COMPUTER MODEL FOR TREATMENT OF SMALL VOLUME WASTEWATER

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INTRODUCTION

There is an increasing need for its use in small scale projects to treat low volume domestic and small community wastewater in developing as well as developed countries.

To date, all the small scale wastewater treatment projects using VS is based on trial and error methods and experience. To overcome this, a scientifically based Model is needed to convince authorities of its effectiveness and accuracy.

The objectives are to develop a scientifically based computer Model for treatment small volume input from:

- **Individual coffee farmer or small cooperatives in Colombia, and Latin America**
- **Individual household sewage effluent and landfill leachate from small communities in countries around the world**

Principles of Wastewater Treatment with Vetiver System

Vetiver is highly suitable for the treatment of wastewater due to its extraordinary morphological and physiological attributes and most important of all is its capacity to produce a *very high biomass* under a wide range of climatic conditions and adverse soil conditions.

The ability of vetiver grass to remove pollutants and water from the growing medium depends solely on its biomass production, hence the faster and higher biomass production the faster and more effective the treatment process is.

Therefore, if the biomass production can be estimated for a certain environment, the efficiency of the treatment process can be predicted and subsequently the land area needed can be worked out reasonably accurately

Input Data

Weather data:

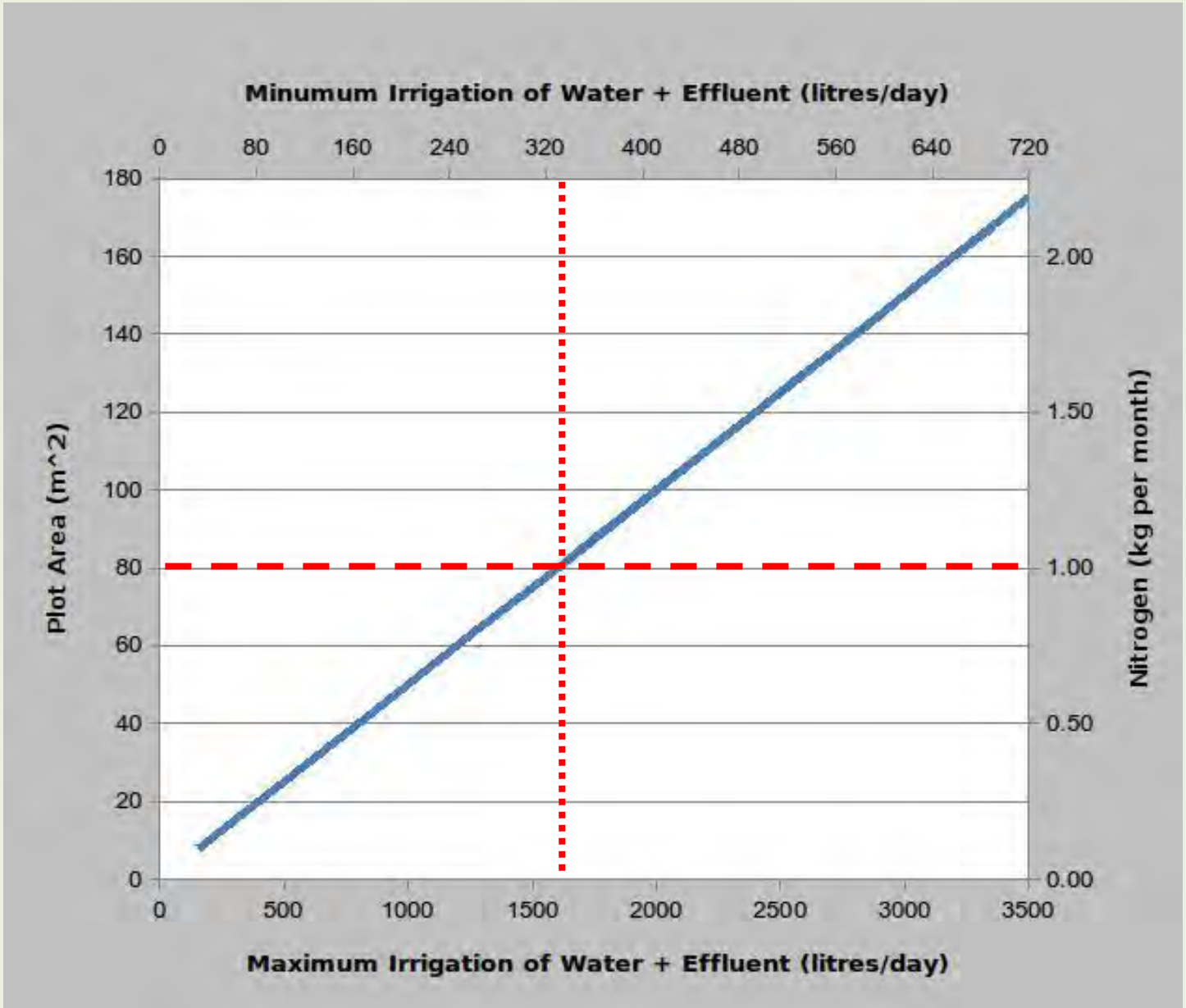
- **Rainfall (mm/year)**
- **Pan Evaporation (mm/day)**
- **Potential Evapo-transpiration (PET),**

Effluent data:

- **Monthly effluent input volume**
- **Monthly N input. (Volume x N level in effluent)**
- **Monthly P input. (Volume x P level in effluent)**

MODEL RESULTS FOR NITROGEN DISPOSAL

Land area, minimum and maximum volume

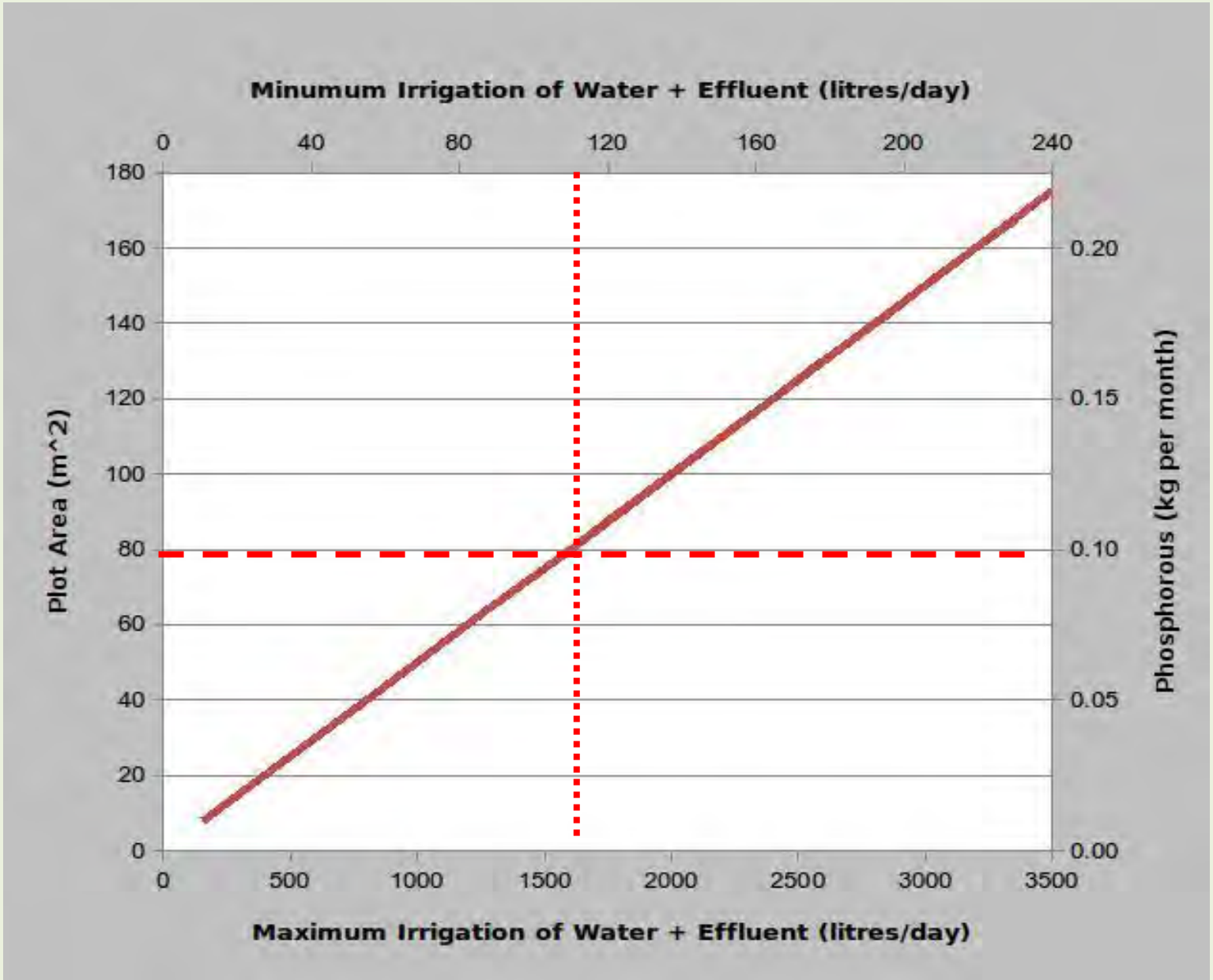


From the Chart above this table shows land area, minimum and maximum volume required for disposal of monthly Nitrogen inputs from 0.1 to 3.0 kgN/month.

N per month (kg)	Land area needed (m^2)	Min input* (L/Day)	Max input** (L/Day)
0.1	8	33	160
0.2	16	66	320
0.5	40	164	800
0.8	64	263	1280
1.0	80	329	1600
1.5	120	493	2400
2.0	160	658	3200
3.0	240	986	4800

MODEL RESULTS FOR PHOSPHORUS DISPOSAL

Land area, minimum and maximum volume



From the Chart above this table shows land area, minimum and maximum volume required for disposal of monthly Phosphorus inputs from 0.01 to 0.30 kgP/month.

P per month (kg)	Land area needed (m^2)	Min input (L/Day)	Max input (L/Day)
0.01	8	11	160
0.02	16	22	320
0.05	40	55	800
0.08	64	88	1280
0.10	80	110	1600
0.15	120	164	2400
0.20	160	219	3200
0.30	240	329	4800

Establishment and Management of the Vetiver Planting

For a successful application, the following establishment and management procedures are recommended:

- ***Planting material,*** **must be good quality**
- ***Good Watering*** **river or rain water after planting until the plants are about 50cm tall**
- ***Effluent application*****: Effluent can be gradually introduced to the planting when Vetiver is about 50-60cm tall**
- ***Weed control*****: Weed control by hand may be needed during the first 6 months, *Never use RoundUp for weed control on Vetiver planting***
- ***Trimming*****: to 40-50cm high every 3 months**
- ***Cutting:*** **After one year Vetiver should be cut down to 30-40cm when flower heads emerged or every 3 months**
- ***Biomass:*** **The biomass must be removed from the plot after cutting.**

Ethiopian Conventional Coffee Processing Water

Case Study 1

Volume 300L/day

N input/month= 300L/day x 30days x 0.013gN/L = 117g = 0.117kg

P input/month= 300L/day x 30days x 0.0043gP/L = 38.7g = 0.039kg

Land area needed for N: *Approximately 10m²*

Land area needed for P: *Approximately 30m²*

Recommended area for vetiver planting: 30m²

Case Study 2 (Higher N and P input)

Volume 300L/day

N input/month= 300x 30x 0.023g/L = 207g = 0.21kg

P input/month= 300x 30x 0.0073g/L = 65.7g = 0.066kg

Land area needed for N: *Approximately 16m²*

Land area needed for P: *Approximately 50m²*

Recommended area for vetiver planting: 50m²

Australian Sewage Effluent Disposal (Septic Tank)

Case Study 1: Domestic Household with three persons

Volume 450L/day

N input/month= 450x 30x 0.030g/L = 405g = 0.40kg

P input/month= 450x 30x 0.010g/L = 135g = 0.013kg

Land area needed for N: *Approximately 35m²*

Land area needed for P: *Approximately 100m²*

Recommended area for vetiver planting: 100m²

Case Study 2: Domestic Household with three persons and higher N and P input

Volume 450L/day

N input/month= 450 x 30x 0.041g/L = 553g = 0.55kg

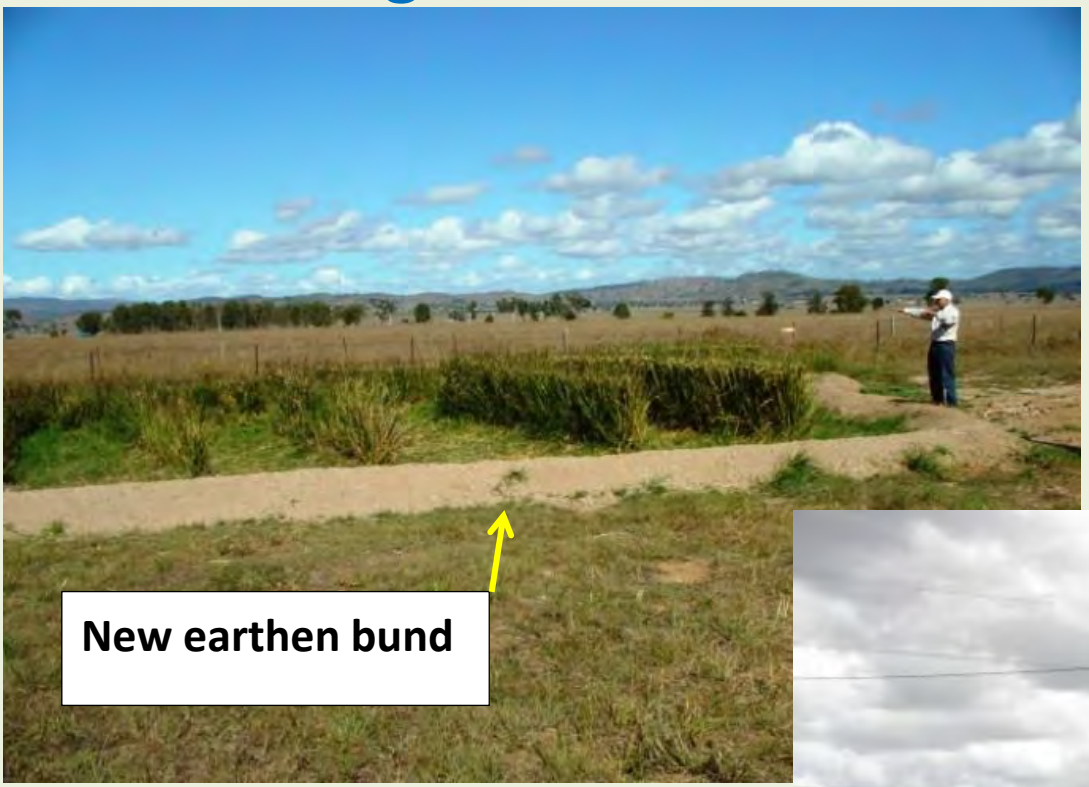
P input/month= 450x 30x 0.022g/L = 297g = 0.30kg

Land area needed for N: *Approximately 40m²*

Land area needed for P: *Approximately 240m²*

Recommended area for vetiver planting: 240m²

Design and Construction of the Disposal Area



Where EPA regulation allows deep drainage

Planting should be spread to cover the whole basin at density of 5plants/$m^{2.}$

Where EPA regulation prohibits deep drainage

Planting should be spread to cover the whole basin at density of 5plants/$m^{2.}$

Wastewater Disposal Combined with Landscaping and Erosion Control

This Model is based on the planting density of 5plants/m^2, *the important point is 5 plants are needed*. For example when an area of 80m^2 is required, 400 plants are needed, these can be planted in single or multiple rows. This planting layout can be combined with erosion control on sloping land as part of the landscaping of the garden.

Domestic sewage effluent disposal in Australia

Domestic Sewage Effluent Disposal in Australia

Domestic Sewage Effluent Disposal in Australia

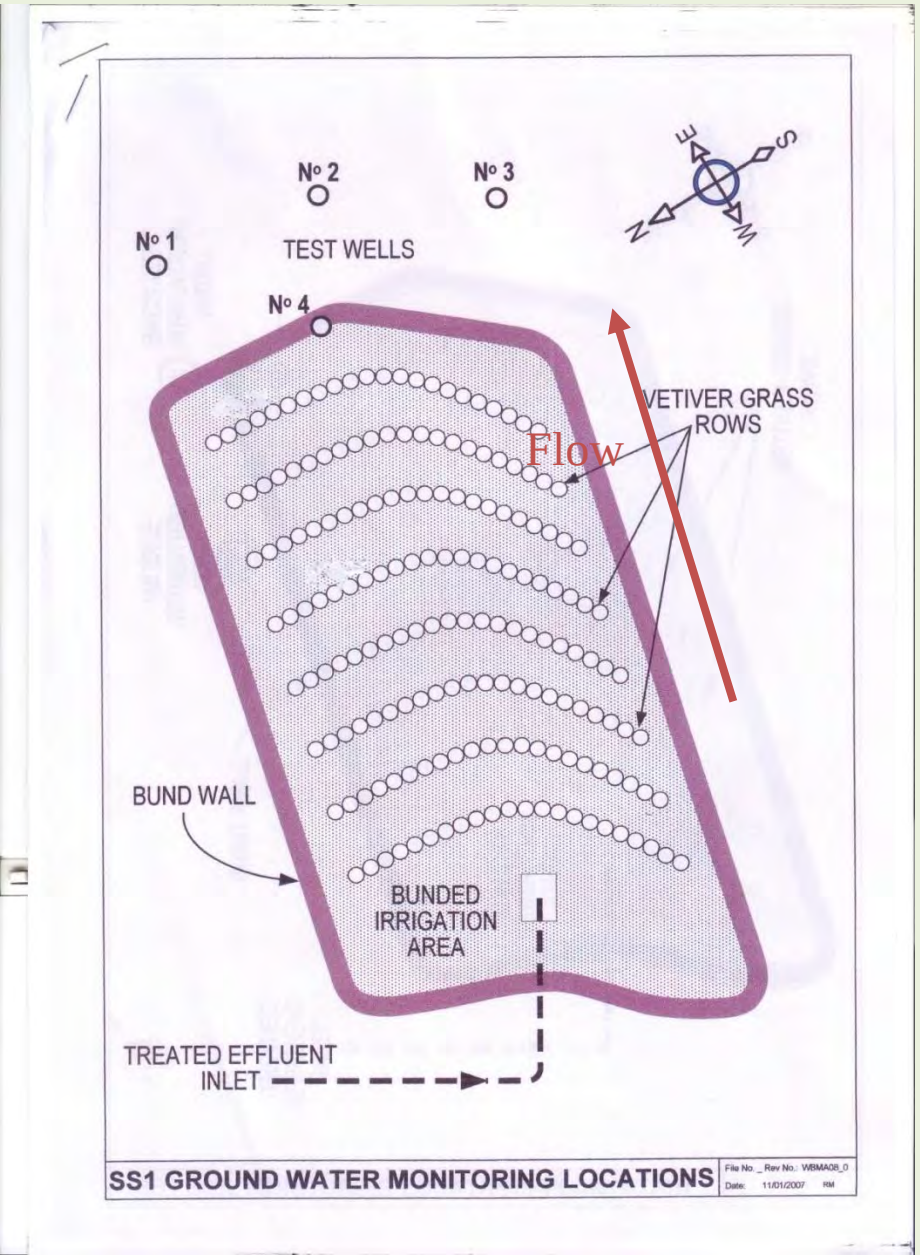
Domestic Sewage Effluent Disposal in Aceh, Indonesia

American Red Cross built 3 500 units for the Tsunami disaster in 2 009

PC: Vant Hoff

American Red Cross built 3 500 units for the Tsunami disaster in 2 009

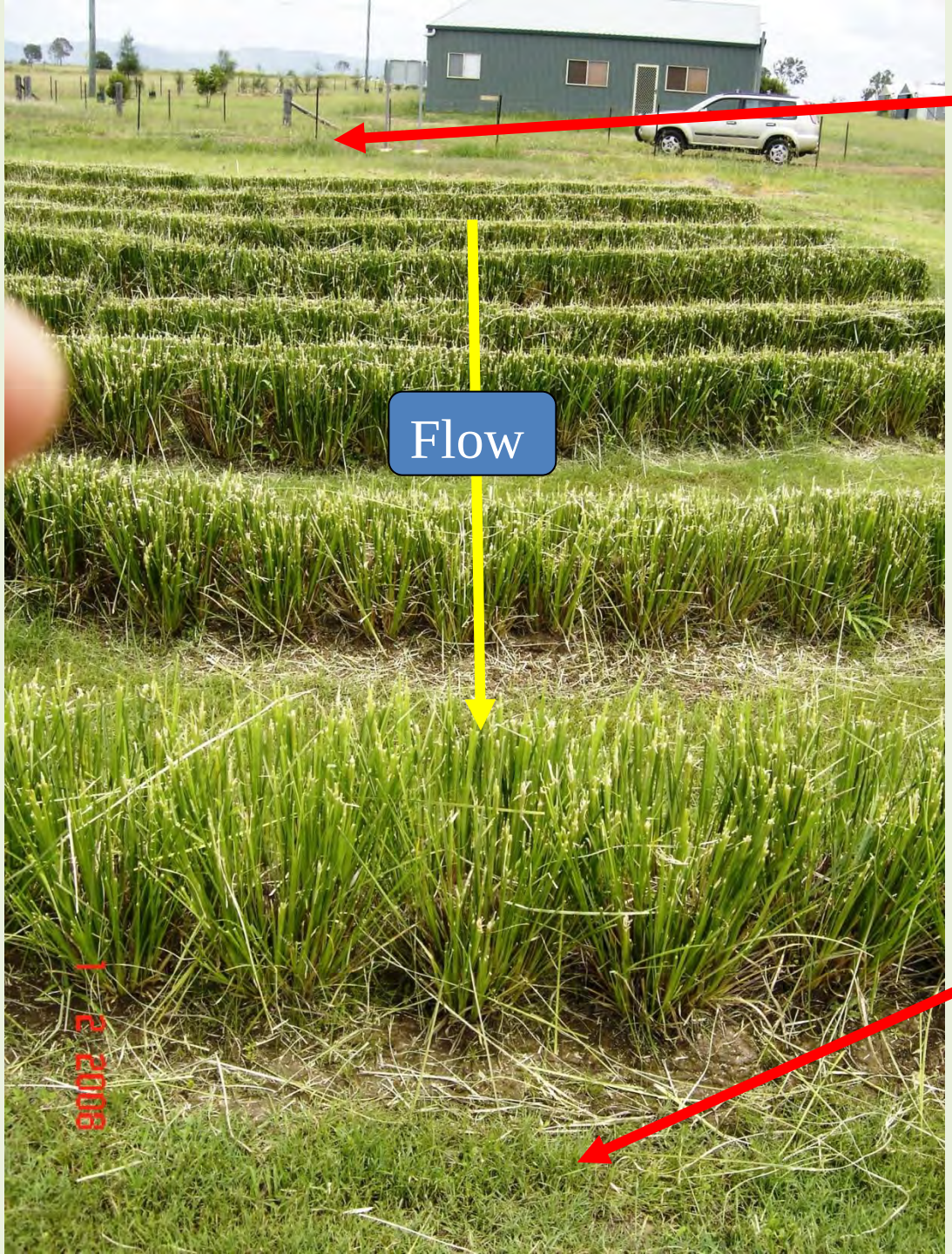
Domestic Sewage Effluent Disposal of a Small Community, Australia



Planting Design

- 8 rows of vetiver
- 10m long each
- Inter-row spacing 1m
- Plant spacing 5/m
- Total plants 400
- Gravel trench 60cm deep
- Land area 100 sqm
- Bund wall W54 X H30cm

Excellent growth after 12 months



IN FLOW

Average daily flow: 1 670L

Average total N: 68mg/L

Average total P: 10.6mg/L

Average Faecal Coliform:>8 000

SUMMARY

OUT FLOW

Average daily flow: Almost Nil*

Average total N: 0.13mg/L

Average total P: 0.152mg/L

Average Faecal Coliform:<10

* Only flow after heavy rain


VETIVER
This grass is being used as a low impact alternative to managing effluent.
The increased uptake rate of Vetiver reduces odours, leakages and contamination of the subsoil and water table.
Thank You