DESIGN by NATURAL CHARACTER

RIVER CORRIDOR MANAGEMENT of GRAVEL-BED RIVERS in AOTEAROA/NEW ZEALAND

GARY WILLIAMS
WATERSCAPE
www.waterscape.co.nz
HOW DO WE MANAGE THIS REACH?

SITE DESIGN — WHOLE SYSTEM
Wave pattern \( W \) = function of (Coast shape \( C \))

Sediment movement \( S \) = function of (Wave pattern \( W \))

Coast shape \( C \) = function of (Sediment movement \( S \))

Channel shape \( C \) = function of (Sediment movement \( S \))

Flow pattern \( Q \) = function of (Channel shape \( C \))

Sediment movement \( S \) = function of (Flow pattern \( Q \))

Wave pattern \( W \) = function of (Coast shape \( C \))

Coast shape \( C \) = function of (Sediment movement \( S \))

Sediment movement \( S \) = function of (Wave pattern \( W \))
Integrated systems, with feedback loops, where the river type depends on the catchment and climatic context and local conditions.

**RIVER SYSTEMS**

**CATCHMENT**
- Changes in Climate & Geological landform
- Seepage/Runoff
- Sediment supply/Transport
- Imposed form
- Landscape shaping
- Drainage Network

**WATERWAYS**
- Meander migration
- Oscillating form
- Seepage/Runoff
- Sediment supply/Transport
- FLOOD PATTERN
- Channel/Floodplain exchanges
- Floods

**CHANNEL SHAPE**
- Erosion & Deposition
- Pulse movement
- Interwoven spirals
- Transport

**SEDIMENT MOVEMENT**

**FLOW PATTERN**

**INTEGRATED RIVER SYSTEMS**

**CATCHMENT CONTEXT & LOCAL CONDITIONS**

**RE-CYCLING SYSTEMS**

**RIVER TYPE**

**LIVING ECOSYSTEMS** ↔ **BIO-PHYSICAL SYSTEMS**
LOCATION ENVIRONMENT

PLACE BASED

CLIMATE

OCEANIC
Large Islands on the “Ring of Fire”
Steep landscape
Rapidly uplifted & shattered base rock
High intensity rainfall
Highly mobile gravel bed rivers

AOTEAROA
NEW ZEALAND
NATURAL CHARACTER  RIVER MANAGEMENT
LOCATION of REACHES

APPLICATIONS

VOLCANIC MOUNTAINS

REACHES APPROACH APPLIED
REGION
LOWER NORTH ISLAND

METHODOLOGY

CONTEXT

DIFFERENTIATE BASED ON DRIVERS
CATCHMENT CHARACTER
WAIRARAPA – TARARUA RANGE CATCHMENTS

GEOMORPHOLOGY
REACH CHARACTER — WAIOHINE RIVER

PLAINS REACH

GEOMORPHOLOGY

TERRACED Confined SEMI-BRAIDED

WAIOHINE

VALLEY FAN SEMI-BRAIDED

VALLEY PLAIN WANDERING

RUAMAHANGA
REACH CHARACTER — WAINGAWA RIVER

PLAINS REACH

GEOMORPHOLOGY

WAINGAWA RIVER

CROSS-VALLEY SEMI-BRAIDED

VALEY PLAIN SEMI-BRAIDED

PERCHED WANDERING

TERRACED SEMI-BRAIDED

GEOMORPHOLOGY

WAINGAWA RIVER

CROSS-VALLEY SEMI-BRAIDED

VALEY PLAIN SEMI-BRAIDED

PERCHED WANDERING

TERRACED SEMI-BRAIDED

GEOMORPHOLOGY
CHANNEL FORM INFLUENCING FACTORS

Discharge (Q)

Bed Material Size ($d_{50}$)

Slope ($s$)

Discharge (Q)

Bed Material Size ($d_{50}$)

Slope ($s$)

Discharge (Q)

Bed Material Size ($d_{50}$)

Slope ($s$)

Discharge (Q)

Bed Material Size ($d_{50}$)

Slope ($s$)

Discharge (Q)

Bed Material Size ($d_{50}$)

Slope ($s$)

Discharge (Q)

Bed Material Size ($d_{50}$)

Slope ($s$)

Discharge (Q)

Bed Material Size ($d_{50}$)

Slope ($s$)
### CHANNEL FORM MEANDER WIDTHS

#### EMPIRICAL FORMULAE RESULTS

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TIME DYNAMICS
CLIMATIC CYCLES

WAIRARAPA RIVERS 1955 - 2015

TIME VARIATIONS

WAIRARAPA RIVERS – FLOOD INTENSITY

RUAMAHANGA RIVER – FLOOD INTENSITY
MANAGEMENT ALTERNATIVES

EXISTING
HEAVY CONTROL
Design Channel
Heavy strengthening
Vegetation buffer

“STABLE”

INTERMEDIATE
Design Fairway
Partial strengthening
Wider vegetation buffer

“CHAOTIC”

RETREAT
Fenced off
Wide vegetation buffer
Some channel clearing

GENERAL CONCEPTS

Cost effective.
Managed river environment.

High cost from loss of land.
Longer term management difficulties.

High cost of river works.
Degraded river environment.
MANAGEMENT FACTORS — WAIOHINE RIVER

MANAGEMENT REACHES

 Grade Change
 Flooded
 Potential Channel Change
 Terrace
 Railway
 Bridge

 GREYTOWN

Ahikouka

SAZ

GRADE CHANGE
FLOODING
POTENTIAL CHANNEL CHANGE
TERRACE
TERRACE
TERRACE
MANAGEMENT FACTORS — WAINGAWA RIVER

MANAGEMENT REACHES

TERRACE
GRADE CHANGE
FLOODING
POTENTIAL CHANNEL CHANGE
FLOODPLAIN
TERRACE
GRADE CHANGE
RAILWAY
BRIDGE
SH2
**MANAGEMENT**

**OPTION EVALUATION**

**SCHEME OPTIONS**

- **HIGH**
  - **UPGRADED**
  - **ORIGINAL**
  - **FAIRWAY (CHANNEL & ROCK)**
  - **MINIMAL**
  - **RETREAT**

- **LOW**

**STANDARD**

- **RETIREMENT**
- **FAIRWAY (BEACH & VEGETATION)**
- **EXISTING**

- **Channel re-direction & Structural edge protection**
- **Bar clearance & Vegetation buffers**

**APPROACH**
EXAMPLE — WIDE, SHALLOW/FULLY BRAIDED

WAIMAKARIRI RIVER
DESIGN by NATURAL CHARACTER

- **WHOLE SYSTEMS DYNAMICS** — CONTEXT & CONNECTION
- **PLACE BASED** — CLIMATE & LANDSCAPE
- **GEOMORPHOLOGY** — INTER-DEPENDENT INFLUENCES
- **REACH CHARACTER** — MANAGEMENT ZONES
- **SPACE / TIME VARIATIONS** — RIVER CORRIDORS