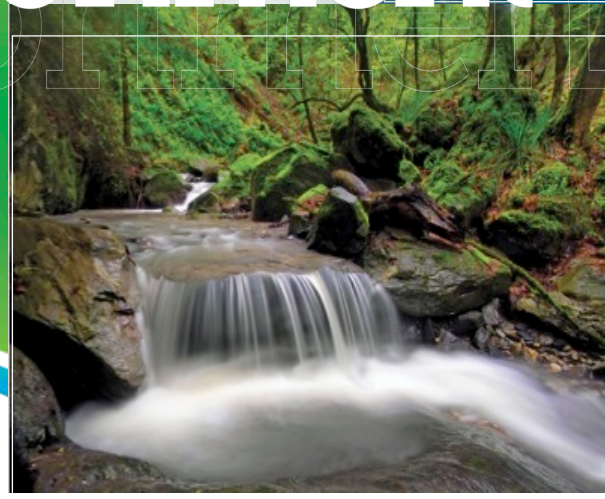




A New Take on the

Environment



**Kishon River Remediation,
Haifa, Israel**

Philippe Gingras, Englobe Corp.
RemTech, October 17, 2014

Large-Scale Remediation in a Complex Environment: Some Key Points

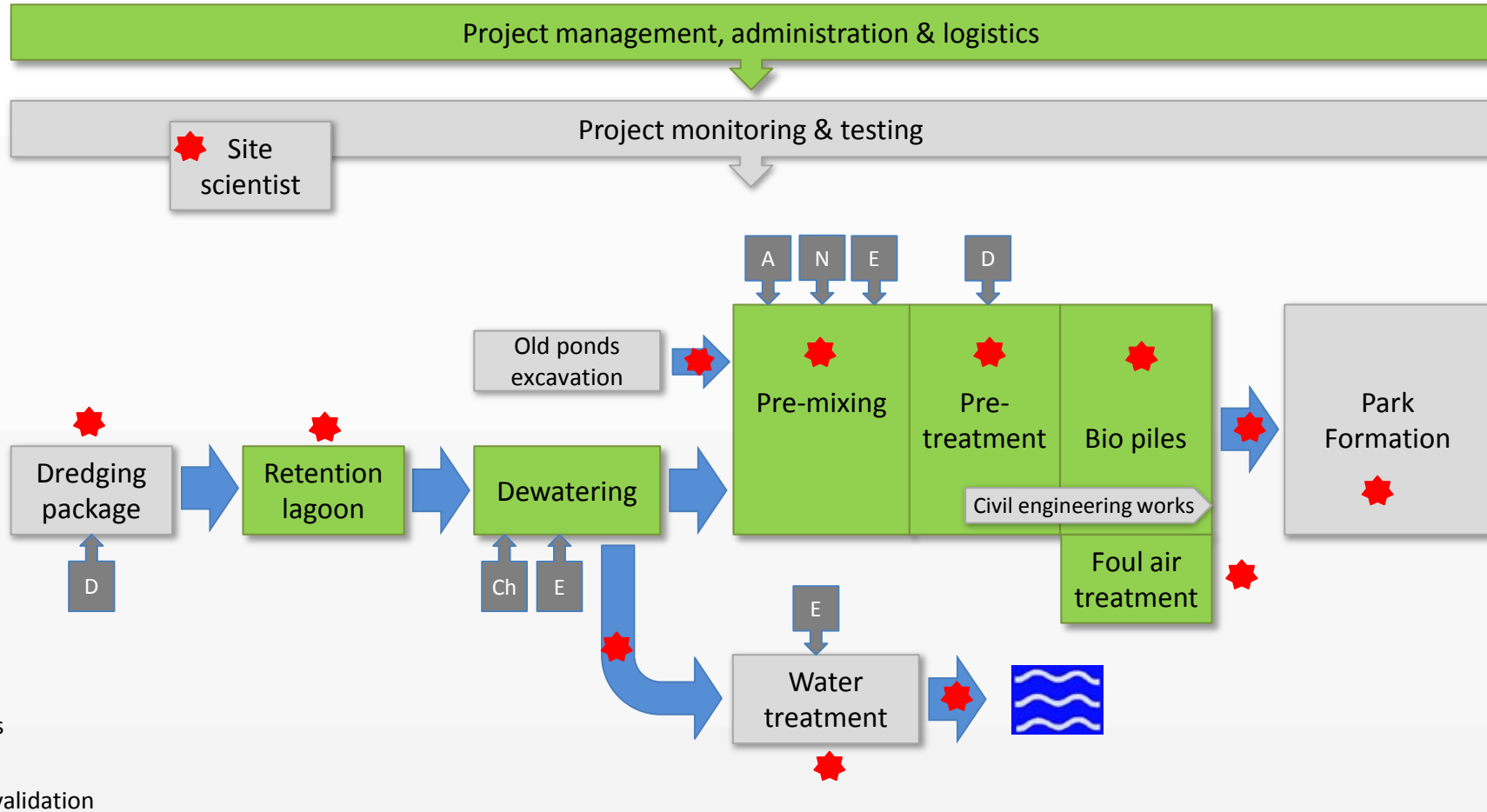
- 6.5 km of river dredging
- Coordinate sediment slurry dewatering & water-treatment
- Biological treatment of impacted sediments
- Formation of a parkland







General Project Process Diagram



Over 70,000
 m^3 of
Earthworks
including the
Lagoons



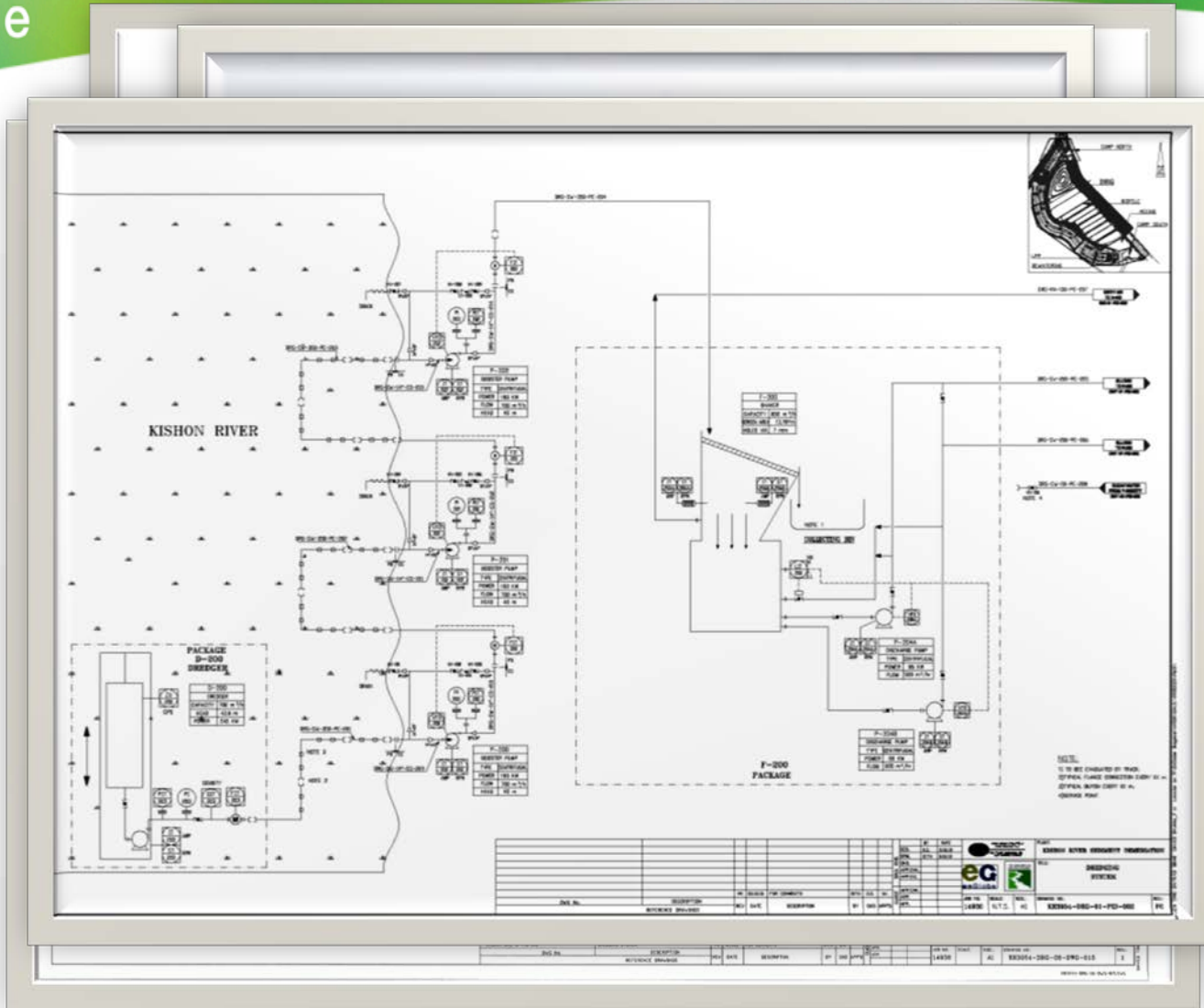
Density
Tests every
200 mm
layer plus
2 layers of
Geogrid

42,000 m^2
of HDPE to
complete
'waterproof
ing' of the
site

Over 3.5 km
of Roads
Constructed
with
Geotextile
protection

IMS 7012
Dredge,
900 m³/hr
at 40 m
head

9,000 m³
Slurry per
day, 1,350
m³ dry
solids



4 No. 900
m³/hr
Flowserve
Booster
Pumps with
12" floating
pipes

In-let
screen
with 2 No.
450 m³
discharge
pumps

6,000 m³
Retention
Lagoon with 4
Mixers &
2 Slurry Pumps

250 m³
Settlement
Tank and
associated
Flocculent /
Coagulant
dosing tanks

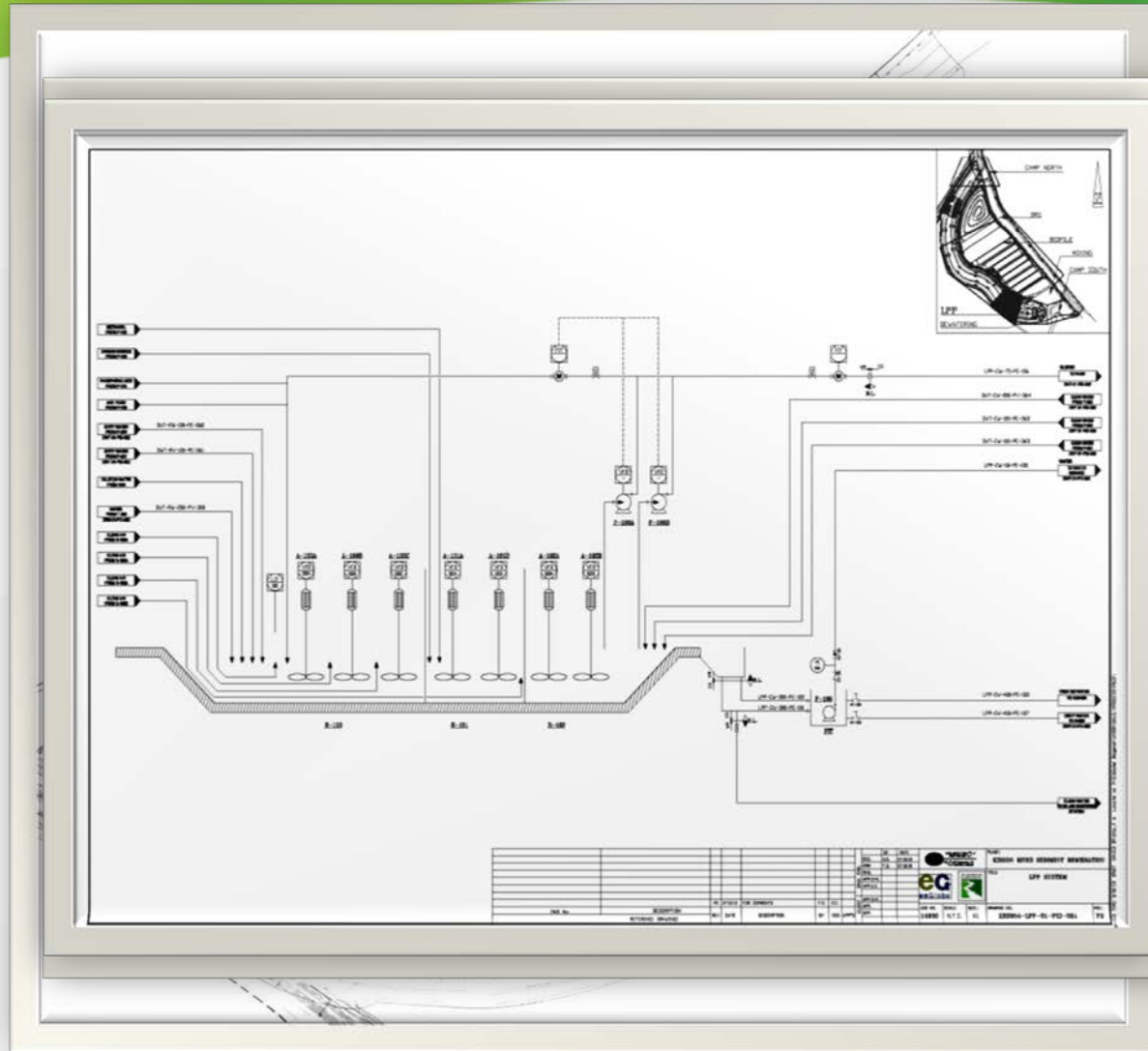


4 No.
Dewatering
Centrifuges

Conveyors
for
Dewatered
Sediments

11,000 m³
LPP Lagoon
with 4 Mixers

Aerobic
nitrification
Zone
(Ammonia to
Nitrates)
followed by
anaerobic
de-
nitrification
(nitrates to
Nitrogen)

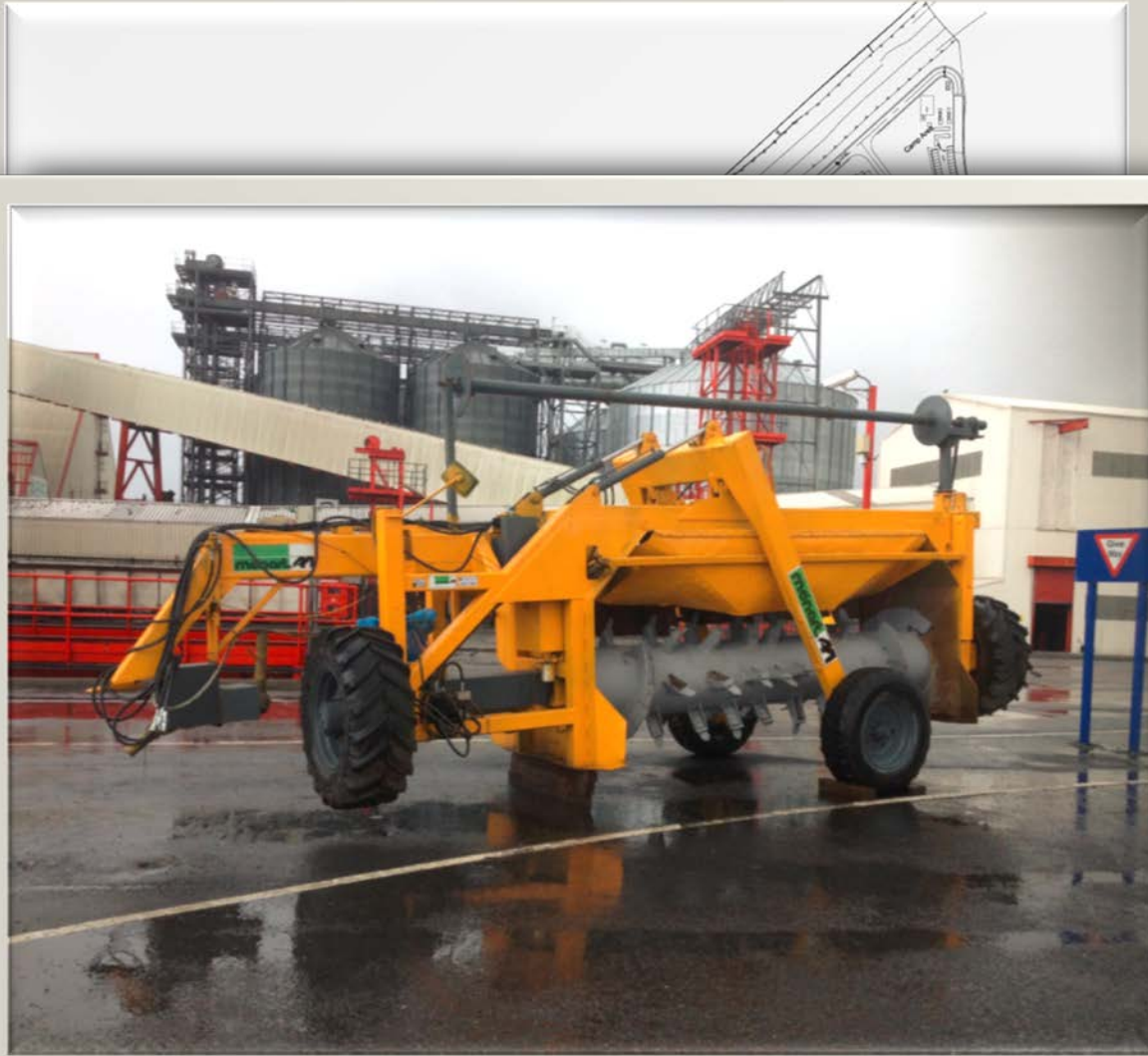


Biomass and phosphoric acid addition in the aerobic zone. Carbon source addition in the anoxic zone. Constant in-

line
Monitoring
for TN
(20mg/l),
Ammonical
N (5 mg/l),
TSS (100
mg/l), pH (6-
8

Mixing Plant
with 3
hoppers, mixer
and conveyor

Capacity of
100 m³/hr
sediments
and 130
m³/hr total
including
organic and
inorganic
admixtures



Biopiles with
air extraction
utilising
EnGlobe's
P95 system
and foul air
treatment

Additional
bioremediation
option with
windrow
method

4,000 m of
Pipework
installed

2,500 m of
electrical
cabling

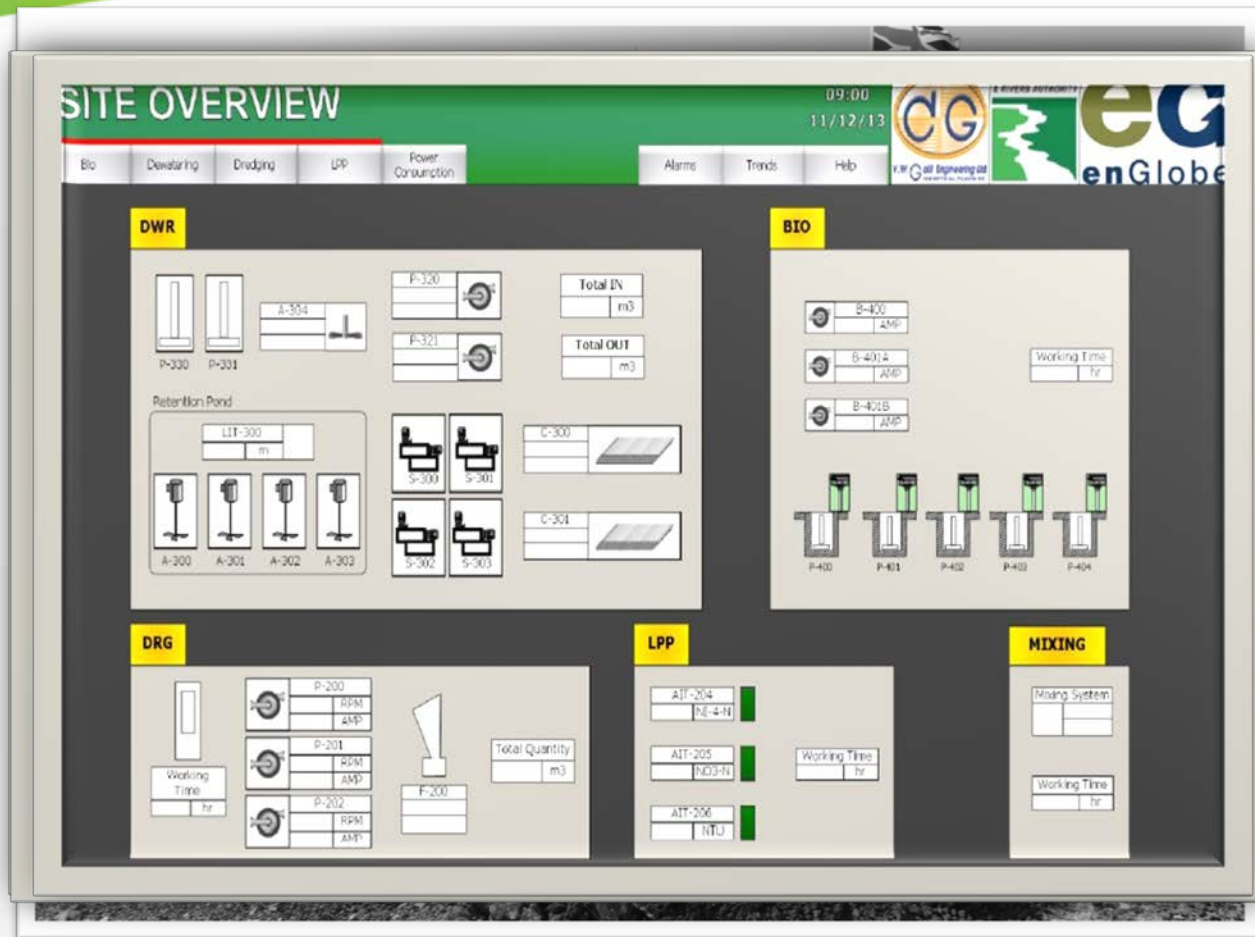


Over 500 m³ of
concrete
poured

500 m of
control
cabling

Operations controlled from Management Offices

And from Engineers Offices in the South Camp



With control information routed via the Main Control Centre

And displayed by HMI software



Dredging

- IMS 7012 dredger on site and in the water
- Licensed
- Connected to pipework and Operational Qualification OQ passed





Dredged Sediment Slurry pumped into a
8,000 m³ retention pond:
To maintain a sediment suspension & 24-hour LPP



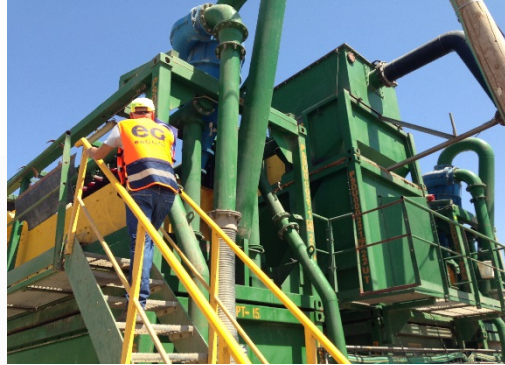
Initial Slurry Pumping Rates:

- 400 m³ of slurry/hour
- Gradually optimizing
- High sediment variability encountered

Inlet Filters:

1. Screen oversize to < 6mm
2. Hydrocyclone de-sanders removing particles to 0.5 mm





Dewatering performance

- Yields $>500 \text{ m}^3$ cake/day



Dewatering includes 4 large centrifuges

- Continuous optimization of polymers and flocculants
- Extension of operating times to increase production

The centrate water is sent to a treatment lagoon where the water is subjected to a 2-stage biological treatment to remove nitrogen:

- Ammonium – Nitrate (aerobic)
- Nitrate – Nitrogen gas (anaerobic)



To date achieving:

- 0.9 mg/l Ammoniacal N (*<5 mg/l*)
- 9 mg/l total N (*<20 mg/l*)
- 60mg/L TSS (*100 av; 200 max*)

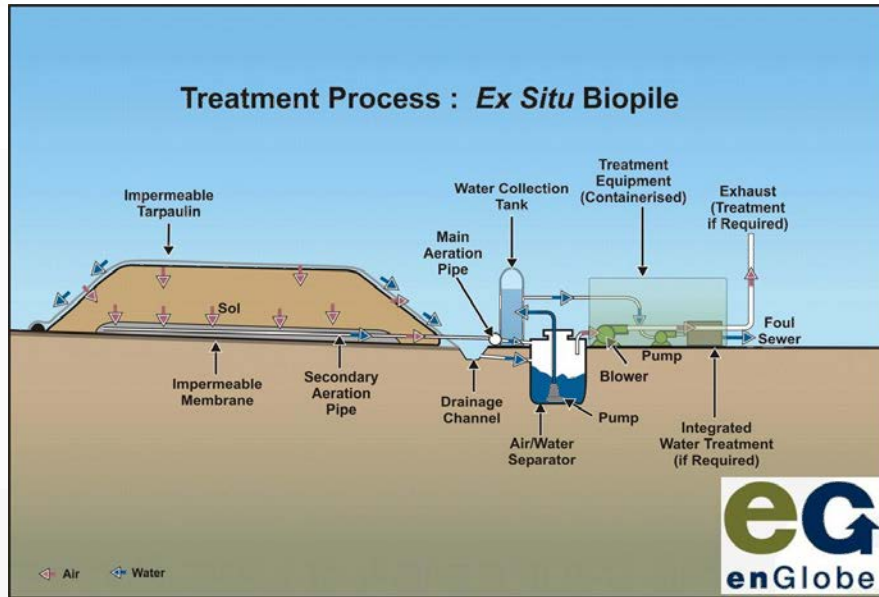


Dewatered Cake Before Mixing



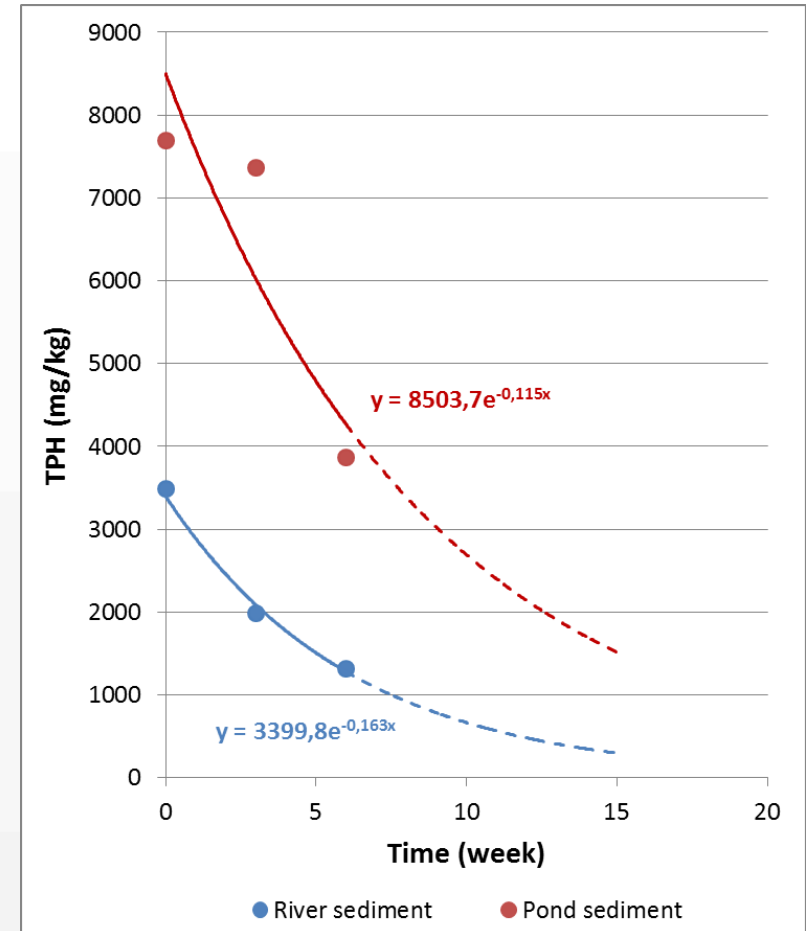
Additive Mixing Plant Mix sediments with organic and inorganic additives





Contamination profile:

- Average impacts: 6,000 mg/kg
- Generally C₁₆-C₂₄ range
- Criteria: 1,560 mg/kg (C₈-C₃₂)



- Windrow initial treatment





Air Monitoring

- Dust
- VOCs
- Noise
- Odour

Water Monitoring

- Solids content (SS) & Turbidity in vicinity of dredging
- Control monitoring of LPP
- Monitoring of water discharge (TSS, N, metals, etc)

Process Control & Validation Monitoring

- Solids sampling and analysis
- Includes TPH, VOCs, SVOCs, PAHS, metals, etc



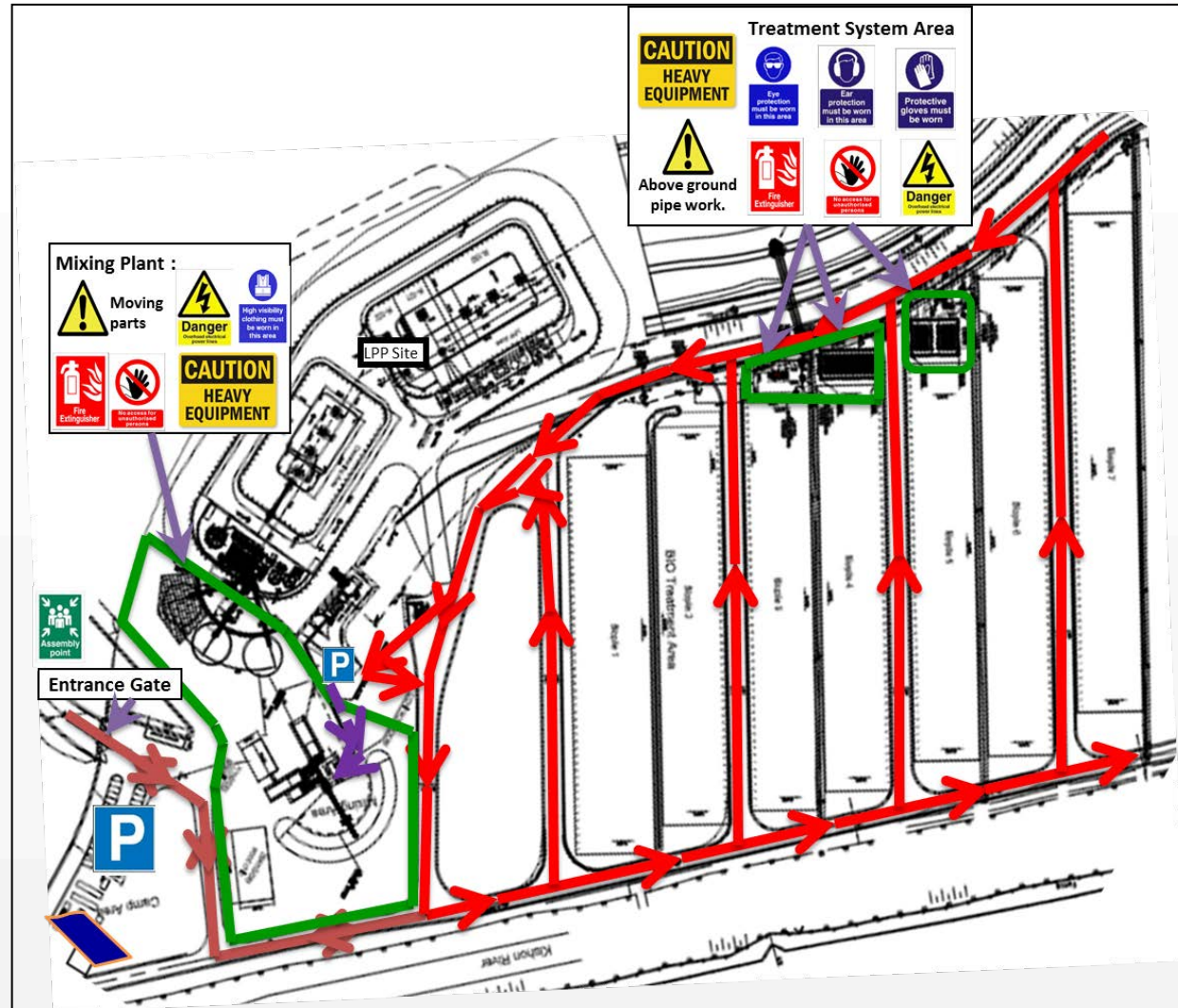
EnGlobe Remediation team

- 7 expats from Canada, UK and Netherlands
- 15 local employees
 - Dredging
 - Dewatering
 - Bioremediation
 - Lab operation
 - Landscaped hills



Key Risks:

- High volume of site traffic throughout the site.
- Heavy plant at dynamic locations.
- High numbers of staff site wide.
- Prevention of unauthorised access.



Englobe has a dedicated monitoring team,
together with fully equipped and staffed onsite laboratory.

Team Interaction

Monitoring Team

Both teams work together to:
3 Experienced and
Sample team members.
Monitor,
Aspects of the system
Brandy Alig deployed in
Sample, Englobe in
Israel by Englobe.
The team is lead by an
Analyse,
The team is led by a
Monitoring Manager
Report.
With over 7 years of
experience within
Englobe,
Feasible current data to
enable real time
responses in a dynamic
environment.



The primary health risks to receptors both on and off site are:

- **TPH (Total Petroleum Hydrocarbons)** – The principal contaminant in the material to be dredged and bioremediated.
- **Metals** – Present in varying quantities throughout the project.



- **Site 'Set-Up' & associated permits was fully completed in May 2014**
- **Dredging started in June 2014, starting at the remediation site**
- **From initial dredging – gradual (careful) increasing of production rates**
- **Treatment results to date are very limited but positive**