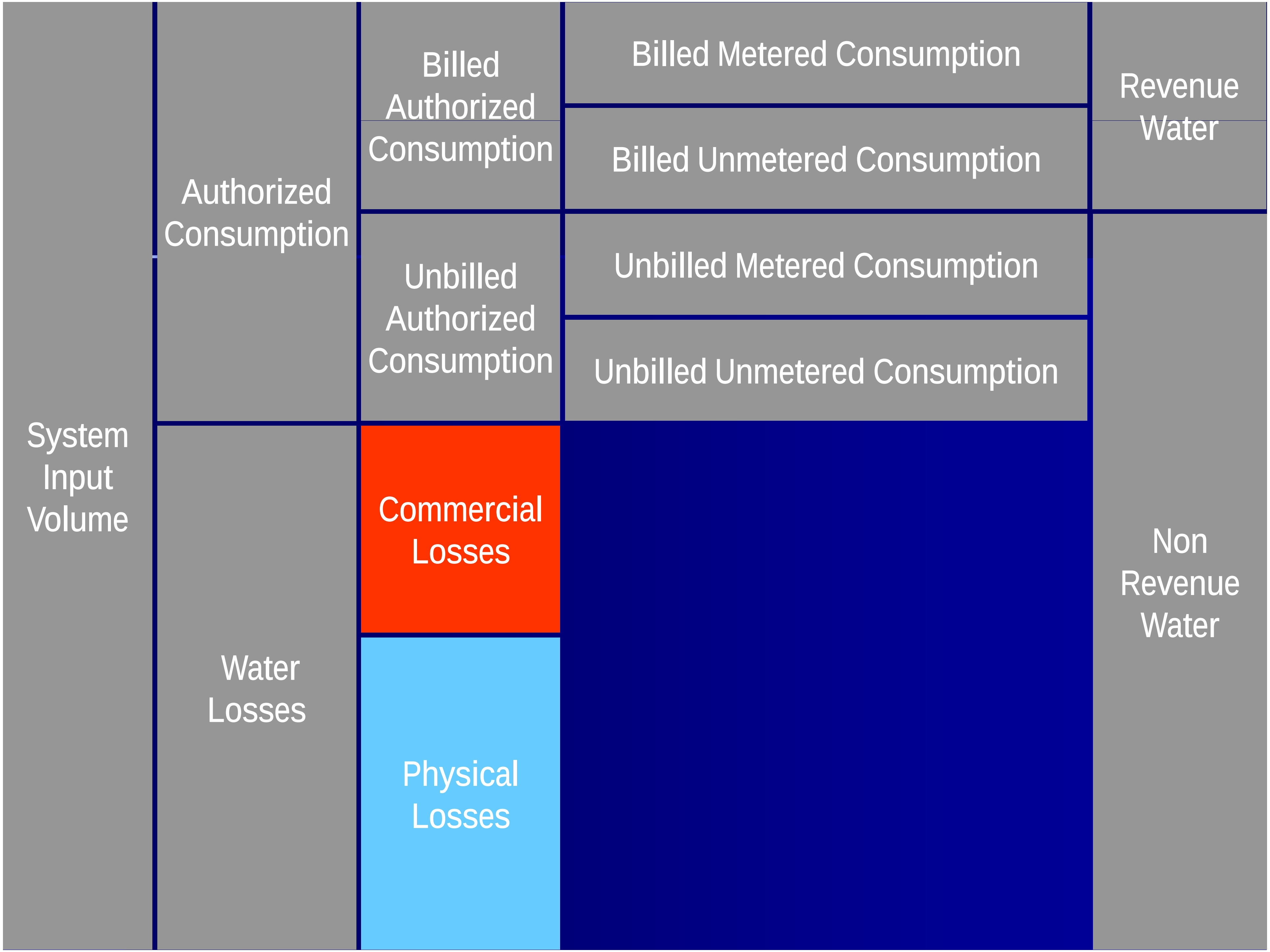
Physical Loss Assessment

Non-Revenue Water Management Training

DMCI Homes Corporate Center, Nov 18-19, 2010

miya

Arison Group


System Input Volume
Authorized Consumption
Billed Authorized Consumption
Billed Metered Consumption
Billed Unmetered Consumption
Revenue Water
Unbilled Authorized Consumption
Unbilled Metered Consumption
Unbilled Unmetered Consumption
Water Losses
Commercial Losses
Physical Losses
Non Revenue Water

Physical Loss Component Analysis

Main Components of Physical Losses

- Leakage and Overflows at Storage Tanks
- Background Losses
- Reported Bursts
- Unreported Bursts

Principle of Physical Loss Components Analysis

- Estimate individual loss components
  - background leakage (very small leaks)
  - reported burst (visible leaks)
  - unreported bursts (detected through leak detection teams)
  - losses from the utility's reservoirs
- "Hidden Losses": Difference between total physical losses and the sum of the above components = leaks yet to be detected

Component Analysis

Physical Losses (from the Water Balance)	Leakage and Overflows at Storage Tanks
	Background Losses
	Reported Bursts
	Unreported Bursts
	Hidden Losses

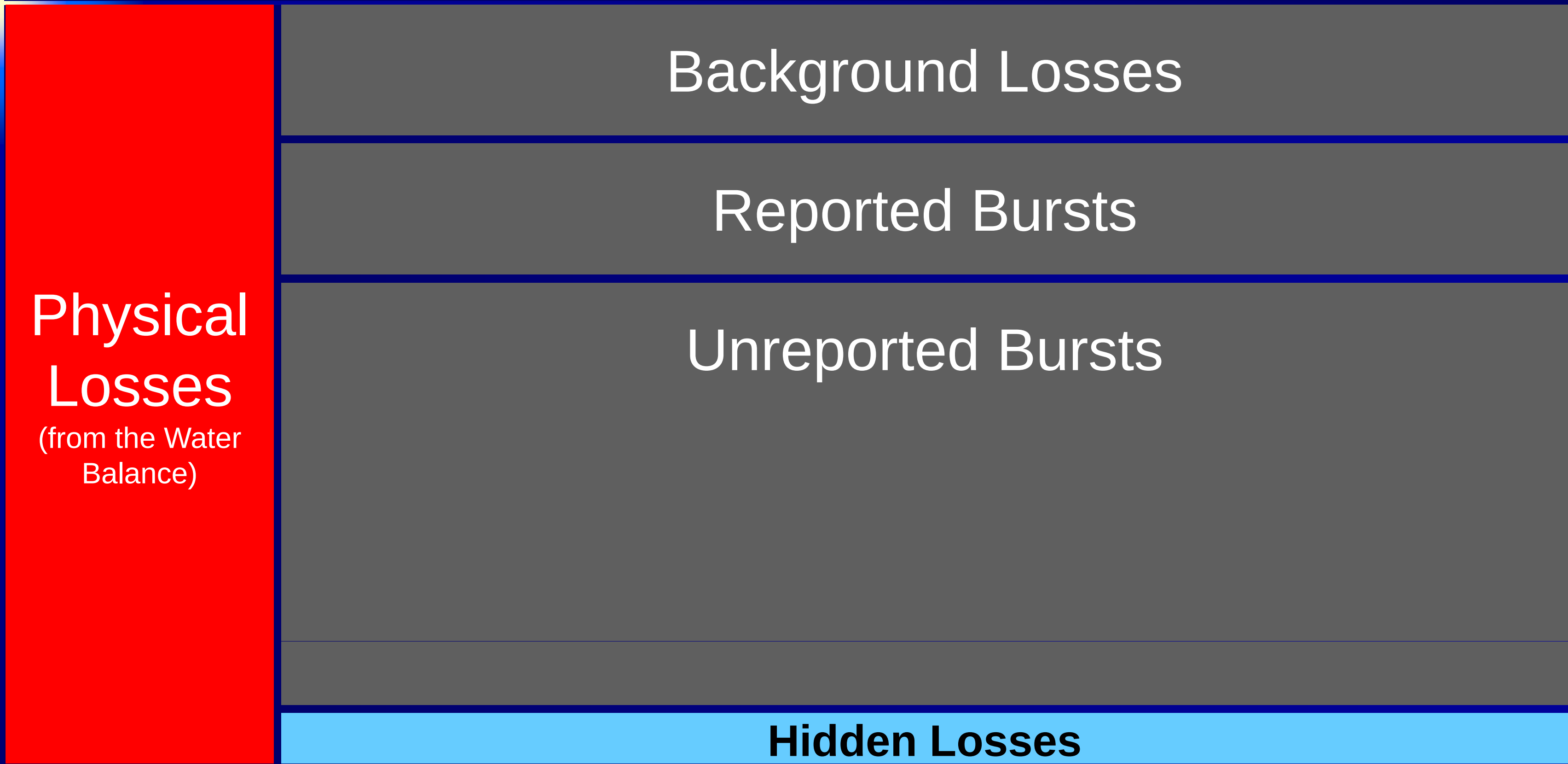
Calculating Volume of Water Lost for Individual Components

- **Approach:**

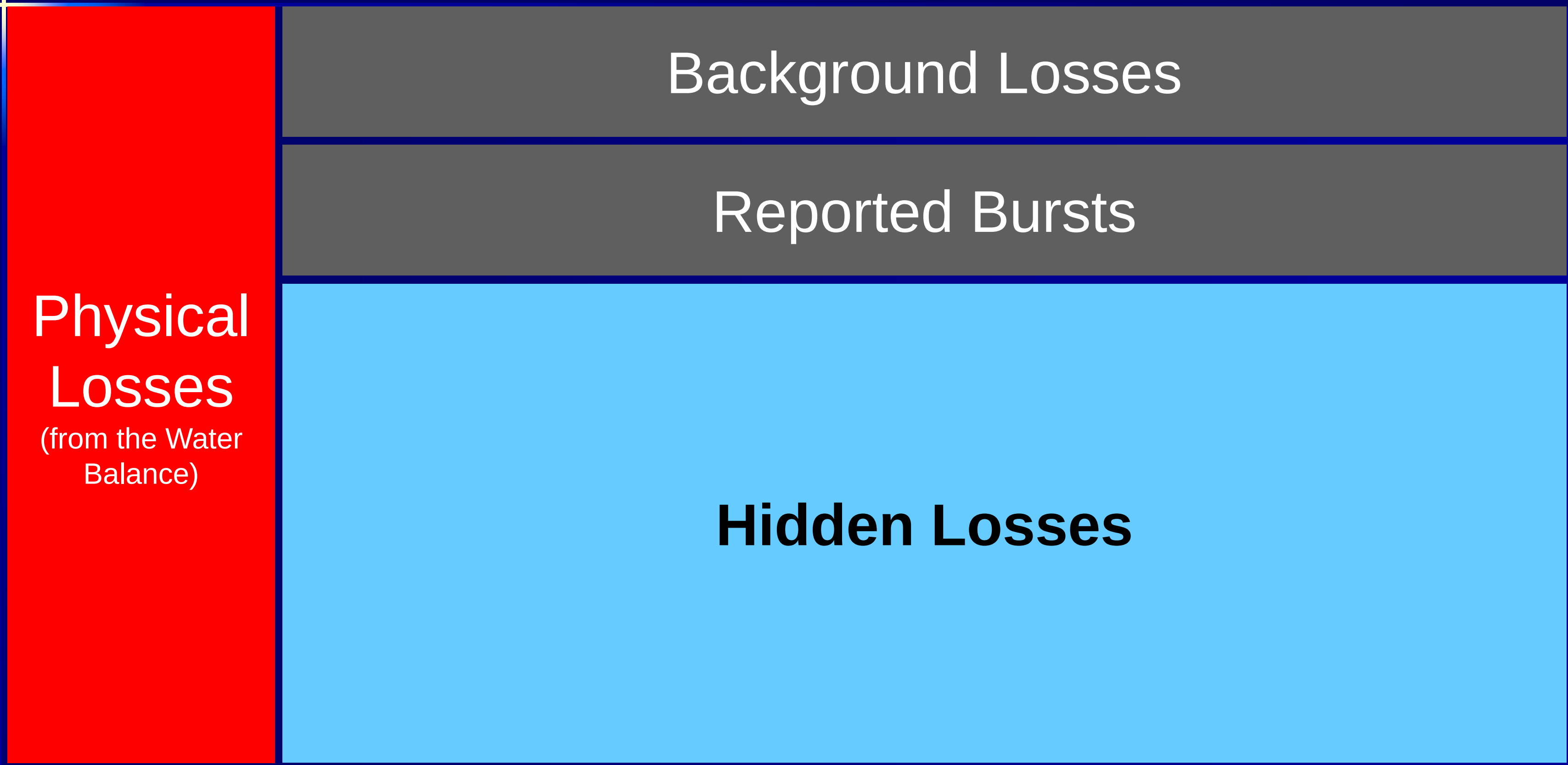
  Leakage = flow rate x run time

- **Data requirements:**
  - **Length of pipe network, number of service connections**
  - **Average pressure**
  - **Number of reported and unreported bursts – on mains and on service connections**
  - **Average leak flow rates for leaks on mains and connections**
  - **Repair time for leaks on mains and connections**
  - **Average supply time (intermittent supply)**
  - **Information on leakage control policy (to estimate awareness time)**
  - **Estimates of storage tank leaks and overflows**

Scenario A: High Losses but Comprehensive Active Leakage Control



Scenario B: High Losses and NO Active Leakage Control



Potential Errors

- Component analysis can lead to wrong conclusions if volume of physical losses (from the Water Balance) is wrong
- Example 1: Obvious Error
- Example 2: More dangerous – potential error but not so obvious

Error Example 1 (obvious problem)

Physical Losses (from the Water Balance)	Leakage and Overflows at Storage Tanks
	Background Losses
	Reported Bursts
	Unreported Bursts

Error Example 2 (potential problem)

Physical Losses
(from the Water Balance)

Leakage and Overflows at Storage Tanks

Background Losses

Reported Bursts

Unreported Bursts

Hidden Losses
(really so high or Volume of Physical Losses from the Water Balance wrong ????)

Bottom-Up Physical Loss Assessment

Allows calculation of magnitude of physical losses through flow and pressure measurements and leakage modeling

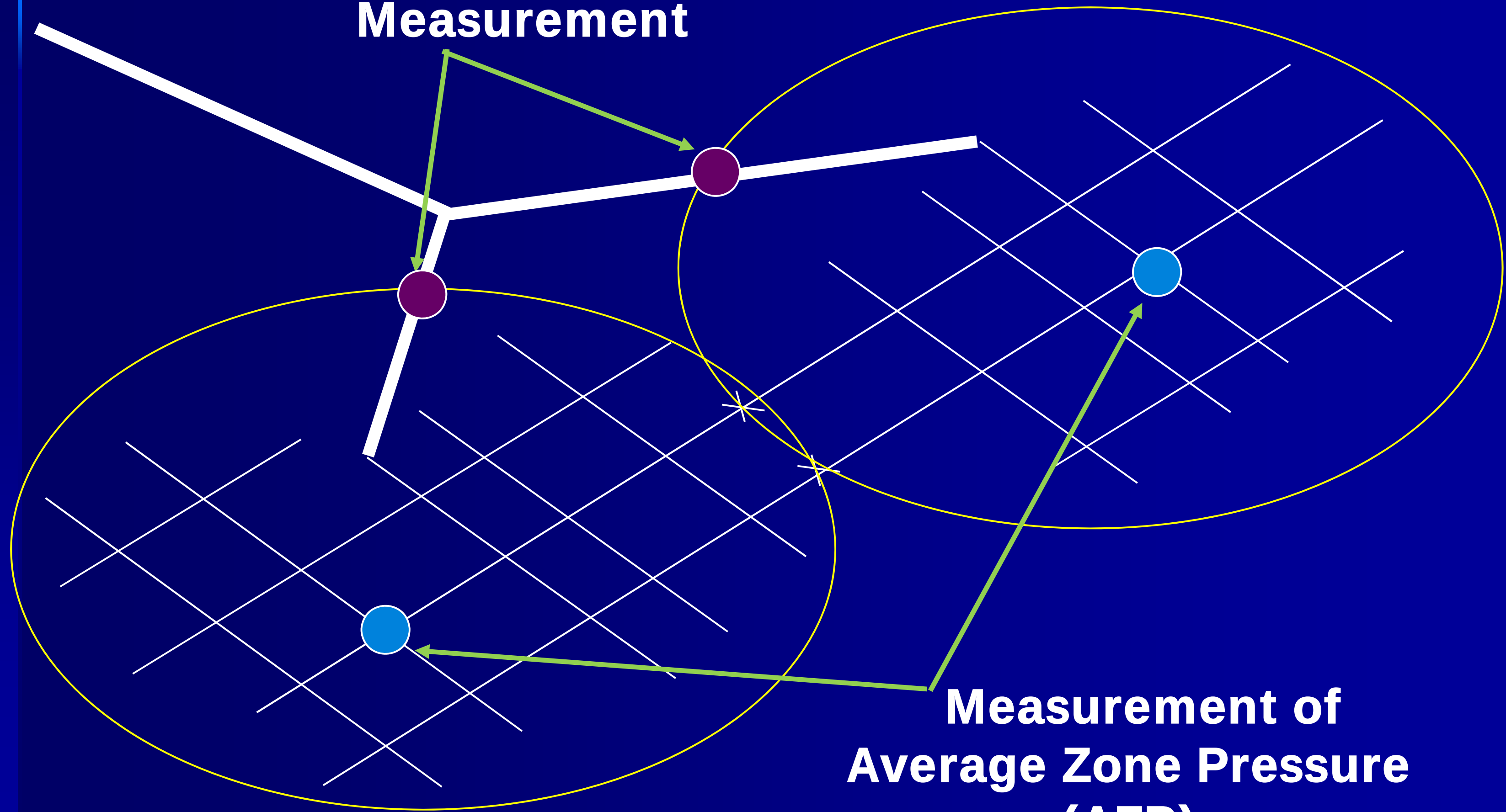
Principle Steps

- 24 hour flow and pressure measurements in isolated zones of the network
- Minimum night flow analysis
- 24 h leakage modelling
- Calculation of leakage performance indicators

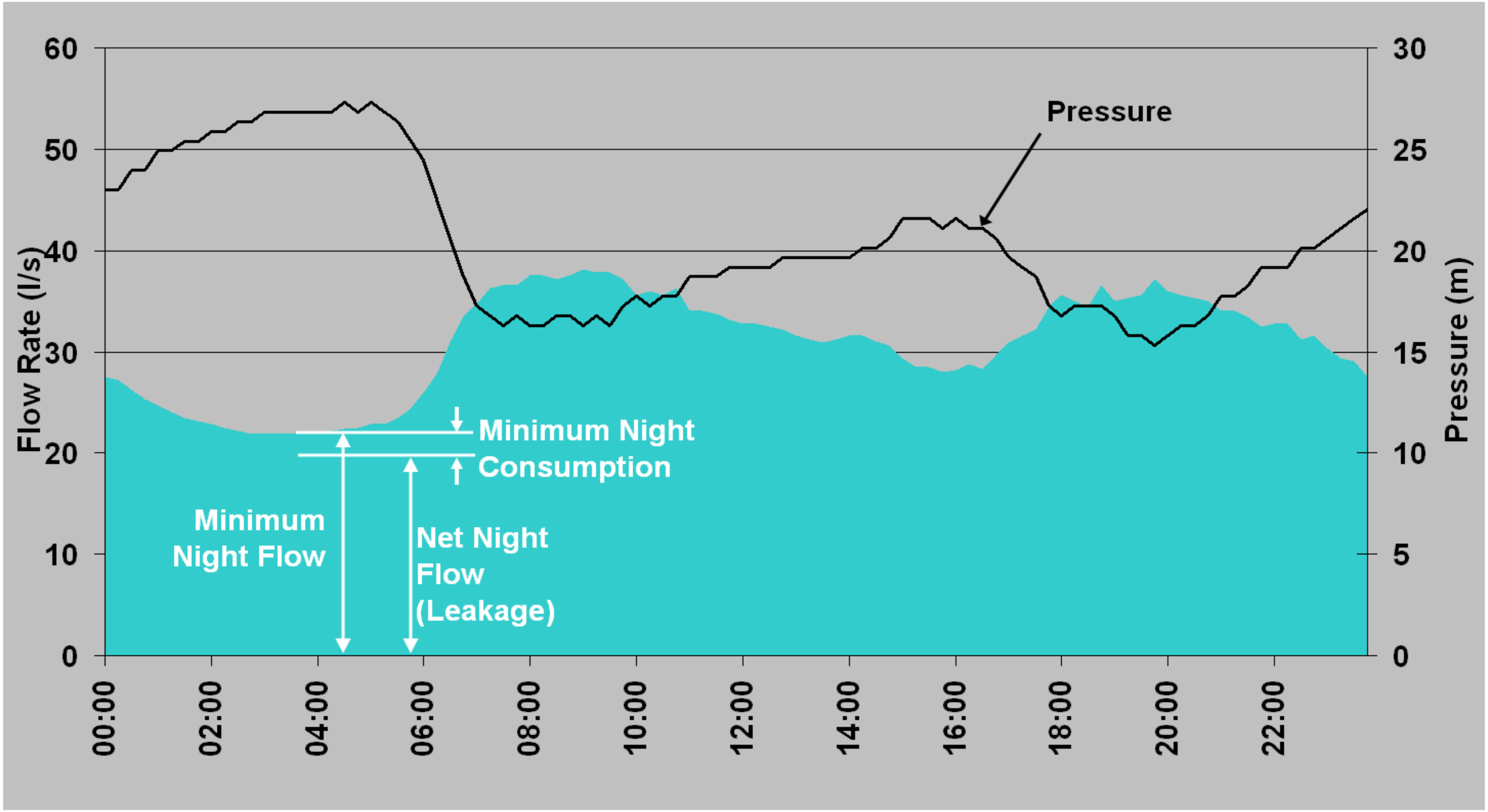
Step 1:
24 Hour Measurement

- Separation of the network into (temporarily) isolated assessment zones
- 24h flow and pressure measurement with portable devices at inflow points and strategic locations in the network
- Attention: method becomes much more complicated and unreliable in intermittent supply situations!

Measuring Flow and Pressure in Hydraulically Isolated Zones



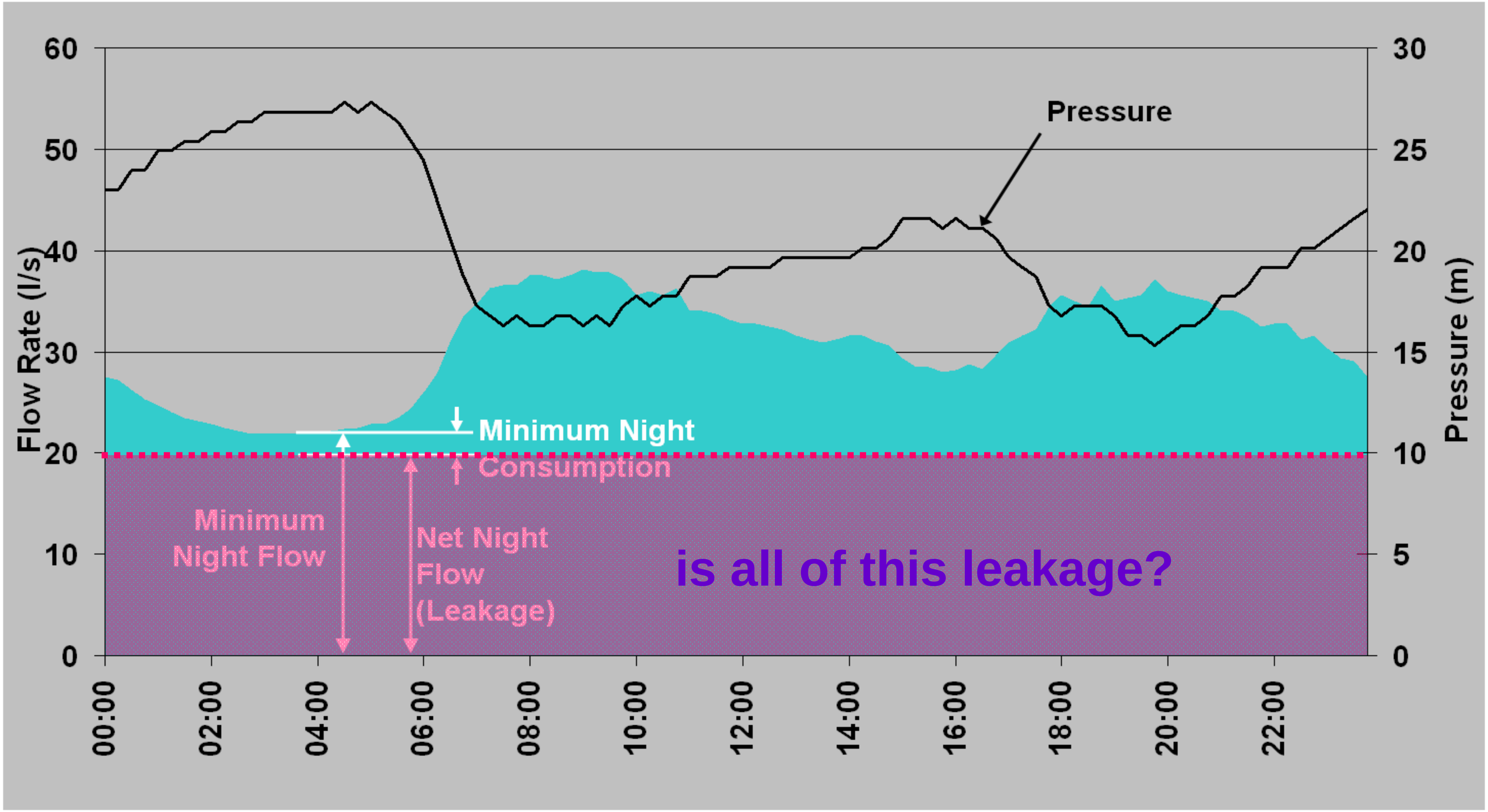
Flow and Pressure Profile and Minimum Night Flow



Step 2: Minimum Night Consumption Assessment

- **Household consumption:**
  - **sample measurements of individual houses and extrapolation**
  - **can vary substantially depending on local conditions, season (irrigation!)**
  - **attention: ground and roof tanks!!!**
- **Commercial customers to be assessed separately**
- **Meters of large customers to be read during night hours of measurement**

Flow and Pressure Profile and Minimum Night Flow



Step 3: Leakage Modeling

- **Relate Leakage to pressure applying N1 methodology**

  $L1 = L0 \times (P1/P0)^{N1}$

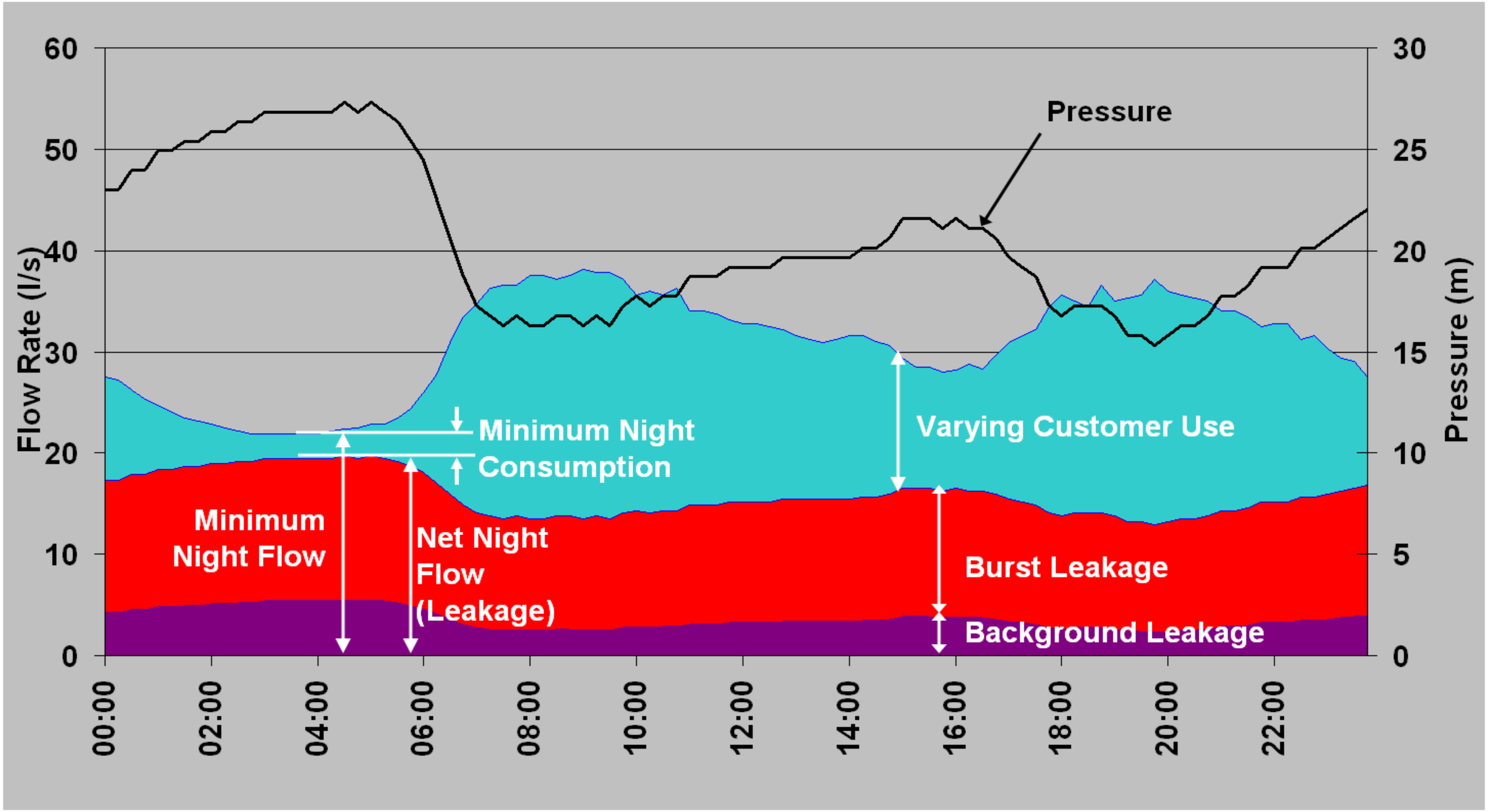
  L0 = leakage at minimum night flow

  P0 = pressure at minimum night flow

  N1 = ideally to be measured ("pressure step test"), to get started: try values between 0.5 and 1.5

- **Model leakage over 24 hours**
- **Calculate 24h volume of leakage and consumption**

Leakage Modeling, Night Flow Analysis



Step 4: Performance Indicators and Extrapolation

- Repeat Physical Loss Assessment in several representative zones
- Calculate leakage performance indicator
- Calculate weighted average from all zones (weighting factor: number of connections)
- Compare with figure from Water Balance and investigate discrepancies

Bottom-up Physical Loss Assessment
A Great Tool for Overcoming Poor Data

- **Work requires some expert knowledge, experience, equipment**
- **BUT, it's the only way to obtain reliable estimates (especially if data is poor)**
- **Results are essential for:**
  - **for understanding nature, magnitude and location of leakage**
  - **developing a cost effective, prioritized leak reduction strategy**

Example: Ho Chi Minh City, Vietnam

- First draft water balance (2003) showed high leakage (660 – 790 l/connection/day, at 12m pressure)
- This figure was questioned – therefore bottom-up leakage assessment was done in 10 zones
- Result: Average value: 805 l/connection/day
- Conclusion: Reliability of water balance very likely

Key Message

- **Physical loss component analysis important to understand the causes of physical losses but does not allow to check the accuracy of the water balance**
- **Needs to be complemented by bottom-up physical loss analysis**