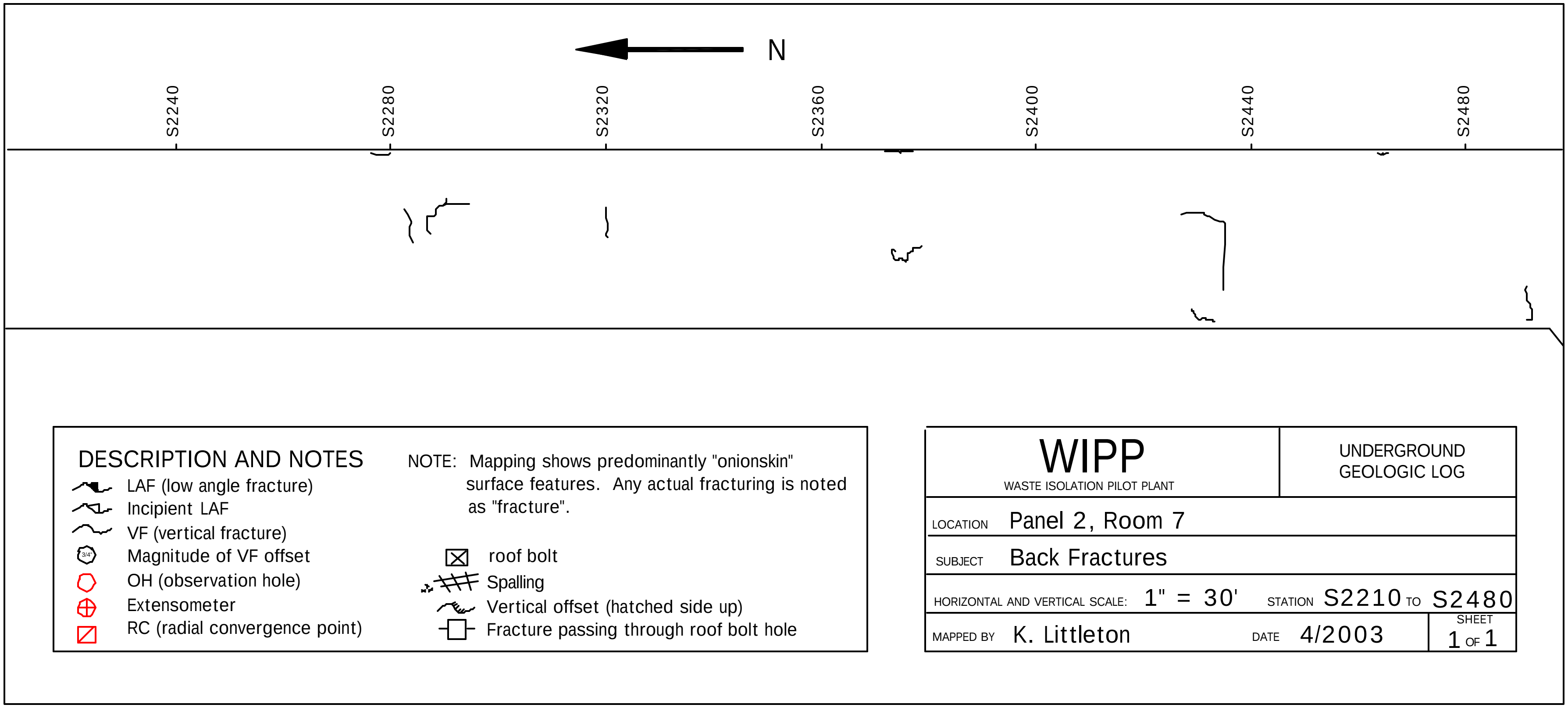


Figure 7-10
Panel 2 Room 7 Back Fractures

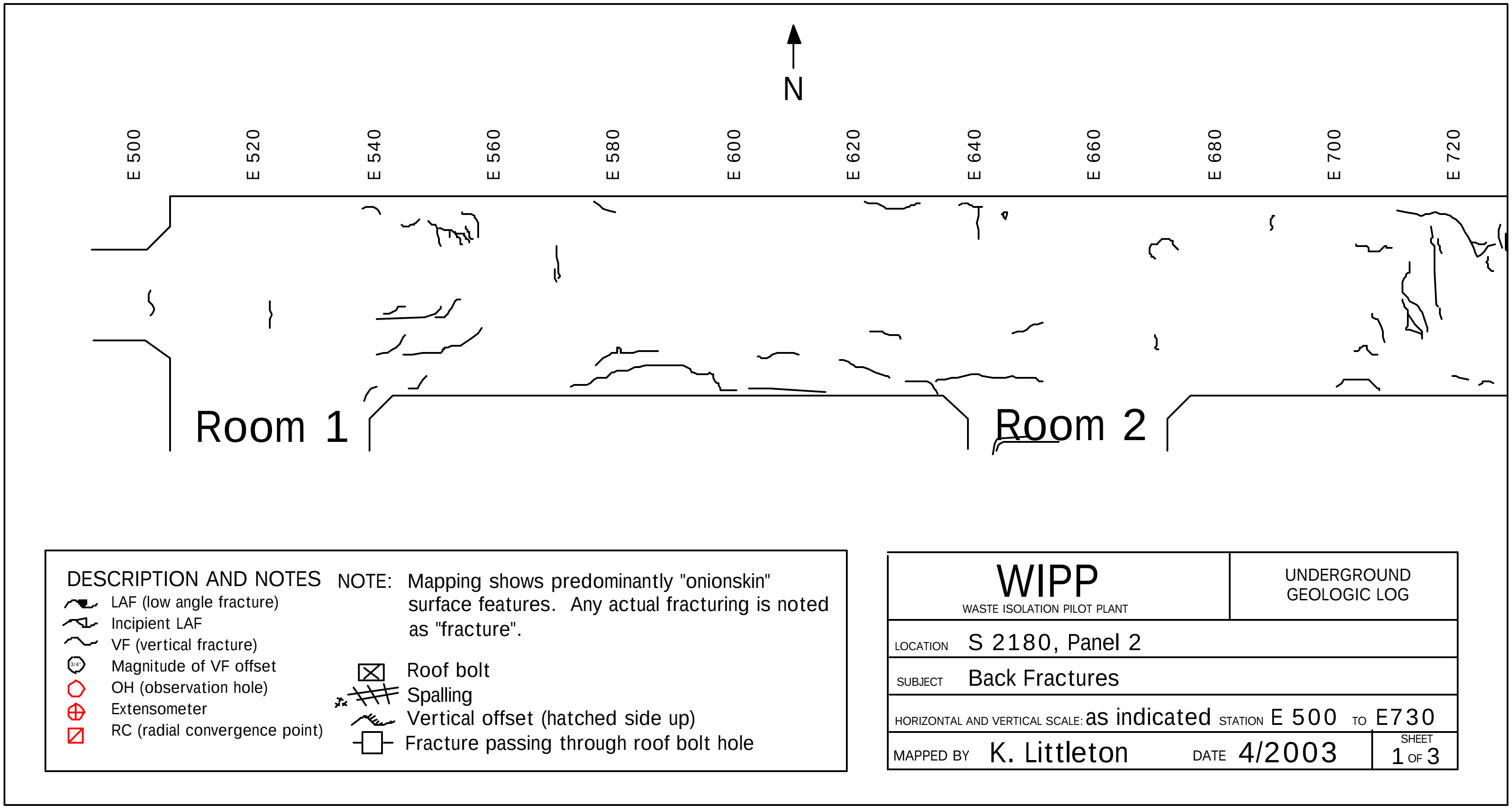


Figure 7-11
Panel 2 South 2180, E500 to E730, Back Fractures

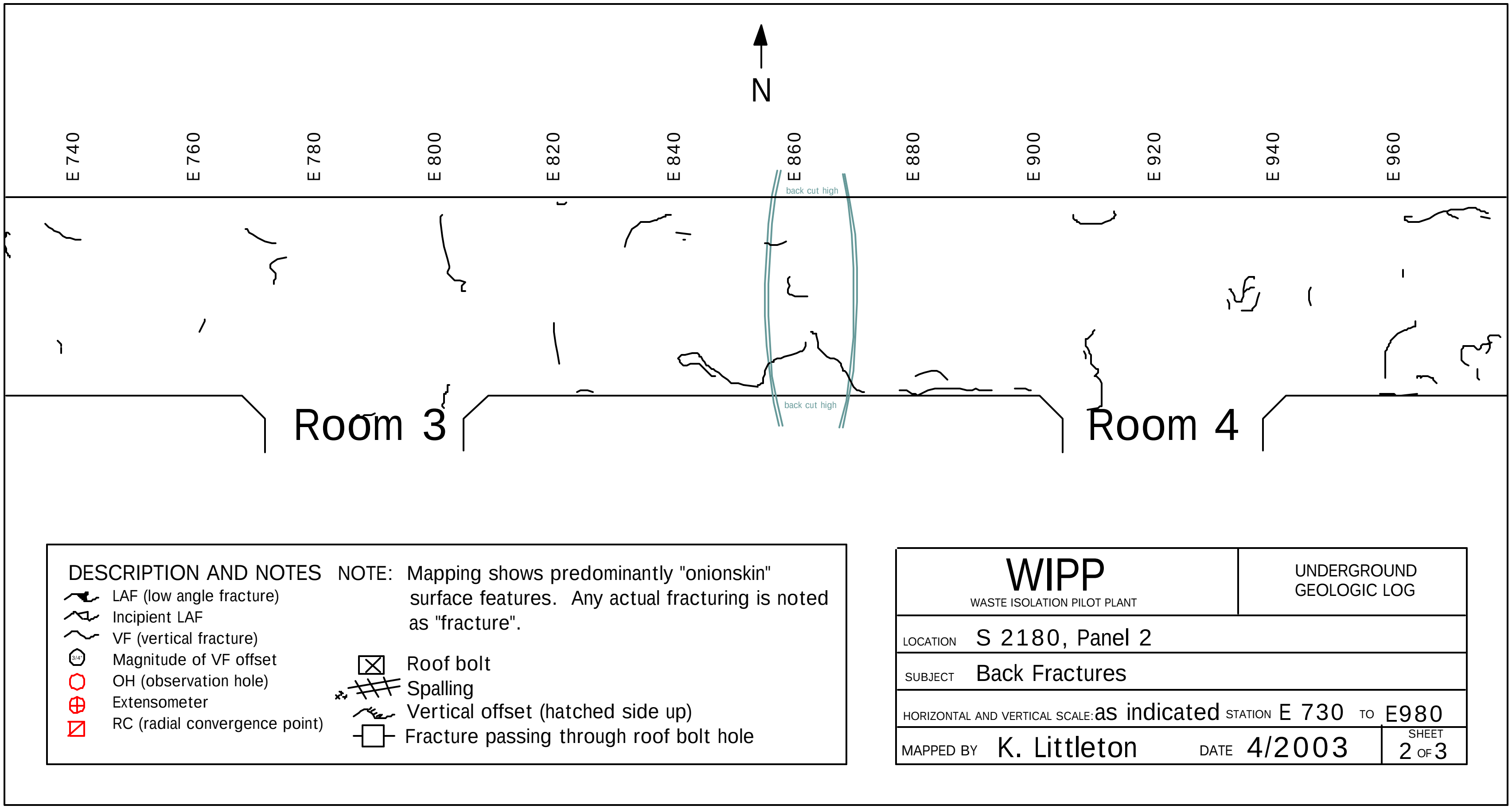


Figure 7-12
Panel 2 South 2180, E730 to E980, Back Fractures

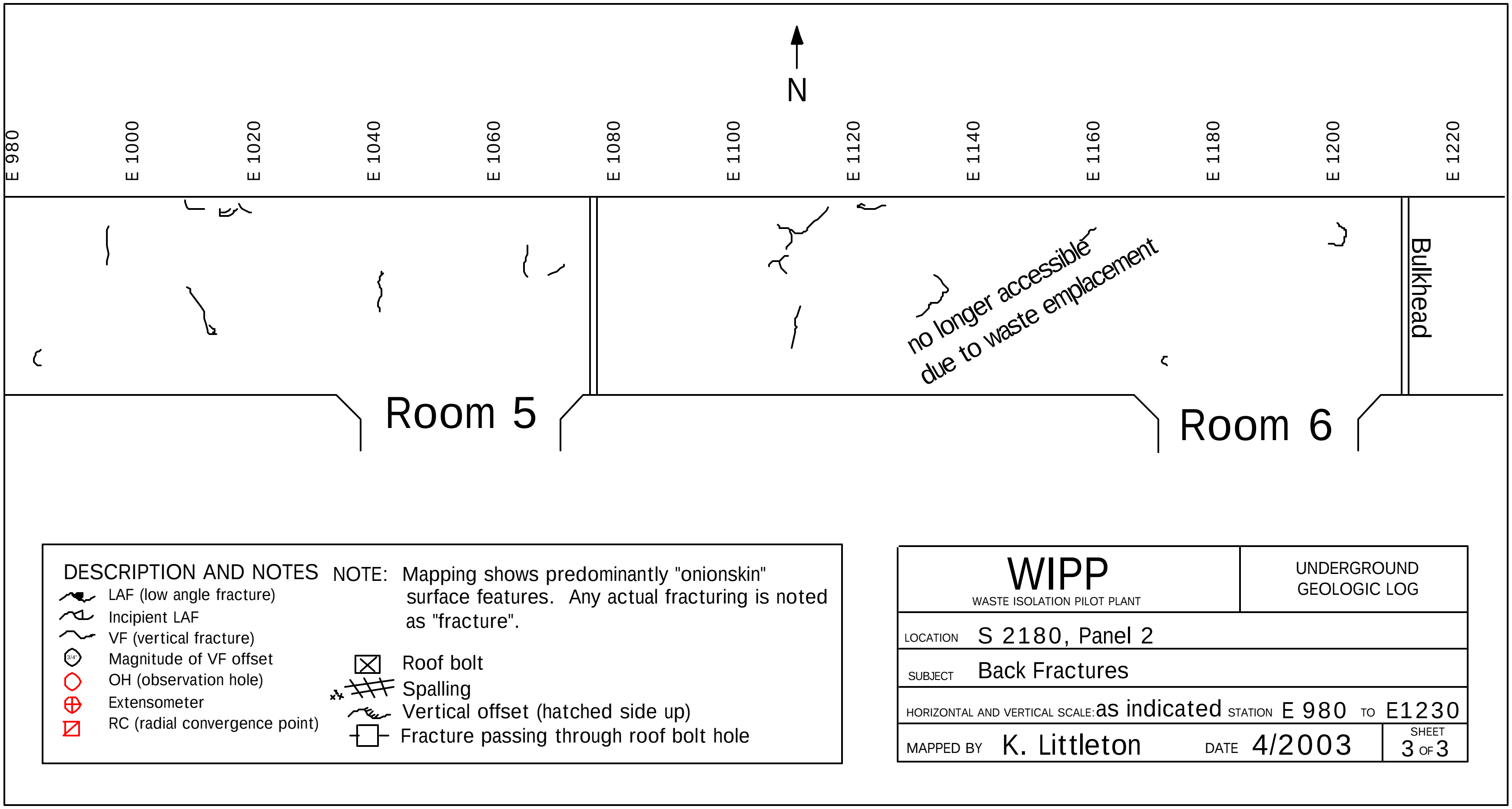


Figure 7-13
Panel 2 South 2180, E980 to E1230, Back Fractures

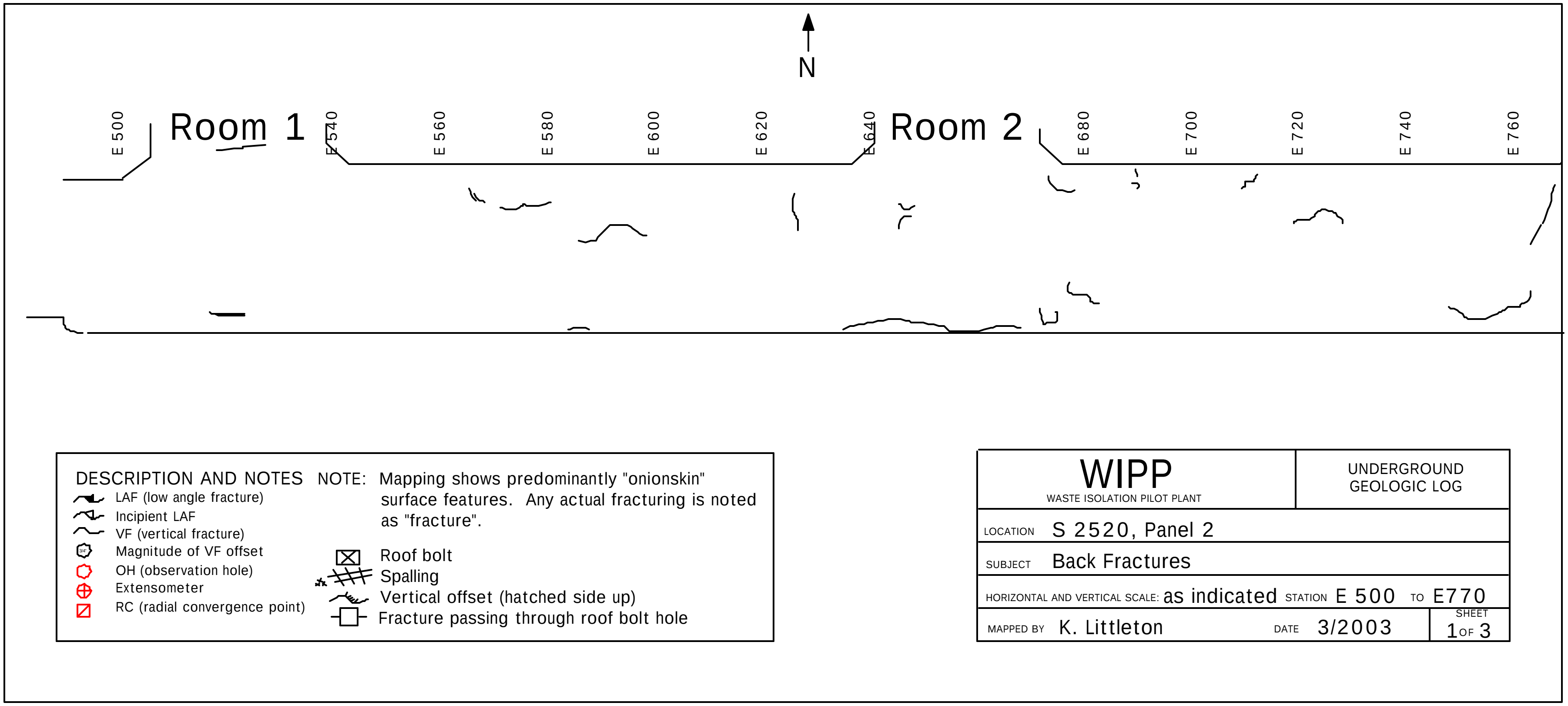


Figure 7-14
Panel 2 South 2520, E500 to E770, Back Fractures

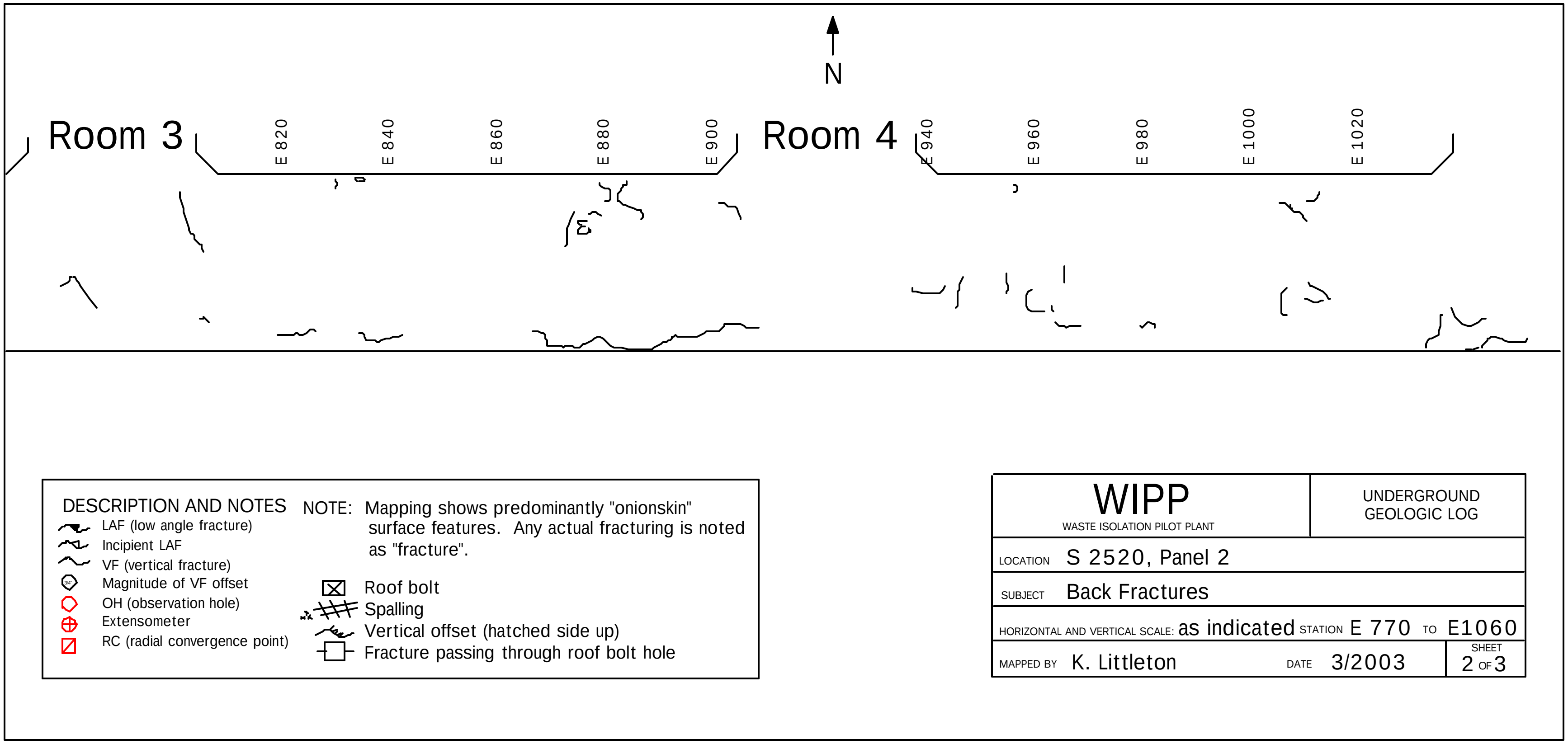


Figure 7-15
Panel 2 South 2520, E770 to E1060, Back Fractures

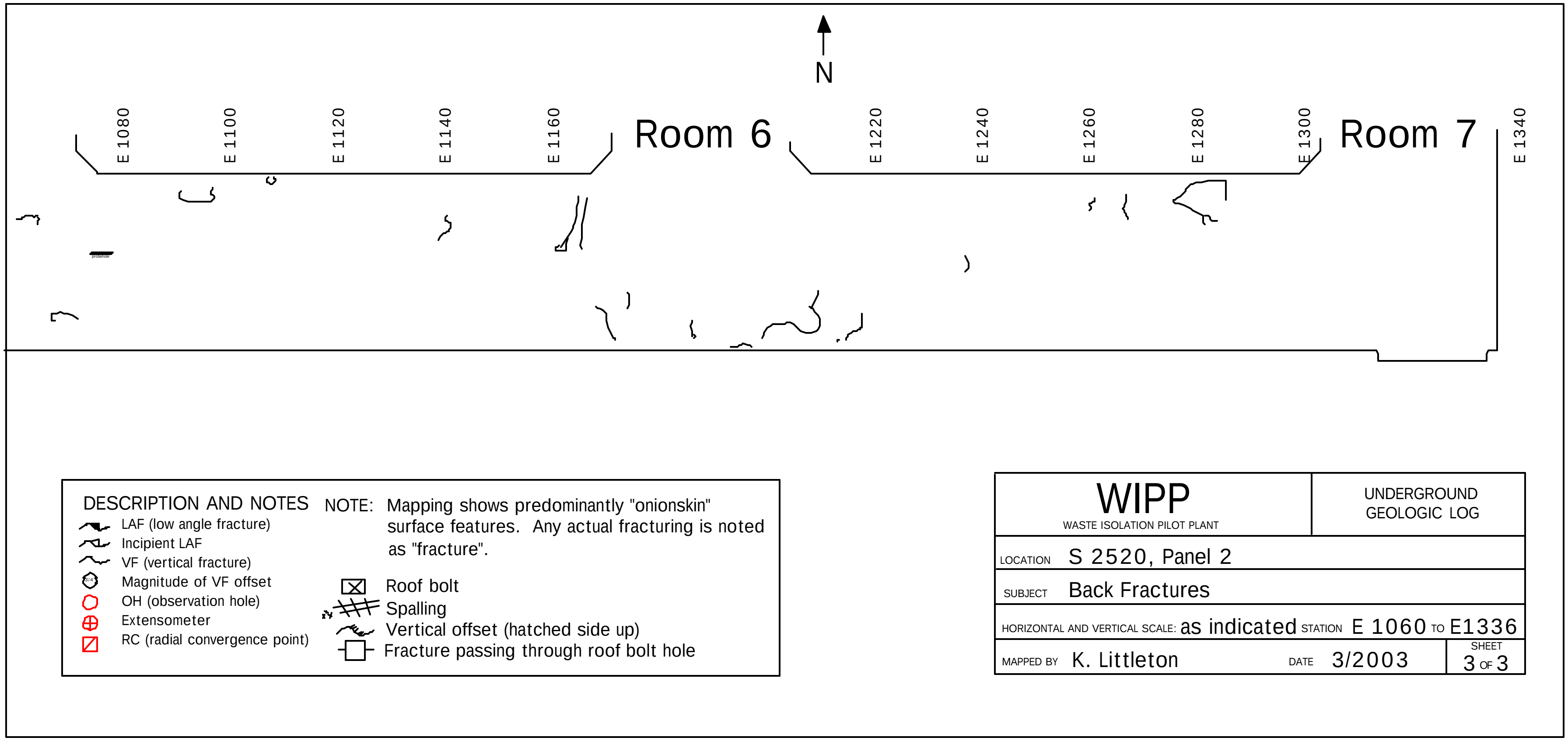


Figure 7-16
Panel 2 South 2520, E1060 to E1336, Back Fractures

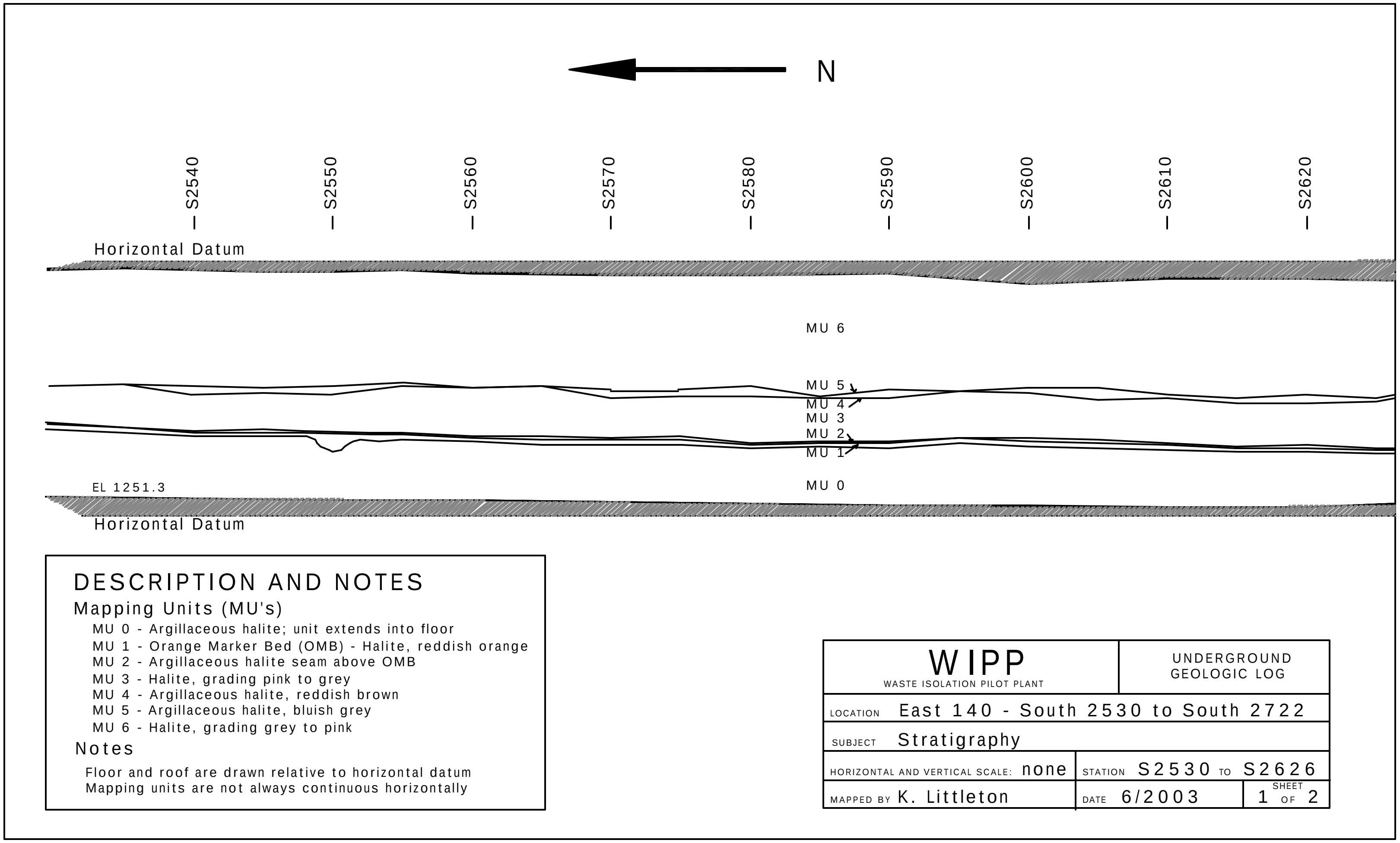
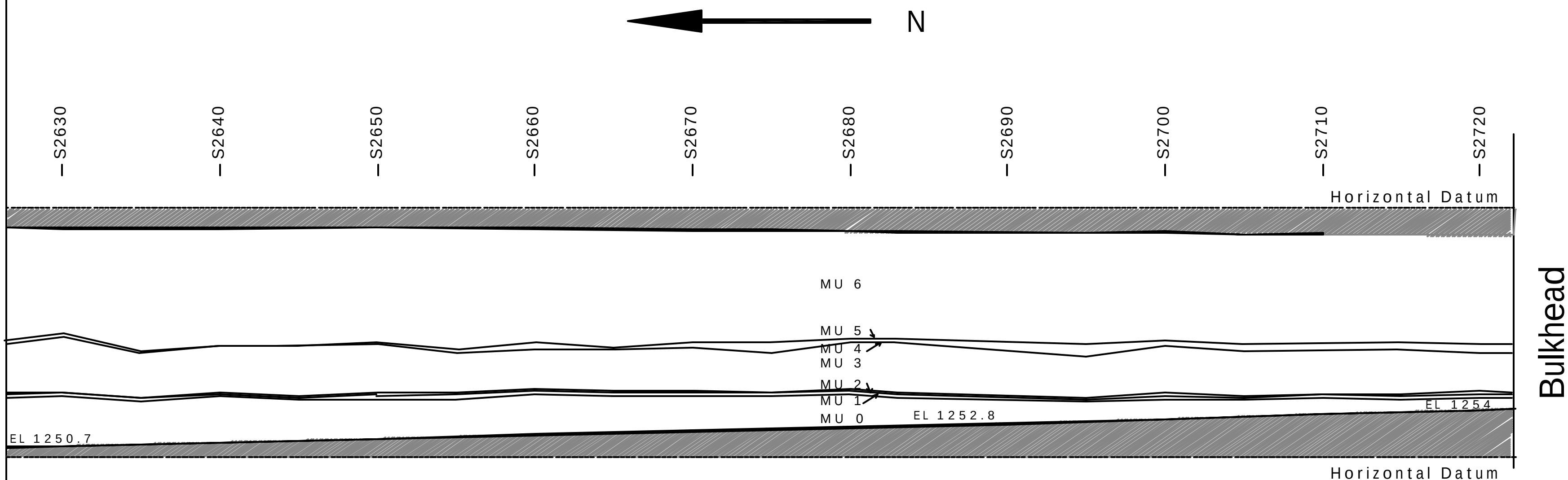


Figure 7-17
East 140, S2530 to S2626, Stratigraphy



DESCRIPTION AND NOTES

Mapping Units (MU's)

- MU 0 - Argillaceous halite; unit extends into floor
- MU 1 - Orange Marker Bed (OMB) - Halite, reddish orange
- MU 2 - Argillaceous halite seam above OMB
- MU 3 - Halite, grading pink to grey
- MU 4 - Argillaceous halite, reddish brown
- MU 5 - Argillaceous halite, bluish grey
- MU 6 - Halite, grading grey to pink

Notes

Floor and roof are drawn relative to horizontal datum
Mapping units are not always continuous horizontally

WIPP WASTE ISOLATION PILOT PLANT	UNDERGROUND GEOLOGIC LOG	
LOCATION East 140 - South 2530 to South 2722		
SUBJECT Stratigraphy		
HORIZONTAL AND VERTICAL SCALE: none	STATION S2626 TO S2722	
MAPPED BY K. Littleton	DATE 6/2003	2 SHEET OF 2

Figure 7-18
East 140, S2626 to S2722, Stratigraphy