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WATER WELL DEVELOPMENT& METHODOLOGY

Purpose

- To remove the fine material in the aquifer or gravel puck and any drilling fluids in near bore area.(Water that remains solid-free;)
- to explore the real and natural yield of water bearing aquifer trough Successful completion of the well development.
- Better mach the installation of pumping plant to the well.


I-DS 175S

Well design

- Objectives:
- To obtain the design yield with minimum drawdown consistent with aquifer capabilityand economic optimization of the well;
- Good quality water with proper protection from contamination;
- Water that remains solid-free;
- A well with a long life (more than 25 years);
- Reasonable capital and operational costs.

The main points in designing a well

- Choice of well location;
- Selection of appropriate drilling method;
- Selection of appropriate construction materials, including pump specification;
- Proper dimensional factors of borehole and well structure;
- Geological and geophysical logging, water quality sampling and test-pumping can becarried out in a satisfactory way;
- The well pumping rate should satisfy the demand for water;
- geological formations;
- Well design should be such that pollutants from land surface or other sources can not enter the well;
- Materials used in the well should be resistant to corrosion and possess sufficient
- strength to prevent collapse
- Well design should be based on low installation and running costs while not affecting well performance.

Well testing

Well testing is: measurement performance of the well; at variable flow rates, through pump step tests at predetermined constant rates. The data of pumping test helps to select pumping equipment with proper power and capable of the highest energy efficiencies.

The long constant rate test evaluates the effects of long term pumping on an aquifer, is the basis of determination that the pumping equipment proposed to be installed in the well will remain efficient during sustained pumping.

Well Development

Well development occurs as the last phase of well construction.

For initial development using the drilling rig and final development by pumping after the rig has been removed and fallows following steps

Preliminary Well Development

Preliminary well development occurs as the last phase of well construction site. The intention of these procedures are to remove the heaviest weight drilling fluid from the well and move at least a small amount of water from the intervals of water bearing formation. The effectiveness of the preliminary well development phase is greatly enhanced by following a drilling fluids control procedure that monitor the solids content and conditions the drilling fluid prior to the removal of the drill pipe which precede the installation of the casing and gravel pack material

I-Washing well by clean **water**

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for proper fixing the column of pipes in the well it s require to wash the well by clean water to reduce the concentration mud in drilling solution to required norm which used for stability of well walls from collapse.

If the well drilled in very fine formation its not necessary to reduce the concentration to much.

Preliminary washing of well starts by placing the drilling rods with a proper bit in the bottom of well and clean water pumps by drilling rig made pump in to the well .

During pumping water the concentration of mud monitors continually.

11-Back washing of Well

Back washing: when the column of pipes and screen installed inside the well, for back washing of well flowing steps will be considered.

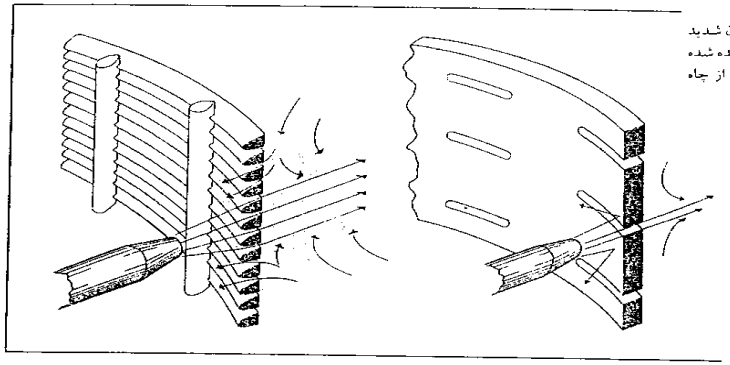
- The drilling rods with the drilling bit fix in the upper interval of screens .
- The mouth of casing closes by clothes and weight of rods.
- Clean water circulation starts inside the well by drilling rig mud pump and drilling solutions cross the screens washes the mud round of casing and filters came out to surface.
- The concentration of mud monitors
- If the drilled formations are very fine, first occur gravel puck then stars circulation of clean water.
- if the formations are stable the gravel puck procedure starts after awhile rather the solution became cleaner.
- The washing process continues step by step trough the bottom of the well.

111-Cleaning of well by piston system

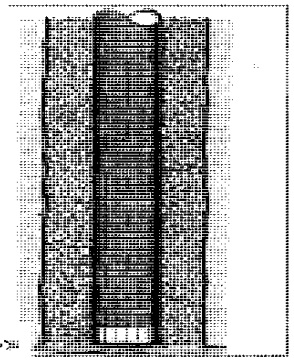
- piston fixes in drilling rod. The diameter of piston is near to internal diameter of casing column
- by changing the position of piston up and down the circulation of water occur inside and outside of casing.
- Change of hydraulic pressure cases to destroy the clay layer in well walls and ground waters fine the opportunity to inter in side the well .
- The efficiency of the method for cleaning of fine clay and silts is very low

1V-Jetting or injection method

- In this method the clean water injects trough a pipe 2-4 with 4 small holes 0.25-0-5 inches in diameter trough screens and wells walls by an high pressure water pump. The mud cake and fine sands in walls destroys and come into the well column and removes out of well. For better cleaning and development of well, it's better to turn and move the injector up and down along the screen. The injectors jets diameter selects according the power of water pump which uses for development and cleaning the well.
- The following table helps for

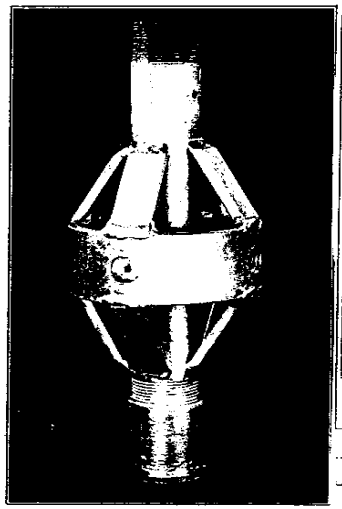


شکل پایین نشان می‌دهد که چگونه روش فوران شدید سبب می‌گردد که گل و لای سیلت، و شن پیچیده شده بین فرماسیون طبیعی و گراول پک مصنوعی از چاه استخراج گردد.

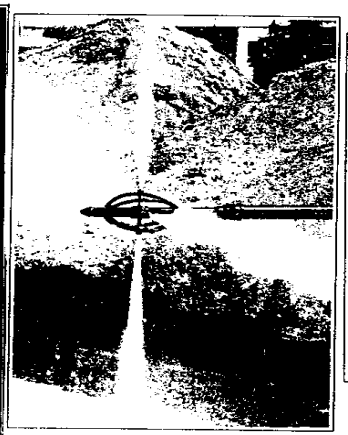


طرح خطوط جویان شدید آب در برخورد به اسکرین **مشبک V** شکل و یک لوله مشبک معمولی

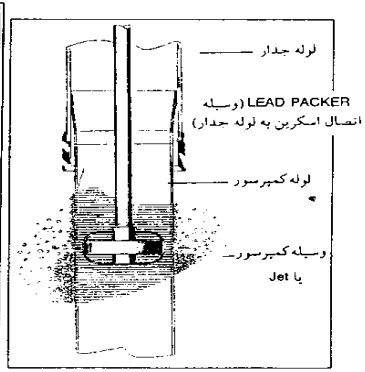
فوران شدید آب از شکافهای اسکرین جانسون (سمت چپ) گذشته و در شنهای موجود اطراف اسکرین تولید تلاطم می‌کند. اما در اسکرین سمت راست میزان کیفیت این روش تنها ۵ درصد کیفیت را دارد و ۹۵ درصد مواقع آب به دیوارهٔ اسکرین برخورد می‌کند.



وسیله آب‌پخش‌کن چهار منفذه



شکل بالا جریان آب را با سرعت شدید نشان می‌دهد. دستگاه مورد استفاده حاوی ۴ انژکتور است و محل آزمایش در سطح زمین می‌باشد.



توسعه چاه توسط آب‌پخش‌کن

توسعه چاه بوسیله فوران شدید آب

selection of injector in relation to water pump power

	Amount of 100 psi pressure		Amount of 200 psi pressure		Amount of 250psi pressure	
Diametr of jets in inch	V=feet/sec	Q=gallon /min	V= feet/sec	Q=gallon /min	V= feet/sec	Q=gallon/ min
1/4	110	17	150	26	180	29
3/8	110	38	150	56	180	61
1/2	110	67	150	100	180	110

selection of injector in relation to water pump power and head loss

Head loss Psi in each 100m of 2inch pie	Q =gallon /min
4	50
10	100
19	150
31	200

Example

Question: For development of a well with the depth of 200 feet with a devise by 2 injector 3/8 inch in diameter and connection pipe2 inches in diameter and flow velocity150ft/sec, required to determine the.

- Pump pressure in PSI=? (with out concentration pressure los, and with pressure loss.
- Required volume of water per hour

Answer: pressure of pump without consideration of loss is 200 and with loss is 220 psi.

Required water in one hour 6720 Gallon/ h

Well development by Compressor

compressor set mainly consist of air pipe compressor set drain pipe. pipe ,valve well cover .

Installation:

- 60-70% of drain pipe (4-6inch…In diameter should be placed under water level.
- Air pipe(1/2,3/4,/,I inch in diameter should be install 3meter shorter than the lower point of Drain casing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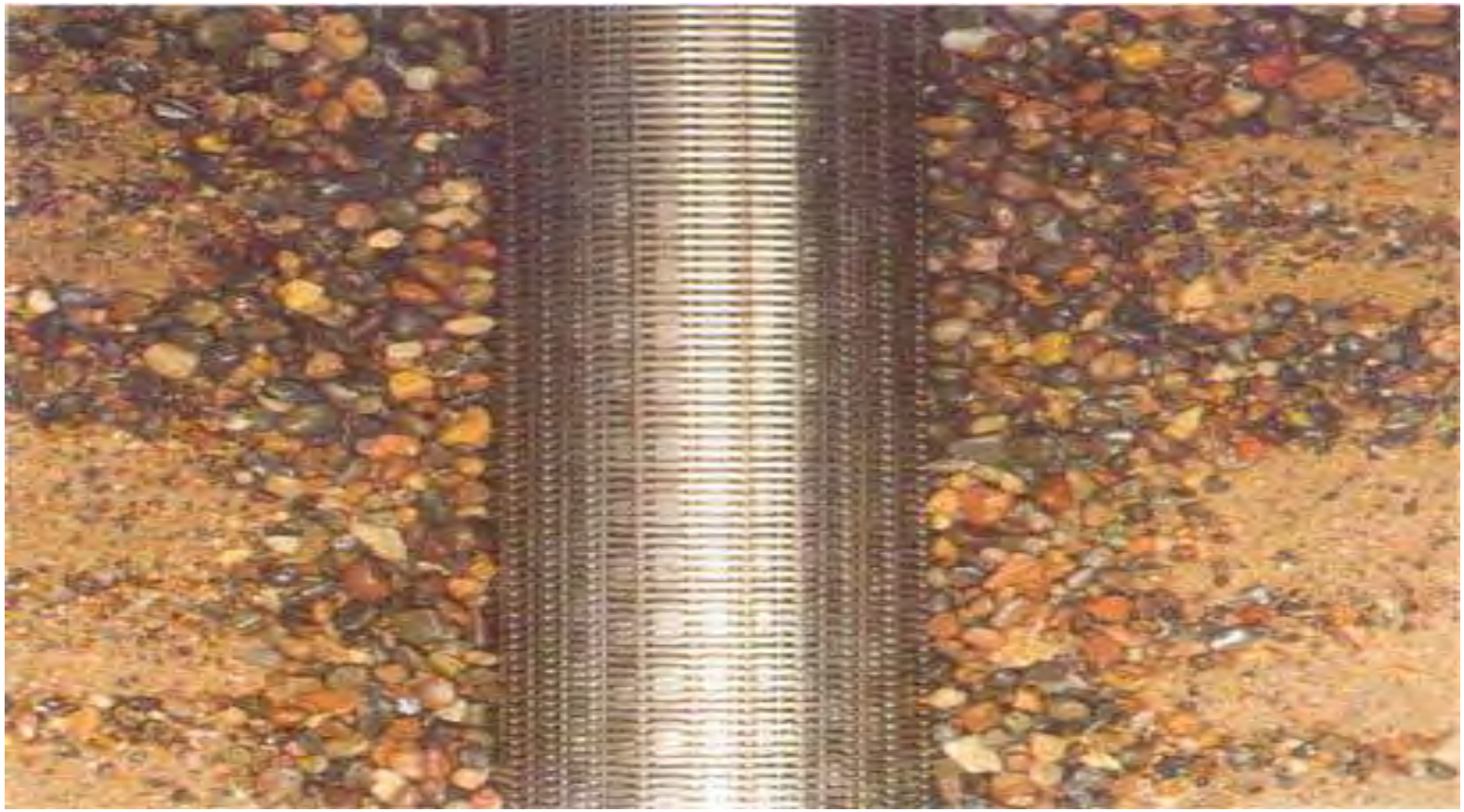
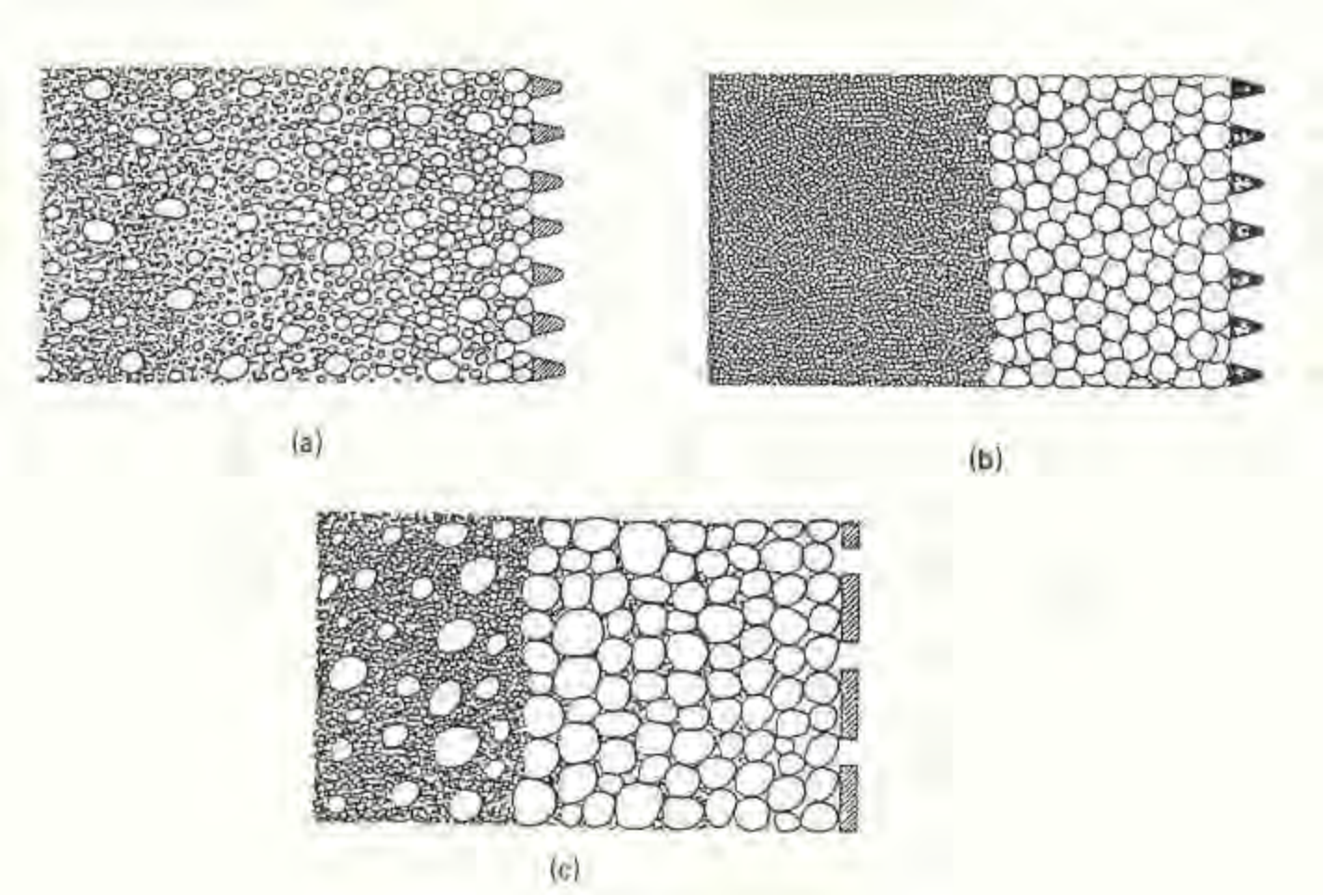
- Top of well closes by an proper device
- by starting compressor and injection of compress air trough air pipe in to the well water leads by drain pipe to surface.
- In starting of compressor operation the water level drops to the end of air pipe.
- The pressure should be cut off
- After a short time again the process begins and repeats . By hydraulic pressure the movement of fine grain of sediments flow in to the well and mud cake round of well walls destroys

- the operation continues till the water become clean. The compressor operation time refer to the composition of layers verify from 8 hours to 3 days.
- Some time for better settlement of gravel round of casing the air pipe can be set 3 meter lower than the end of drain pipe in this condition the water leads trough screens round of casing and screen and leads from back of mentioned casing to surface. By off and on of air pressure gravels settles better in round of casing and filter

Settlement of gravel round of casing and screen culumn

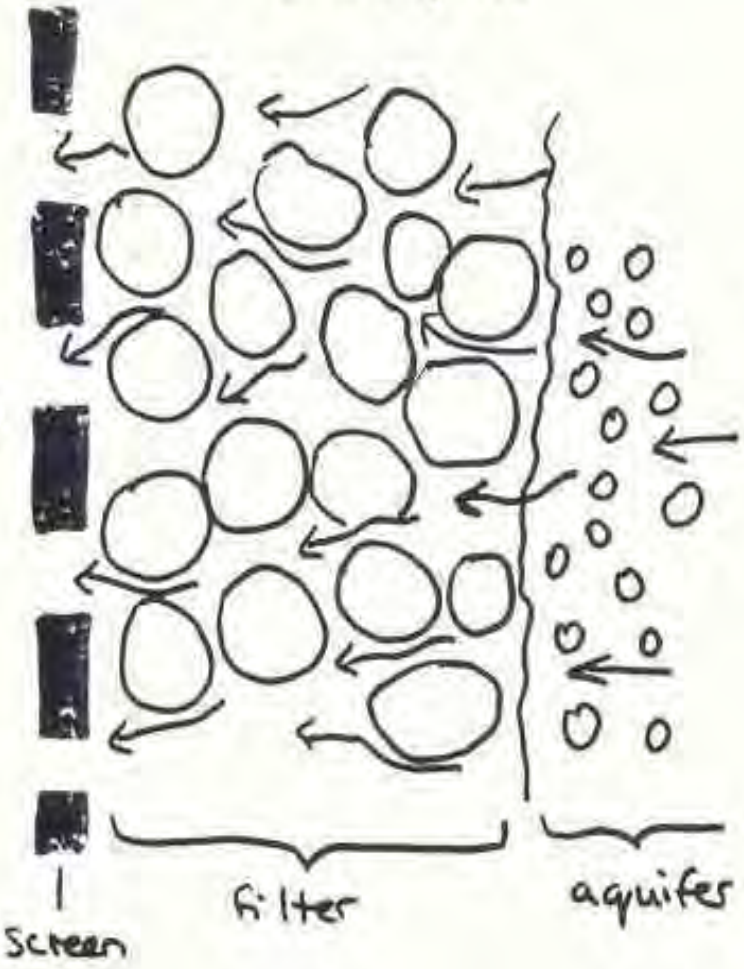


Gravel settelment



pore size of filter

$= 0.4\ D_{10}$ filter



Well Development by Pumping

- In the well design phase of the project a rough determination of the wells potential pumping rate, anticipated standing water level and pumping level is estimated. It is by reviewing this data and experience of completing other wells in a general area that the depth, pump column diameter, horse power requirements and selection of a temporary development and well testing turbine pump bowl assembly is made.

- The selection of all the temporary test pump equipment is an approximation, because none of the aforementioned selections can be accurately made until the end of the well testing phase. The objective is to measure the new well performance and selected permanent pumping equipment that most accurately matches the conditions of the well.

The temporary development and test pump equipment is set deep enough to lower the static head pressure inside the well to achieve sufficient entrance velocities of water to thoroughly remove drilling fluids, natural sediments, and sort the gravel pack material establishing the free movement of water though the gravel pack material and limiting the entrance velocities of the water precluding the movement of sand and silts into the well

The well is then developed further by rapidly bringing the water to the surface through the use of a high horsepower variable speed diesel driven engine, where by after the development water reaches the surface the pump power is withdrawn and the water back flows into the well creating a massive surging action. Rapid and repeated surging actions of the development remove drilling fluids and sediments which may have become lodged in the gravel pack and promote further sorting of the gravel pack material.

The development pumping and surging phase of the work is continued until no further evidence of drilling fluid color is observed and the pumping water level ceases to continue to rise. It is not good practice to pump the well at rates higher than 120 per cent over the intended finial pumping rate or at a rate that continues production of measureable sand can be detected.

This is accomplished by initial production of water from the well at low pumping rates, cleaning the gravel pack, water bearing formations and slowly increasing the pumping rates until a production rate close to the anticipated pumping rate is reached. The pumping rates are only increased as sand and silt production is not measurable or very low and water appears clear of heavy clay particles.

Observation of drawdown

measurements are take every minute for 10 minutes, then every 5 minutes for 30 minutes, and every 10 minutes for 30 minutes followed by once every 30 minutes. It is though an evaluation of the step drawdown information that the most efficient rate for the well can be determined. Step drawdown information is the basis for the determination of the long constant rate test.

Table of measurement and observation of drawdown during pumping test

Date	Time observation		Water level, M	Dynamic level in M	Draw down in M	Log T
	hour	min				
20.09.2013	9	00	4,00	4,00	00	0
		01				
		02				
		03				
		04				
		05				
		06				
		07				
		08				

Table of observation and measurement the recovery of water level after stopping the pumping test

Date	Time observation		Water level, M	Dynamic level in M	recovery in, M	Log T
	hour	min				
21.09.2013	9	00	12	12	00	0
		01	12	9	3	
		02	12	7	5	
		03	12	6	6	
		04				
		05				
		06				
		07				
		08				

Step drawdown

- The yield (specific capacity) of the well is calculated on 3 or 4 points from the step drawdown test, due to the duration of the each of the step drawdown test the accuracy of the yield calculations are greatly enhanced. It is though the calculation of reliable step drawdown information that horsepower requirements based on gallons per minute and total dynamic head from each of the test can be made and a selection of pumping equipment can be made. The most efficient pumping equipment can be installed in the well when the point (production vs. drawdown) can be determined.

Constant Rate Test – Aquifer Testing

It is during the constant rate test, in most cases should not be less than eight hours and can be run longer depending on conditions a determination can be made as to how well the performance or the well can be maintained under sustained pumping. In essence it is possible to do a long term test of the new well at the production rate permanent equipment will be engineered to meet. By doing the long constant rate test it is possible have assurance that the performance of the well will be able to maintain the conditions where the permanent pumping equipment will remain efficient.

Water costs can be greatly increased by the installation and operations of pumping equipment that are engineered on incomplete well and aquifer testing information.

If after long term pumping the drawdown of the well increases; so will horse power requirements for a given amount of water should be changed. Additional drawdown will also push pumping efficiencies down should additional drawdown occur that is not considered in the pump bowl unit engineering

Aquastream Suction Control

If the aquifer composed from fine sedements.some times sands flow is difficult to be stopped. The fallowing pictures shows the result of permanent sand flow

Pump operation in the top and down of screen

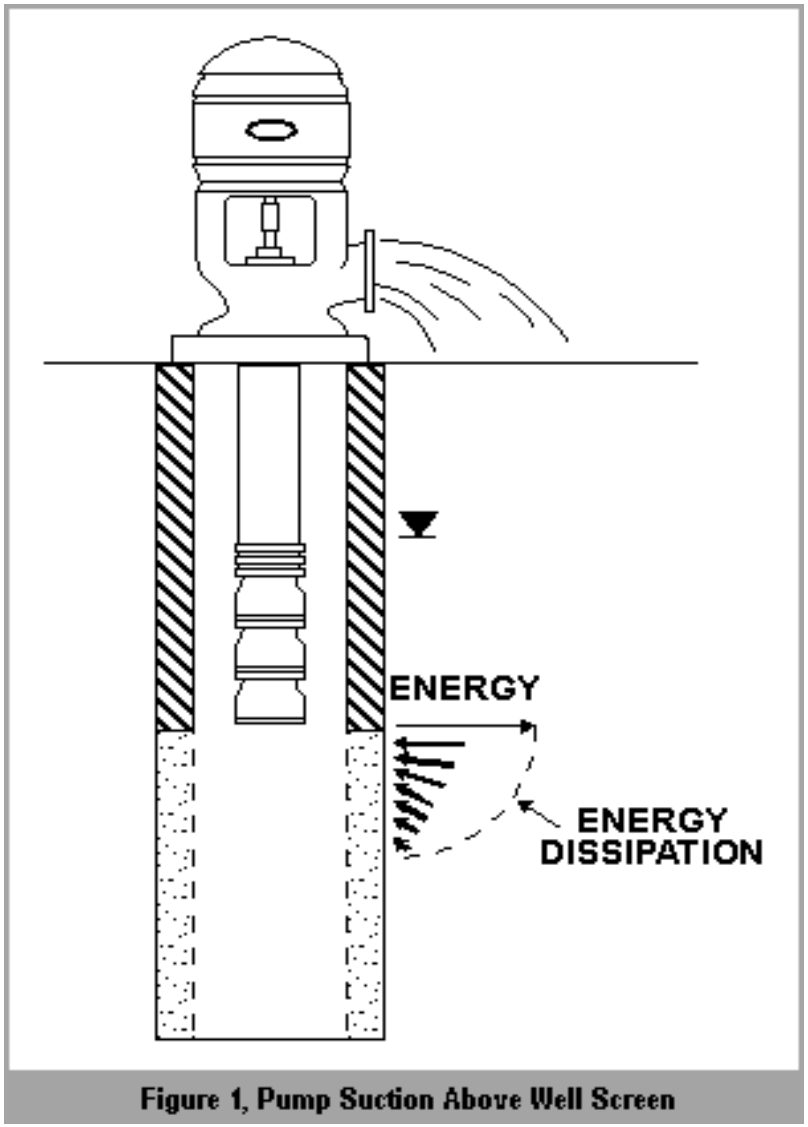


Figure 1, Pump Suction Above Well Screen

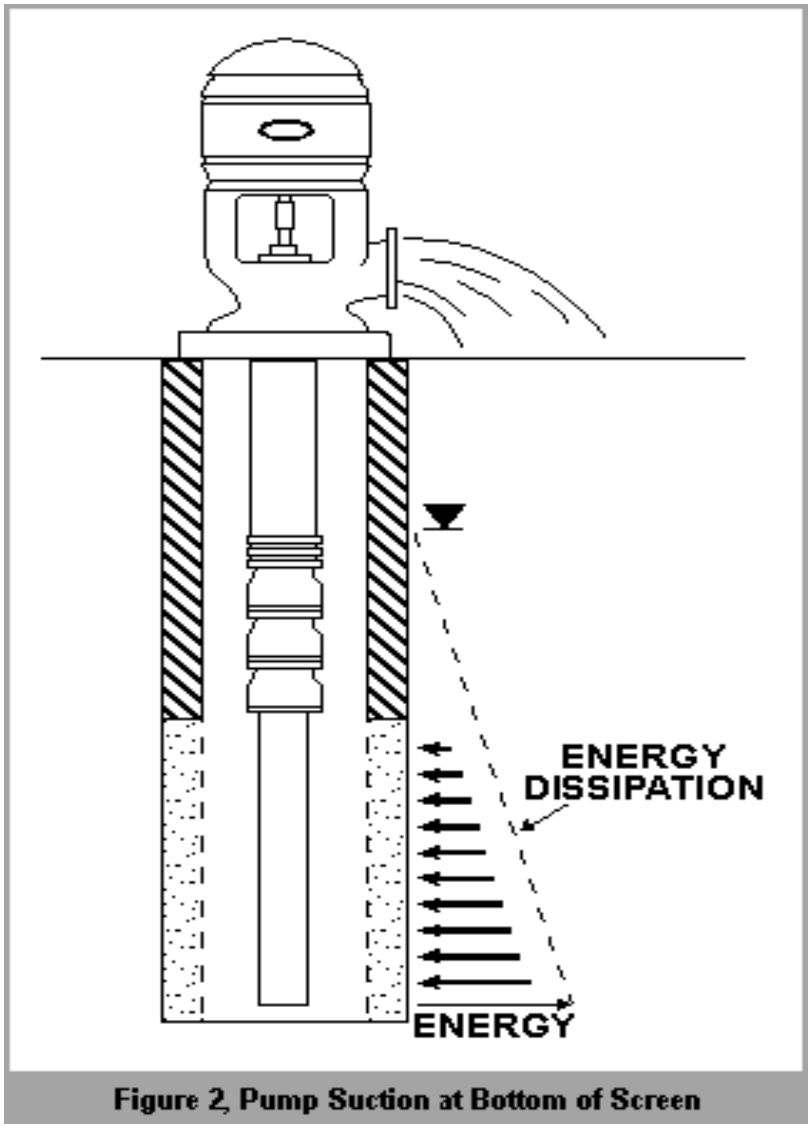


Figure 2, Pump Suction at Bottom of Screen

Change of laminar flow to Turbulent flow

- $Q_{btf} = 2.35\ Q_{nfl}$

Q_{nfl} = Flow rate in gallons per minute (gpm),

Q_{btf} = Rate at beginning of turbulent flow, gpm

$$Q_{btf} = 12\ Q_{nfl}$$

Where:

Q_{btf} = Maximum turbulent flow rate, gpm

Pump with suction control device

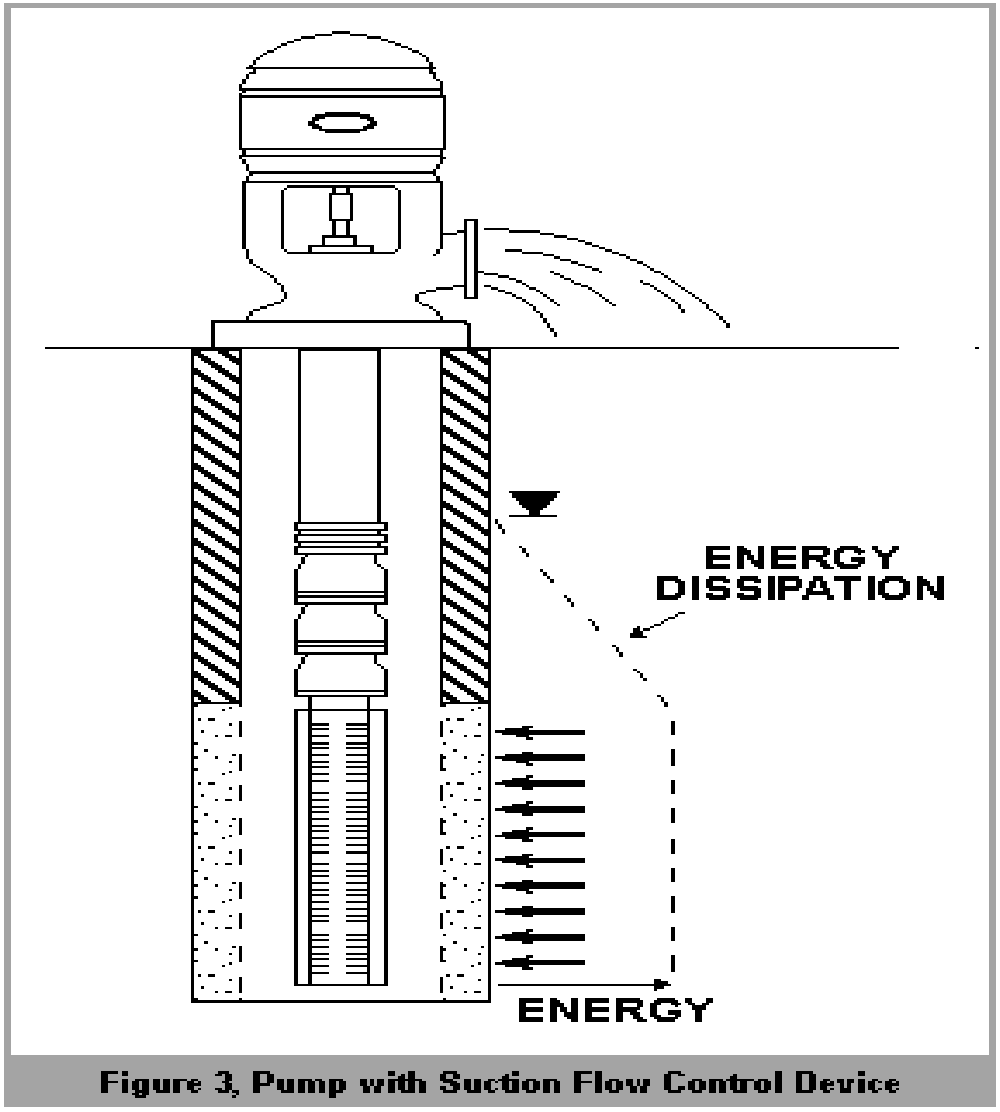
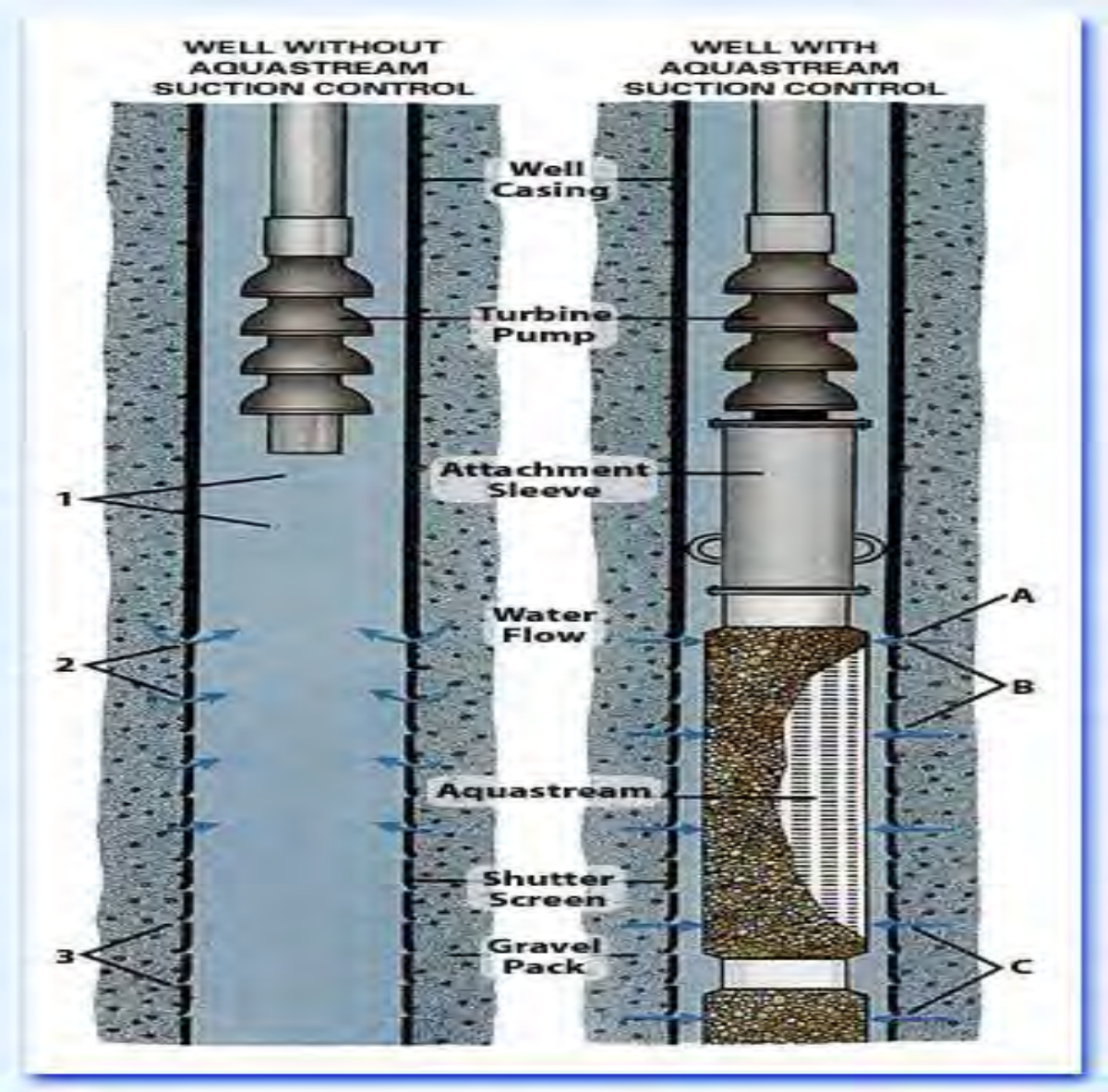


Figure 3, Pump with Suction Flow Control Device

Design of suction contro device



Typical Well and Pump Operation with Aqua stream Suction Control

- Water velocity is greatly reduced at the top of the well where most sand pumping originates.
- Drawdown is reduced and turbulent flow is shifted to uniform, laminar flow. This increases water output.
- Energy is dissipated evenly over the well. Water is extracted more uniformly throughout the well. Well yield is increased, sandfree.

Thank you