CHAPTER 4: RESULTS

4.1 RESULTS

4.1.1 Which indicators were detectable with which sensor type?

(Described by Grundling and Van den Berg, 2004)

4.1.1.1 Landsat ETM and Landsat TM Images.

Images of both Landsat TM and Landsat ETM were used. They were tested in two wetlands namely, Mbongolwane and Seekoeivlei. It became evident that these sensors are not suitable for mapping wetland indicators because of thier characteristics (Table 17). The spatial resolution of the data is not adequate, although the spectral band width would make it a good option. Bands 2-5 and 7 would work very well for mapping vegetation, soil and water. The multispectral bands (2-5 and 7) of Landsat were used to do a resolution merge with the panchromatic EROS data. The process is explained in the section EROS (4.1.1.3)

Table 17: Landsat TM and Landsat ETM+ characteristics.

Band Number	Spectral Range (μm)	Ground Resolution (m)
1 Blue	0.45 to 0.515	30
2 Green	0.525 to 0.605	30
3 Red	0.63 to 0.690	30
4 Near IR	0.75 to 0.90	30
5 SW IR	1.55 to 1.75	30
6 Thermal	10.40 to 12.50	60
7 SW IR	2.09 to 2.35	30
PAN	0.52 to 0.90	15

The images cover an area of 185 x 185 km and the coverage is repeated every 16 days within 233 orbits. The characteristics of Landsat TM are similar to those of Landsat ETM, the main difference being that Landsat TM does not have a panchromatic band and only one thermal band.

4.1.1.2 SPOT 5.

Appendix 6 contains an A3 size map of the SPOT 5 imagery covering the Kromme River wetland area. Although this data was relatively expensive (Table 16) to acquire for such a small area, it proved to be useful for mapping the rehabilitation sites and vegetation classes. Even though the structures were not that obvious it was possible to identify the site with the assistance of GPS points collected. Differences between the different vegetation, sediment deposits, degraded land and erosion could easily be mapped using only three bands (Table 18). This sensor proved to be very good for vegetation mapping of larger areas (with a resolution of 10 m), but for monitoring rehabilitation structures it was inadequate. Bands B1 to B3 spectral range 9 (Table 18) proved to be the best to map the wetland indicators. The spectral profile (Figure 86) indicates the following profiles: profile 1 is for wetland vegetation, profile 2 for sediment and profile 3 for natural vegetation that is predominantly Fynbos.

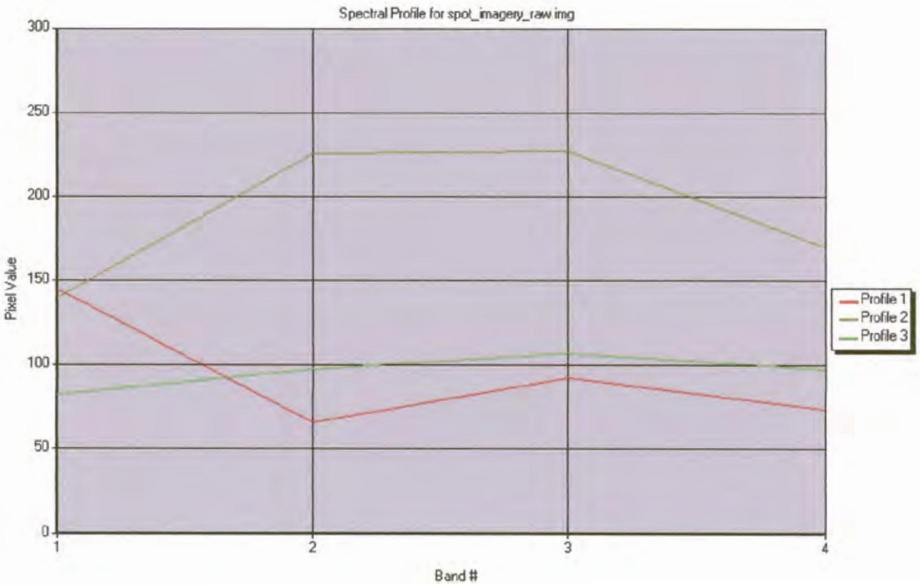

Figure 86: Spectral profile for SPOT 5 Imagery.

Table 18: SPOT 5 Characteristics.

Band Number	Spectral Range (μm)
B1 Green	0.50 to 0.59
B2 Red	0.61 to 0.68
B3 Near Infra Red	0.79 to 0.89
B4 SWIR (Short Wave Infrared)	1.58 to 1.75

Figure 89 is a subset of the SPOT 5 imagery showing some of the indicators that could be mapped (Figures 87 and 88) with verification in the field. Figure 90 shows the same area but classified into the indicator classes. The images cover an area of 60 x 60 m with a 10 m resolution for all four bands. Availability and quality of data are usually very good, depending on the cloud coverage over the study areas. It should be mentioned that a panchromatic band with 2.5 m (resample) resolution is available that could be used with the multispectral data to map the structures in more detail.

SPOT: Kromme River wetland – site 5.

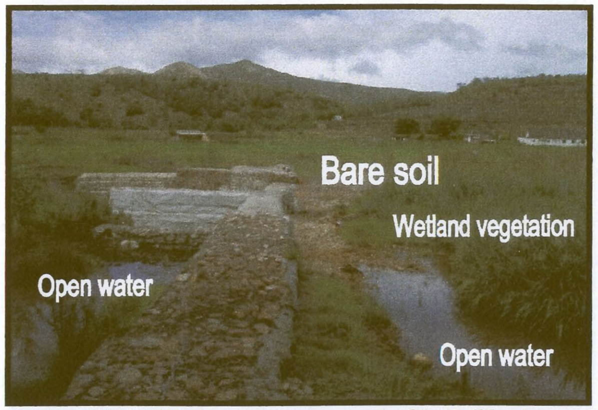

Figure 87: Gabion structure at site 5 (Hudsonvale) of the Kromme River Wetland.

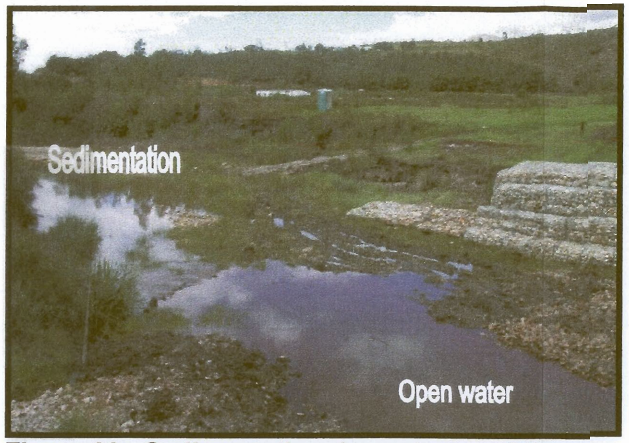

Figure 88: Sedimentation downstream of the gabion structure at site 5.

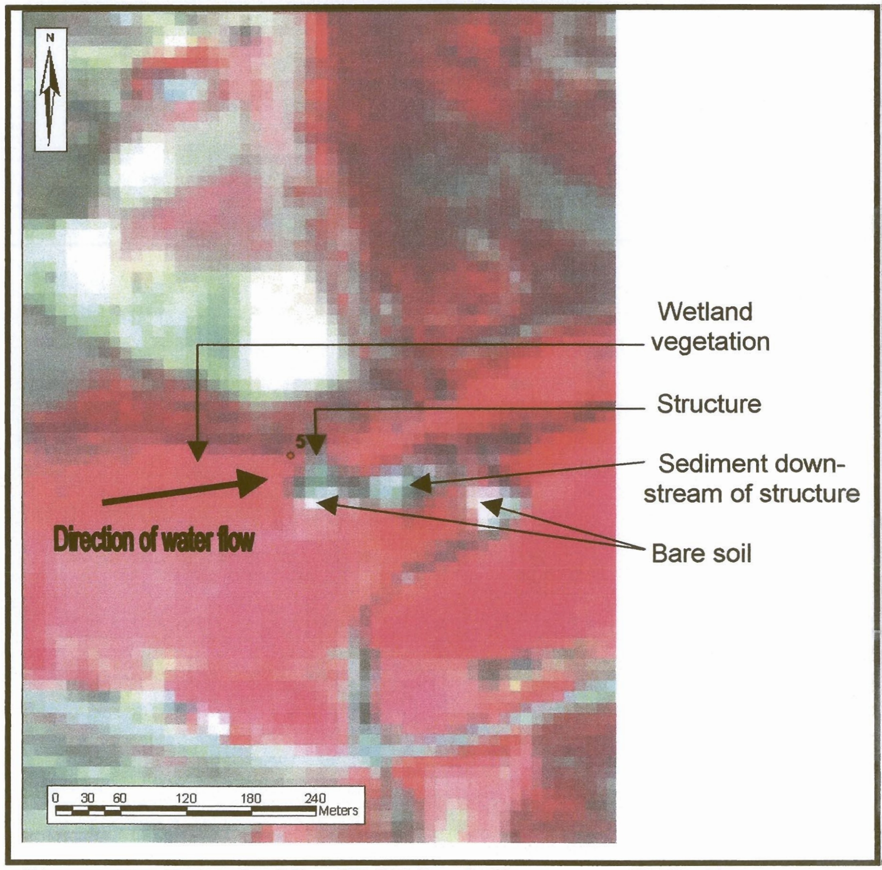

Figure 89: Subset of the SPOT 5 satellite image at site 5. Resolution: 10 m. Acquisition date: 10/02/2003.

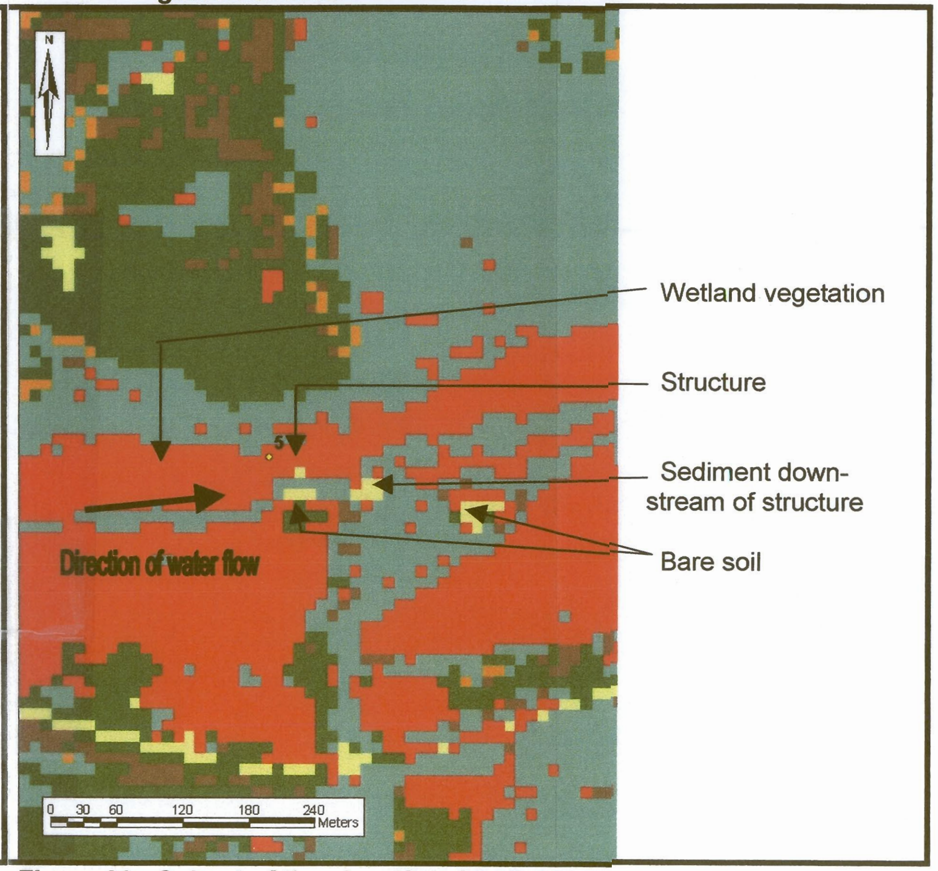

Figure 90: Subset of the classified SPOT 5 image.

4.1.1.3 EROS.

Appendix 6 contains A3 size maps of the EROS imagery covering Mbongolwane and Seekoeivlei wetland areas. The EROS A1 sensor has a panchromatic channel at 1.8 m resolution. A full EROS scene covers an area of 12.5 km x 12.5 km. These high resolution (1.8 m) images visually display the rehabilitation structures, sediment deposits and erosion (example 1) but proved not to be ideal for mapping vegetation (example 2). The reason for this is the fact that only one panchromatic band is available. The following subset examples from Mbongolwane and Seekoeivlei wetlands illustrate the visually effectiveness of this sensor.

Example 1: Mbongolwane wetland: Uvova. Photos depicting the site details are shown in Figures 91, 92, 94, 95 and 96. Figure 93 is a subset of the Uvova site (refer to example 1 used in section 11.2.5 DuncanTech CIR).

Example 2: Seekoeivlei wetland. Figure 97 is a subset of the EROS satellite image of sites 3 and 4. Figures 98, 99 and 100 are photos depicting the rehabilitation structures at sites 3 and 4. Figure 101 is a photo of an aerial view of flooded Seekoeivlei wetland covering sites 3 and 4.

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EROS example 1: Mbongolwane wetland – Uvova.

Figure 91: Erosion downstream at the Uvova site.

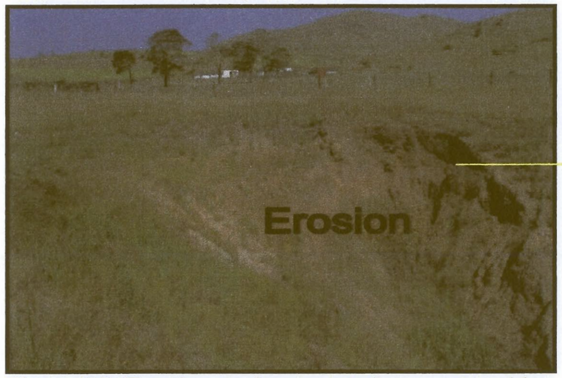

Figure 92: Erosion and revegetation on the sides at the Uvova site.

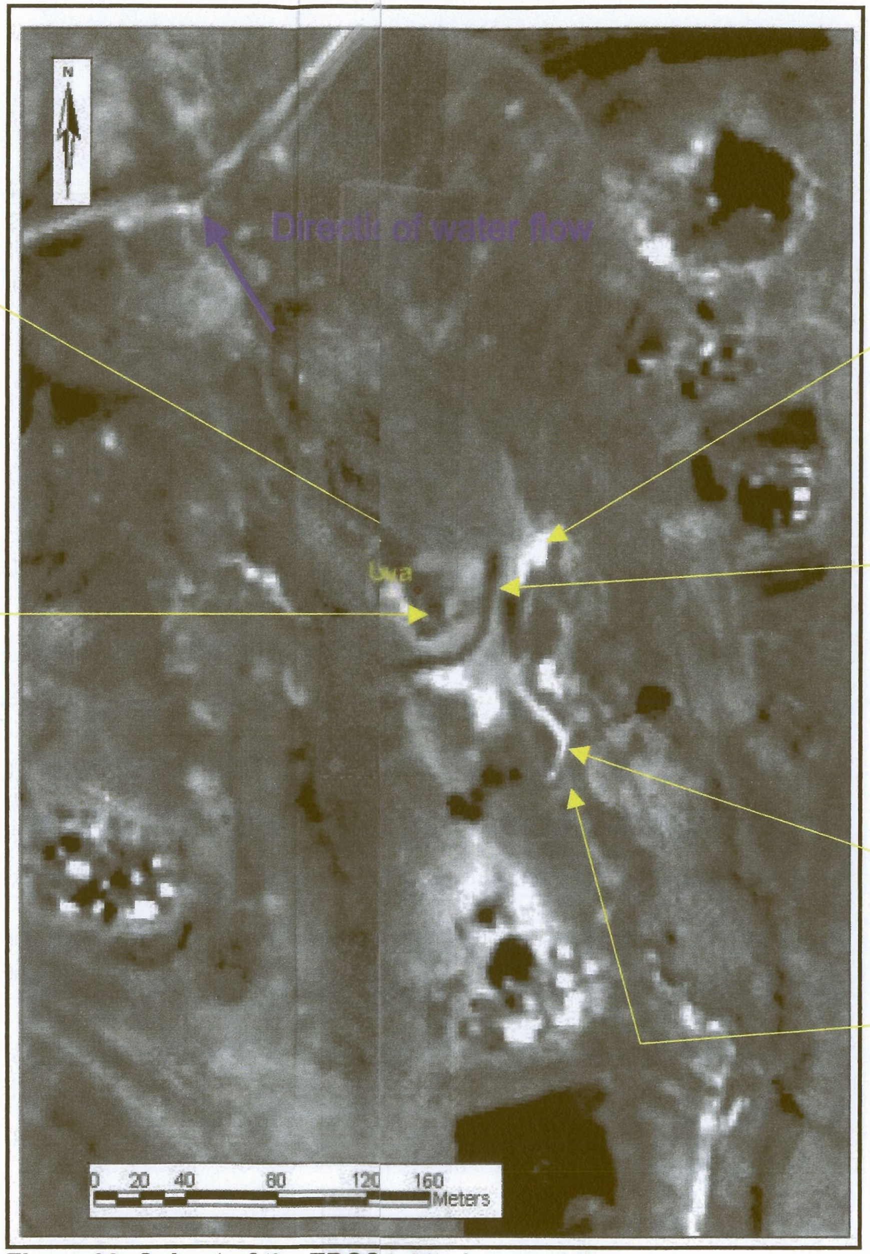

Figure 93: Subset of the EROSatellite image at the Uvova site. Resoluti: 1.8 m. Acquisition date: 24/12/2002.

Figure 94: Concrete weir.

Figure 95: Earthen embankment.

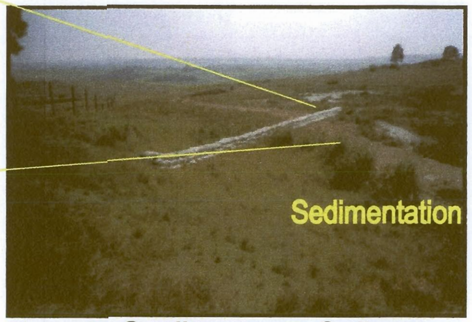

Figure 96: Sandbag groyne. Sediment Down- and upstream of the groyne.

EROS Example 2: Seekoeivlei wetland – site 3 and site 4.

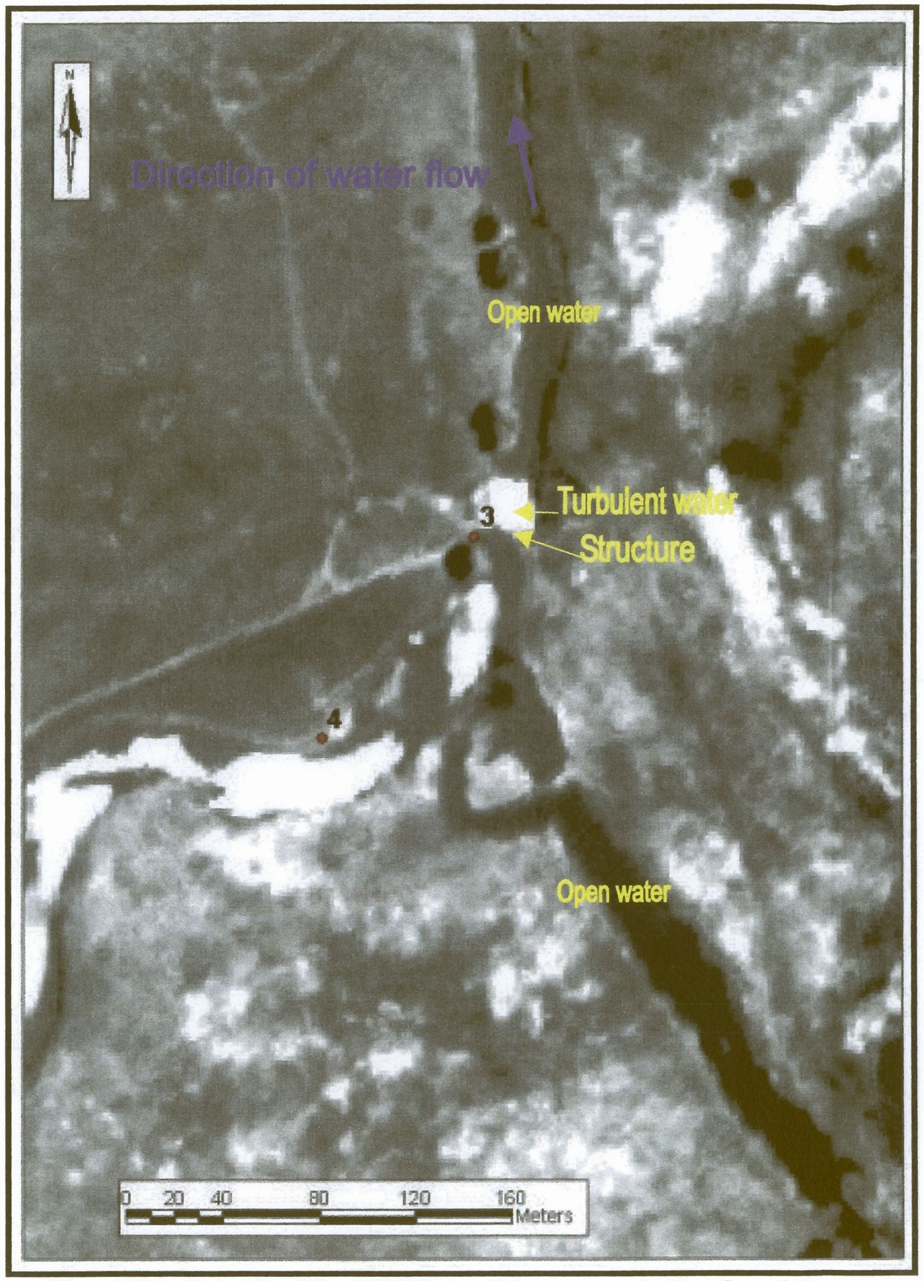

Figure 97: Subset of the EROS satellite image at sites 3 and 4. Resolution: 1.8 m. Acquisition date: 24/12/2002.

Figure 98: Site 3 at Merel's vlei. Photo taken July 2002.

Figure 99: Maintenance on the structure at site 3. Photo: J.v.d. Schyff (July 2003).

Figure 100: Site 4 at Merel's vlei. The weir is drowned below the water surface.

Figure 101: Aerial view of sites 3 and 4. Photo: G. Wandrag.

Example 3 of site 5 at the Seekoeivlei wetland shows that an EROS image together with other multispectral data with lower resolution could be used with success. Figure 102 is a subset of an EROS image at site 5 (resolution 1.8 m). For this project Landsat TM and Landsat ETM data were used with a resolution of 25-30 m (Figure 103). A resolution merge with a Browey transform and cubic convolution resampling technique was done with the data stretched to 8-bit values. The result of the resolution merge is a colour image with 1.8 m resolution which makes interpretation easer although some of the colour quality is lost (Figure 104). A resolution merge was done using the best 3 bands (Figure 105) from archived Landsat data available at ISCW. Figure 106 was taken at site 5 in July 2002. These images were used only for interpretation and not for classification. This technique could be used to interpret vegetation change but not for the visual inspection of rehabilitation structures. The erosion due to floodwaters along the edges of the rehabilitation structure at site 5 was not clear on the images. Figure 107 of site 5, taken in July 2003, shows the maintenance work that had to be done as a result of the side erosion at the structure. The sedimentation recorded on site, behind the structure, is a result of the intervention of man and not the success of the structure. Note the sandbags on the sedimentation bank in Figure 107.

It must be mentioned that the Landsat data used was data in the ISCW archive and did not fall into the optimum time periods or season to map wetland vegetation. The product could be further enhanced if multispectral data within the correct season would have been available. Multispectral bands between wavelengths of 0.52-0.90 nm with a ground resolution of 15 m or better would be a further enhancement to this product.

EROS example 3: Seekoeivlei wetland – site 5.

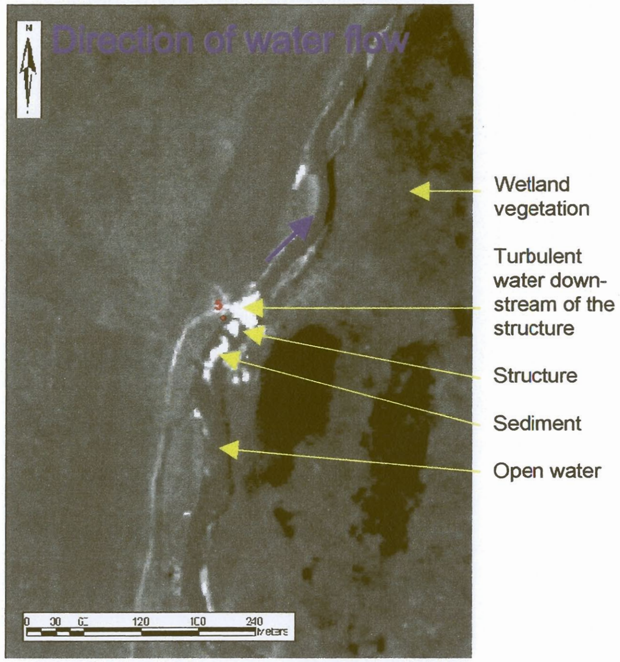

Figure 102: Subset of the EROS satellite image at Site 5. Resolution: 1.8 m. Acquisition date: 24/12/2002.

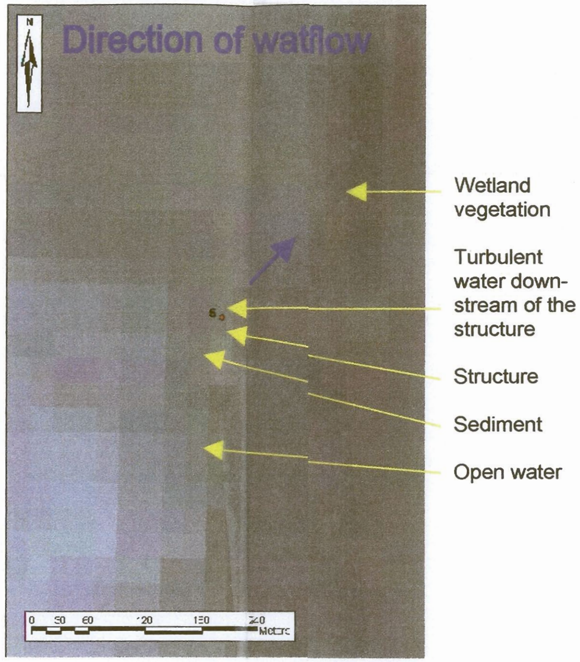

Figure 103: Subset of thendsat satellite image at Site 5. Restion: 30 m. Acquisition date: 1992, 1! and 2001.

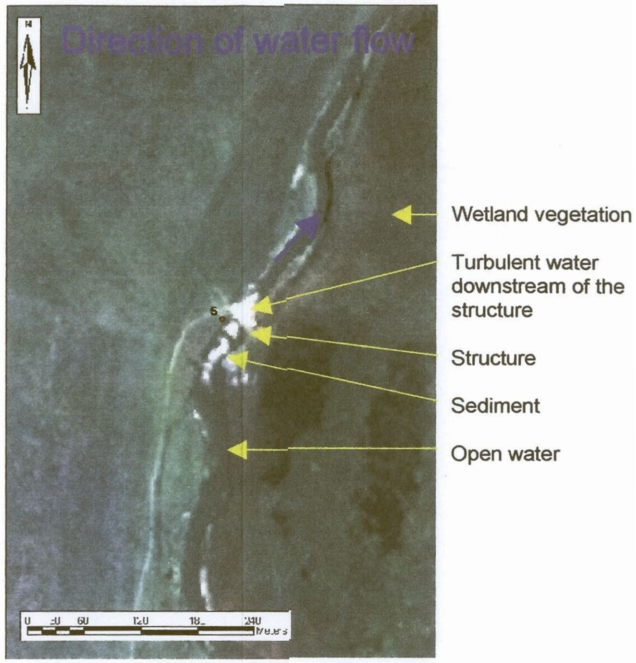

Figure 104: Pan multispectral resolution merge between EROS and Landsat. Resolution: 1.8 m.

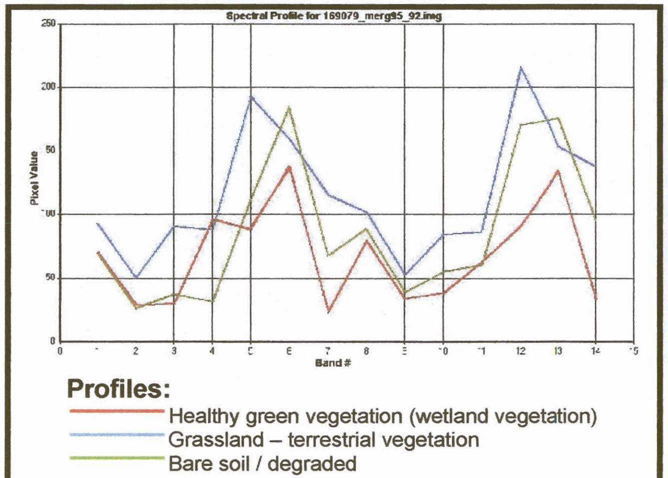

Figure 105: Spectral profile of Landsat TM layer stack image.

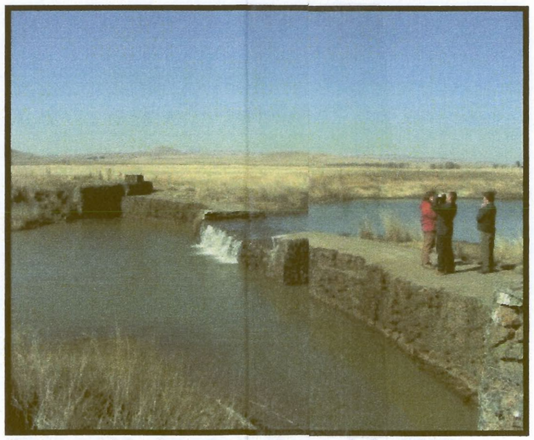

Figure 106: Site 5 photo en July 2002.

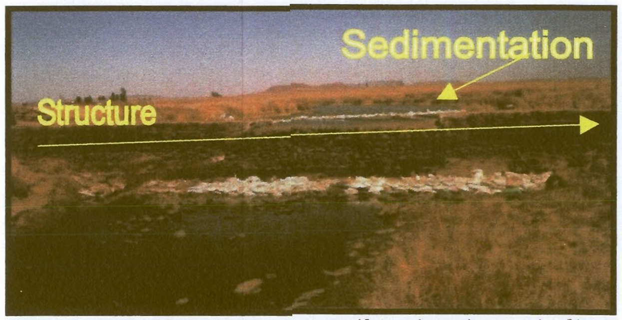

Figure 107: Maintenance on the structure at site 5. Photo: J.v.d. Schyff (July 2003).