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# Vibratory Reverse Osmosis Treatment of Hampton Downs Leachate

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# Hampton Downs PARRC

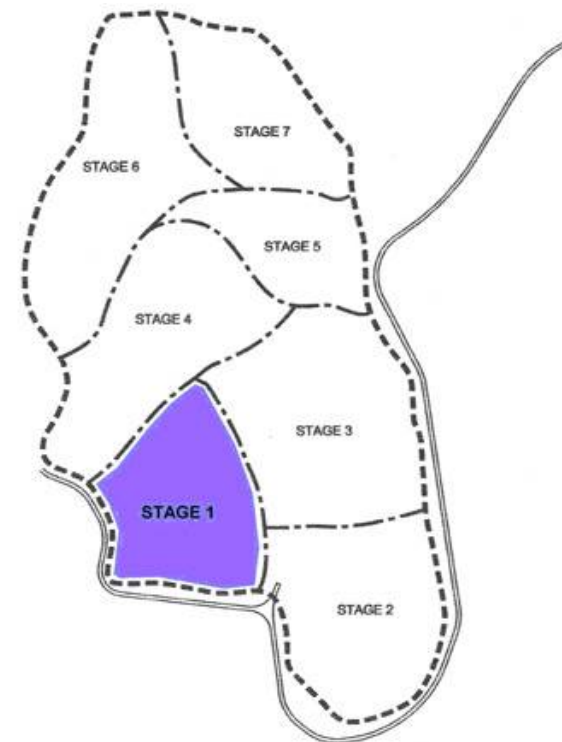
Power and Resource Recovery Centre

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# Hampton Downs Landfill

- Opened in 2005 at cost >\$30m
- 35 year consent
- 360 Ha site, 87 Ha landfill footprint
- 7 stages
- 70m max depth
- 42 Mm<sup>3</sup> of airspace capacity
- 38M tonnes of refuse capacity
- Currently disposing 500,000tpa
- Expected life greater than 35yrs



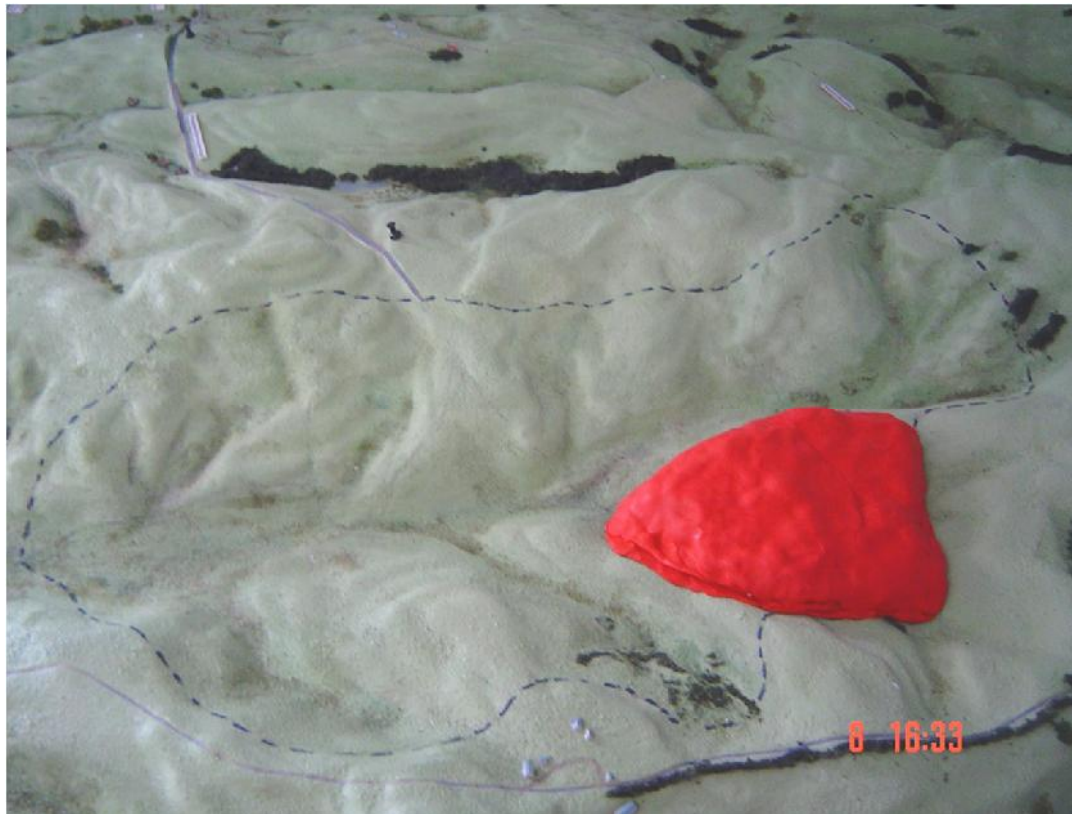
# Pre-development landform

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# Filling Stage 1

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## Filling Stage 2



## Filling Stages 3,4,5,6 and 7





# Landfill Leachate – Key Issues

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## Cost

- All leachate tankered off site
- Treatment and disposal at Mangere WWTP
- 150 to 300m<sup>3</sup>/day
- Cost \$22.00/m<sup>3</sup>
- Total Cost per annum >> \$ 1m / year



# Landfill Leachate – Key Issues

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## Quantity

Leachate volumes generated are highly dependent upon rain infiltration

<b>Year</b>	<b>Leachate Tankered Offsite (m3)</b>	<b>mm of rain (mm)</b>	<b>Total Landfill Area (m2)</b>
2007	28,000	825	140,000
2010	34,500	1173	197,000
2011	48,000	1313	250,000
2013	55,281	874	265,000
2014	43,300	784	294,000

# Landfill Leachate – Key Issues

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## Quality

Current disposal cost dependent on quality as well as quantity

- cBOD5 - range 400 to 4000 ppm
- Sulphides – 1.0ppm, treated onsite to ensure <5ppm
- Ammonia – range 300 to 1600ppm
- Boron – range 0.4 to 40 ppm

Leachate Constituent g/m <sup>3</sup> unless stated	Raw leachate	NZDWS	ANZECC Irrigation <sup>+</sup>	ANZECC water quality 90%
Arsenic	0.22	0.01	2	0.04
Cadmium	0.001	0.004	0.05	0.0004
Chromium	0.58	0.05	1	NA
Copper	0.07	2	5	0.0018
Nickel	0.22	0.02	2	0.013
Lead	0.036	0.01	5	0.0056
Zinc	2.1	1.5*	5	0.015
Manganese	2.26	0.4	10	2.5
Fluoride	0.43	1.5	2	NA
Barium	0.41	0.7	NA	NA
Total sulphide	<b>0.88</b>	0.05*	NA	0.0015
Total Alkalinity as CaCO <sub>3</sub>	5,800	NA	NA	NA
Total Sodium	1,431	NA	NA	NA
Chloride	1,466	NA	NA	NA
Total Ammoniacal -N	<b>930</b>	NA	NA	1.43
Nitrate - N	0.024	50	NA	3.4
Sulphate	96	NA	NA	NA
cBOD <sub>5</sub> g O <sub>2</sub> /m <sup>3</sup>	<b>1,898</b>	NA	NA	NA
COD g O <sub>2</sub> /m <sup>3</sup>	4,346	NA	NA	NA
Total Boron	<b>17</b>	1.4	0.5	0.68
Total Iron	4.7	0.2	0.2	NA

Note 1: \* zinc and sulphide values are guidelines not Maximum Acceptable Values.

Note 2: + Irrigation values for short term use (20 years).

# The Problem

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## Increasing Costs and Risk

- Total costs increasing with landfill size by \$1.0m every 5 years
- \$2.5m Transport Treatment Disposal Opex by 2020
- Increasing future capital - more storage tanks, tankers
- Risk - WWTP changing waste acceptance criteria, price
- No local disposal options without significant treatment



# Treatment Options

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## Processes considered

- Evaporation
- Chemical Physical Biological
- Reverse Osmosis

Objective – disposal to

- local WWTP or onsite (air, land, water)

# Treatment Processes Not Favoured

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## Evaporation

Use of landfill gas (LFG) to evaporate leachate

- Uneconomical for ESL
- Lost electrical revenue is \$38.00/m<sup>3</sup> of leachate
- Compared to current cost \$22.00/m<sup>3</sup>
- Capital cost similar to Reverse Osmosis

## Evaporation to air

- Limited by Auckland average humidity 70 – 85%



# Reverse Osmosis – Best Option

## Reverse Osmosis

- Attractive blanket removal of contaminants
- Established RO history - used at landfills
- Equador - 0.5mg/l Boron, 0.5mg/l Ammonia
- Lab work on HD leachate
- Good rejection rates, colloidal solids fouling
- New Logic Research – Vibratory RO

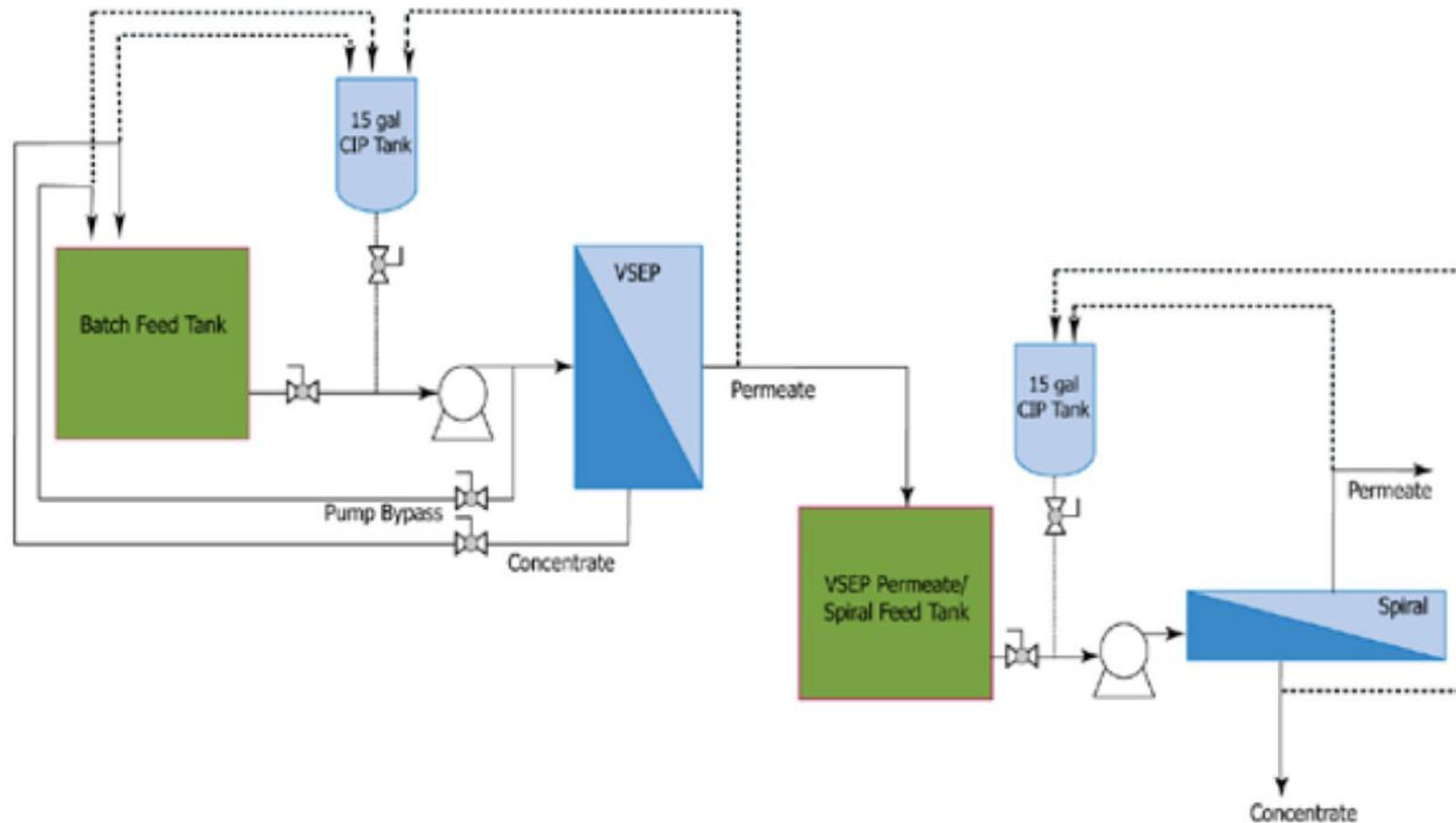


# Reverse Osmosis Trial

New Logic Research - San Francisco

- Vibratory separation enhanced processing (VSEP) used at several landfills
- Mitigates colloidal fouling of membrane
- Trial plant flown to Auckland
- VSEP unit and Spiral unit

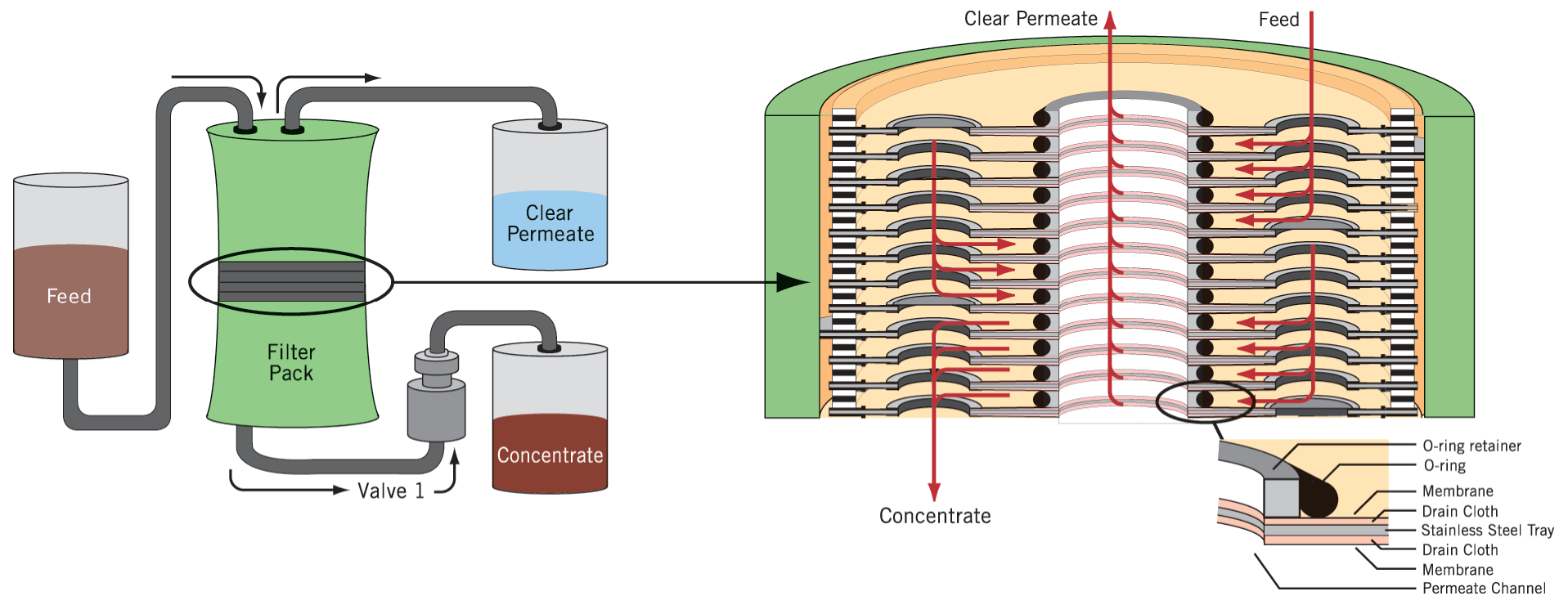




VSEP Pilot Batch/Spiral Process Diagram



# VSEP Separation Technology



# VSEP Trial Results

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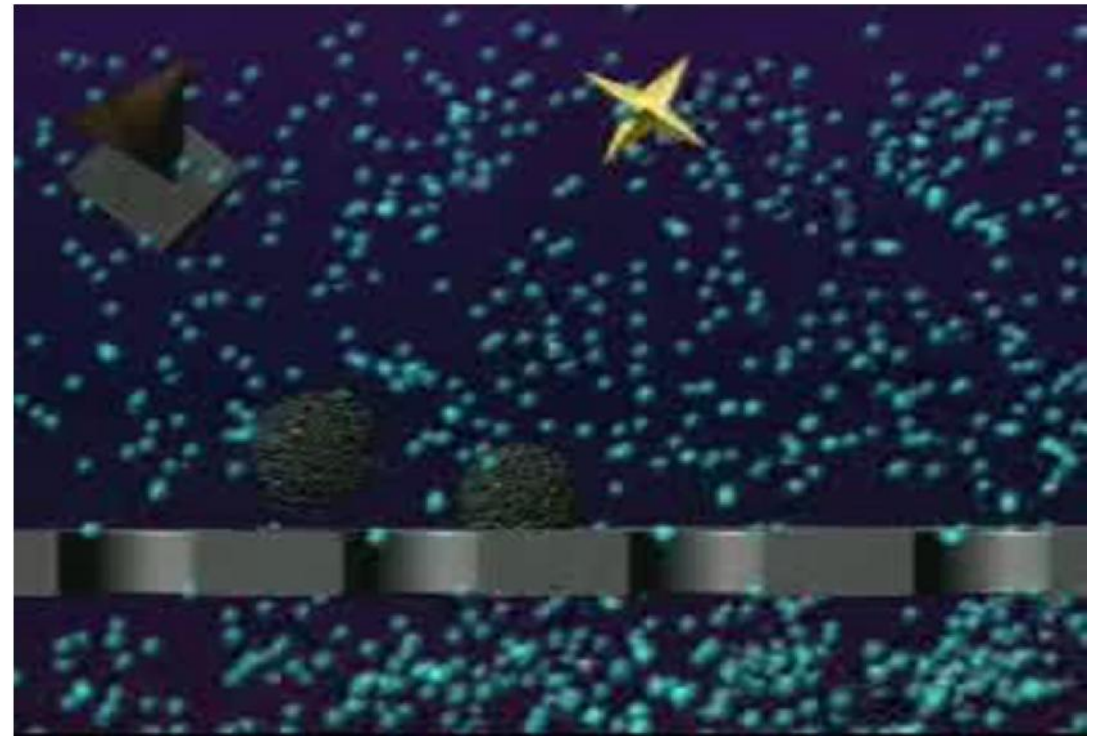
- Pressure study to determine flux
- Cleaning study
- 60 – 73% recovery of permeate
- Boron reduction 26 to 6mg/l
- Ammonia reduction 730 to 15mg/l
- Conductivity 1300 to 6mS/m
- All other contaminants compliant



# VSEP Separation Technology

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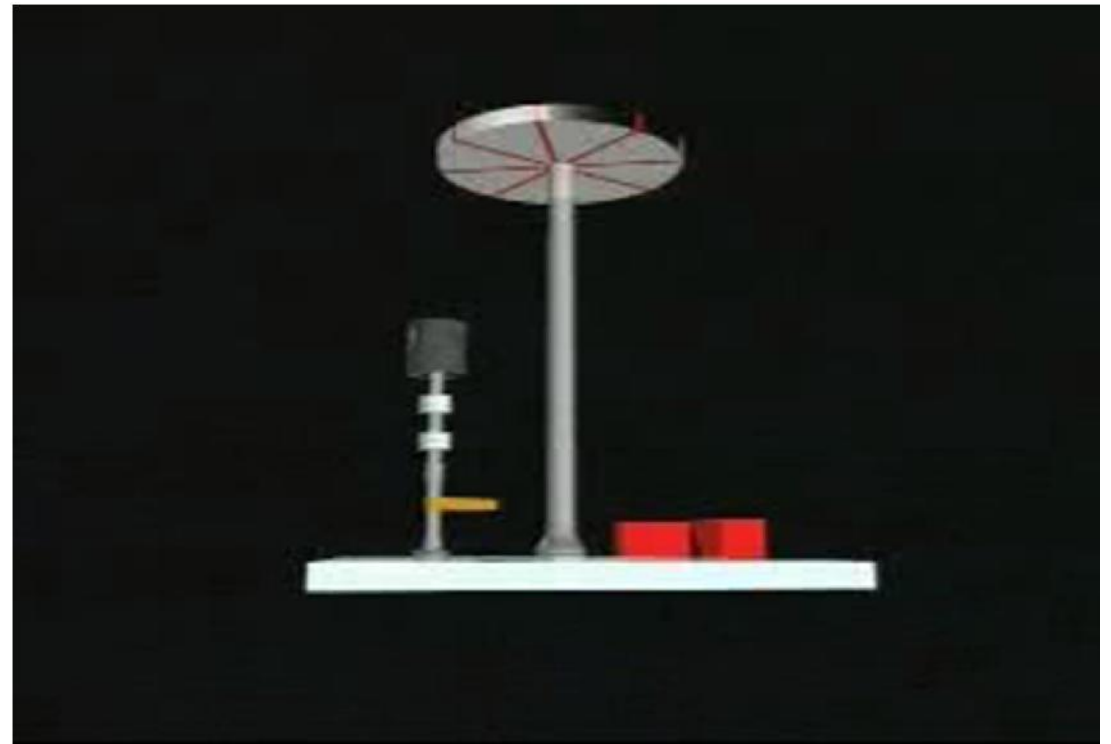
- Oscillating movement of membranes
- Helps eliminate membrane blinding
- Allows free access of the liquid to the membrane pores
- Shear created causes suspended solids to be held above the membrane surface which are washed away with laminar flow.



# VSEP Separation Technology

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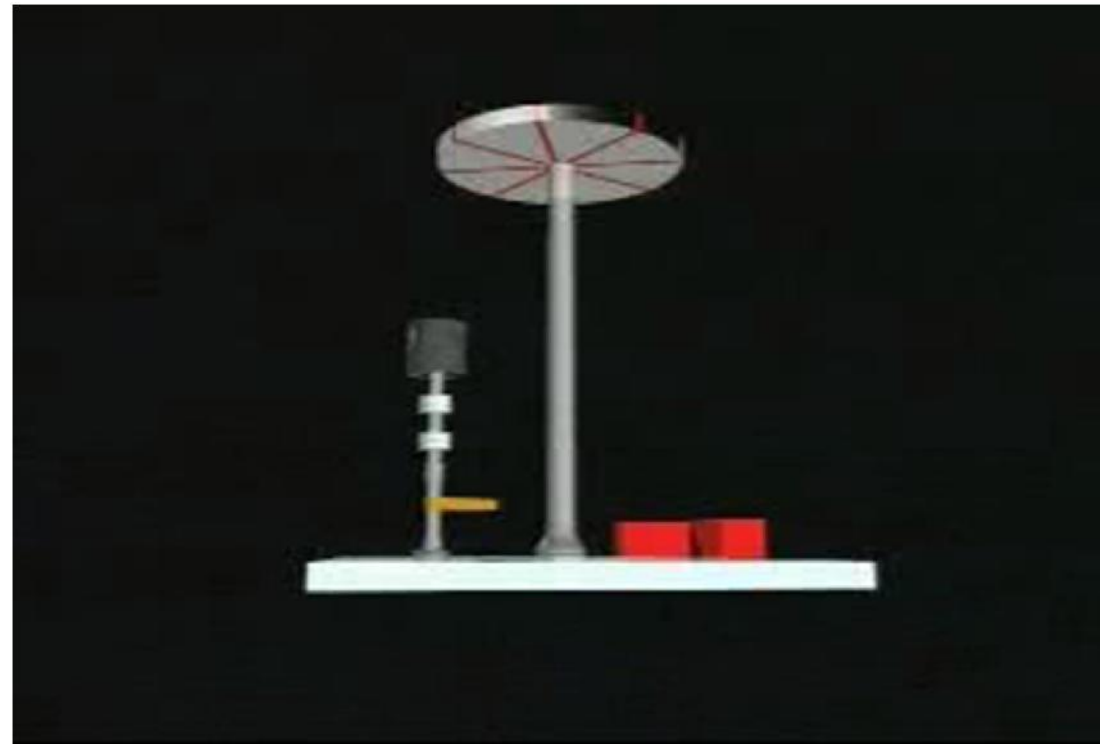
- Membrane filter stack mounted on a resonating mechanical drive system
- A 20 hp drive motor spins an eccentric lobe
- Drives a large steel mass at the bottom
- Once speed increases whole system resonates at a harmonic frequency
- 19mm peak to peak displacement



# VSEP Separation Technology

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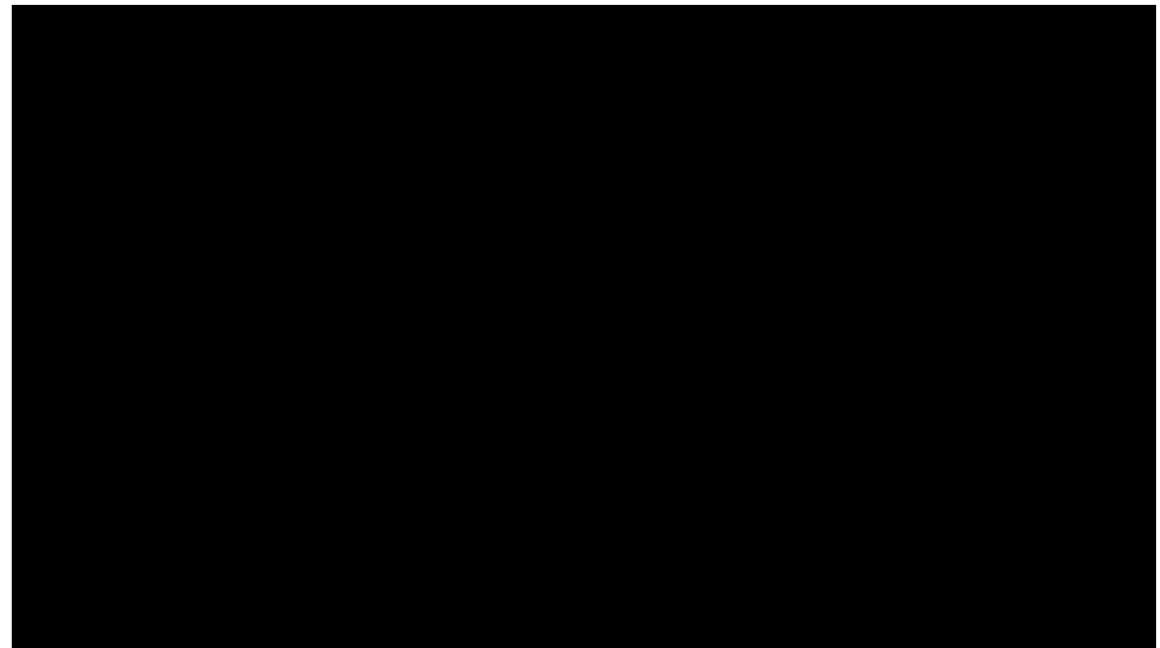


# HDLF Leachate Treatment Plant

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## New Treatment Plant

- New Logic Research and Syngineering
- Design Capacity 300m<sup>3</sup>/ day
- 6 VSEP units + 4 Spiral units
- Capex \$6.0 million
- Opex ~ \$6.50/m<sup>3</sup> excl Depreciation
- Justified by Opex Savings ~ \$0.5m/yr
- 65 – 75 % recovery as permeate
- Concentrate returned to landfill



# HDLF Leachate Treatment Plant

- Under construction
- Completion Q2 2016







# Black Mudfish

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- Ecological study
- Relic species black mudfish found
- HDLF wetlands and Clune stream
- Iwi treasured species (toanga)
- DOC Species at Risk - Relictual
- Hibernate in summer (estivate)
- High quality water environment





# Consents

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## **Land Irrigation Consents issued**

- Only when soil moisture deficiency
- 150m<sup>3</sup>/hectare per 3 day period, 1 Oct to 31 March
- 20 year term, expiring 2034

## **Stream Disposal Consent issued**

- ANZECC 90% Protection of Species
- Conductivity 20mS/m
- Annual average
  - Boron 0.4mg/l, Iron 0.2mg/l, Sodium 1.0mg/l,
  - Ammoniacal Nitrogen 0.5mg/l
- 15 year term, expiring 2029



# Innovation, Environment & Sustainability

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## **New Leachate Treatment Plant**

For 40,000m<sup>3</sup>/yr disposed to land/stream

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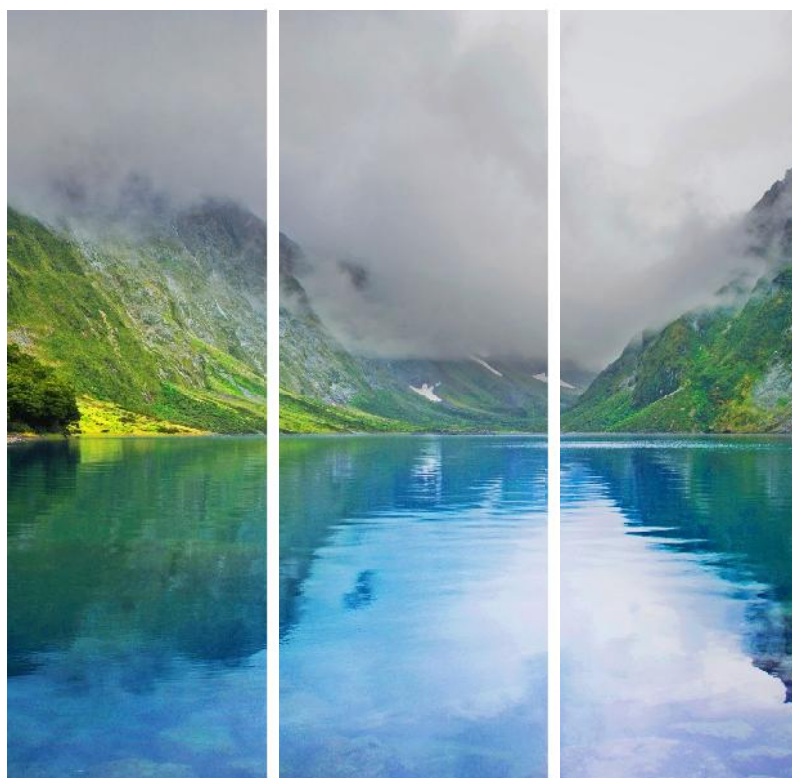
- 1600 tanker trips per year
- 179,000 km/yr
- 85,000 litres of diesel per year
- 227 tonnes CO<sub>2</sub>e / year

Recycled water for site use



# Questions ?

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