PRESENTATION

ON

WATER NEUTRAL

IN

LOW IMPACT URBAN DEVELOPMENTS

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URBAN DEVELOPMENT - INTRODUCTION

- **In urban development, developmental works are carried out on :-**

- ✓ **Construction of different types of buildings for the urban population.**

- ✓ **Infrastructure works like road network, water supply network, sewage network, rainwater (storm water) drainage network, electrical supply network etc.**

URBAN DEVELOPMENT – LOW & HIGH IMPACT

- **In building construction and in infrastructure works, lot of natural resources like water, building materials along with energy (power / electricity) etc. are required.**
- **These developmental works can be of high impact or low impact.**
- **The developmental projects which do not engage in any resource conservation practices, or the projects which severally affects the project site and it's surroundings are categorized as high impact developments and vice versa for low impact developments.**
- **Presently, we are going to discuss the low impact developments w.r.t. water in construction project developments only or in other words sustainable building construction developmental projects w.r.t. water.**

POPULATION CALCULATION OF A RESIDENTIAL PROJECT

- **POPULATION IN A BUILDING CAN BE FIXED TYPE OR FLOATING TYPE**
  - **RESIDENTIAL (FIXED POPULATION)**

✓**Group housing projects (irrespective of no. of beds requirement i.e. 1 BHK, 2 BHK, 3 BHK or 4 BHK)**	**5 persons / flat or apartment**

A CASE STUDY

ACTIVITY	PARTICULARS	POPULATION
No. of Apartments	**815 Apts.**	**4,075 Persons (5 Persons / Apts.)**

Source : National Building Code of India & "Manual on norms and standards for environment clearance of large construction projects" by Ministry of Environment & Forests, Govt. of India.

DAILY WATER CONSUMPTION
(DOMESTIC CONSUMPTION) – CONVENTIONAL vs REDUCED

- Daily water consumption for domestic purposes is divided into Non-flushing requirement (direct contact with water) and Flushing requirement (no direct contact with water).
- As per IS : 1172 – 1971, the domestic consumption of water for a resident (fixed population) is 135 ltr. / capita / day.
- A comparison with break-up of the conventional consumption & reduced consumption is as follows: -

Sr. No.	Category	Conventional Consumption (lpcd)	Reduced Consumption (lpcd)	Reduction (%)
A.	Human Consumption (Drinking & cooking)	7	7	Nil
B.	Bathing	20	20	Nil
C.	Clothes washing	40	15	62
D.	Miscellaneous (Utensil & house washing)	23	23	Nil
E.	Flushing	45	21	53
	Total Consumption (A+B+C+D+E)	135	86	36

- The break-up of the total domestic consumption (flushing & non flushing) are as follows: -

Category	Conventional Consumption (lpcd)	Reduced Consumption (lpcd)	Reduction (lpcd)	Reduction (%)
Non-Flushing Req.	90	65	25	27
Flushing Req.	45	21	24	53
Total consumption	135	86	49	36

DESCRIPTION ON REDUCTION IN DAILY DOMESTIC WATER CONSUMPTION – CONSERVATION PLAN

- **The areas of reduction are in cloth washing and in flushing.**

CLOTH WASHING

- **In conventional method of cloth washing, 1 kg of cloth require 20 ltr. of water. Per capita per day cloth is about 2 kg for washing and hence 40 ltr. water consumption.**
- **Now a days, washing machine is not a luxury but part and parcel of a domestic gadget.**
- **The washing machine require 7.5 ltr. of water for 1 kg of cloth washing and 15 ltr. for 2 kg of cloth washing and hence a reduction of 25 ltr. per capita per day.**

FLUSHING

- **Conventionally , the flush tank contains about 9 ltr. of water and 5 times usage, the total consumption become 9 ltr. x 5 = 45 ltr.**
- **With double button water cistern, the consumption reduces to 21 ltr. (6 ltr. x 2 + 3 ltr. x 3 = 12 ltr. + 9 ltr.).**

SAVINGS ON ACCOUNT OF WATER CONSERVATION – A CASE STUDY

❑ REDUCTION IN DAILY WATER CONSUMPTION

Water Req. in Conventional System, @ 135 Ltr. / Capita / Day (in KL)	Water Req. in Efficient Fixtures, @ 86 Ltr. / Capita / Day (in KL)	Total Savings / Day (in KL)	Water Saving in %
550	350	200	36.36

❑ REDUCTION IN DAILY SEWAGE GENERATION

Sewage generation (in KL)	Reduced sewage generation (in KL)	Reduction in sewage generation (in KL)
440	280	160

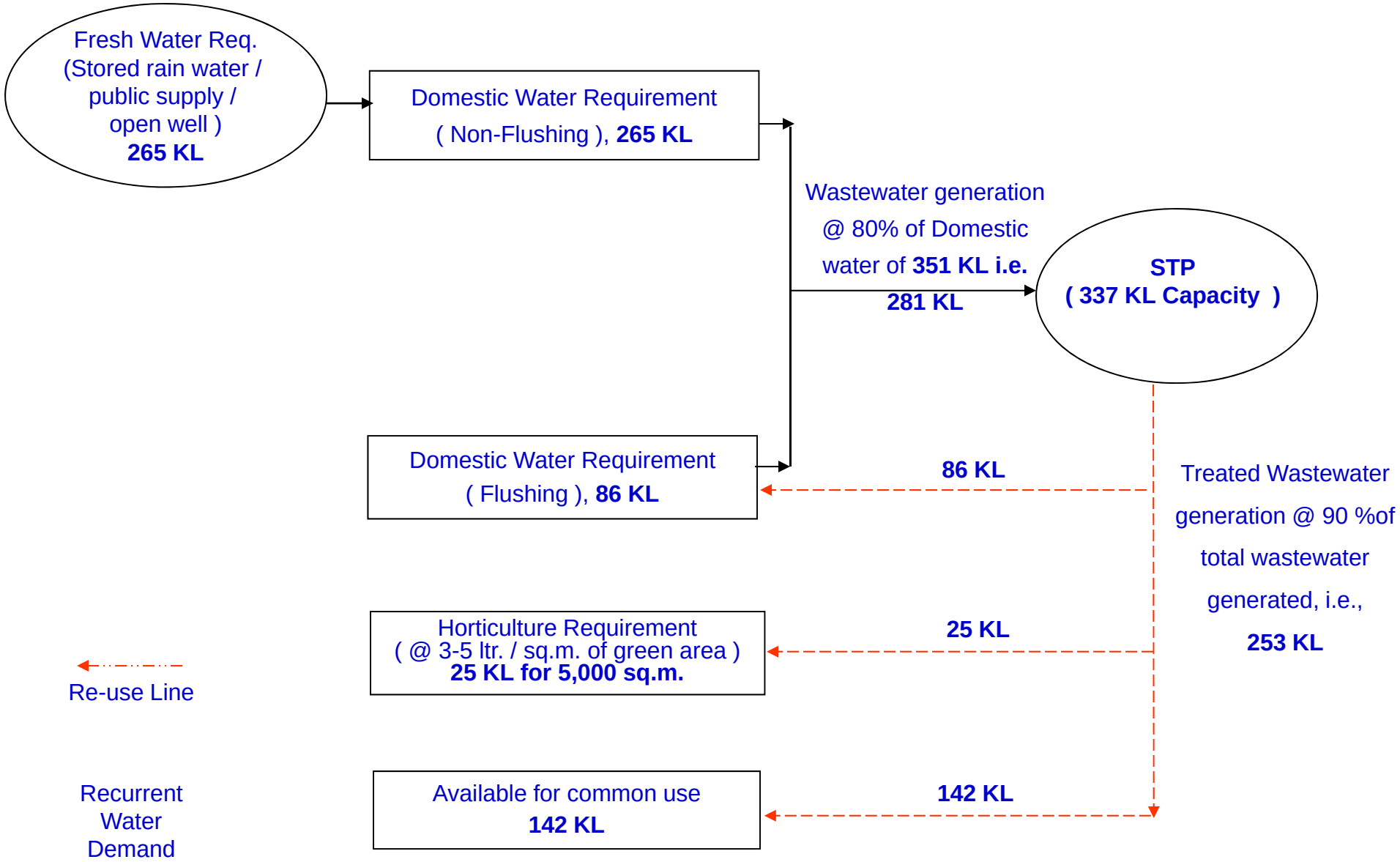
❑ SAVINGS IN REDUCTION IN WATER CONSUMPTION & SEWAGE GENERATION

	Energy saving (per day)	Daily savings (Rs.)	Annual savings (Rs.)
Water Pumps (@ 4 KW for every 10 KL Pumping)	80 KWH	400/-	1,50,000/-
STP (@ 3 KW for every 10 KL of Sewage)	48 KWH	240/-	87,600/-
TOTAL			2,37,600/-

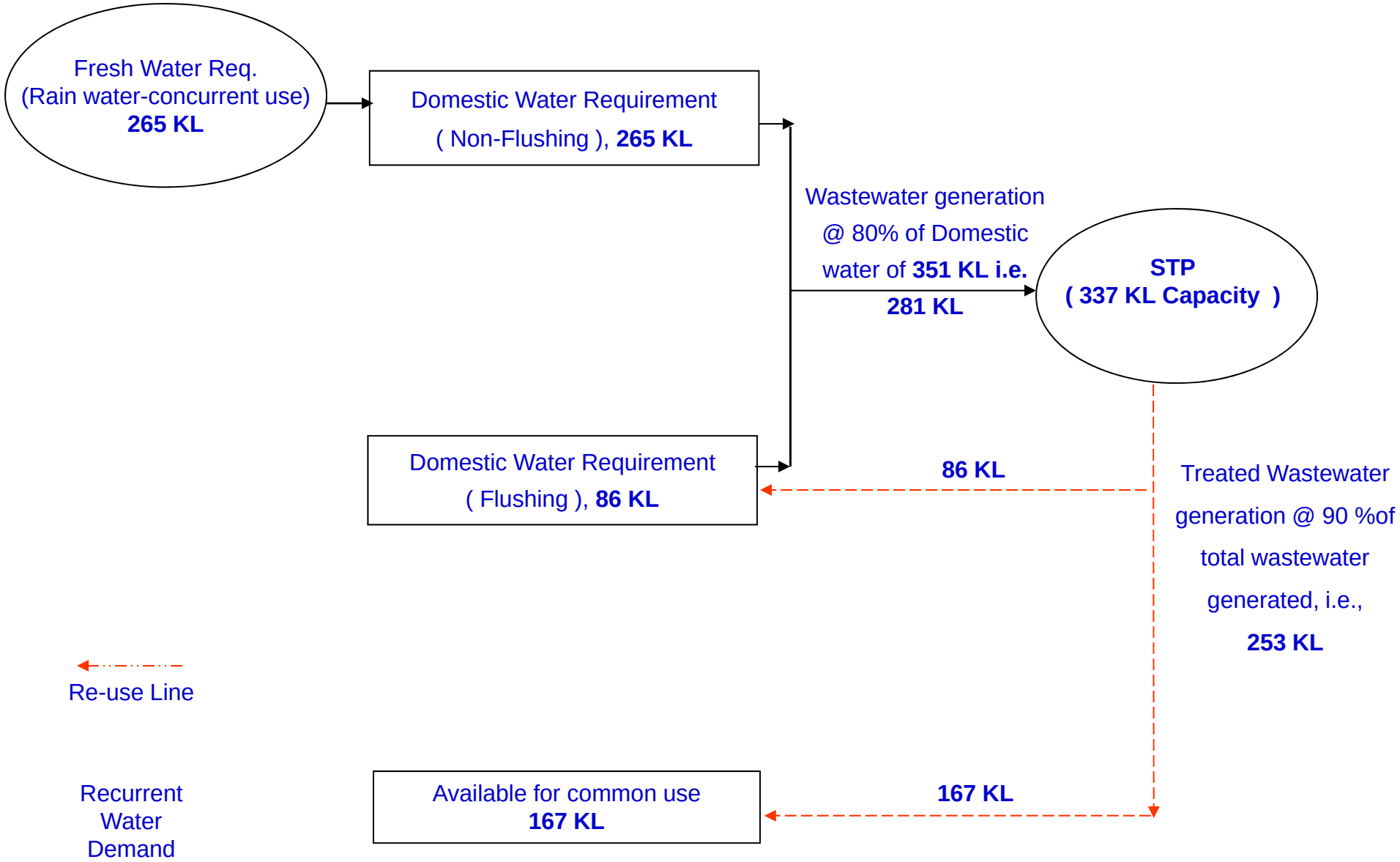
❑ **CAPITAL COST IN INSTALLATION OF STP OF 280 KL = Rs. 28 Lakhs**

❑ **PAY BACK PERIOD OF STP BY REDUCTION IN WATER REDUCTION & SEWAGE GENERATION = 9-10 YEARS**

DAILY WATER CONSUMPTION BALANCE CHART
(NON - RAINY DAYS)



DAILY WATER CONSUMPTION BALANCE CHART
(RAINY DAYS)



POPULATION CALCULATION OF A COMMERCIAL COMPLEX PROJECT

➢ COMMERCIAL COMPLEX

✓Shopping malls, Super market, Hyper market,	@ 3 sq. m. / person of carpet area for ground floor to 1st floor & @ 6 sq.m. / person of carpet area for 2nd floor onwards + 10% as staff of total population estimated above
✓Office complexes including I.T. buildings	@ 10 sq. m. / person of total carpet area of office space + 10% as housekeeping staff of total population estimated above
✓Multiplexes	@ 1 person per seat + 10% as housekeeping / operating staff of total seats
✓Restaurant / food courts	@ 1 person per seat + 10% as housekeeping / operating staff of total seats.

POPULATION CALCULATION – Contd…

✓Convention centre	@ 1 person per seat + 10% as housekeeping / operating staff of total seats
✓Auditorium	@ 1 person per seat + 10% as housekeeping / operating staff of total seats
✓Banquet hall	@ 1 person per seat + 10% as housekeeping / operating staff of total seats
✓Hotels	@ 2 persons per rooms + 10% as housekeeping / operating staff of total population estimated above .

COMMERCIAL COMPLEX PROJECT –

A CASE STUDY

(The project with Retail shops, Offices, Multiplex

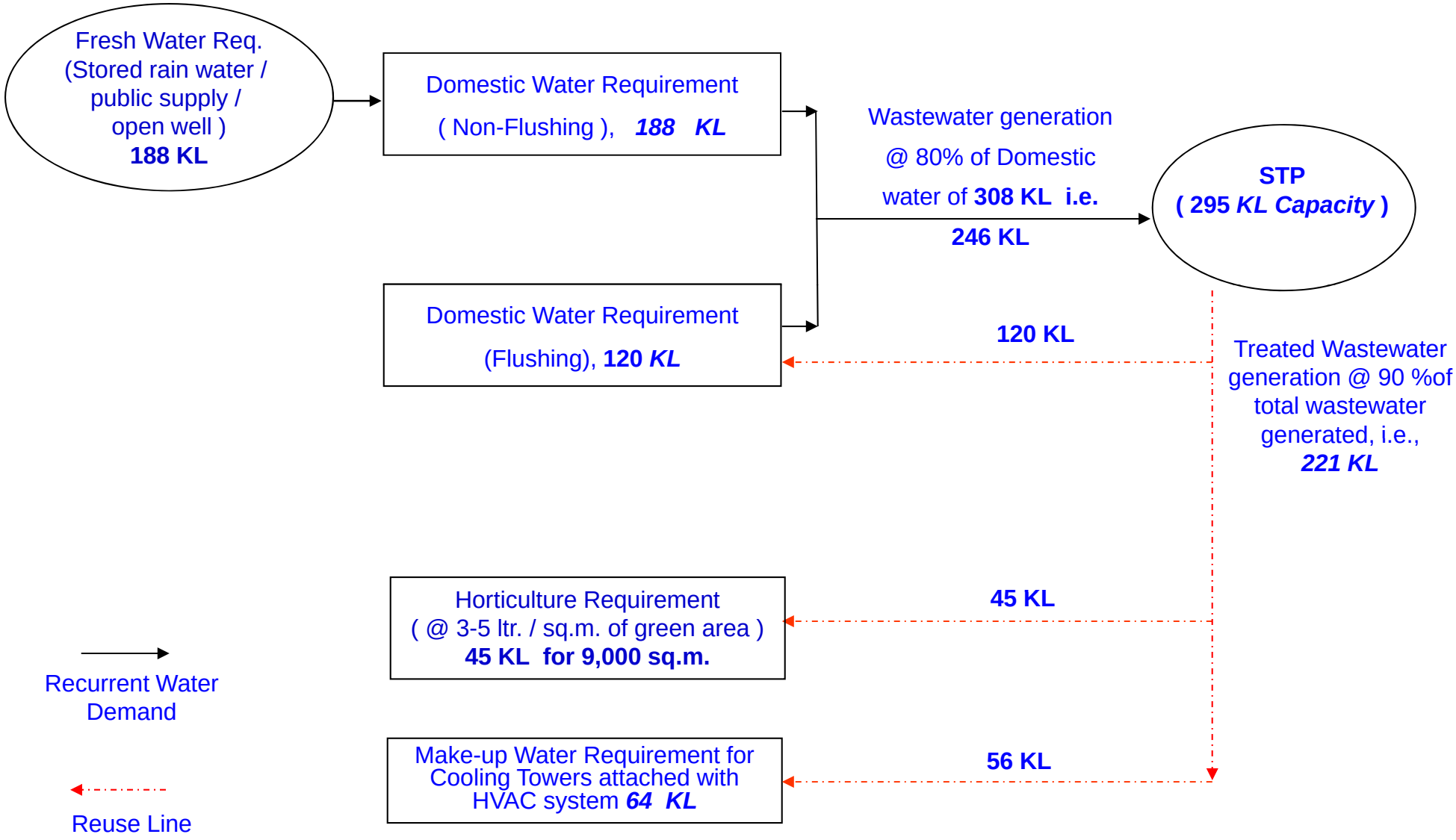
(1,300 seats), Banquet hall (350 seats), Restaurant

(600 seats) & Hotel (198 rooms))

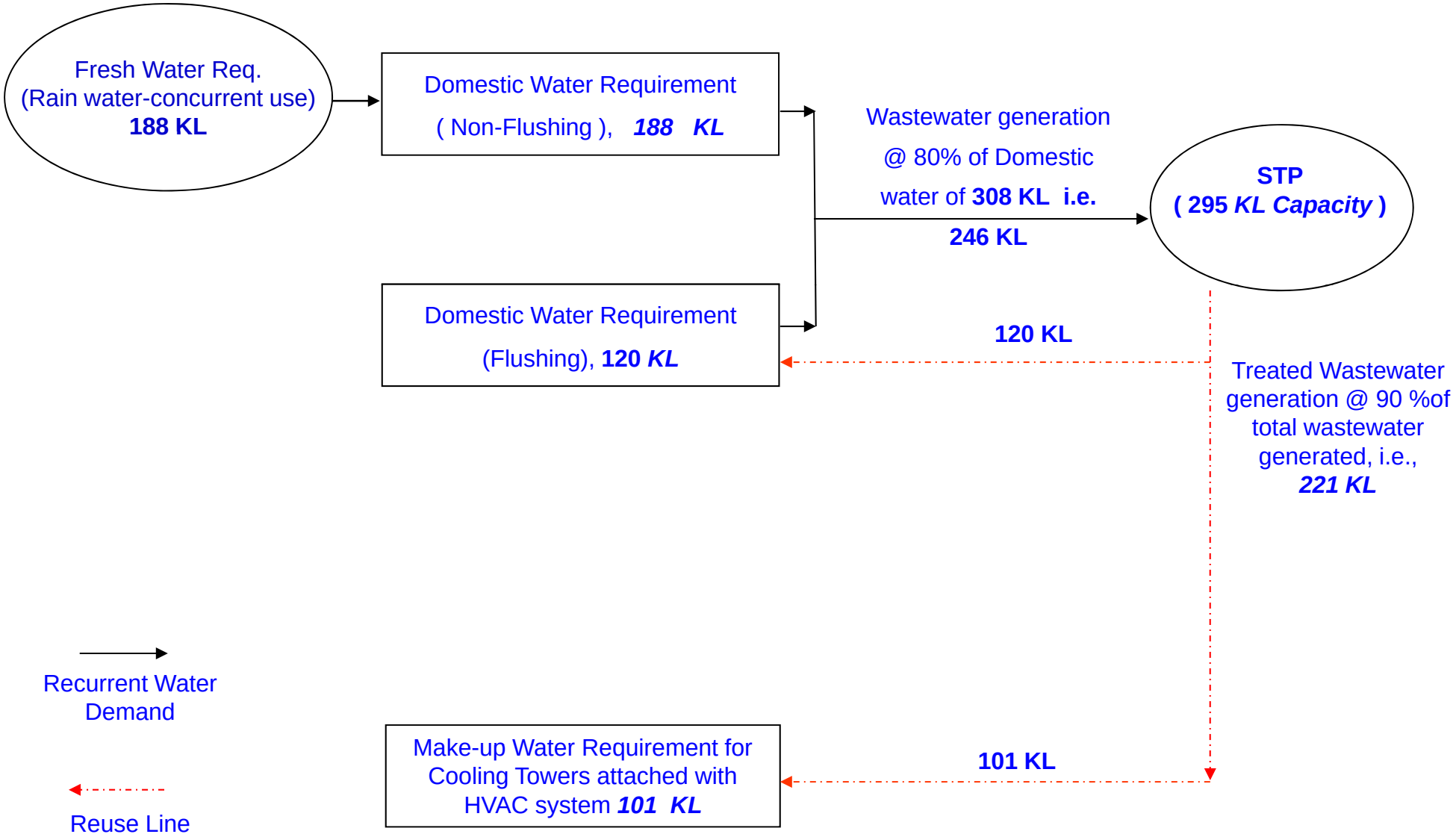
❑ DAILY DOMESTIC WATER CONSUMPTION CALCULATION DETAILS FOR A COMMERCIAL COMPLEX PROJECT

ACTIVITY	CARPET AREA / SEATING CAPACITY	POPULATION	NON-FLUSHING (in KL)	FLUSHING (in KL)	TOTAL (in KL)
Retail Area (Shoppers)	21,785 sq.m. (Gr. + 1st floor)	7,262 Persons (based @ 3 Sq. m. / Person)	7,262 x 3 Ltr. = 22	7,262 x 6 Ltr. = 44	66
Retail Area (Shoppers)	21,785 sq.m. (2nd floor to 4 floor)	3,631 Persons (based @ 6 sq. m. / Person)	3,631 x 3 Ltr. = 11	3,631 x 6 Ltr. = 22	33
Staff (Retail Area)	--	1,089 Persons (10% of shoppers of 10,893 Persons, 7,262 + 3,631)	1,089 x 15 Ltr. = 16	1,089 x 12 Ltr. = 13	29
Offices	8,507 sq.m.	851 Persons (@ 10 sq.m. / person)	851 x 15 Ltr. = 13	851 x 12 Ltr. = 10	23
Staff	--	85 Persons (10% of Staff of 851 Persons)	85 x 15 Ltr. = 1	85 x 12 Ltr. = 1	2
Multiplex	1,300 Seats	1,300 Persons (1 person / seat)	1,300 x 3 Ltr. = 4	1,300 x 6 Ltr. = 8	12
Banquet Hall	350 Seats	350 Persons (1 person / seat)	350 x 3 Ltr. = 1	350 x 6 Ltr. = 2	3
Restaurant	600 Seats	600 Persons (1 person / seat)	600 x 40 Ltr. = 24	600 x 12 Ltr. = 7	31
Staff (Multiplex, Banquet hall, Restaurant)	--	225 Persons (10% of 2,250 Persons, 1300+350+600)	225 x 15 Ltr. = 4	225 x 12 Ltr. = 3	7
Hotel	198 Rooms	396 Persons (2 person / Room)	396 x 225 Ltr. = 89	396 x 21 Ltr. = 8	97
Hotel Staff	--	198 Persons (1 Person / Room)	198 x 15 Ltr. = 3	198 x 12 Ltr. = 2	5
TOTAL		15,987 Persons	188	120	308

DAILY WATER CONSUMPTION BALANCE CHART
(NON-RAINY DAYS) (ZERO EXIT DISCHARGE)



DAILY WATER CONSUMPTION BALANCE CHART
(RAINY DAYS) (ZERO EXIT DISCHARGE)



SOURCE OF WATER & IT'S JUDICIOUS USE FOR LOW IMPACT DEVELOPMENTS

- **Source of water can be public supply or own source or a combination of both for different developmental activities.**

- **There is always a limitation in the supply of sufficient quantity of public water supply.**

- **To balance the deficiency in public supply, the project proponents resort to own source of water supply i.e. digging open well, deep bore well / tube well, ponds etc.**

- **Alternatively, the project proponents can avail rain water which is the untapped source of water for developmental purposes.**

RAINWATER AS THE SOURCE OF WATER

- **Rain water is the purest form of water naturally available.**
- **With minimal treatment like filtration & disinfection, rain water can be used for portable purposes.**
- **In places, where the ground water table is high and recharging of aquifers through rainwater harvesting pits is not feasible, rainwater storage tanks, or large collection ponds can be proposed.**
- **The stored rainwater can be a source of water during non-rainy days.**
- **The capacity or volume of rain water storage tank or pond as per the norms of MoEF is:-**

  V = (T x N x Q) + Et, where

  V = volume of the tank (litres)
  T = length of the dry season (days)
  N = number of people using the tank / pond
  Q = consumption per capita per day (litres)
  Et = evaporation loss during dry period (which may be ignored in case of closed storage tanks)

RAINWATER STORAGE TANK / POND – A CASE STUDY

- For a residential project with 100 Apartments, with daily fresh water requirement of 45,000 ltrs. (100 apts. x 5 persons x 90 ltrs.), the capacity of the rain water storage tank / pond is calculated as below.
- The calculation is:-
- **Rain water storage tank**

T = length of the dry season (days) = 60 days

N = number of people using the tank / pond = 100 apts. x 5 persons = 500 persons

Q = consumption per capita per day (liters) = 90 liters

V = 60 x 500 x 90 = 27,00,000 liters = 2,700 KL (27 Lakhs ltrs.)

- **Rain water storage pond**

V = 2,700 KL + 20 % Extra (Evaporation losses)

= 2,700 KL + 540 KL

= 3,240 KL (about 32 Lakhs ltrs.)

- **The project can survive with this storage for at least 60 days of non rainy days.**

RAINWATER STORAGE TANK REQUIREMENT AS PER LOCAL RULES – CONTRADICTION WITH THE GROUND REALITY - A CASE STUDY

- As per Kerala Municipality Building Rules (KMBR) / Kerala Panchayat Building Rules (KPBR) as amended in December, 2012, the requirement of rain water storage tank capacity is:-
- For a residential project with 100 Apartments in 8,000 sq.m of land (about 2 Acres) & with a ground coverage of about 45% (i.e. 3,600 sq.m) in Kerala, the capacity of the rain water storage tank requirement as per KMBR / KPBR is :- 3,600 sq.m x 25 liters = 90,000 liters
- **The project can survive with this storage for only 2 days of non rainy days which is very less.**
- **Therefore, think above the requirements under local rules and promote enhancement of Rain water storage tank capacity.**
- **Try to impound the rain water within the site to the maximum either by storage or by recharging so as to achieve low impact developments.**

RAINWATER AS THE SOURCE OF WATER Contd..

- **Most of the places in Kerala, rainwater storage tanks are being constructed in the name of "*Jalasambharani*"**

- **Therefore, in project site where ground water table is high, large projects can construct decentralized rain water storage tanks or ponds for each tower or each block of the project so as to sustain the project with the stored rain water during non rainy days without dependent on tanker water supply or other sources for achieving low impact developments.**

- **Also, the rain water storage tanks can be proposed in cases, where the subsoil is rocky, clayey or silty in nature, the recharging through harvesting pits possibilities are very less due to the non-porosity of such type of soil.**

- **The rain water harvesting through pits is ideal only for sandy soil.**

INFLUENCE OF RAIN WATER ON OPEN WELLS

- Open wells are alternative source of water for developmental projects.
- Open wells are water bodies at shallow depth.
- The rain water which is impounded in the soil is the source of water in open wells.
- Therefore, if a project intends to have an open well or wells in their project site, it should also allow the rain water to percolate.
- Generally, the project site area distribution is as follows:-

  40 – 50% → Ground coverage or foot print of building
  30 – 40% → Roads, concrete parking spaces and pavements
  10 – 20% → open ground in different patches as landscape.

- In other words , 70 – 90% of the surface of the project area is sealed and devoid of possibilities of percolation of rain water to the ground and open wells in the project site become redundant after few years.
- Added with the installation of a heavy duty pump installed in the open well by the project proponent, the ground water from the surroundings trespasses into the open well within the project site and it will have negative impact on open wells in the neighborhood.
- Therefore, it is necessary to allow the percolation of rainwater at various points / locations within the site for replenishment of open well provided the soil conditions are suitable for low impact development.

HIGH GROUND WATER TABLE vs EXCAVATION FOR BASEMENT

- **If one of the source of water for the developmental activity is from open well or if the source of water of your neighbor is open well, no under ground excavation for basement construction is to be permitted. It will definitely deplete the ground water of the area.**
- **By excavation for basement construction, dewatering of the site is required and it will severely affect the hydrogeology of the area.**
- **Therefore, whenever there is high ground water table, no excavation is to be permitted and which will ensure low impact development.**
- **Also, if the subsoil is sandy or clayey in all these cases, no excavation is to be permitted for basement construction.**

DEEP TUBE WELL / CONFINED AQUIFERS

- **These water sources are the "*FIXED DEPOSIT OF WATER*" which our ancestors left for us.**
- **It took several decades for such confined aquifer water formations.**
- **It is our choice either to exhaust or not to touch it and leave it for the future generations.**
- **For achieving low impact development, abstraction of water from deep tube well is to be avoided.**

PICTURES OF DUAL FLUSH CISTERNS

OTHER WATER CONSERVATION PRACTICES

REDUCTION IN WATER FOOTPRINT

SAVE OUR GOOD GREEN EARTH

- ✓ **Adopting water efficient fixtures like flow restrictors & aerators in flow taps / showers (these measures will make the flow feel stronger, while flow controls)**
- ✓ **Specs. : 8 LPM under 3 bar pressure, Make and manufacturers : *Jaquar,* Rocca, Grohe.**
- ✓ **Photographs of different types of flow restrictors & aerators**

PHOTOGRAPHS SHOWING WATER FLOW FROM CONVENTIONAL TAP AND TAP WITH FLOW RESTRICTOR

CONVENTIONAL TAP

TAP WITH FLOW RESTRICTOR

SAVINGS ON ACCOUNT OF USE OF RAIN WATER – A CASE STUDY

- **WATER CONSERVATION BY CONCURRENT USE OF RAIN WATER AS SOURCE OF WATER DURING RAINY SEASON & STORED RAIN WATER DURING NON-RAINY SEASON**

Fresh Water Requirement (KL / year) without use of rain water	Fresh Water Requirement (KL / year) with use of rain water	Total Saving (KL / Year)	Saving %
96,725	41,075	55,650	57.53

- **COST OF 1 KL OF WATER (AVERAGE) (MUNICIPAL SUPPLY) = Rs. 30/-**
- **ANNUAL SAVING ON ACCOUNT OF USE OF RAIN WATER = Rs. 17 Lakhs**
- **POWER CONSUMPTION FOR ABSTRACTION OF WATER FROM WELL = 22,260 kWh**
- **SAVING ON ACCOUNT OF USE OF RAIN WATER = Rs. 1.2 Lakhs**
- **TOTAL SAVING ON ACCOUNT OF USE OF RAIN WATER = Rs. 18.20 Lakhs**
- **CAPITAL COST IN CONSTRUCTION OF RAIN WATER STORAGE = Rs. 1.6 Crores**
- **PAY BACK PERIOD OF RAIN WATER STORAGE FACILITY = 7-8 YEARS**

THANK YOU

POPULATION CALCULATION – Contd…

➢ **HOSPITAL BUILDINGS**

✓ Hospital inpatients	@ 1 person per bed (inpatient)
✓ Attendants/ bye-standers to patients	@ 2 person per bed
✓ Out patients	@ 2 persons per bed (outpatient)
✓ Attendants to patients	@ 1 person per patient
✓ Hospital doctors, nurses, paramedical staffs, office administrative staff, Class-IV employees, drivers, peons etc.	@ 1 person per bed

POPULATION CALCULATION – Contd…

- **INSTITUTIONAL BUILDINGS**

✓ **Schools / Colleges**	**@ No. of seats in each class / each branch** **+** **@ 1 teacher per 15 students – 30 students** **+** **@ one non teaching staff per 15 students – 30 students**

INSTITUTIONAL PROJECT

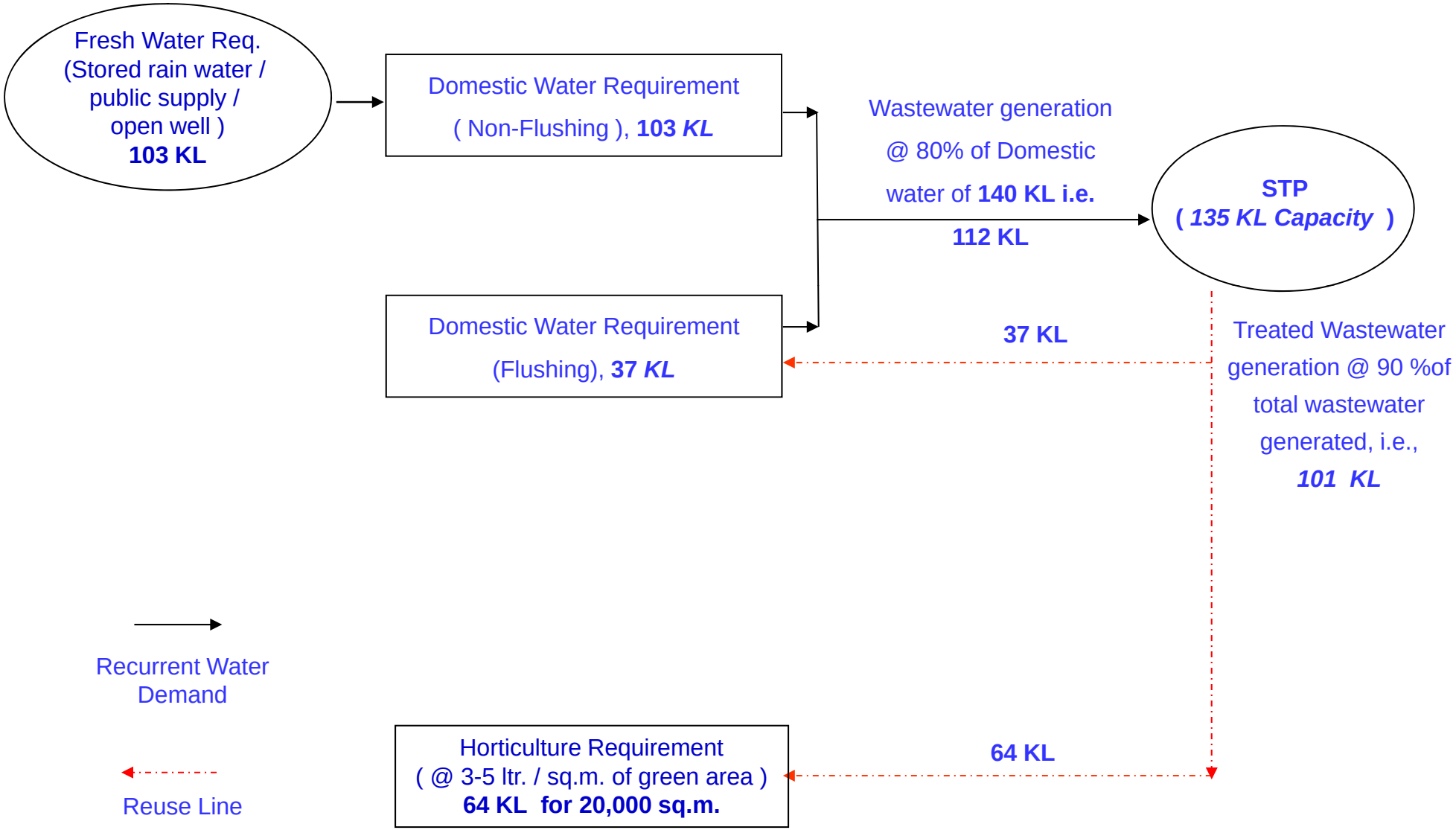
(An Institutional building project (Engineering College campus) with 400 students per batch (5 branches), 4 year course (400 students, non-residential & 1,200 students, residential), 110 rooms for faculty/staff & 10 houses for sr. faculty)

WATER ENVIRONMENT

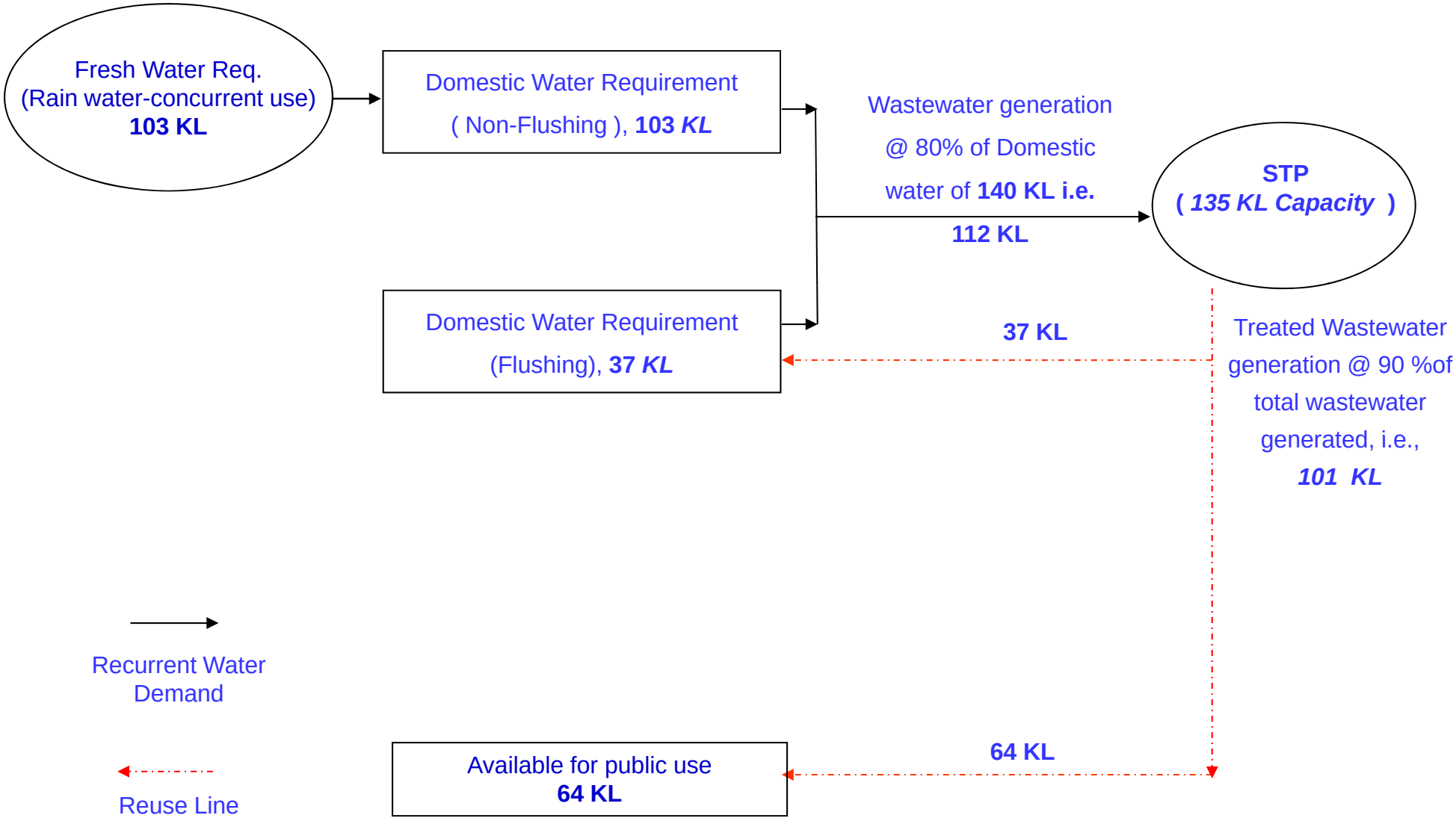
- **DAILY DOMESTIC WATER CONSUMPTION CALCULATION DETAILS FOR A ENGINEERING COLLEGE PROJECT**

Description	Non-Flushing Requirement	Flushing Requirement	Total
	(KLD)		
INSTITUTIONAL BLOCK			
No. of Students = 400 Nos. (without hostel facility)	400 x 15 Ltr. = 6	400 x 12 Ltr. = 5	11
No. of Staff = 141 Persons (without accommodation facility)	141 x 15 Ltr. = 2	141 x 12 Ltr. = 1	3
ACCOMMODATION BLOCK			
No. of Students = 1,200 Nos. (with hostel facility) (400 Rooms x 3 Students = 1,200 Students)	1,200 x 65 Ltr. = 78	1,200 x 21 Ltr. = 25	103
270 Persons (with accommodation facility) (110 Rooms x 2 Persons = 220 Persons) + (10 houses for Sr. Faculty x 5 Persons = 50 Persons)	270 x 65 Ltr. = 17	270 x 21 Ltr. = 6	23
Total	103	37	140

DAILY WATER CONSUMPTION BALANCE CHART
(NON-RAINY DAYS)



DAILY WATER CONSUMPTION BALANCE CHART
(RAINY DAYS)



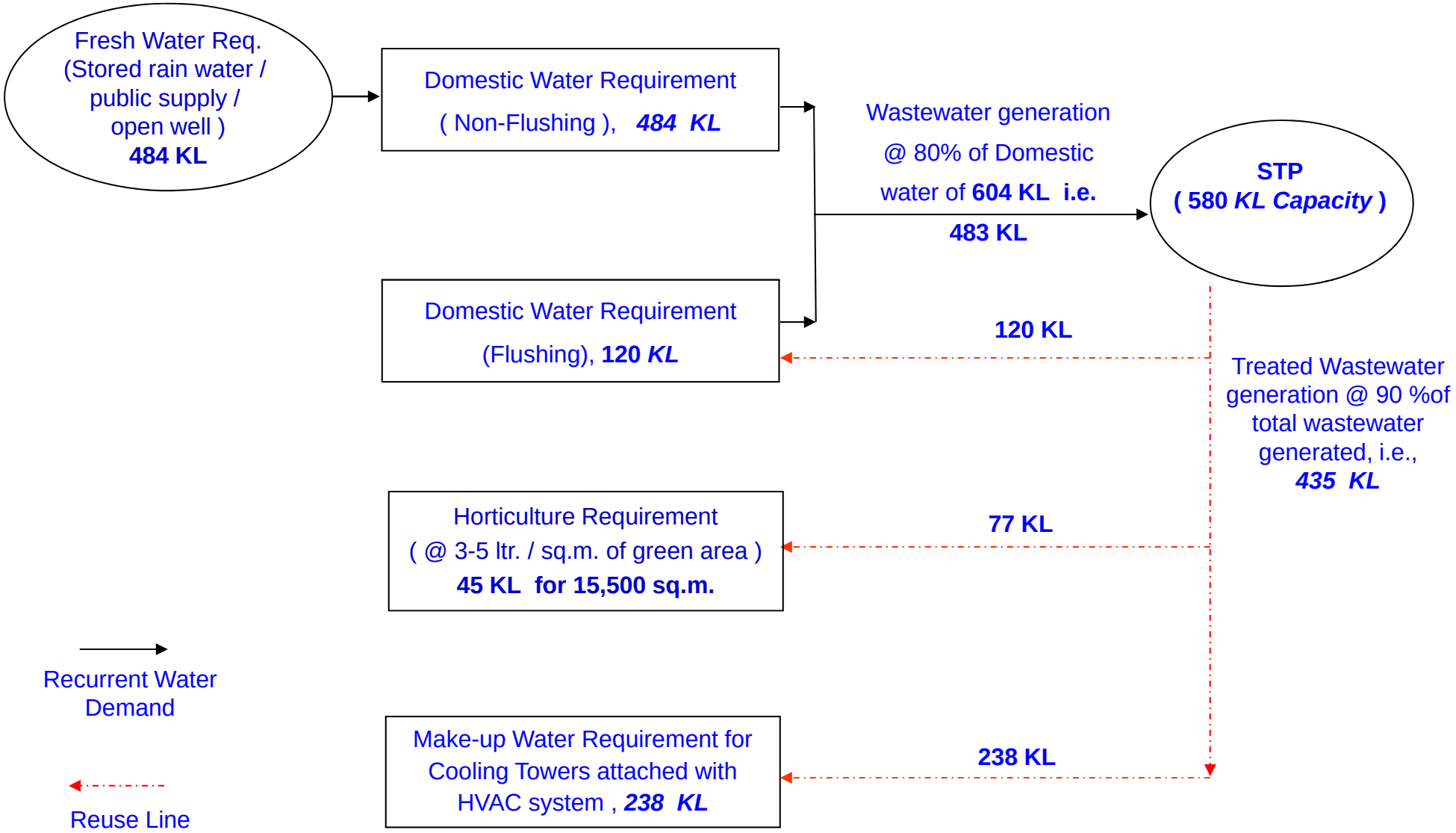
MEDICAL COLLEGE & HOSPITAL PROJECT

(The project with 1,100 in patients, 288 apartments for doctors/faculty, nurses, paramedical staff, hostel facility for 860 students of MBBS & post graduation, nursing students and accommodation for bye-standers / attendants (110 nos.) to the patient)

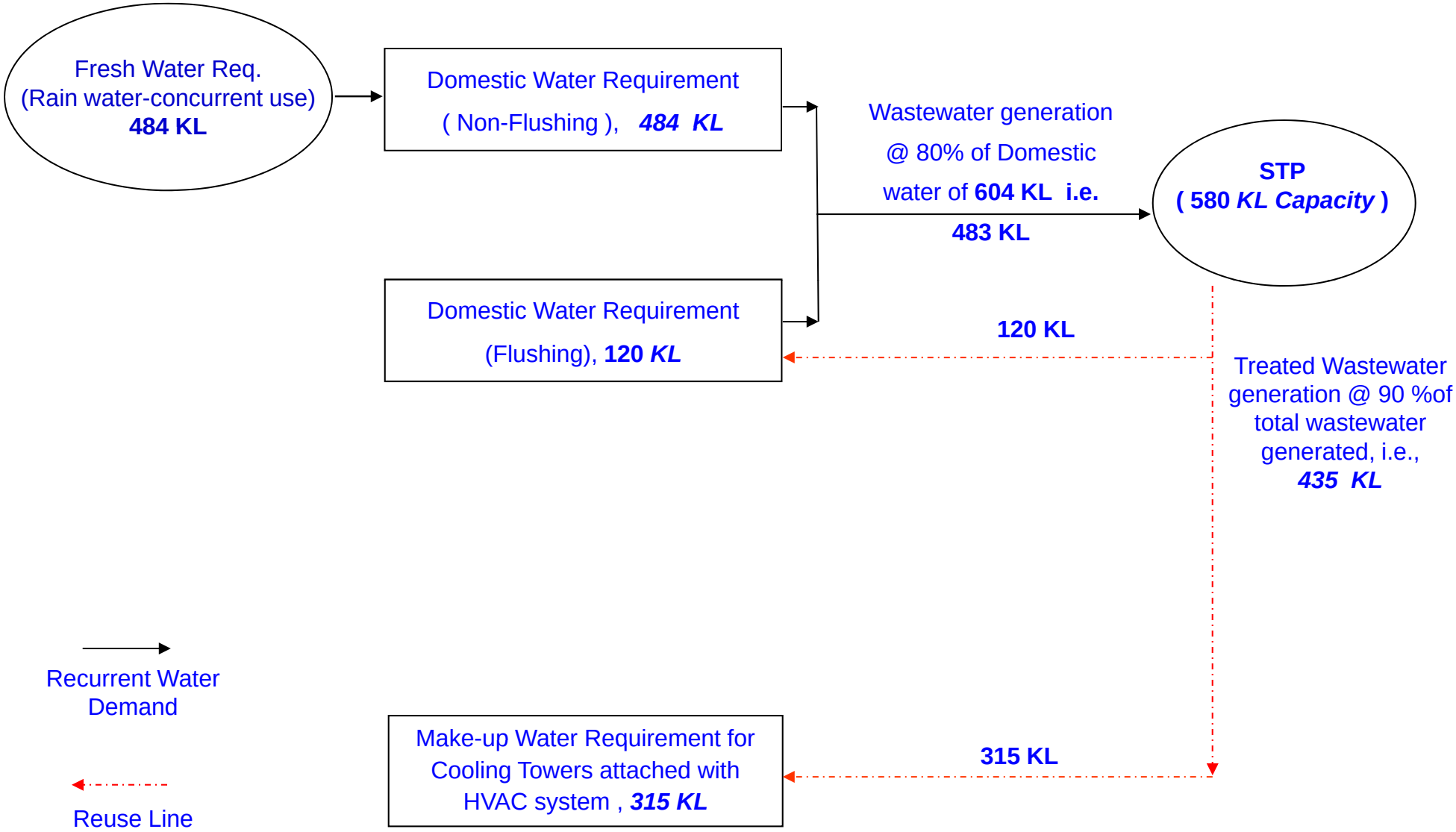
❑ DAILY DOMESTIC WATER CONSUMPTION CALCULATION DETAILS FOR A MEDICAL COLLEGE & HOSPITAL COMPLEX PROJECT

Sr. No.	Description	Non-Flushing Requirement (KL)	Flushing Requirement (KL)	Total (KL)
A.	**HOSPITAL & ACADEMIC BLOCK**			
1.	In Patients (No. of Beds) = 1,100 Nos. (Including Laundry)	1,100 x 270 Ltr. = 297	1,100 x 21 Ltr. = 23	320
2.	Visitors / Attendants = 2,200 Persons (2 Persons / Bed)	2,200 x 3 Ltr. = 7	2,200 x 6 Ltr. = 13	20
3.	Out Patients=2,200 Persons	2,200 x 3 Ltr. = 7	2,200 x 6 Ltr. = 13	20
4.	Visitors / Attendants = 2,200 Persons (1 Person / 1 Patient)	2,200 x 3 Ltr. = 7	2,200 x 6 Ltr. = 13	20
5.	Staff (Non-Residential) = 630 Persons	630 x 15 Ltr. = 9	630 x 12 Ltr. = 8	17
B.	**RESIDENTIAL & HOSTEL BLOCK**			
1.	Staff with Residential Facility = 288 Persons (Total Population, 288 Apts. x 5 Persons = 1440 Persons (Residential facility for doctors / faculty, nurses, paramedical staff & Class-IV employees)	1,440 x 65 = 94	1,440 x 21 = 30	124
2.	Hostel Facility = 860 Students (MBBS, MD & Nursing Students)	860 x 65 Ltr. = 56	860 x 21 Ltr. = 18	74
C.	**OTHER FACILITIES**			
1.	Accommodation for Attendants = 110 Persons (10% of total no. of beds)	110 x 65 Ltr. = 7	110 x 21 Ltr. = 2	9
	TOTAL	484	120	604

DAILY WATER CONSUMPTION BALANCE CHART
(NON-RAINY DAYS) (ZERO EXIT DISCHARGE)



DAILY WATER CONSUMPTION BALANCE CHART
(RAINY DAYS) (ZERO EXIT DISCHARGE)



DAILY WATER CONSUMPTION (DOMESTIC CONSUMPTION) – CONVENTIONAL vs REDUCED

- A comparison with break-up of the conventional consumption & reduced consumption for other activities is as follows: -

Category	Conventional Consumption (lpcd)	Reduced Consumption (lpcd)
➢ Shopping malls, super market, hyper market shoppers, multiplex, convention centre, auditorium, banquet hall, out patients, attendants to patients	15 (3* + 12**)	9 (3* + 6**)
➢ Staffs of shops, office complex, IT buildings, housekeeping staff, restaurant staff	45 (15* + 30**)	27 (15* + 12**)
➢ Restaurant / food courts	70 (40* + 30**)	52 (40* + 12**)
➢ Hotels (upto 4 star)	180 (135* + 45**)	131 (110* + 21**)
➢ Hotels (above 4 star)	320 (275* + 45**)	246 (225* + 21**)
➢ Hospital (in patient) (below 100 beds)	340 (295* + 45**)	291 (270* + 21**)
➢ Hospital (in patient) (above 100 beds)	450 (405* + 45**)	401 (380* + 21**)

* Non-flushing water requirement

** Flushing requirement

BUILDING CONSTRUCTION DEVELOPMENTAL PROJECTS

- **Building construction projects in an urban scenario are buildings for different activities.**
  - **Residential buildings - individual villas, group housing complexes (low rise apartment buildings & high rise apartment buildings).**
  - **Commercial complexes - Shopping malls, supermarkets, hyper markets, office complexes, multiplexes, restaurants & food courts, convention centres & auditorium, hotels (budget hotels & luxury hotels).**
  - **Institutional buildings - Hospitals, schools, colleges.**
  - **I.T. Parks & I.T. Buildings**
  - **Socio cultural centers**
  - **Sports pavilions & stadiums**
  - **Recreational / Entertainment complexes**