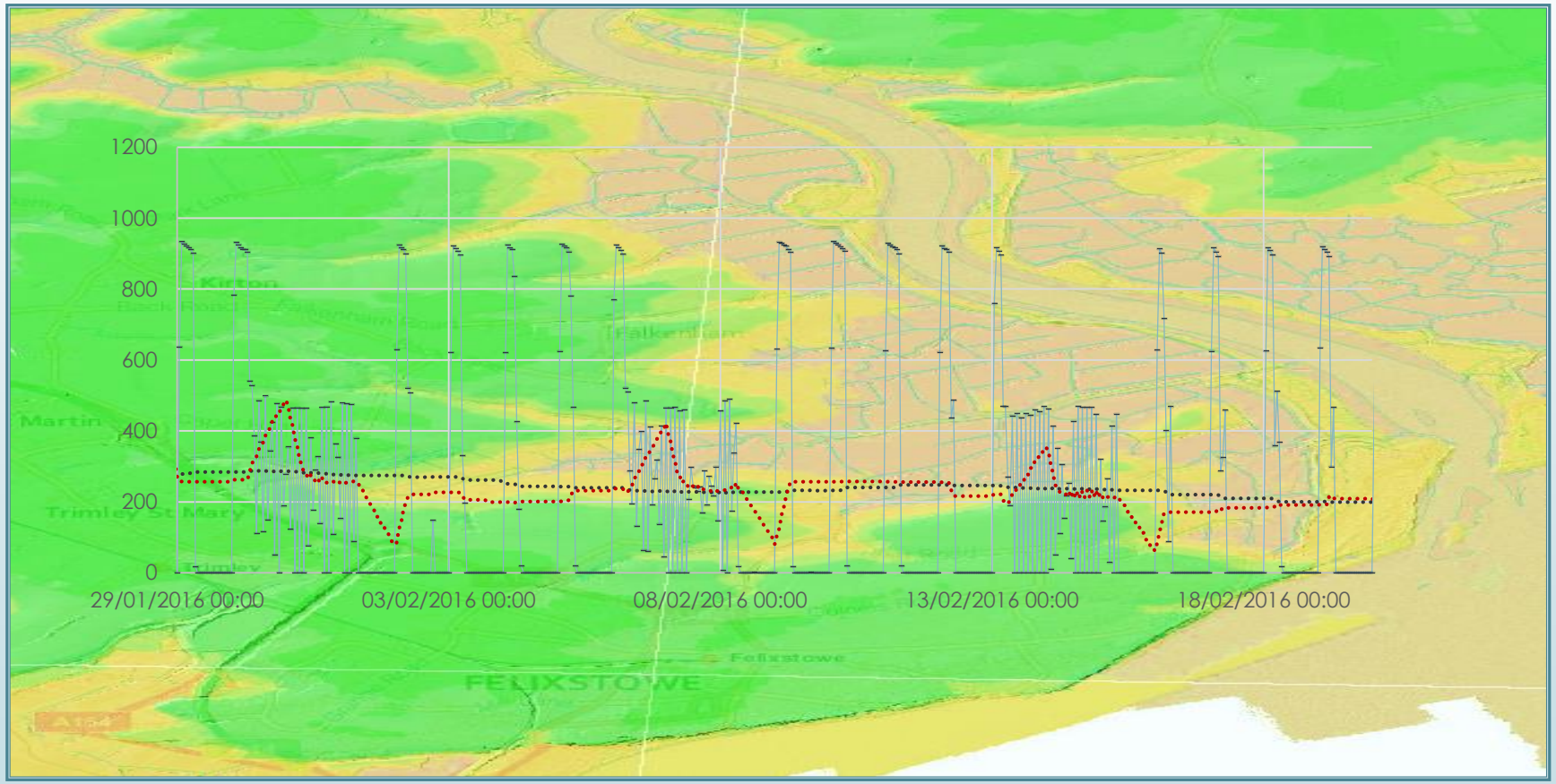
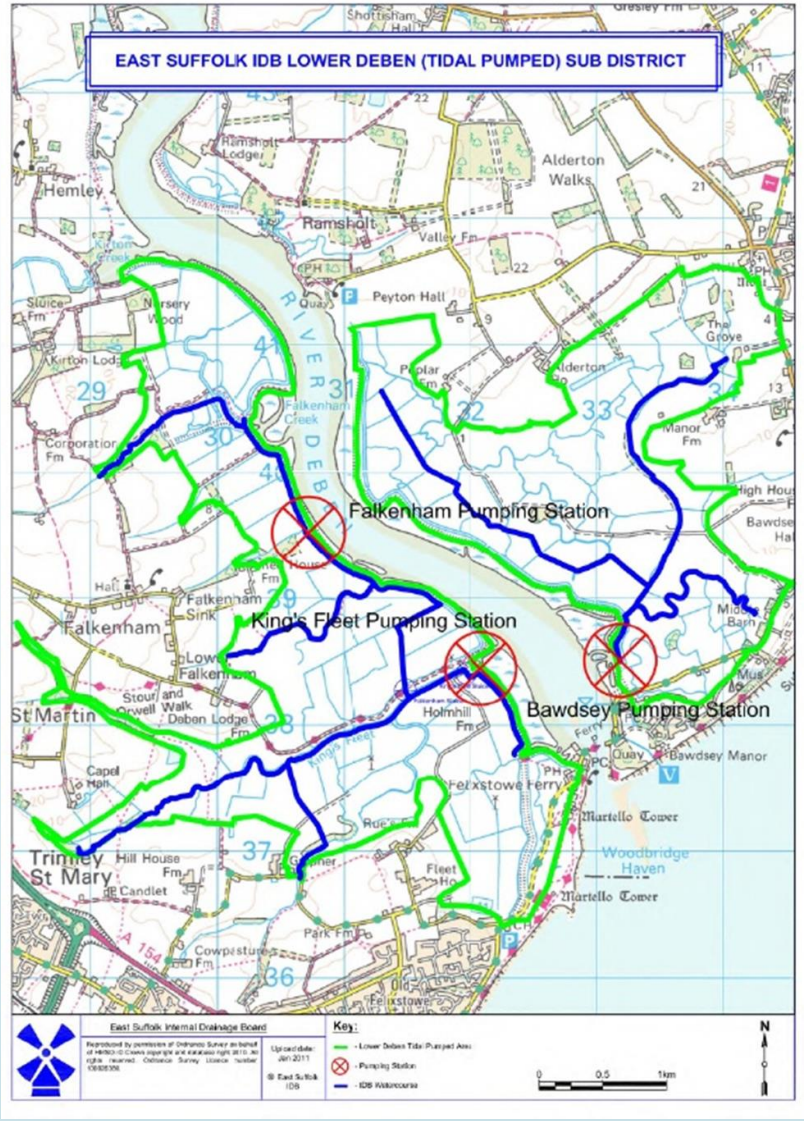
Kings Fleet & Falkenham IDB Abstraction Licence Application Yield Assessment



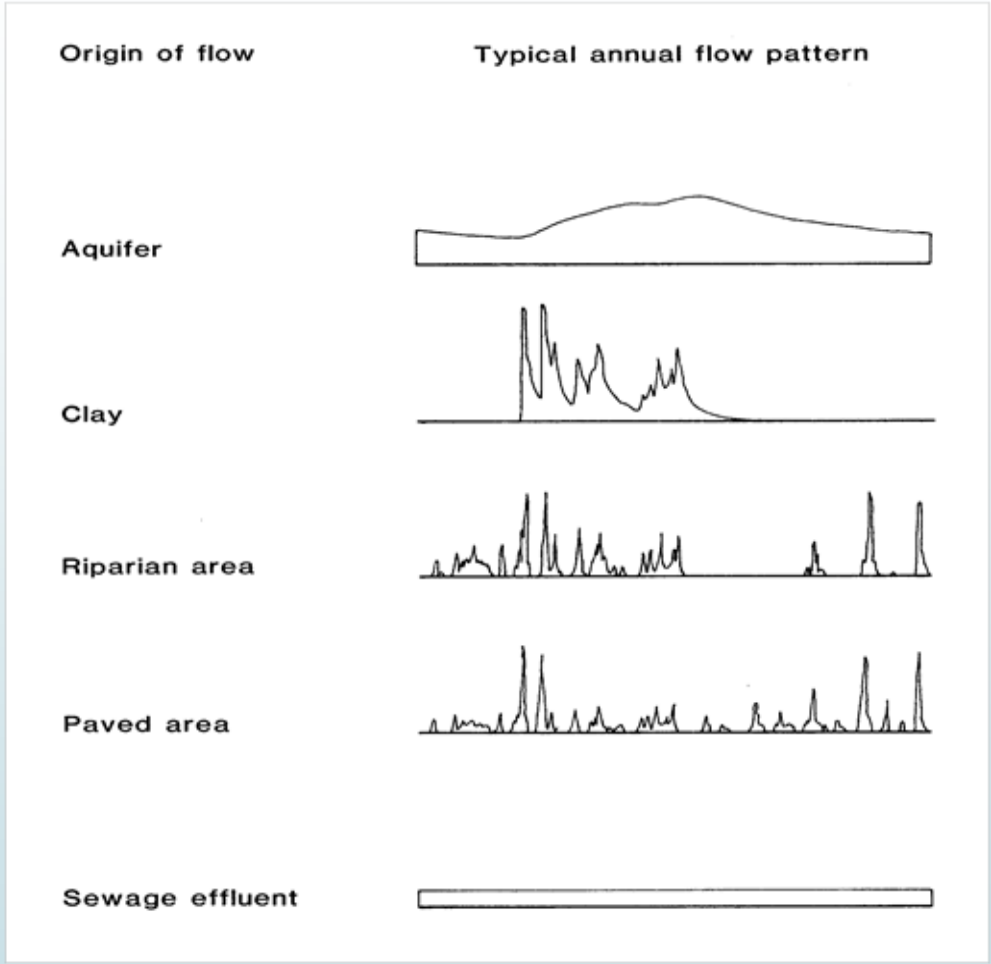
Conjunctive use or Farm reservoir – yield Dependent Current Constraints

- Estimated average yield 1500-2000Ml.
- 600-800 Ml demand for irrigation
- 1000Ml+ demand for P.W.S
- 188 Ml currently licenced
- Design year yield unknown
- Lack of local reliable flow data
- Currently two pumping stations Kings fleet and Falkenham
- Possible to move water from Kings Fleet to Falkenham
- Water Quality constraints
- Freshwater flow to Estuary



Assessing Yield
Hydrological models
Catchment Hydrology

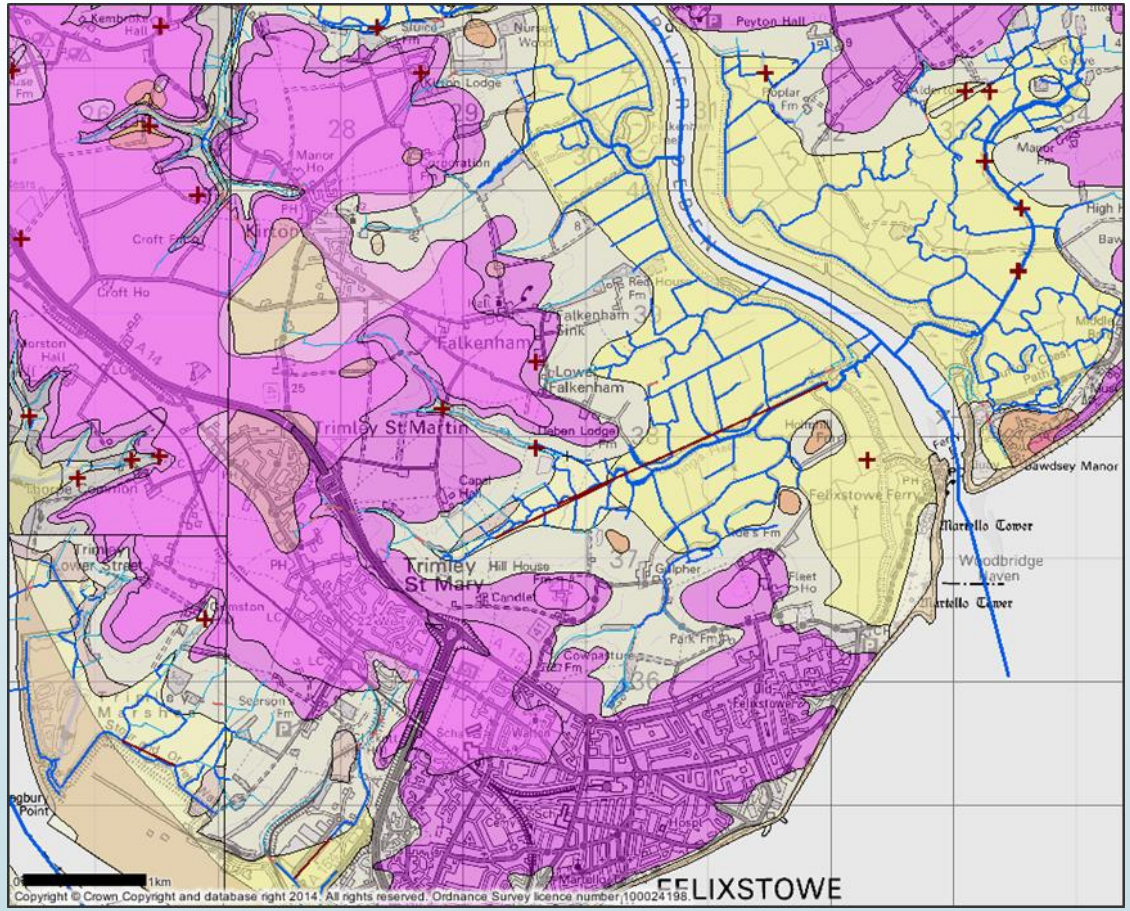
- Available Methods include Low Flows Enterprise; NEAC model ; Catchment comparison; Rainfall run off modelling .
- Catchmod Rainfall runoff modelmost suited to this application .
- Catchment divided into hydrological zones.
- Water moves vertically through a series of conceptual stores in each zone
- Inputs Potential Evaporation and Rainfall 1970-2015.
- Calibrated with catchment observed flow data



Kings Fleet – Falkenham model Build

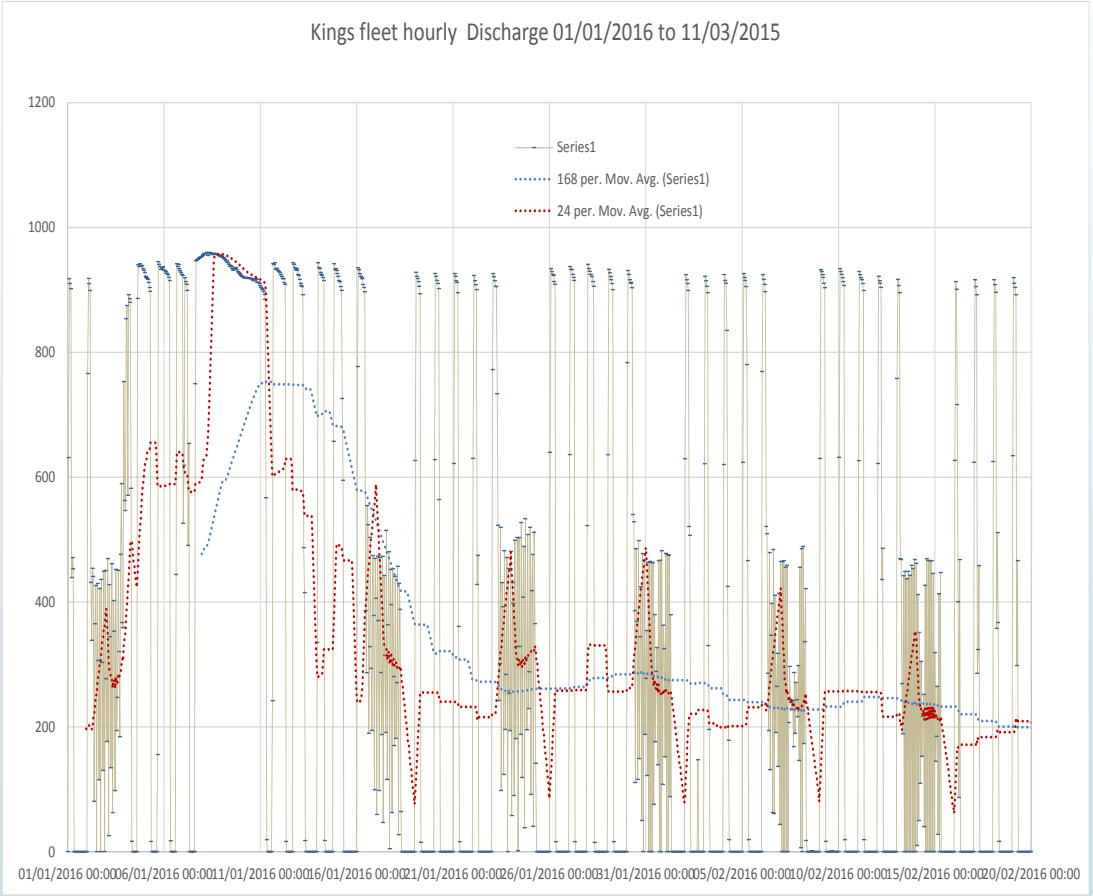
Inputs

- Potential Evaporation MORECS weekly .
- 1970-2015 Rainfall Locally gauged for Calibration – Levington for P.O.R. (inc other gauges for infilling).
- Flows – gauged at Falkenham and kings fleet Pumps . Check with other gauges , Holesley, Brantham, Playford etc.
- Hydrological zones; superficial Aquifer 35%, Alluvium 32%, London clay 25%, Hard surface rapid 8%
- Single unit calibration



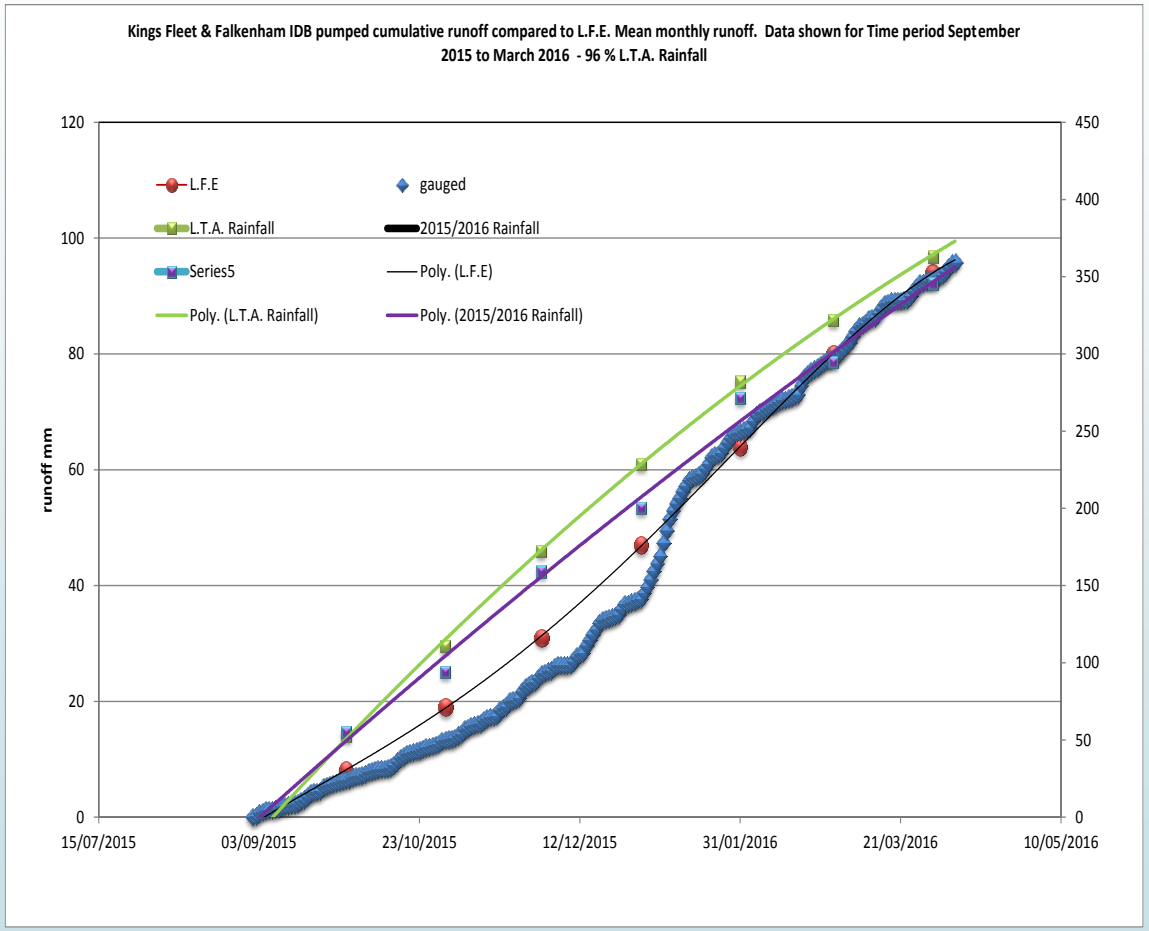
IDB Pump data

- Significant periodicity @ 24 hour and 7 day – not hydrological – cost minimisation
- Correction required for calibration . Maximum period of 7 day selected as filter .
- Model output's reported to 7 day rolling output .
- Uncertainty regarding the more rapid response functions of the catchment .
- Local gauge and model checks indicate good accuracy of gauged data (next slide)



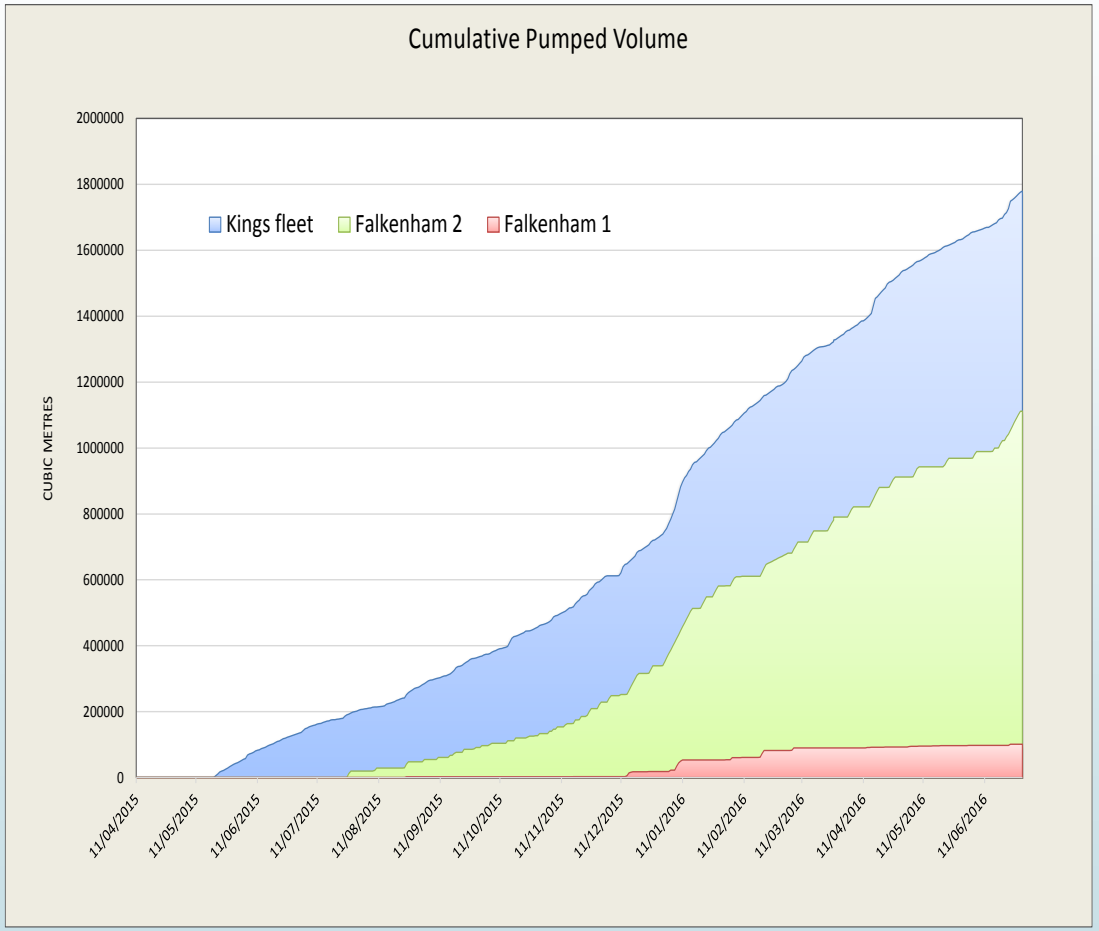
IDB Gauging Plausibility checks

- Early monitoring data Sep 2015 – Mar 2016 run off compared to gauge and existing steady state models .
- Sep 2015 – Mar 2016 Rainfall 96 % of L.T.A.
- Sep 2015 – Mar 2016 Measured run off 99 % L.T.A compared to L.F. E model . (95mm)
- Very encouraging checks for accurate metering .



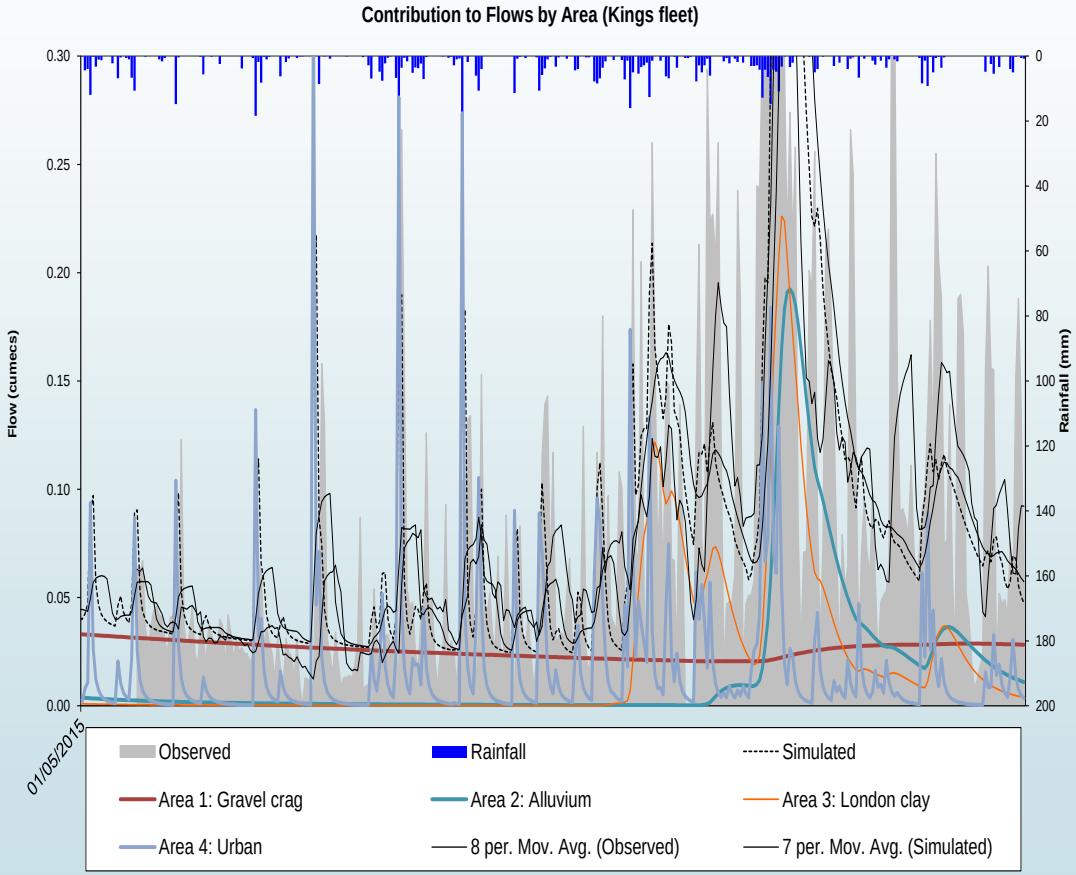
IDB Pump Totals 2015-2016

- Total Measured discharge 01/08/2015 to 31/06/2016. Approx. 2800000m3
- Runoff 57 % Kings fleet: 43% Falkenham
- Area 61% king fleet: 39% Falkenham
- Rainfall Aug to June 114 % L.T.A.



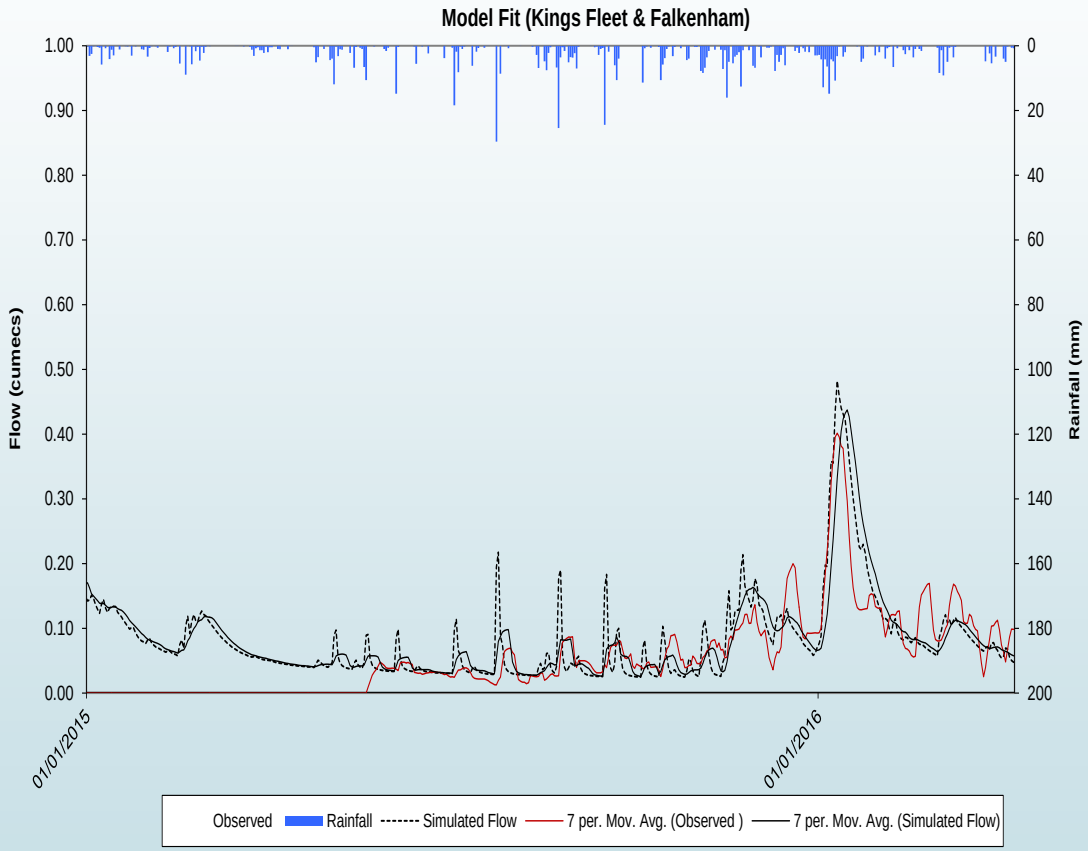
Catchmod Rainfall runoff model Calibration

- Calibrate to individual hydrological zones .
- Soil moisture profiles
- Flow statistics including flow duration curves .
- Catchment yield.
- Total flow



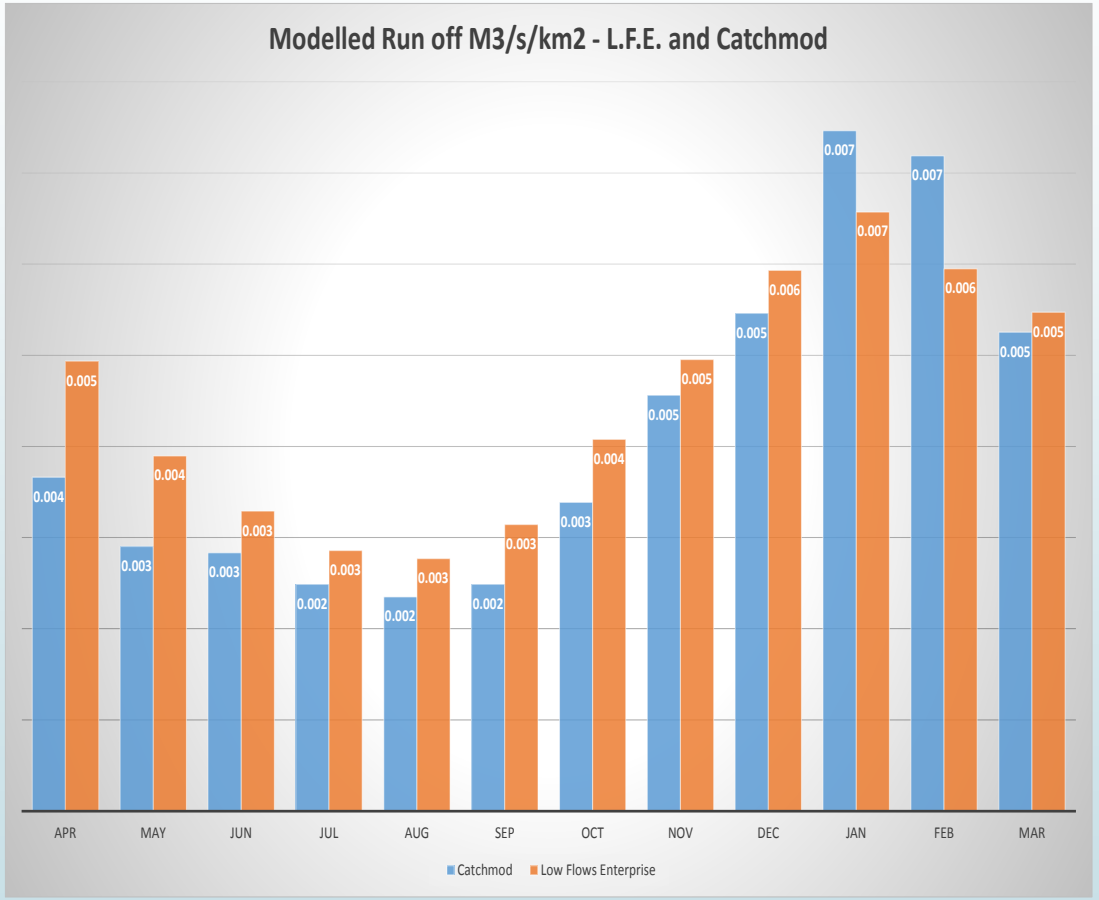
Total flow Calibration

- 7 day rolling output to remove periodicity.
- Removes probable urban peaks- attenuated by storage
- Good calibration of observed aquifer baseflow trends.
- Probable 10-15 % underestimate of long term average yield
- Underestimate associated with run off from marsh area , too high S.M.D. in shoulder months. ?
-



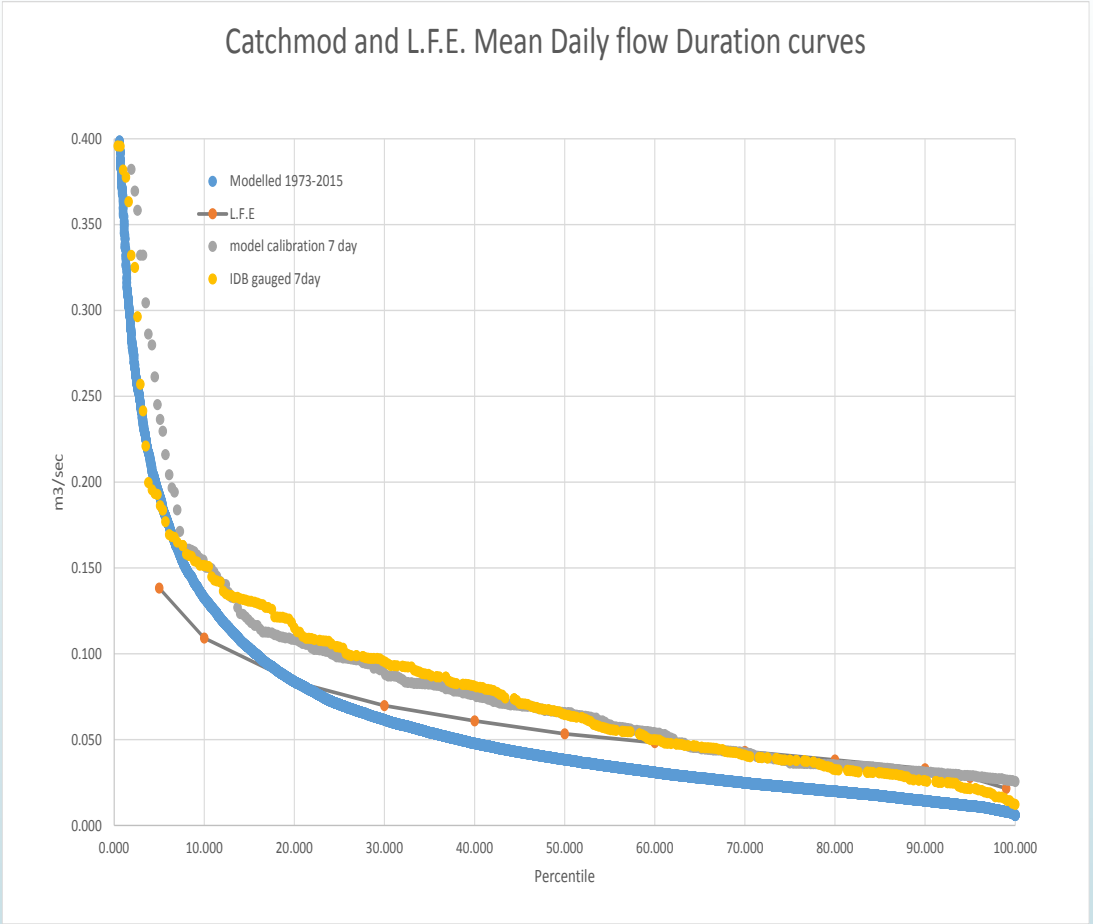
Catchmod calibration ‘v’ existing models. L..F E

- Good calibration of seasonal runoff with steady state models .
- Baseflow months Consistently 10-15 % lower . Runoff dominated months 10-15 5 higher.
- Consistent with conceptualisation that L. f. E. model overestimates baseflow index @ 0.82 .



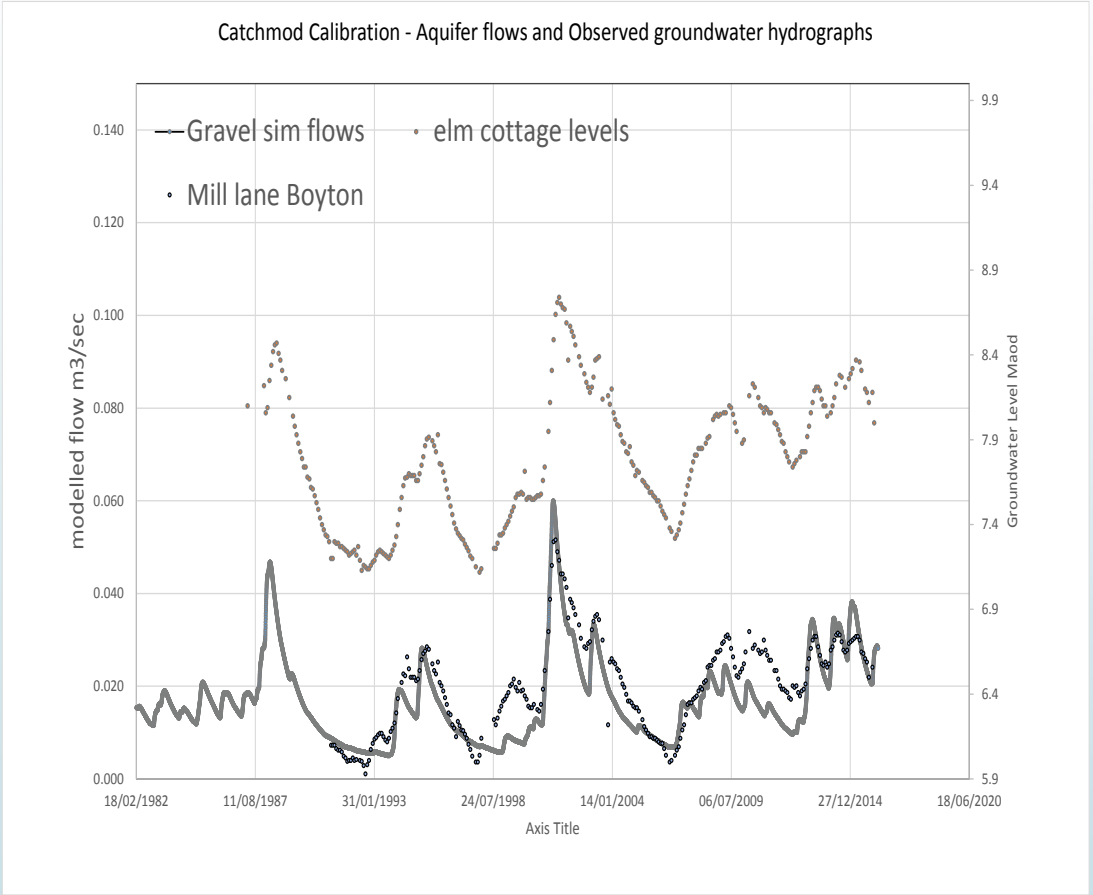
Calibration flow Duration statistics

- Good Calibration with observed
- Modelled and observed flow expected to exceed L.T.A.
- Monitoring period generated significantly more run off than Long term 1970-2014 modelled
- Long term modelled conforms to conceptualisation of greater runoff and lower baseflow relative to existing model .
- Catchmod Modelled mean yield believed to be 10-15 % below actual .



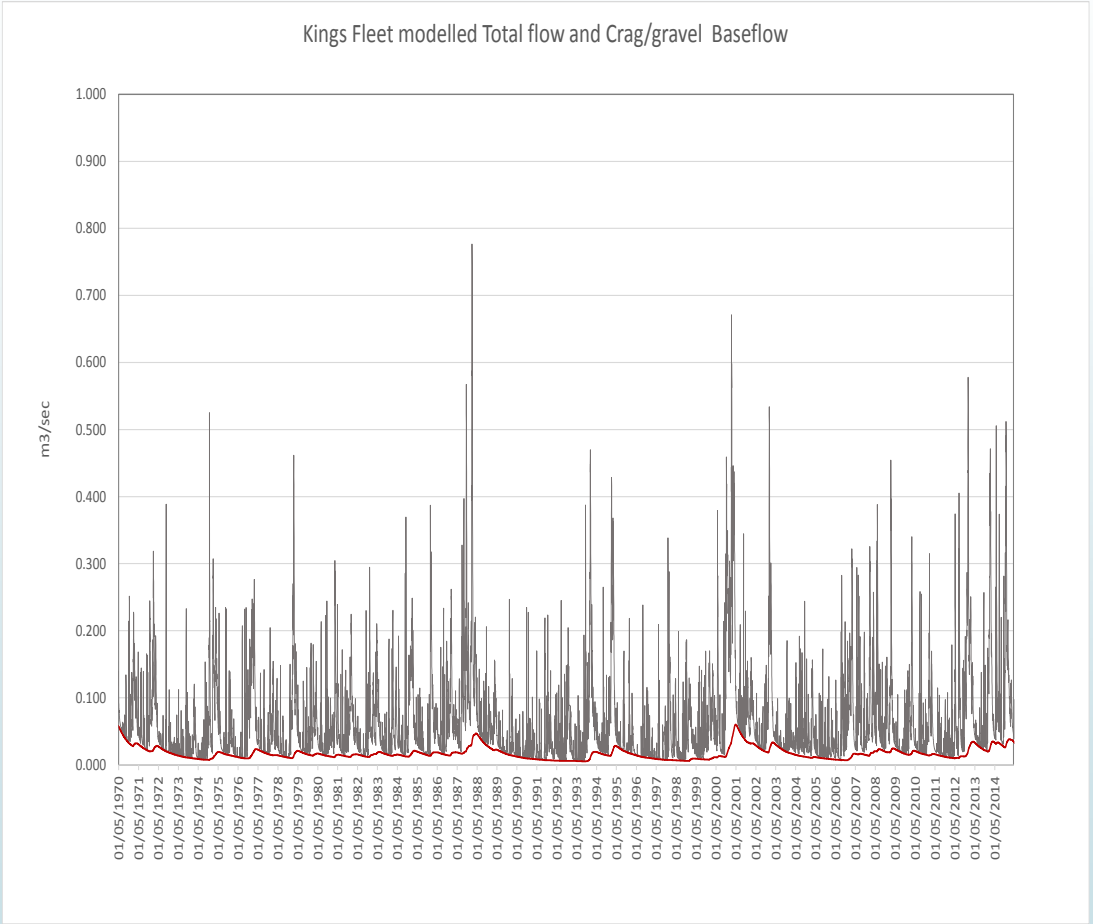
Catchmod Aquifer zone Calibration

- Aquifer 35 % of total runoff. Major summer component .
- Longer term Calibration with local groundwater levels , extends calibration period beyond flow monitoring .
- Very good trend calibration with Elm Cottage Hollesley and mill Lane Boyton.
-



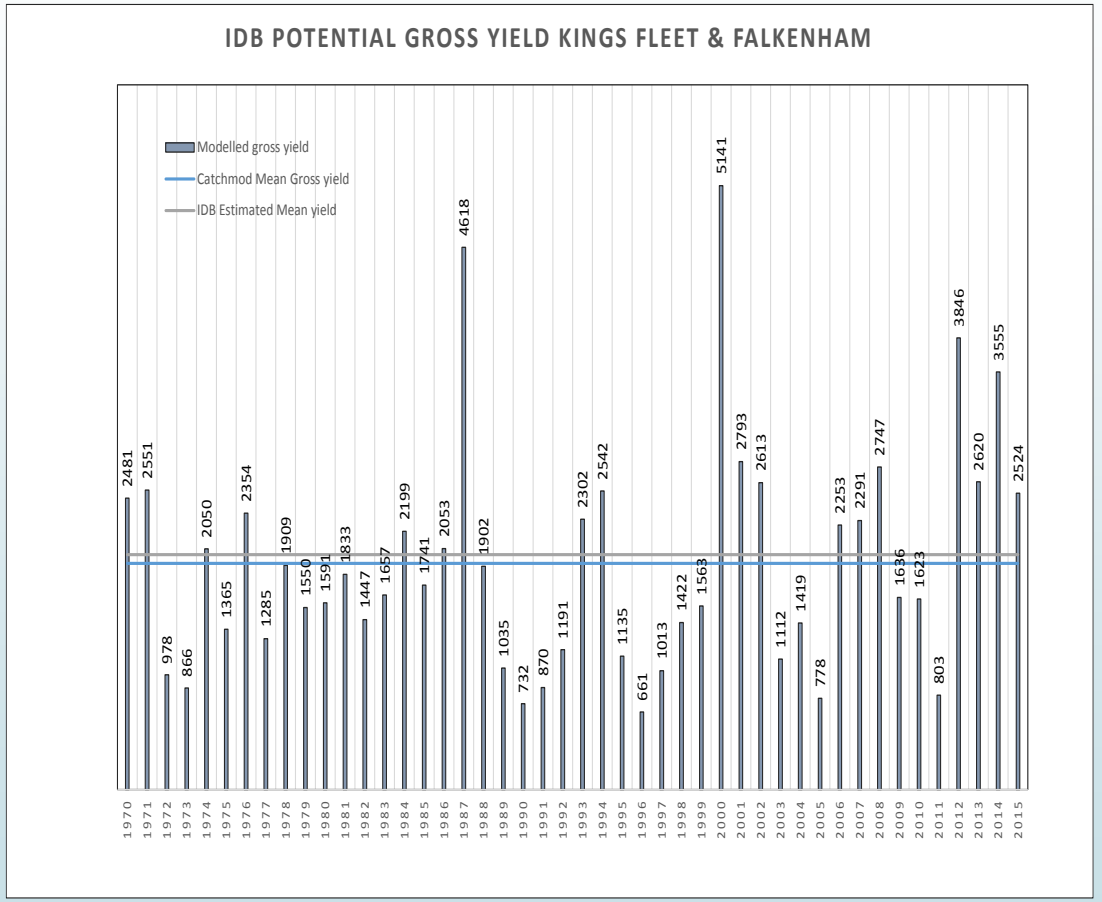
Catchmod Final Calibration

- Mean Daily flow data sets 1970-2015 (calibrated to weekly)
- Winter run off more significant than other models B.F.I. 0.62 ‘v’ 0.85 L.F.E
- Vulnerability to dry winters
- Significant hard surface runoff component.
- Crag/gravel baseflow providing significant summer yield . Model believed to underestimate crag flows in dry years . Q(bf) mean = 0.025m3/sec . Probable 0.030m3/sec
- Calibration Mean run off - low 119mm, MORECS/HOST gridded 127mm (baseflow component)



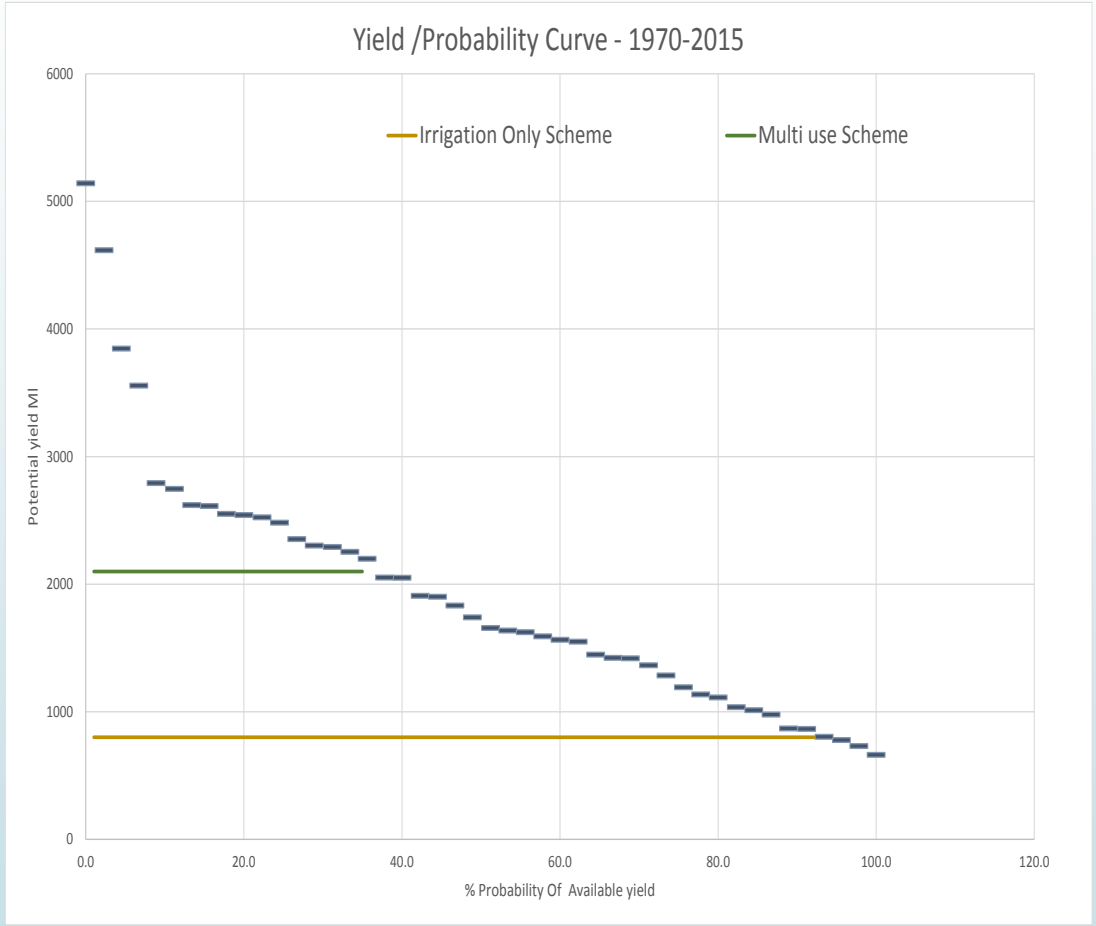
IDB pumped Catchment Design Year

- IDB estimated mean yield 2000 Ml
- Modelled mean yield 1930 Ml
- Lowest 661Ml in 1990
- Highest 5141 Ml in 2000



Scheme Reliability

- Assuming Resource can be fully optimised. Unrestricted infrastructure capability
- Multi use Scheme – 2100 Ml- 65 % chance of non-availability in any year.
- Irrigation Scheme – 800 Ml - 4 % risk of non- availability.
- Irrigation Scheme – 600 Ml – 100 % reliable.
- Precautionary model calibration Reasonable assumption to increase dry year yield by 10-15%



Further constraint

- Infrastructure to transfer high flows.
- Freshwater flow to tide – (S.P.A.) 0.6 Ml/day could reduce deployable output by 33%.
- Freshwater flow to tide TRAC waterbody whole estuary target. W.F.D. assessment required .
- Salinity
- Access arrangements for new point of abstraction .