الباب الأول

مشروع محطة تنقية المياه

مشروع محطه تنقيه المياه الشرب لمدينة

النوته الحسابية لمحطة تنقية مياه الشرب لمدينة

Knowing the following data :-

POP	215,000	capita
W.C	300	l/c/d
Rate (r)	2.8	%
n	25	year

$$pop = pop(1 + r)^n$$

$$= 215000\left(1 + \frac{2.8}{100}\right)^{25}$$ =428812capita

$$Qavg(25) = pop * \frac{wc}{1000}$$ $=428812 * 300$/1000=128643.6m³/d

$$Qm.m = 1.4 * \ Qavg(25)$$

=1.4*128643.6= 128643.6m³/d

$$Qm.d = 1.7 * \ Qavg(25)$$

$$=1.7*128643.6=180101.04 m^3/d$$

$$Qm.h = 2.5\ Qavg(25)$$

$$=2.5*128643.6 = 321609 \quad m^3/d$$

Discharge	m^3/d	m^3/sec
Q av	128643.6	1.49
Q mm	180101.04	2.08
Q md	218694.12	2.53
Q m h	321609	3.72

Collection works: -

1-Design of intake:-

A-Design of intake pipes:

اسس التصميم :

-التصرف التصميمي للمأخذ = أقصى استهلاك شهري + 10 % من أقصى استهلاك شهري

-سرعة المياه في المواسير لا تقل عن 0.6 م/ث ولا تزيد عن 1.5 م / ث.

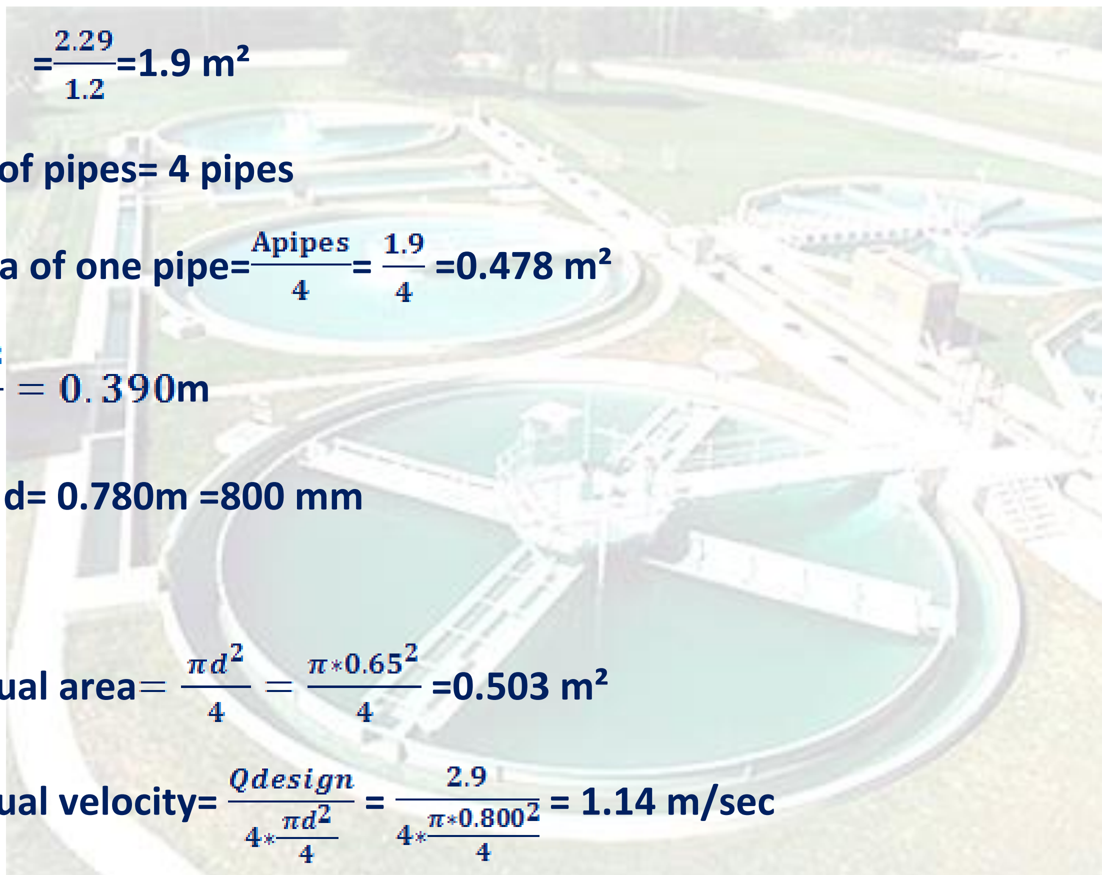
-عدد المواسير لا تقل عن ماسورتين.

-في حالة كسر أحد الماسورتين فمن الممكن أن تصل السرعة إلى 2.5 م/ث.

$Qdesign$=1.1*Q max monthly

=1.1*2.08=2.29m³/sec

A pipe=$\frac{\text{Qdesign}}{\text{velocity}}$ velocity (0.6-1.5) m/sec



=$\frac{2.29}{1.2}$=1.9 m²

No of pipes= 4 pipes

Area of one pipe=$\frac{\text{Apipes}}{4}$= $\frac{1.9}{4}$ =0.478 m²

$\frac{\pi d^2}{4} = 0.390$m

$\therefore$ d= 0.780m =800 mm

Actual area$=\frac{\pi d^2}{4} = \frac{\pi * 0.65^2}{4}$ =0.503 m²

Actual velocity= $\frac{Qdesign}{4*\frac{\pi d^2}{4}}$ = $\frac{2.9}{4*\frac{\pi*0.800^2}{4}}$ = 1.14 m/sec

IF one pipe broken:

Velocity = $\frac{2.9}{3*\frac{\pi*0.800^2}{4}}$ =1.60 m/sec < 2.5 m/sec ok safe

calculation of frictional head loss (Hf)

$V=0.355*C*D^{0.63}*S^{0.54}$

assume C=120

get S=0.04

Hf =S * Pipe length =S * 1000 =43.22 m

B- Design of pumps building:

Assume Pump=300 L/S=0.3 m^3/sec

No of pumps = $\frac{Qdesign}{Qpump}$ +0.5 no.of. pumps

$=\frac{2.5}{0.3}$ +0.5*n =10 pumps

Distance between pumps=(1.5m-3m)

Length of pumps building = (No of pumps/2-1) *distance between pumps + 4m

=4*3+ 4 = 16 m

Area of suction pipe $=\frac{Qpump}{2} = \frac{0.3}{2} = 0.15$ m^2

$$\therefore 0.15 = \frac{\pi d^2}{4}$$

- Diameter of pipe = 0.4m = 400 mm

C-Design of low lift pump:

HP: horse power

H: total dynamic head ((assume 6-10 m if we can't calculate))

$\eta_1=\eta_2= 0.8$

Assume Hst =35 m

Assume Hm =1 m

TDH= Hst + Hf + Hm

=35+43.22+1=79.22 m

HP= $\frac{\gamma * Qd * H}{75 * \eta_1 * \eta_2} = \frac{1000*2.5*79.22}{75*0.8*0.8} = 495\ hp$

Treatment works: -

2-Design of coagulation units:

A-Design of alum concentration tank:

$\nu = \frac{Qd*S}{C*\gamma*10^6}$

ν: volume of tank & Q d : Q max monthly

S: dosage (30-80) ppm & C1: concentration of alum (5-20%)

$\therefore \nu = \frac{198111.14*50}{0.15*1.02*10^6} = 64.74\ m^3$

ν=n*D*A

n: number of tanks(take=2) & D=height of tank(take=2m)

$\therefore$ **40.15= 2*2*A → A=16.19²**

Take L=B=4.0m

B-Design of flash mixing tank:

Qi=1.1*Mm=1.1*2.08= 2.29m^3/sec

Retention time= 5-60 sec → take R. T=30sec

ν=Qi*R. T=2.29*30=68.79m^3

Take D=2m & n=1

area=V/(D*n) =68.79/(2*1) =34.39 m2

Diameter of tank = 6.62m=6.65 m

C-Design of clarifloculators:

Design=1.1*Qmax monthly=1.1*180101.04=198111.144 m^3/d

=1.1*2.08 =2.29 m^3/sec

1-Design of tanks:

Assume n=6 tanks &surface flow rate=30m^3/m^2/d

$$A\ tot = \frac{Qdesign}{S.L.R} = \frac{198111.144}{30} = 6603.70\ m^2$$

$$6603.70 = \frac{\pi}{4}(Øs^2 - Øf^2)$$

Ø s : total tank diameter & Ø f: Flocculation zone diameter=0.4Øs

$$6603.70 = \frac{\pi}{4}(Øs^2-(0.4\ Ø\ s)^2)$$

$Øs=41m$ & $Ø\ f=16.36m$

2-check for flocculation zone:

Assume D f =5m

$$v=n*\frac{\pi}{4}*\ Øf^2*\ D\ f=6*\frac{\pi}{4}*\ (16.36)^2*5=6305\ m^3$$

$$R.T=\frac{volume}{Qd}=\frac{6305}{2.9*60}=45.83min \rightarrow (15\text{-}40\ min)\ ok$$

3-check for sedimentation zone:

Assume Ds=Df+0.5m=4+0.5=4.5m

$$R.\ T=\frac{n*\frac{\pi}{4}*(Øs^2-Øf^2)*Ds}{Qd}=\frac{6*\frac{\pi}{4}*(41^2-16.36^2)*4.5}{198111.144}=0.1hr \rightarrow (2\text{-}4hr)\ ok$$

$$S.L.R=\frac{Qd}{n*\frac{\pi}{4}*(Øs^2-Øf^2)}=\frac{198111.144}{6*\frac{\pi}{4}*(41^2-16.36^2)}=29.9\ m^3/m^2/d \rightarrow (25\text{-}40)\ m^3/m^2/d$$

ok

$$Weir\ load\ rate=\frac{Qd}{n*\pi*\ Øs}=\frac{198111.144}{6*\pi*41}=257.02\ m^3/m/d< 300\ m^3/m/d\ ok$$

4-Design of sludge hopper:

Vs: voume of sludge

S.S : raw water suspended solids(300ppm)

R.R: removal ratio (90-95%)

N: number of sludge hopper evacuation per day (2-3)/day

ɤ s : sludge specific density (1.02)t/m^3

vs=$\frac{Qd*s.s*R.R}{n*N(1-WC)*\gamma s*10^6}$=$\frac{198111.144*300*0.95}{6*2*(1-.95)*1.02*10^6}$=92.26$m^3$

5-Design of sludge pipe:

Qs =$\frac{vs}{time}$=$\frac{92.26}{10*60}$=0.154 m^3/sec

Time: evacuation time (10-20) min

Assume velovity (1-2) m/sec

A=$\frac{Qs}{v}$=$\frac{0.154}{2}$= 0.0769 m^2

$$0.0769 = \frac{\pi d^2}{4}$$

•Diameter of pipe = 0.4m≈0.4m=400mm

6-inlet pipe:

V=(1-1.5)m/sec

Q= $\frac{Qd}{n}$ = $\frac{2.29}{6}$ =0.38 m^3/sec

A= $\frac{Q}{v}$ = $\frac{0.38}{1}$ = 0.38 m^2

$$0.38 = \frac{\pi d^2}{4}$$

•Diameter of pipe = 0.7m=700mm

7-outlet pipe:

V= 0.5 m/sec

Q= $\frac{Qd}{n}$ = $\frac{2.29}{6}$ =0.38 m^3/sec

A= $\frac{Q}{v}$ = $\frac{0.38}{0.5}$ = 0.76 m^2

$$0.76 = \frac{\pi d^2}{4}$$

•Diameter of pipe = 1m=1000mm

3-Design of filtration unit:

A-Design of rapid sand filter:

Assume rate of filtration=130 $m^3/m^2/d$

Q d=Q mm=180101.04 m^3/d

A total =$\frac{Qd}{R.O.F}$= $\frac{180101.04}{130}$= 1385 m^2

Assume Area of one unit=80 m^2 →L=10m & B=8m

n=$\frac{Atotal}{Aone}$= $\frac{1385}{80}$ =18 filter

n total=18+2 stand by=20 filter

R .O.Fact =$\frac{Qd}{n*L*B}$ =$\frac{180101.04}{18*10*8}$=125.1 $m^3/m^2/d$

B-inlet pipe:

V=0.5m/sec

Q d=180101.04m³/d=2.08m³/sec

A= $\frac{Q}{v}$ = $\frac{2.08}{0.5}$ = 4.16 m²

$$4.17 = \frac{\pi d^2}{4}$$

•Diameter of pipe = 2.3m

c-outlet pipe:

V= 1 m/sec

Q d=2.08m³/sec

A= $\frac{Q}{v}$ = $\frac{2.08}{1}$ = 2.08 m²

$$2.08 = \frac{\pi d^2}{4}$$

•Diameter of pipe = 1.65m=1650mm

4-Design of storage tank:

A- (6-10) hours for emergency:

C1 = Q mm *(6-10) hr

C1 = 180101.04*8 = 60033.7m³

B- The differenc between Q max daily & Q max monthly:

C2 = Q md – Q mm

C2 = 218694.12- 180101.04= 38593.08 m³

C- 0.8 of fire demand:

C3 = 0.8*fire demand for 2 hours

$$C3 = 0.8 * \frac{pop}{10000} *120 \text{ min}$$

$$C3 = 0.8*\frac{215000}{10000}*120 = 2064 \text{ m}^3$$

D- 0.5 hour of Q max monthly:

C4 = 0.5*180101.04= 3752.1 m³

E- Capacity of ground tanks:

CT = max of C1&C2&C4 + C3

CT = 60033.68+2064 = 62097.68m³

F- Dimension of tanks:

Take D = (5-7) m =6 m

Take n=8tanks

CT=n*L*B*D

take L = 45m

take B = 30m

NO .OF .Tanks =7.67 Tanks

Take No .of .Tanks =8 Tanks

وقد تم الاستعانة ببرنامج الاكسيل للقيام بالعمليات الحسابية في النوته الحسابية لمحطة تنقية مياه الشرب

النوتة الحسابية لمحطة معالجة مياه الشرب		
pop	215000	cap
w/c	300	l/c/d
n	50	year
rate	2.8	%
pop(25)	428812	cap
Qavg(25)	128643.6	m³/d
Qmm	180101.04	m³/d
Qmd	218694.12	m³/d
Qmh	321609	m³/d
Discharge	m³/d	m³/sec
Qavg(25)	128643.6	1.49
Qmm	180101.04	2.08
Qmd	218694.12	2.53
Qmh	321609	3.72
1-Design of intake:		
A-design of intake pipes:		
Qdesign	2.29	m³/sec
velocity	1.2	m/sec

Apipes	1.9	m²
Take no.of.pipes	4	pipes
A pipe	0.478	m²
diameter	0.780	m
Take Diameter	0.800	m
actual area	0.503	m²
actual velocity	1.14	m/sec
If no.of.pipes	3	pipes
velocity	1.60	m/sec
calculation of frictional head loss (Hf)		
$V = 0.355 * C * D^{0.63} * S^{0.54}$		
assume C =	120	
get S =	0.04	
Hf = S * pipe length = S * 1000m =	43.22	m
B- Design of pumps building:		
ass Qpump = 300 l/c/d	0.3	m³/sec
no.of.pumps	10	pumps
Distance between pumps	3	m
L.of.p.building=(n/2-1)*(Dis. bet. Pumps)+4m		
L.of.p.building	16	m
Take velocity	2	m/sec
A.of suction pipe	0.15	m²
diameter	0.44	m
c-Design of low lift pump:		
hp=ɤ*Qd*H/75*ɥ1*ɥ2		

TDH = Hst + Hf + Hm		
Ass Hst	35	m
Ass Hm	1	m
TDH	79.22	m
Ass ɣ1=ɣ2	0.8	
HP	495	hp
2-Design of coagulation units:		
A-Design of alum concentration tank:		
□ =Qd*s/c*ɣ*10^6		
Qdesign	198111.14	m^3/d
Ass dose =	50	PPM
ɣ	1.02	t / m^3
Ass Conc. =	15	%
volume	64.74	m^3
□=n*D*A		
n	2	
depth	2	m
area	16.19	m^2
L=B	4.0	m
B-Design of flash mixing tank:		
Qd=1.1Qmm	2.29	m^3/sec
Take R.T	30.0	sec
volume=Qd*R.t	68.79	m^3
take D	2.0	m
take n	1.0	

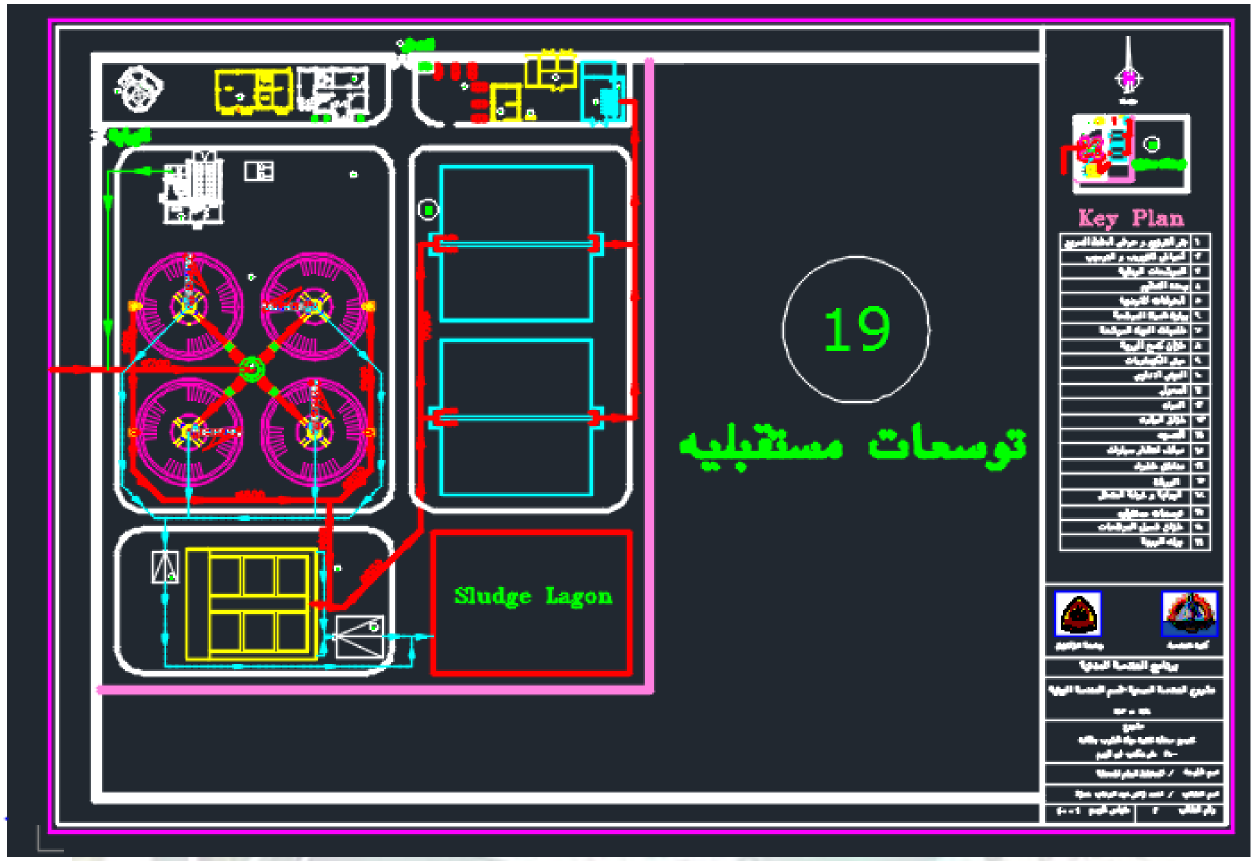
area = V/(D*n)	34.39	m^2
diameter	6.62	m
Take D	6.65	m
C-Design of clarifloculators:		
Qd=1.1*Qmm	198111.144	m^3/d
1-Dimension of tanks:		
assume n=	6	tanks
surface flow rate	30	$m^3/m^2/d$
Atot=Qd/S.F.R	6603.70	m^2
$A=n*(\pi/4)*(Øs^2*Øf^2)$		
Øs	41	m
Øf	16.36	≈16.40 m
2-check for flocculation zone:		
assume (Depth) f	5	m
$volume=n*(\pi/4)*Øf^2*Df$	6305	m^3
retention time=volume/Qd	45.83	min
3-check for sedimentation zone:		
assume Ds=Df+.5m	4.5	m
$R.t=n*(\pi/4)*(Øs^2*Øf^2)*Ds/Qd$	0.1	hr
$S.L.R=Qd/n*(\pi/4)*(Øs^2-Øf^2)$	29.9	$m^3/m^2/d$
$weir\ load\ rate=Qd/n*\pi*Øs$	257.02	$m^3/m/d$
4-Design of sludge hopper:		
□ $s=Qd*s.s*R.R/n*N*(1-Wc)*\gamma s*10^6$		
Take R.R =	0.95	
Take S.S =	300	PPM

Take W.C =	0.95	
□ s	92.26	m^3
5-Design of sludge pipe:		
Take t=	10	min
Qs=□ s/time	0.154	m^3/sec
Ass v =	2.00	m/sec
area =Qs/v	0.0769	m^2
diameter of pipe	0.4	m
6-inlet pipe:		
Q=Qd/n	0.38	m^3/sec
Ass v =	1.00	m/sec
A=Q/v	0.38	m^2
diameter of pipe	0.7	700mm
7-outlet pipe:		
Q=Qd/n	0.38	m^3/se
Ass v =	0.50	m/sec
A=Q/v	0.76	m^2
diameter of pipe	1.0	m
3-Design of filtration unit:		
A-Dimension of rapid sand filter:		
rate of filtration	130	$m^3/m^2/d$
Qd=Qmm	180101.04	m^3/d
Atot = Qd/R.O.F	1385	m^2
L	10	m
B	8	m

n = Atot/Aone	17.32	
take n	18.00	filter
stand by	2	filter
N tot	20.00	
R.O.Fact=Qd/(n*L*B)	125.1	m³/m²/d
B-inlet pipe:		
Qd	2.08	m³/se
Ass v =	0.50	m/sec
A=Q/v	4.17	m²
diameter of pipe	2.3	m
C-outlet pipe:		
Qd	2.08	m³/sec
Ass v =	1.00	m/sec
A=Q/v	2.08	m²
diameter of pipe	1.63	≈1.65m
4-Design of storage tank:		
Qd	2.08	m³/sec
C1 = Qmd - Qmm	38593.08	m³
C2 = 8hr * Qd	60033.7	m³
C3 = 0.5hr * Qmm	3752.1	m³
Take Cmax	60033.68	m³
Pop.	215000	Capita
C4 = 0.8 * fire demand	2064	m³
Volume = Cmax + C4	62097.68	m³
Ass water depth =	6.0	m

Area = V / Depth	10349.61333	m²
Ass width =	30	m
Ass length =	45	m
no.of. Tanks =	7.67	Tanks
Take No. of Tanks	8	Tanks

- سوف تستعرض اللوحات ما تم تصميمه في محطة تنقية مياه الشرب موضحا عليها كافة الاجزاء وذلك لعدم امكانية عرضها هنا بشكل يوضح كافة البيانات عليها.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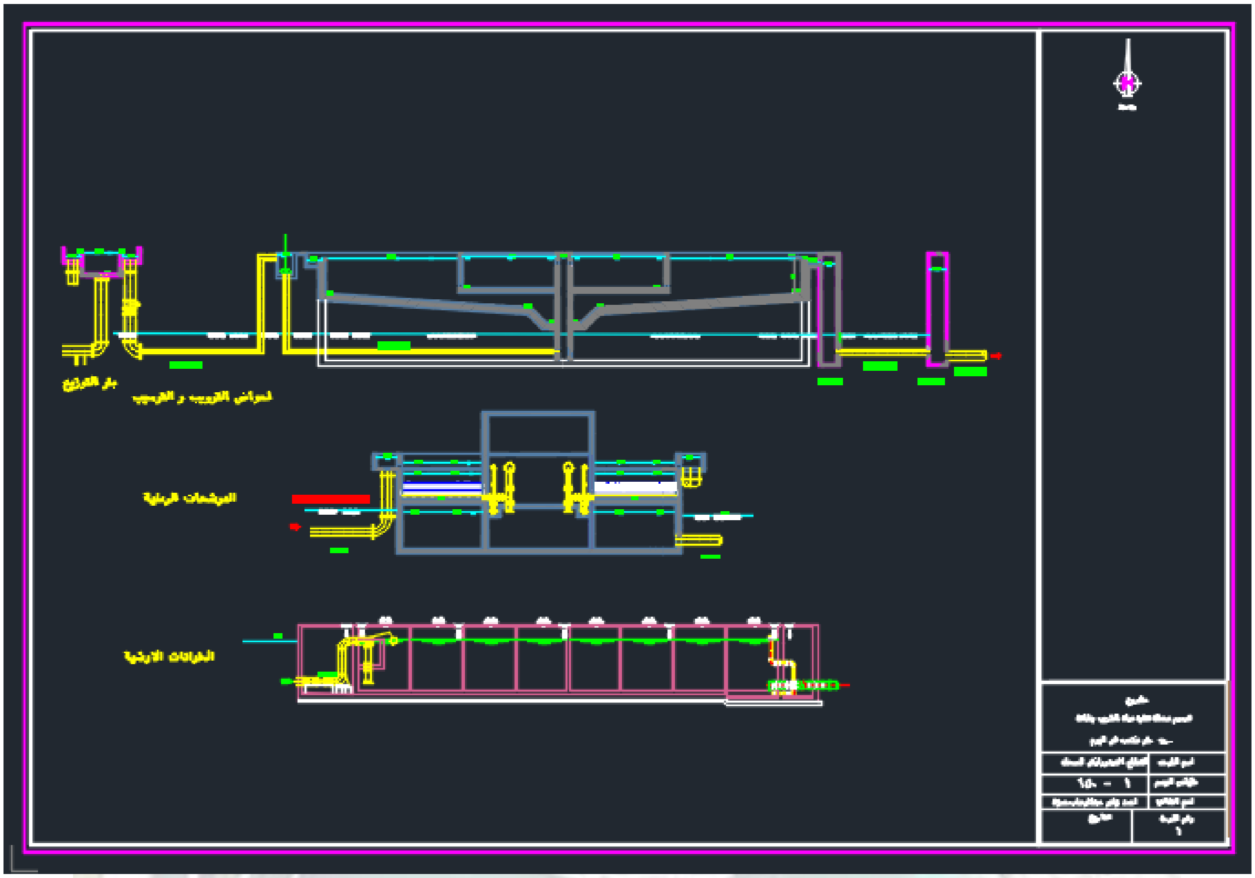
توسعات مستقبليه


بئر التوزيع
أحواض الترويب و الترسيب
المرشحات الرملية
الخزانات الأرضية