

History of Sewage Management

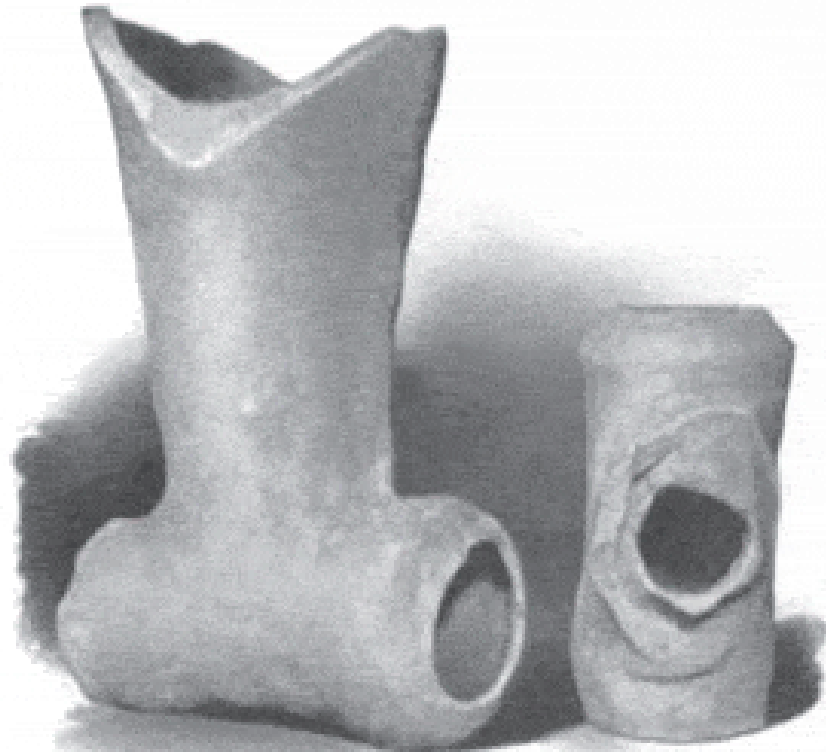


Recycling Using Existing Infrastructure

History of Sewage Management

Technology	Date BCE	Location
Cesspool	4000	Babylon (Bagdad)
Piped systems	4000	Babylon (Bagdad)
Complete network	3000	Indus Civilization Pakistan
<ul style="list-style-type: none">▪ Using Flush water▪ Bathrooms Toilets▪ Garbage Chutes▪ Manholes▪ River Discharge		

Babylon 4000 BCE



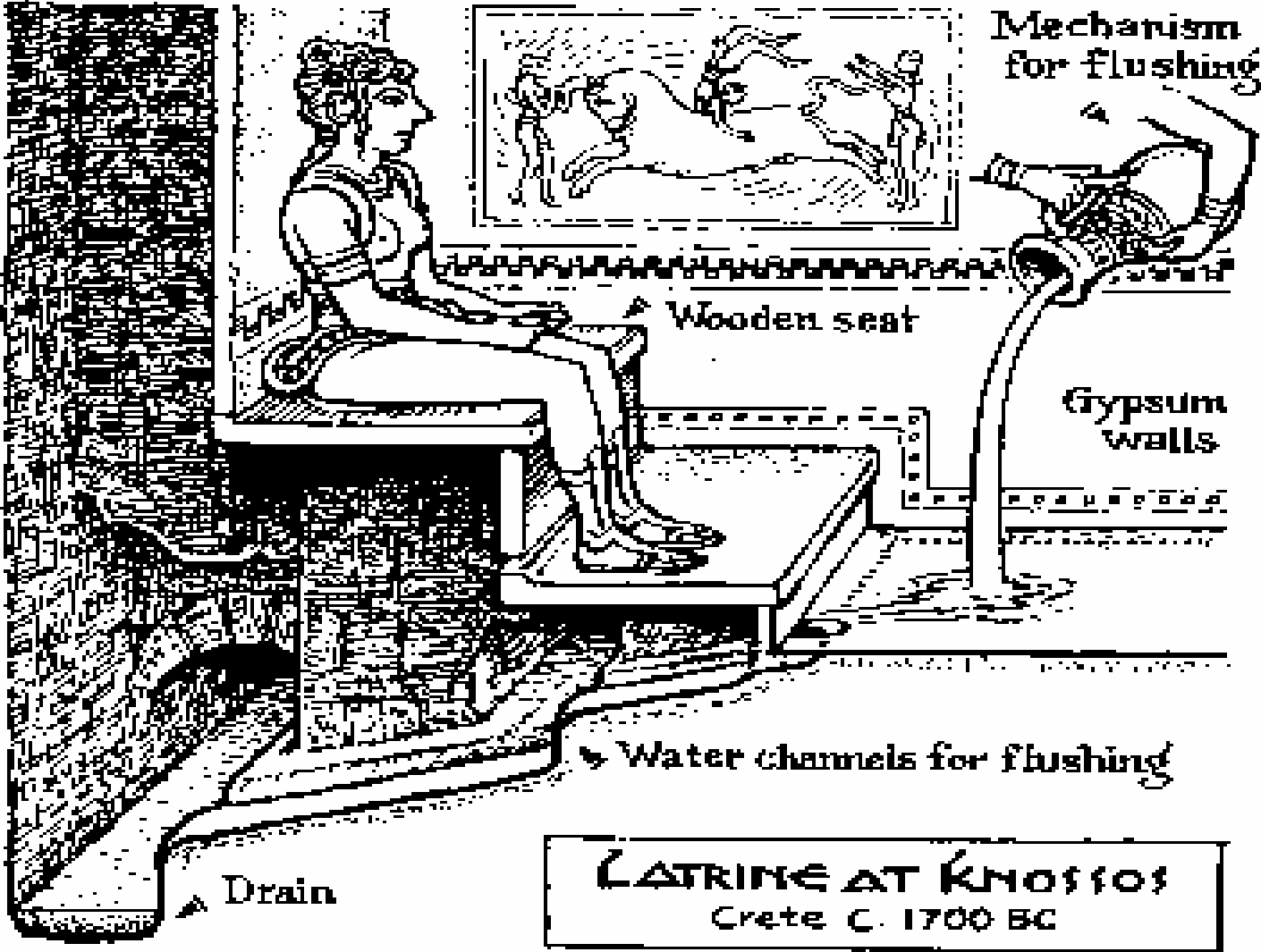
Knee and T Joints

Made about 4000 B.C. Found in the excavations of the Temple of Bel, at Sippar, Babylonia.

History of Sewage Management

Technology	Date BCE	Location
Rooftop storage Ground floor Latrine waste	2000	Knossos
Flushing toilet	1700	Minoan Palace
Toilets with solids capture & removal (Sand beds)	1000	Egypt

Flushing Toilet 1700 BCE



History of Sewage Management

Technology	Date BCE	Location
Sewers to Lagoons Thence to orchards and field crops	500	Greece
Toilet with running water	200	China
	Date CE	
Direct connection to sewer from houses mandated.	100	Rome
Recycling bath water to flush public latrines and sewers.		See Frontinus quote

History of Sewage Management

A quote from Frontinus, the Water Commissioner of Rome:

"I desire that nobody shall conduct away any excess water without having received my permission or that of my representatives, for it is necessary that a part of the supply flowing from the water-castles shall be utilized not only for cleaning our city but also for Flushing the sewers."

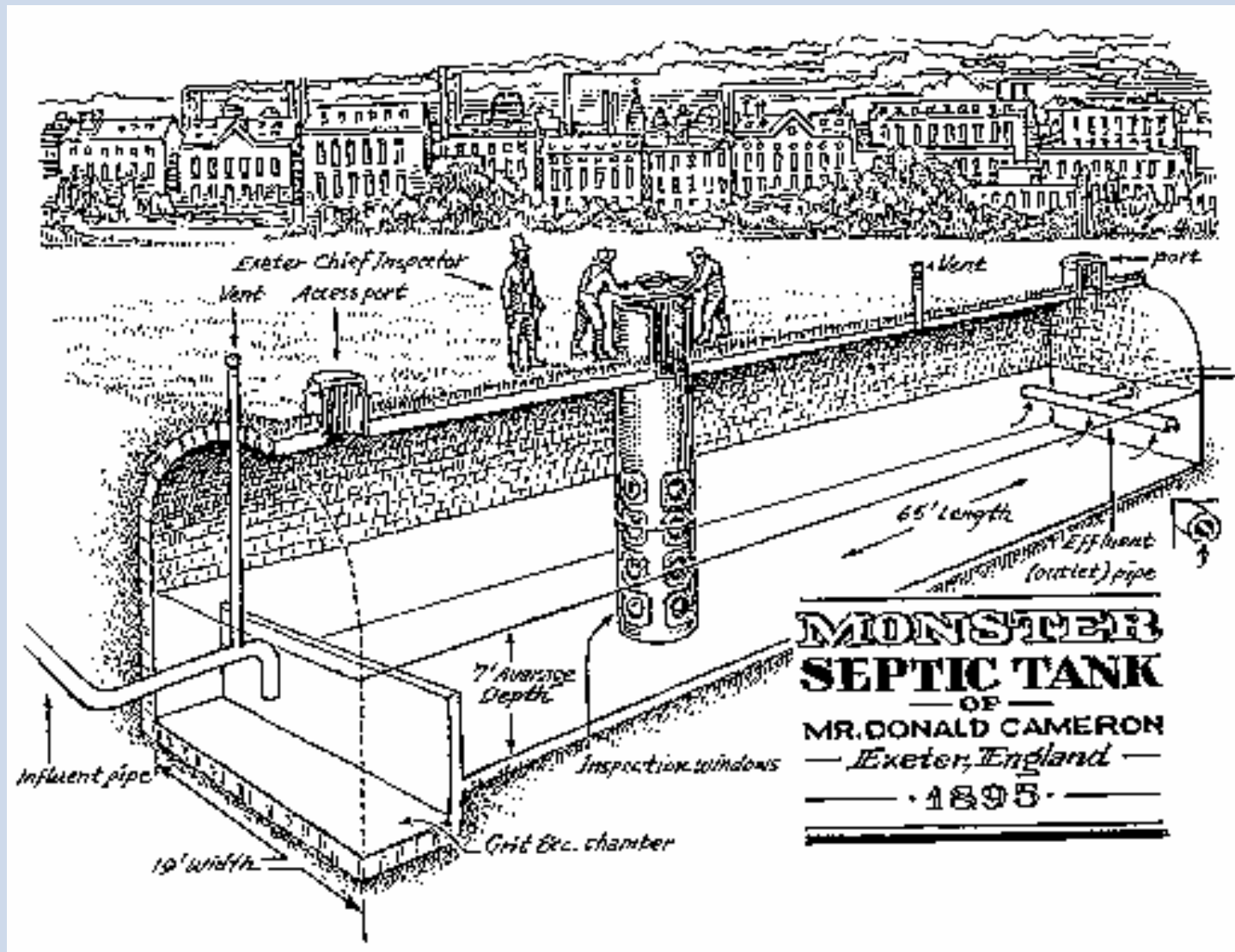
Roman Public Latrine Turkey



History of Sewage Management

Technology	<u>Date CE</u>	Location
Primary Sedimentation (pits prior to land application)	1830	Edinburgh
Flat Bottomed Sed Tanks with lime precipitation	1846	England
Septic tank	1860	France – Louis Moureas
Trickling Filters (fill & draw)	1890	UK & US

Septic Tank – Exeter, 1895



History of Sewage Management

Technology	<u>Date CE</u>	Location
2 chamber Imhoff Tank	1908	Essen -Germany
Royal Commission on Sewage disposal	1901-1915	England
Activated Sludge (Arden and Lockett) (fill & draw method trialled)	1913	US & UK

History of Sewage Management

Technology	<u>Date CE</u>	Location
Full Scale Activated sludge	1920	Sheffield
Process Development	1913-1965	1 st World
	<u>Environment</u>	
N reduction	1965	US
P Reduction	1975	South Africa

Health Impacts of Delayed STPs

Mortality rate/million

- England and Wales 1941–1950 1.5
- Sweden 1941–1947 4.0
- Switzerland 1941–1949 5.3
- Finland 1931–1940 25.0
- **Finland 1941–1950 43.0**

History of Sewage Management

Current Trends

- **Membranes – 1st World – for Advanced Treatment**
- **Reed Beds – Europe – where land is available for decentralised systems**

Sewage Management - Summary

- **Pre-History to mid 1800's – Transport it away**
- **1845-1910 – variations on land application with chemical sedimentation & septic Tanks**
- **British Royal Commission into Sewage disposal sets 20:30 standard around 1915**

Today we have a new opportunity

**Maximising the Use of Existing
Infrastructure for the
Production of High Quality
Recycled Water**

Effluent is now a resource not a problem



Projects are now judged on a triple bottom line basis

Technical – Can we



Economic – Should we

Community – Must we



Community

- Greenhouse Gases
- Beneficial Uses
- Supporting Quality of Life
 - Hose the dog
 - Hose the car
 - Have a Job
 - Have Fun

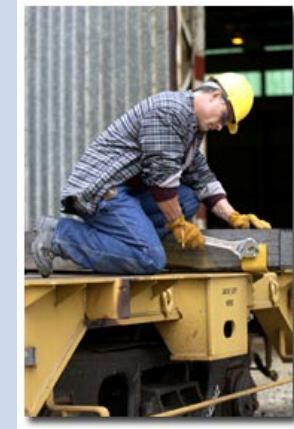


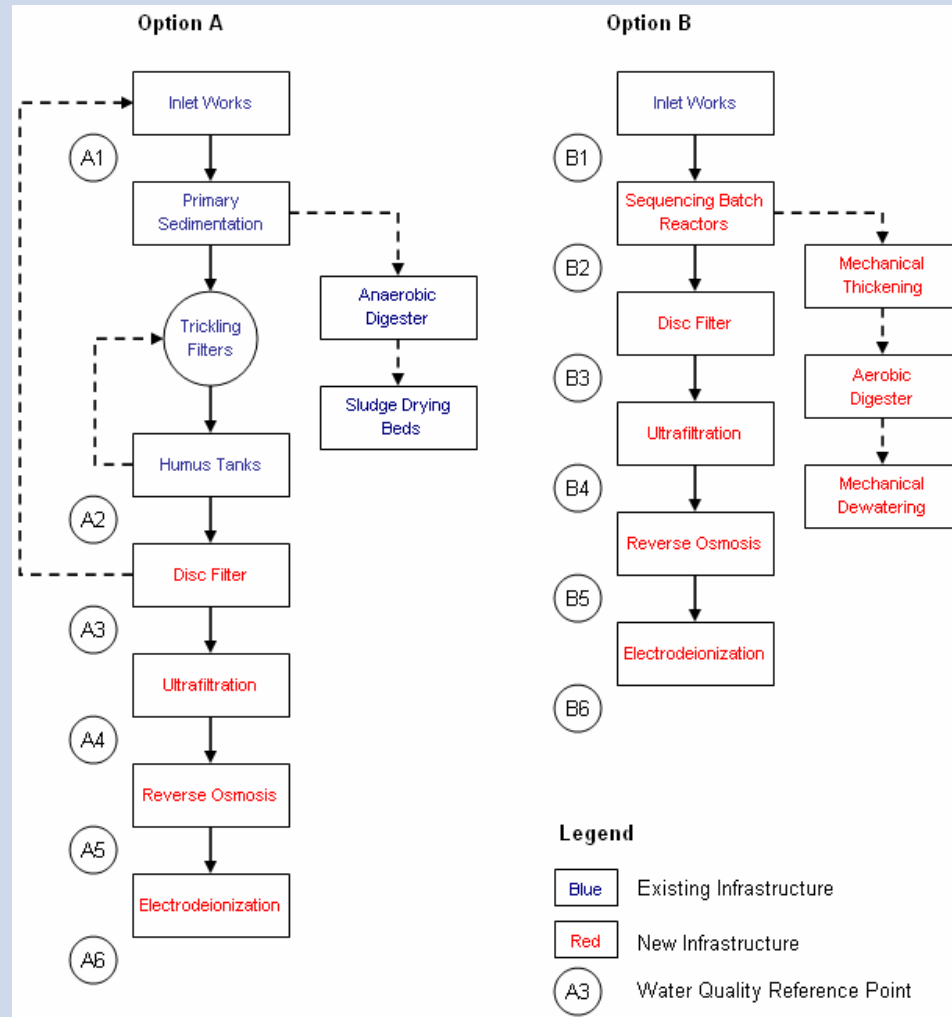
Table 1- Environment and Drinking Water Quality Guidelines

Pollutant	Units	ANZECC Upland River Trigger Values	ANZECC Lowland River Trigger Values	Drinking Water Health Guidelines	Drinking Water Aesthetic Guidelines
E. coli	cfu/100mL	-	-	0	-
Total Phosphorus	mg/L	0.020	0.050	-	-
Total Nitrogen	mg/L	0.250	0.500	-	-
Nitrate	mg/L	0.015	0.040	50	-
Ammonia	mg/L	0.013	0.020	-	0.5
DO	%	90-110	85-110	-	85
pH	pH	6.5-8	6.5-8.5	-	6.5-8.5
Turbidity	NTU	2-25	6-60	-	5
Salinity	µS/cm	30-350	125-2000	-	1000

Table 2 - Adopted Influent Quality and Product Water Quality Requirements

Pollutant	Units	Adopted Influent Quality	Adopted Water Quality Targets
E. coli	cfu/100mL	-	0
BOD	mg/L	220	0.5
COD	mg/L	550	0.5
Suspended Solids	mg/L	250	0.5
Total Dissolved Solids	mg/L	-	200
Turbidity	NTU	-	2
Total Phosphorus	mg/L	10	0.05
Total Nitrogen	mg/L	55	0.50
Nitrate	mg/L	0	0.04
Ammonia	mg/L	40	0.02
pH	pH	7.3	6.5-8.5

A hypothetical Case Study



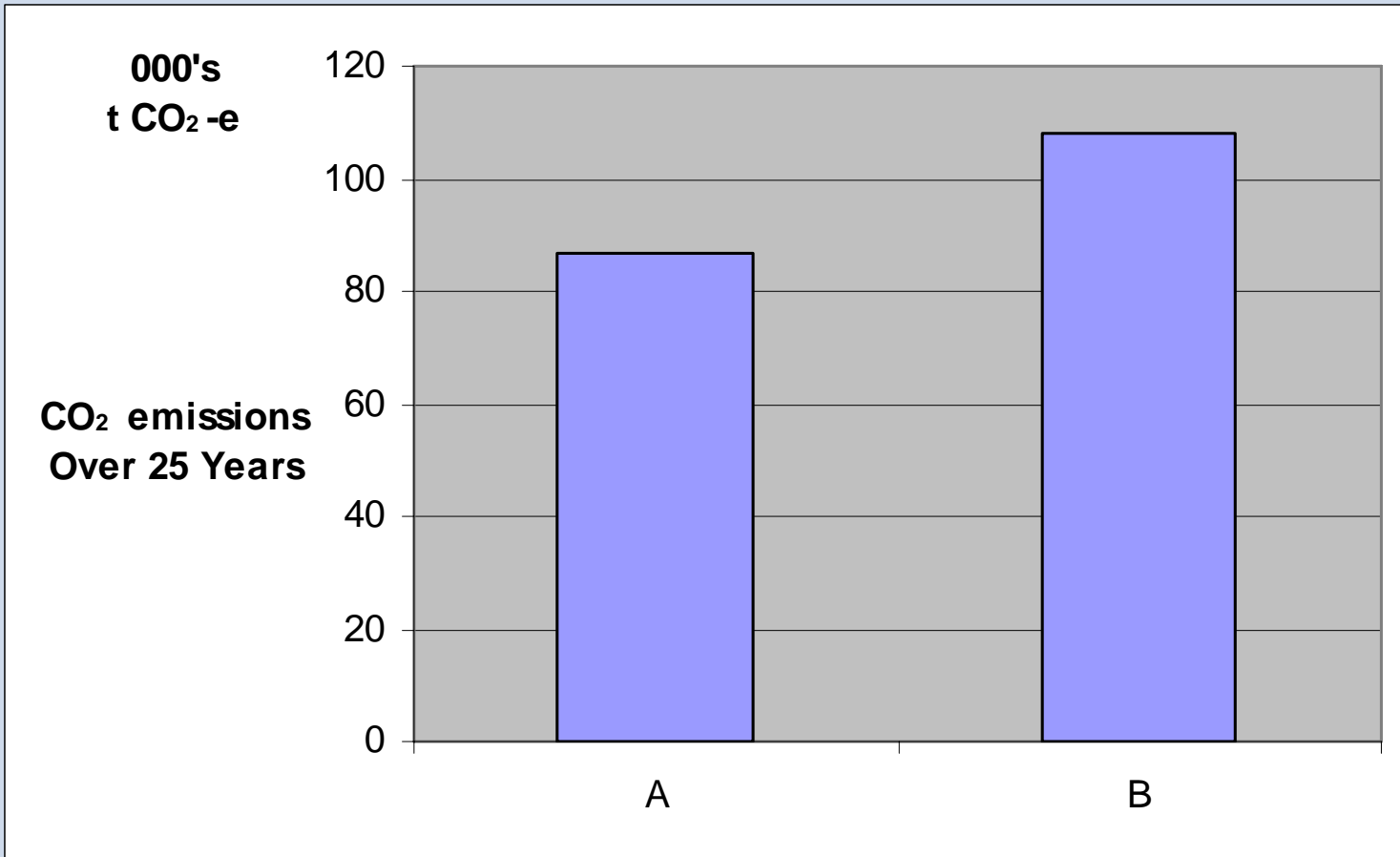
Comparative Performance

Parameter	Option A		Option B	
	A5	A6	B5	B6
BOD	< 0.5	-	< 0.5	-
SS	-	< 0.1	-	< 0.1
TP	< 0.05	< 0.01	< 0.05	< 0.01
TN	-	-	-	< 0.05
NO_x-N	4.73	< 0.01	1.66	< 0.01

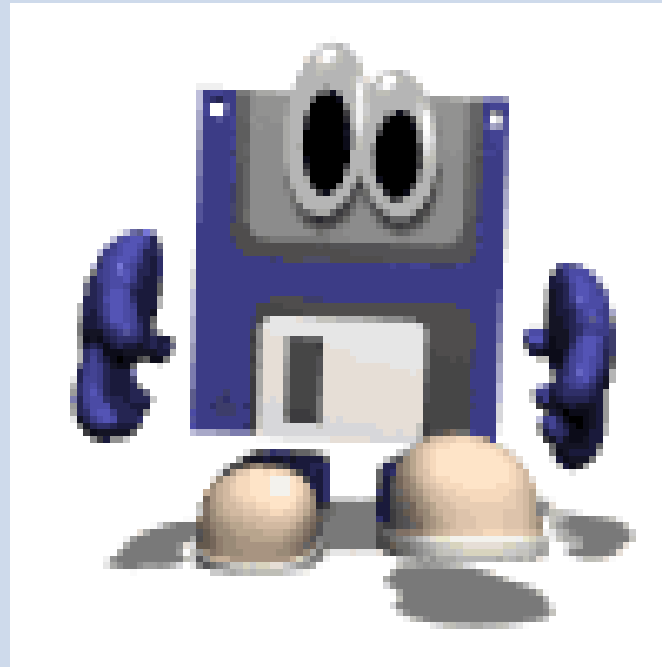
Comparative Costs

Comparative Costs		
	Option A	Option B
Capital	M\$7	M\$13.6
O&M	M\$0.5	M\$0.8
NPV 7%	M\$12	M\$21.5
WOL Cost	M\$19.7	M\$33.9

WOL Carbon emissions Reduced by ~20%



Older Technologies may still have legs



Acknowledgements

- Dow Chemicals
 - Kai-Uwe Hoehn
- Norit X-Flow
 - Peter Miller