Tideway tunnel

by

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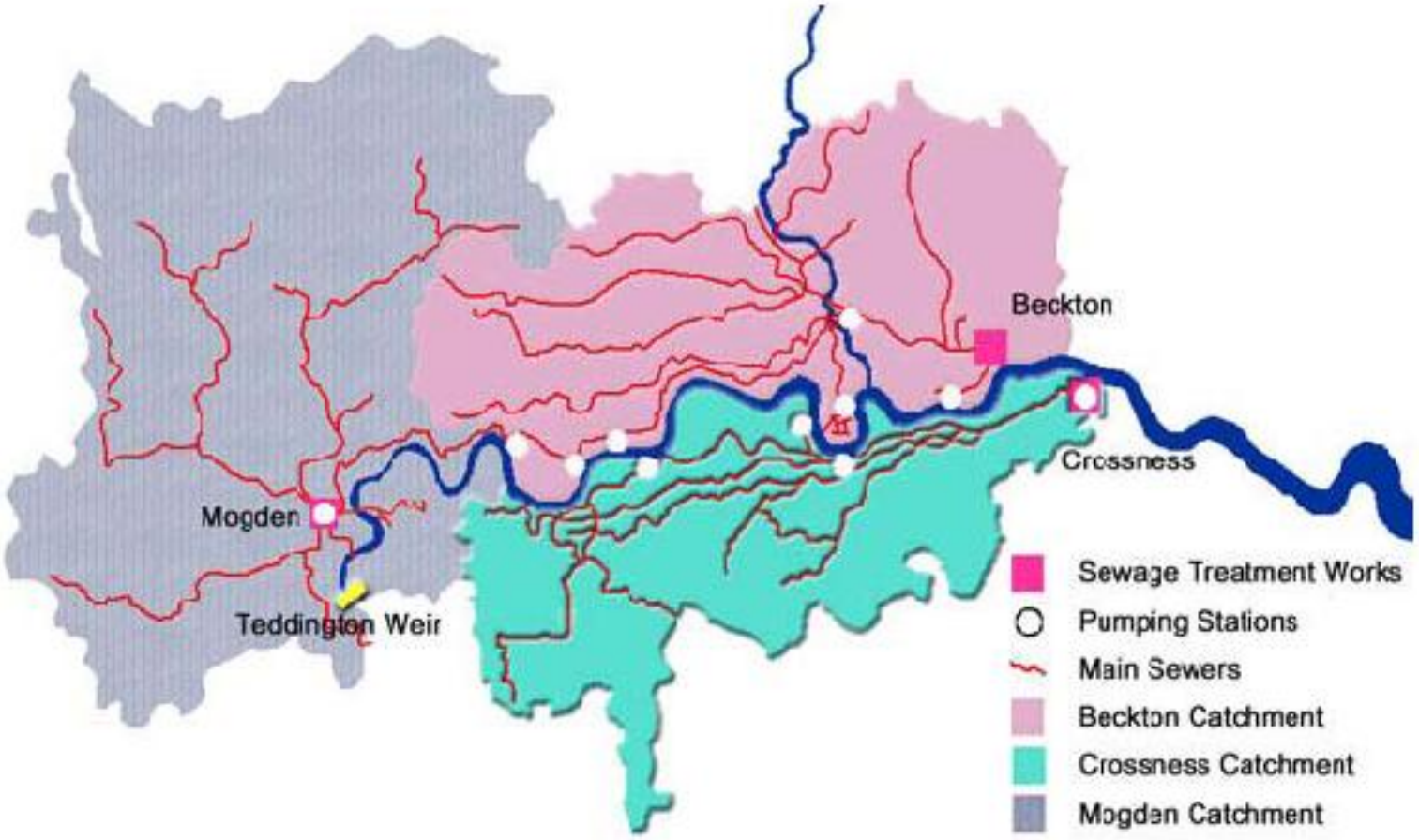
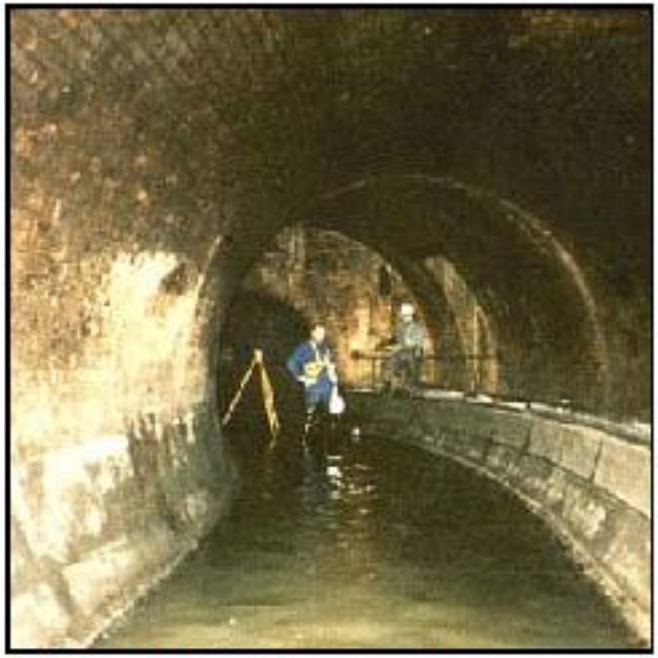
Sewer catchment map



National programme of work to solve unsatisfactory CSOs since 1989

- Tidal Thames always seen as a problem because of its size, the volume of storm waters discharged and accessibility



Storm relief sewer

A CSO in action

2001 – Tideway Strategy Steering Group established to investigate problem and potential solutions

- £4+ million investigation
- Drivers include:
  - Fish populations
  - Aesthetics (litter)
  - Health and safety (recreational use of river)

Thames Tideway Strategy Study

- Fish kills from Mogden STW, upgrade STW works, reduce spill of about 110 times/year.
- Low dissolved oxygen in lower tideway, upgrade Beckton & Crossness STW
- Considered SuDs but little experience of implementation elsewhere.
- Total separation of combined sewers. By itself, too expensive and disruptive.
- Recommended tunnel in 2005 at £1.7bn
- Subsequently Lee tunnel implemented to reduce CSO spill from

  39 Mm3/year to 18 Mm3/year, half.

Two strands to achieving desired river water quality

1. Increased capacity and improved quality for Tideway STWs; Beckton, Mogden, Crossness, (short-medium term implementation)

Beckton STW

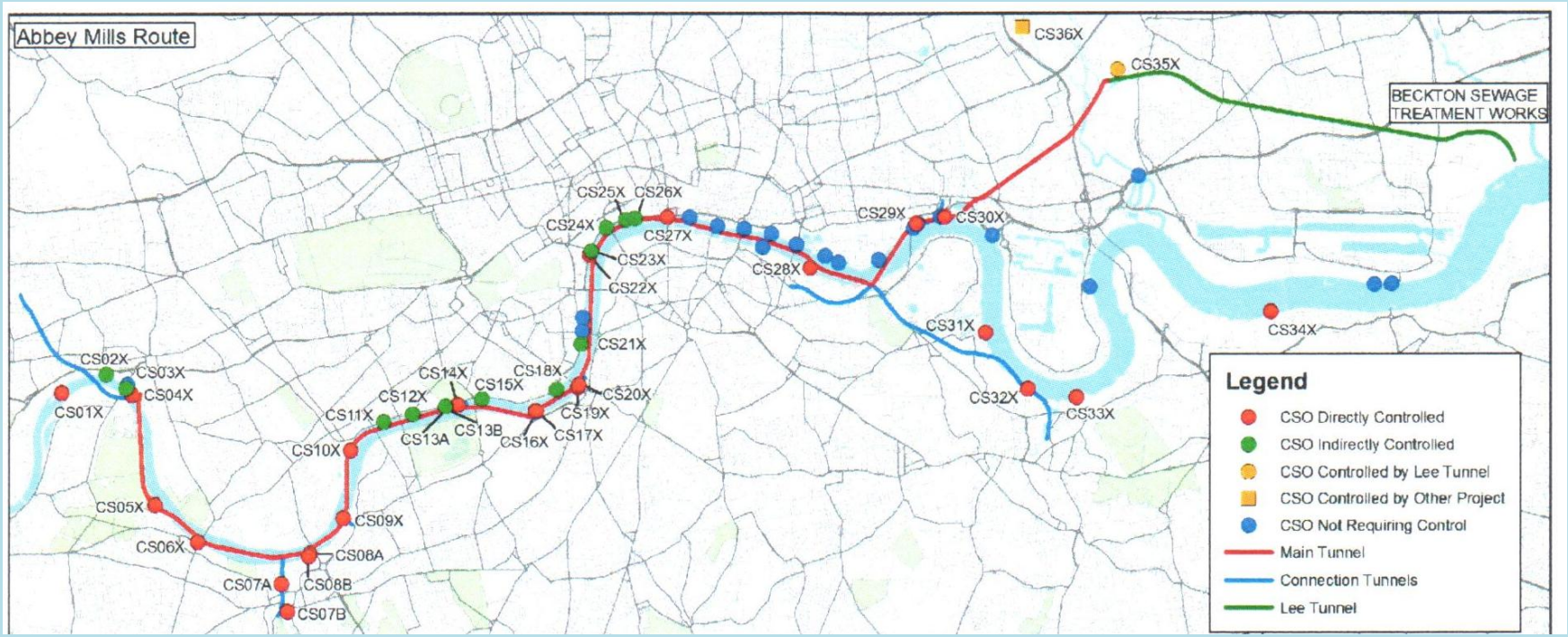
Mogden STW

2. Tunnel to capture CSO discharges (long term implementation)

Lee tunnel and Thames tunnel

Lee tunnel reduces spill volume from 39 Mm3/year to 18 Mm3/year.

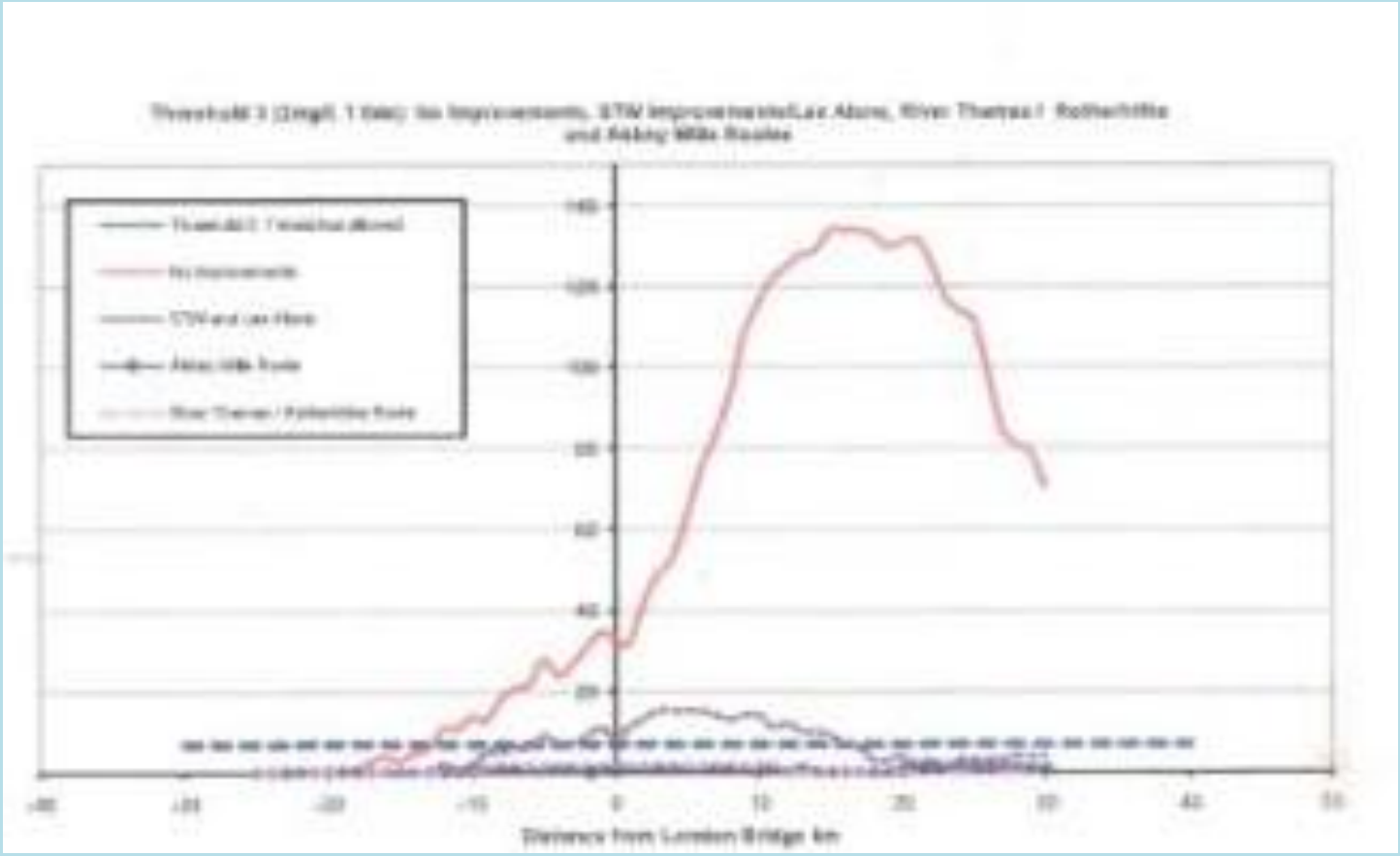
Thames tunnel designed for 4 spills/year.



Number of dissolved oxygen failures in the Tideway in 34 year record.

Threshold 3

red line current 130, mauve line post STW upgrade and Lee tunnel, 15.



Urban Waste Water Treatment Directive

- *"concerns the collection, treatment, and discharge of urban waste water..."*
- *"Sewer overflows may occur under conditions of* ***unusually heavy rainfall.***
- *Measures shall be taken* ***to limit pollution*** *from sewer overflows."*
- NB the Directive does not set:
  - specific pollution level
  - the number of spills allowed
- *The sewerage system, and the measures taken to limit pollution from CSOs, must be undertaken in accordance with the* ***Best Technical Knowledge Not Entailing Excessive Cost****,* ***(BTKNEEC)****."*

Tideway issues

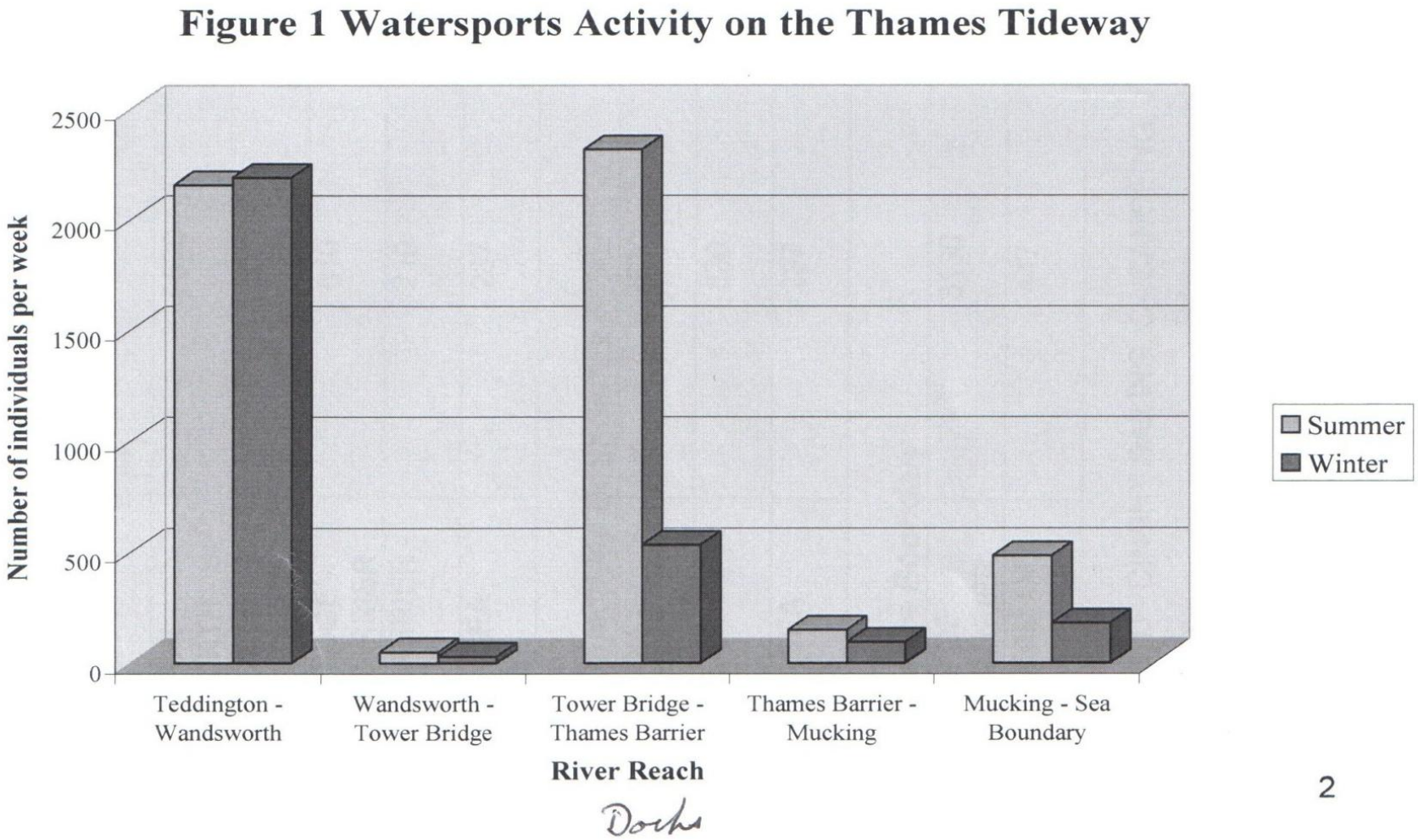
- 57 Combined sewer overflows.
- Spills are surface water mixed with sewage.
- Spills frequency from minimal to about 50 per year.

Infraction proceedings. 20 spills a year.

- "*Both in the pre-litigation stage and before the court the Commission did indicate that, as a rule, exceeding the limit of 20 overflows a year would be cause for concern."*Advocate General Opinion 2011.
- EC Judgement " *the Commission does not propose a strict 20 spill rule but points out that the more an overflow spills...the more likely it is that the overflow is not in compliance with Directive 91/271."*
- Court did not instruct that the tunnel be built, merely that the Directive be complied with.
- 20 spills/year compares with 4 spills a year target quoted by the EA in SuDs assessment report. page 9.
- "*We will end the so-called gold plating of EU rules, so that British business are not disadvantaged relative to their European competitors*." Coalition in its Our programme for government 2010
- Mogden STW upgrade, as approved by the EA, has spilled 15 times in 9 months, 20 spills a year. No signs of fish mortality.

Health- Recreational activity on the Tideway

Tower Bridge to Thames Barrier largely sailing and water skiing in enclosed docks. Could treat top-up water.



Health of Rowers.

Health Protection Agency study 2007

- About 5,000 rowers in the Upper Tideway.
- Gastric infection in the general population 190/1,000/year
- Gastric infection in Tideway rowers by HPA 18/1,000/year
- Quality Adjusted Life Year, NICE methodology for health issues.
- People x risk x value x length of time. NERA
- 5,000 x 0.018 x £30,000 x 3/365 = £22,000/year = £1.5mNPV.NERA

- Compares with WTP assessment of about £2,400m for health element.
- Mogden STW capacity now 50% greater, and spill frequency reduced from about 110/year to about 20/year, so even less sewage impact on the upper Tideway.

Aesthetics/litter

- Only 10% of litter is from CSOs
- CSO litter includes condoms, pantiliners, and faecal matter.
- "*Shortly after discharge floating matter disseminates relatively quickly so the plug of effluent moves unnoticed with the ebb and flood tide*." Health Protection Agency 2007.
- No actual data to support an assessment.
- The EA designated 35 usCSOs on the theoretical basis of volume, 1000m3/year to 50,000m3/year, and location.
- DETR Guidance on definition of unsatisfactory CSO must have "*A history of justified public complaints*"
- "*Unsurprisingly the number of formal public complaints regarding sewage debris is relatively few.*" EA 18/1/2012

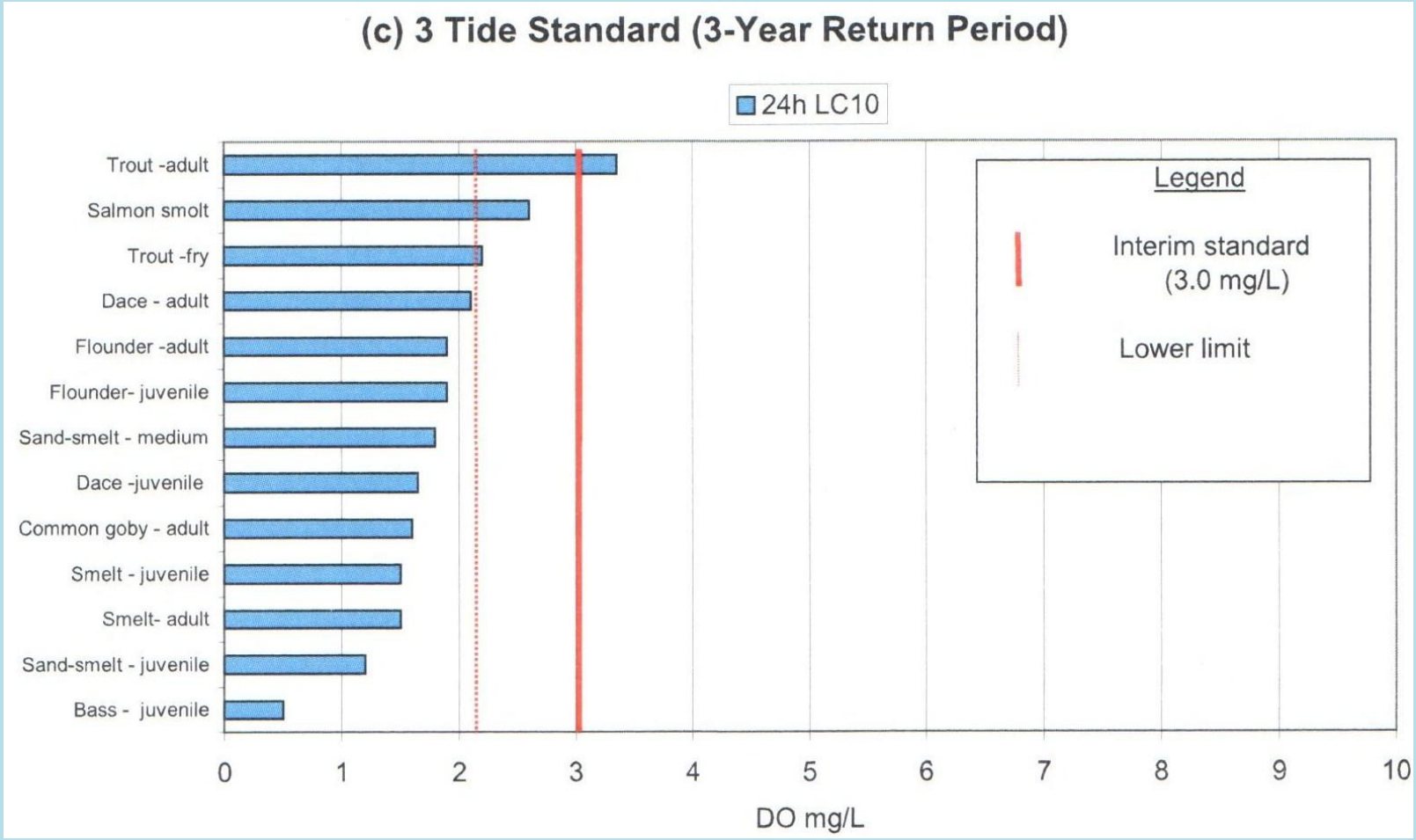
Litter collectors

"The vessels have greatly contributed to improving the environmental and aesthetic quality of the river...real success story enabling us to collect litter which overflows from sewers ..." TW 2008.

Typical floating debris collector

On Tideway cost about £2m for most CSOs.

Fish trials of dissolved oxygen sensitivity



Sustainable mortality of different fish species

Table 3-4 ***Values used for sustainable mortality. It is assumed that fish with more reproductive year classes are able to sustain a higher mortality in a single year.***

Species	No. of Reproductive Age classes	Sustainable Mortality %
Salmon	3	30
Bass	10	30
Sand smelt	2	10
Dace	4	20
Smelt	2	10
Flounder	7	30
Common goby	2	10

Tideway Fish Risk Model

Includes consideration of location of fish species, stage of development, risk of mortality, and sustainable mortality

- "*The number of "not sustainable" incidences is zero*"

  FARL Experimental studies on the dissolved oxygen requirements of fish, 2004, p 91.

- "*Tideway fish populations should already be sustainable*." Fisheries Review Appendix F to the Needs case 2010 p16

- These quotes include salmon which is the most sensitive species.
- Since then the base case includes the Lee tunnel which halves the spill volume.
- Model for the future years uses wrong sewer dry weather flows and unsupported temperature increase.

Salmon migration in the Thames

AST 2013 "*Marine survival of Atlantic salmon has collapsed.*"
"Marine survival unsustainable" Dr Friedland after modelling the long term.
2013 return, 3 salmon

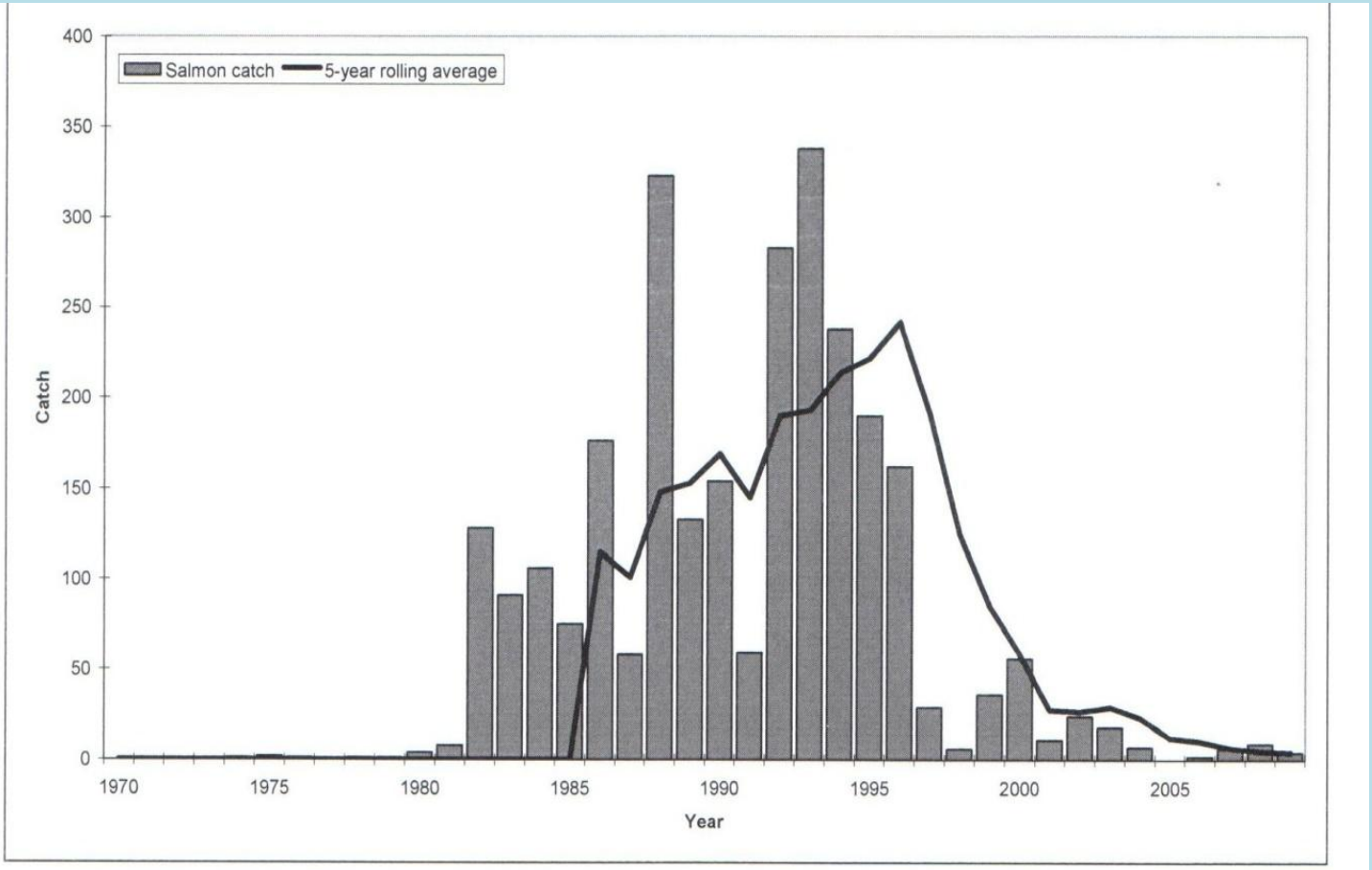
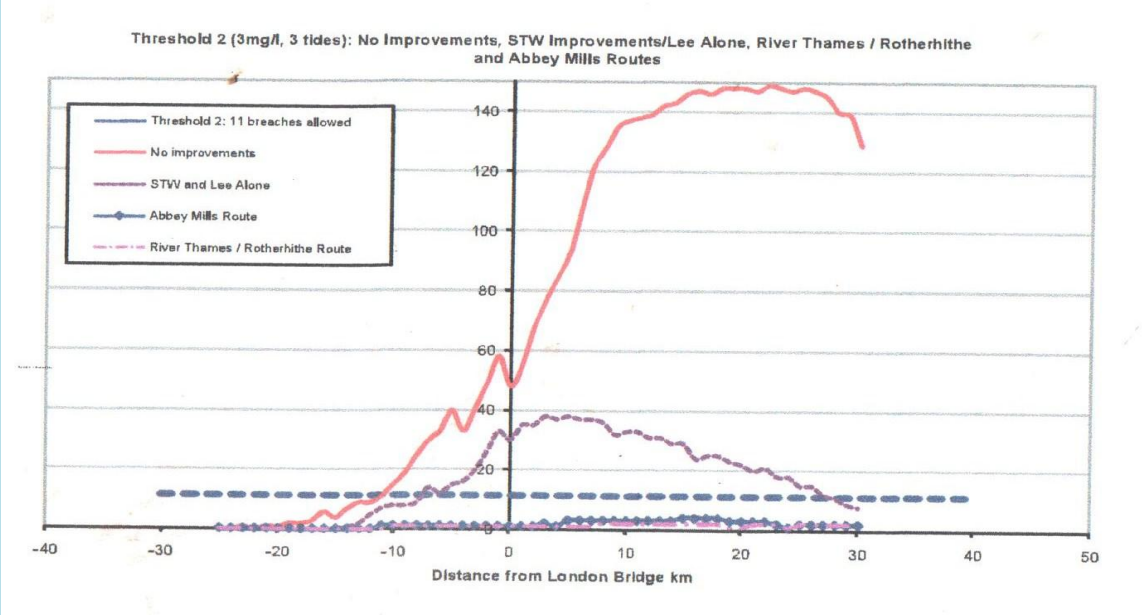


Figure 1 - River Thames recorded salmon catch and five year rolling average

Reported fish kills in the Tideway in the last ten years

Mogden STW 3 fish kills, upgrade has now dealt with problem.
Abbey Mills 2 fish kills, Lee tunnel will deal in 2015.
Tideway, one fish kill reported of one dead fish.

Model of “No improvements” shows 150 fish kills in 34 years, ie 45 fish kills in 10 years
Actual 3 recorded fish kills in the Tideway,
Doubt about the accuracy of the table and the model output
Lee tunnel will deal with Abbey Mills.
One recorded dead fish in 10 years due to CSOs , then Tideway fish are sustainable
No need to build tunnel to sustain fish.



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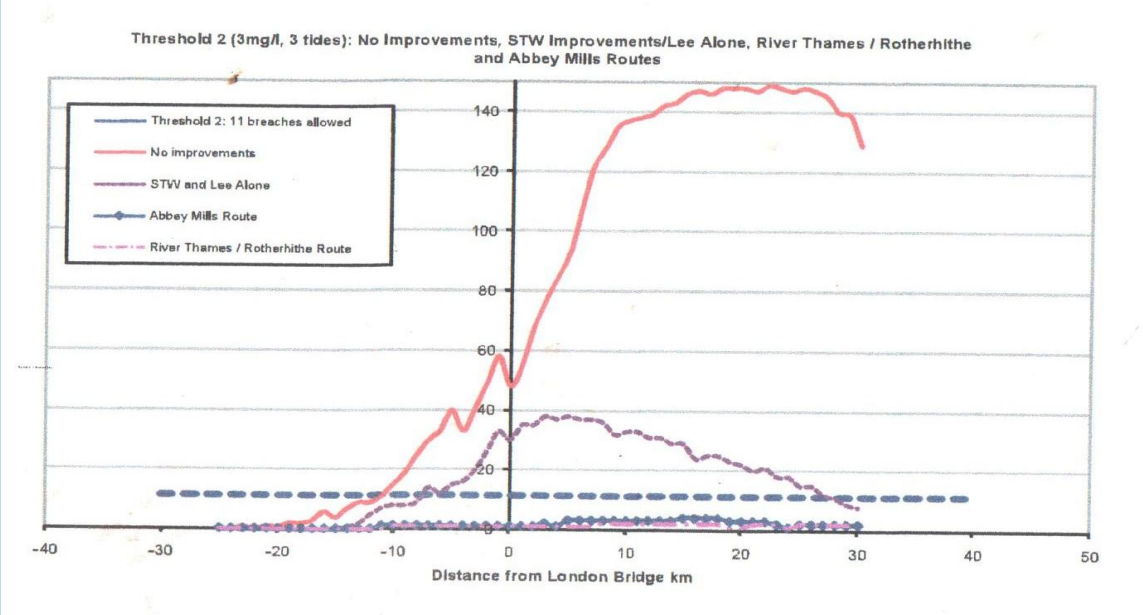


Bubbler to raise dissolved oxygen levels in the Tideway

Oxygen injection system in the Seine in Paris

Some of the measures to reduce spill frequency
as alternative to the tunnel

- Revise sewer dry weather flow to reflect WRMP
- Some detention tanks
- Some separation of foul and storm sewers.
- Remove obstructions in the sewers.
- Real time control
- All these should be achievable in 3 to 5 years
- Apply Sustainable Drainage systems
- Apply Blue Green Infrastructure

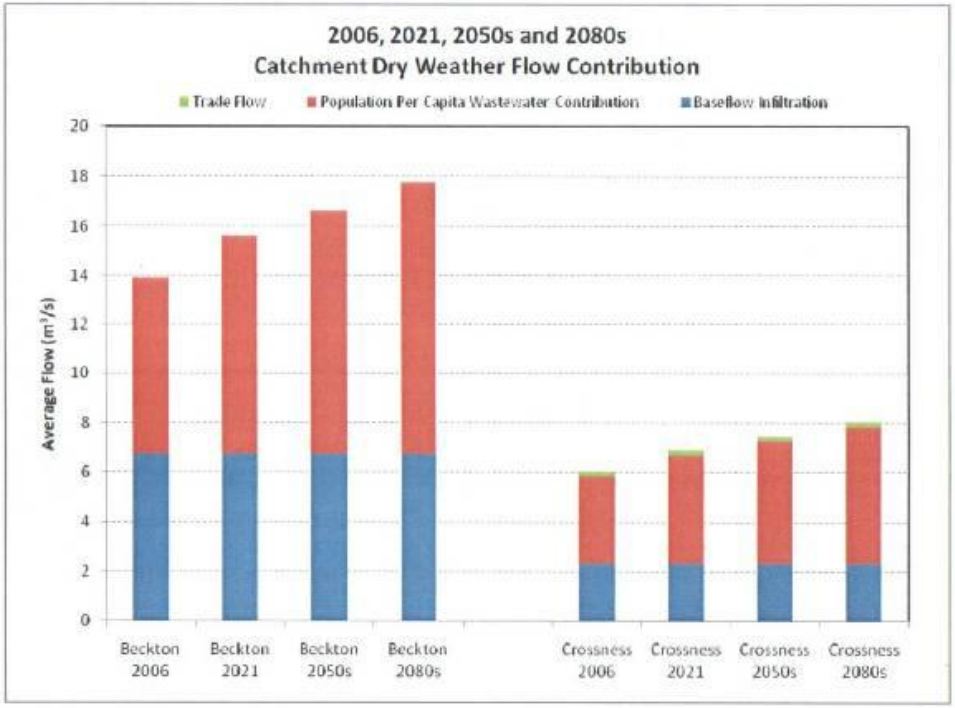
Dry weather sewer flows

TW model shows increasing sewer spills in future

Water delivered 2007/8 **1633** Ml/d, 2022/3 **1534** Ml/d TW WRMPs

Thus model of the future needs revision.

Population and Wastewater Flows



Wastewater Profile	Per capita (L/head/day)	Catchment
Beckton Combined	200	Beckton
Beckton City	150	Beckton
Beckton Separated	150	Beckton
Crossness Combined	200	Crossness
Crossness Partially Separat	155	Crossness
Crossness Separated	155	Crossness
Fraser Rd (Separated)	145	Crossness

Assumptions:

1. Population change based on latest GLA projection to 2030 and ONS from 2030 to 2050
2. No change to per capita rating
3. No change in baseflow infiltration
4. No change in impervious connected area
5. Point 2, 3 and 4 subject to compliance to other TW work such as SOLAR values

Sustainable drainage.

This is one of many methods of storing storm water and releasing it slowly. Such a system could be under a road or car park.

Spill frequency of pilot study of Putney CSOs/year.

Pilot study area comparing current modelled spill frequency with that with 50% impermeable removed by SuDs. No infiltration allowed in the SuDs.

Conclusion that SuDs could not achieve 10 spills a year. But sewer model wrong

From Appendix E to Needs Report 2010

Corrected model. Conclusion that SuDs should be able to meet EC 20 spills /year.

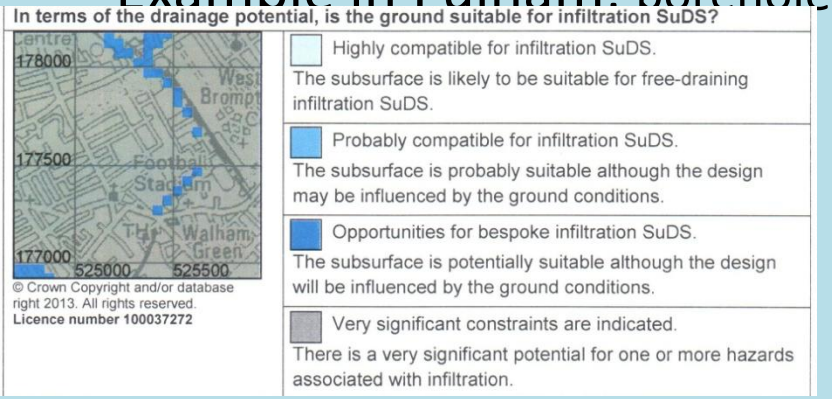
TW Table of Performance, 2011.

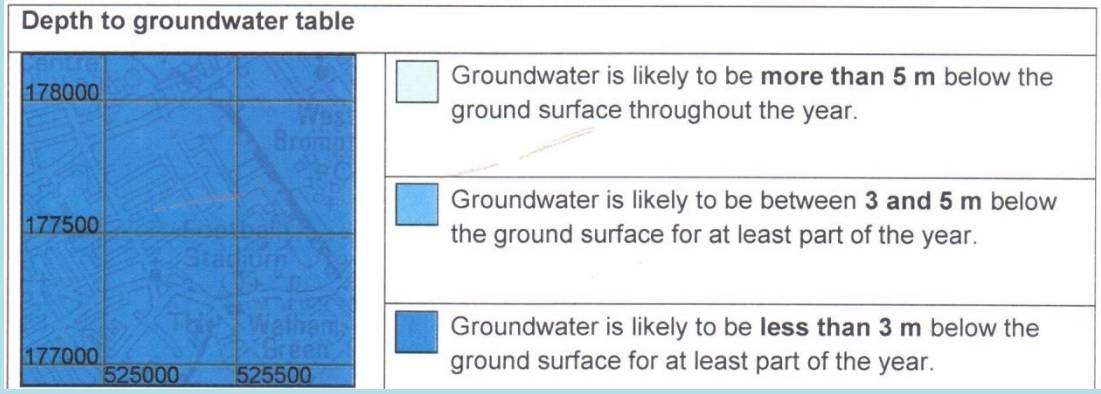
Catchment	Existing system spill frequency Appendix E	Existing system spill frequency TW Model 2011	Appendix E 50% impermeable removed	Likely revision 50% impermeable removed
West Putney	59	26	52	about 20
Putney Bridge	33	33	16	stays at 16
Frogmore Bu Rd	29	19	10	less than 10
Compare with	EC proposal	of 20 spills/year		All 20 or less.

Suitability for infiltration SuDs. Source EA/BGS

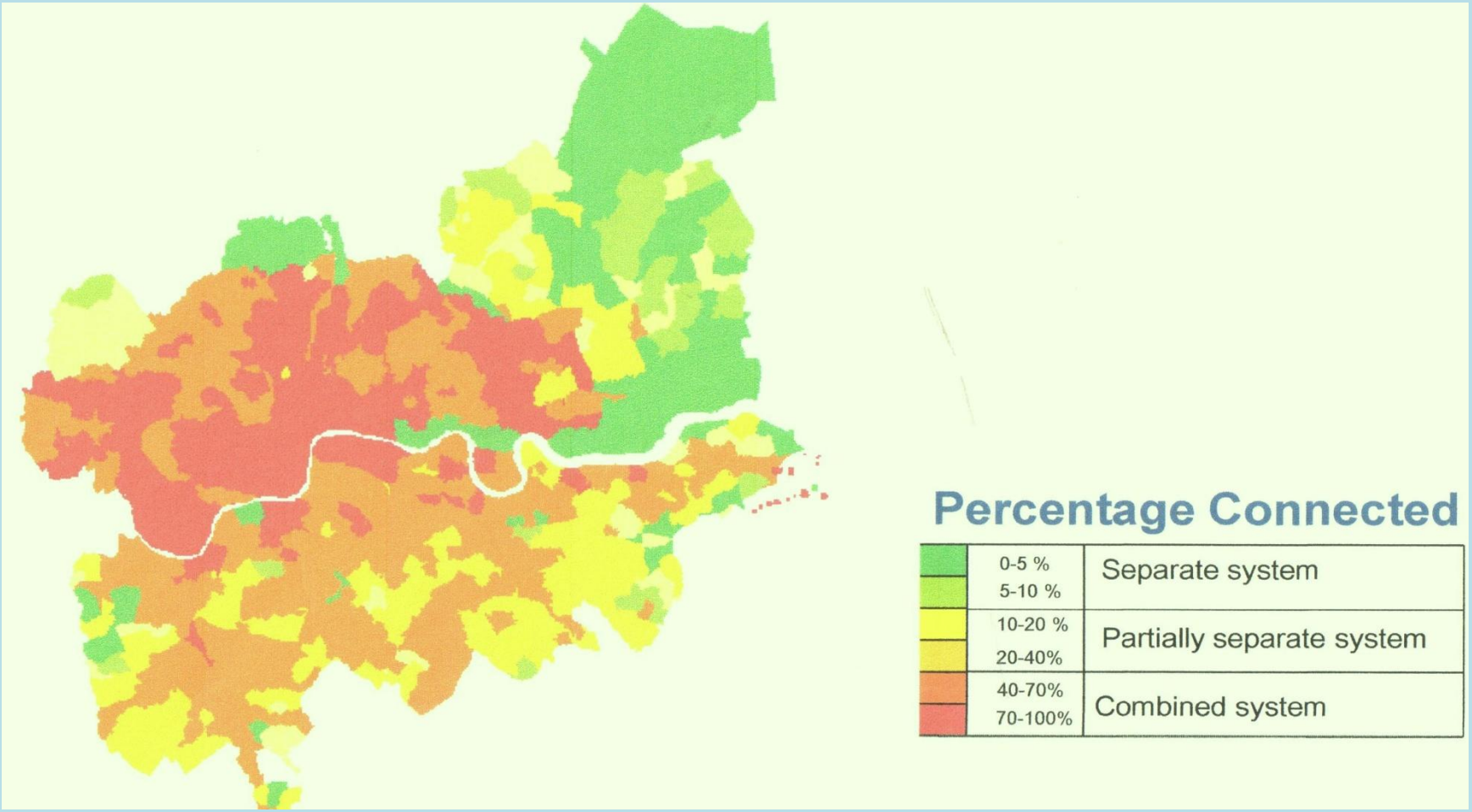
Suitable	8%
Probably compatible	20%
EA assumption	28%, “limited”
Opportunities for bespoke infiltration SuDs	39%
Bloomberg assessment	67%
Very significant constraints	33%

Example in Fulham. borehole showed no groundwater less than 3m

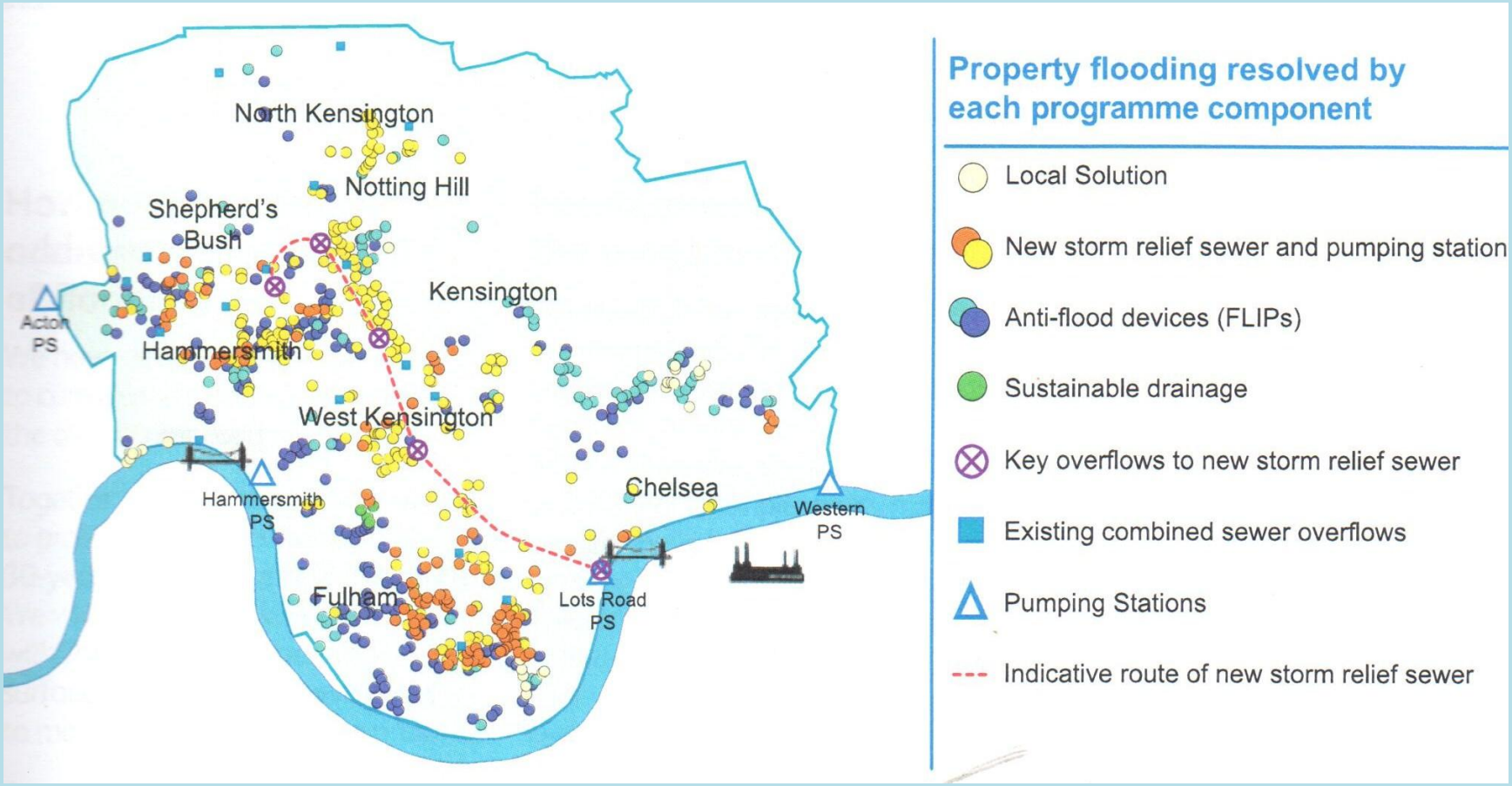




Sewer separation

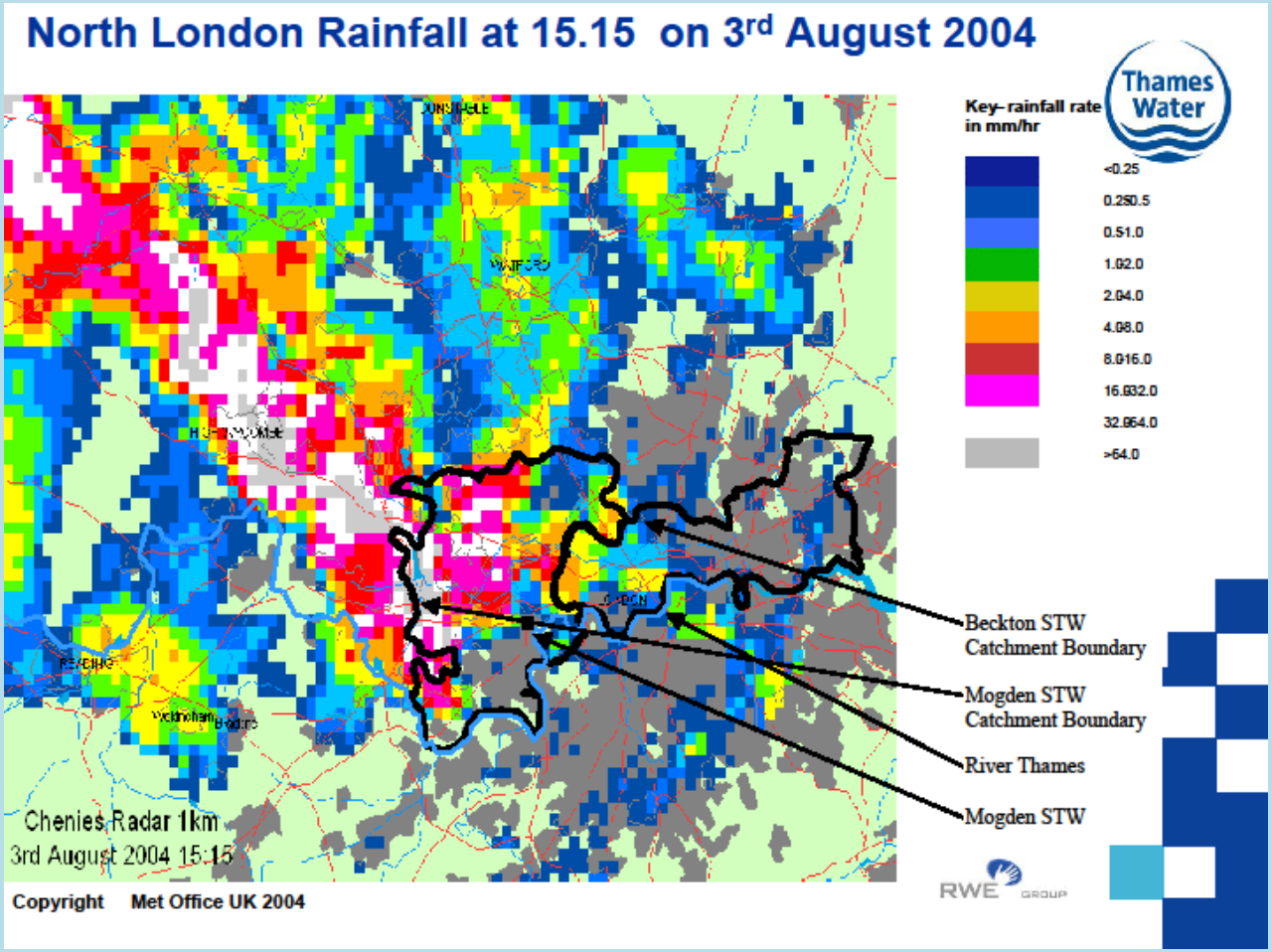


Proposed Counters Creek combined sewer. Adapt to storm water collection



Ranelagh sewers.
Separate into foul and storm.

Typical heavy summer rainfall



Real time control

At each interconnection there is a fixed weir. Because rainfall varies with location, there could be spare interceptor capacity. Put in moveable weirs and control their operation to maximise use of interceptor capacity. In **Quebec RTC reduced spills from 45/year to 26/year,**(Bloomberg)

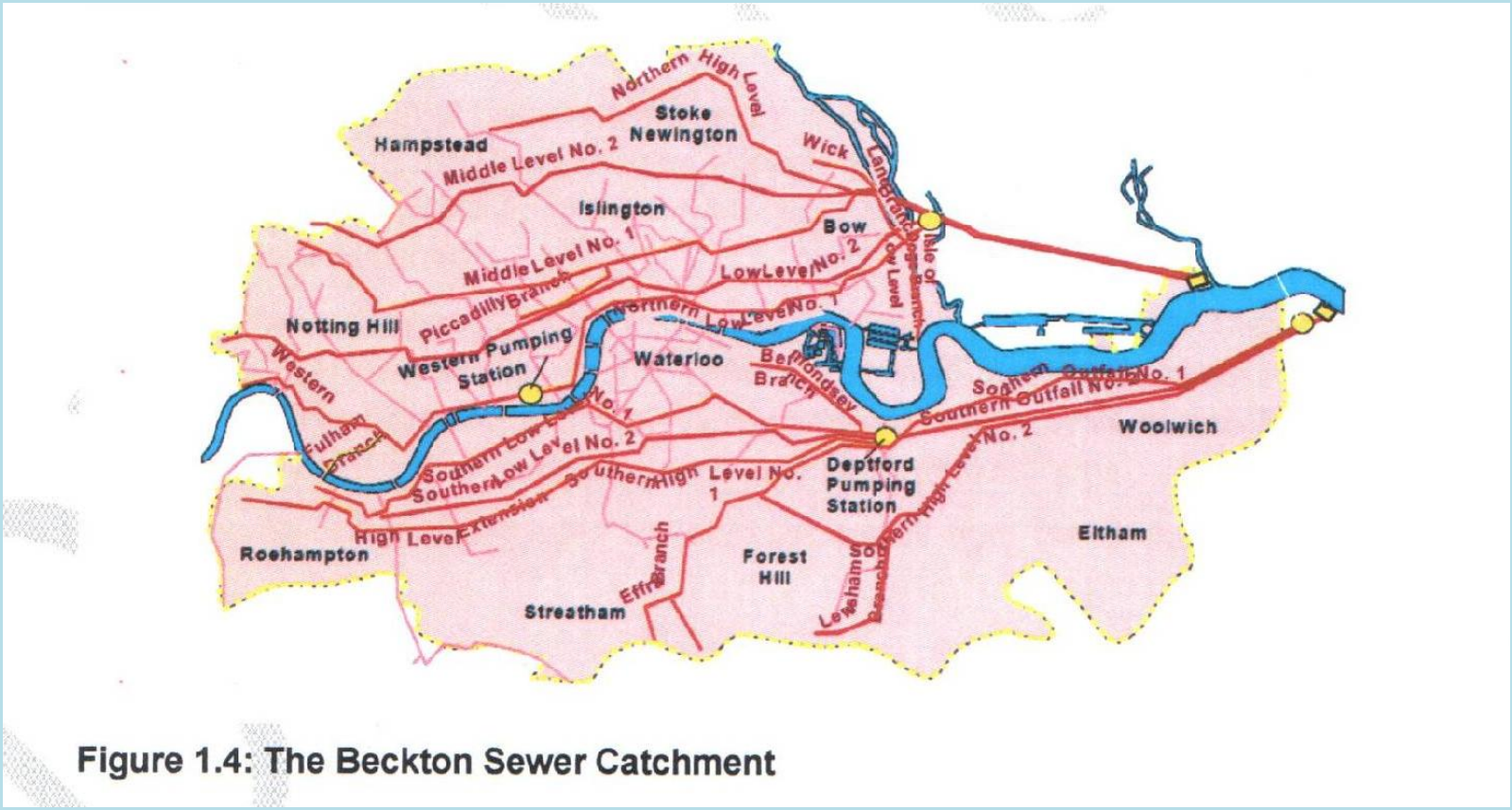


Figure 1.4: The Beckton Sewer Catchment

Need to study a combination of measures.

- The defra RBPG Vol 2 August 2008 states in 9.4 "*As river basin planning principle makes clear the Environment Agency should consider the* ***full range of measures*** *which are available*." My emboldening
-
- In 9.5 the RBPG states "***The WFD requirement is to make judgements about the most cost effective combination of measures, so it is important that the Environment Agency considers the inter-relationship between measures***". My emboldening.

- I cannot find a study where a combination of all measures to reduce spill frequency of the London sewerage system has been studied.

Possible action to achieve max 20 spills

First correct the sewer inflow in line with TW WRMP

CSO name	In Appendix E	2011 modelling	Possible action to achieve 20 spills/year
West Putney storm relief	59	26	Detention tank/sep/SuDs.
Hammersmith	57	50	Counters Creek separation
Abbey Mills Pumping station	55	0	OK Lee tunnel
Holloway Storm Relief	49	8	OK
Savoy Street	47	18	OK
Greenwich Puming Station	45	28	?Separation/RTC
Falcon Brook Pumping Station	43	40	?separation/RTC/SuDs
Acton Storm relief	40	29	Separation/detention tanks
Lots Road pumping station	39	38	Counters Creek separation
Westen Pumping station	39	37	Counters Creek separation
Deptford Storm relief	38	36	?Separation/RTC
Frogmore SR Bell Lane	36	26	small, detention tank
Heathwall Pumping station	35	34	? Separation/RTC
Putney Bridge	33	33	Det tank/SuDs App E 16
North east storm relief	31	31	SuDs App E 18
Brixton Storm Relief	30	28	? Separation/RTC
Frogmore SR Buckhold Rd	28	19	OK
Earl Pumping station	28	26	? Separation/RTC
Ranelagh	27	26	Separation
Fleet Main	20	23	remove obstruction/RTC
Rest below 20 spills/year			

Changes since NPS in March 2012

- Judgement of the European Court 18th October 2012, 20 spills/year
- Commission policy on Blue Green infrastructure, May 2013.
- Economic circumstances changed.
- Perceived high energy and water bills.
- Ofwat announcement proposed water companies bills to 2018, most reducing. TW sewerage bill going up 20% above inflation.
- Thames Water 2012 profit £150m, dividend £230m
  2013 profit £250m, dividend £280m.
- TW require a Special Purpose Vehicle to develop the tunnel

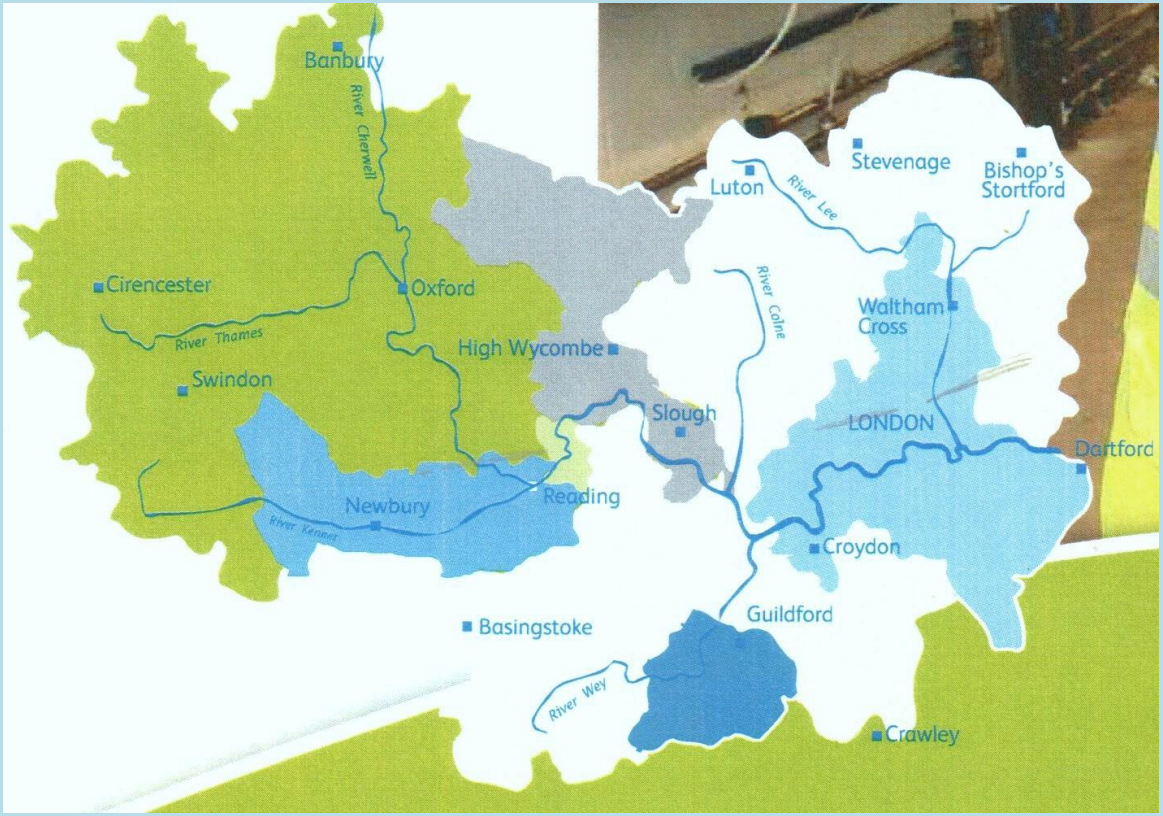
Cost benefit assessment.

- WTP survey in 2006.
- Admin area /England
- Single/multiple
- 60 years/100 years
- Real income growth from 2006, assumed increase 33%
- No construction impact disbenefit
- Assumed benefit **£4,502m**
- QALY health benefit and making adjustments **£310m**.
- My updated cost benefit assessment report available.

Effect on household bills in TW area.

Median willingness to pay £10 to 20/hh/year. Eftec 2006 p 30

Expected increase to pay for the Thames Tunnel £70-£80/household/year in the whole Thames Valley.



Better Regulation Executive 2010, page 6.

- New approach
- Opening existing regulation up to tougher, more meaningful, scrutiny.

- Ministers should
- focus on identifying the most cost effective way to achieve desired policy outcomes.
- Exercise discipline in considering any new regulatory measures, as any new costs must be offset by reductions elsewhere so the cumulative burden is reduced.
- Encourage and challenge civil servants to actively explore creative solutions to achieve desired policy outcomes

- Civil Servants should
- Review more frequently whether policies are delivering the intended outcomes.

Summary 1

- U W W T directive aim to limit pollution,
- Health QALY £1.5m.
- Fish, only 1 recorded fish killed as a result of the Tideway CSO spill in last 10 years.
- Aesthetics "formal public complaints relatively few"
- unusual rainfall, EC proposed 20 spills a year.

Summary 2

- Requirement to study a combination of measures for London.
- Measures within 3 to 5 years
  - Revise sewer dry weather flows to reflect WRMP.
  - Some detention tanks
  - Some separation of foul and storm flows
  - Real time control
- Longer term measures
  - Sustainable Drainage systems
  - Apply Blue Green Infrastructure

Recommendation.

- Independent study to see whether a combination of measures could comply with the EC spill frequency and at what cost.