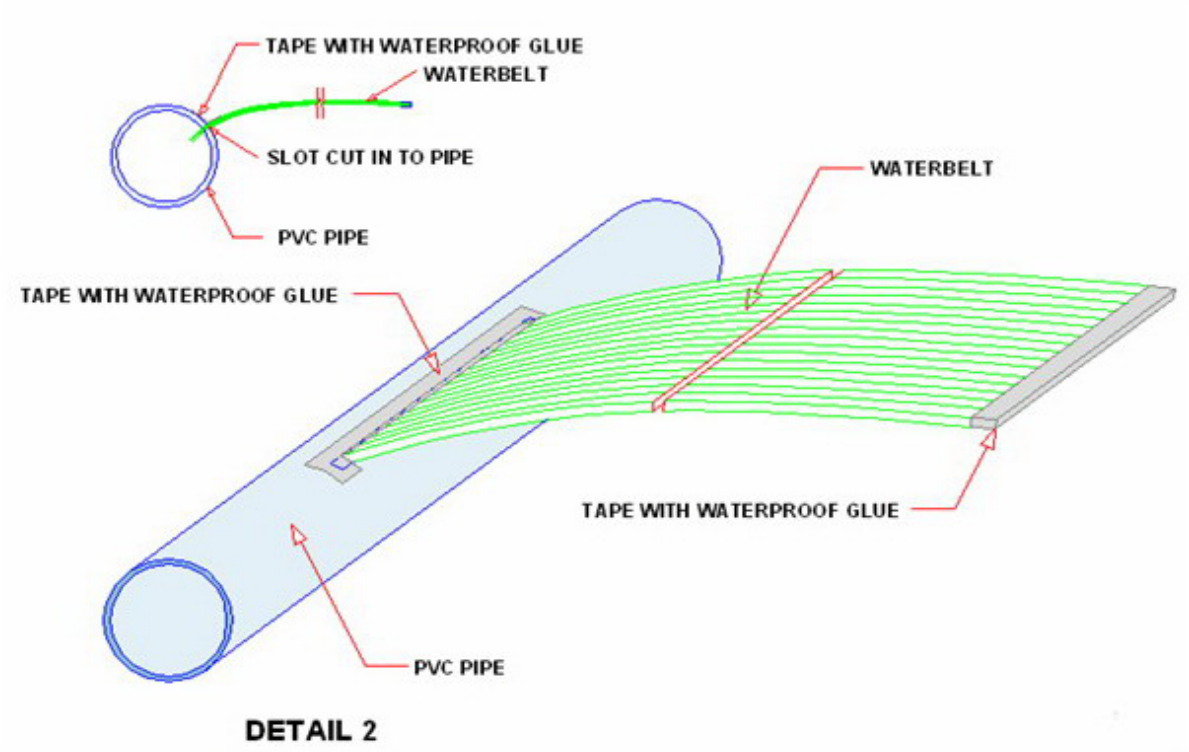
A MIRACLE OF DRAINAGE

PRODUCT DESCRIPTION

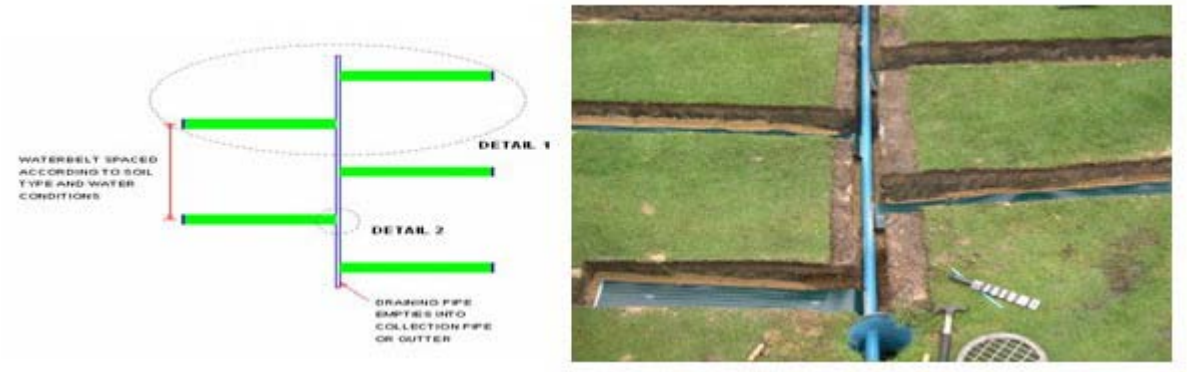
WATERBELT is a thin strip of flexible pvc in the shape of a belt, with a series of grooves and channels evenly distributed through the body of the belt and open for water collection on the underside. It is installed in the earth to effectively remove excess water without clogging or crushing.



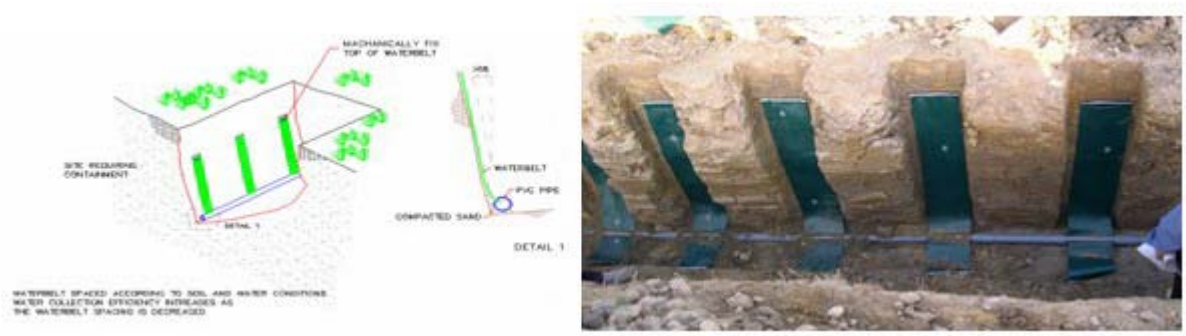
One end is inserted into a collection pipe and the other end is sealed with tape so the collection of water is from the underside.

CONFIGURATIONS

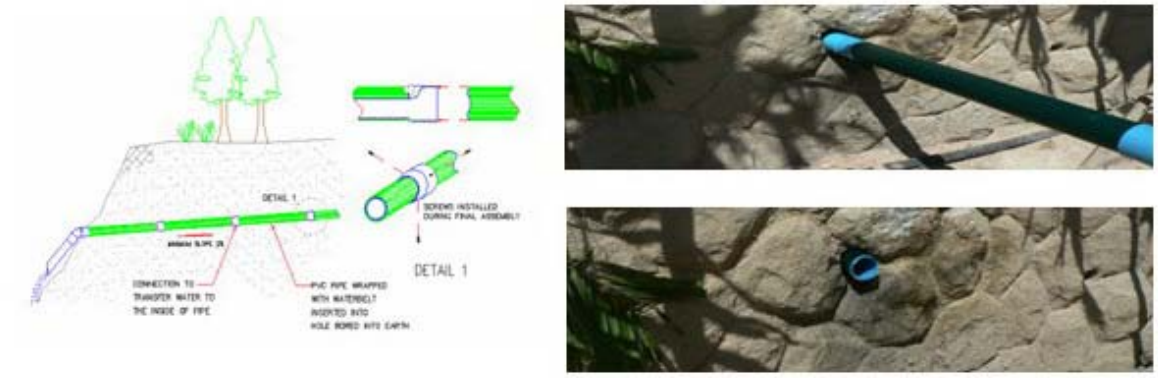
The assembly is installed in the soil in a variety of configurations depending on jobsite and water conditions.



HORIZONTAL DRAINAGE FIELD

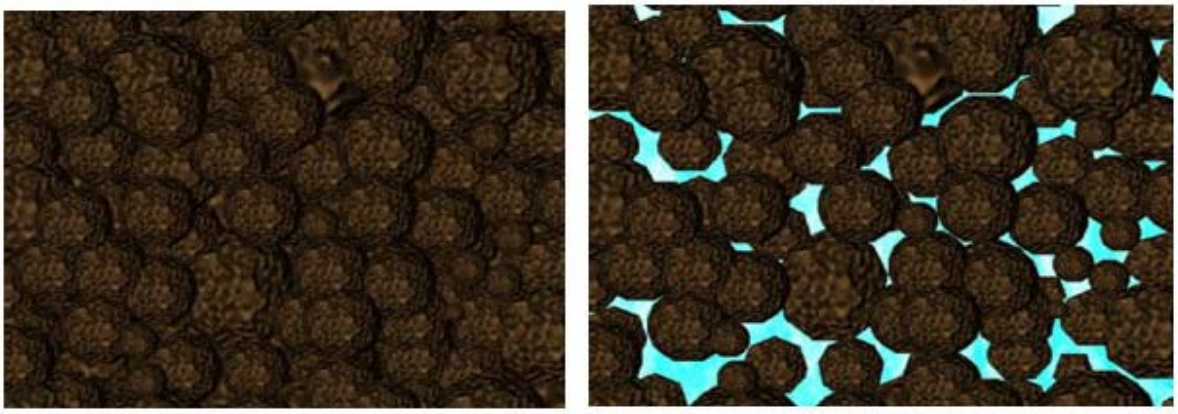


VERTICAL DRAINAGE FIELD



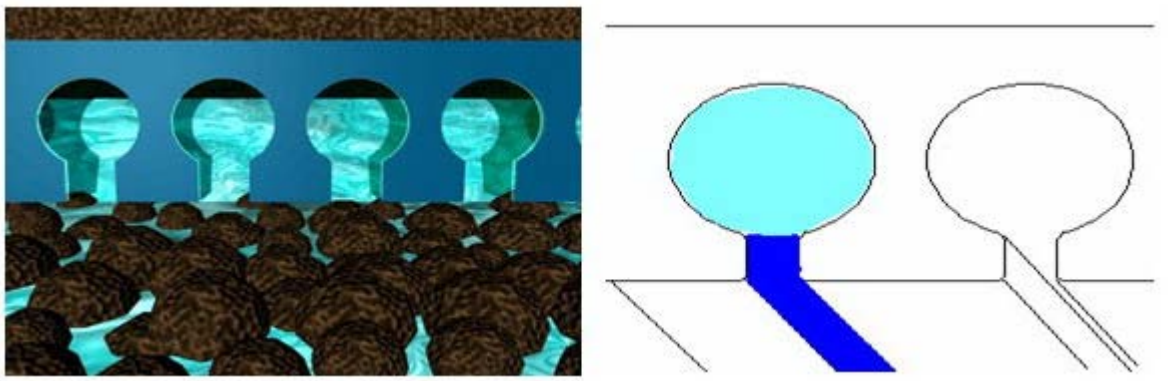
INLINE DRAINAGE

HOW IT WORKS



Soil is a mass of solid particles separated by voids. The composition and size of the particles determine the soil type.

The voids of a soil may be filled with air or water or both. If only air is present the soil is dry, whereas if only water is present the soil is saturated. The voids are connected together and form continuous passageways for the movement of water.

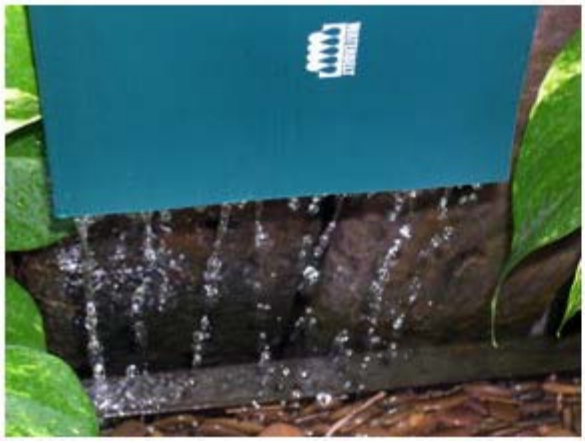


In nature, water flowing through the soil without external turbulence from the surface is clean and does not carry particles. Nature accomplishes this with gravity and capillary action.

WATERBELT is designed to separate the soil particles from the water in the same way as nature. It is a series of elevated capillary channels accessed through a corresponding series of continuous narrow slots.

Once the water is in the capillary channels, surface tension of the water forms a seal along the narrow slits. The seal supports the weight of the water in the channel and makes it possible for water to move through the channels. As the water flows towards the discharge pipe with the

help of gravity, the seal remains intact and supports siphon action, which further enhances absorption of water from the outside.



The combination of capillary, surface tension, and siphon, creates a collection system that does not clog, has a high absorption rate, does not displace soil, and can be used in almost any configuration.

WATERBELT IS BETTER

Pipes were designed to transport water in a closed system to prevent contamination from particles.

Pipes with holes, slots, and screens create artificial water flow and cause erosion as soil particles are carried with the water flow.

The particles settle in the pipes and eventually block the water flow and the drainage.

Drain rock, installed to filter the soil, soon becomes contaminated with soil particles and does not prevent the clogging of the holes or the pipe. Flexible pipe wrapped with filter fabric quickly becomes inoperative as the fine particles clog the pores in the fabric. This solution only introduces another element to clog and generally clogs faster than the pipe.

THE SOLUTION TO THE PROBLEMS OF CLOGGING IS THE SEPARATION OF THE SOIL PARTICLES FROM THE WATER WITHOUT AN EXTERNAL FILTER

ONLY WATERBELT CAN DRAIN THE WATER WITHOUT DISPLACING THE SOIL

COMPARISON OF COLLECTION AREA

TYPE	SIZE	OPEN AREA	COLLECTION AREA / m2
Pipe - drilled holes	2 inch (55)	3%	7.42 sq. in.
	3 inch (80)	3%	11.13 sq. in.
Slotted pipe	2 inch (55)	5.70%	14.09 sq. in.
	3 inch (80)	5.80%	21.51 sq. in.
Screen pipe	2 inch (55)	8%	19.78 sq. in.
	3 inch (80)	7%	25.96 sq. in.
Perforated pipe	3 inch (80)	3%	11.13 sq. in.
	6 inch (150)	3%	22.25 sq. in.
WATERBELT		**>20%**	**62.99 sq. in.**
* open area is approximate			

DISCHARGE FLOW RATE

The discharge flow rate is a measure of the amount of water that can exit the discharge conduit. The discharge can only equal the collection, and with only 2 to 8 percent of the surface area of the pipe available for collection, the actual discharge will be very small compared to the discharge rating.

FLOW RATE COMPARISON

PRODUCT	DIAMETER (mm)	OPENING RATE (%)	OPEN AREA A (m^2)	FLOW RATE Q_C(m^3/sec)	RESULT
PIPE WITH HOLES (Q1)	**100**	**2.25**	**0.47**	**0.47 X 10^{-6}**	**12.5% OF Q5**
PE PERFORATED PIPE (Q2)	**100**	**6.3**	**1.98**	**1.98 X 10^{-6}**	**50% OF Q5**
PVC WITH HOLES ON TOP (Q3)	**100**	**1.5**	**0.31**	**0.31 X 10^{-6}**	**7.69% OF Q5**
SCREW COIL PIPE (Q4)	**100**	**6.3**	**1.32**	**1.32 X 10^{-6}**	**33% OF Q5**
WATERBELT (Q5)	**WIDTH 20cm**	**20**	**4**	**4.00 x 10^{-6}**	**100%**
*** Embedded length = 100m**					
Flow rate formula $Q_c = k_s$ x i x A					
k_s = permeability (k_s = 1 x 10^{-6} m/sec)					
i = hydro gradient (i = 1)					
A_s = area of opening (m^2)					

SIPHON ASSISTED SUCTION

Type Of Installation	Width (cm)	Permeability (m/sec)	Effective Area Of Belt (cm^2)	Theoretical Flow Rate (L/min)	Measured Flow Rate (L/min)	Siphon Efficiency
Embed In Sand Horizontally	20	1.18 x 10^{-4}	440	0.312	1.04 (H = 20 cm)	3.33
Embed In Clay Horizontally	20	5 x 10^{-6}	440	0.013	0.45 (H = 5 cm)	34.6
Embed in Clay Vertically	17	5 x 10^{-6}	900	0.027	1.8 (H = 15 cm)	66.6
* Theoretical Flow Rate = Permeability x Effective Area Of Belt						
* Efficiency = Measured Flow Rate / Theoretical Flow Rate						

CHARACTERISTICS

CLOG FREE DESIGN

WATERBELT uses gravity in combination with “endless” slots to separate water from the solid particles.

EFFICIENCY IS ALWAYS AT 100%

Since there is nothing to clog, the efficiency does not drop with age or use.

HIGH CRUSH RESISTANCE

WATERBELT is designed to withstand heavy equipment traffic and virtually all backfill requirements without special treatment.

SIPHON ASSISTED SUCTION

The combination of capillary, surface tension, and siphon, supercharges the drainage and extends the area of collection for up to a one meter radius.

EXTRA LARGE COLLECTION CAPABILITY

The collection area extends the entire length and width of the belt with over 20% of open area.

CONFORMS TO ALL SHAPES AND CONFIGURATIONS

The thin and flexible profile of WATERBELT allows it to conform to all ground variations and adapt to the many configurations required to provide complete drainage solutions for any problem.

EASY HANDLING

A 100 meter roll can be carried by one person and jobsite layout is easy. Apart from the excavation, virtually no tools are needed for the installation.

ECONOMICAL

Reduced excavation costs, elimination of filtering materials and washed aggregate, and the elimination of maintenance and replacement costs makes WATERBELT the most economical drainage system available.

APPLICATIONS

BANK AND RETAINING WALL

Drainage for levees and embankments
Back drainage for retaining walls
Coastal erosion control
Highway slide control

CONSOLIDATION

Earth dams
Highway and railroad
Swamp land and dredge fill
Reclaimed land

CONSTRUCTION

Foundation walls
Basements
Underpass
Roof gardens
Tunnels

AGRICULTURAL

Oversaturated land
Water management
Irrigation
Saline soil leaching

ENVIRONMENTAL

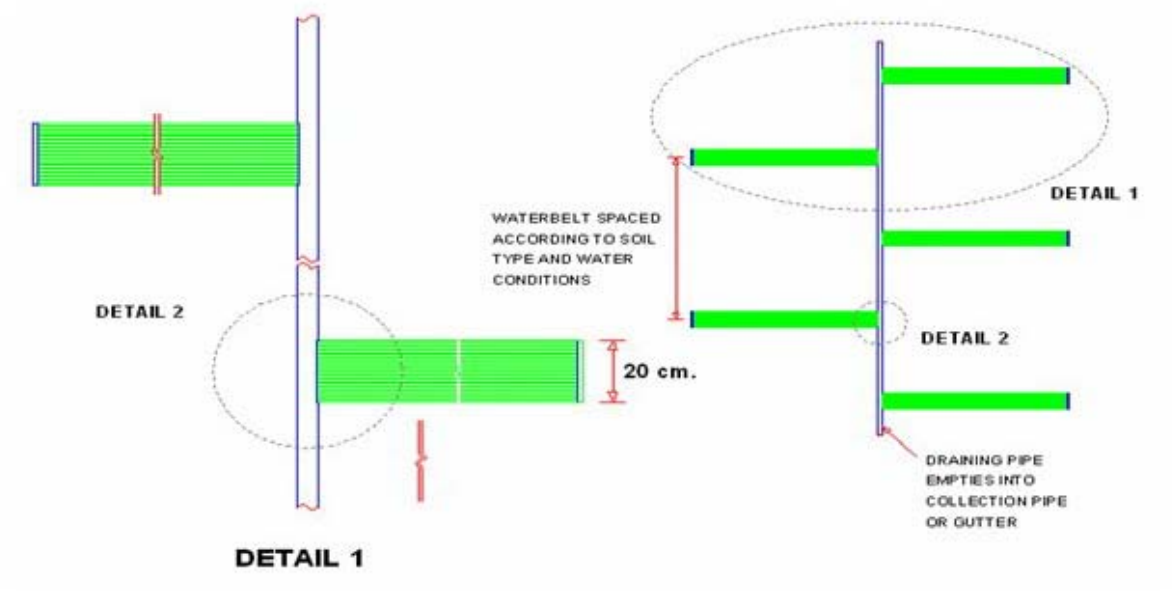
Biowaste
Mine tailings
Landfill sites
Hazardous sites and settling ponds
Ground and aquafier recharging

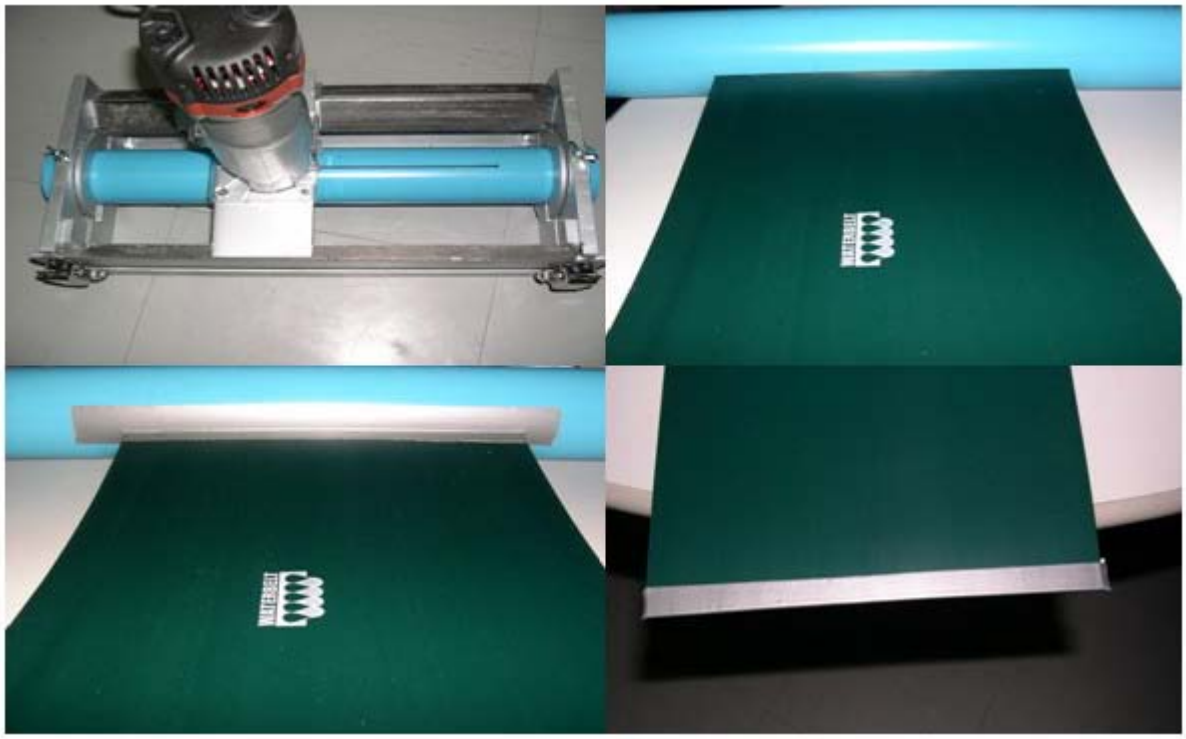
RECREATIONAL

Golf courses
Sports fields
Parks and landscaping

THE WATERBELT SYSTEM

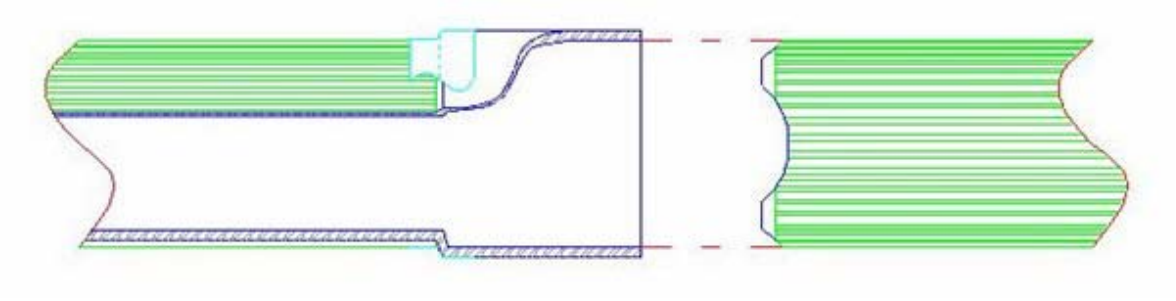
WATERBELT / PIPE JOINTS (HORIZONTAL & VERTICAL APPLICATIONS)

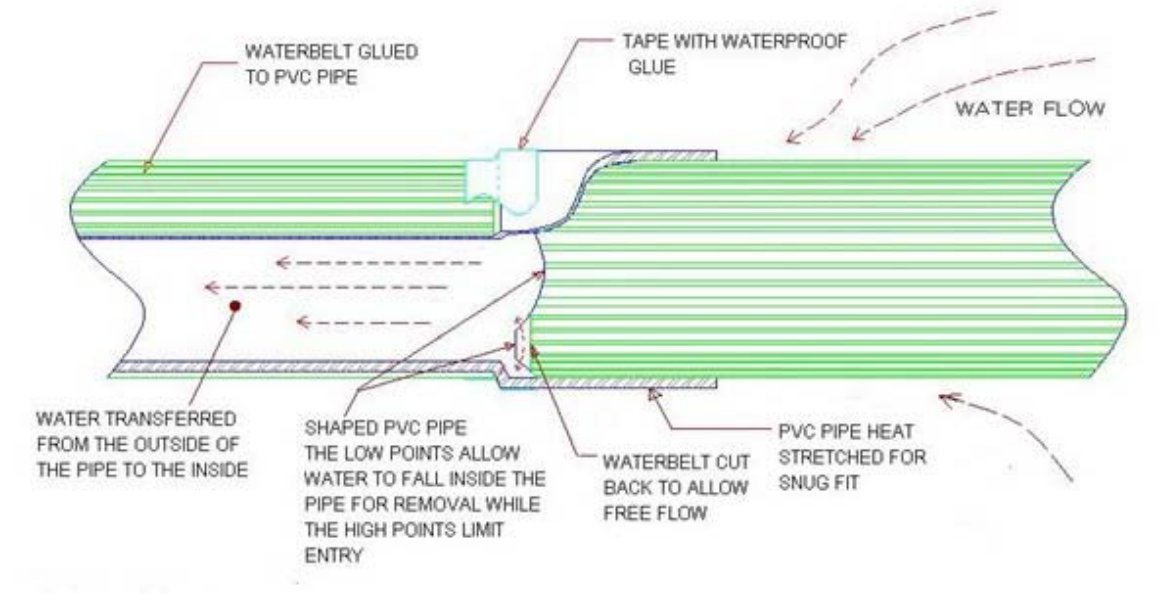




SECTIONS CAN BE PREASSEMBLED

WATERBELT / PIPE JOINTS (INLINE INSTALLATION)





ASSEMBLED PIPES READY FOR INSTALLATION

THE CHOICE OF DRILLING EQUIPMENT DEPENDS ON JOBSITE CONDITIONS AND ACCESS

GENERAL DESIGN PRINCIPLES

COLLECTION OF WATER

WATERBELT was not designed to transport water. Adding length to the collection side beyond the maximum flow rate does not increase the efficiency of the system. Lengths of Waterbelt should not exceed 5 meters before discharging into a collection pipe.

The rate of discharge should always exceed the maximum collection capability of the drainage system. The discharge pipe must be sized to accommodate the volume of water collected.

SLOPE

The minimum slope should ensure the proper movement of water through the system. The collection rate is determined by the source of the water, the type of soil, and the design of the collection system. In general, a minimum of 2 % slope is required for proper discharge of the drainage system.

EMBEDMENT

The depth of installation is influenced by the site conditions and the desired drainage results. For horizontal applications, a depth of 30 cm or more is recommended.

SPACING

Spacing is determined by the type of soil, the amount of the source water, and the speed of drainage. In general, fine particle soils require closer spacing than course particle soils where the spacing can be increased.

EXAMPLES OF APPLICATIONS

TAIPEI INTERNATIONAL AIRPORT

APRON SLAB DRAINAGE

CHUN-ING RESEROIR (CHINA)

VERTICAL INSTALLATION IN 2 METER TRENCH

BANK IS NOW DRY

DISCHARGE FROM COLLECTION

RETAINING WALL INSTALLED TO STABILIZE SLOPE

DRAINAGE BLOCKED FROM MINERAL SLUDGE EXCEPT WATERBELT OUTLETS

DRAINAGE CONTINUES DESPITE SLUDGE

WATERBELT INSTALLED AS A BACK DRAIN FOR A RETAINING WALL IN A VERTICAL CONFIGURATION. THE COLLECTION OF WATER DURING A TYPHOON RESULTS IN A HEAVY DISCHARGE

INSTALLING WATERBELT FOR SPORTS FIELD

BACKFILL AND SOD

COMPLETED SPORTS FIELD AFTER HEAVY RAIN

ST ANDREWS 2000 GOLF COURSE (THAILAND)

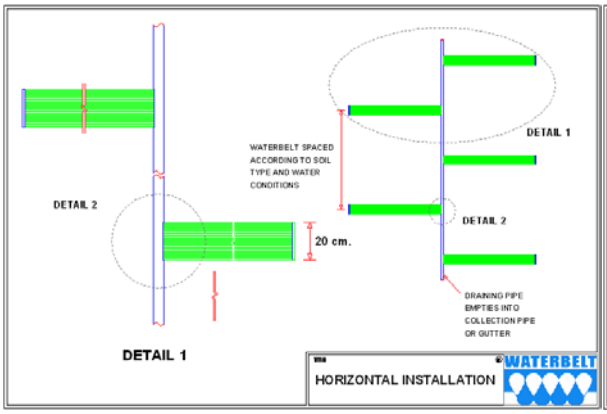
FAIRWAY DRAINAGE REPLACEMENT

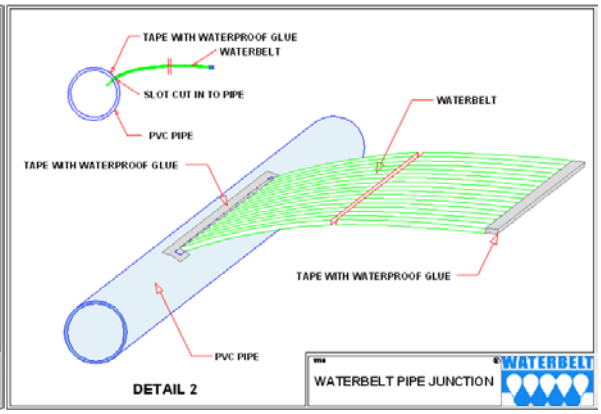
BUNKER DRAINAGE REPLACEMENT

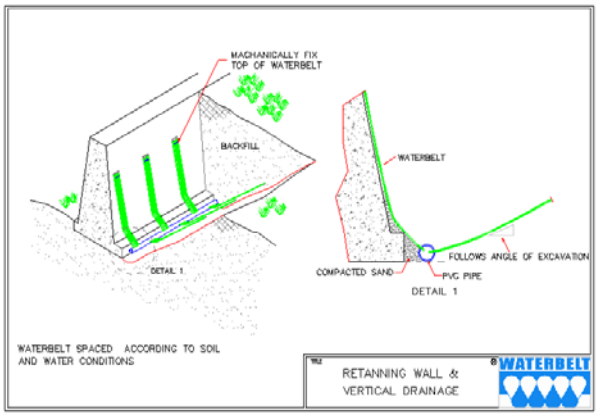
RETAINING WALL OF TAWULOON HIGHWAY (TAIWAN)

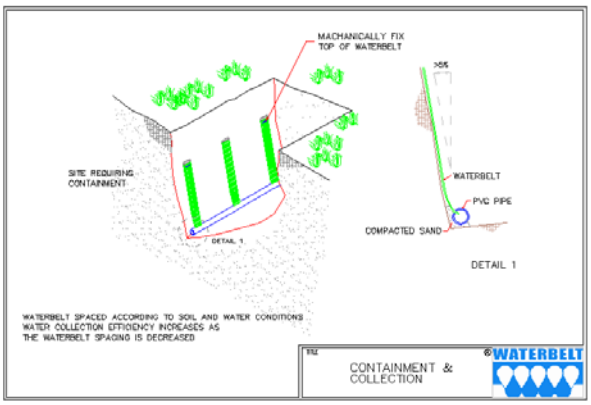
TRADITIONAL DRAINAGE BLOCKED BY LIMOLITE AFTER ONLY 15 DAYS

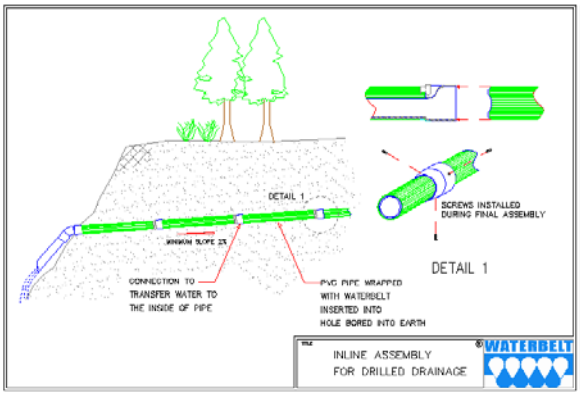
WATERBELT DRAINAGE STILL PERCOLATING AFTER 10 MONTHS

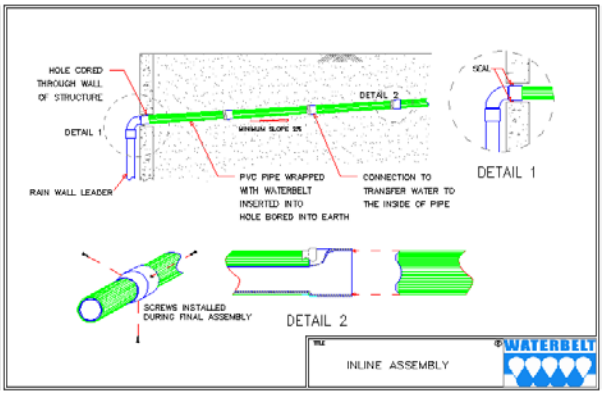

DETAIL 1
DETAIL 2
WATERBELT SPACED ACCORDING TO SOIL TYPE AND WATER CONDITIONS
20 cm.
DRAINING PIPE EMPTIES INTO COLLECTION PIPE OR GUTTER
DETAIL 1
HORIZONTAL INSTALLATION
WATERBELT

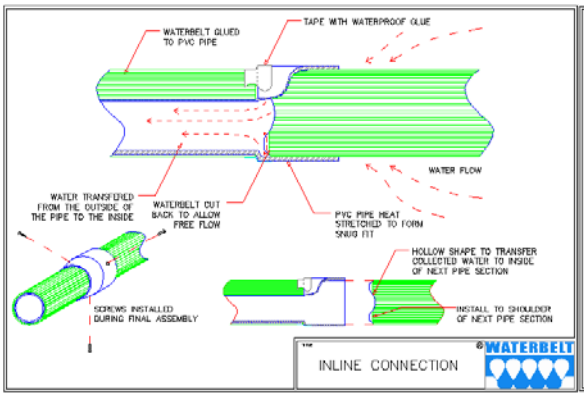

TAPE WITH WATERPROOF GLUE
WATERBELT
SLOT CUT IN TO PIPE
PVC PIPE
WATERBELT
TAPE WITH WATERPROOF GLUE
TAPE WITH WATERPROOF GLUE
PVC PIPE
DETAIL 2
WATERBELT PIPE JUNCTION
WATERBELT

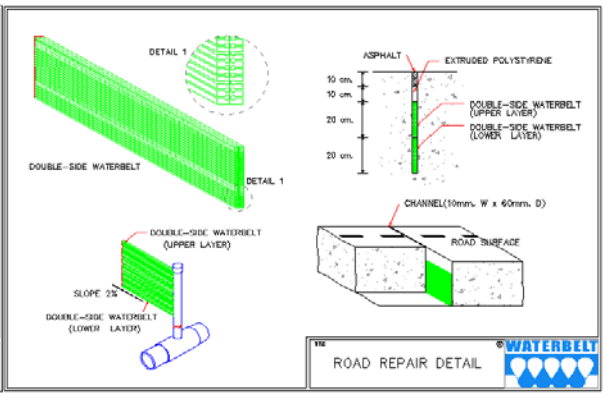

MACHANICALLY FIX TOP OF WATERBELT
BACKFILL
DETAIL 1
WATERBELT
FOLLOWS ANGLE OF EXCAVATION
COMPACTED SAND
PVC PIPE
DETAIL 1
WATERBELT SPACED ACCORDING TO SOIL AND WATER CONDITIONS
RETAINING WALL & VERTICAL DRAINAGE
WATERBELT

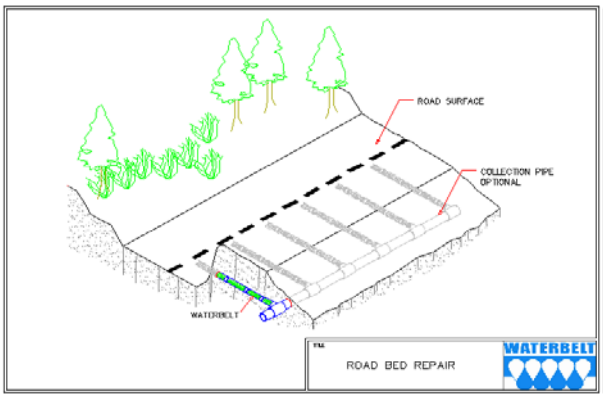

MACHANICALLY FIX TOP OF WATERBELT
SITE REQUIRING CONTAINMENT
DETAIL 1
WATERBELT
PVC PIPE
COMPACTED SAND
DETAIL 1
WATERBELT SPACED ACCORDING TO SOIL AND WATER CONDITIONS
WATER COLLECTION EFFICIENCY INCREASES AS THE WATERBELT SPACING IS DECREASED
CONTAINMENT & COLLECTION
WATERBELT

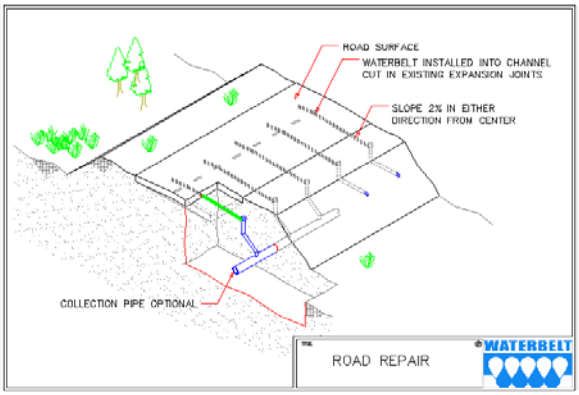

DETAIL 1
SCREWS INSTALLED DURING FINAL ASSEMBLY
DETAIL 1
CONNECTION TO TRANSFER WATER TO THE INSIDE OF PIPE
PVC PIPE WRAPPED WITH WATERBELT INSERTED INTO HOLE BORED INTO EARTH
INLINE ASSEMBLY FOR DRILLED DRAINAGE
WATERBELT

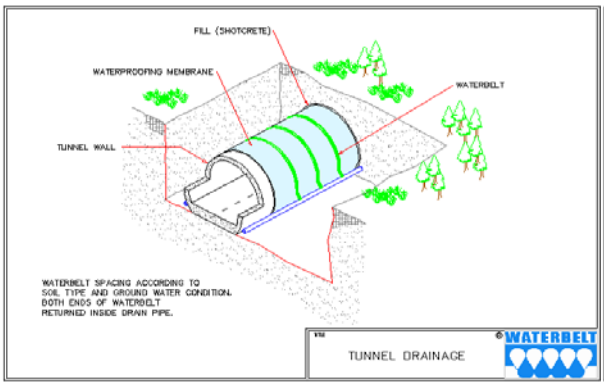

HOLE CORED THROUGH WALL OF STRUCTURE
DETAIL 2
DETAIL 1
SEAL
RAIN WALL LEADER
PVC PIPE WRAPPED WITH WATERBELT INSERTED INTO HOLE BORED INTO EARTH
CONNECTION TO TRANSFER WATER TO THE INSIDE OF PIPE
DETAIL 1
SCREWS INSTALLED DURING FINAL ASSEMBLY
DETAIL 2
INLINE ASSEMBLY
WATERBELT

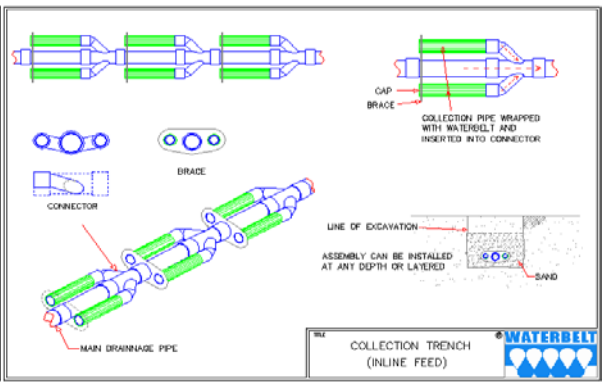

WATERBELT GLUED TO PVC PIPE
TAPE WITH WATERPROOF GLUE
WATER FLOW
WATER TRANSFERED FROM THE OUTSIDE OF THE PIPE TO THE INSIDE
WATERBELT CUT BACK TO ALLOW FREE FLOW
PVC PIPE HEAT STRETCHED TO FORM SNUG FIT
HOLLOW SHAPE TO TRANSFER COLLECTED WATER TO INSIDE OF NEXT PIPE SECTION
SCREWS INSTALLED DURING FINAL ASSEMBLY
INSTALL TO SHOULDER OF NEXT PIPE SECTION
INLINE CONNECTION
WATERBELT

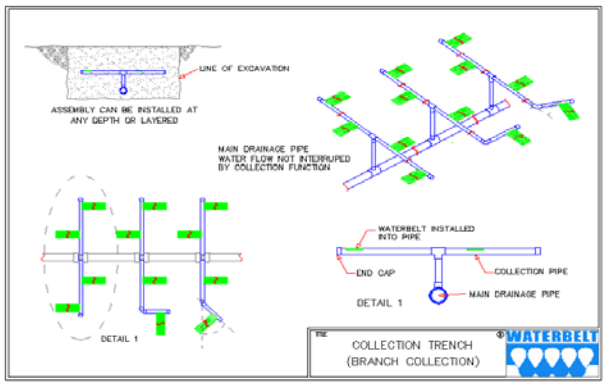

DETAIL 1
DOUBLE-SIDE WATERBELT
DETAIL 1
ASPHALT
EXTRUDED POLYSTYRENE
10 cm.
10 cm.
20 cm.
20 cm.
DOUBLE-SIDE WATERBELT (UPPER LAYER)
DOUBLE-SIDE WATERBELT (LOWER LAYER)
CHANNEL(10mm. W x 60mm. D)
ROAD SURFACE
DOUBLE-SIDE WATERBELT (UPPER LAYER)
SLOPE 2%
DOUBLE-SIDE WATERBELT (LOWER LAYER)
ROAD REPAIR DETAIL
WATERBELT

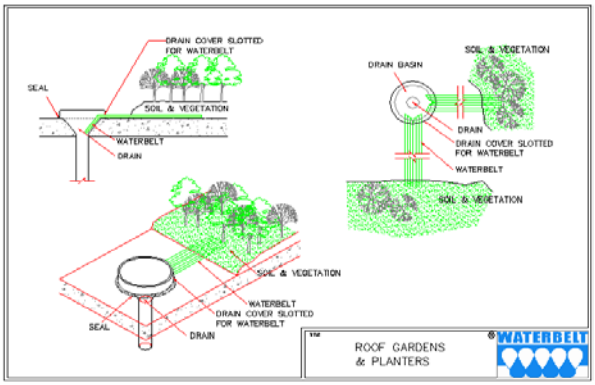

ROAD SURFACE
COLLECTION PIPE OPTIONAL
WATERBELT
ROAD BED REPAIR
WATERBELT

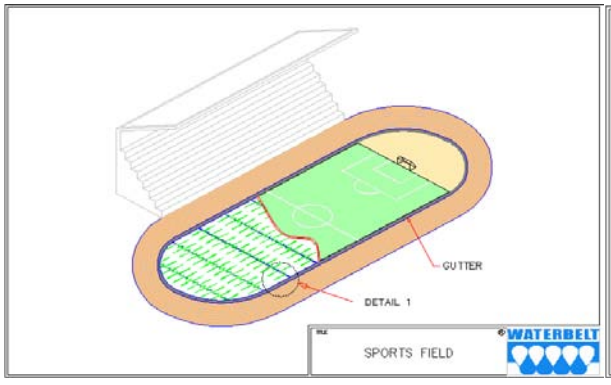

ROAD SURFACE
WATERBELT INSTALLED INTO CHANNEL CUT IN EXISTING EXPANSION JOINTS
SLOPE 2% IN EITHER DIRECTION FROM CENTER
COLLECTION PIPE OPTIONAL
ROAD REPAIR
WATERBELT

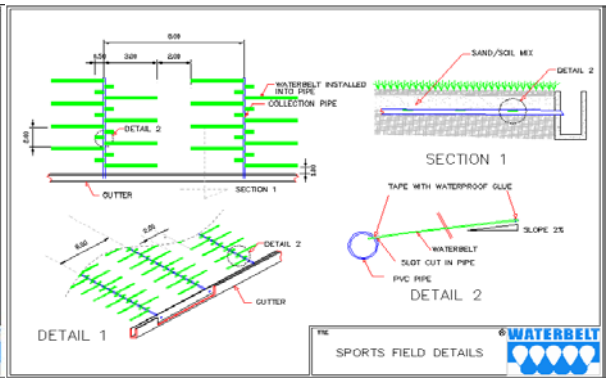

FILL (SHOTCRETE)
WATERPROOFING MEMBRANE
WATERBELT
TUNNEL WALL
WATERBELT SPACING ACCORDING TO SOIL TYPE AND GROUND WATER CONDITION. BOTH ENDS OF WATERBELT RETURNED INSIDE DRAIN PIPE.
TUNNEL DRAINAGE
WATERBELT


CAP
BRACE
COLLECTION PIPE WRAPPED WITH WATERBELT AND INSERTED INTO CONNECTOR
BRACE
CONNECTOR
LINE OF EXCAVATION
ASSEMBLY CAN BE INSTALLED AT ANY DEPTH OR LAYERED
SAND
MAIN DRAINAGE PIPE
COLLECTION TRENCH (INLINE FEED)
WATERBELT


LINE OF EXCAVATION
ASSEMBLY CAN BE INSTALLED AT ANY DEPTH OR LAYERED
MAIN DRAINAGE PIPE WATER FLOW NOT INTERRUPED BY COLLECTION FUNCTION
DETAIL 1
WATERBELT INSTALLED INTO PIPE
END CAP
COLLECTION PIPE
MAIN DRAINAGE PIPE
DETAIL 1
COLLECTION TRENCH (BRANCH COLLECTION)
WATERBELT


DRAIN COVER SLOTTED FOR WATERBELT
SEAL
SOIL & VEGETATION
WATERBELT
DRAIN
DRAIN BASIN
SOIL & VEGETATION
DRAIN
DRAIN COVER SLOTTED FOR WATERBELT
WATERBELT
SOIL & VEGETATION
SOIL & VEGETATION
WATERBELT
DRAIN COVER SLOTTED FOR WATERBELT
SEAL
DRAIN
ROOF GARDENS & PLANTERS
WATERBELT


GUTTER
DETAIL 1
SPORTS FIELD
WATERBELT


WATERBELT INSTALLED INTO PIPE
COLLECTION PIPE
DETAIL 2
SECTION 1
GUTTER
SAND/SOIL MIX
DETAIL 2
SECTION 1
TAPE WITH WATERPROOF GLUE
SLOPE 2%
WATERBELT
SLOT CUT IN PIPE
PVC PIPE
DETAIL 2
DETAIL 2
GUTTER
DETAIL 1
SPORTS FIELD DETAILS
WATERBELT