

# **Capital and Operating Costs of Full-Scale Faecal Sludge and Wastewater Treatment Systems in Dakar, Senegal**

## **SUPPORTING INFORMATION**

Table S1 Calculation of Annualized Capital Costs for Sewer Based (SB) System

Table S2 Itemisation of Values for Sewer Based (SB) Operating Costs

Table S3 Calculation of Annualized Capital Costs for Faecal Sludge Management (FSM) System

Table S4 Itemisation of Values for Faecal Sludge Management (FSM) Operating Costs

## Table S1 Calculation of Annualized Capital Costs for Sewer Based (SB) System

### ASSUMED LIFETIMES

House connection	20
Sewer - PVC	30 <sup>1</sup>
Pumping station	30
WWTP	30

<sup>1</sup> based on the assumption that new sewers will be built with PVC. This was used as a conservative estimate as PVC is less expensive than concrete or cast iron, and so would not overestimate the cost of the sewer

### TOTAL CAPITAL COSTS

Item	Paid by	Description	Total USD	USD per capita
House connection	ONAS	PVC, approx. 11 ml DN 160		62 <sup>2</sup>
Sewer - PVC	ONAS	344 km - PVC, 88% DN 250, 12% >DN 250	67977287	295.55
Pumping station	ONAS	N=26 - Throughput = 340 m <sup>3</sup> /h	38790226	168.65
WWTP	ONAS	Nominal capacity of 19 200 m <sup>3</sup> /day for primary	26476264	115.11

<sup>2</sup> estimated with Sahm Notaire data

### ASSUMPTION FOR NUMBER OF RESIDENTS SERVED BY SB SYSTEM

20410	households in 2004
10	people per household
2.96	% annual growth rate
<hr/>	
230000	per capita in 2008

### ANNUALIZED COST EQUATION

$$AC_o = -C_o \left( \frac{(1+i)^{no} \times i}{(1+i)^{no} - 1} \right) - F_o$$

C=capital cost in USD/capita (value from above)

0.05 i=real interest rate

n=lifetime of equipment (value from above)

### ANNUALIZED CAPITAL VALUES

Item	Paid by	Description	USD per capita*year
Connection	ONAS	PVC, approx. 11 ml DN 160	4.98
Sewer	ONAS	344 km - PVC, 88% DN 250, 12% >DN 250	19.23
Pumping station	ONAS	N=26 - Throughput = 340 m <sup>3</sup> /h	10.97
WWTP	ONAS	Nominal capacity of 19 200 m <sup>3</sup> /day for primary	7.49

<b>Table S2 Itemisation of Values for Sewer Based (SB) Operating Costs</b>					
<b>Classification</b>	<b>Paid by</b>	<b>Item</b>	<b>Description</b>	<b>Amount (USD)</b>	<b>Amount (per capita)</b>
Sewer	ONAS	External service provision	Clearing, cleaning, repairs	- 822'500	
		Technical personnel ONAS		- 121'120	
		Main office	Management, administration, representation	- 66'566	
	<b>Total</b>			- 1'010'186	-4.39
Pumping station	ONAS	Technical personnel ONAS	Regular cleaning and maintenance	- 74'460	
		Technical personnel ONAS	Electrical repairs	- 162'800	
		Electricity	Operation of pumps	- 151'200	
		Diesel fuel	Emergency lighting system	- 62'400	
		Security		- 18'000	
		Miscellaneous	Materials and consumables	- 9'600	
		Main office	Management, administration, representation	- 39'340	
<b>Total</b>			- 517'800	-2.25	
WWTP	ONAS	Technical personnel ONAS	Plant operation: administration, lab, maintenance	- 218'760	
		Material	Reagents and consumables	- 175'200	
		Security and cleaning		- 13'400	
		Electricity	Treatment operation	- 908'600	
		Electricity	Building (lighting, computers, air conditioning)	- 50'440	
		Diesel fuel	Emergency lighting system	- 28'800	
		Head Office	Management, administration, representation	- 90'760	
<b>Total</b>			- 1'485'960	-6.46	
Endproducts	ONAS	Production of electricity	Biogas recovery	260'000	1.13
		Production of water and biosolids	Sale of treated water (5,100 m3/day) and biosolids	2'540	0.01
		<b>Total</b>		262'540	1.14
Sanitation fee	Household	Fee paid based on drinking water consumption	0.1 USD/m3 of drinking water		-2.00 <sup>†</sup>
<sup>†</sup> the exact value is not known by ONAS, and was estimated based on population and average water usage					

<b>Table S3 Calculation of Annualized Capital Costs for Faecal Sludge Management (FSM) System</b>				
<b>ASSUMED LIFETIMES</b>				
Septic tank		50		
Emptying truck		15		
FSTP		30		
<b>TOTAL CAPITAL COSTS</b>				
Item	Paid by	Description	Total USD	USD per capita
Septic tank	Household	1 tank for a 10-member household	500	50.00 <sup>1</sup>
Vacuum truck	C&T company	1 emptying truck of 10 m3 capacity	30'000	2.88 <sup>2</sup>
FSTP	ONAS	Capacity of 100 m3/day faecal sludge	654'000	15.76
<sup>1</sup> 1 household, 10 people per household				
<sup>2</sup> 4 round trips a day, 10 people per house, 260 working days in a year				
<b>ASSUMPTION FOR NUMBER OF RESIDENTS SERVED BY FSM SYSTEM</b>				
100 m3/day				
260 operating days/year				
1000 L/capita*year FS production				
41500 per capita in 2008				
<b>ANNUALIZED COST EQUATION</b>				
$AC_o = -C_o \left( \frac{(1+i)^{no} \times i}{(1+i)^{no} - 1} \right) - F_o$				
C=capital cost in USD/capita (value from above)				
0.05 i=real interest rate				
n=lifetime of equipment (value from above)				
<b>ANNUALIZED CAPITAL VALUES</b>				
Item	Paid by	Description	USD per capita*year	
Septic tank	Household	1 tank for a 10-member household	2.74	
Emptying truck	Collection and transport	1 emptying truck of 10 m3 capacity	0.28	
FSTP	ONAS	Capacity of 100 m3/day faecal sludge	1.03	

<b>Table S4 Itemisation of Values for Faecal Sludge Mangement (FSM) Operating Costs</b>						
<b>Classification</b>	<b>Paid by</b>	<b>Item</b>	<b>Description</b>	<b>Amount (USD)</b>	<b>Amount (per capita)</b>	
Septic tank	Household <sup>1</sup>	Faecal sludge emptying	10 m3 capacity	- 50.00	5.00	
C&T company	C&T	Staff	1 Manager	- 10'000.00		
		Staff	1 Salesman	- 4'800.00		
		Staff	1 Driver	- 3'300.00		
		Staff	1 Handler	- 4'280.00		
		Fuel		- 21'420.00		
		Management	Phone, food, accountancy ...	- 1'320.00		
		Discharging fee <sup>2</sup>	Fee at the FSTP	- 4'200.00		
	Total			- 49'320.00	-4.74	
		<sup>1</sup> emptying fee collected from households		52'000.00	5.00	
		net annual profit		2'680.00	0.26	
FSTP	ONAS					
		Technical personnel ONAS	Sludge handling, operating drying beds	- 17'846.00		
		Non-technical services	Security, maintenance, disposal	- 9'780.00		
		Energy	Electricity, fuel for backup generator	- 3'480.00		
		Consumables	Uniforms, office supplies	- 4'010.00		
		Personnel Head Office	Management, administration, representation	- 10'140.00		
	Total			-45256.00	-1.09	
		<sup>2</sup> discharging fee	0.4 USD/m3 x 100 m3/day *261 days / 41500	10400.00	0.25	
		net annual cost of operation			-0.84	
Valorisation	Enduser	Biosolids	0.8 USD/m3	- 240.00	- 0.01	