Prob 1

A community is expected to reach a pop of 35000 in 20 yrs. It has $P_o = 28000$ with avg. WC $= 16 \times 10^6$ l/d.. The existing water treatment plant has a design capacity of 28350 m³/d. Assume an arithmetic rate of population growth. Determine in which year the existing plant will reach its design capacity. Assume the plant to be designed on max. daily consumption.

Sol

$P_f = 35000$ $\quad K = \frac{35000 - 28000}{20 - 0} = 350$ p/year

$P_o = 28000$

Avg WC per capita per day $= \frac{16 \times 10^6 \text{ l/d}}{28000 \text{ persons}} = 571.4$ lpcd

Max. daily WC $= 1.5 \times 571.4 = 857.14$ lpcd

P_f for water treatment plant $= \frac{28350 \times 10^3 \text{ l/d}}{857.1 \text{ lpcd}} = 33075$ persons

$P_f = P_o + K(t_f - t_o)$

$33075 = 28000 + 350(t_f - t_o)$

$t_f - t_o \approx 14$ yrs.

Problem-Design period

- Problem 1 : A small community had a population of 65000 and 85000 in the year of 1995 and 2005 respectively. Assuming a geometric growth rate and an average WC of 300lit/cap/day. Calculate the design flow for the treatment plant and the transmission main from current year. **Select an appropriate value for design period.**
- Problem 2: The present population of a community is 160000 increasing at a geometric growth rate of 0.043 per yr. The present water requirement of the community are fully met by a number of tube wells installed in the city. The average WC is 350l/c/d using a design period of 15 yrs. Calculate the number of additional tube-wells of 3.4m3/min capacity to meet the demand of design period.

Data:

$P_o = 160000$

$K = 0.043$ per yr.

AWC = 350 l/c/d

Design period = 15 yrs

Additional tube wells = ?

Tubewell capacity = 3.4 m^3/min

Solution of Prob. 1

Data:

$P_{1995} = 65000$ $\quad P_{2005} = 85000$

AWC = 300 lpcd

Design flow for: i) treatment plant ii) transmission main

$P_f = P_o e^{Kn}$ Current year = 2017

$85000 = 65000 \times e^{10K}$

K = 0.0268 person/yr.

For transmission main design period = 50 yrs (design yr = 2017+50 = 2067)

Treatment plant = 15 yrs (design year = 2017+15 = 2032)

P_f (transmission main) = $85000 \times e^{0.0268 \times (2067-2005)}$ = 447757 persons

P_f (treatment plant) = $85000 \times e^{0.0268 \times (2032-2005)}$ = 175257 persons

Max. daily WC = 1.5 × 300 = 450 lpcd

Capacity for transmission mains = 447757 × 450 = 201490.65 m³/d

Capacity for treatment plant = 175257 × 450 = 78865.65 m³/d

Prob. 2

Sol.

$P_f = P_o e^{Kn} = 160000\, e^{0.043 \times 15} = 304957.92$

Additional population = 304957.92 − 160000 = 144957.92

Total WC = 350 × 144957.92 = 50735272 l/d = 50735.2 m³/d

Tubewell capacity = 3.4 × 60 × 24 = 4896 m³/d

→ With storage / OHR:

MDD = 1.5 × 50735.2 = 76102.9 m³/d

Total no. of tubewells = $\frac{76102.9}{4896}$ ≈ 16

→ No OHR / Without storage:

PHF = 2.25 × 50735.2 = 114154.4 m³/d

Total no. of tubewells = $\frac{114154.4}{4896}$ ≈ 24