

# ARCHAEOLOGICAL IMPACT ASSESSMENT OF SPECIFIC INTERVENTIONS FOR EMBANKMENT REHABILITATION PROPOSED AS PART OF THE STELLENBOSCH RIVER MANAGEMENT PLAN

(Assessment conducted under Section 38 (8) of the  
National Heritage Resources Act as part of an EIA.)

Prepared for

**Jeffares & Green (Pty) Ltd**

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On behalf of

**Stellenbosch Municipality**

November 2012



Prepared by

**Dave Halkett**

ACO Associates cc  
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## DECLARATION

by the independent person who compiled a specialist report or undertook a specialist process

I ...David John Halkett....., as the appointed independent specialist hereby declare that I:

- act/ed as the independent specialist in this application;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2010 and any specific environmental management Act;
- have and will not have no vested interest in the proposed activity proceeding;
- have disclosed, to the applicant, EAP and competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the Environmental Impact Assessment Regulations, 2010 and any specific environmental management Act;
- am fully aware of and meet the responsibilities in terms of NEMA, the Environmental Impact Assessment Regulations, 2010 (specifically in terms of regulation 17 of GN No. R. 543) and any specific environmental management Act, and that failure to comply with these requirements may constitute and result in disqualification;
- have provided the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not; and
- am aware that a false declaration is an offence in terms of regulation 71 of GN No. R. 543.

Note: The terms of reference must be attached.



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Signature of the specialist:

---

ACO Associates cc  
Name of company:

---

15<sup>th</sup> November 2012  
Date:

## **EXECUTIVE SUMMARY**

The report was prepared in response to the requirements of HWC in response to a NID submission. An HIA focussing on Stone Age and Historical archaeological material was requested.

No archaeological or historical heritage was identified during the assessment of the proposed embankment rehabilitation sites.

The assessment of the upgrade proposals has indicated no perceivable impact on archaeological or historical sites or material. None of the measures lie inside the old historic town core as defined by Hennie Vos. In many instances the proposed new erosion control measures will supplement existing measures to prevent undermining of adjoining pathways, roads and properties. These works need to be implemented to prevent further damage to existing edges and infrastructure.

There will be no impact on the Bosman's River Crossing PHS, nor on the Idas's Valley NHS.

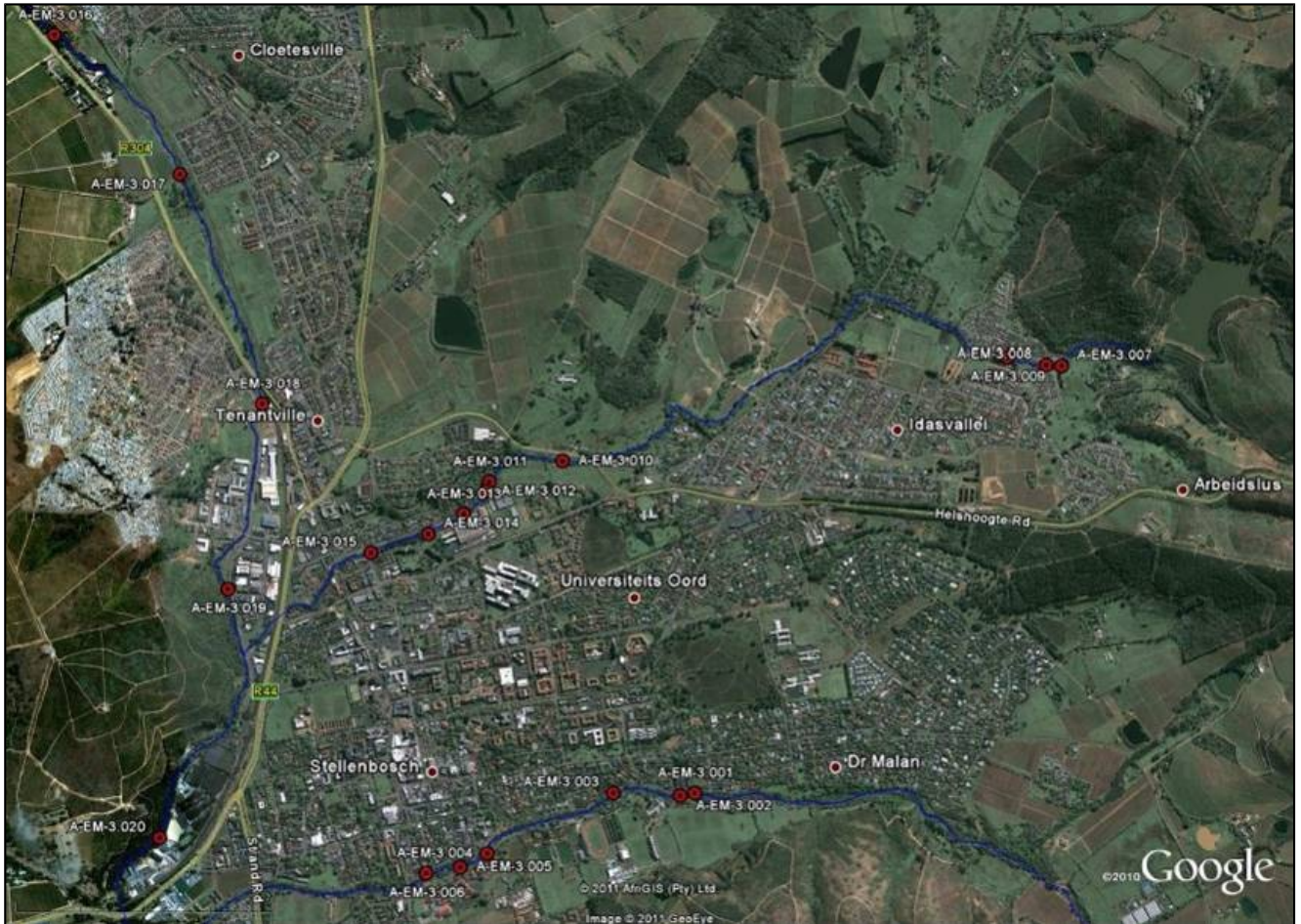
Proposed control measures are much the same as those already in place along stretches of the affected rivers. No mitigation of heritage (archaeology) is therefore required in this respect.

In the unlikely event of any heritage material being uncovered during construction, this must immediately be reported to Heritage Western Cape to determine what action is required.

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## 1. INTRODUCTION

This application impacts the courses of three rivers within the town of Stellenbosch namely the Eerste (Jonkershoek) River, Krom River & Plankenbrug River. In 1999, the Stellenbosch Municipality developed a River Management Plan (RMP) with subsequent *status quo* assessments carried out in 2002 and 2003. In 2011, Jeffares & Green (Pty) Ltd were appointed by Stellenbosch Municipality to update the RMP.



**Figure 1:** Project components within the Stellenbosch urban area (blue lines - rivers, red dots - proposed sites for specific interventions for embankment rehabilitation). See Appendix 2, Figures 3.5.1 - 3.5.39 for details of the interventions.

The Updated RMP identified a number of issues in the river corridors requiring management. Critical issues such as erosion and bank stability require immediate attention and owing to the relative size/extent and impact on the environment, the interventions will require an environmental Basic Assessment process to be followed. An NID form was submitted to HWC by ACO Associates cc and the comment received back (Appendix 1) required a Heritage Impact Assessment (HIA) to be conducted that included an Archaeological Impact Assessment (AIA), and consultation with the Stellenbosch Interest Group, Stellenbosch Heritage Foundation and South African Heritage Resources Agency (comments as received are also presented in Appendix 1). ACO Associates were appointed by Jeffares Green (Pty) Ltd to conduct the AIA which is the subject of this report. Documents describing the project as well as the NID have been sent to the various heritage bodies and their comments will be encapsulated within the HIA.

There are nearly 300 properties (private and municipal) located along the rivers that will be affected by the proposed rehabilitation interventions, and all landowners will be notified of the proposed projects during the course of the Basic Assessment process. The interventions are of relatively limited

nature aimed at curbing ongoing erosion of river banks, and in many cases will improve similar measures already in place at the sites. Three separate BAR applications will be made to DEA&DP (one for each of the rivers).

## 1.1 Project Description

The detailed project components consist of a number of interventions along the courses of three rivers, the locations of which are shown in Figure 1, and described in Table 1. Diagrams showing details of the interventions at the various sites are presented in Appendix 2.

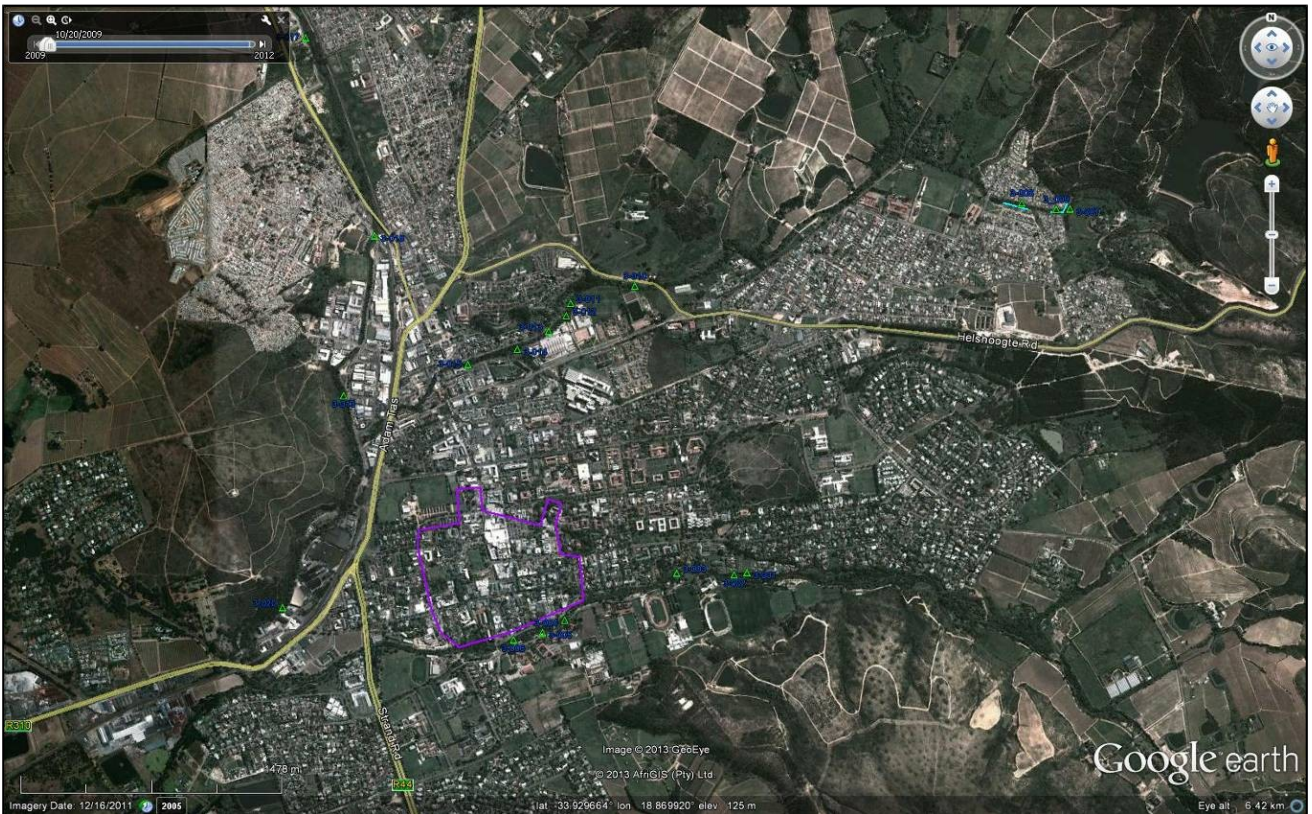
**Table 1:** River management interventions at the various sites

Intervention	Intervention Extents			Volumes				Description	Type
	Length	Width	Height	Excavation	Fill	Gabions	Rip Rap		
	(m)	(m)	(m)	(m3)	(m3)	(m3)	(m3)		
3.001	100	5	5	74	74			Extension of Gabion Mattress Protection	Gabion
3.002	5	1.6	1	8				Protection of Tree Roots	Rip Rap
3.003	15	2.5	4.63	105				Protection of Embankment Downstream of Retaining Wall	Gabion
3.004	50	2	3	240	260	240		Stabilisation of Steep Embankment Adjacent to Roadway	Gabion
3.005	30	4	2.5	130	210			Protection of Steep Embankment	Gabion
3.006	150	4.5	5	620	1500			Protection of Steep Eroded Embankment	Gabion
3.007	150	6	4	1125	1500			Slope Stabilisation	Gabion
3.008	5	5	2	16	20			Cascade	Gabion
3.009	150	2	3	375	600			Embankment Protection	Gabion
3.010	4	2	3	10	16			Headwall Undercut Protection	Gabion
3.011	100	4	5	540	600	140		Retaining Wall at 'Die Rand'	Retaining Wall
3.012	10	2	0.7	7				Protection of Retaining Wall Foundation at 'Die Rand'	Rip Rap
3.013	120	2	3	300	480			Stabilisation of Slope at 'Die Rand'	Gabion
3.014	30	25	4	180	330			Protection of Banks Downstream of Cascade	Gabion
3.015	10	2.5	4	42	70			Protection of Steep Embankment	Gabion
3.016	40	2	3	100	160			Stabilisation of Eroded Embankment Toe	Gabion
3.017	20	7	7	75	120			Stabilisation of Unconsolidated Embankment Toe	Gabion
3.018	20	2	3	35	80			Extension of Gabion Wing-Wall	Gabion
3.019	15	2	3	40	60			Protection of Eroded Embankment	Gabion
3.020	20	3	4.5	75	55	20		Retaining Wall at Wine Processing Factories	Retaining Wall

## 2. BRIEF BACKGROUND

The town of Stellenbosch has a well known colonial history, starting in the 17<sup>th</sup> C and the development of the town and its layout are intrinsically linked to the historical layout. According to Franssen (2006:65), early Stellenbosch is an example of a planned village at its best; ...."it is intimate, on a human scale and organic yet with a clearly established logical structure"....."It also set a pattern for many dozens of later Cape town designs, in that it received a long row of houses (facing onto a main road) that stood at the top of strips of well watered land down to the river(s)".

The Historic core of the town is shown on Figure 2 after a map in Vos 1993, showing the town in 1780. There are at least 94 provincial monuments in the town, many within the core historic area around Dorp Street. None of the proposed interventions which are confined to the river courses, will have any impact on the built environment. The rivers are discussed below:



**Figure 2:** The historic 18<sup>th</sup> century town core (purple) after Vos 1993, with proposed embankment rehabilitation sites indicated (green triangles)

## 2.1 Eerste River

A part of the course of the Eerste River south of the historical town core was altered historically. The current river course is to the south of where it originally flowed.

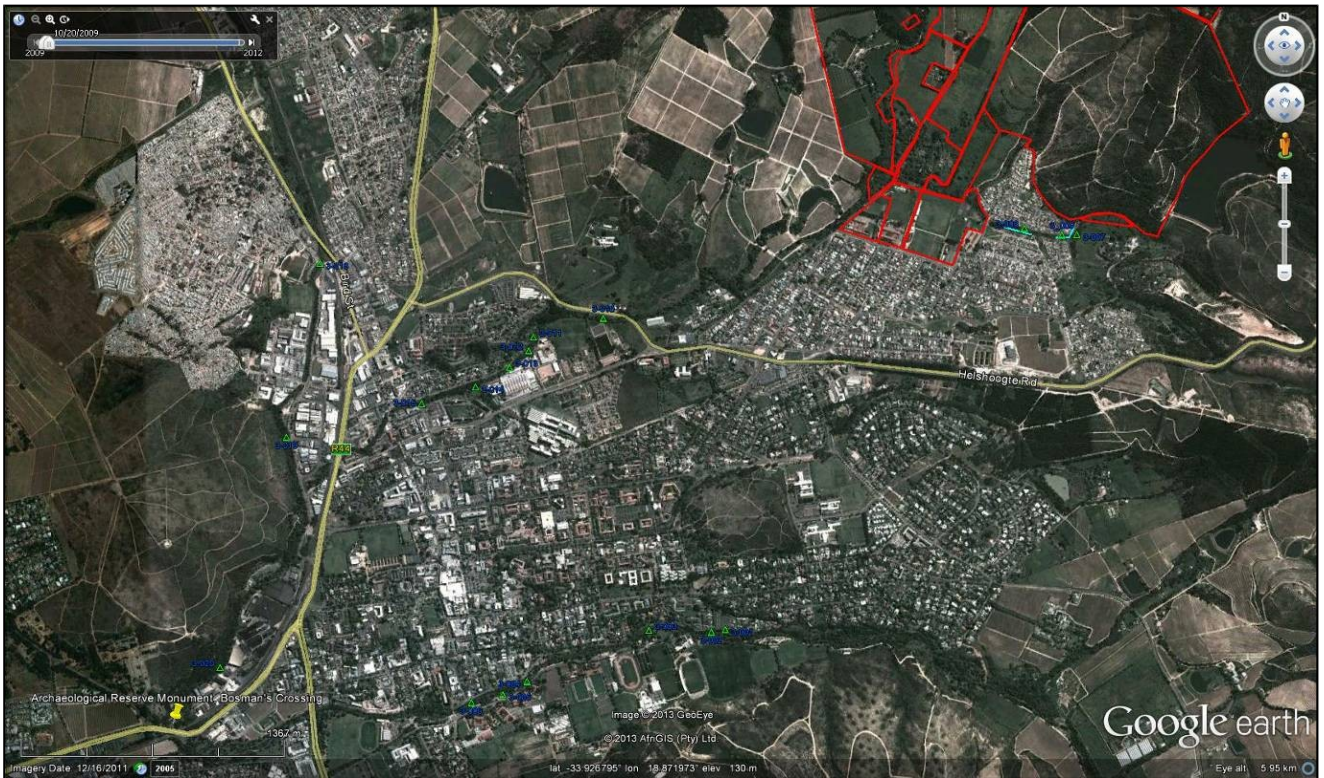
## 2.2 Krom River

The Krom River flows through Ida's Valley, part of which is a declared national Heritage Site (Grade 1). As far as we can determine, none of the three interventions on the upper reaches of the Kromme River fall within the declared area but rather in the existing urban area of Ida's Vallei (see Figure 3).

## 2.3 Plankenbrug River

There is one area of significance along the Plankenbrug River with respect to the bank rehabilitation measures. The "Archaeological Reserve" at Bosmans Crossing, next to the railway bridge on Adam Tas road was the site where according to the wording of the plaque on the monument (now stolen) that: "in a road-maker's borrow-pit here in 1899 Louis Peringuey made the first discovery of "Stellenbosch" stone implements and thereby proved the great antiquity of man in southern Africa." (see Figure 3)

The Historical Monuments Commission declared the site in 1961/2 and was later taken over by the National Monuments Council (Deacon 2011). It is now a Grade II Provincial Heritage site. While none of the interventions directly affect this declared area, one intervention, namely A-EM-3.020, is about 400 m as the crow flies to the NE. We have determined that there will be no impact on the PHS.



**Figure 3:** The locations of the Ida's Valley NHS (red polygons) and Bosman's Crossing PHS (yellow pin) in relation to the proposed embankment rehabilitation sites (green triangles)

### 3. METHODOLOGY

Locations of the proposed intervention sites were provided by Jeffares Green, converted to digital format and loaded onto handheld GPS receivers (set to the WGS84 datum) to facilitate the identification of the areas during field work. Drive and walk search paths were recorded with the GPS and photographs were captured to characterise the local receiving environment and heritage resources. Most works will occur within the existing river.

The fieldwork was conducted on the 10<sup>th</sup> August by Mr D Halkett and Ms R Mosdell and completed on the 13<sup>th</sup> August 2012 by Mr D Halkett and Ms L Webley .

#### 3.1 Limitations

Some intervention sites (3-008, 011, 012, 013) were difficult to access due to thick riverine vegetation or bank collapses, and in some cases no access was possible via fenced private property. Having seen other sites in the vicinity we do not believe that that impacts would occur I these areas.

### 4. FINDINGS

No archaeological or historical sites were identified during the field survey. In our opinion, there is little chance of archaeological or historical material being impacted by the proposed works. Photographs of typical site examples are shown in Section 6 of the report. It is important to note that may of the areas already have existing flood control measures of the type discussed here in place.

#### 4.1 Summary of comments from specific I&AP's

Refer to Appendix 1 for attached comments.

The comment from SAHRA: Built Environment Unit has indicated that the committee supports the application as read from the "Stellenbosch River Management Plan Update Specific Interventions For



Embankment Rehabilitation - Additional documents to accompany the NID application". The rider to this is that, should any archaeological material be anticipated and/or discovered during operations, work is to cease and an AIA submitted to SAHRA for assessment. The matter as it stands may be submitted to HWC for final processing as the requirements of Section 38(5) have been addressed.

No comment was received from the Stellenbosch Heritage Foundation.

The Stellenbosch Interest Group, after a lengthy delay, commented thus: "Having had a look at the proposal for work on the Eerste River, the Stellenbosch Interest Group believes that the next step will be a site visit with the consultants, a town engineer and SIG representatives present. Please could you arrange this meeting preferably in the morning and at a time suitable to all concerned".

Their request was forwarded to the Environmental Assessment company so they could be included in the I&AP list. Jeffares Green have responded that SIG will be kept informed of all project information and developments. The public engagement process will involve making the draft BAR and EMP available for public comment to registered Interested and Affected Parties (I&APs) for a period of 40 days. All registered I&APs including all State Departments and Organs of State will be notified of the availability of the draft BAR through site notices, notification letters and/ or advertisements.

The 40 day commenting period will also include a public meeting where the draft BAR will be presented and the issues and concerns can be discussed in more detail with authorities and I&APs. Any heritage comments emanating from that process have been included in this report.

## **5. CONCLUSIONS AND RECOMMENDATIONS**

The assessment of the upgrade proposals has indicated no perceivable impact on archaeological or historical sites or material. None of the measures lie inside the old historic town core as defined by Hennie Vos. In many instances the proposed new erosion control measures will supplement existing measures to prevent undermining of adjoining pathways, roads and properties. These works need to be implemented to prevent further damage to existing edges and infrastructure.

There will be no impact on the Bosman's River Crossing PHS, nor on the Idas's Valley NHS.

Proposed control measures are much the same as those already in place along stretches of the affected rivers. No mitigation of heritage (archaeology) is therefore required in this respect.

In the unlikely event of any heritage material being uncovered during construction, this must immediately be reported to Heritage Western Cape to determine what action is required.

## **6. BIBLIOGRAPHY**

Deacon, J. 2011. Background document for a meeting regarding replacement of information board at the Stellenbosch Archaeological Reserve, 21 November 2011 at Pane E Vino, Stellenbosch. Unpublished document.

Fransen, H. 2006. Old owns and villages of the Cape. Jonathan Ball. 65-75.

Peringuey, L. 1911. The Stone Ages of South Africa. Annals of the South African Museum 8.

Seddon, J. D. The Early Stone Age at Bosman's Crossing, Stellenbosch. South African Archaeological Bulletin, Vol. 21, No. 83: 133-137

Vos, H. 1993. An historical and archaeological perspective of colonial Stellenbosch, 1680-1860. Unpublished MA Thesis, Univ Stellenbosch.

## 7. PHOTOGRAPHS

### Typical intervention site examples



Intervention site 300-001 gabions (existing can be seen at left), Intervention site 300-002 tree roots



Intervention site 300-003 (l&r) existing gabions and retaining wall



Intervention site 300-005 with existing gabions, Intervention site 300-006 with existing gabions



Intervention site 300-006 erosion between existing gabions, Intervention site 300-015 new gabions to supplement existing ones upstream,



Intervention site 300-014 gabions, Intervention site 300-020 existing retaining wall to be repaired



Intervention site 300-019 new gabions to be installed

**APPENDIX 1:**

**NID Comment from HWC**

**Comments from SAHRA: Built Environment Unit**

**Stellenbosch Heritage Foundation (SHF)**

**Stellenbosch Interest Group (SIG).**

Our Ref: HMICAPE WINELANDS\STELLENBOSCH\EERSTE, KROM AND PLANKENBRUG RIVERS



Enquiries Jenna Lavin

Date: 25 July 2012

Tel: 0214839685

Case No: 120712JL05E

Email: [jenna.lavin@pgwc.gov.za](mailto:jenna.lavin@pgwc.gov.za)

Auto IDs: 1863 - 1958

**RESPONSE TO NOTIFICATION OF INTENT TO DEVELOP**  
In terms of section 38(8) of the National Heritage Resources Act (Act 25 of 1999)  
and the Western Cape Provincial Gazette 6061, Notice 298 of 2003

Attention: Mr Quinton Williams  
Jeffares & Green (Pty) Ltd  
PO Box 38561  
Pinelands  
7430

**CASE NUMBER: 120712JL05E**

**NID: STELLENBOSCH RIVER MANAGEMENT PLAN UPDATE FOR THE SPECIFIC INTERVENTIONS FOR EMBANKMENT REHABILITATION FOR THE EERSTE, KROM AND PLANKENBRUG RIVERS, STELLENBOSCH**

The matter above has reference.

Your NID received on 12 July 2012 was tabled and the following was discussed;

1. A number of interventions are proposed along the courses of three rivers that flow through Stellenbosch including protection and stabilisation mechanisms
2. The proposed interventions are aimed at curbing the ongoing erosion of river banks
3. The Krom River flows along Ida's Valley which has been graded as Grade 1 and is in the process of being declared a National Heritage Site for its significance to slavery. No interventions are proposed in the declared area
4. The Provincial Heritage Site of the Archaeological Reserve at Bosmans Crossing along the Plankenbrug River will not be directly affected. However, the nearest intervention lies 400m NE of this site and may have a broader impact on the heritage resource
5. No impacts on declared heritage resources have been identified however there may be minimal impact to unidentified archaeological and historical resources

**Decision**

1. Since there is reason to believe that heritage resources will be impacted upon, HWC requires an HIA in terms of S. 38(3) of the NHRA (Act 25 of 1999) assessing the impacts on the following heritage resources which it has identified; stone age and historical archaeological resources.
2. The comments from SAHRA, the Stellenbosch Heritage Foundation and the Stellenbosch Interest Group are required.

**Terms and Conditions:**

Heritage Western Cape reserves the right to request additional information as required.

**Should you have any further queries, please contact the official above and quote the case number above.**

Yours faithfully

Andrew B Hall  
Chief Executive Officer  
Heritage Western Cape

[www.capegateway.gov.za/culture\\_sport](http://www.capegateway.gov.za/culture_sport)

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Straatadres: Pieter Assuransiegebou, Groenmarktplein, Kaapstad, 8000 • Posadres: Privatebag X9067, Kaapstad, 8001  
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## Response from SAHRA, western Cape



SOUTH AFRICAN HERITAGE RESOURCES AGENCY  
BLOCK C, CASTLE OF GOOD HOPE, CAPE TOWN, 8000  
PO BOX 2771, CAPE TOWN, 8001  
TEL (021) 4652198 - FAX (021) 4655789

**Our Ref:** 9/2/084/0002  
**Enquiries:** Gregory Ontong  
**Date:** 9 January 2013

DAVE HALKETT  
ACO ASSOCIATES CC  
ARCHAEOLOGY AND HERITAGE SPECIALISTS  
8 JACOBS LADDER  
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7945

**TELEPHONE:** 021 706 4104  
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**E-MAIL:** [david.halkett@aco-associates.com](mailto:david.halkett@aco-associates.com)

**FOR ATTENTION: MR. DAVID HALKETT**

Dear Mr. Halkett

**RE: STELLENBOSCH RIVER MANAGEMENT PLAN UPDATE: SPECIFIC INTERVENTIONS FOR EMBANKMENT REHABILITATION**

Thank you for submitting your application to SAHRA for assessment. The application was assessed in terms of Section 27 as a portion of the river traverses the southernmost edge of Idas Valley, a National Heritage Site.

The Committee was informed that the matter was brought before it as part of the suggested rehabilitation and stabilization in conjunction with other activities that may have an impact on Idas Valley, a National Heritage Site.

In discussing the matter the primary concern was around archaeological impacts on the site as gleaned from the **STELLENBOSCH RIVER MANAGEMENT PLAN UPDATE SPECIFIC INTERVENTIONS FOR EMBANKMENT REHABILITATION- Additional documents to accompany the NID application;**

**Stellenbosch River Management Plan Update- Specific Interventions for Embankment Stabilisation Additional Information, November 2011, Submitted by:**

**JEFFARES & GREEN (PTY) LTD**

**P.O. Box 38561, Pinelands, 7430**

**Cape Town, South Africa**

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The Committee supported the content of the report but stated that, should any archaeological impacts be anticipated, an Archaeological Impact Assessment should be undertaken as portions of the stabilization and rehabilitation program extended over portions of the Idas Valley Site, a NHS and hence the application of Section 27 of the NHRA, 25 of 1999.

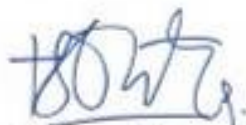
**DECISION**

The Committee supports the application as read from the **STELLENBOSCH RIVER MANAGEMENT PLAN UPDATE SPECIFIC INTERVENTIONS FOR EMBANKMENT REHABILITATION- Additional documents to accompany the NID application.**

The rider to this is that, should any archaeological material be anticipated and/or discovered during operations, work is to cease and an AIA submitted to SAHRA for assessment. The matter as it stands may be submitted to HWC for final processing as the requirements of Section 38(5) have been addressed.

Should you have any queries in this regard, please do not hesitate to contact the Divisional Manager: Built Environment Unit, Mr. Gregory Ontong, [gontong@wc.sahra.org.za](mailto:gontong@wc.sahra.org.za) or Mr. Goobani Sipoyo at [gsipoyo@wc.sahra.org.za](mailto:gsipoyo@wc.sahra.org.za)

Kind regards  
Yours Sincerely



**Divisional Manager: Built Environment Unit  
South African Heritage Resources Agency  
For SAHRA BELCom**

## Response from the Stellenbosch Heritage Foundation

Via e-mail: 2012-12-18

**RE: EROSION CONTROL MEASURES IN STELLENBOSCH RIVERS - HERITAGE COMMENT**

Dear David

I haven't received all the member's feedback as yet, but as we are out of time with commenting on this matter, HWC will allow you to proceed with your application without our comment.

I apologize for the non response. I believe the end of year work pressure has been the cause of the delay from the members.

Regards

We will be closed from the 14th of December 2012 and reopen on the 7th of January 2013.

Corlie Smart  
B.Proc \*\* \*LLM (Commercial Law)\*\*\* DIP. Insolvency (UP)  
SMART ATTORNEYS  
HERITAGE AND COMMERCIAL LAW ATTORNEYS  
BRANCHES: Stellenbosch and Pretoria  
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**From:** [david.halkett@aco-associates.com](mailto:david.halkett@aco-associates.com)  
**Sent:** 2012-12-12 12:53:01  
**To:** [smartest@mweb.co.za](mailto:smartest@mweb.co.za)  
**Cc:**  
**Subject:** Erosion control measures in Stellenbosch rivers - heritage comment

Dear Ms Smart,

I was wondering if the matter (see below) had been discussed and if a comment could be provided?

Regards  
Dave

---

**From:** [david.halkett@aco-associates.com](mailto:david.halkett@aco-associates.com)  
**Sent:** 2012-11-15 14:40:01  
**To:** [smartest@mweb.co.za](mailto:smartest@mweb.co.za)  
**Cc:**  
**Subject:** Erosion control measures in Stellenbosch rivers - heritage comment

Dear Ms Smart,

I have been working on the heritage aspects of the above project for Jeffares Green (Pty) Ltd on behalf of the Stellenbosch Municipality. Much of the proposed work involves adding additional protection or upgrading existing erosion control measures along portions of the rivers that flow through the town.

After submission of a Notice of Intent to Develop form to HWC, they have requested comment on the proposed measures from the Stellenbosch Interest Group, Stellenbosch Heritage Foundation and South African Heritage Resources Agency.

I would very much appreciate it if you could circulate the attached three documents to your committee (Stellenbosch Heritage Foundation) and provide me with comment of your organisation's views of the proposed works that I can include in the Heritage Impact Assessment report to be submitted to HWC.



I look forward to your response.

--

David Halkett  
ACO Associates cc  
Archaeology and Heritage specialists

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CK 2008/234490/23



---

**David Halkett** <david.halkett@aco-associates.com>

12/12/2012

to Patricia

Dear Patricia,

I was wondering if the matter had been discussed and if a comment was available?

Regards

Dave

---

On Thu, Nov 15, 2012 at 8:16 PM, Patricia Botha <[bothapatricia@gmail.com](mailto:bothapatricia@gmail.com)> wrote:

Dear Mr Halkett

Thank you for the documents. The SIG committee will provide comment after our next meeting at the end of November.

Regards

Patricia

---

On 15 November 2012 14:40, David Halkett <[david.halkett@aco-associates.com](mailto:david.halkett@aco-associates.com)> wrote:

Dear Ms Botha,

I have been working on the heritage aspects of the above project for Jeffares Green (Pty) Ltd on behalf of the Stellenbosch Municipality. Much of the proposed work involves adding additional protection or upgrading existing erosion control measures along portions of the rivers that flow through the town.

After submission of a Notice of Intent to Develop form to HWC, they have requested comment on the proposed measures from the Stellenbosch Interest Group, Stellenbosch Heritage Foundation and South African Heritage Resources Agency.

I would very much appreciate it if you could look at the attached three documents and provide me with comment on your organisation's views of the proposed works that I can include in the Heritage Impact Assessment report to be submitted to HWC.

I look forward to your response.

Yours sincerely

David Halkett

--

ACO Associates cc  
Archaeology and Heritage specialists

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Fax to e-mail: 086 6037195

CK 2008/234490/23

**APPENDIX 2: Intervention site diagrams**

A-EM-3.001 – Extension of Gabion Mattress Protection

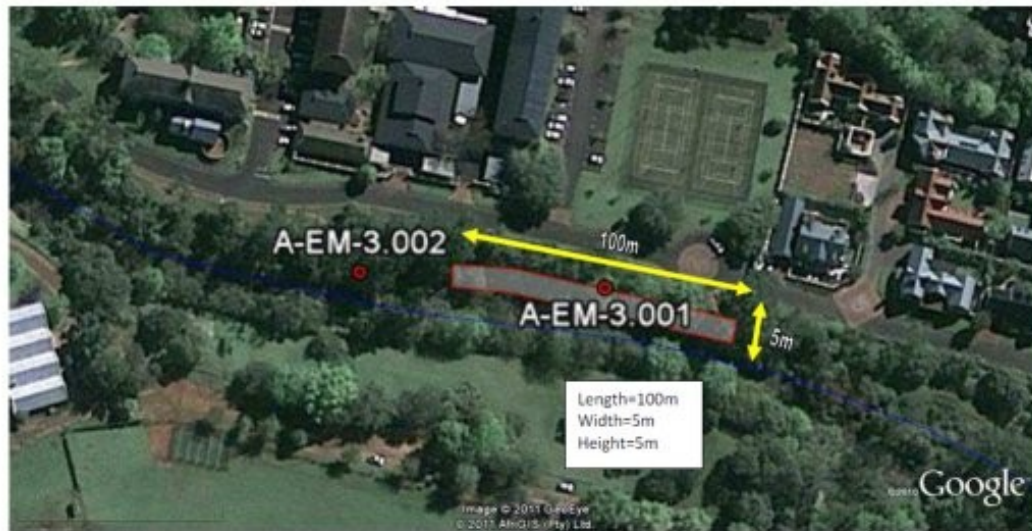


Figure 3.5.1. Extent and Locality of Projects A-EM-3.001/2

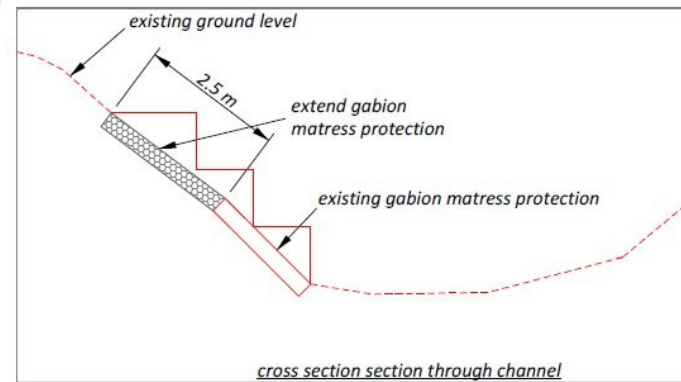


Figure 3.5.2. Extension of existing gabion mattress protection

Extent of intervention (m)	Total volume of excavation (m <sup>3</sup> )	Total volume of gabions (m <sup>3</sup> )
100	74	74

A-EM-3.002 – Protection of Tree Roots

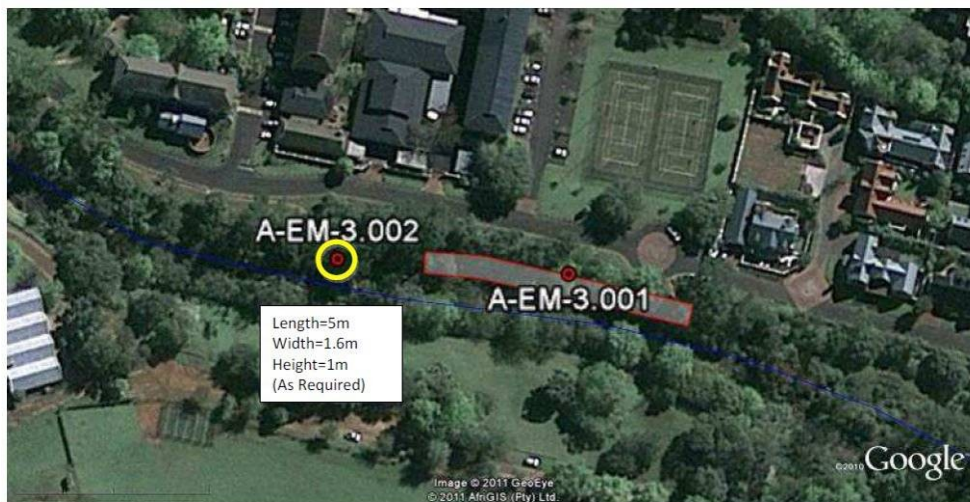


Figure 3.5.3. Extent and Locality of Projects A-EM-3.001/2

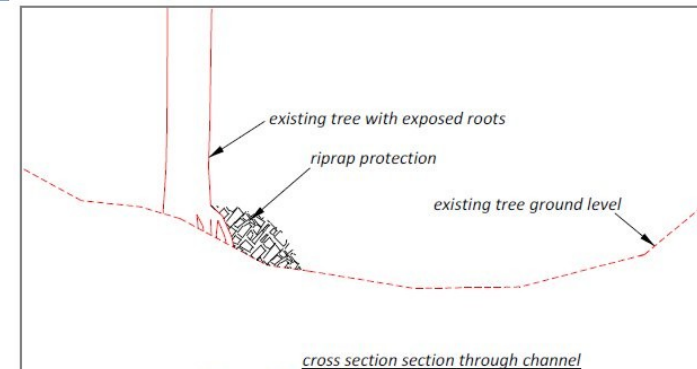


Figure 3.5.4. Protection of Tree Roots

Extent of intervention (m)	Total volume of excavation (m <sup>3</sup> )	Total volume of rip rap (m <sup>3</sup> )
5	-	8

A-EM-3.003 – Protection of Embankment Downstream of Retaining Wall



Figure 3.5.5. Extent of Project A-EM-3.003

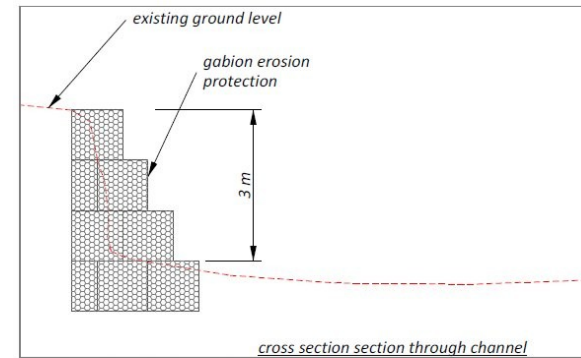


Figure 3.5.6. Protection of Embankment Downstream of Retaining Wall

Extent of intervention (m)	Total volume of excavation (m <sup>3</sup> )	Total volume of gabions (m <sup>3</sup> )
15	63	105

A-EM-3.004 – Stabilisation of Steep Embankment Adjacent to Roadway

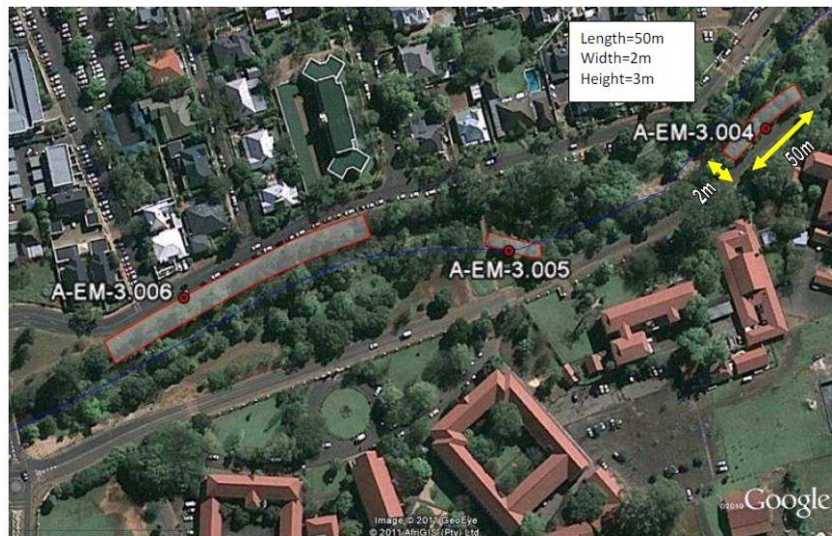


Figure 3.5.7. Extents of Projects A-EM-3.004/5/6

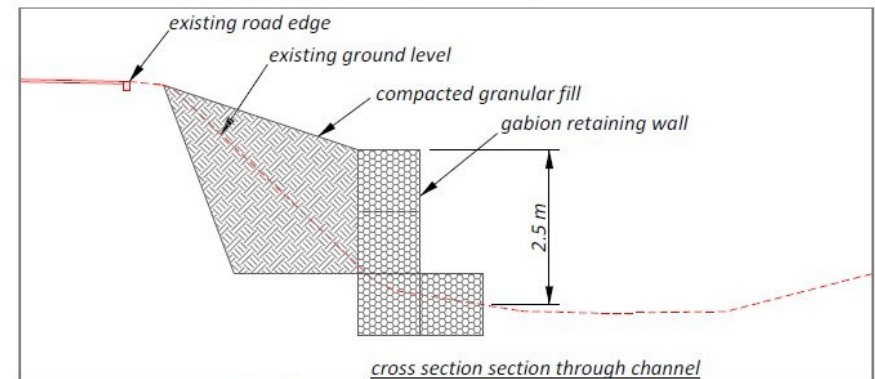


Figure 3.5.8. Stabilisation of Steep Embankment Adjacent to Roadway

Extent of intervention (m)	Total volume of excavation (m <sup>3</sup> )	Total volume of fill (m <sup>3</sup> )	Total volume of gabions (m <sup>3</sup> )
50	240	260	240

A-EM-3.005 – Protection of Steep Embankment

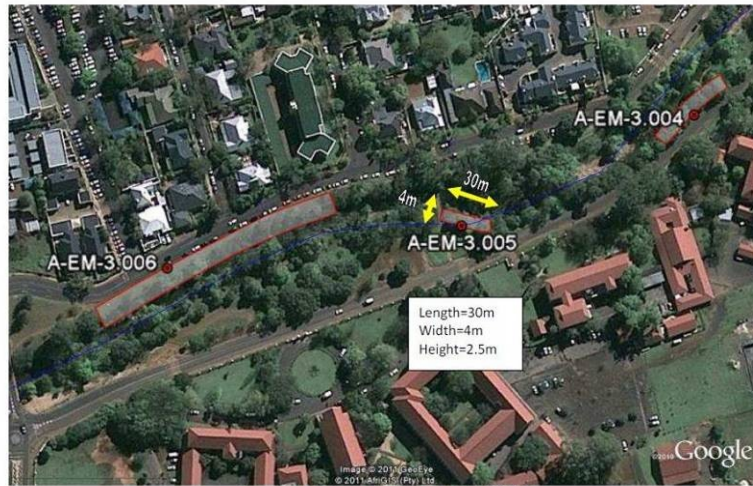


Figure 3.5.9. Extents of Projects A-EM-3.004/5/6

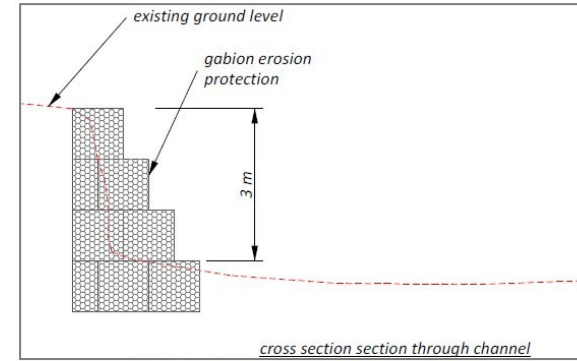


Figure 3.5.10. Protection of Steep Embankment

Extent of intervention (m)	Total volume of excavation (m <sup>3</sup> )	Total volume of gabions (m <sup>3</sup> )
30	130	210

A-EM-3.006 – Protection of Steep Eroded Embankment

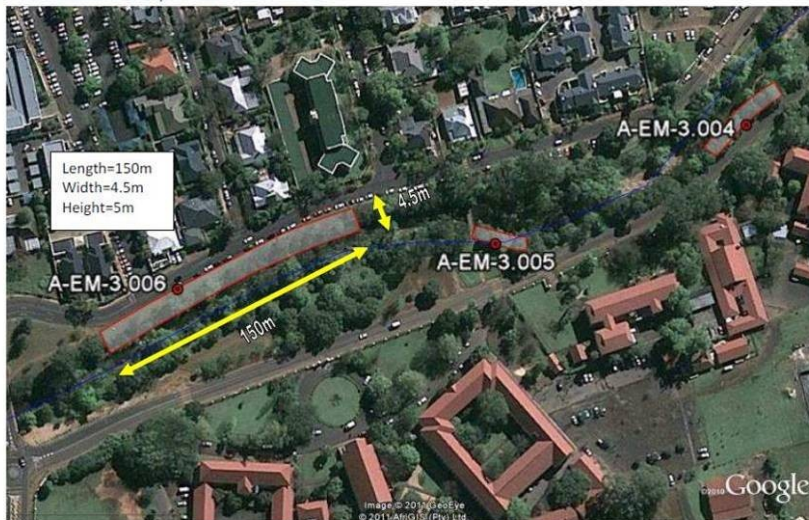


Figure 3.5.11. Extents of Projects A-EM-3.004/5/6

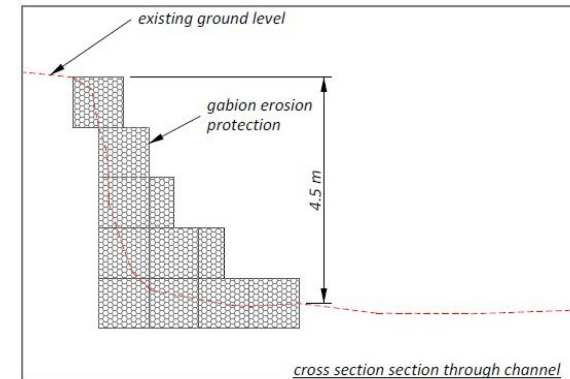


Figure 3.5.12. Protection of Steep Eroded Embankment

Extent of intervention (m)	Total volume of excavation (m <sup>3</sup> )	Total volume of gabions (m <sup>3</sup> )
150	620	1500

A-EM-3.007 – Slope Stabilisation



Figure 3.5.13. Extents of Projects A-EM-3.007/8/9

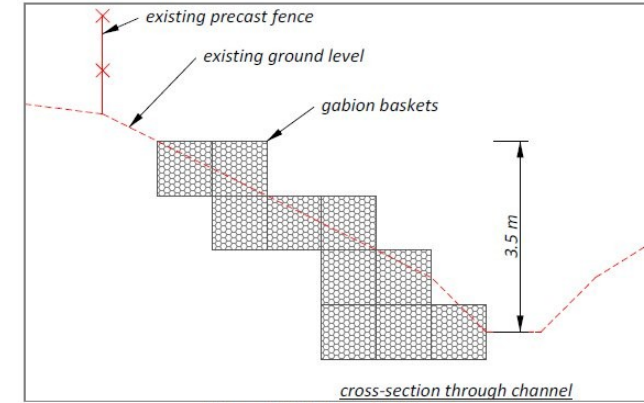


Figure 3.5.14. Slope Stabilisation

Extent of intervention (m)	Total volume of excavation (m <sup>3</sup> )	Total volume of gabions (m <sup>3</sup> )
150	1125	1500

A-EM-3.008 – Cascade



Figure 3.5.15. Extents of Projects A-EM-3.007/8/9

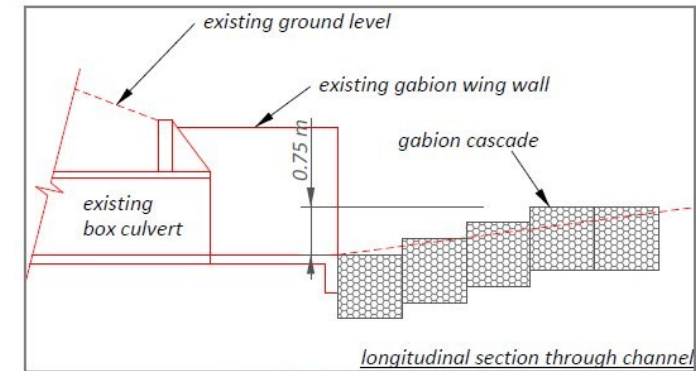


Figure 3.5.16. Gabion Cascade

Extent of intervention (m)	Total volume of excavation (m <sup>3</sup> )	Total volume of gabions (m <sup>3</sup> )
5	16	20



A-EM-3.009 – Embankment Protection



Figure 3.5.17. Extents of Projects A-EM-3.007/8/9

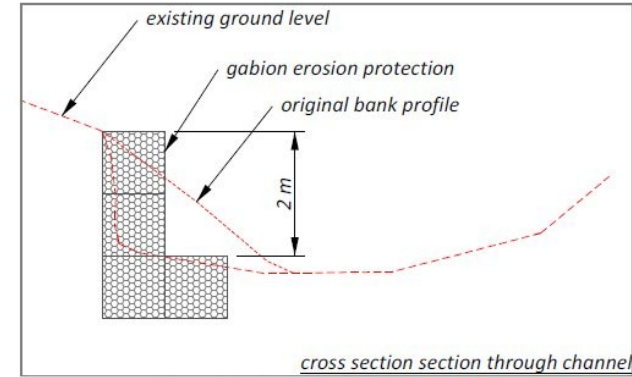


Figure 3.5.18. Embankment Protection

Extent of intervention (m)	Total volume of excavation (m <sup>3</sup> )	Total volume of gabions (m <sup>3</sup> )
150	375	600

A-EM-3.010 – Headwall Undercut Protection



Figure 3.5.19. Locality of Project A-EM-3.010

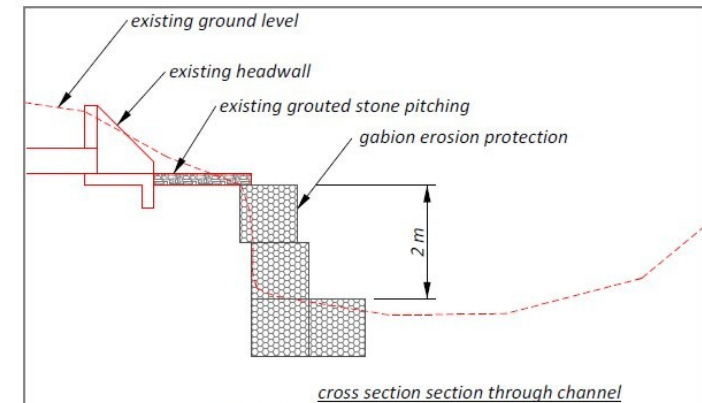


Figure 3.5.20. Headwall Undercut Protection

Extent of intervention (m)	Total volume of excavation (m <sup>3</sup> )	Total volume of gabions (m <sup>3</sup> )
4	10	16

A-EM-3.011 – Retaining Wall at 'Die Rand'

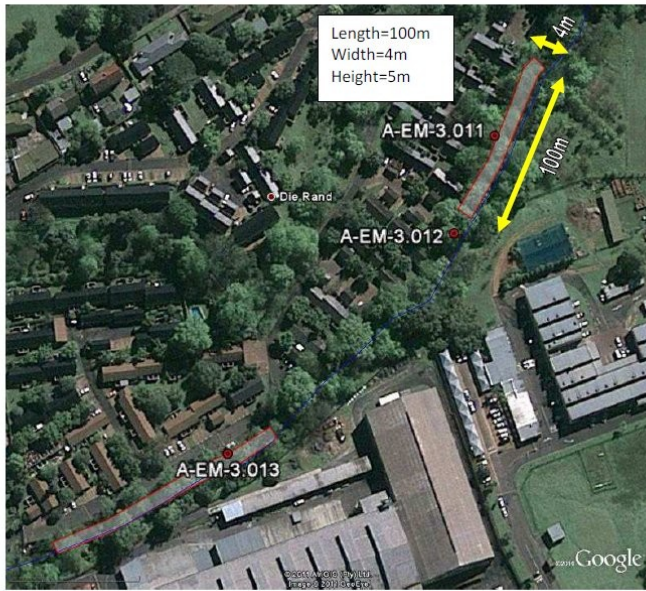


Figure 3.5.21. Extents of Projects A-EM-3.011/12/13

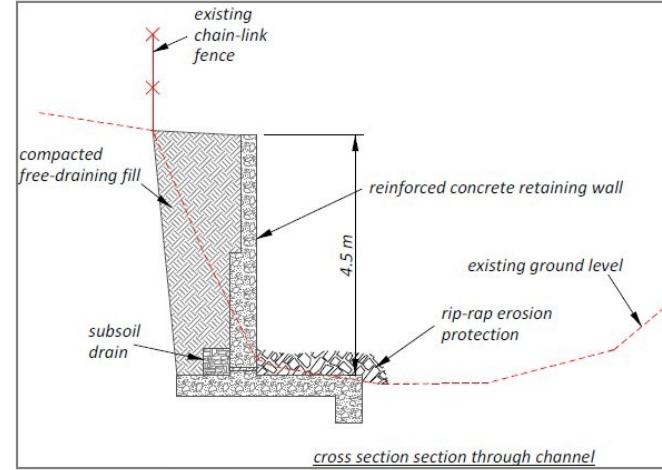


Figure 3.5.22. Retaining Wall at 'Die Rand'

Extent of intervention (m)	Total volume of excavation (m <sup>3</sup> )	Total volume of rip-rap (m <sup>3</sup> )	Total volume of fill (m <sup>3</sup> )
100	540	140	600

A-EM-3.012 – Protection of Retaining Wall Foundation at 'Die Rand'



Figure 3.5.23. Extents of Projects A-EM-3.011/12/13

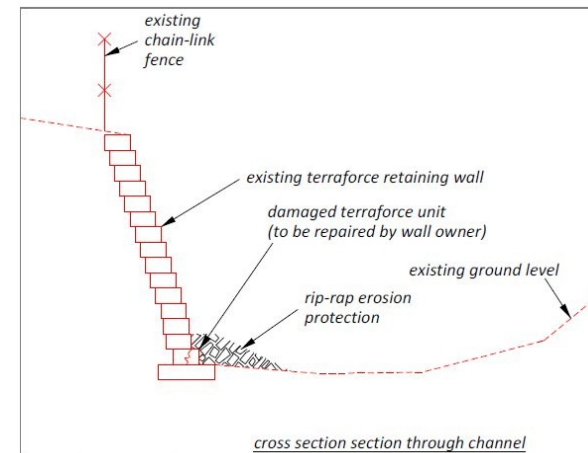


Figure 3.5.24. Protection of Retaining Wall Foundation at 'Die Rand'

Extent of intervention (m)	Total volume of excavation (m <sup>3</sup> )	Total volume of rip-rap (m <sup>3</sup> )
10	-	7

A-EM-3.013 – Stabilisation of Slope at 'Die Rand'

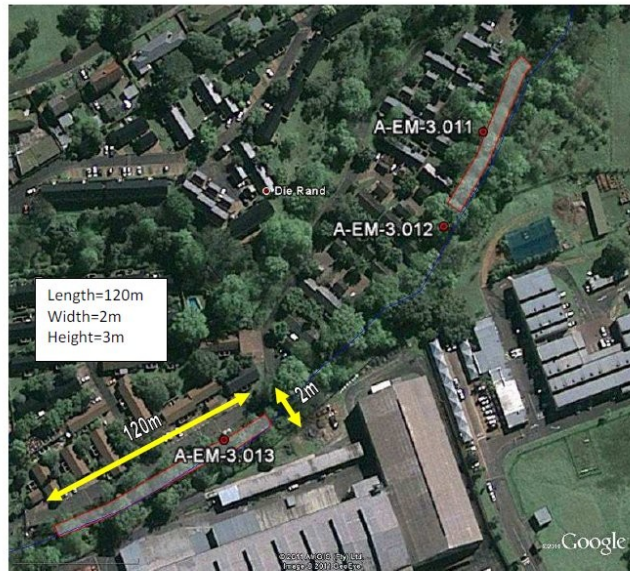


Figure 3.5.25. Extents of Projects A-EM-3.011/12/13

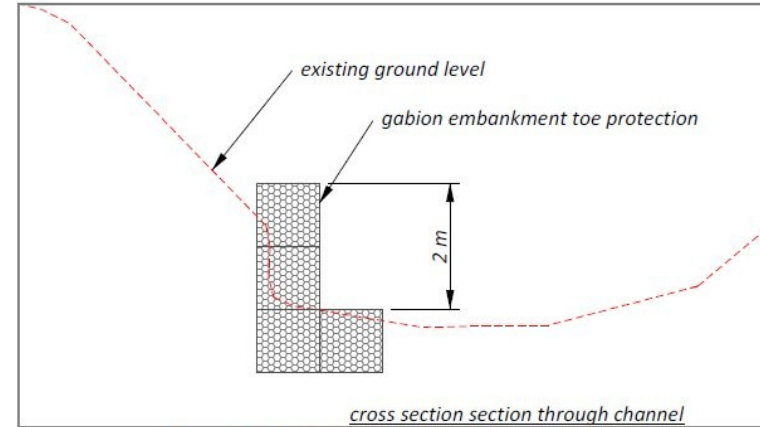


Figure 3.5.26. Stabilisation of Slope at 'Die Rand'

Extent of intervention (m)	Total volume of excavation (m <sup>3</sup> )	Total volume of gabions (m <sup>3</sup> )
120	300	480

A-EM-3.014 – Protection of Banks Downstream of Cascade



Figure 3.5.27. Extent of Project A-EM-3.014

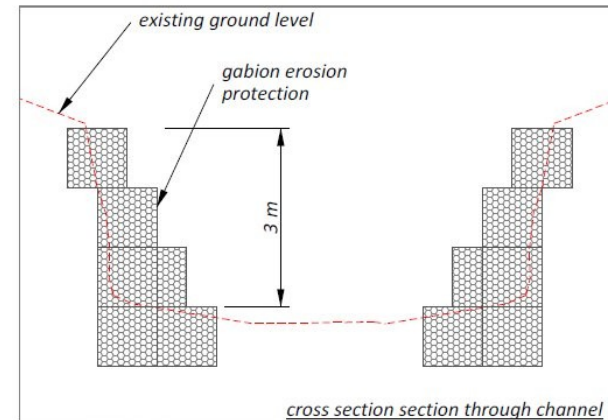


Figure 3.5.28. protection of Banks Downstream of Cascade

Extent of intervention (m)	Total volume of excavation (m <sup>3</sup> )	Total volume of gabions (m <sup>3</sup> )
30	180	330

A-EM-3.015 – Protection of Steep Embankment



Figure 3.5.29. Extent of Project A-EM-3.015

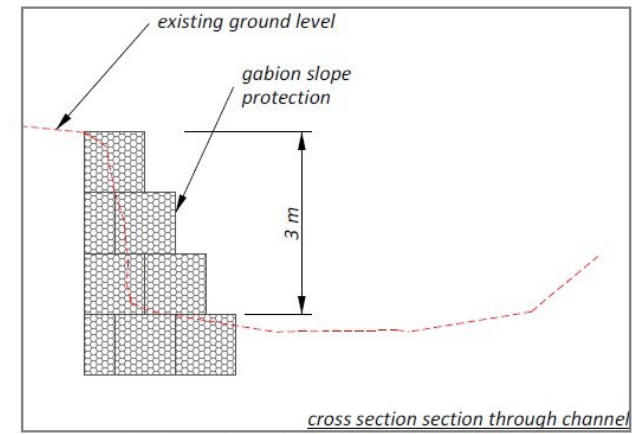


Figure 3.5.30. Protection of Steep Embankment

Extent of intervention (m)	Total volume of excavation (m <sup>3</sup> )	Total volume of gabions (m <sup>3</sup> )
10	42	70

A-EM-3.016 – Stabilisation of Eroded Embankment Toe



Figure 3.5.31. Extent of Project A-EM-3.016

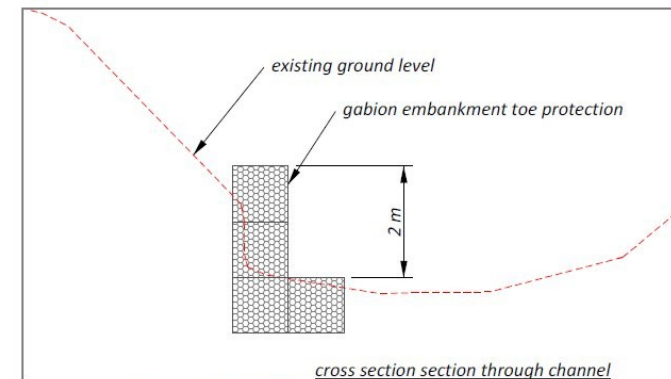


Figure 3.5.32. Stabilisation of Eroded Embankment Toe

Extent of intervention (m)	Total volume of excavation (m <sup>3</sup> )	Total volume of gabions (m <sup>3</sup> )
40	100	160

A-EM-3.017 – Stabilisation of Unconsolidated Embankment Toe

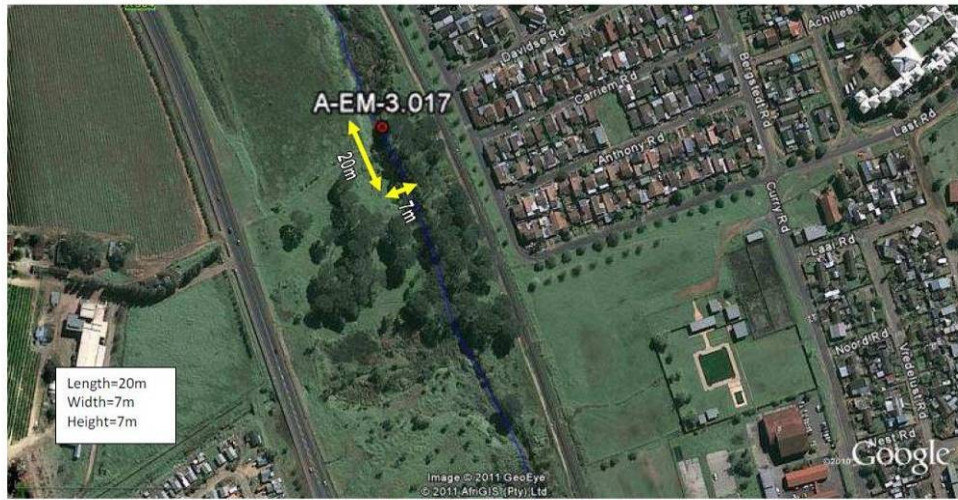


Figure 3.5.33. Location of Project A-EM-3.017

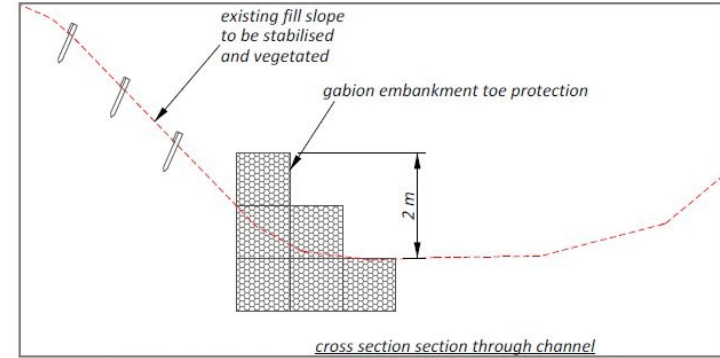


Figure 3.5.34. Stabilisation of Unconsolidated Embankment Toe

Extent of intervention (m)	Total volume of excavation (m <sup>3</sup> )	Total volume of gabions (m <sup>3</sup> )
20	75	120

A-EM-3.018 – Extension of Gabion Wing-Wall



Figure 3.5.35. Extent of Project A-EM-3.018

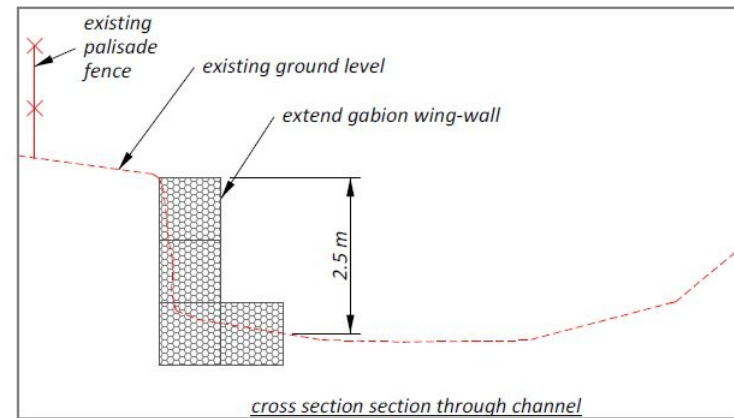


Figure 3.5.36. Extension of Gabion Wing-Wall

Extent of intervention (m)	Total volume of excavation (m <sup>3</sup> )	Total volume of gabions (m <sup>3</sup> )
20	35	80

A-EM-3.019 – Protection of Eroded Embankment



Figure 3.5.37. Extent of Project A-EM-3.019

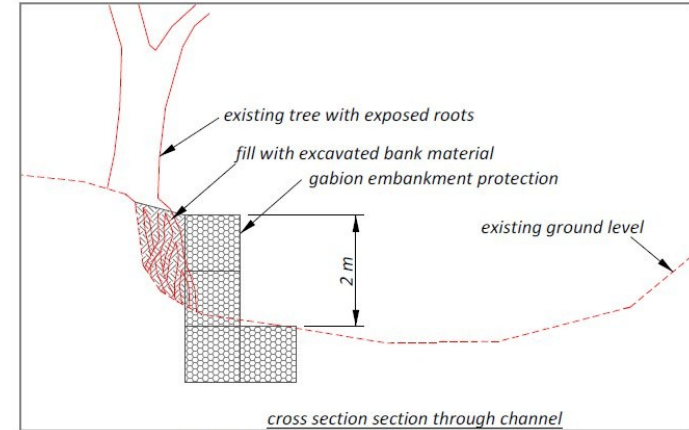


Figure 3.5.38. Protection of Steep Embankment

Extent of intervention (m)	Total volume of excavation (m <sup>3</sup> )	Total volume of gabions (m <sup>3</sup> )
15	40	60

A-EM-3.020 – Retaining Wall at Wine Processing Factories



Figure 3.5.39. Extent of Project A-EM-3.020

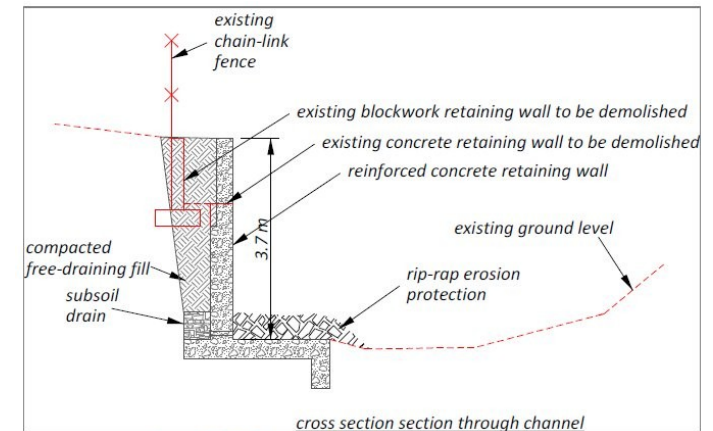


Figure 3.5.40. Retaining Wall at Wine Processing Factories

Extent of intervention (m)	Total volume of excavation (m <sup>3</sup> )	Total volume of rip-rap (m <sup>3</sup> )	Total volume of fill (m <sup>3</sup> )
20	75	20	55