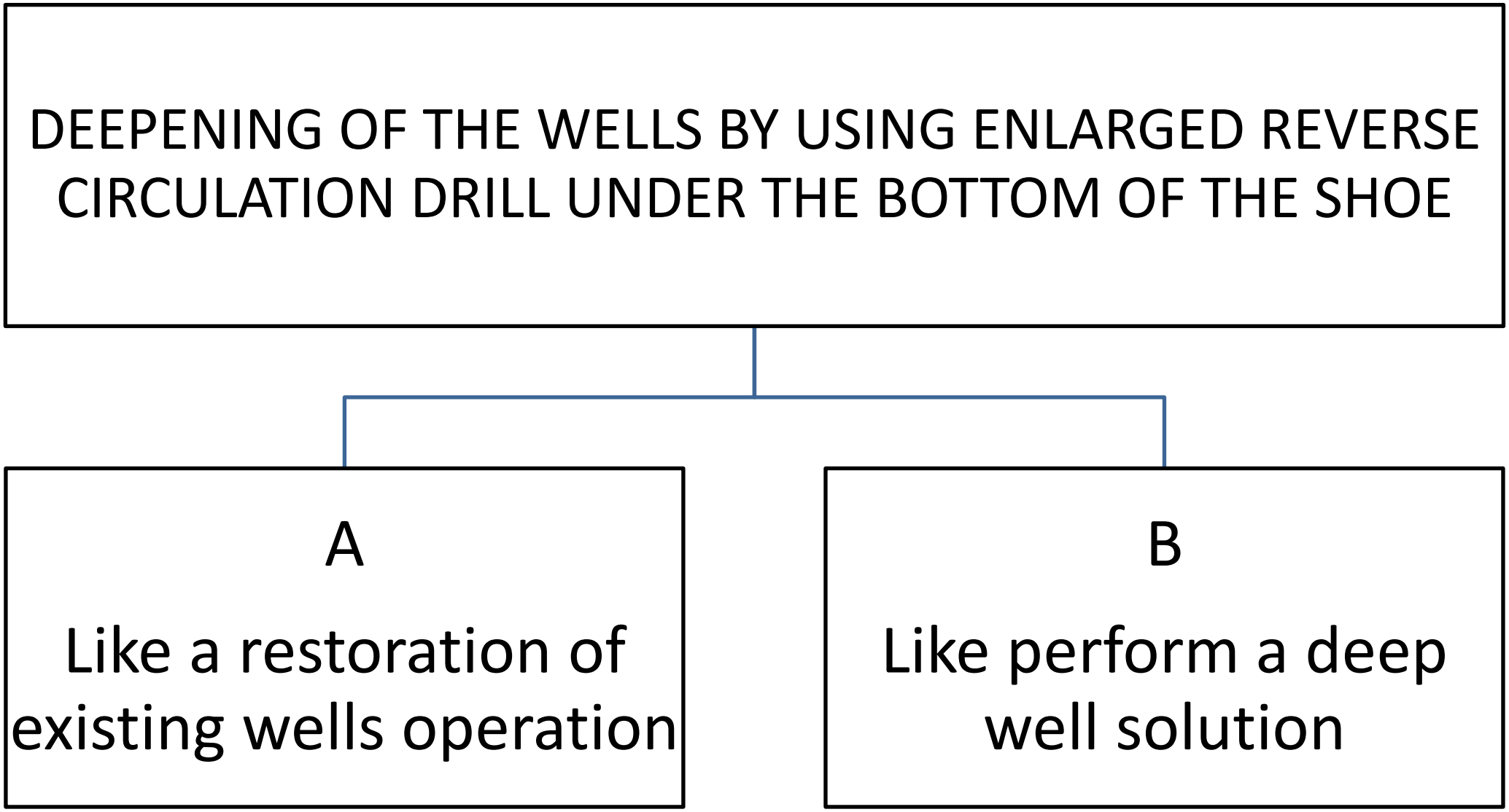
DEEPENING OF THE WELLS BY USING ENLARGED REVERSE CIRCULATION DRILL UNDER THE BOTTOM OF THE SHOE

14-15-16 SEPTEMBER 2011

SUPERVISOR: CLAUDIO GUARESCHI


DEEPENING OF THE WELLS BY USING ENLARGED REVERSE CIRCULATION DRILL UNDER THE BOTTOM OF THE SHOE
A
Like a restoration of existing wells operation
B
Like perform a deep well solution

CASE A -RESTORATION OF WATER WELLS

The target of the restoration of the wells by enlarged perforation operation is to intercept a homogeneous aquifer (medium-medium deep) that have the best protection conditions and shows the best qualitative features of the waters (ruling out superficial aquifer by cementation and restoration of the existing geological layers).

The expected result of this restoration operation is an absolute protection of the aquifer, providing the necessary warranties from eventual fluid pollution along the well axis. This operation also allows to reuse the upper section of the well case as pumping chamber and can also permit at the end of the works to reuse all the infrastructures and tools (measuring, control and interception instruments), beyond the electropump and the delivery pipes of the original well.

CASE A -PRELIMINARY CHECKS FOR DESIGN

Beyond geological surveys it is necessary to check the technical feasibility of the restoration project as follows:

- Preliminary Tv inspection
- Comparison between the historical stratigraphy and the TV inspection
- Check of the Depth of the well
- Calibration of the well
- Conservation status of the of the existing pipes
- Presence on the bottom of the well of foreign objects like pumps or others (this does not preclude the implementation but can rises significantly the price)
- Check of the spaces to set up the construction site

CASE A - TECHNICAL CHOICES

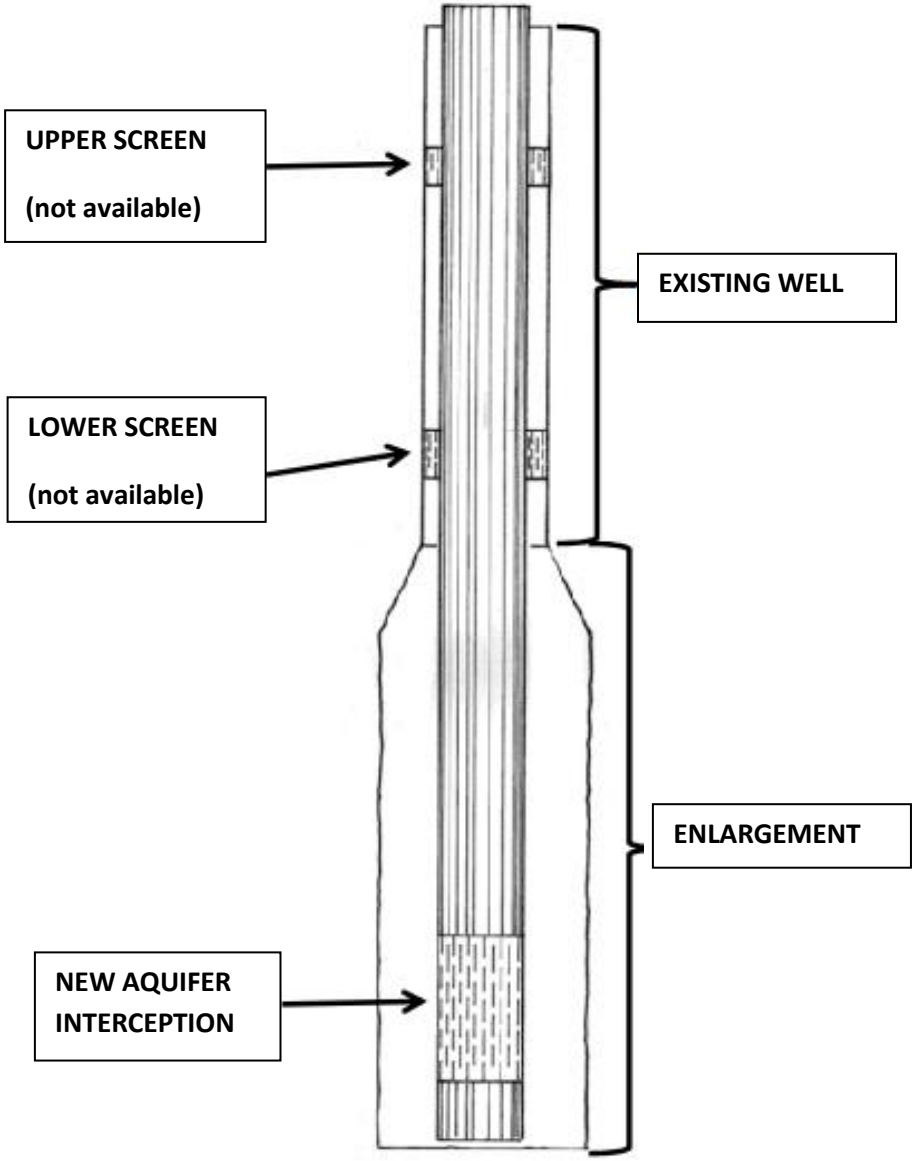
- ***FIRST CASE***: The diameter of existing pipe is wide enough to include the new well case

- ***SECOND CASE***: The restoration includes the interception even of the more depth filter of the existing well.

- ***THIRD CASE:*** The diameter of existing well is not wide enough to include the new well case

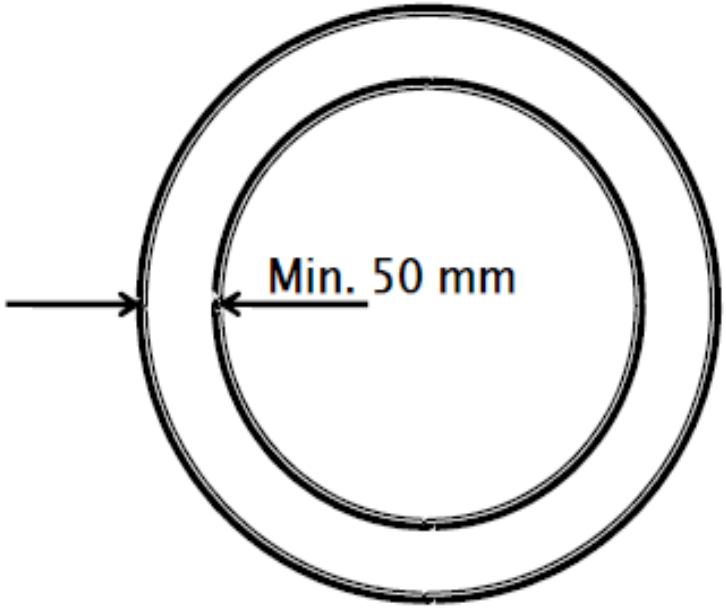
CASE A – TECHNICAL CHOICES

FIRST CASE: The diameter of existing pipe is wide enough to include the new well case



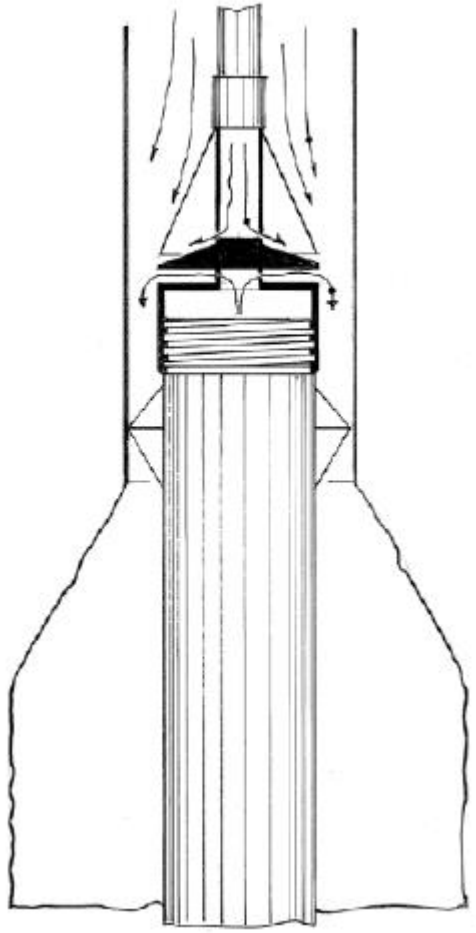
CASE A – TECHNICAL CHOICES-FIRST CASE

Due to constructive reasons we can consider the minimum distance between the old and the new piping case as 50mm. This minimum dimension allows the operations of dabbing (cementification) and graveling up with higher chances of success due to the possibility to check these measurements with an appropriate depth sounding.



CASE A – TECHNICAL CHOICES-FIRST CASE

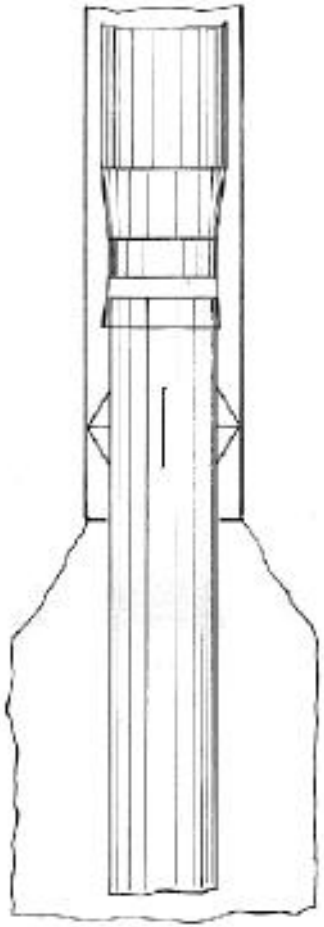
An option is to splits in two phases the piping operations to ease the descent of the gravel or other dabbing materials.



CASE A – TECHNICAL CHOICES-FIRST CASE

After the screen plug and the cementification we can join the lower piping with the upper piping thanks to a reverse trunk-conical joint attached at the inferior part of the upper piping (the hydraulic seal is provided by mechanical interference) (fig.1) or thanks threaded joint (male-female joint) (fig.2).

FIG. 1



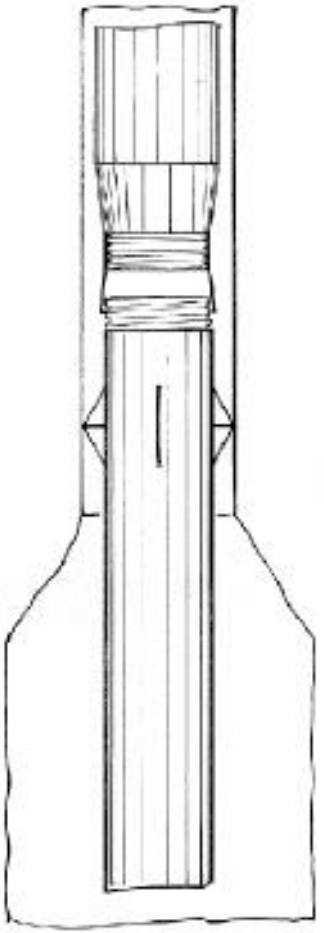
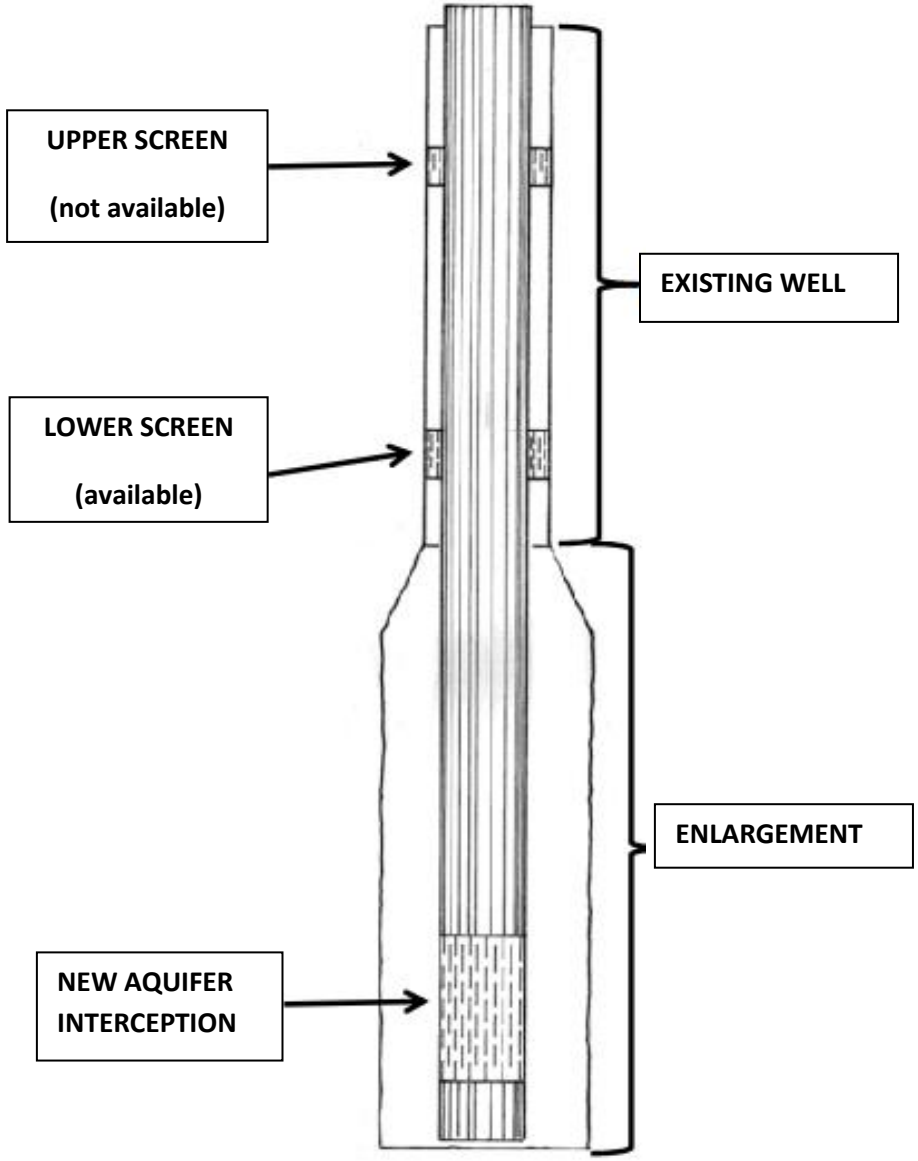


FIG. 2

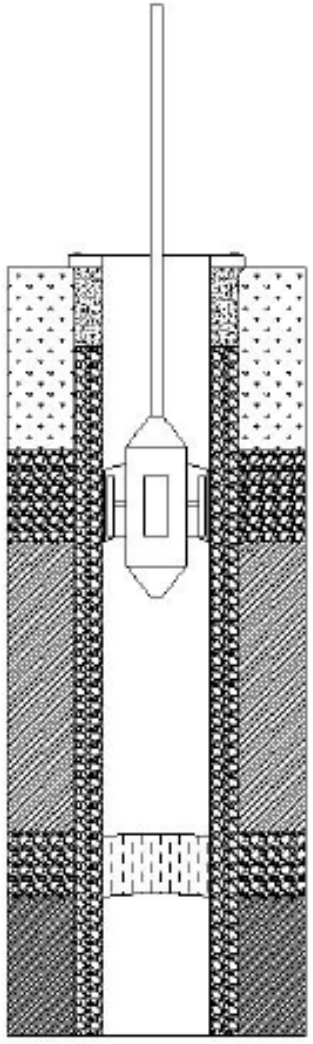
CASE A – TECHNICAL CHOICES

SECOND CASE: The restoration includes the interception even of the more depth filter of the existing well



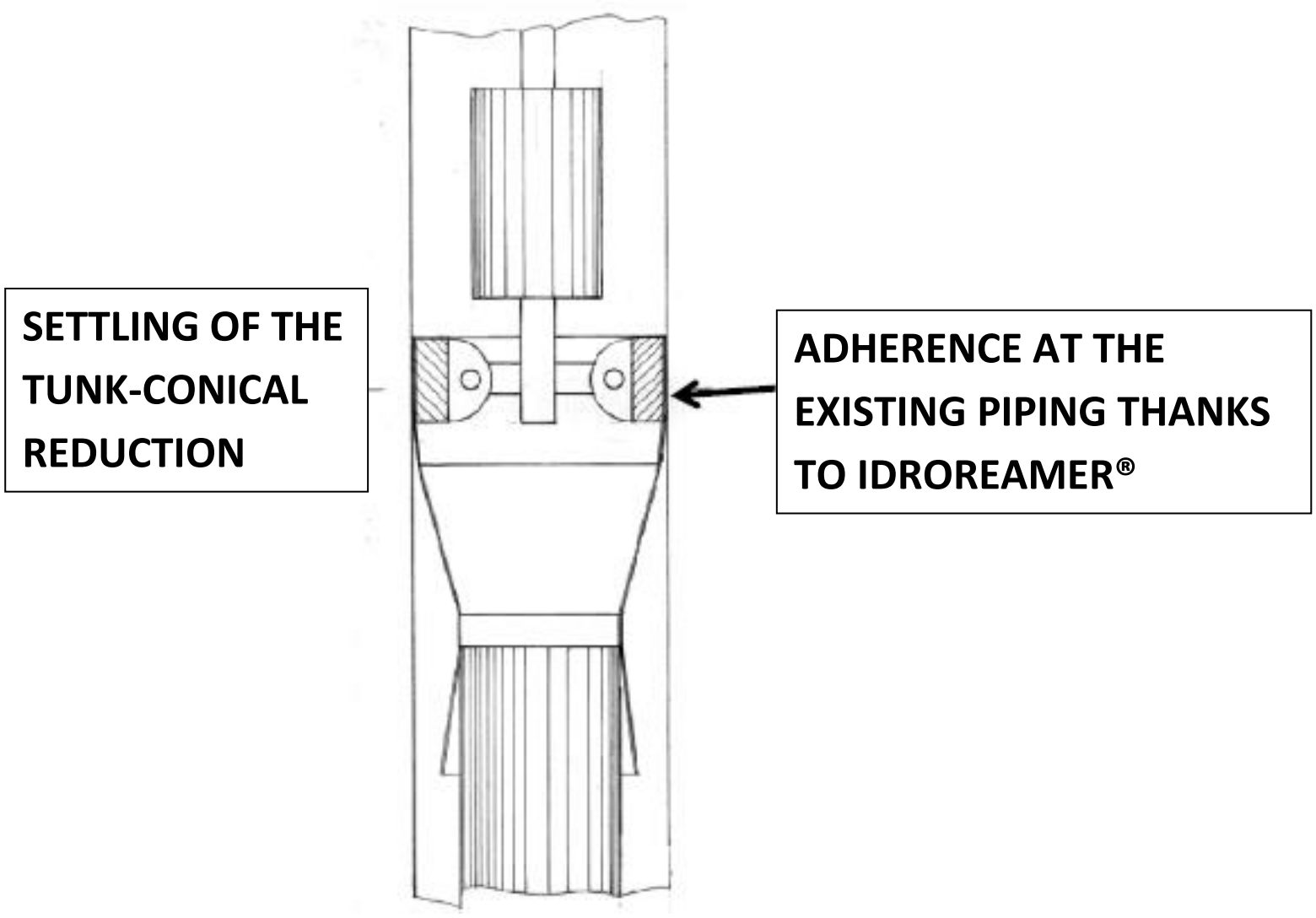
CASE A – TECHNICAL CHOICES – SECOND CASE

To keep a section of the old case (old lower screen) it is necessary to plug tight the old upper screen without a significant decreasing of diameter with an appropriate technique (IDROREAMER ®).



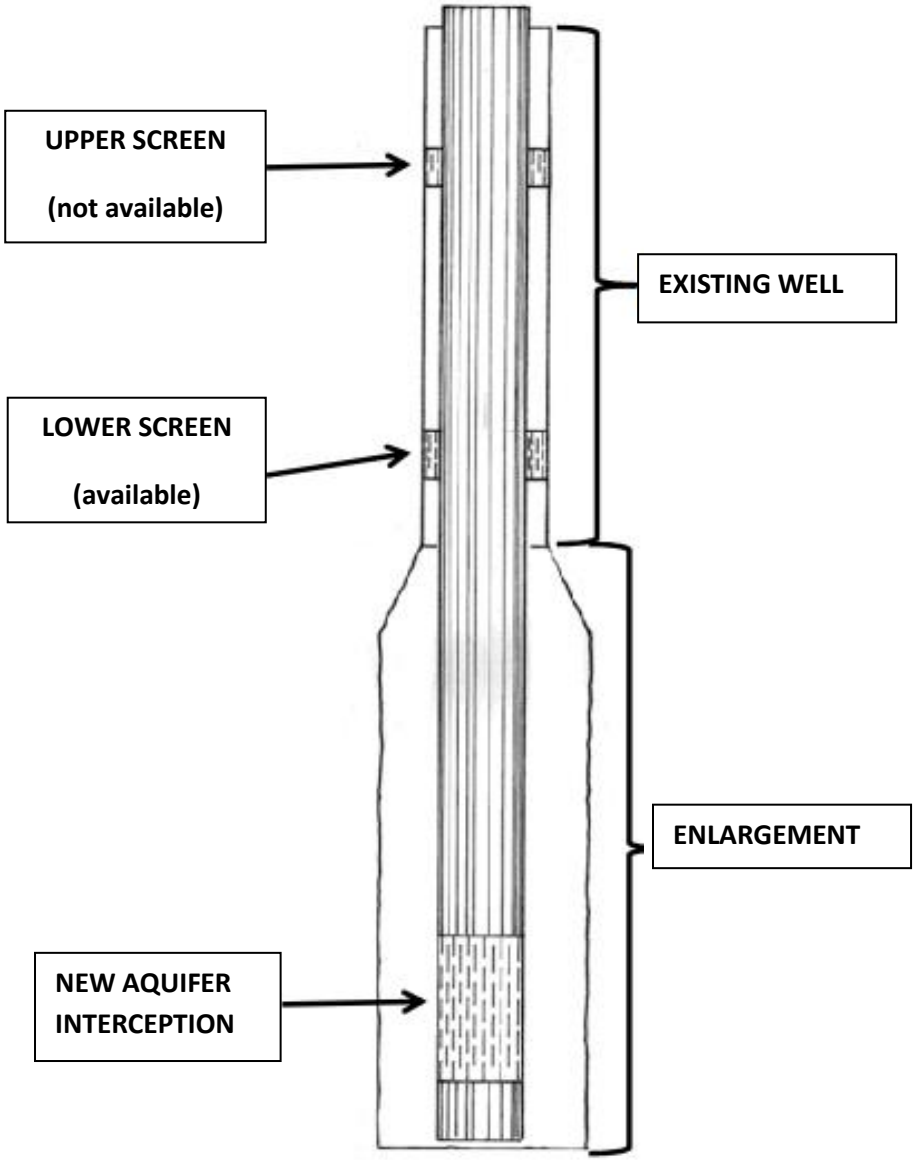
CASE A – TECHNICAL CHOICES – SECOND CASE

Settling of the new deep piping and joining with the old one with trunk-conical joint.



CASE A – TECHNICAL CHOICES

THIRD CASE: The diameter of existing well is not wide enough to include the new well case



It is necessary to plug tight the old upper and screens without a significant decreasing of diameter with an appropriate technique (IDROREAMER ®).

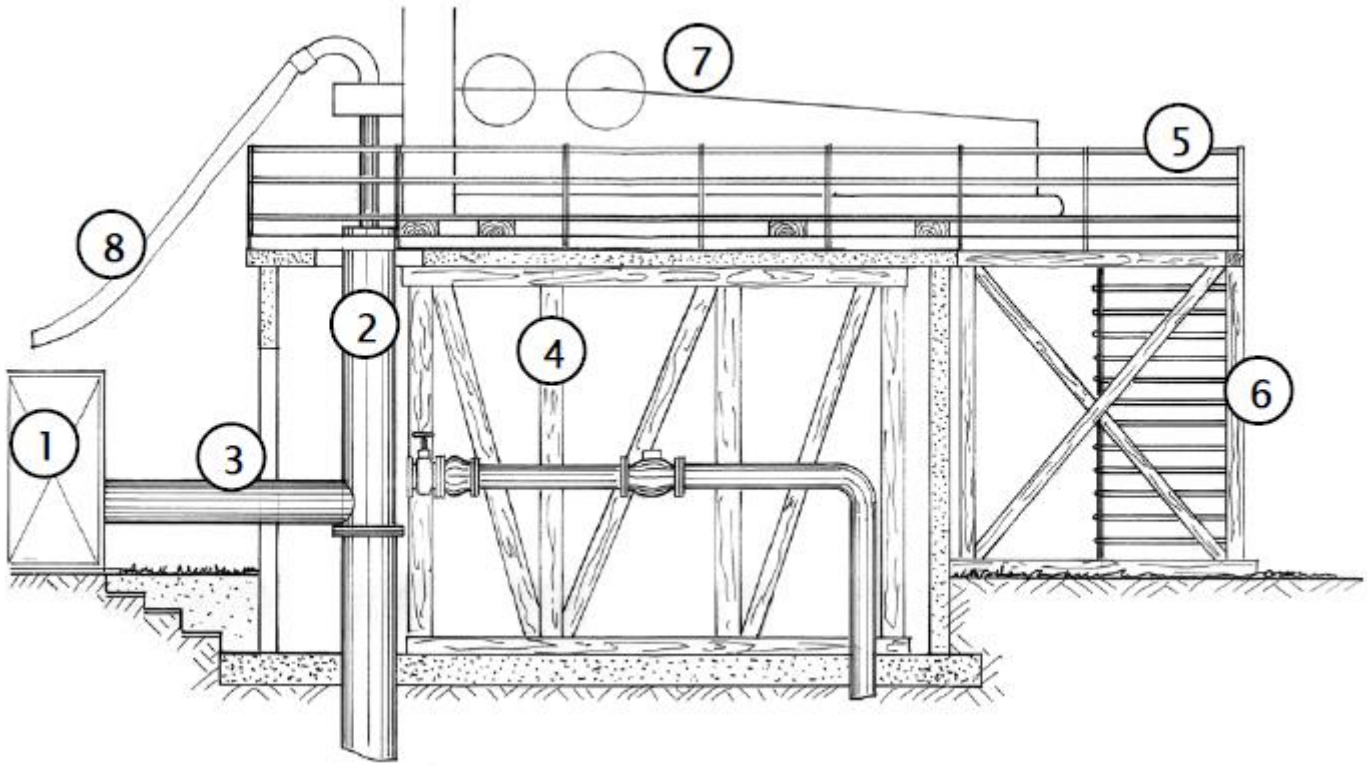
The new piping must have a smaller diameter of minimum 50 mm and the two piping must not overlap each other for more than 2/4 meters.

CASE A – WORK SITE

Most of the time these renovations require very light and versatile rigs, indeed it often happens that the rig is above the masonry chamber.

Before the work site set up we must make all the infrastructure properly to perform safely.

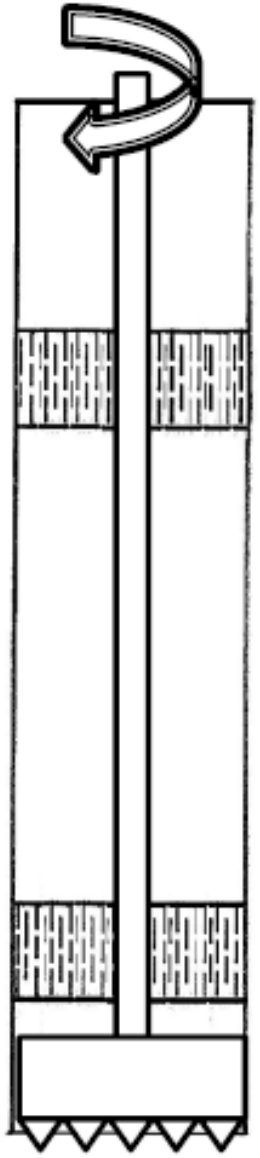
CASE A – WORK SITE



1. Mud pit
2. Conductor pipe
3. Connecting pipe
4. Safety struts
5. Work platform with railing
6. Access ladder
7. Rig
8. Rotary hose

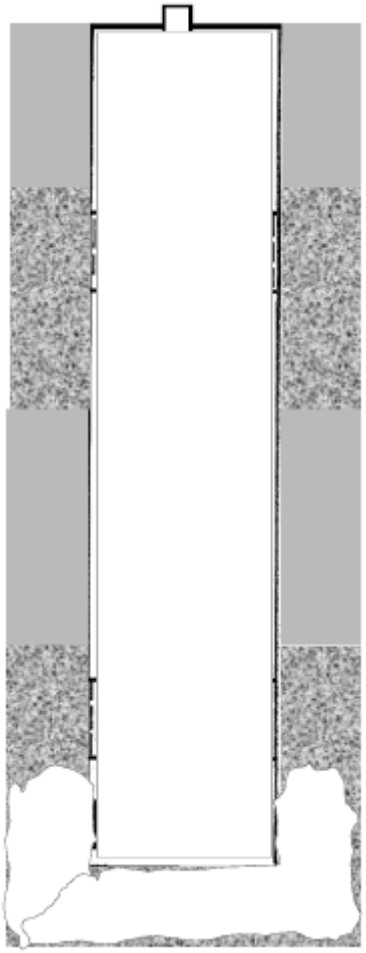
CASE A – REMOVAL OF THE BASE PLATE

If there is a base plate at the bottom of the existing well it is necessary to remove it. To do so we must lower in to the piping a rotary shoe to cut and remove the base plate.



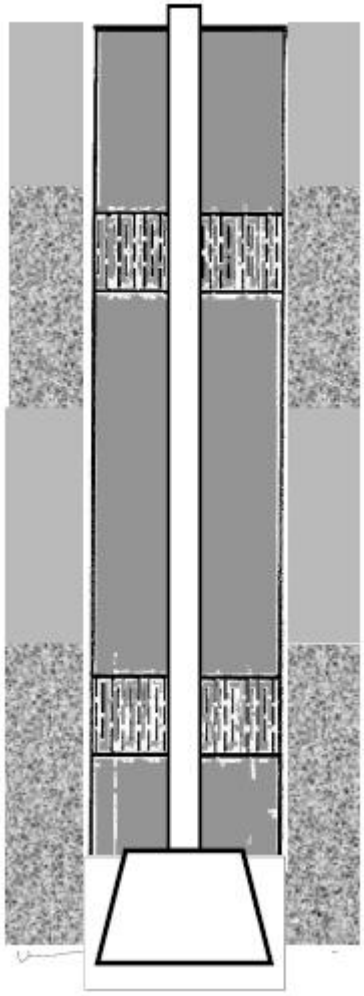
CASE A – STABILIZATION OF THE ARTIFICIAL GRAVEL PACKED SCREEN

The first goal of this operation is to saturate with high pressure cementification a significant section of the gravel packed screen of the existing well starting from the bottom. If the lower screen is not cementable (because is available to receive clean water) we have to drill the pipe to create appropriate holes with a suitable hydraulic puncher. The second goal is to saturate with appropriate fluids (water-bentonite with appropriate density and viscosity) all the screens in the existing piping case to ensure support in the subsequent operative phases.



CASE A – DRILLING START

We star to drill with a tool of the same diameter of the existing drive pipe. This tool is used to drill down some meters below the shoe of the existing well to check the real seal of the cementification and to check the saturation of the well.



CASE A – DRILLING WITH UNDER-REAMER

After this primary drill we take out the drive pipe and the tool. Than we introduce the widening tool (under-reamer)

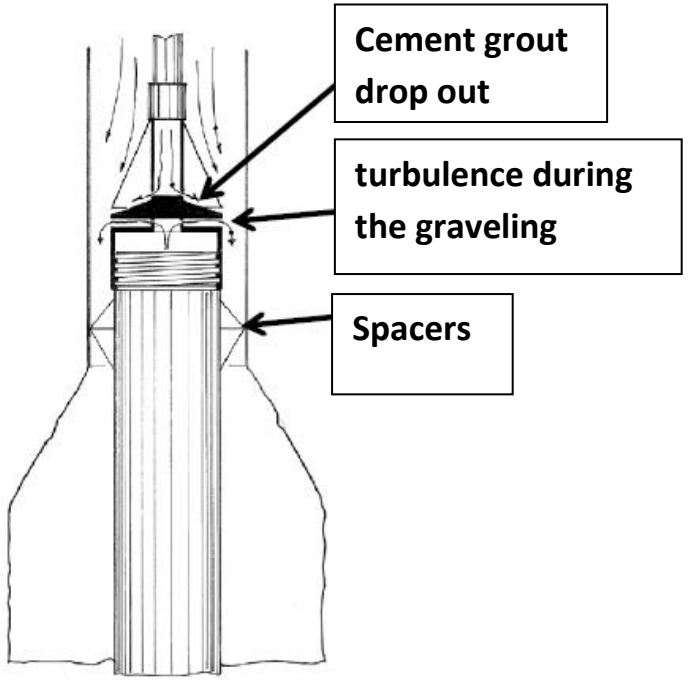
Roller under-reamer: for coherent type of soils (cemented gravel, cobble, sandstone etc.…)

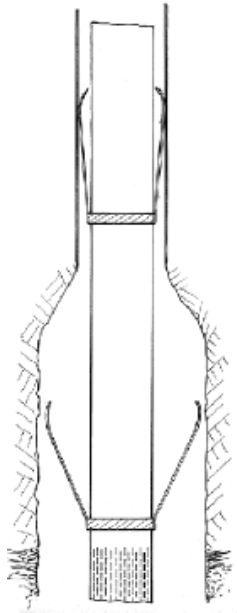
CASE A – DRILLING WITH UNDER-REAMER

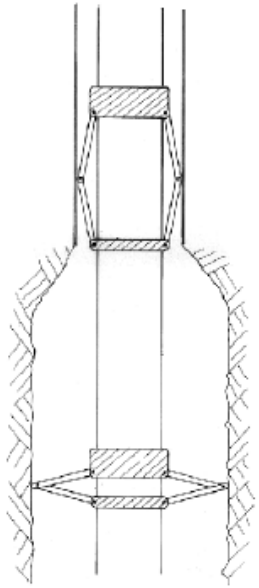
Drug under-reamer: for more soft soils (loose gravel, sands, silt, clay, etc.)

CASE A – STANDING CASE PIPE AND ARTIFICIAL GRAVELING AND SEALING

Later after the appropriate checks (electric log, caliper, etc.) we can set down the standing case pipe with all the scanners, spacers, base plate and eventually of the fishing hook in case of deep release. In this case we must not overlap the old pipe with the new pipe for more than 2-4 mt otherwise the sealing and graveling will be critical. Indeed, bridges of gravel or clay can obstruct the correct saturation of the annulus cave. After the filling operations we have to cement the upper part and then is possible to retrieve all the equipment.





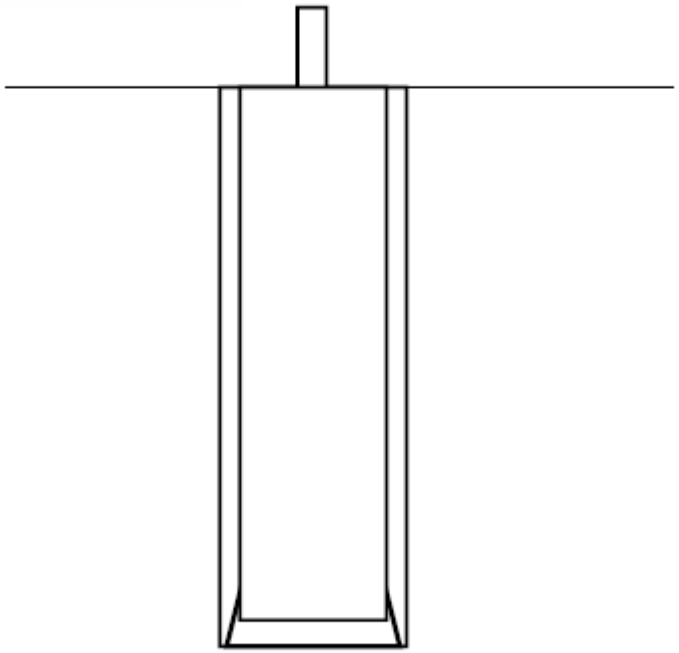


CASE B – DEEP WELL SOLUTION

The goal is to intercept deep aquifer and to do so, because of geological nature, is necessary to create a minimum annular drain space of 150/200mm. This technical solution allows to build a well using the benefits of two different drill techniques: direct circulation drilling and reverse circulation drilling.

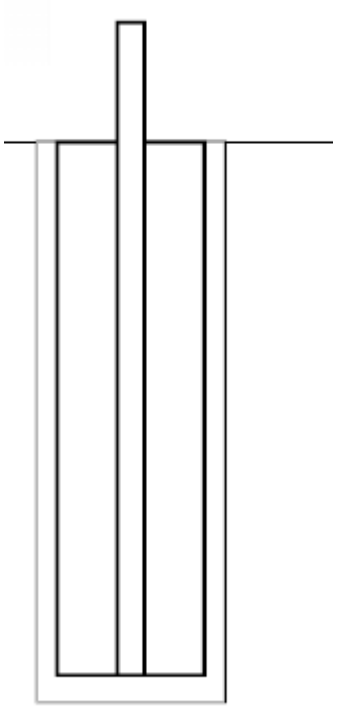
CASE B – DEEP WELL SOLUTION – THE DRILLING OPERATIONS

The upper part of the hole is drilled with direct circulation drilling, we drill this way only fire the time to create the space lo set down the blank pipe with the cemented shoe and relatives spacers and valve.



CASE B – DEEP WELL SOLUTION – CEMENTIFICATION

After the first drill we must cement from the bottom to the head of the hole with plugs or stinger. Then after drying of the cementification we can mill the shoe down till some meters down. Later we proceed to restore the drilling fluid (also water can be used) and to replace the drill tool whit the under-reamer tool, in the end we continue to drill with the reverse circulation till we reach the aquifer.



ADVANTAGES AND DISADVANTAGES – CASE A

ADVANTAGES

- Drill on a site already used for the same scope
- Uses of some existing equipment and infrastructures: power line, distribution piping, control devices, turbine pump and stand pipe, masonry infrastructures;
- Part of the drilling already completed;
- Less disposal costs;
- Reusable well casing (if available);

DISADVANTAGES

- The existing well can be in a critical position and this can raise the prices to set up the working site;
- More complex drilling, cementing, gravelling operations that lead to more costs;
- Often forced to use very light and versatile rigs;
- Very qualify staff is needed, even if is a consolidated technology;
- Very hardly to find drilling tools;
- Small sized drilling tools don’t allow to work whit high driving torque.

ADVANTAGES AND DISADVANTAGES – CASE B

ADVANTAGES

- Drilling with direct dry circulation the first part can allow to have less and more manageable disposal waste and to drill at a higher penetration rate;
- Cementification only in the early part of the well, this mean less infiltration risks;
- Reverse circulation on the aquifer layer allows to have a lower hydrostatic pressure;
- Possibility to have wider holes;
- Less disposal costs;
- Most of the drilling string of the direct circulation can be also used for the reverse circulation;

DISADVANTAGES

- All the disadvantages of the A case;
- Perform the same hole with two technical solutions requires a very qualified staff;
- Times to replace the equipment.