DIGGING DEEPER

RICHARD ENGLISH ON BEHALF OF THE WATER RIGHTS TRUST
Setting the Scene

- Aggregate Usage
- Cleanfilling
How much aggregate have we been using?
How much will we use in the future?

NB: Remaining earthquake demand < 5 million tonnes

Area demand: 2016 – 2041
175 million tonnes

Christchurch: 125 million tonnes
The Demand - Resource balance.

<table>
<thead>
<tr>
<th>AREA</th>
<th>EXISTING RESOURCE</th>
<th>DEMAND 2016 - 2041</th>
<th>ADDITIONAL RESOURCES REQUIRED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Christchurch</td>
<td>75 million + 0.45 million annually ex river</td>
<td>125,000,000</td>
<td>40,000,000</td>
</tr>
<tr>
<td>Selwyn</td>
<td>45 million +0.05 million annually ex rivers</td>
<td>25,000,000</td>
<td>(20,000,000) (surplus)</td>
</tr>
<tr>
<td>Waimakariri</td>
<td>&lt; 10 million</td>
<td>25,000,000</td>
<td>+/- 15 million</td>
</tr>
<tr>
<td>Rivers</td>
<td>Included above</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td>+/- 130 million + 0.5 million annually ex rivers</td>
<td>175,000,000</td>
<td>35,000,000</td>
</tr>
</tbody>
</table>
Where are the potential new resources?  (Geology 101)
Resources local to Christchurch.
Transportation costs - The Tyranny of Distance

Cost of transportation is determined by:

Capacity of truck (and trailer) and its associated costs.

Size of load in relation to capacity of truck (and trailer).

Time to load at quarry and unload at point of delivery.

Distance between quarry and point of delivery.

Average speed over the journey.
"The cost of aggregates doubles for every 30 km it is carted" Is this correct?

ASSUME:

- The cost of the product load on the quarry floor is say $15
- The cartage cost is say $20 for 30 km
- THEN the total delivered cost is: $15 + $20 = $35

BUT....... If the material is carted an additional 30 km

Then (simplistically) the new delivered cost is $15 + ($20 + $20) = $55

I.E. approx 50% more  (So the statement is not correct.)
What is Cleanfill?

MfE Guidelines (2002) state that cleanfill is:

“Material that when buried will have no adverse effect on people or the environment.”

“Cleanfill material includes virgin natural materials such as clay, soil and rock, and other inert materials such as concrete or brick ....”
Christchurch City Cleanfill Bylaw (2003)

- Introduced as a Waste Minimisation tool.
- List of Acceptable Materials derived on this basis.
- Not intended to be used for environmental protection purposes.
Technical Guideline for Disposal to Land (2016) states that:

“When discharged to the environment, cleanfill material will not have a detectable effect relative to the background.”

It comprises “Virgin excavated materials such as clay soil and rock …..”
Christchurch (Pre-Earthquakes):
16 sites
Accepting av. 700,000 tonnes per year
## Sources and quantities.

Data ex Christchurch 2006

<table>
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<tr>
<th>ACTIVITY</th>
<th>Percentage of Total</th>
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<tbody>
<tr>
<td></td>
<td>COVER SOIL</td>
</tr>
<tr>
<td>Roading</td>
<td>12%</td>
</tr>
<tr>
<td>Trenching</td>
<td>1%</td>
</tr>
<tr>
<td>Site Clearance</td>
<td>86%</td>
</tr>
<tr>
<td>Demolition</td>
<td>1%</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td><strong>9%</strong></td>
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Leaching - Complex Mechanisms.
Concentration of leachate with pH

- **Cations (Ni, Cu, Zn, Cd, Pb, Al, Fe, ...)**
- **Anions (Mo, Cr(VI), As, Se, Sb, SO4)**
- Salts (Na, K, Cl, Br, ...)
How is Leaching Potential Evaluated?

Total Content Analysis.
- Assumes everything leaches.
- (TGfDL 2016 recommends TCA for Class 3 & 4 fills.)

TCLP & SPLP Leaching Tests.
- Simulate leaching for a pre-defined situation
- Provide a single data point (concentration)
**TCLP (Toxicity characteristic leaching procedure.)**

Designed to replicate aggressive landfill environments. Not applicable to cleanfills. – May over or underestimate.

**SPLP (Synthetic Precipitation Leaching Procedure.)**

Designed to replicate effects of acid rain. Potentially not applicable to New Zealand.
TCLP ph: 3 - 5.  SPLP ph: 4 - 5  “Cleanfill” : 6.5 – 7.5 ?

Black: TCLP  Red: SPLP  Green: “Cleanfill”
An alternative.

Leaching Environmental Assessment Framework (LEAF) Test Methods.

(Endorsed by US EPA)

A change from current leaching assessment approaches. The methods comprise a suite of leaching tests for:

- pH dependence
- Percolation
- Mass transport
- Liquid / solid ratio dependence

(Similar approach used in Europe and proposed in W.A.)
Leaching tests
Determination of release of contaminants by leaching under different conditions. Interpretation of results.

Evaluation and calculations
Results of leaching tests are used as input for impact assessment – transport and comparison to criteria at end target.
Waste Acceptance Criteria.
(Discussed extensively for NZ conditions in TGfDL 2016)

Physical, Chemical and Biological

As per Class 4 landfills and also including:
- soils, rocks, gravel, sand, clay etc. which do not meet the Class 4 WAC;
- bricks, blocks and pavers;
- ceramics;
- concrete (exposed reinforcing removed);
- road sub-base;
- tiles and pipes made of clay, concrete or ceramics; and
- asphalt.

Maximum incidental or attached biodegradable materials (e.g. vegetation) to be no more than 2% by volume per load.

Extract from TGfDL Class 3 Fill Criteria
(Note: Class 3 fills not to be sited above drinking water aquifers.)
Local Cleanfill Contaminants potentially include:

- Pesticides and Herbicides
- Hydrocarbons
- Copper, Lead & Zinc
- Cadmium and Boron
- Chromium, Aluminium, Selenium & Antimony
- Altered pH, alkalinity and hardness
- Polycyclic Aromatic Hydrocarbons (PAH’s)
Coal tar in Christchurch streets
- previous coring ⇒ high levels of coal tar PAHs
  - roads: 4200 mg/kg
  - footpaths: 7700 mg/kg

Compared to <5 mg/kg in bitumen road
- best estimate - coal tar present in half the streets
- require reconstruction within 10-20 years

roadside soil also contaminated
- up to ca. 1000 μg/g of PAHs

aggregate beneath seal layers also contaminated with PAHs
- footpaths: up to 1200 μg/g
- roads: up to 320 μg/g

“Toxicity and Management of Coal Tar Contaminated Roads using Foamed Bitumen Stabilisation”
- C Depree, NIWA & S McNeill Christchurch City Council – 2009
Testing Regime.

- Sampling and testing has to be sufficiently frequent to provide 99% confidence that the samples are representative of the whole. (TGfDL 2016)

- Sampling and testing should be undertaken by independent IANZ laboratory accredited for that purpose.

- Reports to be sent direct to monitoring authority and copied to fill operator.
THE CAPG PROPOSAL

- Backfill materials
- Operational Issues
- Consent Conditions
- Alternatives
- Economics
Backfill Materials - “Deep Placement”

- Materials to be” inert” / “uncontaminated.”


- No analysis of levels of potential contaminants in either current or proposed fill.

- Proposed SPLP test inappropriate.

- No analysis of leaching potential or impacts on groundwater - other than hydrocarbon spill, avian bacteria and concrete slurry.

Waimairi: wet or dry or both?

Paparua: not appropriate?

(Quotes from: “The Paparua landfill: Hydrogeological, geophysical and hydrogeochemical investigations of groundwater contamination by leachate, Christchurch, New Zealand” – V.R. Smith.)

• “The silty sand therefore functions as an aquitard, producing a perched watertable in the overlying refuse and inhibiting downward leachate percolation.”

• “Leachate confinement by fortuitous hydrogeologic factors at the Paparua County Council Landfill cannot be taken as indicative of leachate behaviour at other unlined landfills in Canterbury....”
Doubts over assumptions in contamination models.

- Plume length
- Concentrations in leachate
- Volumes of leachate
- Gravel parameters
No chemical or biological waste acceptance criteria specified.

Sampling and testing regime not clear. May not reach ‘confidence’ requirements.
(Not clearly specified in Quarry Deepening Environmental Management Plan or draft conditions of consent)

Trigger levels fail to consider sensitivity of aquifer stygofauna or ecology of downstream surface waters.
Timescales.

Operationally this has to equal this

**BUT** backfill return rate is only approx 25% of the production rate
Available Material.
I.E.

On average over the next twenty five years only approximately 1 million tonnes of material potentially available annually, in Christchurch area, for filling.

BUT ......

Applicant quarries will only receive a proportion of this ( < 75% ? )
And....

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Assume total quantity from deepened areas is 30 million tonnes

THEN....

Minimum timescale to complete excavation and filling of deepened areas is 30 years

BUT....

potentially longer once applicant’s proportion of cleanfill market accounted for, even before considering the ‘suitability’ or otherwise of the materials for ‘deep placement.’ (60 years?)
Flooded pits
Quarry Rehabilitation.

- Current major backlog of rehabilitation.

- Problem acknowledged by CAPG at pCRDP Hearings.

- Proposal has potential to significantly delay rehabilitation of areas currently open.
Proposed consent conditions of concern include:

- No proposed time limit on standing water being extant.
- Materials acceptance and testing regime not specified.
- Sampling of groundwater to potentially cease after two years.
- Trigger levels set without reference to ecological values.
- Potential delays in remedial action if trigger levels exceeded.
- Proposal to exclude liability for contamination of downstream wells established post the granting of the CAPG consent.
Alternatives:

(1) The Status Quo

(2) Rivers - Waimakariri

Aggraded gravels: 6 – 7 million tonnes

Replenishment rate: 0.5 million tonnes p.a.

Current extraction rate 0.8 million tonnes p.a.

c.f. CCC area demand: 4 – 5 million tonnes p.a.
Alternatives (cont.)

- (3) Wards Road Quarry, Rolleston.
- (4) Recycling
- (5) Sources of Cleanfill
Alternatives (cont.)

- (6) New Quarries – western Christchurch

(Insert map showing potential location of new quarries.)
Economics.

Scenarios.

(1) CAPG Proposal: dig deeper at current sites and cart to processing plant on current site.

(2) Establish new ‘excavation only’ quarry and cart equivalent amount to processing plant on current site.

(3) Establish new ‘excavation only’ quarry when current resources exhausted and cart to processing plant at current location.

(4) Establish new full quarry (i.e. excavation and processing) at new site and cart ‘dig deeper’ materials to processing plant on new full quarry site.

(5) Establish new full quarry with reserves that include equivalent of ‘dig deeper’ materials.
Economics (cont.)

<table>
<thead>
<tr>
<th>Cost Generator (above current)</th>
<th>CAPG Proposal $ million</th>
<th>‘Excavation Only’ Quarry to replace CAPG Proposal $ million</th>
<th>Excavation Only quarry as additional resource $ million</th>
<th>New Quarry (DD at current quarry) $ million</th>
<th>New Quarry $ million</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groundwater level measurement equipment, Monitoring, Reporting and Excavation management.</td>
<td>2</td>
<td>None</td>
<td>None</td>
<td>2</td>
<td>None</td>
</tr>
<tr>
<td>Increased cleantill, Sampling, Testing, Monitoring, Compliance reporting and Management.</td>
<td>10 - 14 (20 – 28)</td>
<td>None</td>
<td>None</td>
<td>10 - 14 (20 - 28)</td>
<td>None</td>
</tr>
<tr>
<td>Rehandling / movement of fill stockpiles to excavated areas.</td>
<td>12 - 17</td>
<td>None</td>
<td>None</td>
<td>12 - 17</td>
<td>None</td>
</tr>
<tr>
<td>Mitigation measures re standing water</td>
<td>2</td>
<td>None</td>
<td>None</td>
<td>2</td>
<td>None</td>
</tr>
<tr>
<td>Up and downstream well installation , Sampling, Testing, Monitoring, Reporting and domestic Drinking water well Sampling, Testing, Monitoring and Reporting</td>
<td>1</td>
<td>None</td>
<td>None</td>
<td>1</td>
<td>None</td>
</tr>
<tr>
<td>Increased raw material costs (Land purchase, consenting, quarry establishment.)</td>
<td>None</td>
<td>24 - 35</td>
<td>15 - 20</td>
<td>None</td>
<td>15 - 20</td>
</tr>
<tr>
<td>Increased cartage and its management</td>
<td>None</td>
<td>25 - 35</td>
<td>20 - 30</td>
<td>40 - 60</td>
<td>20 - 30</td>
</tr>
<tr>
<td>Establishment of processing plant, etc</td>
<td>None</td>
<td>None</td>
<td>Not additional</td>
<td>Not additional</td>
<td>Not additional</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td><strong>$30 – 35 million</strong></td>
<td><strong>$50 – 70 million</strong></td>
<td><strong>$35 – 50 million</strong></td>
<td><strong>$65 – 95 million</strong></td>
<td><strong>$35 – 50 million</strong></td>
</tr>
</tbody>
</table>

Value of CCC municipal water supply $70 million per year
Evidence of Drs Scott and Burbery

Underestimate timescale standing water will be extant.

Do not discuss impacts on, or provide trigger levels for the protection of stygofauna or ecology of surface waters.

State that there is a risk to the aquifer but that it is not possible to quantify this risk.

But then conclude that contamination is likely to be restricted to aesthetic impacts provided fill is “inert” - without defining “inert” (Appear to assume aesthetic impacts not important.)

State that any contamination is likely to be restricted in its extent.

However they provide no evidence to substantiate their assumptions which are critical to their conclusions.
Concluding Comments.

- Proposal lacking in a number of critical areas, contains numerous areas of uncertainty and is potentially incorrect in some of its base assumptions.

- No evidence provided of potential contaminants in backfilling proposed for use.

- Appear to have defaulted to an outmoded definition of ‘inert’ contained in a document that has been superceded.
Concluding comments (cont.)

- Appear to have underestimated the potential impacts of the change of environment within the deepened fill areas.

- Application, critically, takes no account of the very restricted availability of suitable backfill.

- No evidence provided that economic gains, outweigh potential risks to drinking water supplies of both rural and urban populations.
Concluding Comments (cont.)

- There are economically viable supply alternatives.
- Proposal has potential to augment local supply of aggregates over long term, however risk to local aquifers is likely to remain throughout and beyond life of proposal.
- In summary, this risk significantly outweighs the small (if any) benefits of the proposal.