Majuro Sewer Outfall

Condition of Existing Damage

March 2008.

Location

SCHOOL

PUMP STATION

OUTFALL

(With visible trench erosion)

35 feet down on the edge

The Outlets.
1 of 2 Branch lines

The end of the outfall in approx. 35 ft of water consists of two branch lines separating in a 'Y' formation. The pipe project from the junction point and come to a vertical 'Tee' forming the first of three outlet vents. The delivery pipe continues on to the next two outlet vents but as the pipe exits each vertical tee the pipe diameter reduces to maintain the pressure in the line to force the sewerage to exit the outlet vents.
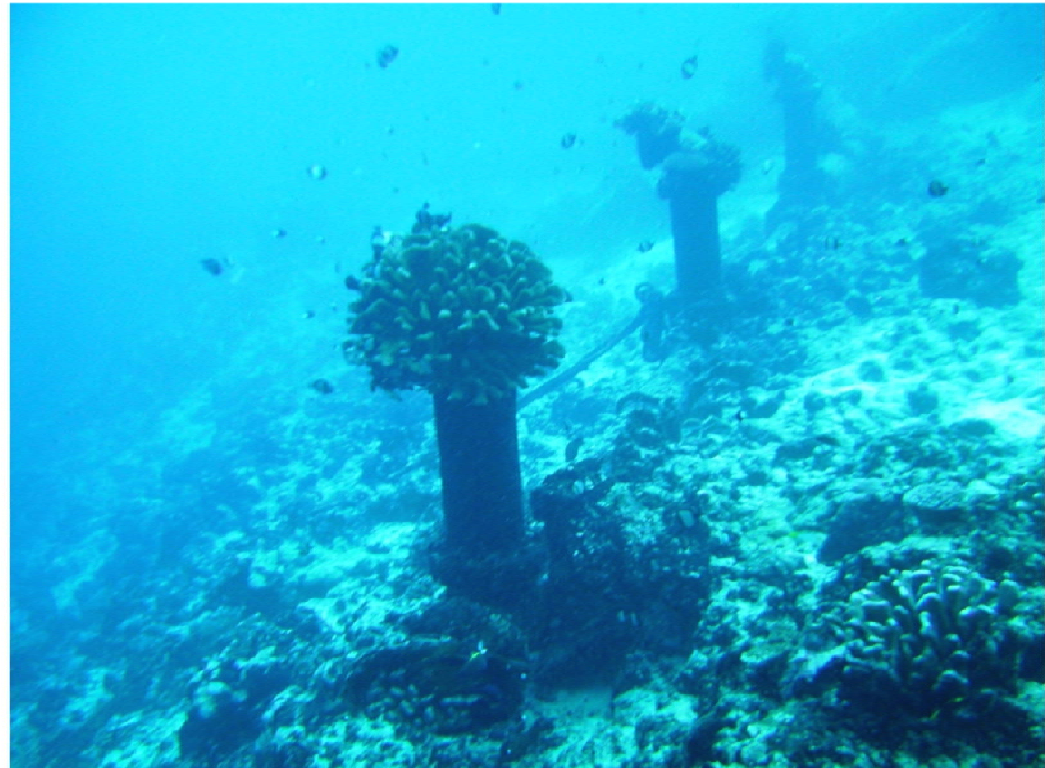
Outlet Vent Details

Here the branch line delivery pipe enters from the Left into the vertical Tee. Exiting from the vertical Tee on the right side the delivery pipe diameter is clearly reduced in size to maintain pressure in the pipeline.

Pipe Anchor System

Here we show one method used to hold the pipeline in position. These are just threaded rods drilled into the coral reef with a saddle type strapping band clamped over the pipeline. Many of these components have failed due to corrosion and abrasion.
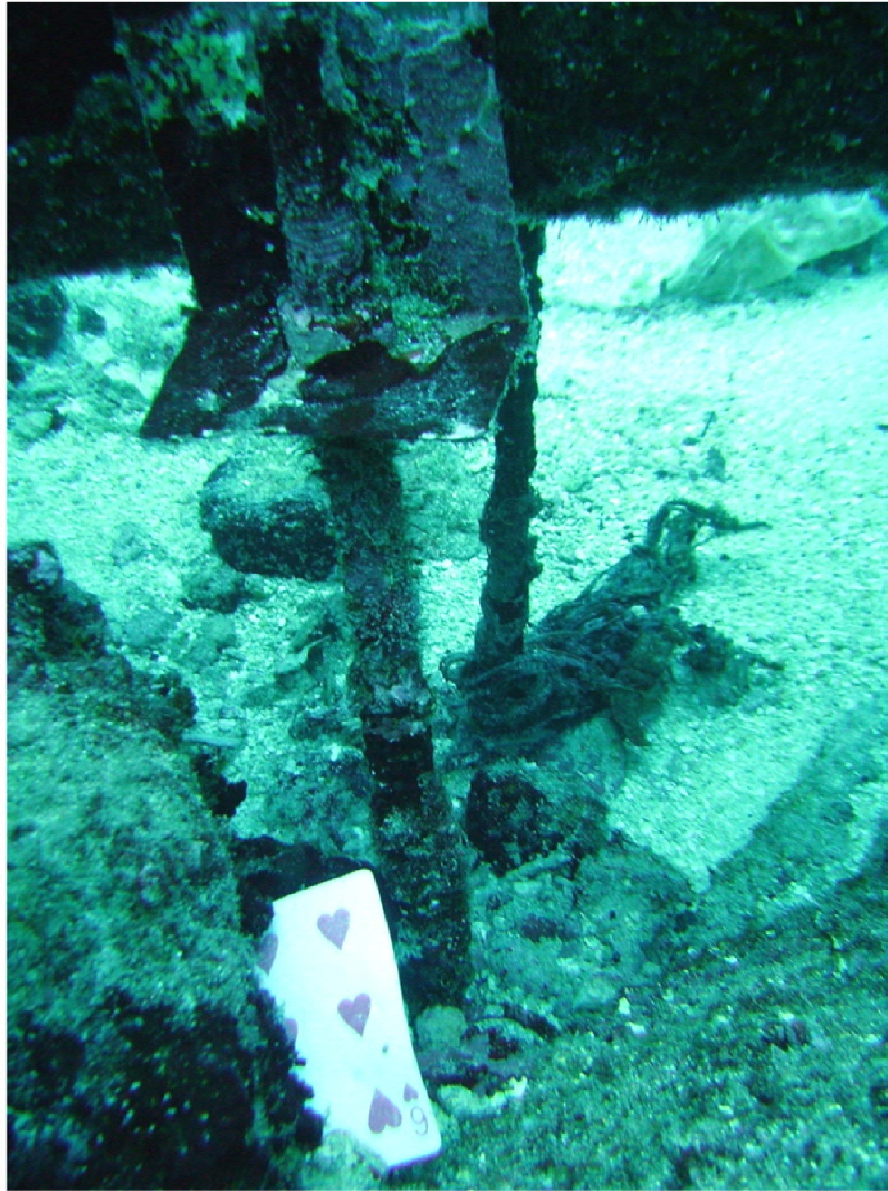
The Outlet Junction

Two views of the outlet junction.

The top view is looking towards the deep water and over the edge.

The bottom picture is looking back to the shore and the surf zone. Notice the concrete saddle weight lying alongside the pipeline.

The outfall consist of two lines with three outlet vents on each line. However there is an additional short central branch line that allows waste water to exit through a flap valve if for some reason the line over pressurizes.
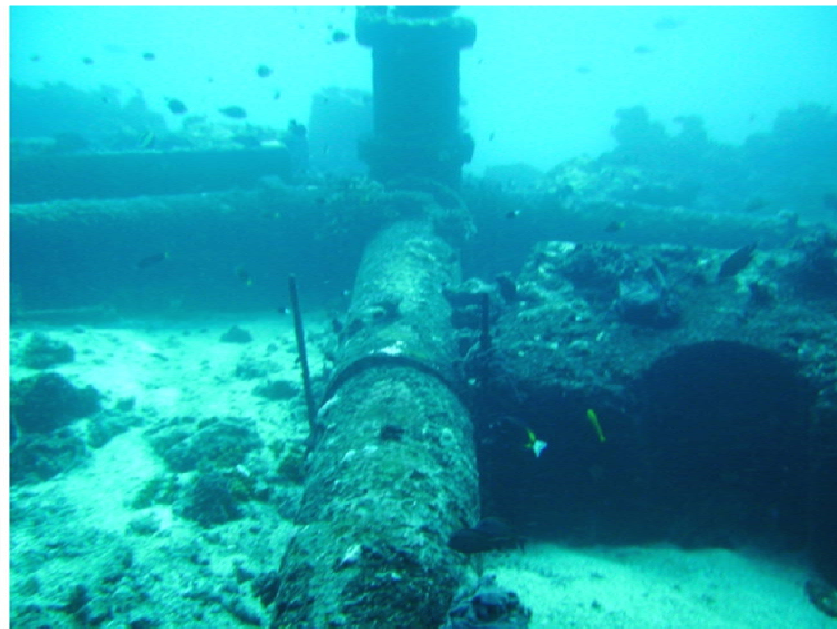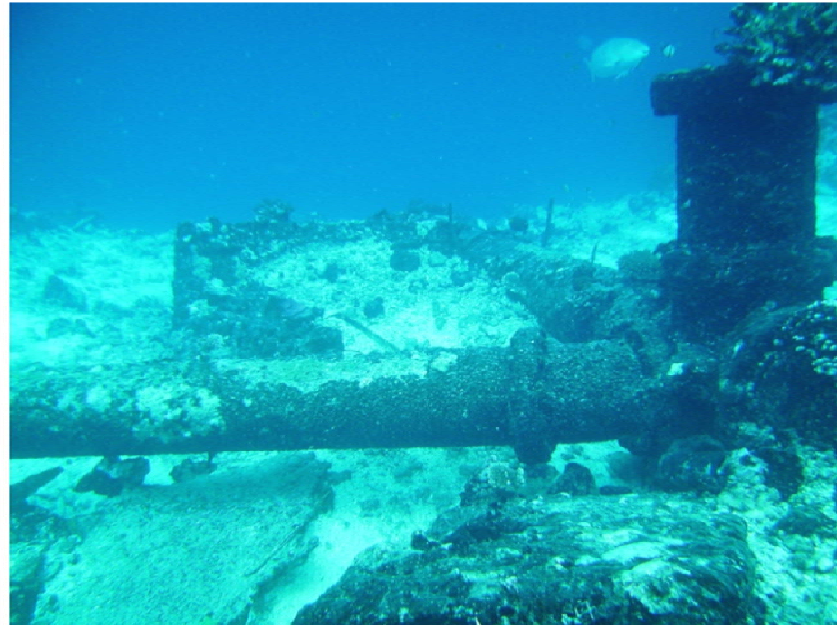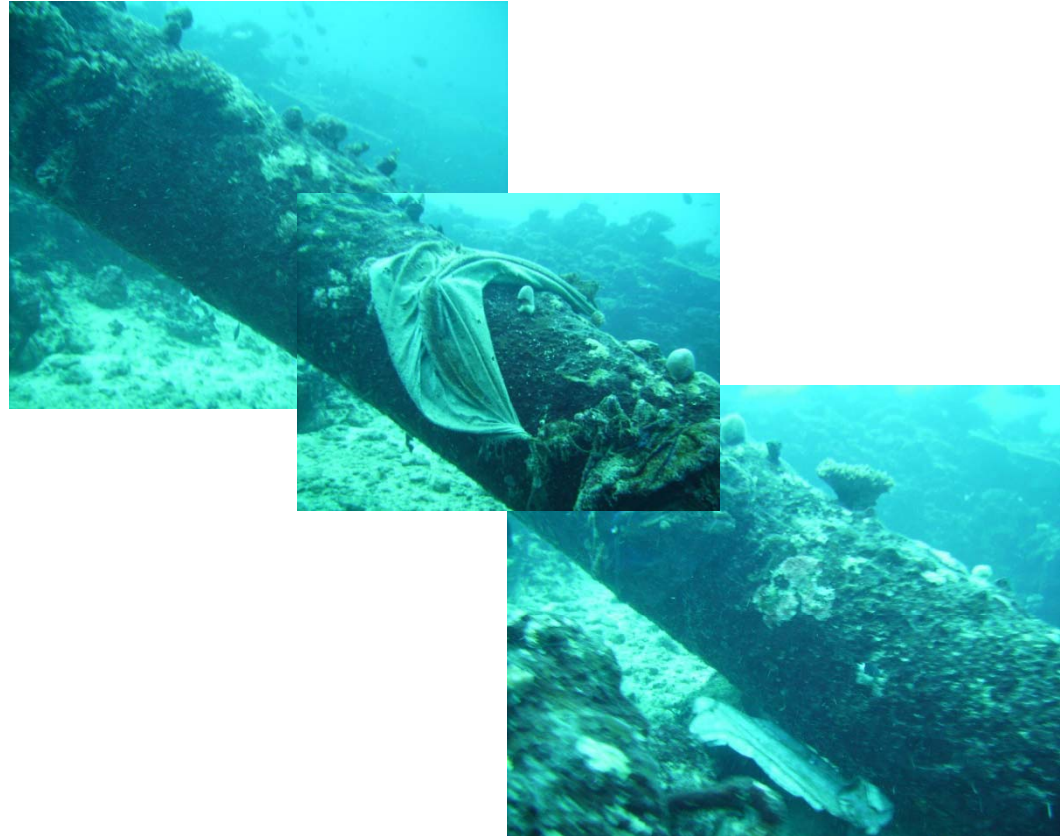
The Emergency Exit

Two photos of the flap valve on the end of the central line. This valve has been seized in this position for many years and has not worked in a long time.
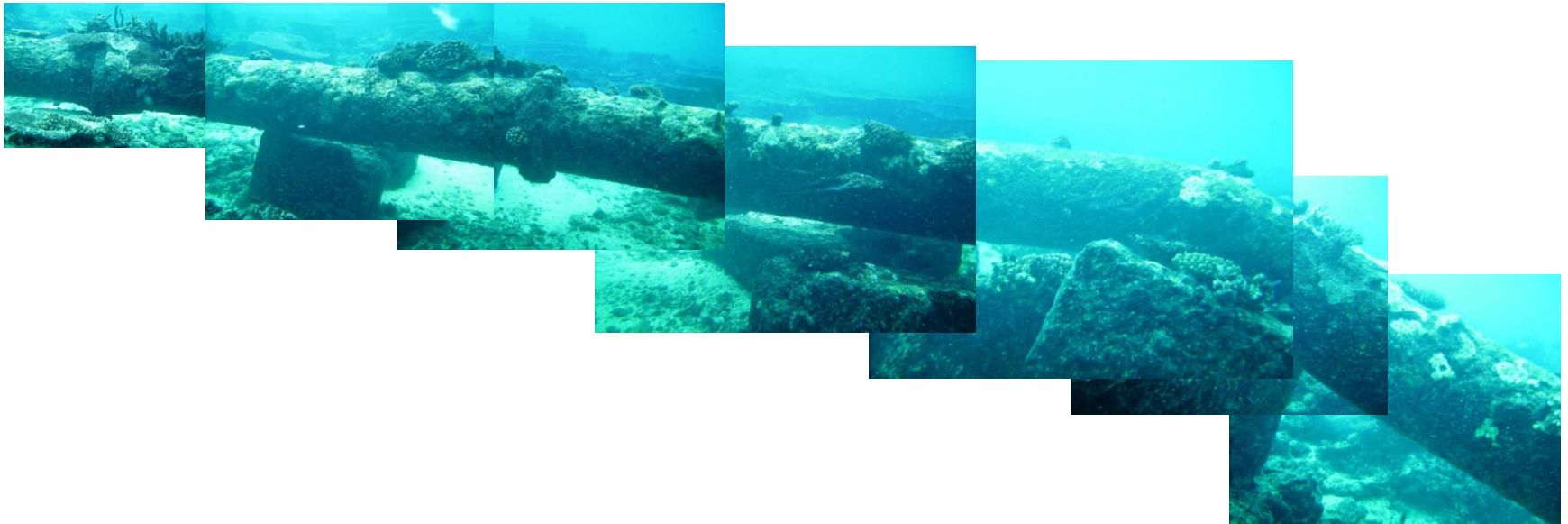
Heading Back to Shore

Much of the pipeline that is undamaged remains unsupported over the length of the line. There are very few holding down anchors still able to hold the pipeline on location.

# From the Surf Zone and over the first ledge to the outlet vents.

Concrete Saddle Weights

The majority of the concrete saddle weights that were made to sit under and over top of the pipeline are no longer in their original intended positions. Many have been cast aside because whatever method that was used to hold them in position has failed. Over the years as the restraints began to fail, the concrete weight slowly began to 'Dance' up and down on the pipe material as they were affected by the forces of the waves and turbulence generated.
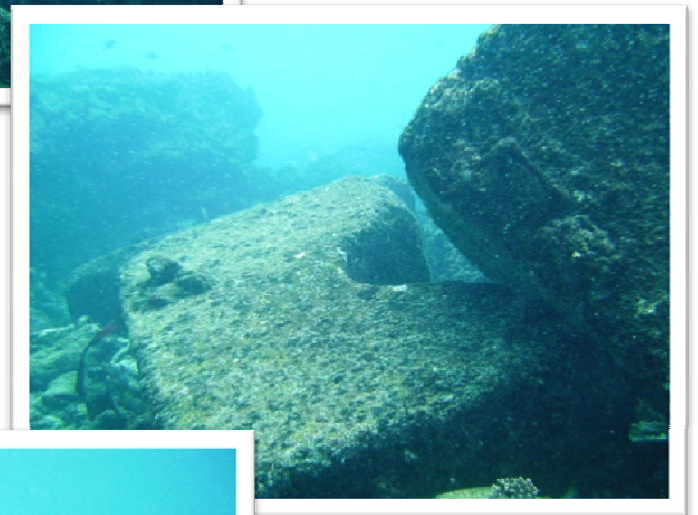
Pipe Damage

Abrasion and impact damage have caused many sections of the pipeline in the shallow region to very thin and eventually break through the pipe wall. In some areas large sections of the top part of the pipeline have been removed and in other areas whole sections of the pipeline have been lost.
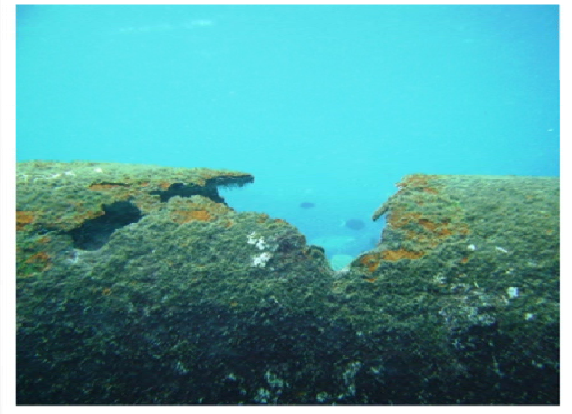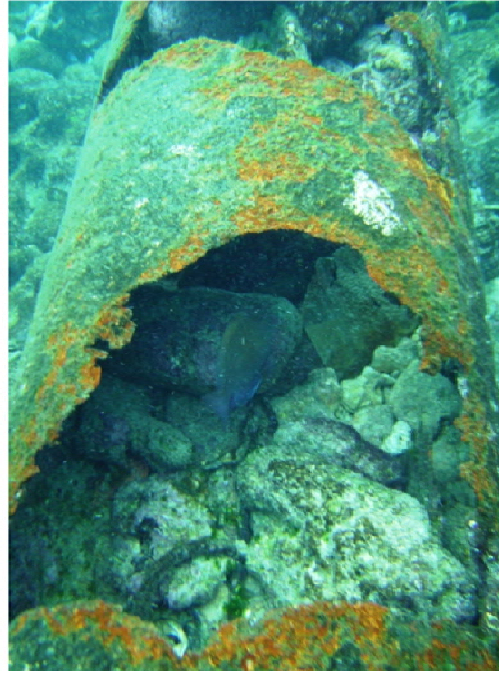
Emerging from the Reef.

The pipeline is buried in an excavated and filled trench from the pumping station and out through the exposed surf zone. The fill material put back into the trench has been washed out over the years . This has exposed the pipeline to very active wave action along with abrasion and impact damage from the material used to fill the trench. This picture shows the damaged and broken pipe emerging from the remains of the filled trench. Approx. 40 ft or 12 m of trench has been washed out.

Existing Outlet

Sewerage currently exits the damaged pipeline within the remains of the washed out trench in the surf zone. The whitish coating on the seabed indicates this. The lack of this coating elsewhere along the pipeline indicates that the pipeline has been damaged for many years.

To take these photos, the island sewerage system was shut down for approx. 6 hrs and salt water flushed through the outfall line to clear the area of any suspended particles of matter in the water. Additionally the surface currents helped clear the area as well.
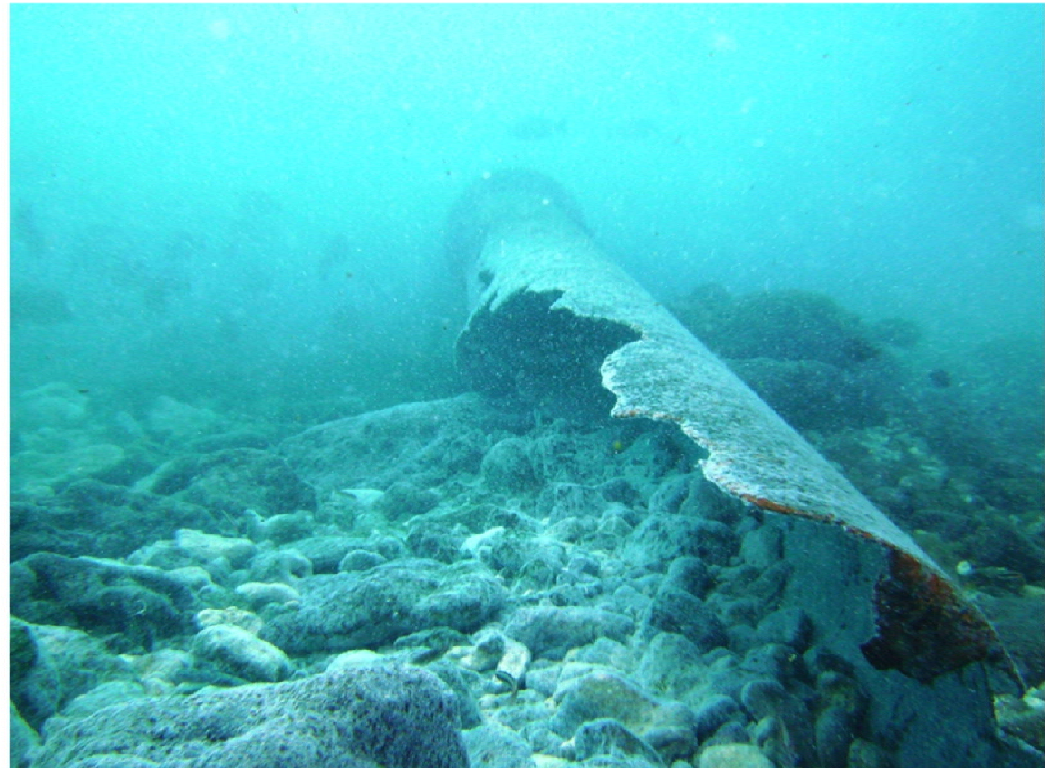
Facts & Risks

- The outfall is on the southern side of the atoll and discharges into the ocean.
- When the outfall was working as designed it was very effectively removing and dispersing the effluent waste. The outlet vents were discharging the effluent into a level of the ocean that had a current of approx. 1 knot constantly running in the opposite direction to the 1 knot surface current. This effect very rarely allowed the effluent to be visible on the ocean surface in all but calm weather.
- The pipeline system consists of sections of epoxy coated and lined ductile iron pipe that is joined by both bolted flange or bell & spigot joints. Flange bolts are mostly stainless steel and in good condition.
- It is possible to repair the pipeline but it will be difficult.

- The pipeline now discharges into the eroded trench in the surf zone. This has the potential to contaminate the reef area adjacent to the outfall.
- An large elementary school is immediately adjacent to the outfall area along with many residences.
- A large processing facility is also in the vicinity and may require to source sea water for equipment cooling.
- Due to the porosity of the coral reef structure and that freshwater wells source the freshwater from a lens floating on top of the natural saltwater in the ground, there is potential for contaminants to migrate from the ocean water to the freshwater lens structure.

Repairs

- The system could be repaired using the same materials in a similar fashion but with improved components and construction.

- The damaged sections could be replaced with heavy duty plastic pipes as used elsewhere around the world for this purpose. Anticipated costs for this work would be less than $1,000,000.

- A whole new outfall could be constructed adjacent to the existing outfall. Anticipated costs would range from $1 - $3 million.

- The best and most protected solution would be to use a horizontal directional drilled tunnel through to any deeper depth on the reef wall but the price range for this type of work is in the range of $2 – $7million.