



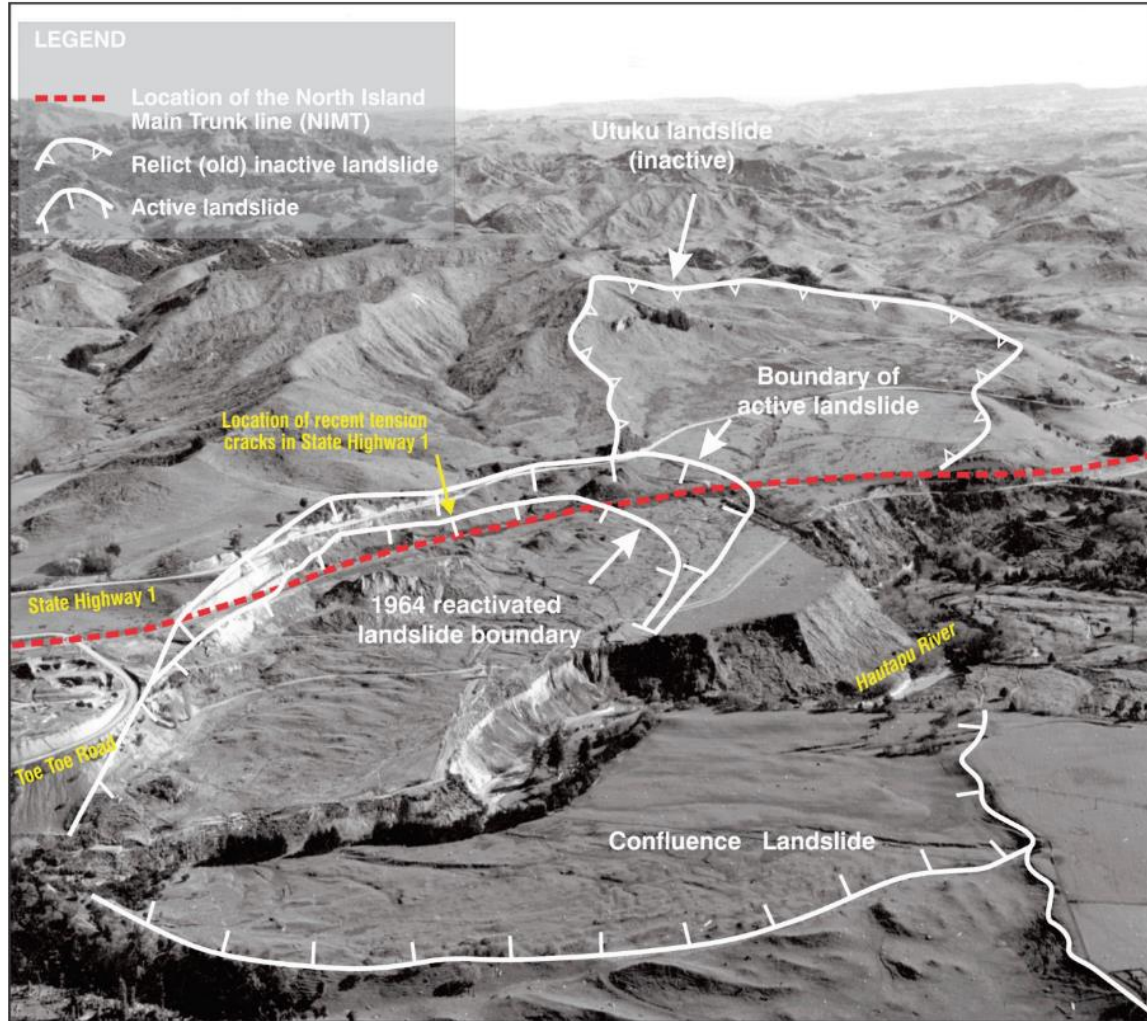
# SH1 UTIKU LANDSLIDE

# OUTLINE

- History & impacts of the Utiku Landslide
- Emergency response to landslide movement in 2023
- Remedial design:
  - Pavements, roading and drainage
  - Inclined drains
  - Instrumentation and monitoring



# HISTORY OF THE UTIKU LANDSLIDE



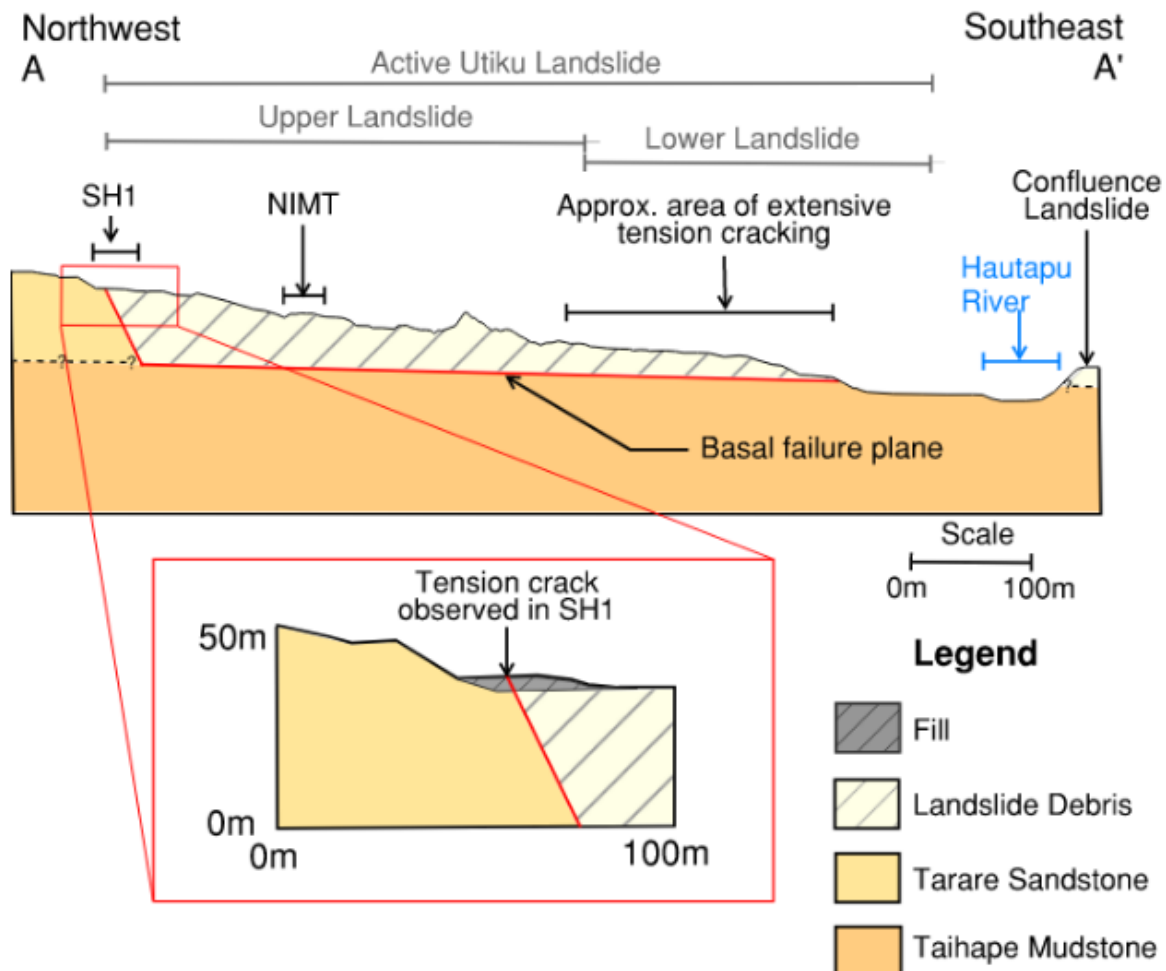
- Located 10 km south of Taihape
- The active landslide is crossed by the NIMT and SH1
- Total landslide area of ~800,000 m<sup>2</sup>
- Various remedial works completed historically when landslide reactivates

# EMERGENCY RESPONSE: WHAT HAPPENED?



- August 2023: significant tension cracks observed across the landslide following prolonged above average rainfall.
- Emergency response consisted of:
  - Temporary road reinstatement and TTM
  - Monitoring and establishment of a TARP
  - Landslide assessments

# FAILURE MECHANISM OF THE UTIKU LANDSLIDE



- Large, reactivated, deep-seated landslide
- Failing along a clay seam about 45-75m below road level
- Landslide movements are caused by elevated groundwater levels, related to long periods (12-20 weeks) of above average rainfall

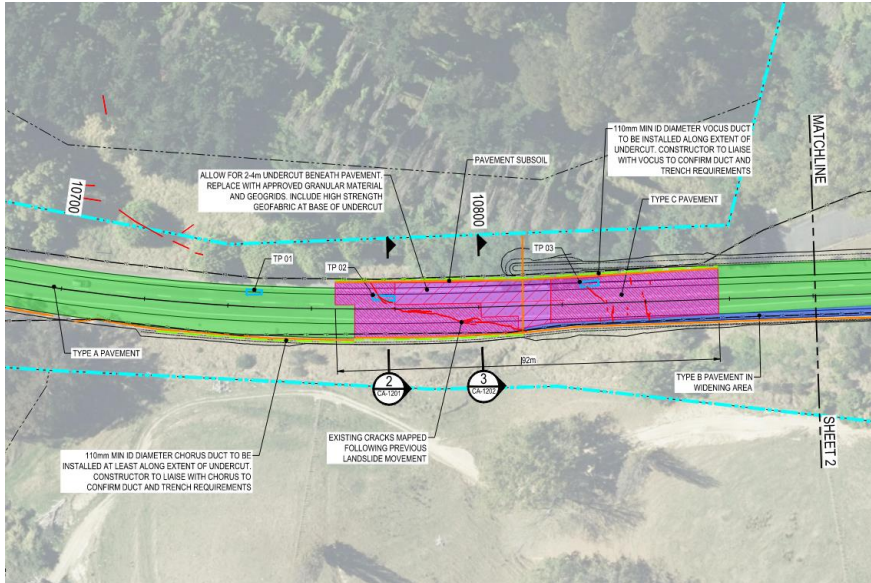


# REMEDIAL DESIGN

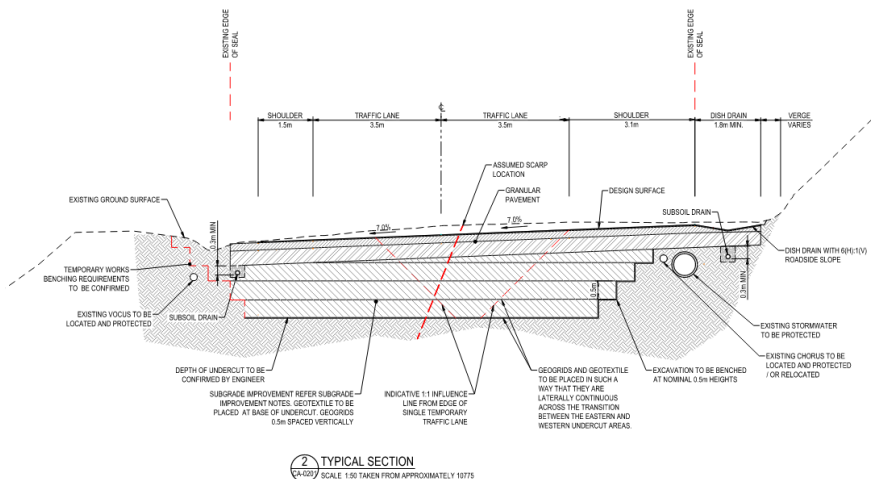
- Highway needed to be reinstated to a normal state highway level of service by Easter 2024
  
- Multi-faceted design:
  1. Minor road realignment including undercut and subgrade improvement, with surface water and pavement drainage improvements;
  2. Installation of fanned inclined drains to relieve groundwater pressure and improve landslide stability;
  3. Ongoing instrumentation and monitoring



# REMEDIAL DESIGN: PAVEMENTS AND ROADING

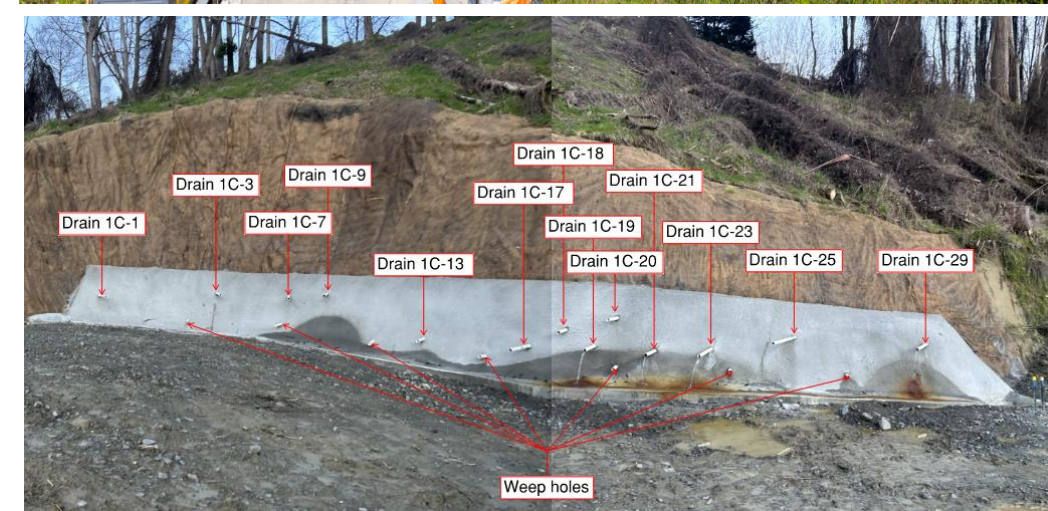
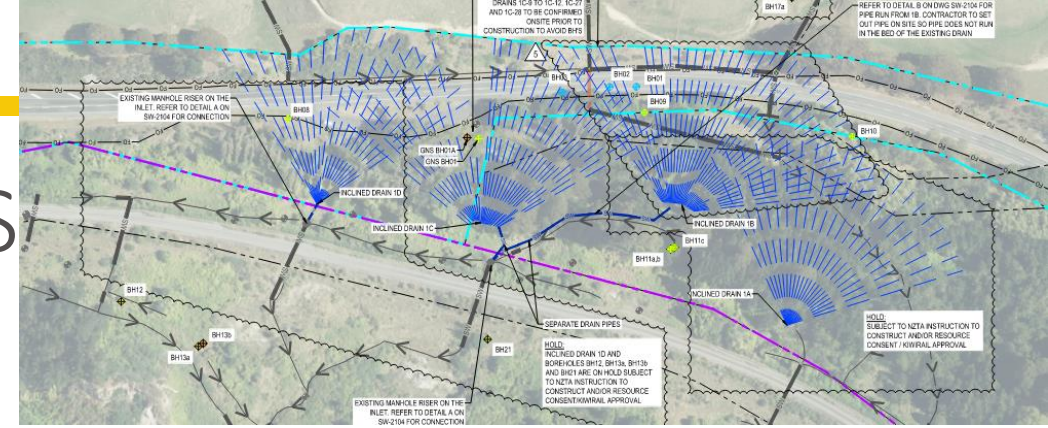


- Design intent: reduce surface expression of movements
- Undercut in areas where movement has been experienced or signs of deformation observed
- Surface and pavement drainage

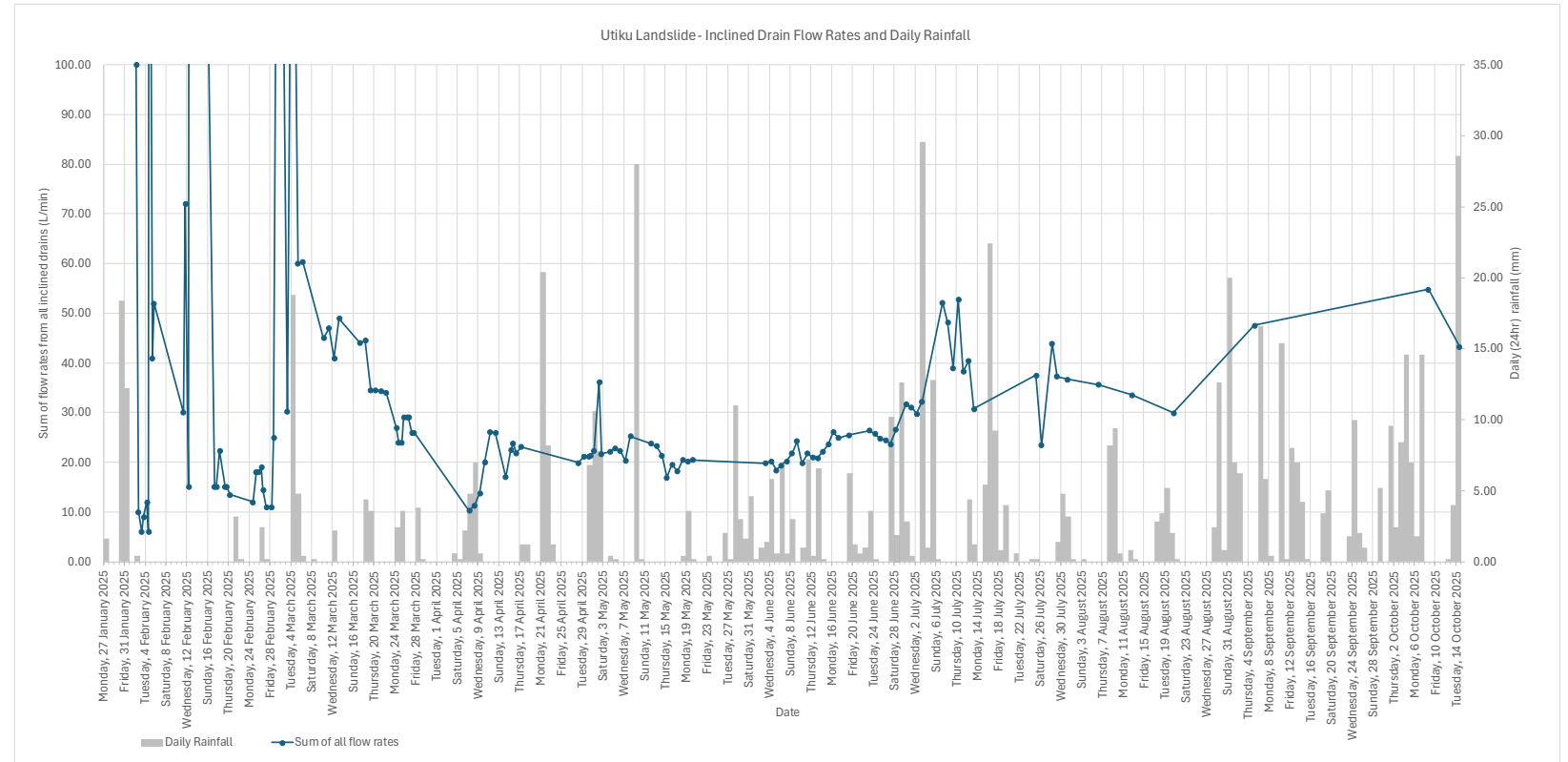


# REMEDIAL DESIGN: INCLINED DRAINS

- Management of groundwater levels is key to reducing the likelihood of landslide movement.
- Fanned inclined drains (up to 100m long) chosen as preferred solution. Designed 4 drain platforms between SH1 and NIMT, based on:
  - Geology and hydrogeology
  - Efficiency
  - Cost
  - Resilience
- Constructed two platforms (1B and 1C) & total of 24 drains



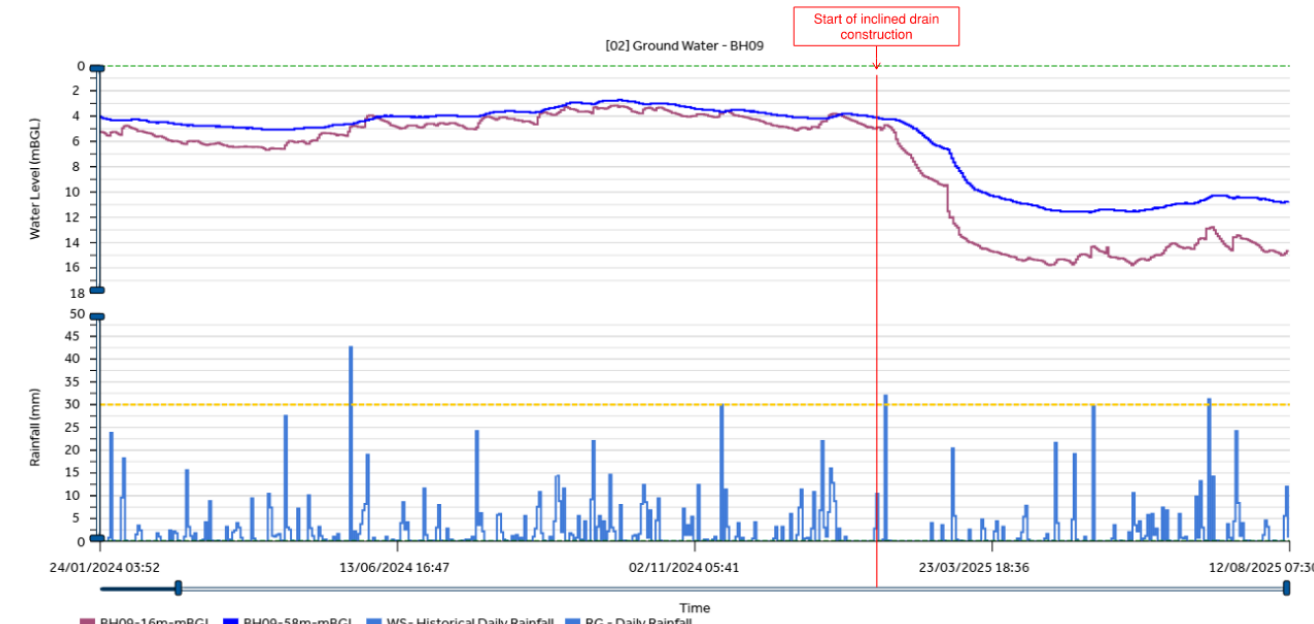
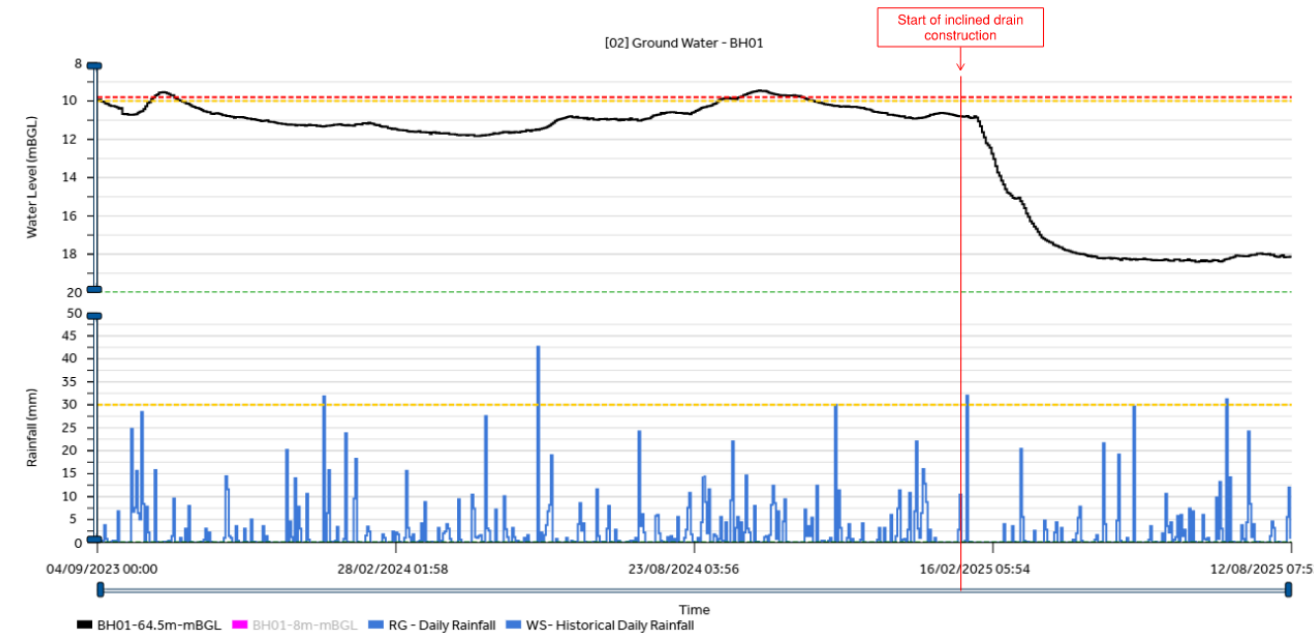
# REMEDIAL DESIGN: INCLINED DRAIN FLOW RATES



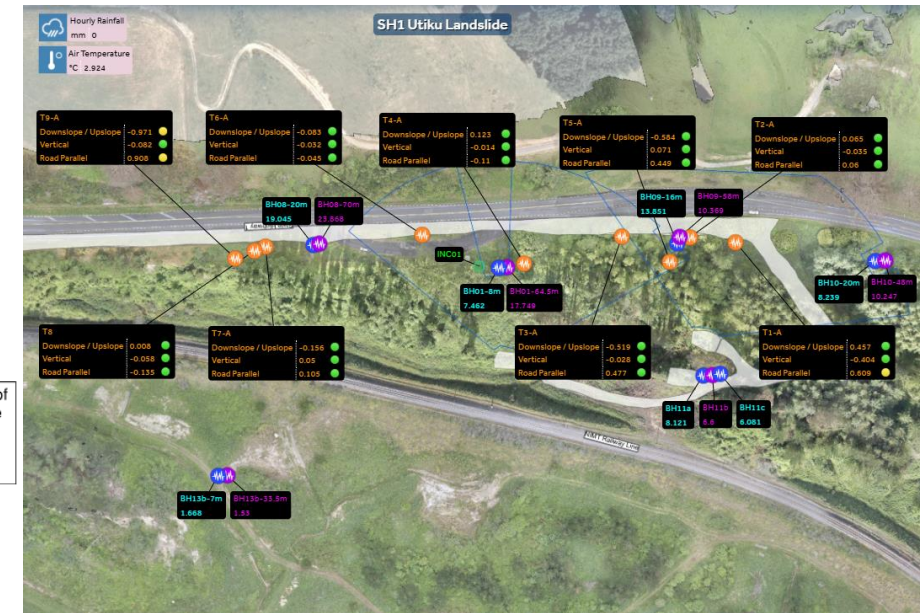
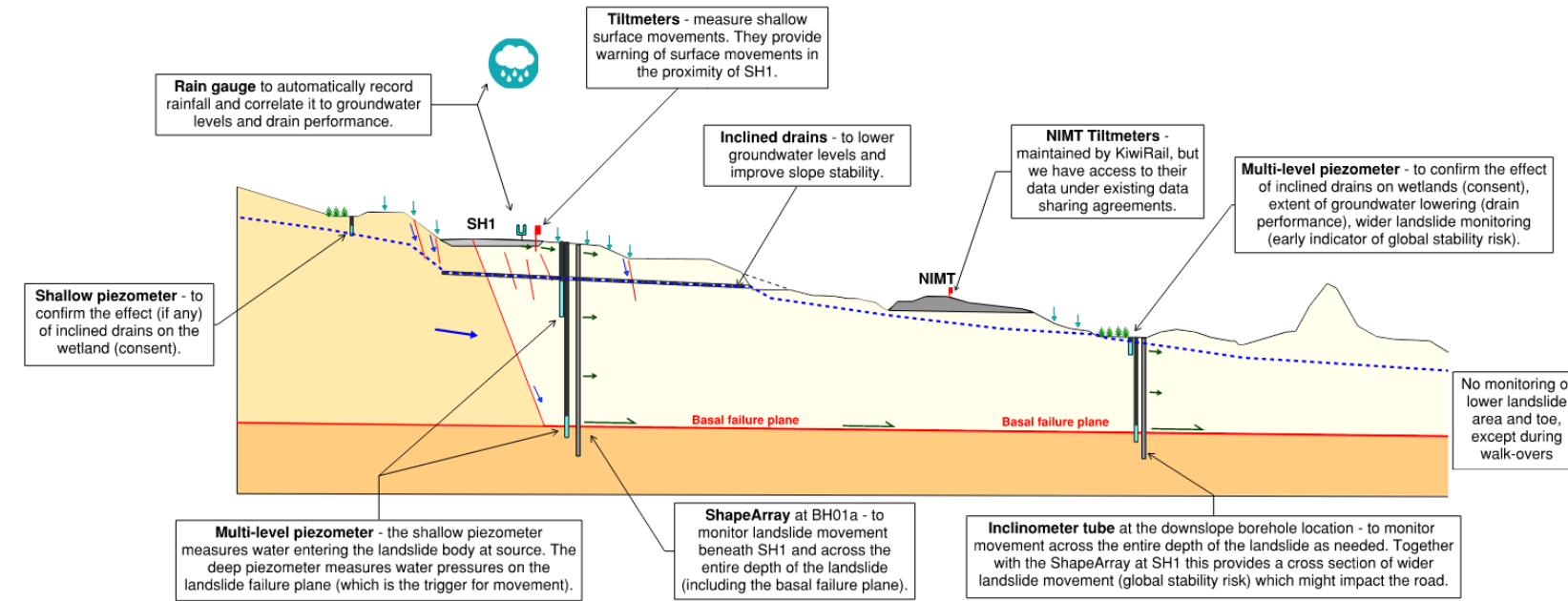
- Generally a high flow rate after initial drain installation, and then a significant decrease in the flow rates over time, with sustained flows at lower rates at a few drains.
- Combined flow rates on average 30 L/min

# REMEDIAL DESIGN: INCLINED DRAIN IMPACT ON GROUNDWATER

- Drains almost immediately had significant impacts on groundwater levels
- Groundwater lowered by up to 9 m
- Performance based observational approach (real time monitoring used to guide drain installation) enabled the team to:
  - target drain construction and maximize the effectiveness of the drains
  - utilise the available budget as efficiently as possible.



# INSTRUMENTATION AND MONITORING



The instrumentation and monitoring has been, and continues to be, utilized for multiple purposes:

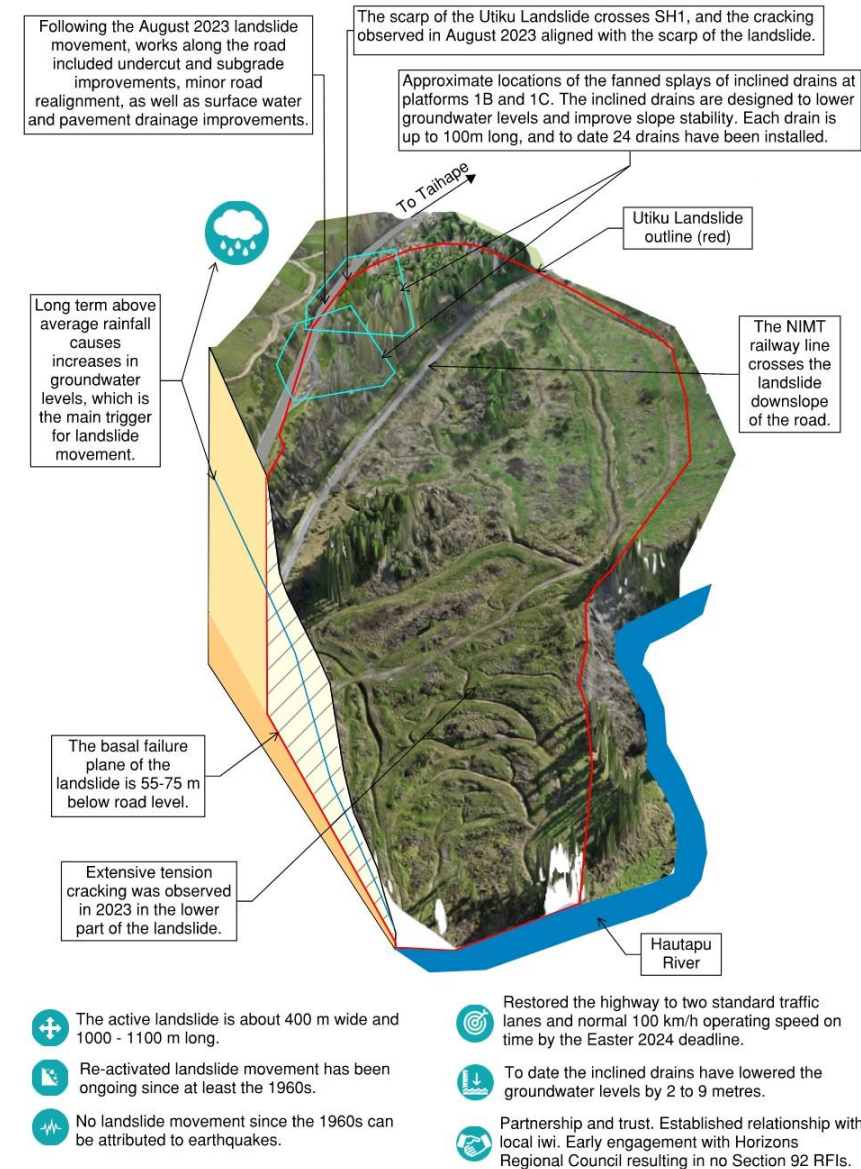
- Landslide risk monitoring (TARP)
- Inclined drain construction
- Inclined drain performance

# CONCLUSIONS

- The road was back to normal operating conditions in time (by Easter 2024)
- Public access facilitated through monitoring and use of the TARP
- Integrated design solution provided successful outcomes:
  - Optimised design using performance-based observational approach.
  - Lowered groundwater levels improving landslide stability and the resilience of this section of SH1.
  - Remote monitoring of drain performance and provides proactive monitoring of the residual risk.



## Utiku Landslide



# ACKNOWLEDGEMENTS

