This bibliography contains historic and current published scientific papers, contract reports, popular articles, posters and news items on topics of relevance to Tairawhiti and to those participating in the Transition Advisory Group Meetings.

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Many of the earlier published articles are not available in electronic form. For some of the later publications I have provided links to websites.

I've endeavoured to group these publications into themes. Some publications address more than one theme so are listed more than once.

Each publication will also contain a list of references some of which will be of relevance to this TAG.

This bibliography is by no means complete. Please feel free to suggest additional references of relevance.

Themes:

1. Previous reviews into impacts of erosion and floods on pastoral and forestry land pre-and post-Bola.
2. Costs of erosion, soil and carbon loss and flooding
3. NES-PF
4. Historic mass movement and gully erosion
5. Vegetation & slope stability
6. Environmental effects of forestry including hydrology, sediment yields, water quality, & ecology
7. Alternative vegetative mitigation strategies
8. Forest management on highly erodible hill country
9. Slash management and riparian buffers
10. Changes in mean bed levels East Coast rivers
11. Sediment sources and delivery to stream channels
12. Social implications of erosion and forestry
13. Research posters
14. Popular articles
15. Newspaper articles/Radio/TV
16. Soils
17. Waiapu Catchment, East Coast Region, North Island.
18. Waipaoa Catchment, East Coast Region, North Island

1. Previous reviews into impacts of erosion and floods on pastoral and forestry land pre-and post-Bola.

National Water and Soil Conservation Organisation (NWASCO). (1970). *Wise Land Use and Community Development.* [Report of the technical committee of enquiry into the problems of the Poverty Bay-East Coast District of New Zealand. National Water and Soil Conservation Organisation.] Wellington, New Zealand: Water and Soil Division, Ministry of Works. 119p, also known as the Taylor Report, as this document sets the scene regarding land use, and in particular, erosion-related issues that have plagued this region since the late 1880—early 1920 through to present-day.

Poverty Bay Catchment Board (1978). Report of land use planning and development study for erosion prone land in the East Cape Region. Section 1: The East coast (The Red Report).

Water and Soil Directorate. (1987). *East Coast project review*. Wellington, New Zealand: Water and Soil Directorate, Ministry of Works, and Development. 123p & Appendices.

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Office of Parliamentary Commissioner for The Environment. (1988). Inquiry into flood mitigation measures following Cyclone Bola. 59p.

Ministry of Agriculture and Fisheries (1989). The effect of Cyclone Bola on hill country farms in the Gisborne -East coast Regions: Physical damage, Government assistance, cash flows and dept. 111p.

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Ministry for Primary Industries. (2017). *Erosion Control Funding Programme*. https://www.mpi.govt.nz/forestry/funding-tree-planting-research/closed-funding-programmes/erosion-control-funding-programme/

2. Costs of erosion, soil and carbon loss and flooding

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5. Vegetation & slope stability

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6. Environmental effects including hydrology, sediment yields, water quality, & ecology

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17. Waiapu Catchment, East Coast Region, North Island.

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Abstract: Recent studies of continental margins suggest that small, high-yield rivers are capable of generating shelf sediment-gravity flows, an idea that fundamentally alters our understanding of material flux from the continents to the ocean. Discharge measurements indicate that the Waiapu River, North Island, New Zealand reaches hyperpycnal concentrations (> 36 kg m^{-2}) on a yearly basis. This study contrasts shelf-edge basins with a broad trough along the shelf-edge off the Waiapu River, testing whether there is evidence that shelf sediment-gravity flows propagate to topographic lows. Observations and measurements through geochemical and sedimentological analyses of sediment cores, EM1002 swath bathymetry, and Chirp sub-bottom profiles suggest differing transport modalities on the outer shelf. In general a southern trough-shaped region exhibits high terrigenous inputs and non-steady-state ^{210}Pb profiles, whereas the northern basins

contain steady-state ^{210}Pb profiles and increased marine influence. Sediment-gravity flows dominate accumulation in the southern region, whereas within the northern portion, surface plume sedimentation is indicated. Overall this study suggests that sediment-gravity flows could be bypassing the northern basins, perhaps a result of oceanographic influences and bathymetric steering as they seek a more direct route across the shelf. Keywords: sedimentation; sediment-gravity flow; hyperpycnal flow; Waiapu River; New Zealand

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Abstract: High-resolution digital elevation models (DEMs) were derived from sequential aerial photography of an active fluvio-mass movement (gully) complex in **New Zealand's North Island East Coast** region, to measure geomorphic changes over approximately one year. The gully showed a complex behaviour, combining fluvial and mass movement erosion, deposition, and reworking of materials stored in an active debris fan. During the measurement period 5200 ± 1700 m^3 of material were eroded from the 8·7 ha gully complex and 670 ± 180 m^3 from the 0·8 ha depositional fan, giving a total of 5870 ± 1710 m^3 for the entire gully complex-fan system.
The results provide a high-resolution description of gully behaviour over a short time period, and also demonstrate that mass movement (slumping and debris flows) accounted for almost 90 per cent (4660 ± 200 m^3) of the sediment generated. This erosional response is described in terms of gully evolution by comparing the gully complex to other systems in the region in various stages of development. The effect of gully evolution on geomorphic coupling between the gully complex and channel system is described, and coupling is also shown to vary with the magnitude and frequency of rainfall events.
From a land management perspective the success of strategies, such as tree planting, to mitigate against gully erosion depends on the stage of gully development - particularly on whether or not mass movement erosion has begun. In contrast to gully rehabilitation efforts elsewhere, basin-wide afforestation in the early stages of gully incision is favoured over riparian planting, given that mass movement assisted by excessive groundwater pressure is the main process leading to uncontrollable gully expansion.
To protect land effectively against continuing gully erosion of headwater catchments and resulting downstream aggradation, it is necessary for land managers to understand the spatial and temporal variability of gully development fully so that mitigation efforts can be targeted appropriately.

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the attenuation of wave agitation with depth to be compensated for by a downslope increase in the contribution of gravity. The model is consistent with shelf profiles off the mouths of the Eel (California), Ganges-Brahmaputra (Bangladesh), **Waiapu** (New Zealand), Po (Italy), and Rhone (France) Rivers. The equilibrium profile is predicted to be a function of wave climate and riverine sediment supply only, with deeper and broader profiles associated with decreasing sediment supply, increasing wave height and/or increasing wave period.
Keywords: Gravity-driven; Sediment transport; Continental shelf; Equilibrium profiles; Analytical model; River mouths

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Abstract: The sediment delivery ratio was estimated for two periods (28 years and eight years) following reforestation of seven tributary catchments (0·33 to 0·49 km^2) in the headwaters of the Waipaoa River basin, North Island, New Zealand. In these catchments, gully erosion, which largely resulted from clearance of the natural forest between 1880 and 1920, is the main source of sediment to streams. Reforestation commenced in the early 1960s in an attempt to stabilize hillslopes and reduce sediment supply. Efforts have been partially successful and channels are now degrading, though gully erosion continues to supply sediment at accelerated rates in parts of the catchment.
Data from the area indicate that the sediment delivery ratio (SDR) can be estimated as a function of two variables, Ψ(the product of catchment area and channel slope) and A_g (the temporally averaged gully area for the period). Sediment input from gullies was determined from a well defined relationship between sediment yield and gully area. Sediment scoured from channels was estimated from dated terrace remnants and the current channel bed. Terrace remnants represent aggradation during major floods. This technique provides estimates of SDR averaged over periods between large magnitude terrace-forming events and with the present channel bed. The technique averages out short-term variability in sediment flux.

Comparison of gully area and sediment transport between two periods (1960-1988 and 1988-1996) indicates that the annual rate of sediment yield from gullies for the later period has decreased by 77 per cent, sediment scouring in channels has increased by 124 per cent, and sediment delivered from catchments has decreased by 78 per cent. However, average SDR for the tributaries was found to be not significantly different between these periods. This may reflect the small number of catchments examined. It is also due to the fact that the volume of sediment scoured from channels was very small relative to that produced by gullies.

According to the equation for SDR determined for the Waipaoa headwaters, SDR increases with increasing catchment area in the case where A_g and channel slope are fixed. This is because the amount of sediment produced from a channel by scouring increases with increasing catchment area. However, this relationship does not hold for the main stem of the study catchments, because sediment delivered from its tributaries still continues to accumulate in the channel. Higher order channels are, in effect, at a different stage in the aggradation/degradation cycle and it will take some time until a main channel reflects the effects of reforestation and its bed adjusts to net degradation.

Results demonstrate significant differences among even low order catchments, and such differences will need to be taken into consideration when using SDR to estimate sediment yields.

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Abstract: Forest clearance between the 1890s and the early 1920s, subsequent scrub growth, and commencement of an afforestation program in 1979, modified the pattern and rate of sediment delivery to valley floors via shallow landslides and gully complexes in a steep headwater catchment (4.8 km^2) in New Zealand. Analysis of the historical record, air photograph interpretation, and field survey indicates that both erosion types occurred across the catchment in the 1938 storm, aggrading channel beds and widening the active channel zone. In contrast, a 1 in 100 year event in 1988 (Cyclone Bola) induced numerous shallow landslides, but erosion of gully complexes was largely restricted to subcatchments that retained pasture, and the geomorphic impact of this event on channels was small. The changing volume and calibre of materials delivered to the valley floor, and the distribution of gully complexes, altered patterns and rates of channel adjustment after the events, and the resulting sediment flux. Development of gully complexes maintained coupling processes with channels for periods up to 10^2 years, forming wide channels in downstream reaches. Upstream–downstream connectivity along the trunk stream was altered by the formation of a large debris fan at the confluence with a tributary subjected to gully complex erosion. In contrast, slopes subjected to shallow landslides became decoupled from channels within 10 years, accelerating channel degradation and narrowing. Effective conveyance of a large volume of fine-grained materials promoted immediate aggradation of gentle-gradient channels downstream. As gully complex areas stabilized following an increase in forest and scrub cover, channel courses became significant sediment sources. Although shallow landslide activity will continue to induce intermittent aggradation in the future, it is inferred that average sediment yield will continue to diminish to levels approaching those experienced prior to clearcutting, and the pattern of sediment flux will recover by 2030.

Keywords: Steep headwater catchment; Hillslope erosion; Storm events; Sediment budget; Coupling; Channel morphology; Land-use change

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development of gullies and gully complexes under pasture and forest by using topographic thresholds (slope-area relationships) of catchments for the initiation of gullies and gully complexes. In addition, the influence of two different lithologies as well as the occurrence of major rainfall events was related to gully activity.

Twenty gullies and four gully complexes (occupying 62·5 ha or 12·5 per cent of the catchment area) occurred in the study catchment between 1939 and 2003. However, the majority of these were not active at all of the dates studied. Gullies developed in the sandstone-dominated Tapuwaeroa Formation tended to attain their maximum size by 1957 with a mean catchment area of 2·1 ha. Gullies developed in mudstone of the Whangai Formation attained their maximum size in 1939 with a mean catchment area of 4·31 ha. Exceptions are gullies which developed into mass movement deposits or into an earth flow deposit as well as gullies developed under indigenous forest. Topographic threshold values for gullies under pasture and indigenous forest show that values for gullies under forest plot far above the threshold line of gullies under pasture, indicating that the topographical threshold for gully development under forest is higher compared to under pasture. A threshold value of 9·4 ha in catchment area is needed for the development of gully complexes under pasture, all located in the Whangai Formation and with the same orientation as the strike of the mudstones. Gully-complex area and dominance of mass-movement erosion increased with larger catchment area. A decreasing distance to the threshold line for gullies under pasture indicates a later development for gully complexes. No gully complexes developed under indigenous forest, indicating that the threshold value for gully-complex development is higher than for gully complexes under pasture and was not reached in the study area. A model of shifting topographical threshold for gully development for a given catchment is developed which depends on land use. When a catchment has an indigenous forest cover the topographical threshold is very high. After conversion to pasture, threshold values decrease drastically. With the invasion of scrub, the threshold slowly increases and returns to a similar level to that under indigenous forest after reforestation. Development of gullies and gully complexes is a highly dynamic phenomenon, and phases of expansion and inactivity indicate that models describing only unidirectional advancing stages without periods of inactivity are not suitable. Therefore, this study adds more phases to models of gully and gully-complex development in the East Coast Region. The threshold line for gully initiation under pasture and a value of 9·4 ha in catchment area for gully-complex initiation permits one to predict which catchments, under similar environmental settings, develop gullies and gully complexes on a physical basis. This enables land managers to implement sustainable land-use strategies to reduce erosion rates of gullies and gully complexes.

Keywords: gully erosion, gully complex, topographic threshold, land-use change

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sustenance but can be initiated by sediment flux convergence and supported by wave and current-induced suspension within relatively thin near-bed layers. As these layers move downslope under the influence of gravity, they may deposit sediment in response to decreases in bottom orbital velocities, near-bed current velocity, and/or bed slope. Direct or indirect evidence for wave or current supported sediment gravity flows has recently been reported off other high-load rivers including the Atchafalaya, Fly, Ganges–Brahmaputra, Klamath, Mad, Mississippi, Po, Rhone, **Waiapu**, **Waipaoa,** Yangtze, and Yellow among others. Growing evidence from observational and modelling studies suggests that flux convergence followed by wave and current supported gravity driven transport is a primary cause of across-shelf transport and emplacement of flood deposits on many muddy shelves and may be a major contributor to and control on the large-scale formation and morphology of subaqueous deltas and shelf clinoforms. Recent and ongoing studies on this subject are synthesized in this paper and recommendations are offered for further study.
Keywords: Fluid mud; Sediment transport; Turbidity currents; Subaqueous delta

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