



Te Kaunihera ā rohe o Te Taitokerau

Severe Weather Event Report (January 2026): Technical Report

Severe Weather Event Report (January 2026) 2026/01

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Executive Summary

Between 18 and 22 January 2026, a compound severe weather event produced significant rainfall across eastern Northland, resulting from two meteorologically distinct but successive systems. Event 1, which occurred on 18 January, triggered intense localised rainfall concentrated along a narrow coastal strip in eastern Northland. Weather models initially indicated that the heaviest rainfall was likely to remain offshore; however, an overnight shift in the system's track resulted in intense rainfall over land, leading to impacts that were more severe than initially anticipated. Event 2 delivered prolonged rainfall over approximately 84 hours from 18 January, intensifying as Tropical Disturbance 05F tracked southeast across the upper North Island from 21 January. MetService issued Heavy Rain and Severe Thunderstorm Warnings for Northland on 18 January, with warnings progressively upgraded to Red Heavy Rain Warnings for Northland on 21 January as Tropical Disturbance 05F approached.

The highest rainfall totals were recorded along the east coast of Northland. Punaruku at Otetao Reti Marae recorded a maximum of 92.1 mm in one hour and 164.2 mm over two hours during Event 1 — among the most intense short-duration rainfall totals on record for Northland. The 12-hour total at Punaruku reached 296 mm. Whakapara at Puhipuhi recorded a maximum of 387.9 mm over 84 hours during Event 2 — a separate and distinct episode confirmed by an 18-hour interevent dry period at Punaruku exceeding the 6-hour IETD threshold.

Rainfall frequency analysis was conducted at two long-record stations — Hatea at Glenbervie Forest HQ (79 years) and Whakapara at Puhipuhi (121 years) — using Annual Maximum Series (AMS) and five probability distributions fitted by L-moments. The Generalised Extreme Value (GEV) distribution was selected as the preferred distribution based on the L-moment ratio diagram and Anderson-Darling goodness-of-fit statistics, consistent with the GEV distribution adopted in High Intensity Rainfall Design System (HIRDS; Carey-Smith et al., 2018). Event 1 produced peak return periods of approximately 26.4 years at Hatea (2-hour duration) and 28–30 years at Whakapara (1–6-hour durations) under GEV. Event 2 produced a peak return period of approximately 34.8 years at Whakapara (72-hour duration) — the highest across both events and sites. At Hatea, Event 2 did not exceed 8.2 years at any duration.

In addition, antecedent conditions are likely to have contributed to an enhanced flood response. Standardised Precipitation Index (SPI) analysis confirmed above-normal rainfall accumulation in eastern Northland over the 3–6 months preceding the events. Although station-level soil moisture data indicated some soils were drier than normal prior to the storm, the extreme magnitude of Event 1 was sufficient to likely saturate catchments. The sequential nature of the two events — with insufficient time for catchment recovery between them — meant Event 2 may have fallen on fully saturated soils, converting the majority of rainfall to direct runoff.

The events produced widespread and severe impacts. Extensive infrastructure damage included the washout of the Ngaiotonga Bridge, a slip of up to 100,000 m³ blocking access to Ōakura. Approximately 300 people were evacuated to local marae, and a state of emergency was declared across Whangārei District on 20 January.

These events underscore the importance of improved forecasting and early warning capability across Northland, particularly for rapidly evolving rainfall systems affecting eastern catchments. The rapid overnight shift in weather models prior to Event 1 — with the system initially forecast to remain offshore — highlights the forecasting challenges posed by fast-moving coastal rainfall systems. The findings and recommendations of this report are directed towards strengthening NRC's hazard monitoring and early warning capabilities across Northland.

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List of Abbreviations

AD	Anderson-Darling (goodness-of-fit statistic)
AMS	Annual Maximum Series
AWS	Automatic Weather Station
EWS	Environmental Weather Station
ESNZ	Earth Sciences New Zealand
GEV	Generalised Extreme Value distribution
GLO	Generalised Logistic distribution
GOF	Goodness-of-Fit
IDW	Inverse Distance Weighting
IETD	Inter-Event Time Definition
LN3	Log-Normal three-parameter distribution
MetService	Meteorological Service of New Zealand
NRC	Northland Regional Council
NZDT	New Zealand Daylight Time
PE3	Pearson Type III distribution
SMD	Soil Moisture Deficit
SPI	Standardised Precipitation Index

1 Introduction

This report presents a post-event hydrological analysis of the severe rainfall that affected eastern Northland between 18 and 22 January 2026. The event was characterised by two meteorologically distinct but successive rainfall systems that delivered extreme rainfall totals across the region. The resulting flooding caused widespread infrastructure damage, community evacuations, and a formal state of emergency declaration across Whangārei District. The events also caused extensive landslide and slip damage, confined to a relatively small area from Ōakura to Rawhiti across eastern Northland catchments. Post-event analysis of severe weather is important to provide a documented record of event characteristics, an objective assessment of rainfall rarity, and an evidence base to inform future hazard management.

The objectives of this report are to:

- (i) document and quantify the rainfall associated with the January 2026 events.
- (ii) assess how rare the January 2026 rainfall was, by comparing it against the long-term historical record and expressing the results as return periods; and
- (iii) describe the impacts of the events and provide recommendations.

1.1 Geographic Scope

The primary analysis focuses on eastern Northland, encompassing the eastern coastal strip. Rainfall frequency analysis was conducted at two long-record monitoring stations — Hatea at Glenbervie Forest HQ and Whakapara at Puhipuhi — which were the only stations with sufficiently long continuous records for reliable frequency analysis.

1.2 Data Sources and Period of Analysis

The primary data source is the NRC Hilltop database, which provided quality-checked sub-hourly rainfall data from automatic gauges across the monitoring network. Spatial analysis used operational PublicTelemetry data from 49 stations across Northland. Antecedent condition assessment drew on NRC hydrological report SPI maps and Earth Sciences New Zealand (ESNZ) daily soil moisture deficit records. The event analysis period is 18 January 2026 (00:00 NZDT) to 22 January 2026 (00:00 NZDT).

1.3 Report Structure

This report is structured as follows. Section 2 provides a meteorological overview of the weather systems responsible for the January 2026 events. Section 3 presents the rainfall analysis, including data sources, IETD-based event separation, cumulative rainfall, maximum accumulations at multiple durations, spatial distribution maps, and rainfall frequency analysis including distribution selection and return period estimation. Section 4 assesses antecedent conditions using SPI and soil moisture data. Section 5 documents the impacts of the events. Section 6 presents conclusions and recommendations. References are provided in Section 7.

2 Meteorological overview

This section describes the synoptic weather systems responsible for the January 2026 Northland rainfall events, drawing on daily MetService synoptic maps published between 17 and 22 January 2026.

On Saturday 17 January, a ridge of high pressure moved over New Zealand from the southwest, bringing cooler southerly winds to most areas including Northland (Figure 1). A large high was establishing over the South Island by Sunday, while a disturbed easterly flow was beginning to develop over the North Island.

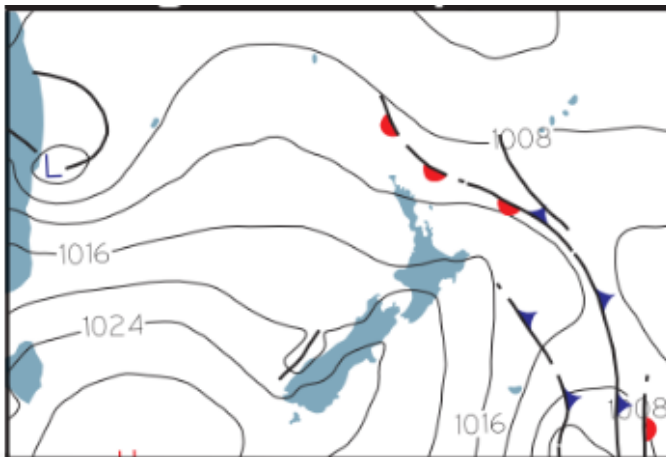


Figure 1 Synoptic weather map, midnight 17 January 2026. Source: Meteorological Service of New Zealand (2026), Herald on Saturday, January 17, p. A19.

On 18 January, a ridge of high pressure built over the South Island and lower North Island, while a strong disturbed easterly flow drove air against the coastal ranges of eastern Northland (Figure 2), triggering intense localised rainfall concentrated along a narrow coastal strip. The event was spatially highly localised, with extreme intensities recorded at Punaruku at Otetao Reti Marae while neighbouring stations recorded comparatively modest totals. MetService issued Heavy Rain and Severe Thunderstorm Warnings for Northland on 18 January (Figure 3). Weather models had initially placed the heaviest rain offshore, with a rapid overnight shift causing the system to track over land (1News, 2026).

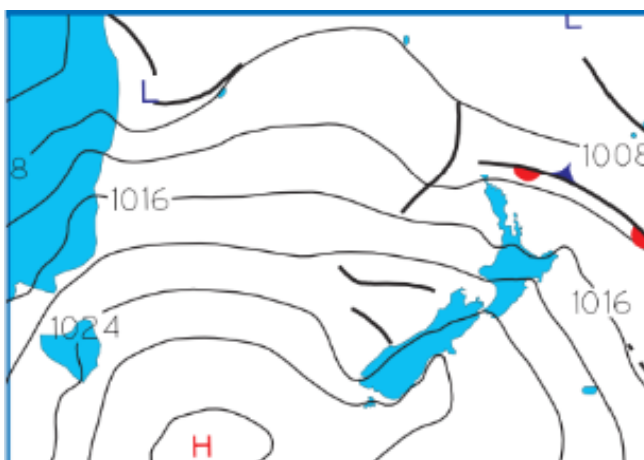


Figure 2 Synoptic weather map, noon 18 January 2026 (Event 1). Source: Meteorological Service of New Zealand (2026), Herald on Sunday, January 18, p. 22.

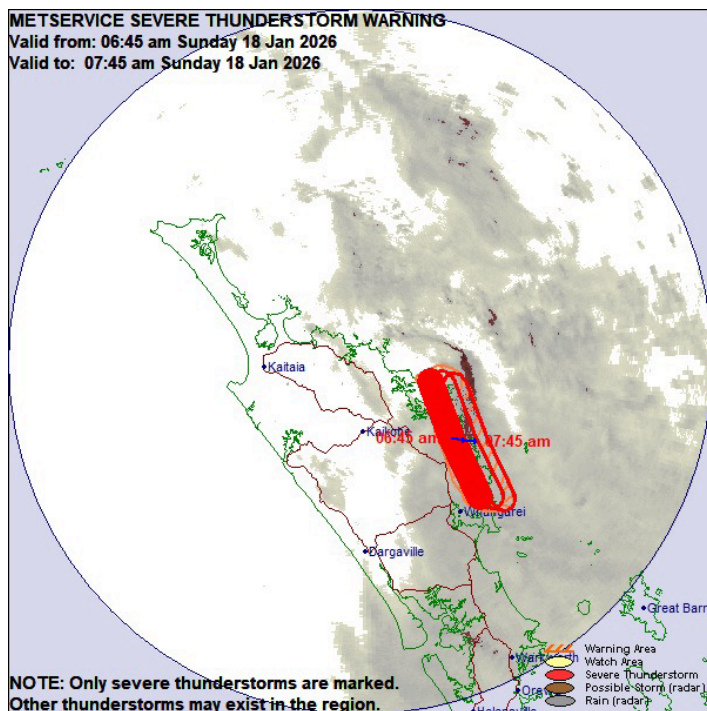


Figure 3 MetService Severe Thunderstorm Warning for Bay of Islands to Helena Bay, 18 January 2026. Source: MetService New Zealand (2026)

On 21 January, Tropical Low 14U — previously known by that name while it was in the Australian region, and redesignated Tropical Disturbance 05F by the Fiji Meteorological Service upon crossing into the South Pacific basin — deepened and tracked southeast directly over the upper North Island (Figure 4). Warnings were progressively upgraded ahead of Event 2, with Red Heavy Rain Warnings issued for Northland on 21 January as Tropical Disturbance 05F approached. By 22 January, the tropical low was moving away to the east of New Zealand, leaving an unstable westerly flow over the country.

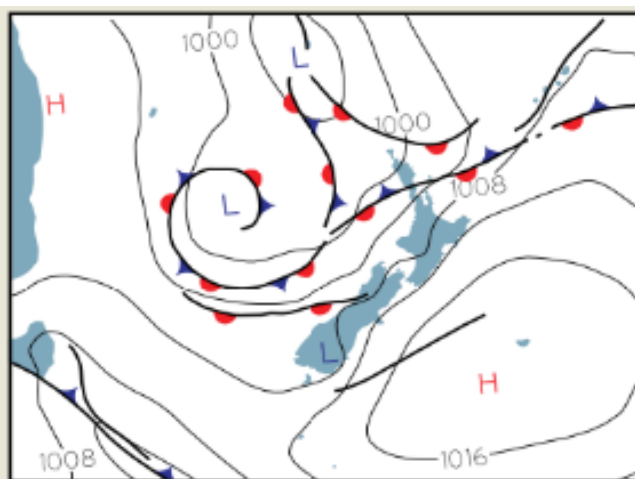


Figure 4 Synoptic weather map, noon 21 January 2026 (Event 2) — Tropical Disturbance 05F. Source: Meteorological Service of New Zealand (2026), The New Zealand Herald, January 21, p. A28.

3 Rainfall Analysis

This section presents the rainfall analysis for the January 2026 Northland storm events. It covers the data sources and monitoring network (Section 3.1), the objective identification of event boundaries using IETD analysis (Section 3.2), the storm rainfall patterns and spatial distribution (Section 3.3), and rainfall frequency analysis including distribution selection and return period estimation (Section 3.4).

3.1 Data Sources

Reliable and spatially representative rainfall data are fundamental to any post-event hydrological analysis. Two complementary datasets were used in this report, each serving a distinct purpose: operational telemetry data for broad spatial coverage, and quality-checked archive data for rigorous quantitative analysis.

The primary source for quantitative analysis was the NRC Hilltop database, which provided sub-hourly automatic rainfall gauge data. Hourly rainfall totals were extracted using the R Hilltop package.

Four monitoring sites were selected for analysis based on data availability, record length, and geographic coverage of the storm-affected area (Table 1). Frequency analysis was restricted to Hatea at Glenbervie Forest HQ and Whakapara at Puhipuhi, which are the only stations with sufficiently long continuous records to support statistically reliable return period estimation. At-site frequency analysis requires preferably a minimum of 30 years of data at the target catchment (Pearson and Davies, 1997). Punaruku at Otetao Reti Marae — which recorded the highest rainfall intensities during Event 1 — has been operational for less than one year and is therefore unsuitable for frequency analysis. Veronica Channel at Opuia Wharf, with approximately 17 years of record, was also excluded as its record length is insufficient for return period estimation.

Table 1 Summary of key monitoring sites used in the January 2026 rainfall analysis.

Site Name	Latitude	Longitude	Record Start	Record Length (yr)	Role in Analysis
Hatea at Glenbervie Forest HQ	-35.655	174.346	1947	79	Frequency analysis, IETD, cumulative plots, spatial analysis
Whakapara at Puhipuhi	-35.506	174.276	1905	121	Frequency analysis, IETD, cumulative plots, spatial analysis
Punaruku at Otetao Reti Marae	-35.385	174.318	2025	<1	IETD, cumulative plots, spatial analysis only
Veronica Channel at Opuia Wharf	-35.312	174.121	~2009	~17	IETD, cumulative plots, spatial analysis only

For spatial analysis, the broader NRC PublicTelemetry network — comprising 49 operational stations across the Northland region (Figure 5) — was used to produce Inverse Distance Weighting (IDW) interpolated rainfall maps for both events.

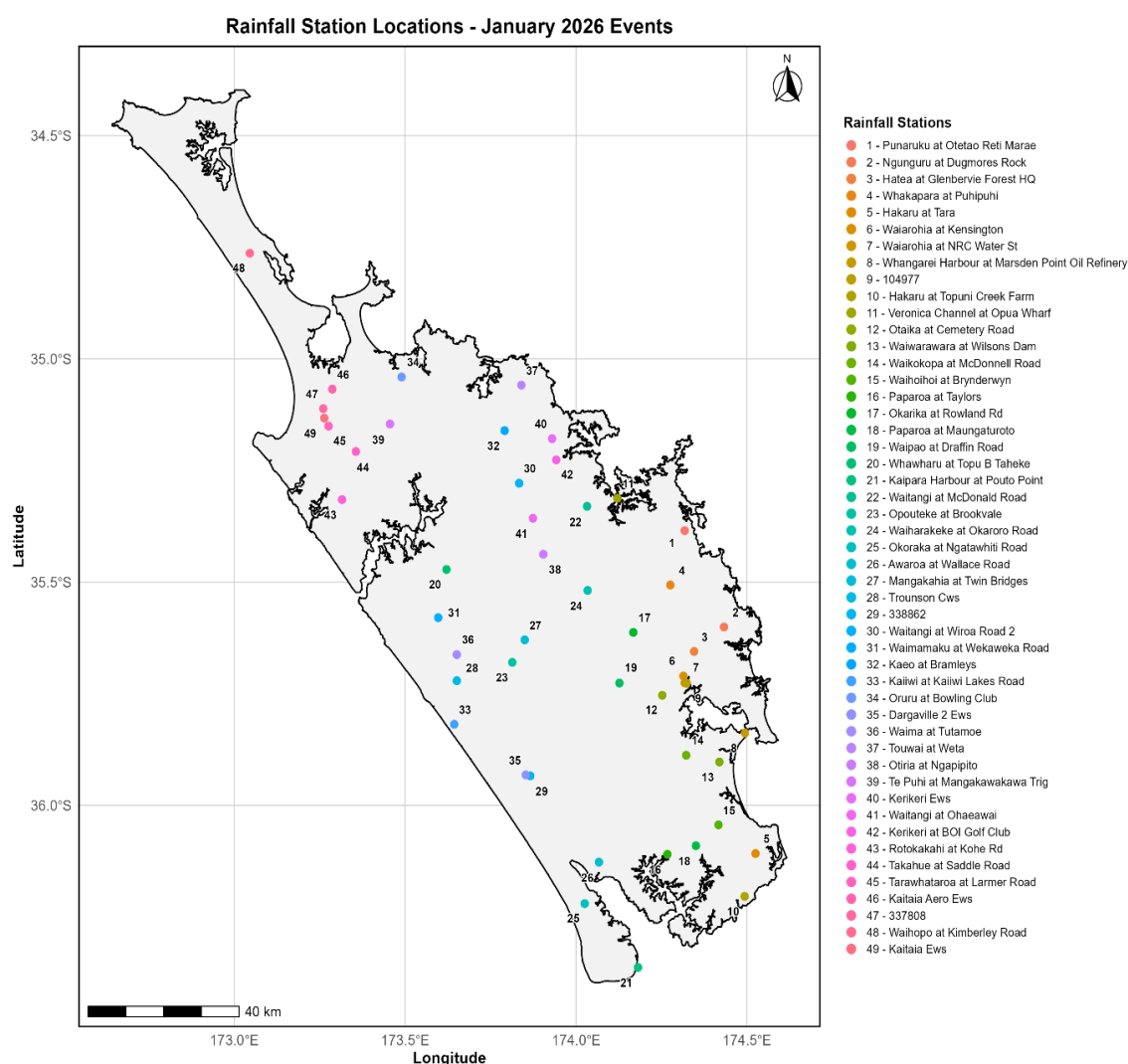


Figure 5 Spatial distribution of rainfall monitoring stations used in the January 2026 event analysis.

3.2 Event Separation: Inter-Event Time Definition (IETD) Analysis

Before conducting rainfall frequency analysis, it is necessary to determine whether the January 2026 storm sequence constituted a single continuous event or two statistically distinct events. This distinction is important because frequency analysis uses the maximum rainfall accumulation within each event window — combining two separate events into one would overestimate multi-day totals, while treating them separately allows each event's characteristics to be assessed independently against the historical record.

IETD is a standard method in hydrology for separating discrete rainfall events from a continuous time series. The method identifies dry periods — intervals during which rainfall intensity falls below a defined threshold — and uses these gaps to define boundaries between successive events. In this analysis a minimum dry period threshold of 6 hours was applied across all four sites.

Visual inspection of the hourly rainfall time series (Figure 6) confirmed that all four sites exhibited a pronounced peak during the morning of 18 January, followed by cessation or near-cessation of rainfall by approximately 12:00 NZDT. IETD analysis detected an 18-hour dry period (rainfall < 0.1 mm/hour)

at Punaruku from 08:50 on 18 January to 02:30 on 19 January, confirming the two phases as statistically distinct events. The event boundary was set at 12:00 NZDT on 18 January, where the 6-hour threshold was met consistently across all four sites, rather than the end of the longest single-site dry period at Punaruku (02:30 on 19 January).

Based on this analysis, events were defined as follows:

Event 1 — 18 January 2026, 00:00 to 12:00 NZDT (12 hours)

Event 2 — 18 January 2026, 12:00 to 22 January 2026, 00:00 NZDT (84 hours)

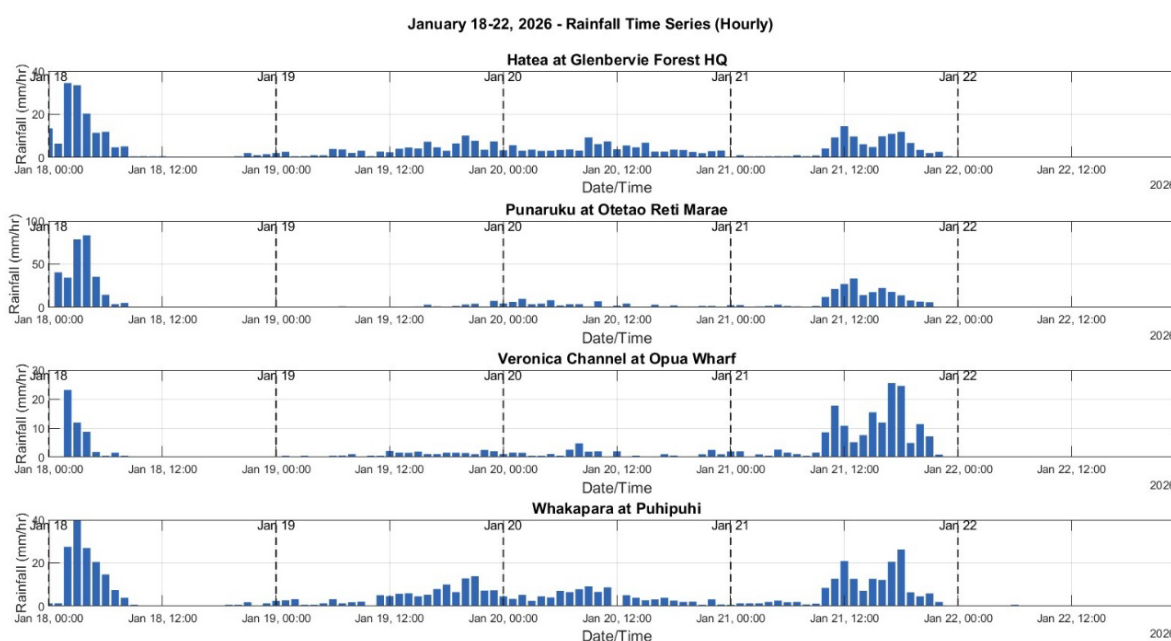


Figure 6 Hourly rainfall time series during the January 18–22, 2026 storm sequence at four monitoring sites, with dashed vertical lines indicating daily boundaries.

3.3 Storm Rainfall Patterns

This section characterises the rainfall patterns of the January 2026 events using three complementary approaches: cumulative rainfall plots, maximum accumulations at multiple durations, and spatial distribution maps produced by IDW interpolation.

3.3.1 Cumulative Rainfall

Cumulative rainfall curves were produced using quality-checked sub-hourly data from the NRC Hilltop database. Steep gradients indicate periods of intense rainfall; flat segments indicate dry or low-intensity periods. Figure 7 presents cumulative rainfall for January 2026 across all four sites, with Event 1 (cyan shading, 18 January 00:00–12:00) and Event 2 (rose shading, 18 January 12:00 to 22 January 00:00) clearly delineated.

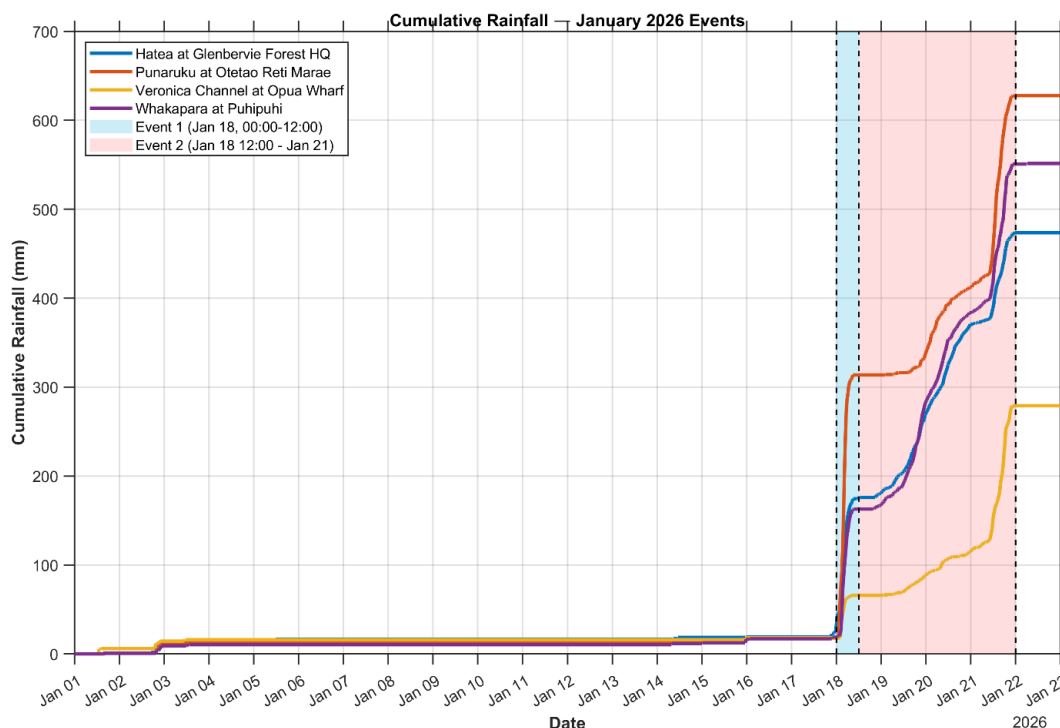


Figure 7 Cumulative rainfall time series during the January 2026 storm sequence across four monitoring sites.

During Event 1, Punaruku exhibited an exceptionally steep gradient — near-vertical between 00:00 and 06:00 on 18 January — reflecting extreme rainfall intensity. Whakapara and Hatea showed similarly steep gradients, albeit at lower magnitudes. Veronica Channel recorded minimal accumulation during Event 1.

During Event 2, rainfall accumulation shifted to a more gradual, sustained rate of accumulation. Whakapara eventually overtook Hatea in total volume, while Punaruku maintained the highest cumulative total throughout the combined event sequence. Veronica Channel again recorded the smallest cumulative totals across both events.

3.3.2 Maximum Rainfall at Multiple Durations

Maximum rainfall totals were extracted using a trailing moving window approach applied to quality-checked sub-hourly resolution data. For each duration of interest, a window of that length was moved sequentially through the event period. For Event 1, windows of 1, 2, 6 and 12 hours were applied. For Event 2, windows of 1, 2, 6, 12, 24, 48, 72 and 84 hours were applied. Tables 2 and 3 present the maximum rainfall accumulations for Event 1 and Event 2 respectively.

Table 2 Maximum rainfall accumulations (mm) during Event 1 at four monitoring sites.

Site	1-hour (mm)	2-hour (mm)	6-hour (mm)	12-hour (mm)
Hatea at Glenbervie Forest HQ	41.3	72.1	120.7	142.7
Punaruku at Otetao Reti Marae	92.1	164.2	288.3	296.0
Veronica Channel at Opuia Wharf	23.2	36.6	47.6	48.0
Whakapara at Puhipuhi	50.4	78.0	137.4	143.9

Punaruku recorded the highest rainfall intensities during Event 1, with an extreme 1-hour peak of 92.1 mm and a 2-hour maximum of 164.2 mm. The 6-hour maximum reached 288.3 mm, with rainfall strongly concentrated in the first six hours, accounting for 97% of the 12-hour total. Hatea and Whakapara received rainfall more gradually across the full 12-hour period, reaching nearly identical 12-hour totals of approximately 143 mm.

Table 3 Maximum rainfall accumulations (mm) during Event 2 at four monitoring sites.

Site	1hr	2hr	6hr	12hr	24hr	48hr	72hr	84hr
Hatea at Glenbervie Forest HQ	16.2	25.9	58.1	94.9	127.0	225.4	293.5	298.1
Punaruku at Otetao Reti Marae	36.9	63.4	139.8	199.7	217.3	296.6	313.6	313.6
Veronica Channel at Opua Wharf	30.0	51.2	94.7	150.6	166.5	193.8	213.2	213.2
Whakapara at Puhipuhi	26.2	48.4	91.6	150.7	170.2	299.6	384.7	387.9

Event 2 shifted from the short, intense bursts characteristic of Event 1 to a more prolonged and widespread period of heavy rainfall. Punaruku again showed the highest short-term intensities over the 1–6-hour windows. Its accumulation rose only marginally after the 48-hour mark and then plateaued completely by 72 hours. In contrast, Whakapara continued to gain steadily throughout Event 2, showing a pronounced increase between the 24- and 48-hour marks and ultimately recording the highest event-total accumulation at 387.9 mm. Veronica Channel at Opua Wharf recorded moderate accumulation throughout Event 2, reaching 213.2 mm by 72 hours — the lowest total across all four sites — with no further rainfall recorded in the final 12 hours of the period.

3.3.3 Spatial Distribution of Rainfall

IDW interpolation of event total rainfall from the 49-station PublicTelemetry network was used to map accumulated rainfall distribution across the Northland region. The Event 1 spatial distribution (Figure 8) reveals an extremely localised rainfall pattern, with a high-intensity core along the eastern coast near Punaruku and Ōakura.

In addition to gauge rainfall, rain radar data (Figure 9) from the MOATA portal (Mott MacDonald) provides secondary validation: radar grid 4418701 near the junction of Punaruku Road and Russell Road recorded approximately 280 mm, consistent with the 296.0 mm gauge observation. The rain radar also confirms that rainfall extended well offshore to the east, consistent with the initial forecast that the system would remain offshore, and highlights that the land-based gauge network alone cannot capture the full spatial extent of such systems.

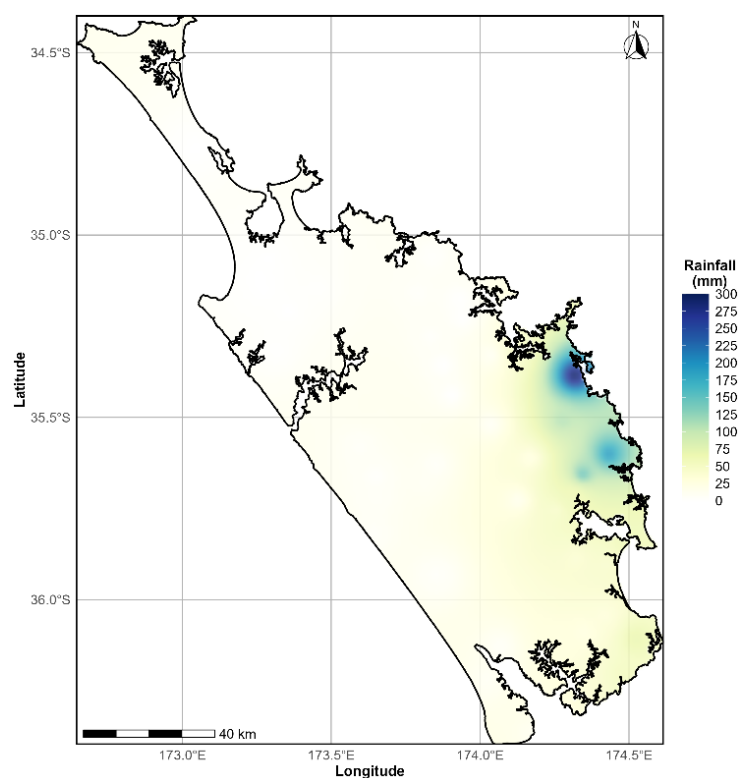


Figure 8 Spatial distribution of Event 1 accumulated rainfall.

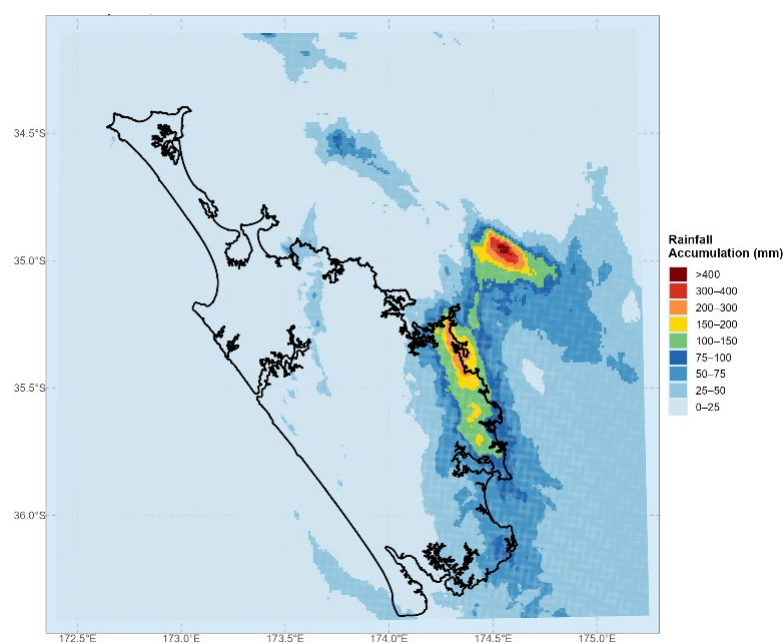


Figure 9 Rain radar accumulation for Event 1.

The Event 2 spatial distribution (Figure 10) contrasts markedly with Event 1, displaying a broader and more uniform pattern consistent with the large-scale forcing of Tropical Disturbance 05F. Widespread moderate-to-high accumulations extend across much of eastern Northland and into central areas, with maximum totals in the eastern catchments. Rain radar data (Figure 11) confirms this regional pattern: a radar cell (grid 4420854) north of Puhipuhi recorded 379.8 mm, consistent with the 387.9 mm gauge observation at Whakapara. The radar also reveals a clear east-to-west rainfall gradient and two distinct high-intensity cores along the eastern coast.

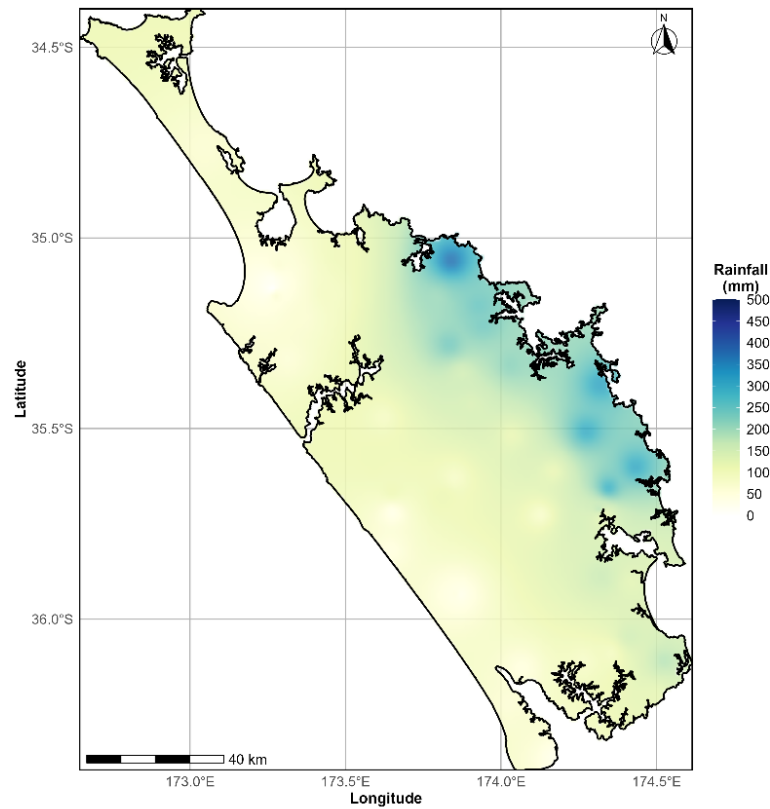


Figure 10 Spatial distribution of Event 2 accumulated rainfall.

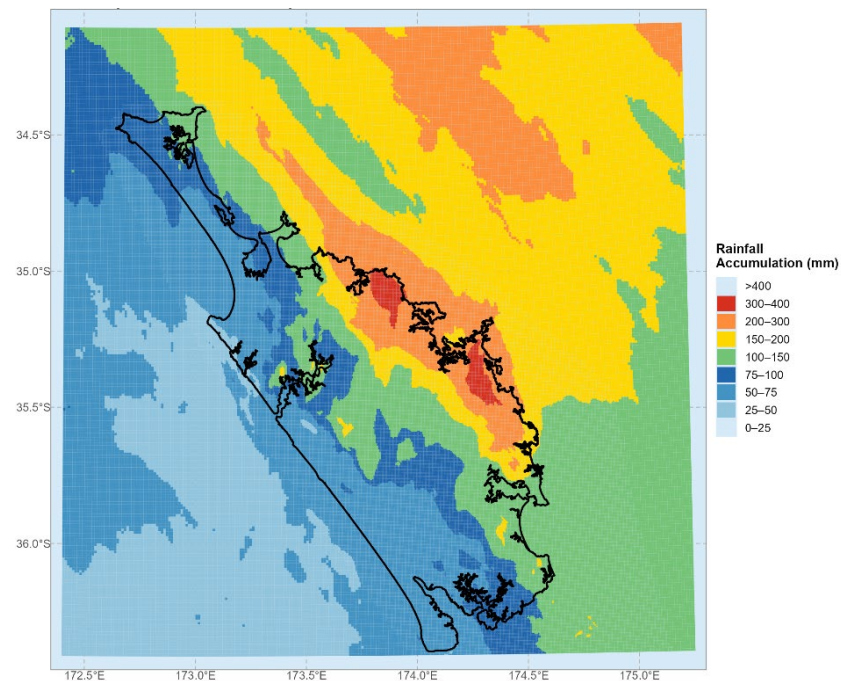


Figure 11 Rain radar accumulation for Event 2.

Across both events, the interpolated rainfall maps and radar show broadly consistent patterns in terms of the location of maximum totals. However, some differences are evident. The interpolated rainfall maps, derived from the gauge network, appear smoother due to interpolation between sparse gauge points, while the radar captures more spatial detail and variability. This discrepancy is most

evident in Event 2, where the broader spatial extent of rainfall makes the contrast between eastern and western Northland more apparent.

3.4 Rainfall Frequency Analysis

Rainfall frequency analysis determines the rarity of the observed January 2026 rainfall by comparing maximum values at each duration against the long-term historical record. This section describes the methodology, distribution selection, and return period results for both events at both monitoring sites.

3.4.1 Methodology

Frequency analysis was performed using the AMS approach, in which the single highest rainfall accumulation for each duration is extracted from each calendar year of the historical record. The AMS was derived for durations of 1, 2, 6, 12, 24, 48, 72 and 84 hours using a rolling window applied to the full historical record at each site. Records were truncated to 31 December 2025, deliberately excluding the January 2026 events, so that the observed January 2026 maximum rainfall at each duration could be evaluated as independent observations against the historical baseline.

The analysis used 79 years of records (1947–2025) at Hatea at Glenbervie Forest HQ and 121 years (1905–2025) at Whakapara at Puhipuhi — among the longest continuous rainfall records in Northland. All parameter estimation was performed using the method of L-moments (Hosking, 1990; Hosking and Wallis, 1997), which offer greater robustness to outliers and lower sensitivity to sampling variability compared to conventional product-moments. All analyses were implemented in R using the *lmomco* package (Asquith, 2023).

While rainfall frequency analysis in New Zealand is commonly conducted using the High Intensity Rainfall Design System (HIRDS), which provides gridded rainfall frequency estimates for a range of durations and return periods across New Zealand (Carey-Smith et al., 2018), station-based frequency analysis was preferred in this report. Hatea and Whakapara have exceptionally long records of 79 and 121 years respectively, extending to 2025 — whereas the HIRDS Version 4 dataset extends to 2016, meaning an additional 9 years of data are available at both sites beyond the HIRDS record. This allows more site-specific and up-to-date return period estimates to be derived directly from the local gauge data.

3.4.2 Candidate Distributions

Five probability distributions were fitted to the AMS data at each site and duration: Generalised Logistic (GLO), Generalised Extreme Value (GEV), Log-Normal three-parameter (LN3), Pearson Type III (PE3), and Gumbel, because all five distributions are well-established in hydrology, and collectively cover a range of tail behaviours, providing a robust basis for distribution selection.

3.4.3 Goodness-of-Fit and Distribution Selection

Two complementary methods were used to assess goodness-of-fit and select the preferred probability distribution: the Anderson-Darling (AD) test and the L-moment ratio diagram. These methods are independent of each other — the AD test provides a quantitative measure of distributional fit with

emphasis on the tails, while the L-moment ratio diagram provides a visual assessment of how well the shape of the data matches each theoretical distribution.

The AD test measures the discrepancy between the empirical data and the fitted distribution, with greater weight placed on the tails of the distribution — the region of greatest relevance for extreme rainfall frequency estimation (Anderson & Darling, 1954). A lower AD value indicates a closer match between the fitted distribution and the observed data. Distributions were ranked by their AD statistic for each site-duration combination, and the distribution achieving the lowest AD value was identified as the best fit at that combination.

The L-moment ratio diagram was constructed by plotting theoretical L-skewness (τ_3) and L-kurtosis (τ_4) curves for each candidate distribution, following the approach described by Hosking (1990) and Hosking & Wallis (1997). A significant advantage of the L-moment ratio diagram is that several distributions can be compared using a single graphical instrument. The best-fit distribution is identified by plotting the sample L-skewness and L-kurtosis for each site-duration combination alongside the theoretically derived curves — the distribution whose curve passes closest to the sample point provides the best representation of the observed data's shape. Theoretical curves were derived for GEV, GLO, LN3 and PE3, with the Gumbel distribution represented as a fixed point at $\tau_3 = 0.1699$ and $\tau_4 = 0.1504$. The Gumbel distribution is represented as a fixed point rather than a curve because it has no shape parameter.

Table 4 Best-fitting distribution by site and duration based on the lowest Anderson-Darling (AD) statistic.

Duration	Site	Best Fit	AD Statistic
1 hr	Hatea at Glenbervie Forest HQ	PE3	3.16
2 hr	Hatea at Glenbervie Forest HQ	PE3	1.969
6 hr	Hatea at Glenbervie Forest HQ	LN3	0.171
12 hr	Hatea at Glenbervie Forest HQ	GLO	0.241
24 hr	Hatea at Glenbervie Forest HQ	GLO	0.413
48 hr	Hatea at Glenbervie Forest HQ	GLO	0.161
72 hr	Hatea at Glenbervie Forest HQ	GEV	0.271
84 hr	Hatea at Glenbervie Forest HQ	GEV	0.231
1 hr	Whakapara at Puhipuhi	LN3	5.29
2 hr	Whakapara at Puhipuhi	LN3	3.281
6 hr	Whakapara at Puhipuhi	LN3	0.906
12 hr	Whakapara at Puhipuhi	GEV	0.27
24 hr	Whakapara at Puhipuhi	GLO	0.135
48 hr	Whakapara at Puhipuhi	LN3	0.128
72 hr	Whakapara at Puhipuhi	GLO	0.17
84 hr	Whakapara at Puhipuhi	GEV	0.159

Table 4 presents the best-fitting distribution and corresponding AD statistic for each site-duration combination. Results varied across durations and between sites, with no single distribution performing consistently best across all combinations. At 1-hour and 2-hour durations, AD statistics were markedly elevated at both sites, ranging from 1.969 to 5.29, indicating poor distributional fit at these durations. At Hatea, GLO achieved the lowest AD statistic at three durations (12, 24 and 48 hours), GEV at two

durations (72 and 84 hours), LN3 at one duration (6 hours), and PE3 at two durations (1 and 2 hours). At Whakapara, LN3 achieved the lowest AD statistic at four durations (1, 2, 6 and 48 hours), GLO at two durations (24 and 72 hours), and GEV at two durations (12 and 84 hours). Across all sixteen site-duration combinations, GLO and LN3 each achieved the lowest AD statistic at five combinations, followed by GEV at four combinations and PE3 at two combinations. Notably, Gumbel did not achieve the lowest AD statistic at any of the sixteen site-duration combinations.

The L-moment ratio diagram (Figure 12) plots L-skewness (τ_3) against L-kurtosis (τ_4) for annual maximum series at both sites across all eight accumulation durations, alongside theoretical curves for GEV, GLO, LN3 and PE3, with the Gumbel fixed point indicated.

At 1-hour and 2-hour durations, data points at both sites plot well below all theoretical curves, confirming the poor distributional fit indicated by the elevated AD statistics at these durations. At durations of 6 hours and above, data points cluster in a relatively narrow band of the τ_3 - τ_4 space.

The GLO curve is the uppermost curve in the diagram and sits above the majority of observed data points. The GEV and LN3 curves both pass through or near the observed data points across most durations of 6 hours and above, with the densest cluster of points sitting between these two curves. The longer-duration points at both sites (48, 72 and 84 hours) plot near the Gumbel fixed point, suggesting that rainfall extremes at these durations are broadly consistent with Gumbel-type behaviour. However, the 12-hour points at both sites plot away from the Gumbel fixed point and closer to the GEV curve, indicating that Gumbel is not appropriate across all durations. The PE3 curve is the lowest curve in the diagram and is generally inconsistent with the observed L-moment structure across most durations.

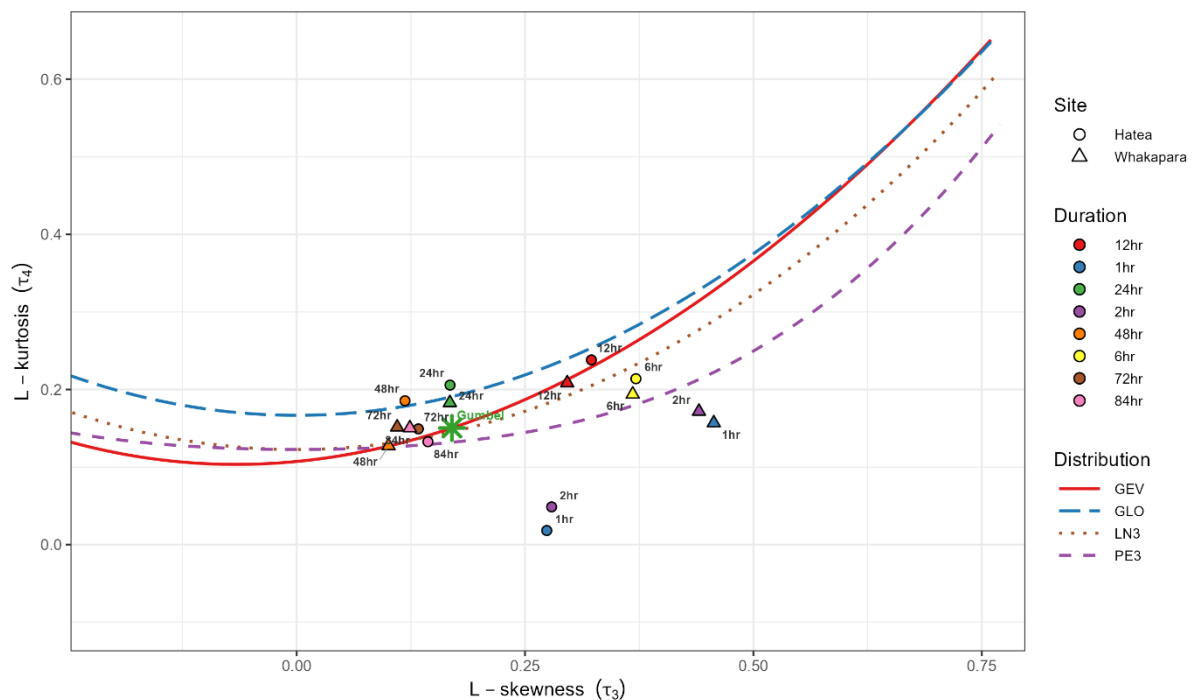


Figure 12 L-moment ratio diagram for Hatea at Glenbervie Forest HQ and Whakapara at Puhipuhi.

Based on the Anderson-Darling goodness-of-fit statistics and the L-moment ratio diagram, GEV was selected as the preferred distribution for return period estimation at both sites.

The AD statistic does not identify a single dominant distribution — GLO and LN3 each achieved the lowest AD statistic at five of sixteen site-duration combinations, followed by GEV at four combinations. However, the L-moment ratio diagram provides additional and independent evidence for distribution

selection. The majority of observed data points fall below the GLO curve across all durations. While LN3 passes close to several data points, the densest cluster of points at durations of 6 hours and above sits between the GEV and LN3 curves, with GEV providing a marginally closer fit to the majority of observed points. GEV is therefore considered an appropriate single distribution for reporting purposes, as it provides a consistent and balanced fit across both sites and most accumulation durations.

Although GEV did not achieve the lowest Anderson-Darling statistic at the greatest number of site-duration combinations, it was selected as the preferred distribution on the basis of the L-moment ratio diagram, which showed the majority of data points plotting closest to the GEV curve, and its adoption in HIRDS (Carey-Smith et al., 2018) for New Zealand rainfall frequency analysis.

3.4.4 Return Period Estimates — Event 1

Return periods express the average recurrence interval of a rainfall event of a given magnitude, with longer return periods indicating less frequent and more extreme events. In this report, return periods were computed by evaluating each observed rainfall total within the fitted cumulative distribution function to obtain the non-exceedance probability, which was converted to an annual exceedance probability and expressed as a return period (Stedinger et al., 1993).

Table 5 shows the observed totals and return period estimates for Event 1 using GEV and the other fitted distributions, along with the minimum and maximum estimates across all five distributions to illustrate methodological variability.

Table 5 Event 1 return period estimates (years) by site, duration and distribution. GEV* = selected distribution (bold); RF = observed rainfall (mm); Min and Max = lowest and highest estimates across all five distributions.

Duration	RF (mm)	GEV*	GLO	LN3	Gumbel	PE3	Min	Max
Hatea at Glenbervie Forest HQ								
1 hr	41.3	14.9	16.1	14.4	15.9	13.6	13.6	16.1
2 hr	72.1	26.4	27.6	25.9	34.8	25.9	25.9	34.8
6 hr	120.7	17.4	18.5	16.1	20.0	14.7	14.7	20.0
12 hr	142.7	10.2	11.0	9.6	9.6	8.8	8.8	11.0
Whakapara at Puhipuhi								
1 hr	50.4	29.6	31.1	26.6	56.3	24.6	24.6	56.3
2 hr	78.0	28.7	30.2	26.1	52.1	24.2	24.2	52.1
6 hr	137.4	28.0	29.5	26.5	45.5	25.8	25.8	45.5
12 hr	143.9	9.8	10.6	9.3	9.3	8.6	8.6	10.6

Event 1 produced the most significant short-duration rainfall of the two events.

At Hatea, the 2-hour total of 72.1 mm produced the highest return period estimate of approximately 26.4 years under GEV, rising to 34.8 years under Gumbel. The 1-hour and 6-hour totals were estimated at 14.9 and 17.4 years respectively under GEV. By the 12-hour duration, return periods decreased to approximately 10.2 years under GEV.

At Whakapara, the 1-hour total of 50.4 mm was estimated at 29.6 years under GEV. The 2-hour and 6-hour totals were estimated at 28.7 and 28.0 years respectively under GEV, indicating consistently high return periods across short to medium durations at this site. Gumbel produced notably higher estimates across these durations, reaching 56.3 years at 1-hour, 52.1 years at 2-hour, and 45.5 years

at 6-hour. By the 12-hour duration, return periods decreased to 9.8 years under GEV. PE3 produced the lowest estimates across most durations at both sites.

3.4.5 Return Period Estimates — Event 2

Observed rainfall totals and return period estimates for Event 2 across all eight accumulation durations and both sites are presented in Table 6.

At Hatea, Event 2 was comparatively minor across all durations. Short-duration return periods (1–12 hours) ranged from 2.2 to 3.3 years across all five distributions, with all distributions converging at 1.9 years at the 24-hour duration. This convergence occurs because the observed 24-hour total of 127.0 mm was close to the long-term mean of the Hatea 24-hour annual maximum series (137.9 mm). Under L-moment fitting (Hosking, 1990), all distributions share the same location parameter, and distributional differences emerge only in the tails — producing near-identical return period estimates near the sample mean. The lower 24-hour total also reflects the rolling window capturing a period of reduced rainfall intensity within the broader Event 2 sequence. Return periods increased at longer durations, peaking at 72 hours with estimates ranging from 8.1 to 9.1 years across all five distributions, before declining to 7.1–7.9 years at 84 hours.

Table 6 Event 2 return period estimates (years) by site, duration and distribution. GEV* = selected distribution (bold); RF = observed rainfall (mm); Min and Max = lowest and highest estimates across all five distributions.

Duration	RF (mm)	GEV*	GLO	LN3	Gumbel	PE3	Min	Max
Hatea at Glenbervie Forest HQ								
1 hr	16.2	2.4	2.4	2.4	2.2	2.4	2.2	2.4
2 hr	25.9	2.5	2.5	2.5	2.3	2.5	2.3	2.5
6 hr	58.1	3.1	3.2	3.1	2.5	3.0	2.5	3.2
12 hr	94.9	3.3	3.3	3.2	2.8	3.2	2.8	3.3
24 hr	127.0	1.9	1.9	1.9	1.9	1.9	1.9	1.9
48 hr	225.4	4.5	4.9	4.6	4.8	4.5	4.5	4.9
72 hr	293.5	8.2	9.1	8.2	8.3	8.1	8.1	9.1
84 hr	298.2	7.2	7.9	7.2	7.3	7.1	7.1	7.9
Whakapara at Puhipuhi								
1 hr	26.2	8.3	8.7	7.6	6.1	6.5	6.1	8.7
2 hr	48.4	10.6	11.1	9.5	8.7	8.2	8.2	11.1
6 hr	91.6	9.7	10.3	9.0	8.5	8.1	8.1	10.3
12 hr	150.7	11.3	12.2	10.7	11.1	10.0	10.0	12.2
24 hr	170.2	3.7	3.9	3.6	3.7	3.6	3.6	3.9
48 hr	299.6	14.0	15.1	14.2	13.1	14.2	13.1	15.1
72 hr	384.7	34.8	32.4	35.1	27.6	35.6	27.6	35.6
84 hr	387.9	24.6	24.8	25.0	21.8	25.1	21.8	25.1

At Whakapara, Event 2 was considerably more extreme. Short-duration return periods (1–12 hours) ranged from 6.1 to 12.2 years across all five distributions. A similar dip was observed at the 24-hour duration, where all distributions produced estimates of approximately 3.6–3.9 years, consistent with the pattern at Hatea. Return periods increased substantially at longer durations: the 48-hour total was estimated at approximately 13.1–15.1 years across all distributions, and the 72-hour total of 384.7

mm produced the highest return period across both events and both sites. Under GEV, the 72-hour return period was estimated at 34.8 years, with estimates ranging from 27.6 years (Gumbel) to 35.6 years (PE3) across all five distributions.

Across most durations, the five probability distributions produced similar return period estimates, indicating good agreement between methods. The notable exception is the Whakapara 72-hour duration, where estimates ranged from 27.6 years (Gumbel) to 35.6 years (PE3). At Hatea, the same 72-hour duration showed much closer agreement, with estimates ranging from 8.1 to 9.1 years.

3.4.6 A Comparison of the Two Events Across All Durations

Figure 13 and Table 7 present GEV return period estimates for both events at both sites across all available durations.

Figure 13 shows the duration-dependent pattern of return periods for each event and site. At Hatea, Event 1 return periods peaked at the 2-hour duration and declined steadily toward 12 hours, while Event 2 return periods remained consistently low across all durations, with a notable dip at 24 hours before gradually increasing toward 72 hours. At Whakapara, Event 1 return periods were consistently elevated across the 1 to 6-hour durations before declining sharply at 12 hours. Event 2 at Whakapara shows a more complex pattern — a dip at 24 hours followed by a substantial increase at longer durations, peaking at 72 hours and declining at 84 hours.

Table 7 provides the corresponding GEV return period estimates. Event 1 dominated at short durations, with return periods reaching 26.4 years at Hatea (2-hour) and 28–30 years at Whakapara (1–6-hour durations). Event 2 dominated at longer durations, with Whakapara 72-hour reaching 34.8 years — the highest across both events and both sites. The contrast between the two sites under Event 2 is particularly notable: the 72-hour return period at Whakapara (34.8 years) was approximately four times higher than at Hatea (8.2 years), despite both sites being subject to the same synoptic event.

In combination, the short-duration rainfall of Event 1 and the long-duration accumulation at Whakapara during Event 2 highlight the compounding nature of the January 2026 storm sequence.

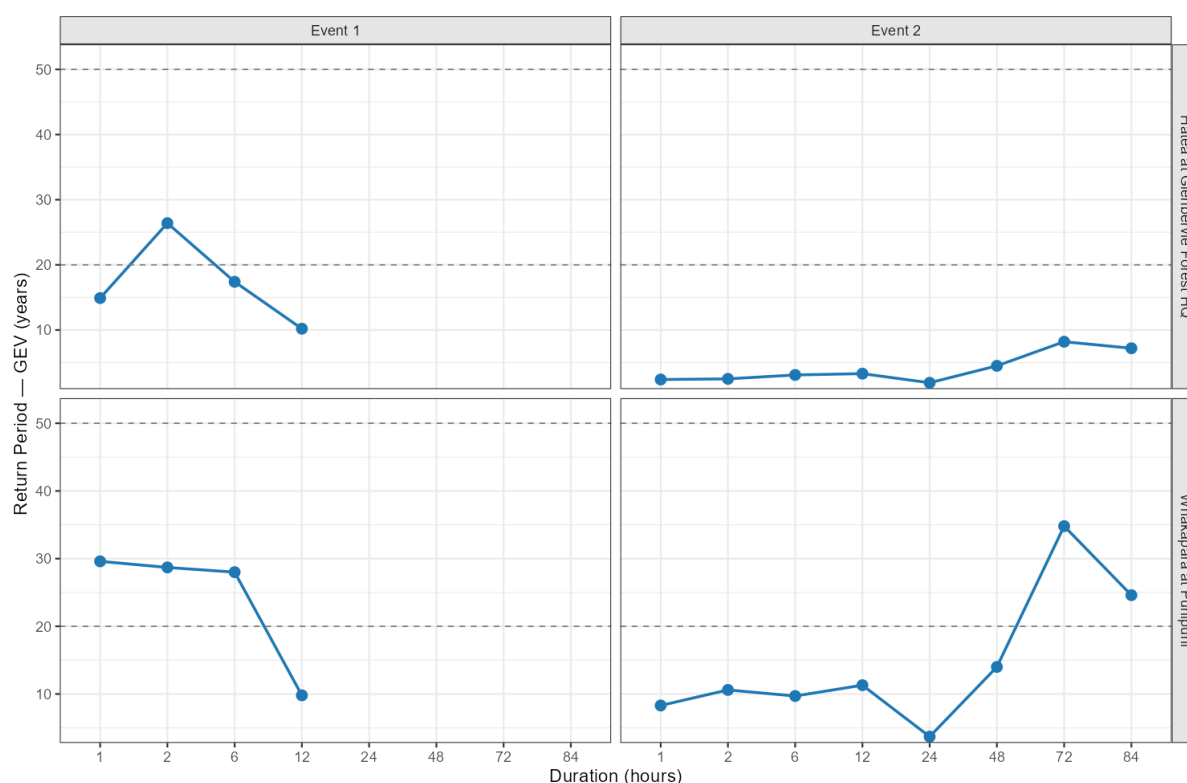


Figure 13 Return period estimates (GEV) for the January 2026 rainfall events — Hatea at Glenbervie Forest HQ and Whakapara at Puhipuhi.

Table 7 Head-to-head comparison of GEV return period estimates (years) for both events and both sites across all durations. — = not applicable (Event 1 duration was 12 hours).

Duration	Event 1		Event 2	
	RF (mm)	GEV (yr)	RF (mm)	GEV (yr)
Hatea at Glenbervie Forest HQ				
1 hr	41.3	14.9	16.2	2.4
2 hr	72.1	26.4	25.9	2.5
6 hr	120.7	17.4	58.1	3.1
12 hr	142.7	10.2	94.9	3.3
24 hr	—	—	127.0	1.9
48 hr	—	—	225.4	4.5
72 hr	—	—	293.5	8.2
84 hr	—	—	298.2	7.2
Whakapara at Puhipuhi				
1 hr	50.4	29.6	26.2	8.3
2 hr	78.0	28.7	48.4	10.6
6 hr	137.4	28.0	91.6	9.7
12 hr	143.9	9.8	150.7	11.3
24 hr	—	—	170.2	3.7
48 hr	—	—	299.6	14.0
72 hr	—	—	384.7	34.8
84 hr	—	—	387.9	24.6

Bold = return period ≥ 20 years.

4 Antecedent Conditions

Antecedent conditions — encompassing both regional rainfall accumulation and catchment soil moisture prior to an event — play an important role in determining how much rainfall becomes surface runoff and how quickly. Understanding pre-event conditions therefore provides important context for interpreting the severity of the January 2026 flood response.

4.1 Regional Antecedent Rainfall: Standardised Precipitation Index

The Standardised Precipitation Index (SPI) is a dimensionless measure of rainfall deviation relative to the long-term historical average for a given location and time period. Two SPI accumulation periods are presented: SPI-3 (November 2025 to January 2026) and SPI-6 (August 2025 to January 2026), both sourced from the NRC January 2026 monthly hydrological report (Northland Regional Council, 2026) and shown in Figure 14.

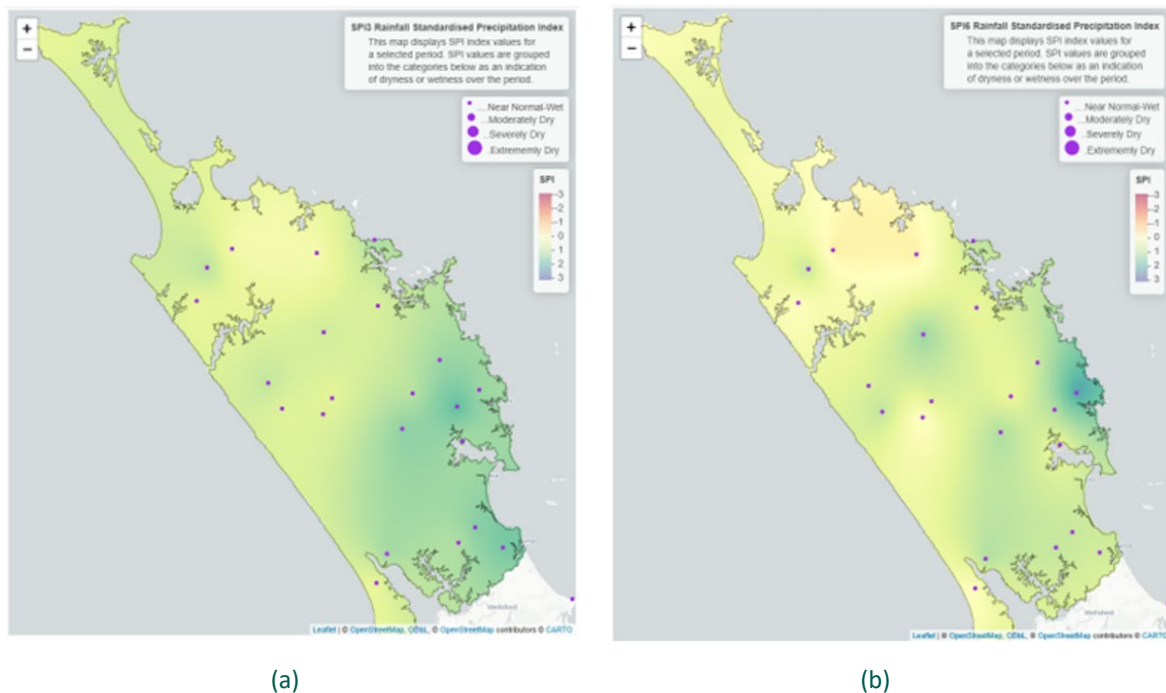


Figure 14 SPI maps for Northland: (a) SPI-3 and (b) SPI-6. Source: Northland Regional Council (2026).

Both SPI maps show Northland as predominantly Near Normal to Wet in the months preceding the January 2026 events. In the SPI-3 map, the eastern and central portions of Northland display a moderately above-average signal. The SPI-6 map reveals a more pronounced and spatially coherent wet signal across eastern and central Northland, confirming a sustained six-month period of above-average rainfall accumulation prior to the events (Northland Regional Council, 2026). The SPI maps indicate that above-normal rainfall accumulation had persisted across the region over the six months preceding the storm and was not confined to the immediate weeks before the event.

4.2 Station-Level Soil Moisture Conditions

Daily soil moisture deficit (SMD) records were sourced from the NRC January 2026 monthly hydrological report (Northland Regional Council, 2026), which draws on Earth Sciences New Zealand monitoring data. Each figure presents four curves: average SMD (black), last season (blue), two seasons back (green), and the current season (red, 2025–26).

4.2.1 Kerikeri EWS

Prior to the January 2026 events, the current season (red) deficit was slightly deeper than the long-term average (black), indicating soils were drier than normal (Figure 15). A deeper deficit suggests greater initial storage capacity to absorb rainfall. However, the January 2026 events were so extreme that they overwhelmed this storage, likely saturating soils rapidly despite the drier antecedent soil conditions.

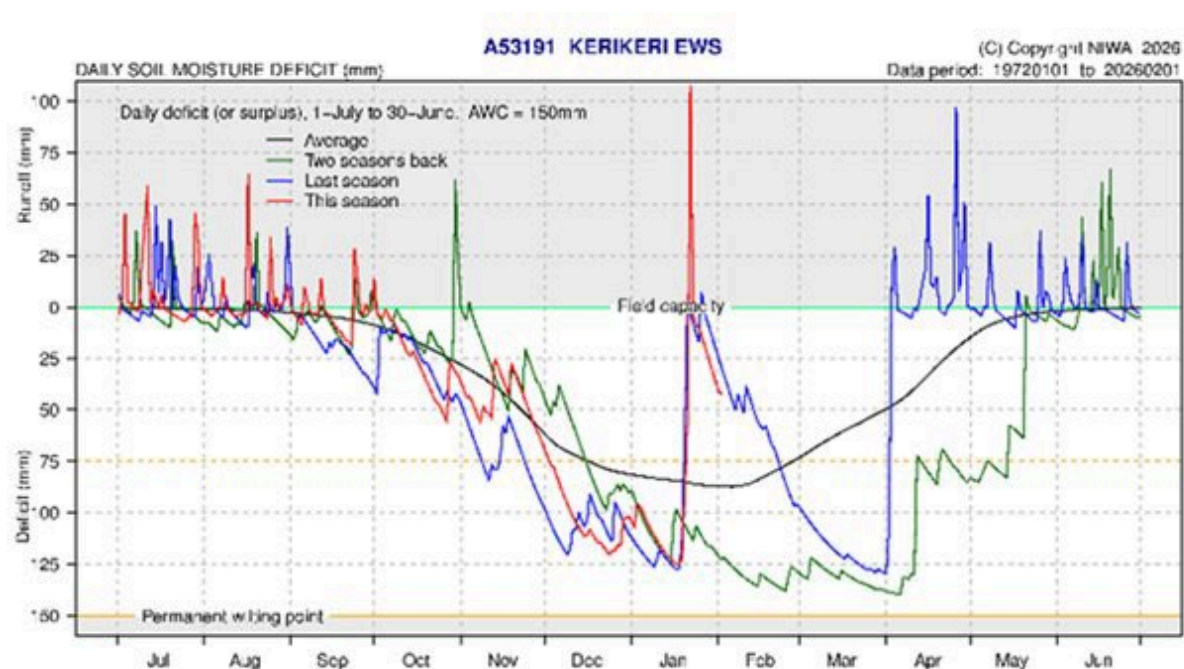


Figure 15 Daily soil moisture deficit at Kerikeri EWS. Source: Earth Sciences New Zealand.

4.2.2 Whangārei Aero AWS

At Whangārei Aero AWS, antecedent soil moisture conditions were more variable than at Kerikeri EWS. The current season deficit was shallower than average in November (wetter than normal), deepened to below average through December (drier than normal), then partially recovered following a late December rainfall pulse. Following this brief recovery, soils remained in a modest deficit in early January prior to the events (Figure 16). Despite this transitional state, the January 2026 storm events were of sufficient magnitude to likely saturate soils rapidly.

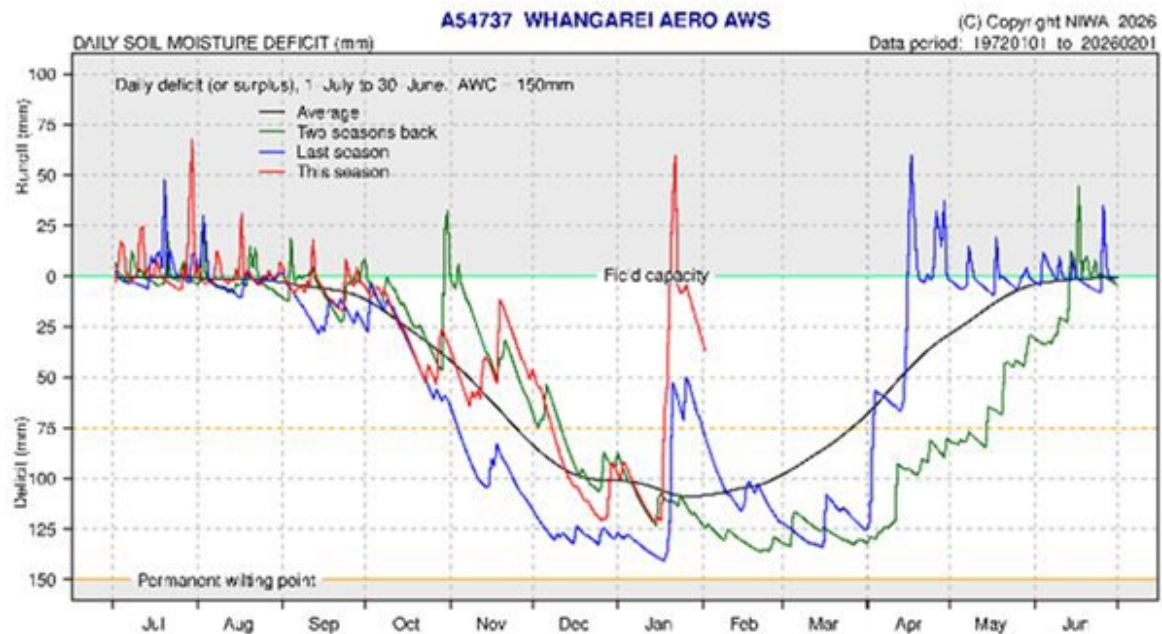


Figure 16 Daily soil moisture deficit at Whangārei Aero AWS. Source: Earth Sciences New Zealand.

5 Impacts of the January 2026 Northland Severe Weather Events

The January 2026 storms produced widespread and severe impacts across the east coast of Northland as part of a broader weather sequence affecting the upper North Island between 18 and 22 January. Approximately 300 people were evacuated to local marae (The Spinoff, 2026) and a state of emergency was declared across Whangārei District on 20 January 2026 (National Emergency Management Agency, 2026). The communities of Ngunguru, Helena Bay, Ōākura, Punaruku and Whangaruru were all cut off by floodwaters (1News, 2026) (Figure 17). By 22 January all Northland state highways had reopened, but dozens of local roads remained affected (NZ Transport Agency Waka Kotahi, 2026). The events also triggered coastal landsliding along the eastern Northland coastline (Figure 18).

The most consequential single infrastructure failure was the Ōākura slip — estimated at up to 100,000 cubic metres of clay, vegetation and debris (Northern Advocate, 2026b). The washout of the Ngaioitonga Bridge on Rawhiti Road also isolated the Rawhiti peninsula communities, demonstrating how individual infrastructure failures can have compounding access consequences in coastal areas with limited road network redundancy (Far North District Council, 2026).

The prolonged rainfall saturation during both events created conditions conducive to slope failure, as evidenced by the landslides and slips recorded across eastern Northland. Prolonged rainfall increases soil pore-water pressures where drainage is limited, reducing slope stability and increasing the likelihood of slope failure. This pressure, combined with gravity, can cause the slope to collapse (Rosser, 2026). Many landslide locations were recorded across eastern Northland following the January 2026 events, based on field reconnaissance data compiled by Earth Sciences New Zealand (Figure 19). Aerial reconnaissance by Earth Sciences New Zealand following the January 2026 events noted that the location of landslides was strongly associated with areas of highest rainfall

accumulation across eastern Northland. NRC is working with Earth Sciences New Zealand to map the landslides triggered by these events. The scale of mass movement across the affected area reflects the combination of pre-event soil saturation, steep terrain, and cumulative duration of high-intensity rainfall.



Figure 17 Aerial view of flood inundation in the Whangaruru and Ōakura area, January 2026. Source: Ngātiwai Trust Board, reproduced from Northern Advocate (2026a).



Figure 18 Aerial view of the Ōakura township slip, January 2026. Source: Northland Regional Council.



Figure 19 Coastal landsliding at Elliot Bay, January 2026. Source: Earth Sciences New Zealand.

6 Conclusions

The January 2026 Northland severe weather events were characterised by two meteorologically distinct but successive rainfall systems that together produced a compound hydrological extreme across eastern Northland. This report has documented and analysed both events, with a focus on quantifying how rare the rainfall was through frequency analysis at long-record monitoring stations.

6.1 Key Findings

- 1. Two distinct events.** IETD analysis confirmed a minimum dry period of approximately 6 hours across all four monitoring sites, establishing Event 1 and Event 2 as statistically independent episodes.
- 2. GEV selected as the preferred distribution.** GEV was selected based on the L-moment ratio diagram, which showed sample points clustering closest to the GEV theoretical curve across durations of 6 hours and above. This selection is consistent with the GEV distribution adopted in HIRDS (Carey-Smith et al., 2018).
- 3. Event 1 produced rare short-duration rainfall.** Return periods reached approximately 28–30 years at Whakapara across the 1, 2 and 6-hour durations under GEV, and 26.4 years at Hatea at the 2-hour duration. Punaruku recorded 92.1 mm in one hour and 296 mm over 12 hours — among the most intense short-duration totals on record for Northland — however frequency analysis was not conducted at this site due to insufficient record length.
- 4. Event 2 produced rare long-duration accumulation at Whakapara.** The 72-hour total of 384.7 mm was estimated at approximately a 34.8-year return period under GEV — the highest return period

across both events and both sites. At Hatea, Event 2 was comparatively moderate, peaking at approximately 8.2 years at 72 hours under GEV.

5. Compound structure contributed to an enhanced flood response. Above-normal antecedent wetness across eastern Northland, combined with the sequential nature of the two events, is likely to have contributed to an enhanced flood response beyond what either event would have produced independently.

6.2 Recommendations

The January 2026 events highlight the need for improved forecasting and early warning capability across Northland, particularly for rapidly evolving rainfall systems affecting eastern catchments. The rapid overnight shift in weather models prior to Event 1 — with the system initially forecast to remain offshore — highlights the forecasting challenges posed by fast-moving coastal rainfall systems. NRC is engaging with MetService and relevant agencies to explore and expand early warning systems tailored to the rainfall characteristics of eastern Northland catchments. In parallel, NRC is developing an in-house Early Flood Warning System based on the Delft FEWS platform to further strengthen operational flood forecasting capability across the region. The January 2026 events also triggered widespread landsliding across eastern Northland. The landslide mapping project underway in partnership between NRC and Earth Sciences New Zealand is also expected to improve the accuracy of the Earth Sciences New Zealand Rainfall Induced Landslide forecast tool for Northland, where robust landslide data has previously been limited.

In terms of the frequency analysis methodology, while GEV was selected as the preferred distribution on the basis of the L-moment ratio diagram, supported by Anderson-Darling goodness-of-fit statistics and consistent with HIRDS (Carey-Smith et al., 2018), distribution selection has a notable influence on return period estimates, particularly at longer accumulation durations. A review of distribution selection criteria across long-record sites in eastern Northland is recommended to improve the consistency of future return period estimates in the region.

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