An Introduction to Swimming Pool Filtration and water flow

Presented by Will Dando FISPE

The Swimming Pool

Looking at a pool from behind the scenes

- Safe
- Comfortable
- Enjoyable

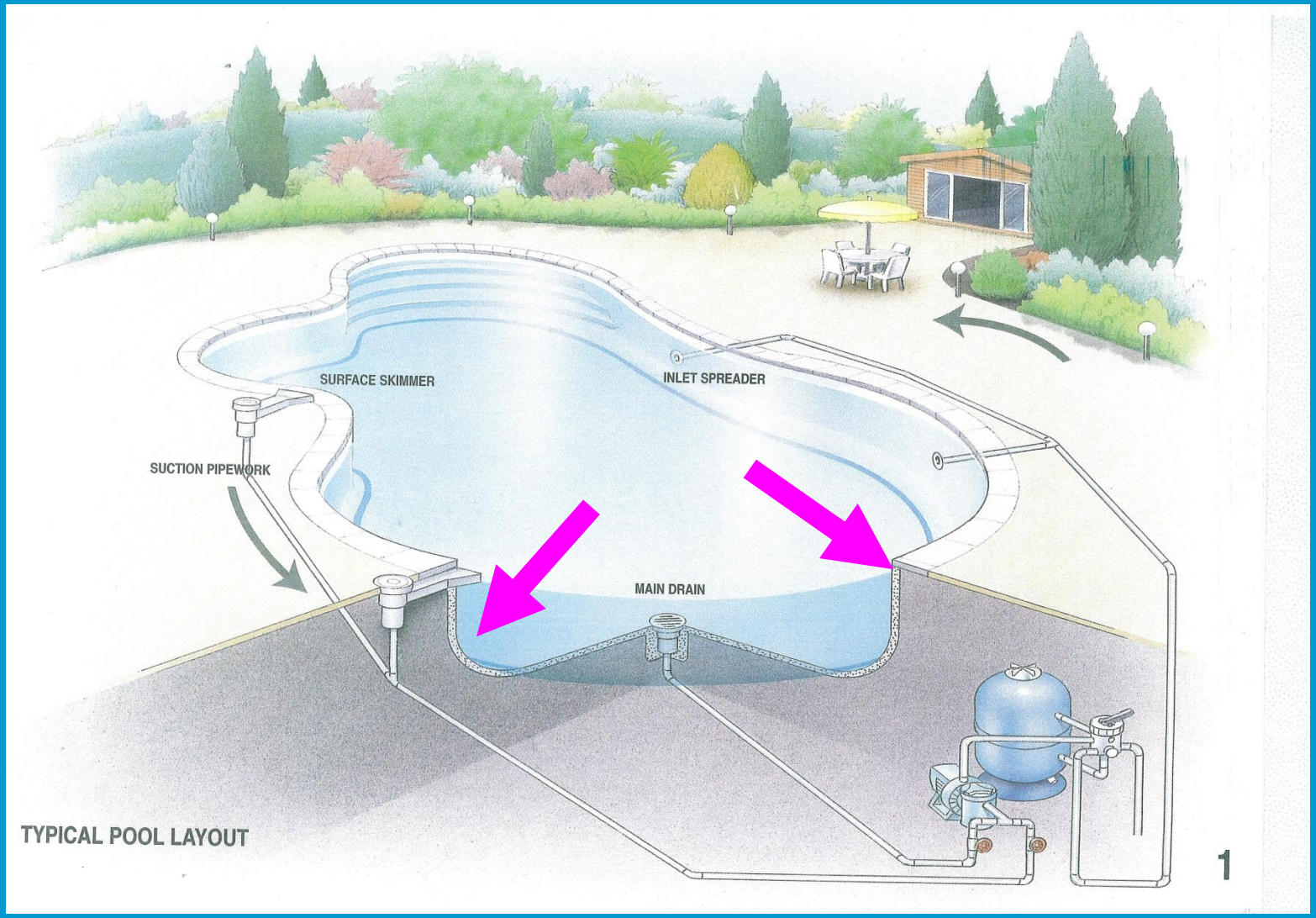
- Affordable
- Durable

The Swimming Pool

Looking at a pool as a Pool Builder

- Waterproof structure
  - Construction
  - Membrane
- Circulation
  - Pump,
  - Filter
  - Pipe
  - Pool Fittings

Waterproof Structure



Liner Pool

Why have Filtration / Chemicals

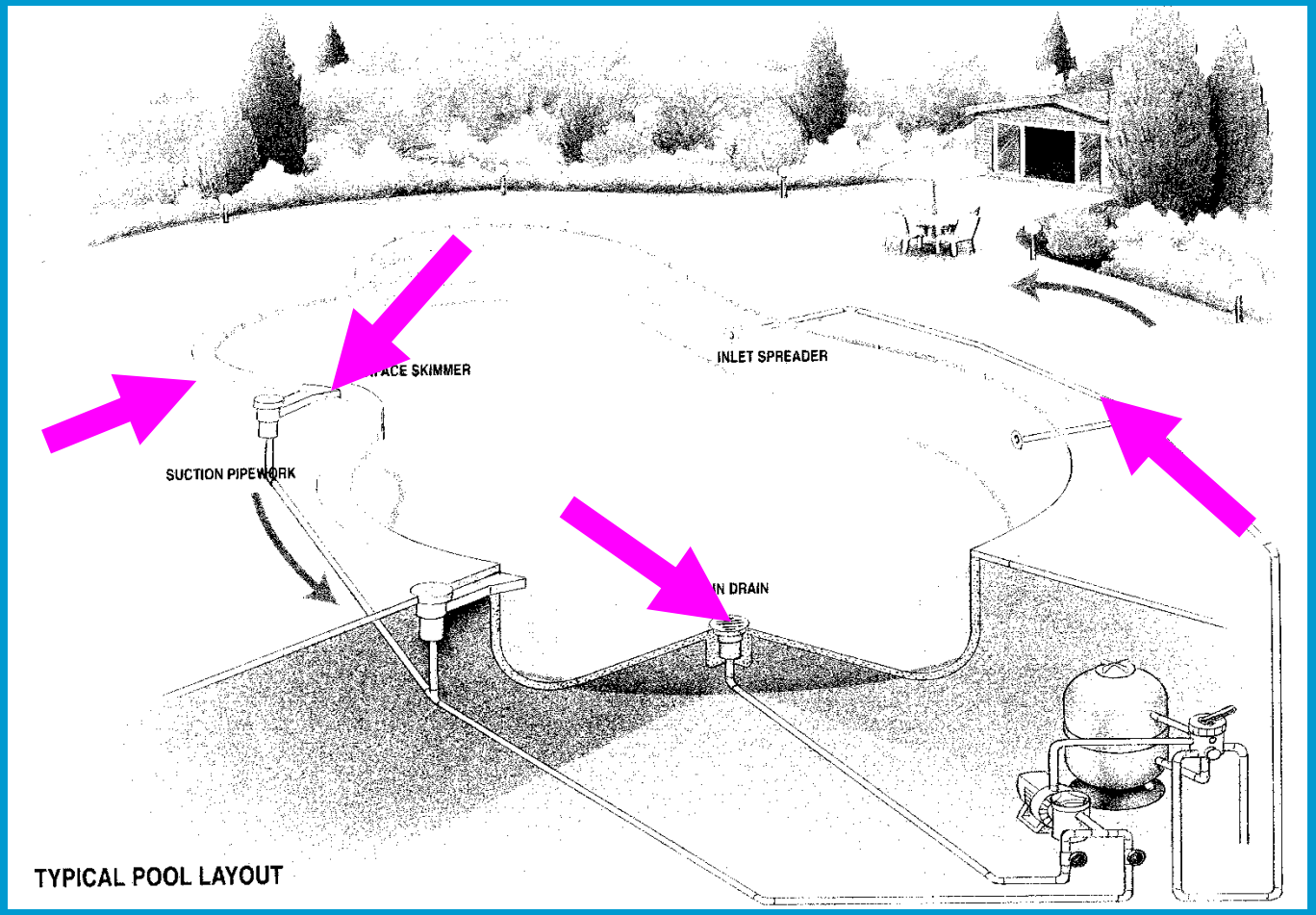
- The reason we have a filtration system in a swimming pool, is to remove particles from the water, to keep clarity, and make the water safe and pleasurable to swim in.

- Chemicals are dosed to make the pool safe to swim in by ensuring that Bacteria cannot live in the pool water. Chemicals are also used to balance the pool water to make it comfortable, for both bathers and equipment.

Water Flow Fittings

- Skimmer(s)
- Main Drains
- Vacuum Point
- Returns

Water Flow & Filtration



Water Flow & Filtration

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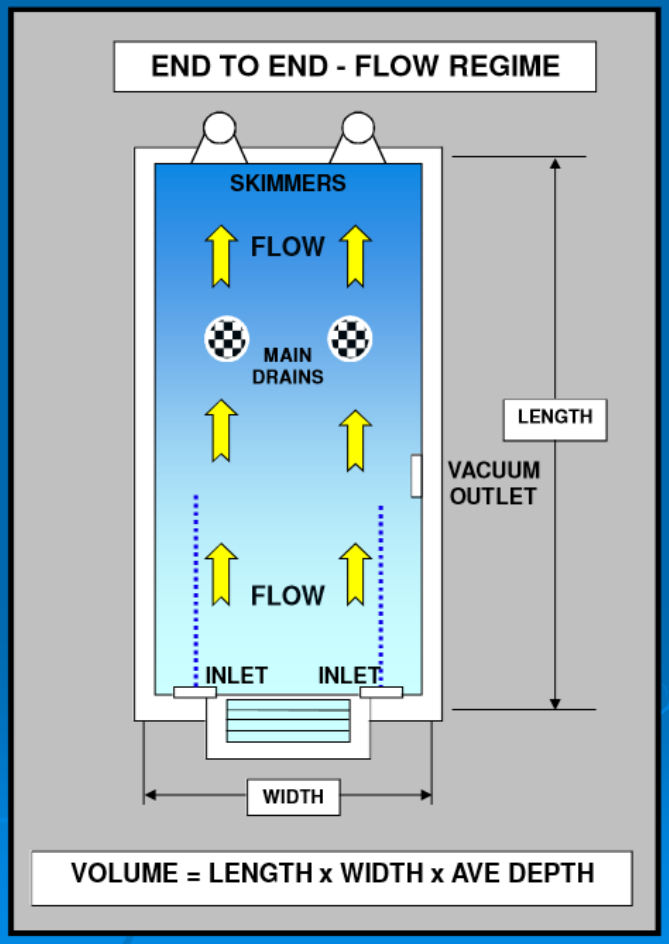
Layout…

There are many
different flow regimes
(See ISPE Books)
Pool shapes will vary
Work with the client
And site conditions
For the best layout



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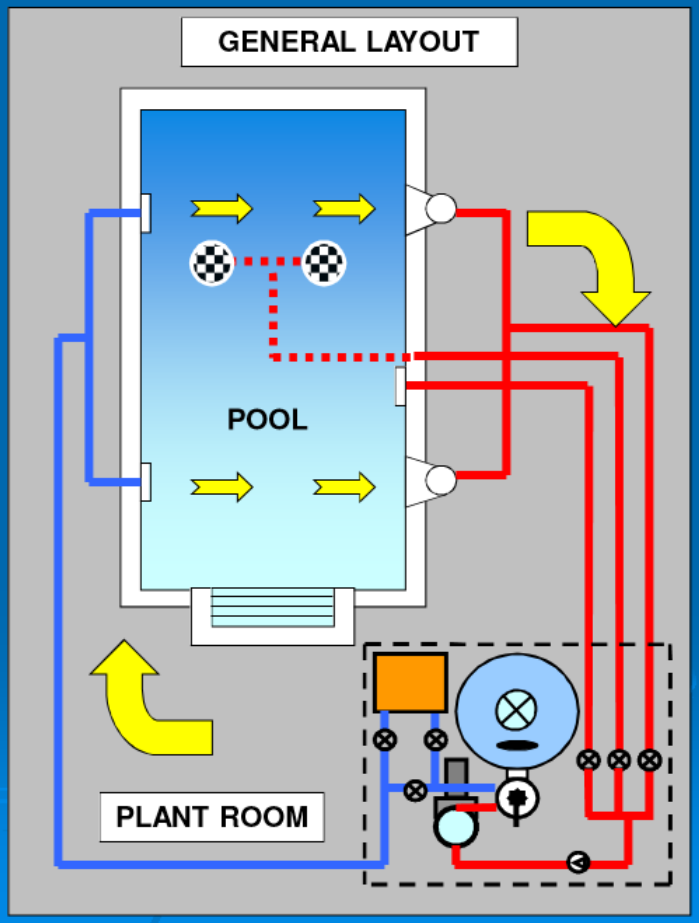
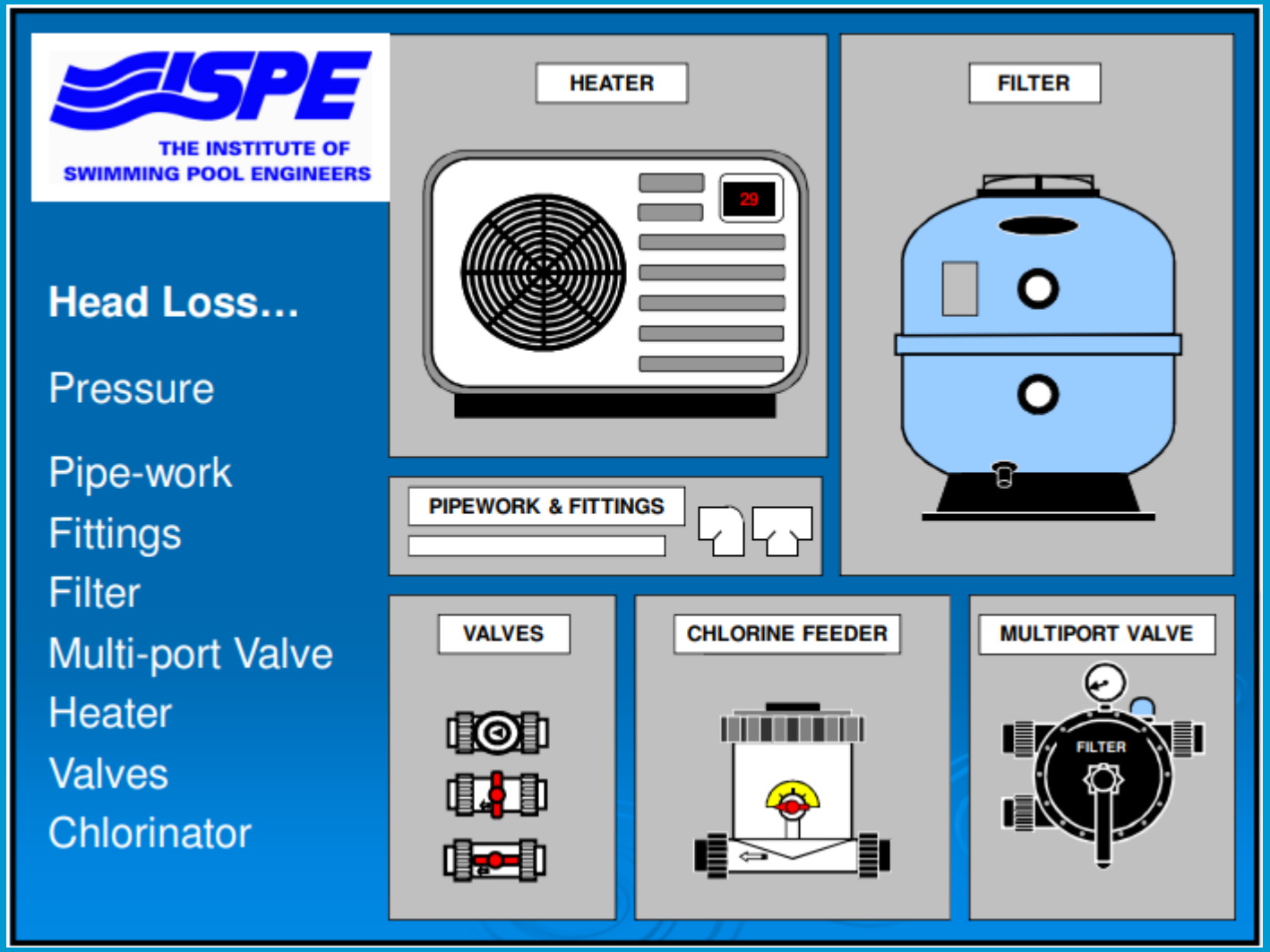
Circulation…

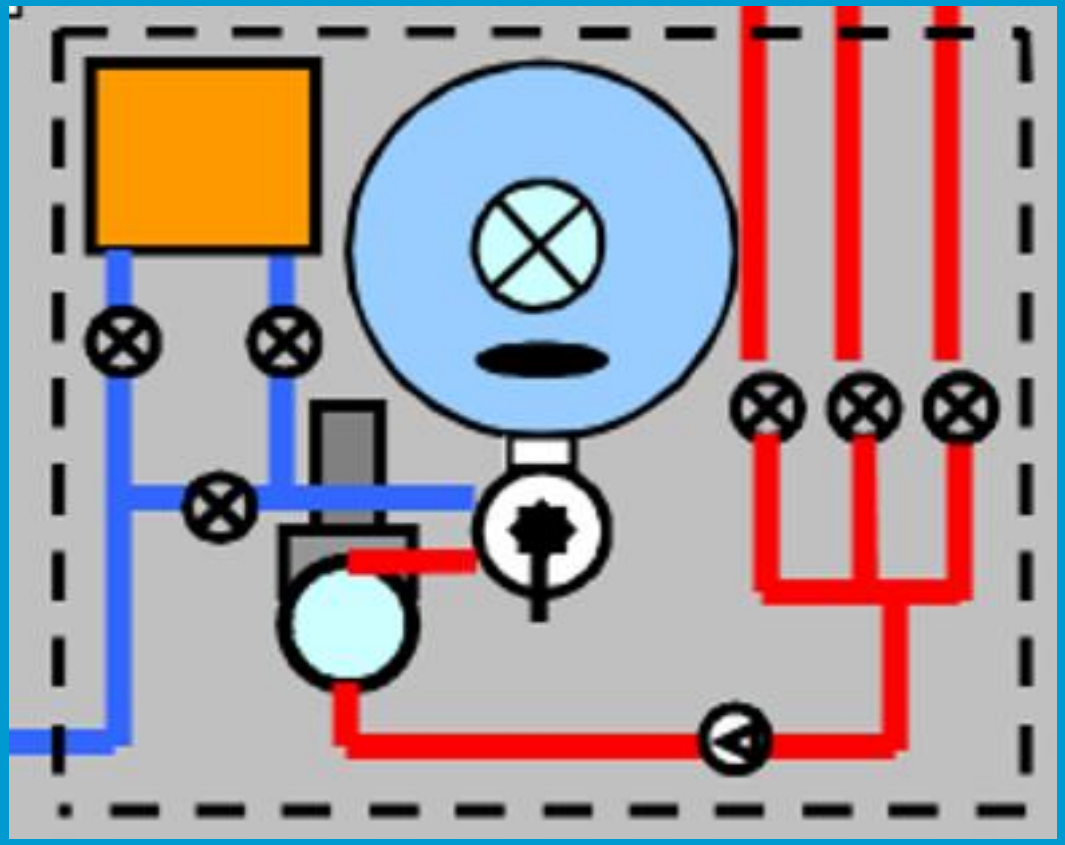
From Skimmers & Drains
Through Suction pipes
Through Pump
Multi-port Valve
Through Sand Filter
Through Heater unit
Chlorine dosing
Return Pipes & Inlets



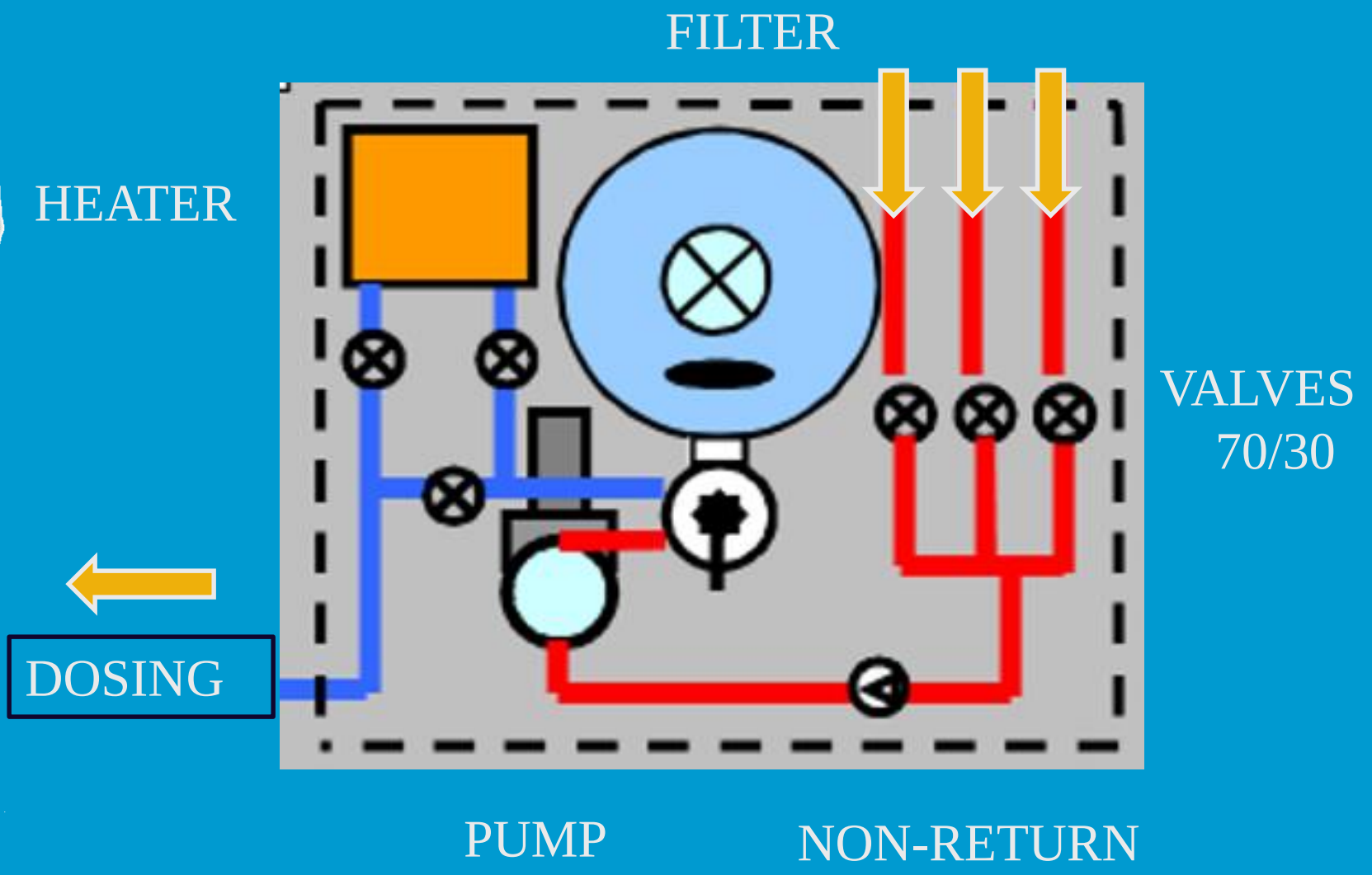
Water Flow & Filtration



Water Flow & Filtration



Water Flow & Filtration

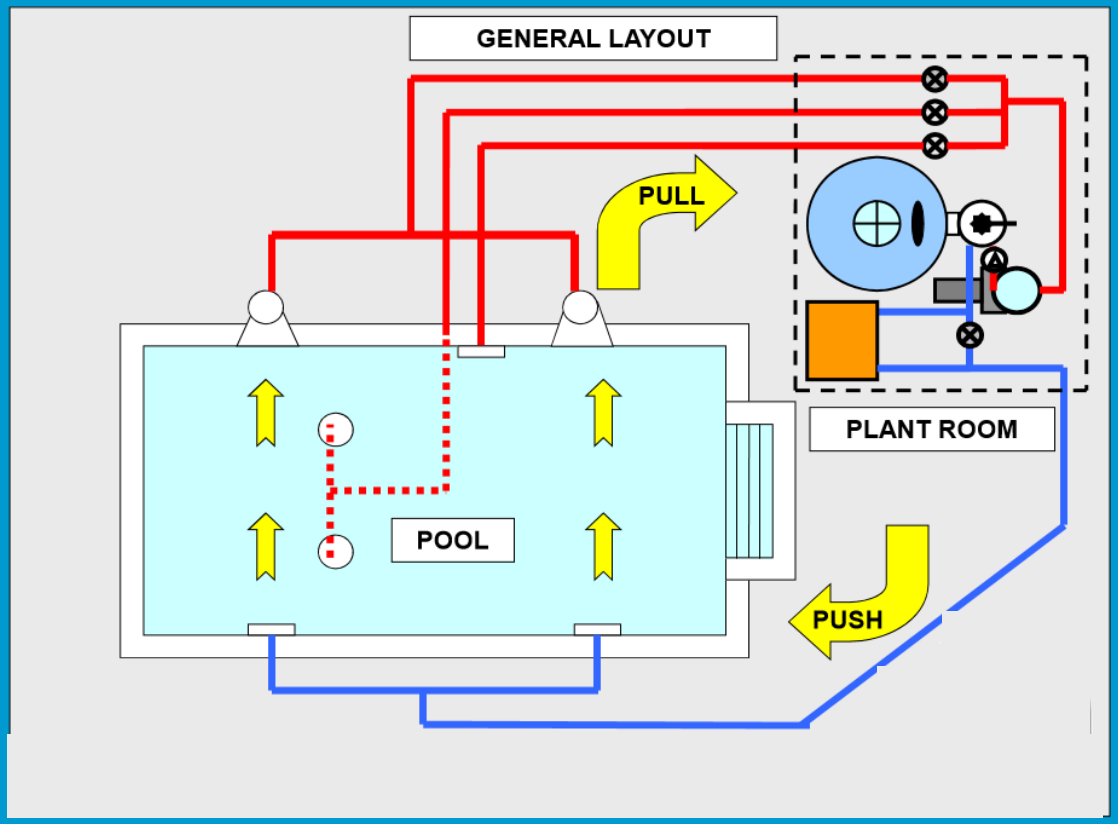


Pump Manifold

- For the benefit of the pump, and to keep flow noise and vibration to a minimum, it is beneficial to have about 0.5m of pipe in a straight run into the front of the pump, from the nearest fitting i.e. 90^0 elbow.

- The manifold should be constructed in 2”Ø pipe and fittings if possible, and only reduced at the last moment if the pump only has a 1.5”Ø suction.

Water Flow & Filtration



The is not random and has to be calculated

Water Flow & Filtration

$$e^{i\pi} + 1 = 0$$

The is not random and has to be calculated

Sizing of Filtration System.

- Start with size of pool
- Calculate bathing load (Surface area)
- Calculate the Filtration Rate required
- Check Turnover (Volume)
- Choose filter to allow filtration rate
- Choose pump to give flow rate
  - Pipe runs
  - Head Total = Lift & Filter Resistance etc.

Filtration Rates

FILTRATION DESIGN

FLOW RATE FORMULA

The standard maximum flow rate and water turnover rates shall be

	Flow Rate	Water Turnover
Commercial	$25m^3/m^2/hr$ ($500g/ft^2/hr$)	3 hours
Private	$50m^3/m^2/hr$ ($1000g/ft^2/hr$)	8 hours

Taking this as basic premise, the following table (when used in conjunction with other design criteria) should prove helpful in the sizing of a filter plant.

TYPE OF POOL	Turnover period in hours
Leisure water bubble pools	0.1 – 0.33
Spas	0.1 – 0.25
Teaching Pools	0.5 – 1
Waterslide splash pools	0.5 – 1
Hydrotherapy Pools	0.5 – 1
Leisure waters up to 0.5m deep	0.2 – 0.6
Leisure waters up to 0.5 – 1m deep	0.6 – 1.2
Leisure waters 1 – 1.5m deep	1 – 1.8
Leisure waters over 1.5m deep	1.8 – 2.5
Conventional public pools up to 25m long with a 1m shallow end	2.5 – 3
Competition pools 50m long	3 – 4.5
Diving pools	4 - 8
Domestic pools	4 - 8

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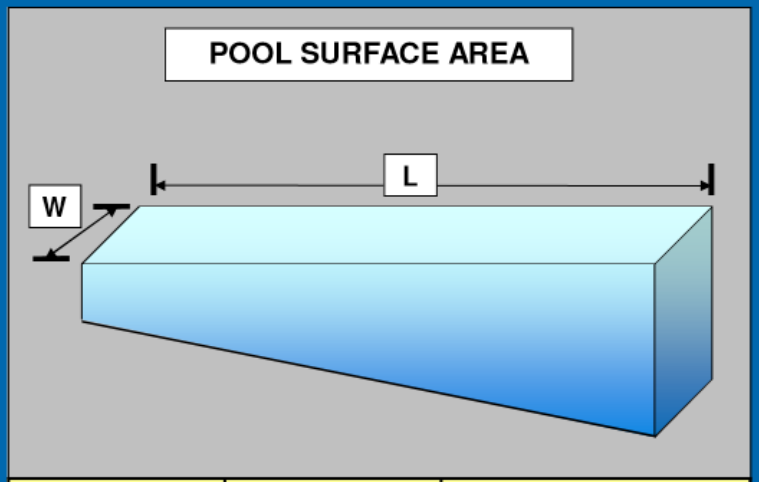
Check Dimensions And Limitations
The Surface Area Will limit Bathers
Discuss Limitations with your Client & ensure Requirements are Met.

Example Pool:
9 x 4.5 = 40.5m²



LENGTH m	WIDTH m	SURFACE AREA m^2
6.0	3.5	21.0
7.0	3.5	24.5
8.0	4.0	32.0
9.0	4.5	40.5
10	5.0	50.0
12	6.0	72
15	7.5	112.5

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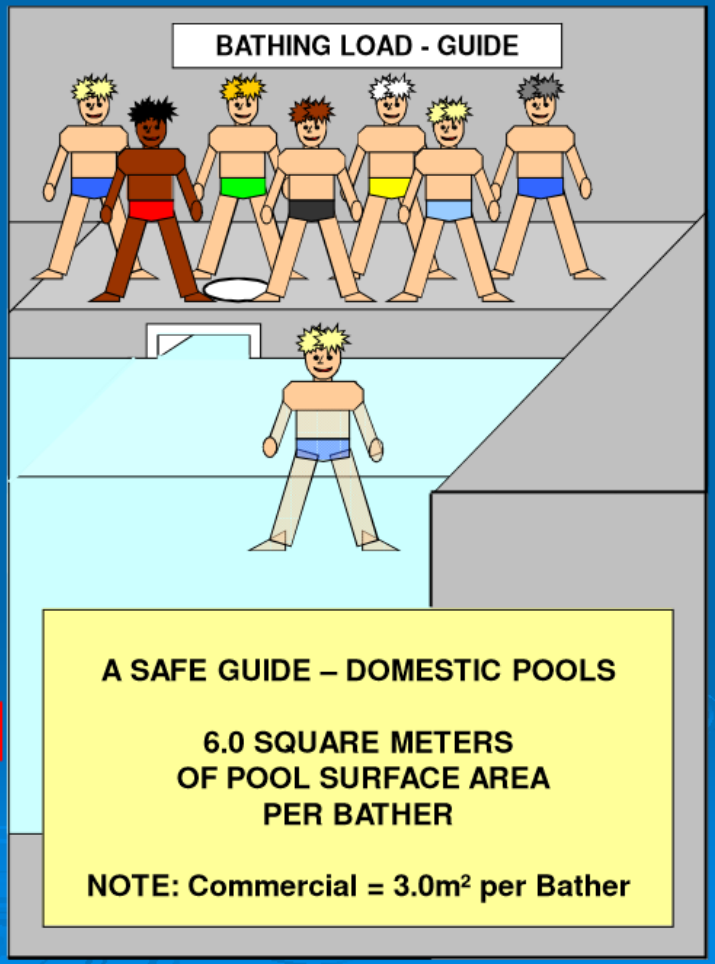
Domestic Pools are…
A Confined Space

Size	m^2	Bathers
6 x 3.5 =	21 div 6 =	3.5
7 x 3.5 =	24 div 6 =	4.0
8 x 4.0 =	32 div 6 =	5.3
9 x 4.5 =	**40 div 6 =**	**6.6**
10 x 5.0 =	50 div 6 =	9.0
12 x 6.0 =	72 div 6 =	12.0
15 x 7.5 =	112 div 6 =	18.6



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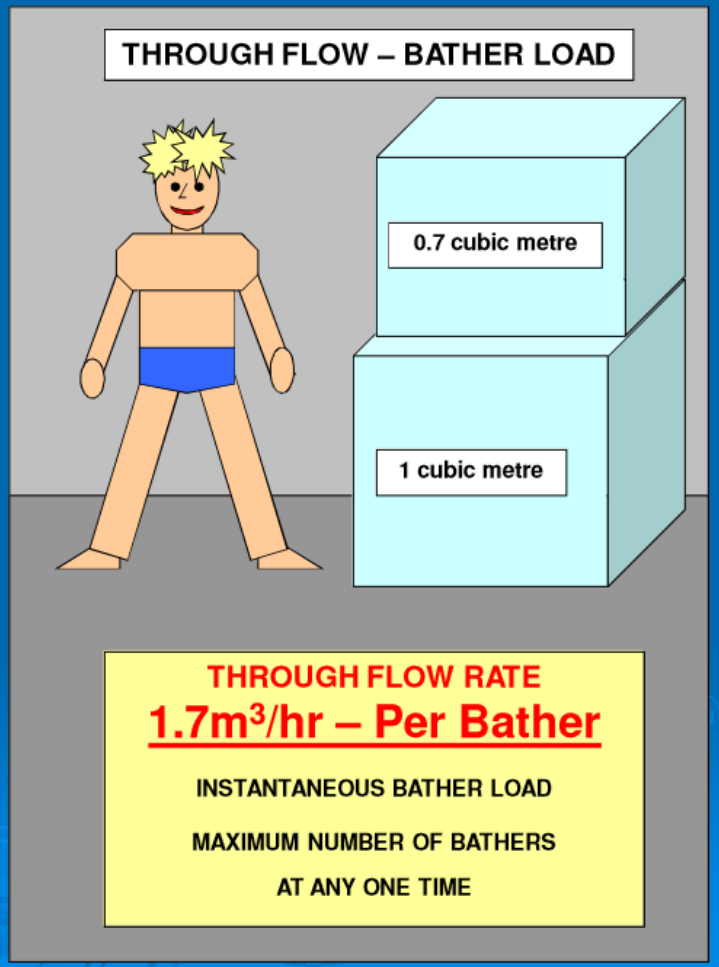
Bather Load

3 Bathers = 5.1m³/hr
4 Bathers = 6.8m³/hr
5 Bathers = 8.5m³/hr
6.6Bathers = 11.2m³/hr
8 Bathers = 13.6m³/hr
9 Bathers = 15.3m³/hr
12 Bathers = 20.4m³/hr
15 Bathers = 25.5m³/hr
18 Bathers = 30.6m³/hr



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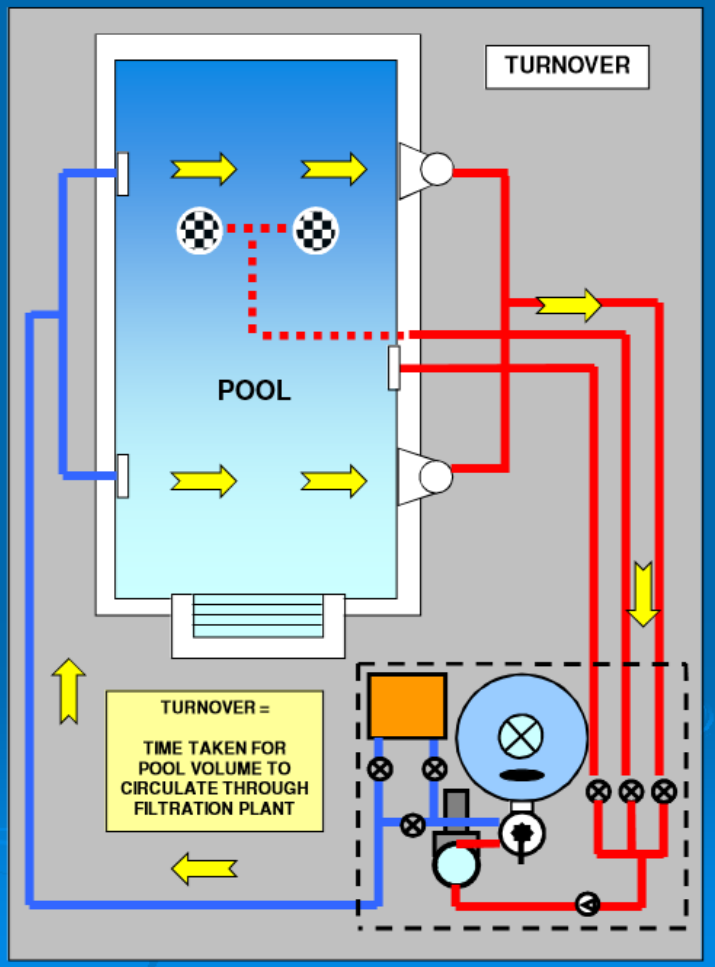
Turnover is:
The time it takes for -
The Entire Pool Volume
To Circulate Through
The Filtration Plant – Once

Domestic Pools - SPATA
4 – 8hrs
5 – 6 hours is ideal

Commercial Pool Standard
PWTAG - 2 ½ - 3hrs



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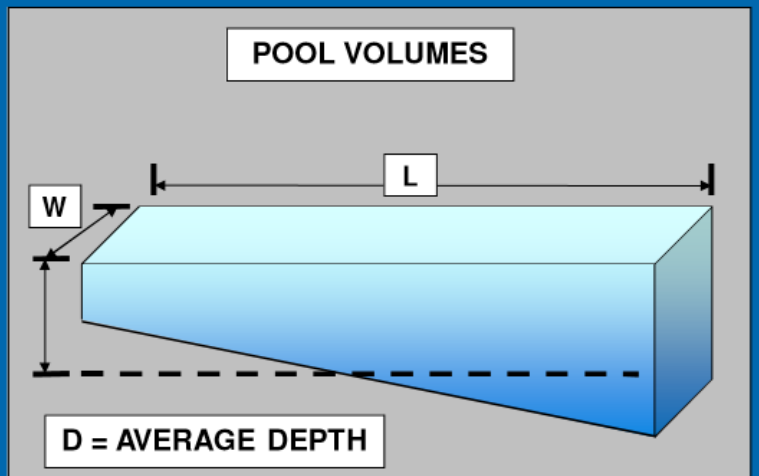
First…

Calculate Volume
Length x Width x
Average Water Depth

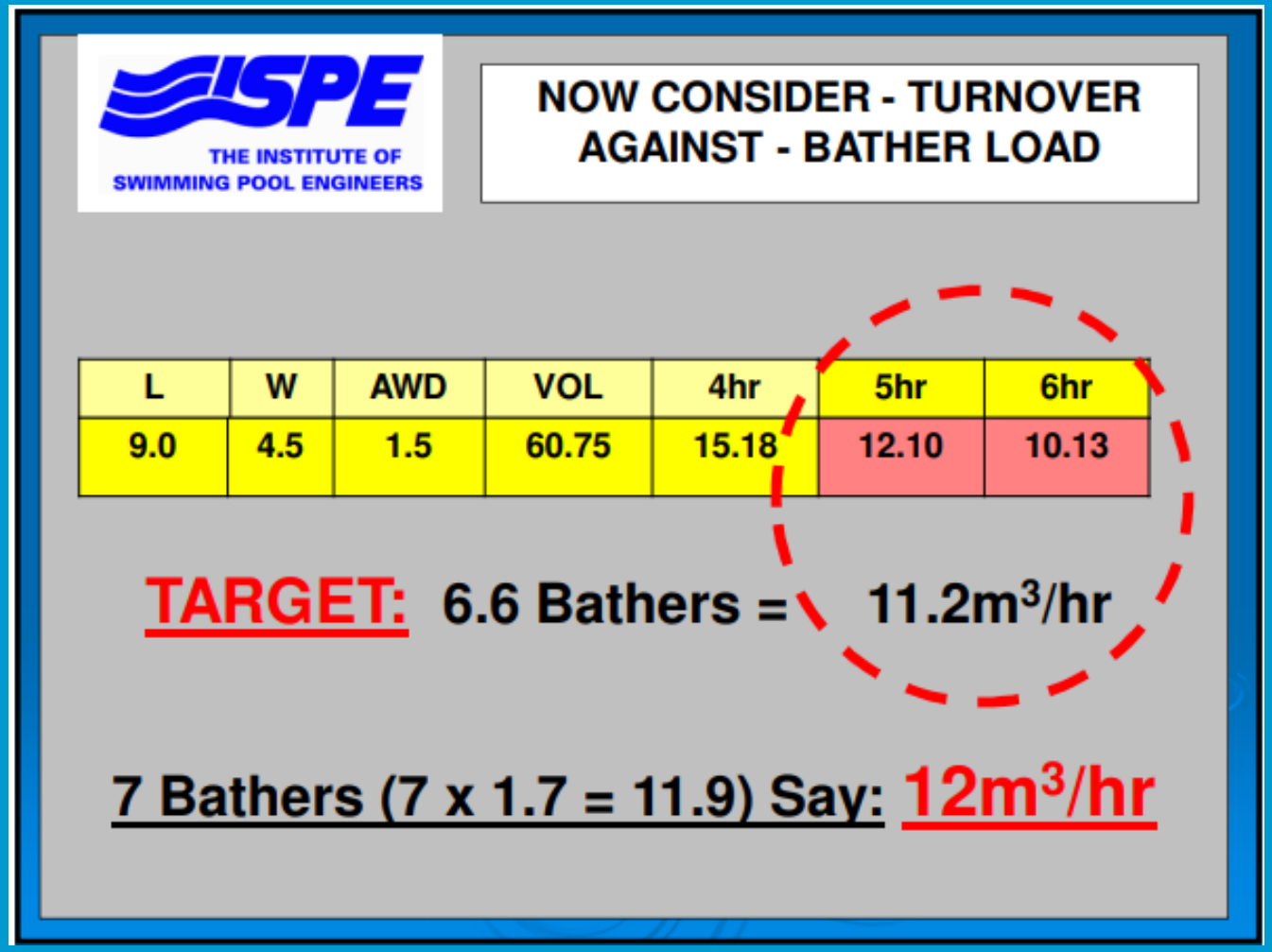
Our Example Pool is:
9 x 4.5 x 1.5 = 60.75m³

Ideal Turnover time
5 – 6 hours =
10.13 – 12.10m³/hr



L	W	D	VOL	4hr	5hr	6hr	7hr	8hr
6.0	3.5	1.5	31.5	7.80	6.30	5.25	4.50	3.90
7.0	3.5	1.5	36.75	9.18	7.35	6.125	5.25	4.59
8.0	4.0	1.5	48.00	12.00	9.60	8.00	6.80	6.00
9.0	4.5	1.5	60.75	15.18	12.10	10.13	8.67	7.59
10	5.0	1.5	75.00	18.75	15.00	12.50	10.71	9.30
12	6.0	1.5	108.00	27.00	21.60	18.00	15.42	13.50
15	7.5	1.5	168.75	42.18	33.60	28.12	24.10	21.09

Water Flow & Filtration



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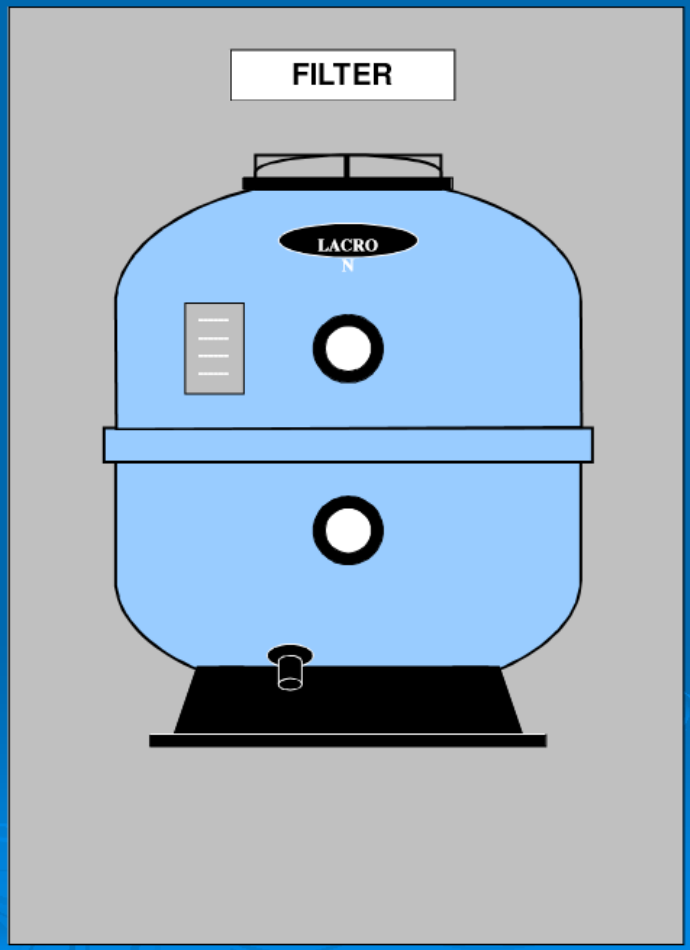
Selecting The Filter…

First consider Velocity

Low rate – Drinking Water
0 – 10 $m^3/m^2/hr$

Medium Rate - Commercial
11 – 25 $m^3/m^2/hr$

Hi Rate - Domestic
25 – 50$m^3/m^2/hr$



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Velocity is…

The speed of the water
Flowing through the Media

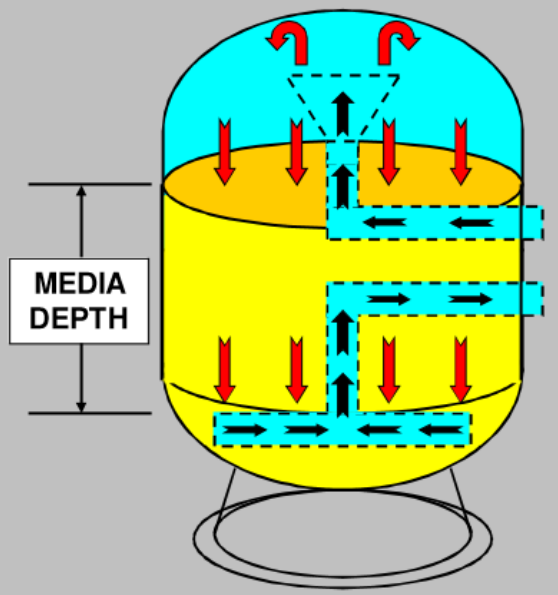
Cubic Metres – m^3
Per Square Metre – m^2
Per Hour – hr

Ideal Domestic Velocity
$40m^3/m^2/hr$

FILTER VELOCITY

RESIDENTIAL FILTRATION VELOCITY

30 – 50 m3/m2/hr



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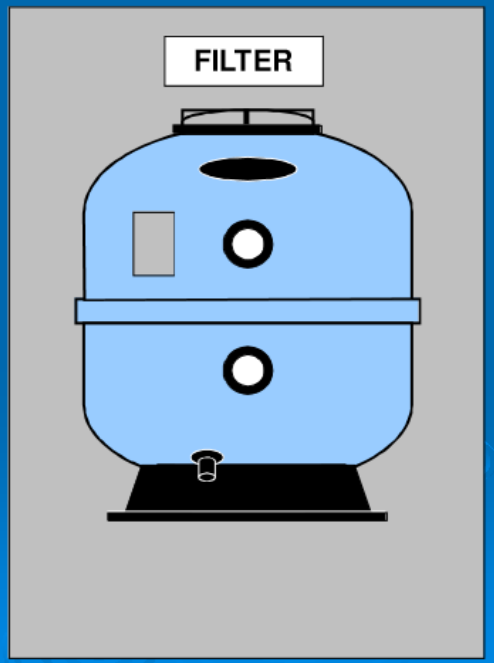
FILTER SELECTION GUIDE

Filter Size Diameter	Area m^2	Output @40m^3	@50m^3
16" – 400	0.12	5.0m^3	6.0m^3
18" – 450	0.16	6.3m^3	8.0m^3
20" – 500	0.20	8.0m^3	10.0m^3
24" – 610	0.30	**12.0m^3**	15.0m^3
30" – 762	0.45	18.0m^3	22.5m^3
36" – 915	0.66	26.4m^3	33.0m^3
42" – 1100	0.97	39.0m^3	48.5m^3



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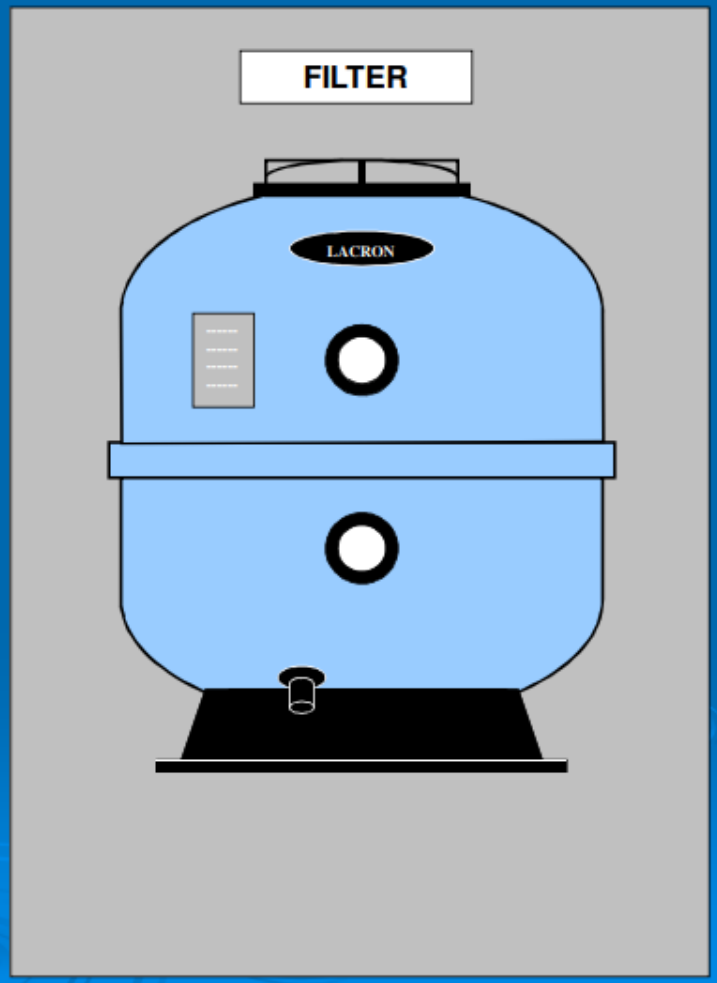
Check Filter Size…

Take the required output of 12m3/hr and divide it by the Velocity of 40$m^3/m^2/hr$
This will give a filter surface area of 0.3m^2
This equates to a Filter size

24” 610mm Diameter



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TURNOVER - BATHER LOAD V FILTER SIZE

L	W	AWD	VOL	4hr	5hr	6hr
9.0	4.5	1.5	60.75	15.18	12.10	10.13

TARGET: 6.6 Bathers = 11.2m^3/hr

Filter Surface: 0.3m^2 x 40$m^3/m^2/hr$ = 12m^3/hr

7 Bathers x 1.7m^3 = 11.9m^3 (12m^3)

Selected Filter = 24" – 610mm Diameter

Water Flow & Filtration

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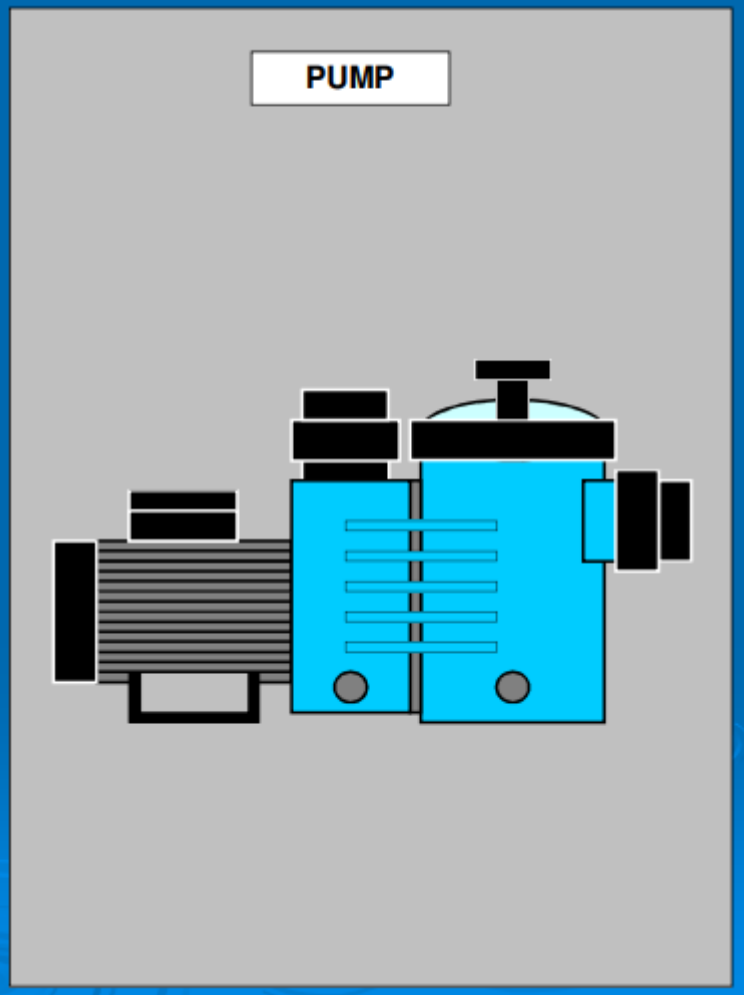
Selecting The Pump…

The pump…
generates flow & will develop pressure due to restrictions on the system known as:
'System Head Loss'

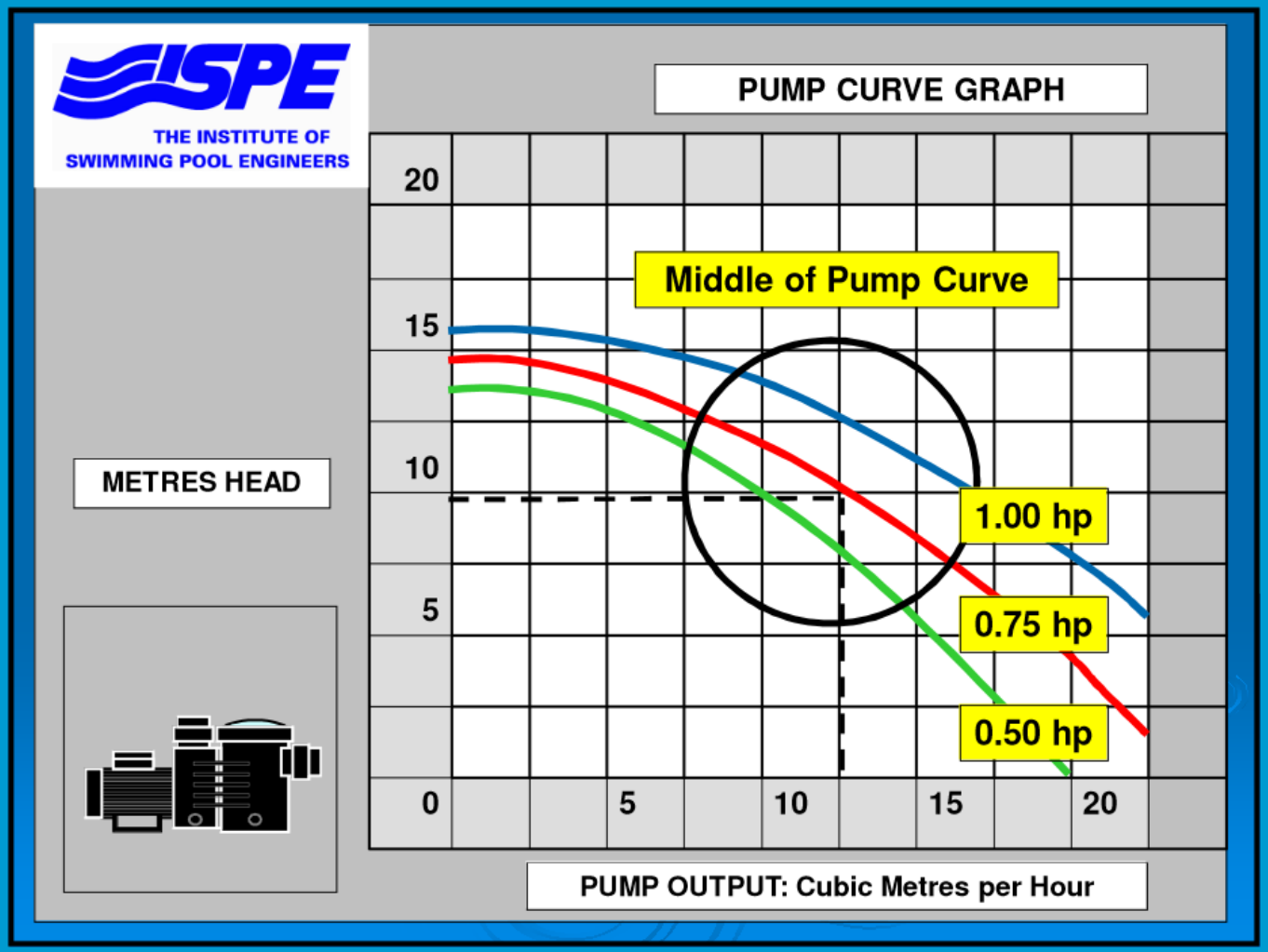
'Head Loss' - Pressure



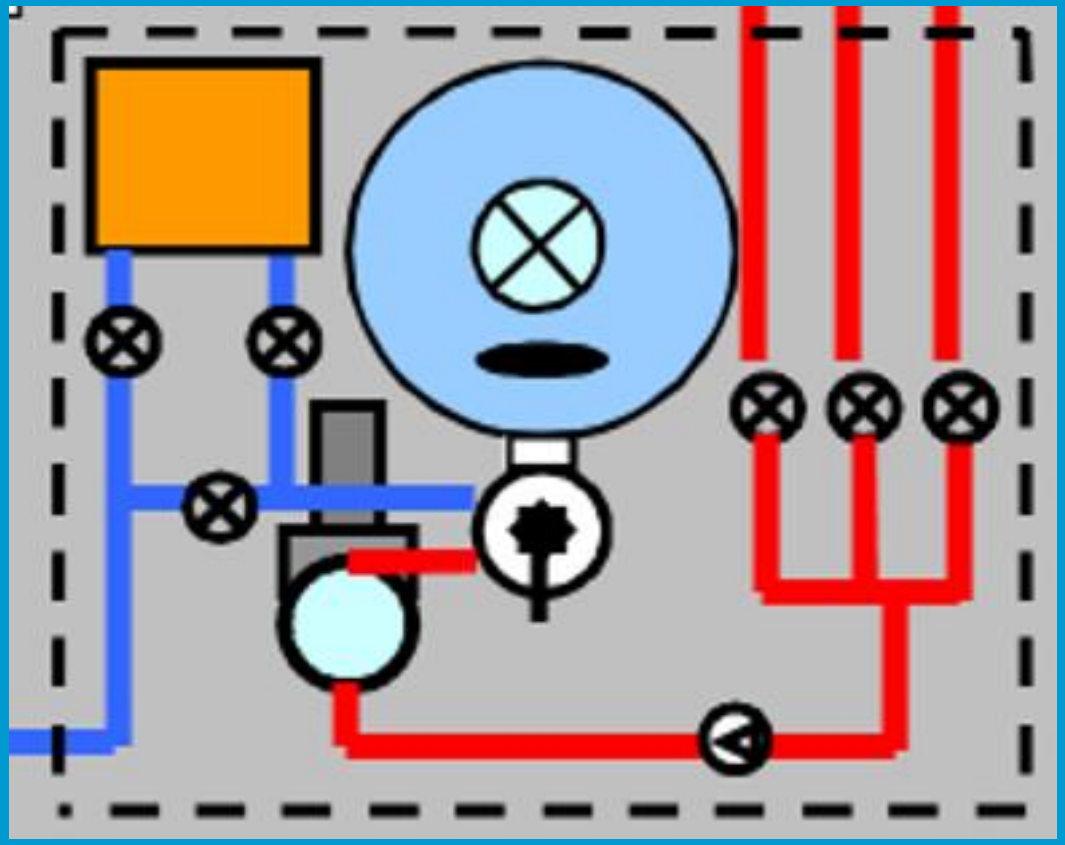
Pipe & Fittings – How to size them.

PIPE SIZE	SUCTION PIPE	PRESSURE PIPE
1.5” Ø	6.0 m^3 per hour	10.0 m^3 per hour
2” Ø	9.5 m^3 per hour	15.8 m^3 per hour
Max Flow	1.2m per sec	2.0m per sec

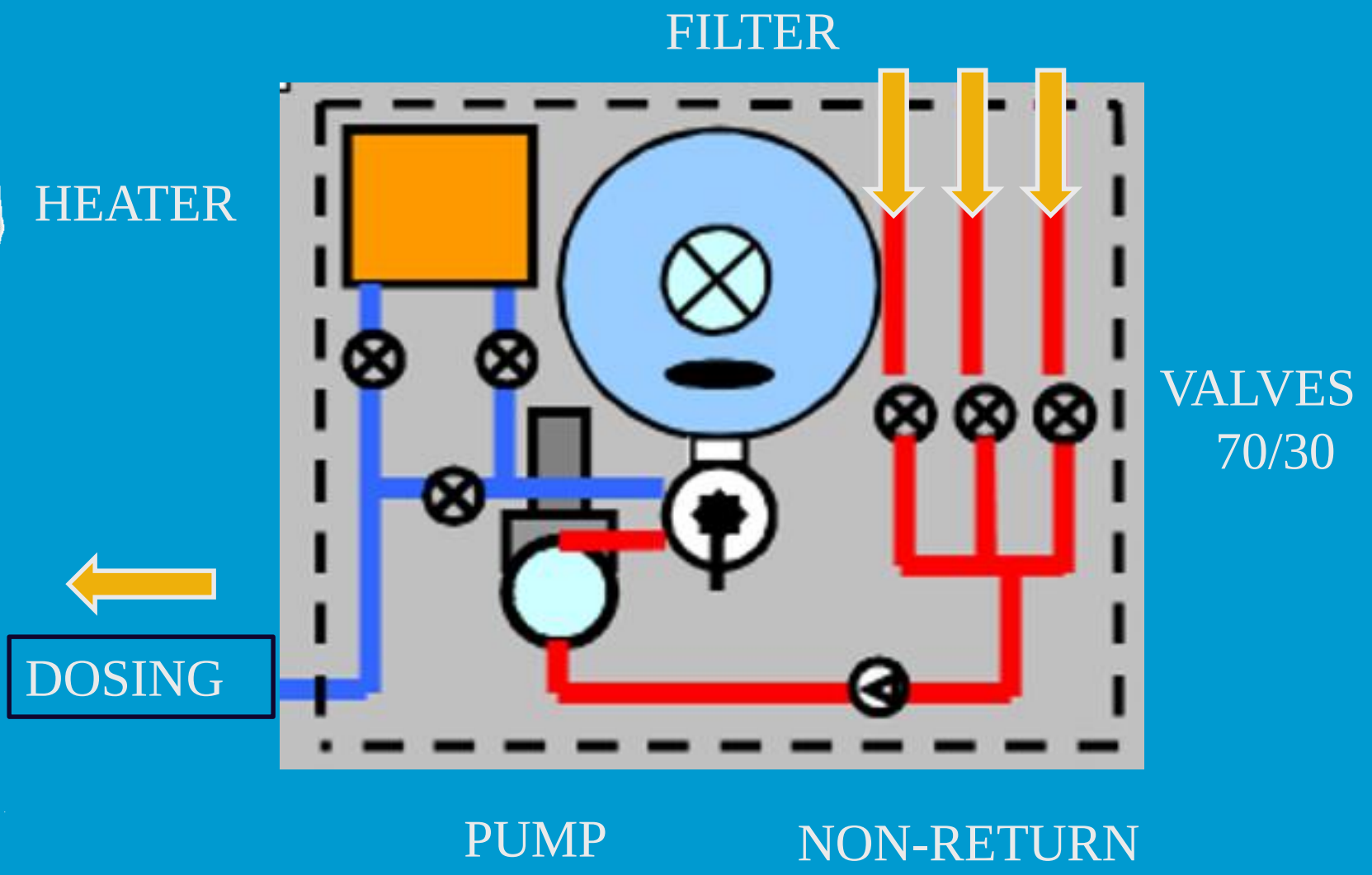
Water Flow & Filtration



Flow & Filtration – SORTED



Filtration Components



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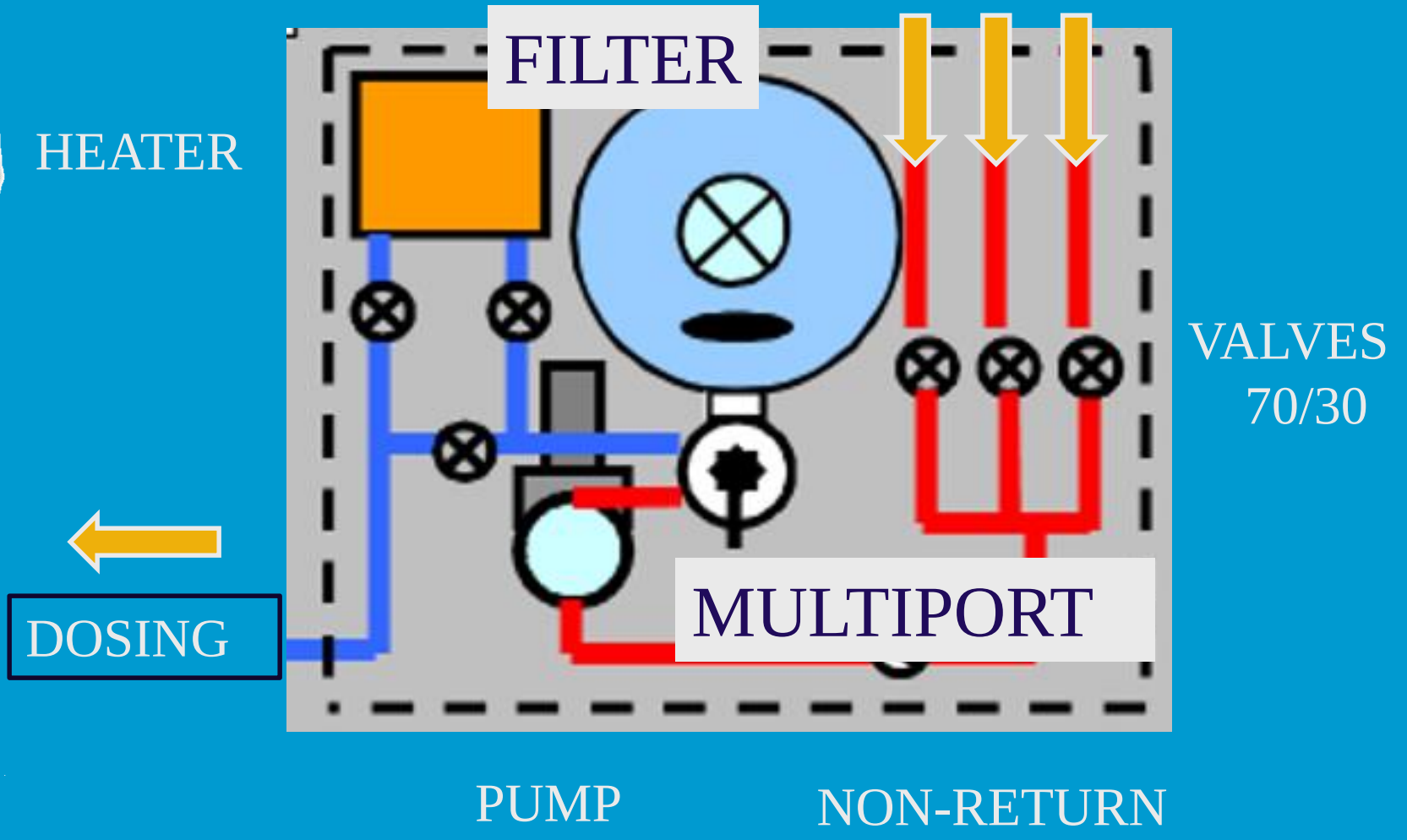


Multiport Valve

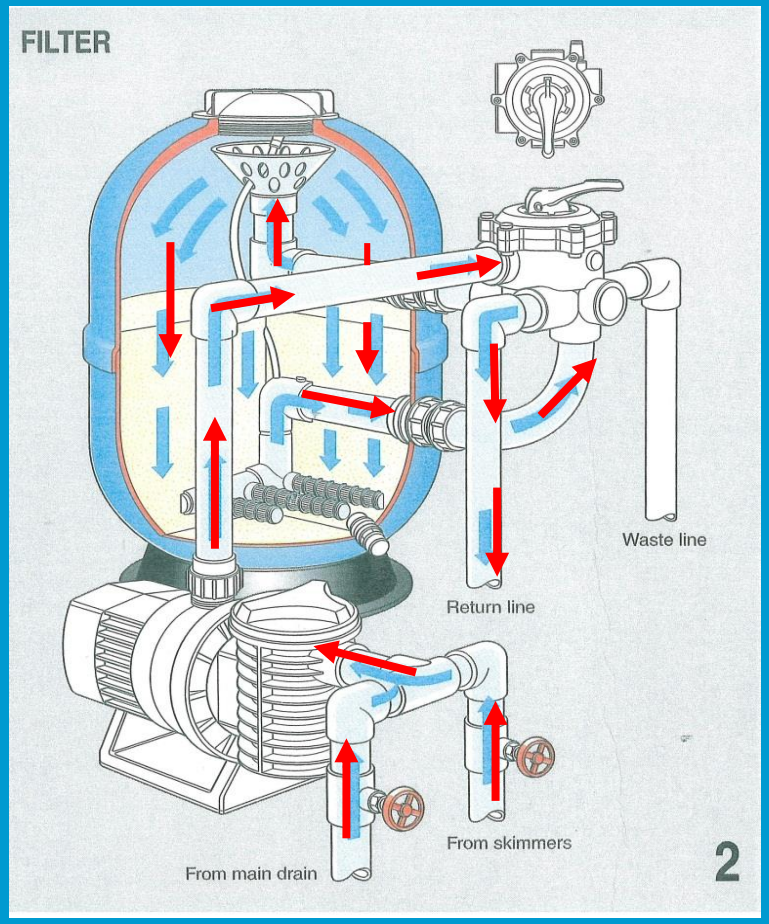
- This controls the flow of water around the filter tank, and its simplicity of use may explain the popularity of sand filters.
- The handle may only be moved when the pump is switched off.
- The state of the spider gasket within the MPV is paramount to its operation, and any leaks down the backwash line indicate that it needs immediate replacement. This problem cannot be solved by a valve installed on the backwash line.
- Contact adhesive should be used not superglue which is soluble in water.

Types of Filters

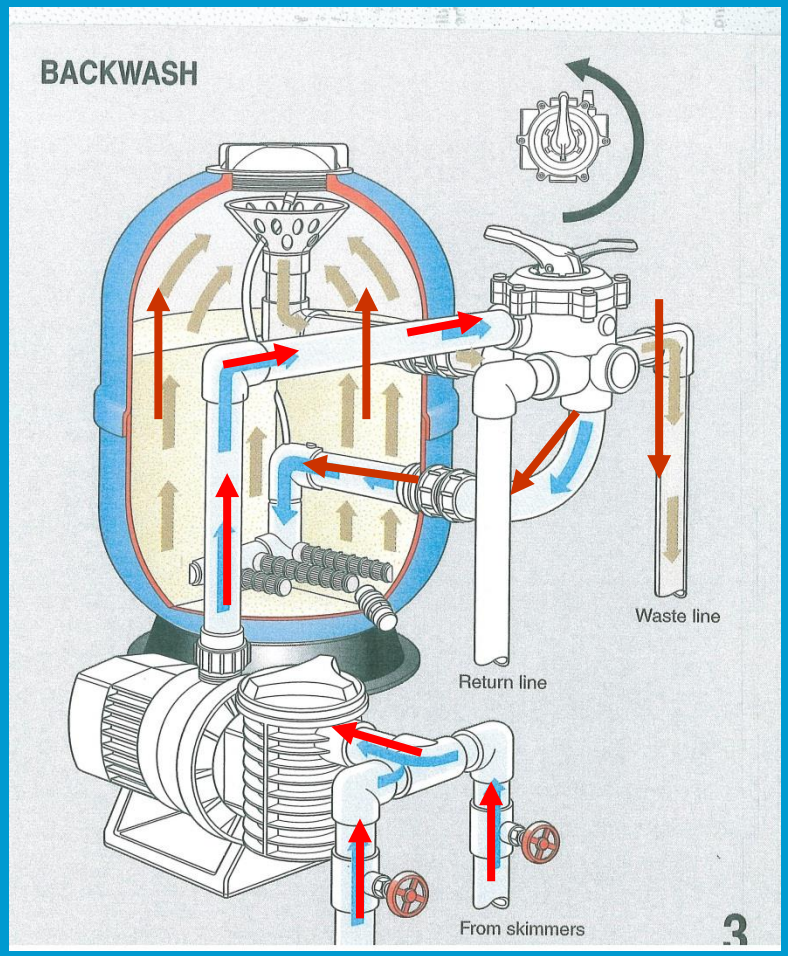
- Sand Filters, slow, medium and high rate.
  - Slow & medium rate used on commercial pools, will filter particles down to 5-10 micron (0.005 – 0.10mm).
  - High rate sand is the most common type used on domestic pools, and will filter down to 10 microns.
- Cartridge Filters
  - Used mainly on spas and above ground pools. Less expensive but more difficult to clean. Filters down to 5-25 microns.
- Diatomaceous Earth (DE) Filters.
  - Very efficient, filters down to 1-5 micron particle size, but takes more work than sand filters.

Cartridge & D.E.

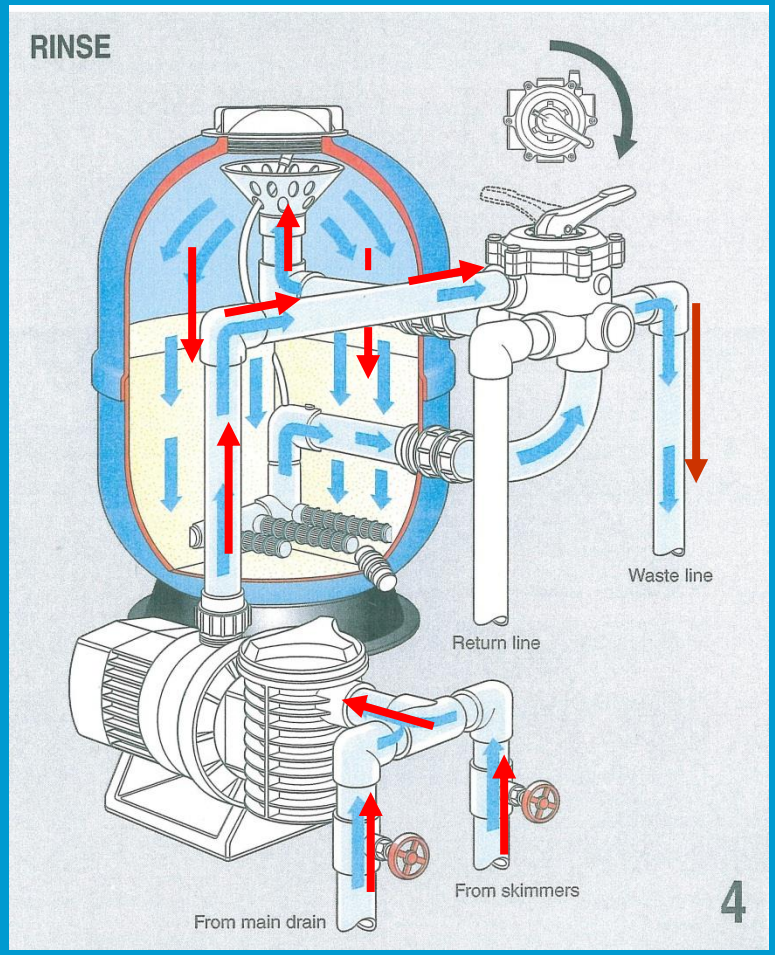
Sand Filtration Flow



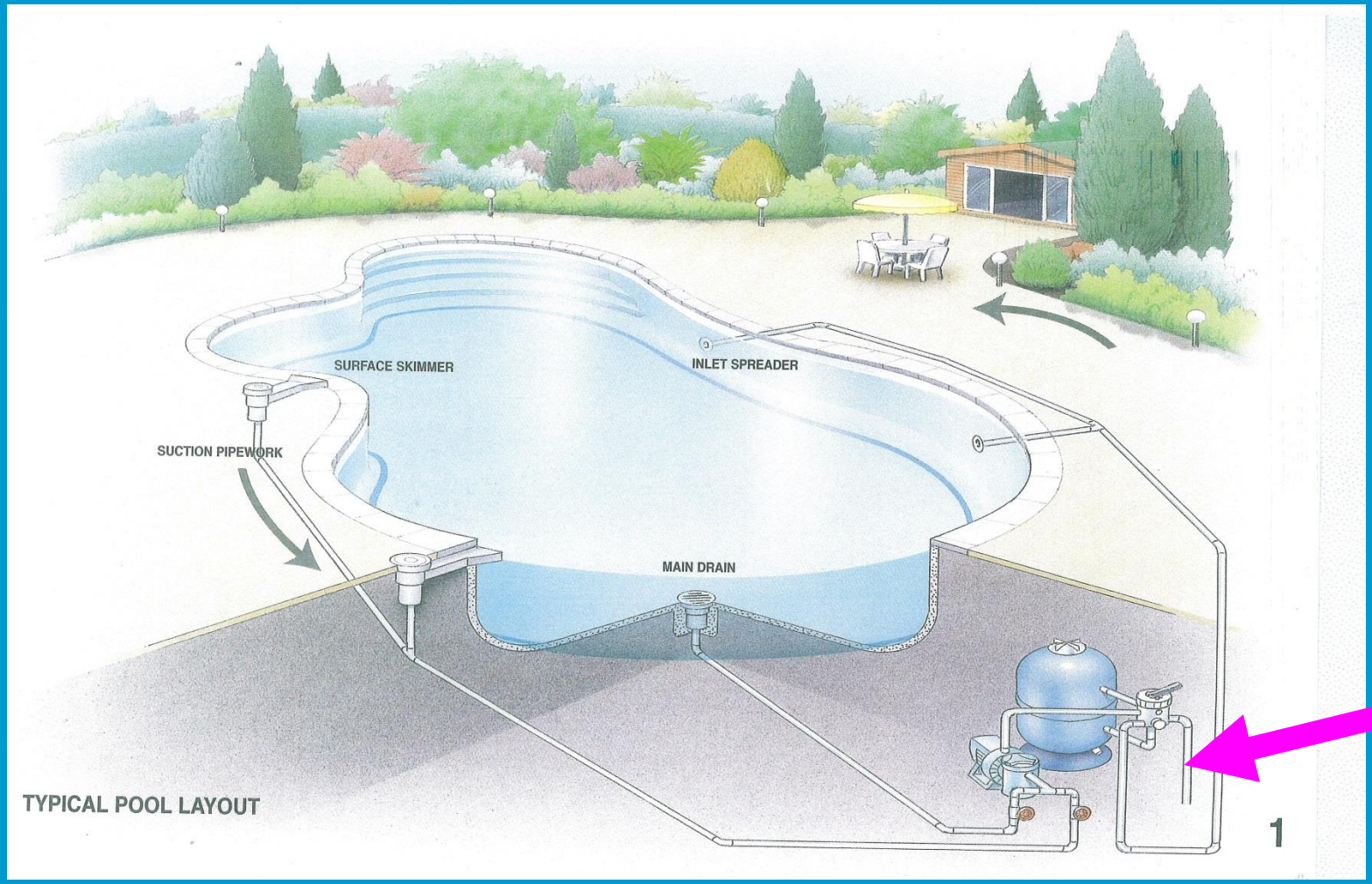
Sand Filtration Flow



Sand Filtration Flow



Filtration, Return Flow



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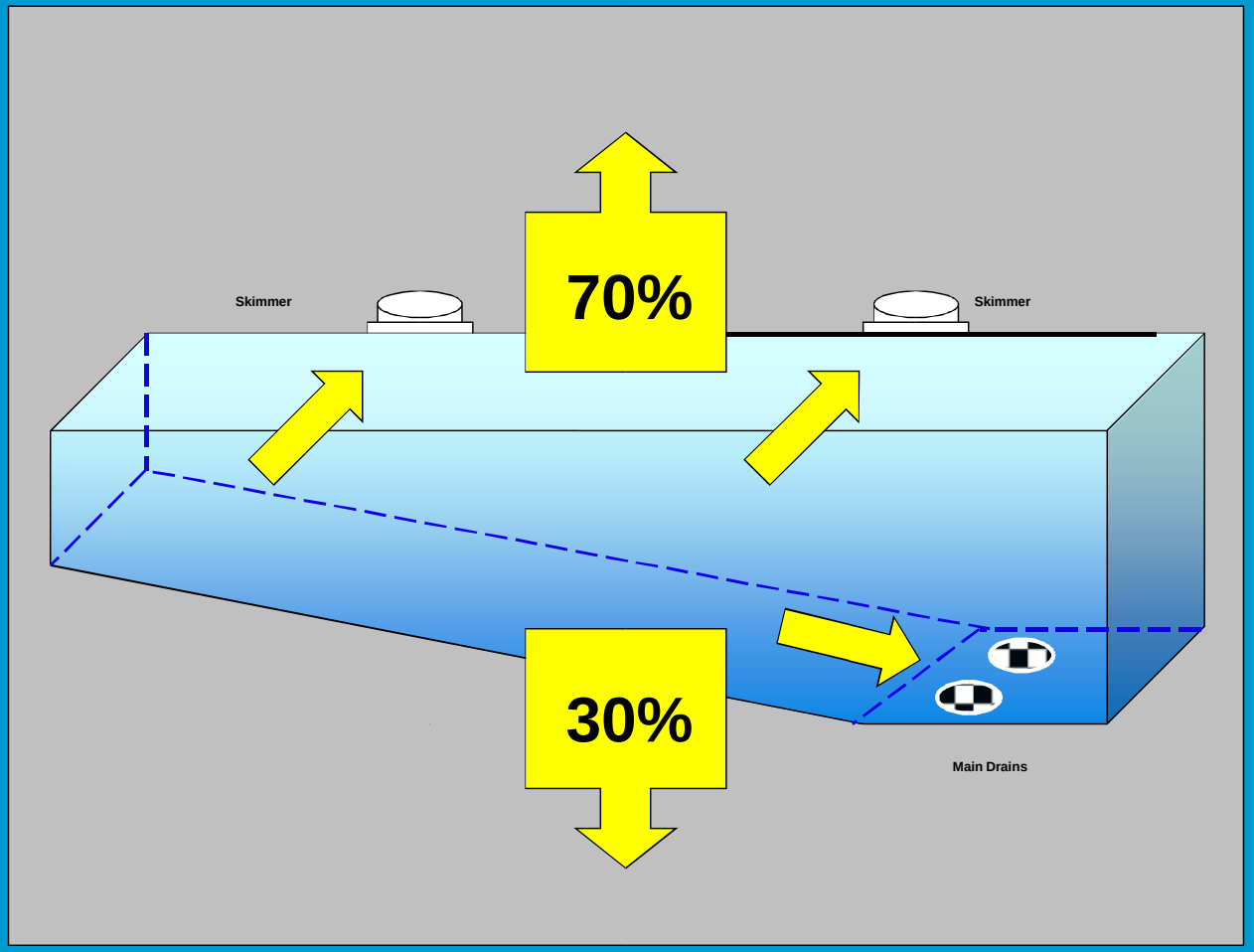


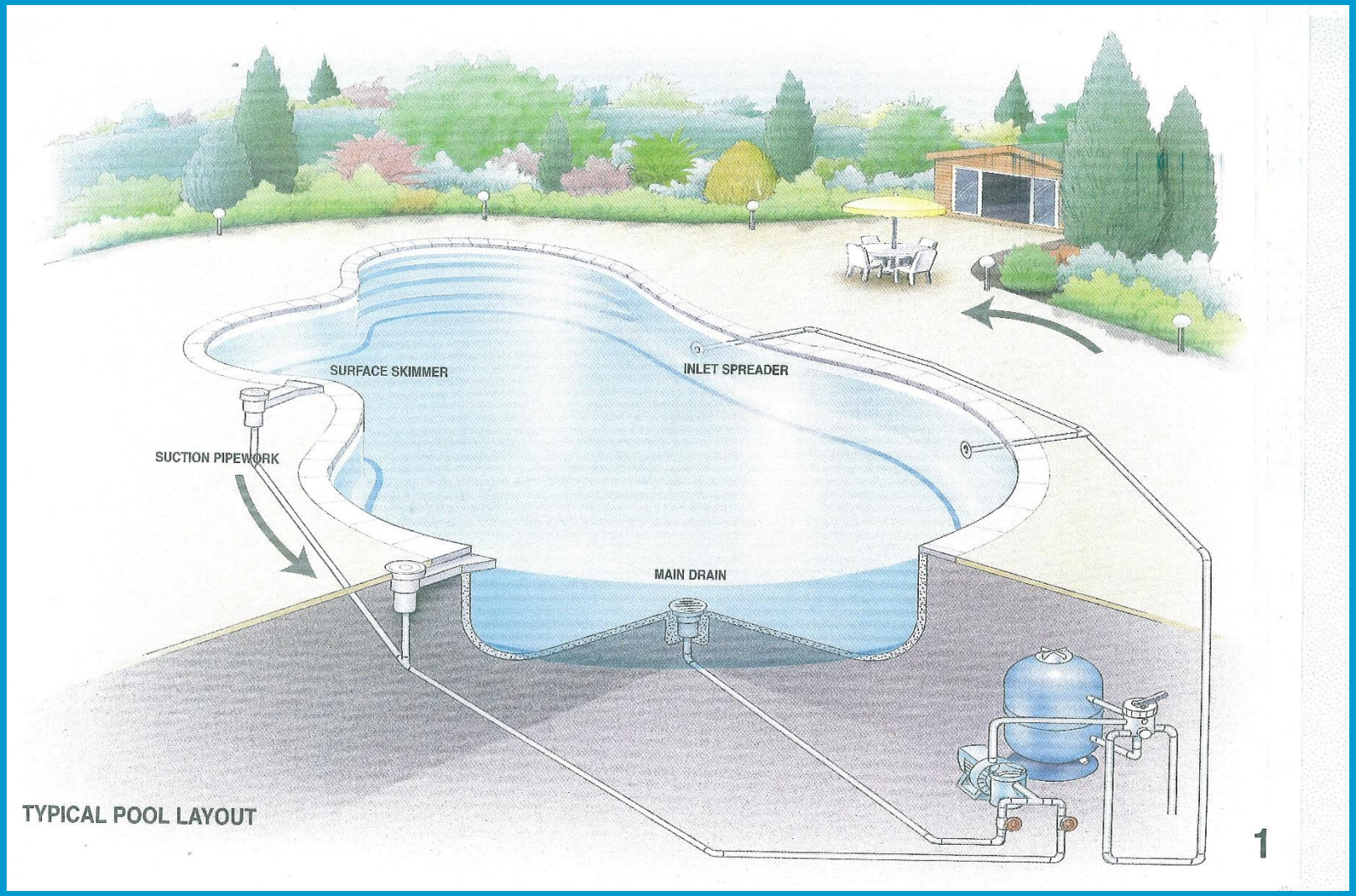
Water Flow Fittings

- Where to place them ?

Many alternatives available

- Flow from one end to another.

The Swimming Pool



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