



Landfill Safety Plan

A methodology to guarantee safe waste management



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Outline

- ▶ Landfill: a public health & environmental issue
- ▶ Modern landfill concept as a multi-barrier principle
- ▶ Framework for Safe Landfill
- ▶ Conclusions

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Landfill: a public health & environmental issue



Landfill: a public health & environmental issue

- ▶ Public health protection
 - ▶ Occupational works and scavengers
 - ▶ Disease vectors for neighbourhood exposures (birds, rodents, insects, etc.)
 - ▶ Odour, noise, litter and dust

Landfill: a public health & environmental issue

- ▶ Environmental protection
 - ▶ Leachate treatment and disposal
 - ▶ Landfill gas treatment and utilisation
 - ▶ Vegetation damage
 - ▶ Soil pollution
 - ▶ Surface water pollution
 - ▶ Groundwater pollution
 - ▶ Explosion and fire hazards

Landfill: a public health & environmental issue

- ▶ What is necessary?
 - ▶ More systematic information on pathogenic organisms and emergent chemicals
 - ▶ Toxicology studies
 - ▶ Risk assessment and risk management methodologies
 - ▶ Strategies/measures for reduction of contaminants concentration levels on environment
 - ▶ Contaminants removal strategies
 - ▶ New concepts in legislation initiatives

Landfill: a public health & environmental issue

► Risk assessment and management paradigms

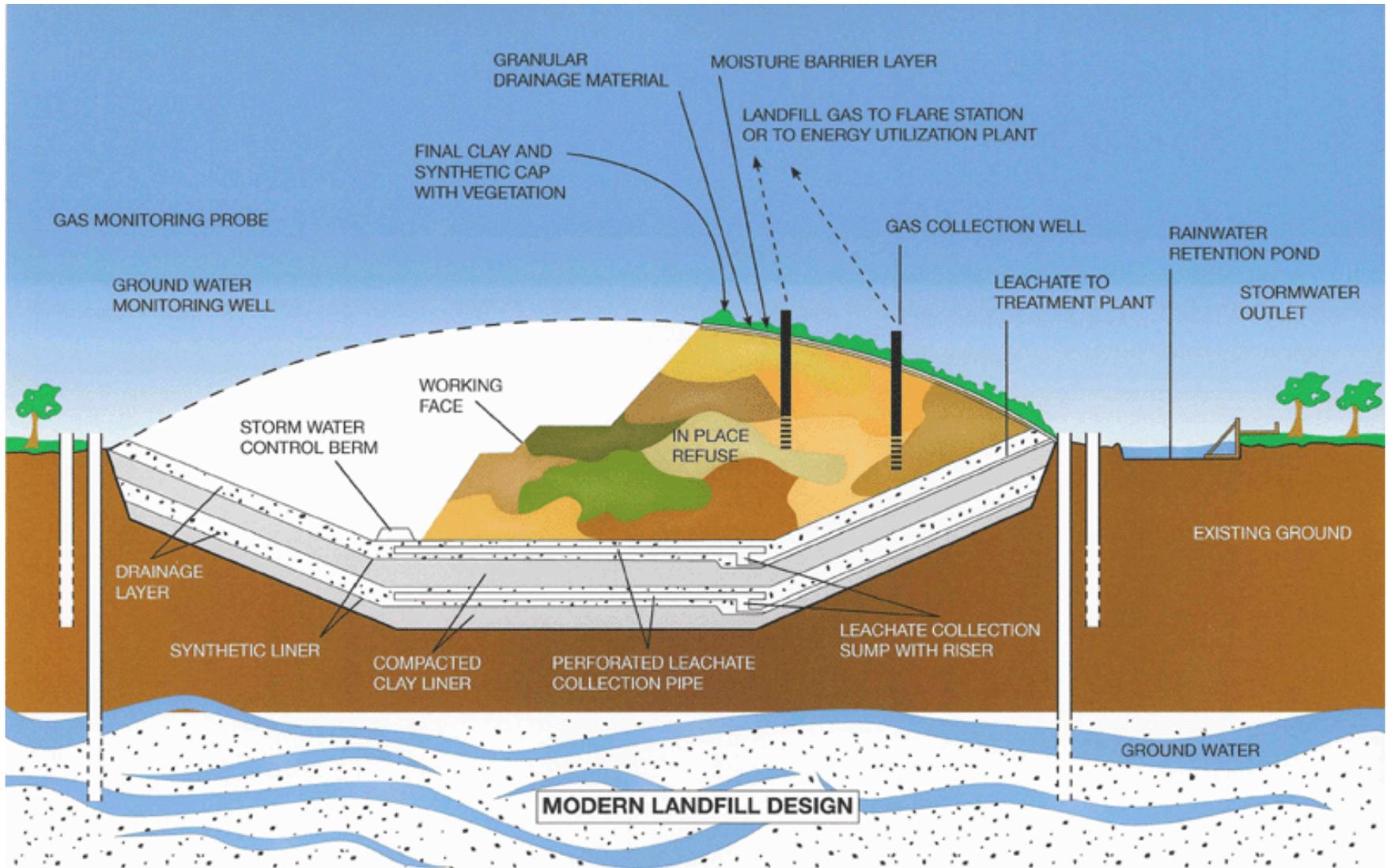
Paradigm	Environment	Health
Timing	Chronic	Acute
Reporting	Continuous	Categorical
Monitoring	Population and systems	Individuals and groups
Hazards	Cumulative	Specific
Endpoint	The broad natural system	Humans

- A fully integrated plan must consider **health** and **environmental** endpoints

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Modern landfill concept



Modern landfill concept

▶ The multi-barrier principle



Design



Construction



Operation



Post-closure

● Operational quality management system

Modern landfill concept

▶ Design concerns (examples)

- ▶ Inadequate base slope to promote leachate drainage
- ▶ Type and thickness of geomembrane
- ▶ Leachate collection system
- ▶ Geologic characteristics of the landfill site
- ▶ Groundwater protection systems

Modern landfill concept

- ▶ Construction concerns (examples)
 - ▶ Inadequate preparation of sub-base
 - ▶ Poor quality control over materials used
 - ▶ Penetration of liner containment system
 - ▶ Failure of welded geomembrane joints
 - ▶ Quality control of construction

Modern landfill concept

- ▶ Operation concerns (examples)
 - ▶ Poor operational procedures
 - ▶ Failure of leachate drains due to poor site practices
 - ▶ Excessive rain entry

Modern landfill concept

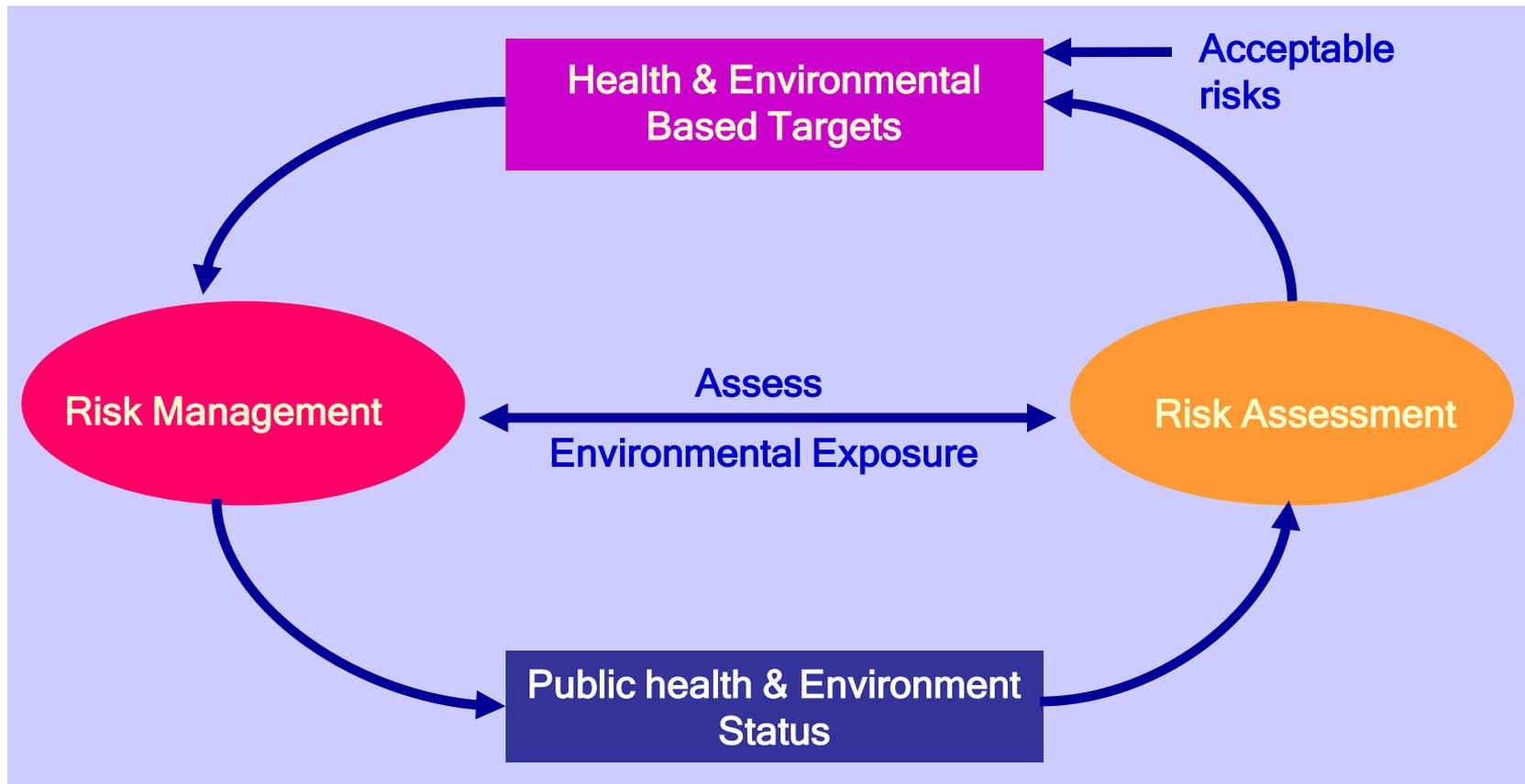
- ▶ Post-closure concerns (examples)
 - ▶ Failure of the capping system due to human or natural actions
 - ▶ Collapse of leachate collection system
 - ▶ Harmful long-term effects of inappropriate wastes

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Framework for Safe Landfill

► Health & Environmental targets



Adapted from Bartram *et al.*, 2001

Framework for Safe Landfill

Health & Environmental based targets



Landfill Safety Plan

System Assessment

Analysis of the system (hazards, risks, events) to determine whether it can meet the targets

Operational Monitoring

Monitoring of control measures which are of particular importance in securing landfill safety

Management Plans

Documentation of system assessment and monitoring describing actions to be taken in normal operation and incident conditions, including upgrade and improvement, and communication



Independent surveillance

Verification that system operates properly

Framework for Safe Landfill

- ▶ What is Landfill Safety Plan?
 - ▶ LSP is a systematic approach used to ensure proper management of landfills
 - ▶ LSP places emphasis on ensuring that hazards are excluded or removed at all stages of landfill systems resulting in more consistent safety guaranty for public health and environment
 - ▶ LSP applies a risk assessment and management approach for landfill quality control

Framework for Safe Landfill

- ▶ Engaging everybody in a risk management culture
 - ▶ Must start from the top managers
 - ▶ Transparency with all staff
 - ▶ Encourage reporting and feedback of problems- respond positively
 - ▶ Mistakes should be seen as a way of learning
 - ▶ All staff should encouraged to “own” quality
 - ▶ Make sure all know why quality matters
 - ▶ Pride in the job and belief in the utility

Framework for Safe Landfill

▶ Components of a Landfill Safety Plan

- ▶ • System assessment
- ▶ • Operational monitoring
- ▶ • Management plans
- ▶ ■ Independent surveillance

Framework for Safe Landfill

▶ System assessment

“to determine where the landfill chain as a whole can assure a performance quality that meets identified targets. This also includes the assessment of design criteria for new systems”

- Identification of hazards and threats
- Prevention and reduction of contamination
- Concern about improvements of system performance



Framework for Safe Landfill

▶ Operational monitoring

“monitoring of the control measures in the landfill chain which are of particular importance in securing landfill safety”

- Monitoring of control measures
- Assure that barriers are working (**barriers \cong safety**)
- Different approaches
 - Visual Inspection
 - Quality testing
 - Standard operational procedures



Framework for Safe Landfill

▶ Management plans

“management plans documenting the system assessment and monitoring; and describing actions to be taken during normal operation and incident conditions, including upgrade and improvement and documentation and communication”

- System assessment
- Control measures
- Management procedures (routine and exceptional situations)
- Communication protocols
 - Internal
 - Surveillance authorities
 - *Media e Public*

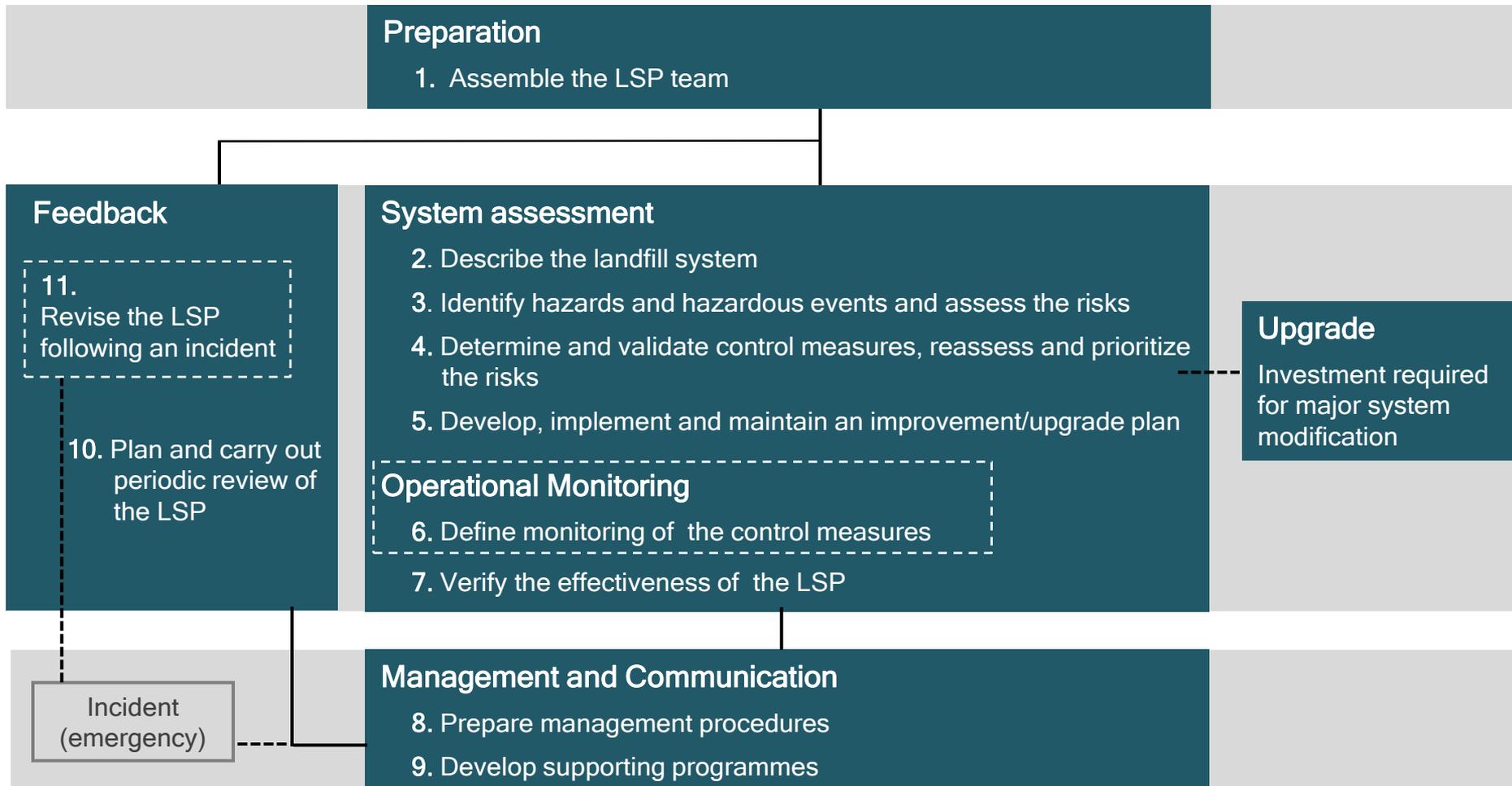


Framework for Safe Landfill

- ▶ Independent surveillance
 - Audit based
 - Direct investigation
 - Validation of control measures

Framework for Safe Landfill

► Preventative, risk-based management



Framework for Safe Landfill

▶ Stakeholders responsibilities in each step

Health & Environmental Based
Targets



Health and
Environmental Authorities

System assessment
Operational monitoring
Management plans

Landfill safety plan



Solid waste utility

Independent surveillance



Regulators

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Conclusions

- ▶ Landfill safety plan. Methodology adequate for:
 - Systematic assessment
 - Minimisation of accidents probabilities
 - Contingency plans for exceptional events
 - Support for Regulators inspection activities
 - More efficient use of resources

Conclusions

- ▶ Landfill Safety Plans challenges:
 - ▶ Landfill Quality Management is everyone's business
 - ▶ Changing staff attitude & work culture
 - ▶ Willingness of Management to spend on improvements
 - ▶ Commitment of landfill technical staff to stick to schedules set
 - ▶ How to involve consumers in LQM & raise their concern

Conclusions

Stakeholder Involvement

