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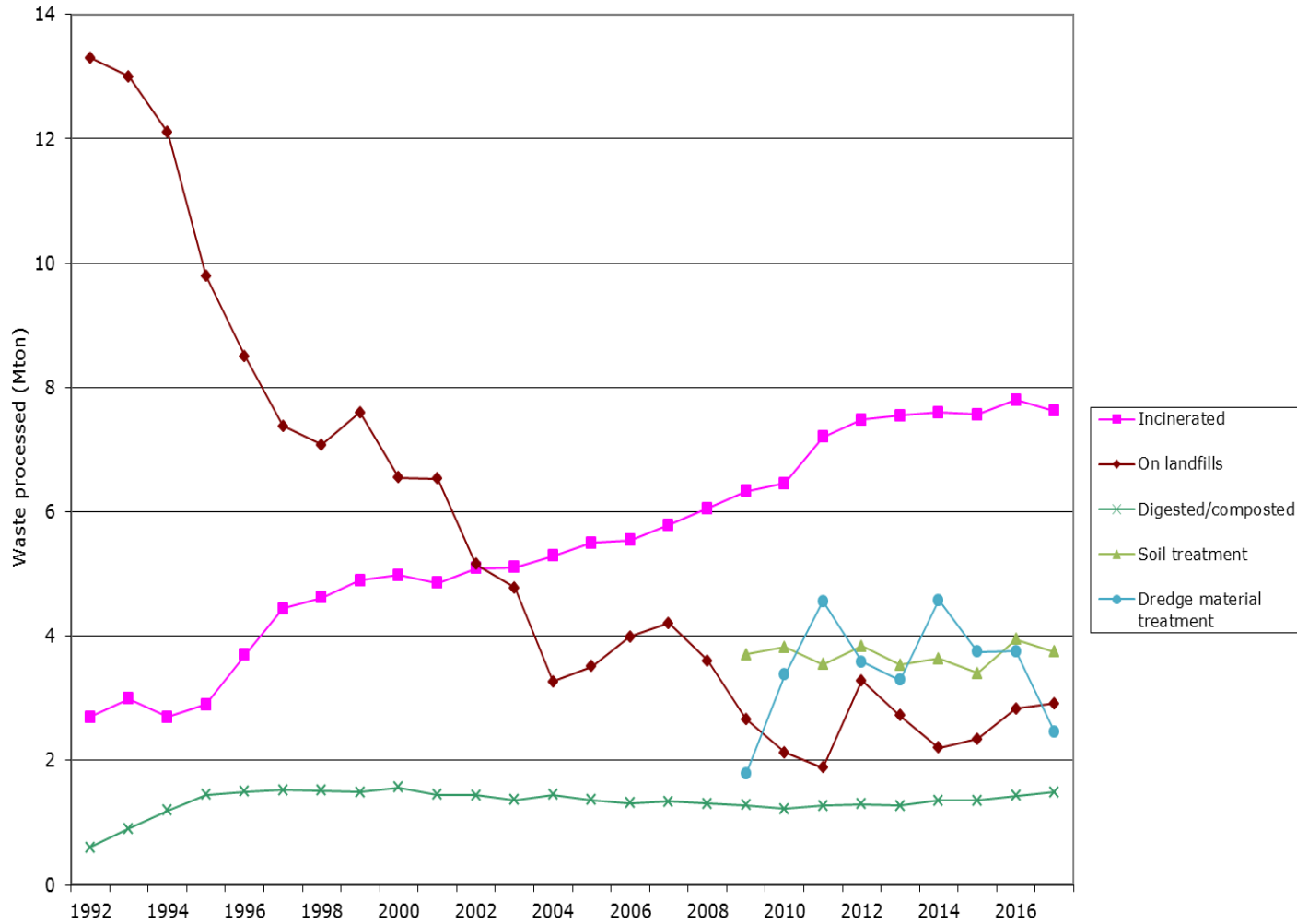
Landfill management in the Netherlands

Dutch policy regarding landfill mining

Fons van de Sande
Rijkswaterstaat

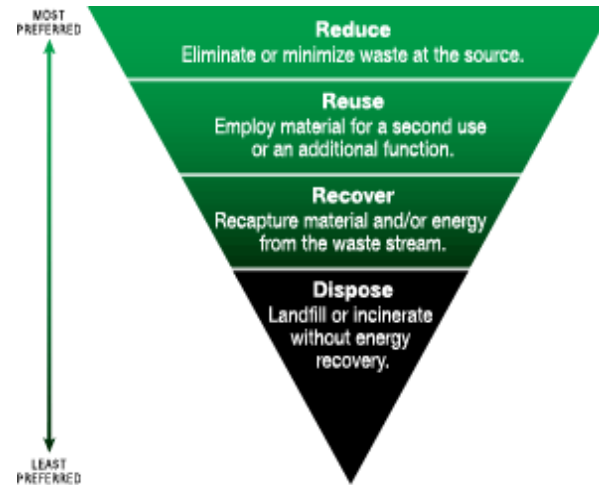
Lindlar, 22/10/2019

Amount of waste processed (1992-2017)



Characteristic elements of Dutch waste management

- National Waste Management Plan has a policy framework and 85 sector plans→policies several waste streams (textile, plastics,...)
- Core of each sector plan is 'minimum standard' (stringent waste treatment standards)→ indication how the waste material must be processed.



Characteristic elements of Dutch waste management

- Landfill bans for materials that can be treated/recycled with best available techniques
- Various (economic) instruments to stimulate prevention of waste and stimulate recycling: local municipal waste taxes (fixed and variable part), differentiated taxes on municipal waste ('pay as you throw away'), landfill tax, tax on incineration waste
- Producer responsibility (WEEE, batteries, car wrecks, car tires, packaging)

Operational landfills in the Netherlands

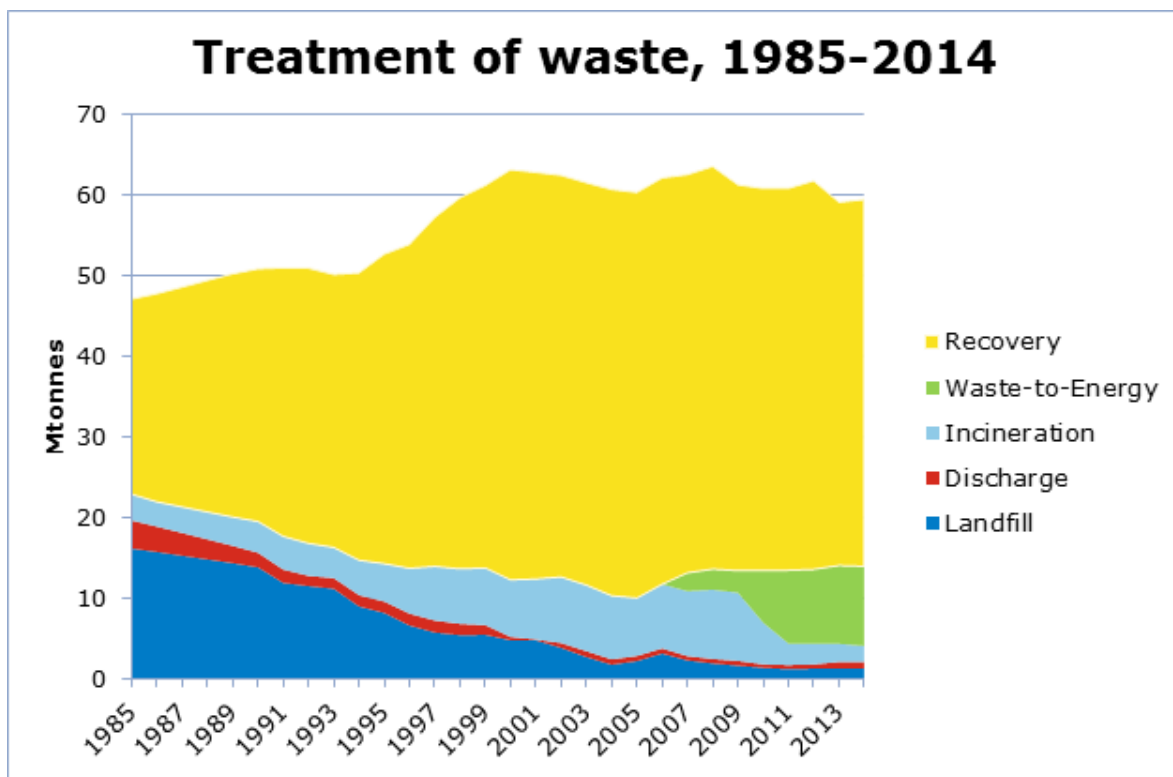
1970: over 1.600

1980: 200

1992: 80

2019: 19

<https://www.interregeurope.eu/cocoon/news/news-article/3676/evaluation-of-the-dutch-landfill-management-policy/>



..... 2% landfilling, 81% recycling, 17% waste to energy

Landfills in the Netherlands: two types

1. Former landfills (4.000 - 6.000)

- Taken out of operation by 1 September 1996
- Mostly owned by local or regional authorities
- No specific legal framework for these landfills; competent authorities mostly acted on the basis of the Soil Protection Act and permits according provincial environmental regulations

Landfills in the Netherlands: two types

2. Sanitary landfills (80)

- In operation after 1 September 1996
- Have to meet stringent regulations and reconstructed as a sanitary landfill (comply with the Dutch Environmental Management Act)
- Provinces are competent authorities (permits)
- Aftercare is mandatory:
 - Site operator responsible (during operation)
 - Province responsible for aftercare
 - Dedicated fund needed to finance the aftercare (established and managed by province, funded by landfill operator)
 - Currently 19 operational sanitary landfills

Legislation and regulations sanitary landfills

European level: Directive 1999/31/EU

→ largely determines the conditions within which waste can be deposited in landfills

National level: Directive 1999/31/EU implemented in:

- Directive for Landfill and Waste Disposal Bans
- Dutch Soil Protection Decree (Soil Protection Act): describes the measures to be taken at the time of construction of a landfill ('isolate, manage, control')
- Environmental Protection Act: rules and regulations for aftercare/monitoring after closure

Soil Protection Act and Environmental Protection Act will be integrated in Environmental and Planning Act (2021) → municipalities become (sole) authority for soil protection: responsibilities transform from provinces to municipalities

Former landfills

- 'Lekkerkerk': national attention to contamination of soil
- National government and provinces made an national overview of potential risks of former landfills: investigation program NAVOS
- Goals:
 - to locate former landfill sites
 - formulate realistic proposals with regard to the content, organization and financing of remediation efforts for former landfills
- Results:
 - in 90% insufficient thickness of top-covering, but in most cases no risks
 - at 60-80 sites (remediation) measures were taken to prevent spread of contamination and to mitigate human and/or ecological risks →remediation measures executed under the Soil Protection Act

Former landfills

Commission 'DUIV' advised to make policies for redevelopment of former landfills (provincial environmental regulations, provincial policy notes etc).

Policies based on the Environmental Protection Act and Soil Protection Act

- Give opportunity to achieve environmental objectives
- Competent authorities can require a remediation plan when an initiative for redevelopment of a landfill is born

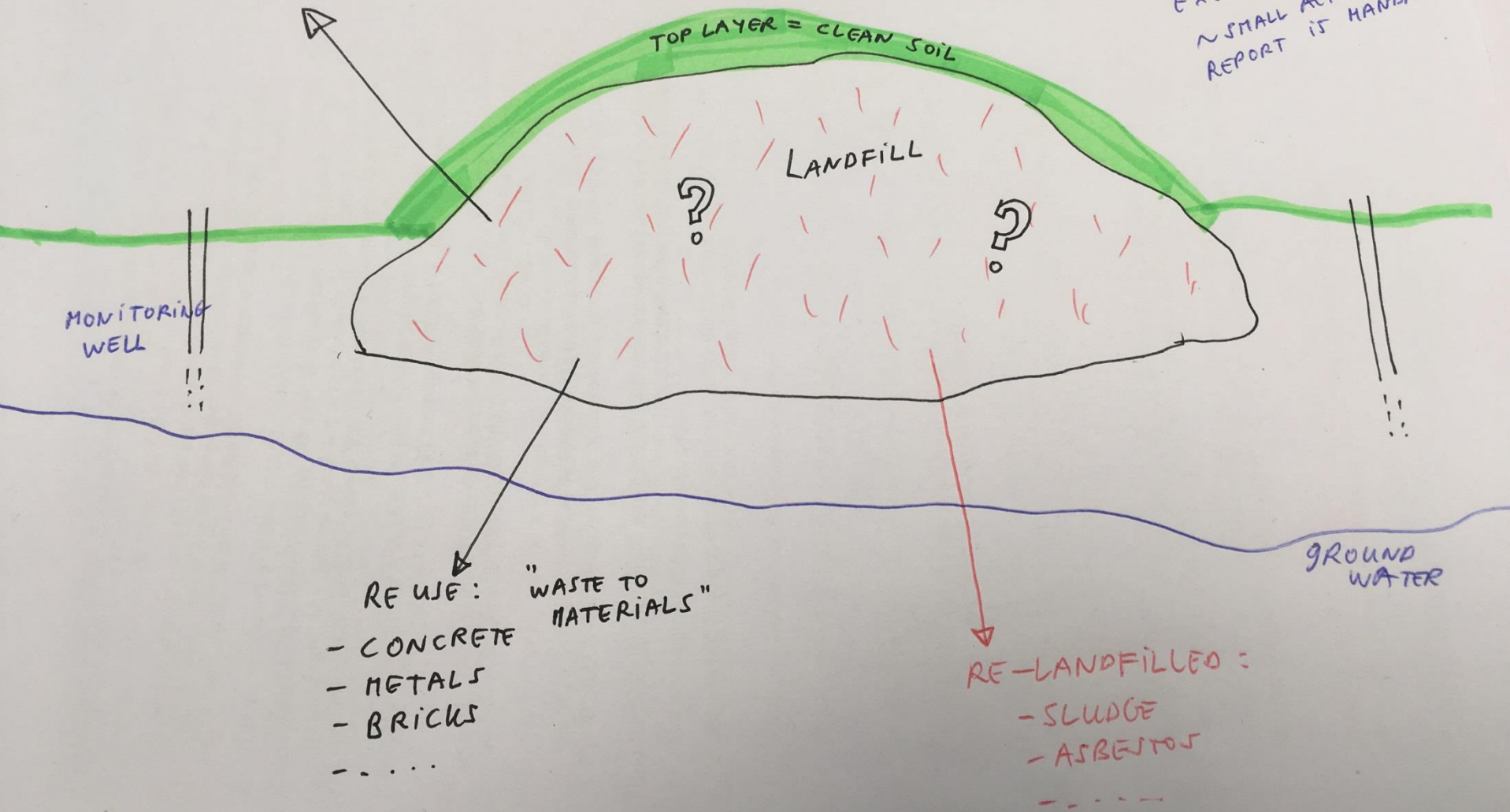
For example province Noord Brabant: 600 former landfills

- Space is scarce in the Netherlands!→prefer redesigning the area
- Province checks whether the initiative meets the environmental requirements
- For redesign activities an exemption is required (e.g. for mining) or a report must be made (small activities)

- WOOD/ORGANICS }
- PLASTICS } INCINERATOR
- } "WASTE TO ENERGY"

REMEDIATION PLAN
(SOIL PROTECTION ACT
PROVINCIAL ENVIRONMENTAL REGULATIONS)

PROVINCE CHECKS:
~ MINING?
EXEMPTION IS REQUIRED
~ SMALL ACTIVITIES?
REPORT IS MANDATORY



TOP LAYER = CLEAN SOIL

LANDFILL

?

?

MONITORING WELL

GROUND WATER

RE USE: "WASTE TO MATERIALS"
- CONCRETE
- METALS
- BRICKS
-

RE-LANDFILLED:
- SLUDGE
- ASBESTOS
-

Mining former landfills in the Netherlands

2015: Desk research about potentials mining former landfills

Conclusions:

- Limited experience mining
- No profitable business case when focus is on recovering materials
- Knowledge building is limited
- Environmental risks former landfills are limited (natural attenuation)

But also awareness of benefits mining:

- Decrease environmental risks
- Potential for high quality use of area
- Decrease less primary raw materials by recycling landfilled waste

Mining former landfills in the Netherlands

Trends:

- Transition to a circular economy
- Transition in waste management (increasing reuse, recycling)
- Less use primary raw materials

Give new attention to former landfills:

- Waste to materials
- Waste to energy
- Interim use

Raw materials in former Dutch landfills

Distinction of 4 categories of raw materials in former landfills:

- Raw materials that are almost fully worked up into a raw material that can no longer be distinguished from primary raw materials (e.g. gold, copper)
- Raw materials that will be used for the same material and function as they used to be (e.g. soil)
- Raw materials that will be used in a less high-quality application (e.g. concrete that is applied in mixed granulate) → down cycling
- Residual fractions for generating energy

Composition of raw materials in former landfills:

- Differs from landfill to landfill
- Distinction in:
 - Landfills which contain largely household waste
 - Landfills which contain largely construction- and demolition waste
 - Waste from several sources

Raw materials in former Dutch landfills

Composition (approximately) of waste from 'household' landfills

| Component | 1958 (%) | 1971 (%) | 1990 (%) | Average |
|----------------------|----------|----------|----------|---------|
| Organic waste | 56 | 52 | 52 | 53 |
| Paper and card board | 20 | 26 | 25 | 24 |
| Plastics | 0 | 5 | 8 | 4 |
| Glass | 2 | 10 | 5 | 6 |
| Iron | 2 | 3 | 3 | 3 |
| Non-ferrous metals | 0 | 0 | 1 | 0 |
| Textile | 1 | 2 | 2 | 1 |
| (Small) toxic waste | 0 | 0 | 1 | 0 |
| Other/rest | 19 | 2 | 4 | 8 |

Compendium voor de Leefomgeving, samenstelling huishoudelijk restafval 1940-2001

Raw materials in former Dutch landfills

Composition (approximately) of waste from ‘construction and demolition’ landfills

| Component | 1990 (%) |
|----------------------------------|----------|
| Organic waste (incl. inert soil) | 0 |
| Paper and card board | 1 |
| Plastics | 1 |
| Glass | 1 |
| Ferro | 1 |
| Non-ferro | 0 |
| Ceramics | 60 |
| Wood | 6 |
| Diverse flammable | 1 |
| Diverse non-flammable | 29 |

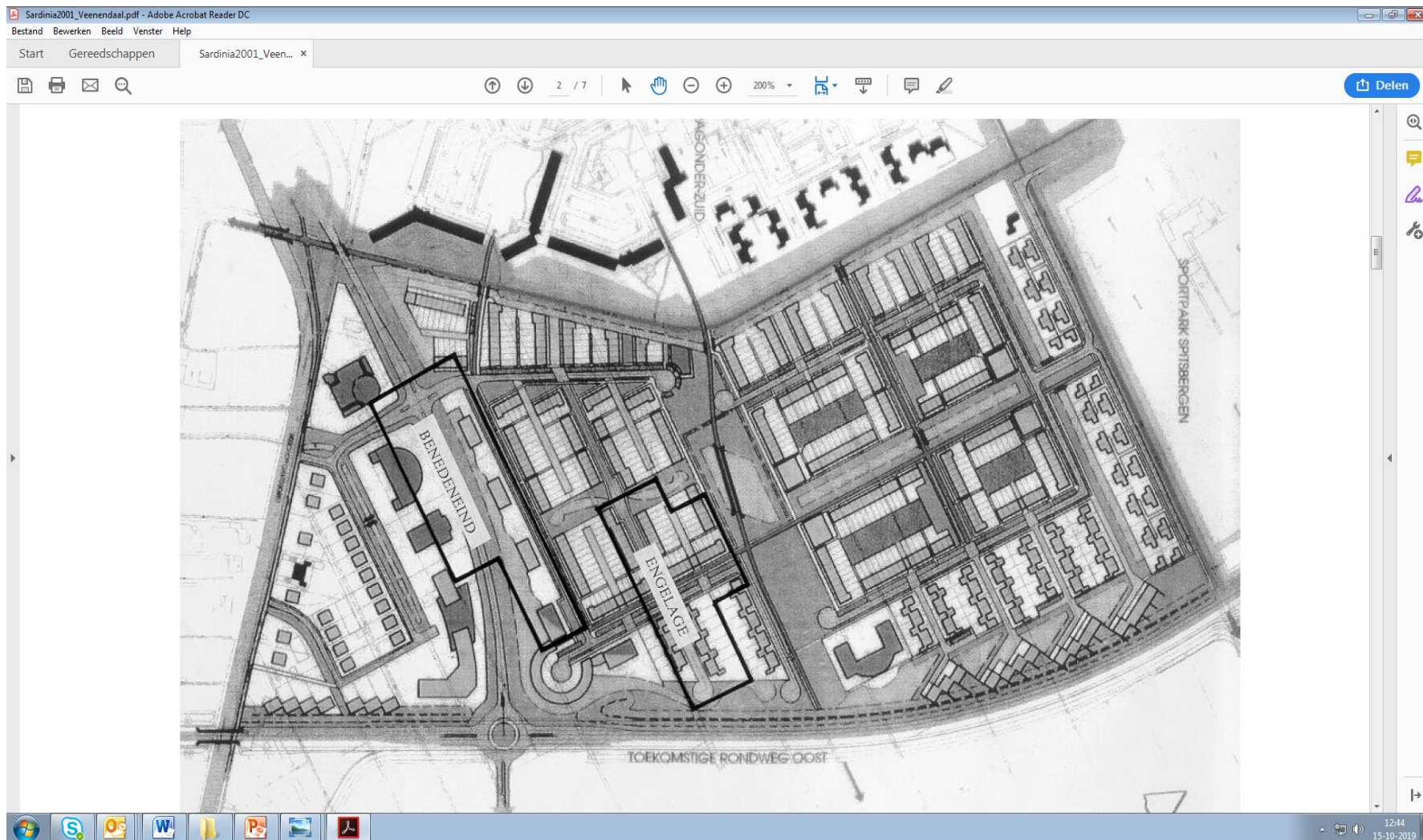
AOO, 1994

Mining: waste to materials

Veenendaal

- Expanding area for 700 houses (region Utrecht)
- In middle development two former landfills (household waste) → obstruction!
- Study: complete removal with separation into partly reusable fractions was the most preferred and affordable/economic option
- Removal was economically viable by
 - increased land price (land is scarce, demand on land in this region is high)
 - financing municipality
 - subsidy province
- Excavation: April - December 2000

Veenendaal



Veenendaal



Excavation and separation

- Excavation by excavator
- Separation by:
 - screening
 - sieving
 - visual inspection and hand sorting (removal hazardous waste, metals, bricks)
 - on-site stone crushing
 - off-site soil cleaning

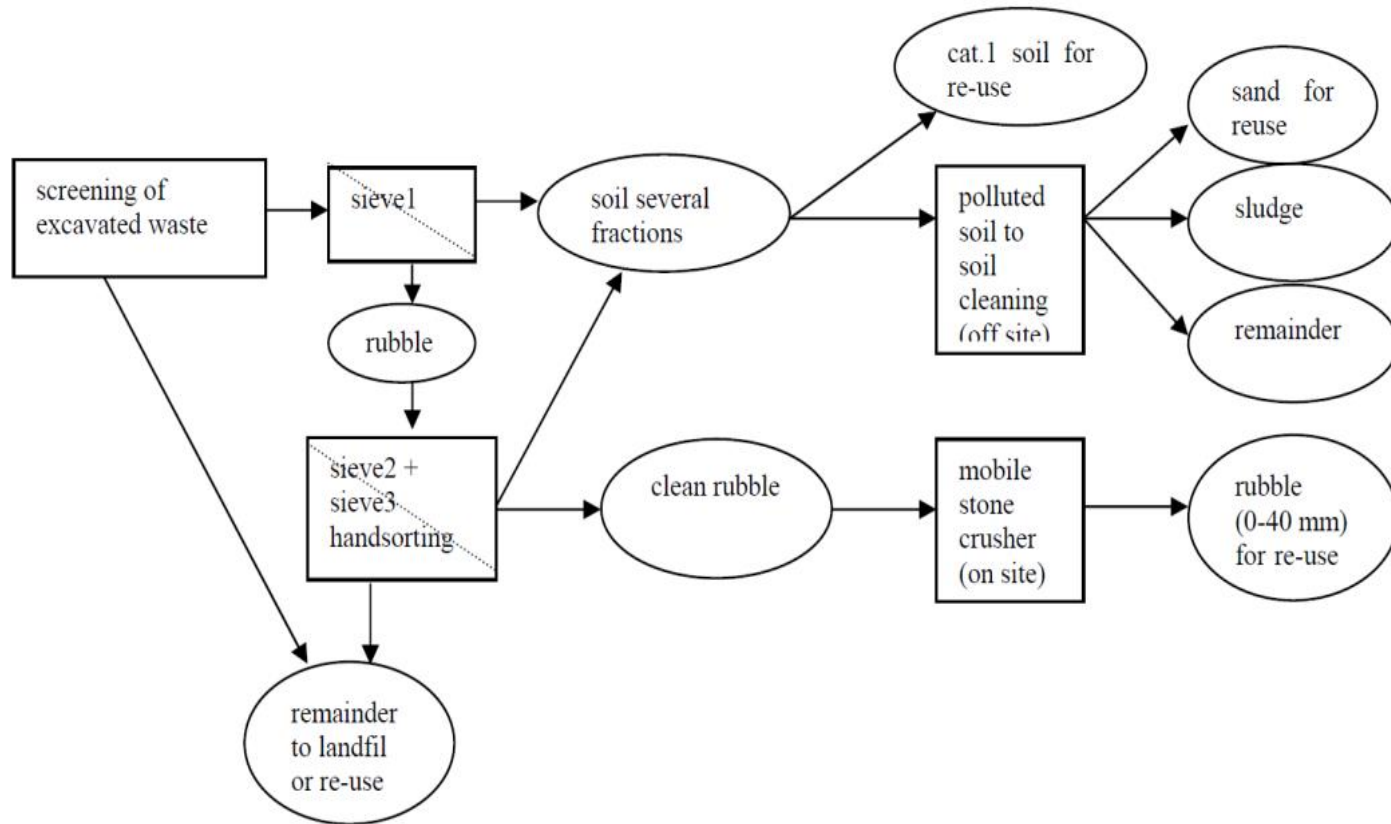
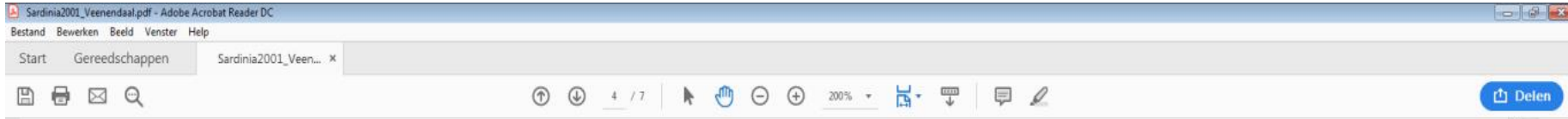


Figure 3. Flow chart of the separation process.



Sardinia2001_Veenendaal.pdf - Adobe Acrobat Reader DC

Bestand Bewerken Beeld Venster Help

Start Gereedschappen Sardinia2001_Veen... x

4 / 7 200%

Delen

Table 2 – Overview of the different fractions

| Material | Amount (ton) | Destination |
|------------------|--------------|--|
| Excavated waste | 85,000 | |
| Rubble | 10,000 | re-use under roads |
| Soil (cat.1) | 7,000 | direct re-use |
| Polluted soil | 50,000 | soil cleaning plant |
| Waste | 17,000 | landfill |
| Special category | 1,000 | several treatment facilities (tyres, iron, chemical waste, wood) |

1341
15-10-2019

Evidence of success

- 80% excavated waste was extracted for reuse
- Remainder 20% transported to sanitary landfill (plastics, car tires, asbestos)
- Lowest percentage re-landfilled waste in Dutch mining project

Amersfoort Vathorst area (2006-2007)

- Two former landfill sites (461.000 m³ of household waste, industrial waste and sludge and 160.000 m³ soil) completely excavated
- Ground water was lowered by means of pump drainage into sedimentation reservoir → discharged to municipal sewer system
- Majority of the waste (including 160.000 m³ excavated soil) was transported to a sanitary landfill
- 94% waste was re-landfilled
- Excavated soil (top cover) could be reused almost completely

Stakeholders:

- Municipality of Amersfoort
- Province of Utrecht
- Smink Afvalverwerking BV (contracting firm, now part of Renewi)
- Vathorst C.V. (development company/customer; cooperation between municipality and several contractors)

Project funded by Vathorst C.V.

Evidence of success

- 100% waste excavated
- Top soil cover reused almost completely
- Excavation pit was drained successfully, by which groundwater contamination was minimized



Remainder Dutch mining projects

Several other (mining) projects with various motives:

- Generating new landfill capacity
- Mining resources (metals and combustible waste)
- Area development
- Pilot (testing cost effectiveness of available technologies)

Mining: waste to renewable energy

Biozon



- Former landfill Langenberg (household waste) closed in 1990
- Landfill 43 m above ground level covered by trisoplast, foil and 2 m soil layer
- Since 1994 gas extraction by a commercial enterprise
- Engine be replaced by one with less power that fits the actual gas volume→business model no longer positive for the commercial enterprise
- AGEM (a cooperation of municipalities, citizens and business from the region) ambition to become energy neutral in 2030
- AGEM set up the local cooperation BioZon to replace the old motor and exploit the landfill gas installation (80 kW)
- BioZon cooperation exploits the installation
- Financed by subsidy from the province and selling certificates to the local community

Mining: waste to renewable energy

- Members of the BioZon cooperation profit from a national tax regulation for renewable energy according to their certificates of participation
- Estimated costs of exploitation: € 205.000,- for the next six years.
- Next to renewable energy the landfill has been transformed into an attractive green hill full of nature (open area for hikers and other recreational activities)



COREL: Collective Regeneration of former Landfills

‘A method for governments and financiers to take responsibility for the multifunctional regeneration of former landfills’

- Cooperation of 9 municipalities (Clean tech region), ministry, province, Afvalzorg (public investor)
- Goal: regenerating former landfills with a sound business case
- How?
 - Functions create yields: generating renewable energy (gas extraction, solar panels), agriculture, recreation, housing, industry,...
 - Business cases increase when various functions share costs and enhance one another (e.g. agriculture under solar panels→energy to houses=cheap energy). Yields enable to manage the landfill!
- Problem: governments and financiers have difficulties to take responsibility for these kind of multifunctional business cases
- Solution: create larger portfolios of landfills, collectives!



COREL: Collective Regeneration of former Landfills

For example:

A portfolio of 20 landfills. Financiers will finance as a whole the clean energy projects, as a whole the housing projects, as a whole the agriculture projects etc.

But: governments and investors can't take responsibility for the whole portfolio

In the COREL project:

1. A portfolio manager will make a comprehensive plan for each individual landfill, wherein for instance energy, housing and park share costs and enhance one another
2. Portfolio manager will create packages of energy projects, housing projects and will present those to governments and investors
3. Portfolio manager will guard (in stage of development) that on each landfill the projects will be realized in a comprehensive way

