

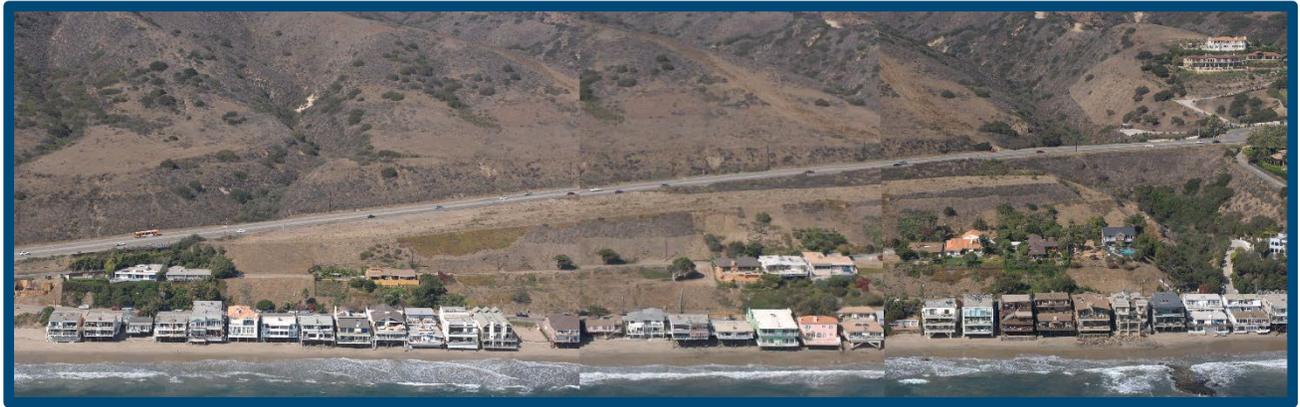
# **FY23/24 Maintenance and Monitoring**

**AD98-3, Malibu Road**

**City of Malibu, California**

Yeh Project No.: 220-278

March 20, 2025



Prepared for:

City of Malibu  
23825 Stuart Ranch Rd.  
Malibu, California 90265  
Attn: Mr. Arthur Aladjajian

Prepared by:

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March 20, 2025

Project No. 220-278

City of Malibu  
23825 Stuart Ranch Rd.  
Malibu, California 90265

Attn: Mr. Arthur Aladjajian, Public Works Superintendent

**Subject: Annual Monitoring and Maintenance Report FY23/24, City of Malibu Assessment District 98-3, Malibu Road, Malibu, CA**

Dear Mr. Aladjajian:

Yeh and Associates, Inc. is pleased to submit this monitoring and maintenance report FY23/24 for the City of Malibu Assessment District AD-3, Malibu Road in Malibu, California. This report was prepared in accordance with our Agreement for Professional Services, dated June 22, 2020 between the City of Malibu and Yeh and Associates, Inc. and Amendment 1, dated June 25, 2024. This report provides a geotechnical and annual summary of monitoring and maintenance for the project over fiscal year July 1, 2023, to June 30, 2024.

The geotechnical services consisted of monitoring and maintenance, data management, public outreach, reporting, and capital improvements. A map showing the location of the maintenance and monitoring facilities are provided on Plate 1. Table 6 provides a summary of maintenance activities performed during the monitoring year.

We appreciate the opportunity to be of service. Please contact Nick Simon at 805-414-0991 or [nsimon@yeh-eng.com](mailto:nsimon@yeh-eng.com) if you have questions or require additional information.

Sincerely,  
**YEH AND ASSOCIATES, INC.**



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## 1. PURPOSE AND SCOPE OF STUDY

Yeh and Associates (Yeh) was retained by the City of Malibu (City) to perform maintenance and monitoring of the existing geotechnical instrumentation and dewatering facilities within the City of Malibu's Malibu Road Landslide Assessment District, 98-3. The project location is shown by the polygon in Figure 1. This report presents monitoring results, a maintenance summary, and facilities status for the (monitoring year) July 2023 through June 2024. Yeh monitors groundwater levels, surveys slope inclinometers, and measures the dewatering flow from dewatering wells and horizontal drains. Yeh also oversees and maintains the function of the monitoring and dewatering facilities. Plate 1 shows the approximate locations of the specific assessment district facilities. Table 1 summarizes the equipment inventory and the approximate frequency of monitoring and maintenance over the monitoring year. Section 5.0 of this report provides a detailed summary of the maintenance activities performed during this monitoring period.



Figure 1: Project Location Map

**Table 1. Summary of Annual Monitoring and Maintenance**

Type of Monitoring Instrument or Dewatering Device	Number of Locations	Brief Description	Monitoring Frequency	Maintenance Effort <sup>2</sup>
Standpipe piezometer	8 <sup>1</sup>	2.75-inch PVC, or other casing, used to measure depth to groundwater using electric sounder or by a transducer/datalogger	monthly; hourly data from pressure transducer	low
Inclinometer survey casings	5 <sup>1</sup>	2.75-inch diameter grooved casings made of PVC, used to survey for shear displacement by an inclinometer probe	quarterly	low
Dewatering wells	14	6-inch or 12-inch diameter steel or PVC casings equipped with 0.5 to 1/3 HP submersible pump and connected to electrical controls, pumped water flows through meter and into conveyance piping to discharge	monthly	high
Horizontal Drains (hydraugers)	19	1-inch to 1.5-inch perforated PVC casings drilled slightly higher than horizontal into the slope along Malibu Road for up to 180 feet and used to drain groundwater that intercepts the casing. Flow rates are measured along Malibu Road.	monthly	medium
Big Rock Mesa Rain Gauge #1239	1	Documented Rainfall, Data obtained from Los Angeles County Public Works	monthly	N/A
Notes: <sup>1</sup> - SI-5 and SI-6 are used as both inclinometers and standpipe piezometer. <sup>2</sup> - maintenance effort (generalized): "high" – services monthly, "medium" – services quarterly, "low" – services annually				

## 2. MONITORING

The following provides the result of water level monitoring in standpipe piezometers and the results of inclinometer surveys performed. For the purposes of discussion and context throughout the report, the monitoring results are discussed with respect to two areas within the 1978 landslide boundaries: Malibu Road and Bayshore Drive:

- Malibu Road Area:** The southern portion of landslide including Malibu Road. The toe of the 1978 landslide is mapped to the south of Malibu Road, obscured beneath shoreline development and residences. The east and west boundaries of the landslide are visible as topographic changes across Malibu Road. Active district monitoring and dewatering facilities are located on the north side of Malibu Road.
- Bayshore Drive Area:** The northern portion of the 1978 landslide that includes the headscarp is still mostly visible along the north side of the vacant parcels east of 25377 Malibu Road and



in the vacant parcel east of 25315 Malibu Road. Active district monitoring and dewatering facilities are located to the north of the 1978 head scarp.

**2.1 GROUNDWATER LEVELS**

Groundwater levels were measured approximately monthly in 8 standpipe piezometers shown on Plate 1. Water levels are acquired by lowering an electric probe into the standpipe to contact the groundwater surface and manually recording the depth to water. Groundwater hydrographs for individual standpipes from historic through the end of the current monitoring year are presented in Appendix A.

Pneumatic piezometers were installed with some of the inclinometers until 1998. Most of the existing pneumatic piezometers no longer function and the reliability of remaining locations are not certain. Pneumatic piezometers were not measured during the monitoring year. Appendix A includes historic pneumatic piezometer results.

Table 2 summarizes the average groundwater levels over the monitoring year for standpipe water levels within the two areas, their change from the prior monitoring year average, and their change from the historical average. The average annual groundwater elevation for the Malibu Road Area increased by 1.5 feet and the Bayshore Drive Area average groundwater elevation increased by 2.0 feet. In general, water levels in most individual standpipes in both areas increased following the December 2023 through May 2024 rainfall and are discussed by area in the following sections:

**Table 2: Summary of Average Groundwater Elevations<sup>1</sup>**

Area Averaged	Total No. of Standpipes Monitored	2023-2024 Averaged Groundwater Elevation (ft)	Change in Averaged Groundwater Elevation from Prior Monitoring Period (ft)	2023-2024 Average Annual Groundwater Elevation (ft) Vs Historical Mean Average Annual Groundwater Elevation
Malibu Road	6	8.8	+1.5	+0.6
Bayshore Drive	2	26.6	+2.0	+1.2

Notes: <sup>1</sup> Comparison between the current and prior monitoring periods for the eight standpipe piezometers measured during the current monitoring period, except W-2A which had been dry from 2014 until January 2023 and is not included

**2.1.1 MALIBU ROAD AREA**

Six standpipes and two abandoned dewatering wells along the north shoulder of Malibu Road are used for groundwater level monitoring in the Malibu Road Area. Six of the monitored standpipes water levels were essentially static or declining through the beginning of the monitoring year and all measured increases after the December 2023 through May 2024 rainfall that remained elevated through the end of monitoring year. Standpipe W-2A had been dry since approximately 2014 and recorded a measurable water level beginning in January 2023. Yeh will continue to monitor to



confirm the measurements in W-2A are reliable water levels. Water level information for individual Malibu Road Area standpipes are included on Table 3.

**Table 3: Malibu Road Area Water Level Monitoring**

Standpipe ID	Change in Groundwater Elevation between last and first measurements of monitoring year (ft)	2023-2024 Average Groundwater Elevation (ft)	Change in Average Groundwater Elevation from Prior Monitoring Year (ft)	1991-2024 Historical Mean Groundwater Elevation (ft)	2023-2024 Average Groundwater Elevation from Historical Mean Groundwater Elevation (ft)
PZ-A	+0.3	10.8	+1.0	9.5	+1.3
PZ-B	-0.4	5.5	+1.4	2.6	+2.9
PZ-C	-0.9	4.8	+0.1	3.9	+0.9
PZ-D	+1.3	7.6	+1.8	5.2	+2.4
PZ-E	+0.1	15.2	+3.4	12.5	+2.7
W-2A	+0.1	13.1	+0.0	N/A	N/A

**2.1.2 BAYSHORE DRIVE AREA**

Two standpipes are used for groundwater level monitoring in the Bayshore Drive Area. Water levels in Standpipe SI-5 had continued to decline since November 2021 until rising in response to the above average rain totals in February and March 2023. Measured water levels in SI-5 generally remained elevated over pre-2023 rain season levels; however, the data appears to indicate the water levels have started to decline after April 2024. Water level measurements in Standpipe SI-6 declined from June through February 2024 and then rose approximately 3.0 feet in response to rainfall. Water levels in SI-6 remain elevated over pre-2023 rain seasons. Table 4 presents groundwater change data for individual standpipes in the Bayshore Drive Area.

**Table 4: Bayshore Drive Area Water Level Monitoring**

Standpipe ID	Change in Groundwater Elevation between last and first measurements of monitoring year (ft)	2023-2024 Average Groundwater Elevation (ft)	Change in Average Groundwater Elevation from Prior Monitoring Year (ft)	1991-2024 Historical Mean Groundwater Elevation (ft)	2023-2024 Average Groundwater Elevation from Historical Mean Groundwater Elevation (ft)
SI-5	+8.5	25.1	+1.7	23.7	+1.4
SI-6	+0.3	28.1	+2.3	27.1	+1.0



## 2.2 SLOPE INCLINOMETERS

### 2.2.1 SUMMARY OF SLOPE INCLINOMETER MONITORING EVENTS

Yeh surveyed five inclinometers during the monitoring year. Inclinometers are surveyed approximately quarterly or on an accelerated schedule if movement is interpreted. Inclinometers were surveyed using a vertical traversing probe that measures the tilt of the casing at 2-foot intervals. Inclinometer data were collected via Bluetooth onto a field tablet and processed by comparing each tilt measurement to previous surveys.

Inclinometer data processing and presentation utilized DigiPro2 software (Slope Indicator, 2014). Updated baselines are generally used following a change or repair to the cable and/or servicing of the inclinometer probe sensors and carriage. Appendix B includes an inventory of District inclinometers with a summary of past movements as well as annotated plots of cumulative change and incremental change in the A and B directions for each inclinometer surveyed during the monitoring year.

A summary of key observations over the Monitoring Year include:

- The onset of new shear-type movement on the order of 0.2 inches or less was detected in inclinometers SI-1A, -2A and -4A during the Q1 surveys. No movement was recorded in SI-5 and SI-6.
- Yeh accelerated the inclinometer survey schedule from quarterly to monthly for key inclinometers starting January 2024 as a precaution based on past slope behavior in response to rainfall. The schedule was further accelerated to weekly after shear displacement was detected during the February 13, 2024 surveys. The accelerated survey schedule will be continued until no new shear displacement is detected over 3 consecutive weekly surveys.
- Table 2 summarizes the results of the surveys inclinometers SI-1A, -2A, -4A, -5 and -6 between January 11 and March 22, 2024. The surveys measured shear displacement with depths and directions consistent with the previous landslide shear zones. Most of the displacement occurred during the period between February 13 and 21, 2024 and smaller amounts of displacement occurred between February 21 and 28, 2024.
- Results of the surveys performed March 7, 13 and 22, 2024 indicate displacement has ceased or slowed to below the measurement accuracy threshold for the survey probe.

**Table 5: Summary of Inclinator Survey Results**

Facility ID	Interpreted Shear Displacement (inches)								Cumulative For 23-24 Monitoring Year	Depth of Interpreted Shear (feet)
	6/9/23 to 1/11/24	1/11/24 to 2/7/24	2/7/24 to 2/13/24	2/13/24 to 2/21/24	2/21/24 to 2/28/24	2/28/24 to 3/7/24	3/7/24 to 3/13/24	3/13/24 or 3/7/24 to 9/16/24		
SI-1A	none	none	<0.01	<0.01	<0.01	none	none	none	0.02	28
SI-2A	none	<0.01 (possible)	0.03	0.09	0.04	<0.01 (possible)	Access Blocked	none	0.16	32-34
SI-4A	none	none	0.03	0.12	0.05	<0.01 (possible)	Access Blocked	none	0.20	30-34
SI-5	None	none	N/R	N/R	none	none	N/R	N/R	none	N/A
SI-6	None	none	N/R	N/R	none	none	N/R	N/R	none	N/A

### 3. WATER BUDGET TRACKING

#### 3.1 RAINFALL DATA

Yeh obtained rainfall data for the monitoring year from the Big Rock Mesa Rain Gauge #1239 operated by the Los Angeles County Department of Public Works (LADPW). Prior to 1984, rainfall data was obtained from the Carbon Canyon Rain Gauge #447C and after 1984 from the onsite Big Rock Mesa Rain Gauge #1239. For this report, a 40-year rainfall average of 16.44 inches from the Big Rock Mesa Rain Gauge is used as an annual average.

Plate 2 - Rainfall Graph displays historical monthly and water year annual rainfall from October 1968 through September 2024. Recorded rainfall over the monitoring year from July 1, 2023 to June 30, 2024 totaled 32.37 inches, which is 15.93 inches above the 40-year Big Rock Mesa Rain Gauge running average of 16.44 inches. The recorded rainfall total for the water year from October 1, 2023, to September 30, 2024 totaled 27.92 inches.

This year was the second consecutive year of above average rainfall. The monitoring year’s rainfall total of 32.37 inches was the most recorded since 2005. The monthly total for February 2024 of 14.88 inches was the most recorded in a month since 17.0 inches was recorded at the Carbon Canyon Rain Gauge in February of 1998.

Plate 4 – Discharge Rates vs Rainfall Totals presents rainfall deviation from the 40-year mean and compares rainfall amounts to total dewatering output.



### **3.2 DEWATERING**

Yeh tracks dewatering production for the pumping dewatering wells installed across the district and the horizontal gravity drains (hydraugers) installed in the slope face along Malibu Road. The 2023-2024 monitoring year total dewatering production averaged 4,150 gpd, which is an increase of 214-percent from the previous monitoring years' average production of 1,935 gpd and was the highest annual average dewatering production since the 2004-2005 monitoring year. The increase in production was a response to the above average rainfall from December 2023 through March 2024. Seventy percent of the total dewatering production was pumped from dewatering wells and thirty percent was from hydraugers.

#### **3.2.1 DEWATERING WELL PRODUCTION**

Yeh performed monthly monitoring for discharge rates of the 14 active district dewatering wells. Well production is measured approximately monthly for each well by reading flow totalizers that are installed along the discharge line. A summary of well status for individual wells is included on Page C-1 and graphs of historical production and of this year's annual production versus daily rainfall totals are included in Pages C-2 through C-3. A graph showing total production since 1992 is included on Plate 3.

During the monitoring year, the average total well production was 2,909 gpd which is 179-percent higher than last year's average production of 1,624 gpd, 230-percent higher than the historical production average of 1,263 gpd calculated from 1991 to present and was the highest production since the 2004-2005 monitoring year.

Plates C-2a and C-3a present data that indicate that well production typically varies in response to rainfall totals. The dewatering well production increase over this monitoring year is consistent with the high rainfall totals this monitoring year at the project.

### **3.3 HYDRAUGER PRODUCTION**

Hydrauger production is measured directly from a sampling port installed on each hydrauger. Yeh performed monthly monitoring to measure flow from 19 hydraugers, of which only two locations have recorded consistent flow in recent years. Most of the hydraugers flow intermittently in response to rainfall. An inventory and status for individual hydraugers is included in Appendix C-1 and graphs of historical production and of this year's annual production versus daily rainfall totals are included in Pages C-4 through C-5. A graph showing total hydrauger production since 1992 is included on Plate 4.

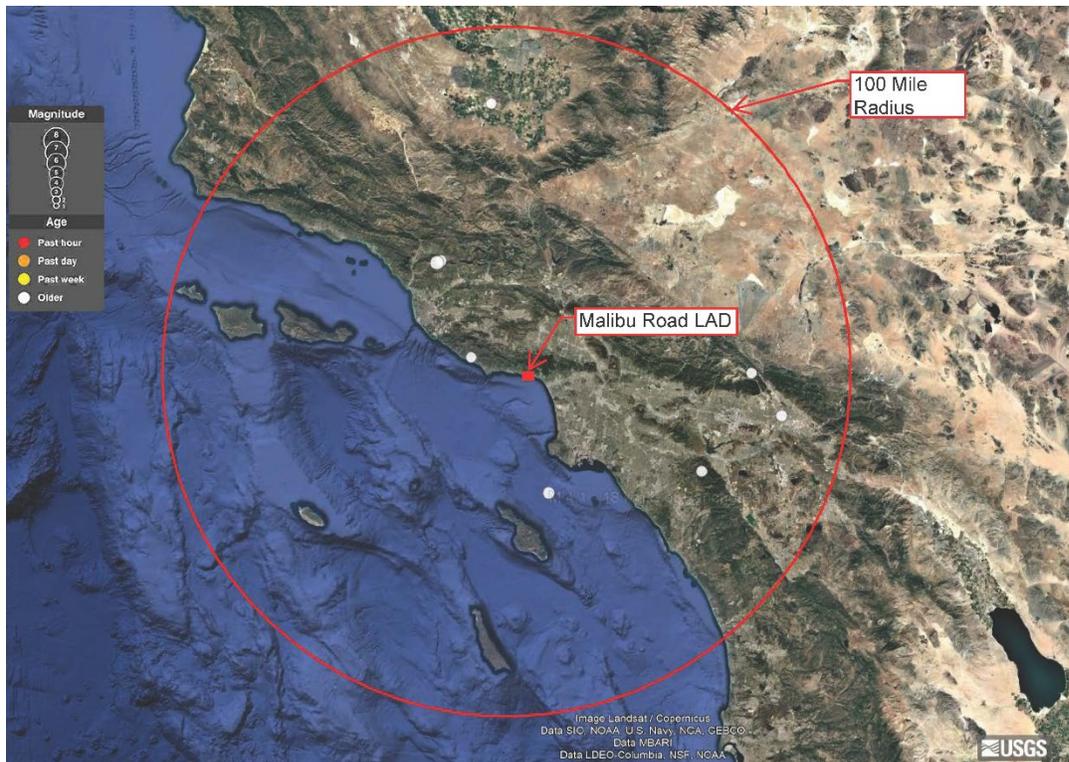
During the monitoring year, the average monthly hydrauger production was 1,241 gpd which is approximately 398-percent more than last year's average monthly production of 311 gpd and 160-



percent more than the historical production average of 777 gpd calculated from 1991 to present. Over the monitoring year, 89-percent of all hydrauger production was from five hydraugers with five other hydraugers producing only intermittently. Hydrauger production was highest in January in response to December 2023 and early January 2024 rainfall and flow volume remained elevated through the end of the monitoring year.

#### 4. SEISMIC EVENTS SUMMARY

Eight earthquakes with a magnitude of 4.0 or greater were recorded within a 100-mile radius of the project area (USGS). Earthquake magnitudes ranged from M4.09 to M5.08 with epicentral distances ranging from 16.6 to 79 miles. The largest event was reported as M5.08 that occurred August 20, 2023, and was located 37 miles to the northwest, near Ojai, CA.



**Figure 2: M4.0+ earthquakes within 100-miles of Malibu Road LAD between 7/1/2023 and 6/30/2024**

Yeh personnel performed post-earthquake observations and measurements that included survey of key inclinometers and/or field observations of the ground surface made during scheduled monitoring and maintenance before and after the earthquake events. Small movement measured on inclinometers that occurred during the monitoring year cannot definitively be attributed to seismic activity. Yeh staff did not observe surface displacements related specifically to the earthquakes and is unaware of any reports of damage local to the Malibu Road Landslide AD resulting from the earthquakes.

## 5. MAINTENANCE AND CAPITAL IMPROVEMENTS

A summary table of the maintenance and capital improvement activities performed over this monitoring year is provided on Table 6. Typical maintenance activities to dewatering wells include assessing and replacing or repairing dewatering well pumps, well electronics and well controls; Typical maintenance to hydraugers included PVC repairs within the conveyance piping for discharge. Capital improvements include replacement and rehabilitation of existing facilities and special projects to improve the monitoring and maintenance capabilities.

**Table 6: Summary of Maintenance and Capital Improvements**

Date Noted	Maintenance Item Description	Assessment	Status
7/7/2023	HD-9 leak	Assess HD-9 casing leak close to where it daylights from the hillside and close to where it connects to the conveyance line. Causing water to pool on road shoulder	HD-9 leak repaired and conveyance rerouted to prevent future damage
1/11/2024	Leaking conveyance at HD-19	Excavate buried conveyance locate leak	Section of PVC replaced and line reburied
2/7/2024	Routine well check	Routine well check all wells	Check production, Amps and Volts
2/27/2024	HD-6, 7, 8, and 8A leaking.	Excavated and located clogged conveyance to MTD -9	Excavated and replaced damaged conveyance, used drain snake to clear blockages
2/27/2024	HD-20 leaking, water pooling onto shoulder	Excavated and assessed, HD-20 is a broken hydrauger that reactivated from the rain and is not connected to conveyance	Re-attached HD-20 to the conveyance line.
2/29/2024	W-8 leaking discharge after returning 2/27 repair	Excavated multiple broken segments of W-8 PVC discharge line	Repaired or replaced broken discharge segments, existing segments cleared with drain snake.
3/8/2024	W-8 low production reading	Assess pump, flow meter found broken	Excavated meter and well vault that was filled with mud from recent storm Installed new 1" meter
3/20/2024	Abandoned well W-1 cover damage	Abandoned well W-1 cover was damaged by heavy equipment clearing mud along Malibu Road	Repaired by welding temporary plate over well vault
5/1/2024	Well W-12/-14 conveyance line leaking, water pooling and infiltrating into vacant lot	Assess two breakages in the above ground conveyance line, most likely caused by recent clearing/grubbing of lot by others	Repaired broken conveyance line segments

## 6. ADDITIONAL OBSERVATIONS AND MONITORING

The following additional field observations were made by Yeh staff over the monitoring year that will continue to be considered and tracked for future improvement projects.



- Rainfall totals for the 2023-2024 monitoring year were the highest since the 2004-2005 monitoring year.
- In January 2024 persistent seepage and spring flow was noted on the slope and pavement along Malibu Road in an area approximately 150 feet long and approximately across from addresses: 25362 and 25366 Malibu Road. Observed flow appeared to increase until early March 2024 and then gradually dried. By June 2024 the area remained moist but was no longer flowing. Yeh and the City coordinated with LADPW to brace the cribbing for the above ground water line that traversed the seep zone.
- Yeh is working with staff at the Los Angeles County Department of Public Works (LACDPW) to coordinate the timing of District facility maintenance and improvements with LACDPW's repair to the existing water main.

## **7. CAPITAL IMPROVEMENTS AND SPECIAL PROJECTS**

### **7.1 WORK IN PROGRESS**

The following capital improvement and special projects have been estimated and are in planning and implementation phases.

- Install in-place shape array sensors across known zones of displacement within inclinometers SI-4A. Materials and instrumentation will be procured and installed during next fiscal year.

### **7.2 FUTURE IMPLEMENTATION**

The following improvement projects have been identified and are being tracked and planned for future consideration.

- A modern form of repeatable surface survey should be re-introduced and continued for the project as a consistent means to observe and evaluate potential land movement throughout the extent of the assessment district area and more specifically in-between inclinometer casing locations.
- Plan and design for stormwater improvements to reduce stormwater and debris infiltration onto the undeveloped ground between Malibu Road and Highway 1.
- Coordinate a solution to repair or replace the obstructed and damaged storm drain on Bayshore Drive.
- Replace Inclinometer SI-3, install new inclinometer with a vibrating wire piezometer and a time domain refractometry cable.
- Upgrade dewatering well flow meters with near real-time data transmission capability.

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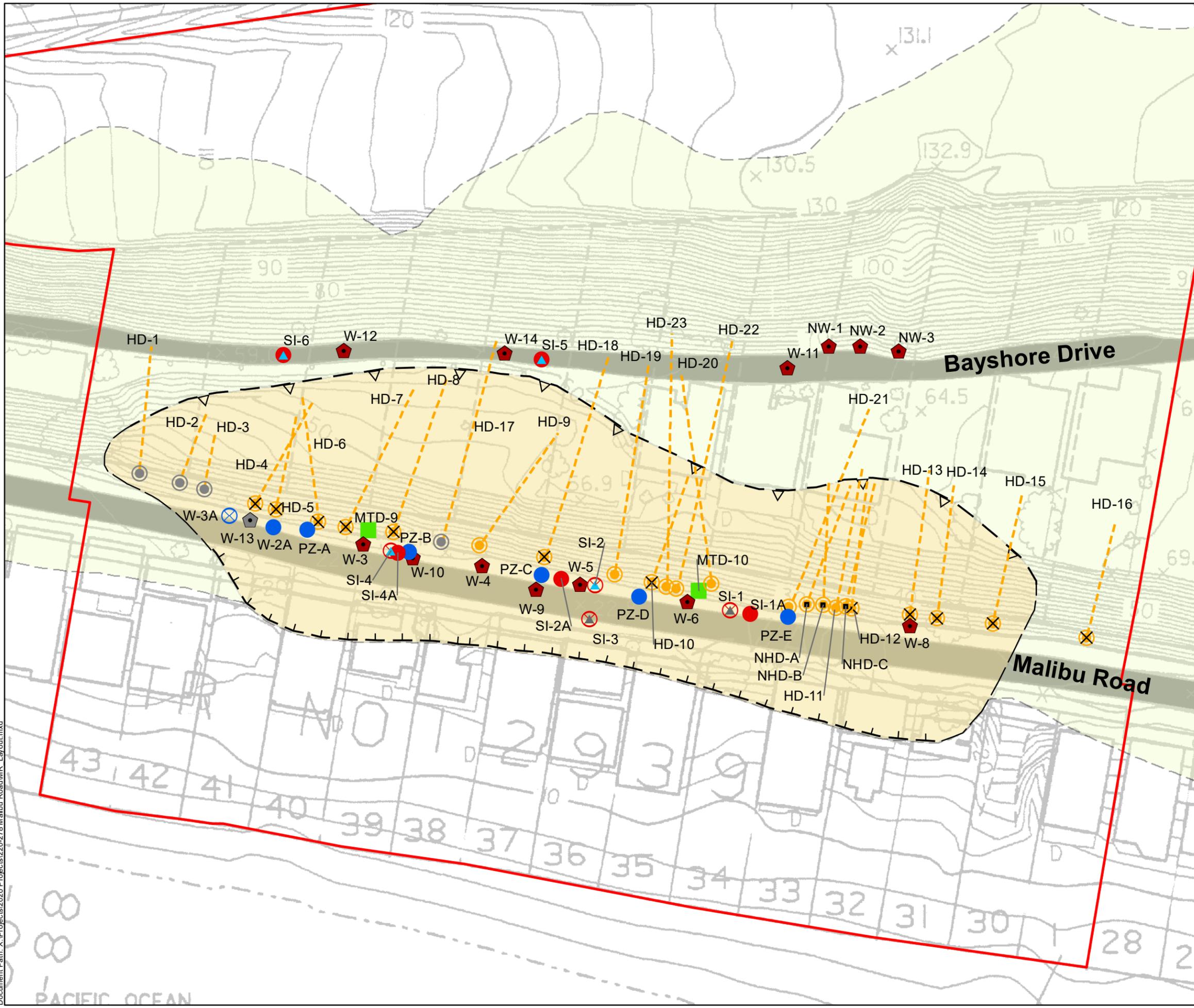
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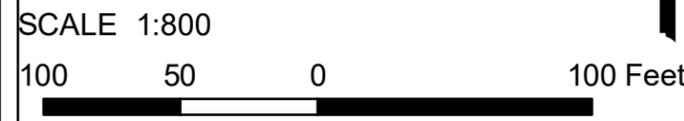


# MALIBU ROAD LANDSLIDE ASSESSMENT DISTRICT MALIBU, CALIFORNIA

## MONITORING INSTRUMENTATION AND DEWATERING FACILITIES MAP

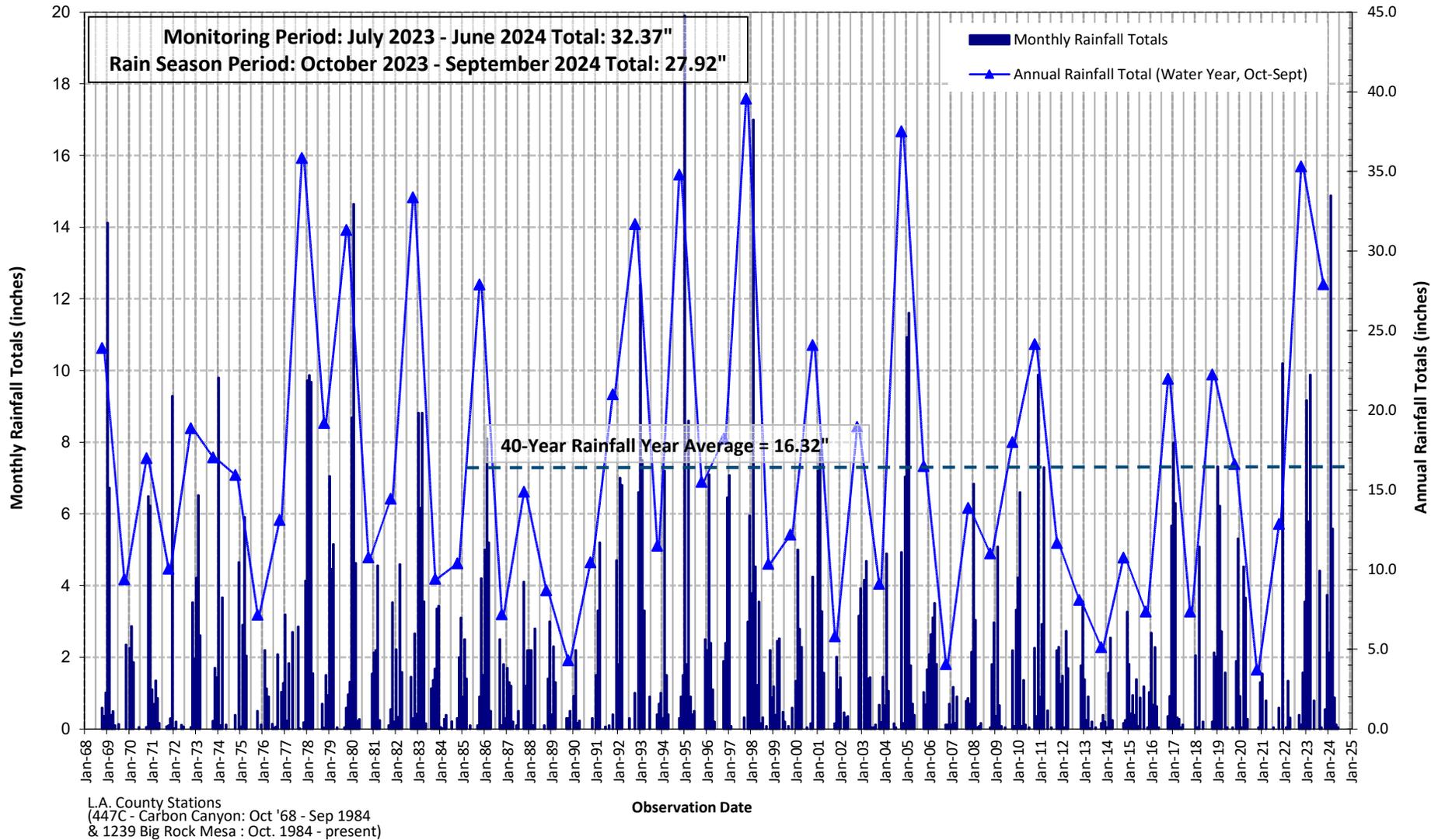


- Dewatering Well
- Dewatering Well (out of service)
- Slope Inclinator/Standpipe Piezometer
- Slope Inclinator/Standpipe Piezometer (standpipe only, not usable for inclinometer)
- Standpipe Piezometer
- Standpipe Piezometer (buried)
- Pneumatic Piezometer
- Pneumatic Piezometer (nonfunctioning)
- Nonproducing Hydrauger
- Private Hydrauger
- Producing Hydrauger
- Hydrauger (unable to locate)
- Hydrauger Installed Length
- Storm Drain Outfall
- District Boundary
- Recent Landslide of 1978 (Boundary from Leighton, 1979)
- Ancient Landslide (Boundary from Leighton, 1979)

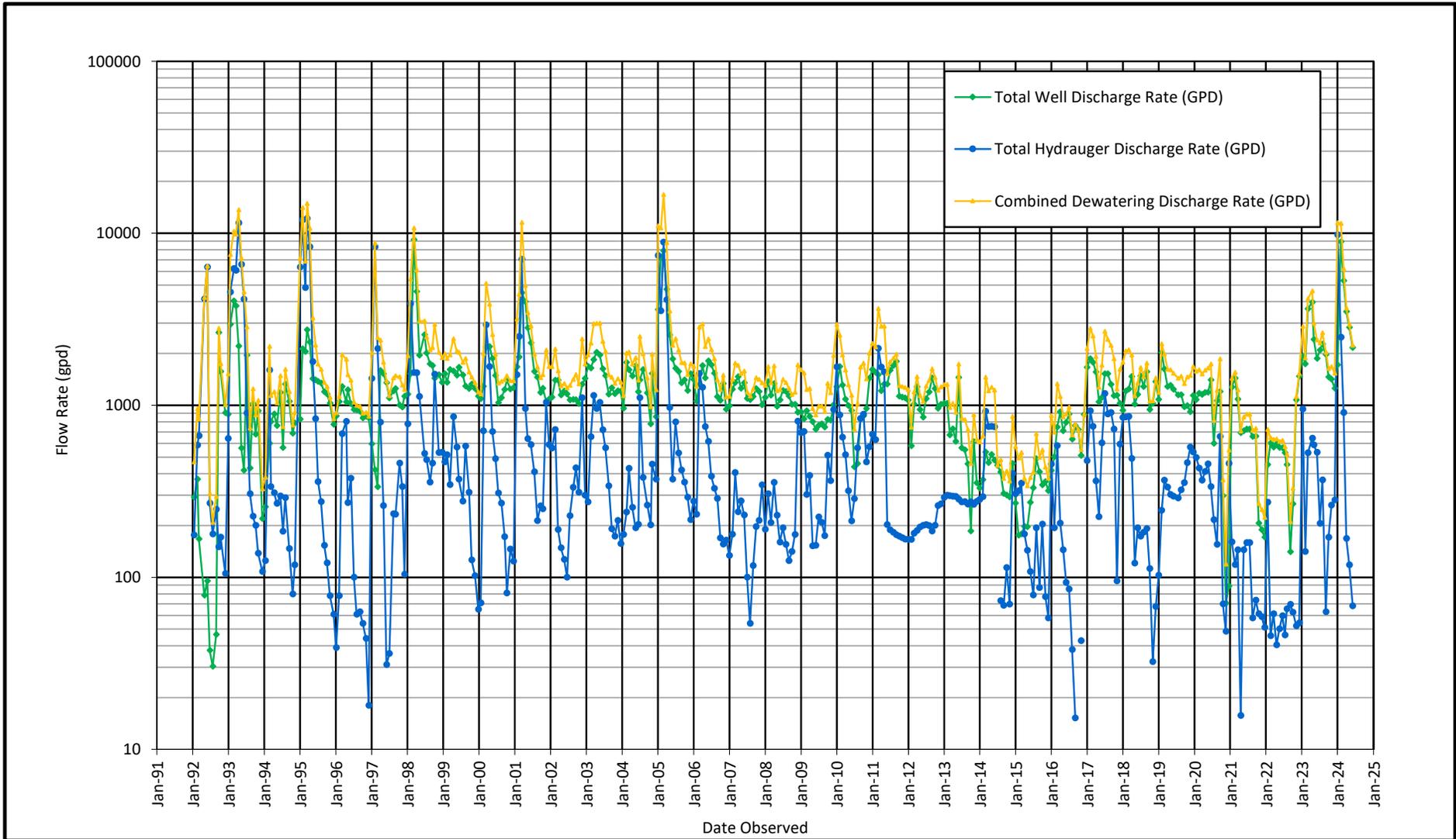


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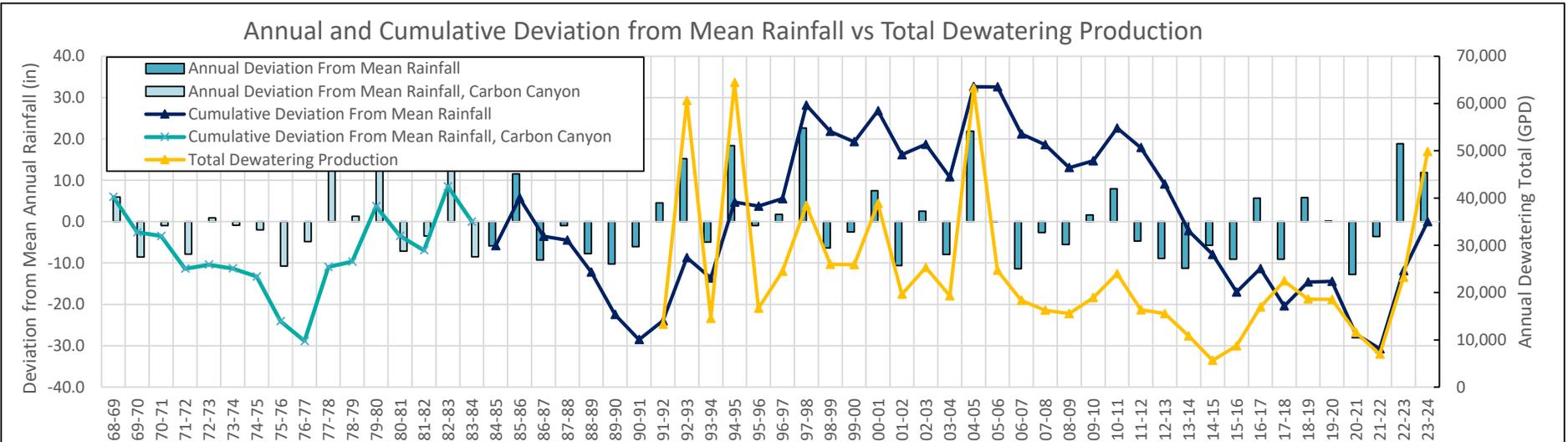
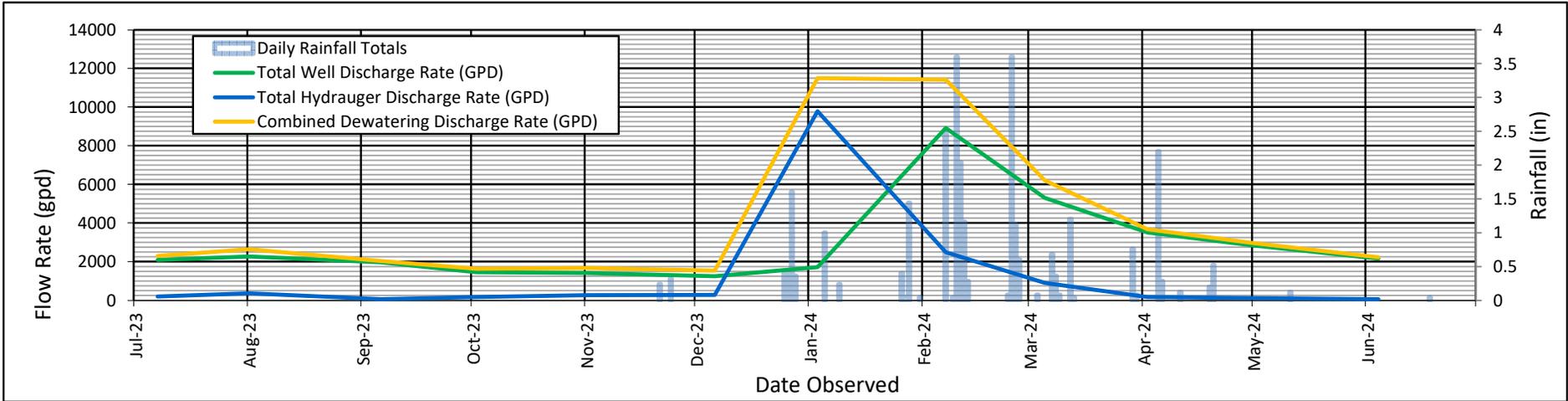
**RAINFALL GRAPH**  
 Landslide Assessment Districts  
 Malibu, California



**TOTAL DISCHARGE - WELLS AND HYDRAUGERS (HISTORIC)**

Malibu Road Landslide Assessment District

Malibu, California



**DISCHARGE VS RAINFALL**

Malibu Road Landslide Assessment District  
 Malibu, California

## APPENDIX A - GROUNDWATER LEVELS

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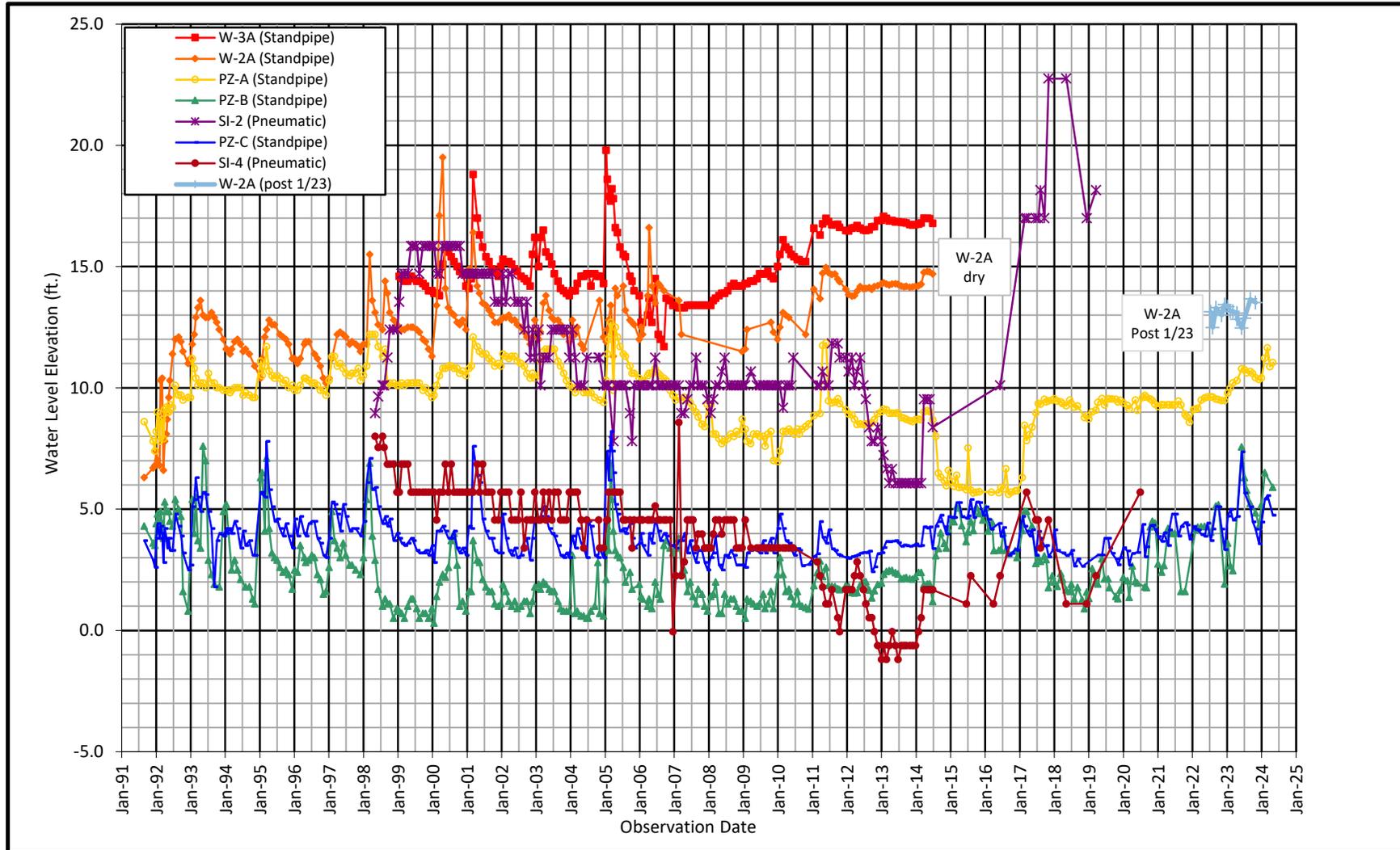
<b>MALIBU ROAD LAD - Standpipe Piezometer Information</b>						
Standpipe ID	Previous Reference Elevation (8/91)	Updated Reference Elevation (4/00)	Casing Depth (ft)	Perforation Interval	Installed By	Notes
W-2A	22.6	20.6	9.0	Unknown	LA COUNTY	Dry from 2014 until January 2023
W-3A	22.0	20.5	32.5	Unknown	LA COUNTY	Buried
PZ-A	20.0	19.8	17.2	Unknown	LA COUNTY	
PZ-B	20.0	19.1	27.9	Unknown	LA COUNTY	
PZ-C	20.0	19.4	29.7	Unknown	LA COUNTY	
PZ-D	20.0	19.2	24.7	Unknown	LA COUNTY	
PZ-E	20.0	21.4	15.8	Unknown	LA COUNTY	
SI-5 <sup>+</sup>	59.0	59.3	78.0	-19.0 to -14.0	BYA	
SI-6 <sup>++</sup>	57.0	58.0	78.0	-21.0 to -16.0	BYA	

Note: + Formerly designated as MR-5  
 ++ Formerly designated as MR-6

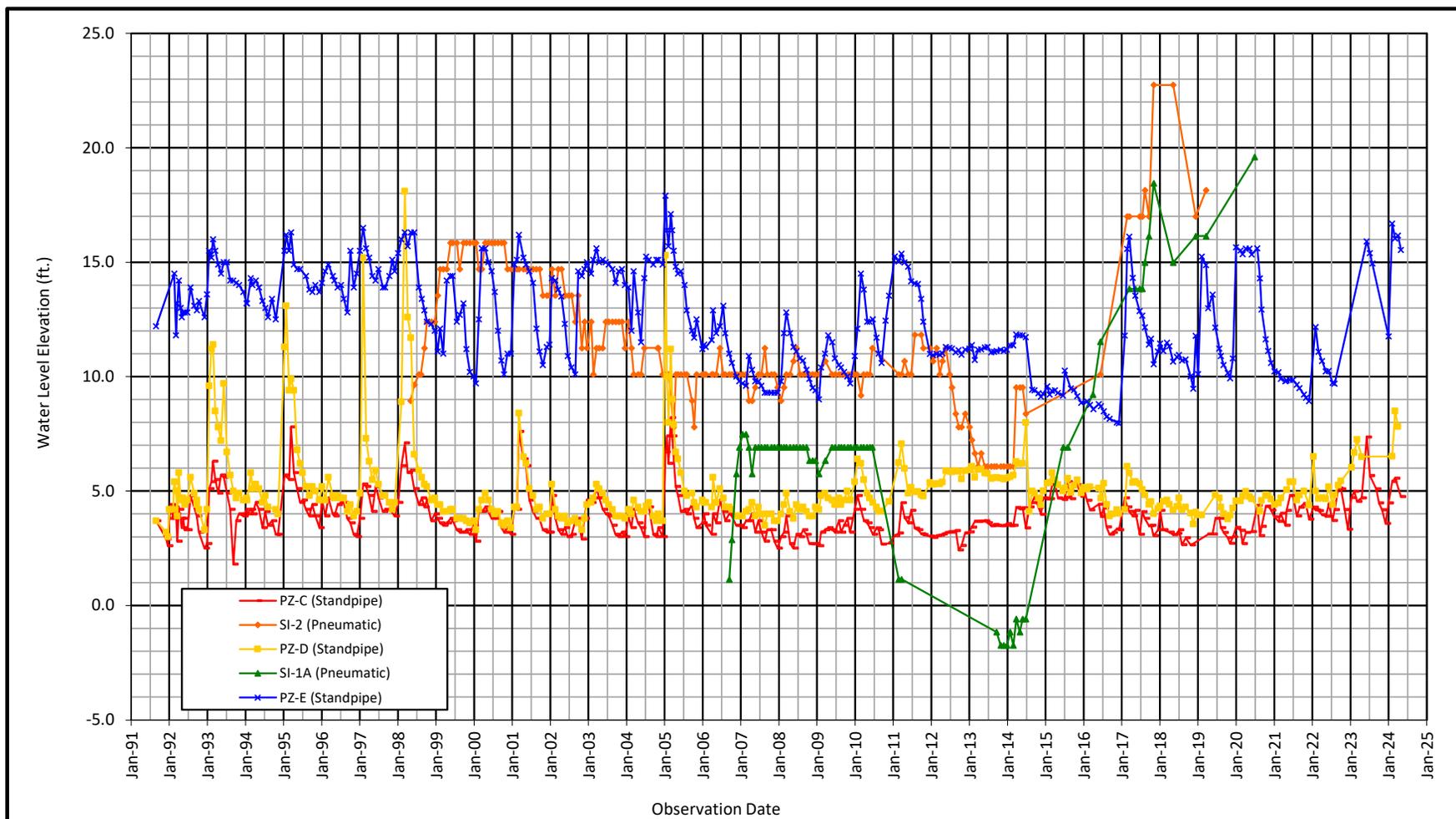
<b>MALIBU ROAD LAD - Pneumatic Piezometer Information</b>						
Well Identification	Previous Reference Elevation (8/91)	Updated Reference Elevation (4/00)	Tip Depth (ft.)	Tip El. (ft)	Installed By	Notes
SI-1*	20.0	20.1	34.6	-14.6	BYA	leaking
SI-2	20.0	19.7	65.1	-45.1	BYA	functioning as of 2020, not measured
SI-3*	20.0	20.3	49.8	-29.8	BYA	clogged
SI-4	22.0	18.9	43.9	-21.9	BYA	functioning as of 2020, not measured
SI-5 Tip 1	59.0	59.3	60	-1	BYA	functioning as of 2020, not measured
SI-5 Tip 2	59.0	59.3	40	19	BYA	functioning as of 2020, not measured
SI-6 Tip 1	57.0	58.0	60	-3	BYA	functionality uncertain since install, not measured
SI-6 Tip 2	57.0	58.0	40	17	BYA	functioning as of 2020, not measured
SI-1A	20.0	20.0	50	-30	FUGRO	functioning as of 2020, not measured

Note: SI-1 thru SI-4 were previously designated MR98-1 thru MR98-4  
 SI-5 and SI-6 were previously designated MR-5 and MR-6  
 \* Piezometer not functioning

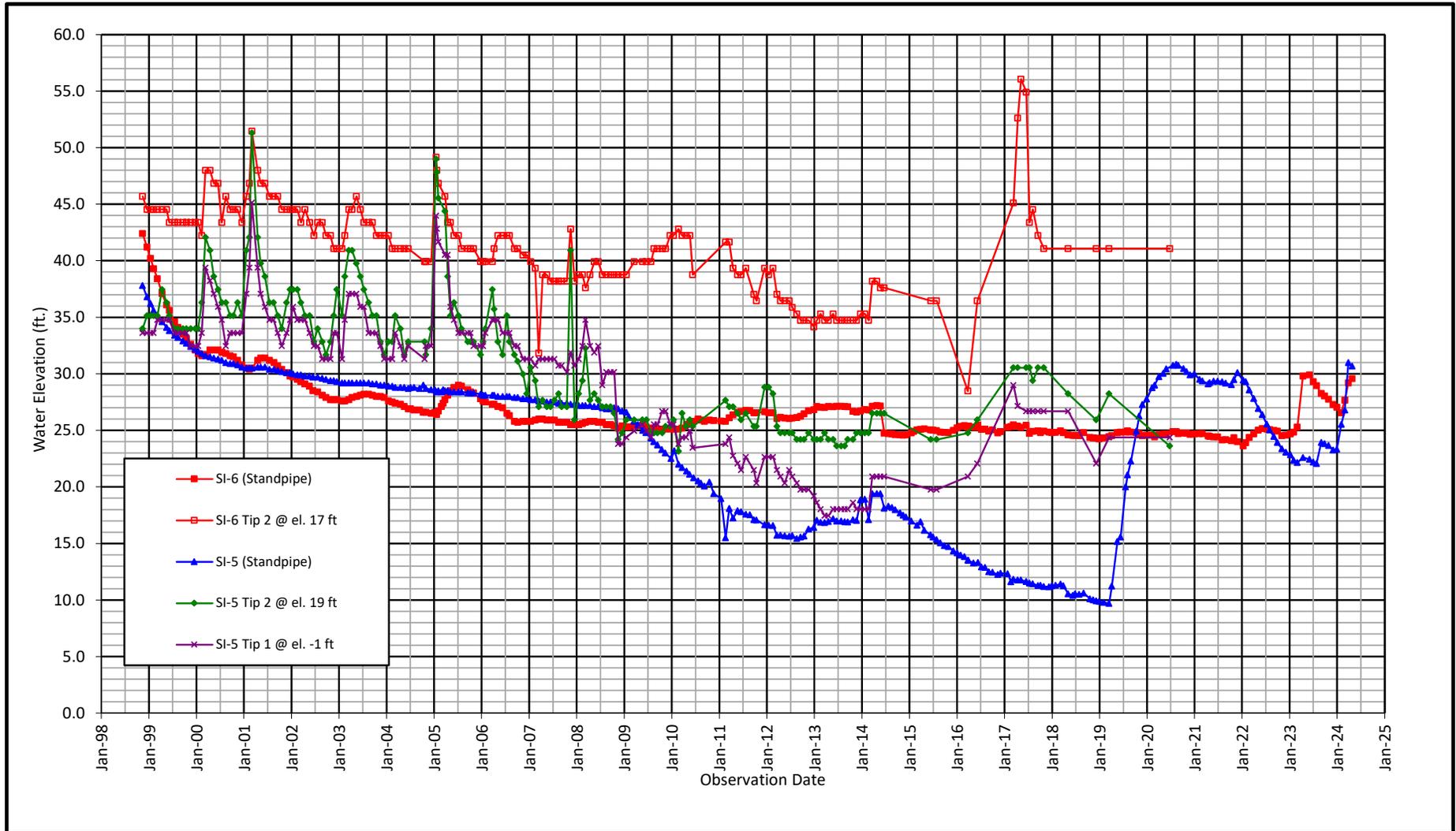
MALIBU ROAD LANDSLIDE ASSESSMENT DISTRICT - SUMMARY OF GROUNDWATER DATA																																							
Standpipe / Piezometer I.D.	91-92	92-93	93-94	94-95	95-96	96-97	97-98	98-99	99-00	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	Mean '91-'24	Stand Dev.	23-24 vs. 97-98	23-24 vs. mean		
<b>MALIBU ROAD - Standpipe Piezometers</b>																																							
W-2A	Mean El.	8.3	12.3	12.1	11.8	11.7	11.2	12.4	12.8	13.5	13.7	12.9	12.6	12.3	12.8	13.4	13.7	--	--	--	14.1	14.2	14.2	14.4	DRY	DRY	DRY												
	Highest El.	11.4	13.6	13.1	12.8	12.2	12.3	15.5	14.4	19.5	16.4	13.4	13.8	12.8	14.1	16.6	14.3	--	--	--	15.0	14.7	14.3	14.8	DRY	DRY	DRY	DRY											
W-3A	Mean El.								14.5	14.4	15.5	15.0	15.3	14.3	16.4	13.9	13.1	13.6	14.3	15.2	16.1	16.6	16.8	16.8	UTL	UTL	UTL	UTL											
	Highest El.								14.6	15.7	18.8	15.4	16.5	14.7	19.8	15.5	13.7	13.9	14.7	16.1	17.0	16.7	17.1	17.0	UTL	UTL	UTL	UTL	UTL										
PZ-A	Mean El.	8.6	10.1	10.0	10.4	10.2	10.5	11.1	10.4	10.2	11.1	11.2	11.0	10.3	10.8	10.7	9.9	8.5	8.1	7.9	9.2	9.0	8.9	8.8	6.3	6.0	6.9	9.4	9.1	9.4	9.4	9.2	9.8	10.8	9.5	1.3	-0.3	1.3	
	Highest El.	9.3	11.2	10.6	11.7	10.5	11.3	12.2	11.6	10.9	12.1	11.4	11.6	11.6	12.7	11.4	10.6	9.3	8.7	8.3	11.9	9.6	9.1	9.1	8.0	7.5	9.0	9.6	9.6	9.6	9.7	9.6	10.8	11.7	10.3	1.3	-0.6	1.3	
PZ-B	Mean El.	4.4	4.5	2.9	3.7	2.6	2.9	3.4	1.0	1.3	2.3	1.3	1.5	1.0	2.8	1.7	2.7	1.3	1.0	1.6	1.8	1.7	2.1	2.1	4.1	4.2	3.8	2.3	1.8	1.9	3.4	3.5	4.1	5.5	2.6	1.2	2.1	2.9	
	Highest El.	5.3	7.6	5.2	7.1	3.5	4.9	6.9	1.3	2.6	4.0	1.9	2.0	3.1	6.9	2.6	3.8	2.0	1.3	3.0	2.9	2.0	2.5	2.4	5.1	5.1	4.9	3.1	3.0	2.7	4.5	4.3	7.6	6.5	4.0	1.9	-0.4	2.5	
PZ-C	Mean El.	3.6	4.6	3.9	4.7	4.2	4.2	5.1	4.0	3.6	4.5	3.6	4.1	3.4	5.2	3.9	3.7	3.0	3.0	3.7	3.4	3.1	3.3	3.7	4.6	4.8	3.7	3.5	3.1	3.2	4.0	4.2	4.7	4.8	3.9	0.6	-0.3	0.9	
	Highest El.	4.4	6.3	4.9	7.8	4.7	5.3	7.1	4.7	4.3	7.6	4.8	5.1	4.2	8.2	4.6	4.1	3.9	3.4	4.8	4.5	3.4	3.7	4.3	5.3	5.4	4.7	4.2	3.8	3.8	4.8	4.8	7.4	5.7	5.0	1.3	-1.4	0.6	
PZ-D	Mean El.	4.4	6.9	5.1	7.6	5.0	5.9	7.8	4.7	4.0	4.8	4.2	4.3	4.1	7.0	4.7	4.2	4.0	4.4	5.1	5.2	5.3	5.8	5.9	5.0	5.1	4.8	4.5	4.2	4.4	4.7	5.0	5.8	7.6	5.2	1.1	-0.2	2.4	
	Highest El.	5.8	11.4	6.7	13.1	5.8	15.2	18.1	5.9	4.9	8.4	5.3	5.3	4.6	15.3	5.6	4.7	4.9	4.9	6.4	7.1	5.9	6.1	8.0	5.8	5.6	6.1	5.1	4.8	5.0	5.4	6.5	7.3	8.5	7.3	3.4	-9.6	1.2	
PZ-E	Mean El.	13.0	14.3	13.9	14.5	14.2	14.6	15.2	12.8	12.7	13.3	12.5	14.1	13.8	15.6	12.1	10.5	10.4	10.4	11.6	13.5	11.9	11.2	11.4	9.3	9.1	11.4	11.4	11.9	13.0	11.3	10.1	11.8	15.2	12.5	1.7	0.0	2.7	
	Highest El.	14.5	16.0	15.0	16.3	14.9	16.5	16.3	14.4	15.6	16.2	14.3	15.6	14.9	17.9	14.0	13.1	12.8	11.8	14.5	15.4	14.1	11.4	11.8	9.6	10.3	16.1	12.7	15.3	15.7	9.6	10.8	16.7	14.0	2.3	0.4	2.6		
Area Average	Mean El.	7.0	8.8	8.0	8.8	8.0	8.2	9.2	8.6	8.5	9.3	8.7	9.0	8.5	10.1	8.6	8.2	6.8	6.9	7.5	9.0	8.8	8.9	9.0	5.9	5.8	6.1	6.2	6.0	6.4	6.6	6.4	7.2	8.8	7.9	1.2	-0.4	0.9	
	Highest El.	8.5	11.0	9.3	11.5	8.6	10.9	12.7	9.6	10.5	11.9	9.5	10.0	9.4	13.6	10.0	9.2	7.8	7.5	8.9	10.5	9.5	9.2	9.6	6.8	6.8	8.2	6.9	7.3	7.3	6.8	7.0	8.8	9.2	1.7	-2.9	0.6		
Change vs. Prior	Mean El.		1.7	-0.8	0.8	-0.8	0.3	0.9	-0.6	-0.1	0.8	-0.6	0.3	-0.5	1.6	-1.5	-0.4	-1.4	0.1	0.6	1.5	-0.2	0.1	0.1	-3.1	-0.1	0.3	0.1	-0.2	0.4	0.2	-0.2	0.9	1.5					
	Highest El.		2.6	-1.8	2.2	-2.9	2.3	1.8	-3.1	0.9	1.4	-2.4	0.5	-0.6	4.1	-3.5	-0.9	-1.4	-0.3	1.4	1.7	-1.0	-0.3	0.5	-2.9	0.0	1.4	-1.3	0.4	0.1	-0.5	0.2	1.8	1.1					
<b>Bayshore Drive - Standpipe Piezometers</b>																																							
SI-5	Mean El.									35.5	32.2	30.7	30.1	29.3	29.0	28.6	28.2	27.3	26.3	22.6	18.8	16.5	16.4	18.0	17.4	14.3	12.2	11.2	11.1	26.5	30.0	28.7	23.4	25.1	23.7	7.1		1.4	
	Highest El.									37.8	33.4	31.2	30.4	29.7	29.2	29.0	28.4	28.0	27.5	27.0	24.3	20.5	17.6	17.2	19.4	18.3	15.6	12.9	11.5	15.6	30.4	30.8	30.1	25.6	31.0	25.1	7.0		5.9
SI-6	Mean El.									38.8	32.6	31.2	29.9	27.9	27.7	27.2	27.9	26.0	25.7	25.4	25.3	26.1	26.4	26.7	26.8	24.8	25.1	25.2	24.8	24.5	24.7	24.7	24.3	25.8	28.1	27.1	3.2		1.1
	Highest El.									42.4	34.6	31.9	31.2	28.4	28.2	28.8	29.0	26.5	25.9	25.7	25.8	26.7	26.8	27.1	27.2	25.1	25.4	25.0	24.8	25.0	24.9	25.1	29.9	29.6	27.9	3.9		1.6	
Area Average	Mean El.									37.2	32.4	31.0	30.0	28.6	28.3	27.9	28.0	26.9	26.5	25.8	23.9	22.4	21.2	21.6	22.4	21.1	19.7	18.7	18.0	17.8	25.6	27.3	26.5	24.6	26.6	25.4	4.7		1.2
	Highest El.									40.1	34.0	31.5	30.8	29.1	28.7	28.9	28.7	27.3	26.7	26.4	25.1	23.6	22.5	22.2	23.3	21.7	20.5	19.2	18.2	20.2	27.7	27.9	27.6	27.7	30.3	26.5	4.9		3.8
Change vs. Prior	Mean El.									-4.7	-1.5	-1.0	-1.3	-0.3	-0.4	0.2	-1.2	-0.4	-0.6	-1.9	-1.5	-0.9	0.1	0.8	-1.3	-1.4	-1.0	-0.7	-0.2	7.8	1.7	-0.8	-1.9	2.0					
	Highest El.									-6.1	-2.5	-0.7	-1.8	-0.4	0.2	-0.2	-1.5	-0.6	-0.3	-1.3	-1.5	-1.4	0.0	1.1	-1.6	-1.2	-1.3	-1.0	2.0	7.5	0.2	-0.2	0.1	2.5					
<b>MALIBU ROAD - Pneumatic Piezometers</b>																																							
SI-1	Mean El.																																						
	Highest El.																																						
SI-1A	Mean El.																5.8	6.9	6.5	6.9						8.6	13.8	15.7	16.1	19.6					11.7	5.2	19.6	8.5	
	Highest El.																7.5	6.9	6.9	6.9						11.5	13.8	18.4	16.1	19.6					12.0	5.2	19.6	7.6	
SI-2	Mean El.							9.3	13.2	15.6	15.1	14.1	11.9	11.5	10.1	9.9	9.9	10.1	10.2	10.1	10.2	11.0	7.4	7.1		10.1	17.0	19.5	17.6					11.9	3.3				
	Highest El.							9.6	15.9	15.9	15.9	14.7	13.6	12.4	11.3	11.3	10.1	11.3	10.7	11.3	10.7	11.8	9.5	9.5		10.1	17.0	22.8	18.2					13.0	3.5				
SI-3	Mean El.																																						
	Highest El.																																						
SI-4	Mean El.							7.8	6.6	5.7	6.0	5.2	4.8	5.0	4.9	4.5	4.0	4.0	3.9	3.4	1.8	1.6	-0.3	0.3		1.7	5.1	3.4	1.7	5.7				3.9	2.1	-2.1	1.8		
	Highest El.							8.0	8.0	6.9	6.9	5.7	5.7	5.7	5.7	5.1	8.6	4.6	4.6	3.4	2.8	2.8	1.1	1.7		2.3	5.7	4.6	2.3	5.7				4.9	2.1	-2.3	0.8		
<b>Bayshore Drive - Pneumatic Piezometers</b>																																							
SI-5 Tip 1	Mean El.									34.2	34.7	36.3	34.2	33.9	32.7	37.6	33.6	31.8	31.7	26.9	25.1	22.9	21.7	18.9	19.0		20.6	27.6	26.7	23.2	24.4				28.5	6.0		-4.1	
	Highest El.									34.8	39.4	45.1	35.9	37.1	35.9	44.0	34.8	33.6	34.8	30.1	26.7	24.4	22.6	20.9	20.9		22.1	29.0	26.7	24.4	24.4				30.8	7.4		-6.5	
SI-5 Tip 2	Mean El.									35.4	36.1	39.1	35.8	36.5	34.0	39.5	33.7	29.8	29.2	26.0	25.2	26.8	26.3	24.3	25.1		24.8	30.5	29.8	27.1	23.6				30.4	5.2		-6.8	
	Highest El.									37.5	42.1	51.3	37.5	40.9	37.5	49.0	37.5	35.1	40.9	27.1	26.5	27.7	28.8	24.8	26.5		25.9	30.5	30.5	28.2	23.6				33.8	8.0		-10.2	
SI-6 Tip 1	Mean El.									42.4																													



**GROUNDWATER HYDROGRAPH**  
 Malibu Road (West End)  
 Malibu Road Landslide Assessment District  
 Malibu, California



**GROUNDWATER HYDROGRAPH**  
**Malibu Road (East End)**  
 Malibu Road Landslide Assessment District  
 Malibu, California



**GROUNDWATER HYDROGRAPH**  
**Bayshore Drive**  
Malibu Road Landslide Assessment District  
Malibu, California

## APPENDIX B - SLOPE INCLINOMETERS

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<b>MALIBU ROAD LAD - Slope Incliner Interpretation Summary</b>									
	SI-1 (MR98-1)	SI-1A	SI-2 (MR98-2)	SI-2A	SI-3 (MR98-3)	SI-4 (MR98-4)	SI-4A	SI-5	SI-6
<b>Installation Details</b>									
Previous Ref.Elev.(8/91)	20.0	20.0	20.0	20.0	20.0	22.0	N/A	59.0	57.0
Updated Ref.Elev.(4/00)	20.1	20.0	19.7	19.7	20.3	18.9	18.9	59.3	58.0
Depth (ft.)	34	50	64	64	49	43	50	78	78
Install Date	Apr-98	Aug-06	Apr-98	Sep-10	Apr-98	Apr-98	Aug-12	Apr-98	Apr-98
A+ Axis orientation (deg)	184	197	201	200	190	204	204	176	186
Casing	RST	SI	RST	RST	RST	RST	SI	SI	SI
Installer	BYA	Fugro	BYA	Fugro	BYA	BYA	Fugro	BYA	BYA
Interpreted Rupture Depth (ft)	30-32	23-30	28-32	28-34	35-38	32-34	32-34	unknown	unknown
Status	D	F	D	F	D	D	F	F	F
Reading Interval	Quaterly	Quaterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quaterly	Quarterly
<b>Interpretation Movement (inches)</b>									
2023-2024	NR	0.02	NR	0.16	NR	NR	0.20	--	--
2022-2023	NR	0.12	NR	0.20	NR	NR	0.28	--	--
2021-2022	NR	--	NR	--	NR	NR	--	--	--
2020-2021	NR	--	NR	--	NR	NR	--	--	--
2019-2020	NR	--	NR	--	NR	NR	--	--	--
2018-2019	NR	--	NR	--	NR	NR	--	--	--
2017-2018	NR	--	NR	--	NR	NR	--	--	--
2016-2017	NR	0.1	NR	0.15	NR	NR	0.15	--	--
2015-2016	NR	--	NR	--	NR	NR	--	--	--
2014-2015	NR	<0.1	NR	--	NR	NR	--	--	--
2013-2014	NR	0.1	NR	--	NR	NR	--	--	--
2012-2013	NR	<0.1	NR	<0.1	NR	NR	--	0.1	0.1
2011-2012	NR	<0.1	NR	--	NR	--	NR	--	<0.1
2010-2011	NR	<0.1	NR	--	NR	0.6	NR	--	<0.1
2009-2010	NR	<0.1	NR	--	NR	--	NR	--	<0.1
2008-2009	NR	<0.1	<0.1 (4)	NR	NR	--	NR	--	<0.1
2007-2008	NR	<0.1	--	NR	NR	--	NR	--	<0.1
2006-2007	NR	NR	--	NR	NR	--	NR	--	0.1
2004-2005	0.5 (3)	NR	0.4	NR	>1(3)	0.4 to 0.5	NR	~ 0.2 *	--
2003-2004 (1)	--	NR	--	NR	--	--	NR	--	--
2002-2003	~ 0.2 *	NR	~ 0.1 *	NR	--	--	NR	--	--
2001-2002	--	NR	--	NR	--	--	NR	--	--
2000-2001	0.5	NR	0.4	NR	0.3	0.6	NR	--	--
1999-2000	--	NR	--	NR	--	--	NR	--	--
1998-1999	3.1	NR	1.5	NR	4.1	1.3 (2)	NR	--	--

**NOTES:**
**D** Destroyed

**F** Functioning

**NI** No information

**(1)** Readings only through March 2004

**(2)** Readings are through 2000, although majority of movement occurred in 1998

**(3)** Inclinerometer sheared off in January, 2005.

**(4)** Inclinerometer sheared off winter of 2009.

**NR** No reading

**--** No clearly defined interpreted movement.

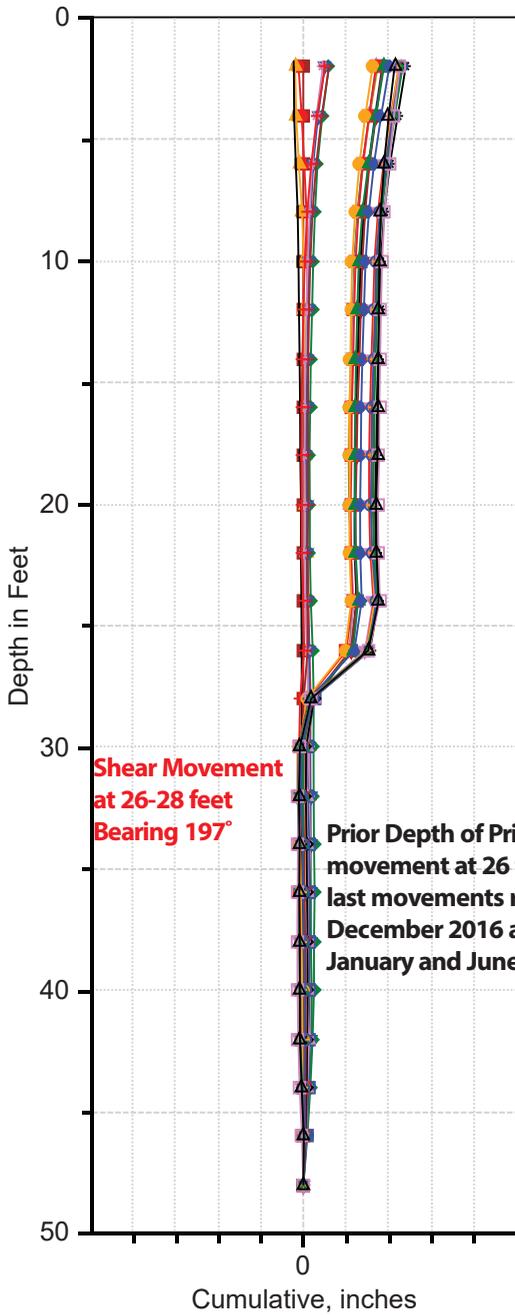
**~ 0.1 \*** Indicated displacement is less than reliable instrument accuracy. Interpreted movement is theoretical.

## SUMMARY OF SLOPE INCLINOMETERS

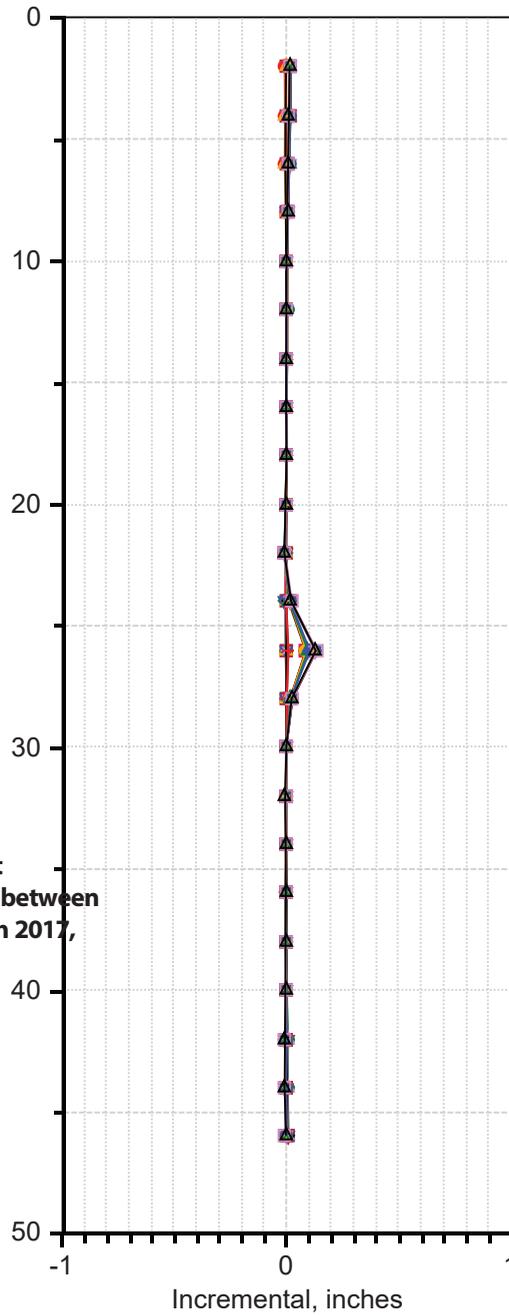
### Malibu Road Landslide Assessment District

### Malibu, California

A-17°



A+197°



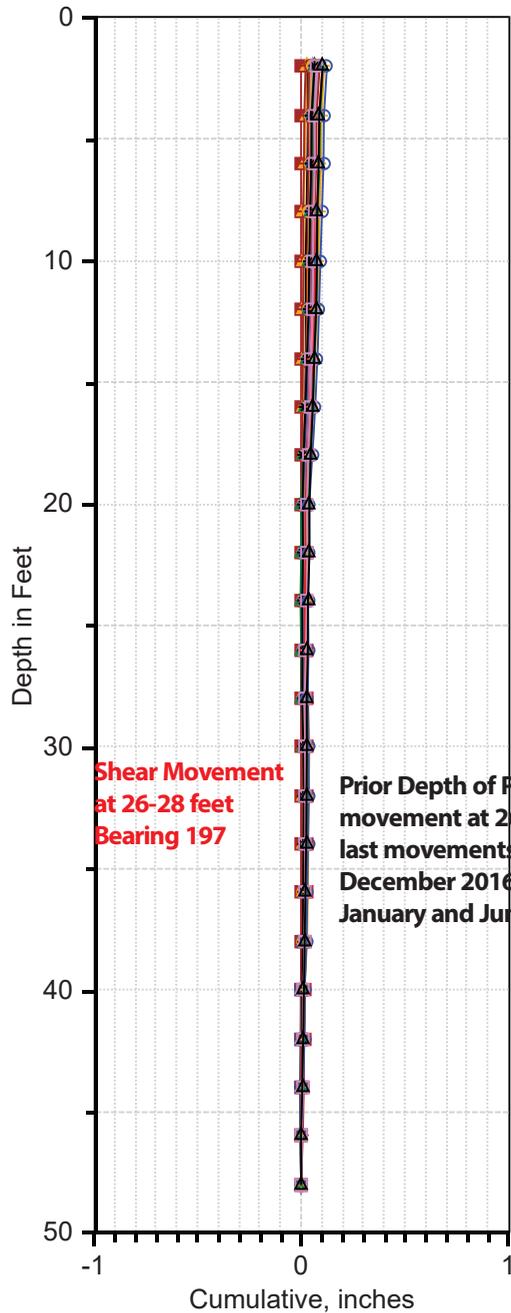
- 5/4/2021
- 8/9/2021
- ▲ 12/15/2021
- ◆ 1/7/2022
- ▼ 1/8/2022
- ◆ 4/11/2022
- 11/2/2022
- 1/18/2023
- 1/30/2023
- ▲ 6/9/2023
- 6/15/2023
- 7/7/2023
- ▲ 8/1/2023
- ◆ 8/25/2023
- ▼ 9/14/2023
- 11/8/2023
- 1/11/2024
- ▲ 2/7/2024
- ◆ 2/13/2024
- ▼ 2/21/2024
- 2/28/2024
- 3/7/2024
- 3/13/2024
- ▲ 3/21/2024
- 4/9/2024
- 5/1/2024
- 7/31/2024
- ▲ 9/16/2024

- 5/4/2021
- 8/9/2021
- ▲ 12/15/2021
- ◆ 1/7/2022
- ▼ 1/8/2022
- ◆ 4/11/2022
- 11/2/2022
- 1/18/2023
- 1/30/2023
- ▲ 6/9/2023
- 6/15/2023
- 7/7/2023
- ▲ 8/1/2023
- ◆ 8/25/2023
- ▼ 9/14/2023
- 11/8/2023
- 1/11/2024
- ▲ 2/7/2024
- ◆ 2/13/2024
- ▼ 2/21/2024
- 2/28/2024
- 3/7/2024
- 3/13/2024
- ▲ 3/21/2024
- 4/9/2024
- 5/1/2024
- 7/31/2024
- ▲ 9/16/2024

Plot of Slope Inclinometer  
SI-1A

Plot Type: Cumulative and Incremental		Plot Direction: A-Direction	
Depth of Survey (ft): 46		Baseline Date: 5/04/2021	
Install Date: 8/2006		Interpreted Movement Since Baseline (in): 0.14	
Installed Depth (ft): 50		Interpreted Movement Monitoring Year (in): 0.02	
Corrections: None			

B-  
107°

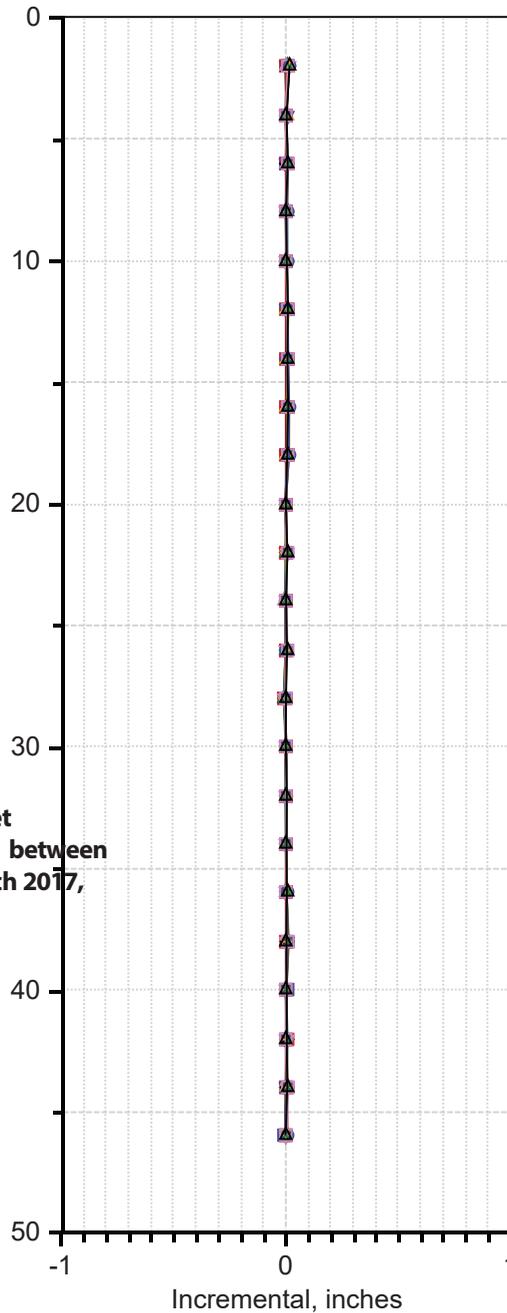


Shear Movement  
at 26-28 feet  
Bearing 197

Prior Depth of Primary  
movement at 26 to 30 feet  
last movements reported between  
December 2016 and March 2017,  
January and June 2023

- 5/4/2021
- 8/9/2021
- ▲ 12/15/2021
- ◆ 1/7/2022
- ▼ 1/8/2022
- ◆ 4/11/2022
- ⊕ 11/2/2022
- 1/18/2023
- ⊕ 1/30/2023
- ⊕ 6/9/2023
- 6/15/2023
- 7/7/2023
- ▲ 8/1/2023
- ◆ 8/25/2023
- ▼ 9/14/2023
- 11/8/2023
- 1/11/2024
- ▲ 2/7/2024
- ◆ 2/13/2024
- ▼ 2/21/2024
- ⊕ 2/28/2024
- ⊕ 3/7/2024
- 3/13/2024
- ⊕ 3/21/2024
- 4/9/2024
- 5/1/2024
- 7/31/2024
- ▲ 9/16/2024

B+  
287°



- 5/4/2021
- 8/9/2021
- ▲ 12/15/2021
- ◆ 1/7/2022
- ▼ 1/8/2022
- ◆ 4/11/2022
- ⊕ 11/2/2022
- 1/18/2023
- ⊕ 1/30/2023
- ⊕ 6/9/2023
- 6/15/2023
- 7/7/2023
- ▲ 8/1/2023
- ◆ 8/25/2023
- ▼ 9/14/2023
- 11/8/2023
- 1/11/2024
- ▲ 2/7/2024
- ◆ 2/13/2024
- ▼ 2/21/2024
- ⊕ 2/28/2024
- ⊕ 3/7/2024
- 3/13/2024
- ⊕ 3/21/2024
- 4/9/2024
- 5/1/2024
- 7/31/2024
- ▲ 9/16/2024

Plot of Slope Inclinometer

SI-1A

Plot Type: Cumulative and Incremental

Plot Direction: B-Direction

Depth of Survey (ft): 46

Baseline Date: 5/04/2021

Corrections: None

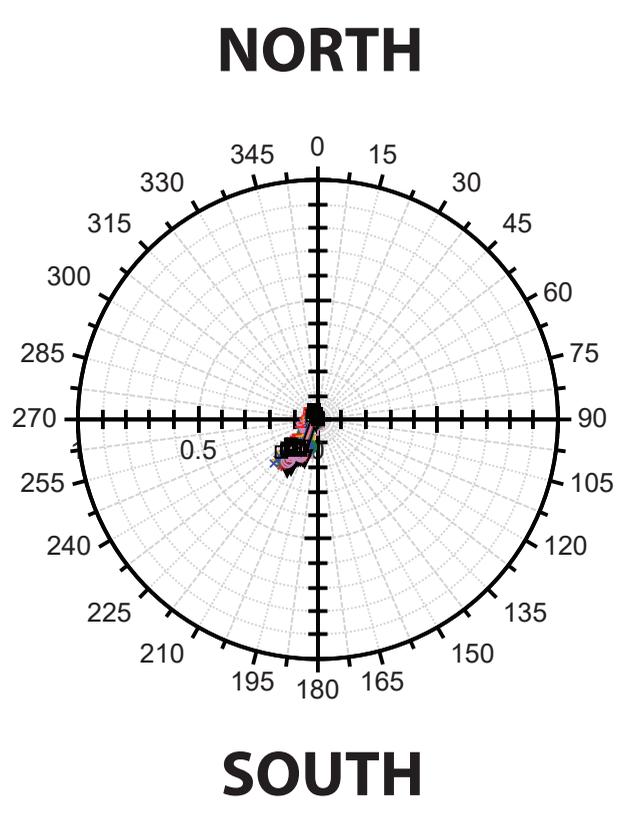
Install Date: 8/2006

Installed Depth (ft): 50

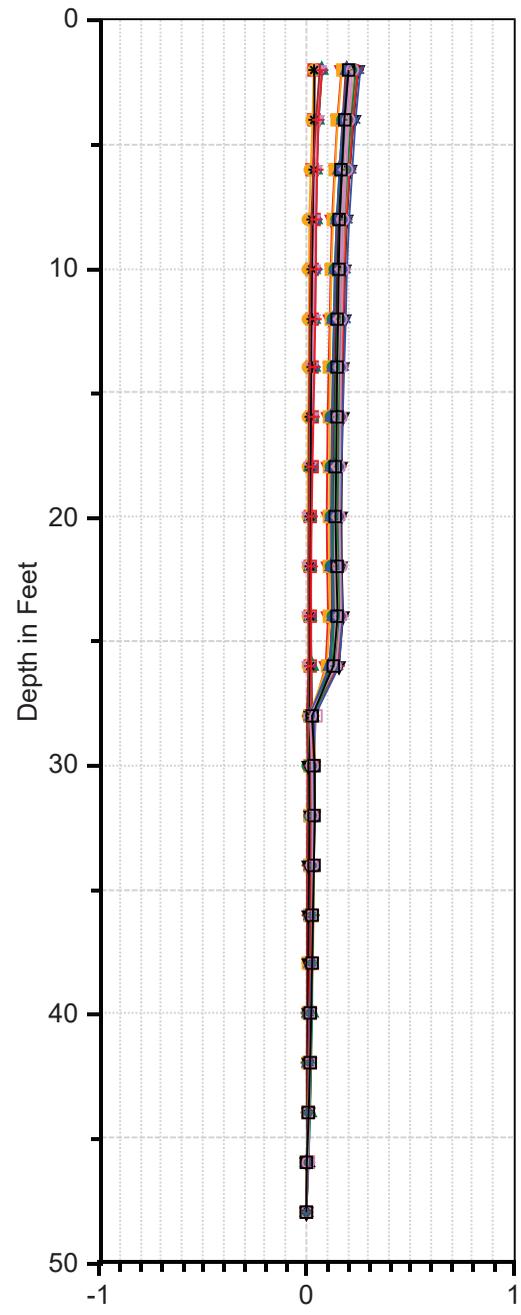
Interpreted Movement Since Baseline (in): 0.14

Interpreted Movement Monitoring Year (in): 0.02

- |           |            |           |           |            |           |
|-----------|------------|-----------|-----------|------------|-----------|
| 8/9/2021  | 12/15/2021 | 1/7/2022  | 8/9/2021  | 12/15/2021 | 1/7/2022  |
| 1/8/2022  | 4/11/2022  | 11/2/2022 | 1/8/2022  | 4/11/2022  | 11/2/2022 |
| 1/18/2023 | 1/30/2023  | 6/9/2023  | 1/18/2023 | 1/30/2023  | 6/9/2023  |
| 6/15/2023 | 7/7/2023   | 8/1/2023  | 6/15/2023 | 7/7/2023   | 8/1/2023  |
| 8/25/2023 | 9/14/2023  | 11/8/2023 | 8/25/2023 | 9/14/2023  | 11/8/2023 |
| 1/11/2024 | 2/7/2024   | 2/13/2024 | 1/11/2024 | 2/7/2024   | 2/13/2024 |
| 2/21/2024 | 2/28/2024  | 3/7/2024  | 2/21/2024 | 2/28/2024  | 3/7/2024  |
| 3/13/2024 | 3/21/2024  | 4/9/2024  | 3/13/2024 | 3/21/2024  | 4/9/2024  |
| 5/1/2024  | 7/31/2024  | 9/16/2024 | 5/1/2024  | 7/31/2024  | 9/16/2024 |



Cumulative Resultant, inches



Cumulative Resultant, inches

<b>Plot of Slope Inclinometer</b>  <b>SI-1A</b>	Plot Type: Cumulative Resultant, Polar and Profile Views		Plot Direction: Resultant
	Depth of Survey (ft): 48	Baseline Date: 8/9/2021	
	Install Date: 8/2006	Installed Depth (ft): 50	Interpreted Movement Since Baseline (in): 0.14
		Interpreted Movement Monitoring Year (in): 0.02	

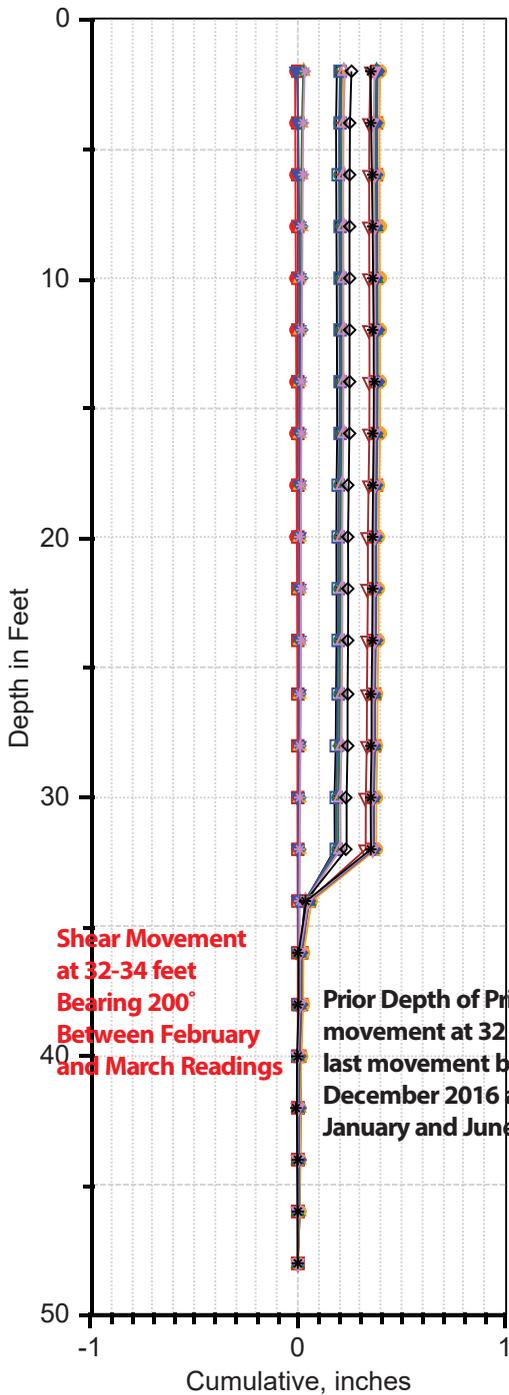
**Yeh and Associates, Inc.**  
 Geotechnical • Geological • Construction Services

PROJECT: **Malibu Road LAD**  
 Malibu, CA

PROJECT NUMBER: **220-278**

REVISION DATE: 10/8/2024

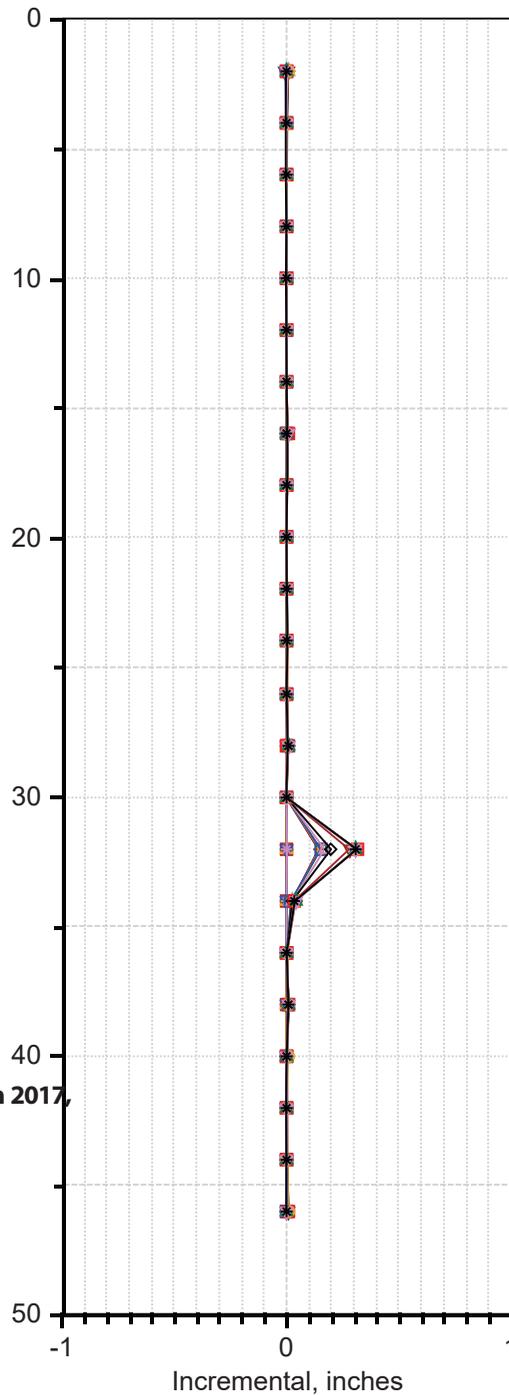
A-20°



Shear Movement at 32-34 feet Bearing 200° Between February and March Readings

Prior Depth of Primary movement at 32 to 34 feet last movement between December 2016 and March 2017, January and June 2023

A+200°



- 8/13/2021 (red square)
- 4/11/2022 (green diamond)
- 6/7/2023 (black cross)
- 8/25/2023 (orange triangle)
- 2/7/2024 (pink triangle)
- 2/28/2024 (red square)
- 4/9/2024 (blue diamond)
- 12/15/2021 (red circle)
- 11/2/2022 (blue inverted triangle)
- 6/15/2023 (red inverted triangle)
- 11/8/2023 (green circle)
- 2/13/2024 (black diamond)
- 3/7/2024 (yellow circle)
- 5/1/2024 (purple inverted triangle)
- 1/7/2022 (yellow triangle)
- 1/30/2023 (pink inverted triangle)
- 7/7/2023 (red inverted triangle)
- 1/11/2024 (blue square)
- 2/21/2024 (red inverted triangle)
- 3/21/2024 (green triangle)
- 9/16/2024 (black cross)

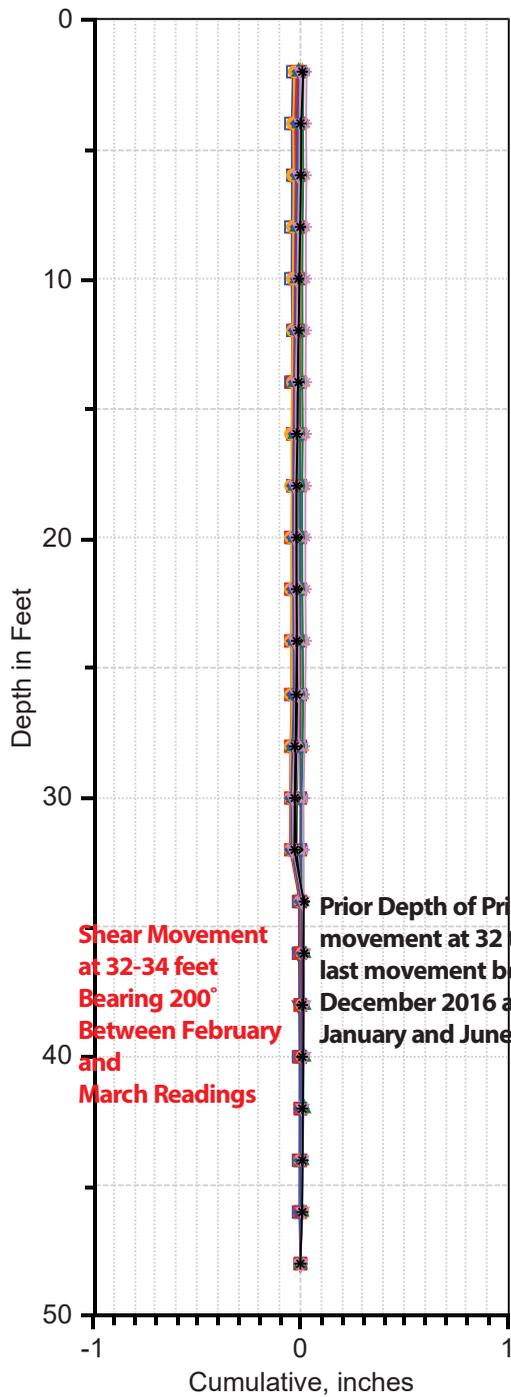
- 8/13/2021 (red square)
- 4/11/2022 (green diamond)
- 6/7/2023 (black cross)
- 8/25/2023 (orange triangle)
- 2/7/2024 (pink triangle)
- 2/28/2024 (red square)
- 4/9/2024 (blue diamond)
- 12/15/2021 (red circle)
- 11/2/2022 (blue inverted triangle)
- 6/15/2023 (red inverted triangle)
- 11/8/2023 (green circle)
- 2/13/2024 (black diamond)
- 3/7/2024 (yellow circle)
- 5/1/2024 (purple inverted triangle)
- 1/7/2022 (yellow triangle)
- 1/30/2023 (pink inverted triangle)
- 7/7/2023 (red inverted triangle)
- 1/11/2024 (blue square)
- 2/21/2024 (red inverted triangle)
- 3/21/2024 (green triangle)
- 9/16/2024 (black cross)

Plot of Slope Inclinometer  
SI-2A

Plot Type: Cumulative and Incremental		Plot Direction: A-Direction	
Depth of Survey (ft): 48		Baseline Date: 8/13/2021	
Install Date: 9/2010		Corrections: None	
Installed Depth (ft): 64	Interpreted Movement Since Baseline (in): 0.36	Interpreted Movement Monitoring Year (in): 0.16	

PROJECT: Malibu Road LAD Malibu, CA	PROJECT NUMBER: 220-278
REVISION DATE: 10/8/2024	

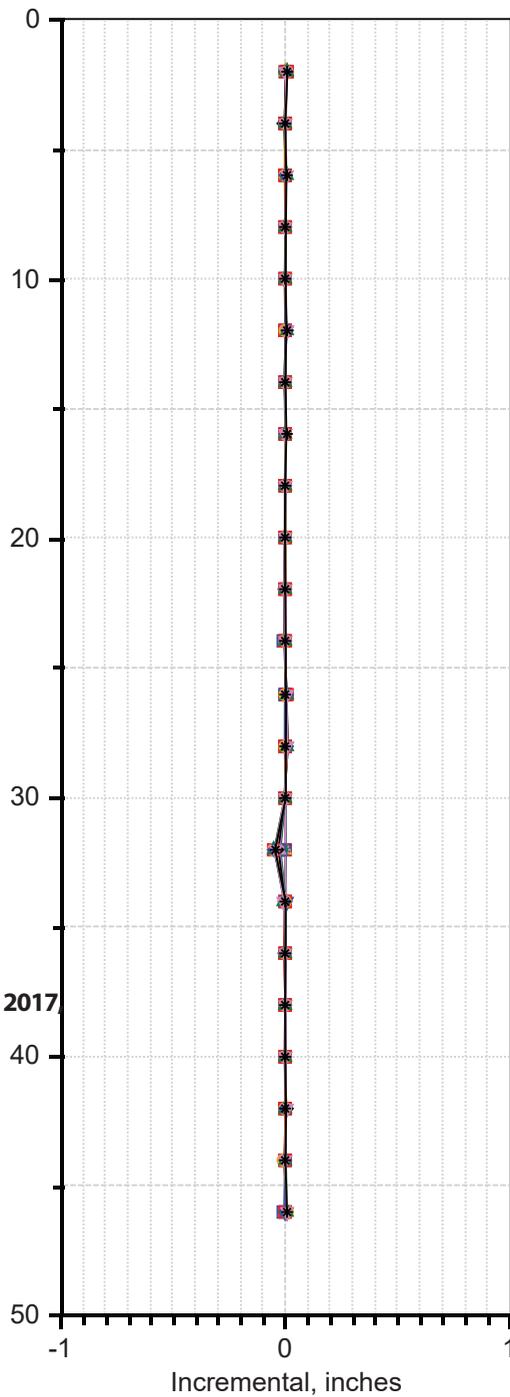
B-  
110°



Shear Movement  
at 32-34 feet  
Bearing 200°  
Between February  
and  
March Readings

Prior Depth of Primary  
movement at 32 to 34 feet  
last movement between  
December 2016 and March 2017,  
January and June 2023

B+  
290°



- 8/13/2021
- 4/11/2022
- 6/7/2023
- 8/25/2023
- 2/7/2024
- 2/28/2024
- 4/9/2024
- 12/15/2021
- 11/2/2022
- 6/15/2023
- 11/8/2023
- 2/13/2024
- 3/7/2024
- 5/1/2024
- 1/7/2022
- 1/30/2023
- 7/7/2023
- 1/11/2024
- 2/21/2024
- 3/21/2024
- 9/16/2024

- 8/13/2021
- 4/11/2022
- 6/7/2023
- 8/25/2023
- 2/7/2024
- 2/28/2024
- 4/9/2024
- 12/15/2021
- 11/2/2022
- 6/15/2023
- 11/8/2023
- 2/13/2024
- 3/7/2024
- 5/1/2024
- 1/7/2022
- 1/30/2023
- 7/7/2023
- 1/11/2024
- 2/21/2024
- 3/21/2024
- 9/16/2024

Plot of Slope Inclinometer

SI-2A

Plot Type: Cumulative and Incremental

Plot Direction: B-Direction

Depth of Survey (ft): 48

Baseline Date: 8/13/2021

Corrections: None

Install Date: 9/2010

Installed Depth (ft): 64

Interpreted Movement Since Baseline (in): 0.36

Interpreted Movement Monitoring Year (in): 0.16



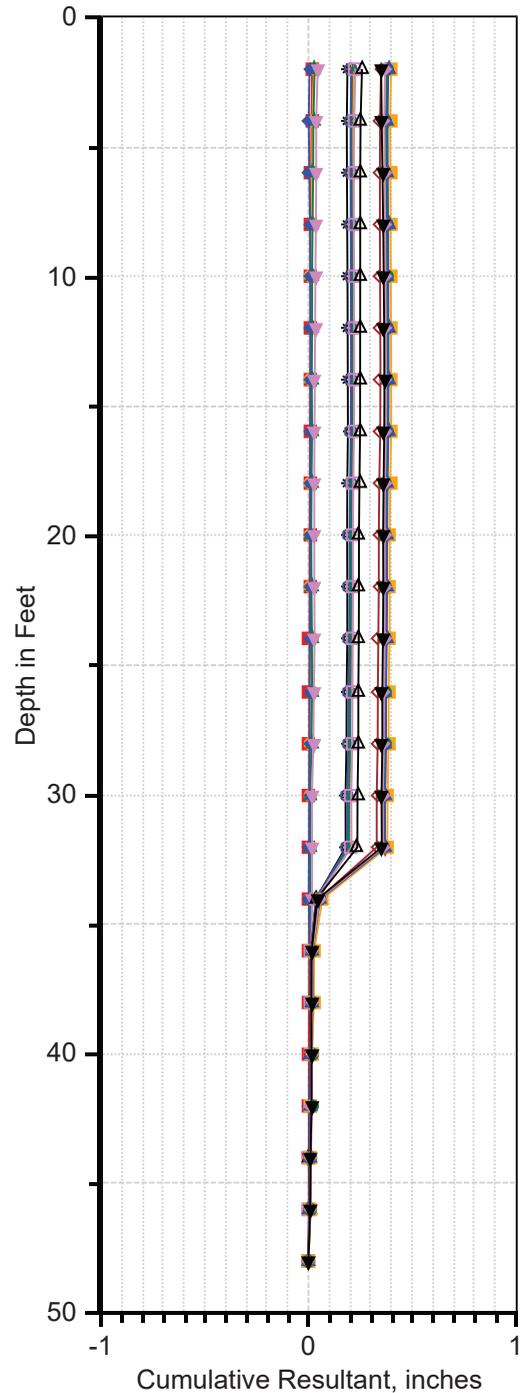
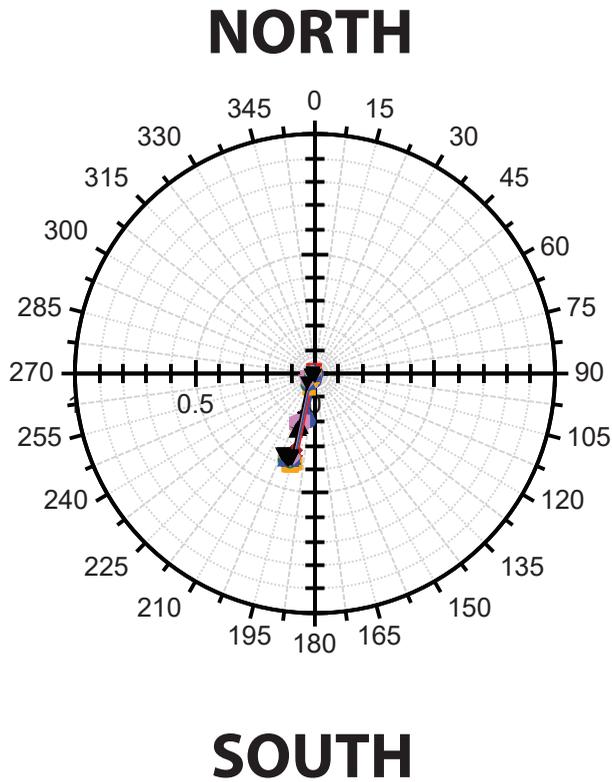
PROJECT:

Malibu Road LAD  
Malibu, CA

PROJECT NUMBER:

220-278

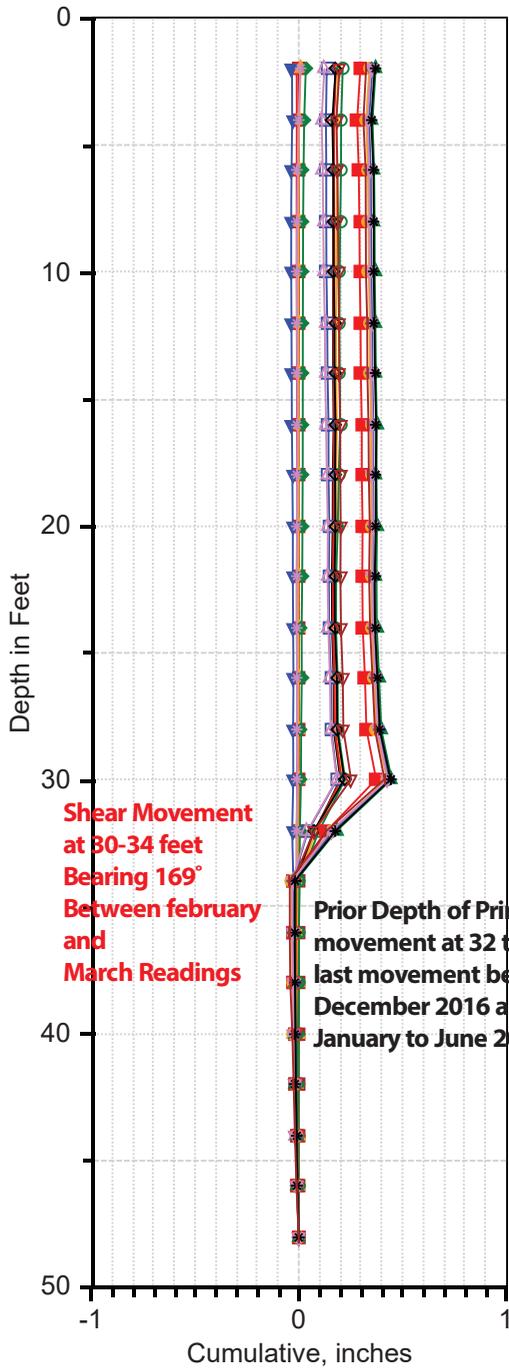
REVISION DATE: 10/8/2024



<b>Plot of Slope Inclinometer</b>  <b>SI-2A</b>	Plot Type: Cumulative Resultant, Polar and Profile Views		Plot Direction: Resultant
	Depth of Survey (ft): 48	Baseline Date: 12/15/2021	
	Install Date: 9/2010	Installed Depth (ft): 64	Interpreted Movement Since Baseline (in): 0.36
		Interpreted Movement Monitoring Year (in): 0.16	

<b>Yeh and Associates, Inc.</b> Geotechnical • Geological • Construction Services	PROJECT: <b>Malibu Road LAD</b> Malibu, CA	PROJECT NUMBER: <b>220-278</b>
	REVISION DATE: 10/8/2024	

A-24°

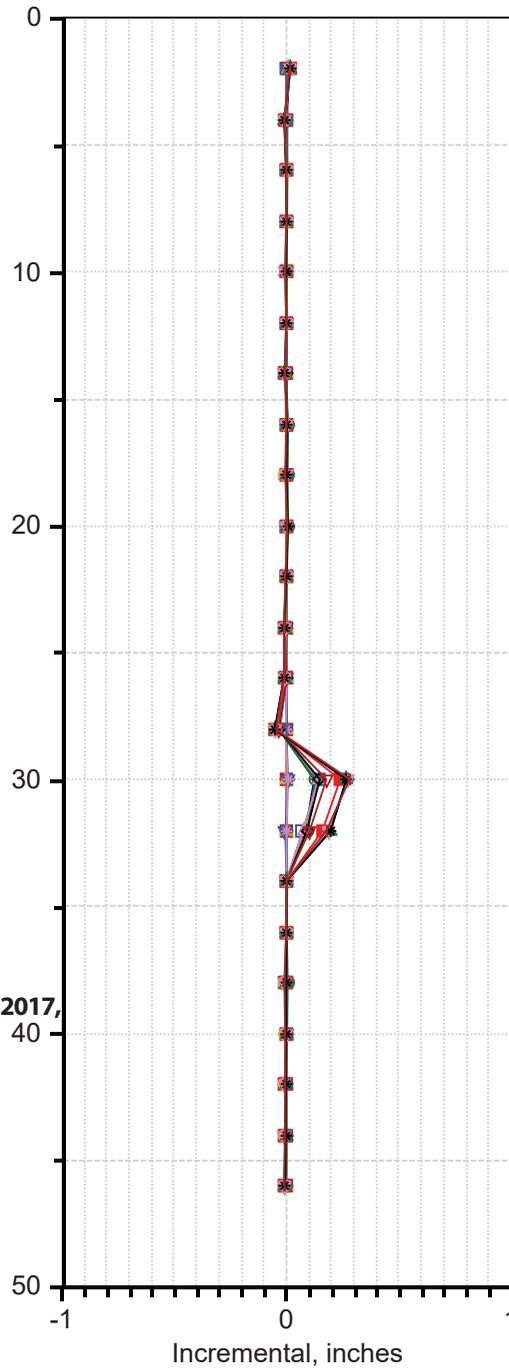


Shear Movement at 30-34 feet Bearing 169° Between february and March Readings

Prior Depth of Primary movement at 32 to 34 feet last movement between December 2016 and March 2017, January to June 2023

- 8/6/2021
- 12/15/2021
- 1/7/2022
- 4/11/2022
- 11/2/2022
- 1/30/2023
- 6/7/2023
- 6/15/2023
- 7/6/2023
- 8/2/2023
- 8/22/2023
- 11/8/2023
- 1/11/2024
- 2/7/2024
- 2/13/2024
- 2/21/2024
- 2/28/2024
- 3/7/2024
- 3/22/2024
- 4/9/2024
- 5/1/2024
- 7/31/2024

A+204°

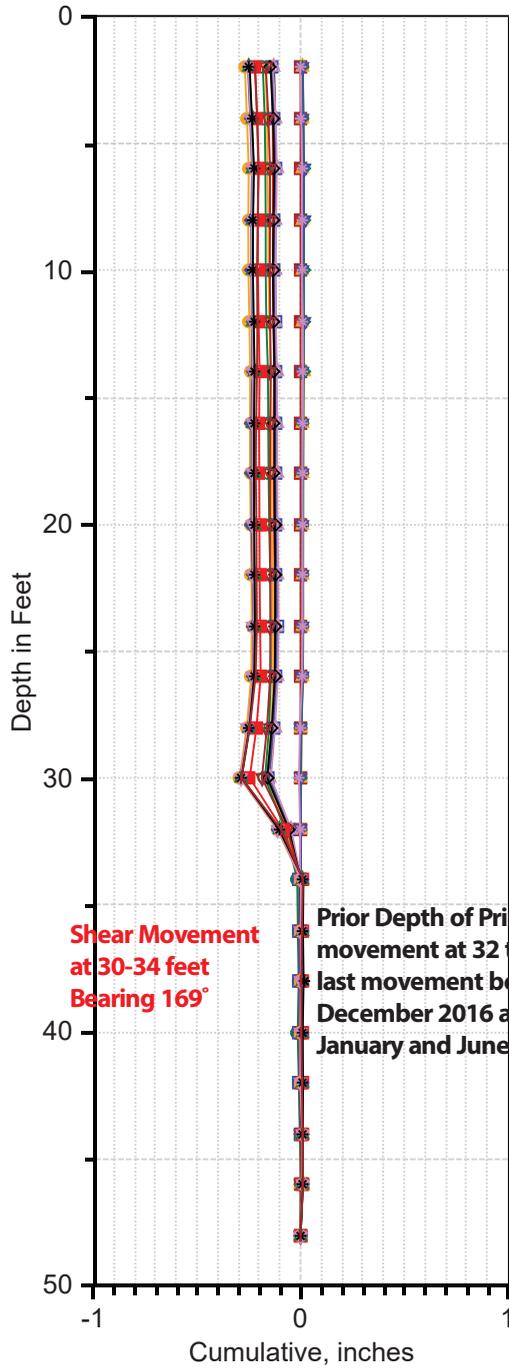


- 8/6/2021
- 12/15/2021
- 1/7/2022
- 4/11/2022
- 11/2/2022
- 1/30/2023
- 6/7/2023
- 6/15/2023
- 7/6/2023
- 8/2/2023
- 8/22/2023
- 11/8/2023
- 1/11/2024
- 2/7/2024
- 2/13/2024
- 2/21/2024
- 2/28/2024
- 3/7/2024
- 3/22/2024
- 4/9/2024
- 5/1/2024
- 7/31/2024

Plot of Slope Inclinometer  
SI-4A

Plot Type: Cumulative and Incremental		Plot Direction: A-Direction	
Depth of Survey (ft): 48		Baseline Date: 8/06/2021	
Install Date: 8/2012		Interpreted Movement Since Baseline (in): 0.48	
Installed Depth (ft): 50		Interpreted Movement Monitoring Year (in): 0.20	
		Corrections: None	

B-  
114°

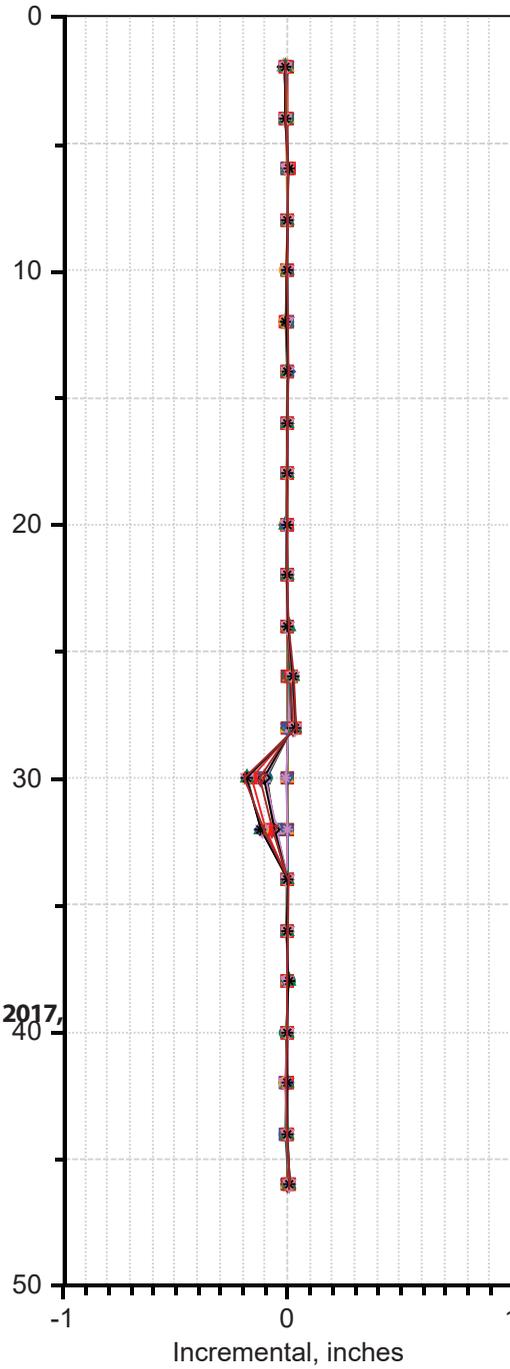


Shear Movement at 30-34 feet Bearing 169°

Prior Depth of Primary movement at 32 to 34 feet last movement between December 2016 and March 2017, January and June 2023

- 8/6/2021
- 4/11/2022
- 6/7/2023
- 8/2/2023
- 1/11/2024
- 2/21/2024
- 3/22/2024
- 7/31/2024
- 12/15/2021
- 11/2/2022
- 6/15/2023
- 8/22/2023
- 2/7/2024
- 2/28/2024
- 4/9/2024
- 1/7/2022
- 1/30/2023
- 7/6/2023
- 11/8/2023
- 2/13/2024
- 3/7/2024
- 5/1/2024

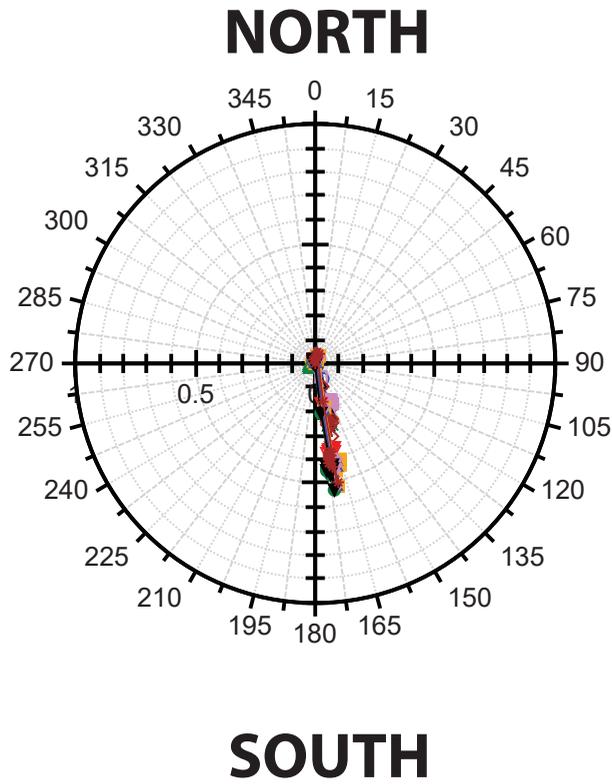
B+  
294°



- 8/6/2021
- 4/11/2022
- 6/7/2023
- 8/2/2023
- 1/11/2024
- 2/21/2024
- 3/22/2024
- 7/31/2024
- 12/15/2021
- 11/2/2022
- 6/15/2023
- 8/22/2023
- 2/7/2024
- 2/28/2024
- 4/9/2024
- 1/7/2022
- 1/30/2023
- 7/6/2023
- 11/8/2023
- 2/13/2024
- 3/7/2024
- 5/1/2024

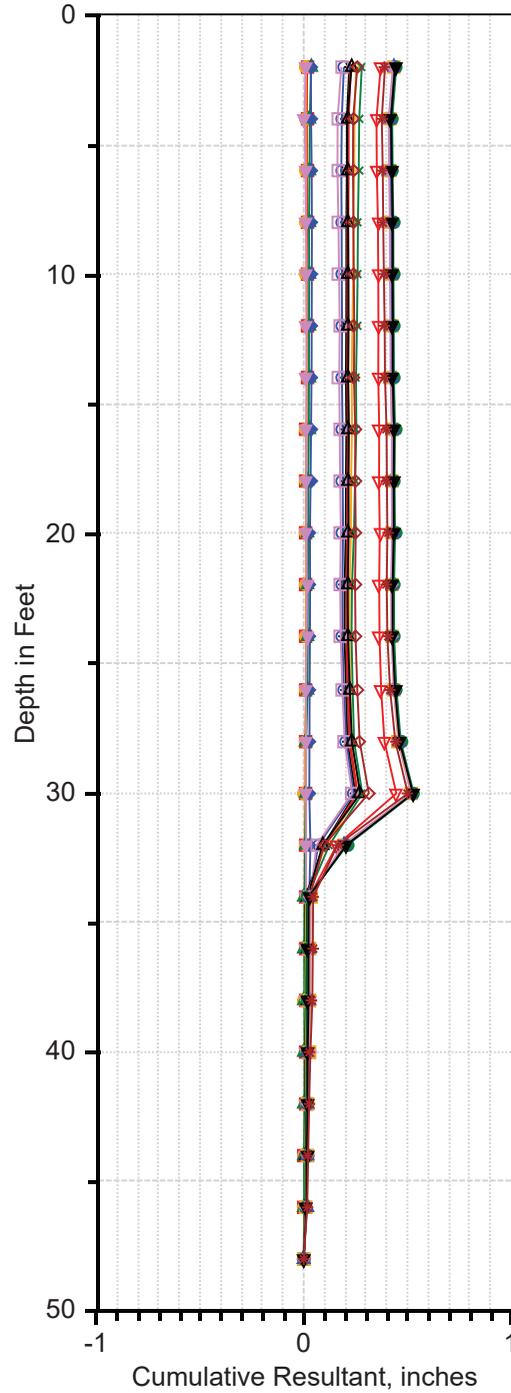
Plot of Slope Inclinometer  
SI-4A

Plot Type: Cumulative and Incremental		Plot Direction: B-Direction	
Depth of Survey (ft): 48		Baseline Date: 8/6/2021	
Install Date: 8/2012		Interpreted Movement Since Baseline (in): 0.48	
Installed Depth (ft): 50		Interpreted Movement Monitoring Year (in): 0.20	
Install Date: 8/2012		Interpreted Movement Monitoring Year (in): 0.20	



Polar View

Cumulative Resultant, inches

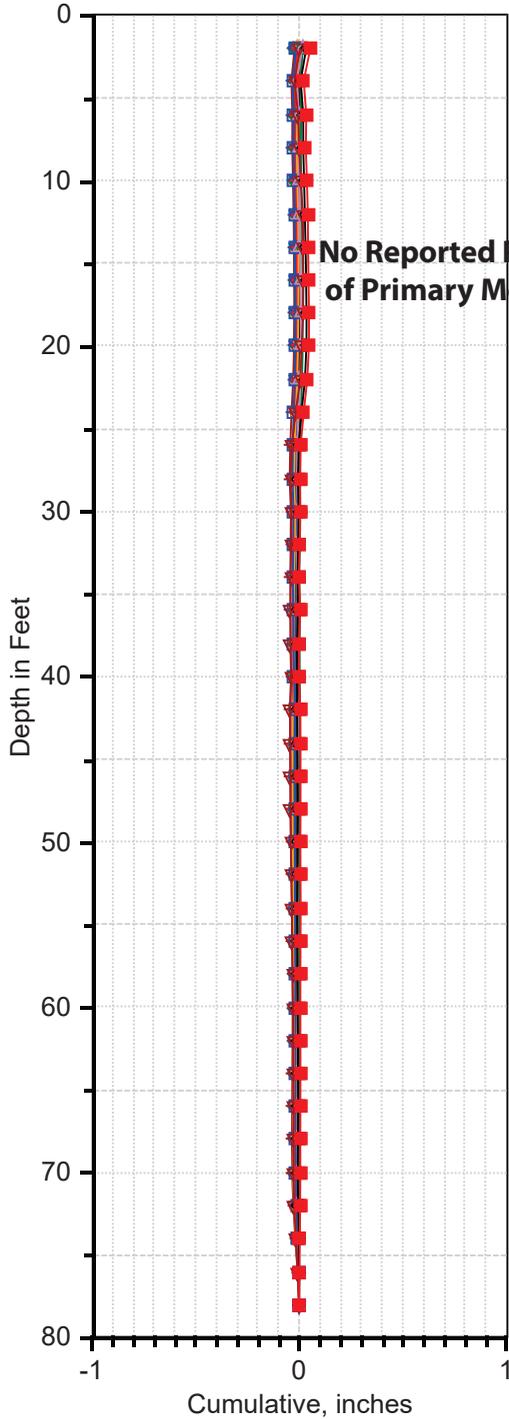


**Plot of Slope Inclinometer**  
**SI-4A**

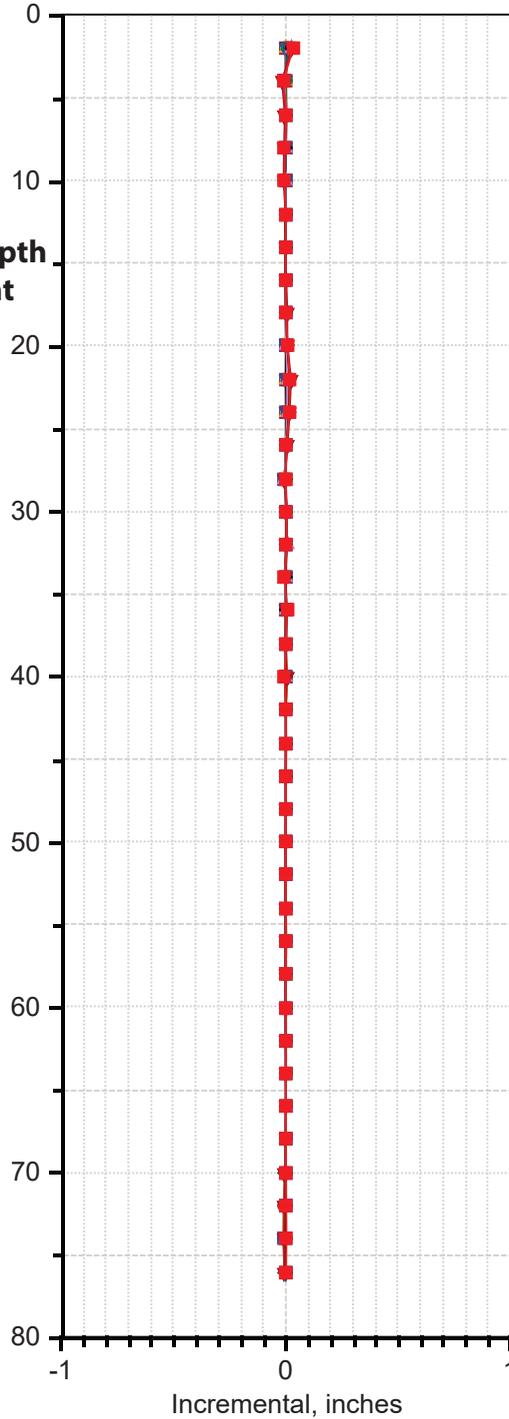
Plot Type: Cumulative Resultant, Polar and Profile Views		Plot Direction: Resultant	
Depth of Survey (ft): 48		Baseline Date: 12/15/2021	
Install Date: 8/2012		Interpreted Movement Since Baseline (in): 0.48	
Installed Depth (ft): 50		Interpreted Movement Monitoring Year (in): 0.20	

PROJECT:	<b>Malibu Road LAD</b> Malibu, CA	PROJECT NUMBER:	<b>220-278</b>
REVISION DATE:	10/8/2024		

A-  
356°



A+  
176°



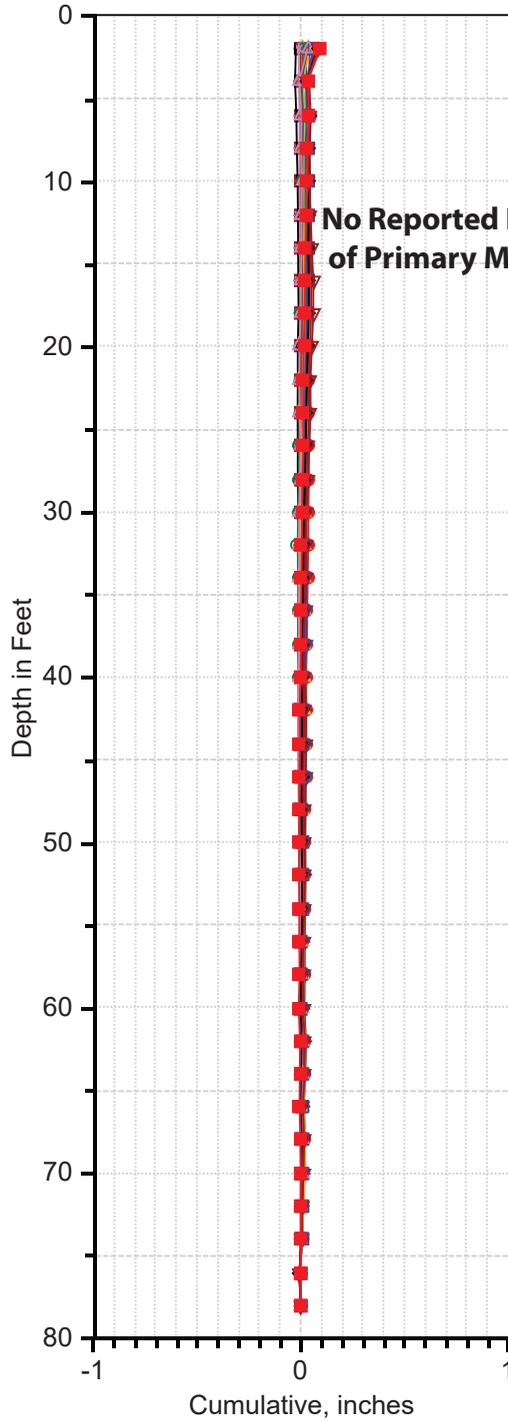
- 5/3/2021
- 8/6/2021
- ▲ 12/15/2021
- ◆ 1/7/2022
- ▼ 3/25/2022
- ◆ 11/2/2022
- 1/18/2023
- 6/6/2023
- 7/6/2023
- 8/22/2023
- 11/8/2023
- 1/15/2024
- ▲ 2/7/2024
- ◆ 3/7/2024
- ▼ 5/1/2024
- 7/31/2024

- 5/3/2021
- 8/6/2021
- ▲ 12/15/2021
- ◆ 1/7/2022
- ▼ 3/25/2022
- ◆ 11/2/2022
- 1/18/2023
- 6/6/2023
- 7/6/2023
- 8/22/2023
- 11/8/2023
- 1/15/2024
- ▲ 2/7/2024
- ◆ 3/7/2024
- ▼ 5/1/2024
- 7/31/2024

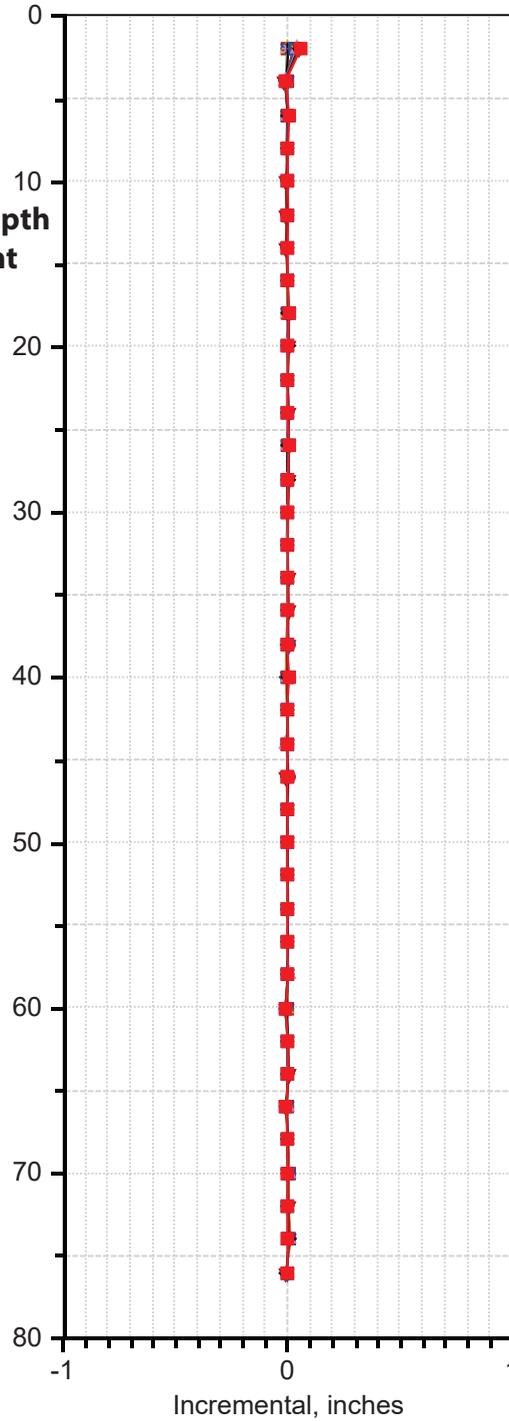
Plot of Slope Inclinometer  
SI-5

Plot Type: Cumulative and Incremental		Plot Direction: A-Direction	
Depth of Survey (ft): 78		Baseline Date: 5/3/2021	
Install Date: 4/1998		Interpreted Movement Since Baseline (in): 0	
Installed Depth (ft): 78		Interpreted Movement Monitoring Year (in): 0	
		Corrections: None	

B-  
86°



B+  
266°



- 5/3/2021
- 8/6/2021
- ▲ 12/15/2021
- ◆ 1/7/2022
- ▼ 3/25/2022
- + 11/2/2022
- + 1/18/2023
- 6/6/2023
- + 7/6/2023
- 8/22/2023
- 11/8/2023
- 1/15/2024
- ▲ 2/7/2024
- ◇ 3/7/2024
- ▼ 5/1/2024
- 7/31/2024

- 5/3/2021
- 8/6/2021
- ▲ 12/15/2021
- ◆ 1/7/2022
- ▼ 3/25/2022
- + 11/2/2022
- + 1/18/2023
- 6/6/2023
- + 7/6/2023
- 8/22/2023
- 11/8/2023
- 1/15/2024
- ▲ 2/7/2024
- ◇ 3/7/2024
- ▼ 5/1/2024
- 7/31/2024

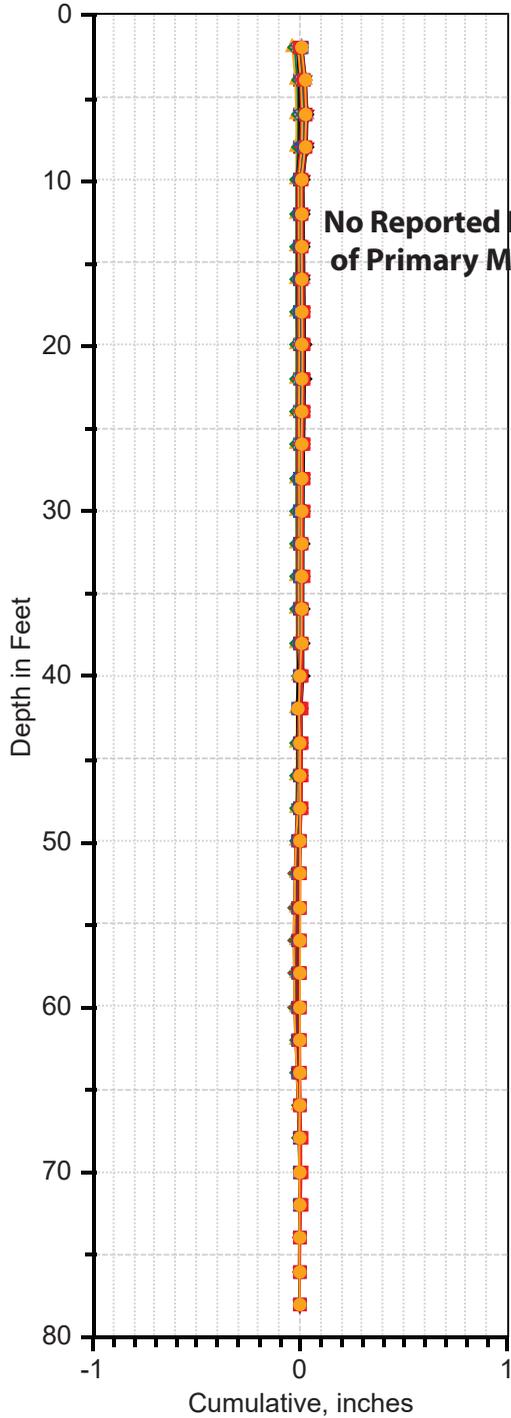
Plot of Slope Inclinometer  
**SI-5**

Plot Type: Cumulative and Incremental		Plot Direction: B-Direction	
Depth of Survey (ft): 78		Baseline Date: 5/3/2021	
Install Date: 4/1998		Corrections: None	
Installed Depth (ft): 78	Interpreted Movement Since Baseline (in): 0	Interpreted Movement Monitoring Year (in): 0	

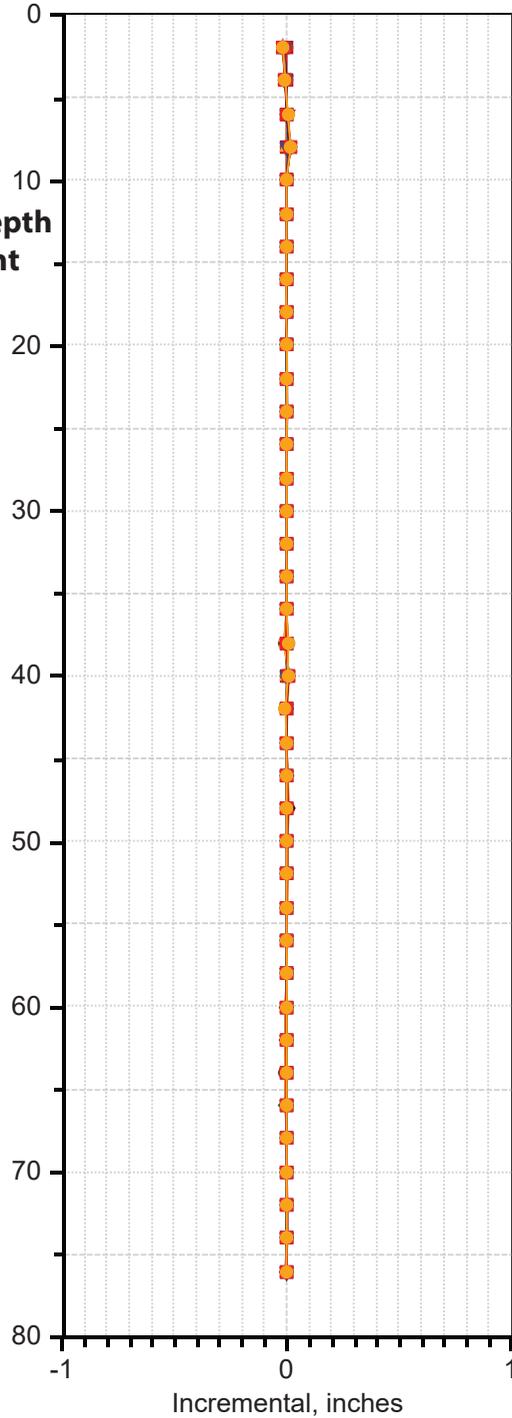


PROJECT: **Malibu Road LAD**  
Malibu, CA  
PROJECT NUMBER: **220-278**  
REVISION DATE: 10/14/2024

A-6°



A+ 186°



- 5/3/2021
- 8/6/2021
- ▲ 12/15/2021
- ◆ 1/7/2022
- ▼ 3/25/2022
- ✦ 11/2/2022
- ⊕ 1/18/2023
- ⊖ 6/6/2023
- ⊗ 7/6/2023
- ⊘ 8/22/2023
- ⊙ 11/8/2023
- ⊚ 1/15/2024
- ⊛ 2/7/2024
- ⊜ 2/28/2024
- ⊝ 3/7/2024
- ⊞ 5/1/2024
- ⊟ 7/31/2024

- 5/3/2021
- 8/6/2021
- ▲ 12/15/2021
- ◆ 1/7/2022
- ▼ 3/25/2022
- ✦ 11/2/2022
- ⊕ 1/18/2023
- ⊖ 6/6/2023
- ⊗ 7/6/2023
- ⊘ 8/22/2023
- ⊙ 11/8/2023
- ⊚ 1/15/2024
- ⊛ 2/7/2024
- ⊜ 2/28/2024
- ⊝ 3/7/2024
- ⊞ 5/1/2024
- ⊟ 7/31/2024

Plot of Slope Inclinometer  
SI-6

Plot Type: Cumulative and Incremental		Plot Direction: A-Direction	
Depth of Survey (ft): 78		Baseline Date: 5/3/2021	
Install Date: 4/1998		Interpreted Movement Since Baseline (in): 0	
Installed Depth (ft): 78		Interpreted Movement Monitoring Year (in): 0	

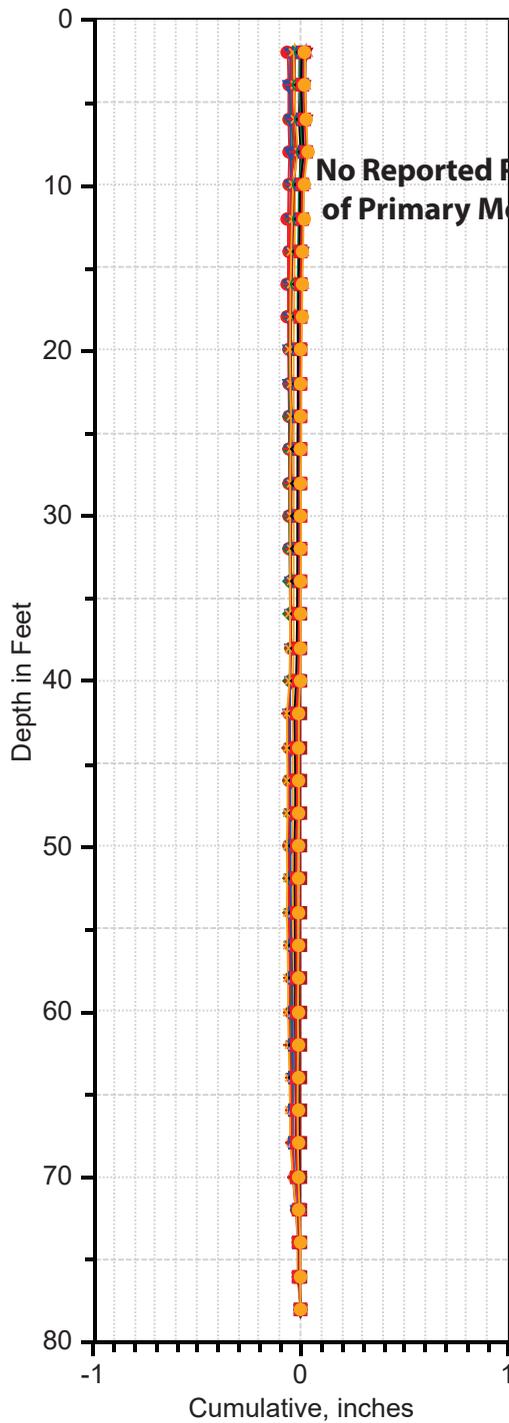


PROJECT: Malibu Road LAD  
Malibu, CA

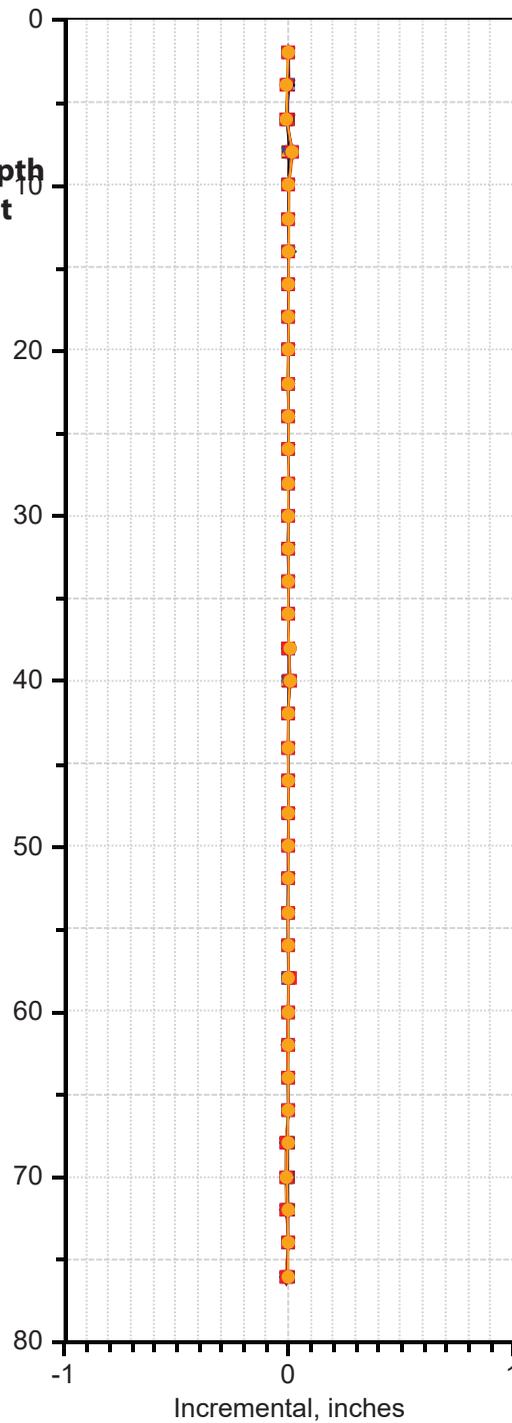
PROJECT NUMBER: 220-278

REVISION DATE: 10/14/2024

B-  
96°



B+  
276°



- |             |             |              |             |             |              |
|-------------|-------------|--------------|-------------|-------------|--------------|
| ■ 5/3/2021  | ● 8/6/2021  | ▲ 12/15/2021 | ■ 5/3/2021  | ● 8/6/2021  | ▲ 12/15/2021 |
| ◆ 1/7/2022  | ▼ 3/25/2022 | ◆ 11/2/2022  | ◆ 1/7/2022  | ▼ 3/25/2022 | ◆ 11/2/2022  |
| ⊕ 1/18/2023 | ⊖ 6/6/2023  | ⊕ 7/6/2023   | ⊕ 1/18/2023 | ⊖ 6/6/2023  | ⊕ 7/6/2023   |
| ⊗ 8/22/2023 | ⊙ 11/8/2023 | ⊗ 1/15/2024  | ⊗ 8/22/2023 | ⊙ 11/8/2023 | ⊗ 1/15/2024  |
| ◇ 2/7/2024  | ◇ 2/28/2024 | ◇ 3/7/2024   | ◇ 2/7/2024  | ◇ 2/28/2024 | ◇ 3/7/2024   |
| ■ 5/1/2024  | ● 7/31/2024 |              | ■ 5/1/2024  | ● 7/31/2024 |              |

<b>Plot of Slope Inclinometer</b>  <b>SI-6</b>	Plot Type: Cumulative and Incremental		Plot Direction: B-Direction	
	Depth of Survey (ft): 78		Baseline Date: 5/3/2021	
	Install Date: 4/1998	Installed Depth (ft): 78	Interpreted Movement Since Baseline (in): 0	Interpreted Movement Monitoring Year (in): 0

 <b>Yeh and Associates, Inc.</b> Geotechnical • Geological • Construction Services	PROJECT: <b>Malibu Road LAD</b> Malibu, CA	PROJECT NUMBER: <b>220-278</b>
	REVISION DATE: 10/14/2024	

**APPENDIX C - DEWATERING**

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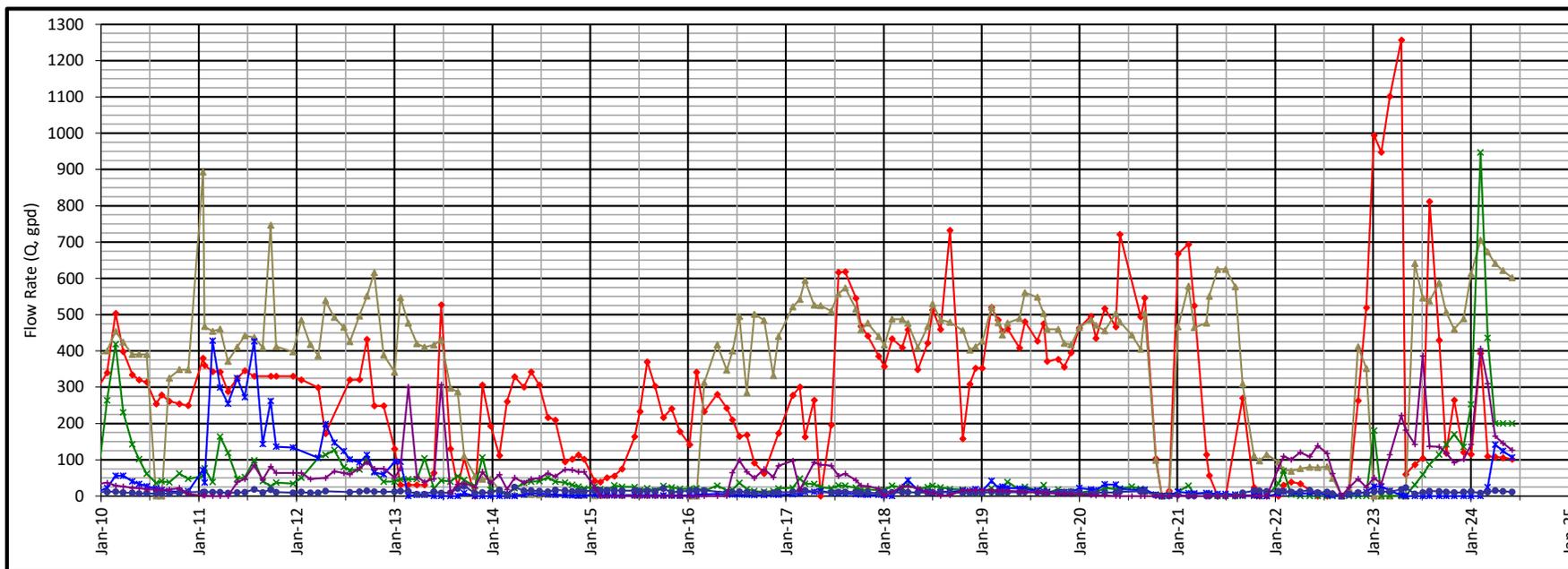
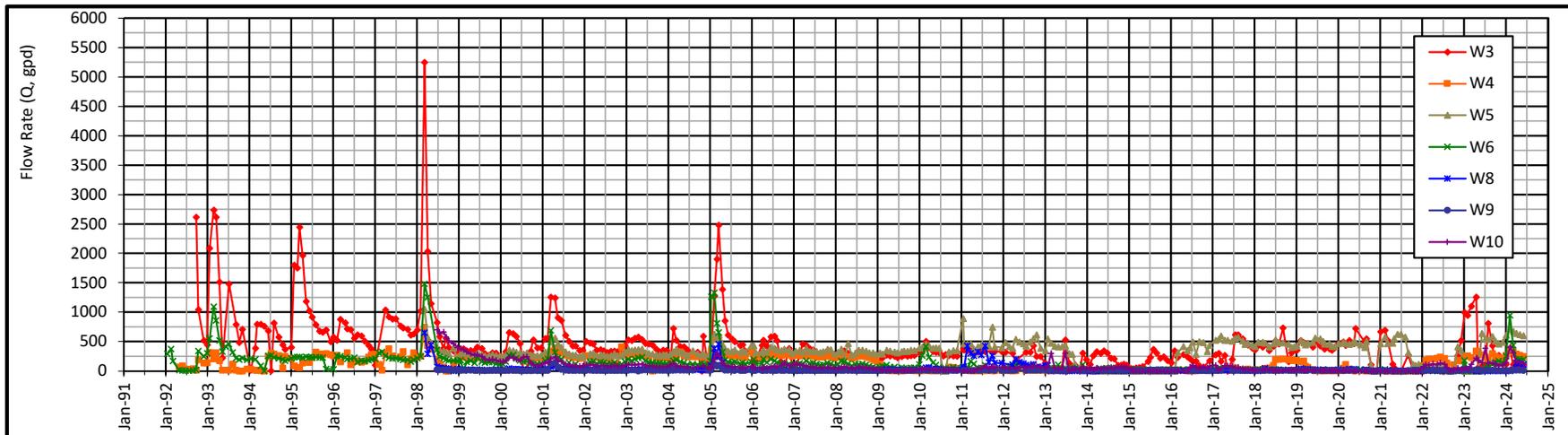
<b>MALIBU ROAD LAD - Dewatering Well Information</b>							
Well ID	Vault Elevation (ft.)	Bottom Elevation (ft.)	Pump Elevation (ft.)	Pump Size (hp)	2023-2024 Mean Pumping Rate (gpd)	% of Total Well Production	Installed By
W-3	19.5	-4.0	Unknown	1/2	232	8%	LA Co.
W-4	20.0	-9.0	-4.0	1/2	263	9%	LA Co.
W-5	19.0	-9.5	Unknown	1/2	582	20%	LA Co.
W-6	20.0	-4.5	0.0	1/2	245	8%	LA Co.
W-8	27.5	11.0	Unknown	1/2	33	1%	LA Co.
W-9	20.0	-40.0	-35.0	1/3	12	0%	LA Co.
W-10	19.0	-26.0	-21.0	1/3	189	6%	LA Co.
W-11	61.0	1.0	13.0	1/3	74	3%	BYA
W-12	58.0	-2.0	8.0	1/3	741	25%	BYA
W-13	20.0	-28.0	N/A	N/A	0	0%	Fugro
W-14	60.0	-20.0	Unknown	1/3	520	18%	Fugro
NW-1	Unknown	Unknown	Unknown	Unknown	0	0%	Homeowner
NW-2	Unknown	Unknown	Unknown	Unknown	19	1%	Homeowner
NW-3	Unknown	Unknown	Unknown	Unknown	0	0%	Homeowner

<b>MALIBU ROAD LAD- Hydrauger Information</b>						
Hydrauger ID	Installed Length (ft.)	Bearing	Functional Length* (ft)	2023-2024 Mean Flow Rate (gpd)	% of Total Production	Installed By
HD-1**	Unknown	N05E	74	0	0%	LA County
HD-2**	Unknown	N21E	34	0	0%	LA County
HD-3**	Unknown	N06E	13	0	0%	LA County
HD-4	Unknown	N29E	53	88	7%	LA County
HD-5A	Unknown	N13E	41	95	7%	LA County
HD-6	Unknown	N08W	55	51	4%	LA County
HD-7	Unknown	N26E	87	37	3%	LA County
HD-8	Unknown	N19E	92	2	0%	LA County
HD-8A	Unknown	Unknown	Unknown	76	6%	Unknown
HD-9	Unknown	N34E	76	0	0%	LA County
HD-10	Unknown	N19E	55	0	0%	LA County
HD-11	Unknown	N11E	78	0	0%	LA County
HD-12	Unknown	N08E	70	0	0%	LA County
HD-13	Unknown	N09E	79	0	0%	LA County
HD-14	Unknown	N08E	80	0	0%	LA County
HD-15	Unknown	N14E	82	0	0%	LA County
HD-16	Unknown	N15E	69	0	0%	LA County
HD-17**	150	N15E	150	0	0%	BYA
HD-18	150	N18E	150	136	11%	BYA
HD-19	150	N10E	150	52	4%	BYA
HD-20	150	N09W	150	256	20%	BYA
HD-21	150	N22E	150	183	14%	BYA
HD-22	180	N13E	180	170	13%	Fugro West
HD-23	160	N01E	160	145	11%	Fugro West

Note: \* Measured on 4/1/98 (except HD-22 and HD-23 installed 1/22/05)  
 \*\* buried/unable to locate

**DEWATERING WELL / HYDRAUGER INFORMATION**

Malibu Road Landslide Assessment District  
 Malibu, California

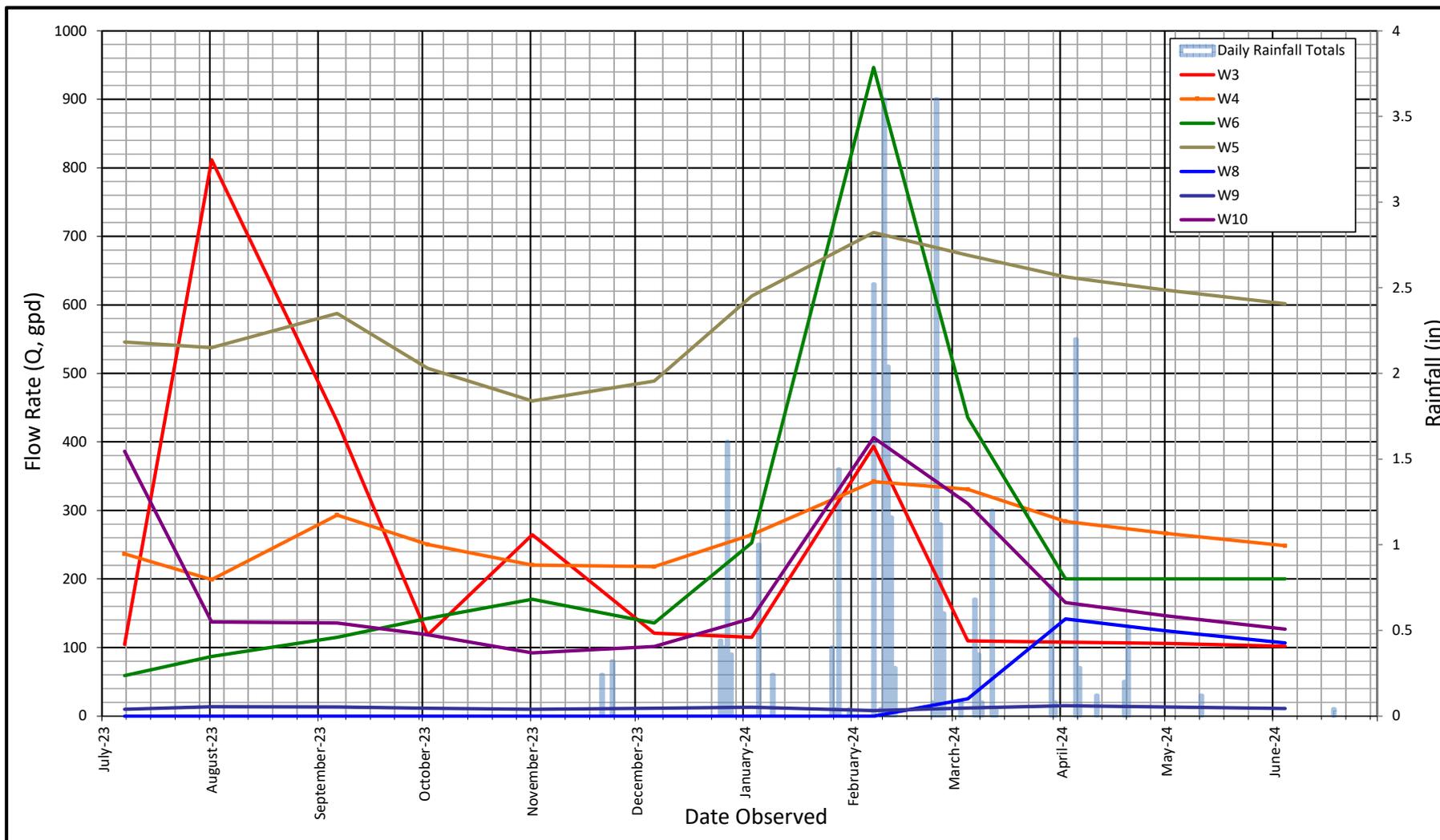


**DEWATERING WELL DISCHARGE RATE GRAPH (HISTORIC)**

**Malibu Road**

Malibu Road Landslide Assessment District

Malibu, California

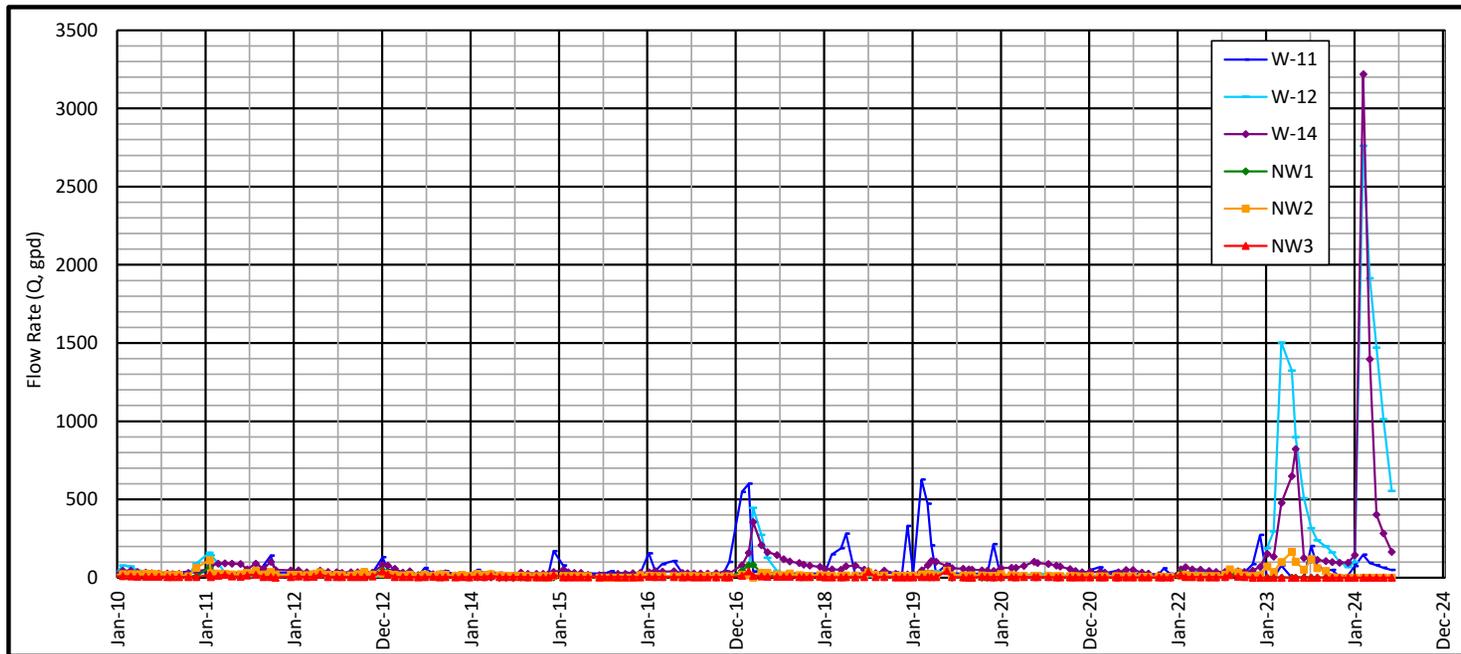
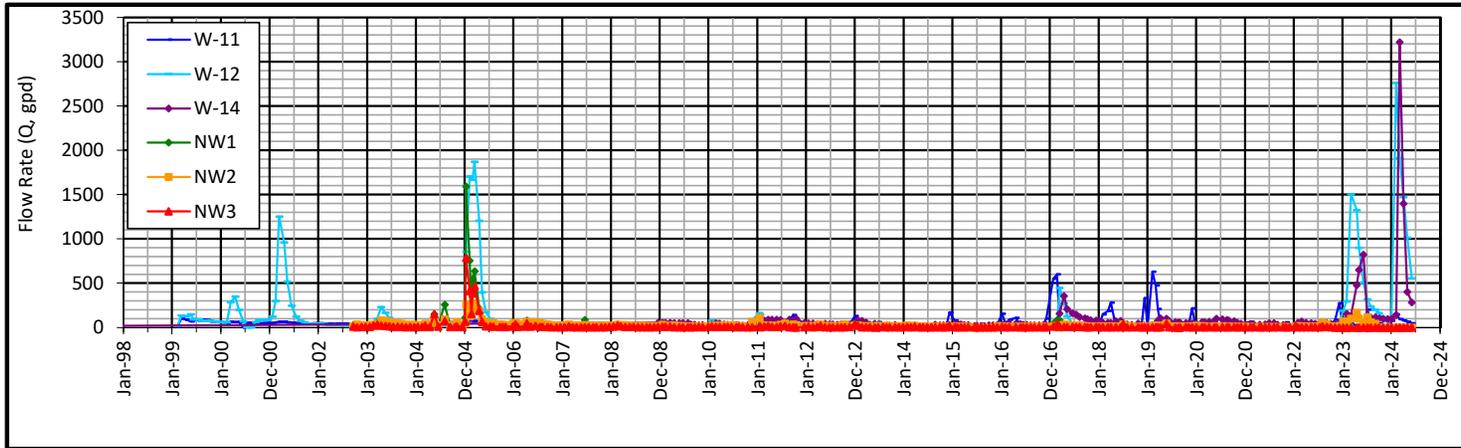


**DEWATERING WELL DISCHARGE RATE GRAPH (MONITORING YEAR)**

**Malibu Road**

Malibu Road Landslide Assessment District

Malibu, California

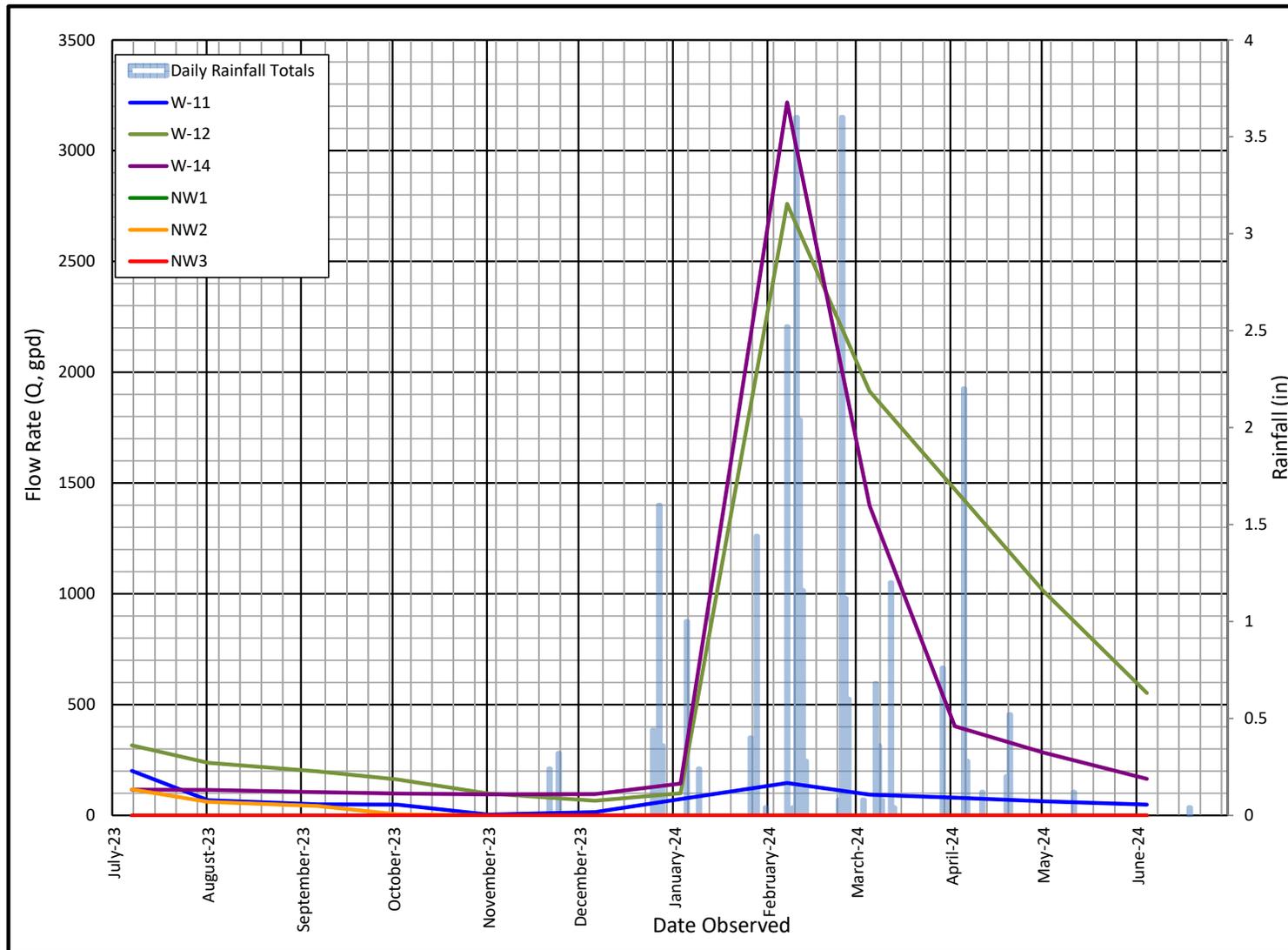


**DEWATERING WELL DISCHARGE RATE GRAPH (HISTORIC)**

**Bayshore Drive**

Malibu Road Landslide Assessment District

Malibu, California

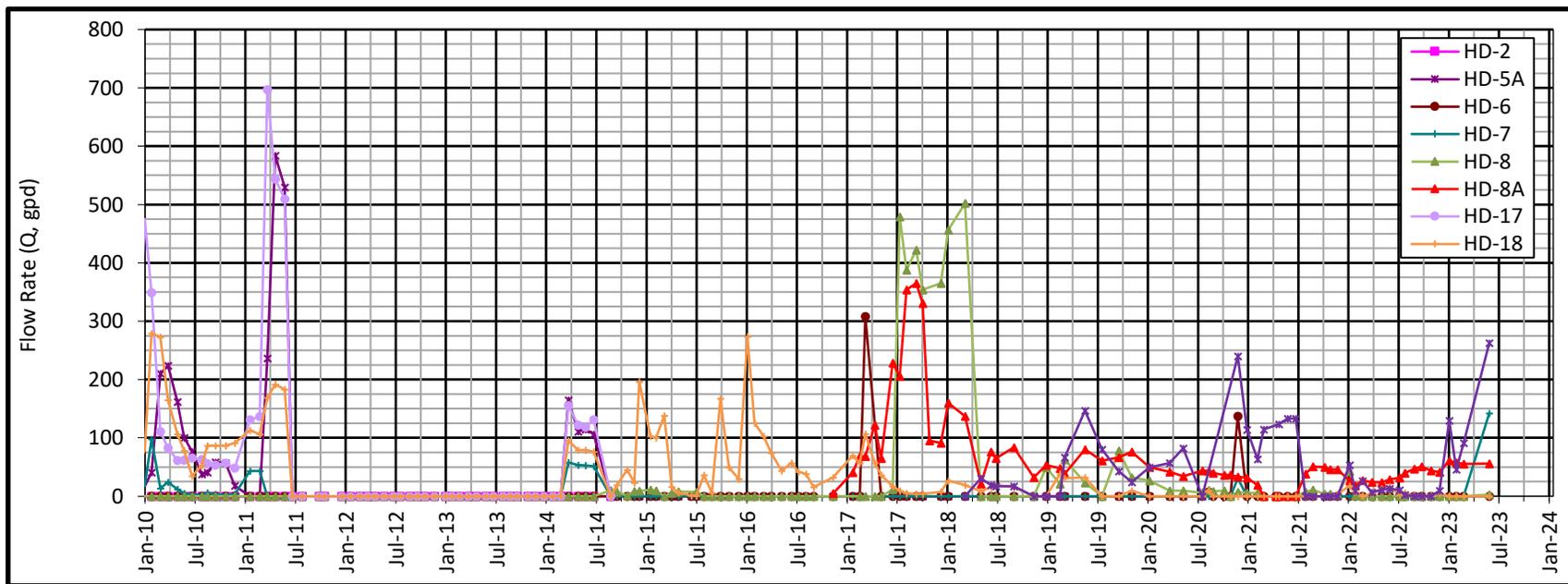
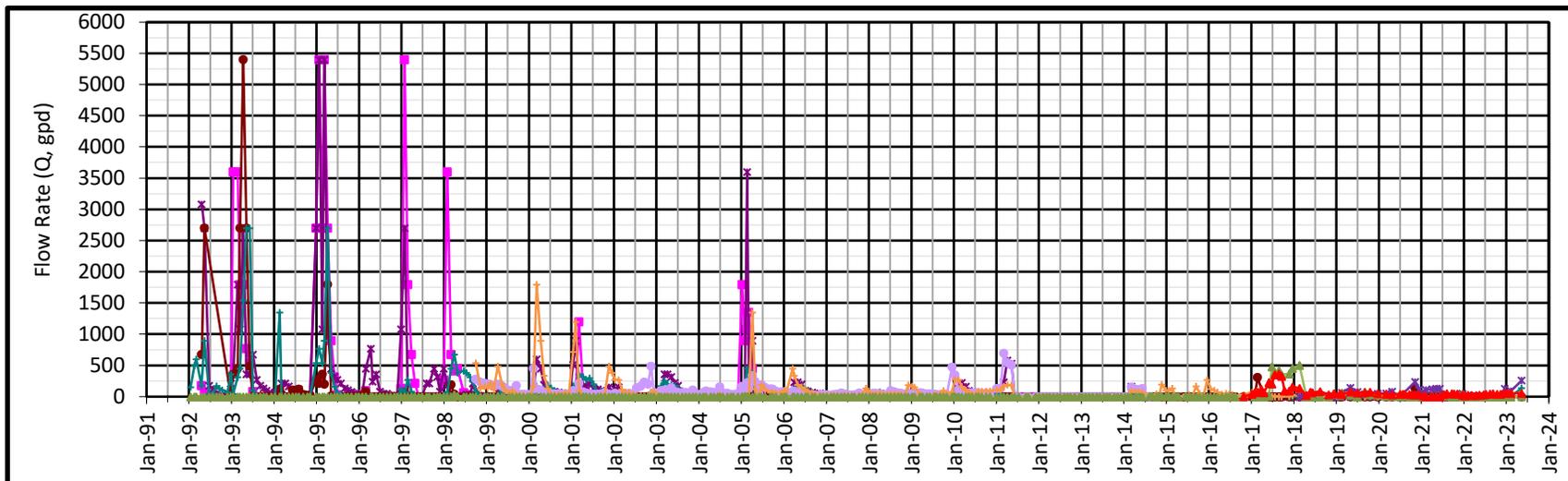


**DEWATERING WELL DISCHARGE RATE GRAPH (MONITORING YEAR)**

**Bayshore Drive**

Malibu Road Landslide Assessment District

Malibu, California

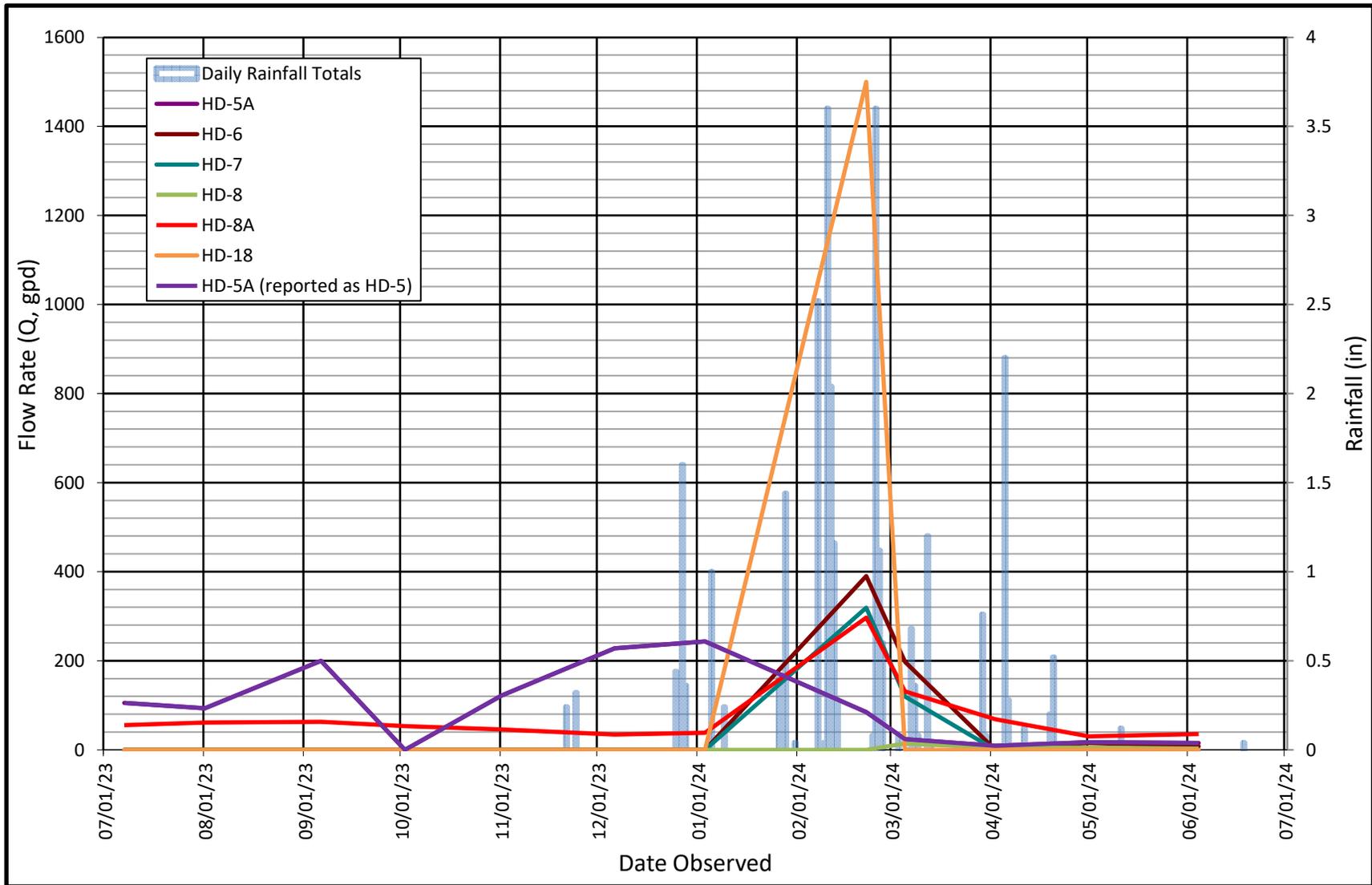


**HYDRAUGER DISCHARGE RATE GRAPH (HISTORIC)**

**Malibu Road (West End)**

Malibu Road Landslide Assessment District

Malibu, California

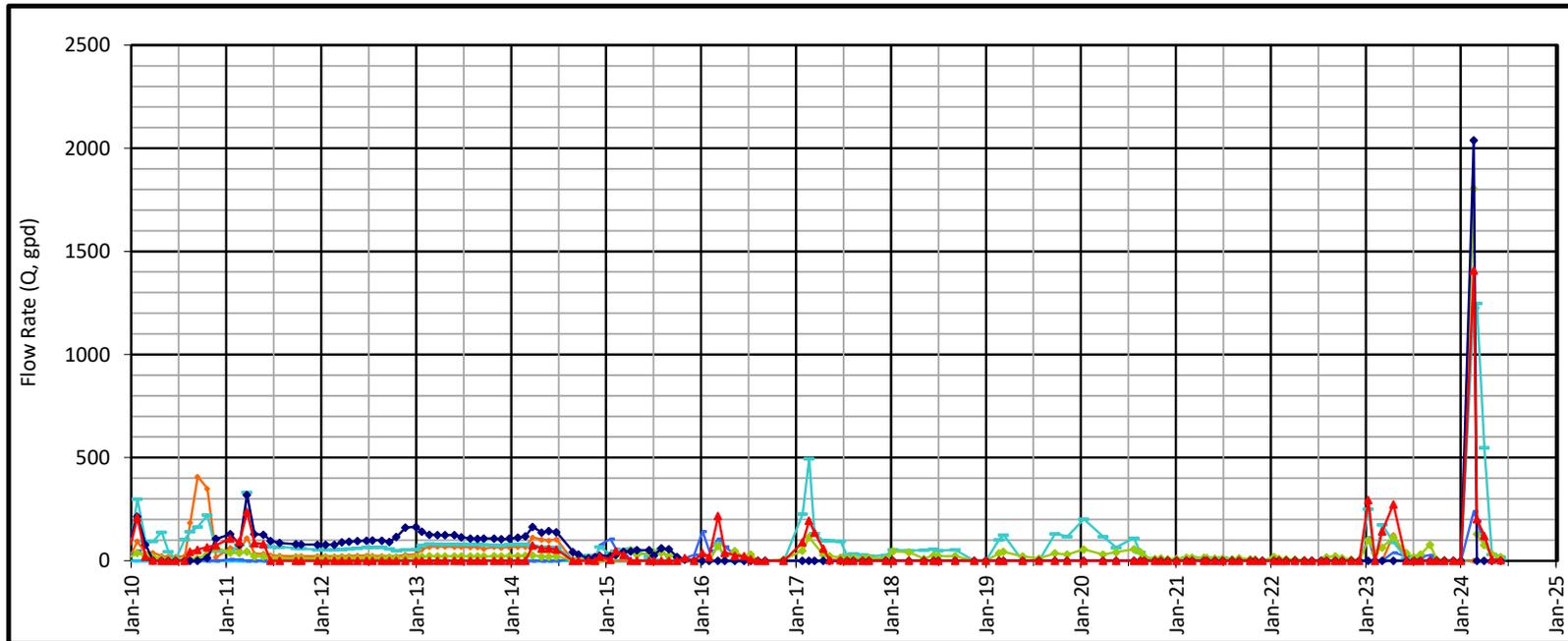
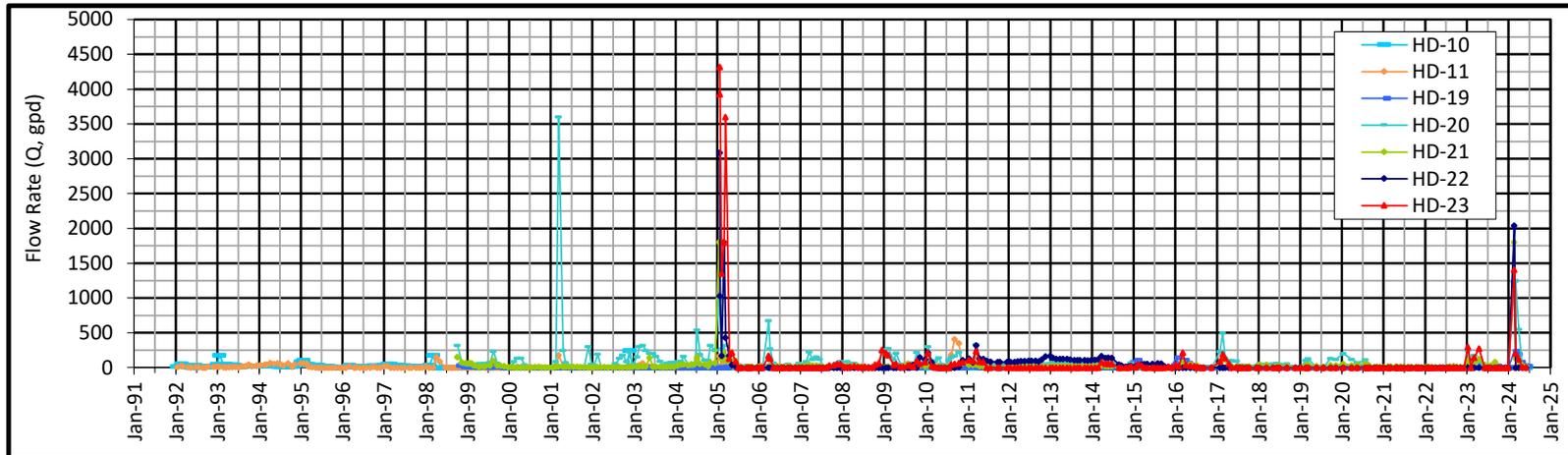


**HYDRAUGER DISCHARGE RATE GRAPH (MONITORING YEAR)**

**Malibu Road (West End)**

Malibu Road Landslide Assessment District

Malibu, California

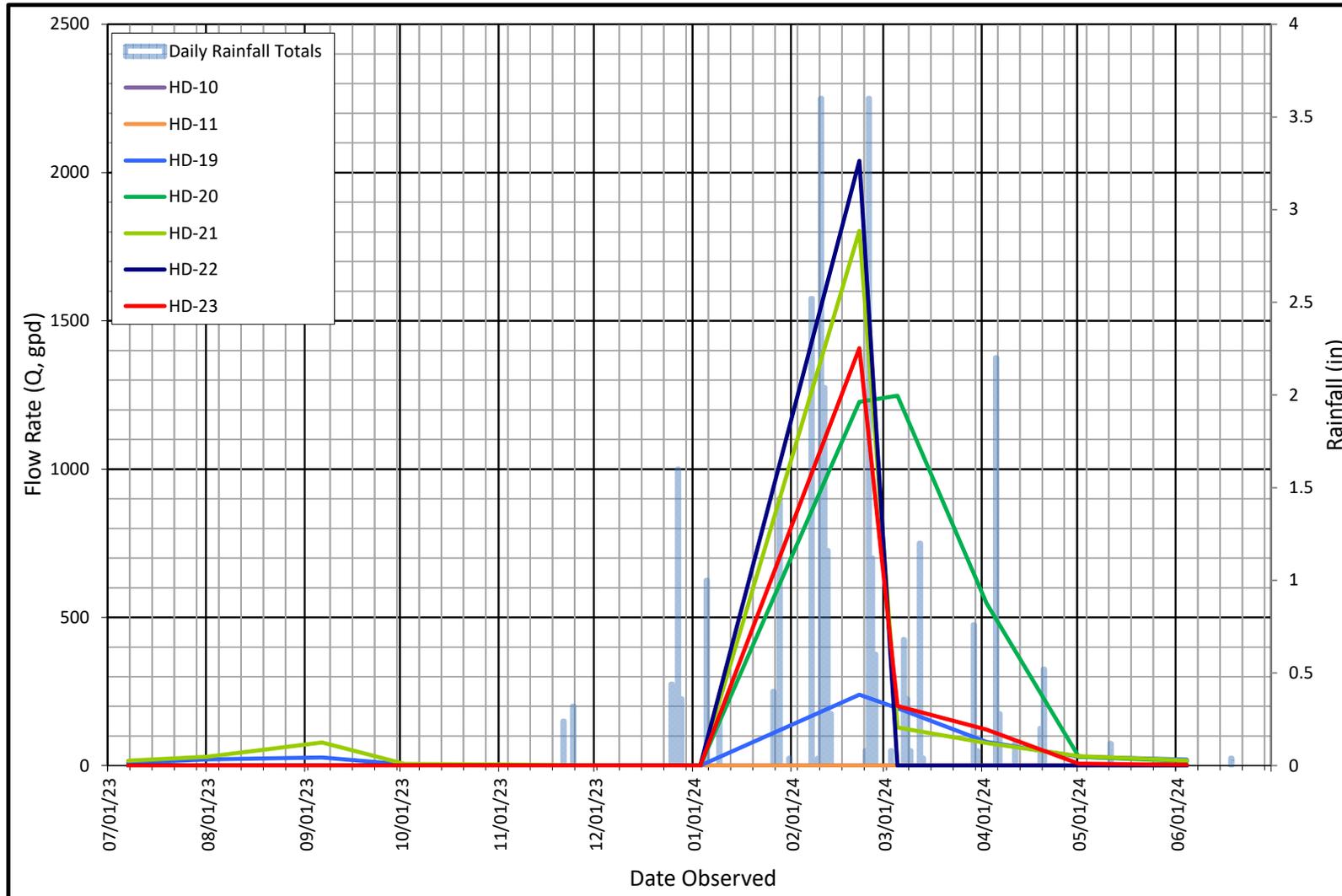


**HYDRAUGER DISCHARGE RATE GRAPH (HISTORIC)**

**Malibu Road (East End)**

Malibu Road Landslide Assessment District

Malibu, California



**HYDRAUGER DISCHARGE RATE GRAPH (HISTORIC)**

**Malibu Road (East End)**

Malibu Road Landslide Assessment District  
 Malibu, California