Abydoz Environmental Inc.

Engineering Class – Term 7
Presentation

- Technology
  - Kickuth Engineered Wetlands
  - World Leading Specialists
    - Patented Wastewater Treatment
- Review of Company Progress
  - 1999 to current 2008
- Advantages of System

Our Company - ABYDOZ

- Wastewater Treatment Company Specializing in Engineered Wetlands
- Kickuth BioReactor™ Wastewater Treatment
  - Branch of the German Kickuth Organization
  - License Area - Canada & Caribbean
- Office in Portugal Cove, Newfoundland
- Nursery in Argentia and Windsor, Ontario

Kickuth Technology

- World Leading Technology
  - Worlds First Domestic Secondary Treatment System 1974 - 5,000 PE
  - Worlds Largest Wetland Projects
  - World Leading Firsts in Applications
- Examples of World Projects

Municipal Sewage - Marutendorf

Weller Switzerland – Domestic System

Glycol

Schonefeld Airport, Berlin


Schonefeld Airport
Glycol System

Landfill Leachate

Hamburg, Germany

Industrial use of this Technology

Sample Companies

- **Sudapet, Petronas - Hydrocarbons**
- **Shell / PDO - Oil field produced water**
- **British Steel - Coking Oven Effluent**
- **British Aerospace - Explosives**
- **Huntsman Corp. - Chemicals**
- **Berlin Airport - Glycol**
- **Mercedes Benz - Stormwater**
- **Cerestar Corp. - Cellulose**

Site Of Former Oil Refinery-
Pumpherston Scotland

Remediation of hydrocarbon, PAH, surfactant contaminated groundwater.

BP Environment Award winner.

First Phase Constructed.

Second Phase also installed. Discharge to Class I Salmon river.

Natural or Engineered?

Winner of BP Chairman's Environmental Award

Oil Extraction Process Water

Heglig project, Sudan

Fully Matured - Heglig Sudan

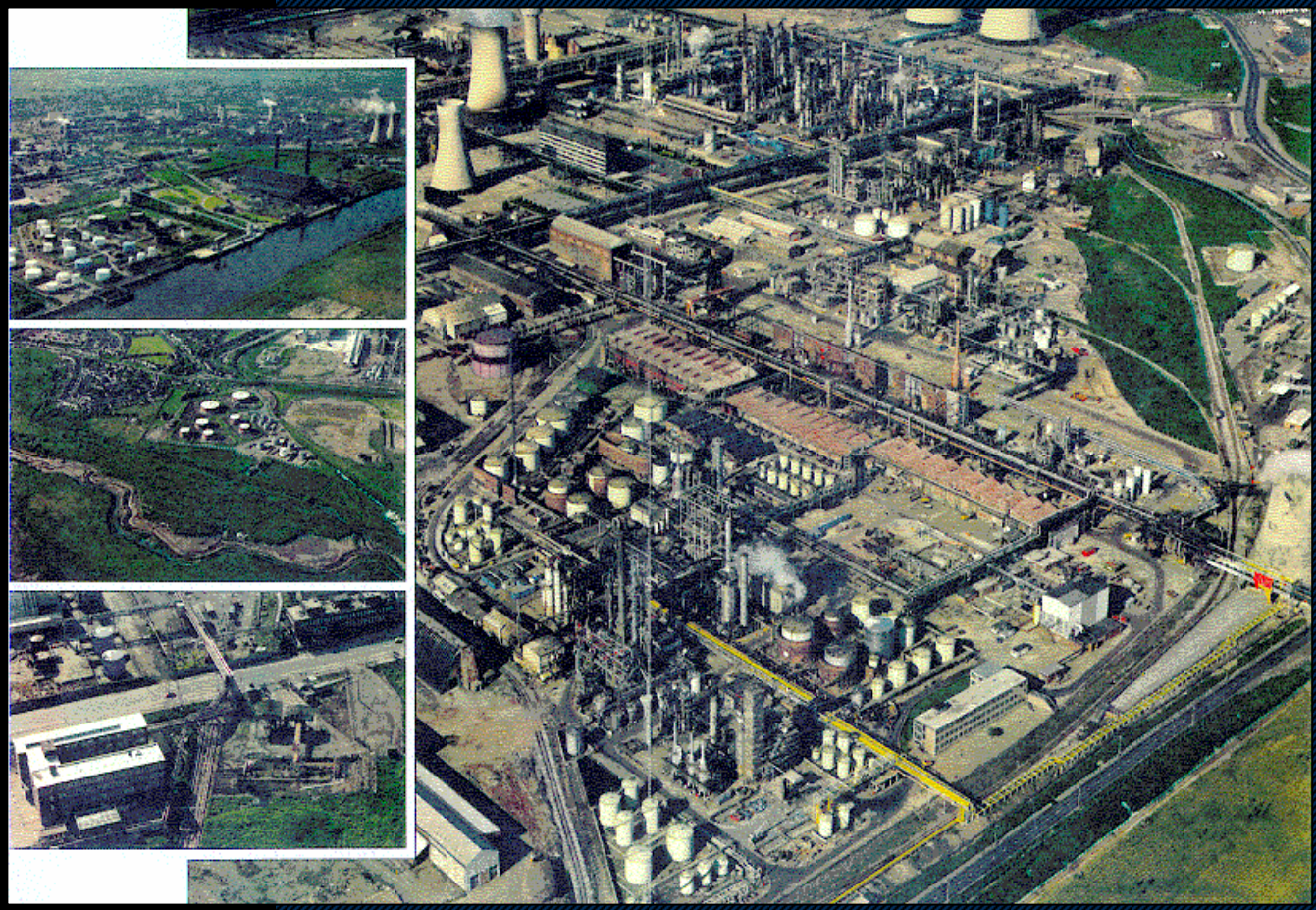
The reed beds are currently operating on 40,000 tonnes per day of water.
With expansion planned for 300,000 tonnes or 77 million gallons per day.

Hydrocarbon Treatment

Oman project

Billingham Industrial Complex

ICI Amines Manufacturing



250 different chemical process streams.

Size: 70,000 m2

All effluent successfully treated since reed beds operational from 1989 to closure of plant.
Operational Capacity

3000 m^3 per day, or 660,000 gal per day.

System now operated as a liquid landfill – leachate from landfills and commercial liquid wastes.

Amines are organic derivatives of ammonia

ICI - Billingham, UK

Steel Mill Effluent

Whylla, Australia

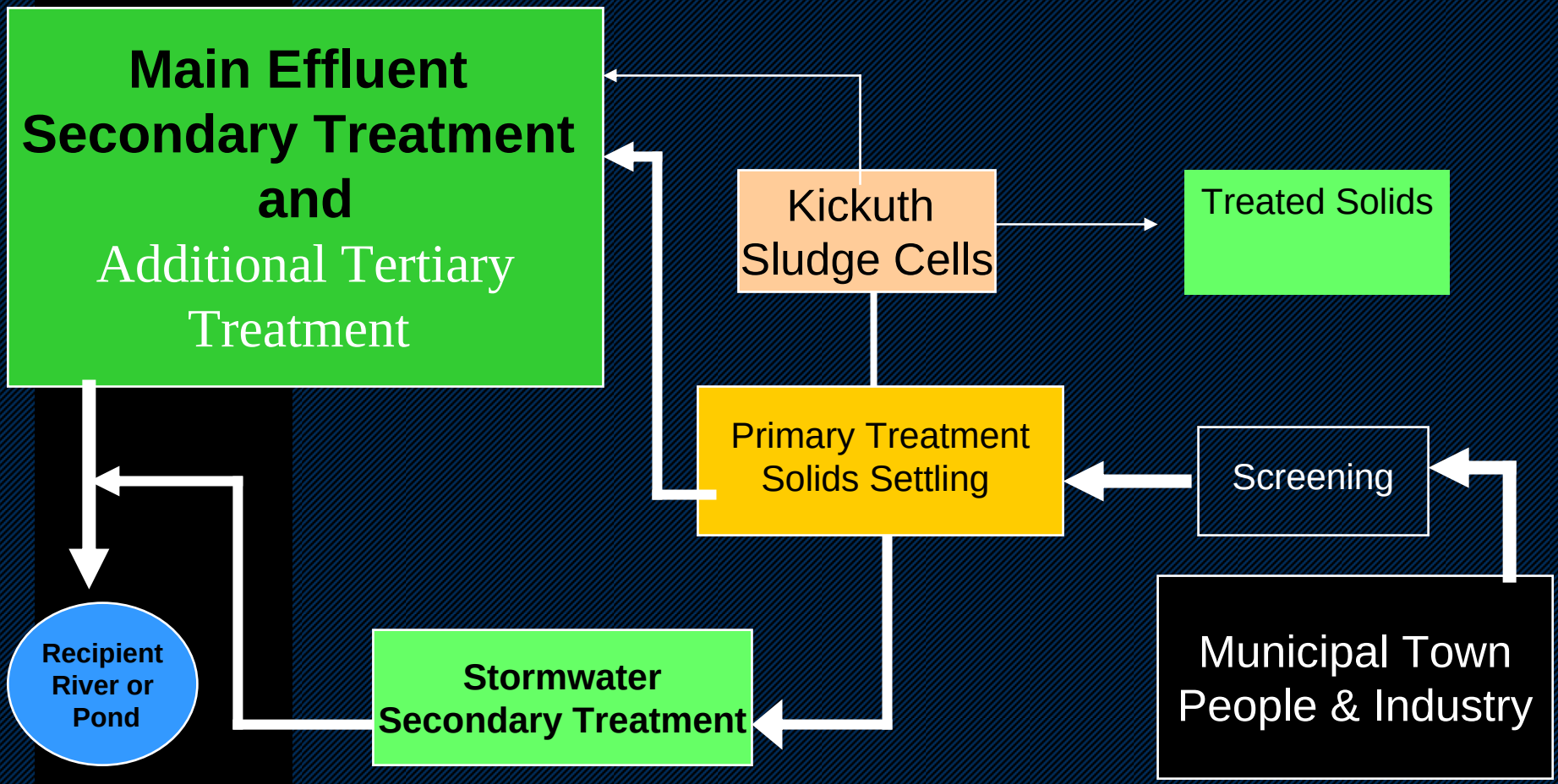
Engineered Wetland Technology

How it works

- **Specialized Plants are catalysis to the system**
  - **Oxygen is transferred to their root mass**
  - **Oxygen allows Aerobic bacteria to thrive**
  - **Biological reduction occurs naturally**
- **Matrix material is blended to provide components for chemical reduction**
  - **Chemical and biological reduction work in combination to reduce contaminants**

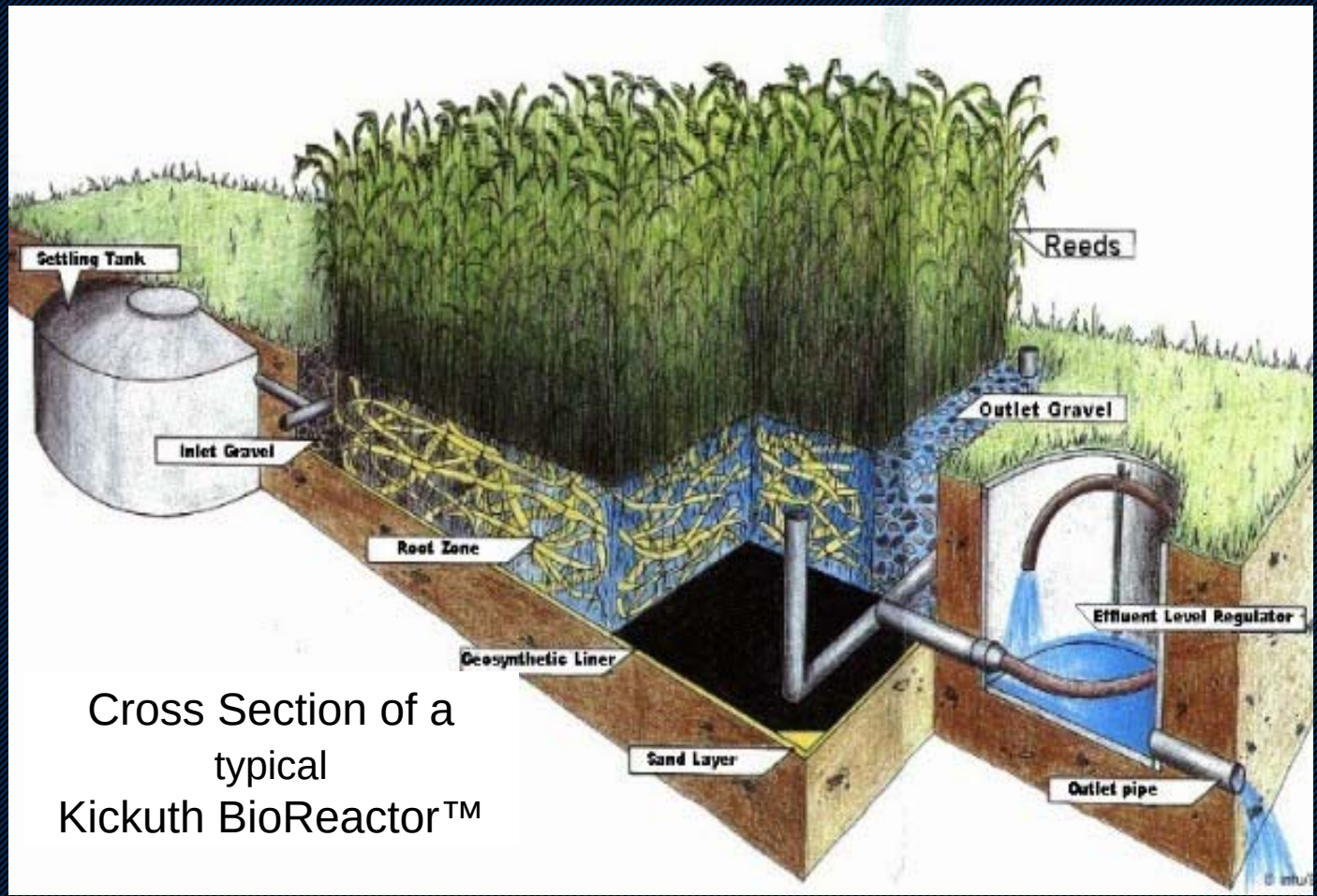
Full Treatment - Effluent and Solids

Higher treatment levels with flow protection



Kickuth BioReactor™ System

An Engineered Wetland



Cross Section of a
typical
Kickuth BioReactor™

How does the Kickuth Wetland System Work for Nitrogen ?

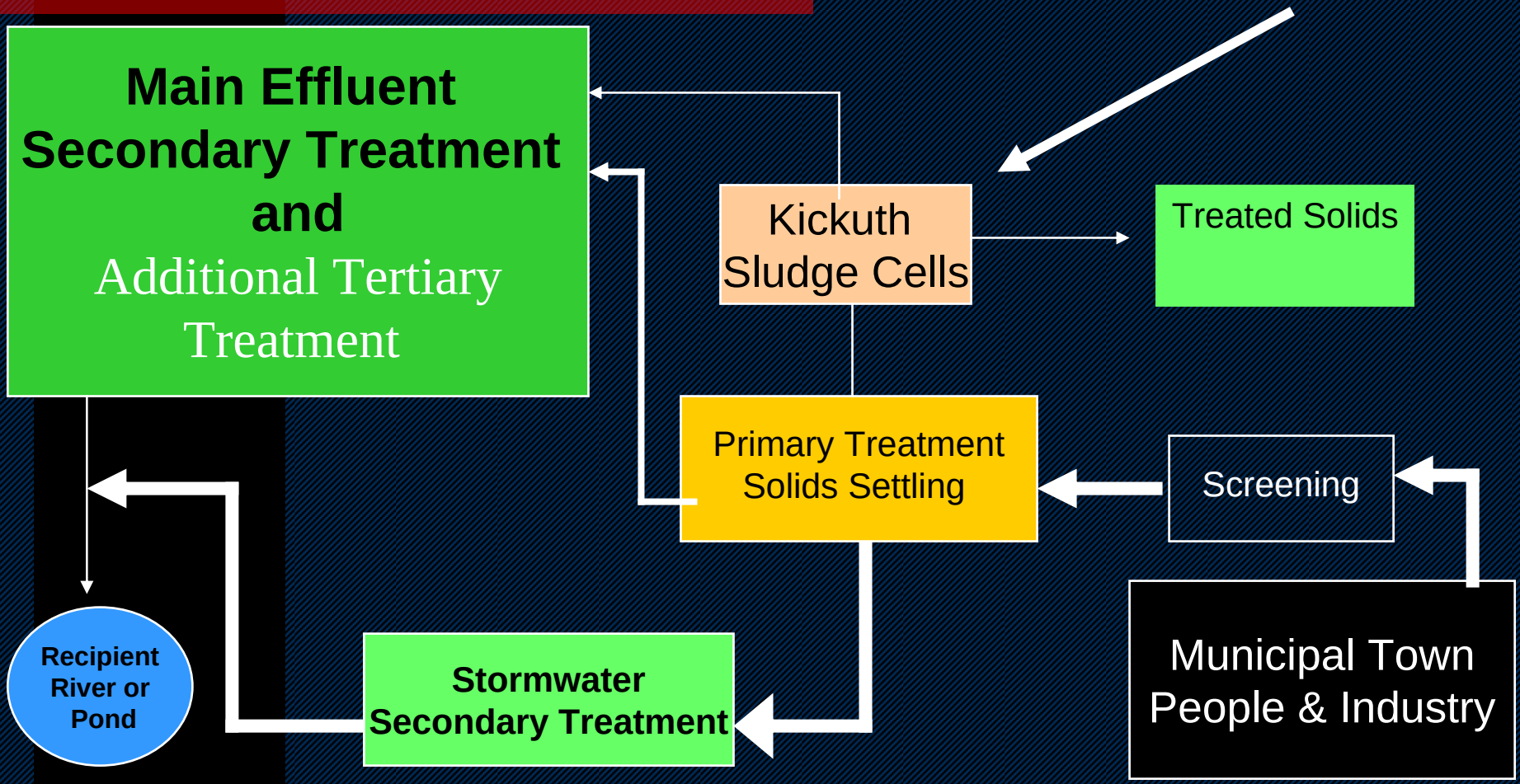
- **Nitrification and De-nitrification**
  - **Nitrification occurs in the presence of oxygen when nitrifying bacteria metabolize ammonia (NH_3). The nitrifying bacteria convert the ammonia to nitrates (NO_3).**
  - **De-nitrification occurs in the absence of oxygen when nitrates (NO_3) is used as an oxygen source creating (NO_2) then this is converted into nitrogen gas (N_2).**

This occurs in man made sequential batch reactors which creates a region rich in oxygen followed by a region starved of oxygen. The wetland system has thousands of these areas and the waste water moves through them continuously producing good nitrogen reduction.


Matrix Cross Section - Sub
Surface-rhizome of plants

Full Treatment - Effluent and Solids

Higher treatment levels with flow protection



Municipal Sludge - Solid Treatment

Newfoundland Start

- **Transfer Technology from Germany**
  - **R & D work with the NRC from 1999 – 2004**
  - **Testing for 2 years**
- **Dept. of Environment**
  - **Small single family systems - pilot beds**
- **Dept of Municipal Affairs**
  - **Marystown Municipal Pilot -35 homes**

Single Family Home System - 1999

Marystown Domestic System - 2002

35 home- 55m3/day

Marystown Domestic System

Marystown Data

(average over 2 years of testing – end of pipe)

- **Reduction of contaminants as %**
- **BOD – 85 % Effluent Avg. = 7 mg/l**
- **TSS - 76 %**
- **Ammonia - 65 %**
- **Phosphorous - 90%**
- **Fecal Coliform - 99.5%**
- **Total Coliform - 99.6%**

Newfoundland Activity

- **Small projects in NL**
  - **IOCC Mine Office Sewage**
  - **Circle Square Ranch**
  - **Coast of Bays Interpretation Centre**
  - **Decentralized systems - Holyrood**

Full Scale Newfoundland Currently Completed Projects

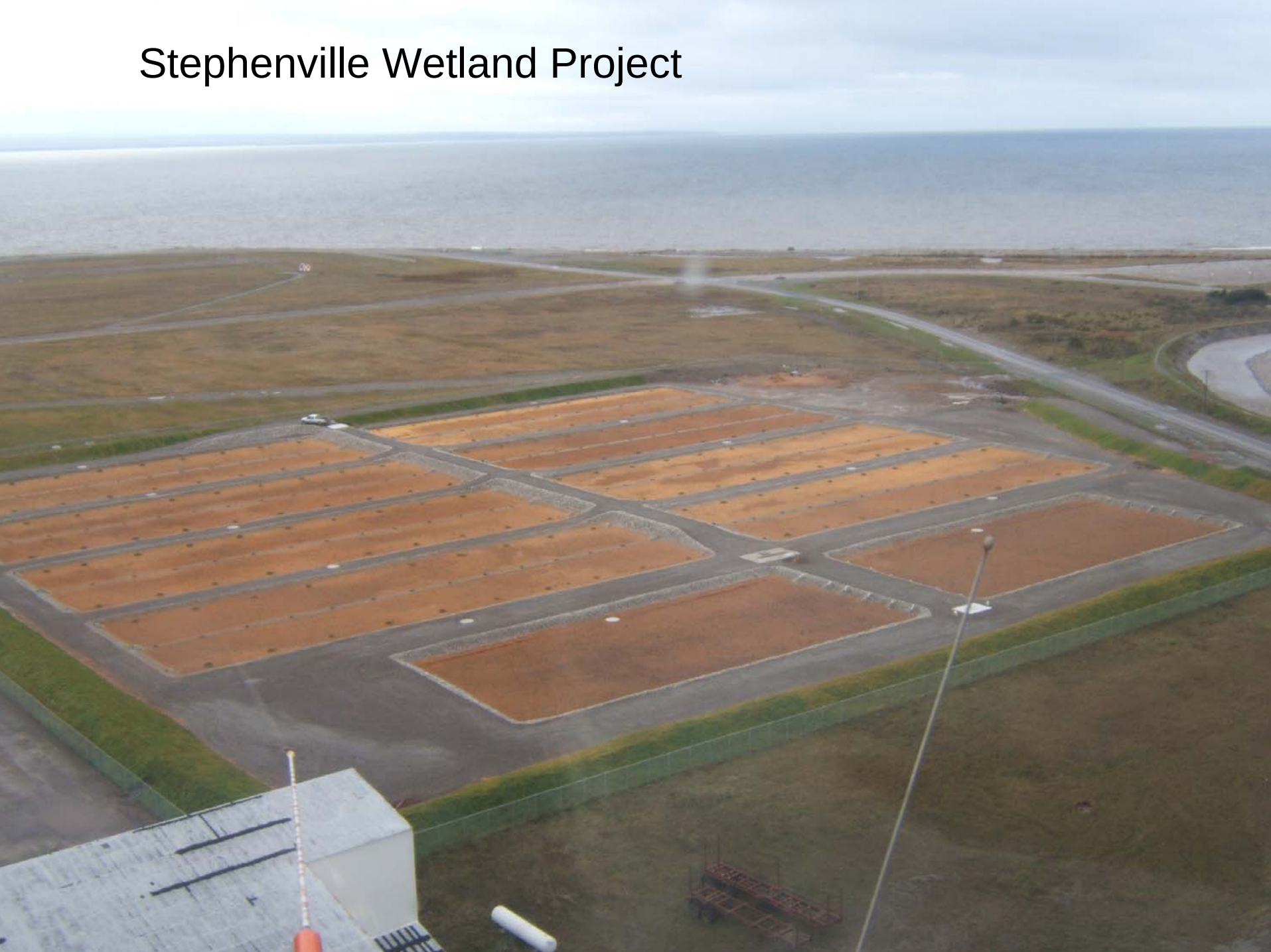
- **Stephenville Town Project - 2005**
  - **8000 PE, system 19,000 m2**
- **Appleton /Glenwood Town project -2006**
  - **1800 PE, system 10,000 m2**
- **Stephenville Sludge Beds - 2007**
  - **Composting of domestic sludge from primary clarifiers**

Stephenville System

Stephenville Project 2005

- **Construction Started In May 2005**
- **Wetlands completed in August 2005**
- **Approx 19,000 m^2 of Engineered wetlands**
- **8 Horizontal beds & 2 vertical beds**
  - **Town population 7280 PE.**
  - **Flow 107 l/sec , or 9244 m^3 /day = 2.44 million gal /day**
- **Head-works built in 2006 – 2007**
- **Commissioning planned for May 2008**

Stephenville Wetland Project



Appleton- Glenwood System

Appleton/ Glenwood Project 2006

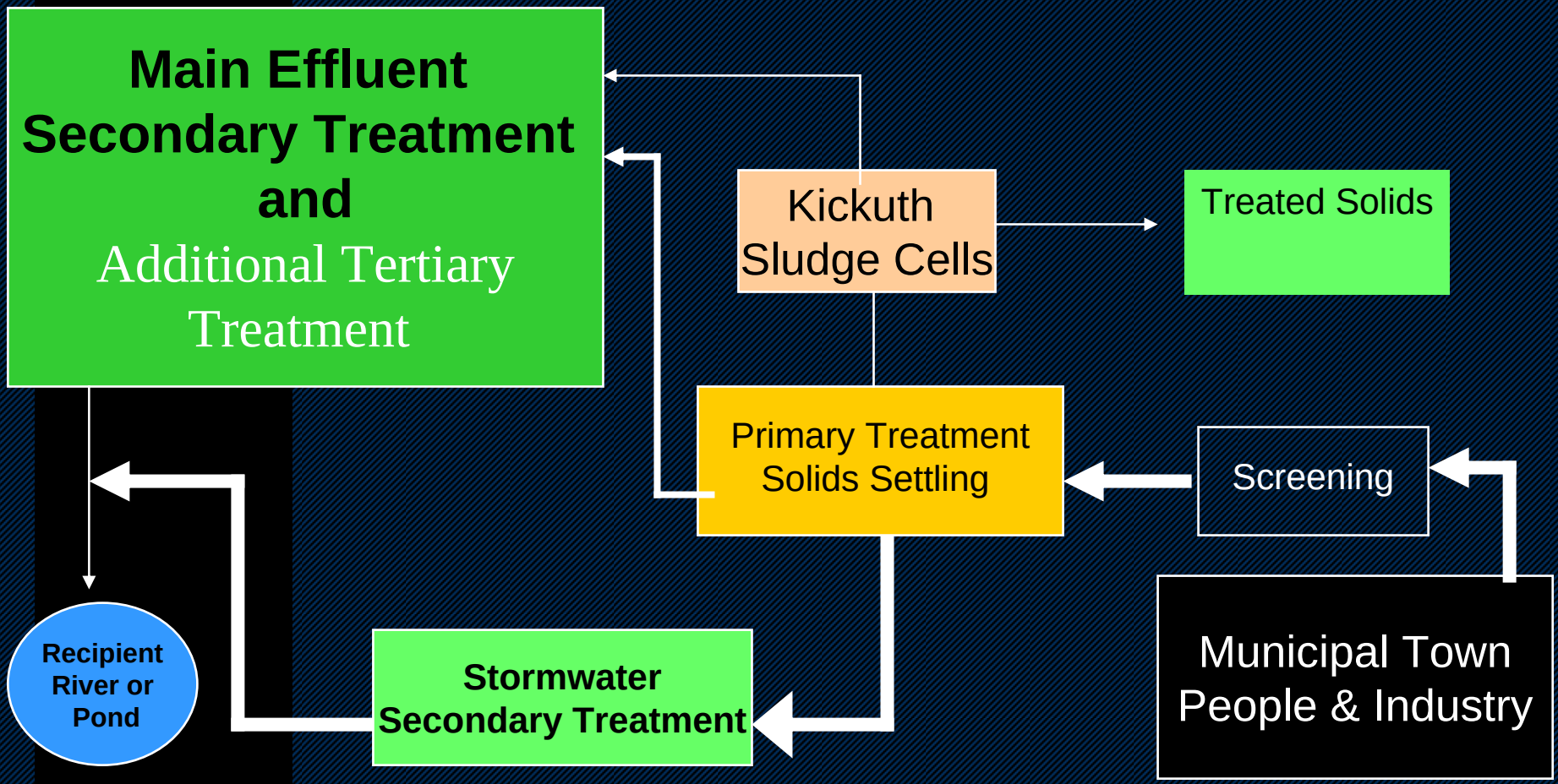
- **Construction Started In May 2006 - completed November 2006**

- **Approx 10,000 m^2 of Engineered wetlands**
- **4 Horizontal beds, 1 vertical bed & 1 Stormwater Treatment Bed**
  - **Town population 1800 PE.**
  - **Flow 53 l/sec , or 4555 m^3 /day = 1.0 million gallons /day**

- **Started running Dec 2006**
- **Commissioned January – June 2007**
- **1- year operation**

Full Treatment - Effluent and Solids

Higher treatment levels with flow protection



Appleton /Glenwood Data

(average over 1st year operation- out of system prior to discharge to mixing in Gander River-end of pipe values)

- **Reduction of contaminants %**
- **BOD - 90.15 % Treatment from 106 to 7.2 mg/l**
- **TSS - 96.74 % 1622 to 5.9 mg/l**
- **Limits BOD 20mg/l & TSS 30 mg/l**

- **Ammonia - 65.84 %**
- **Phosphorous - 79.23 %**
- **Fecal Coliform - 97.85 %**
- **Total Coliform - 96.48 %**

Sludge Cells

Sludge Cells for Secondary Sludge

Sludge Cells for Secondary Sludge

Sludge Cells Just Planted

Sludge cells after established

Sludge Cells - Weller Switzerland

Stephenville Sludge Cells- 2007

- **Construction Completed Fall 2007**

- **Approx 2,250 m^2 of Sludge cells**
- **Wetland 200 m^2 Horizontal bed**
  - **Town population 7280 PE.**
  - **Sludge volume 0.9 l/day/PE = 6.5 m^3 /day or 2373 m^3/year**

- **Commissioning planned for May 2008**

Stephenville Sludge beds

Stephenville Sludge Cells

Abydoz Wetland Pilot Study St. John's Landfill – Pilot Bed 150 m2

Bench Scale Landfill project

What has been achieved?

Bench Scale Reductions of IRON

	Original Sample mg/l	PH 8.0 Time Settled 0 -hrs	% removal	PH 8.0 Time Settled 24 -hrs	% removal	PH 8.0 Time Settled 48 -hrs	% removal
Total Iron	39	12	69%	0.9	98%	0.3	99%
Ferric Iron	9.8	10	-2%	ND	100%	ND	100%
Ferrous Iron	29	2.2	92%	0.8	97%	0.5	98%

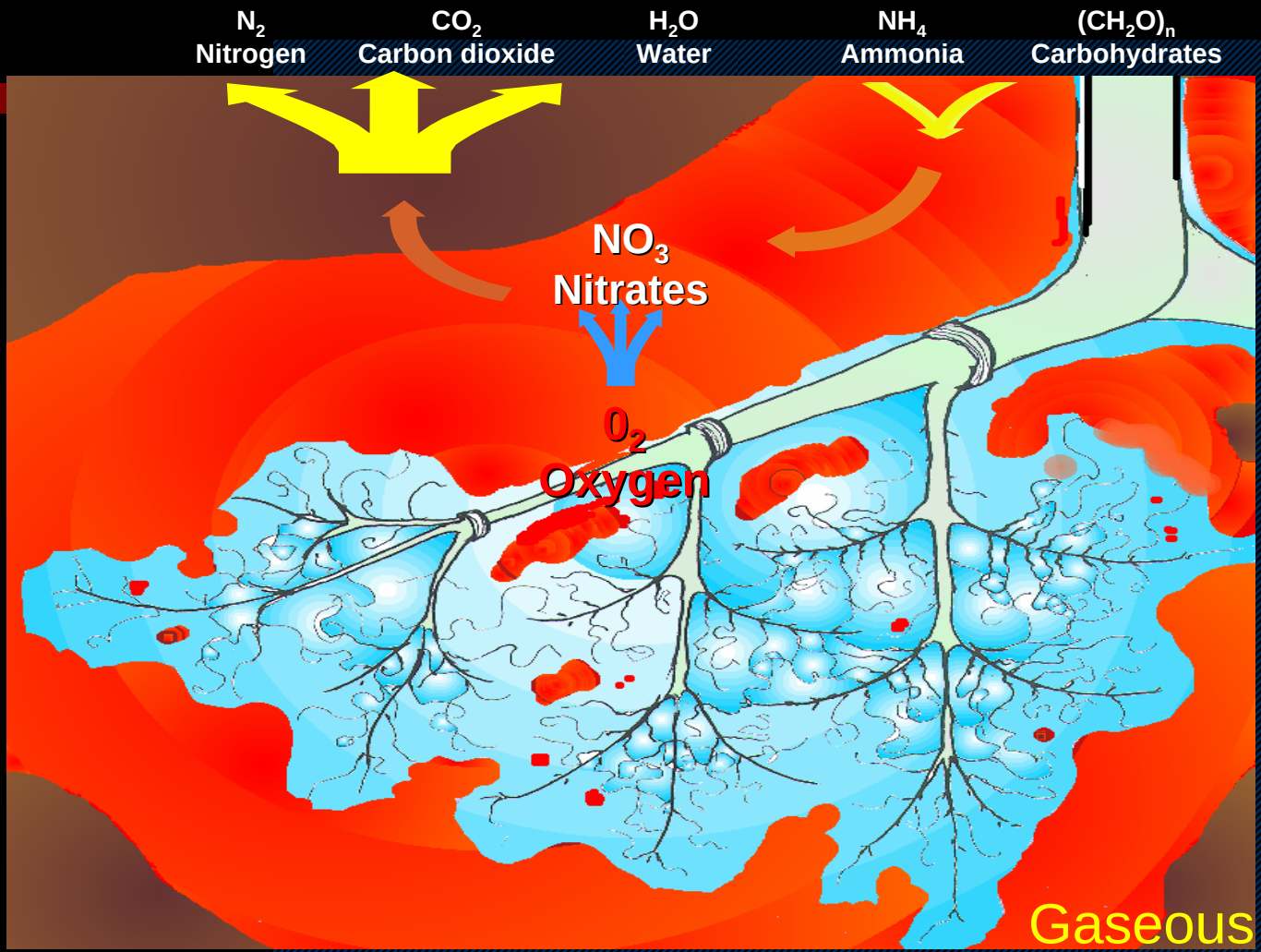
Best option for Iron removal from initial bench scale testing

Iron removal can be achieved with pH adjustment, and settlement.

Pilot Conclusions

- **Leachate is not phytotoxic for reeds.**
- **Iron can be removed.**
  - **precipitation through pH adjustment in Head-works prior to wetlands preventing any issues of plugging.**
- **Results in pilot were as expected.**
  - **The pilot can be used for treatment and hydraulic projections to full scale.**
  - **Pilot proved Kickuth Design Equations are accurate for Leachate at Robin Hood Bay.**
- **Nitrogen and hydraulics will be the main parameters for design of the Wetlands.**

Nitrogen Reduction –Chemical biological & plant uptake



The root growth of Phragmites structures the soil and allows aerobic and anaerobic bacterial organisms to flourish.

Chemicals flowing through the system are exposed to oxidation and reduction processes.

Gaseous Pathways

Design Input – Variables Considered

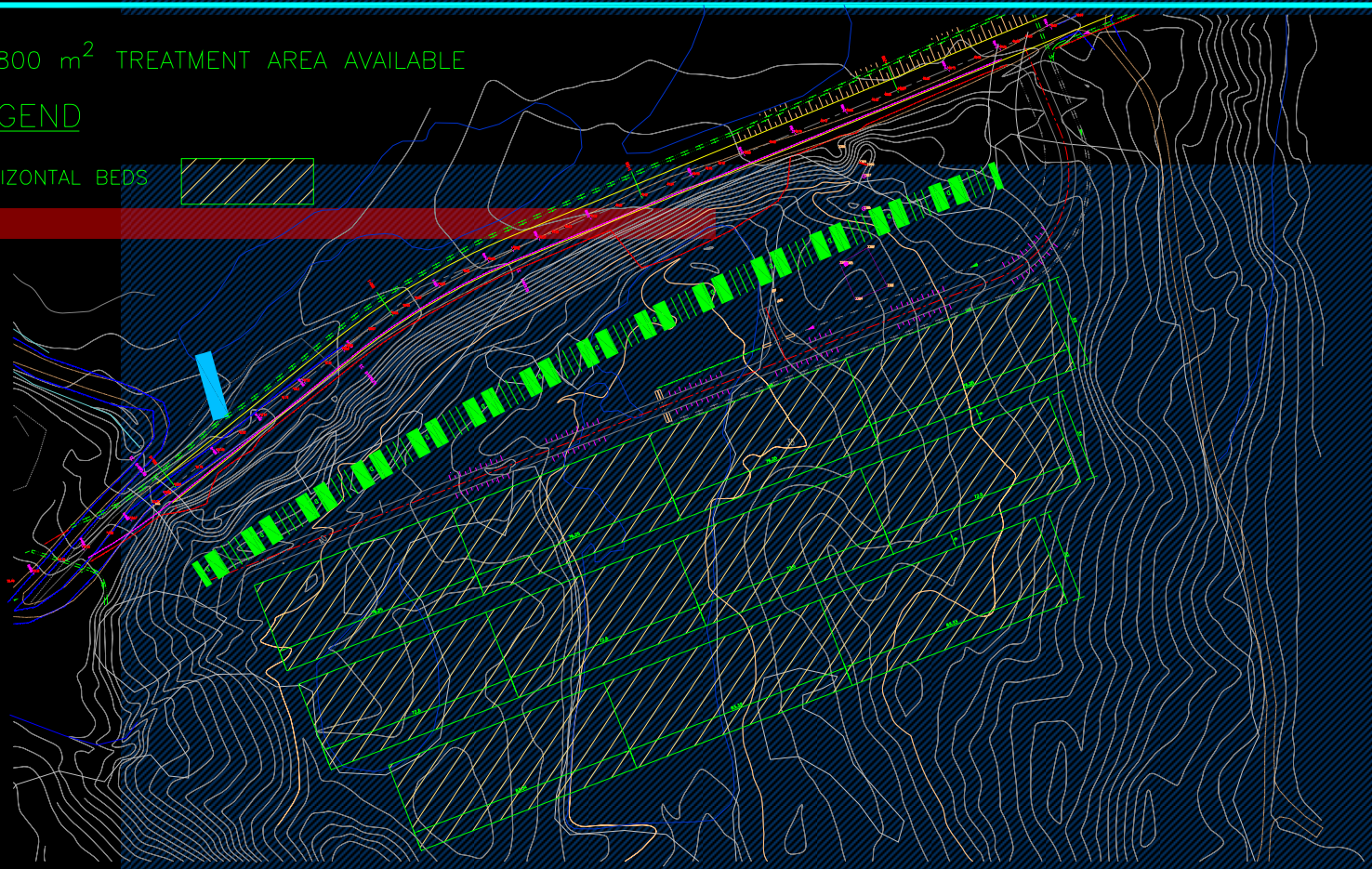
- Flow profile projected
  - **Diversion will create change in flow**
  - **Seasonal fluctuations**
  - **Wet weather fluctuations**

- Leachate total loadings can fluctuate
  - **Changes due to combining effluent**
  - **Changes due to diversion**
  - **Changes due to landfill aging**
  - **Changes due to suppression by Iron**

27,800 m^2 TREATMENT AREA AVAILABLE

LEGEND

HORIZONTAL BEDS



ABYDOZ

ENVIRONMENTAL INC.
Nature is the Way.
Treating Wastewater...Naturally.

PROJECT:

PROPOSED ENGINEERED WETLAND TREATMENT

ST. JOHN'S LANDFILL

ST. JOHN'S, NL

DRAWING TITLE:

SITE PLAN

SCALE: 1:2000

DATE: DEC./07

DRAWING NO.: SK-1

Kickuth Wetland Advantages

Fits Well in the Environment

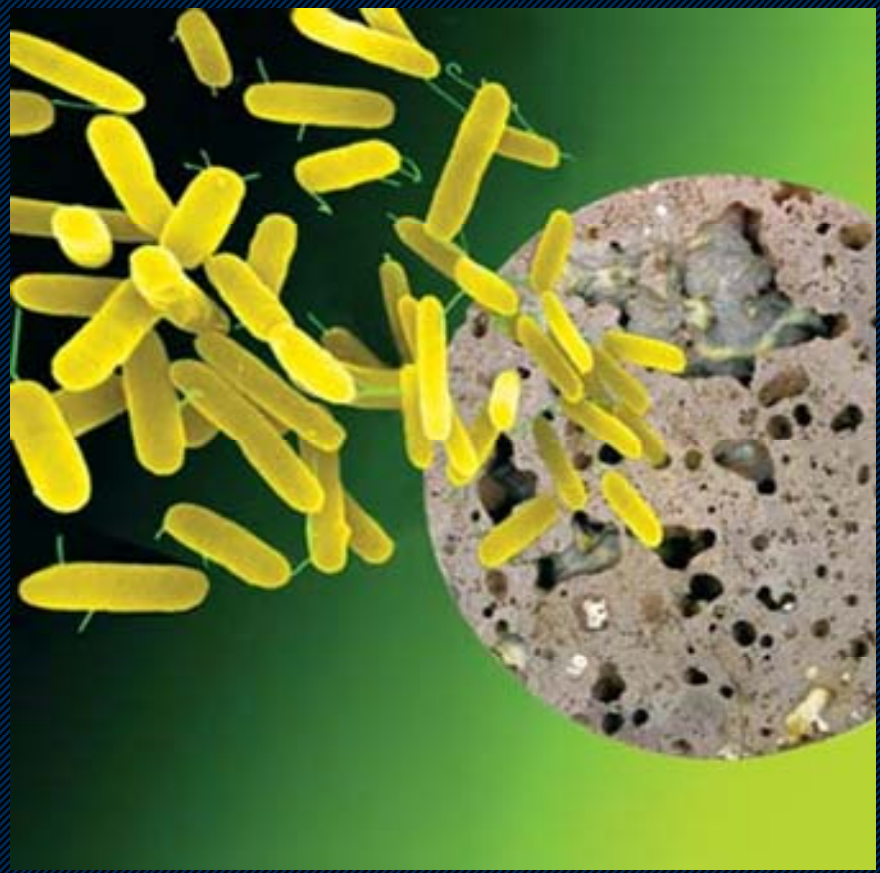
Environmental – Friendly

- **Park Like Setting**
  - **Can Connect to walking trails in town**
- **Green Sustainable Technology**
- **Educational tours for schools**
- **Do not need to hide away system**

Environmental - Green

In Engineered Wetlands

- **No Electricity**
- **No Chemicals**
- **No Mechanical Items**
- **No Moving Parts**



Green House Gas Reduction

DECONTAMINATION, EMISSIONS AND ENERGY BALANCE

over a sixteen-year operating period compared with an identical-sized plant of conventional design and mode of operation (activated sludge)

DESIGN

Layout and operation for 2,500 PE (7 operating years)

Layout and operation for 4,500 PE (9 operating years)

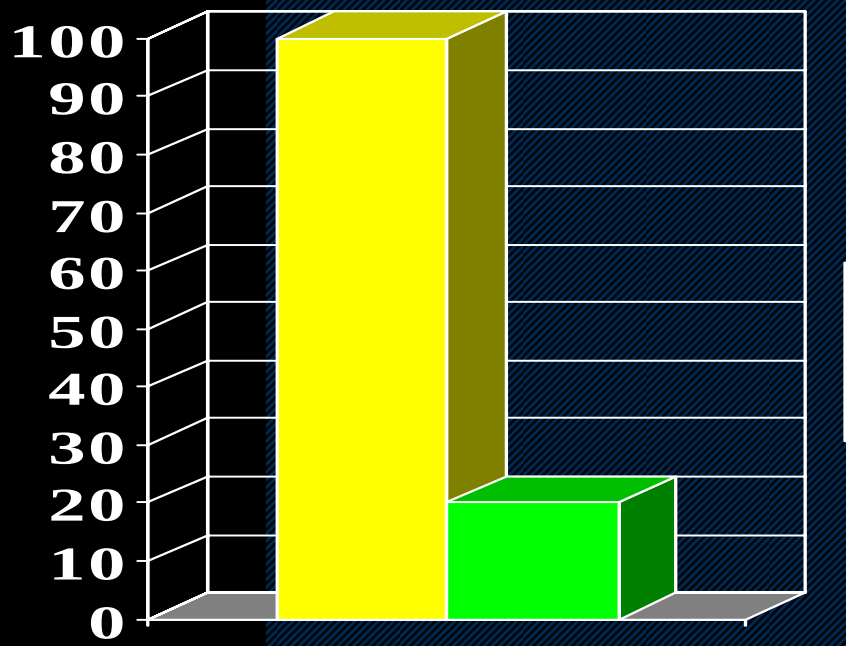
DISPOSAL RATES FOR 16 YEARS OPERATING:

COD	1,500,000 kg
N	140,000 kg
P	16,000 kg

OBTAINED AT THE COST OF:

Energy	Engineered Wetland	Conventional plant
Electricity consumption	35,000 kWh	40,000,000 kWh
Equivalent coal	17,000 kg	20,000,000 kg
Emissions		
CO_2	47,000 kg	53,000,000 kg
NO_x	70 kg	81,000 kg
SO_2	125 kg	142,000 kg

Low Maintenance



- **Kickuth BioReactor™ typically costs 10% to 20% of the operating costs of a mechanical treatment system.**
- **Life cycle cost savings**

Self Regulating

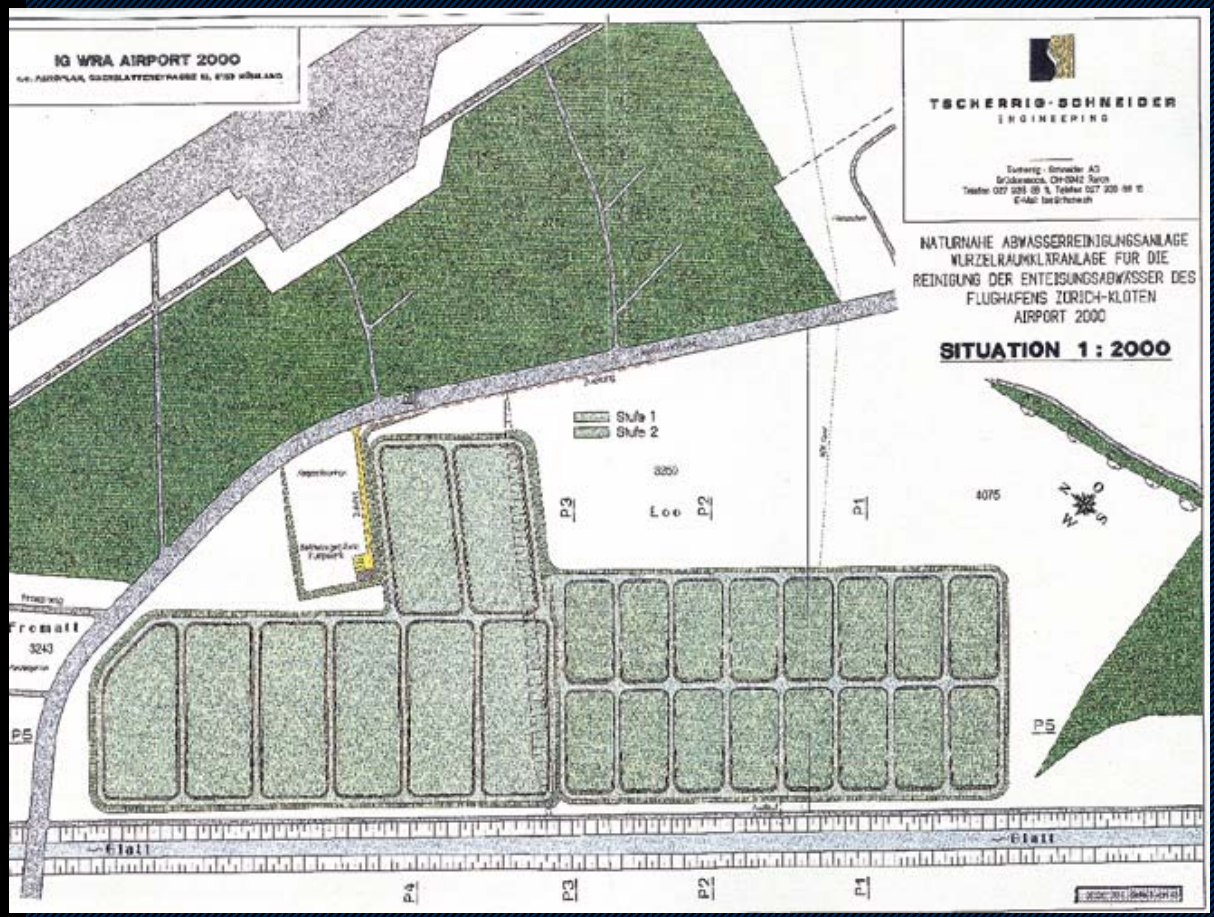
- No replacement of plants (Phragmites Australis)
- No cutting of plants
- No removal of plants
- No site remediation
- Low operating skills

Sustainable - Technology

- Expected 40 to 60 even 100 year life of system.
- No energy required for treatment. Wetland is powered by solar & plants not electricity.
- Treatment is achieved through natural biological and chemical interaction and reduction, no continuous chemicals or bugs to be added. No highly skilled labour required.
- Higher levels of treatment provides future savings as Environmental limits become more stringent.
- No transportation of sludge, treatment on site reducing impacts on landfills for disposal, and eliminating transportation costs which will increase.

Incremental and Economical Expansion

as Required – just add beds



Plants Grown in Placentia Area

Local Industry

Fabrication and built with local labour and materials.

ABYDOZ
System selection

- **Selection by Town Engineers based mostly on Capital Costs**

- **Items which should be considered**
  - **40 year life cycle –very low operating costs**
  - **Higher levels of treatment**
    - **Treatment of solids as well as liquids**
    - **Specialized treatment – Stormwater protection**
  - **Green, Sustainable Technology**
  - **Promotes Innovative Technology in NL**

End of Presentation