

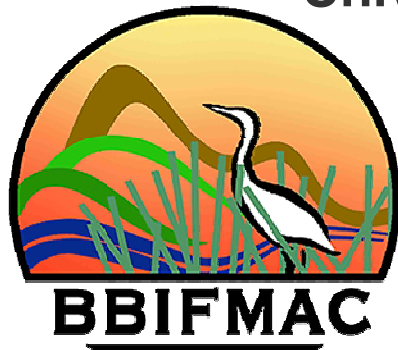


BBIFMAC EEIG

Matching a pump to a pipeline system

– Mackay Dec. 2014

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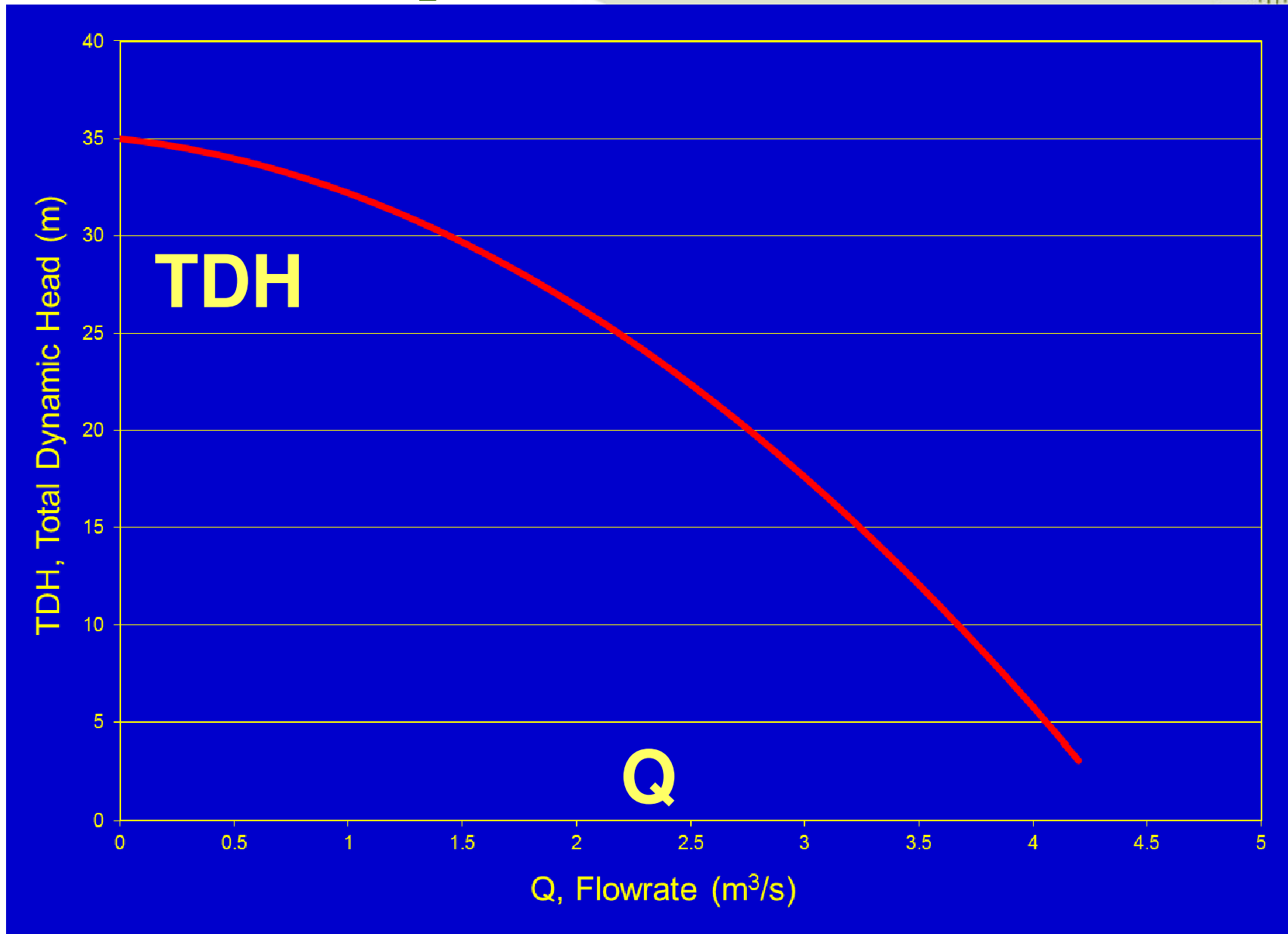
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Introducing Pump Curve

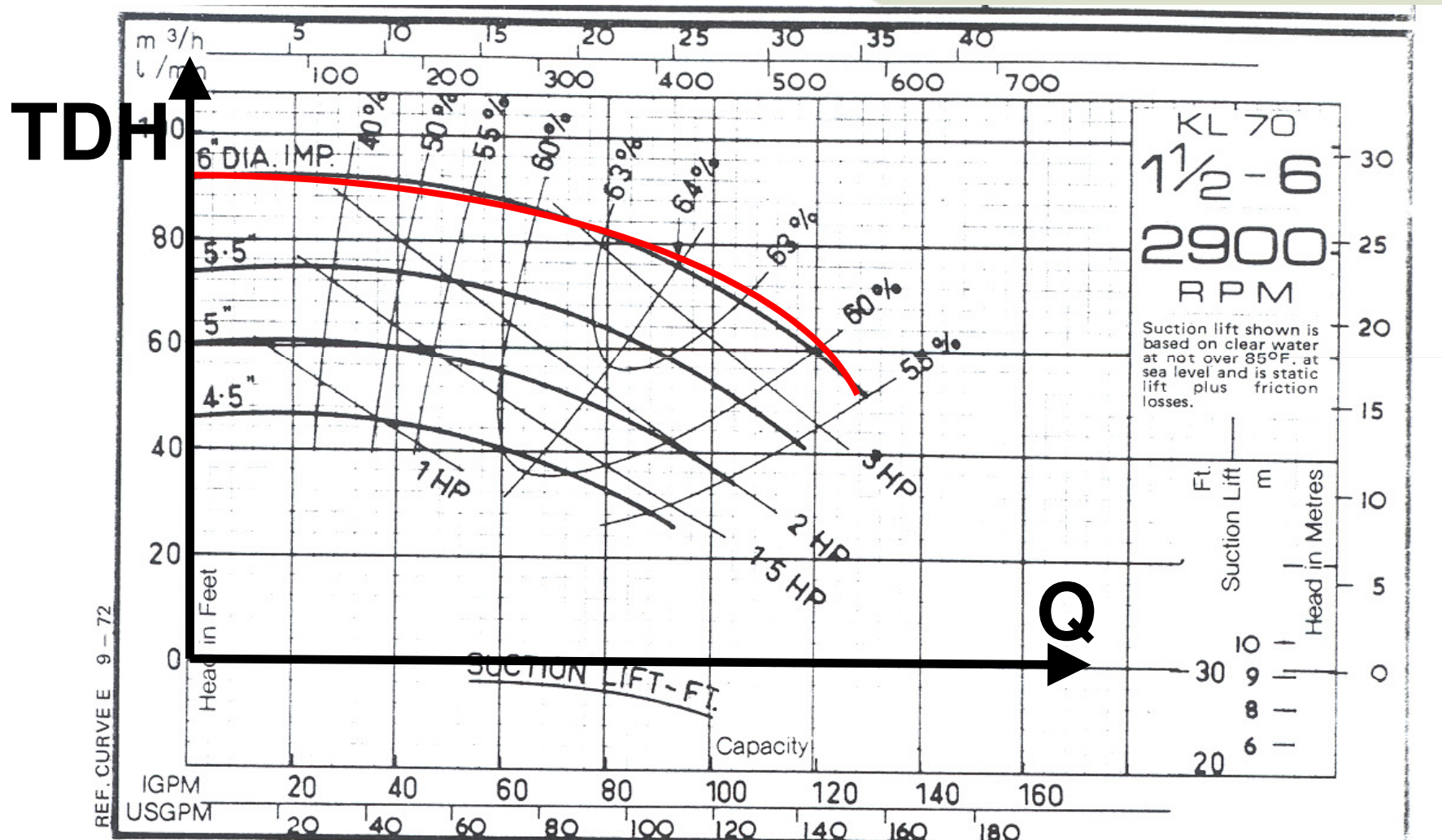


- Describes the relationship between the head and discharged produced for a specific pump configuration
- For a given pump make & model
- For a given speed
- For a given impeller trim

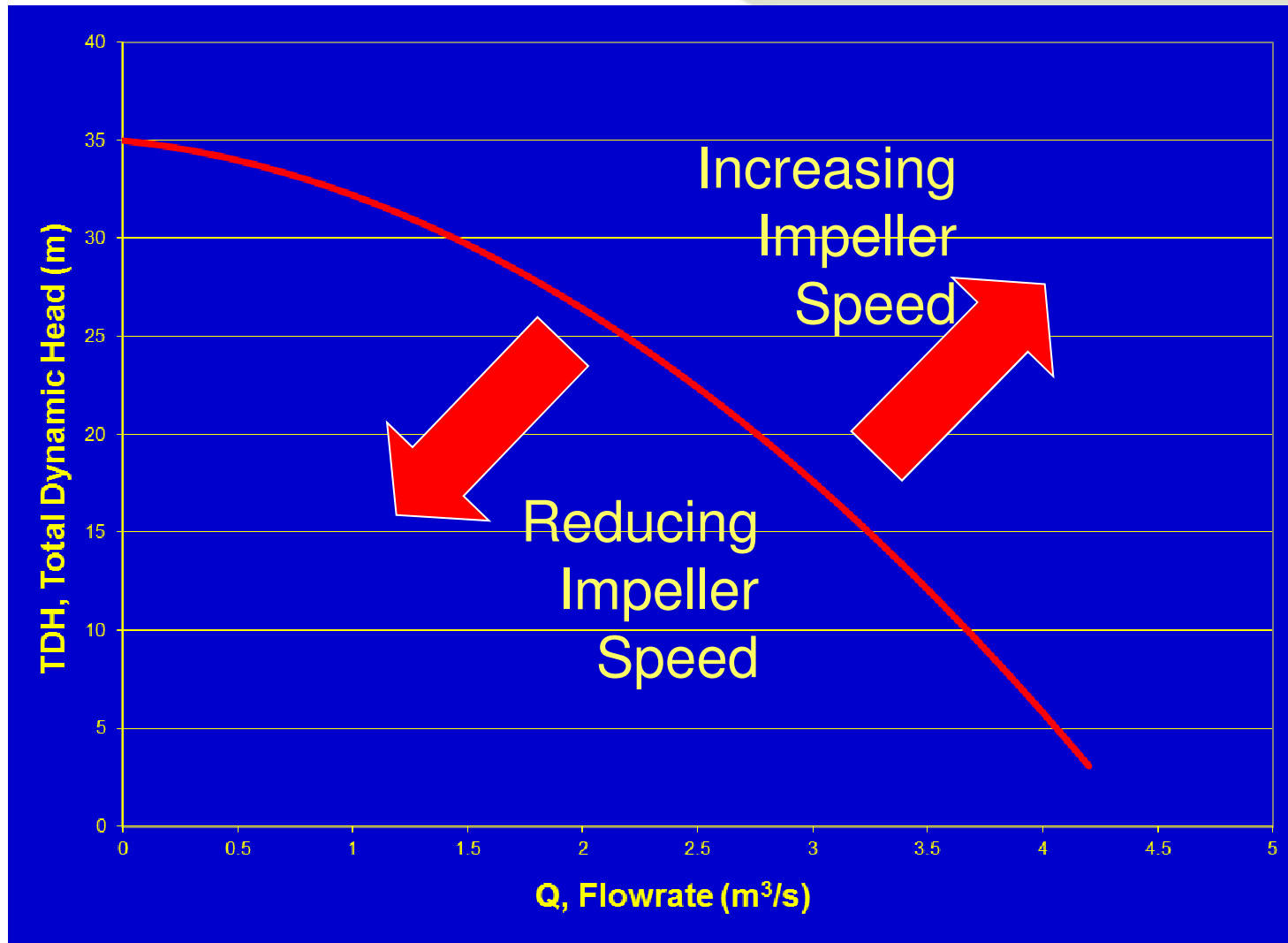
Pump Curve



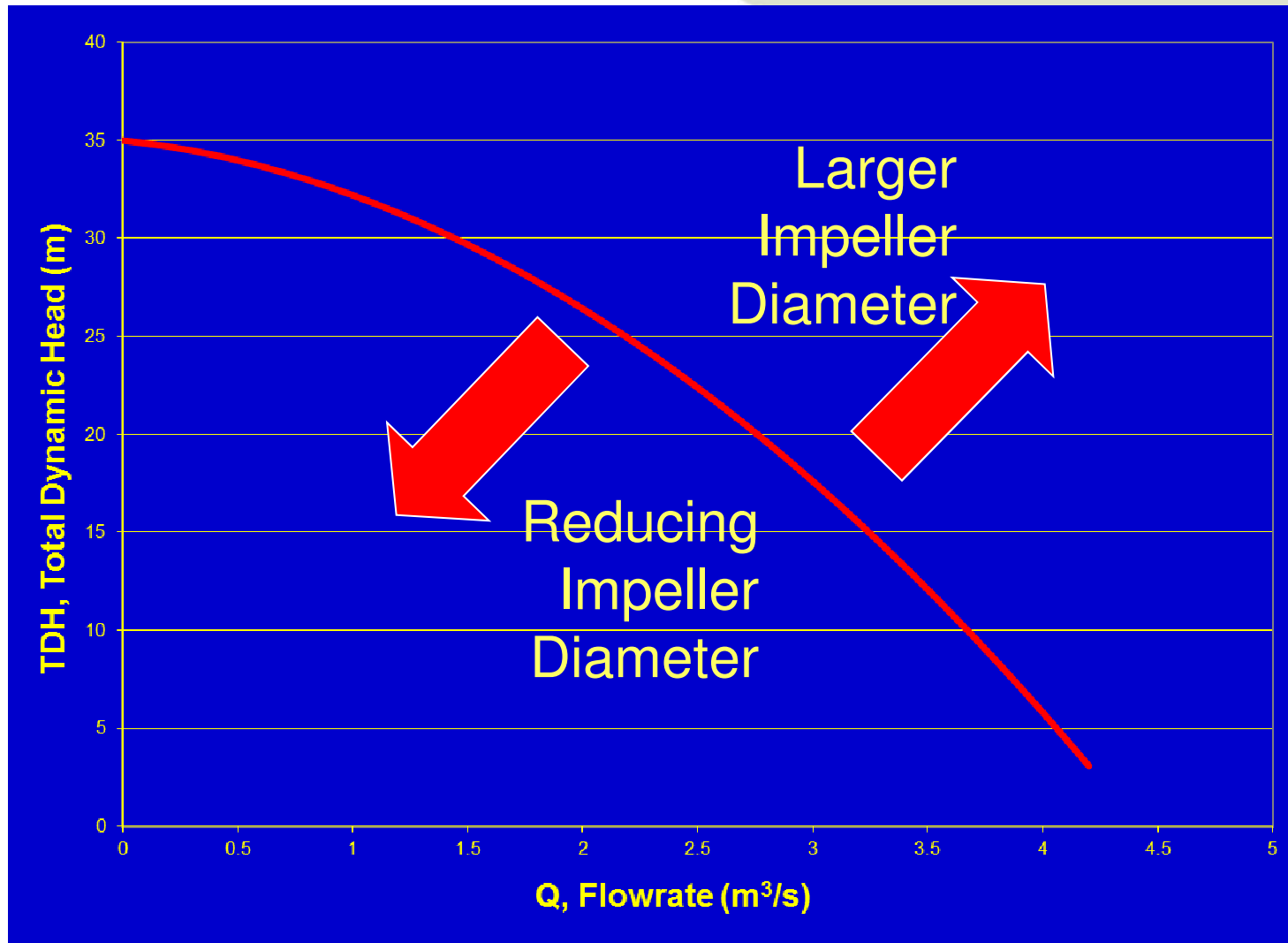
Pump performance Curve – Electric Motor



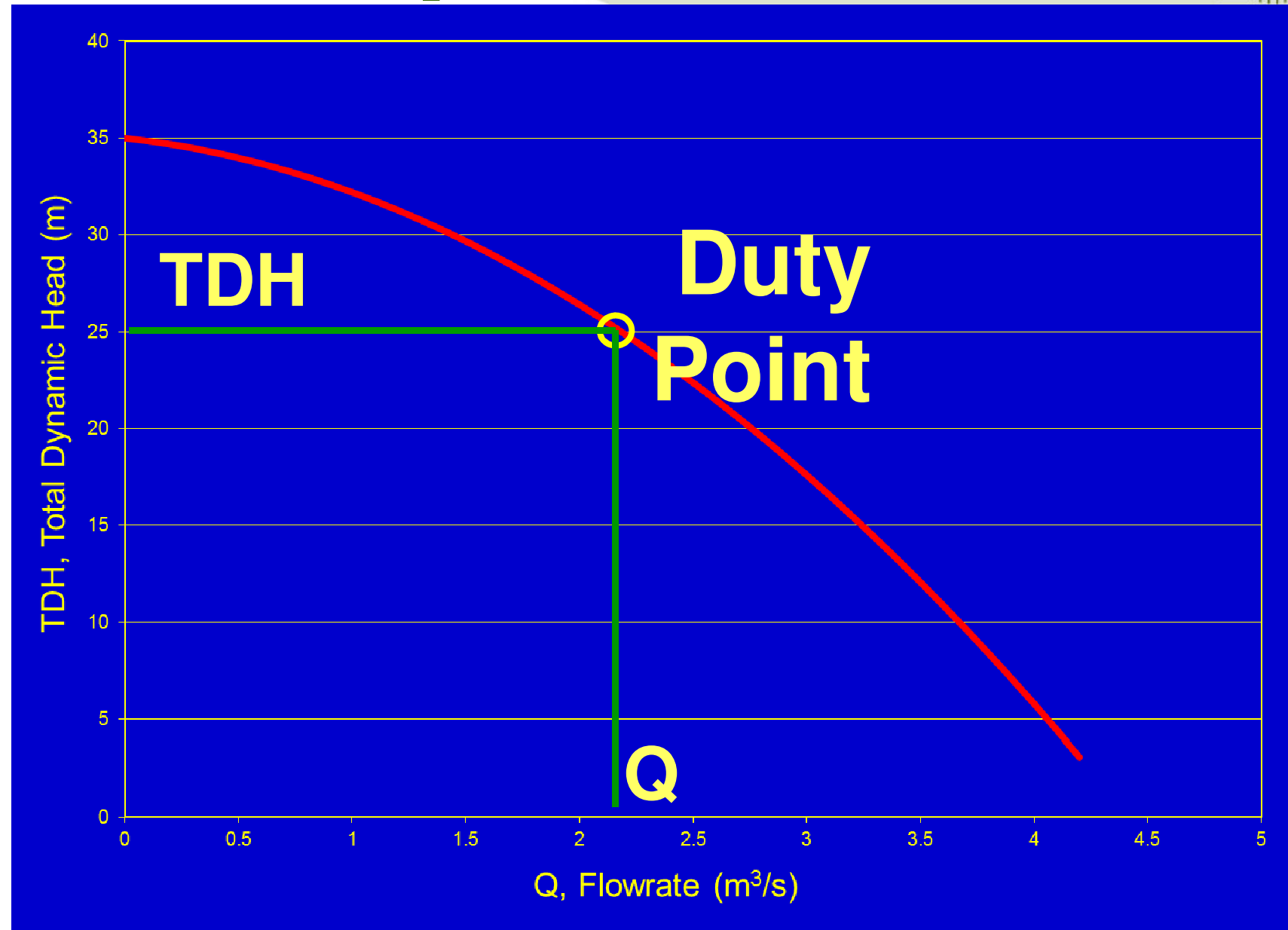
Reducing & Increasing Speed



Reducing (trimming) your Impeller or replacing with new Larger Impeller



Pump Curve



Pump Duty point – operating point of pump



- The single discharge (flowrate) and Total Dynamic Head (TDH) at which a pump operates
- Called “Duty Point” or “Operating point”
- The one point on the pump curve where the pump operates, giving single flowrate and total dynamic head, at any one time
- Pump can only operate at one point at a time

Pump discharge or flowrate



- Discharge or flowrate measured with any variety of flowmeter types
- Discharge or flowrate is the most important information you can obtain about pumped systems
- Flowrate can be determined for big guns from pressure, nozzle type and nozzle size – from manufacturer's chart

Total Dynamic Head

■ Total Dynamic Head

- Is a measure of the energy per unit weight imparted to the water by the pump

■ Calculate from :

- the discharge dynamic head minus the suction dynamic head
- suction dynamic head – measured relative to the pump centreline

Five key parts involved in pump Total Dynamic Head



- Pressure Head
- Elevation Head
- Velocity Head
- Friction Headloss
- Minor Headloss

Pressure Head



- Pressure Head – strictly is energy per unit weight held in water when under pressure
- Units of metres head of water
- Measure pressure with a gauge
- Pressure Head (m)
 - = $0.102 \times \text{pressure (kPa)}$
 - = $\text{pressure (kPa)} \div 9.81$

Elevation Head



- Elevation Head – strictly is energy per unit weight held in water when at height – potential energy
- Units of metres head of water
- Measured as elevation above datum
- Elevation Head (m) = simply measure elevation above some R.L., datum, or benchmark

Velocity Head



- Velocity Head – strictly is energy per unit weight held in water when moving with velocity – kinetic energy
- Units of metres head of water
- Measured from discharge (flowrate) and cross-sectional area of flow
- Velocity Head (m) = $0.051 \times \text{velocity}^2$
 $= 0.0826 \times \text{discharge}^2 \div (\text{int. diam.})^4$

Discharge m³/s and diameter in m

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Friction Headloss



- Friction Headloss – distributed energy loss in pipes from roughness of pipe
- Units of metres head of water
- Calculated from formulae, off tables, from graphs etc
- Occurs all the way along pipe
- Example: 26.5 L/s in 201.2 m of 4" n.b. soft hose is 9.98 m (14.2 psi) headloss

Minor Headloss



- Minor Headloss – energy loss due to bends, valves, changes in diameter
- Units of metres head of water
- Not always “minor” (small)
- Calculated from velocity head \times “K” factor from tables
- Occurs at bend, valve, reduction
- Example: 26.5 L/s in 90° elbow 4” n.b.
= 0.243 m headloss (0.345 psi)

Energy or TDH Line



- Energy line is made up of the five components of Head and Headloss just discussed above
- Shows all parts of Total Dynamic Head
- Units of metres head of water
- Graphical way of “seeing” the energy line and change through a pumped system

Pump Total Dynamic Head & Energy Line

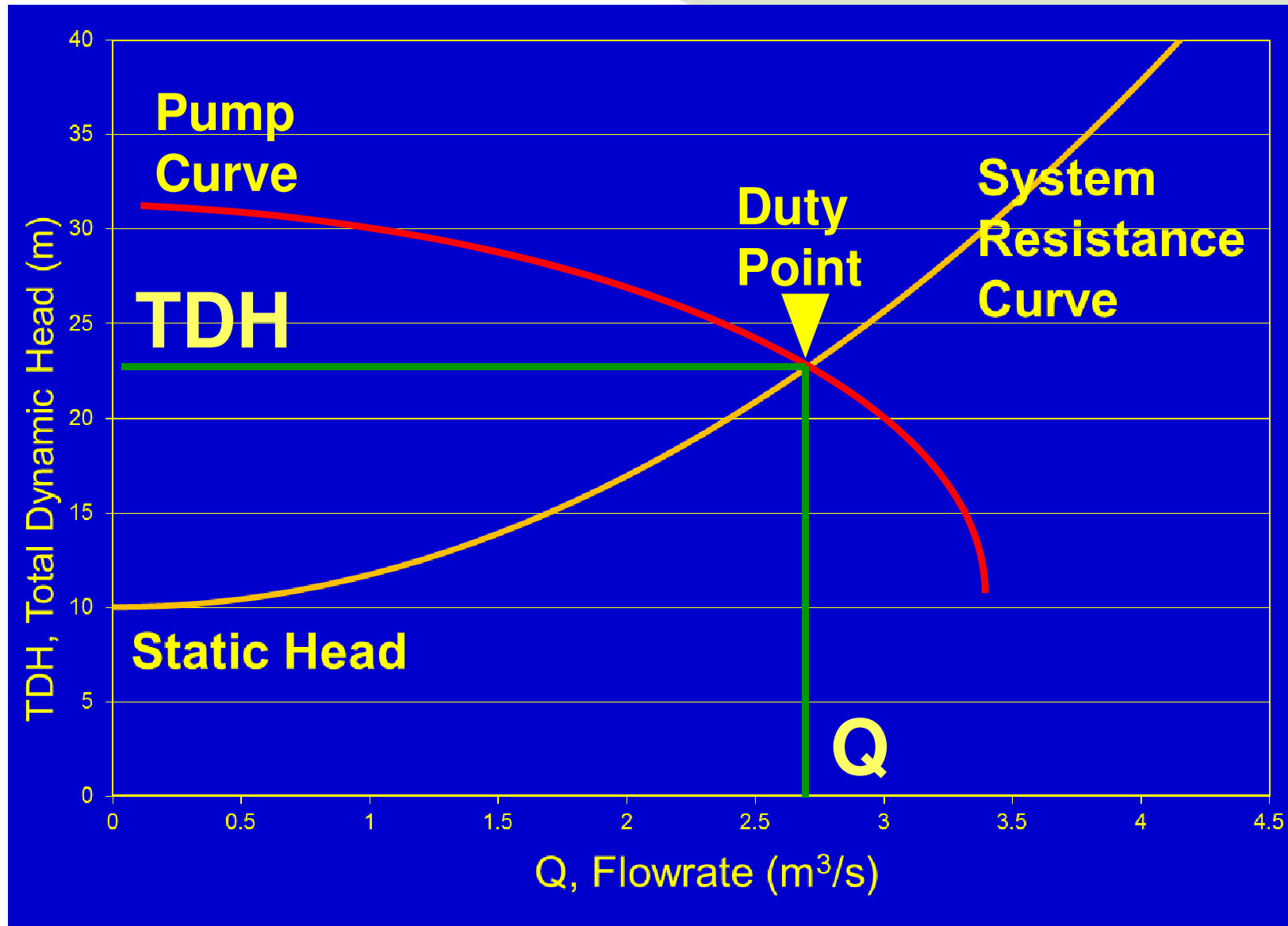


System Resistance Curve = Pipeline Resistance Curve

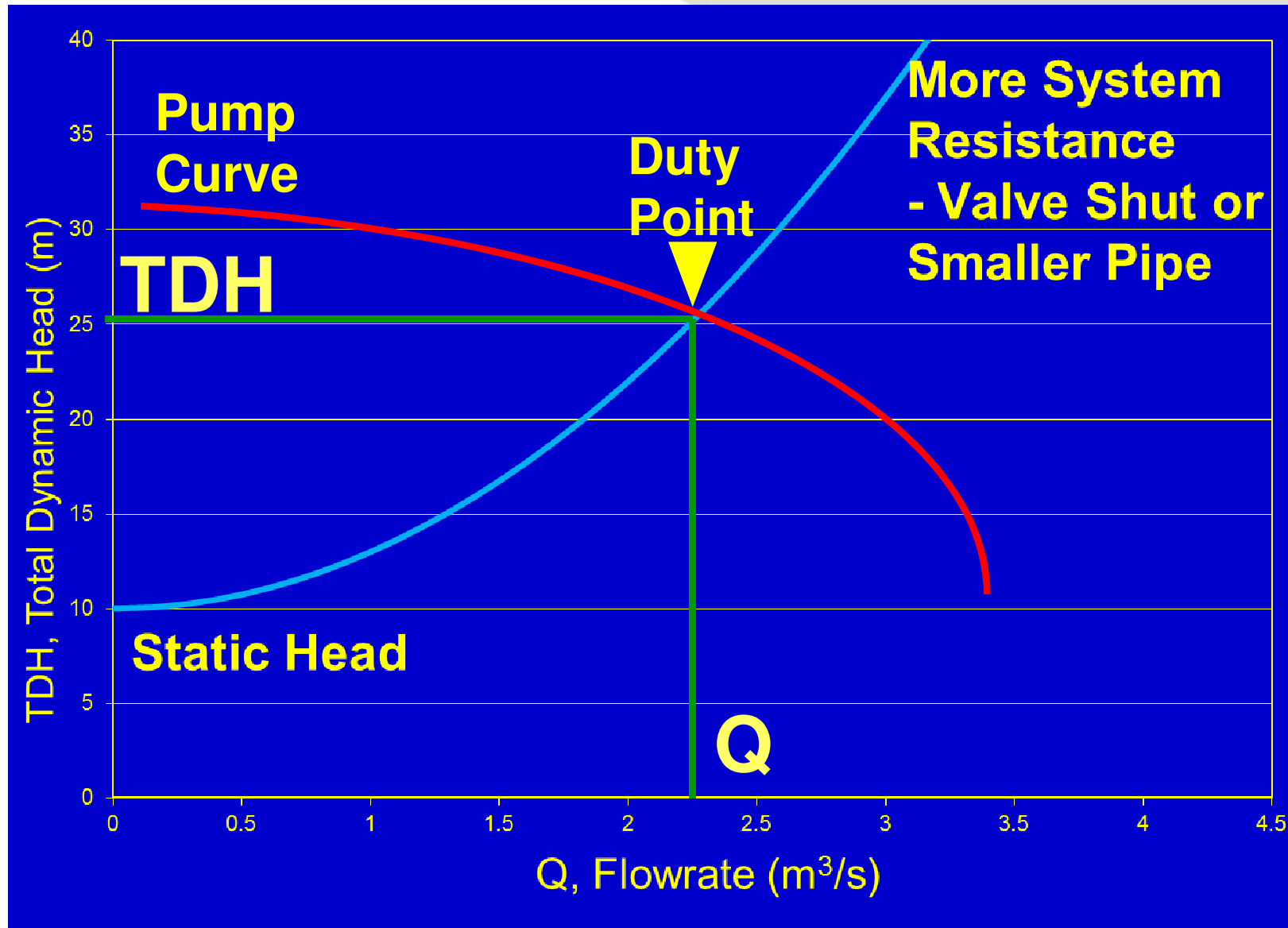


- Describes the relationship between the head and discharge for a specific pipeline configuration
- accounts for the static, friction & minor head loss over a wide range of discharge
- developed for increments of *flowrate*, calculating *headlosses* for each

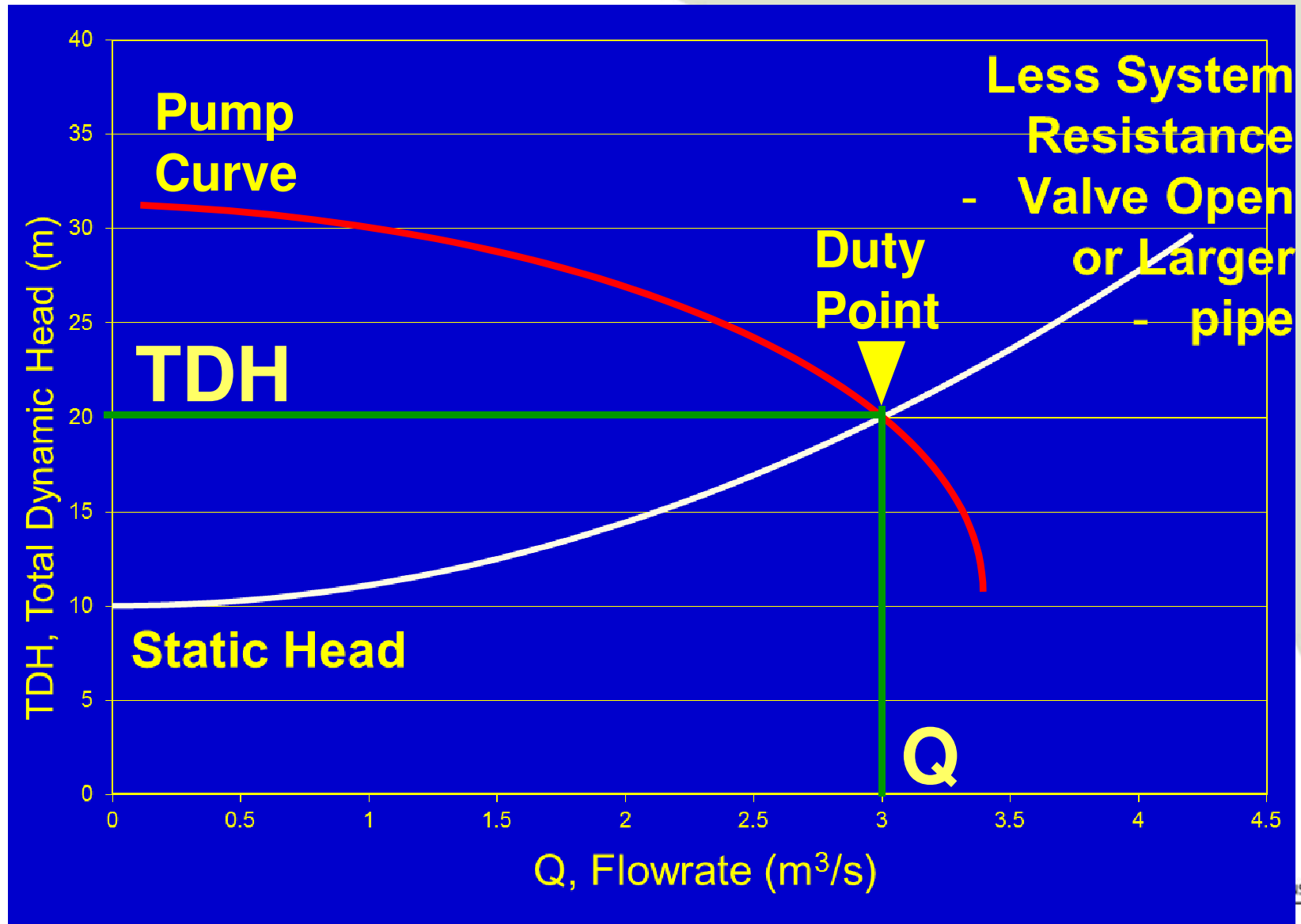
System Resistance and Pump Curve



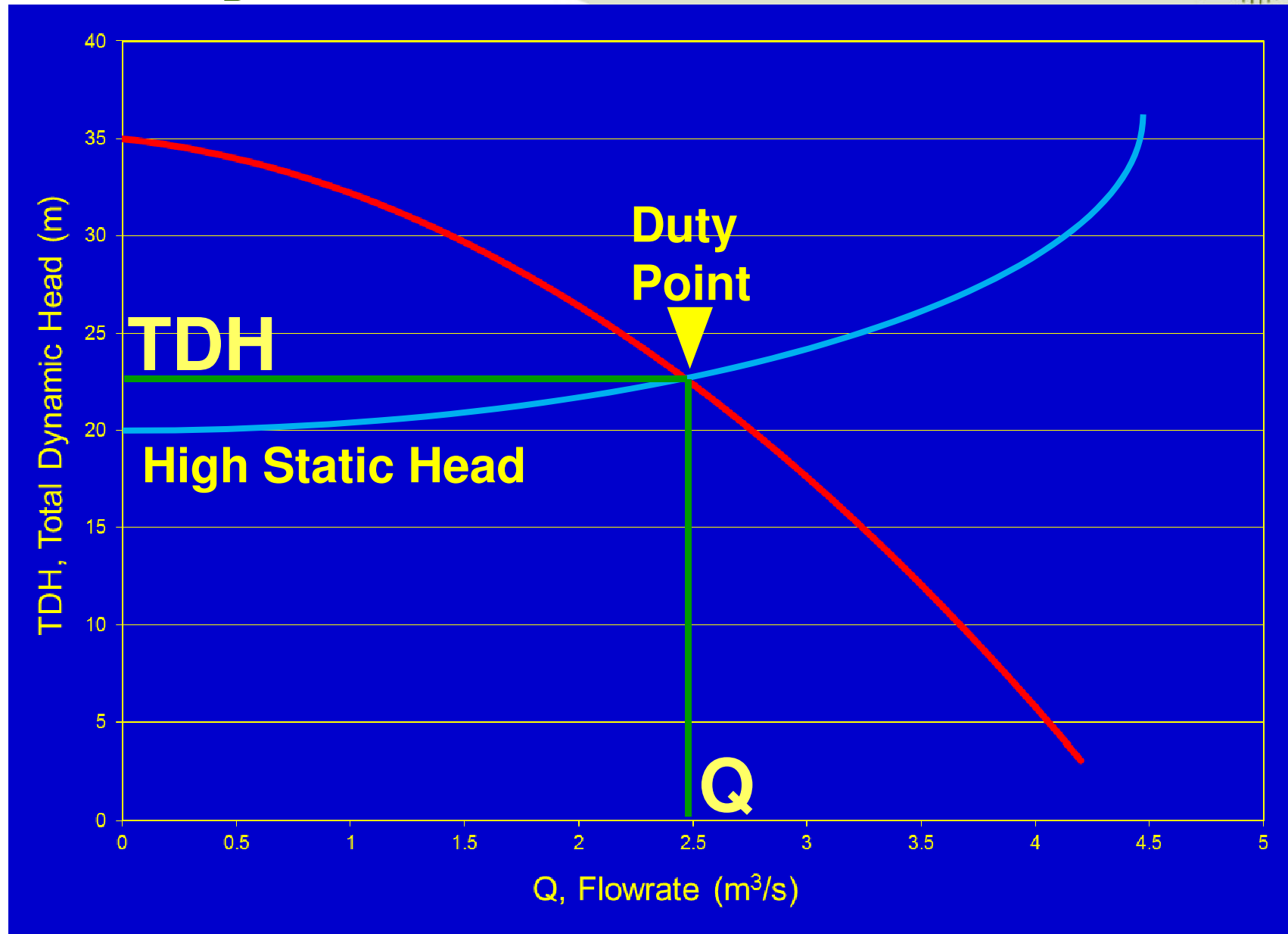
Altering System Curve



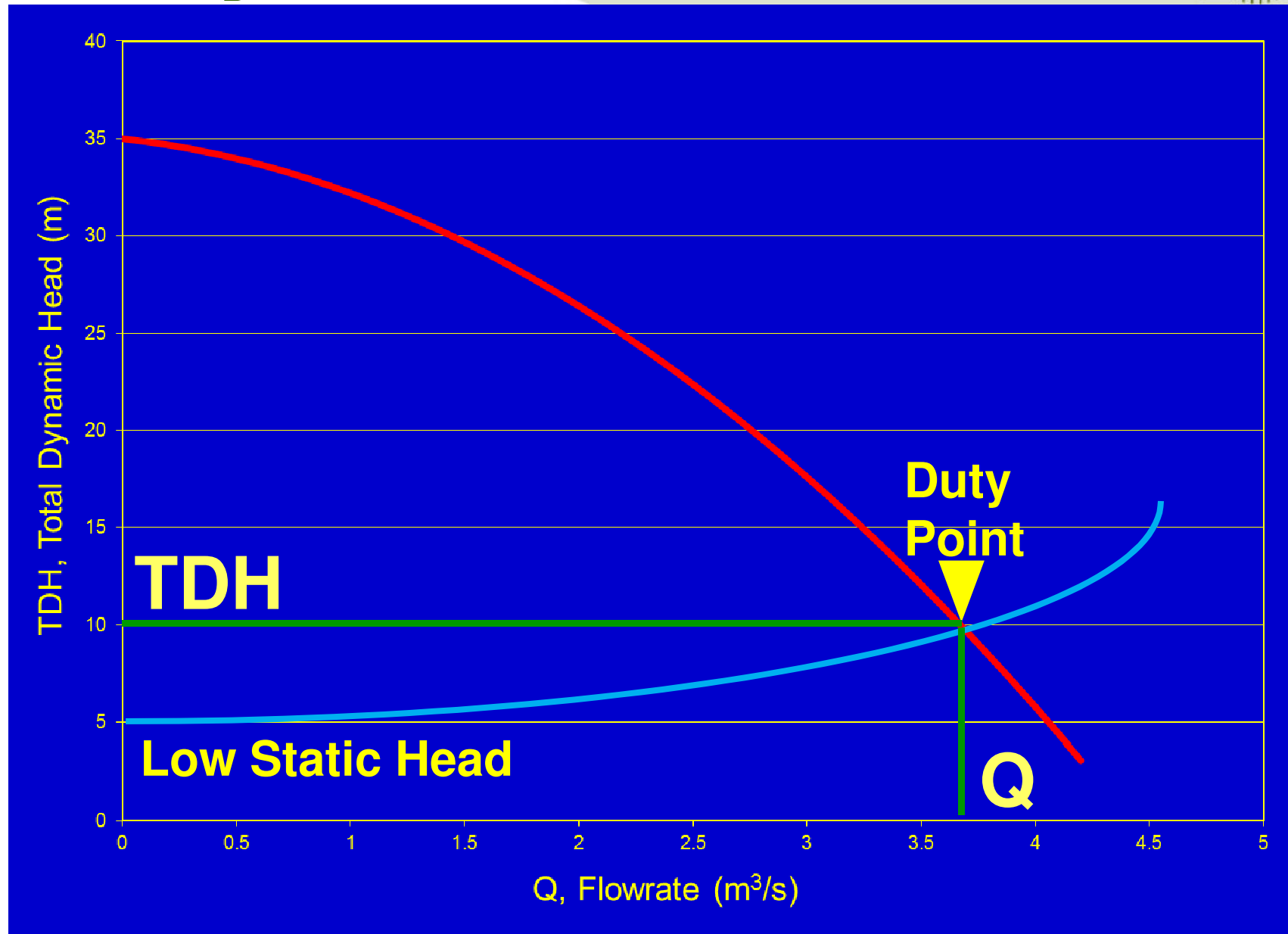
Altering System Curve



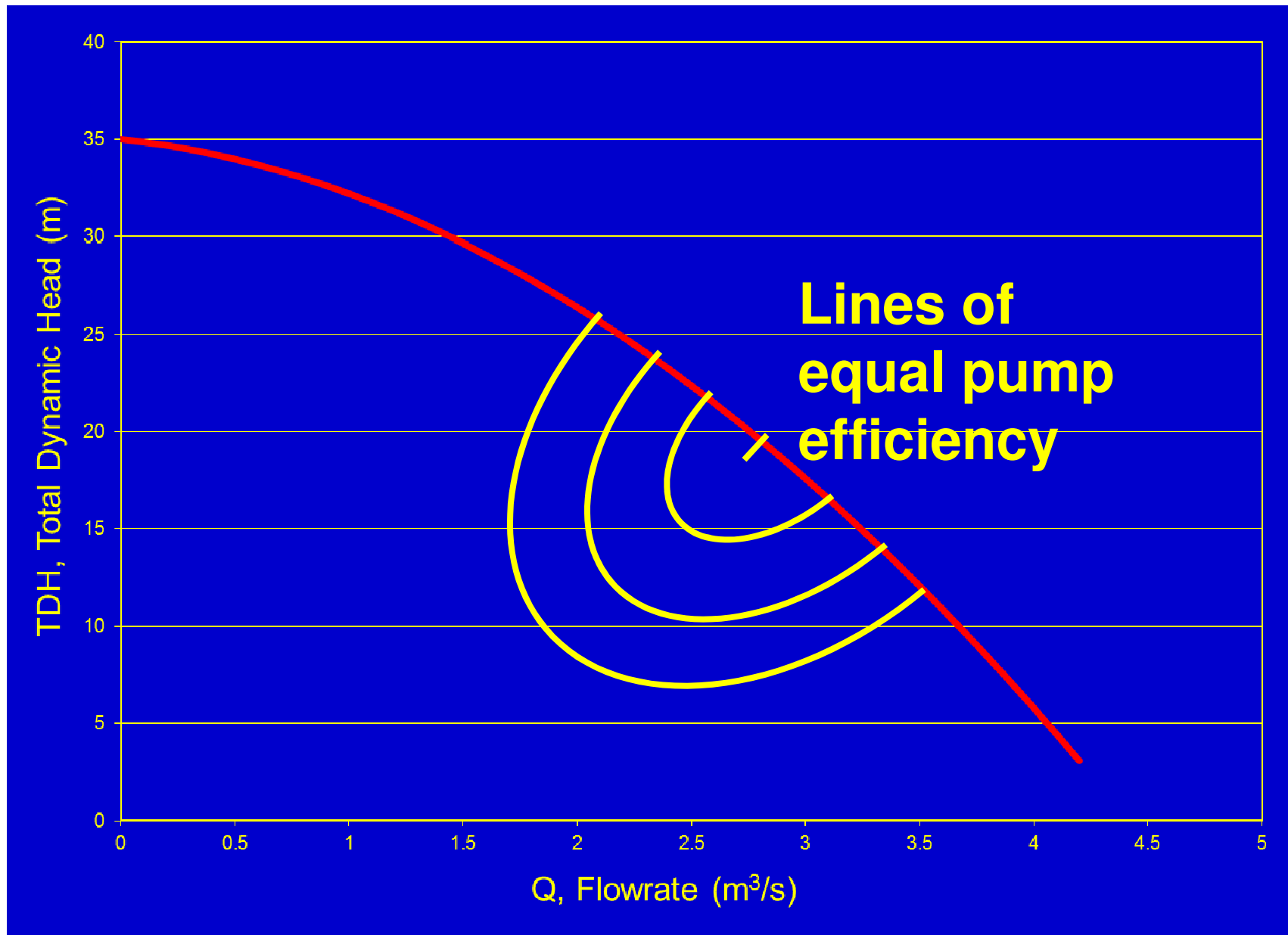
System Curve



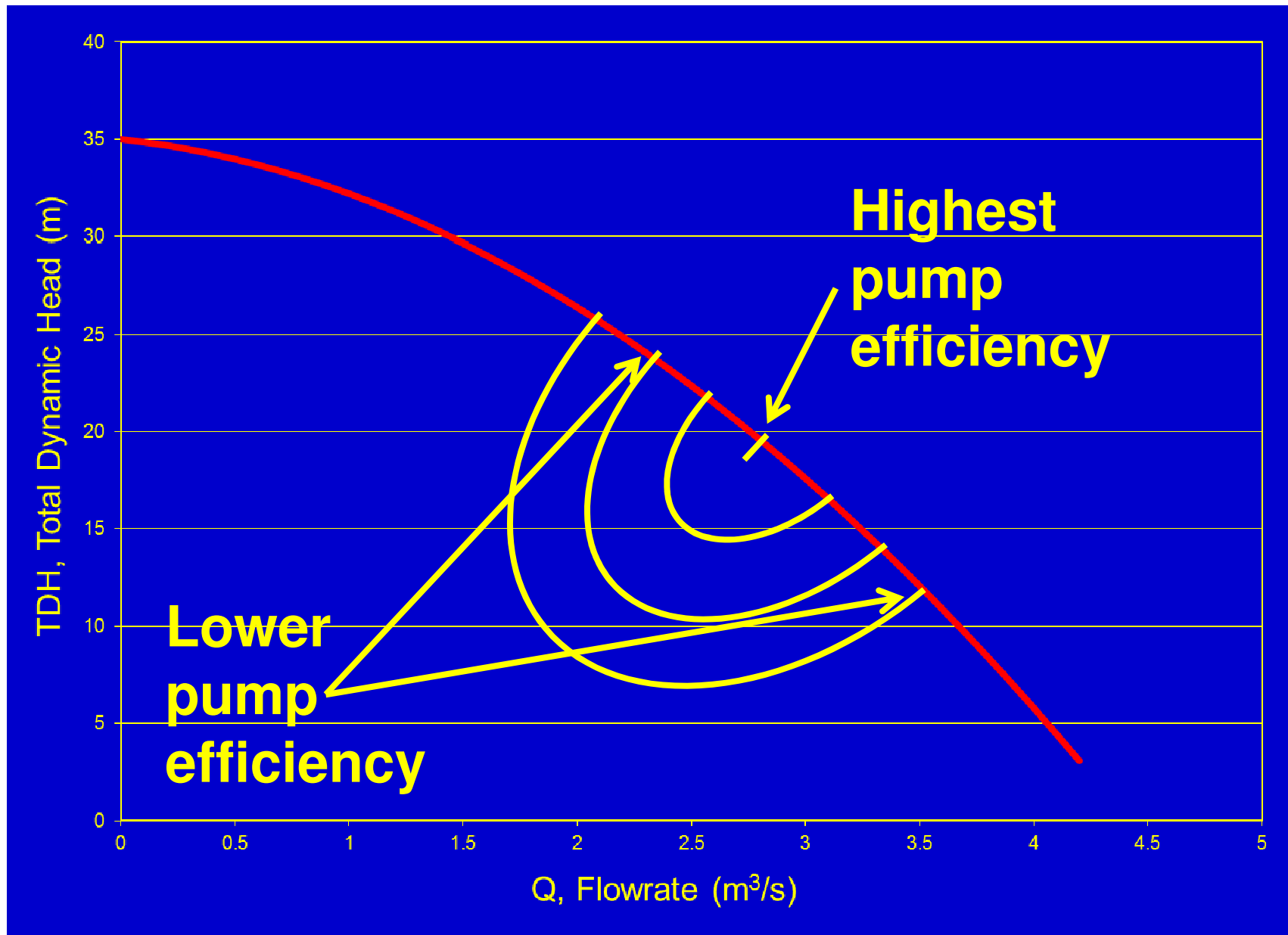
System Curve



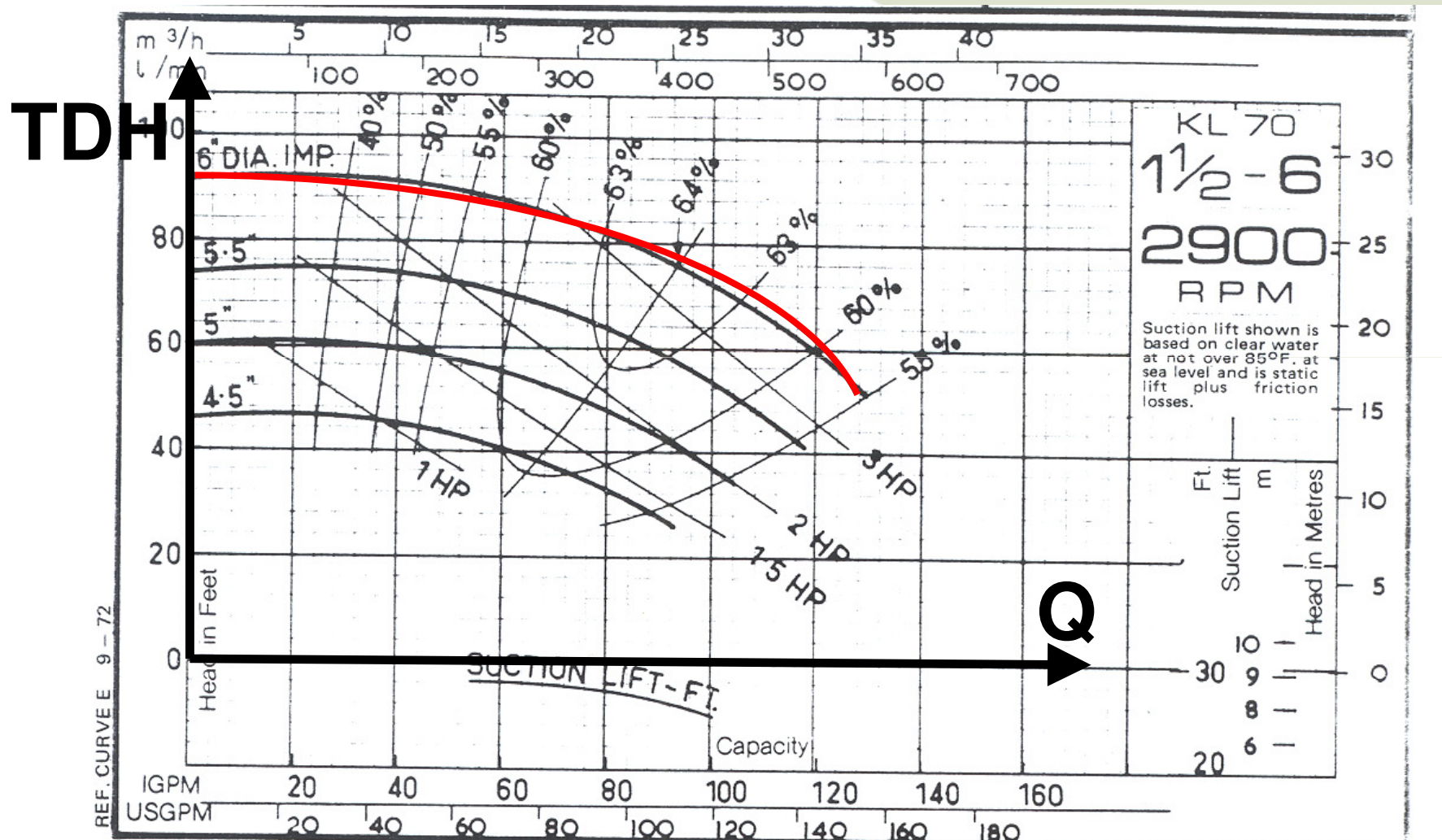
Pump Efficiency Curves



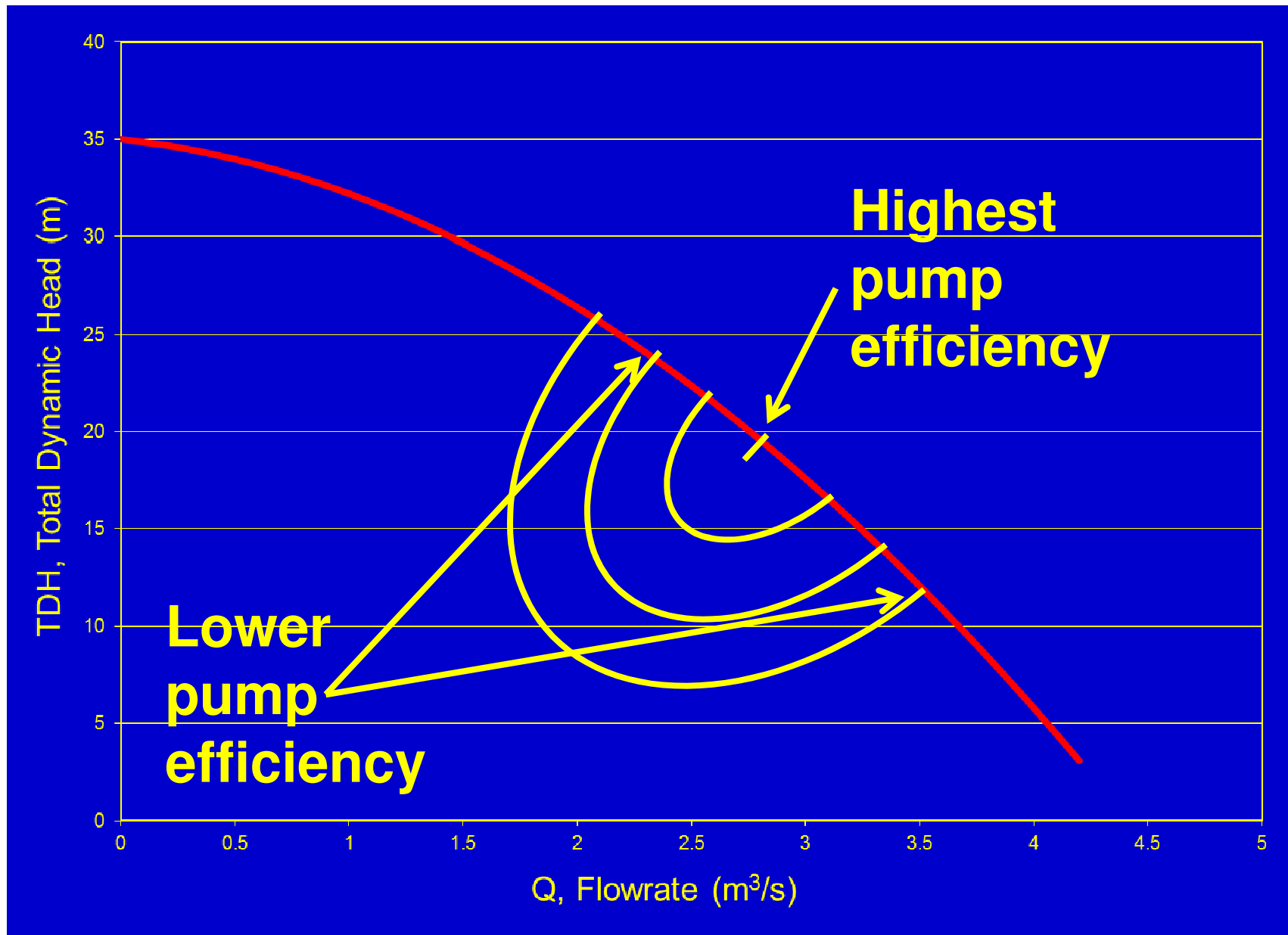
Pump Curve + Efficiency



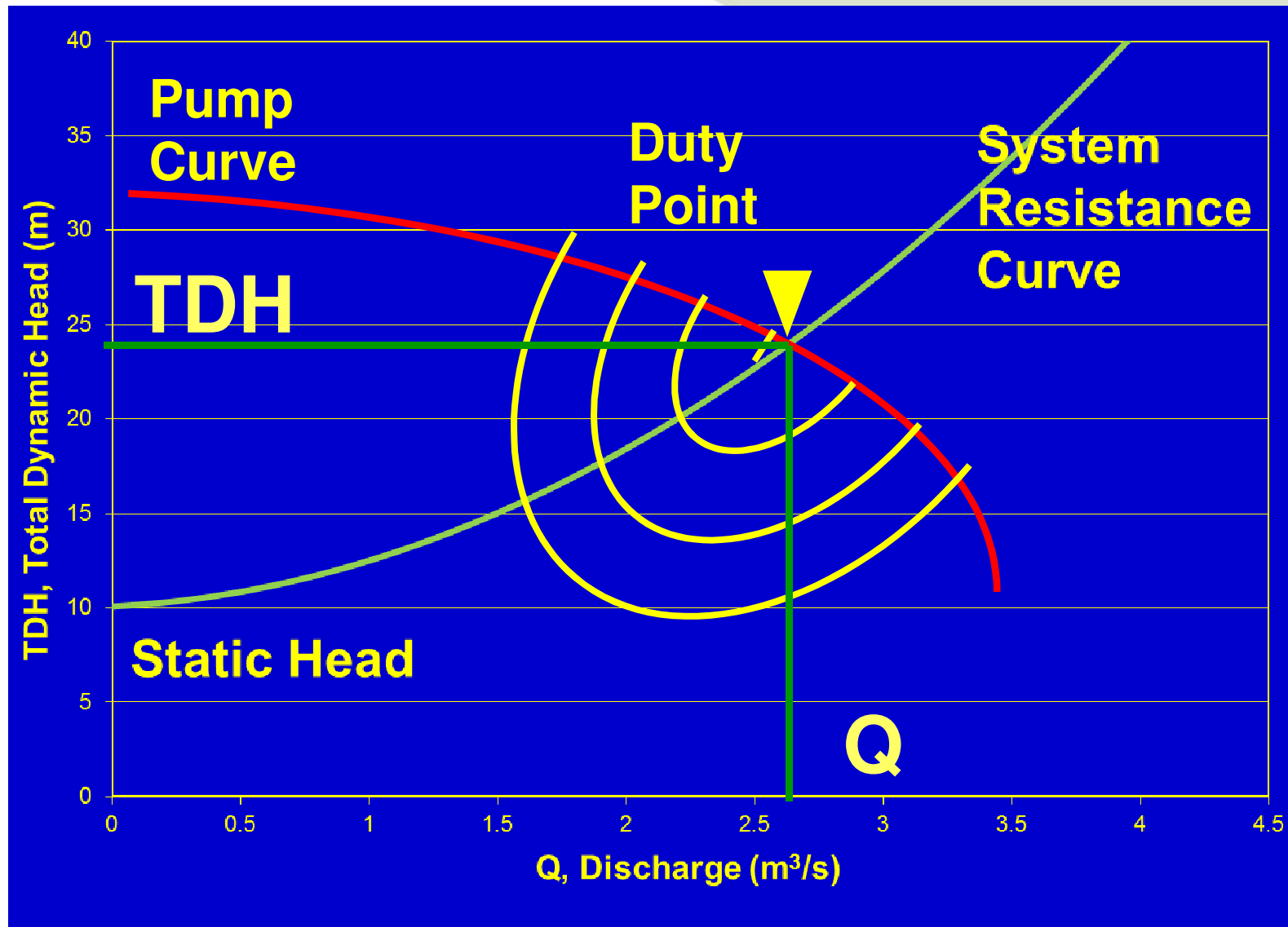
Pump performance Curve – Electric Motor



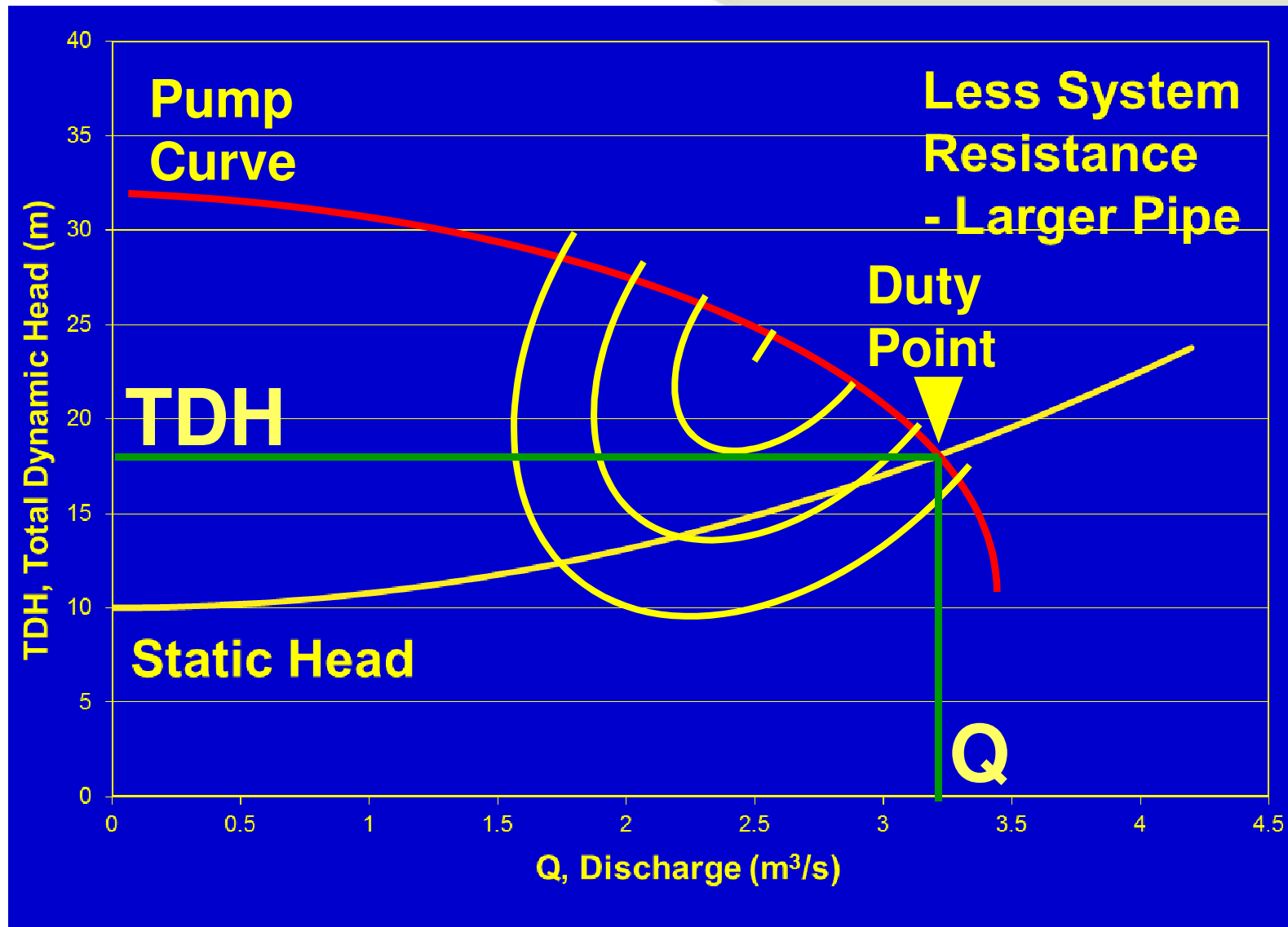
Pump Curve + Efficiency



Altering Duty Point



Altering Duty Point





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