



## Meaning and design of nature for the urban built environment

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### **Natural landforms, artificial substrates and habitat in the built environment**

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Natural landforms and soils are an integral part of the built environment, forming the foundation of both the living and built ecosystems. New Zealand has a unique and extremely diverse suite of natural landforms, resulting from its long and complex geological history and location on a volcanically and deformationally active crustal plate boundary. Landforms encompass any physically recognisable form or feature of the Earth's surface produced by natural causes, and having a characteristic shape. They include major (plains, plateaux, mountain ranges) and minor forms (hills, valleys, slide slopes, terraces, dunes), which together make up the surface configuration of the Earth.

The highest concentration of the built environment is in our cities. Their location has been largely determined by historical reasons: access, water and food supplies, the siting of trade routes and safe harbours. Most cities are built on relatively flat land, on or close to waterways. As a consequence landforms and soils characteristic of gently sloping terrain – alluvial floodplains, coastal plains and river mouths – and rolling to moderately sloping hill slopes surrounding harbours dominate our urban centres.

The built environment imposes significant impacts on natural landforms and soils. The construction of roads, building platforms, and drainage networks often results in a reshaping of landforms and the natural fluvial drainage network, the modification of the chemical, physical and biological properties of soils, and the formation of artificial substrates.

Soils and near-surface materials are modified by cut and fill operations, compaction, erosion, drainage, physical and chemical pollution, the removal of vegetation cover, the placement of impervious materials, and reduced organic matter and biological activity.

Soils and substrates in the built environment are characterised by high vertical and spatial variability; modified soil structure; high bulk density; low structural stability; the presence of a surface crust on bare soil which is often water repellent; restricted aeration and water drainage; modified soil pH; low organic matter and plant nutrients; interrupted nutrient cycling and modified soil organism activity; the presence of man-made materials and other pollutants; and modified soil temperature and water regimes.

Artificial substrates in the built environment often have similar properties and habitat characteristics to natural soils. For example concrete and masonry surfaces have similar properties to those of natural rock outcrops. Both present colonising plants with extremely limited rooting depths, plant available water and nutrients, and fluctuating temperature regimes. Non-compacted 'river run' gravel fill retains similar properties to its riverbed source, although it may have been transported and 'deposited' at a location out of its geomorphic context.

Ideally knowledge of landform and soil properties and their distribution should guide development of the built environment, and serve as a basis for ecological restoration at both the site and landscape scale. To minimise the impacts of the built environment on natural landforms and soils, sympathetic design and construction procedures should aim to: preserve the natural runoff system and maximise the use of natural channels and detention areas; minimise imperviousness; minimise cutting and filling; avoid or remedy trafficking by heavy machinery; retain or enhance existing vegetation (especially near waterways); maintain soil organic matter and biological activity; and avoid development on steep slopes, erodible soils, and directly adjacent to watercourses.