

# ***WATER & ROADS***



**Draft Documentation Report for Water from Roads & Roads Damages by Water**

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## ***Introduction***

Water and Roads is very important issue especially to the road engineers and contractors and the lack of connection between roads and water cause an environmental, economical, technical and social concern.

Environmental concern related to negative effect of the road runoff to the road body as it's damaged by the force of water and misdesign of water drainage structures and also the effect of runoff to the nearby landscape as the force of water erode the soil and degrade the terraces also it cause the transfer of cut materials to wadis beds.

Economical concern related to the increased of the investments cost of water and consequently the roads maintenance works caused by water force and lack of water protection infrastructure.

Technical concern related to the sense of connecting the twins (Water & Roads) in an integrated approach that will be advantageous advance for integrated infrastructure development.

Social concern related to benefits that will be achieved throw the community especially females and farmers and livestock .

Water and landscape in construction road or highway projects is very important subject, As we know water is vital factor for the life in all levels and also affect all the construction behavior and maintenance.

In Yemen the water harvested from the road infrastructure and the road infrastructure and environment also affected by water flow especially in rural area's as a result of neglecting or misevaluating the effect of water to the roads.

In this small documentation report there are two main subjects :

- 1- Water from Roads
- 2- Roads damages by Water

## I- Water from Roads

Road surfaces may act as a great catchment area in rainy seasons especially in rural areas thus we can established harvesting structures along the alignment of the road near to the right of the road and at the same time prevent the road body from deterioration by the accumulated water throw the road surface and side ditches, and also protect the entire environment and the degradation of soil because of the water at the outlets of the culverts and spillways in term of an integrated approach related (local communities and specialist roads engineers) whom have direct interface to the overall landscape along the roadway.

Here under a documenting of various water harvesting techniques observed in Yemen throw my work experience in the General Corporation for Roads & Bridge and also my work in Social Fund for Development as Projects Officer in Rural Roads Unit and my Consultancy work with various firms and throw Water and Environment Center.

Here in two sections of water harvesting techniques from roads for paved and stone paved roads and for asphaltic roads.

### 1. *Section 1 : Paved and Stone Paved Rural Roads*

Rural roads vary from area to area depending on the number of traffic and population density and the important intervention in these roads are to rehabilitate of the road surface by several civil works such as (Stone Paving, Retaining Walls, Irish Crossing structures, RipRap Paving for ditches, Widening of Horizontal Curves, Widening the Right of the Way, etc..)



in some areas the people used to harvest water from roads by traditional rules, but they suffered from road roughness and corruption caused by water flow but by enhancing the road surface by paved stone the nature of water way will affected and water conflict will take place either by water share at the first water outlet or by water damages to the next water outlet, so some of the solution to this problem is listed below:

### 1.1. Vertical Sag Distance with Spill Way Wall :

Vertical sag distance is short straight or sag distance lay between steep vertical slopes to divide the high vertical slopes which reached 25 % in some rural roads and act as water surface crossing, in some plain slopes a small hump is used to divert surface water from road to the side outlet.



**Figure 1 . Vertical Sag Distance**

### 1.2.Canals :

In low slopes a canal of stones is used to divert water under paving surface and it used in some areas to transport water from springs under road surface, a plastic pipe may be used.



**Figure 2 . Canal under Stone Paving**

### 1.3.Under Ground Excavated Cisterns :

It is excavated pits in the side of mountain and the rocks not so rough and they used water to deteriorate the rock before excavating them.



**Figure 3 . Under Ground Excavated Cisterns**

#### 1.4. Water Harvesting Tanks:

Traditional water harvesting tanks with different shapes and dimensions, and the road surface is their main catchment area.



**Figure 4. Water Harvesting Tanks from Paved Roads**

## 2. Section 2 Rural Roads ( Asphalt Paved )

### 2.1. Water Harvesting Tanks from road surface:

Traditional water harvesting tanks with different shapes and dimensions, and the asphalt road surface is their main catchment area.



**Figure 5. Water Harvesting Tanks from Asphaltic Road Surface**

## 2.2. Water Harvesting Tanks from Culverts Outlets:

Traditional water harvesting tanks with different shapes and dimensions, and the culvert outlet under road surface is their main source of water.



**Figure 6. Water Harvesting Tanks from Culvert Outlet**

## 2.3. Water Harvesting Cisterns from Side Ditches of the Road:

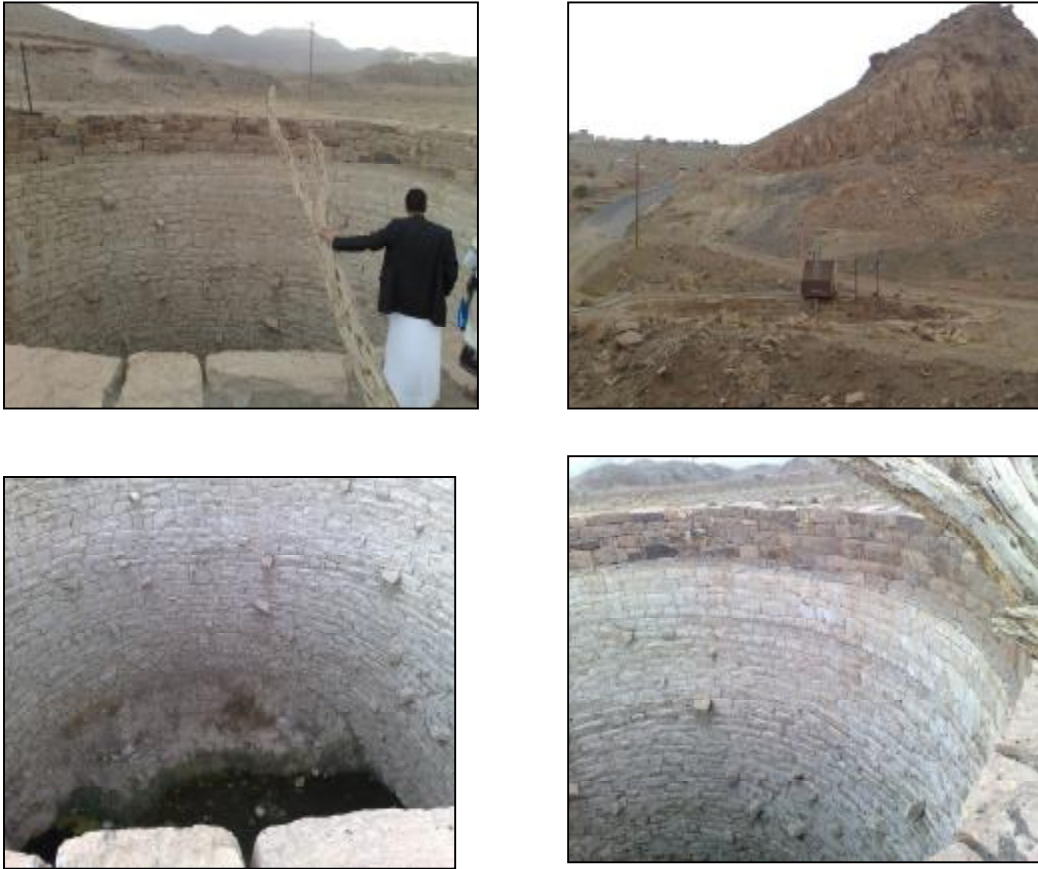
Traditional water harvesting cisterns with different shapes and dimensions and with reinforced roof, and the side ditches of the road surface is their main source of water.



**Figure 7. Water Harvesting Cistern from Side Ditches**

## 2.4. Water Harvesting Well from Road:

Wide well during rainy season it act as water harvesting structure and ground water recharge



**Figure 8. Water Harvesting Well**



## 2.5. Water Harvesting Earth Ponds from Road :

Excavation of fill materials that used to road layers and at the end of the project it act as harvesting and recharge tank.



**Figure 9. Water Harvesting Earth Pond**

The variety of the road network will help to identify the appropriate method to harvest and deal with water from and crossing the road surface in different topology.

## 2.6. Water lines ( Springs) crossing the Road :

As a result of cutting of the road surfaces to the design levels the water lines affected by this man-made interruption and some special intervention should take place to sustain the water sources .



**Figure 10. Water Spring Consideration**

As the above documentation illustrated the different techniques to collect water from roads, for example road body can act as small dams in some rural areas as advantage of the Integrated Road Design.

## II-Roads Damages by Water

### Roads affected by water force and Scouring

#### 1. Irish Crossing:



**Figure 11. Damages to Irish Crossing Outlet in an Asphaltic Road**

## 2. Culverts:



**Figure 12. Damages to Box & Pipe Culverts in an Asphaltic Road**

### 3. Side Road Ditches :

At the side ditches which Rip-Raped by grouting stones



**Figure 13. Damages to Side Rip-Raped Ditches in an Asphaltic Road  
Four above Photos was by Eng. Ahmed Al-Husiani**

#### 4. Rural Roads:

**At the outlets of Spill Ways Retaining Walls of Surface Culverts (Irish Crossing at water Streams ways in rural roads)**



**Figure 12. Damages to Irish Crossing Wall in Stone Paved Rural Road**



**Figure 12-a. Damages to Irish Crossing Dry Stone Wall in Stone Paved Rural Road**

**To be continued .....**