The choice of sanitation systems and technologies

Outcomes of the NETSSAF workpackage 3 activities

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25/09/2008
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Rationale

- There are a wide range of sanitation technologies available - however often many are still unknown at local level
- There is a need for structured assessment and evaluation of these various technologies showing the drawbacks and opportunities of each and how the various technology components can be combined to a “full” sanitation system

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- agreement for a structured characterization of sanitation systems and their respective potential sanitation technology configurations.
- description of systems and technology configurations
- streamlined list of criteria for appraisal
- qualitative appraisal of technologies

The concept of Inputs – Products – Processes

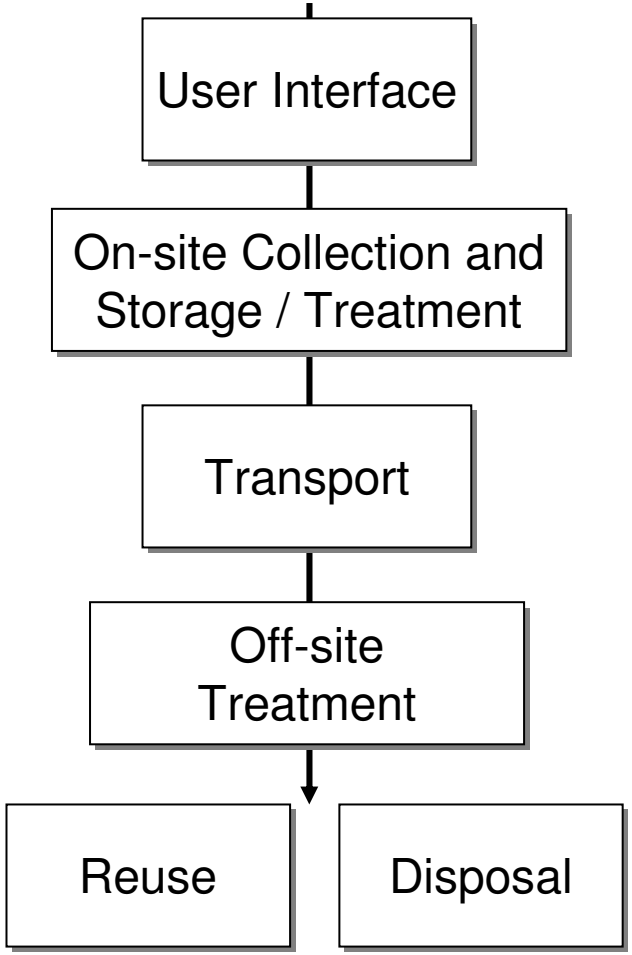
Waste Inputs

- Urine
- Faeces
- Beigewater
- Dry Cleansing Material
- Flushwater
- Greywater
- Stormwater
- Organic SW

Waste Products

- Urine
- Excreta
- Blackwater
- Faecal sludge
- Compost Humus

Processes



Some Terminology

Sanitation System includes all the components (physical parts and actions) required for the adequate management of human waste. By considering 'sanitation' as a multi-step process, and not a single point, all waste products are accounted for from the point of generation to the point of ultimate disposal.

Waste Products are types of human wastes (urine, faeces, flushing water, blackwater, greywater, etc.) obtained by the system characteristics

Flowstreams: Waste products that are generated in the system will pass through different processes before they can be appropriately reused or disposed of. This "flow" of a product through process steps is called a flowstream.

Process step is a generic description of what happens to the product (e.g. collection, storage, transport, treatment)

Technologies are simply product-specific processes that contain, transform, or transport products to another process or a final point of use or disposal.

Typical Sanitation Systems

No.	System name	Flowstreams
1	Wet mixed blackwater and greywater system with offsite treatment	▪ blackwater mixed with greywater flowstream ▪ faecal sludge flowstream
2	Wet mixed blackwater and greywater system with onsite treatment	▪ blackwater mixed with greywater flowstream ▪ faecal sludge flowstream
3	Wet blackwater systems (blackwater separated from greywater)	▪ blackwater flowstream ▪ faecal sludge flowstream ▪ greywater flowstream
4	Wet urine-diversion system	▪ urine flowstream/ yellowwater ▪ brownwater mixed with greywater flowstream ▪ faecal sludge flowstream
5	Dry greywater-separate system	▪ excreta flowstream ▪ greywater flowstream
6	Dry urine- and greywater-diversion system	▪ urine flowstream ▪ faeces flowstream ▪ greywater flowstream
7	Dry all mixed systems	▪ excreta mixed with greywater flowstream

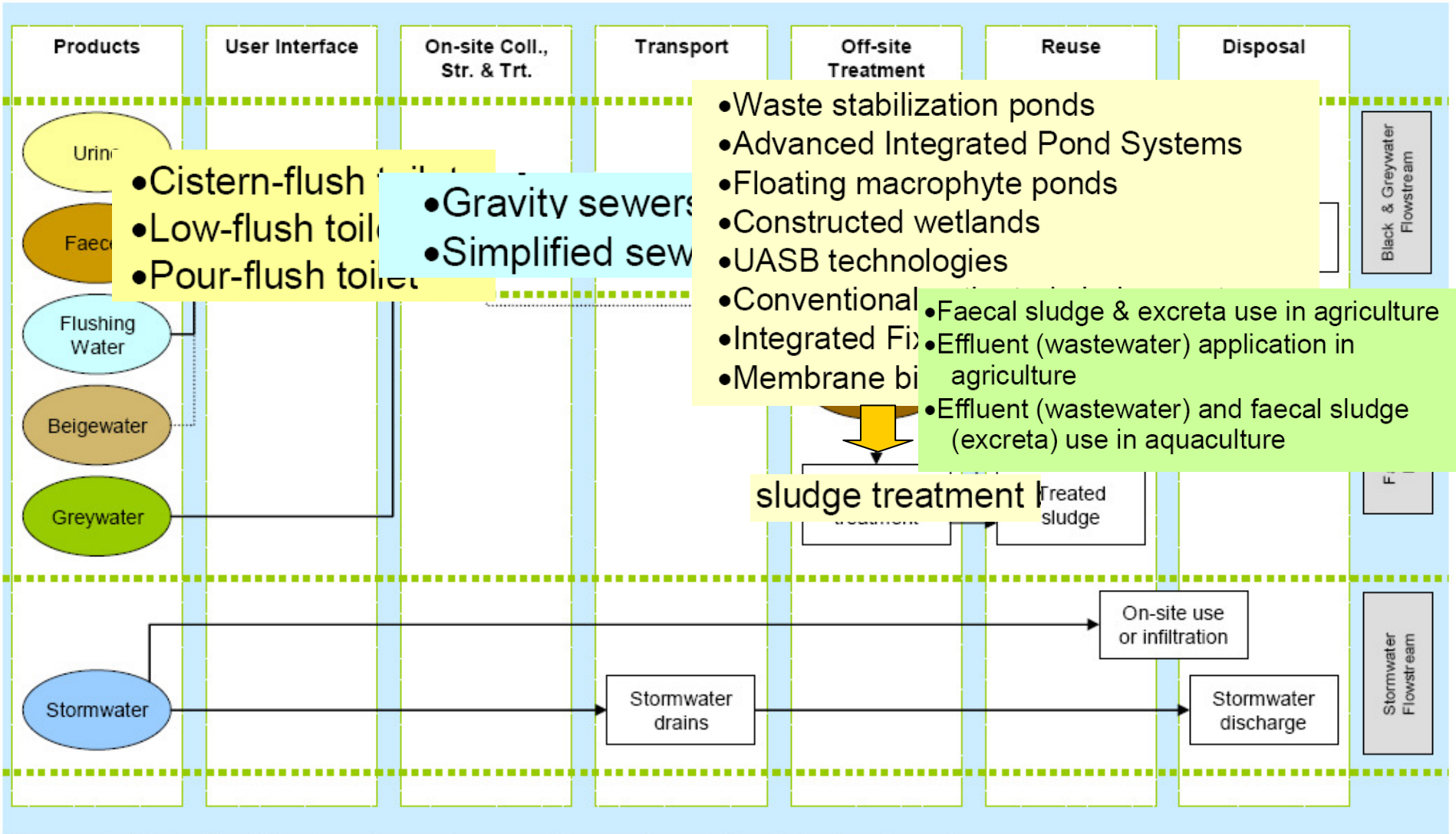


Figure 1. Wet mixed blackwater and greywater system with offsite treatment

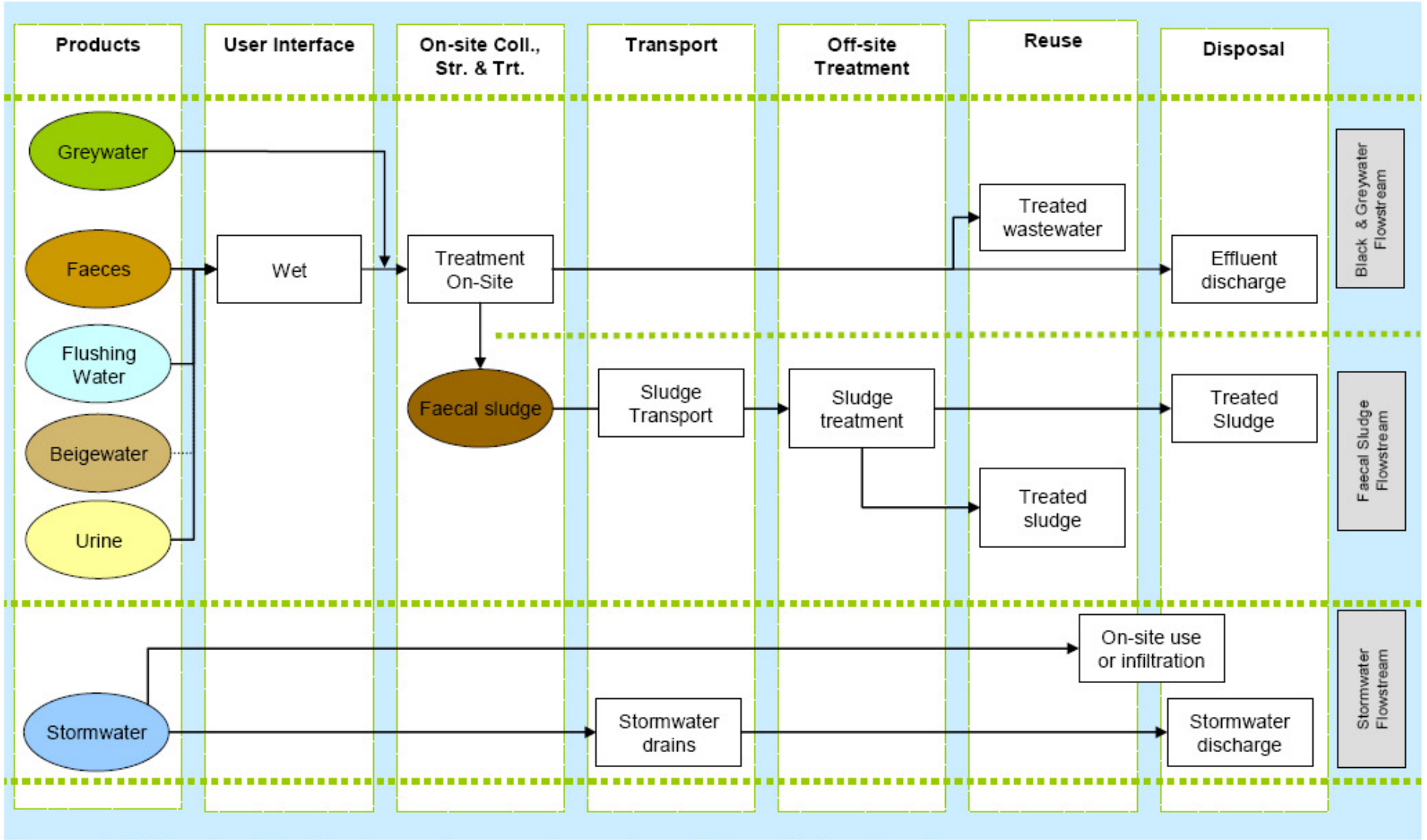


Figure 2: Wet mixed blackwater and greywater system with onsite treatment

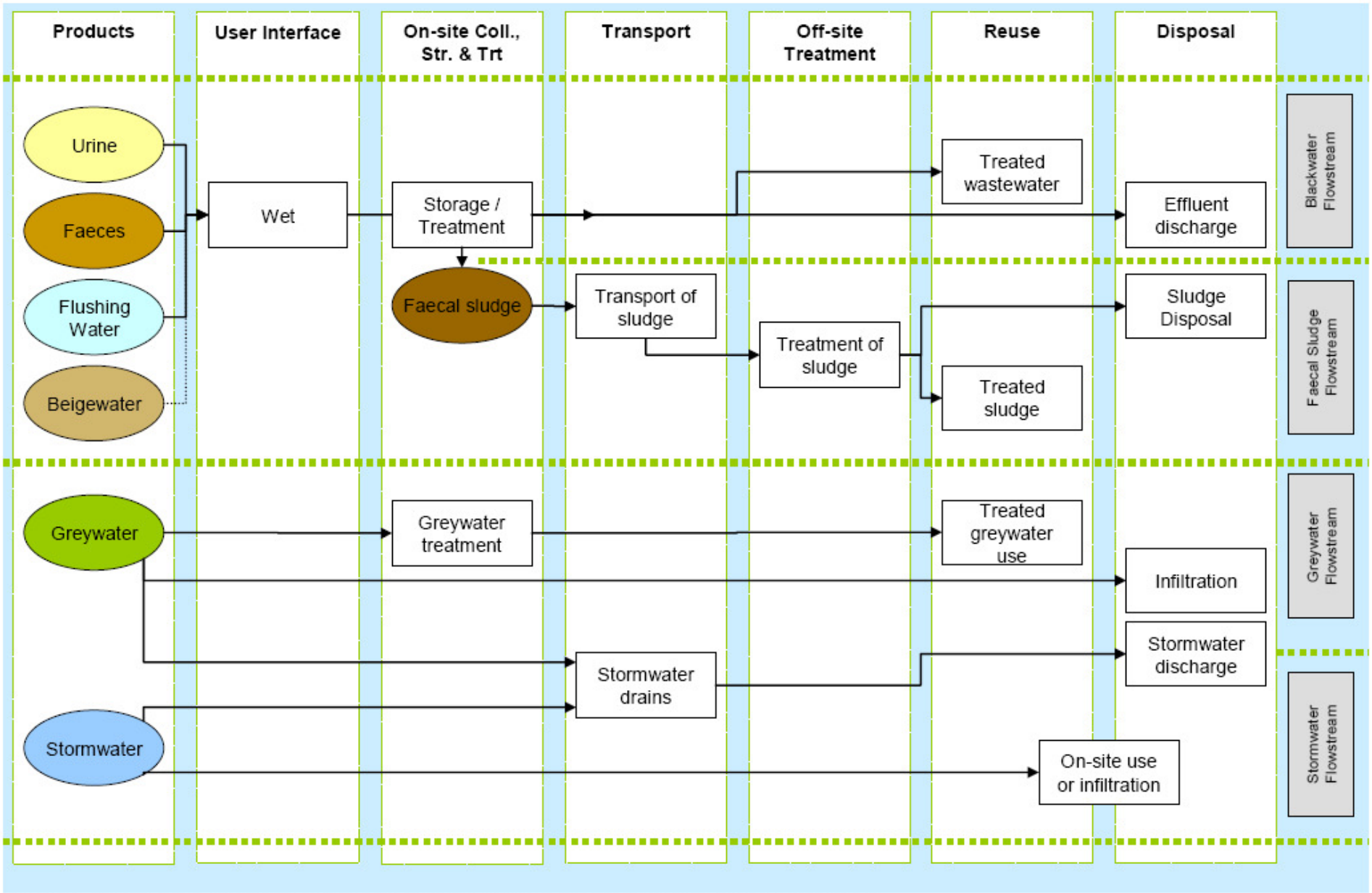


Figure 3. Wet blackwater system where greywater is managed separately

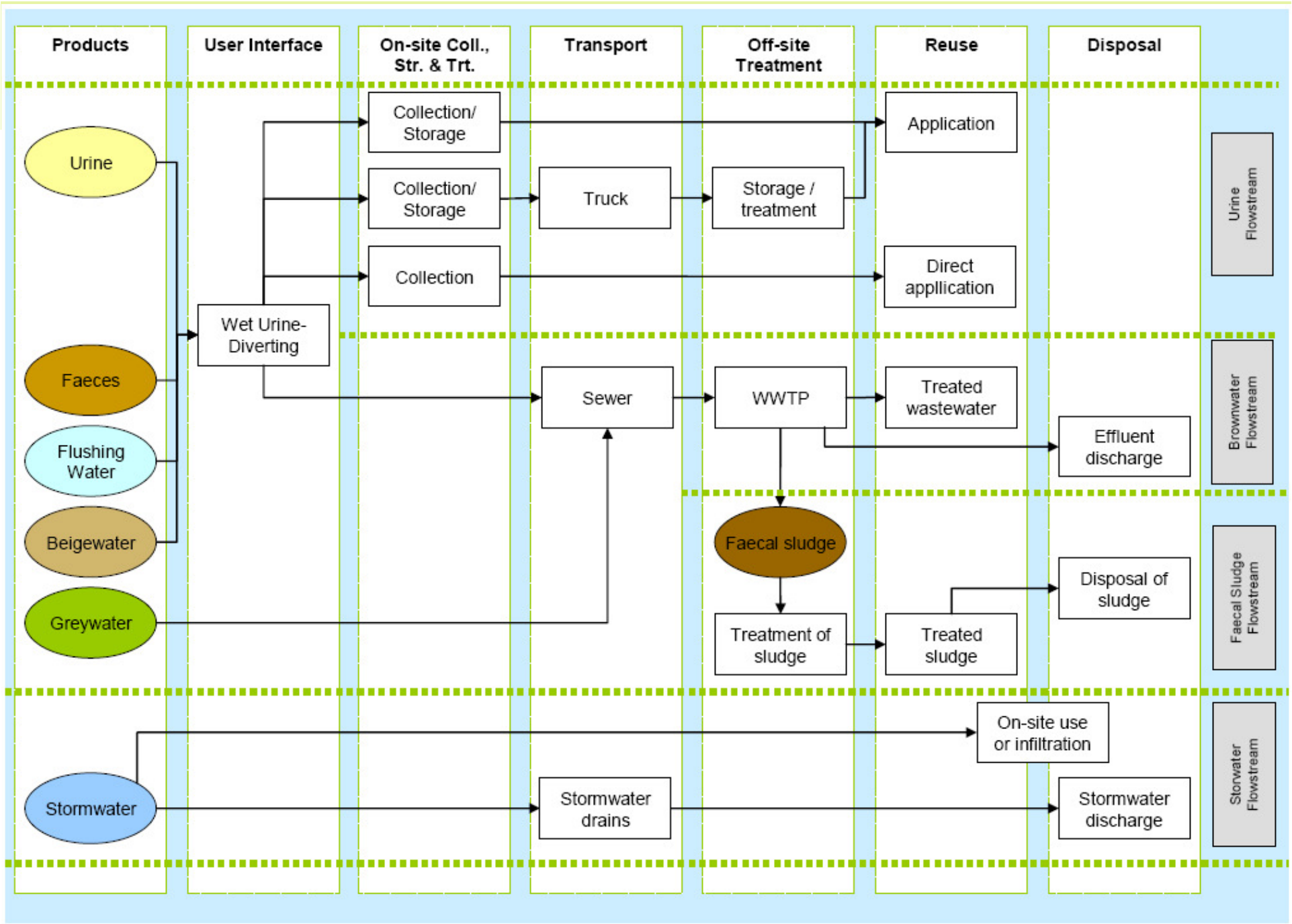


Figure 4: Wet urine diversion system where urine and brownwater (with greywater) are managed separately

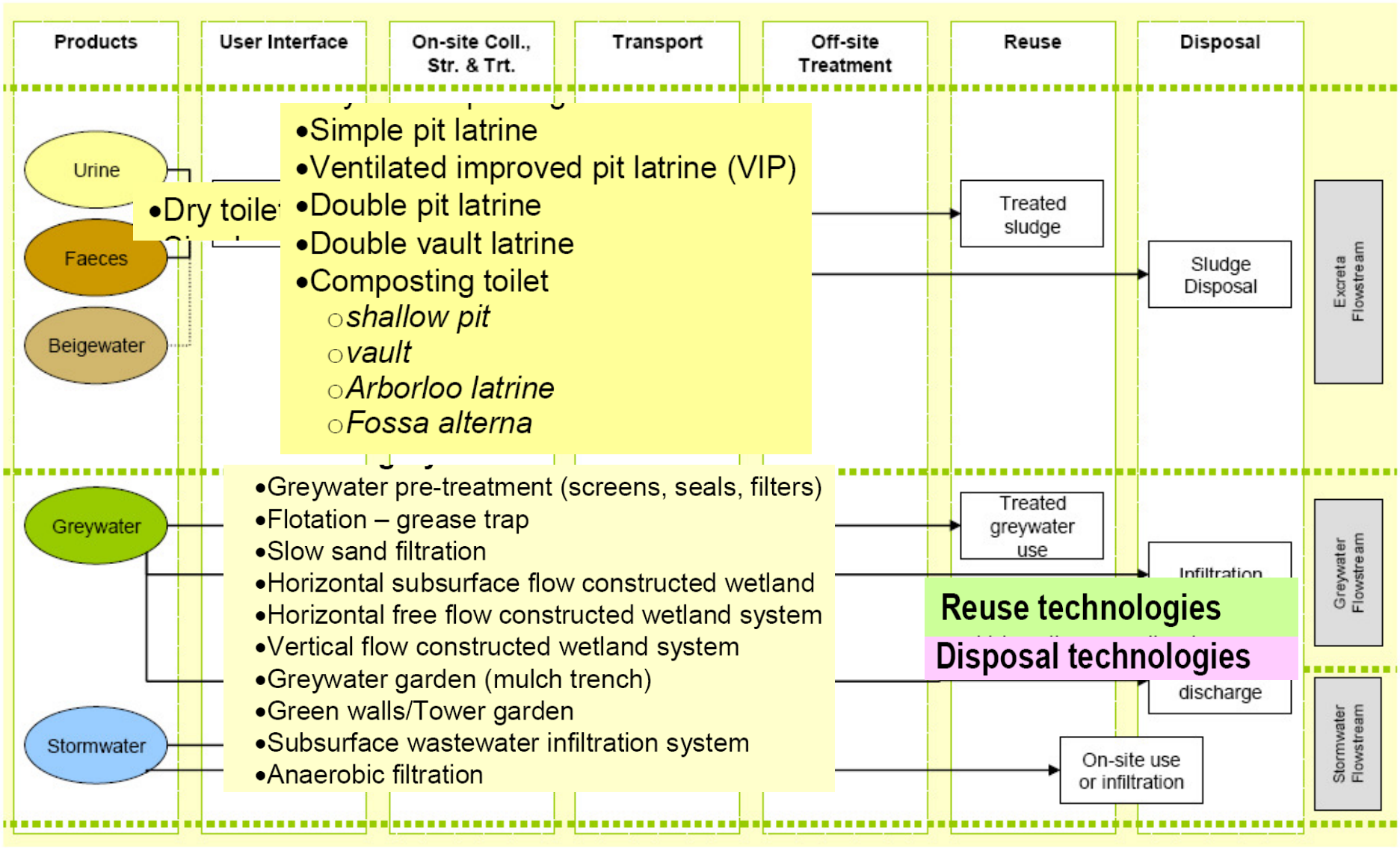


Figure 5: Dry onsite excreta storage with greywater diversion system

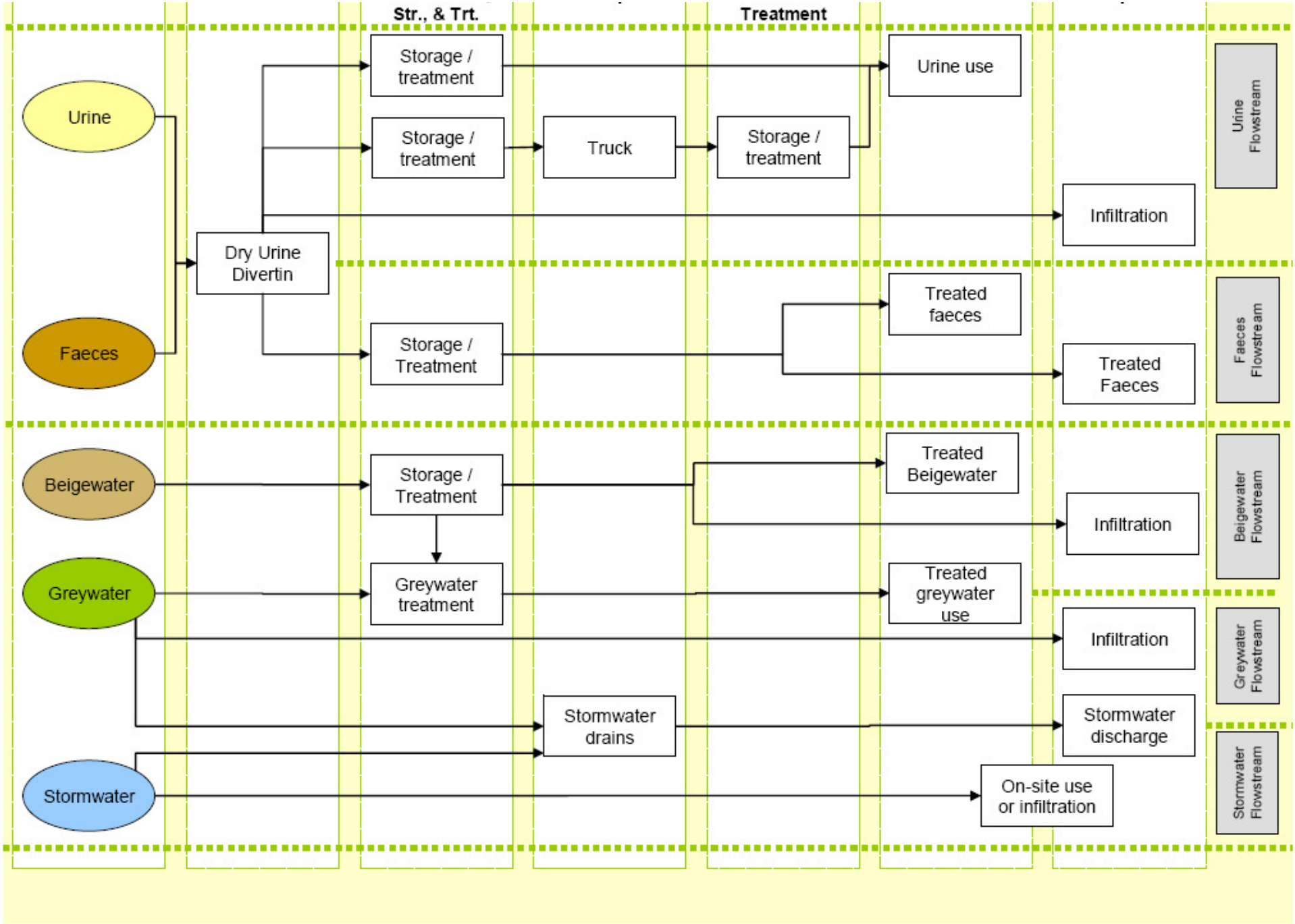


Figure 6. Dry urine, faeces and greywater diversion

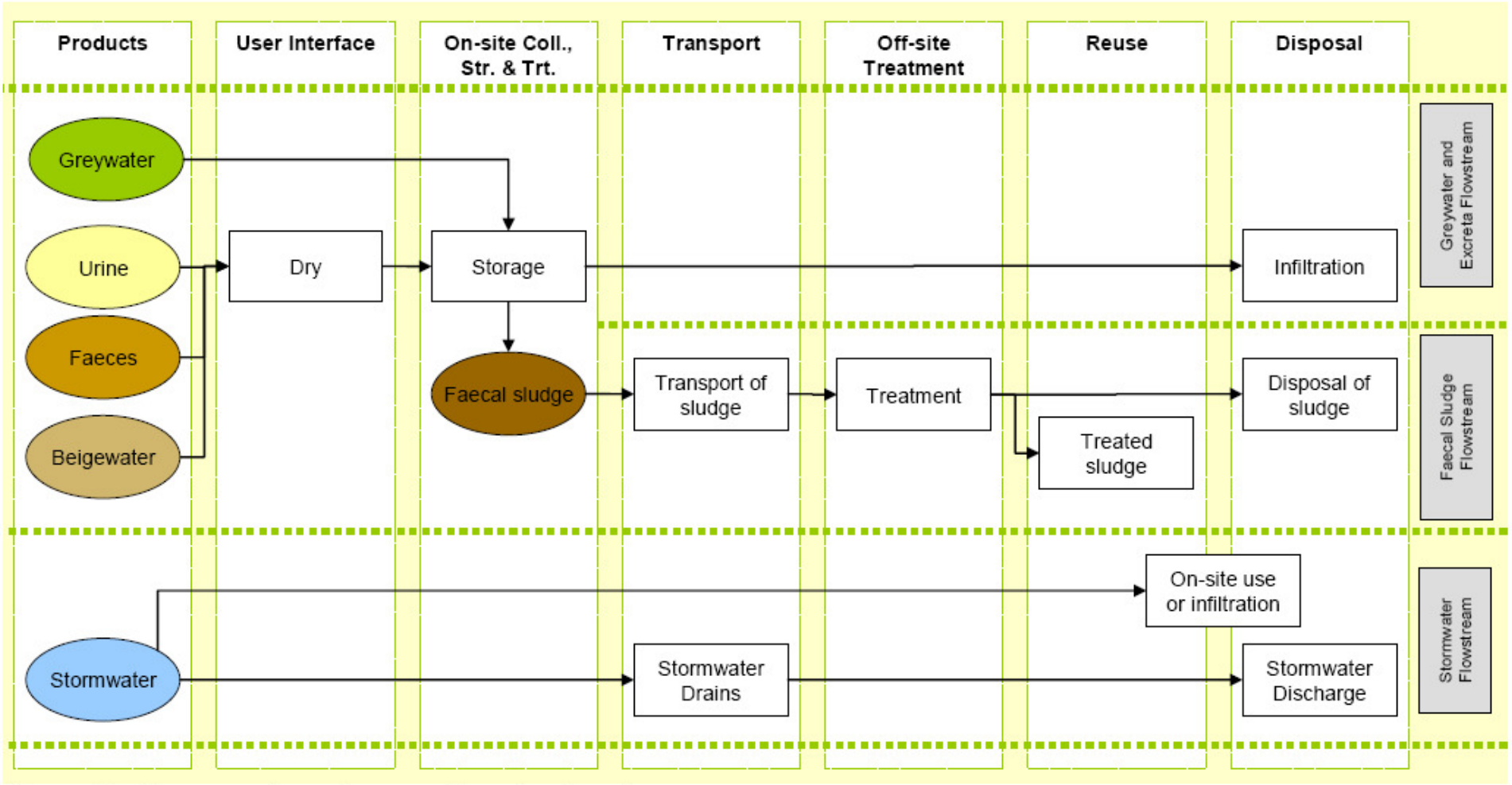


Figure 7. Dry excreta and greywater mixed system

Processes and Technologies

Toilet & collection technologies

- Cistern-flush toilet
- Low-flush toilet
- Pour-flush toilet
- Urine-diversion toilet
  - *Flush toilet*
  - *Waterless toilet*
- Urinal
  - *Waterless urinals*
  - *Low-flush urinals*
- Dry toilet squatting slab
- Simple pit latrine
- Ventilated improved pit latrine (VIP)
- Double pit latrine
- Double vault latrine
- Composting toilet
  - *shallow pit*
  - *vault*
  - *Arborloo latrine*
  - *Fossa alterna*

Transport technologies

- Gravity sewers
- Small bore sewers
- Simplified sewerage
- Vacuum sewerage
- Open drains
- Urine pipes
- Manual urine transport
- Trucked urine transport
- Manual or suction truck faecal sludge emptying and transport

On-site storage and treatment technologies

Related to wastewater

- Septic tank
- Cesspit
- Anaerobic baffled reactor
- Anaerobic digester
- Trickling filter
- UASB reactor (Upflow Anaerobic Sludge Blanket)

Related to urine

- Urine long-term storage
  - *in different types of containers*
  - *in large storage tank*
- Urine can, bucket or container storage
- Urine desiccation

Related to excreta and faecal sludge

- Faecal sludge co-composting
- Faecal sludge treatment by
  - *constructed wetlands (humification)*
  - *unplanted drying beds*
  - *settling ponds*
  - *anaerobic digestion*

Related to greywater

- Greywater pre-treatment (screens, seals, filters)
- Flotation – grease trap
- Slow sand filtration
- Horizontal subsurface flow constructed wetland
- Horizontal free flow constructed wetland system
- Vertical flow constructed wetland system
- Greywater garden (mulch trench)
- Green walls/Tower garden
- Subsurface wastewater infiltration system
- Anaerobic filtration

Off-site treatment technologies

Related to wastewater

- Pre-treatment
- Waste stabilization ponds
- Advanced Integrated Pond Systems
- Floating macrophyte ponds
- Constructed wetlands
- UASB technologies
- Conventional activated sludge systems
- Integrated Fixed-film Activated Sludge
- Membrane biological reactors

Related to urine

- Off-site urine storage tank
- Urine MAP-dissipation

Reuse technologies

- Urine direct application
- Urine on-site reuse
- Urine mechanized off-site reuse
- Faecal sludge & excreta use in agriculture
- Effluent (wastewater) application in agriculture
- Effluent (wastewater) and faecal sludge (excreta) use in aquaculture

Disposal technologies

- Soakaway pit
- Infiltration trench/field

Addressing non-site specific criteria

Health issues	
reduces exposure	of users
	of waste workers
	of resource recoverers /reusers
	of "downstream" population
hygienization rate	
increases health benefits	
Impact to environment / nature	
use of natural resources	needs low land requirements
	needs low energy requirements
	uses mostly local construction material
	low water amounts required
low emissions and impact to the environment	surface water
	ground water
	soil / land
	Air
	noise, smell, aesthetics
good possibilities for recovering resources	Nutrients
	Energy
	organic matter
	Water
Technical Characteristics	
allows simple construction and low level of technical skills required for construction	
has high robustness and long lifetime/high durability	
enables simple and low operational procedures and maintenance and low skills required	
Economical and financial issues	
has low construction costs (unit cost per household)	
provides benefits to the local economy (business opportunities, local employment, etc.)	
has low operation and maintenance costs	
provides benefits or income generation from reuse	
Social, cultural and gender	
delivers high convenience and high level of privacy	
requires low level of awareness and information to assure success of technology	
requires low participation and little involvement by the users	
takes special consideration issues of women, children and elderly	

Addressing site specific criteria still required

Summary

raise awareness and knowledge for informed decision making by

- launching discussion and debate on the concept of sanitation systems
  - Cradle to Grave/Use (functional steps)
  - Different waste products….different flowstreams
- describing a selection of sanitation system templates, their waste products, flowstreams and the possible technology configurations showing pros and cons

- Suggested criteria for critical technology evaluation

Thank you for your attention !

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