Tonkin+Taylor

NATURAL CHANNEL DESIGN

IN THE TASMAN REGION

Exceptional thinking together

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Setting

- The Nelson-Tasman region is experiencing strong growth with the development of greenfield areas.
- Stream channels within these areas are being modified.
- Stream modification design is ad hoc without holistic guidance.
- Ecological and geomorphological outcomes are variable.

So what's been going on?

- "Over-armoured" with large rock (ecologist).
- Not enough rock (engineer).
- Underlying causes of erosion are being exacerbated.
- Erosion risk to infrastructure.
- Variable outcomes in planting design.
- Cumulative loss of habitat type and diversity.
- Altered stream behaviour.
- Increased sediment loading.
- Future management and maintenance costs not understood or identified.

Tasman's perspective

- Nelson Tasman Land Development Manual (NTLDM) preparation was in progress.
- Tasman acknowledged the need to provide a framework in order to appropriately design stream channels.
- Tasman engaged T+T to assist with guidelines based on ecological, fluvial-geomorphological and engineering principles.

Stream design literature

- The principles of stream dynamics and function have been ‘understood’ for some time.
- Many international publications and case studies.
- Some NZ literature available but piecemeal
- Comprehensive NZ stream design guidelines effectively absent.

Tasman's options

- Keep calm and carry on.
- Undertake a hydraulic and hydrological assessment of a range of stream types in the Tasman region to better inform design elements, specifically, **regime equations** for channel element sizing.
- **Progress and use principles based guidelines in the first instance and then undertake monitoring to determine how the design guidance could be modified or improved.**

Vision for the guideline

- Aid land development project teams to scope stream design projects, and as a last resort, design stream diversions through their developments.
- Help developers, practitioners, resource consent applicants and TDC to meet the statutory requirements of the Resource Management Act (RMA), the Tasman Regional Policy Statement and Tasman Resource Management Plan.
- Promote cross-discipline principles to meet local and national objectives, leaving streams in a better state for the next generation.

What is in the guideline?

- Natural Channel Design Guideline **Part One** is a 'vision' for Natural Channel Design (NCD)
  - The Part One Guideline contains:
  - Local stream type definitions that the guidelines apply to,
  - An overview of 'type specific' stream channel processes and potential risks to constructed stream channels,
  - An ideal project plan,
  - High level guidance on the four stages of investigation and design.
- TDC intend to develop Part Two of the guideline, which will be a step-by-step methodology for all eight steps in the stream design process.

What is NCD?

- A principle based on:
  - providing the required hydraulic conveyance of a drainage channel and floodway while maximising its potential ecological, cultural, amenity and/or recreational values. This holistic approach combines the disciplines of hydraulic engineering, fluvial geomorphology and in-stream and riparian ecology

- The desirable outcomes for the Guideline have been based on the Queensland Government's Guideline for Watercourse Diversions (DNRM, 2014) which state that:

  "A permanent watercourse diversion should be designed and operated to ensure that it is stable, self-sustaining and does not impact on the adjoining upstream and downstream reaches of the existing watercourse. A self-sustaining diversion functions without features or characteristics that rely on ongoing maintenance or that impose a financial or other burden on the proponent, government or the community."

NCD process outline

- NCD principles are based on four levels of investigation and design:
  1. Catchment level assessment of the stream;
  2. Reach level of stream type assessment;
  3. Channel cross-section and local planform design; and
  4. Design of in-channel features.

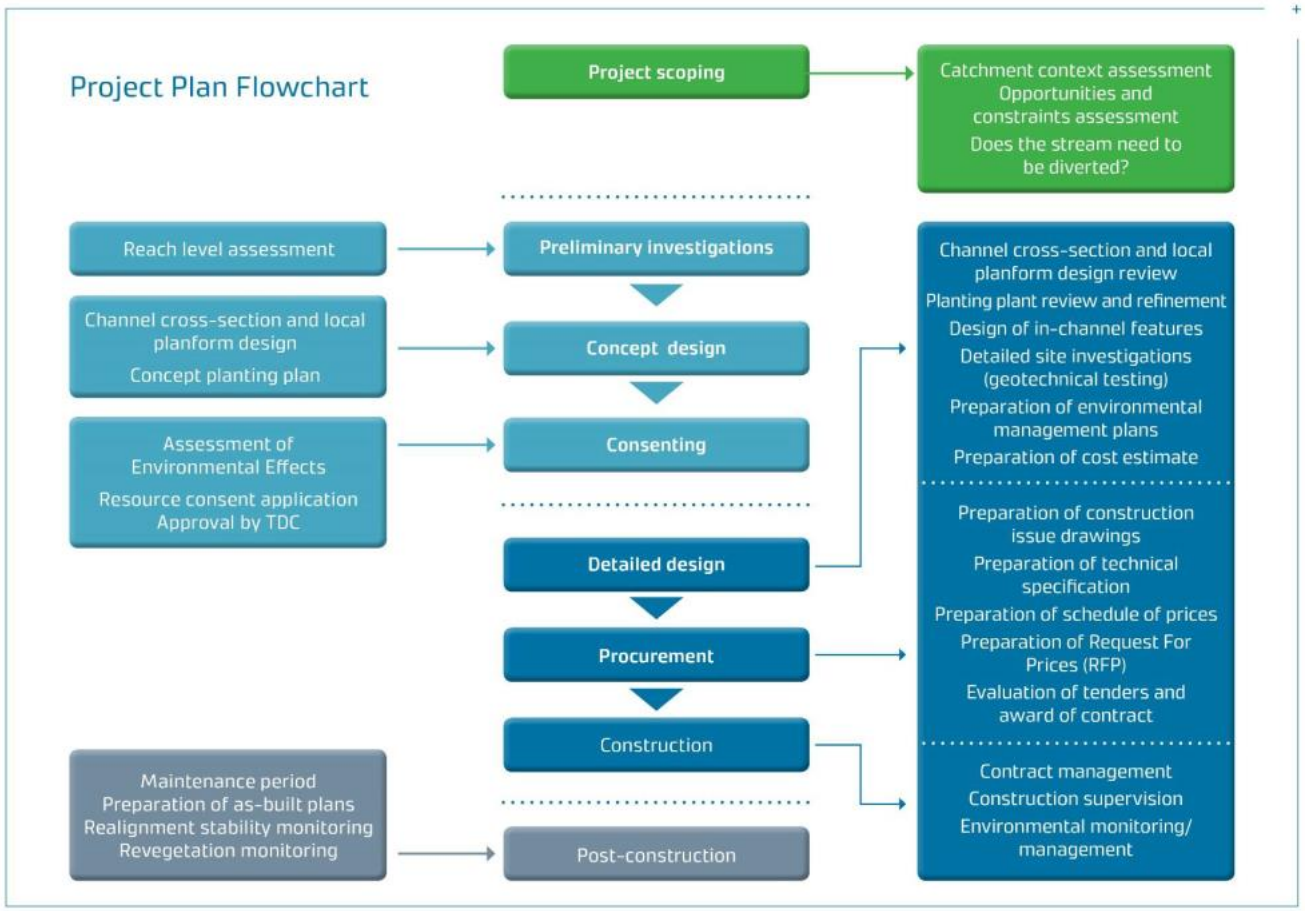
NCD steps

- Essentially eight steps in any stream design process;
  1. Project scoping.
  2. Preliminary investigations.
  3. Concept design.
  4. Consenting.
  5. Detailed design.
  6. Procurement.
  7. Construction.
  8. Post construction monitoring.

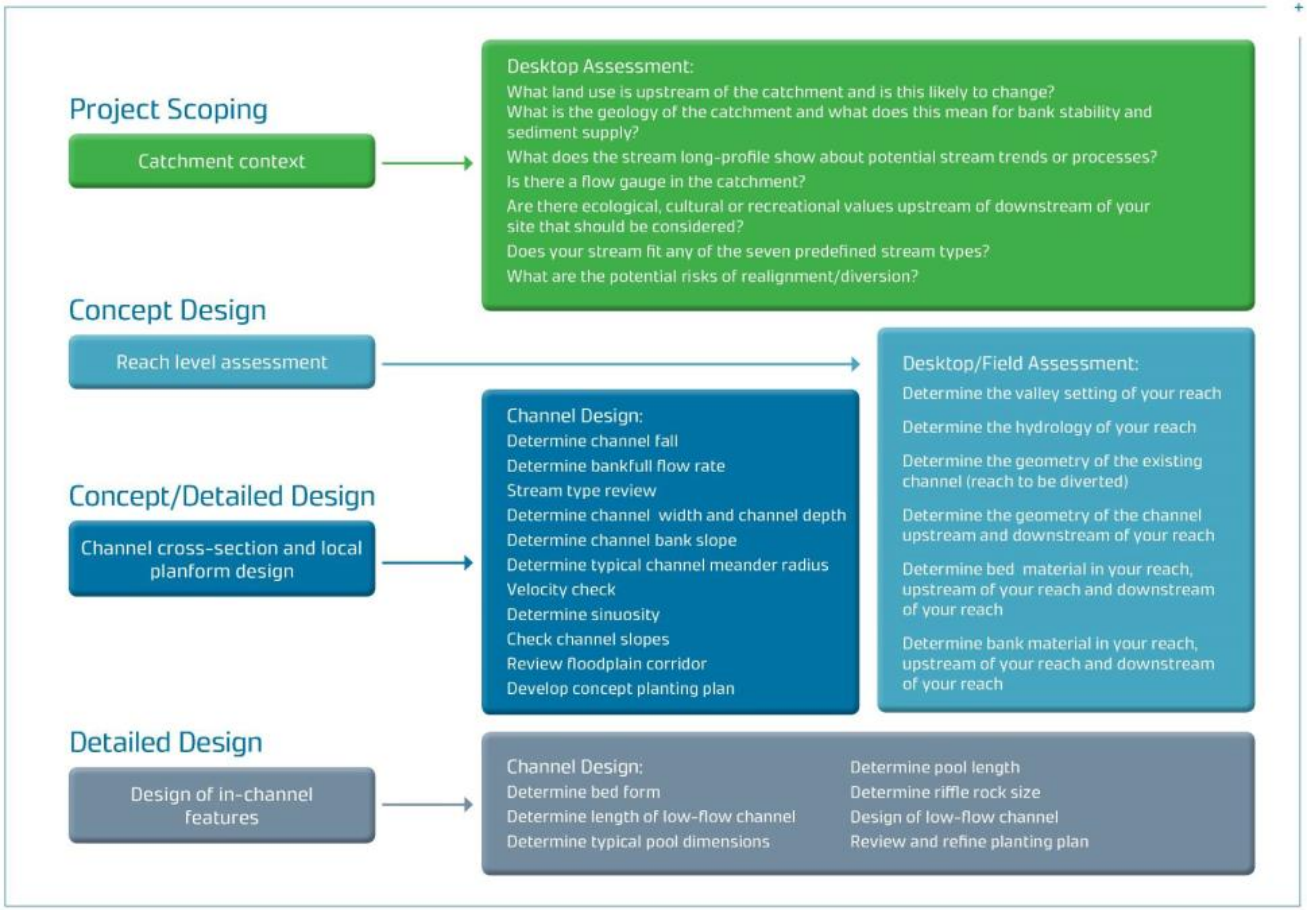
NCD Guidelines

- A quick tour of what's in the guide.

Indicative project plan



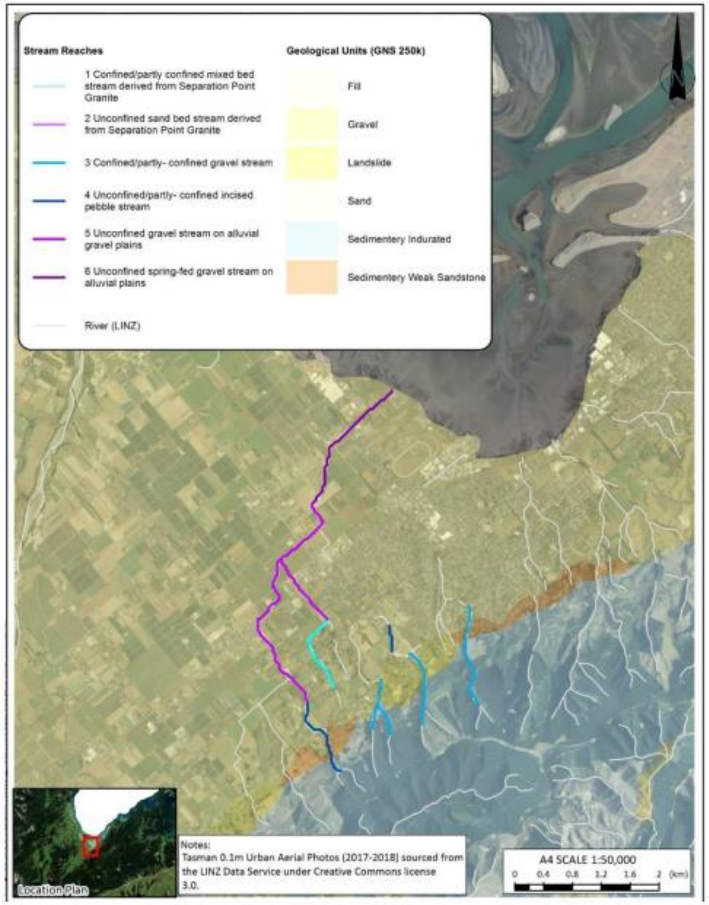
Project scoping



Glossary

Term	Sub-classifications	Meaning
AEP		Annual Exceedance Probability
Aggradation		The process of general bed raising by deposition of sediment.
Aggradation (rates)	Moderate bed aggradation	Accumulations of material at obstructions; bed tending to flat; same size material on bed as bars; evidence of minor overbank siltation.
	Extreme bed aggradation	High width/depth ratio; flat bed; channel largely blocked; overbank siltation evident; adjacent water logging, trees or vegetation in the channel.
Active channel		The width of the stream channel that is wider than the low-flow channel, narrower than the bankfull channel and carries frequent flow events (i.e. seasonal rainfall).
Artificial stream		A constructed stream that contains no natural portion from its confluence with a river or stream to its headwaters and includes any: • Irrigation canal • Water supply race • Canal for the supply of water for electricity power generation • Roadside drain (or water table or culvert) that is constructed alongside or under roads used by vehicles and has as its primary function the drainage of surface water from the road • Farm drainage canal

Stream typing



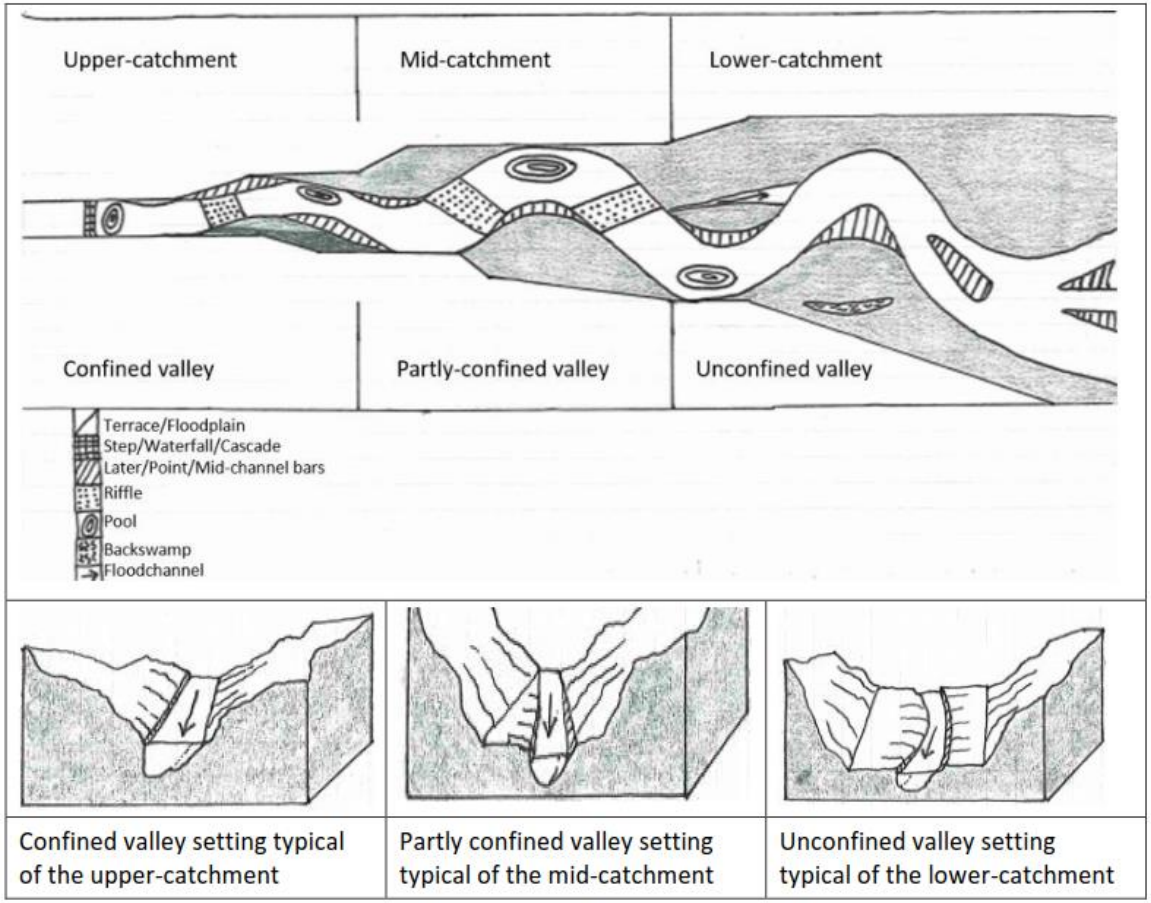
Stream type considerations

Stream type	Catchment location	Slope	Substrate	Low-flow (m)	Bankfull (m)	Hydrology	Generalised sediment processes	Design considerations	Stream crossing considerations	Habitat considerations	Planting considerations
Confined/partly-confined gravel stream	Upper-mid	3-10	Gravels	0.5-1	3-5	Permanent	Aggradation/ degradation (linked to land use)	Confirm medium/long-term geomorphic trends.	Consider sediment movement. Fish passage.	Wood, boulders	Woody riparian (stability).
Unconfined/partly-confined incised pebble stream	Mid	1-5	Pebbles/ fines	0.4-0.6	1-2	Permanent	Degradation	Consider sediment transport.	Maintain suitable low flow channel widths. Fish passage.	Wood, boulders	Standard riparian.
Unconfined gravel stream on alluvial gravel plains	Lower	<1	Pebbles/ fines	1.5-2	>6	Intermittent	Aggradation/ degradation (event driven change)	Regime approach may not be applicable.	Maintain suitable low flow channel widths. Fish passage.	Wood, boulders, Fish refuge pools. Shade.	Woody riparian (shade and stability). Tolerant of a range of conditions.
Unconfined spring-fed gravel stream on alluvial plains	Lower	<1	Pebbles/ fines	2-3	>10	Permanent	Aggradation	Consider benched profile to contain flood/tidal flows.	Maintain capacity for floods, tides. Fish passage.	Wood, riffles, bench.	Sedges, grasses, rushes. Tolerant of saline conditions.

Stream type examples

	
An example of an unconfined sand bed stream derived from Separation Point Granite, showing a 'cut' response.	An example of an unconfined sand bed stream derived from SPG which has filled with sediment after an event, and the channel has avulsed (moved to a new location).

Catchment setting



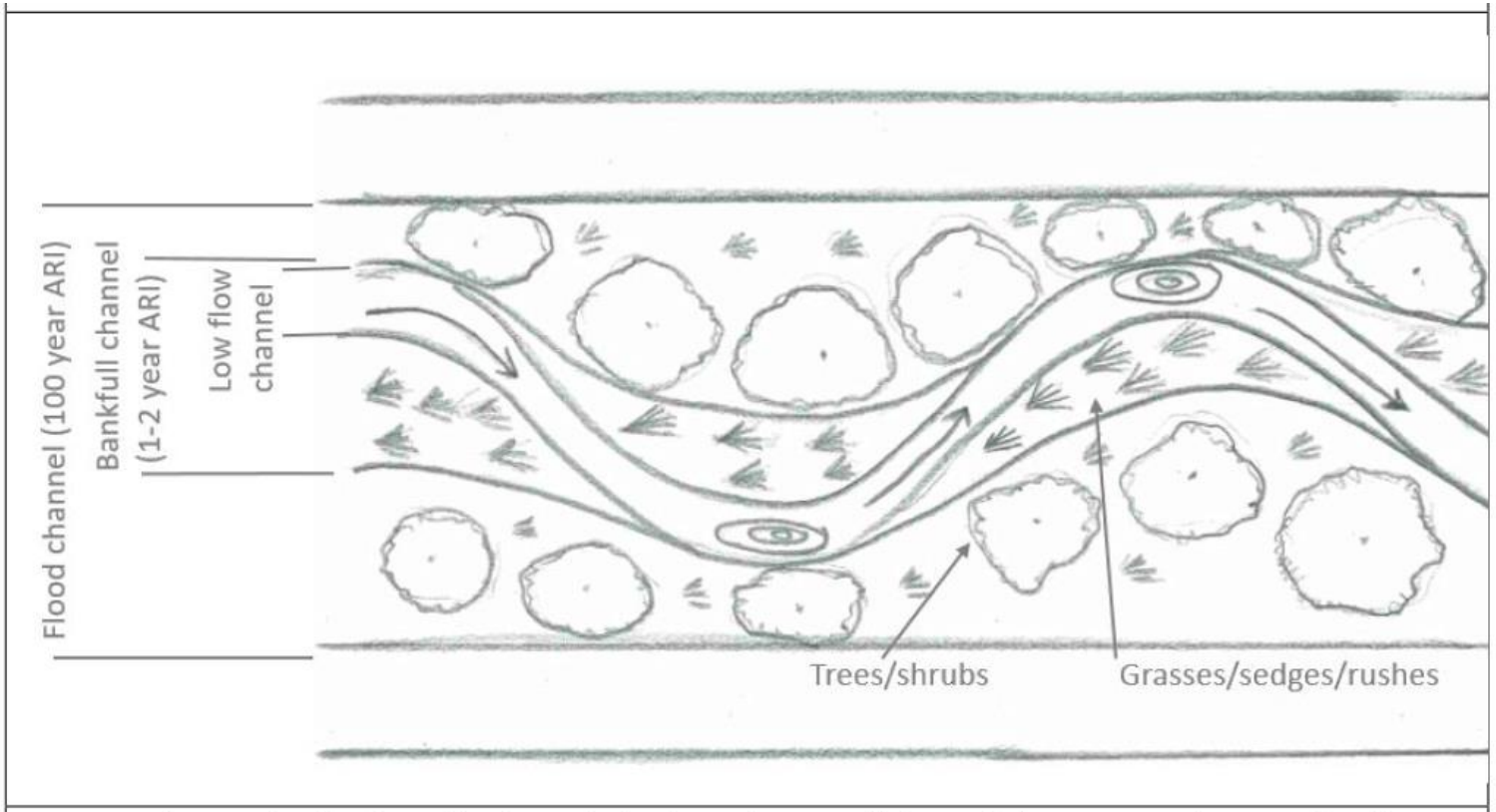
Confined valley setting typical of the upper-catchment	Partly confined valley setting typical of the mid-catchment	Unconfined valley setting typical of the lower-catchment

Channel character

Bed material & processes

	
Example of a constructed stream which has approximately 0.5m of aggradation across the bed, likely due to an over-wide channel.	Example of a constructed stream which is over-wide and will be prone to aggradation. Note aggradation beginning to occur on the right of the photo (red arrow).

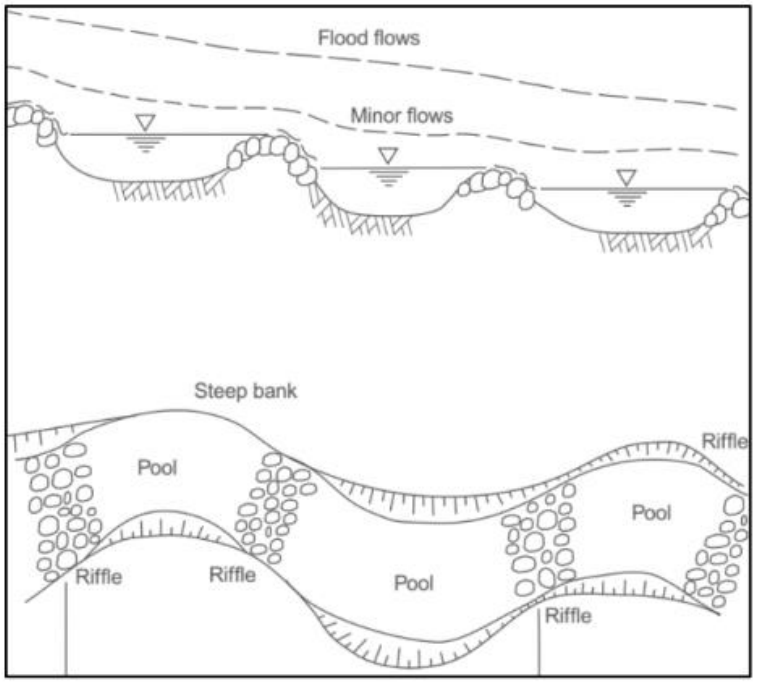
Channel form



Conceptual example of a desirable channel planform showing all channel elements in relation to flood capacity, as well as indicative planting for habitat and conveyance.

In-channel feature types

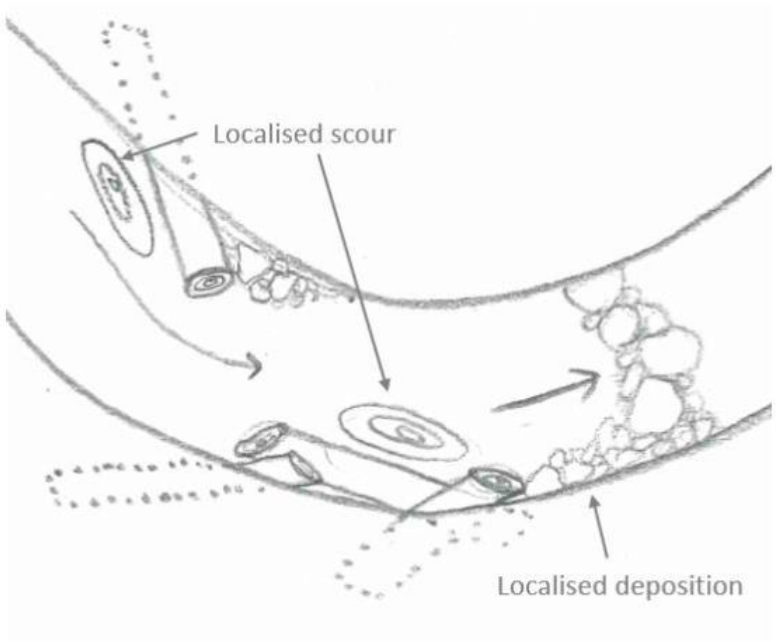
An example of a series of rock riffles fitted into a natural stream to control bed degradation (incision) (image from Department of Environmental protection Maryland, 2018).



Plan and cross section view of riffle construction and placement in regard to meanders and flows (image from Brisbane City Council, 2003).

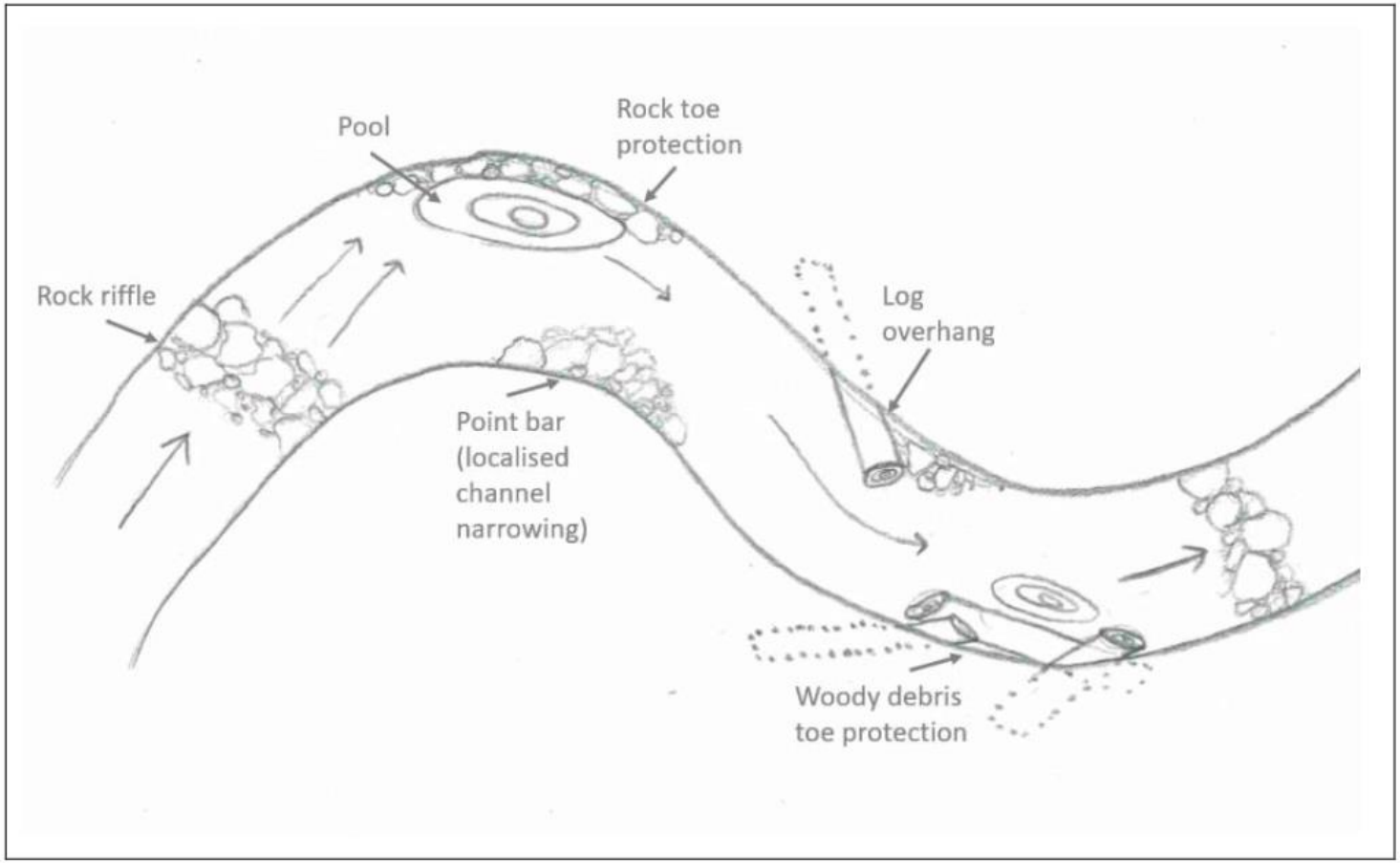
In-channel feature types

Example of a series of log groynes keyed into the bank and with additional boulder anchors (image supplied by Waikato Regional Council).

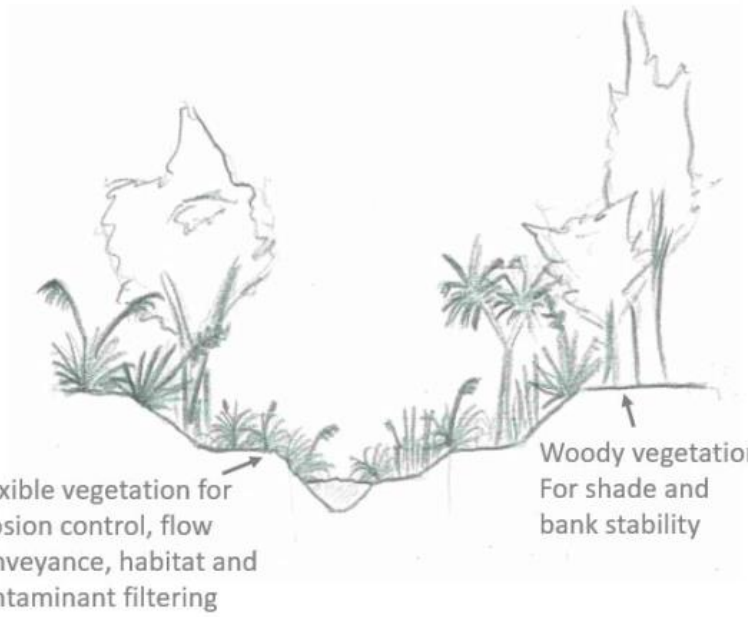


Example of woody debris placed within a stream channel and the predicted areas of scour and deposition which are critical to aquatic habitat.

In-channel feature location



Planting



Example of plant types within the different channel elements to help with erosion control, flow conveyance, habitat provision and contaminant filtering.

Example of desirable stream planting suitable for the stream type, as to provide stability and habitat (image taken from Christchurch City Council, 2003).

National opportunity

- Some work has started to initiate National Stream Management guidance.
- Early days, but a group of people have started talking and engaged with EngNZ and MfE.
- Watch, or maybe join?, this space!