**Strategic Sludge Modelling Brief**

We would like to model forwards between 5 and 40 years (adjustable by the user)

We would like to model in years.

The model should be based on TDS with costs reflected either as a cost per year, or a cost per TDS, and a TDS per year.

For managing the fleet capacity %DS data and vehicle sizes will be defined to calculate volumes moved and ensure the fleet capacity is sufficiently large.

Similarly, for recycling capacity %DS data is provided to understand the volumes recycled.

Sludge destroyed within the digestion process is provided so that TDS to be recycled can be calculated.

Opex costs to be modelled would need to include:

Energy, chemicals, recycling, transport, liquor treatment, third party contracts etc as per the operational model on a cost per TDS throughput basis;

Also “fixed annual opex costs” for eg staff, rates, overhead, maintenance of the asset etc that are not dependent on TDS throughput in a given year but which can change when there is an investment decision made.

In any future year a choice of investments and other strategic changes can be made. Typical examples shown in table at the end of this document.

The investments and decisions would be of different types

1. Refurbishment, generally needed to be completed by a set date, if capital is not spent, site must close, capacity does not change, opex of site may.
2. Expansion of a site increasing the capacity to treat sludge, with changes to opex
3. Reduction in capacity, with changes to opex
4. Change of site type, eg STW becomes a thickener, thickener a dewaterer, digester becomes a thickener
5. Third party contracts
   1. with guaranteed minimum TDS (and maximum allowable) traded for a set period of years
   2. with no guaranteed trading volumes
6. Investments may be
   1. Entirely optional
   2. Unable to happen until a set date but must happen by a second fixed date, unless
      1. Another investment on that site is made
      2. Site is closed by set date
   3. Must happen in a given year
7. We may sign up to third party contracts with others guaranteeing them treatment in our capacity.

The model would take into account the routing between all the production sites; classes of sites such as thickeners; dewaterers; sludge treatment centres; third party outlets etc.

**The capex costs; opex changes; capacity changes etc would be provided to the model.**

The model would contain sludge production at all STW locations, and have options to route to any class of site that is higher:

STWs can go to thickeners, dewaterers or treatment centres

Thickeners can go to dewaterers or treatment centres

Dewaterers can go to treatment centres

Any site can go to a third party that is defined in the model

All sludge produced in one year is treated in that year. Any lack of capacity uses a “most expensive emergency third party route” to relieve pressure in the location that makes most sense.

The capacity of the fleet to move sludge should be taken into account. ( number of drivers, vehicles required).

There could be between 1 and 200 investments considered in a run. Typically it would be <30 in a five year period.

The constraint could be set to one of the following:

A) Lowest CAPEX (over a user defined period)

B) Lowest TOTEX (total of capital and opex spent in a user defined time period)

C) Lowest OPEX (over a user defined period)

D) lowest TOTEX (over a user defined period, given a total capex cap of a maximum capital spend).

The output would tell us which investments are recommended and when.

There would be other things to understand:

For the optimised solution;

What is the demand and capacity in each year.

In any given year what is the export to third parties?

what is the spare capacity we have in any given year?

How dependent are we on individual sites a bottlenecks/risks?

how much third party import could we bring into our sites?

How much energy is generated?

What is spend on chemicals?

How many KM are driven?

What is the number of vehicle movements into and out of any location?

For the same constraints and investments we may want to run different production demands to see how this influences the choice, and sensitivity of solution to choice to production factors.

**For consideration on how to include in this phase:**

**Certain aspects of our operation impact on our carbon footprint. The financial aspects of this optimised through the pricing of fuels, energy, etc. But it would be useful to be able to assign carbon impacts eg to km travelled, energy consumed, chemicals consumed etc.**

**This could be included as a separate carbon reference table to be applied to the outcome of the optimisation to calculate the carbon footprint of the optimised solution.**

**Excluded from the scope:**

**Excluded from the brief (potential for an additional phase) Landbank constraints?? Not included in this proposed brief is the modelling of land bank in use by YW and future regulatory pressures on recycling. This might be worth considering for a further phase.**

Examples of strategic changes

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Investment | Capex £ | Location | Opex | Capacity | Site type | Time (latest date this must happen by) |
| 1 | 1,000,000 | An existing location | Changes to the opex per TDS for that location | Provides cake import capacity | Stays the same | Optional |
| 2 | 10,000,000 | An existing location |  | Increases overall capacity of site | Stays the same | Optional Not before start of year 4 |
| 3 | 1,000,000 | An existing location | Changes | Changes (reduces) | changes | MUST DO In Year 4 (fixed input by user) |
| 4 | n/a | New third party Route, but with guaranteed minimum TDS delivered for x years | New | new | Third party | Optional, but once taken locked in for x years. |
| 5 | n/a | New third party route | New | new | Third party | Optional from year 2 onwards, does not need to be used |
| 6 | 1,000,000 | An existing location | Changes | Changes | Changes to dewaterer from a lower grade | Optional Not before year 3 |
| 7a) (refurbishment) | 3,000,000 | existing | Changes | changes | No change | Must do Before Year 5 (fixed input by user, unless 7b or 7 c chosen) |
| 7b) (close) | 500,000 | Existing same as 7a) | changes | Changes | Changes from STC to STW or STF/T | Must do Before Year 5 (fixed input by user, unless 7a or 7 c chosen) |
| 7c (expand) | 15,000,000 (takes three years to spend the capex before benefit is delivered) | Existing same as 7a | changes | Increases for imports of cake and liquid and indigenous | Stays the same | Must do Before Year 5 (fixed input by user, unless 7a or 7b chosen) |
| 8 a | 13,000,000 | Existing site | changes | Increases for imports of cake and liquid and indigenous | Stays the same | Must do Before year 10 (fixed by user unless 8 b is chosen before that date) |
| 8 b | 5,000,000 | Refurbish sites | changes | No change | Stays the same | Must do before year 10 (fixed by user unless 8 a is chosen before that date) |
| 9 | 2,000,000 | Close site | changes | changes | Changes to thicker | Optional Before year 7 |
| 10 | 1,000,000 | A dewaterer location | changes | changes | Changes to thickener | optional |

The model should choose the optimised selection of some of the above such that the cost optimisation is met and the time constraints in column 7 are met.