Balancing a Community’s Wastewater Aspirations with Affordability – The Gisborne Experience

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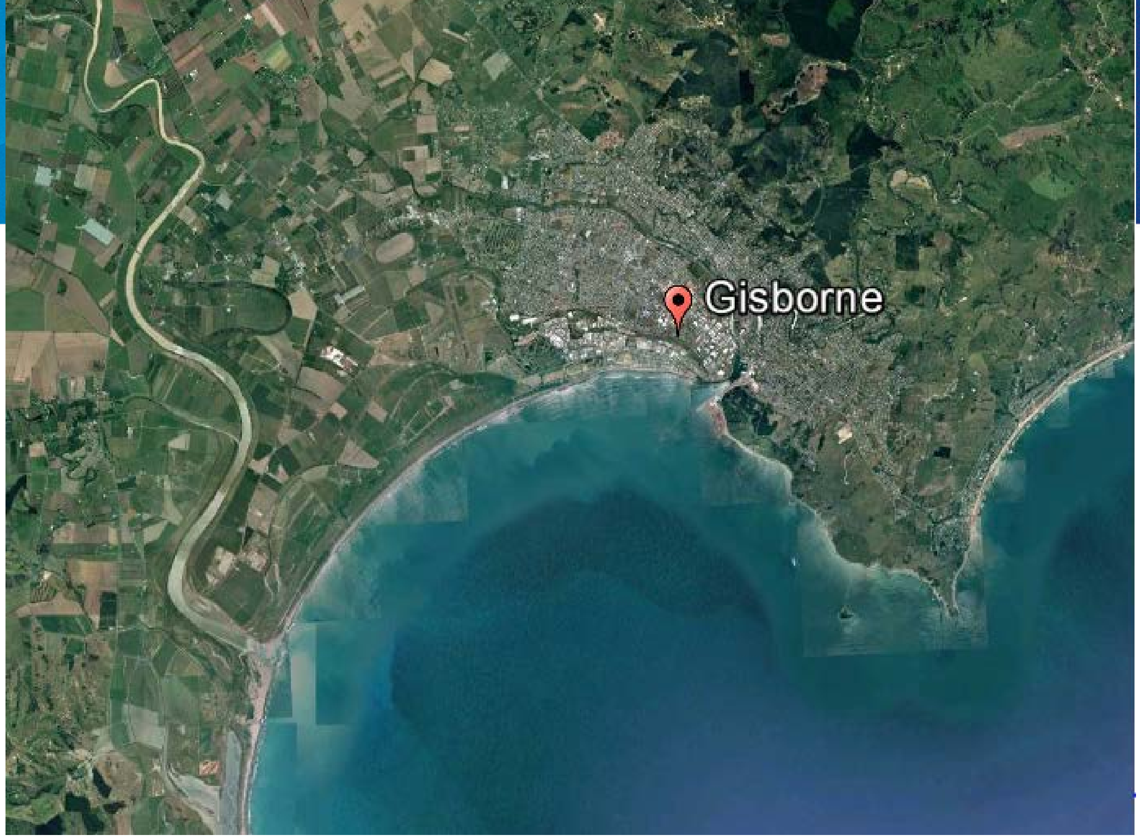
Introduction

- Background and Context
- Consents
- Enhanced Wetland Pond System Trial (EWPS)
- Scaling up
- Value Engineering
- Conclusions

- Acknowledgements: Gisborne District Council, Wastewater Technical Advisory Group, NIWA, ESR, Northcott Research Ltd


New
Zealand

Gisborne



Quiksilver


STARTER
SONIC NZ
SONIC

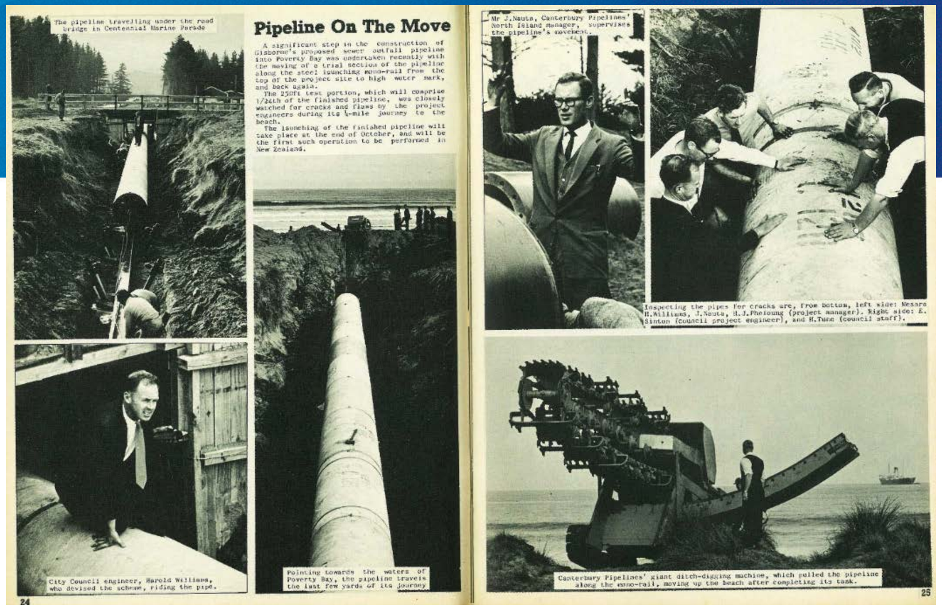

GIZZY
HOROUTA

Wastewater History

- 1964 – untreated wastewater to Marine outfall
- 1990 – 2010 milliscreen plant
- 2010 – BTF Stage 1
- 2015 - 2017 Stage 2 AUD investigations, long term treatment & disposal
- 2016 –EWPS pilot and concept design

“The permit holder shall use its best endeavors to adopt those AUD options that are identified as feasible and which will enable the progressive removal of the treated human sewage from the discharge, via the marine outfall, with the objective of complete removal by 2020.”

(Watson, June 2009)



The pipeline travelling under the road bridge in Centennial Marine Parade

Pipeline On The Move

A significant step in the construction of Gisborne's proposed sewer outfall pipeline into Poverty Bay was undertaken recently with the moving of a trial section of the pipeline along the steel launching mono-rail from the top of the project site to high water mark, and back again.

The 250ft test portion, which will comprise 1/24th of the finished pipeline, was closely watched for cracks and flaws by the project engineers during its ¼-mile journey to the beach.

The launching of the finished pipeline will take place at the end of October, and will be the first such operation to be performed in New Zealand.

Mr J.Nauta, Canterbury Pipelines' North Island manager, supervises the pipeline's movement.

Inspecting the pipes for cracks are, from bottom, left side: Messrs H.Williams, J.Nauta, H.J.Pheloung (project manager). Right side: E. Sinton (council project engineer), and H.Tune (council staff).

City Council engineer, Harold Williams, who devised the scheme, riding the pipe.

Pointing towards the waters of Poverty Bay, the pipeline travels the last few yards of its journey

Canterbury Pipelines' giant ditch-digging machine, which pulled the pipeline along the mono-rail, moving up the beach after completing its task.

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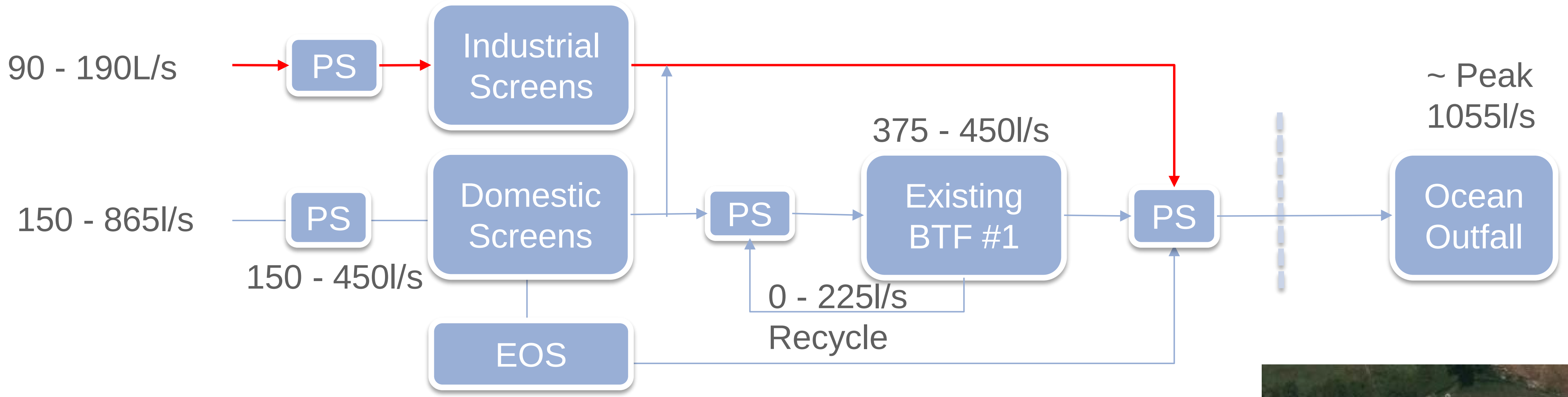
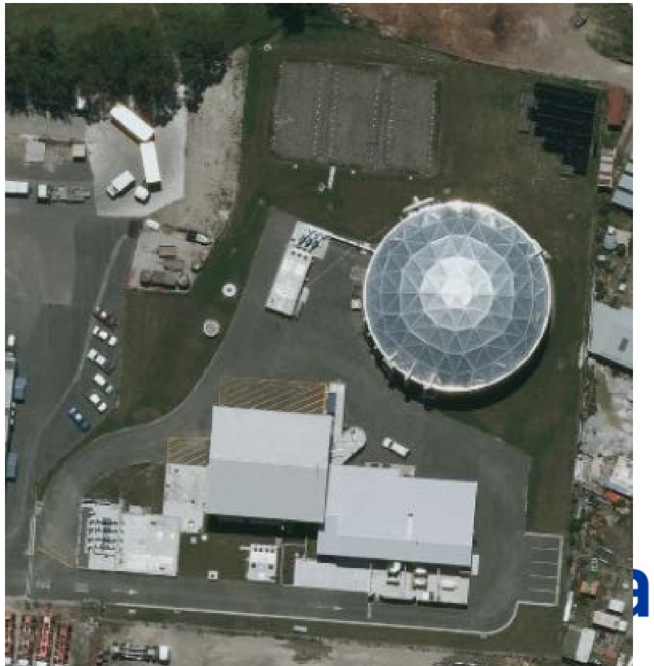
Existing Banks St Treatment Plant





WTAG and the EWPS Pilot

- WTAG Key Objective → use natural treatment to restore the *mauri* or life force of the wastewater
- undertook series of investigations culminating in selection of Enhanced wetland pond system (EWPS) pilot
- Pilot Objective
  - *Is alternative treatment of Gisborne's domestic WW feasible?*
  - *What level of treatment can be achieved through a tertiary enhanced wetland & pond system?*
  - *Identify potential performance issues*
  - *Confirm basis for scale up*
  - *Operated between January & June 2016*
  - *NIWA, ESR and GDC collaboration*

Sludge settler for biosolids (sludge) removal from BTF effluent

High Rate Algal Ponds (HRAPs) for sunlight disinfection, organic compound (e.g. BOD_5) and nutrient removal

Algal Harvester (AH) for algal solids removal from the HRAP effluent

Surface Flow Constructed Wetland(SFCW) for further organic compounds and nutrient removal

Woodchip Denitrification Filter for residual nitrate removal via disinfection

Final Surface Flow Constructed Wetland (HW) for further polishing the BTF effluent before discharge

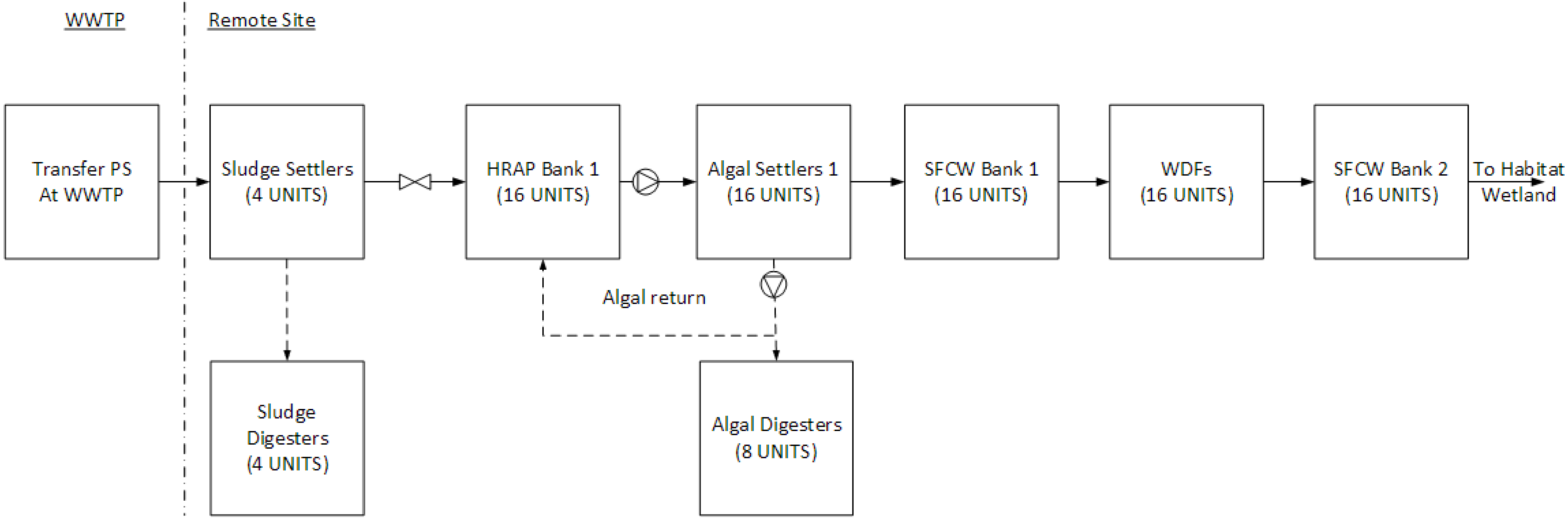
Pilot Performance

Table 1: Mean Pilot Plant Final Effluent Quality and Removal Efficiency Across EWPS (Tanner, 2016)

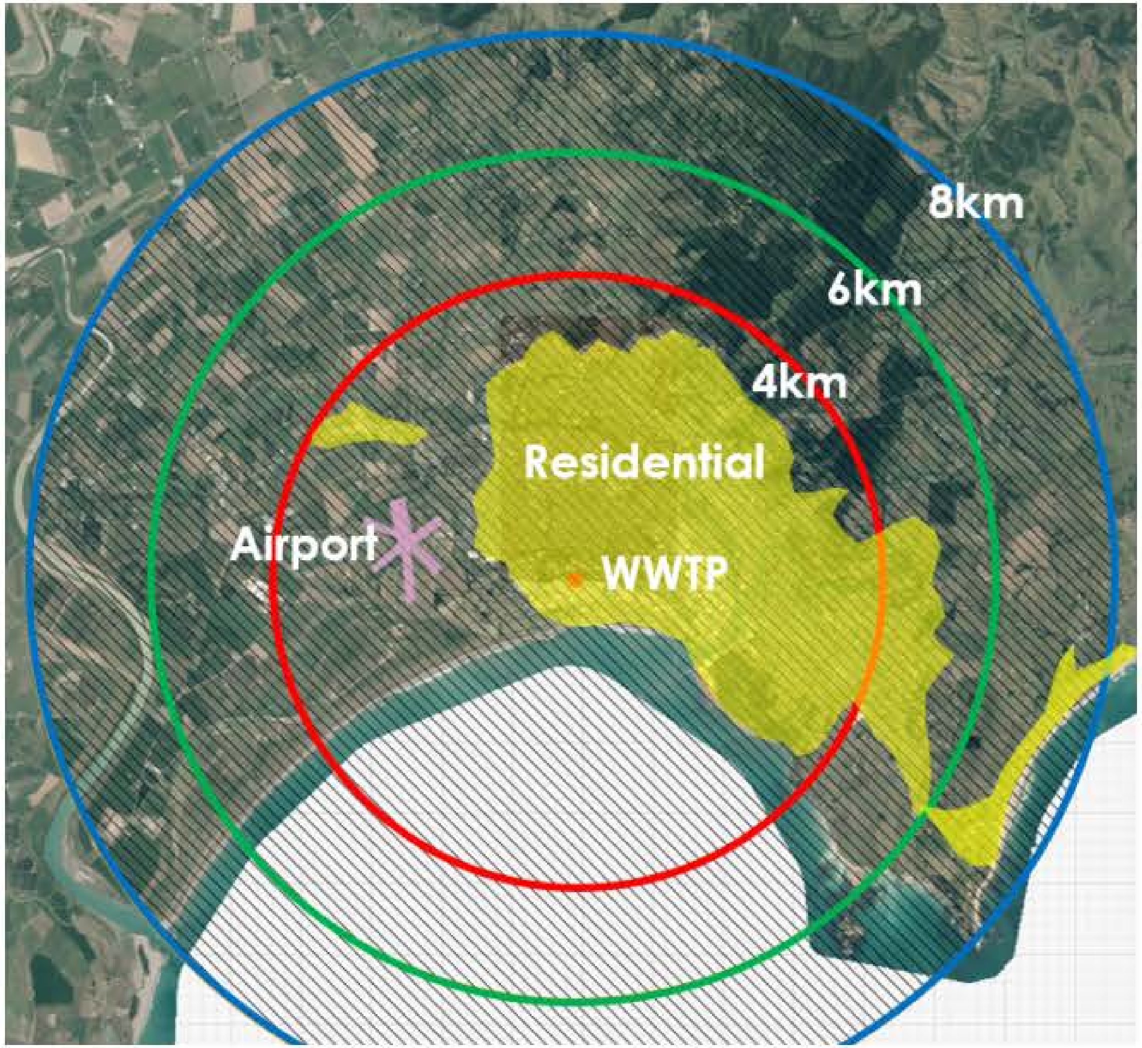
Parameter	TSS (mg/L)	cBOD5 (mg/L)	NH4-N (mg/L)	TN (mg/L)	TP (mg/L)	E.coli (cfu/100ml)
Raw influent to WWTP#	199	206	NM	NM	NM	NM
Post BTF (unsettled)#	71	27	NM	NM	NM	NM
Influent to HRAP Concentration (post settlement)	6.4	8.0	5.69	10.14	3.36	3.8E+0.4
Effluent Concentration	4.3	2.9	0.32	2.1	1.4	1.5E+1
Removal efficiency across EWPS	33%	64%	94%	80%	59%	3 log reduction
Removal efficiency across complete treatment system	97.7%	98.7%	NM	NM	NM	NM

NM Not Measured
\# Based on compliance monitoring data for period 23 February to 7 June 2017

EWPS Process FLow



Scale up - Location



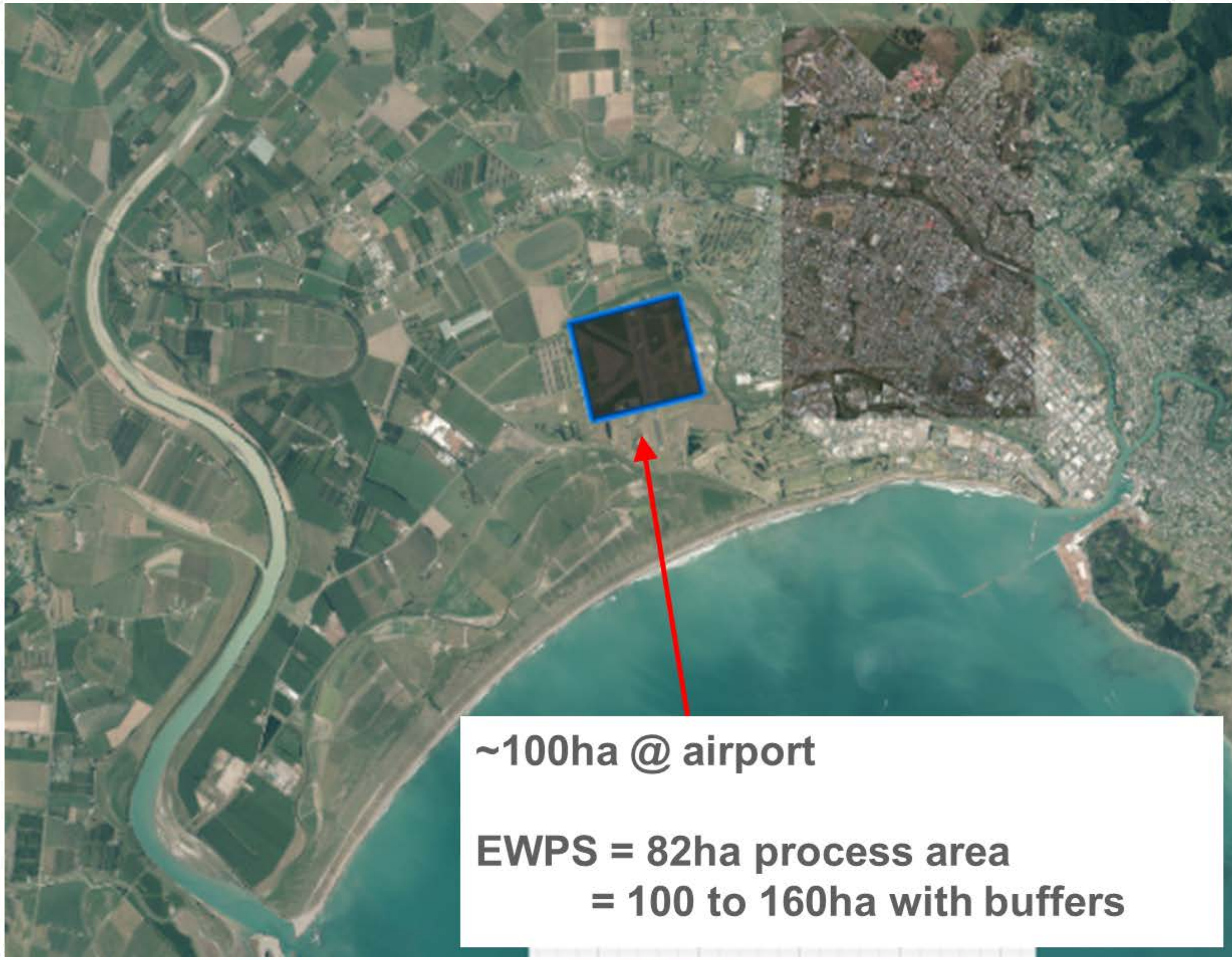


Figure 1: EWPS Hypothetical Site Study Area

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EWPS Scale-Up Design Factors

- Unknown site →distance, size, topography, neighbours
- Geotech factors →Soil type, stability, seismic risk
- Depth to groundwater → have to build up
- Lining requirements
- Prototype design for sludge and algal settlement with 1:1 bund batters
- Scalability of system
  - Access and maintenance
  - Treatment performance,
  - Nuisance affects
  - Constructability

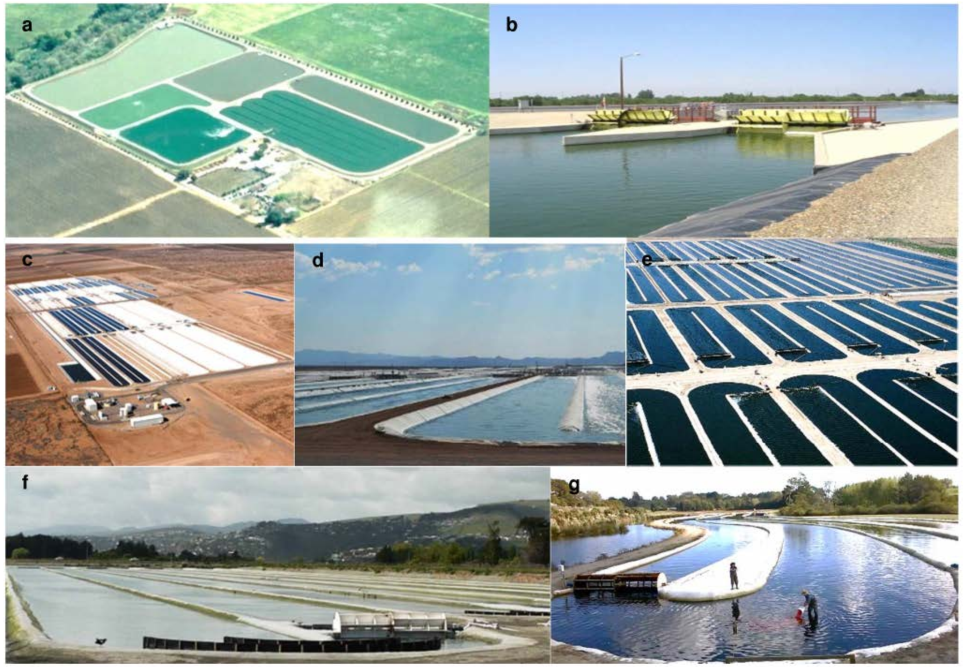

Figure 2-3: High Rate Algal Ponds in California (a & b), New Mexico (c, d & e) and New Zealand (f & g).

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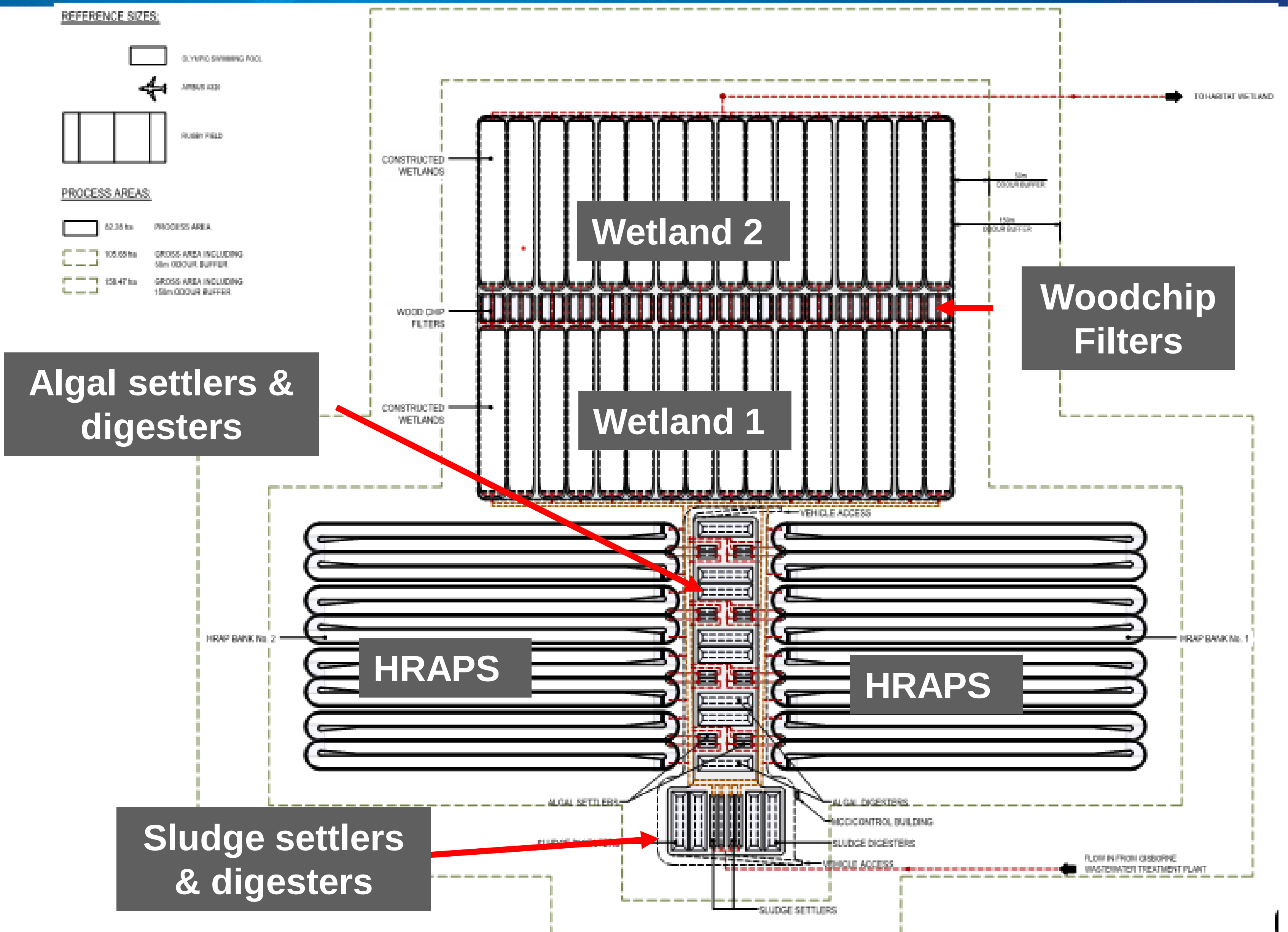
Option 1 - Alternative Treatment Layout

82ha of process plant area, not including buffers

Gross area required 100 - 160ha depending on buffers

Capital Cost:

$67.4M - $74.9M
(4 - 8km pipeline)



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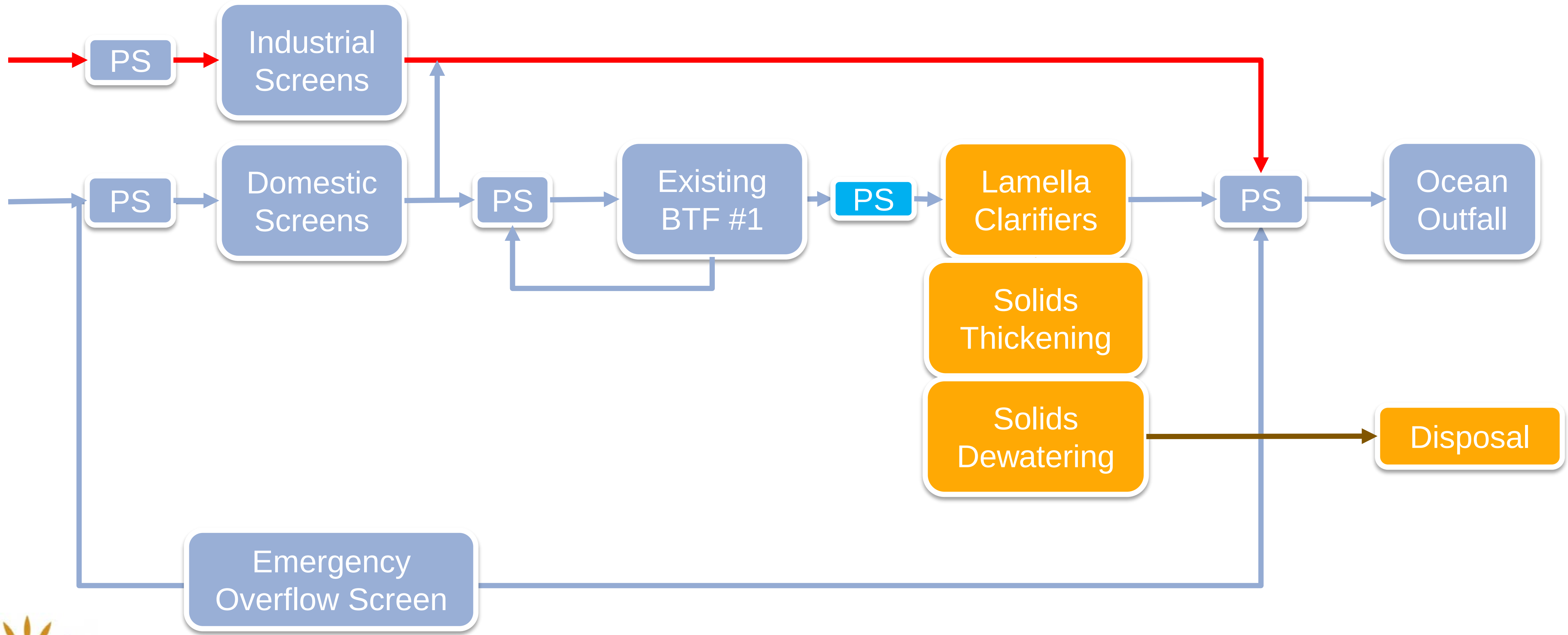
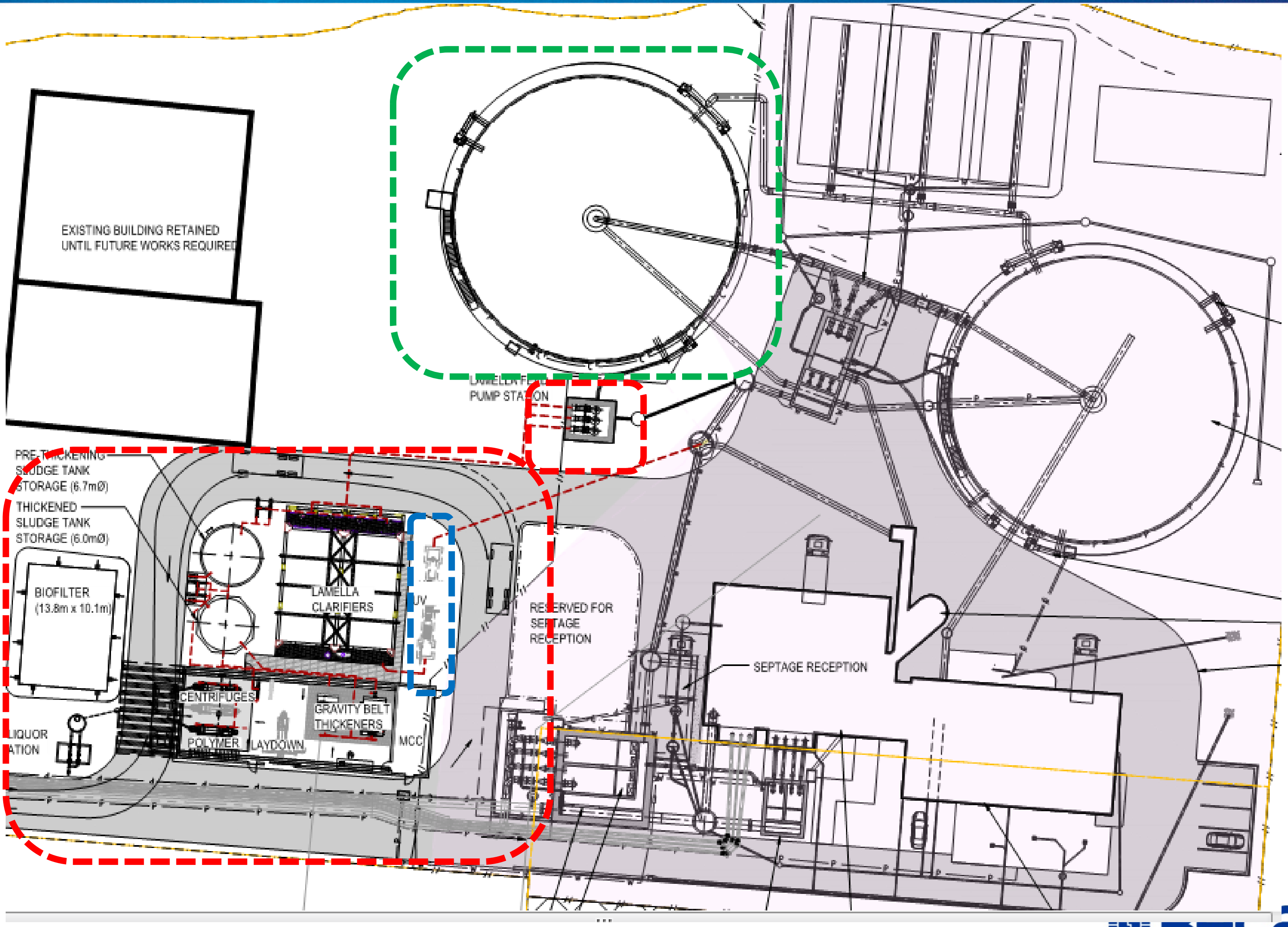
Option 2 – Solids Removal at Banks St



Conventional Treatment at Banks St

- Clarifier + Solids Handling ~$17.7M
- 2nd BTF ~ $10M
- UV ~ $0.8M

- Total Capital Cost: $28.5 M



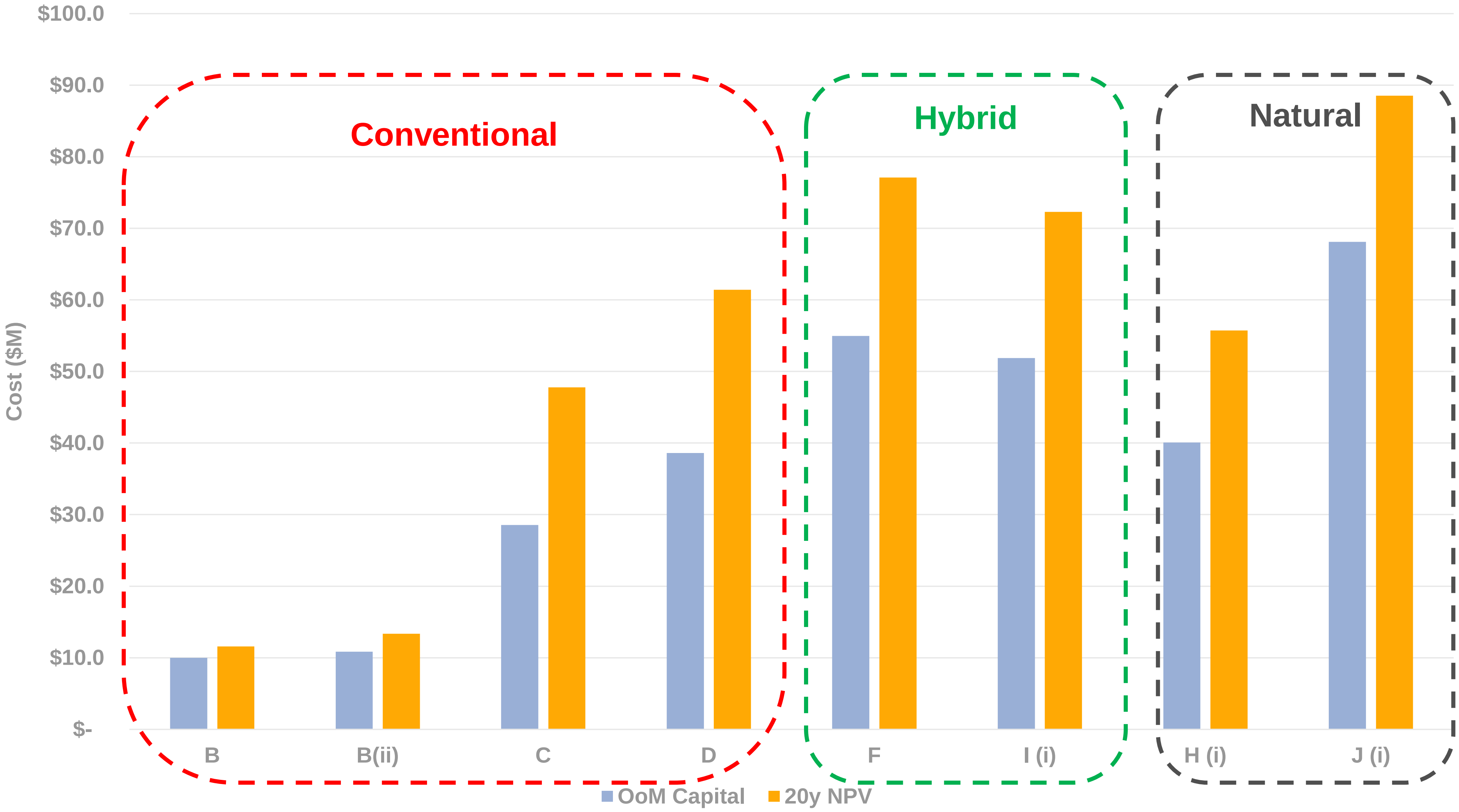
Value Engineering

- Work-shopped with WTAG October
- Significant cost reduction required significant changes to the original natural treatment concept
- Some objectives may not be fully met
- Treatment processes priced as “building blocks”
- Where do you get the most benefit/cost
- What are the cost reduction opportunities?
  - Reduce, downsize, eliminate
  - Conventional + Natural Hybrid schemes

Value Engineering Options

Option	General Overview	Type of Treatment	WOL ranges ($M)
Option A	(Option 2) Conventional solids removal, thickening and dewatering processes.	Conventional	$35
Option B	Second BTF for biotransformation and provide redundancy	Conventional	$12M
Option C & D	Second BTF + solids removal + disinfection, improving the “transformational”/cultural objectives of the Scheme, and limiting the process risk through the use of conventional treatment processes.	Conventional	$48 - 61
Options E, F & G:	Conventional solids removal and disinfection with elements of the EWPS to provide BOD and nutrient removal, with or without a second BTF. This allows for more fulfilment of the cultural objectives of the system through the use of additional natural treatment processes	Hybrid	$77 – $94
Options H, I, J & K:	Provide all further wastewater treatment at a remote site using either the full EWPS system (as described in Option 1) or significant elements of it combined with conventional UV disinfection. This provides the most fulfilment of the cultural objectives of the system.	Natural	$56 - 89

WOL Cost Comparison of Options



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Conclusion

- EWPS can achieve high level of effluent polishing but may be more suited to smaller communities.
- Multiple units in series and parallel increase complexity of distribution. For natural processes to be cost effective, require simple configurations
- Conveyance to and from remote sites can form a disproportionate part of the overall scheme cost
- Options need to be aligned to the possible receiving environments and Community objectives to maximise the benefit for the cost (capital and whole of life)
- Identify end use markets for both effluent and solids and design treatment to suit.