Overview of Gas Collection and Control Systems

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Novi Sad, Serbia

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Overview

- Objectives of LFG Collection/Control
- Biogas Recovery Modeling
- Elements of a LFG collection System

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Objectives

- Recover and utilize LFG
- Minimize potential environmental impacts
- Control off-site migration
- Control odors
- Comply with regulatory requirements

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Biogas Recovery Potential

- Observation and analysis of landfill operations
- Collection of accurate data
- Use of landfill biogas modeling
  - Selection of appropriate model and inputs based on landfill characteristics
  - Close scrutiny of model results via comparison with results from other landfills (if possible)
- Development of multi-year biogas recovery estimates

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Biogas Recovery Modeling

- Biogas Recovery Estimates Are Used For:
  - Developing gas collection system design and sizing requirements
  - Evaluating utilization project feasibility and economics
- Modeling can be Challenging
  - May result in a large source of error in evaluating project system requirements and project feasibility
  - Many models based on U.S. waste profiles
  - Unrealistic biogas recovery projections can lead to investment in uneconomical projects (or neglecting opportunities)
- Average international LFG project performance = 49% (actual recovery / modeled recovery)

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Elements of an Gas Collection System

- Network of interconnecting piping
- LFG collection points
  - Vertical extraction wells
  - Horizontal collectors/trenches
  - Connection to existing vents, wells, etc.
- Elements of condensate management
- Flow control
- Blower and flare
- Monitoring systems

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Gas Collection and Control Systems

- Blower – provides vacuum to extract gas from the landfill and transport it to the flare (or other combustion devices)
- Flares – greater than 90% destruction of landfill biogas
- Monitoring equipment – used to balance well field and ensure proper operation, track gas flow, and quantify greenhouse gas emission reductions

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Vertical Extraction Wells

- Most common approach for recovering LFG
- Install in existing or operational disposal areas
- Waste depth preferable >10 meters

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Vertical Extraction Wells

- Install approx 2.5 wells per hectare(~ 1 well per 0.4 hectare)
- May lose efficiency or not work in landfills with elevated leachate levels
- Maximize biogas recovery per well
  - Wells in deeper areas
  - Wells in areas of new waste

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Vertical Extraction Wells Design Features

- In-refuse wells: 75% of the refuse depth
- Boreholes typically 60 cm to 90 cm in diameter
- Casing is generally PVC or HDPE
- Bottom perforated - start 6 meters below ground surface
- Spacing depends upon “radius of influence” (typical 60 m - 122 m)

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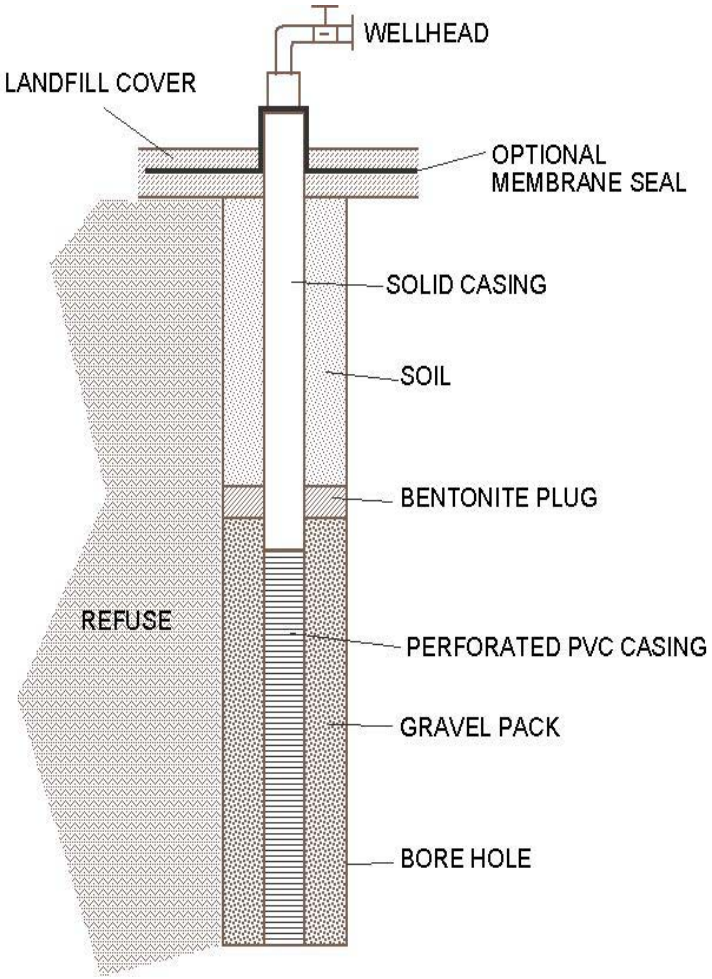
Typical Vertical Extraction Well



- Bentonite seal prevents air infiltration
- Wellhead incorporates:
  - Flow control valve
  - Gas sampling port
  - Pressure monitoring port
  - Flow monitoring port or device (optional)
  - Thermometer (optional)

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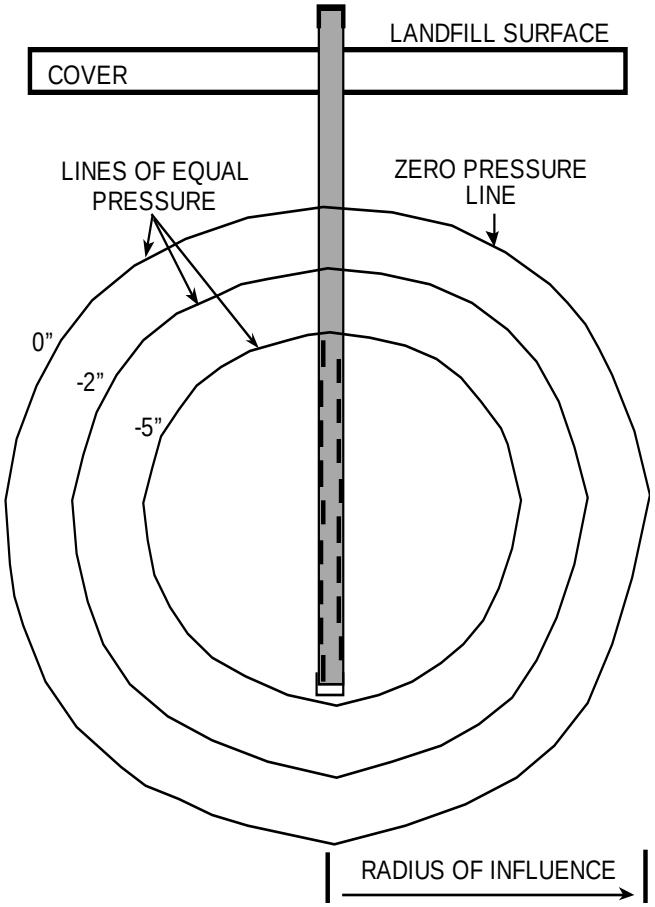
Theoretical Radius of Influence of a Vertical Gas Well



- Radius of influence 2 to 2.5 times well depth
- Increase vacuum to increase the radius of influence
- Variations in vacuum are the operator’s only control tool

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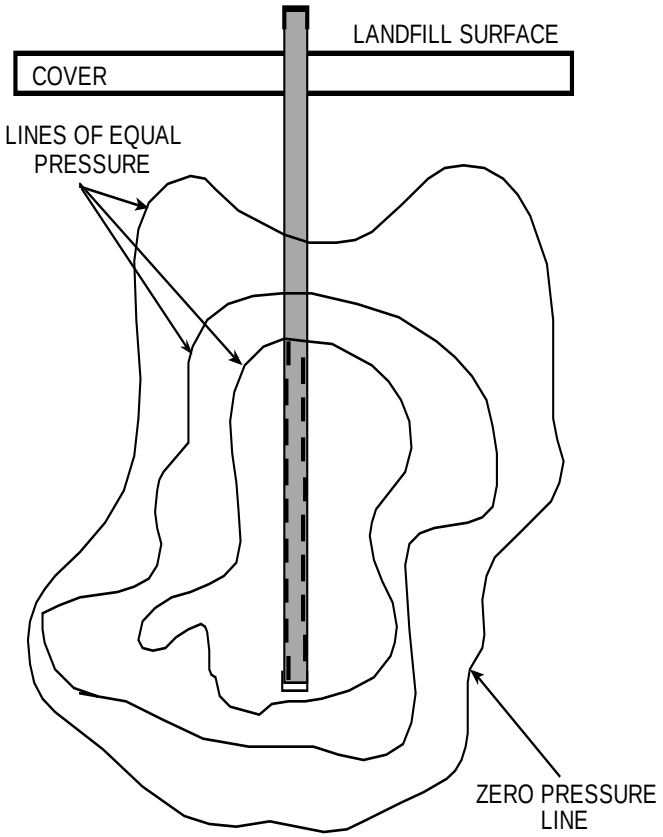
Actual Radius of Influence of a Landfill Gas Well



- **A well's radius of influence is unlikely to be ideal:**
  - Variations in waste characteristics
  - Interim cover and cell configuration
  - Presence of leachate

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Horizontal Collectors

- Alternative approach for LFG recovery
- Can be a better financial option
- Install in existing or operational disposal areas
- Install at a spacing of approx. 30 to 100 meters
- Can be used in landfills with elevated leachate levels

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Horizontal Collectors - Design Features

- Install in trenches or place on grade and cover with gravel and waste
- Construct out of approx 100 mm slotted PVC or HDPE pipe
- Alternatively construct out of “nested” 100 mm and 150 mm pipes

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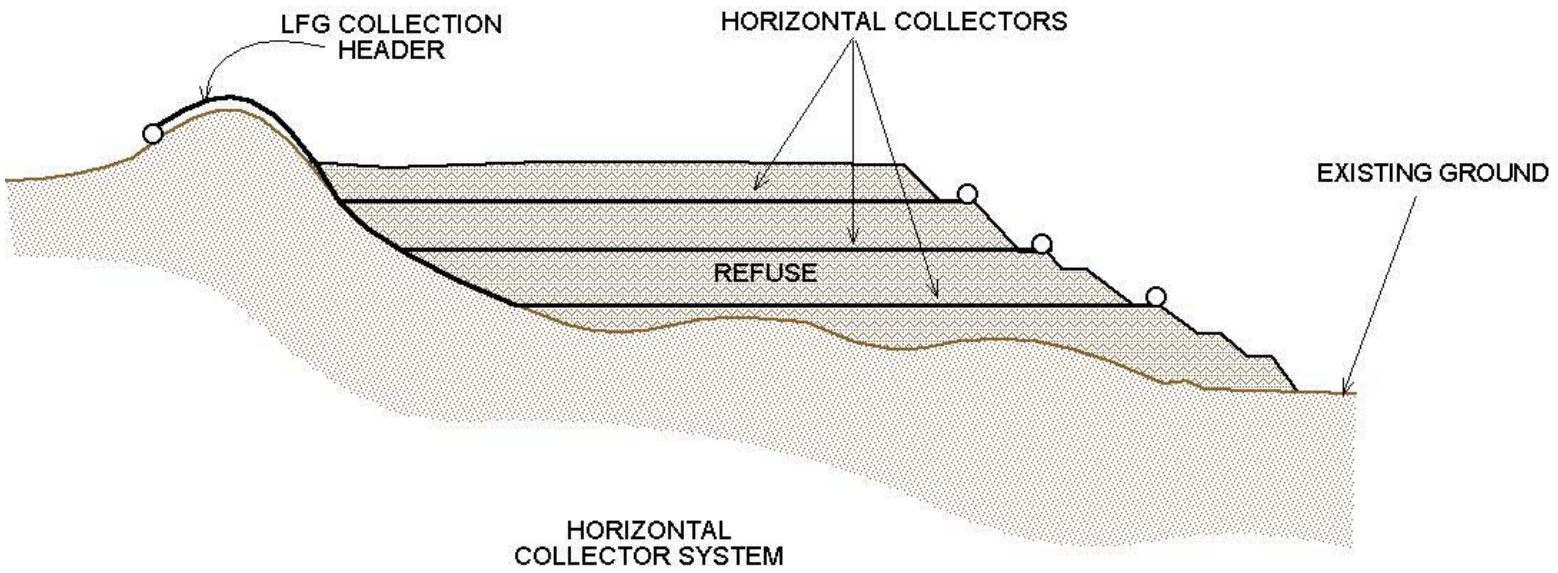
Typical Horizontal Collector Arrangement



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Laterals and Headers

- Pathway for LFG from wellheads to blowers
- Can be above-grade or underground
- Generally HDPE - PVC sometimes used above-grade
- Pipe sloped to promote condensate drainage
- Unusual drops in vacuum normally due to condensate blockages
- Sized on flow rate and pressure drop
- Evaluate different types of system designs
  - Individual lateral per well
  - Header system with shorter laterals to wells

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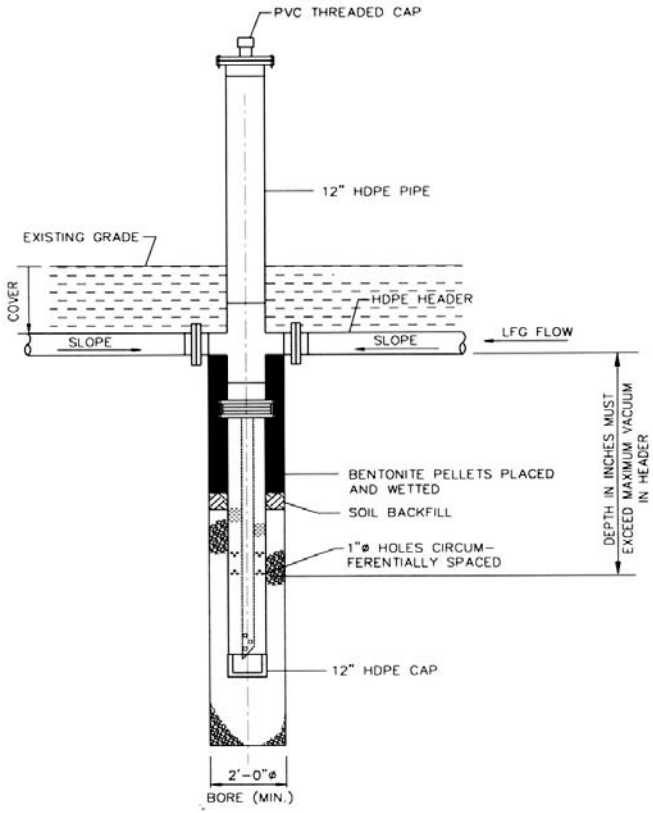
Condensate Removal

- LFG cools in the LFG collection piping and the moisture condenses out into the piping
- Piping designed to allow condensate to drain
- Traps allow for drainage by gravity
- Sumps collect condensate



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Landfill Gas Flaring

- Open flares (candle-stick flares)
  - Can be less expensive
  - Lower destruction efficiency for greenhouse gas projects
- Enclosed flares (ground flares)
  - Higher destruction efficiency

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Flare Systems

- May be used in combination with beneficial use system
- Needed during utilization system startup and downtime
- Location should be central to collection system, close to potential end user or utility service, away from trees
- Design with flexibility to handle future gas flows

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Blower/Flare Station – Typical Elements

- Moisture separator
- Blowers
- Flare (open or enclosed)
- LFG piping and flame arrestor
- Flow meter
- Methane analyzer (optional)
- Pilot fuel supply
- Control panel (controls both blower and flare)
- Auto shutoff valve

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Closing

- Gas collection systems are used for many purposes
- Biogas modeling is important for gas collection system design and operation
- Design the gas collection system to meet the needs of the landfill and project goals

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