



Specialist Group
Efficient Operation
and Management
Water Loss Task Force



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Some Examples of European Water Loss Targets, and the Law of Unintended Consequences



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Introduction



- Our paper considers some performance indicators currently used in Europe for Non-Revenue Water and Real Losses
- In France and Germany, the traditional ‘losses per km of mains’ are still most widely used
 - usually applied using a table/matrix approach
- We will look at this in more detail and consider some of the consequences
 - which you may find surprising!
- Malta (2006) and Austria (2009) now use ILI as their principal Real Losses PI
 - and Italy and West Balkans are increasingly moving to use ILI



What % of Real Losses occurs on mains?



- The % of Real Losses on mains decreases as the number of service connections/km increases
- Water Loss Task Force (1999) conclusion based on the BABE component analysis used in the UARL formula is:
 - less than 50% of Real Losses occur on mains when there are more than 20 service connections/km of mains
- So French and German Performance Assessment methods using 'per km' have to also use:
 - density of connections
 - or something related to density of connectionsto try to interpret losses expressed 'per km of mains' for systems with different connection densities



Terminology



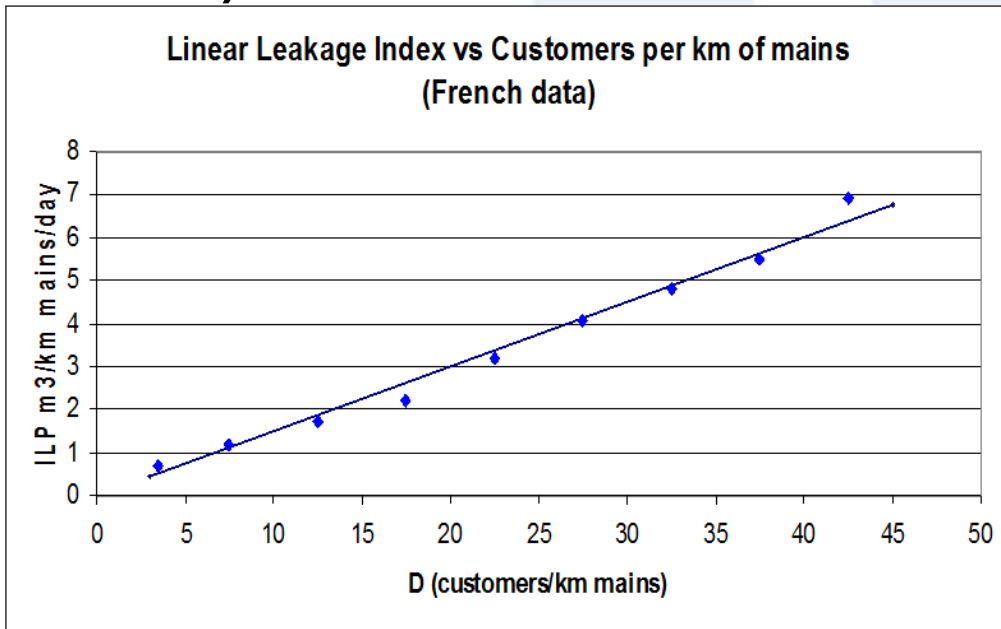
- The German example in the paper (DVGW Worksheet 392 (2003)) relates to Real Losses calculated from an IWA Water Balance
- The French examples in the paper relate to ‘Pertes’ – Losses – which are defined in different ways in different organisations at different times (pre and post 2007)
 - but include Real and Apparent Losses = Water Losses in IWA terminology
 - so will be referred to as Water Losses in this presentation



In 2007 a large French study (Cemagref) showed very low water losses on mains



- Renaud et al found that ILP (m^3/km mains/day)
= $0.150 \times$ Number of properties/km of mains
- or, **Water Losses = 150 litres/property/day**
- so the mains component of Water Losses is very small (almost zero!)



Why not use water losses per property or per service connection?

What is the logic in using losses per km of mains?

In fact, using water losses per km with a Matrix approach generates discontinuities



Water losses per km of mains: France



Some French organisations (e.g. Laboratoire GEA) use **properties/km of mains** and **Water Losses in m³/km of mains/day** to classify performance

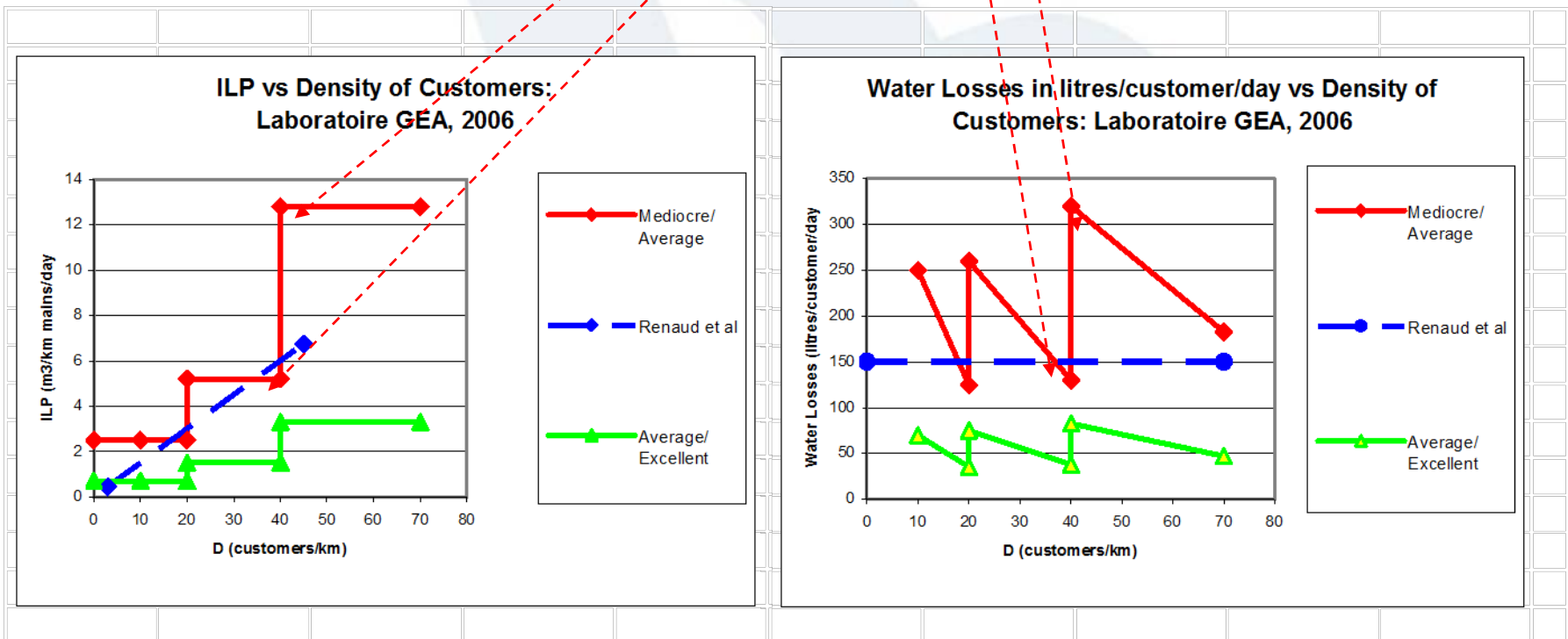
Each Network is classified as *Rural, Intermediate or Urban* based on the density of Properties (D) per km of mains

The performance in managing Water Losses is then classified as *Excellent, Average or Mediocre* based on the Linear Losses Index (Indice Lineaire Pertes, ILP) in m³/km mains/day, calculated from a Water Balance

Network Type	Rural	Intermediate	Urban
Criterion	$D \leq 20$	$20 < D \leq 40$	$D > 40$
Excellent	$ILP < 0.7$	$ILP < 1.5$	$ILP < 3.3$
Average	$0.7 \leq ILP \leq 2.5$	$1.5 \leq ILP \leq 5.2$	$3.3 \leq ILP \leq 12.8$
Mediocre	$2.5 < ILP$	$5.2 < ILP$	$12.8 < ILP$

This example is from Laboratoire GEA; other French organisations use different terminology and class limits for D and ILP

- Using a matrix to represent the rising ILP vs D line introduces subjective class limits, which creates 'steps', but this gives discontinuities at the 'Step' points
- Using Laboratoire GEA criteria, for 'average' performance a Utility with:
 - 41 customers/km needs ILP < 12.7 m³/km/day, 310 litres/customer/day
 - 39 customers/km needs ILP < 5.1 m³/km/day, 130 litres/customer/day





Using alternatives to Density of Connections



- Other classification systems in France use ‘**Consumption per km of mains**’ (not properties/km) to interpret water losses per km using a matrix
- The German DVGW classification system uses ‘**System Input Volume per km of mains**’ (instead of properties/km) to interpret real losses per km using a matrix
- It can be shown that in both these approaches:
 - ‘per km’ disappears from the assessment
 - the assessment criteria are in fact related to %s of system input
 - the inherent discontinuities in the matrix approach remain



Losses per km of mains: France



Other French organisations (e.g. FNCCR, 2003) use Consumption/km of mains and Water Losses/km of mains to classify performance

Each Network is classified as *Rural*, *Intermediate* or *Urban* based on the Linear Consumption Index ILC (m³/km mains/day)

The performance in managing Water Losses is then classified as *Worrying*, *Mediocre*, *Almost Satisfactory* or *Satisfactory* based on the Linear Losses Index ILP (m³/km mains/day), calculated from a Water Balance

ILC m ³ /km/d	Network Type	FNCCR Network classification according to its ILP			
		Worrying	Mediocre	Almost satisfactory	Satisfactory
ILC < 10	rural	ILP > 5	3 < ILP < 5	2 < ILP < 3	ILP < 2
10 < ILC < 30	intermediate	ILP > 11	8 < ILP < 11	6 < ILP < 8	ILP < 6
ILC > 30	urban	ILP > 16	13 < ILP < 16	10 < ILP < 13	ILP < 10

This example is from FNCCR (2003): other organisations use different terminology and class limits for ILP and ILC



FNCCR (2003)

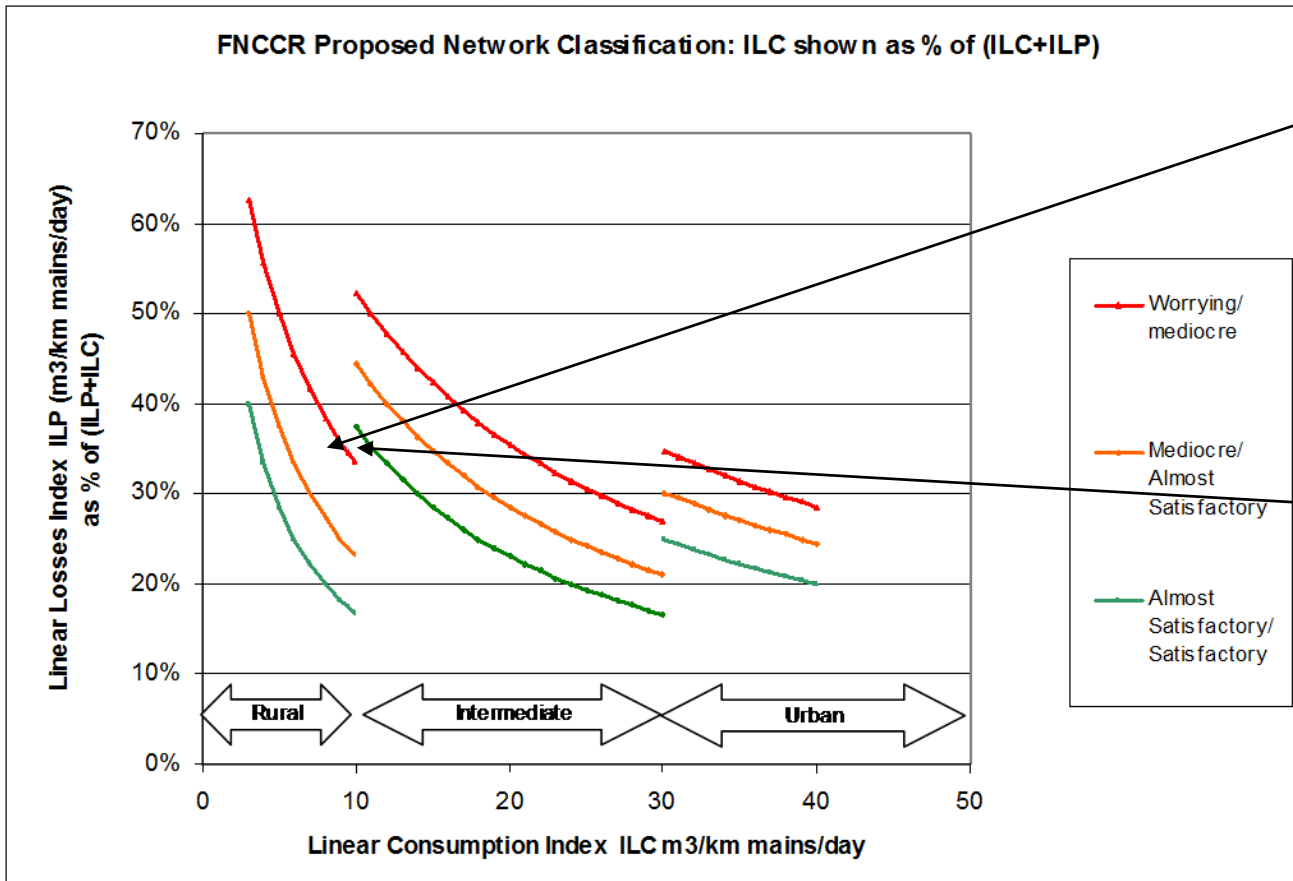


- % Losses reduce as consumption/km (ILC) increases
- large discontinuities at matrix class limits

Water Losses 35% Consumption = 9 m³/km/day Losses = 5 m³/km/day 'Mediocre'

Water Losses 35% Consumption = 11 m³/km/day Losses = 6 m³/km/day 'Satisfactory'

This does not give any incentive for Demand Management!





Germany: DVGW



- DVGW provides technical and scientific guidance to the German Gas and Water Industry
 - a technical standardisation organisation
 - lays foundations for technical self-regulation
- Workbook 392: Network inspection and water losses – activities, procedures and assessments
 - reissued in May 2003
 - replaced 3 old Guidelines, including Water Losses (W391) and Leak Detection (W392)



W392 (2003)



- Paper to IWA Leakage 2005 (Halifax) by Roland Liemberger reviewed important changes
 - W392 uses IWA Water Balance and definitions
 - emphasises effects of types of leaks and run time, service connection density and pressure
 - states that use of % of system input volume is unsuitable
 - recommends use of m^3/km mains/hour (Specific Loss)
 - based on a Table/Matrix approach



Real losses per km of mains: Germany



The DVGW Worksheet 392 (2003) uses Real Losses/km of mains and **System Input Volume/km of mains** to classify performance

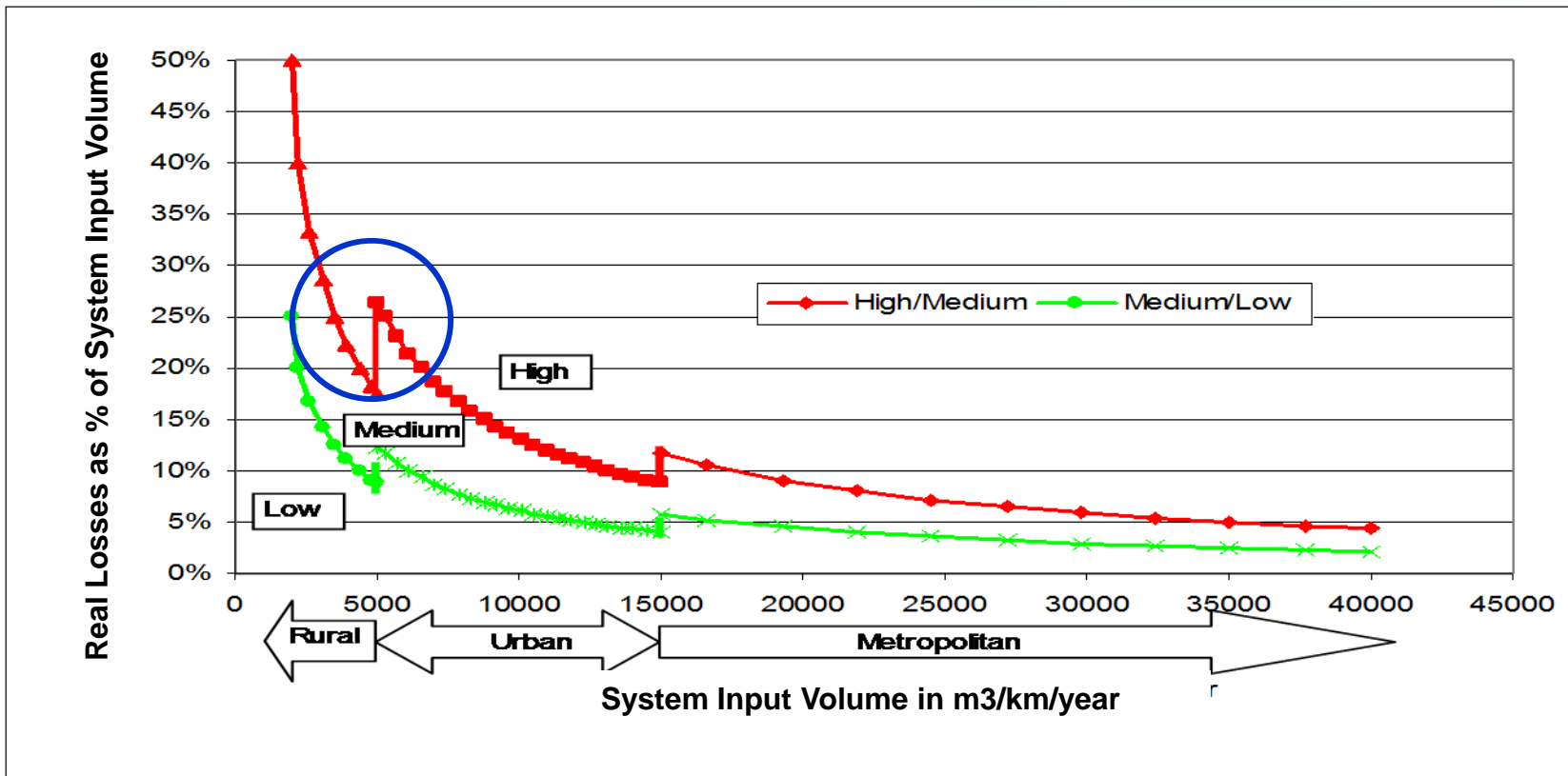
A Distribution Network is classified as *Rural, Metropolitan or Urban* based on the System Input volume in m³/km mains/year

The Real Losses are then classified as being *Low, Medium or High* based on the Real Losses in m³/km mains/hour (known in Germany as 'Specific Loss'), calculated from a Water Balance

Assessment of Real Losses	Structure of Distribution Network		
	Area 1 Metropolitan System Input	Area 2 Urban System Input	Area 3 Rural System Input
	>15000 m ³ /km/year	5000-15000 m ³ /km/year	< 5000 m ³ /km/year



W392 Guidelines shown as a graph



- Guidelines are based on % real loss reducing with system input volume
 - but with significant discontinuities at matrix class limits
 - **small changes in consumption near class limit trigger performance re-assessment**
- **‘per km of mains’ disappears – not relevant in fact!**



Comments on W392 approach



- Influence of average pressure on real losses not mentioned
- Influence of meter location not mentioned
 - Customer meters are usually located within properties in Germany
- Influence of service connection density not mentioned
 - but possibly used in derivation of earlier versions of the matrix
- Cannot be used for international comparisons
 - definitions of 'Metropolitan', 'Urban' and 'Rural' definitions are unique to DVGW
- Fundamentally based on % of System Input, not losses/km of mains
 - therefore influenced by changes in consumption, with problems of interpretation at discontinuities
- No explanation or audit trail of how relationships were decided
 - Liemberger (2005) considers real losses may have been based on ILI categories



W392 in terms of ILI?



Liemberger (2005 paper) calculations:

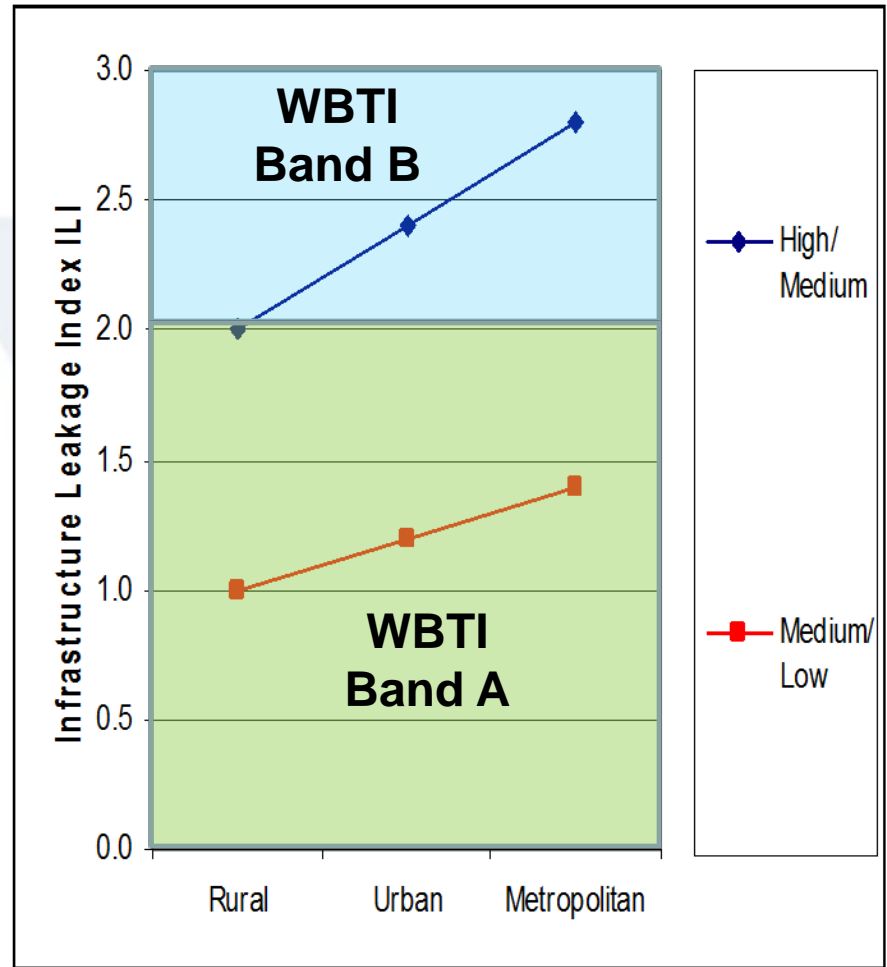
IF average German parameters are:

- Density of Connections:
 - ‘Rural’ < 25 conns/km
 - ‘Urban’ 25 to 40 conns/km
 - ‘Metropolitan’ > 40 conns/km
- Length of Private Pipe (m/conn):
 - ‘Urban’, ‘Metropolitan’ = 0 m
 - ‘Rural’ = 5 m
- Average Pressure = 30 metres

THEN ILI equivalents of assessments

Medium/Low 1.0 (rural) > 1.4 (Metro)

High/Medium 2.0 (rural) > 2.8 (Metro)





Malta and Austria



- Malta changed from 'per km' and '% of System Input Volume in 2006
 - ILI now used by Malta WSC and its regulator
 - also uses 'Snapshot' ILI calculated from night flows
- Austrian OVGW reviewed performance indicators 2003 onwards; in 2009 OVGW:
 - adopted ILI as the decisive PI, used in conjunction with a version of the World Bank Institute Banding System
 - included calculations of 'per service connection'
 - limited use of 'per km' to systems with < 20 conns/km



Italy



- Decreto No 99/97 (1997) recommends use of 'per km' and '% of system input volume'
 - but pre-dated IWA methodology (1999/2000)
- Since 2005, training workshops promoted by FederUtility (Italian Water Works Association) promote the IWA water balance & Performance Indicators
 - now used by Regulators (Region Emilia Romagna, Region Piedmont) and many Italian Utilities

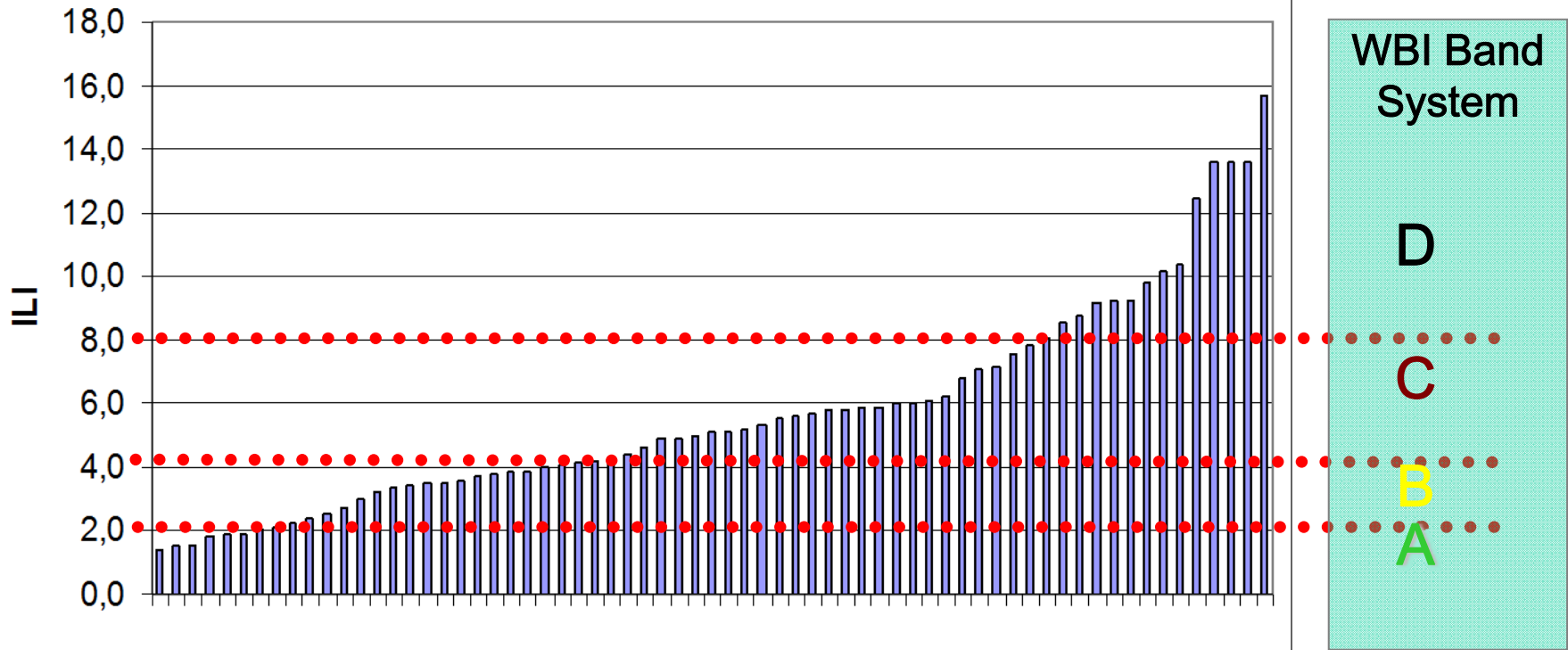


Italian ILI data set for Piedmont, Emilia Romagna and Tuscany Regions

classified according to World Bank Institute Banding System A to D



ILI Data Set for 67 Italian water systems



Source: M. Fantozzi



West Balkans



Croatia:

- NRW % by volume is still used as the main indicator for water losses.
- From mid 2009 the Association of Water Utilities in Croatia advises water utilities to start to use the IWA WLTF methodology with ILI as the principal performance indicator.

Serbia:

- NRW % by volume is also still used but a national effort is now being made to promote the IWA methodology.
- This involves pilot case studies, education and use of ILI as the main performance indicator.
- It will be supported on many levels including government, local municipalities and universities, and by an international non-profit organization specializing in capacity building for water loss reduction activities.



Summary

- ‘per km of mains’ is used in Germany (for Real Losses) and France (for Water Losses) to assess management performance using Matrix approaches, interpreted using
 - system input volume, or consumption, or properties/km of mains,
 - different terminology (Rural, Intermediate, Urban, Metropolitan) and different class limits within the matrices
 - different subjective descriptions for assessing performance (Excellent, Low, Satisfactory, Almost Satisfactory, Average, Medium, Mediocre, Worrying, High) and different class limits within the matrices
- All of these matrix methods result in significant inconsistencies for national comparisons
- None of the methods are suitable for international comparisons
- Malta and Austrian OVGW have adopted the ILI as their principal PI for Real Losses
 - Italy and West Balkans are now also moving towards using IWA performance indicators



Conclusions



The law of unintended consequences is not yet dead !!



Thanks !

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