INTERNATIONAL COURT OF JUSTICE

DISPUTE CONCERNING THE CONSTRUCTION OF A ROAD IN COSTA RICA ALONG THE SAN JUAN RIVER

NICARAGUA *v.* COSTA RICA

REJOINDER OF COSTA RICA

VOLUME II

ANNEXES 1 - 3

2 FEBRUARY 2015

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ANNEX 1

Professor Neil Craik

The Requirement to Perform a Prior Environmental Impact Assessment

January 2015

DISPUTE CONCERNING

CONSTRUCTION OF A ROAD IN COSTA RICA ALONG THE SAN JUAN RIVER

(NICARAGUA V. COSTA RICA)

The Requirement to Perform a Prior Environmental Impact Assessment

Report prepared by

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January 2015

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1. Introduction

1.1. I am Neil Craik, Associate Professor of Law at the University of Waterloo, Canada. I have appointments in the School of Environment, Enterprise and Development, of which I am the Director, and the Balsillie School of International Affairs. Prior to my appointment at the University of Waterloo, I was a Professor at the University of New Brunswick Faculty of Law, where I taught international and Canadian environmental law, and other public law subjects. Prior to that I practised law with a national law firm in Toronto, Canada. I am an expert in international environmental law and governance, with a particular expertise in environmental assessment law. I am the author of *The International Law of Environmental Impact Assessment: Process, Substance and Integration* (Cambridge University Press, 2008), as well as numerous other peer reviewed papers and book chapters that focus on the international legal dimensions of environmental assessment. I currently hold several research grants from the Social Sciences and Humanities Research Council of Canada that focus on aspects of international and Canadian environmental assessment law. My *curriculum vitae* is included as **Attachment A** to this Report.

1.2. I have been requested by Costa Rica to prepare an independent expert report for the International Court of Justice (the ***Court***) in connection with the claim brought against Costa Rica by Nicaragua concerning the construction of a road in Costa Rica near the San Juan River. I have been asked to provide an independent expert opinion on legal aspects related to a State's obligation under international law to perform a prior environmental impact assessment (***EIA***). In particular, I have been requested to provide an opinion in relation to the threshold requirement for conducting an EIA in international law, whether there exists an emergency exception in the international rules respecting EIA, and any further obligations that may arise in relation to assessment in the face of an emergency.

1.3. I have reviewed the following documents:

(a) Memorial of the Republic of Nicaragua (focusing on Chapter 5B);

(b) Counter-Memorial of Costa Rica (focusing on Chapter 5B);

(c) Reply of the Republic of Nicaragua (focusing on Chapter 6);

(d) Report by W. Sheate, July 2014, Annex 5 to Nicaragua Reply;

(e) Golder Associates Report, July 2014, Annex 6 to Nicaragua Reply;

(f) Report by M. Kondolf et al, December 2012, Annex 1 to Nicaragua Memorial

(g) Report by C. Thorne, November 2013, Annex 9 to Costa Rica Counter-Memorial;

(h) Environmental Diagnostic Assessment prepared by Centro Científico Tropical, November 2013, Annex 10 to Costa Rica Counter-Memorial;

(i) Astorga and Mende, "Route 1856: Analysis of the Change in Land Use Based on Satellite Images Before and After the Construction of the Border Road", August 2013, Annex 3 to Costa Rica Counter-Memorial;

(j) Report by M. Kondolf, July 2014, Annex 1 to Nicaragua Reply; and

(k) Costa Rica, Emergency Decree No. 36440-MP, Annex 28 to Costa Rica Counter-Memorial.

2. An International Law Obligation to Conduct an EIA

2.1. Nicaragua relies upon Principle 17 of the Rio Declaration as the basis of an international obligation to conduct an EIA.[1] It also refers to the formulation of a general obligation to conduct transboundary EIAs that is most authoritatively set out in the *Pulp Mills Case*.[2]

2.2. Principle 17 of the Rio Declaration is non-binding, and is formulated as a broader principle of sound environmental practice, applicable to both domestic and international contexts. In this regard, Principle 17 does not distinguish between transboundary and domestic impacts. Nicaragua relies on this formulation to argue in favour of a distinct obligation in international law to conduct an EIA where the impacts are wholly domestic in scope.[3] Extending the obligation to conduct EIAs to domestic impacts is not supported in international law. To the extent that Principle 17 has been cited in support of an international obligation to conduct EIAs, for example in the *Pulp Mills Case*, the harm has been transboundary in character.

2.3. There are no examples of which I am aware of state practice that would extend the obligation in international law to purely domestic harm. For example, in all international disputes where states have raised an international obligation to conduct EIAs. the harm in question has been of a transboundary kind or has involved harm to a shared resource.[4] Likewise, in the judicial cases where an obligation to conduct EIAs has been accepted, the *Pulp Mills Case* and the advisory opinion on the *Responsibilities and Obligations of States sponsoring persons and entities with respect to activities in the Area,* the harm in question

[1] Memorial, para. 5.6
[2] *Pulp Mills on the River Uruguay (Argentina v. Uruguay),* ICJ 20 April 2010, para. 204
[3] Memorial, para 5.6 – 5.29.
[4] The *Pulp Mills Case, supra* n.2; the *MOX Plant Case (Ireland v. United Kingdom),* Provisional Measures, (2002) 41 ILM 405 (ITLOS); *Request for an Examination of the Situation in Accordance with the Court's Judgment of December 1974 in the Nuclear Tests (New Zealand v. France) Case,* 1995 ICJ Rep 288; the *Gabcikovo Nagymaros Project (Hungary v. Slovakia),* (1997) ICJ Rep 7.

was either transboundary in character, or concerned areas beyond national jurisdiction.[5]

2.4. The Convention on Environmental Impact in a Transboundary Context (the Espoo Convention)[6] and the Protocol on Environmental Protection to the Antarctic Treaty (the Madrid Protocol),[7] which are the two detailed treaties on EIA, focus respectively on transboundary impacts and on impacts to the global commons. Other treaties containing EIA obligations tend to focus on transboundary pollution, such as the Agreement between United States and Canada on Air Quality,[8] or shared resources such as watercourses,[9] regional seas,[10] or the marine environment.[11] The predominant treaty practice of states is to require EIAs where activities are likely to have a significant transboundary impact or significant impact upon shared or common resources.

2.5. There is an argument that Article 14 of the Convention on Biological Diversity supports a wider obligation that extends beyond transboundary harm, since that provision does not focus on transboundary harm. However, Article 14 is

[5] *Pulp Mills Case, supra* n.2; *Advisory Opinion on the Responsibilities and Obligations of States Sponsoring Persons and Entities with Respect to Activities in the Area,* (ITLOS), 1 February 2011, para. 145, 148.
[6] 30 ILM 802, entered into force June 27, 1997.
[7] 30 ILM 1461, entered into force January 14, 1998.
[8] 30 ILM 676, entered into force March 13, 1991, Art. V
[9] United Nations Convention on the Non-Navigational Uses of International Watercourses, 36 ILM 719 (not yet in force), Art. 12
[10] Convention for Co-operation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region, Abidjan, March 23, 1981, 20 ILM 746, entered into force August 5, 1984, Art. 13; Convention for the Protection of the Marine Environment and Coastal Area of the South-East Pacific, Lima, November 12, 1981, International Environmental Legal Materials and Treaties 981, entered into force May 19, 1986, Art. 8; Regional Convention for the Conservation of the Red Sea and Gulf of Aden Environment, Jeddah, Saudi Arabia, February 14, 1982, 9 EPL 56, entered into force August 20, 1985, Art. XI; Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region, Cartagena de Indias, March 24, 1983, 22 ILM 221, entered into force October 11, 1986, Art. 12; Convention for the Protection of the Natural Resources and Environment of the South Pacific Region, Noumea, New Caledonia, November 25, 1986, 26 ILM 25, entered into force August 22, 1990, Art. 16. Convention on the Protection of the Black Sea Against Pollution, Bucharest, April 21, 1992, 32 ILM 1110 (1993), in force January 15, 1994, Art. XV(5); Convention on the Protection of the Marine Environment of the Baltic Sea Area, Helsinki, April 9, 1992, in force January 17, 2000, Art. 7 (Helsinki Convention).
[11] United Nations Convention on the Law of the Sea, 21 ILM 1291, entered into force November 16, 1984, Art. 206

qualified by the phrase, "as far as possible and as appropriate", indicating an intention not to create a binding obligation to assess purely domestic harm.[12]

2.6. It has been suggested that EIA obligations have a broader scope in relation to internationally protected areas, particularly those areas identified under the Ramsar Convention, and those areas designated as UNESCO Biosphere Reserves.[13] At least insofar as EIA obligations are concerned, the idea that internationally identified natural features, such as wetlands, must be protected by states as an obligation *erga omnes partes*, is a novel claim and is so far not supported by state practice. In that context I would note that the Ramsar Convention explicitly states that a wetland designation "does not prejudice the exclusive sovereign rights of the Contracting Party in whose territory the wetland is situated",[14] suggesting an intention not to create rights in relation to domestic wetlands that are enforceable by third parties.

2.7. There is a more ecologically-oriented argument to the effect that the ecological connectivity of the potentially affected ecosystem makes it appropriate to consider the impacts in both Costa Rica and Nicaragua.[15] Here, I would simply caution that the obligation accepted in international law requires transboundary impact to be demonstrated. These impacts do not need to be direct and may be mediated by ecological processes, but those indirect impacts still need to be demonstrated.

2.8. It is suggested that the inclusion of the words "as a national instrument" in Principle 17 of the Rio Declaration speak to an obligation to assess purely domestic harm.[16] This phrase, however, simply indicates that EIA procedures

[12] United Nations Convention on Biological Diversity, 31 ILM 818, entered into force December 29, 1993, Art. 14.
[13] Nicaragua Reply, para.4.11; see also Report by W. Sheate, July 2014, Annex 5 to Nicaragua Reply, section 5.
[14] Convention on Wetlands of International Importance Especially as Waterfowl Habitat, 996 UNTS 245, entered into force December 21, 1975, Art.2(3).
[15] Golder Associates Report, July 2014, Nicaragua Reply, Annex 6
[16] Memorial, para. 5.29.

necessarily originate in domestic, not supranational, instruments. Moreover, this phrase indicates that international law will not dictate the contents of an assessment, but rather will leave the particulars of implementation to national legal systems; a point which the Court confirmed in the *Pulp Mills Case*[17] and which is also confirmed in the International Law Commission's *Draft Articles on Prevention of Transboundary Harm from Hazardous Activities*.[18]

2.9. Given that the international obligation relates to transboundary harm, and given that arguments centre on the likelihood of transboundary harm, I will focus on the obligation to conduct an EIA in relation to transboundary harm as set out by the ICJ in the *Pulp Mills Case* in paragraphs 204 and 205.

> Para. 204
>
> In this sense, the obligation to protect and preserve [the environment]…, has to be interpreted in accordance with a practice, which in recent years has gained so much acceptance that it may now be considered a requirement under general international law to undertake an environmental impact assessment where there is a risk that the proposed industrial activity may have a significant adverse impact in a transboundary context, in particular, on a shared resource. Moreover, due diligence, and the duty of vigilance and prevention which it implies, would not be considered to have been exercised, if a party planning works liable to affect the régime of the river or the quality of its waters did not undertake an environmental impact assessment on the potential effects of such works.
>
> Para 205

[17] *Pulp Mills Case, supra* n.2, para. 205.
[18] International Law Commission, "Commentaries to the Draft Articles on Prevention of Transboundary Harm from Hazardous Activities", in *Report of the International Law Commission.* Fifty-Third Session, UN GAOR, 56th Sess., Supp. No. 10, UN Doc. a/56/10 (2001), Art.7, Commentary 7.

> …Consequently, it is the view of the Court that it is for each State to determine in its domestic legislation or in the authorization process for the project, the specific content of the environmental impact assessment required in each case, having regard to the nature and magnitude of the proposed development and its likely adverse impact on the environment as well as to the need to exercise due diligence in conducting such an assessment. The Court also considers that an environmental impact assessment must be conducted prior to the implementation of a project. Moreover, once operations have started and, where necessary, throughout the life of the project, continuous monitoring of its effects on the environment shall be undertaken.

2.10. There are several distinct elements in this formulation that necessarily inform the understanding of the international obligation to conduct an EIA. First, the EIA obligation arises as a "practice" by which the broader obligation of due diligence to prevent significant transboundary harm is implemented. Second, the obligation applies to harm that may have "a significant adverse impact in a transboundary context". Third, international law leaves it to states to determine the specific content and modalities of conducting an EIA.

2.11. The first and second points are addressed in the following sections. The third point raises a question regarding where, and on which specific issues, international law defers to national law in defining EIA obligations. The Court in *Pulp Mills* drew a distinction between the conditions under which an EIA is required (determined by an internationally defined threshold) and the specific contents of the EIA (which are left to national laws), although state discretion was qualified by the phrase "having regard to the nature and magnitude of the proposed development and its likely adverse impact on the environment as well as to the need to exercise due diligence in conducting such an assessment". Allowing states discretion to determine how EIAs are carried out is appropriate since the EIAs must be implemented in domestic legal systems, and be

integrated into the specific environmental decision-making structure of each state. There is considerable diversity among national EIA systems in the manner by which projects ought to be subject to a full EIA.

3. EIA as part of a state's obligation of due diligence

3.1. The obligation to conduct a transboundary EIA is a distinct obligation in international law, but it is to be interpreted in light of the substantive purpose of transboundary harm prevention. The underlying goal of conducting an EIA, as identified by the Court, is to satisfy the requirement to use due diligence in preventing transboundary harm. The relationship between due diligence and EIA obligations is reflected in numerous treaties containing EIA obligations, which also contain a reference to the harm principle and specify the function of EIA as one of the means by which the harm principle is to be implemented by states.[19]

3.2. The due diligence obligation in relation to transboundary harm is expressed in Article 3 of the ILC Draft Articles on Prevention of Transboundary Harm as requiring the state of origin to "take all appropriate measures to prevent significant transboundary harm or at any event to minimize the risk thereof".[20] Elsewhere, the ILC describes the obligation as requiring "reasonable efforts", [21] and that "the degree of care in question is that expected of a good Government".[22] The standard of "reasonable efforts" or "appropriate measures" will be dependent upon what is reasonable or appropriate based on the specific facts surrounding the activity. The terms "due diligence" and "appropriate measures" are described by the ILC as "synonymous." [23]

[19] For example, Convention on Environmental Impact Assessment in a Transboundary Context, 25 February 1991, 1989 U.N.T.S. 310 (the "Espoo Convention"), Art. 2(1); Convention on Biological Diversity, 5 June 1992, 1760 U.N.T.S. 79, (the "CBD"), Article 14(1)(a).
[20] ILC, Draft Articles, supra n.18, Art. 3.
[21] *Ibid.* Art. 3, Comm. 10.
[22] *Ibid.* Art. 3, Comm.17.
[23] ILC, *Report of the Fifty-second session (2000)* GAOR A/55/10, para. 718.

3.3. Understanding EIA obligations in the context of due diligence indicates that the obligation to conduct EIA's must be assessed in light of the particular circumstances of the activity in question. The notion of due diligence is not restricted to consideration of the environmental circumstances, but includes other conditions that may impact the feasibility or reasonableness of carrying out an EIA, including the presence of an emergency or national security concerns. As outlined below, this interpretation is supported by international and state practice.

4. The Threshold Requirement to Conduct a Transboundary EIA

4.1. The due diligence obligation is triggered in international law where there is a "risk of significant transboundary harm". Consistent with this threshold, "significant harm" is the trigger for conducting a transboundary EIA, as reflected in the Espoo Convention, the CBD, the UNEP EIA Goals and Principles,[24] as well as the *Pulp Mills Case*. The threshold of significance also reflects domestic EIA practice, which overwhelmingly adopts this standard.[25] The pleadings disclose little debate respecting the applicability of this standard.

4.2. The "significance" threshold is intended as an objective standard and cannot be determined in the complete discretion of the state of origin. It is described by the ILC as "something more than detectable but need not be at the level of 'serious' or 'substantial'".[26] This determination is context-dependent, but it will be impacted by the scale of the activity proposed, the nature of the potential

[24] UNEP Res. GC14/25, 14th Sess. (1987), endorsed by GA Res. 42/184, UN GAOR, 42nd Sess., UN Doc. A/Res/42/184 (1987) (''UNEP EIA Goals and Principles'), Principle 1.
[25] See for example, *National Environmental Policy Act,* 42 USC §§ 4321-4370(f) ("NEPA"); European Council Directive 85/337 on the Assessment of the Effects of Certain Public and Private Projects on the Environment, [1985] O.J. l 175/40. Subsequently amended by EC, Council Directive 97/11, EC, Council Directive 03/35, and EC, Council Directive 09/31; *Canadian Environmental Assessment Act,* 2012, SC 2012, c.19.
[26] ILC, Draft Articles, *supra* n.18, Article 2, Commentary 4.

impacts, and sensitivity of the receiving environment to the impacts in question.[27]

4.3. One question that does arise is whether there is a meaningful difference between the Court's formulation that requires a "risk of significant adverse harm", and that of the CBD, which uses the term "likely" to have significant adverse effects. "Likelihood" is the term most commonly used: it finds expression in Principle 17, and the Espoo Convention.[28] The difference is not material in my view. The intent is that the threshold of significant harm must be more than a mere possibility. It must be supported by a reasonable evidentiary basis.

4.4. EIA practice, at both domestic and international levels, includes different approaches to determining "significance", often referred to as "screening" in EIA parlance. One approach is to identify certain activities that, by virtue of their scale or risk, are automatically subject to an EIA. The Espoo Convention, for example, provides a list of activities that might require assessment.[29] A similar approach is used in the European Community EIA Directive,[30] and is acknowledged as an appropriate mechanism in the Guidelines for Biodiversity Inclusive Impact Assessment under the CBD.[31] Other domestic EIA systems, such as those in the US (NEPA) and Canada (CEAA), also contain mandatory inclusions, as well as exclusions, from the requirement to conduct an EIA. Other approaches to determining significance in EIA practice include the use of initial environmental assessments, or the use of criteria such as the size of activity, its location, and the nature of the potential environmental risks.

4.5. International law does not dictate the manner by which significance is determined, but rather, in keeping with the due diligence obligation, requires

[27] Espoo Convention, *supra* n.19, Appendix III; ILC Draft Articles, *ibid.* Art 7, Comm. 9.
[28] Espoo Convention, *supra* n.19, Art. 2.
[29] Espoo Convention, *supra* n.19, Article 2(3); and Appendix 1
[30] EC EIA Directive, *supra* n.25, Article 4.
[31] Conference of the Parties to the CBD, Decision VIII/28, "Impact Assessment: Voluntary guidelines on biodiversity-inclusive impact assessment", UN Doc. UNEP/CBD/COP/8/31, (CBD EIA Guidelines) Art. 10.

that each state have a reasoned process for the determination of significance that accounts for the contextual nature of that determination. Thus, while the threshold of "significant adverse harm" is intended to be objective, state practice indicates that states retain some discretion in determining the screening mechanism.

4.6. It is true that the Espoo list (Appendix 1) includes, "motorways" and "express roads", as well as "deforestation of large areas".[32] However, the definition of the road-related terms in Appendix 1 would exclude a road, which does not meet the definition of "motorway" or "express road", provided in Appendix 1.[33] It is also unlikely that the clearing activities associated with an ordinary road (as distinct possibly from an expressway) would amount to "deforestation of large areas".[34] In other words, were the Espoo Convention to apply (which it does not), Costa Rica would not owe a obligation to conduct an EIA, but rather would at most owe a duty to engage in "discussions" with a concerned party.[35]

4.7. I am informed that under Costa Rican law, in the absence of an emergency, a road of this kind would have been subject to an EIA. This is not evidence in and of itself of a significant transboundary impact, which should be determined in accordance with the international standard.

4.8. In this regard, I would note the following:

(a) The onus to demonstrate that the threshold to trigger an EIA has been met is on the state invoking the EIA obligation in question.[36]

[32] Memorial, Footnote 474
[33] Espoo Convention, *supra* n.19, Appendix 1.
[34] Environmental Diagnostic Assessment, section 6.2.4.1, Counter-Memorial, v.2, (noting that a total of 83.2 hectares of forest were cut down). See also Report by Astorga and Mende, "Route 1856: Analysis of the Change in Land Use Based on Satellite Images Before and After the Construction of the Border Road", August 2013, Counter-Memorial, v.2, Annex 3, Section 3 ("Conclusions").
[35] *Ibid,* Article 2(5)
[36] *Pulp Mills Case, supra* n.2, para. 162

(b) The harm must be both "significant" and "transboundary" in nature. Harm to terrestrial ecosystems due to deforestation and harm to ecosystem components located within the state of origin are not transboundary. Indirect impacts may be relevant, but where alleged, the connection between domestic impacts and some consequential transboundary harm must be demonstrated.

(c) In the present case, the principal transboundary impact alleged relates to the impact of increased sedimentation loading to the San Juan River. It is for the Court to apply the law to the facts as found: I would simply say that increases in the existing sediment load of a river which fall within the range of natural variability of that river are unlikely to rise to the level of substantial harm. This is not a case where toxic wastes or other deleterious substances are introduced: rather, on one view the river is transporting somewhat more by way of sediment than it would have done had the road not been constructed. In such a case, proof of deposition would not seem sufficient to cross the EIA threshold of significant or even appreciable transboundary harm. Indeed I note Professor Thorne's conclusion that the impact of the road on sedimentation loading was "in practice indiscernible".[37]

(d) A number of the factors identified by Nicaragua are directed primarily at concerns respecting the impacts on biological diversity. In relation to whether the Road presents "significant adverse effects on biological diversity", the threshold under Article 14 of the CBD, Nicaragua has presented little direct evidence. Using the screening criteria identified in the CBD Voluntary Guidelines on Biodiversity-inclusive impact assessment, there is little or no specific evidence of 1) biological changes that would increase the "risks of extinction of genotypes, cultivars, varieties, populations of species, or the chance of loss of habitat or ecosystems", 2) activities that would "surpass the maximum sustainable yield, the carrying capacity of a habitat/ecosystem or the

[37] Thorne Report, November 2013, Costa Rica Counter-Memorial, Annex 9, para.12.2.

maximum allowable disturbance level of a resource, population or ecosystem, or 3) activities that would "result in changes to the access to, and/or rights over biological resources".[38]

5. The presence of an emergency exception in international law

5.1. I am asked to comment specifically on the existence and scope of an emergency exception for EIA application. Costa Rica has argued that States have the possibility to exempt activities from EIA requirements in the face of an emergency, having regard in particular to the role of national law in EIA determinations.[39] Nicaragua takes the position that the discretion afforded to States to determine the content of EIAs does not extend to emergency exceptions and that such an exception is tantamount to invoking an internal law to avoid an international obligation.[40]

5.2. In my opinion, emergency exceptions to EIA requirements should be understood and interpreted in light of state practice, which consistently recognizes the ability of states to exempt specific projects under particular circumstances, namely activities undertaken in relation to national security and civil emergencies. The practice in this regard is recognized in both international EIA practice and in domestic EIA practice. In particular:

(a) The Antarctic EIA regime contained in Annex 1 to the *Protocol on Environmental Protection to the Antarctic Treaty* includes the following provision, entitled "Cases of Emergency", which exempts emergencies from the EIA requirements of the treaty:

> 1. This Annex shall not apply in cases of emergency relating to the safety of human life or of ships, aircraft or equipment and facilities of high value, or the protection of the environment,

[38] CDB EIA Guidelines, *supra* n.31, section 1.2(a) "Screening"
[39] Counter-Memorial, para. 5.14.
[40] Memorial, paras.5.23-25.

> which require an activity to be undertaken without completion of the procedures set out in this Annex.
> 2. Notice of activities undertaken in cases of emergency, which would otherwise have required preparation of a Comprehensive Environmental Evaluation, shall be circulated immediately to all Parties and to the Committee and a full explanation of the activities carried out shall be provided within 90 days of those activities.[41]

(b) The *Espoo Convention* contains, in paragraph 2(8), a provision that retains for states the rights to implement domestic laws to protect "information the supply of which would be prejudicial to industrial and commercial secrecy or national security".

(c) The *Kiev Protocol on Strategic Environmental Assessment* (to the Espoo Convention on Environmental Impact Assessment in a Transboundary Context) includes a provision which exempts plans and programmes otherwise subject to assessment in cases of "civil emergencies".[42]

(d) Article 4(6) of the *Draft Protocol on Environmental Impact Assessment in a Transboundary Context to the Framework Convention for the Protection of the Marine Environment of the Caspian Sea* reserves the rights of the Parties to implement laws in the "interests of national security".[43]

(e) Article 1(3) of the *EC EIA Directive* provides that states may decide on a case-by-case basis to exempt the Directive from "projects or parts of

[41] Protocol on Environmental Protection to the Antarctic Treaty, 4 October 1991, 30 I.L.M. 1455 (1991), Annex 1, Article 7.
[42] Protocol on Strategic Environmental Assessment to the Convention on Environmental Impact Assessment in a Transboundary Context, 21 May 2003, U.N.T.C. No. 34028, in force 11 July 2010, Art. 4(5)(a).
[43] Protocol on Environmental Impact Assessment in a Transboundary Context to the Framework Convention for the Protection of the Marine Environment of the Caspian Sea, Draft prepared for Conference of the Parties, Fifth Meeting, 28-30 May 2014, UN Doc. TC/COP5/4 Rev.1, Art. 4(6)

projects, having defence as their sole purpose, or to projects having the response to civil emergencies as their sole purpose".[44]

(f) The pioneering United States statute, the National Environmental Policy Act contains in its regulations (40 C.F.R. 1506.11), a provision entitled "Emergencies", which states:

> Where emergency circumstances make it necessary to take an action with significant environmental impact without observing the provisions of these regulations, the Federal agency taking the action should consult with the Council about alternative arrangements. Agencies and the Council will limit such arrangements to actions necessary to control the immediate impacts of the emergency. Other actions remain subject to NEPA review.

(g) Other national EIA legislation that has an emergency exemption includes Canada[45], Australia,[46] Mexico,[47] Chile,[48] Paraguay,[49] and Peru,[50] as well as Nicaragua's own EIA legislation, which contains an emergency exemption in Article 12.[51]

5.3. Given the widespread incorporation of emergency exemptions to EIA requirements in international and national instruments, the exemption appears to be a standard part of the EIA process.[52] The international obligation should,

[44] EC EIA Directive, *supra* n.25.
[45] CEAA, *supra* n.25.
[46] Environmental Protection and Biodiversity Conservation Act 1999, (Cth.), s.158(5), (Acts of Parliament of the Commonwealth of Australia, No.91, 1999, as amended).
[47] Reglamento de la ley general del equilibrio ecológico y la protección al medio ambiente en materia de EIA, (Federal), Art.7, (Mexico, Reglamentos le Leyes Federales Vigentes, No.100)
[48] Ley General de Bases del Medio Ambiente, Ley 19 300, Art. 15, (Chile, Congreso Nacional de Chile, http://www.leychile.cl/Navegar?idNorma=30667)
[49] Evaluación de Impacto Ambiental, Ley 294, Art. 9, (Paraguay, Congreso de la Naciona Paraguaya, http://www.gat.org.py/gat/baseslegales/LeyN-294-Deevaluaciondeimpactoambientalydecretoreglamentario.pdf)
[50] Ley del sistema nacional de EIA y su reglamento, Art. 81, (Peru, Congreso de la Republica del Peru, http://www.minam.gob.pe/wp-content/uploads/2013/10/Ley-y-reglamento-del-SEIA1.pdf)
[51] Costa Rica Counter Memorial, v.3, Annex 25
[52] The Report prepared by W. Sheate for Nicaragua acknowledges that "[a] number of EIA regimes across the world – the European Union, the United States of America, for example – have exemption clauses in relation to civil emergencies or projects associated with national defence, so Costa Rica's

therefore, be interpreted to be subject to the right of states to incorporate an emergency exemption. The invocation of an emergency exemption to the requirement to conduct an EIA is distinct from an invocation of the rule of necessity. It is a reflection of international and state practice in relation to EIA, which contemplates that EIA requirements shall not apply to activities arising in circumstances of emergency.

5.4. While the specific exemption originates in domestic law, this is not a case where an internal law is invoked to excuse an international obligation: it is the international obligation itself that includes the right of states to exempt activities under conditions of civil emergencies and national security concerns. The exemption applies without distinction between domestic and transboundary harm. The non-application of Article 2(4) of the EC EIA Directive to transboundary harm (noted in Sheate's Report[53]) relates to a much broader exemption related to non-application of EIAs in "exceptional circumstances". Pointedly, the more applicable exemption found in Article 1(3) does not contain a similar qualification, and would therefore apply to any harm regardless of location.

5.5. The presence of an emergency exemption in international law is consistent with the obligation of states to use due diligence. In the case of an emergency, it is not "reasonable" nor within the degree of care "expected of a good Government" to require it to delay urgent activities in order to conduct an EIA. The exemption is consistent with the deference that international law provides to states to determine the contents of their EIA instruments, as it leaves it up to states to determine whether and how they shall implement an emergency exception.

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exercise of an emergency exemption per se is not particularly unusual". Sheate Report, *supra* n.13, p.27 (references excluded).

[53] Sheate Report, *supra* n.13, p.27.

5.6. The extent of the exemption varies from instrument to instrument, but generally allows activities that relate to national security and civil emergencies to be exempted from EIA requirements.[54] The exemptions do not define what circumstances would constitute an emergency, but reviewing the exemptions granted under the U.S. EIA system, the circumstances are diverse, and include the creation of flood protection measures in aftermath of Hurricane Katrina, Navy sonar training necessary for training exercises, the mass eradication of fish populations in the face of disease outbreaks and fire road construction in the face of fire threats.[55]

6. A State's Legal Obligations in Emergency Circumstances

6.1. In circumstances where an activity has been exempted from EIA requirements, the proponent may still be under an obligation to use an alternative assessment method to identify and mitigate any potential significant adverse harm associated with the activity.[56] The requirement for an alternative assessment is not consistently present in international and domestic EIA practice. In many of the EIA systems containing emergency exemptions, the legislation does not impose any further obligation. However, in the case of NEPA and the EC EIA Directive's "exceptional circumstances" exemption (but not its defence and civil emergencies exemption), there is a requirement for the proponent to undertake some form of alternative assessment. None of the exemptions contained in international instruments require an alternative assessment, although the Antarctic requirements include subsequent reporting measures.[57] It can be argued that given the uneven approach to alternative assessments, international law does not require an alternative assessment. But the better approach in my view is that an alternative assessment method is consistent with a state's due

[54] See, for example, Winter v. Natural Resources Defense Council Inc. 129 S. Ct. 365 (2008).
[55] Council on Environmental Quality, "Alternative Arrangements Pursuant to 40 CFR Section 1506.11 – Emergencies (2008), available https://ceq.doe.gov/nepa/eis/Alternative_Arrangements_Chart_092908.pdf
[56] This approach is found in NEPA and in the EC EIA Directive.
[57] Protocol on Environmental Protection to the Antarctic Treaty, *supra* n.41, Annex 1, Article 7.

diligence obligation, as it represents a state's reasonable effort in light of the emergency circumstances.

6.2. In the present case Costa Rican law required the preparation of an alternative assessment, which was in fact done through the carrying out of an Environmental Diagnostic Assessment (EDA) of the road project. On the basis of the available facts, the EDA appears to meet the requirements of an alternative assessment; in particular the assessment was carried out by independent experts and had as its aim the identification of environmental risks associated with the road and any required mitigation measures necessary to address those risks.

6.3. I stress in this regard that alternative assessment is intended to provide a different form of assessment than a prior EIA that nonetheless enables a state to meet its due diligence requirements. By its very nature, an alternative assessment is not likely to be undertaken on an *ex ante* basis, but rather will take the form of an assessment that is carried out during or after the project is completed. The same reasons by which the ICJ found it best to not prescribe the contents of an EIA suggest that the state of origin should have some discretion to determine the form and contents of the alternative assessment, while "having regard to the nature and magnitude of the proposed development and its likely adverse impact on the environment as well as to the need to exercise due diligence in conducting such an assessment".[58]

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7. References

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Convention for Co-operation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region, Abidjan, March 23, 1981, 20 ILM 746, entered into force August 5, 1984

Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region, Cartagena de Indias, March 24, 1983, 22 ILM 221, entered into force October 11, 1986

Convention for the Protection of the Marine Environment and Coastal Area of the South-East Pacific, Lima, November 12, 1981, International Environmental Legal Materials and Treaties 981, entered into force May 19, 1986

Convention for the Protection of the Natural Resources and Environment of the South Pacific Region, Noumea, New Caledonia, November 25, 1986, 26 ILM 25, entered into force August 22, 1990

Convention on Environmental Impact Assessment in a Transboundary Context, Espoo, Finland, February 25, 1991, 30 ILM 802, entered into force January 14, 1998

Convention on the Protection of the Black Sea Against Pollution, Bucharest, April 21, 1992, 32 ILM 1110 (1993), entered into force January 15, 1994

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UNEP Goals and Principles of Environmental Impact Assessment, UNEP Res. GC14/25, 14th Sess. (1987), endorsed by GA Res. 42/184, UN GAOR, 42nd Sess., UN Doc. A/Res/42/184 (1987)

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Protocol on Environmental Impact Assessment in a Transboundary Context to the Framework Convention for the Protection of the Marine Environment of the Caspian Sea, Draft prepared for Conference of the Parties, Fifth Meeting, 28-30 May 2014, UN Doc. TC/COP5/4 Rev.1

National Legislation

National Environmental Policy Act, 42 USC §§ 4321-4370(f)

European Council Directive 85/337 on the Assessment of the Effects of Certain Public and Private Projects on the Environment, [1985] O.J. l 175/40. Subsequently amended by EC, Council Directive 97/11, EC, Council Directive 03/35, and EC, Council Directive 09/31

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Reglamento de la ley general del equilibrio ecológico y la protección al medio ambiente en materia de EIA, (Federal) (Mexico, Reglamentos le Leyes Federales Vigentes, No.100)

Ley General de Bases del Medio Ambiente, Ley 19 300 (Chile, Congreso Nacional de Chile, http://www.leychile.cl/Navegar?idNorma=30667)

Ley 294 Evaluación de Impacto Ambiental, (Paraguay, Congreso de la Naciona Paraguaya, http://www.gat.org.py/gat/baseslegales/LeyN-294-Deevaluaciondeimpactoambientalydecretoreglamentario.pdf)

Ley del sistema nacional de EIA y su reglamento, (Peru, Congreso de la Republica del Peru, http://www.minam.gob.pe/wp-content/uploads/2013/10/Ley-y-reglamento-del-SEIA1.pdf)

Domestic Cases

Winter v. Natural Resources Defense Council Inc. 129 S. Ct. 365 (2008)

Other References

Council on Environmental Quality, "Alternative Arrangements Pursuant to 40 CFR Section 1506.11 – Emergencies (2008), available https://ceq.doe.gov/nepa/eis/Alternative_Arrangements_Chart_092908.pdf

8. Statement of Independence and Truth

8.1. The opinions I have expressed in this Report represent my true and complete professional opinion. Where I have relied on instructions or on information supplied to me by another person, I have noted this in my Report.

8.2. I understand that my overriding duty is to the Court. I have complied and will continue to comply with that duty.

8.3. I have set out in my Report what I understand from those instructing me to be the questions in respect of which my opinion as an expert is required. I have done my best, in preparing this Report, to be accurate and complete. I have mentioned all matters that I regard as relevant to the opinions that I have expressed. I consider that all the matters on which I have expressed an opinion are within my field of expertise. I have drawn the attention of the Court to all matters, of which I am aware, which might adversely affect my opinion.

8.4. In preparing this Report, I am not aware of any conflict of interest actual or potential which might impact upon my ability to provide an independent expert opinion.

8.5. I confirm that I have not entered into any arrangement where the amount or payment of my fees is in any way dependent on the outcome of this proceeding.

8.6. In respect of matters referred to which are not within my personal knowledge, I have indicated the source of such information.

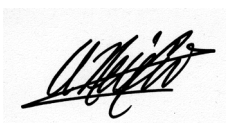
8.7. I have not, without forming an independent view, included anything which has been suggested to me by others, including those instructing me.

8.8. At the time of signing this Report I consider it to be complete and accurate subject to any qualifications noted herein. I will notify those instructing me if, for any reason, I subsequently consider that the Report requires any material correction or qualification.

8.9. I understand that this Report will be the evidence that I will give, if required, under oath, subject to any correction or qualification I may make before swearing to its veracity.

8.10. The substance of all facts and instructions given to me which are material to the opinions expressed in this Report or upon which those opinions are based are reflected in my Report.

8.11. I confirm that I have made clear which facts and matters referred to in this Report are within my own knowledge and which are not. Those that are within my own knowledge I confirm to be true. The opinions I have expressed represent my true and complete professional opinion.



Professor Neil Craik, LL.B, LL.M, SJD
University of Waterloo
School of Environment, Enterprise and Development and Basillie School of International Affairs

14 January, 2015

ANNEX 2

Professor Ian Cowx

Ecological Impacts of Route 1856 on the San Juan River Nicaragua

December 2014

Independent Expert Report concerning Evidence of Impacts on the Aquatic Ecology of the San Juan River, Nicaragua due to construction of Route 1856 in Costa Rica

11 December 2014

Prepared by:

Prof. Ian G. Cowx

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1 INTRODUCTION

1.1 About the author

Professor Ian Cowx: received his BSc Hons in Zoology specialising in Freshwater Fisheries from the University of Liverpool UK and PhD on Management and Ecology of Fish in the River Exe from the University of Exeter. He was subsequently employed as a Fisheries Biologist with Severn Trent Water and Senior Lecture in Fisheries studies at Humberside College of Higher Education before moving to the University of Hull in 1989. Professor Cowx is now Director of the University of Hull International Fisheries Institute, Hull UK and Adjunct Professor at Michigan State University.

He has extensive experience in management strategies for freshwater ecosystems in both developed (UK, Europe and Australia) and developing (Africa and Asia) countries and considerable consultancy experience in rehabilitation techniques for freshwater fisheries, integrated aquatic resource management planning, environmental impact assessment (particularly associated with water resources development schemes), and aquaculture extension. He is currently working on the impact of climate change and hydropower dam development on the fisheries of the lower Mekong Basin. In addition, Professor Cowx teaches undergraduate and postgraduate courses on Fisheries Ecology, Inland Fisheries Management, Fisheries Resources, and Aquatic Ecology. He is currently researching into fish capture techniques, stock assessment for management purposes, rehabilitation of inland fisheries, impact of dams on tropical fisheries, and aquatic resource management planning, including recently on Lake Victoria in East Africa, Kafue Flats River in Zambia Bangweulu wetlands in Zambia and Shatt Al-Arab wetlands in Iraq.

He has worked for a wide range of clients including Worked for a wide range of clients including The European Commission DG Fish, DG Environment, UK Department of te Environment and Rural Affairs, World Bank, GEF, United Nations Food and Agriculture Organization [FAO], UNDP, DANIDA, Mekong River Commission, UK Department for International Development (DFID), Environment Agency and numerous national governments and consultancy companies.

He is the Editor in Chief of Fisheries Management and Ecology, a fellow of the Institute of Fisheries Management and a Chartered Environmentalist. In 2012 he was recipient of the International Fisheries Science Prize in honour of life time contribution to fisheries science and conservation (an awarded endowed only once every 4 years by World Council of Fisheries Societies) and was awarded an Honorary PhD from Michigan State University (USA) for services to Inland Fisheries.. In 2008 he won the American Fisheries Society award for outstanding contribution to international inland fisheries management.

Professor Cowx's short curriculum vitae is included in Appendix 2.

1.2 Background

In the 'Construction of a Road' case, Volume I, Section 2.31 of the Memorial of Nicaragua 2012) and Volume I, Chapter II, Section B of the Reply of Nicaragua (2014) Nicaragua makes various assertions concerning the ecological consequences for the San Juan River of the construction of 1856 (the Road) project. In 2011 Nicaragua argued that "the road seriously affects the environment and the rights of Nicaragua." and that "If the project is not ceased it would have irreversible and transcendental ecological and environmental consequences."[1]. In the same document, Nicaragua went on to specify the nature of the ecological impacts in two of seven, numbered consequences:

> "*3. Impact over the hydrological resources, particularly affecting fishing in the river because of the changes in the quality of the water.*
>
> *7. Decrease or alteration of the aquatic life due to the water cloudiness resulting from the sediments of the road construction*."

In annexes to its Reply of August 2014, Nicaragua submitted evidence relating to ecological damage to the San Juan River which it alleges has been caused by the Road. The relevant documents are:

- Annex 1 to Nicaragua's Reply: which is a Report prepared by Dr G. Mathias Kondolf entitled, "Erosion and Sediment Delivery to the Rio San Juan from Route 1856", July 2014 (the ***2014 Kondolf Report***); and

- Annex 4 to Nicaragua's Reply; which is a Report by Dr Blanca Ríos Touma, "Ecological Impacts of the Route 1856 on the San Juan River, Nicaragua", July 2014 (the ***Ríos Report***).

This report provides an independent expert assessment of the concerns expressed by Nicaragua about the impact of the road construction on the aquatic biota of the San Juan River and the supporting evidence provided in the 2014 Kondolf and Ríos Reports.

This report does not comment on planning or construction issues, which are outside the area of expert knowledge of the author. It focuses on examining the ecological evidence presented in the 2014 Kondolf and Ríos Reports to allege the existence of ecological harm to the San Juan River in Nicaragua. The evidence provided by the 2014 Kondolf and Ríos Reports centres on fish and macroinvertebrate communities and assemblages, and their vulnerability to high and variable suspended sediment concentrations and loads. As this report is responsive to Nicaragua's allegations, it focuses on these aspects of the aquatic ecology of the San Juan River. Where evidence for impacts to aquatic ecology within Costa Rica presented by Professor Thorne in its 2013 EDA are considered, this is purely to help inform consideration of the potential for harm to the San Juan River. This report acknowledges and builds on the insightful comments made by Arturo Angulo Sabaja and Bernald Pacheco in their 2014 reports on fish and macroinvertebrates, respectfully.

[1] NM, para. 2.31, quoting Diplomatic Note from the Minister of Foreign Affairs of Nicaragua, to the Minister of Foreign Affairs of Costa Rica, Ref: MRE/DVS/VJW/0685/12/11, 10 December, 2011, NM, Annex 16.

2 FISH AND FISHERIES

2.1 Background information on the San Juan River relevant to aquatic biota

The climate of the basin of the San Juan River below Lake Nicaragua is characterised by high precipitation throughout the year, but especially during the rainy season. Reflecting this, flow in the San Juan River is relatively high between July and December and lower between March and May. This typifies the flood pulse concept as a major driver of ecological processes in tropical rivers of this region (Junk et al. 1989; Junk 2000) to which the biota are well adapted (Bussing 2002) Downstream of Lake Nicaragua tributaries join the main stream from both sides of the basin. Major tributaries draining from the south (Costa Rica) originate in mountains that are volcanically and tectonically active, mainly running through upland valleys before confluencing with the San Juan River. Tributaries draining from the north drain smaller basins with lower relief. Low order streams in the mountains are characterised by naturally high sediment loads due to upland erosion processes that are especially active during the rainy season. The San Juan River itself, which drains Lake Nicaragua, also exhibits a high natural sediment load, largely fed by its tributaries and especially those draining from the mountains to the south of the river. The San Juan River bifurcates at Delta Costa Rica and its waters and sediment load are discharged unequally through two sites: the smaller fraction flows to the Bay of San Juan del Norte in Nicaragua and the greater fraction flows to the estuary of the Colorado River in Costa Rica (PROCUENCA-San Juan 2004).

The pH of river water in the region usually varies between 6.5 and 7.4 and total hardness of 25 to 70 mg/L (Bussing 2002). While many rivers in the region drain basins affected by development (i.e. deforestation, agriculture, urbanisation and domestic and industrial pollution), water quality in the rivers of Costa Rica is generally good and is rarely a determinant factor in fish distribution.

2.2 Regional fish biodiversity (*sensu* Bussing (2002) and Angulo Sibaja (2014))

A number of studies have been carried out on the fisheries of Costa Rica. Diversity is generally relatively low compared to the sub-tropical region of the world, probably due to convergence of neo-tropical species from the South and North American continents coupled with geographical features that restrict colonisation. The fish fauna of the rivers in the region are characterised by a few species representing a wide range of families, suggesting ecological niches have been widely exploited. For example, in the Térraba River basin, Rojas and Rodriguez (2008) found 33 species from 14 families of fishes, with Cichlidae (n = 5), Characidae (n = 4) and Poeciliidae (n = 3) the most diverse families. The authors demonstrated that environmental variables such as temperature, dissolved oxygen, seasonality (winter-summer) and proximity to the sea, were the key determinants of the structure and composition of fish communities in this basin. Despite the catchment producing a high sediment yield - 404 t/km^2/yr (Bonatti *et al.* 2005), Rojas and Rodriguez (2008), found no measurable effect of suspended sediment concentration or load on the dynamics and structure of fish populations in the Térraba River drainage system. The same was found for the Rio Frio despite the basin producing an even higher sediment yield of 897 t/km^2/yr (Ortin *et al.* 2009). The Rio Frio was found to support a total of 52 species (Angulo *et al.* 2013), with Cichlidae (n = 15), Poeciliidae (n = 9) and Characidae (n = 8) the dominant families in terms of total number of species and relative abundances (Garita & Angulo 2009, Saenz *et al.* 2009).

Villegas (2011) came to similar conclusions with respect to abundance of fish species in rivers of the southwestern, Pacific region of Costa Rica and concluded that fluctuations in environmental conditions, including suspended sediment loads and concentrations, were normal characteristics of these dynamic ecosystems, which had no effect on fish abundance, richness, distribution and diversity.

The high sediment yields in these catchments result from a combination of geology (including tectonic activity), steep terrain, land-use patterns and rainfall (Ortin *et al*. 2009) Sediment loads are not only high but highly variable. For example, Tiffer-Sotomayor (2005) reported dramatic increases in the mean concentrations of Total Suspended Solids (TSS), dissolved solids and Suspended Sediment Concentration (SSC), from basal flow levels of 120 mg/l to as much as 6000 mg/l during flood events in the Aranjuez river basin (located in the Central Pacific region of Costa Rica), and other basins in the country including those of the Reventazon, San Carlos and Sarapiqui Rivers (PROCUENCA-San Juan 2004, Jimenez *et al.* 2005). It should be noted that the fish assemblages of these river basins, which are characterized by high SSCs, comprise similar species or species groups to those found in the San Juan River (Bussing 2002; Rojas & Rodriguez 2008; Saenz *et al*. 2009*;* Angulo *et al.* 2013).

In summary, it appears from an initial review of the relevant literature that the fish fauna in rivers of the region are well adapted to the seasonal fluctuations in environmental conditions, including high catchment sediment yields and suspended sediment loads and concentrations, especially during the wet season.

Although no information specific to the fish fauna in the San Juan River was found, the fish fauna mentioned in the papers reviewed comprise similar species or species groups to those found in the San Juan River. This is not unexpected given the similar topography and hydrology of the rivers and biogeography (colonization and distribution processes) of the region. Hence, it seems likely *a priori* that fish fauna in the San Juan River are also well adapted to the seasonal fluctuations in environmental conditions, including high catchment sediment yields and suspended sediment loads and concentrations.

2.3 Fish diversity in San Juan River

The fish species assemblages of Costa Rica, and the San Juan River, specifically, have been comprehensively described by Bussing (2002) and Angulo *et al.* (2013). The fish fauna originated from a convergence of north and south American species assemblages (Bussing 2002; Angulo *et al.* 2013). In total, 81 species have been described for the San Juan River basin, of which 54 are exclusively freshwater (Appendix 1). The fauna is dominated by Cichlidae (n = 17), Poeciliidae (n = 13) and Characidae (n = 9). There are no species endemic only to the catchment. The ecological characteristics and tolerances of the main fish families are summarised in Table 1, overleaf.

A similar pattern in terms of diversity and high levels of sediment transport occurs in adjacent basins of the San Juan River macro-basin, where the values of catchment sediment yields exceed the 600 t/km^2/yr (PROCUENCA-San Juan 2004). For example, at the Terron Colorado station, located on the San Carlos River, a catchment sediment yield of 817 t/km^2/yr is reported (PROCUENCA-San Juan 2004). In San Carlos basin, Bussing (2002) and Angulo *et al*. (2013) reported a total of 54 fish species. Again, Cichlidae (n = 15), Poeciliidae (n = 10) and Characidae (n = 8), dominated.

Most species of fish in the San Juan River are small in size (1, overleaf), growing to less than 20 cm in length. As a consequence there is only minor commercial exploitation of the native freshwater fishes (Bussing 2002). Some of the cichlids (the large piscivore *Parachromis* spp., locally known as guapote) as well as the tarpon (*Megalops atlanticus*), *Brycon* (a characin), mullet (*Joturus pichardi*), robalos (*Centropomus*) and roncador (*Pomadasys*) are of commercial value, but the majority of these are of marine rather than freshwater origin.

Table 1: Ecological characteristics of the main freshwater fish families found in San Juan River (source: Bussing 2002 and FISHBASE and references therein).

Family Name	Common name	Characteristics
Atherinidae	Silversides	Schooling fish that serves as an important source of food for larger fishes.
Centropomidae	Snook	Carnivorous fishes, mainly piscivorous. Are of high sport and commercial importance.
Characidae	Characins, tetras	Small and silvery schooling fishes, some with brilliant colours. Occur in a wide variety of habitats from swamps and large lakes to small acid streams. Most are carnivorous, but others feed mainly on plants. Eggs spawned freely in the water, often among vegetation, although some species practice internal fertilisation and parental care of the eggs and newly hatched fry. Some species undertake in long seasonal migrations to spawn.
Cichlidae	Cichlids	Found in pools and along the shorelines of rivers or lagoons where they live near rocks and undergrowth. Most of the Costa Rica cichlids are adapted to both the lacustrine environment and rivers; only one native species, *Vieja maculicauda*, usually lives in or near brackish waters close to the sea. They are not found at high elevations, their greater diversity being below 100 m elevation. The majority of species feed on insects and detritus but the species locally known as guapote (*Parachromis* spp) are mainly piscivorous and are widely sought by fishers due to its size, combativeness and good flavour.
Eleotridae	Sleepers	Especially abundant in estuaries and river mouths; some species inhabit rivers. Majority are benthic. Typically deposit small adhesive eggs on stones cleaned by the parents; the male cares for the eggs by circulating water with its pectoral fins.
Pimelodidae	Long whiskered catfishes	Benthic species and usually nocturnal seeking hideaways between roots or undergrowth in dark places during the day. Most species are omnivorous and eat aquatic insects, worms and other organic matter. Reproduces during the first rains of April and May, making use of the turbid waters to swim upstream in the rivers until reaching the smaller creeks to deposit their eggs; it is not unusual that they reach fields and ditches during the torrential downpours, being beached by the thousands, in the grass upon the retreat of the rain waters. Females lay eggs, on the aquatic vegetation where they remain deposited for fertilisation and development.
Poeciliidae	Live-bearers	Most of the live-bearers inhabit puddles or shallow river waters where there is little current and much vegetation. Some species live in brackish waters at the mouths of rivers; others have adapted to crystalline, cold mountain brooks. Except for *Belonesox belizanus*, which is piscivorous, most of the Poeciliids eat insects, algae or sediments rich in organic matter and microscopic organisms. Some of these are sold salted and dried for human consumption. The family includes some of the smallest and most polymorphic vertebrates living.
Rivulidae	Oviparous cyprinodonts, rivulins	Some species endure extreme conditions such as temperatures of more than 40˚C and in salinities almost double that of the sea. Eggs deposited in the substratum and resistant to desiccation and when the water dries but hatch on arrival of the rains.

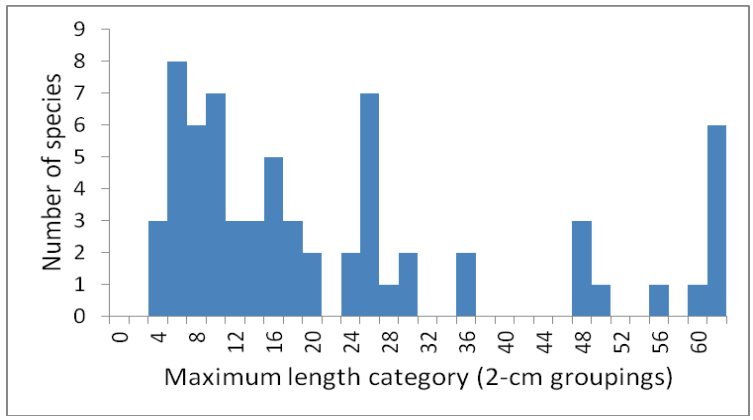

Figure 1: Distribution of maximum size of fishes in the San Juan River (Data sourced from Bussing (2002) and FISHBASE)

Fish species in the San Juan River are mainly insectivores, herbivores and detritivores (Appendix 1), especially when young, although there are some specialist feeders (e.g. the scale eater *Roeboides bouchellei*). There are a variety of piscivorous species (Bussing 2002); species such as "guapotes" (*Parachromis dovii* and *P. managuensis*, Cichlidae), "pepesca gaspar" *Belonesox belizanus* (Poeciliidae), beaked sardine *Bramocharax bransfordii* (Characidae), "barbudos" (*Rhamdia* spp.) and gar fish (*Atractosteus tropicus*), most of them of economic importance and marine origin (Bussing 2002).

Several of these species (*Parachromis* spp, *Belonesox belizanus* and *Atractosteus tropicus*, for example), are particularly abundant in lentic (i.e. sluggish or dead water) environments with high levels of suspended solids and high turbidity (Bussing 2002, Garita & Angulo 2009, Saenz *et al*. 2009). These species could thus be tolerant or even adapted to high levels of sediment, to some degree, as suggested by both Chesney (1993) and Berry and Hill (2003). Indeed, it has been suggested that some piscivorous and insectivorous fish are better able to forage under conditions of high TSS, SSC and hence turbidity because it makes the predator difficult to detect by the prey (Chesney 1993, Berry & Hill 2003).

A small number of species are considered vulnerable or threatened in the River San Juan (

Table 2). These species have been affected mainly through reduction of habitat as a consequence of deforestation and the degradation of habitat, including pollution by (Bussing 2002).

Table 2: Conservation status of fish species recorded in the San Juan River (Source: Bussing 2002; Environmental Diagnosis Assessment 2014)

.Family	Species	Conservation Status	
		National	IUCN
Carcharhinidae	*Carcharhinus leucas*	Limited	NT
Centropomidae	*Centropomus undecimalis*	Limited	
Characidae	*Hyphessobrycon tortuguerae*		LC
Cichlidae	*Parachromis friedrichsthalii*		LC
Megalopidae	*Megalops atlanticus*		VU A2bd
Pristidae	*Pristis pectinata*	Limited	CR A2cd
Pristidae	*Pristis perotteti*	Limited	CR A2abcd
Rivulidae	*Rivulus isthmensis*	Endangered	
Poeciliidae	*Brachyrhaphis olomina*	Less common	
Mugilidae	*Agonostomus monticola*	Threatened	
Mugilidae	*Joturus pichardi*	Less common	

2.4 Responses to Nicaragua's Reply with respect to fishes

The documents submitted with Nicaragua's Reply make further statements regarding the fish of the San Juan River and how they may be negatively affected by what is termed 'pollution' allegedly caused by increased sediment loads and suspended sediment concentrations due to construction of the Road. This section examines the relevance and validity of these statements and the evidence presented in Volume II, Annex 1 of the Reply to support them, with respect to the potential for ecological damage and disruption of ecosystem functioning in the San Juan River.

In The 2014 Kondolf Report, Dr Kondolf states that,

"Increased delivery of coarse sediment (gravel, sand) to rivers can cause aggradation of the river channel and burial of important aquatic habitats (USDA Forest Service 1999, Ziemer & Lisle 1992, Madej & Ozaki 2009). Increased fine sediment (clay, silt, sand) can cause:

- *reduced exchange of stream and shallow groundwater by clogging gravel and sand beds;*
- *burial and loss of aquatic vegetation;*
- *increased turbidity, reduced light penetration, and consequently, reduced primary productivity, which can have effects up the food chain;*
- *loss of periphyton and consequent impact on the food chain;*
- *loss or reduction of macroinvertebrate populations ;*
- *infiltration of fine sediments into formerly clean gravel substrate needed by aquatic macroinvertebrates, juvenile fish, and other organisms as habitat;*

- *clogging and damage to gills of fish from high concentrations of suspended sediment;*
- *reduced ability of fish to recover from wounds;*
- *disrupted reproduction in some fish by damaging or smothering eggs and larvae and/or affecting adult fishes' reproductive behavior (e.g. visual mate recognition);*
- *impaired ability of certain fish to locate food as a result of decreased visibility; and*
- *alteration of the balance of fish species present in a given location.*

(e.g., Wood and Armitage 1997, Yamada and Nakmura 2002, Cederholm et al. 1981, Petts 1984, Brookes 1986, Van Nieuwenhuyse and Laperriere 1986, Henley et al. 2000, Kemp et al. 2011)

These statements are no more than a summary of the fish-sediment literature and are not put into the context of the extant situation of the aquatic biota and ecosystem processes in the San Juan before, during and after construction of the Road. For this list to be meaningful, each factor needs to be related to each species in the San Juan River and its habitat/environmental tolerances, rather than simply implying that these generic outcomes apply to this river and context.

High and variable sediment loads and SSCs may be a naturally occurring phenomenon due to seasonal weather patterns, but can also be caused by broad scale catchment development involving agricultural expansion, farming intensification and deforestation (Collins *et al.* 2011, Kemp *et al.* 2011).

In rivers with high natural sediment loads, especially in the rainy season, fish species and communities are well-adapted to the local sediment regime. There are numerous examples from across the globe where rivers that transport massive sediment loads during their wet season support diverse fish communities and abundant fish populations (e.g. Lowe-McConnell 1977, Payne 1986 and Welcome 2001, and references therein).

In this context, Bussing stated in 2002 that erosion in the San Juan basin is a natural phenomenon and local fishes are adapted to high turbidity during flooding in the rainy season. That said, if catchment erosion has accelerated in the decade since Bussing's study, this could potentially affect certain species directly (for example, by clogging gill filaments) and/or indirectly (for example, by reducing productivity and lowering the habitat diversity necessary to sustain a diverse and abundant ichthyofauna).

In my opinion, to establish whether catchment erosion (due to economic development or any other change in catchment land use) has increased sufficiently to significantly affect the fish species that inhabit the San Juan River, a reliable, multi-decadal record of catchment sediment yields and river sediment loads (including their seasonal variability) would be required. It is my understanding that no such records exist for the San Juan River.

Notwithstanding this, it is known that the concentration, duration of exposure, composition and particle size of the sediment load in a river have strong impacts on the biota present (Chapman *et al*. 2014). Fine sediment loads are known to have direct and indirect impacts on freshwater fish with varying survival responses across different species within the same family, and this is why many species living in rivers with naturally high and variable loads are well adapted to those conditions (Kemp et al. 2011 and literature therein), a point made in the 2013 Thorne Report (Appendix A to Costa Rica's Counter-Memorial) that is disagreed with in the 2014 Kondolf Report (I will return to this disagreement later, having considered the evidence available).

It is recognised that enhanced fine suspended solids can cause clogging of fish gills or bring contaminants into the water (Collins et al. 2011), which can lead to fish kills (Buermann et al. 1997, Lake & Hinch 1999), though rarely is a decline in abundance observed (Chapman *et al.* 2014). Mortalities can also occur due to localised, natural events, for example a type of sudden and massive fish mortality, locally known as the 'borrachera', occurs in the middle reaches of the Pilcomayo River (Gran Chaco) almost every year at the onset of the rainy season. This is mostly due to extremely high suspended sediment concentrations (greater than 100 g/l) that clog the gills of vulnerable fish species (Swinkels *et al.* 2012), though the fish community as a whole is unaffected because this is resilient even to extreme SSCs (Buermann *et al.* 1997, Lake & Hinch 1999, Swinkels *et al.* 2012, Chapman *et al.* 2014).

Below, further points arising from my literature review are discussed in detail with respect individual arguments in the 2014 Kondolf Report.

Dr Kondolf contests the statements in 2013 Counter Memorial of Costa Rica to the effect that, "*sediment is not a pollutant. Rather, the contribution of sediment to a river such as the San Juan is a natural process, and one which is essential to the life of the River. This process is commonly regarded as beneficial. (Counter Memorial of Costa Rica, ¶3.4.)*" Costa Rica cites an article by Dr Kondolf (see Counter-Memorial of Costa Rica, footnote 128).. In contesting these statements Dr Kondolf states in Section 8 of the 2014 Kondolf Report (page 63) that:

> *"These statements are not correct. While rivers have a natural sediment load, and eliminating this natural sediment load by trapping sediment in an upstream dam can have impacts on the downstream channel (the subject of my 1997 article), it is a different matter when sediment loads are increased as a result of anthropogenic activities. In such cases, sediment is treated as pollution by environmental regulators and international organizations. This is because unnatural sediment contributions to bodies of water can be harmful to water quality, aquatic life, and other receptors*."

I agree that eliminating the natural sediment load or increasing the sediment load to a water body can be harmful to aquatic life, but Dr Kondolf does not provide any evidence to distinguish between the contributions of natural and unnatural loading to the San Juan River, nor does he provide any direct evidence that any unnatural loading has resulted solely from construction of the Road. As to the latter, there is a clear need to distinguish between the contribution of 'unnatural' loading from Road construction and that originating from, for example, land use changes in catchments draining to Lake Nicaragua and the San Juan River.

This is important because it is globally acknowledged that sediment plumes running into coastal waters support primary productivity and ultimately fish productivity (Rose & Summers 1992, Houde and Rutherford 1993, Nixon & Buckley 2002. Lane *et al.* 2004, Wissell and Fry 2005, Piazza and La Peyre 2007, Kimmerer *et al.* 2009). Any increase in sediment output from the San Juan is thus likely to increase fisheries productivity in the Caribbean especially inshore around the outlets of the lower San Juan and Colorado Rivers. A similar scenario exists for freshwater systems but is less well explored. The best evidence of increased productivity is that shown for the Tonle Sap River in the Mekong Basin, where Kummu et al. (2005, 2007, 2010) have demonstrated a strong, positive relationship between sediment loading and fisheries productivity.

On page 64 of the 2014 Kondolf Report, it is stated that, "*Increased turbidity has had important consequences on cichlids, as many use vision to maintain a feeding territory, obtain a mate, or defend offspring. Some cichlid species change their behavior depending on turbidity levels (Gray et al. 2012).*" To illustrate this point, Dr Kondolf uses examples from: Seehausen *et al.* (1997) referring to turbidity interfering with mate choice, relaxing sexual selection, and blocking mechanisms of reproductive isolation; and similar visually

mediated speciation events having been documented in Central American cichlid faunas (Barluenga & Meyer 2004, Geiger *et al.* 2013).

However, I consider these examples have been taken entirely out of context and that they are not relevant to the San Juan River. Seehausen *et al.* (1997) refers to sexual selection in the multi-species flock of haplochromine [Cichlid] fishes (which includes 300-500 different species) in Lake Victoria that rely on clear water all year round for visual identification of partners that have very specific colour patterns. In this example, water clarity was not reduced by an unusually high SSC. It was disrupted by eutrophication that generated a dense algal bloom that blocked light penetration, which is an entirely different phenomenon. In slit laden rivers with high and variable SSCs, resident species of the Cichlid family differ from those in Lake Victoria in that they have adapted to reproductive isolation through habitat segregation. In the San Juan, the cichlid species occupy different habitats for breeding and there is no evidence they require clear water all year round to breed.

On the same page, Dr Kondolf also argues that,

> *"In a non-native cichlid, Oreochromis niloticus, elevated turbidity levels caused higher concentrations of lysozyme in blood (a potential indication of stress) (Dominguez et al. 2005). Reduced growth and survivorship have been documented at comparatively higher turbidity levels (Ardjosoediro & Ramnarine 2002). Reduced primary productivity (a consequence of higher turbidity levels) can lead to lower fish yields in ponds with relatively high turbidity (Teichert-Coddington et al. 1992)."*

These are all site-specific experiences, and any fish would be stressed by adverse environmental conditions.

At the foot of page 64 in his 2014 Report, Dr Kondolf writes about fishes in the family Mugiliidae, stating that:

> *"Fishes in the family Mugiliidae typically spawn at sea and carry out longitudinal migrations into rivers. Different life stages are adapted to different environmental conditions and change their habitat and dietary requirements as they develop. The proportional abundance adults and juveniles of mountain mugilliid Agonostomus monticola in the Costa Rican Térraba River Basin can be affected by differences in water volume and turbidity levels, with mullids needing well-oxygenated, flowing waters with low turbidity (Cota Ribeiro & Umaña Villalobos 2010).*"

The clue to identifying the flaw in this example is indicated by the common name of this species of Mugiliidae, which is mountain mugilliid. This particular species of the Mugiliidae family is unusual in that it lives in mountain streams. Unlike most Mugiliidae, this species does not inhabit large, lowland rivers. There is then little similarity between the upland streams where this species is found and the San Juan River. It is all very well inferring that construction of the Road will impact on a named species of fish, but evidence that this is physically possible is required to support that argument, such as a map of the distribution of the mountain mugiliid in relation to the Road.

On page 65 of his 2014 Report, Dr Kondolf suggests that members of the family Poeciliidae would be adversely affected because,

> *"Similar to cichlids, many poecilids utilize visual cues for mating and feeding, which can be affected by changes in water turbidity (Campos Valera 2013; Heubel & Schlupp 2006; Hubbs 1999)."*

It is accepted that many poeciliids are visual predators of insects, but others consume plant material and organic matter but also typically inhabit nearshore, calm-water habitats

among submerged vegetation. This is evident from the review of the ecology of the species found in the San Juan (see Appendix 2). Both trophic groups can be affected by increased water turbidity but the key issue here is the habitat occupied by these species. In the San Juan basin, most of the live bearers (Poeciliids) live in streams and brooks of low to moderate current velocity and/or stagnant waters, puddles, creeks and river shorelines, over soft bottoms (Bussing 2002). These are habits mostly found in and around tributary watercourses and wetlands rather than in the main channel of the San Juan River. It is unlikely that such habitats in Nicaraguan tributaries and wetlands would be affected by any additional sediment entering the San Juan River from the Road.

The commercial species exploited in the basin are some of the cichlids (the large piscivore *Parachromis* spp., locally known as guapote) as well as the tarpon (*Megalops atlanticus*), *Brycon* (a characin), mullet (*Joturus pichardi*), robalos (*Centropomus*) and roncador (*Pomadasys*), the majority of which are of marine origin. Unfortunately, lack of any commercial or artisanal catch data precludes assessment of possible impact, but it is my opinion these fisheries are unlikely to be impacted by marginal changes in suspended sediment loads or concentrations. If they were to be affected, an increase in the suspended sediment load is more likely to be beneficial than detrimental to the fisheries of the coastal area through delivering nutrients that promote primary production (Rose & Summers 1992, Houde and Rutherford 1993, Nixon & Buckley 2002, Lane *et al.* 2004, Wissell and Fry 2005, Piazza and La Peyre 2007, Kimmerer *et al.* 2009).

2.5 Discussion and Conclusions

There are a number of claims made by the Nicaraguan Memorial and Reply with respect to the impact of sediment on fish and fisheries in the San Juan River. The statements presented in the 2014 Kondolf Report to support these claims are either over-generalised, fundamentally flawed or misinterpret the peer reviewed literature. Arguments in the 2014 Kondolf Report are unsupported by empirical evidence from the San Juan River itself and those based on the published literature are often taken out of context.

The San Juan River exhibits an annual hydrograph with a wet season flood pulse typical of tropical rivers and its sediment load is consistent with this, being naturally high and variable (Bussing 2002). The fishes of the San Juan River are well adapted to seasonally variable sediment loadings (Bussing 2002). Their life cycles and behaviours are phased to either benefit from or avoid these natural environmental stressors: i.e. the fish assemblage is adapted to a certain degree of high turbidity during flooding in the rainy season (Bussing 2002). This finding is consistent with statements in the 2013 Thorne Report and contrary to the arguments put forward in the 2014 Kondolf Report.

The main species of fish found in the river adjacent to the Road have not been explicitly defined by Nicaragua's experts, and it would require intense research using specialist gear to determine them. They are, however, likely to be dominated by cichlids, poeciliids and characids. These species are generally small sized with little commercial value, and are not threatened species (IUCN Red List: http://www.iucnredlist.org/initiatives/freshwater).

It seems likely that coastal fishery is more productive than inland fishery, mostly due to exploitation of snook and sport fisheries for tarpon. These fisheries are unlikely be affected by any additional sediment loading, and indeed may be enhanced by any enrichment of the coastal waters.

My literature review, together with close inspection of literature cited in the 2014 Kondolf Report, provides the basis to evaluate Dr Kondolf's general statement on page 64 that,

"What the literature actually demonstrates is that some of the most prevalent fish known to exist in the Río San Juan (as reported in Procuenca 2004 and the EDA, Annex 10), such

as Cichlids, members of the family Mugiliidae, and Poeciliids, are vulnerable to increases in turbidity and suspended sediment."

What the literature actually demonstrates is that Dr Kondolf's statement is a gross over-generalisation. While some members of the families of fishes he names are vulnerable *to increases in turbidity and suspended sediment,* others members of those families are adapted to high sediment loading and this is illustrated through the species specific review summarised herein and reported in detail in the references cited.

Empirical data on the species impacted with particular reference to the San Juan River are required to justify and substantiate claims of any long-term impact of construction of Route 1856 on the fish and fisheries of the river. No such data have been provided by Nicaragua's experts. The examples used as evidence are general and unspecific to the San Juan River and the species that inhabit it.

In conclusion, there is no evidence that the fish and fisheries of the San Juan have or will be impacted by construction of Route 1856.

3 MACROINVERTEBRATES

3.1 Introduction

The aim of this section is to re-examine evidence presented in the Ríos Report (2014) related to the impact of the Road on macroinvertebrates in the San Juan River

3.2 Review of Blanca Ríos Touma (2014) 'Ecological Impact of the Route 1856 on the San Juan River, Nicaragua' – The Ríos Report

The Ríos Report presents the results from a macroinvertebrate sampling programme undertaken on 17 'delta' sites along the banks of the San Juan River. Nine sites are located at the South bank and eight sites at the North bank.

Macroinvertebrate samples were collected over a two-minute sampling period using a D-net (kick net). In addition to macroinvertebrates, Chlorophyll *a*, water temperature, pH, conductivity and substratum characteristics (d16, d50, d84 a sorting index (d84/d16) were recorded. Some of the primary data are included within the report, allowing readers the opportunity to explore some of the patterns recorded directly, although the variability revealed by the minimum-maximum values in Table 3 suggests that this is not appropriate.

The following macroinvertebrate community measures are used as dependent variables in a series of statistical analyses:

- taxa richness,
- abundance,
- number of EPT taxa, and
- EPT abundance.

Based on the results presented, the following are reported to be significantly lower at the sites at the southern bank compared to sites on the northern bank:

- Chlorophyll *a*
- Richness (Number of Taxa)
- Abundance

It is notable, however, that scores for richness (less than 10 at all sites) and abundance (average of less than 100 individuals per sample) are both low and variable (see min-max values in Table 3 and the data plotted on the y-axes in Figures 8 and 9 in the Ríos Report).

Mean values for the following macroinvertebrate community indices are reported to higher at the North Bank, though they were found not to be significantly higher statistically:

- EPT Richness
- EPT Abundance
- Shredder abundance
- Collector-gatherer abundance

Given the low overall richness and abundance scores noted above, I would advise that the higher EPT richness and abundance scores and the higher abundances of shredders and

collector- gatherers apparently found at the northern bank are potentially misleading and cannot reliably be used to infer that the environments and habitats differ between deltas on the northern and southern banks.

However, there are more compelling reasons for treating the results of this study with caution.

First, the data listed in Table 1 of the Ríos Report (reproduced here as Table 3) indicate that for 6 of the 8 'pairs' of deltas (1A, 2A, 3A, 6A, 7A and 8A), catchment drainage areas at the southern bank delta are lower than that at the northern bank.

Table 3: Table 1 from the Ríos Report. "A" points correspond to deltas formed at the southern bank of the San Juan and "B" points correspond to deltas formed at the northern bank.

Point	LONG	LAT	APPROXIMATE DRAINAGE AREA (Km^2)
1A	-84.35933333300	10.99698500000	1.5
1B	-84.29281034980	10.91394448280	25
2A	-84.28382000000	10.89443000000	0.25
2B	-84.28700359230	10.90482145620	1.5
3A	-84.28213166700	10.89327333300	0.1
3B	-84.26302965570	10.89231645490	0.4
4A	-84.26815310670	10.89182263050	6.8
4B	-84.28559759790	10.90077234720	10
5A	-84.35409933930	10.99030940540	1
5B	-84.21508833300	10.84640666700	0.4
6A	-84.27846253600	10.89264772500	0.4
6B	-84.21835833300	10.86338000000	0.7
7A	-84.27767348230	10.89269348540	0.2
7B	-84.23483789070	10.87701472010	0.4
8A	-84.26354020910	10.89096424330	0.5
8B	-84.24867105280	10.88897071090	1.6
9A	-84.23740666700	10.87652500000	4.8

Calculated from available topographic maps.

This is important because the size of the contributing basin affects the quantities, qualities and time variation of water, sediment and nutrients supplied to the delta, which largely influence the environmental attributes and habitat provided by a delta. Differences in the drainage areas of deltas will influence, and are probably in part responsible for, differences between sites located at the northern and southern banks. These differences in

contributing drainage area should have been considered in Dr Ríos' study and it appears that they were not. They call into question whether the 'paired' northern and southern bank deltas were actually comparable.

Differences in drainage areas also represent a potentially confounding factor (co-varying factor) that does not appear to have been considered in the statistical analysis and is a central issue raised in the technical critique by Fonseca (2014).

The co-varying nature of the drainage areas could have been controlled for in some way (e.g. using Analysis of Covariance [ANCOVA], as suggested by Fonseca (2014)), but with only two groups and a relatively small sample size this would be sensitive to the high values associated with some of the sites and samples. A preliminary examination of the data presented by Ríos (2014) in Table 1 (Drainage area), Table 2 (Chlorophyll *a*), Table 3 (Average Richness, Abundance) was explored but the data represent averages of averages and the variability for individual sites appears to be large (see max-min values in Table 3 of Ríos 2014). Ríos concluded that macroinvertebrate abundance on deltas on the Nicaragua bank were higher than those on the Costa Rican bank. However, the low number of samples, low abundance and richness (plus the high within site variability reported in Ríos Table 3) suggest that all of the sites are 'dynamic' and variable. In addition, only three comparisons are significant (and these may be influence by drainage area). Although a number of statistical tests have been used (and others suggested in the response document by Paul E. Gutierrez Fonseca) the data do not appear appropriate and the majority of 'patterns' are marginal. Consequently, the data lack statistical robustness to discriminate any significant differences between locations/deltas.

Non-Metric Multidimensional Scaling (NMDS) is used to explore differences in community composition in association with the environmental variables. The results suggest some apparent differences, but the fauna associated with these differences are not identified and none of the environmental parameters reported are statistically significant (Table 4). This pattern could also be related to drainage area.

Furthermore, in addition to ignoring the effects of catchment size, the Ríos' study also fails to consider the effects of terrain, natural vegetation and land use on physical, chemical and biological processes and environments in streams and the deltas they build. This is particularly relevant because streams on the Costa Rican side of the San Juan are more likely to be impacted by steep terrain, deforestation or agricultural development than those on the Nicaraguan side, which drain lower basins mostly covered in rain forest. For example, in comparing deltas, Ríos (2104) chose to compare macroinvertebrate assemblages between a northern bank (Nicaraguan) delta with dense, intact forest cover (Reserve Indio Maiz) with an adjacent southern bank (Costa Rican) delta that receives runoff from a basin impacted by extensive agriculture and livestock activities.

Basin area and land use are two important and influential variables that Dr Ríos overlooks in her analysis, and her failure to consider them reduces confidence in her conclusion that differences between the macroinvertebrate communities sampled on northern and southern bank deltas can be attributed to degradation of aquatic communities in the San Juan River by sediment eroded from the Road.

This problem is further exacerbated because Dr Ríos chose to sample on the deltas only, yet any increased sediment would be expected to influence the entire river bed and its benthic macroinvertebrate communities across the whole river profile.

Other statements in the Ríos Report regarding the sensitivity of invertebrate taxa and the assertion that abundance of sensitive taxa is higher on the north bank are also questionable on the grounds that these taxa have very low abundances generally and EPT richness is particularly low across all sites.

3.3 Responses to Nicaragua's Reply with respect to Macroinvertebrates

As with fish (dealt with in Section 2.3, above), the 2014 Kondolf Repot includes a number of definitive statements concerning the impact of construction of Route 1856 on macroinvertebrate fauna in the San Juan River.

On page 65 of his 2014 Report, Dr Kondolf describes the use of macroinvertebrate fauna as indicators of environmental degradation, but he misses the point that macroinvertebrates are much better bio-indicators of adverse impacts of water quality than they are of deterioration of hydromorphology (Bonada 2006; Resh 2008). Evidence collected during multiple, integrated projects carried out in the European Union to derive methodologies for implementation of the Water Framework Assessment (see for example: WISER [http://www.wiser.eu/], REFORM [http://www.reformrivers.eu/], and REFRESH [http://www.refresh.ucl.ac.uk/]) have demonstrated the limitations of macroinvertebrates as bio-indicators of the hydromorphological status of rivers. Consequently, care must be taken when interpreting the results of macroinvertebrate studies in the San Juan River as indicators of adverse effects due to the building of micro-deltas at the mouths of some tributary streams.

This is particularly significant because of Dr Kondolf's over-reliance on using of macroinvertebrates to infer that the Road has had significant hydromorphic impacts on the River. For example, on page 65 of his 2014 Report Dr Kondolf concludes that:

> *"The heavy loads of suspended sediment have a negative effect on algal and macroinvertebrate communities in the Río San Juan, as evidenced by differences in ecological communities established on deltas on the north bank, at the mouths of streams draining forest preserve in Nicaragua, which are not affected by Rte 1856, contrasted with those established on the south-bank deltas, which are affected by sediment eroded from the road."*

To support his conclusion, Dr Kondolf cites evidence from the Ríos (2014) Report, which reports to have:

> "*found that macroinvertebrates had much higher species richness and abundance, and importantly, much higher EPT abundance and richness, on deltas on the north side of the Río San Juan, than on the south-bank deltas impacted by sediment from the road."*

Dr Kondolf explains the significance of the EPT results thus,

> *"EPT refers to the orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies), which are known to be sensitive to sediment and other pollutants, and thus are important indicators of water quality."*

EPT fauna are indeed important indicators of *water quality*, but they are less reliable in indicating hydromorphological impacts due to the accumulation and dynamics of hydromorphological features, such as sediment deltas.

The point here is that not only are the EPT richness and abundance scores very low for all the deltas studied (as discussed in the review of Dr Ríos' study above) to the point that they lack statistical robustness (as discussed by Fonseca 2014), but also differences between northern and southern bank deltas are probably more logically attributed to differences water quality in streams draining to the deltas that are attributable to contrasts in basin areas, vegetation and land use. The failure of Dr Ríos' study to control for confounding factors such as the effects of agricultural development thereby becomes doubly significant.

3.4 Discussion and Conclusions

Dr Ríos' Report appears to show differences between macroinvertebrate communities (and associated parameters) on deltas at the North and South banks of the San Juan River. However, the findings of Dr Ríos' study and both her and Dr Kondolf's interpretations of those findings are compromised by the fact that the drainage areas of the northern bank deltas are systematically larger than those of the southern bank deltas and because the study does not consider or account for the effects of natural vegetation and catchment land use on stream water quality and delta habitat. It is contended here that these confounding factors may account, at least in part, for the differences that Nicaragua attributes to sedimentation from the Road.

Further, the low number of samples, low abundance and richness (plus the high within site variability reported in Table 3) suggest that all of the sites are 'dynamic' and variable. While multiple patterns and differences are reported only three are statistically significant (and these may in any case be attributed to differences in drainage area, natural vegetation and land use). Although a number of statistical tests have been used, I would question whether the data are sufficiently robust to support these tests and, in any case, the majority of 'patterns' are marginal. I note that Fonseca (2014) has come to the same conclusion.

In my opinion, differences in the macroinvertebrate communities on the deltas are to be expected because these hydromorphic features are highly dynamic and experience contrasting flow and sediment inputs due to the flashiness and variability of runoff from the micro-basins that drain to them. It is surprising, however, that there is low species abundance and that more Diptera larvae (*Chironomidae, Simuliidae*) were not found, especially since a 500 micron net was used.

In summary, I consider that the Ríos (2014) Report does not provide the evidence necessary to prove that construction of the Road has adversely impacted the benthic macroinvertebrates living in sediment deltas along the southern bank of the San Juan River. Differences between bio-indicators for the northern and southern bank deltas are equivocal and most lack statistical significance, even from tests that are relatively weak. If differences do exist, these are probably related more to contrasts in the size, vegetation and land use of the micro-basins that drain to the deltas and, particularly to contrasts in water quality associated with agricultural activity in south bank tributary streams that is absent from streams draining to the north bank. It is therefore unsound for Dr Kondolf to conclude that Road-derived sediment has had negative effects invertebrate communities in the San Juan River.

Given the problems I have identified with Dr Ríos' study, it is recommended that a more robust monitoring protocol is adopted to consider whether the Road has had any impact on macroinvertebrates. The key for any future sampling and monitoring is to control for the confounding factors I identify above. This should include the following:

- Employ standard 3-minute kick samples covering all the available habitats (standard approach used in many parts of the world – if abundance is low then increase the time (up to 5-min). This should be supplemented with 1 minute of hand sorting for anything attached to rocks.

- In locations not affected by the kick sampling (upstream) collect five Surber samples from riffle habitats (or similar for the system). This will provide fully quantitative data. (However: this may be a pointless task if the low densities reported by Dr Ríos are accurate).

- The selection of sites should be randomised and not specific to the river outlets. This biases the data because of contributing catchment size and land use. Sites beyond the stream outputs, i.e. upstream and downstream of the mixing of input

tributaries, should be selected to account for the full range of habitats in the main river, although I suspect that these habitats may have been avoided because of depth and difficulty in sampling. Consequently, lift pumping or Ekman grabs (if the bed is sandy) should be employed as alternative sampling methods.

- In addition sampling should take place within the tributary streams to account for the precise source of the sediments. This should include sampling upstream and downstream of streams draining from the Road to create upstream control versus downstream impacted sites. If the tributaries are not stable or dry up it would be appropriate to use the main channel (but this may be too deep to use standard methods if it is not wadeable)

- For all sites measure flow velocity, water depth, pH, conductivity, dissolved oxygen, turbidity, light, shading and substratum characteristics as these are the key parameters of interest in terms of the study and affect the distribution and abundance of macroinvertebrates. Some strategically placed water samples to measure suspended load would be sensible (either collected on a regular basis or triggered by water level to capture events when sediment is moved: classic hydrological controls).

- The analysis should calculate the key metrics: abundance per taxa, BMWP-CR, and diversity indices. If the data have been collected to control for confounding factors, Analysis of Variance (ANOVA) would be the most appropriate/easy to follow. This should be supplemented with a multivariate approach either using Canonical Methods (CA, DCA, PCA CCA) so that the data can be examined independently and in combination, and related to the environmental variables as drivers of species assemblages.

4 Conclusion

My independent review provides support for Professor Thorne's assertion that:

> *"Fish and other aquatic organisms in the Río San Juan do not find high turbidity problematic because they are fully adapted to it"*

and shows this to be consistent with available literature on the species of fish known to exist in the San Juan River.

The 2014 Kondolf Report makes over-generalised statements concerning families rather than species of fish and provides no river or fish species-specific evidence to indicate that construction of Route 1856 has adversely impacted fish or the fishery in the San Juan River.

Evidence provided in the Ríos Report that compares environmental bio-indicators for deltas on the northern and southern banks is largely inconclusive and fails to provide the robust empirical data necessary to prove that sediment eroded from the Road has adversely impacted the aquatic ecology of the San Juan River.

5 Acknowledgements

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7 STATEMENT OF INDEPENDENCE

The opinions I have expressed in this Report represent my true and complete professional opinion. Where I have relied on instructions or on information supplied to me by another person, I have noted this in my Report.

I understand that my overriding duty is to the Court. I have complied and will continue to comply with that duty.

I have set out in my Report what I understand from those instructing me to be the questions in respect of which my opinion as an expert is required. I have done my best, in preparing this Report, to be accurate and complete. I have mentioned all matters that I regard as relevant to the opinions that I have expressed. I consider that all the matters on which I have expressed an opinion are within my field of expertise. I have drawn the attention of the Court to all matters, of which I am aware, which might adversely affect my opinion.

In preparing this Report, I am not aware of any conflict of interest actual or potential which might impact upon my ability to provide an independent expert opinion.

I confirm that I have not entered into any arrangement where the amount or payment of my fees is in any way dependent on the outcome of this proceeding.

In respect of matters referred to which are not within my personal knowledge, I have indicated the source of such information.

I have not, without forming an independent view, included anything which has been suggested to me by others, including those instructing me.

At the time of signing this Report I consider it to be complete and accurate subject to any qualifications noted herein. I will notify those instructing me if, for any reason, I subsequently consider that the Report requires any material correction or qualification.

I understand that this Report will be the evidence that I will give, if required, under oath, subject to any correction or qualification I may make before swearing to its veracity.

The substance of all facts and instructions given to me which are material to the opinions expressed in this Report or upon which those opinions are based are reflected in my Report.

I confirm that I have made clear which facts and matters referred to in this Report are within my own knowledge and which are not. Those that are within my own knowledge I confirm to be true. The opinions I have expressed represent my true and complete professional opinion.

_____ Date 11 December 2014

Professor Ian G. Cowx

8 Appendix 1: Fish species diversity of the San Juan River

Family	Species - scientific name	Altitude (m)	Trophic	max size (cm)	Ecological habitat preferences	References
Anguillidae	*Anguilla rostrata*	9-20 m	Insectivore		Streams, rivers, and muddy or silt-bottomed lakes	Page & Burr 1991
Anablepidae	*Oxyzygonectes dovii*	< 15 m			Freshwater; brackish; demersal;	Huber, 1996.
Aplocheilidae	*Rivulus fuscolineatus*	525 and 695 m	Insectivore		Waters of moderate to high current velocity	Costa, 2003.
	Rivulus isthmensis	0-1500 m	Insectivore		Prefers swamps and ditches, with slow movement of streams	
Atherinidae	*Atherinella chagresi*	8 and 60 m	Insectivore, but also eats algae and diatoms	9	Rivers of low to high current velocity	Bussing, 2002.
	Atherinella hubbsi	35-540 m	Insectivore, but also eats algae	7	Rivers of low to high current velocity	Bussing, 2002.
	Atherinella milleri	< 40 m	crustaceans, terrestrial and aquatic insects, and diatoms	5.5.	Coasts and in estuaries, may ascend rivers.	Dyer,2003.
	Atherinella sardina	< 40 m	Insectivore	5.5.	Lakes	Bussing, 1998.
Carangidae	*Caranx latus*		Carnivore	101	Coasts and in estuaries, may ascend rivers.	Robins & Ray, 1986.
	Oligoplites palometa		Adults carnivorous; juveniles feed mainly on scales from larger fishes and benthic and planktonic crustaceans	50	Brackish and fresh waters over muddy bottoms	Cervigón, 1993.
Carcharhinidae	*Carcharhinus leucas*		Piscivore		Coastal and freshwater inhabiting shallow waters	
Centropomidae	*Centropomus parallelus*		Piscivore	130	Coastal and estuarine habitat	
	Centropomus pectinatus		Fish and crustaceans	47	Coastal waters, estuaries and lagoons, penetrating into freshwater	Robins & Ray, 1986.

	Centropomus undecimalis		Opportunistic predators	130	Estuarine-dependent	
Characidae	*Astyanax aeneus*	0-1000 m	algae, seeds, leaves, aquatic and terrestrial insects and fish fry	7.5	Rivers and streams from swift water to swamps and stagnant pools	Bussing, 2002.
	Astyanax nasutus	5 to 20 m	herbivorous : diatoms, seeds and other plant material	10	Large rivers, in slow to moderate current	Lima et al., 2003.
	Bramocharax bransfordii	5 to 530 m	Piscivore	15	Rivers and streams of little to moderate velocity	Lima et al., 2003.
Characidae	*Brycon guatemalensis*	0 and 600 m	Juvenile insectivore; adult herbivore	59	Lakes, rivers and streams .	Lima, 2003.
	Bryconamericus scleroparius	12 to 600 m	herbivorous : diatoms, seeds and other plant material	11	Waters of moderate current as well as lakes	Lima et al., 2003.
	Carlana eigenmanni	35 and 85 m	herbivorous : filamentous algae	5.5	Shoreline, river backwaters or other stagnant biotopes.	Cardoso, 2003.
	Hyphessobrycon tortuguerae	0 to 50 m	Insectivore	3.9	Backwaters and creeks with low or moderate current velocity.	Géry, 1977.
	Roeboides bouchellei	0 to 610 m	Scale eater	8.2	Creeks and shorelines of larger rivers	Lucena, 1998.
Cichlidae	*Amphilophus citrinellus*		Omnivorous, eating mostly aufwuchs, snails and small fishes	24.4	Lakes - including turbid lakes; will penetrate into lower slow flowing river	Kullander, 2003.
	Amphilophus labiatus		mall fish, snails, insect larvae, worms	24	Lakes	Kullander & Hartel, 1997.
	Asthatheros alfari	2 and 1150 m	Insectivore	15	River from the fast flowing upper sections to the slower moving lower reaches. Prefers sand or mud substrata	Kullander, 2003a.
	Asthatheros longimanus					
	Asthatheros rostratus	0 and 200 m	Insectivore	18.5	Floodplain lakes and rivers of low to high current velocity.	Kullander, 2003a.

	Archocentrus centrarchus		detritus and insects	11	Shallow waters or swampy areas of lakes and rivers.	Conkel, 1993.
	Archocentrus nigrofasciatus		Omnivore	10	Small creeks and streams to the shallows of large and fast flowing rivers.	Schmitter-Soto, 2007.
	Archocentrus septemfasciatus	0-600 m	algae, leaves, fruits, aquatic insects and bottom detritus.	10	Rivers and rivulets of all velocities.	Conkel, 1993.
	Herotilapia multispinosa		Detritivore	17	Lakes and swampy areas with muddy bottoms.	Conkel, 1993.
	Hypsophrys nicaraguensis	5 to 200 m	Juvenile insectivore; adult herbivore	16.5	Lakes and rivers with slow to moderate currents	Kullander, 2003a.
Cichlidae	*Neetroplus nematopus*	35 and 535 m	Herbivore	14	Proliferates in rivers with medium to high velocities.	Schmitter-Soto, 2007.
	Parachromis dovii		Piscivore	72	Lakes but also lower and middle river valleys.	Kullander, 2003a.
	Parachromis friedrichsthalii		Piscivore	28	Rivers and lakes, preferring the slower moving waters.	Kullander, 2003a.
	Parachromis loisellei	1 and 70 m	Insectivore/piscivore	18.5	Mostly in swampy waters choked with vegetation.	Kullander, 2003a.
	Parachromis managuensis		Insectivore	55	lakes, prefers turbid waters and mud bottoms of the highly eutrophic lakes .	Kullander, 2003.
	Theraps underwoodi		Herbivore	30	Moderate to fast flowing rivers	Conkel, 1993.
	Vieja maculicauda		Omnivore/detritivore	25	Lakes and rivers. Prefers muddy and sandy bottoms	Conkel, 1993.
Clupeidae	*Dorosoma chavesi*		Filter feeder	18	Rivers and lakes.	Whitehead, 1985.
Eleotridae	*Dormitator maculatus*		Omnivore/detritivore	14.5	Marshes, muddy ponds and channels	Robins & Ray, 1986.
	Eleotris amblyopsis		Carnivorous, feeds on fish and crustaceans	8.3	Fresh water as well as in hyper-saline environments	Kullander, 2003b.
	Eleotris pisonis		Insectivore	12.5	Shallow, muddy or sandy bottoms prefer estuarine	Robins & Ray, 1986.
	Gobiomorus dormitor		Insectivore	36	Larger free flowing clear water streams	Robins & Ray, 1986.

	Hemieleotris latifasciatus	5 and 100 m	Insectivore	12	Rrivers, creeks and ditches in stagnant waters	Hoese, 1995.
Gerreidae	*Eugerres plumieri*		Carnivorous, feeds on fish and crustaceans	30	Shallow coastal waters and common in brackish waters , mostly over mud bottoms	Randall & Vergara 1978.
Gobiesocidae	*Gobiesox nudus*	25 and 580 m	Sacle eater and insectivore	15	Rivers and creeks, in currents of high velocity	Espinosa Pérez & Castro-Aguirre, 1996.
Gobiidae	*Awaous banana*		Herbivore	24.4	Clear streams and rivers over sand and gravel, but also found in turbid waters with muddy bottoms.	Watson, 1996.
	Sycydium altum	1 to 180 m	Detritivore	14	Hiding between stones in creeks and rivers.	Bussing, 1998.
Gymnotidae	*Gymnotus cylindricus*				Freshwater; benthopelagic	Mago-Leccia, 1994.
	Gymnotus maculosus				Freshwater; benthopelagic	Campos-da-Paz, 2003.
Haemulidae	*Pomadasys crocro*		Carnivore	25	Rivers and creeks of low to high current velocity	Robins & Ray, 1986.
Lepisosteidae	*Atractosteus tropicus*			125	Backwaters and slow moving sections of rivers and lakes.	Ferraris, 2003.
Megalopidae	*Megalops atlanticus*		Piscivore	250	Coastal waters, bays, estuaries, mangrove-lined lagoons	Hureau, 1984.
Mugilidae	*Agonostomus monticola*	0 - 650		36	Rivers and streams.	Harrison, 1995.
	Joturus pichardi	0 - 600	Herbivore	25	Upper reaches of rivers but enter brackish waters to spawn	Harrison, 1995.
Pimelodidae	*Rhamdia guatemalensis*		Insectivore	47	Littoral creeks, over sandy bottoms covered with dead leaves	Bockmann & Guazzelli, 2003.
	Rhamdia nicaraguensis	20 and 1160 m	Insectivore	26	Rivers and creeks currents of low to moderate velocity	Bockmann & Guazzelli, 2003.
	Rhamdia rogersi	35 and 1350 m	Insectivore	25	Upland rivers or creeks of moderate to high current velocity,	Bockmann & Guazzelli, 2003.
	Rhamdia laticauda	35 and 1350 m	Insectivore	22.5	Upland rivers or creeks of moderate to high current velocity,	Bockmann & Guazzelli, 2003.
	Rhamdia quelen		Omnivorous	47.4	Littoral creeks, over sandy bottoms covered with dead leaves	Bockmann & Guazzelli, 2003.

Poeciliidae	*Alfaro cultratus*	0-300 m	Insectivore	7.5	Waters of low to moderate velocity	Rodriguez, 1997.
killifish	*Belonesox belizanus*			15	Weedy canals and tolerates poorly oxygenated waters	Page & Burr, 1991.
	Brachyrhaphis holdridgei	35 and 620 m	Insectivore	5	Stagnant waters or creeks over muddy bottoms.	Lucinda, 2003
	Brachyrhaphis olomina	10 - 900	Insectivore	6	Streams and brooks of low to moderate current velocity	Bussing, 1998.
	Brachyrhaphis parismina	5 to 50m	Insectivore	7	Streams and brooks of low to moderate current velocity	Lucinda, 2003
	Brachyrhaphis rhabdophora	3-540 m	Insectivore	6	Streams and brooks of low to moderate current velocity	Lucinda, 2003
	Gambusia nicaraguensis		Insectivore	4	Mouth of slow-moving streams, in brackish or fresh waters	Lucinda, 2003
	Neoheterandria umbratilis					
Poeciliidae	*Phallichthys amates*	0 and 500 m	Detritivore	7	Stagnant waters, creeks and river shorelines, over soft bottoms.	Bussing, 2002.
	Phallichthys tico	35 and 600 m	Detritivore	2.5	Slow flowing waters connected to standing marshy area	Wischnath, 1993.
	Poecilia gillii	0-1220 m	Detritivore	6	Swamps, brooks and in shallow waters of large rivers	Rodriguez,1997.
	Poecilia mexicana		Detritivore	10	Warm springs canals and weedy ditches	Proudlove, 1997.
	Poecilia sphenops		Omnivore	6		Wischnath, 1993.
	Priapicththys annectens	25 - 1270			flounder	
Pristidae	*Pristis pectinata*	0 - 30			Inshore and intertidal species, also ascends rivers	Last & Stevens, 1994.
Sawfishes	*Pristis perotteti*	0 - 30			shallow water inshore and estuarine, particularly lagoons.	Ferreira et al., 1998.

	Pristis pristis		Carnivorous		Inshore coastal waters to moderate depth	Stehmann, 1990.
Rivulidae	*Rivulus isthmensis*	0 - 1500	Insectivore	7	Swamps and ditches and slow moving waters of brooks	Costa, 2003.
Synbranchidae	*Synbranchus marmoratus*				Streams, ponds, canals, drains, rice fields, both clear and turbid water	Kullander, 2003c.
Syngnathidae	*Pseudophallus mindii*				Freshwater habitats	Greenfield & Thomerson, 1997.

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9 Appendix 2: Curriculum Vitae of Prof. Ian G. Cowx

1.	Expertise:	Inland Fisheries and Aquatic Resources Management
2.	Name of Organisation:	University of Hull International Fisheries Institute
3.	Name of Staff:	Ian Graham Cowx
4	Occupation	Professor, Director University of Hull International Fisheries Institute, UK
5.	Date of Birth:	07 April 1952
6	Number of working years in the firm:	25 years
7	Number of working years in other firms:	10 years
8	Nationality:	British
9.	Membership of Professional Associations:	Fellow of Institute of Fisheries Management, Fisheries Society of the British Isles, American Fisheries Society, Chartered Environmentalist
10.	Educational background:	BSc Hons in Zoology specialising in fisheries. University of Liverpool, 1971-1975 PhD in freshwater fisheries. University of Exeter, 1975-1979
11	Academic experience:	PhDs: 40 successfully completed; 10 current MScs: 12 successfully completed; 8 current Editor in Chief – Fisheries Management and Ecology Publications – list available on request: Books edited - 14; Peer review publications in international journals and book chapters – 176; Technical Reports – 216
12.	Employment Record:	
	From:	1989 To Present
	Employer:	University of Hull International Fisheries Institute
	Positions held:	Professor/Director
	From:	1985 To 1989
	Employer:	Humberside College of Higher Education
	Positions held:	Senior Lecturer
	From:	1978 To 1985
	Employer:	Severn-Trent Water Authority
	Positions held:	Scientific Officer, Fisheries and Recreation

13. Projects undertaken

Africa and Middle East	• Iraq: Restoration of the Shatt Al-Arab wetlands for fisheries purposes FAO (2013-2014) • Zambia: Fisheries Management plan for Lake Bangweulu, Zambia PLARDII/Finnish Aid/Department of Fisheries (2013) • Iraq: Rehabilitation of fisheries of Shatt-el-Arab, Iraq. FAO (2012-2013) • Botswana: Fish Stock Assessment in major dams in Botswana EU ACPII/Landell Mills/Department of Fisheries (2011) • Zambia: Fisheries Management plan for the Kafue Floodplain Fishery EU ACPII/Landell Mills/Department of Fisheries (2011) • Malawi: Reconstructing trends in the fisheries of Lake Chilwa: implications for management (Malawi Department of Fisheries (2007-2010) • South Africa: Training for inland fisheries assessment methodologies (Royal Society 2007) • East Africa: Evaluation of fisheries exploitation on Lake Victoria (World Bank, 2004-2008) • East Africa: Evaluation of the Lake Victoria Environment Project (World Bank, 2003-2005) • East Africa: Fisheries management plan for Lake Victoria (EU, 1996-2002) • East Africa: Lake Victoria fish stock assessment (FAO, 1997-1998) • Ethiopia: Impact assessment of water resource development schemes (Ethiopia Gov, 1995) • Ghana: Fisheries Management Plan for Lake Volta (FAO, 1997-2001) • Ghana: Dynamics and management of the fish populations in the Densu Delta and Abrubi Lagoons, Ghana (World Bank, 1996-1999). • Iran: Strategic framework for assessing the efficacy of stocking sturgeon in the Caspian Sea (FAO, 2005) • Kenya: Impact assessment of hydropower development schemes (Kenya Power, 1991/92) • Kenya: Establishment of Fisheries Department for Moi University (FAO, 1990/91) • Oman: Management of the abalone fishery in the Gulf of Oman (Government of Oman, 2002-2006) • South Africa: In-country training course on research techniques in inland fisheries and aquaculture (South African Institute for Aquatic Biodiversity, Royal Society, 2007) • Sudan: Identifying marketing opportunities for freshwater fish in Sudan (CGIAR, 2003-2004) • Tanzania: Population dynamics of the clupieds *Stolothrissa tanganicae* and *Limnothrissa miodon* and their main predator *Lates stappersii* in Lake Tanganyika (FAO, 1995-1998) • Uganda: Fish Exports from Lake Victoria – Export Diversification and Common Resource Management from Uganda (EU, 2001-2002)
Asia Pacific	• Mekong Region: EIA of Don Sahong hydropower scheme on Mekong Fisheries (Mekong River Commission 2014) • Mekong Region: Maintaining the Productivity of the Mekong River by Improving Sediment Passage and Fish Passage through Hydropower Dams in Lao and Cambodia. Natural Heritage Institute/USAID (2014-2015) • Vietnam: Assessment of impacts of mainstream dams on the Mekong Delta. DHI/Vietnam Gov (2014-2015) • Mekong Region: Inland fisheries stock enhancement in the Mekong region (FAO 2014). • Thailand: Assessment of Barriers to Fish Migration in Nam Kam River. MRC/Thai DoF (PhD studies of Aparidee Hanpongkittikul 2013-2016) • Mekong Region: Training of Mekong regional staff in fisheries data collection and analysis Mekong River Commission 2013) • Mekong Region: EIA of Xayaburi hydropower scheme on Mekong Fisheries (Mekong River Commission 2011-2012) • Laos PDR: Socio-economic impact of Nam Theun 2 on rural livelihoods (USGS and PhD studies of Kaviphone Phouthavong 2011-2014) • Mekong Region: Assessment of the impact of mainstream dams on fisheries in the Mekong recruitment (Mekong River Commission 2010-2011) • Mekong region: Impact of dams on larval fish drift and fisheries recruitment (Mekong River Commission 2008-2011) • Mekong region: Dams as barriers to migration (Mekong River Commission 2008-2009) • India: Environmental aspects of Kishenganga dam on Indus River . Indus Commissioner. India

	2011. • Thailand: Improving fishery statistical data collection in Mekong Basin (FAO, 2002) • Bangladesh: Fisheries management of the Hilsa shad populations of Bangladesh (World Bank, 1998-2001) • China: Qinghai lake development scheme, China (FAO, 1990) • Korea: Multi-criteria modelling to assess the importance of recreational fisheries in South Korea (Government of Korea, 2002-2005) • Laos: Assessment of migratory fish stocks in the Mekong River (MRC, 1999-2002) • Malaysia: Impact of a power station development on Malaysian coastal artisanal fisheries (Malaysian Government, 2002-2005) • Pakistan: Cold water fish culture project, Azad Kashmir, Pakistan. (FAO, 1991) • Philippines: Aquaculture development in the Philippines (EC/ADCCP, 1992-1995) • Sarawak: In-country training course on research techniques in inland fisheries and aquaculture (Malaysian Government, 1993)
Europe	• Between fisheries and bird conservation: the cormorant conflict EU/ European Parliament (2012-2013) • Restoring rivers for effective catchment management (REFORM). EUFP7 2011-2015) • Impact of introducing Genetically Modified Fishes into Europe. (European Food Safety Agency 2010) • Facilitating the application of Output from Research and CAse STudies on Ecological Responses to hydro-morphological degradation and rehabilitation (Forecaster) EU IWRM-NET (2008-2010) • Impact of alien species in aquaculture (IMPASSE). (EU FP6, 2006-2008) • New Education and Decision Support Model for Active Behaviour in Sustainable Development Based on Innovative Web Services and Qualitative Reasoning (Naturanet/REDIME) (EU, 2005-2008) • Development, valuation and implementation of a standardised fish-based assessment method for the ecological status of European rivers (EU FP5, 2001-2005). • Portugal: Conservation strategy for *Anaecypris hispanica* (EU LIFE, 1997-2000) • Romania: Rehabilitation of inland fisheries sector in Romania (ODA, 1994/95)
Other	• Central Asia: Impact of Alien species in Central Asia, FAO (2010-2011) • Columbia: Valuation of key conservation areas in the freshwater ecosystems of the Colombian Amazonian Trapezium (Columbian Government 2008-2011) • Jamaica/St Vincent: Improving artisanal fisheries of Caribbean islands (CARICOM, 2000-2001)
UK	• Impact of flow regulation on fish populations in Yorkshire rivers (Yorkshire Water/ARUP, 2014-2018). • Impact of flow regulation on fish migration in the rivers Wye and Usk (AMEC/DCWW, 2012-2014) • Minimising fish entrainment and mortality at Environment Agency pumping stations. (Environment Agency, 2011-2014) • Impact of hydropower development at Ruswarp weir on salmon in the Yorkshire Esk. (Environment Agency, 2011-2014) • Impact of stocking in Natural Heritage sites in Scotland. (Scottish Environmental Protection Agency, 2010-2011) • Impact of river regulation on fisheries in Yorkshire rivers. (Yorkshire Water/CASCADE, 2010-2013) • Impact of water abstraction of flows in River Thames. (Thames Water/CASCADE, 2009-2012) • Impact of flow compensation as a result of drought on river fisheries. (Welsh Water / AMEC, 2010-2012) • Review of impact of run-of-river hydropower on fisheries. (Scottish & Northern Ireland Fisheries Forum/Environment Agency, 2010-2011) • Interaction between fish and flows in rivers (NERC/Centre for Ecology and Hydrology 2008-2011) • Factors affecting the decline of barbel in English rivers (Environment Agency, 2008-2011) • Impact of abstraction on the fisheries of the River Ancholme (Environment Agency, 2008-2009) • Humber eel management issues: barriers and stocking. (Environment Agency, 2006-2007) • Impact of hydropower schemes in Scotland (Shawater Ltd, 2007-2010) • Fisheries assessment of impacts of reservoir development schemes on the River Thames

	(Environment Agency and Cascade Consulting 2007-2009) • Development of predictive fish community typology and abstraction sensitivity rating for river fish communities. (Environment Agency/ ENTEC, 2006) • Uncertainty estimation for monitoring results by the WFD biological classification tools. (Environment Agency/ENTEC, 2006-2007) • Review of Environmental flows in the River Hull. (Environment Agency/ Halcrows, 2006-2007) • Catchment scale overview of rehabilitation of the Great Ouse (Environment Agency, 2006-2007) • The food and feeding relationships of the larvae of important angling fish species in lowland rivers and connected water bodies. (Environment Agency, 2006-2009) • Impacts of urban regeneration for the 2012 Olympic Games on the fish and macrophyte populations of the lower Lea Valley (Capita Symonds, 2006-2007) • Impacts of acute organic pollution on the 0+ fish populations of a recovering industrialised river. (Environment Agency, 2006) • Impacts of a reservoir compensation release scheme on the fish populations of a tributary of the River Aire, Yorkshire. (Environment Agency, 2006-2007) • Impacts of river rehabilitation on the fish and macrophyte populations of an agricultural stream in Lincolnshire. (Environment Agency, 2006) • Assessment of conservation status of brook, river and sea lamprey (*Lampetra planeri*, *L. fluviatilis*, *Petromyzon marinus*) populations in SAC rivers in the UK. (Countryside Commission for Wales, 2005-2006) • Assessment of conservation status of allis and twaite shad (*Alosa alosa*, *A. fallax*) populations in SAC rivers in the UK. (Countryside Commission for Wales, 2005-2007) • Hybridisation between stocked brown trout and wild Atlantic salmon. (English Nature, 2006) • Scoping and determining the risks from trout introductions to the conservation status of SAC/SPA stillwaters. (English Nature,2006) • Feasibility of reintroduction of salmon into the River Mersey (Environment Agency, 2006-2007) • Practical methods for fisheries assessment (Environment Agency, 2004-2006) • Status of lampreys in Yorkshire rivers (Environment Agency, 2004-2005) • Errors in ageing of stocked fish (Environment Agency, 2004-2005) • Establishing protocol for protecting wild brown trout populations in North East England (Environment Agency, 2004-2005) • Triploid trout in native trout waters (Environment Agency, 2004) • Feasibility of connecting floodplain backwaters and gravel pits to the River Great Ouse (Environment Agency, 2004) • Flow and level criteria for coarse fish and conservation species – implications for catchment abstraction management (Environment Agency, 2003-2004) • Dispersal of stocked coarse fish (Environment Agency, 2004-2007) • Developing predictive assessment of ecological status of lakes (Environment Agency, 2004-2005) • Development of protocols and guidelines for stocking of fish in England and Wales (Environment Agency, 2004-2006) • Ageing of coarse fish (Environment Agency, 2003-2009) • Impact of the introduction of *Leucaspius delineatus* into the UK. (DEFRA, 2003-2006) • Fish monitoring and evaluation of flows in Ridings rivers (Environment Agency, 2002-ongoing) • Development of a standardised protocol for sampling rivers of conservation value for salmon, shad, lampreys and bullheads (English Nature, 2001-2002). • Impact of water injected dredging on fish populations (British Waterways, 2001-2004). • Stock enhancement strategies (Environment Agency, FAO, EU, 1999-2006) • Bittern, fish and reedbed management (RSPB, 1998-2001) • Factors affecting coarse fish recruitment (Environment Agency, 1997-ongoing) • Impact of hydropower schemes in Wales, Scotland and Ireland (Shawater Ltd, 1996-2006)
Global	• Developing new strategies for the global assessment of inland fisheries and predicting the response to regional climate change (US Geological Survey/FAO/Michigan State University/University of Hull (2011-2014)

	• FAO/DIFD Foresight project: Food and Farming Futures Project – inland fisheries (FAO/DIFD 2009) • Development of international guidelines for ecolabelling of fish and fishery products from inland capture fisheries (FAO, 2006) • Guidelines for assessing illegal, unreported and unregulated catches in inland fisheries (FAO, 2005-2006) • Code of Conduct for recreational fishing relevant to the FAO Code of Conduct for Responsible Fisheries (FAO 2006-2007) • Guidelines for stock enhancement of inland fisheries (FAO, 2005-2006) • Guidelines for the routine collection of capture fishery data (FAO, 1998) • Stocking strategies for the enhancement of freshwater fisheries in the face of developing countries constraints (FAO, 1997)

ANNEX 3

Andreas Mende

Inventory of Slopes and Water Courses related to the Border Road Nº 1856 between Mojón II and Delta Costa Rica: Second Report

December 2014

Inventory of Slopes and Watercourses related to the Border Road Nº 1856 between Mojón II and Delta Costa Rica

- Second Report -

Elaborated by:

Dr. Andreas Mende

Expert in Geographic Information Systems, Remote Sensing, Environmental Geology and Hydrogeology

Supported by:

Centro Cientifico Tropical (CCT)

Presented to:

***Ministry of Foreign Affairs* - Costa Rica**

San José - Costa Rica

December 2014

1 INTRODUCTION

This report is an update of the report with the same title which has been part of the Counter-Memorial presented to the International Court of Justice by the government of Costa Rica in December 2013 (Mende & Astorga, 2013, Annex 6 to Costa Rica's Counter-Memorial).

The first report provided a complete inventory of all cut slopes, fill slopes, and watercourse intersections (crossings) along Route 1856 between the Mojón II, where the border road first approaches the San Juan River, and Delta Costa Rica, where it ends. Statistical data presented within this first report included, for example, the measured length, estimated height, type of slope or the type erosional features (sheet, rill, landslide or gully erosion) and its percentages on the surface of each slope. In the case of intersections of watercourses collected data included the type of structure, the technical state and the presence/absence of sedimentary/erosional processes.

Applying data on erosion depths and rates of land surface lowering due to sheet, rill, landslide and gully erosion reported in the UCR Report (2013), the sediment yields from all the cut and fill slopes that exist along the border road between Mojón II and Delta were estimated. The sediment yields were, in turn, passed to the ICE working group who used the yields, together with calculations of sediment yields due to sheet and rill erosion of the road bed and other disturbed areas, to estimate overall erosion and sediment delivery from Route 1856 to the San Juan River system (ICE, 2013).

In its Reply of August 2014 to Costa Rica's Counter-Memorial, Nicaragua criticized some aspects of the 2013 Report on the inventory of Slopes and Watercourses. In the 2014 Kondolf Report, a discrepancy is identified between the 2013 UCR erosion rates and the erosion rates applied in the 2013 Mende and Astorga Report (G. Mathias Kondolf, "Erosion and Sediment Delivery to the Río San Juan from Route 1856", July 2014, Reply of the Republic of Nicaragua, Volume II, page 53). The erosion rates applied in our 2013 report were in general higher than the 2013 UCR rates and therefore resulted in a more conservative estimate of erosion from the Road. However, this discrepancy has been corrected in this Report, and the 2014 UCR erosion rates are now applied without any variance.

Dr. Kondolf also focused on the way that surfaces of slopes were calculated in 2013, especially the field estimation of height as well as the surface calculation of slopes in general (G. Mathias Kondolf, "Erosion and Sediment Delivery to the Río San Juan from Route 1856", July 2014, Reply of the Republic of Nicaragua, Volume II, page 54). For this reason the way slope surfaces were determined has been changed in the present report in order to provide a more accurate data set.

Within an extended field work campaign on the entire border road between Mojón II and Delta Costa Rica, carried out between 20 September and 4 December 2014, new field data were collected for all slopes and intersections of watercourses. In order to give an impression as complete as possible about the present situation of the border road, data sheets for all slopes and intersections of watercourses are presented in Appendix B (slopes) and C (intersections of watercourses). These data sheets include the new field data as well as photographs that document the present state as well as the state in the year of 2013.

The last field campaign was executed with better resources and more time so that the data collection is more complete and accurate. For this reason the new data set comprises several new intersections of watercourses as well as a few new slopes which were not included in the 2013 report.

The new base data were used to calculate improved *Estimated Erosion Rates* for all slopes of the Route 1856. In this context the improved measurements regarding erosion rates for the different erosional features from the UCR team were used as a base (UCR, 2014).

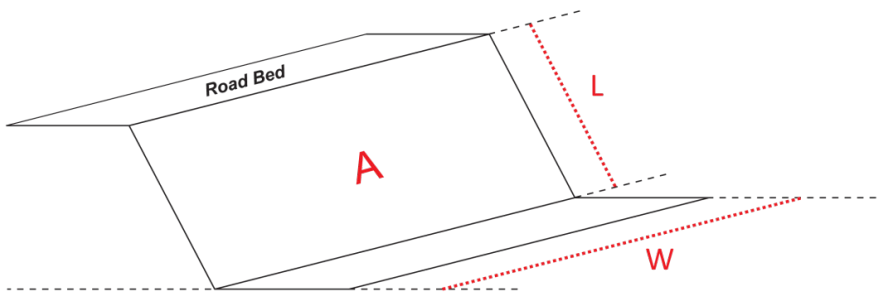
2 METHODOLOGY

In general the methodology of field work, data collection and data management by an ACCESS data base, as presented in the first report (Mende & Astorga, 2013), has been maintained for the herein presented study. The detailed methodology is contained in that 2013 report, and should be read together with this section.

2.1 Calculation of Slope Length and Slope Surface Area

A crucial criticism from Nicaragua was the way altitudes and surface areas of slopes were determined - principally related to the fact that slope length has been estimated and was not measured (Dr G. Mathias Kondolf, "Erosion and Sediment Delivery to the Río San Juan from Route 1856", July 2014, Reply of the Republic of Nicaragua, Volume II, page 54). This study that was carried out for the 2013 report was the best that could be done with the available resources, and taking into account difficult weather conditions during the 2013 field visits.

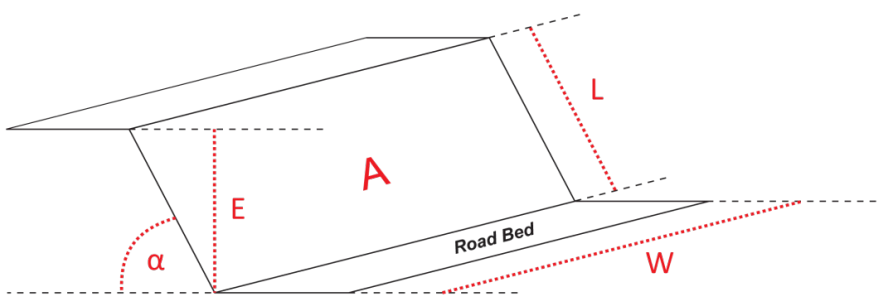
A) Road situated at the top of the slope



Measured Parameters:
W = Slope Width (by GPS)
L = Slope Length (by Laser Hypsometer)

Calculated Parameters:
A (Slope Surface Area) = W x L

B) Road situated at the base of the slope



Measured Parameters:
W = Slope Width (by GPS)
E = Elevation Difference (by Laser Hypsometer)
α = Slope Angle (by Geological Compass)

Calculated Parameters:
L (Slope Length) = E / sin (α)
A (Slope Surface Area) = W x L

Figure 1: Illustration of the methodology to determine the parameters "slope length" and "slope surface area" for the case of slopes with the road situated on top as well as on hhe bottom of the slope.

In order to address this concern, in this report a new method was used to determine the surface area of slopes. The two sketches of figure 1 show the details of this method. It is principally based on the Laser Hypsometer Nikon Forestry Pro. This equipment, widely used for example in forestry, measures the elevation difference of one point to the horizontal or directly between two points. It also may be used to measure actual distances, horizontal distances and angles of the position of one point to the horizontal or between two points as seen from the measurement station.

The measurement distance range of the Forestry Pro is between 10 and 500 meters. For the range between 10 and 100 meters, which is the only one used within this study, horizontal distances can be measured with a maximum accuracy of 0.5 m while elevation differences can be measured with a maximum accuracy of 0.2 m. More technical details of this instrument can be found within the technical manual (https://cdn-1.nikon-dn.com/pdf/sportoptics/%28232K_2E__1204%29ForestryProEnweb_FINAL.pdf).

In the case of slopes where the road is situated on top of the slope, the direct measurement of the actual distance from the top of the slope to its bottom - executed with help of the Forestry Pro - determines the actual slope length **L** (compare sketch “A” in figure 1). In every case several measurements were taken in order to determine the most representative value. The range of values as well as the determined most representative value were recorded for all slopes. These values can be found at the data sheet of every slope in Appendix B. In cases where the slope length is less than 10 meters, the values were measured with help of a conventional tape measure. The surface area **A** of a slope in this case is simply the product of its average length **L** (determined with help of the Forestry Pro) and its width **W** (determined during the 2013 field campaign with use of a high precision GPS).

In the case where the road is situated at the bottom of the slope in question the first step is to measure the elevation difference **E** between the top and the bottom of the slope with help of the Forestry Pro (compare sketch “B” in figure 1). Then the slope angle **α** is measured using a conventional geological compass. As before several measurements were executed in order to determine the most representative values. The slope length **L** can then be determined using the sinus function:

Slope length **L** = elevation difference **E** / sin (slope angle **α**).

Right now the surface area **A** of the slope can be determined as the product of the calculated slope length **L** and the slope width **W** as determined within the 2013 field campaign with help of a high precision GPS.

Several slopes downstream the Infiernillo River (T-68b, T-69b, T-70b, T-72b and T-74b) exhibit complex morphologies, so that the before explained methodology to determine the slope surface area would lead to inacceptable errors. For this reason the working group of the University of Costa Rica (UCR) used UVA Photogrammetry data to determine the surface areas of these slopes. Details can be found in the UCR Report (UCR, 2014).

2.2 Changes regarding the Classification of the Technical State of Slopes and Intersections of Watercourses

In its Reply of August 2014 to Costa Rica's Counter-Memorial, Nicaragua also criticized the categories used to classify the technical state of slopes and intersections of watercourses. For the 2014 report a new set of categories has been established based upon the present state of mitigation works, in order to provide a more accurate view to the present state of the border road. For the reason that the principal question for the International Court of Justice is whether or not the border road is causing substantial harm to the San Juan River or any other Nicaraguan terrain, the evaluation of the mitigation status concentrates on the potential sediment input of any slope or watercourse crossing into the San Juan River.

The following categories regarding the mitigation status were established:

1) ***Mitigated:*** Slope or watercourse crossing where technical deficits have been addressed by adequate mitigation measures so that any sediment input of concern into the San Juan River is stopped or at least substantially reduced.
2) ***Mitigation in Progress:*** Slope or watercourse crossing where mitigation works still continue until present (December 2014).
3) ***Mitigation Scheduled:*** Slope or watercourse crossing where necessary mitigation works are scheduled but not executed.
4) ***No Mitigation Necessary:*** Slope or watercourse crossing without any potential to contribute any significant sediment into the San Juan River.

5) Other: This last category refers to small scale watercourse crossings within sections of the border road which exhibit characteristics more close to a trail than a road (compare section 3 and figure 2). It counts for small provisional bridges, small fill prisms with culverts and crossings without any construction usable only for pedestrians and animals. There is some erosion and/or sedimentation visible but thanks to the small size of these constructions there isn‘t any probability that a significant quantity of sediment can reach the San Juan River.

2.3 Additional Slopes and Intersections of Watercourses

Fortunately the 2014 field campaign has been executed within a larger time span, with better resources and - very important - better weather conditions. So this time the entire road has been examined in detail, a large part of it by means of walking along the road. As a consequence an additional number of 8 intersections of watercourses were identified. So in the present report the total number of watercourse crossings is 129, while in the 2013 report the total number has been 121 including the San Carlos and Sarapiquí Rivers. All these items are located within the segment between Infiernillo River and San Carlos River where some parts could only be examined superficially during the 2013 field visits. The segment in question is the less developed part of the border road and exhibits characteristics more likely to a trail than a road (compare section 3).

For the same reason within the segment between Río Infiernillo and Río San Carlos five additional slopes were identified. Besides this the slope T-83 has been subdivided in six segments (T-83a to T-83f) for the reason of varying characteristics. The same counts for the slope T-114, subdivided in three slopes (T-114a to T-114b) and T-161, subdivided in two slopes (T-161a, T-161b). So in the present report the total number of slopes is 201, while in the 2013 report the total number of slopes was 188.

It is important to stress that these additional items are a small improvement of an almost complete data set. We present the improved base data in order to contribute the the best information possible.

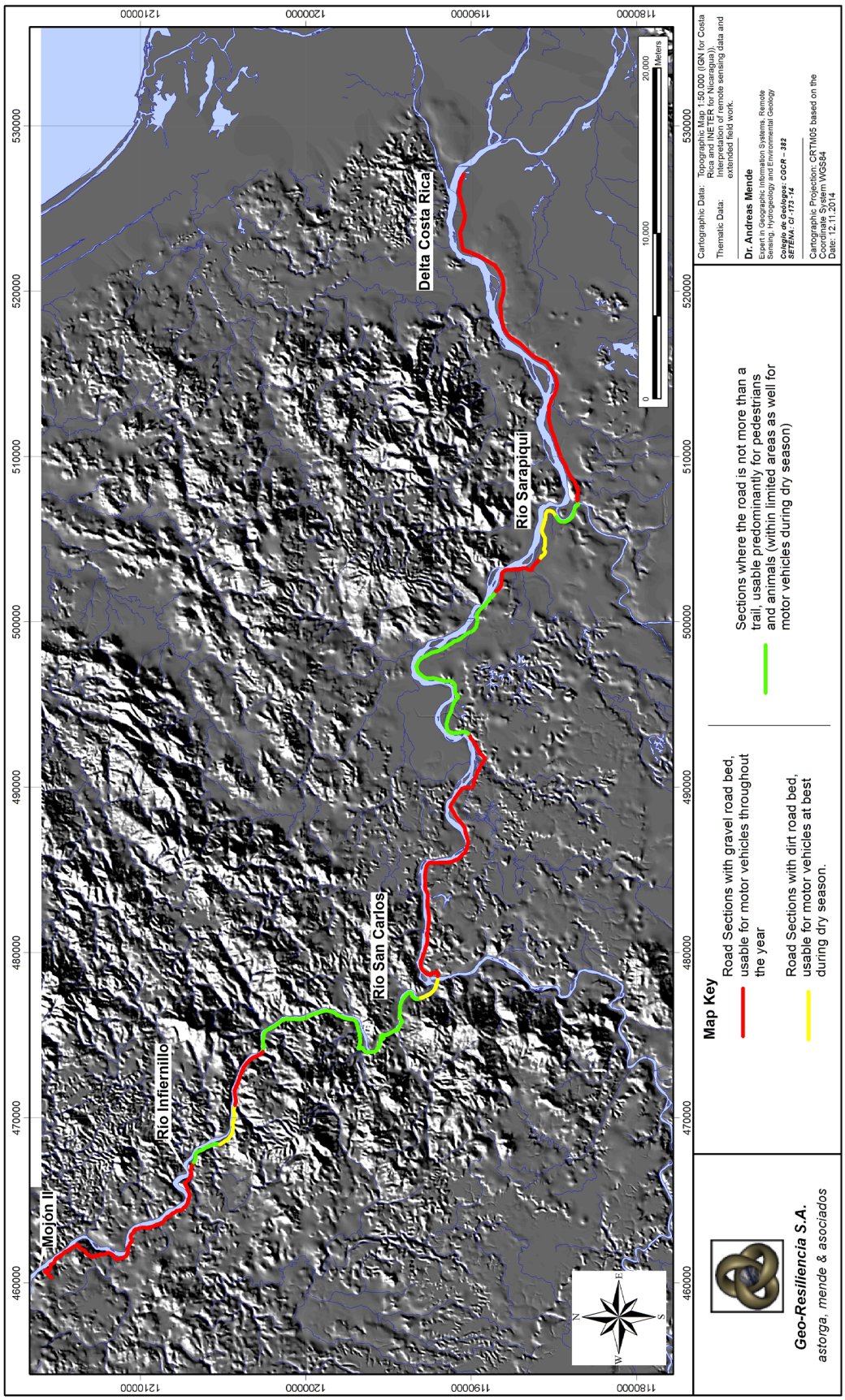


Figure 2: Overview map of the entire border road between Mojón II and Delta Costa Rica showing the differences regarding the present technical state.

3 GENERAL SPATIAL DATA REGARDING THE ROUTE Nº 1856

In figure 2 an overview about the present technical state of the border road is presented, while table 1 shows the corresponding statistical data. From the 107.6 kilometers between Mojòn II and Delta Costa Rica 64.5 km (59.9 %) of the road between Mojón II and Delta Costa Rica have a gravel road bed usable for motor vehicles throughout the year, while 35.1 km (32.6 %) exhibit characteristics more likely to a trail than a road, usable predominantly for pedestrians and animals. Eight km (7.4 %) of the border road at present has a dirt road bed: these sections can be used by motor vehicles at best during the dry season, some parts only by pedestrians and animals.

Present State of the Road	*Length (km)*	*Portion of the entire road (%)*
Gravel Road Bed	**64.5 km**	**59.9%**
Dirt Road Bed	**8.0 km**	**7.4 %**
Trail	**35.1 km**	**32.6 %**
Sum	***107.6* km**	***100 %***

Table 1: Distribution of road sections with different types of present technical state.

Tables 2 and 3 show the actualized statistical data about the number and density of slopes and watercourses within the four segments as defined in the 2013 report: (1) Mojón II to Río Infiernillo (13.8 km), (2) Río Infiernillo to Río San Carlos (27.6 km), (3) Río San Carlos to Río Sarapiquí (43.6 km) and (4) Río Sarapiquí to Delta Costa Rica (22.6 km).

Apart from small insignificant changes the same pattern as in the 2013 report can be seen: The highest density and number of watercourses and slopes are found in the Sections 1 and 2, while Section 3 has an intermediate fashion. Section 4 shows very low values regarding slopes and watercourses. The only notable changes are concentrated in Section 2, where within same parts the lack of time and bad weather conditions did not allow a detailed field examination during the 2013 field campaign (Total Slope Length 8.7 km instead of 7.9 km resulting in a slope density of 31.5% instead of 29.0% and 43 instead of 35 intersections of watercourses resulting in 1.6 instead of 1.3 intersections per km).

Road Section	Section Length (km)	Slopes (number)	Slopes (total length)	Slopes (percentage of segment road length)
Section 1 - Mojón II to Río Infiernillo	13.8 km	62	9.4 km	67.8 %
Section 2 - Río Infiernillo to Río San Carlos	27.6 km	64	8.7 km	31.5 %
Section 3 - Río San Carlos to Río Sarapiquí	43.6 km	66	6.8 km	15.7 %
Section 4 - Río Sarapiquí to Delta Costa Rica	22.6 km	9	1.2 km	5.4 %
Sum	107.6 km	201	26.1 km	

Table 2: Spatial distribution of slopes along the border road Nº 1856 in function of 4 established road sections.

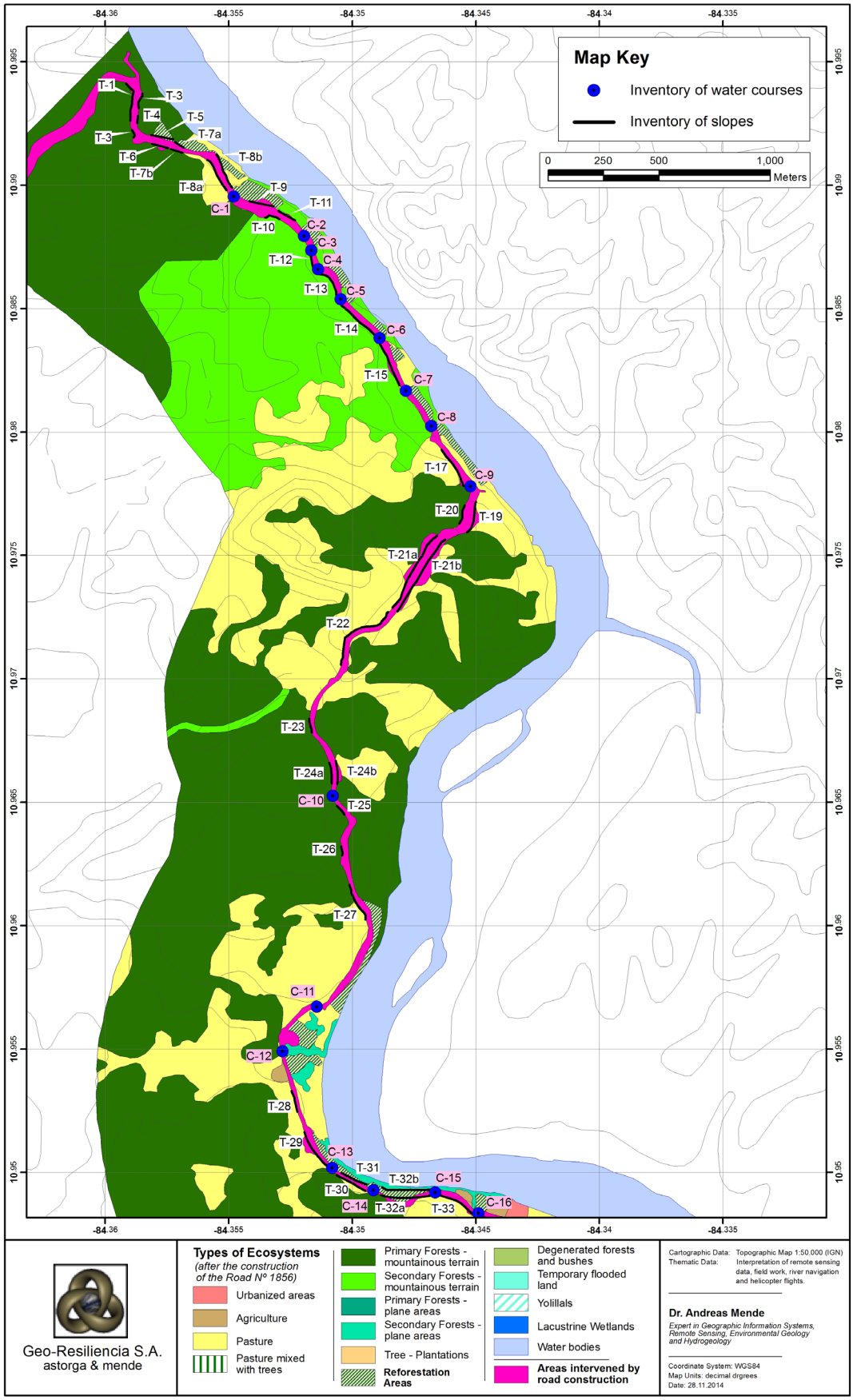
Road Section	Section Length (km)	Water Courses (number)	Number of Water Courses per Kilometre
Section 1 - Mojón II to Río Infiernillo	13.8 km	34	2.5
Section 2 - Río Infiernillo to Río San Carlos	27.6 km	43	1.6
Section 3 - Río San Carlos to Río Sarapiquí	43.6 km	42	1.0
Section 4 - Río Sarapiquí to Delta Costa Rica	22.6 km	10	0.4
Sum	107.6 km	129	

Table 3: Spatial distribution of watercourses along the border road Nº 1856 in function of 4 established road sections.

4 ACTUALIZED MAP SET SHOWING SLOPES AND WATERCOURSES ALONG THE ROUTE Nº 1856

In order to present an update regarding the spatial distribution of all slopes and intersections of watercourses a set of 16 maps at a scale of 1:15.000 is presented integrating the results of the 2014 field work campaign. This map set is based on the land use map actualized in 2014 which was generated by Mende within the frame of the new CCT report (CCT, 2014).

***Figure 3: Updated version of the* Overview Map with the locations of all Slopes and Water Course Intersections along the 1856 Road between Mojón II and Delta Costa Rica**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Inventory of slopes
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Meters
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-84.355
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-84.335
10.995
10.99
10.985
10.98
10.975
10.97
10.965
10.96
10.955
10.95
T-1
T-3
T-4
T-5
T-7a
T-3
T-6
T-7b
T-8b
T-8a
T-9
C-1
T-11
T-10
C-2
C-3
T-12
C-4
T-13
C-5
T-14
C-6
T-15
C-7
C-8
T-17
C-9
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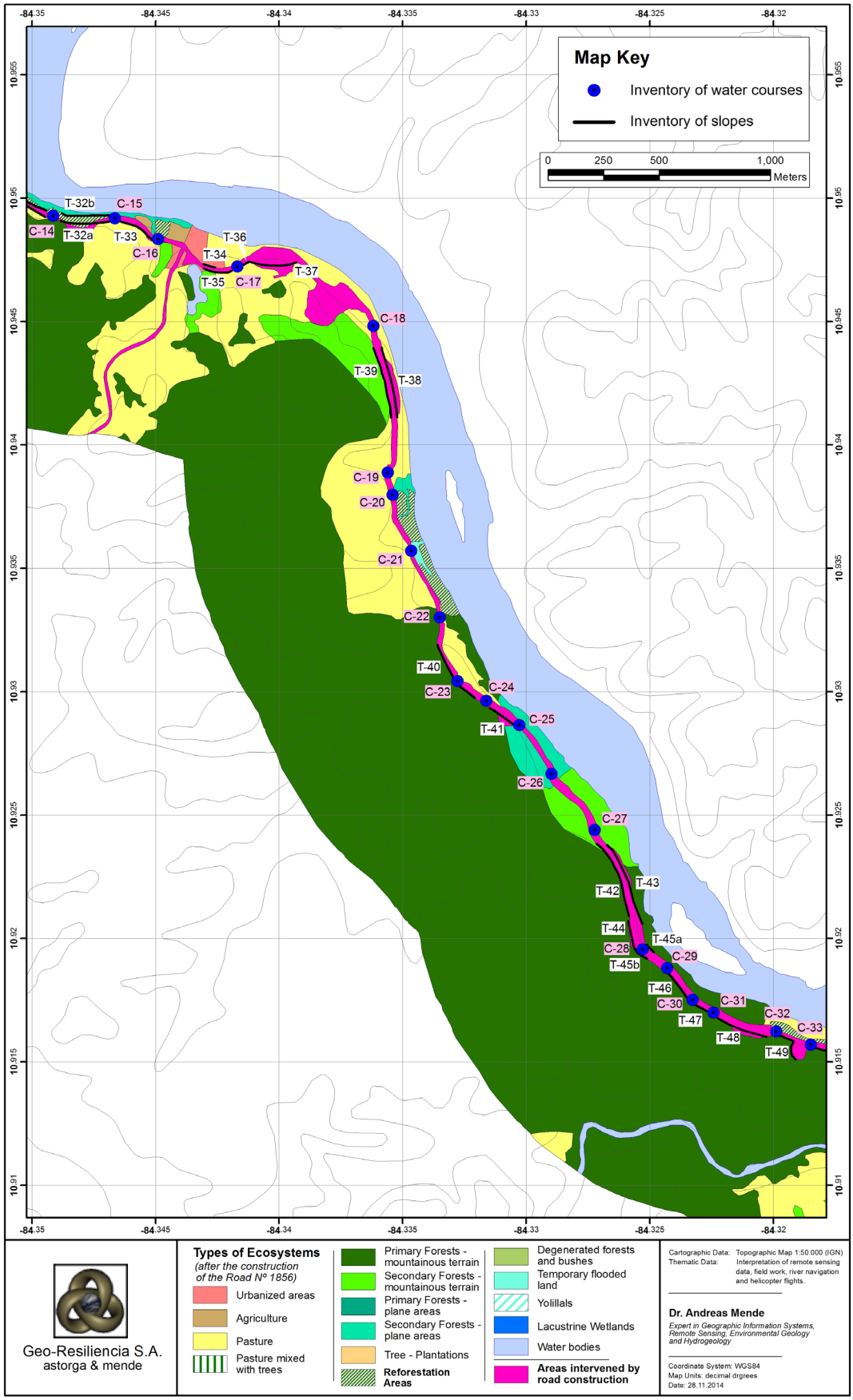
T-19
T-21a
T-21b
T-22
T-23
T-24a
T-24b
C-10
T-25
T-26
T-27
C-11
C-12
T-28
T-29
C-13
T-31
T-32b
C-15
T-30
C-14
T-32a
T-33
C-16
Geo-Resiliencia S.A.
astorga & mende
Types of Ecosystems
(after the construction of the Road Nº 1856)
Urbanized areas
Agriculture
Pasture
Pasture mixed with trees
Primary Forests - mountainous terrain
Secondary Forests - mountainous terrain
Primary Forests - plane areas
Secondary Forests - plane areas
Tree - Plantations
Reforestation Areas
Degenerated forests and bushes
Temporary flooded land
Yolillals
Lacustrine Wetlands
Water bodies
Areas intervened by road construction
Cartographic Data: Topographic Map 1:50.000 (IGN)
Thematic Data: Interpretation of remote sensing data, field work, river navigation and helicopter flights.
Dr. Andreas Mende
Expert in Geographic Information Systems, Remote Sensing, Environmental Geology and Hydrogeology
Coordinate System: WGS84
Map Units: decimal drgrees
Date: 28.11.2014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10.94
10.935
10.93
10.925
10.92
10.915
10.91
T-32b
C-15
C-14
T-32a
T-33
T-36
C-16
T-34
T-37
T-35
C-17
C-18
T-39
T-38
C-19
C-20
C-21
C-22
T-40
C-23
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C-25
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C-26
C-27
T-42
T-43
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T-45a
C-28
C-29
T-45b
T-46
C-30
C-31
C-32
T-47
C-33
T-48
T-49
Geo-Resiliencia S.A.
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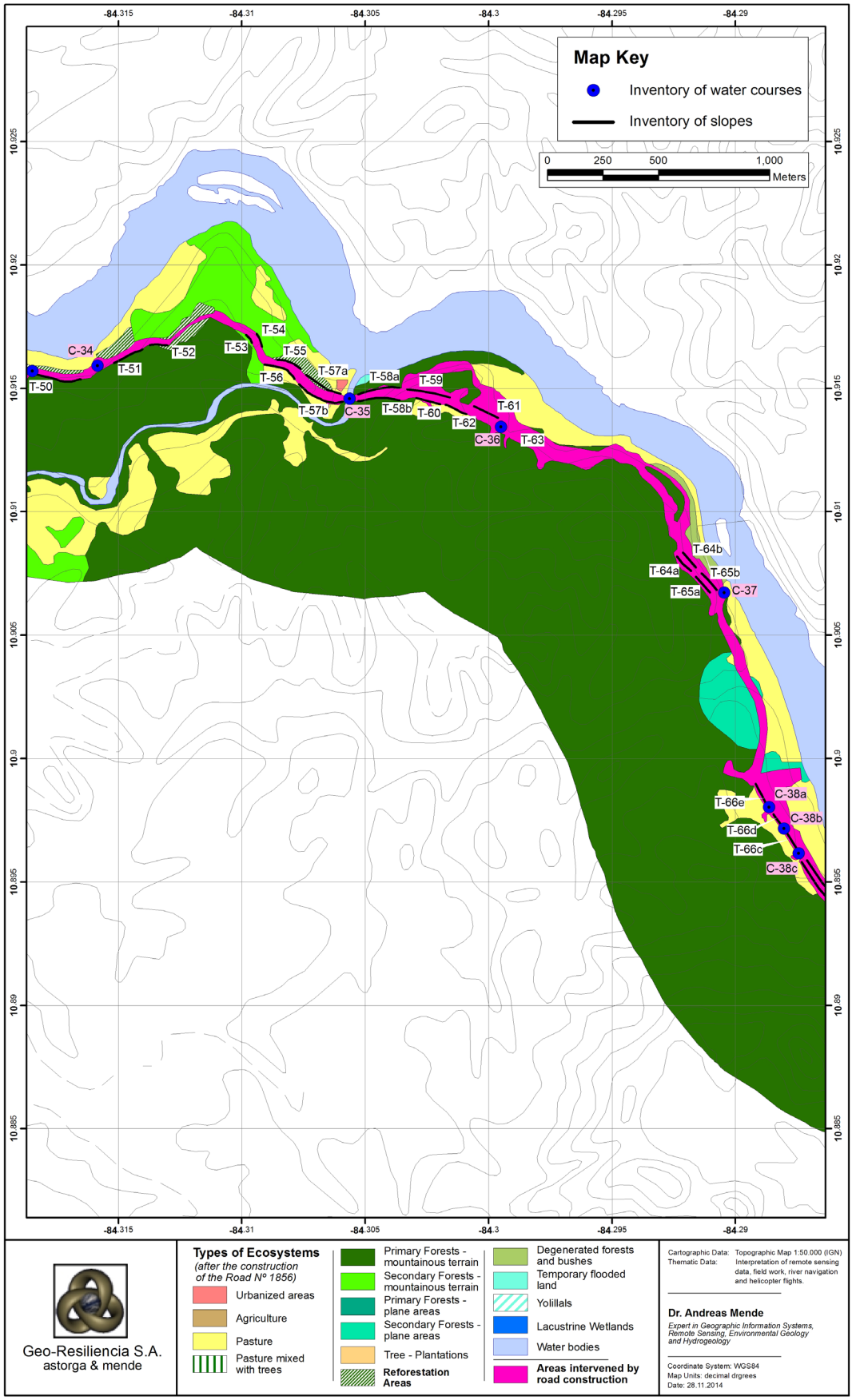
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Inventory of slopes
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T-66c
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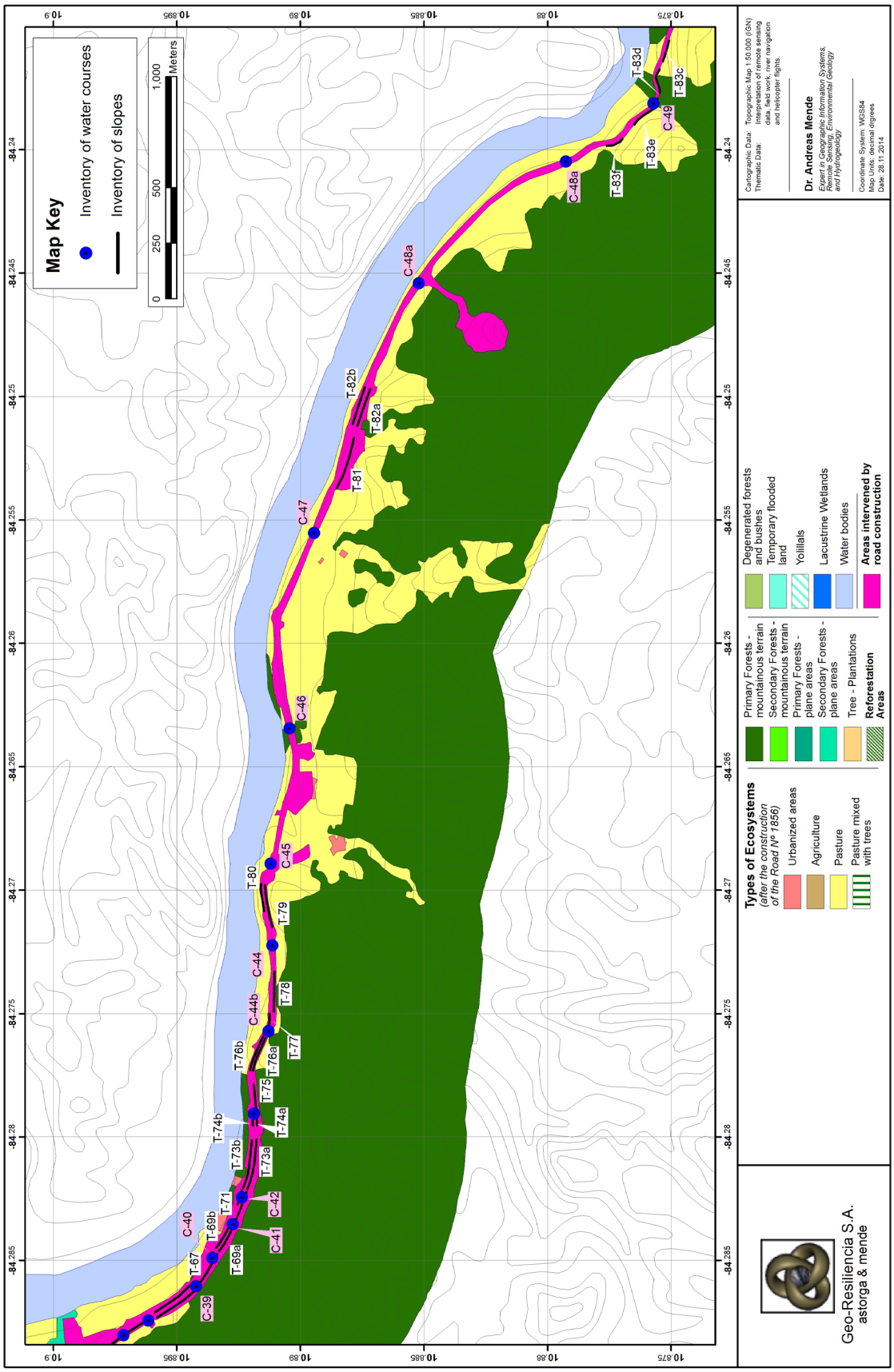
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Inventory of slopes
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500
1,000
Meters
Types of Ecosystems
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Coordinate System: WGS84
Map Units: decimal dr/ees
Date: 26.11.2014
Geo-Resiliencia S.A.
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C-44b
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C-48a
C-49
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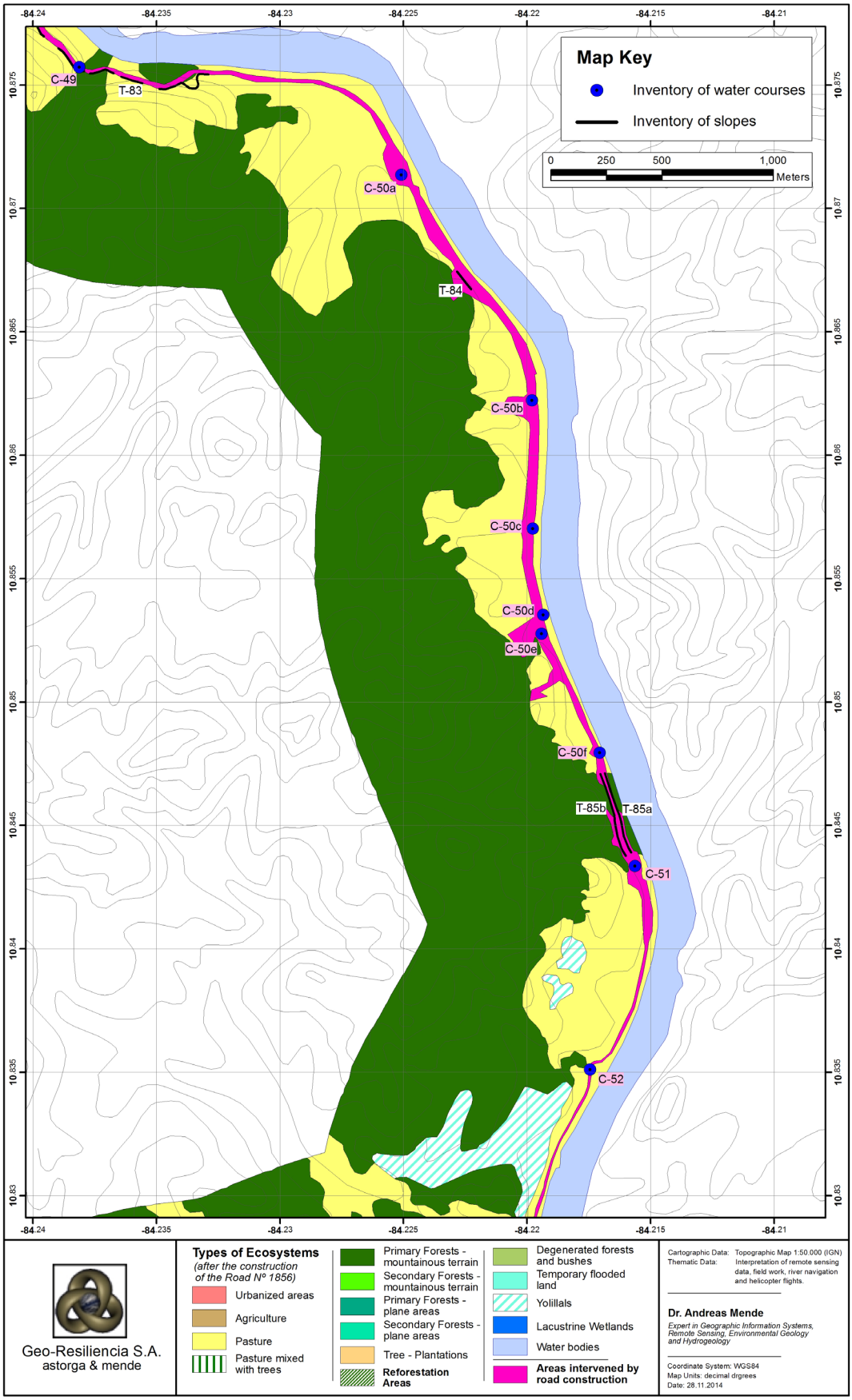
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Meters
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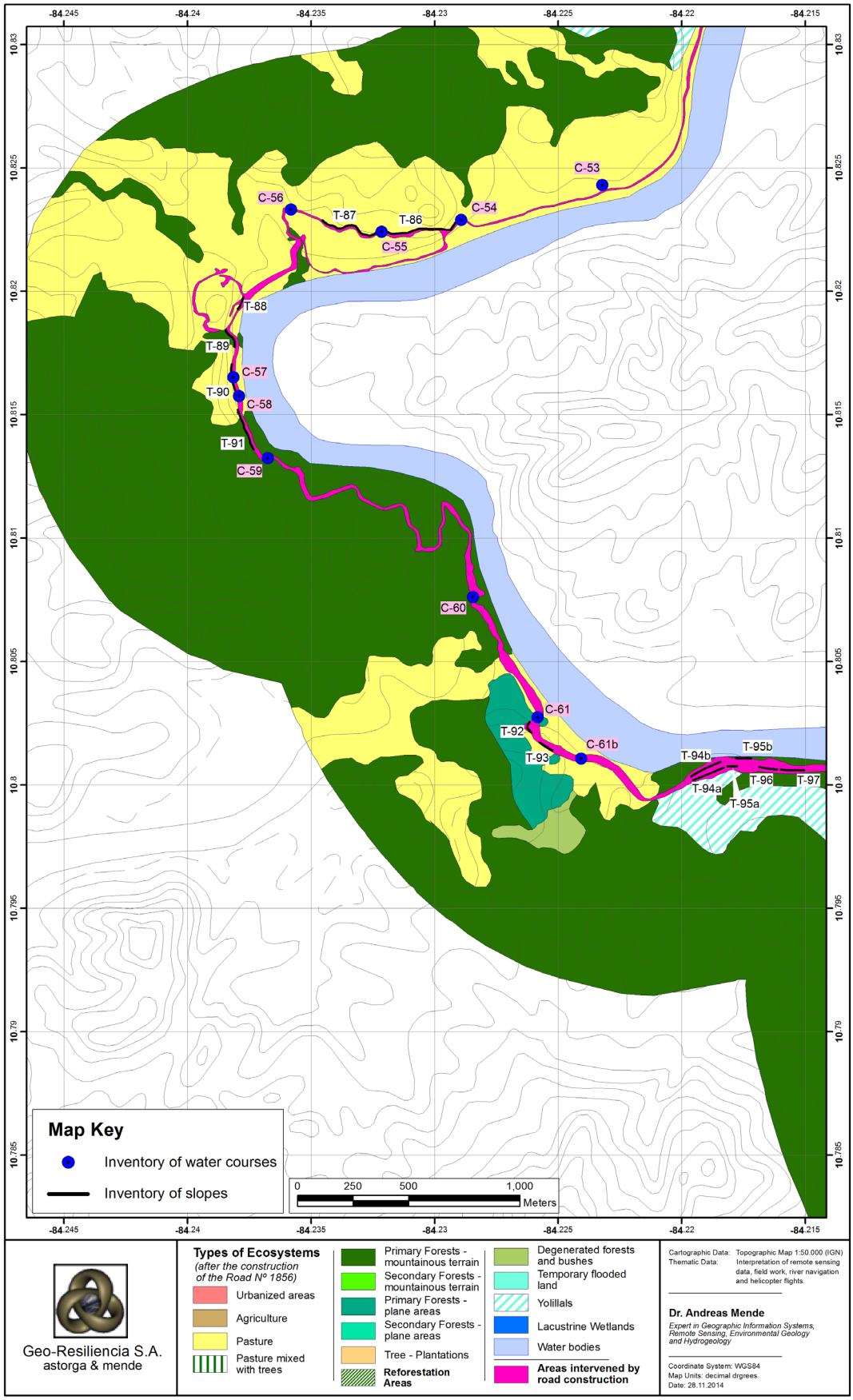
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C-61b
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T-94b
T-95a
T-95b
T-96
T-97
Map Key
Inventory of water courses
Inventory of slopes
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Meters
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astorga & mende
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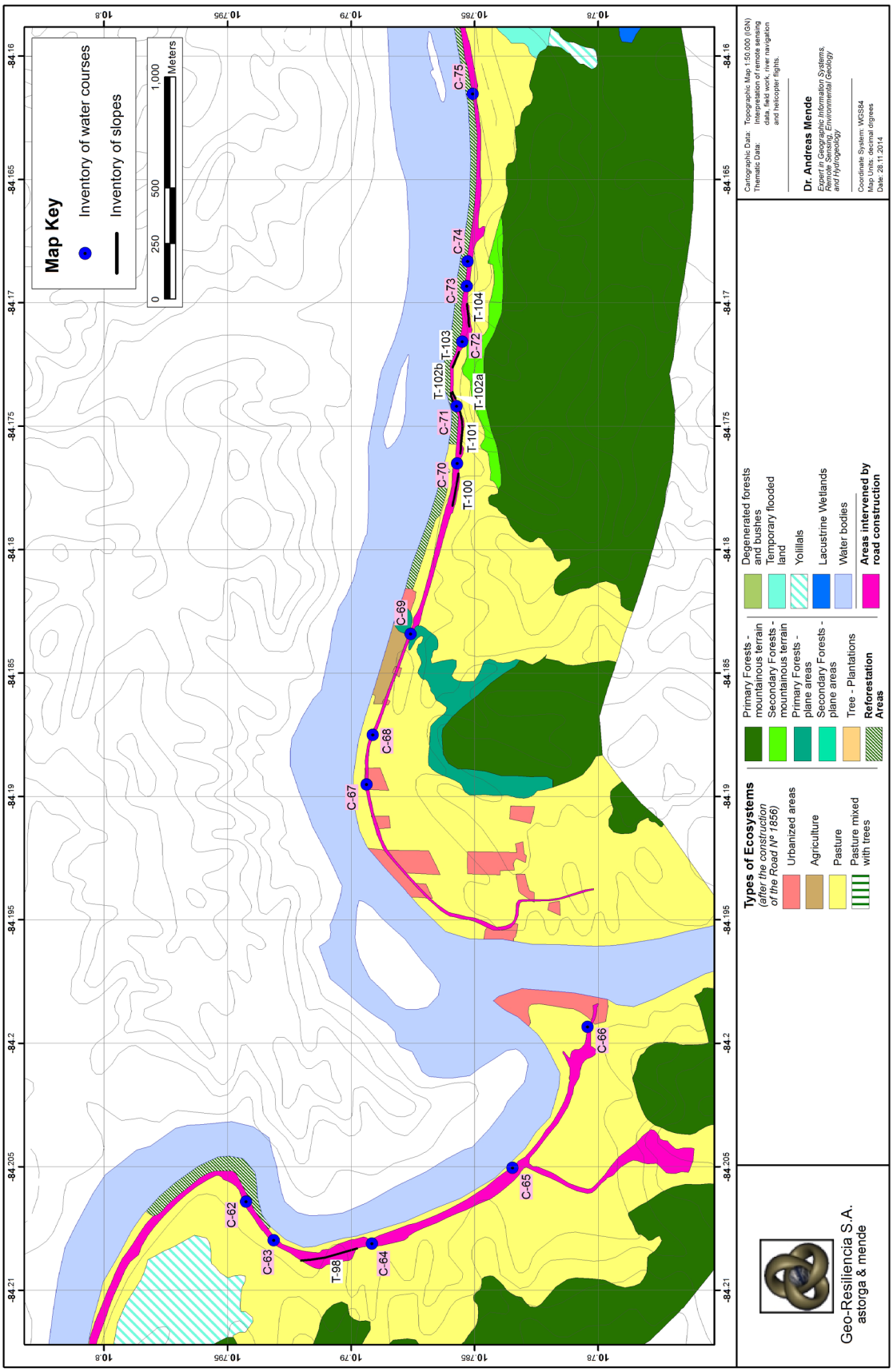
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Inventory of slopes
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1,000
Meters
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T-101
C-71
T-102b
T-102a
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C-72
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C-73
C-74
C-75
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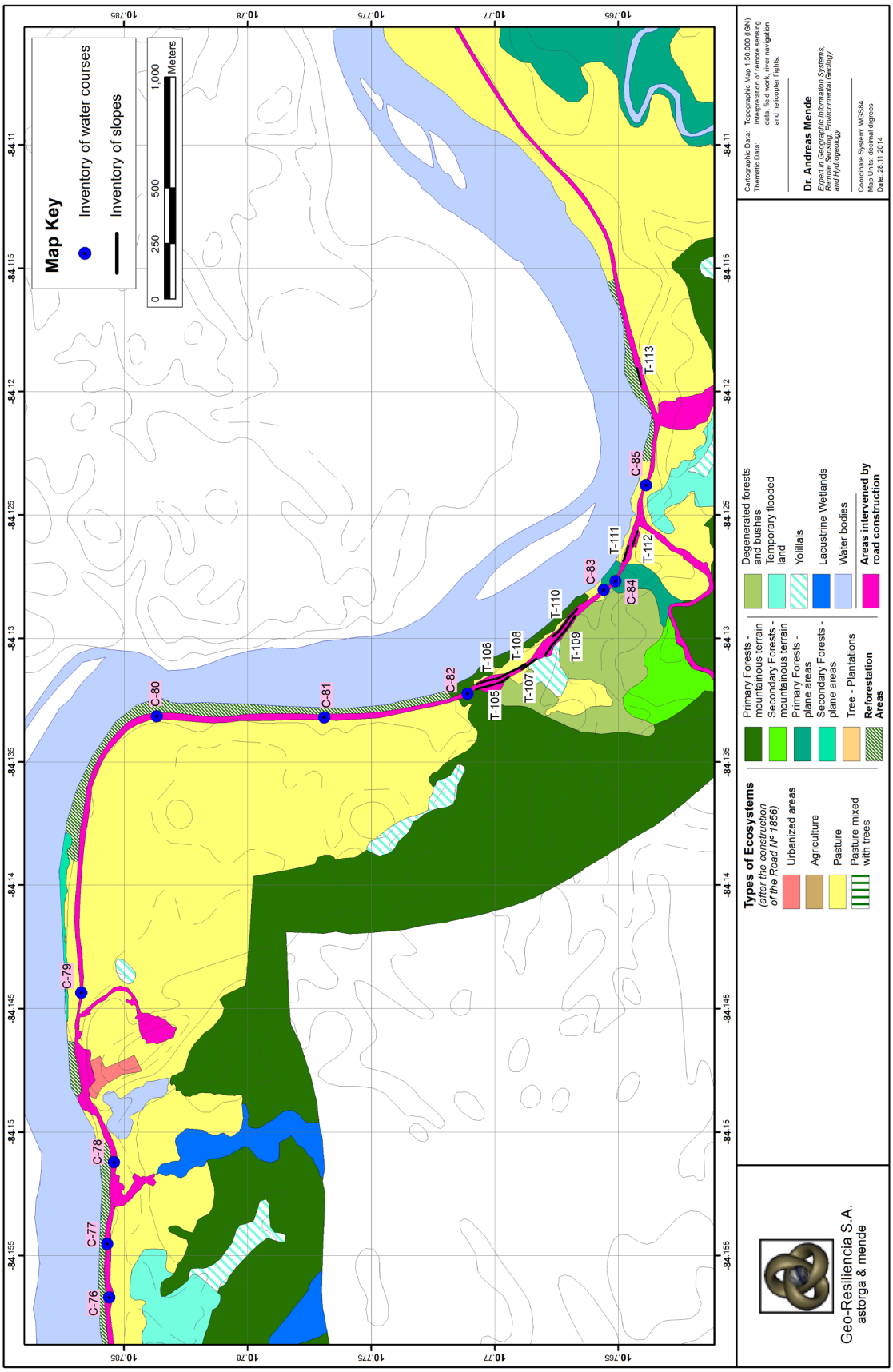
Cartographic Data: Topographic Map 1:50.000 (IGN)
Thematic Data: Interpretation of remote sensing data, field work, river navigation and helicopter flights.
Dr. Andreas Mende
Expert in Geographic Information Systems, Remote Sensing, Environmental Geology and Hydrogeology
Coordinate System: WGS84
Map Units: decimal degrees
Date: 25.11.2014
Geo-Resiliencia S.A.
astorga & mende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T-108
T-109
T-110
T-111
T-112
T-113
Types of Ecosystems
(after the construction of the Road Nº 1856)
Urbanized areas
Agriculture
Pasture
Pasture mixed with trees
Primary Forests - mountainous terrain
Secondary Forests - mountainous terrain
Primary Forests - plane areas
Secondary Forests - plane areas
Tree - Plantations
Reforestation Areas
Degenerated forests and bushes
Temporary flooded land
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Lacustrine Wetlands
Water bodies
Areas intervened by road construction
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Coordinate System: WGS84
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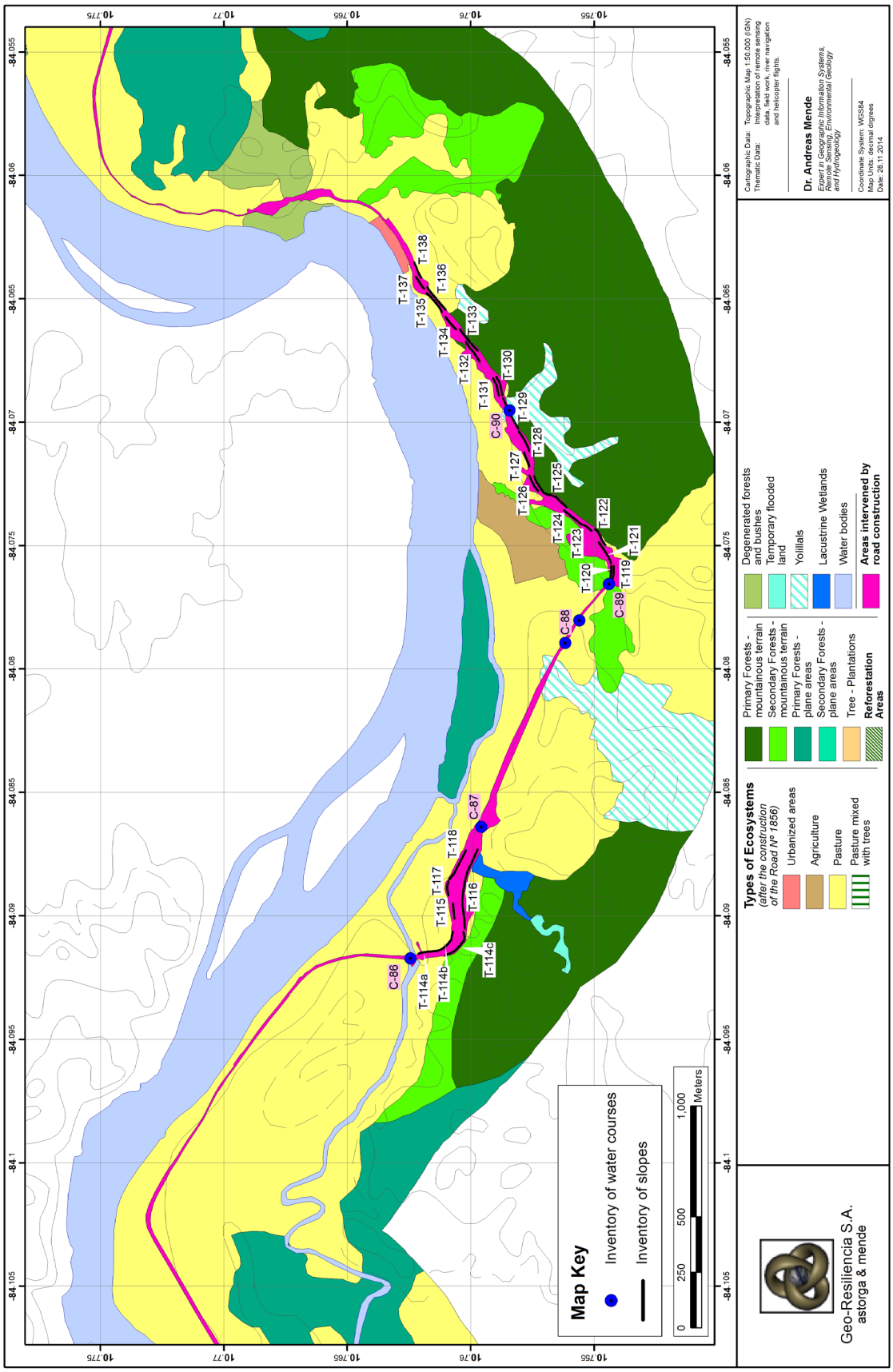
Geo-Resiliencia S.A.
astorga & mende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Coordinate System: WGS84
Map Units: decimal degrees
Date: 28.11.2014
Geo-Resiliencia S.A.
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C-88
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T-114b
T-114c
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T-116
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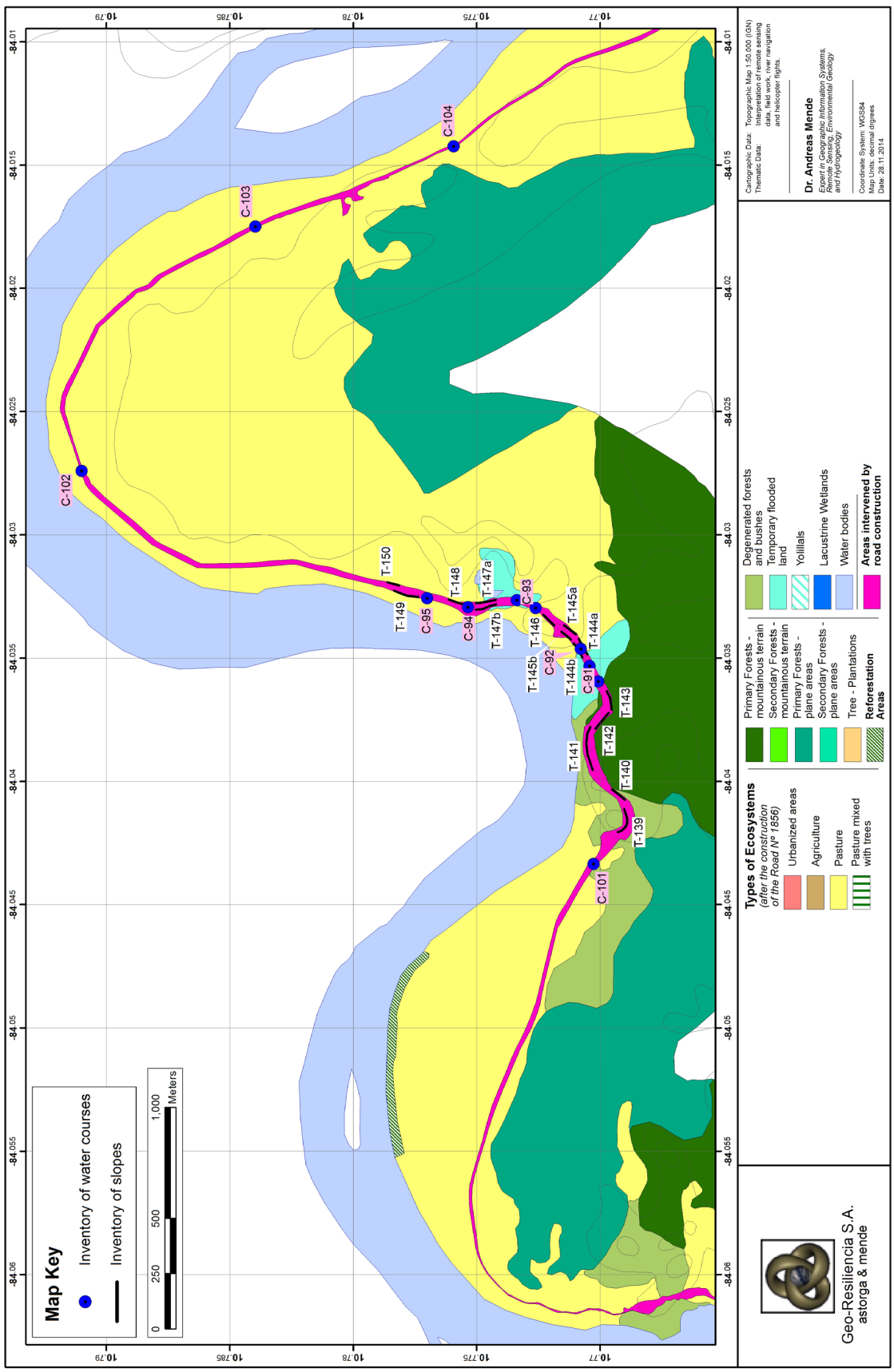
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T-145a
T-145b
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T-147b
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T-149
T-150
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Geo-Resiliencia S.A.
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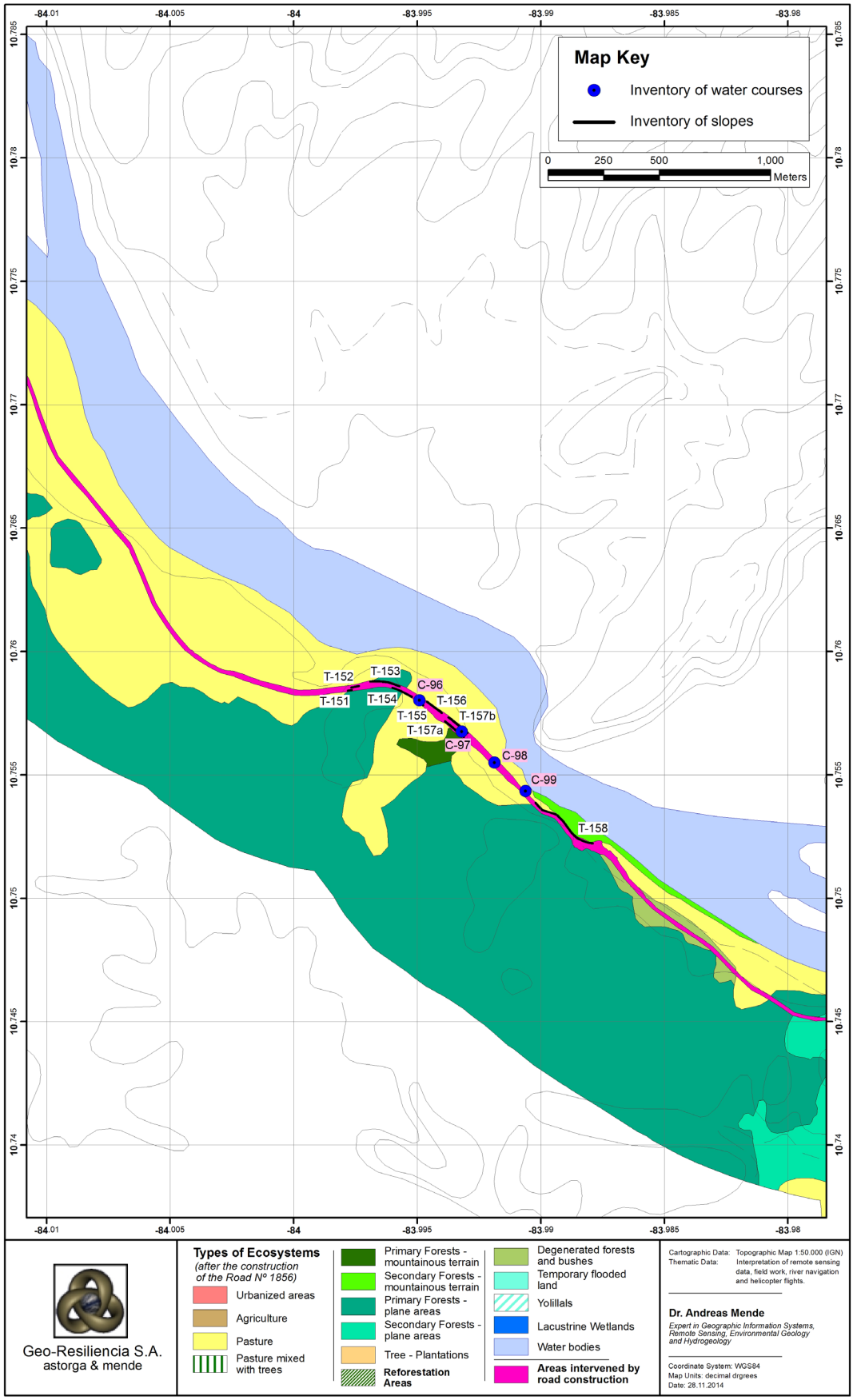
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C-98
C-99
T-158
Geo-Resiliencia S.A.
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Types of Ecosystems
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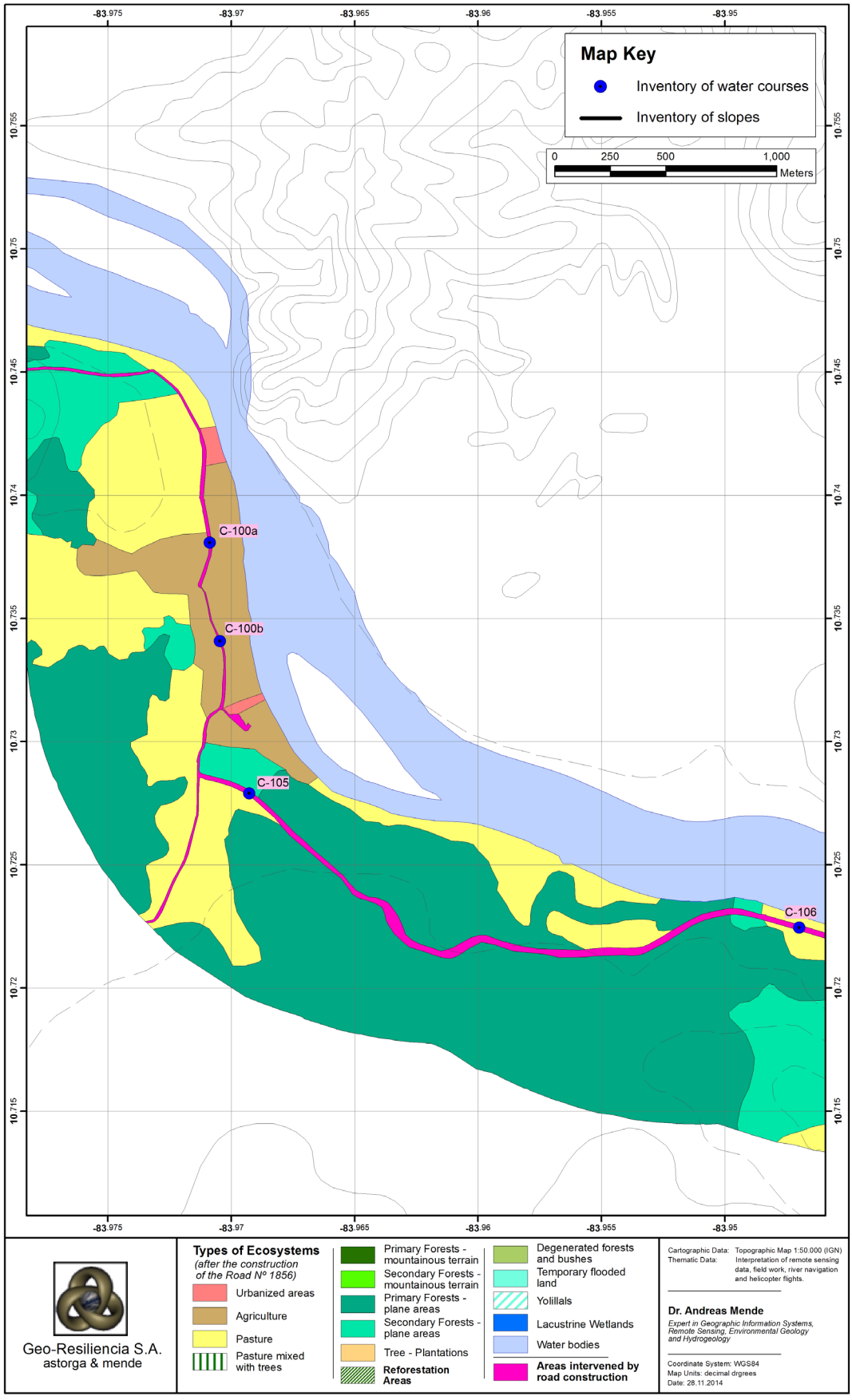
Coordinate System: WGS84
Map Units: decimal drgrees
Date: 28.11.2014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C-100a
C-100b
C-105
C-106
Geo-Resiliencia S.A.
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Types of Ecosystems
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Urbanized areas
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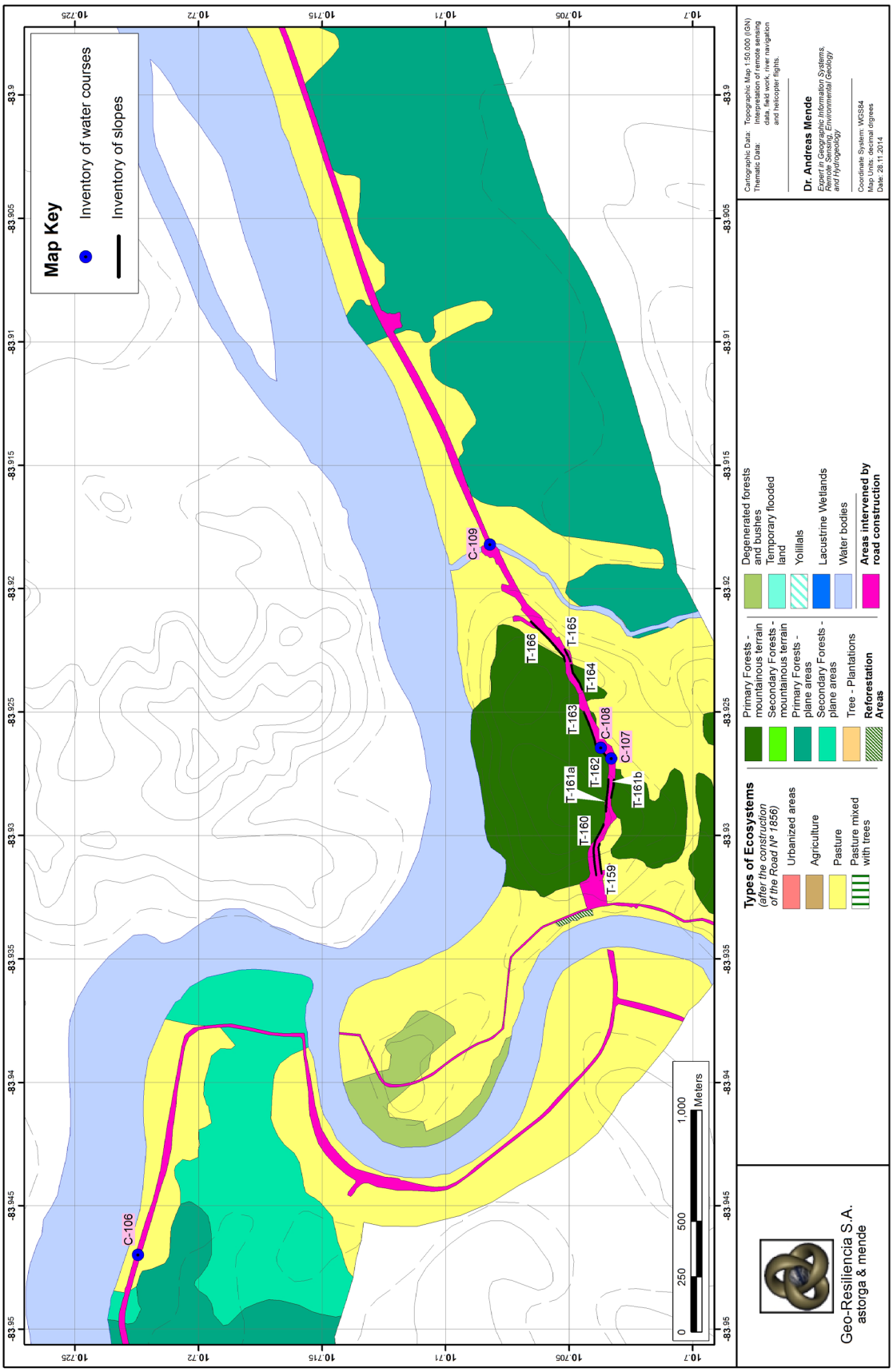
Map Units: decimal drgrees
Date: 28.11.2014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T-163
T-164
T-165
T-166
0
250
500
1,000
Meters
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astorga & mende
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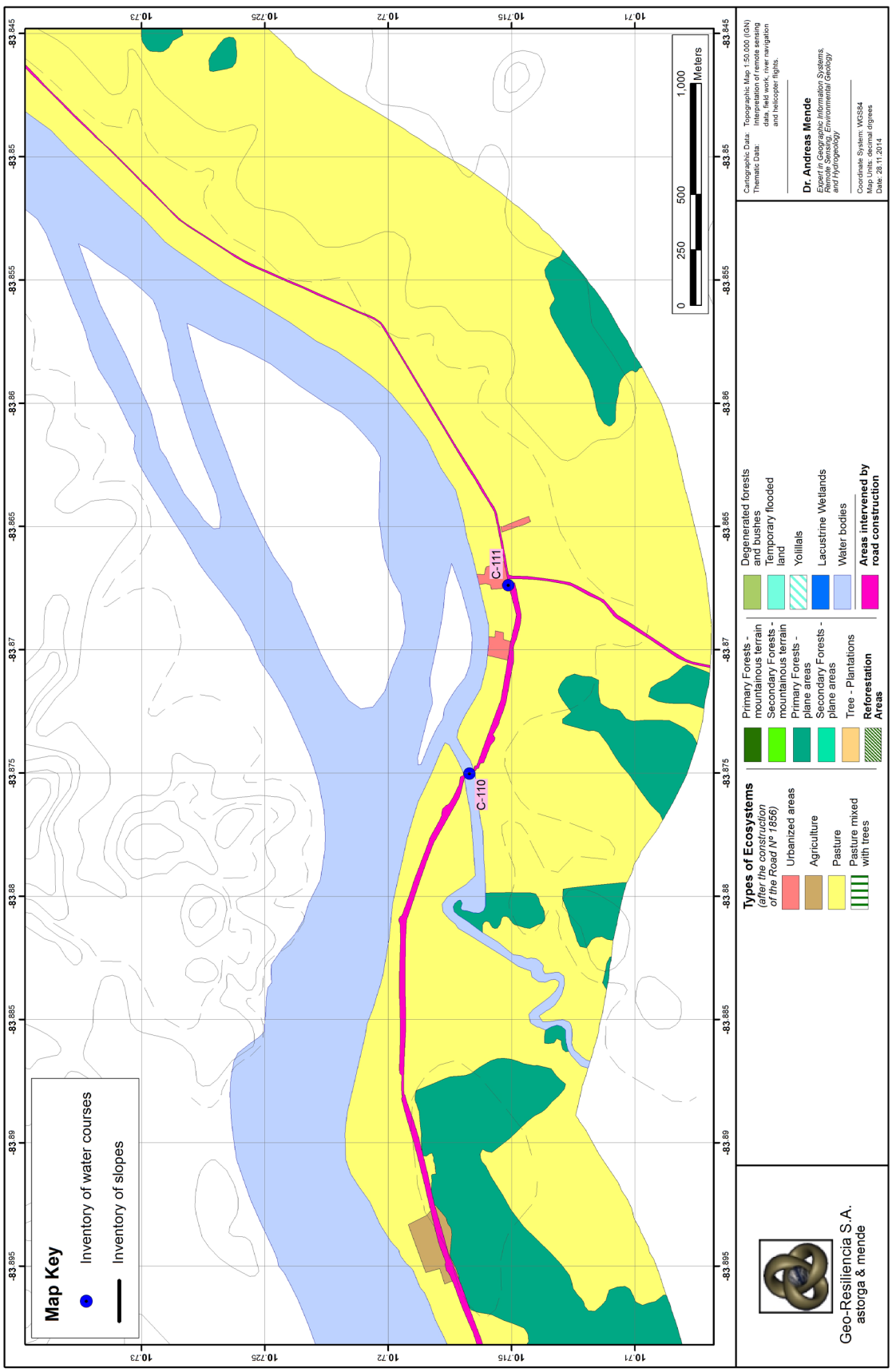
Dr. Andreas Mende
Expert in Geographic Information Systems, Remote Sensing, Environmental Geology and Hydrogeology
Coordinate System: WGS84
Map Units: decimal degrees
Date: 25.11.2014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Thematic Data: Interpretation of remote sensing data, Field work, Forest inventory and helicopter flights.
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Expert in Geographic Information Systems, Remote Sensing, Environmental Geology and Hydrogeology
Coordinate System: WGS84
Map Units: decimal degrees
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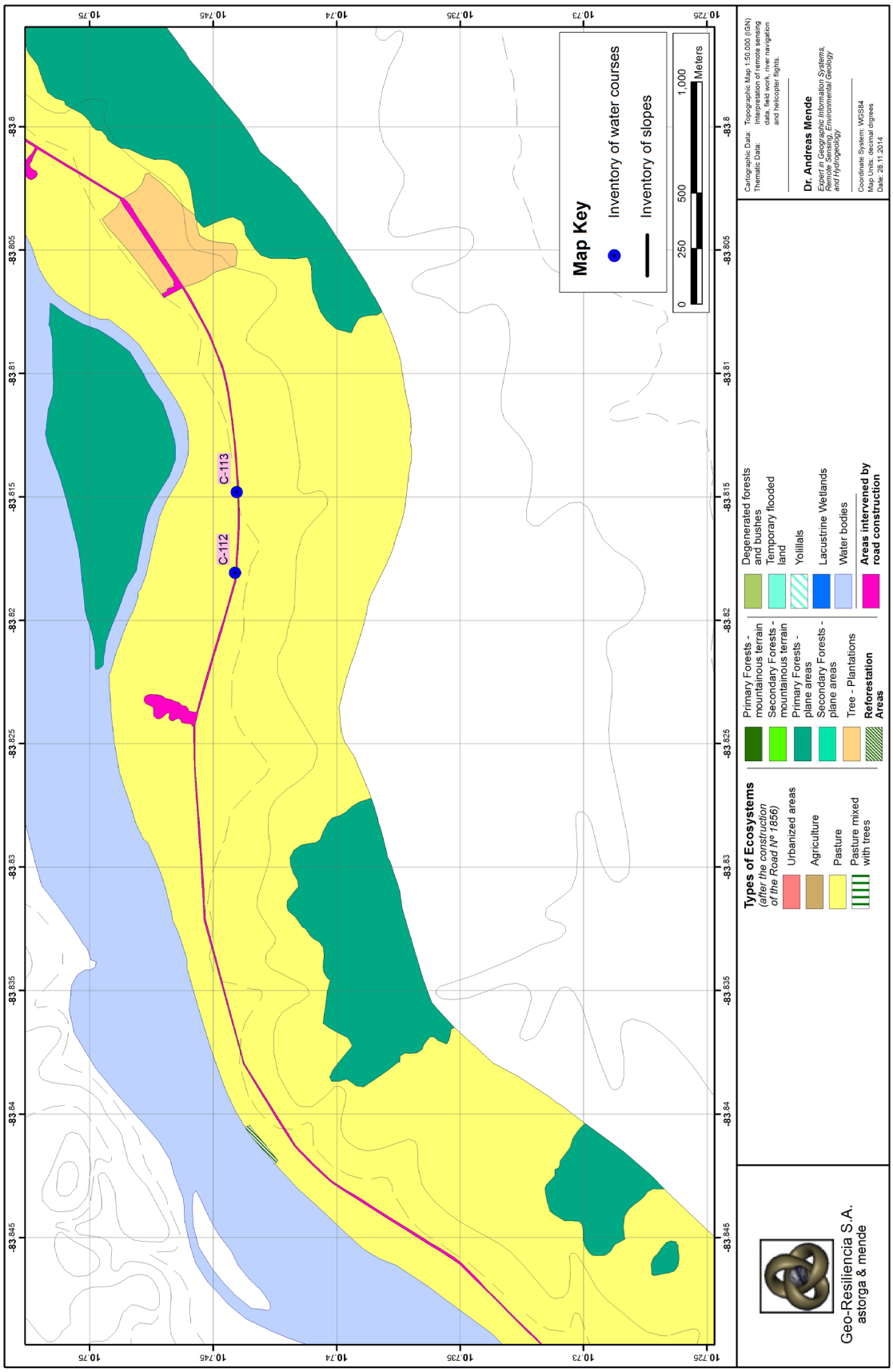
Geo-Resiliencia S.A.
astorga & mende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astorga & mende
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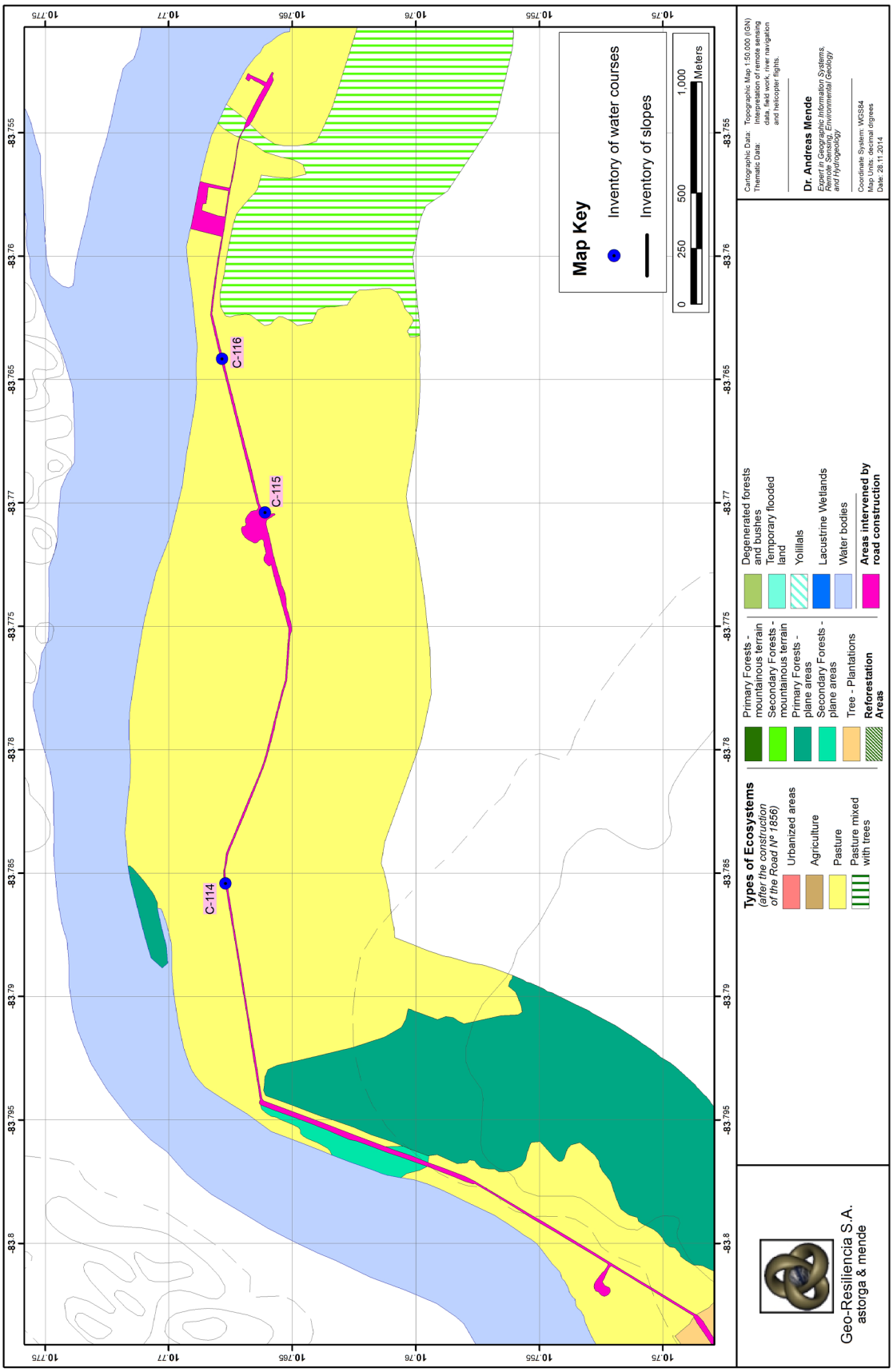
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10.75
Types of Ecosystems
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Dr. Andreas Mende
Expert in Geographic Information Systems, Remote Sensing, Environmental Geology and Hydrogeology
Coordinate System: WGS84
Map Units: decimal degrees
Date: 23.11.2014
Geo-Resiliencia S.A.
astorga & mende

5 CONDITION OF SLOPES AND WATERCOURSE INTERSECTIONS IN 2014

In this section the present state of the road is represented by means of statistical treatment of the base data about slopes and intersections of watercourses.

5.1 INTERSECTIONS OF WATERCOURSES

According to the new base data there are 129 intersections of watercourses along the road between the Mojón II and Delta Costa Rica, including those at San Carlos and Sarapiquí Rivers, which are exceptionally large and which are, therefore, excluded from further statistical treatment.

	2014		2013	
Type Of Structure	**Water courses (number)***	**Water courses (%)**	**Water courses (number)**	**Water courses (%)**
Bridge combined with fill	27 (-8)	21.3 %	35	29.4%
Bridge with no fill	5 (+ 4)	3.9 %	1	0.8%
Culvert with fill prism	72 (+ 24)	56.7 %	48	40.3%
Fill prism	7 (- 9)	5.5 %	16	13.4%
Fill prism with tree-trunks	4 (+ 1)	3.1 %	3	2.5%
No construction	12 (- 4)	9.4 %	16	13.4%
Sum	**127**	**100**	***119***	***100***

Table 4: Statistical data regarding the type of construction used for intersections of watercourses and the changes between 2013 and 2014. (*: the second value (…) represents the changes between 2014 and 2013).

The structural conditions of the watercourse intersections including the changes between 2013 and 2014 are summarized in Table 4. The results show that in 2014 the numbers of principally acceptable structures increased substantially: in 2014, 72 crossings count now with “culverts with fill prisms”, which is 24 more than in 2013. Five crossings instead of one show “bridges with no fill”.

In addition, the number of questionable types of construction were reduced: “fill prisms” 7 instead of 16 (-9) and “no construction” 12 instead of 16 (-4). At the same time “bridges

combined with fill" reduced from 35 to 27 (-8). In these cases mostly provisional wood bridges were replaced by adequate culverts with concrete heads (see the C-6 or C-21 crossings as examples in the appendix C).

Present Mitigation Status	*Water courses (number)*	*Water courses (%)*
Mitigated	28	22.0 %
Mitigation in progress	23	18.1 %
Mitigation scheduled	31	24.4 %
No mitigation necessary	24	18.9 %
Other	21	16.5 %
Sum	***127***	***100.0 %***

Table 5: Present Mitigation Status of structures used for crossing of watercourses in the case of the border road.

The present mitigation status is represented in table 5: here 74.8% (95) of all crossings are or already mitigated (28 crossings or 22.0%), in progress of mitigation (23 crossings or 18.1%), do not need mitigation (24 crossings or 18.9%) or are pedestrian crossings without relevance (21 crossings or 16.5%). In the case of 31 crossings (24.4%) the necessary mitigation works are scheduled but not executed yet.

In conclusion the statistical data for intersections of watercourses between Mojón II and Delta Costa Rica show a clear pattern of improvement compared to the situation in the year of 2013. There is still mitigation work to do but at least in almost 75% of all crossings mitigation works are finished, in progress or not necessary. Details of the present situation of all crossing can be found in the corresponding data sheets of appendix C. Changes between 2013 and 2014 can be verified by means of included photographs.

5.2 SLOPES

According to the new base data of the 2014 field work campaign the total number of slopes between Mojòn II and Delta Costa Rica is 201. The change in comparison to the 2013 data base (188 slopes) has been explained in section 2.3. Based on the new method of slope surface area determination, as explained in section 2.1, the total slope surface

area is 309,313 m^2, of which 165,247 or 53.4% is affected by sheet erosion, 63,692 m^2 or 20.6% by rill erosion, 59,310 m^2 or 19.2 % by gully erosion and 19,278 m^2 or 6.2% by Landslides. 1,786 m^2 or 6.2% is not affected by any type of erosion.

Types of Erosion	Slopes (Area m^2)	Slopes (Area %)
None	1,786	0.6
Sheet Erosion	165,247	53.4
Rill Erosion	63,692	20.6
Gully Erosion	59,310	19.2
Land Slides	19,278	6.2
Sum	***309,313***	***100***

Table 6: Statistical data regarding the types of erosion present at the slopes identified along the border road between Mojón II and Delta Costa Rica.

The current mitigation status of the slopes along Route Nº 1859 exhibits a similar pattern as the intersections of watercourses (table 7): in the case of 71.1% (143 slopes) of all slopes mitigation works are or already finished (25 slopes or 12.4%), in progress of mitigation (107 slopes or 53.2%) or do not need mitigation measures (11 slopes or 5.5%). On the other side for 58 slopes or 28.9% of all slopes mitigation works are scheduled but wait for implementation. Details about the executed mitigation measures are listed in table 8.

Current Mitigation Status	*Slopes (number)*	*Slopes (%)*
Mitigated	25	12.4 %
Mitigation in progress	107	53.2 %
Mitigation scheduled	58	28.9 %
No mitigation necessary	11	5.5 %
Sum	***201***	***100.0 %***

Table 7: Current Mitigation Status of slopes of the border road.

Mitigation Measures	Slopes (number)	Slopes (%)
Mitigation Measures (in general)	142	70.6 %
Geotextiles	26	12.9 %
Drainage Control	26	12.9 %
Stabilization by Terraces	22	10.9 %
Sediment Traps	19	9.5 %
Sowed Vegetation	37	18.4 %
Natural Vegetation	121	60.2 %

Table 8: Present conditions of the different mitigation measures on the slopes of the border road.

A summary of the present situation regarding all slopes between Mojón II and Delta Costa Rica can be found in the corresponding data sheets of appendix B. Changes between 2013 and 2014 can be verified by the photographs included (Appendix B).

6 ESTIMATION OF EROSION RATES AT SLOPES ALONG ROUTE 1856 BETWEEN MOJÒN II AND DELTA COSTA RICA

In the 2014 report the UCR team presents improved estimations of erosion rates for the different erosional features found on slopes along the border road. These data are based on field measurements, but their quality has substantially been improved with help of a laser topography scanner (LiDAR) and the application of UAV Photogrammetry (UCR, 2014). The resultant erosion rates per year for the different types of erosional features in function of cut and fill slopes are presented in table 9.

Based on these improved data in combination with the herein presented improved measurements of slope surface areas, a new estimation was made for the total erosion rate of slopes per year. The calculation method is the same as that presented in the 2013 report:

The first step is to identify the area occupied by each of the different erosion types (sheet erosion, rills, gullies and landslides) of a given slope, using the percentages observed in the field during the 2014 field work campaign. The erosion rate for each slope can then be estimated by multiplying the resulting surface areas with the appropriate erosion rate, as listed in Table 9, and summing the rates for all the types of erosion present on that slope. The resulting estimates of estimated annual sediment rates for all slopes can be found in *Appendix A*.

Erosive feature		Erosion of 1 m^2 per Year (m)
CUT SLOPES	*Sheet Erosion*	**0.07**
	Rills	**0.16**
	Gullies	**0.27**
	Landslides	**0.40**
FILL SLOPES	*Sheet Erosion*	**0.14**
	Rills	**0.16**
	Gullies	**0.76**
	Landslides	**0.40**

Table 9: Average Erosion rates per square meter for the different types of slopes and erosive features as determined by the UCR working group (UCR, 2014).

The total erosion rate of all slopes along the Route 1856 between Mojón II and Delta Costa Rica can be derived by summing up all erosion rates of the slopes as given in Appendix A. The resultant value is 71,836 m^3/year or 119,967 t/year using the transform ratio 1:1.67 from the ICE Report (2013).

It should be stressed that this value represents the upper bound of the annual erosion rate. On the one side the UCR working group emphasizes in the 2014 report that "*maximum or 'worst case' rates of erosion measured at the monitoring sites over a two year period*" are presented for each type of erosion feature and slope. The application of maximum erosion rates to all slopes of the border road is simulating a scenario in which all erosion processes operate at their upper bound rates simultaneously at every slope along the entire length of the Road.

In addition, it can be noted that the effects of implemented mitigation measures, without any doubt resulting in considerably lower erosion rates at the slopes in question, are not considered. At present (December 2014) mitigation measures are or were executed at 142 slopes (70.6% of all slopes, compare table 8) pointing out that this aspect is of considerable importance. As the corresponding effects are difficult to measure in an exact fashion we preferred to do not take into account this factor. However, it suggest that the erosion rates used are conservative.

Compared to the erosion rate given in the 2013 report (36,590 m^3/year or 61,100 t/year) the value has almost doubled. The principal reason for this considerable difference is method used to determine the slope surface areas (compare section 2.1). Especially in the case of fill slopes where the road is situated on top of the slope, the estimates of slope length were considerably underestimated during the 2013 filed campaign. This slope type is dominated by gully erosion exhibiting the highest erosion rates as determined by the UCR working group (compare table 9).

The new value presented in this report for the total estimated erosion rate for all slopes can be recognized as a reasonable value which is now based on values exclusively determined by field measurements.

7 DATA SHEETS FOR ALL SLOPES AND INTERSECTIONS OF WATER COURSES

During the 2014 field work campaign new field data were collected for all slopes and intersections of watercourses. In order to give an impression as complete as possible about the present situation of the border road, data sheets are presented for all slopes and intersections of watercourses including the new field data as well as photographs that document the present state as well as the state in the year of 2013 (appendix B and C). This decision was also made in order to prove that the herein presented data are sound and reflect the real situation of the road in the year of 2014.

In the case of a few slopes and watercourses photographs are not presented for the year of 2013 and/or 2014, because heavy rainfalls did not permit to take photographs of an acceptable quality.

Slopes where the additional comment "*UCR Site*" is added in the data field "*Mitigation Status*" correspond to sites where the UCR working group executed their measurements of erosion rates. For this reason at these slopes mitigation works were not executed or at least delayed.

8 REFERENCES

Gomez-Delgado, F., Leitón-Montero, J.J. & Aguilar-Cabrera, C.A. (2013). *Report on hydrology and sediments for the Costa Rican river basins draining to the San Juan River*. San José, Costa Rica: Instituto Costarricense de Electricidad.

Mende, A. & Astorga, A. (2013): *Inventory of Slopes and Watercourses related to the Border Road Nº 1856 between Mojón II and Delta Costa Rica.*- Technical Report to the Ministry of Foreign Affairs. San José, Costa Rica.

Oreamuno, R. & Villalobos, R. (2013): *Systematic Field monitoring of Erosion and Sediment Yield along Route 1856.*- Universidad de Costa Rica. San José, Costa Rica.

Oreamuno, R. & Villalobos, R. (2014): *Second Report on Systematic Field Monitoring of Erosion and Sediment Yield along Route 1856.*- Universidad de Costa Rica. San José, Costa Rica.

Appendix A: Overview about the most important data for Slopes along the Route 1856 between Mojón II and Delta Costa Rica

Slope	Type	Elevation Difference (m)	Slope Angle (°)	Slope Length (m)	Slope Width (m)	Slope Surface (m^2)	Sheet (%)	Sheet (m2)	Rills (%)	Rills (m2)	Gullies (%)	Gullies (m2)	Landslides (%)	Landslides (m)	Erosion rate (m^3/a)	Erosion rate (t/a)
T-1	cut	2.5	50	3.3	181.9	593.6	100	593.6	0	0.0	0	0.0	0	0.0	41.6	69.4
T-10	cut	3	60	3.5	71	246.0	80	196.8	20	49.2	0	0.0	0	0.0	21.6	36.1
T-100	cut	3.5	60	4.0	145.2	586.8	100	586.8	0	0.0	0	0.0	0	0.0	41.1	68.6
T-101	cut	4.5	60	5.2	199.5	1036.6	85	881.1	15	155.5	0	0.0	0	0.0	86.6	144.6
T-102a	cut	2.3	60	2.7	31.8	84.5	20	16.9	0	0.0	0	0.0	0	0.0	1.2	2.0
T-102b	fill	24			34.7	832.8	100	832.8	0	0.0	0	0.0	0	0.0	116.6	194.7
T-103	cut	4	60	4.6	72.4	334.4	100	334.4	0	0.0	0	0.0	0	0.0	23.4	39.1
T-104	cut	13	60	14.4	101	1457.8	100	1457.8	0	0.0	0	0.0	0	0.0	102.0	170.4
T-105	cut	4.6	50	6.0	158.4	951.2	75	713.4	20	190.2	5	47.6	0	0.0	93.2	155.7
T-106	cut	4.5	55	5.5	155	851.5	100	851.5	0	0.0	0	0.0	0	0.0	59.6	99.5
T-107	cut	2.4	65	2.6	80.3	212.6	100	212.6	0	0.0	0	0.0	0	0.0	14.9	24.9
T-108	fill	25			75.2	1842.4	60	1105.4	15	276.4	25	460.6	0	0.0	549.0	916.9
T-109	fill	37			218.9	8099.3	25	2024.8	30	2429.8	45	3644.7	0	0.0	3442.2	5748.5
T-11	cut	3.2	60	3.7	86.2	318.5	20	63.7	0	0.0	0	0.0	0	0.0	4.5	7.4
T-110	cut	5.5	55	6.7	162.5	1091.1	90	982.0	10	109.1	0	0.0	0	0.0	86.2	143.9
T-111	cut	3.8	55	4.6	68.4	317.3	70	222.1	30	95.2	0	0.0	0	0.0	30.8	51.4
T-112	cut	3.4	40	5.3	69	365.0	100	365.0	0	0.0	0	0.0	0	0.0	25.5	42.7
T-113	cut	1.6	55	2.0	73.8	144.1	100	144.1	0	0.0	0	0.0	0	0.0	10.1	16.9
T-114a	cut	9	45	12.7	106.4	1354.3	20	270.9	20	270.9	35	474.0	25	338.6	325.7	543.9
T-114b	cut	4.5	55	5.5	95.8	526.3	85	447.3	15	78.9	0	0.0	0	0.0	43.9	73.4
T-114c	cut	2.5	60	2.9	148.6	429.0	80	343.2	20	85.8	0	0.0	0	0.0	37.7	63.0
T-115	cut	4.8	45	6.8	67.9	460.9	100	460.9	0	0.0	0	0.0	0	0.0	32.3	53.9
T-116	fill	27			362.6	9790.2	0	0.0	25	2447.6	75	7342.7	0	0.0	5972.0	9973.3
T-117	fill	12			62.8	753.6	60	452.2	30	226.1	10	75.4	0	0.0	156.7	261.8
T-118	cut	8.5	50	11.1	147.5	1636.7	75	1227.5	25	409.2	0	0.0	0	0.0	151.4	252.8
T-119	cut	7.5	45	10.6	60	636.4	85	540.9	15	95.5	0	0.0	0	0.0	53.1	88.7
T-12	cut	7	45	9.9	75.1	743.5	80	594.8	0	0.0	0	0.0	20	148.7	101.1	168.9
T-120	cut	3.9	45	5.5	51.6	284.6	100	284.6	0	0.0	0	0.0	0	0.0	19.9	33.3
T-121	fill	19			109.4	2078.6	0	0.0	10	207.9	90	1870.7	0	0.0	1455.0	2429.9
T-122	cut	7.5	55	9.2	85.6	783.7	100	783.7	0	0.0	0	0.0	0	0.0	54.9	91.6
T-123	fill	19			66	1254.0	0	0.0	10	125.4	90	1128.6	0	0.0	877.8	1465.9
T-124	cut	3.9	65	4.3	76.5	329.2	100	329.2	0	0.0	0	0.0	0	0.0	23.0	38.5

Slope	Type	Elevation Difference (m)	Slope Angle (°)	Slope Length (m)	Slope Width (m)	Slope Surface (m^2)	Sheet (%)	Sheet (m2)	Rills (%)	Rills (m2)	Gullies (%)	Gullies (m2)	Landslides (%)	Landslides (m)	Erosion rate (m^3/a)	Erosion rate (t/a)
T-125	cut	5	45	7.1	208.8	1476.4	100	1476.4	0	0.0	0	0.0	0	0.0	103.4	172.6
T-126	fill	26			79.4	2064.4	60	1238.6	20	412.9	20	412.9	0	0.0	553.3	923.9
T-127	cut	5.7	50	7.4	66.1	491.8	100	491.8	0	0.0	0	0.0	0	0.0	34.4	57.5
T-128	cut	7	50	9.1	100.2	915.6	80	732.5	20	183.1	0	0.0	0	0.0	80.6	134.6
T-129	fill	5.5			149.8	823.9	85	700.3	10	82.4	5	41.2	0	0.0	142.5	238.0
T-13	cut	8.5	45	12.0	131.1	1575.9	70	1103.2	10	157.6	0	0.0	20	315.2	228.5	381.6
T-130	cut	4.5	50	5.9	86.3	507.0	85	430.9	15	76.0	0	0.0	0	0.0	42.3	70.7
T-131	cut	1.8	80	1.8	82.5	150.8	100	150.8		0.0		0.0		0.0	10.6	17.6
T-132	fill	20			107.1	2142.0	10	214.2	20	428.4	70	1499.4	0	0.0	1238.1	2067.6
T-133	cut	5	45	7.1	125.1	884.6	80	707.7	20	176.9	0	0.0	0	0.0	77.8	130.0
T-134	fill	17			73.9	1256.3	20	251.3	30	376.9	50	628.2	0	0.0	572.9	956.7
T-135	fill	8.5			109.1	927.4	40	370.9	10	92.7	0	0.0	0	0.0	66.8	111.5
T-136	cut	3.2	65	3.5	129.8	458.3	50	229.1	20	91.7	0	0.0	30	137.5	85.7	143.1
T-137	cut	3.8	65	4.2	65.1	273.0	75	204.7	0	0.0	0	0.0	25	68.2	41.6	69.5
T-138	cut	1.3	70	1.3	72.8	96.8	100	96.8	0	0.0	0	0.0	0	0.0	6.8	11.3
T-139	cut	11	45	15.6	124.3	1933.7	50	966.8	40	773.5	10	193.4	0	0.0	243.6	406.9
T-14	cut	4.5	50	5.9	203.7	1196.6	50	598.3	30	359.0	10	119.7	10	119.7	179.5	299.7
T-140	cut	3	65	3.3	75	248.3	75	186.2	25	62.1	0	0.0	0	0.0	23.0	38.3
T-141	cut	2.5	45	3.5	198.5	701.8	100	701.8	0	0.0	0	0.0	0	0.0	49.1	82.0
T-142	fill	2.2			93.5	205.7	80	164.6	20	41.1	0	0.0	0	0.0	29.6	49.5
T-143	cut	1.8	45	2.5	85.8	218.4	100	218.4	0	0.0	0	0.0	0	0.0	15.3	25.5
T-144a	fill	6			78.1	468.6	85	398.3	15	70.3	0	0.0	0	0.0	67.0	111.9
T-144b	fill	5.5			77.2	424.6	85	360.9	15	63.7	0	0.0	0	0.0	60.7	101.4
T-145a	cut	1.7	60	2.0	65.5	128.6	100	128.6	0	0.0	0	0.0	0	0.0	9.0	15.0
T-145b	cut	2.2	45	3.1	55.4	172.4	100	172.4	0	0.0	0	0.0	0	0.0	12.1	20.1
T-146	cut	5.5	50	7.2	68.2	489.7	100	489.7	0	0.0	0	0.0	0	0.0	34.3	57.2
T-147a	cut	3.5	45	4.9	91.1	450.9	100	450.9	0	0.0	0	0.0	0	0.0	31.6	52.7
T-147b	cut	2.8	45	4.0	95.2	377.0	100	377.0	0	0.0	0	0.0	0	0.0	26.4	44.1
T-148	cut	3.5	45	4.9	70	346.5	100	346.5	0	0.0	0	0.0	0	0.0	24.3	40.5
T-149	cut	4.5	55	5.5	113.1	621.3	100	621.3	0	0.0	0	0.0	0	0.0	43.5	72.6
T-15	cut	6	55	7.3	213	1560.1	60	936.1	40	624.1	0	0.0	0	0.0	165.4	276.2
T-150	cut	3.6	55	4.4	54.3	238.6	80	190.9	20	47.7	0	0.0	0	0.0	21.0	35.1

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T-151	cut	2.9	65	3.2	16.8	53.8	100	53.8	0	0.0	0	0.0	0	0.0	3.8	6.3
T-152	fill	10			33.1	331.0	50	165.5	25	82.8	25	82.8	0	0.0	99.3	165.8
T-153	cut	7.5	60	8.7	133.3	1154.4	100	1154.4	0	0.0	0	0.0	0	0.0	80.8	135.0
T-154	cut	5.5	50	7.2	95.6	686.4	100	686.4	0	0.0	0	0.0	0	0.0	48.0	80.2
T-155	fill	3.2			47.2	151.0	50	75.5	20	30.2	30	45.3	0	0.0	49.8	83.2
T-156	cut	5.7	50	7.4	82.7	615.4	80	492.3	20	123.1	0	0.0	0	0.0	54.2	90.4
T-157a	fill	3.8			109.6	416.5	55	229.1	30	124.9	15	62.5	0	0.0	99.5	166.2
T-157b	fill	3.8			110.1	418.4	75	313.8	25	104.6	0	0.0	0	0.0	60.7	101.3
T-158	cut	11	30	21.0	325.1	6827.1	60	4096.3	30	2048.1	10	682.7	0	0.0	798.8	1333.9
T-159	cut	1.6	45	2.3	133.4	301.8	80	241.5	20	60.4	0	0.0	0	0.0	26.6	44.4
T-160	cut	1.8	55	2.2	237.4	521.7	60	313.0	40	208.7	0	0.0	0	0.0	55.3	92.3
T-161a	cut	3.8	55	4.6	143	663.4	100	663.4	0	0.0	0	0.0	0	0.0	46.4	77.5
T-161b	cut	3	65	3.3	81.3	269.1	100	269.1	0	0.0	0	0.0	0	0.0	18.8	31.5
T-162	fill	9			45.1	405.9	100	405.9	0	0.0	0	0.0	0	0.0	56.8	94.9
T-163	cut	4.7	65	5.2	157.9	818.8	100	818.8	0	0.0	0	0.0	0	0.0	57.3	95.7
T-164	cut	6.2	55	7.6	121.8	921.9	85	783.6	0	0.0	0	0.0	15	138.3	110.2	184.0
T-165	fill	15			58.3	874.5	100	874.5	0	0.0	0	0.0	0	0.0	122.4	204.5
T-166	cut	4.2	55	5.1	234.9	1204.4	100	1204.4	0	0.0	0	0.0	0	0.0	84.3	140.8
T-17	cut	6.5	50	8.5	191.4	1624.1	70	1136.8	10	162.4	0	0.0	20	324.8	235.5	393.3
T-19	cut	12	50	15.0	147.9	2220.3	70	1554.2	30	666.1	0	0.0	0	0.0	215.4	359.7
T-2	cut	2.2	55	2.7	69.7	187.2	100	187.2	0	0.0	0	0.0	0	0.0	13.1	21.9
T-20	cut	4.5	50	5.9	86	505.2	25	126.3	0	0.0	0	0.0	0	0.0	8.8	14.8
T-21a	cut	13	55	15.3	382.1	5830.7	65	3790.0	0	0.0	0	0.0	35	2040.8	1081.6	1806.3
T-21b	cut	5	65	5.5	387	2135.0	100	2135.0	0	0.0	0	0.0	0	0.0	149.5	249.6
T-22	cut	5	60	5.8	362.8	2094.6	65	1361.5	15	314.2	0	0.0	20	418.9	313.1	523.0
T-23	cut	2	65	2.2	63	139.0	35	48.7	0	0.0	0	0.0	0	0.0	3.4	5.7
T-24a	cut	2.5	55	3.1	94.5	288.4	40	115.4	0	0.0	0	0.0	0	0.0	8.1	13.5
T-24b	cut	2.6	50	3.4	103.5	351.3	40	140.5	0	0.0	0	0.0	0	0.0	9.8	16.4
T-25	cut	1.5	60	1.7	52.1	90.2	0	0.0	0	0.0	0	0.0	0	0.0	0.0	0.0
T-26	cut	1.5	60	1.7	40.7	70.5	20	14.1		0.0	0	0.0	0	0.0	1.0	1.6
T-27	cut	2	60	2.3	174.9	403.9	85	343.3	0	0.0	0	0.0	15	60.6	48.3	80.6
T-28	cut	3	60	3.5	96.4	333.9	75	250.5	10	33.4	0	0.0	15	50.1	42.9	71.7

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T-29	cut	8	65	8.8	188.5	1663.9	60	998.3	25	416.0	0	0.0	15	249.6	236.3	394.6
T-3	cut	1.9	55	2.3	36.8	85.4	100	85.4	0	0.0	0	0.0	0	0.0	6.0	10.0
T-30	cut	7	65	7.7	122.9	949.2	100	949.2	0	0.0	0	0.0	0	0.0	66.4	111.0
T-31	cut	1.5	65	1.7	146.2	242.0	100	242.0	0	0.0	0	0.0	0	0.0	16.9	28.3
T-32a	cut	3.5	60	4.0	226.8	916.6	100	916.6	0	0.0	0	0.0	0	0.0	64.2	107.2
T-32b	fill	48			221.7	10641.6	80	8513.3	15	1596.2	5	532.1	0	0.0	1851.6	3092.2
T-33	cut	6	65	6.6	194.3	1286.3	65	836.1	15	192.9	0	0.0	20	257.3	192.3	321.1
T-34	cut	3.2	65	3.5	54.6	192.8	80	154.2	20	38.6		0.0		0.0	17.0	28.3
T-35	cut	3.5	60	4.0	128.1	517.7	90	465.9	0	0.0	0	0.0	10	51.8	53.3	89.1
T-36	cut	1.2	65	1.3	29.5	39.1	100	39.1		0.0		0.0		0.0	2.7	4.6
T-37	cut	18	40	28.0	202.6	5673.4	35	1985.7	30	1702.0	20	1134.7	15	851.0	1058.1	1767.0
T-38	fill	34			320.3	10890.2	50	5445.1	20	2178.0	30	3267.1	0	0.0	3593.8	6001.6
T-39	cut	4.5	55	5.5	321.5	1766.2	80	1412.9	20	353.2		0.0		0.0	155.4	259.6
T-4	cut	1.6	55	2.0	31.8	62.1	100	62.1	0	0.0	0	0.0	0	0.0	4.3	7.3
T-40	cut	8	50	10.4	295.5	3086.0	20	617.2	20	617.2	0	0.0	60	1851.6	882.6	1473.9
T-41	cut	12	50	15.0	135.6	2035.7	45	916.0	20	407.1	15	305.3	20	407.1	374.6	625.5
T-42	cut	11	50	13.7	360.2	4937.2	10	493.7	40	1974.9	20	987.4	30	1481.2	1209.6	2020.0
T-43	fill	41			390	15990.0	70	11193.0	30	4797.0	0	0.0	0	0.0	2334.5	3898.7
T-44	cut	3.8	55	4.6	146.6	680.1	40	272.0	40	272.0	20	136.0	0	0.0	99.3	165.8
T-45a	fill	12			45.8	549.6	60	329.8	40	219.8	0	0.0	0	0.0	81.3	135.8
T-45b	fill	12			51.1	613.2	80	490.6	20	122.6	0	0.0	0	0.0	88.3	147.5
T-46	cut	6	55	7.3	139.5	1021.8	25	255.4	30	306.5	25	255.4	20	204.4	217.6	363.5
T-47	cut	5	55	6.1	53.9	329.0	65	213.8	15	49.3	0	0.0	20	65.8	49.2	82.1
T-48	cut	3	50	3.9	232.4	910.1	40	364.1	40	364.1	20	182.0	0	0.0	132.9	221.9
T-49	cut	7	55	8.5	156.6	1338.2	65	869.8	35	468.4	0	0.0	0	0.0	135.8	226.8
T-5	cut	2.5	55	3.1	96.3	293.9	100	293.9	0	0.0	0	0.0	0	0.0	20.6	34.4
T-50	cut	5	50	6.5	217.1	1417.0	35	496.0	40	566.8	0	0.0	25	354.3	267.1	446.1
T-51	cut	7.5	55	9.2	140.1	1282.7	60	769.6	40	513.1	0	0.0	0	0.0	136.0	227.1
T-52	cut	2	60	2.3	78.1	180.4	75	135.3	25	45.1	0	0.0	0	0.0	16.7	27.9
T-53	fill	7.5			45	337.5	10	33.8	50	168.8	40	135.0	0	0.0	134.3	224.3
T-54	cut	2	50	2.6	63.7	166.3	100	166.3	0	0.0	0	0.0	0	0.0	11.6	19.4
T-55	cut	3.2	50	4.2	113.8	475.4	50	237.7	15	71.3	0	0.0	35	166.4	94.6	158.0

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T-56	fill	35			154.9	5421.5	65	3524.0	20	1084.3	15	813.2	0	0.0	1284.9	2145.8
T-57a	fill	37			177.4	6563.8	60	3938.3	20	1312.8	20	1312.8	0	0.0	1759.1	2937.7
T-57b	cut	2.9	60	3.3	219.8	736.0	50	368.0	30	220.8	20	147.2	0	0.0	100.8	168.4
T-58a	fill	38			189.1	7185.8	80	5748.6	20	1437.2	0	0.0	0	0.0	1034.8	1728.0
T-58b	cut	9	65	9.9	184.8	1835.1	70	1284.6	10	183.5	0	0.0	20	367.0	266.1	444.4
T-59	cut	7	55	8.5	191.5	1636.4	25	409.1	30	490.9	20	327.3	25	409.1	359.2	599.9
T-6	cut	3.1	50	4.0	73.2	296.2	100	296.2	0	0.0	0	0.0	0	0.0	20.7	34.6
T-60	cut	17			109.3	1803.5	35	631.2	25	450.9	15	270.5	25	450.9	369.7	617.4
T-61	cut	7	50	9.1	118	1078.3	20	215.7	20	215.7	0	0.0	60	647.0	308.4	515.0
T-62	cut	1.5	55	1.8	100.9	184.8	50	92.4	50	92.4	0	0.0	0	0.0	21.2	35.5
T-63	cut			39.2	271.4	10638.0	65	6914.7	25	2659.5	10	1063.8	0	0.0	1196.8	1998.6
T-64a	cut	4.5	70	4.8	89.7	429.6	85	365.1	15	64.4	0	0.0	0	0.0	35.9	59.9
T-64b	fill	35			88.1	3083.5	40	1233.4	20	616.7	40	1233.4	0	0.0	1208.7	2018.6
T-65a	cut	11	65	12.6	94.2	1184.9	75	888.7	10	118.5	0	0.0	15	177.7	152.3	254.3
T-65b	fill	33			100.7	3323.1	20	664.6	20	664.6	60	1993.9	0	0.0	1714.7	2863.6
T-66a	cut	11	50	13.7	207.8	2848.3	25	712.1	15	427.2	30	854.5	30	854.5	690.7	1153.5
T-66b	fill	35			196.7	6786.2	40	2714.5	30	2035.8	30	2035.8	0	0.0	2253.0	3762.5
T-66c	cut	5.5	40	8.6	104.1	890.7	15	133.6	0	0.0	0	0.0	85	757.1	312.2	521.4
T-66d	cut	4	55	4.9	72.8	355.5	100	355.5	0	0.0	0	0.0	0	0.0	24.9	41.6
T-66e	cut	4	45	5.7	94.4	534.0	80	427.2	20	106.8	0	0.0	0	0.0	47.0	78.5
T-67	cut	14	65	15.4	98.7	1524.6	70	1067.3	15	228.7	0	0.0	15	228.7	202.8	338.6
T-68a	fill	10			40.4	420.2	20	84.0	20	84.0	60	252.1	0	0.0	216.8	362.1
T-68b	fill				UCR	728.0	0	0.0	0	0.0	100	728.0	0	0.0	553.3	924.0
T-69a	cut	14	65	14.9	99.9	1488.1	15	223.2	15	223.2	50	744.0	20	297.6	371.3	620.0
T-69b	fill				UCR	1292.0	0	0.0	0	0.0	100	1292.0	0	0.0	981.9	1639.8
T-70a	fill			4.0	48.8	195.2	0	0.0	50	97.6	50	97.6	0	0.0	89.8	150.0
T-70b	fill				UCR	1809.0	0	0.0	0	0.0	100	1809.0	0	0.0	1374.8	2296.0
T-71	cut	17	60	19.1	57.7	1099.3	100	1099.3	0	0.0	0	0.0	0	0.0	77.0	128.5
T-72a	fill			16.5	66.4	1095.6	0	0.0	0	0.0	100	1095.6	0	0.0	832.7	1390.5
T-72b	fill				UCR	3951.0	0	0.0	0	0.0	100	3951.0	0	0.0	3002.8	5014.6
T-73a	cut	10	65	11.0	223	2460.5	25	615.1	25	615.1	25	615.1	25	615.1	553.6	924.5
T-73b	fill	38			216.6	8230.8	30	2469.2	35	2880.8	35	2880.8	0	0.0	2996.0	5003.3

Slope	Type	Elevation Difference (m)	Slope Angle (°)	Slope Length (m)	Slope Width (m)	Slope Surface (m^2)	Sheet (%)	Sheet (m2)	Rills (%)	Rills (m2)	Gullies (%)	Gullies (m2)	Landslides (%)	Landslides (m)	Erosion rate (m^3/a)	Erosion rate (t/a)
T-74a	fill	5			63.4	317.0	40	126.8	20	63.4	40	126.8	0	0.0	124.3	207.5
T-74b	fill				UCR	2386.0	0	0.0	0	0.0	100	2386.0	0	0.0	1813.4	3028.3
T-75	cut	7.6	70	8.1	111.6	902.6	50	451.3	30	270.8	0	0.0	20	180.5	147.1	245.7
T-76a	cut	3	55	3.7	151.1	553.4	80	442.7	20	110.7	0	0.0	0	0.0	48.7	81.3
T-76b	fill	9			159.5	1435.5	80	1148.4	20	287.1	0	0.0	0	0.0	206.7	345.2
T-77	fill	4			98	392.0	80	313.6	20	78.4	0	0.0	0	0.0	56.4	94.3
T-78	cut	4	55	4.9	176.6	862.4	90	776.1	10	86.2	0	0.0	0	0.0	68.1	113.8
T-79	cut	6.8	60	7.9	189.9	1491.1	100	1491.1	0	0.0	0	0.0	0	0.0	104.4	174.3
T-7a	fill	11			44.6	490.6	80	392.5	20	98.1	0	0.0	0	0.0	70.6	118.0
T-7b	fill	13			52	650.0	80	520.0	20	130.0	0	0.0	0	0.0	93.6	156.3
T-80	cut	4.5	50	5.9	121.4	713.1	100	713.1	0	0.0	0	0.0	0	0.0	49.9	83.4
T-81	cut	23	50	30.0	238.5	7160.8	50	3580.4	35	2506.3	15	1074.1	0	0.0	941.6	1572.6
T-82a	cut	7.5	50	9.8	171.6	1680.1	50	840.0	40	672.0	10	168.0	0	0.0	211.7	353.5
T-82b	cut	10	50	13.1	170.6	2227.0	50	1113.5	40	890.8	10	222.7	0	0.0	280.6	468.6
T-83a	cut	28	55	34.2	189.8	6487.7	50	3243.8	30	1946.3	20	1297.5	0	0.0	888.8	1484.3
T-83b	cut	4	60	4.6	93.9	433.7	90	390.3	0	0.0	0	0.0	10	43.4	44.7	74.6
T-83c	cut	9	50	11.7	97.1	1140.8	85	969.7	0	0.0	0	0.0	15	171.1	136.3	227.7
T-83d	cut	6	50	7.8	111.4	872.5	75	654.4	0	0.0	0	0.0	25	218.1	133.1	222.2
T-83e	cut	6.5	50	8.5	160	1357.6	80	1086.1	0	0.0	0	0.0	20	271.5	184.6	308.3
T-83f	cut	3.2	55	3.9	81	316.4	100	316.4	0	0.0	0	0.0	0	0.0	22.1	37.0
T-84	cut	4.5	65	5.0	110.5	548.7	80	438.9	20	109.7	0	0.0	0	0.0	48.3	80.6
T-85a	cut	8	60	9.2	375.5	3468.7	50	1734.4	30	1040.6	20	693.7	0	0.0	475.2	793.6
T-85b	cut	12	65	13.2	375.5	4971.8	50	2485.9	15	745.8	15	745.8	20	994.4	892.4	1490.4
T-86	cut	2.8	55	3.4	332.8	1137.6	40	455.0	0	0.0	0	0.0	60	682.5	304.9	509.1
T-87	cut	2.6	60	3.0	289	867.6	50	433.8	15	130.1	10	86.8	25	216.9	161.4	269.5
T-88	cut	8.5	55	10.4	58.8	610.1	100	610.1	0	0.0	0	0.0	0	0.0	42.7	71.3
T-89	cut	2.3	55	2.8	95.2	267.3	60	160.4	15	40.1	0	0.0	25	66.8	44.4	74.1
T-8a	cut	6.5	35	11.3	163	1847.2	10	184.7	30	554.2	20	369.4	40	738.9	496.9	829.8
T-8b	fill	18			166.1	2989.8	60	1793.9	20	598.0	20	598.0	0	0.0	801.3	1338.1
T-9	cut	3.2	45	4.5	108.7	491.9	15	73.8	65	319.7	0	0.0	20	98.4	95.7	159.8
T-90	cut	3.5	55	4.3	136.7	584.1	70	408.9	20	116.8	0	0.0	10	58.4	70.7	118.0
T-91	cut	4.3	50	5.6	192.2	1078.9	30	323.7	20	215.8	0	0.0	50	539.4	273.0	455.8

Slope	Type	Elevation Difference (m)	Slope Angle (°)	Slope Length (m)	Slope Width (m)	Slope Surface (m^2)	Sheet (%)	Sheet (m2)	Rills (%)	Rills (m2)	Gullies (%)	Gullies (m2)	Landslides (%)	Landslides (m)	Erosion rate (m^3/a)	Erosion rate (t/a)
T-92	cut	1.5	55	1.8	55.7	102.0	100	102.0	0	0.0	0	0.0	0	0.0	7.1	11.9
T-93	cut	2.5	55	3.1	69	210.6	100	210.6	0	0.0	0	0.0	0	0.0	14.7	24.6
T-94a	fill	13			147.5	1843.8	50	921.9	30	553.1	20	368.8	0	0.0	497.8	831.3
T-94b	cut	6	55	7.3	146.2	1070.9	40	428.3	25	267.7	35	374.8	0	0.0	174.0	290.6
T-95a	fill	13			42.1	547.3	20	109.5	40	218.9	40	218.9	0	0.0	216.7	361.9
T-95b	cut	4.3	50	5.6	68.2	382.8	85	325.4	15	57.4	0	0.0	0	0.0	32.0	53.4
T-96	fill	17			80.1	1321.7	30	396.5	35	462.6	35	462.6	0	0.0	481.1	803.4
T-97	cut	3.8	60	4.4	103.8	455.5	30	136.6	30	136.6	20	91.1	20	91.1	92.5	154.4
T-98	cut	11	45	14.8	256	3801.4	30	1140.4	50	1900.7	20	760.3	0	0.0	589.2	984.0
Suma						***309312.9***		***165247.3***		***63691.9***		***59310.1***		***19277.8***	***71836.4***	***119966.8***

Appendix B: Data Sheets for all Cut and Fill Slopes along the Route 1856 between Mojón II and Delta Costa Rica

Slope: ***T-1*** ***Type:*** Cut Slope

Beginning (x/y): 460750 / 1215718 ***End (x/y):*** 460.770 / 1.215.551

Elevation Difference (Range): 1.6 – 2.7 m ***Elevation Difference (Average):*** 2.5 m ***Slope Length:*** 3.3 m

Slope Angle: 50º ***Slope Width:*** 181.9 m ***Slope Surface Area:*** 593 m^2

Geology: Turbidites of Eocene to Paleocene Age, parallel bedding between 5 and 10 cm

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	100	593
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 41.6

Estimated Erosion Rate (t / year): 69.4

Mitigation Measures: ***Mitigation Status:*** mitigated

Geotextiles: no Drainage Control: yes Stabilization by Terraces: no Sediment traps: no

Sowed Vegetation: no Natural Vegetation: yes

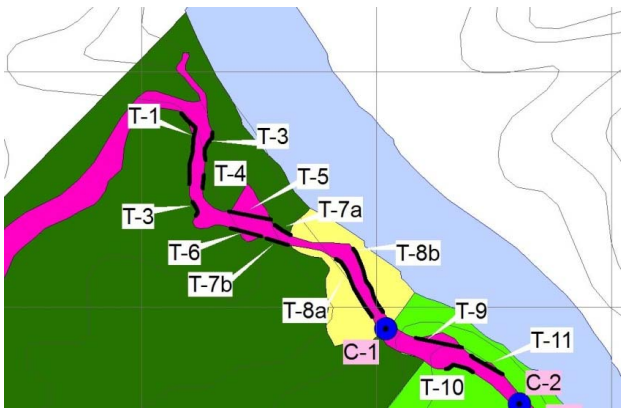
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-2*** ***Type:*** Cut Slope

Beginning (x/y): 460.823/1.215.672 ***End (x/y):*** 460.807 / 1.215.608

Elevation Difference (Range): 1.8 – 2.5 m ***Elevation Difference (Average):*** 2.2 m ***Slope Length:*** 2.7 m

Slope Angle: 55º ***Slope Width:*** 69.7 m ***Slope Surface Area:*** 187 m^2

Geology: Turbidites of Eocene to Paleocene Age, parallel bedding between 5 and 10 cm

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	100	187
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 13.1

Estimated Erosion Rate (t / year): 21.9

Mitigation Measures: ***Mitigation Status:*** Mitigated

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

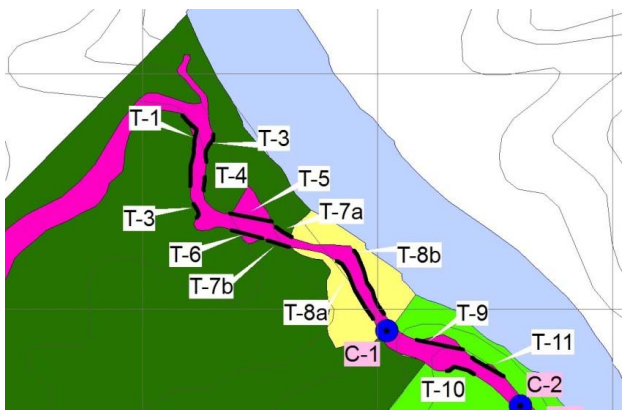
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-3*** ***Type:*** Cut Slope

Beginning (x/y): 460.785 / 1.215.477 ***End (x/y):*** 460.777 / 1.215.510

Elevation Difference (Range): 1.7 – 2.4 m ***Elevation Difference (Average):*** 1.9 m ***Slope Length:*** 2.3 m

Slope Angle: 55º ***Slope Width:*** 36.8 m ***Slope Surface Area:*** 85 m^2

Geology: Turbidites of Eocene to Paleocene Age, parallel bedding between 5 and 10 cm

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	100	85
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 6.0

Estimated Erosion Rate (t / year): 10.0

Mitigation Measures: ***Mitigation Status:*** Mitigated

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

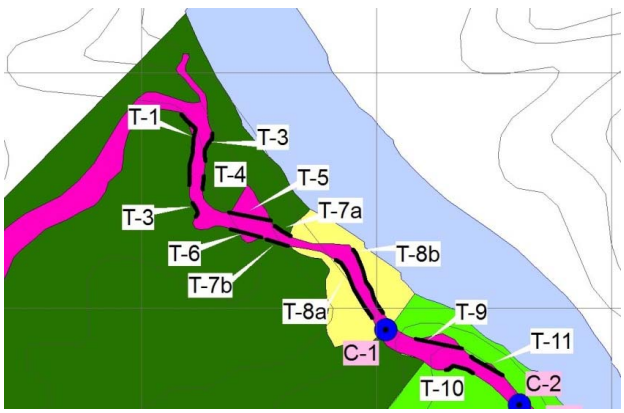
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-4*** ***Type:*** Cut Slope

Beginning (x/y): 460.804 / 1.215.573 ***End (x/y):*** 460.801 / 1.215.542

Elevation Difference (Range): 1.4 – 1.8 m ***Elevation Difference (Average):*** 1.6 m ***Slope Length:*** 2.0 m

Slope Angle: 55º ***Slope Width:*** 31.8 m ***Slope Surface Area:*** 62 m^2

Geology: Turbidites of Eocene to Paleocene Age, parallel bedding between 5 and 10 cm

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	100	62
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 4.3

Estimated Erosion Rate (t / year): 7.3

Mitigation Measures: ***Mitigation Status:*** Mitigated

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

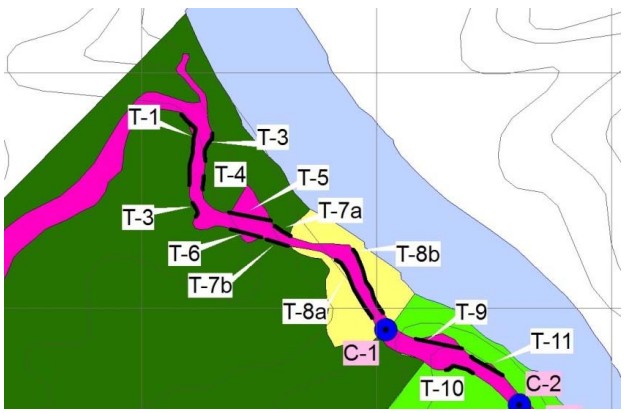
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-5*** ***Type:*** Cut Slope

Beginning (x/y): 460.862 / 1.215.487 ***End (x/y):*** 460.958 / 1.215.468

Elevation Difference (Range): 2.0 – 3.2 m ***Elevation Difference (Average):*** 2.5 m ***Slope Length:*** 3.1 m

Slope Angle: 55º ***Slope Width:***96.3 m ***Slope Surface Area:***294 m²

Geology: Turbidites of Eocene to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	294
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 20.6

Estimated Erosion Rate (t / year): 34.4

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: yes Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: yes Natural Vegetation: no

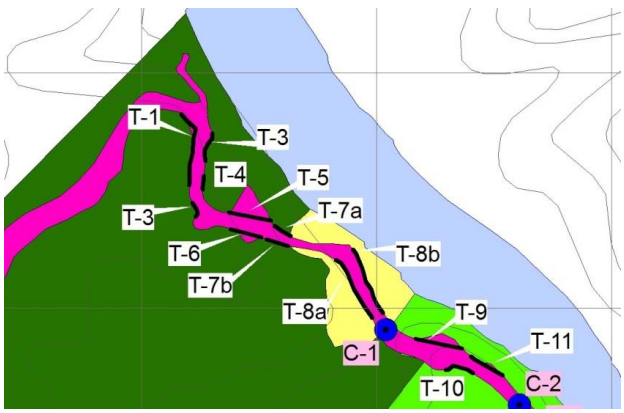
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-6*** ***Type:*** Cut Slope

Beginning (x/y): 460.866 / 1.215.448 ***End (x/y):*** 460.936 / 1.215.428

Elevation Difference (Range): 2.0 – 3.5 m ***Elevation Difference (Average):*** 3.1 m ***Slope Length:*** 4.0 m

Slope Angle: 50º ***Slope Width:*** 73.2m ***Slope Surface Area:*** 296 m^2

Geology: Turbidites of Eocene to Paleocene Age, parallel bedding between 5 and 10 cm

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	100	296
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 20.7

Estimated Erosion Rate (t / year): 34.6

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: yes Drainage Control: yes Stabilization by Terraces: no Sediment traps: no

Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

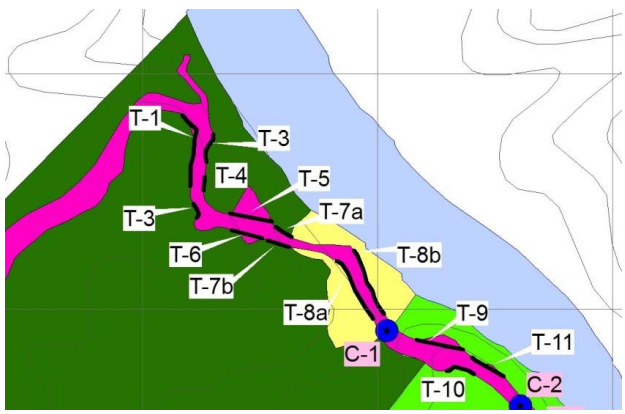
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-7a*** ***Type:*** Fill Slope

Beginning (x/y): 460.998 / 1.215.408 ***End (x/y):*** 460.949 / 1.215.424

Slope Length (Range): 6.0 – 14.0 m ***Slope Length (Average):*** 11.0 m ***Slope Width:*** 44.6m

Slope Surface Area: 491 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	80	392
Rills	20	98
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 70.6

Estimated Erosion Rate (t / year): 118.0

Mitigation Measures:

Mitigation Status: Mitigation in process

Geotextiles: no Drainage Control: yes Stabilization by Terraces: no Sediment traps: no

Sowed Vegetation: yes Natural Vegetation: yes

Condition in 2013

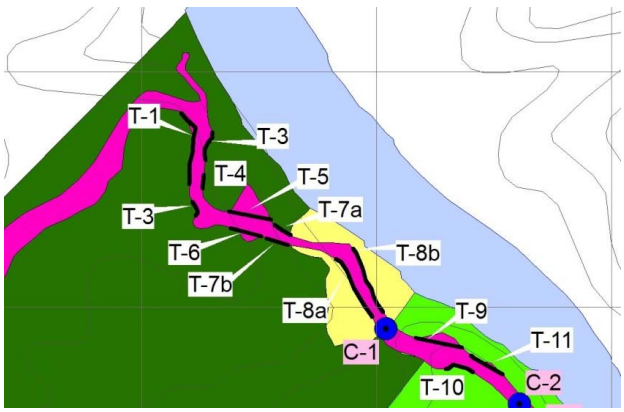
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-7b*** ***Type:*** Fill Slope

Beginning (x/y): 461.005 / 1.215.431 ***End (x/y):*** 460.967 / 1.215.455

Slope Length (Range): 7.0 – 15.0 m ***Slope Length (Average):*** 12.5 m ***Slope Width:*** 52.0m

Slope Surface Area: 650 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	80	520
Rills	20	130
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 93.6

Estimated Erosion Rate (t / year): 156.3

Mitigation Measures:

Mitigation Status: Mitigated

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

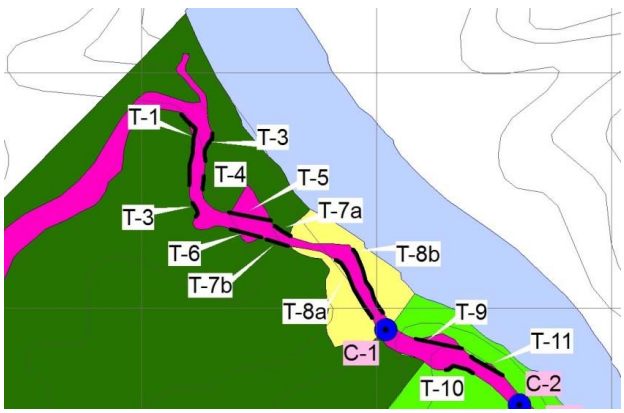
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-8a*** ***Type:*** Cut Slope

Beginning (x/y): 461.110 / 1.215.376 ***End (x/y):*** 461.194 / 1.215.239

Elevation Difference (Range): 3.0 – 8.5 m ***Elevation Difference (Average):*** 6.5 m ***Slope Length:*** 11.3 m

Slope Angle: 35º ***Slope Width:*** 163.0 m ***Slope Surface Area:*** 1,847 **m²**

Geology: Turbidites of Eocene to Paleocene Age, reduced rock strength due to intense weathering

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	10	185
Rills	30	554
Gullies	20	369
Land Slides	40	739

Estimated Erosion Rate (m³/ year): 496.9

Estimated Erosion Rate (t / year): 829.8

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: yes Drainage Control: yes Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

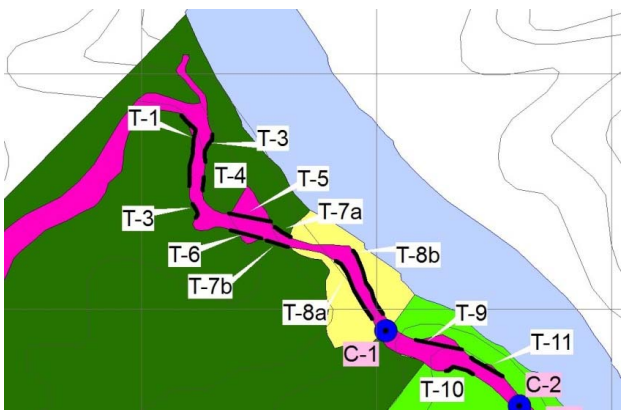
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-8b*** ***Type:*** Fill Slope

Beginning (x/y): 461.150 / 1.215.399 ***End (x/y):*** 461.220 / 1.215.250

Slope Length (Range): 10.0 – 26.0 m ***Slope Length (Average):*** 18.0 m ***Slope Width:*** 166.1 m

Slope Surface Area: 2,990 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	60	1794
Rills	20	598
Gullies	20	598
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 801.3

Estimated Erosion Rate (t / year): 1338.1

Mitigation Measures:

Mitigation Status: Mitigation in progress – UCR Site

Geotextiles: no Drainage Control: yes Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

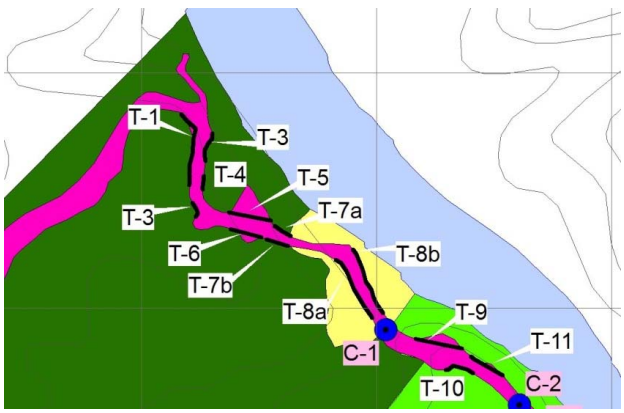
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-9*** ***Type:*** Cut Slope

Beginning (x/y): 461.296 / 1.215.189 ***End (x/y):*** 461.402 / 1.215.166

Elevation Difference (Range): 2.5 – 4.0 m ***Elevation Difference (Average):*** 3.2 m ***Slope Length:*** 4.5 m

Slope Angle: 45º ***Slope Width:*** 108.7 m ***Slope Surface Area:*** 492 **m²**

Geology: Turbidites of Eocene to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	15	74
Rills	65	320
Gullies	0	0
Land Slides	20	98

Estimated Erosion Rate (m³/ year): 95.7

Estimated Erosion Rate (t / year): 159.8

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

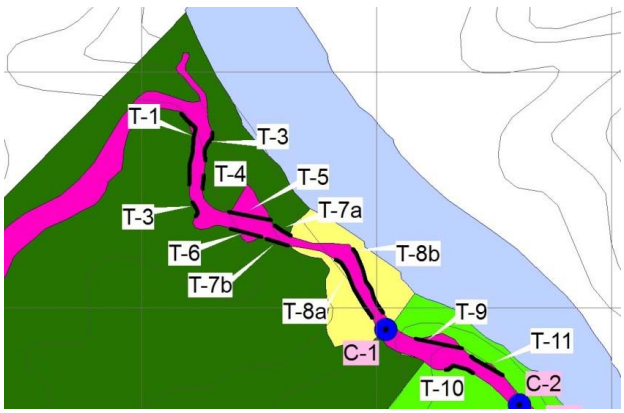
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-10*** ***Type:*** Cut Slope

Beginning (x/y): 461.429 / 1.215.108 ***End (x/y):*** 461.366 / 1.215.116

Elevation Difference (Range): 2.5 – 3.5 m ***Elevation Difference (Average):*** 3.0 m ***Slope Length:*** 3.5 m

Slope Angle: 60º ***Slope Width:*** 71.0 m ***Slope Surface Area:*** 246 **m²**

Geology: Turbidites of Eocene to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	80	197
Rills	20	49
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 21.6

Estimated Erosion Rate (t / year): 36.1

Mitigation Measures: ***Mitigation Status:*** Mitigated

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

86.2

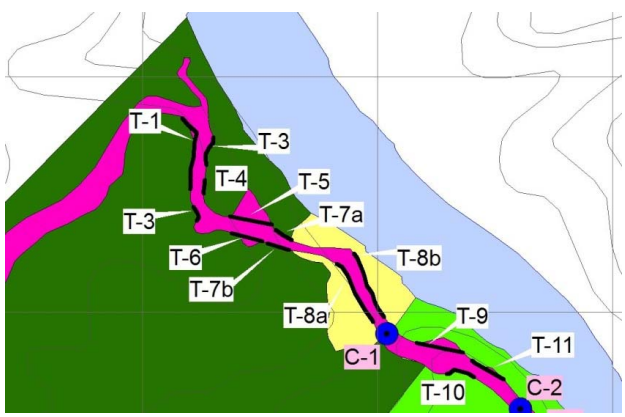
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-11*** ***Type:*** Cut Slope

Beginning (x/y): 461.424 / 1.215.148 ***End (x/y):*** 461.498 / 1.215.103

Elevation Difference (Range): 3.0 – 3.6 m ***Elevation Difference (Average):*** 3.2 m ***Slope Length:*** 3.7 m

Slope Angle: 60º ***Slope Width:*** 86.2 m ***Slope Surface Area:*** 319 **m²**

Geology: Turbidites of Eocene to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	20	64
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 4.5

Estimated Erosion Rate (t / year): 7.4

Mitigation Measures: ***Mitigation Status:*** Mitigated

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

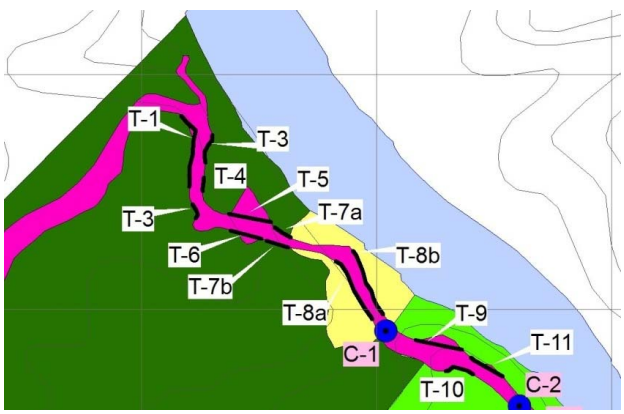
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-12*** ***Type:*** Cut Slope

Beginning (x/y): 461.581 / 1.214.882 ***End (x/y):*** 461.563 / 1.214.955

Elevation Difference (Range): 5.5 – 8.5 m ***Elevation Difference (Average):*** 7.0 m ***Slope Length:*** 9.9 m

Slope Angle: 45º ***Slope Width:*** 75.1 m ***Slope Surface Area:*** 743 **m²**

Geology: Turbidites of Eocene to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	80	595
Rills	0	0
Gullies	0	0
Land Slides	20	149

Estimated Erosion Rate (m³/ year): 101.1

Estimated Erosion Rate (t / year): 168.9

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

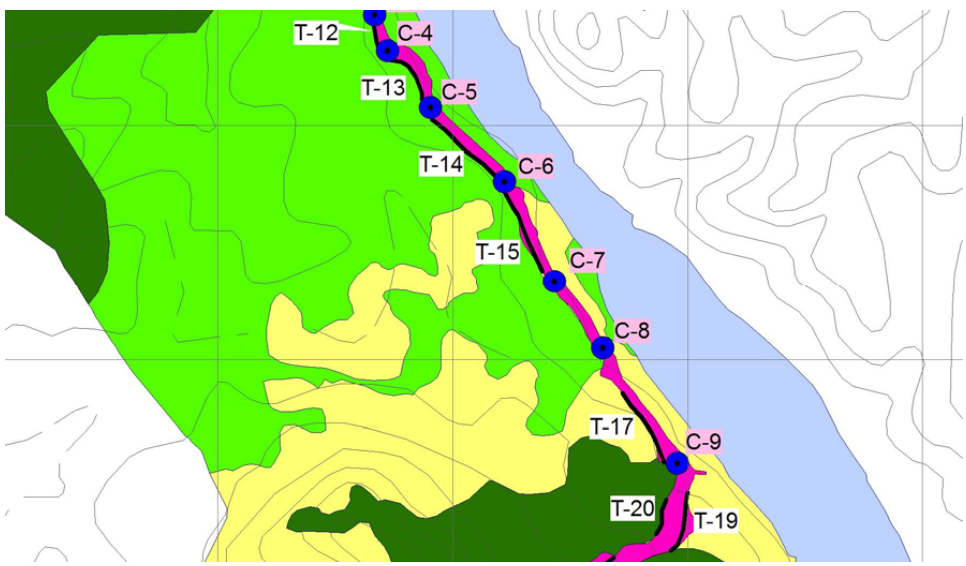
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-13*** ***Type:*** Cut Slope

Beginning (x/y):461.679 / 1.214.768 ***End (x/y):***461.607 / 1.214.861

Elevation Difference (Range):6.0 – 11.5 m ***Elevation Difference (Average):***8.5 m ***Slope Length:***12.0 m

Slope Angle:45º ***Slope Width:***131.1 m ***Slope Surface Area:***1576 **m²**

Geology: Turbidites of Eocene to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	70	1103
Rills	10	158
Gullies	0	0
Land Slides	20	315

Estimated Erosion Rate (m³/ year): 228.5

Estimated Erosion Rate (t / year): 381.6

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

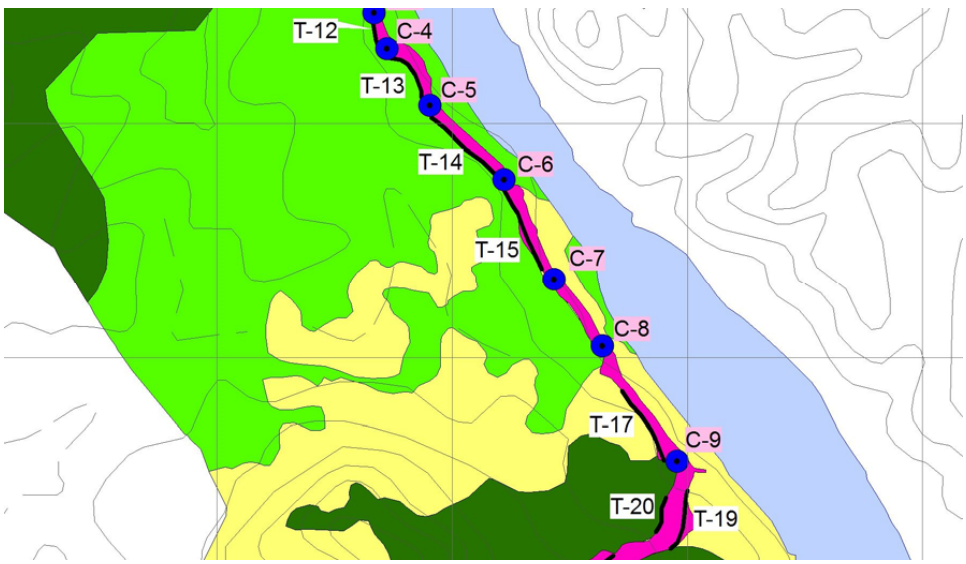
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-14*** ***Type:*** Cut Slope

Beginning (x/y): 461.852 / 1.214.585 ***End (x/y):*** 461.702 / 1.214.722

Elevation Difference (Range): 3.0 – 5.5 m ***Elevation Difference (Average):*** 4.5 m ***Slope Length:*** 5.9 m

Slope Angle: 50º ***Slope Width:*** 203.7 m ***Slope Surface Area:*** 1197 **m²**

Geology: Turbidites of Eocene to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	50	598
Rills	30	359
Gullies	10	120
Land Slides	10	120

Estimated Erosion Rate (m³/ year): 179.5

Estimated Erosion Rate (t / year): 299.7

Mitigation Measures: ***Mitigation Status:*** Mitigated

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

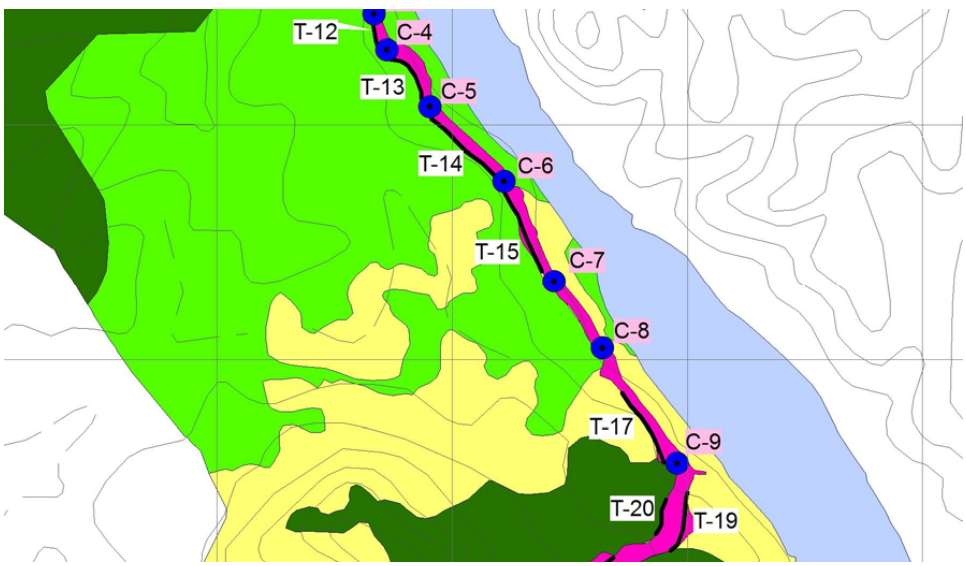
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-15*** ***Type:*** Cut Slope

Beginning (x/y): 461.958 / 1.214.364 ***End (x/y):*** 461.868 / 1.214.557

Elevation Difference (Range): 3.5 – 7.5 m ***Elevation Difference (Average):*** 6.0 m ***Slope Length:*** 7.3 m

Slope Angle: 55º ***Slope Width:*** 213.0 m ***Slope Surface Area:*** 1560 **m²**

Geology: Turbidites of Eocene to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	60	936
Rills	40	624
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 165.4

Estimated Erosion Rate (t / year): 276.2

Mitigation Measures: ***Mitigation Status:*** Mitigated

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

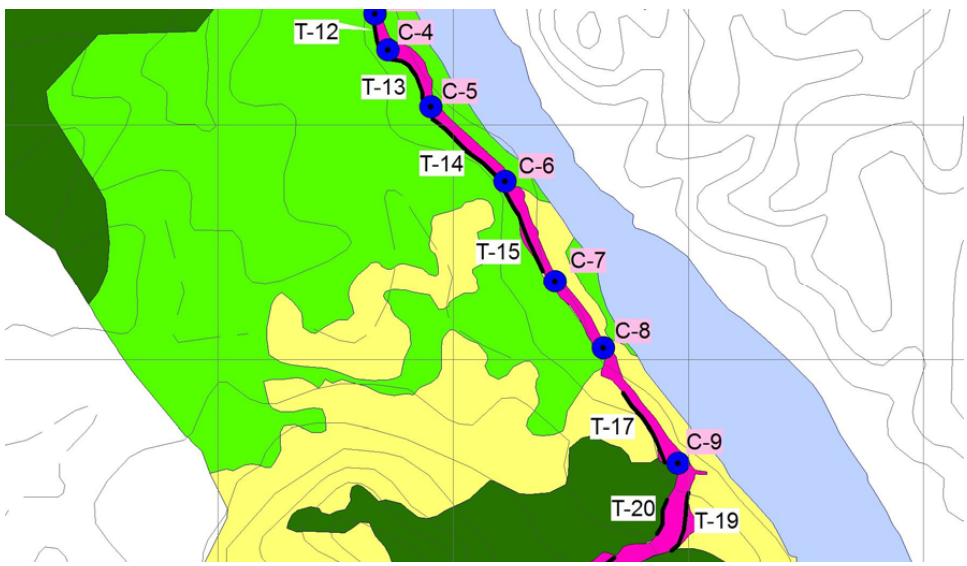
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-17*** ***Type:*** Cut Slope

Beginning (x/y):462.242 / 1.213.912 ***End (x/y):***462.144 / 1.214.075

Elevation Difference (Range):3.0 – 8.5 m ***Elevation Difference (Average):***6.5 m ***Slope Length:***8.5 m

Slope Angle:50º ***Slope Width:***191.4 m ***Slope Surface Area:***1624 **m²**

Geology: Turbidites of Eocene to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	70	1137
Rills	10	162
Gullies	0	0
Land Slides	20	325

Estimated Erosion Rate (m³/ year): 235.5

Estimated Erosion Rate (t / year): 393.3

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: yes Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

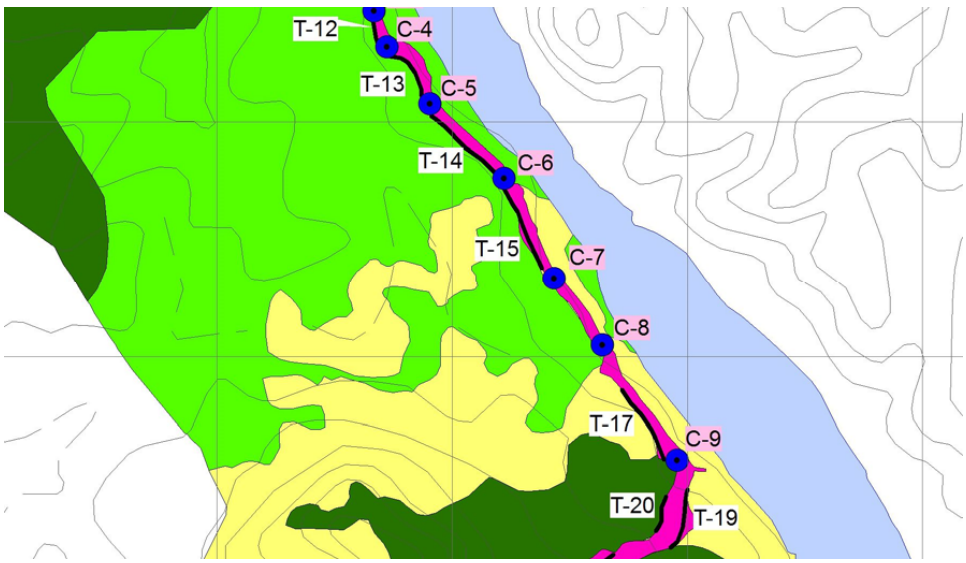
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



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Slope: ***T-19*** ***Type:*** Cut Slope

Beginning (x/y): 462.297 / 1.213.842 ***End (x/y):*** 462.256 / 1.213.705

Elevation Difference (Range): 8.0 – 15.4 m ***Elevation Difference (Average):*** 11.5 m ***Slope Length:*** 15.0 m

Slope Angle: 50º ***Slope Width:*** 147.9 m ***Slope Surface Area:*** 2220 **m²**

Geology: Turbidites of Eocene to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	70	1554
Rills	30	666
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 215.4

Estimated Erosion Rate (t / year): 359.7

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

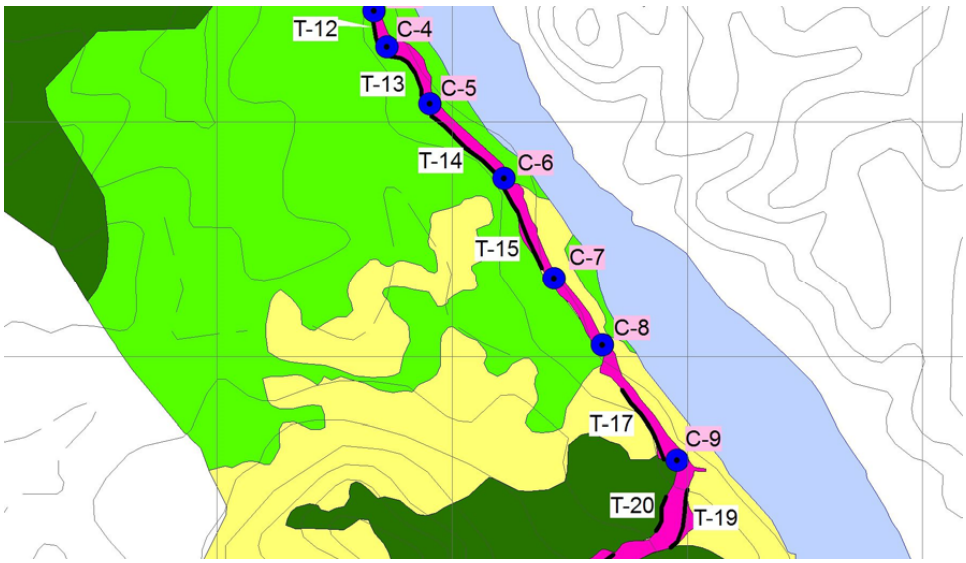
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-20*** ***Type:*** Cut Slope

Beginning (x/y): 462.223 / 1.213.744 ***End (x/y):*** 462.247 / 1.213.825

Elevation Difference (Range): 4.0 – 5.0 m ***Elevation Difference (Average):*** 4.5 m ***Slope Length:*** 5.9 m

Slope Angle: 50º ***Slope Width:*** 86.0 m ***Slope Surface Area:*** 505 **m²**

Geology: Turbidites of Eocene to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	25	126
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 8.8

Estimated Erosion Rate (t / year): 14.8

Mitigation Measures: ***Mitigation Status:*** Mitigated

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

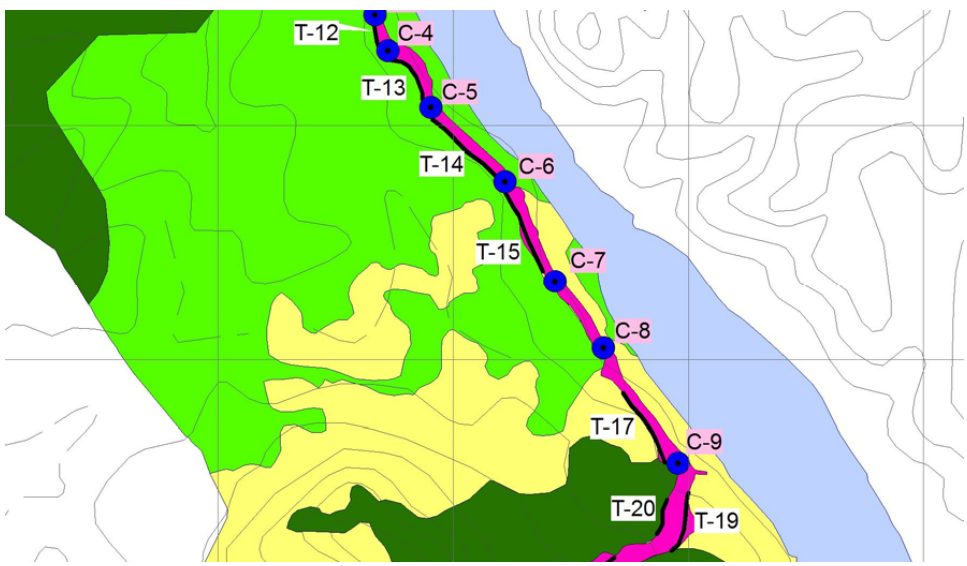
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-21a*** ***Type:*** Cut Slope

Beginning (x/y): 461.927 / 1.213.368 ***End (x/y):*** 462.124 / 1.213.688

Elevation Difference (Range): 3.5 – 15.4 m ***Elevation Difference (Average):*** 12.5 m ***Slope Length:*** 15.3 m

Slope Angle: 55° ***Slope Width:*** 382.1 m ***Slope Surface Area:*** 5831 **m²**

Geology: Ophiolitic Complex of Cretaceous to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	65	3790
Rills	0	0
Gullies	0	0
Land Slides	35	2041

Estimated Erosion Rate (m³/ year): 1081.6

Estimated Erosion Rate (t / year): 1806.3

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: yes Natural Vegetation: yes

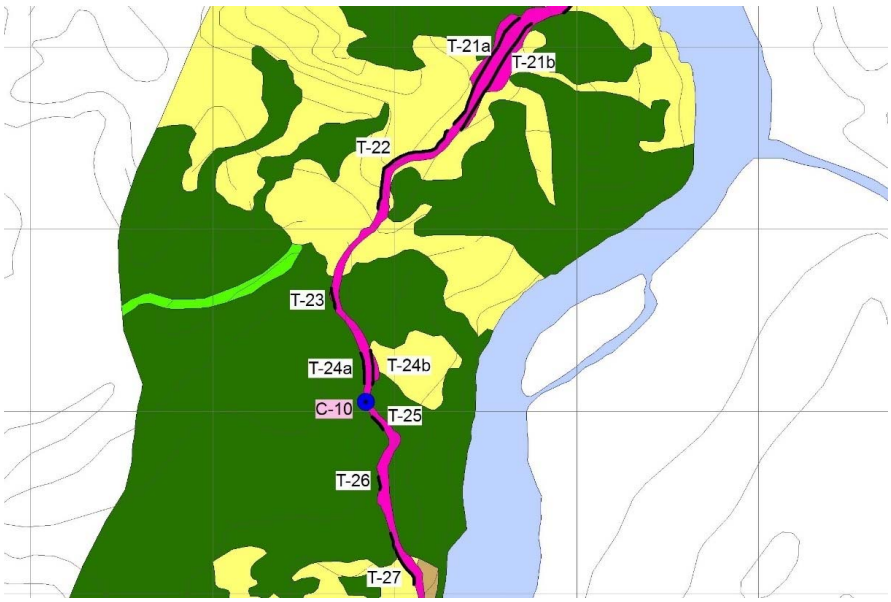
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-21b*** ***Type:*** Cut Slope

Beginning (x/y): 462.160 / 1.213.673 ***End (x/y):*** 461.948 / 1.213.351

Elevation Difference (Range): 3.0 – 6.5 m ***Elevation Difference (Average):*** 5.0 m ***Slope Length:*** 5.5 m

Slope Angle: 65° ***Slope Width:*** 387.0 m ***Slope Surface Area:*** 2135 **m²**

Geology: Ophiolitic Complex of Cretaceous to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	2135
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 149.5

Estimated Erosion Rate (t / year): 249.6

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

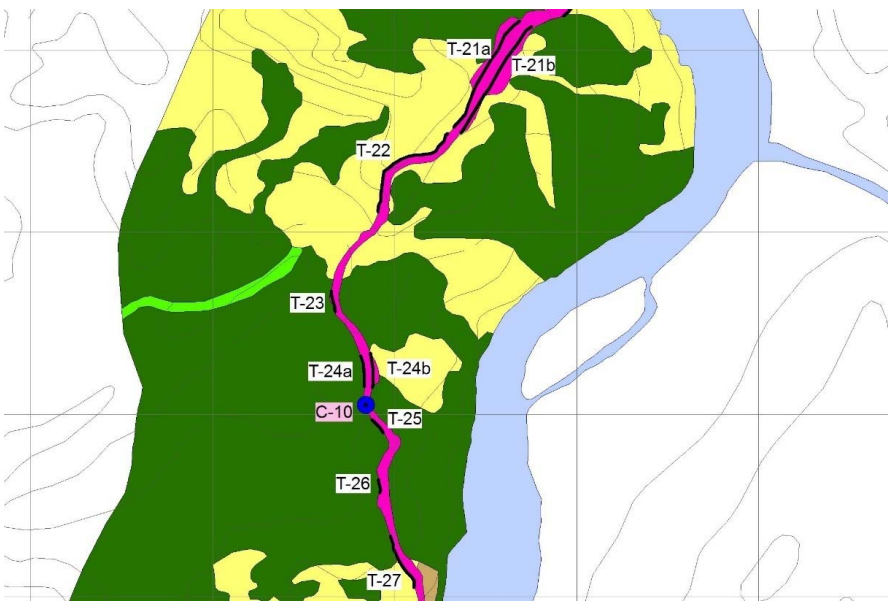
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-22*** ***Type:*** Cut Slope

Beginning (x/y): 461.699 / 1.213.111 ***End (x/y):*** 461.907 / 1.213.348

Elevation Difference (Range): 2.0 – 7.0 m ***Elevation Difference (Average):*** 5.0 m ***Slope Length:*** 5.8 m

Slope Angle: 60° ***Slope Width:*** 362.8 m ***Slope Surface Area:*** 2095 **m²**

Geology: Ophiolitic Complex of Cretaceous to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	65	1362
Rills	15	314
Gullies	0	0
Land Slides	20	419

Estimated Erosion Rate (m³/ year): 313.1

Estimated Erosion Rate (t / year): 523.0

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: yes Natural Vegetation: yes

Condition in 2013

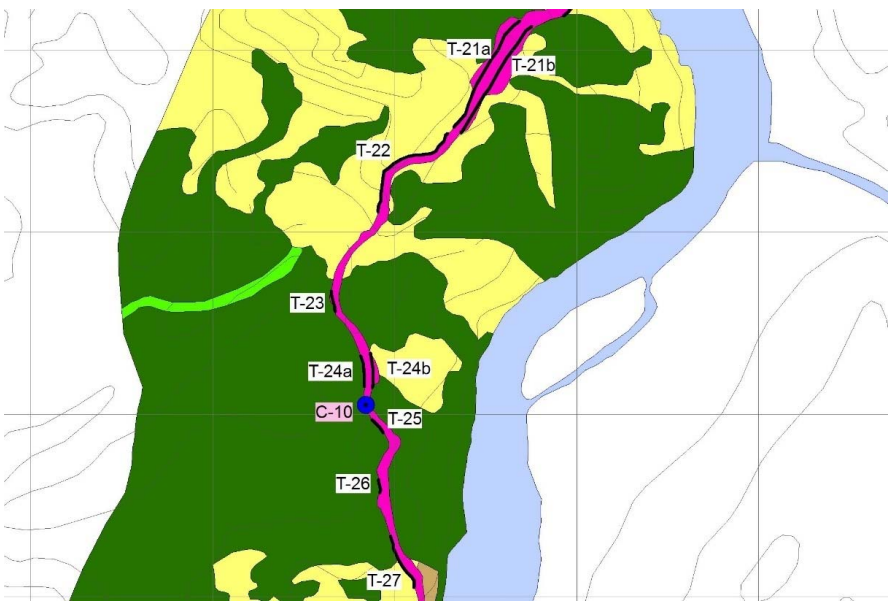
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-23*** ***Type:*** Cut Slope

Beginning (x/y): 461.569 / 1.212.809 ***End (x/y):*** 461.557 / 1.212.870

Elevation Difference (Range): 2.0 – 2.5 m ***Elevation Difference (Average):*** 2.0 m ***Slope Length:*** 2.2 m

Slope Angle: 65º ***Slope Width:*** 63.0 m ***Slope Surface Area:*** 139 **m²**

Geology: Turbidites of Eocene to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	35	49
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 3.4

Estimated Erosion Rate (t / year): 5.7

Mitigation Measures: ***Mitigation Status:*** Mitigated

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

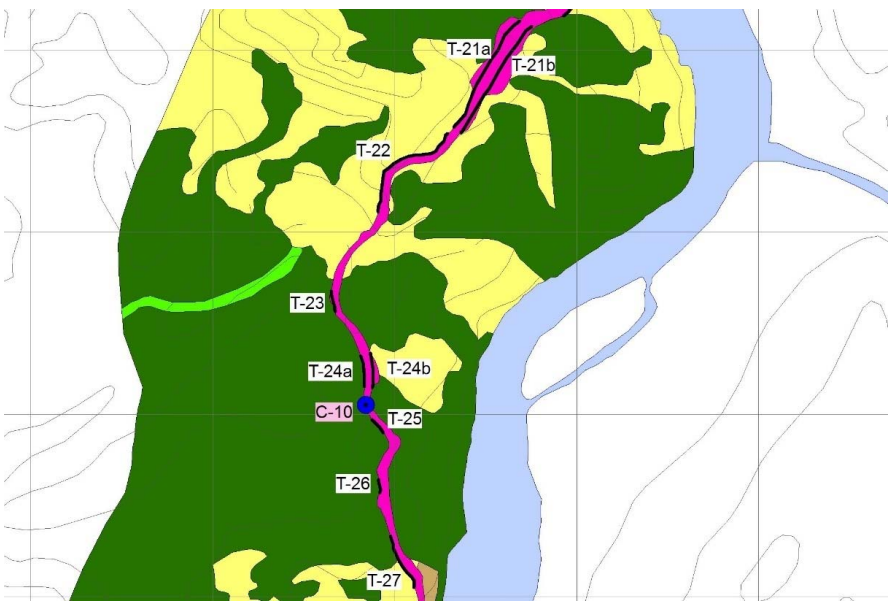
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-24a*** ***Type:*** Cut Slope

Beginning (x/y): 461.569 / 1.212.809 ***End (x/y):*** 461.557 / 1.212.870

Elevation Difference (Range): 1.5 – 2.8 m ***Elevation Difference (Average):*** 2.5 m ***Slope Length:*** 3.1 m

Slope Angle: 55º ***Slope Width:*** 4.5 m ***Slope Surface Area:*** 288 **m²**

Geology: Turbidites of Eocene to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	40	115
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 8.1

Estimated Erosion Rate (t / year): 13.5

Mitigation Measures: ***Mitigation Status:*** Mitigated

Geotextiles: no Drainage Control: no Geotextiles: no Drainage Control: no

Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

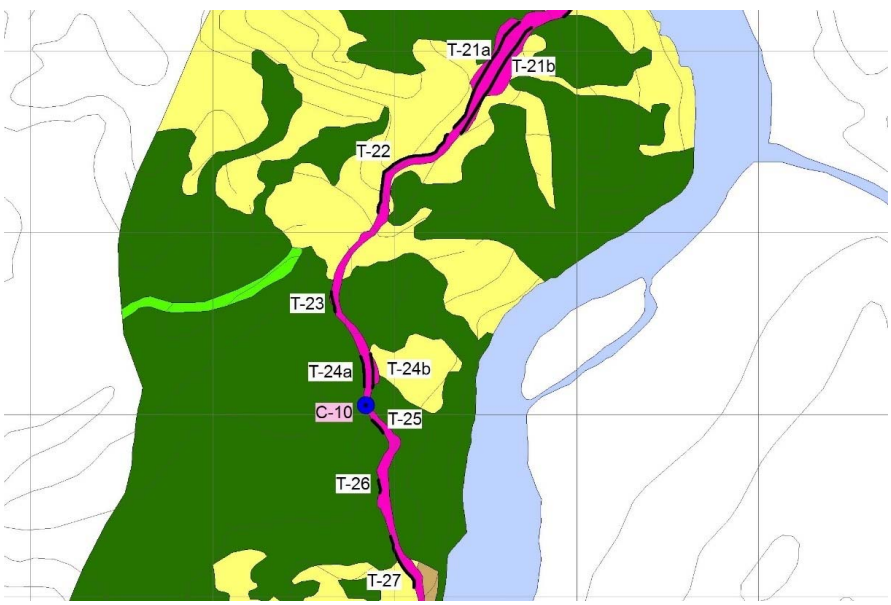
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-24b*** ***Type:*** Cut Slope

Beginning (x/y): 461.674 / 1.212.681 ***End (x/y):*** 461.681 / 1.212.578

Elevation Difference (Range): 1.5 – 3.0 m ***Elevation Difference (Average):*** 2.6 m ***Slope Length:*** 3.4 m

Slope Angle: 50º ***Slope Width:***103.5 m ***Slope Surface Area:***351 **m²**

Geology: Turbidites of Eocene to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	40	141
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 9.8

Estimated Erosion Rate (t / year): 16.4

Mitigation Measures: ***Mitigation Status:*** Mitigated

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

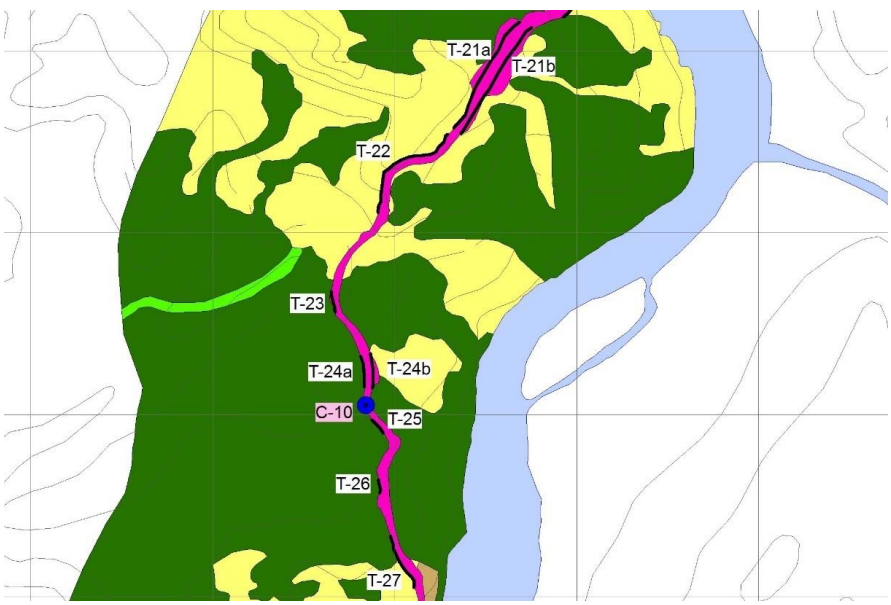
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-25*** ***Type:*** Cut Slope

Beginning (x/y): 461.713 / 1.212.440 ***End (x/y):*** 461.679 / 1.212.479

Elevation Difference (Range): 1.0 – 2.0 m ***Elevation Difference (Average):*** 1.5 m ***Slope Length:*** 1.7 m

Slope Angle: 60º ***Slope Width:*** 52,1 m ***Slope Surface Area:*** 90 **m²**

Geology: Turbidites of Eocene to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	0	0
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 0.0

Estimated Erosion Rate (t / year): 0.0

Mitigation Measures:

Mitigation Status: Mitigated

Geotextiles: no Drainage Control: no Geotextiles: no Drainage Control: no

Sowed Vegetation: no Natural Vegetation: yes

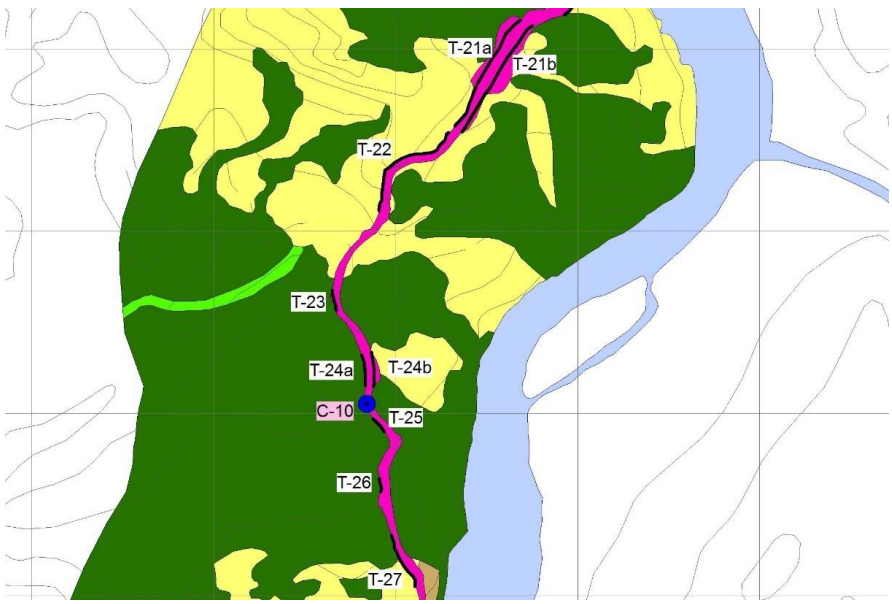
Condition in 2013

Condition in 2014

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-26*** ***Type:*** Cut Slope

Beginning (x/y): 461.703 / 1.212.258 ***End (x/y):*** 461.699 / 1.212.298

Elevation Difference (Range): 1.0 - 2.0 m ***Elevation Difference (Average):*** 1.5 m ***Slope Length:*** 1.7 m

Slope Angle: 60° ***Slope Width:*** 40.7 m ***Slope Surface Area:*** 70 **m²**

Geology: Turbidites of Eocene to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	20	14
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 1.0

Estimated Erosion Rate (t / year): 1.6

Mitigation Measures: ***Mitigation Status:*** Mitigated

Geotextiles: no Drainage Control: yes Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

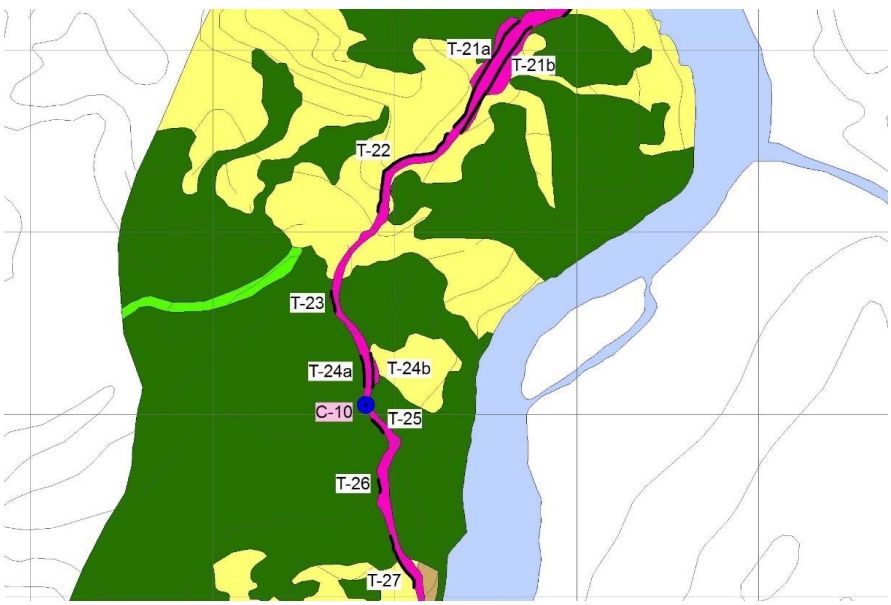
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-27*** ***Type:*** Cut Slope

Beginning (x/y): 461.805 / 1.211.970 ***End (x/y):*** 461.735 / 1.212.125

Elevation Difference (Range): 1.0 – 3.0 m ***Elevation Difference (Average):*** 2.0 m ***Slope Length:*** 2.3 m

Slope Angle: 60° ***Slope Width:*** 174,9 m ***Slope Surface Area:*** 404 **m²**

Geology: Turbidites of Eocene to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	85	343
Rills	0	0
Gullies	0	0
Land Slides	15	61

Estimated Erosion Rate (m³/ year): 48.3

Estimated Erosion Rate (t / year): 80.6

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: yes Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

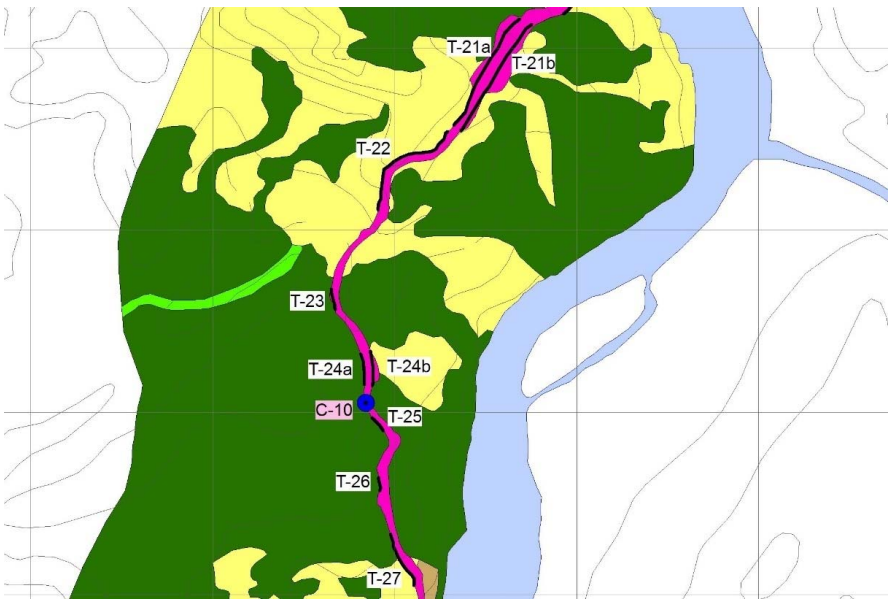
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



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Slope: ***T-28*** ***Type:*** Cut Slope

Beginning (x/y): 461.503 / 1.211.109 ***End (x/y):*** 461.478 / 1.211.202

Elevation Difference (Range): 2.0 – 4.0 m ***Elevation Difference (Average):*** 3.0 m ***Slope Length:*** 3.5 m

Slope Angle: 60° ***Slope Width:*** 96,4 m ***Slope Surface Area:*** 334 **m²**

Geology: Turbidites of Eocene to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	75	250
Rills	10	33
Gullies	0	0
Land Slides	15	50

Estimated Erosion Rate (m³/ year): 42.9

Estimated Erosion Rate (t / year): 71.7

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

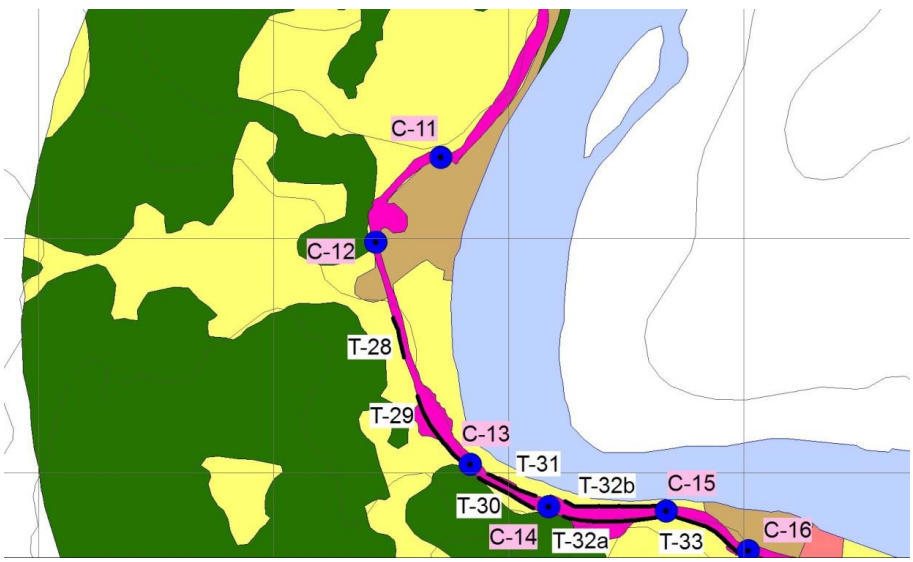
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



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Slope: ***T-29*** ***Type:*** Cut Slope

Beginning (x/y): 461.635 / 1.210.862 ***End (x/y):*** 461.534 / 1.211.017

Elevation Difference (Range): 5.0 – 9.0 m ***Elevation Difference (Average):*** 8.0 m ***Slope Length:*** 8.8 m

Slope Angle: 65° ***Slope Width:*** 188.5 m ***Slope Surface Area:*** 1664 **m²**

Geology: Turbidites of Eocene to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	60	998
Rills	25	416
Gullies	0	0
Land Slides	15	250

Estimated Erosion Rate (m³/ year): 236.3

Estimated Erosion Rate (t / year): 394.6

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: yes Natural Vegetation: yes

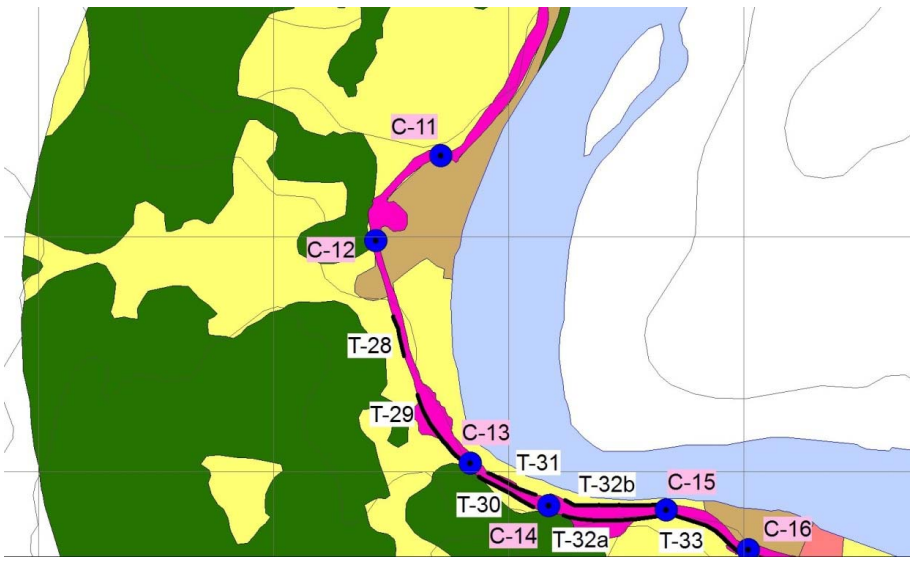
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-30*** ***Type:*** Cut Slope

Beginning (x/y): 461.698 / 1.210.834 ***End (x/y):*** 461.809 / 1.210.782

Elevation Difference (Range): 4.0 – 8.0 m ***Elevation Difference (Average):*** 7.0 m ***Slope Length:*** 7.7 m

Slope Angle: 65° ***Slope Width:*** 122.9 m ***Slope Surface Area:*** 949 **m²**

Geology: Turbidites of Eocene to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	949
Rills	0	0
Gullies	0	0
Land Slides	0	0

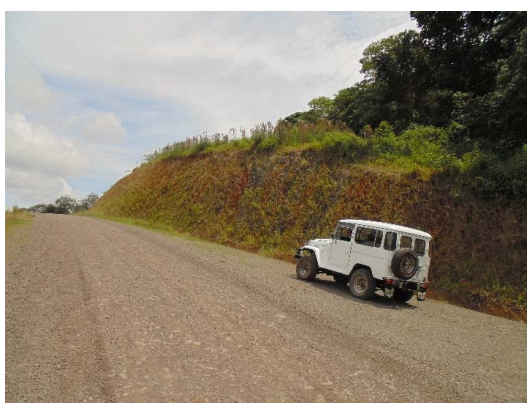
Estimated Erosion Rate (m³/ year): 66.4

Estimated Erosion Rate (t / year): 111.0

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: yes Drainage Control: yes Stabilization by Terraces: no Sediment traps: yes
Sowed Vegetation: yes Natural Vegetation: yes

Condition in 2013 ***Condition in 2014***



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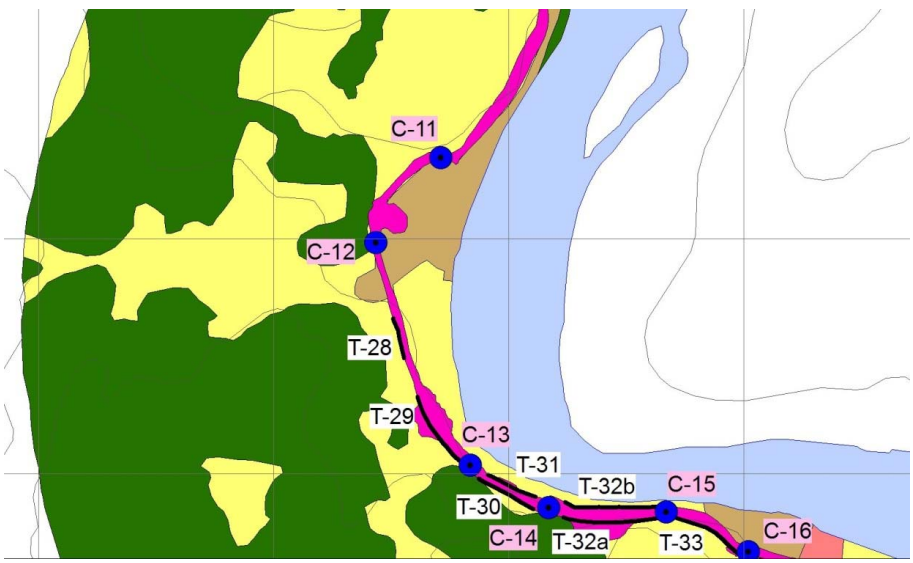
Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-31*** ***Type:*** Cut Slope

Beginning (x/y): 461.804 / 1.210.753 ***End (x/y):*** 461.676 / 1.210.825

Elevation Difference (Range): 1.0 – 2.2 m ***Elevation Difference (Average):*** 1.5 m ***Slope Length:*** 1.7 m

Slope Angle: 65° ***Slope Width:*** 146,2 m ***Slope Surface Area:*** 242 **m²**

Geology: Turbidites of Eocene to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	242
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 16.9

Estimated Erosion Rate (t / year): 28.3

Mitigation Measures: ***Mitigation Status:*** Mitigated

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: yes Natural Vegetation: yes

Condition in 2013

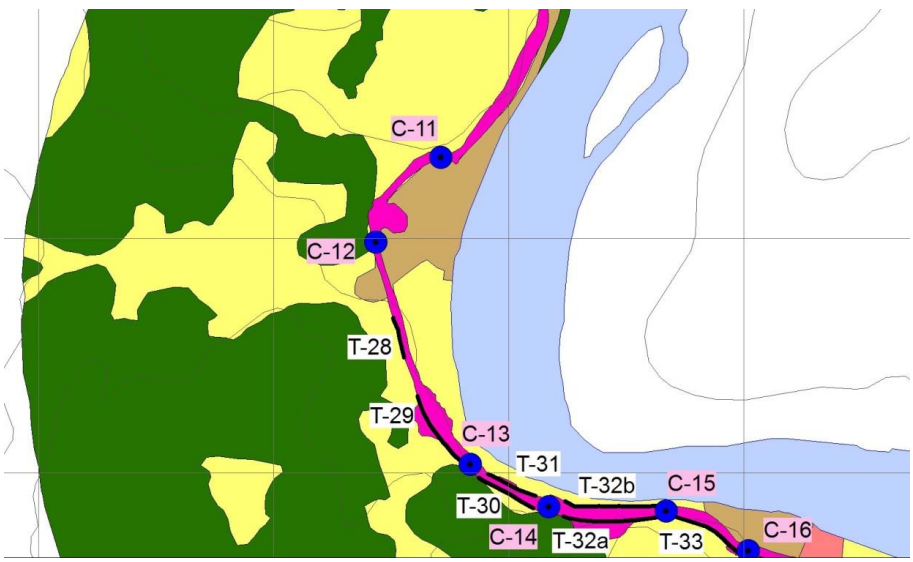
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-32a*** ***Type:*** Cut Slope

Beginning (x/y): 462.098 / 1.210.732 ***End (x/y):*** 461.873/ 1.210.734

Elevation Difference (Range): 1.7 – 4.0 m ***Elevation Difference (Average):*** 3.5 m ***Slope Length:*** 4.0 m

Slope Angle: 60° ***Slope Width:*** 226.8 m ***Slope Surface Area:*** 917 **m²**

Geology: Turbidites of Eocene to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	917
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 64.2

Estimated Erosion Rate (t / year): 107.2

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

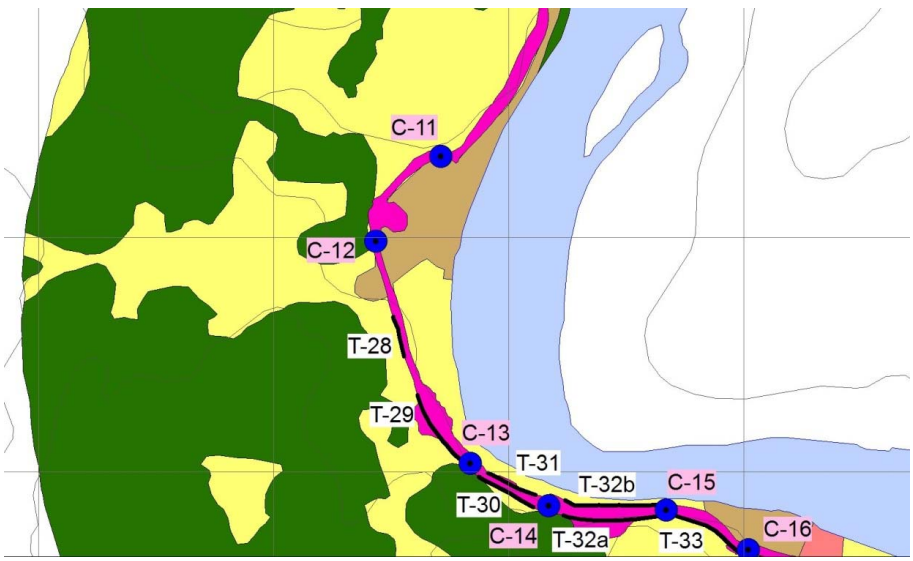
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



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Slope: ***T-32b*** ***Type:*** Fill Slope

Beginning (x/y): 461.877 / 1.210.769 ***End (x/y):*** 462.095 / 1.210.760

Slope Length (Range): 38.0 – 54.0 m ***Slope Length (Average):*** 48.0 m ***Slope Width:*** 221.7 m

Slope Surface Area: 10642 m²

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	80	8513
Rills	15	1596
Gullies	5	532
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 1851.6

Estimated Erosion Rate (t / year): 3092.2

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: yes Drainage Control: yes Stabilization by Terraces: yes Sediment traps: no
Sowed Vegetation: yes Natural Vegetation: yes

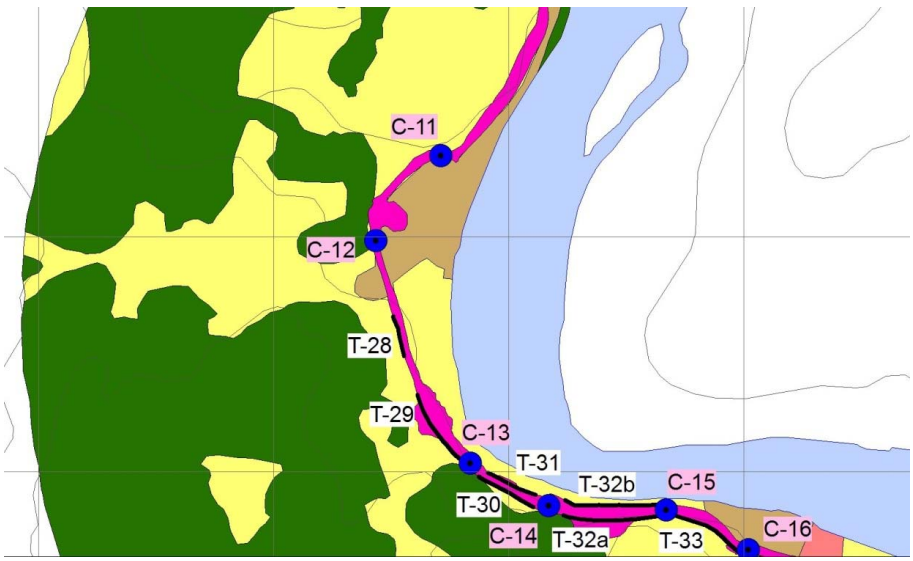
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-33*** ***Type:*** Cut Slope

Beginning (x/y): 462.291 / 1.210.641 ***End (x/y):*** 462.125 / 1.210.733

Elevation Difference (Range): 3.5 – 7.0 m ***Elevation Difference (Average):*** 6.0 m ***Slope Length:*** 6.6 m

Slope Angle: 65º ***Slope Width:*** 194.3 m ***Slope Surface Area:*** 1286 **m²**

Geology: Turbidites of Eocene to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	65	836
Rills	15	193
Gullies	0	0
Land Slides	20	257

Estimated Erosion Rate (m³/ year): 192.3

Estimated Erosion Rate (t / year): 321.1

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress – UCR Site

Geotextiles: yes Drainage Control: yes Stabilization by Terraces: yes Sediment traps: no
Sowed Vegetation: yes Natural Vegetation: yes

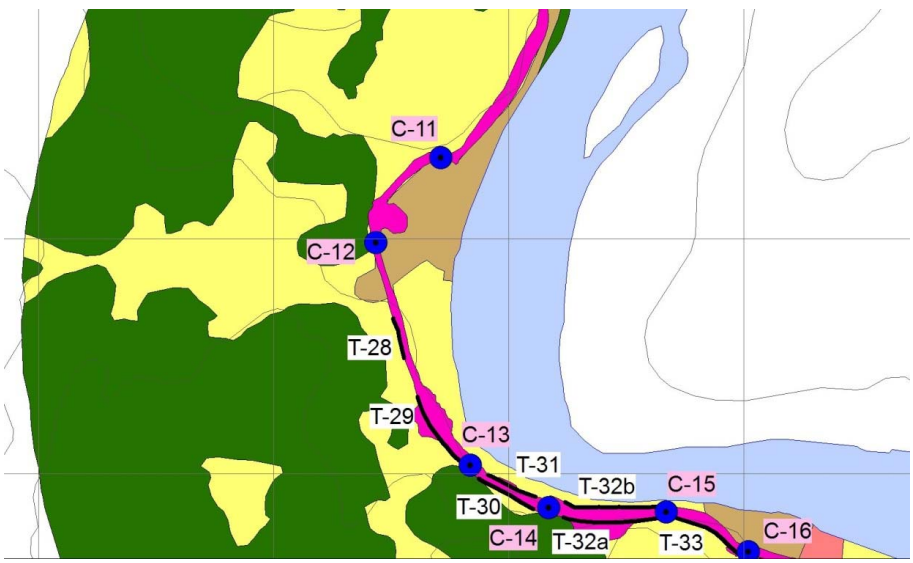
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-34*** ***Type:*** Cut Slope

Beginning (x/y): 462.504 / 1.210. 540 ***End (x/y):*** 462.556 / 1.210.524

Elevation Difference (Range): 1.8 – 4.0 m ***Elevation Difference (Average):*** 3.2 m ***Slope Length:*** 3.5 m

Slope Angle: 65º ***Slope Width:*** 54,6 m ***Slope Surface Area:*** 193 **m²**

Geology: Turbidites of Eocene to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	80	154
Rills	20	39
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 17.0

Estimated Erosion Rate (t / year): 28.3

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

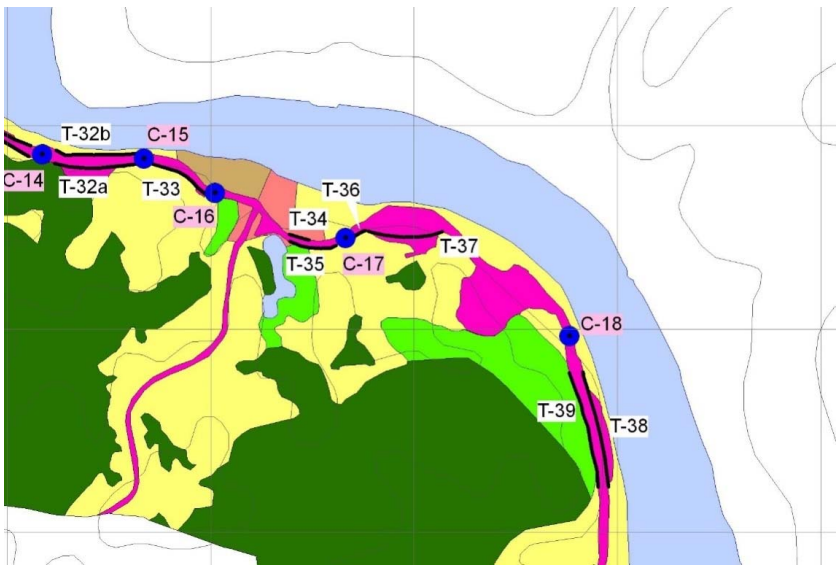
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-35*** ***Type:*** Cut Slope

Beginning (x/y): 462.628 / 1.210.510 ***End (x/y):*** 462.505 / 1.210.521

Elevation Difference (Range): 2.3 – 4.0 m ***Elevation Difference (Average):*** 3.5 m ***Slope Length:*** 4.0 m

Slope Angle: 60º ***Slope Width:*** 128,1 m ***Slope Surface Area:*** 518 **m²**

Geology: Turbidites of Eocene to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	90	466
Rills	0	0
Gullies	0	0
Land Slides	10	52

Estimated Erosion Rate (m³/ year): 53.3

Estimated Erosion Rate (t / year): 89.1

Mitigation Measures: ***Mitigation Status:*** Mitigated

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: yes Natural Vegetation: yes

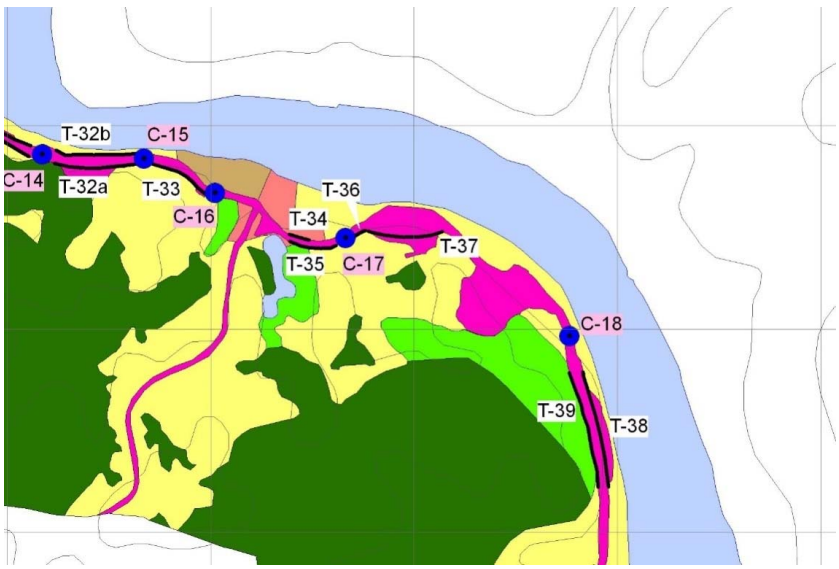
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-36*** ***Type:*** Cut Slope

Beginning (x/y): 462.707 / 1.210.550 ***End (x/y):*** 462.681 / 1.210.536

Elevation Difference (Range): 0.8 – 1.6 m ***Elevation Difference (Average):*** 1.2 m ***Slope Length:*** 1.3 m

Slope Angle: 65º ***Slope Width:*** 29.5 m ***Slope Surface Area:*** 39 **m²**

Geology: Turbidites of Eocene to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	39
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 2.7

Estimated Erosion Rate (t / year): 4.6

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

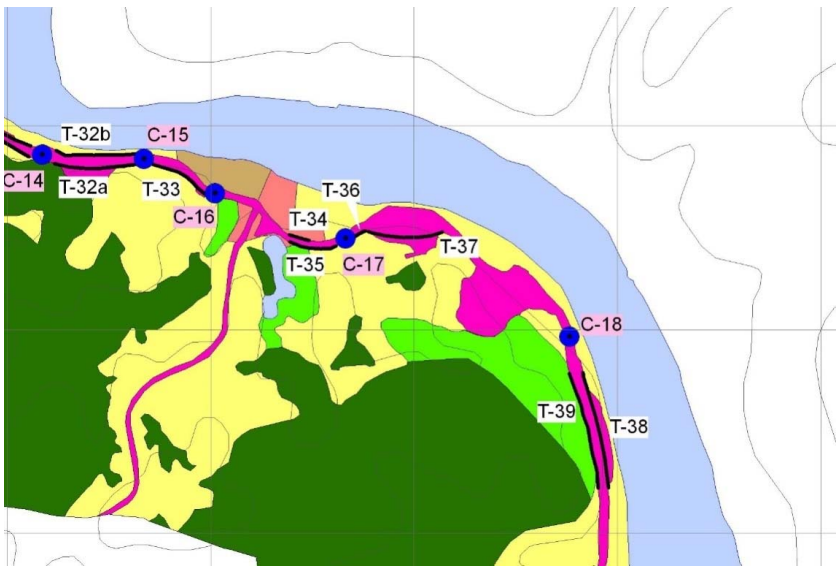
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-37*** ***Type:*** Cut Slope

Beginning (x/y): 462.914 / 1.210.546 ***End (x/y):*** 462.715 / 1.210.548

Elevation Difference (Range): 6.0 – 22.0 m ***Elevation Difference (Average):*** 18.0 m ***Slope Length:*** 28.0 m

Slope Angle: 40º ***Slope Width:*** 202.6 m ***Slope Surface Area:*** 5673 **m²**

Geology: Turbidites of Eocene to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	35	1986
Rills	30	1702
Gullies	20	1135
Land Slides	15	851

Estimated Erosion Rate (m³/ year): 1058.1

Estimated Erosion Rate (t / year): 1767.0

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress – UCR Site

Geotextiles: no Drainage Control: yes Stabilization by Terraces: yes Sediment traps: no
Sowed Vegetation: yes Natural Vegetation: yes

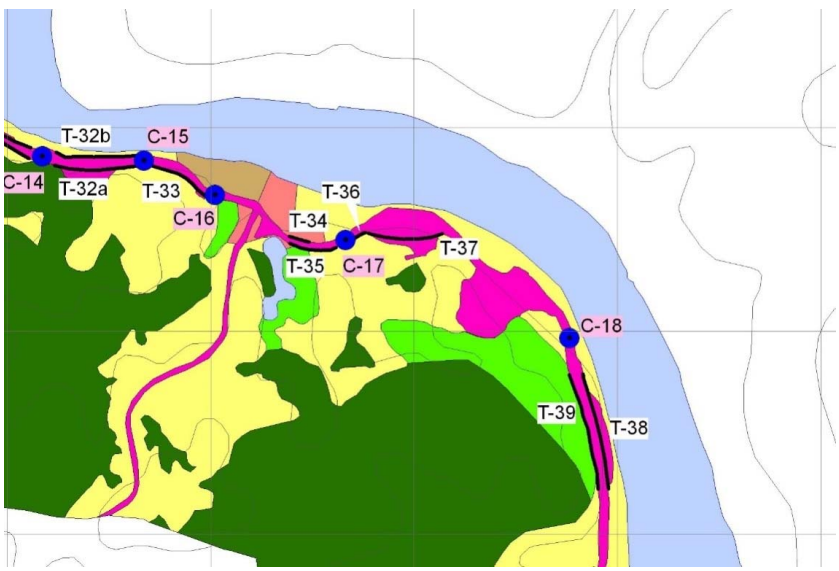
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-38*** ***Type:*** Fill Slope

Beginning (x/y): 463.292 / 1.210.165 ***End (x/y):*** 463.360 / 1.209.853

Slope Length (Range): 32.0 – 36.0 m ***Slope Length (Average):*** 34.0 m ***Slope Width:*** 320.3 m

Slope Surface Area: 10890 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	50	5445
Rills	20	2178
Gullies	30	3267
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 3593.8

Estimated Erosion Rate (t / year): 6001.6

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: yes Drainage Control: yes Stabilization by Terraces: no Sediment traps: yes
Sowed Vegetation: yes Natural Vegetation: yes

Condition in 2013

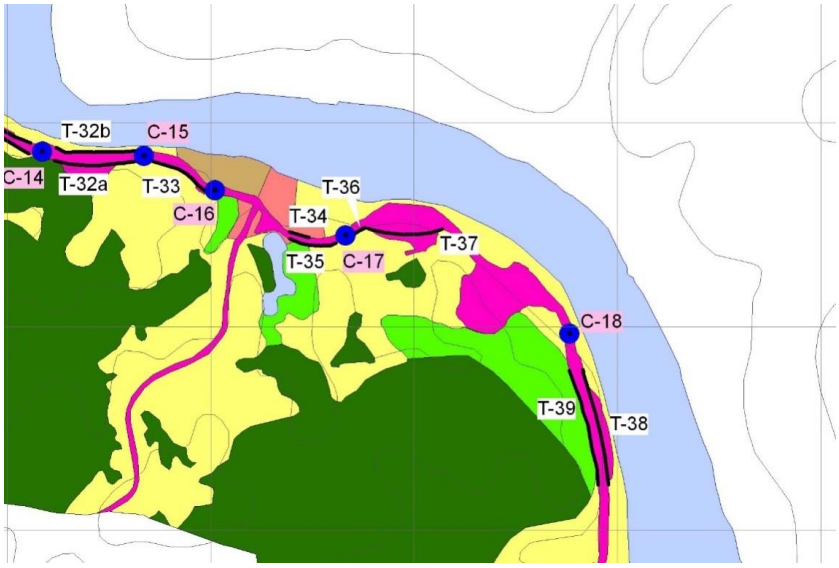
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-39*** ***Type:*** Cut Slope

Beginning (x/y): 463.333 / 1.209.852 ***End (x/y):*** 463.256 / 1.210.162

Elevation Difference (Range): 3.5 – 5.5 m ***Elevation Difference (Average):*** 4.5 m ***Slope Length:*** 5.5 m

Slope Angle: 55º ***Slope Width:*** 321.5 m ***Slope Surface Area:*** 1766 **m²**

Geology: Turbidites of Eocene to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	80	1413
Rills	20	353
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 155.4

Estimated Erosion Rate (t / year): 259.6

Mitigation Measures: ***Mitigation Status:*** Mitigated

Geotextiles: no Drainage Control: yes Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: yes Natural Vegetation: yes

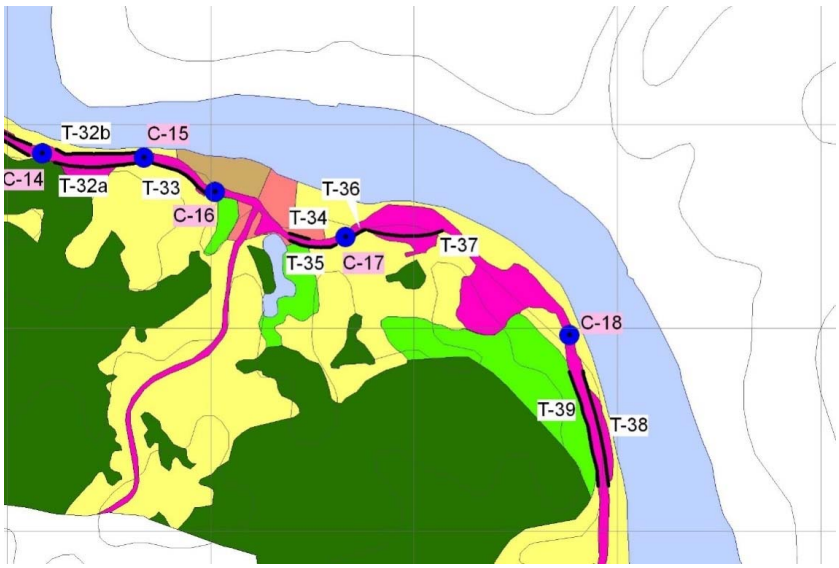
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-40*** ***Type:*** Cut Slope

Beginning (x/y): 463.702 / 1.208.593 ***End (x/y):*** 463.538 / 1.208.831

Elevation Difference (Range): 2.5 – 11.0 m ***Elevation Difference (Average):*** 8.0 m ***Slope Length:*** 10.4 m

Slope Angle: 50º ***Slope Width:*** 295.5 m ***Slope Surface Area:*** 3086 **m²**

Geology: Turbidites of Eocene to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	20	617
Rills	20	617
Gullies	0	0
Land Slides	60	1852

Estimated Erosion Rate (m³/ year): 882.6

Estimated Erosion Rate (t / year): 1473.9

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: yes Drainage Control: yes Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:

Slope: ***T-41*** ***Type:*** Cut Slope

Beginning (x/y): 463.879 / 1.208.470 ***End (x/y):*** 463.769 / 1.208.549

Elevation Difference (Range): 5.4 – 17.6 m ***Elevation Difference (Average):*** 11.5 m ***Slope Length:*** 15.0 m

Slope Angle: 50º ***Slope Width:*** 135,6 m ***Slope Surface Area:*** 2036 **m²**

Geology: Turbidites of Eocene to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	45	916
Rills	20	407
Gullies	15	305
Land Slides	20	407

Estimated Erosion Rate (m³/ year): 374.6

Estimated Erosion Rate (t / year): 625.5

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: yes Drainage Control: yes Stabilization by Terraces: yes Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

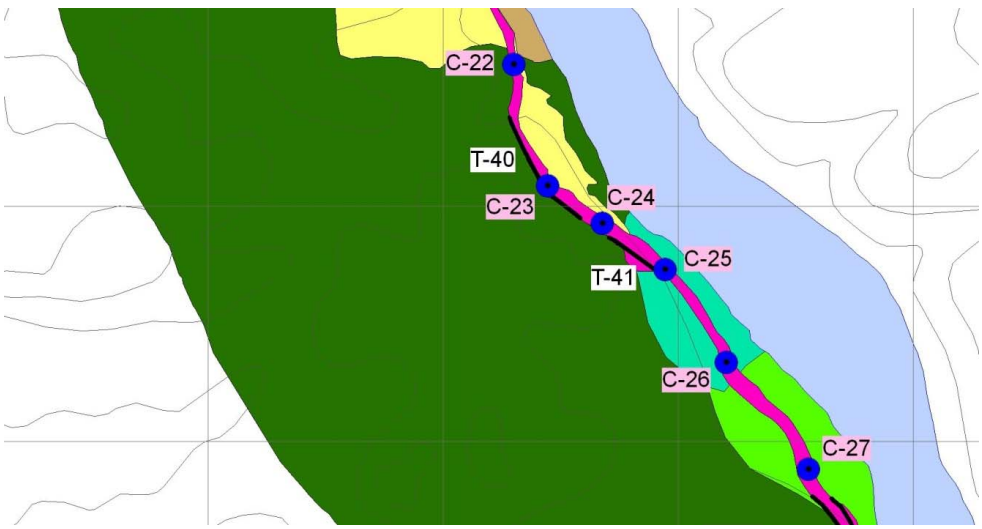
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-42*** ***Type:*** Cut Slope

Beginning (x/y): 464.383 / 1.207.617 ***End (x/y):*** 464.241 / 1.207.939

Elevation Difference (Range): 6.0 – 14.2 m ***Elevation Difference (Average):*** 10.5 m ***Slope Length:*** 13.7 m

Slope Angle: 50º ***Slope Width:*** 360,2 m ***Slope Surface Area:*** 4937 **m²**

Geology: Volcanic Sequence, predominantly andesites and tuffs with varying degree of hydrothermal alteration (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	10	494
Rills	40	1975
Gullies	20	987
Land Slides	30	1481

Estimated Erosion Rate (m³/ year): 1209.6

Estimated Erosion Rate (t / year): 2020.0

Mitigation Measures:

Mitigation Status: Mitigation in progress – UCR Site

Geotextiles: no Drainage Control: yes Stabilization by Terraces: yes Sediment traps: no
Sowed Vegetation: yes Natural Vegetation: no

Condition in 2013

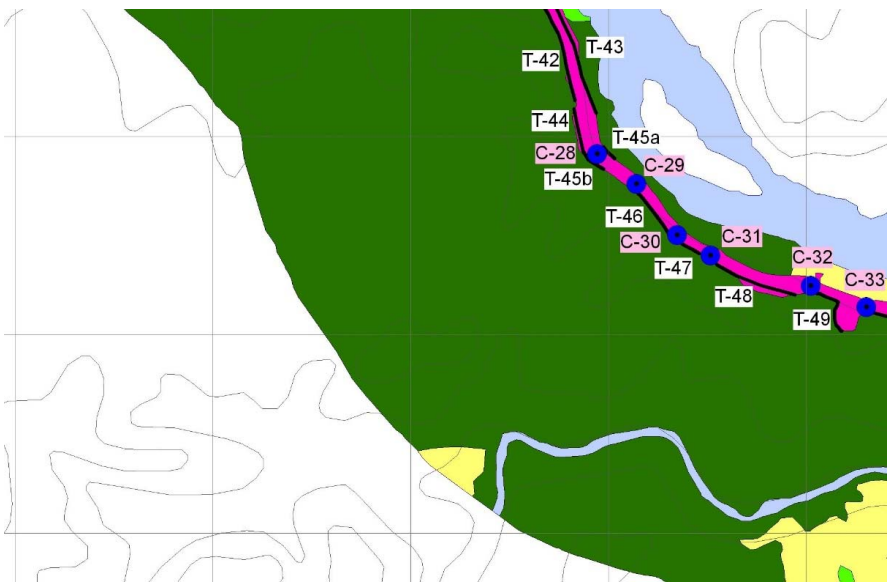
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-43*** ***Type:*** Fill Slope

Beginning (x/y): 464.286 / 1.207.934 ***End (x/y):*** 464.441 / 1.207.581

Slope Length (Range): 38.0 – 44.0 m ***Slope Length (Average):*** 41.0 m ***Slope Width:*** 390.0 m

Slope Surface Area: 15990m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	70	11193
Rills	30	4797
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 15.3

Estimated Erosion Rate (t / year): 25.5

Mitigation Measures:

Mitigation Status: Mitigated

Geotextiles: yes Drainage Control: yes Stabilization by Terraces: yes Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

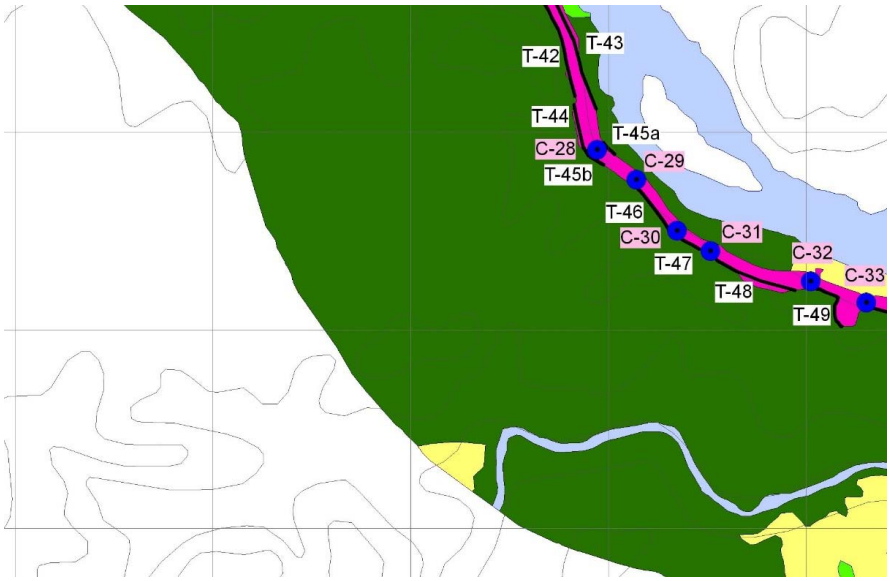
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-44*** ***Type:*** Cut Slope

Beginning (x/y): 464.419 / 1.207.452 ***End (x/y):*** 464.380 / 1.207.593

Elevation Difference (Range): 3.6 – 4.0 m ***Elevation Difference (Average):*** 3.8 m ***Slope Length:*** 4.6 m

Slope Angle: 55º ***Slope Width:*** 146.6 m ***Slope Surface Area:*** 680 **m²**

Geology: Volcanic Sequence, predominantly andesites and tuffs with varying degree of hydrothermal alteration (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	40	272
Rills	40	272
Gullies	20	136
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 99.3

Estimated Erosion Rate (t / year): 165.8

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: yes Stabilization by Terraces: yes Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

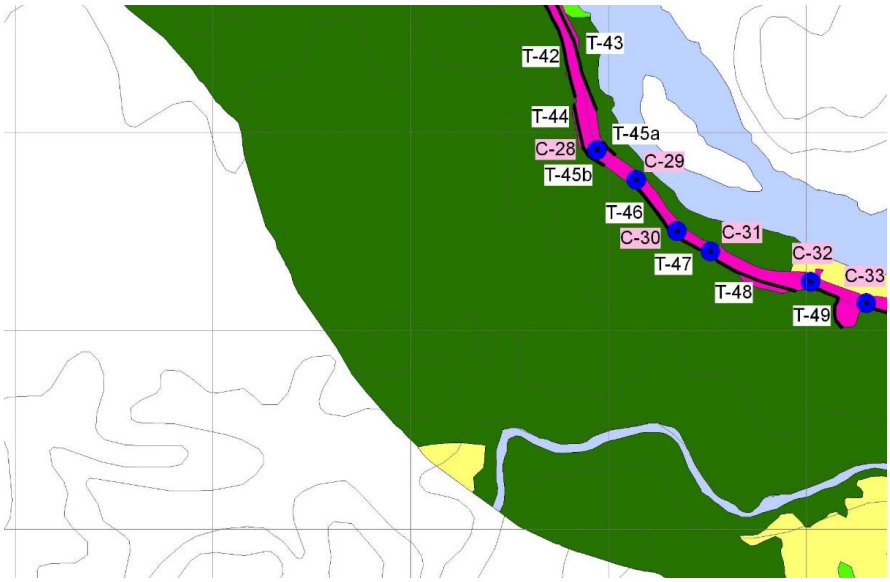
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



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Slope: ***T-45a*** ***Type:*** Fill Slope

Beginning (x/y): 464.462 / 1.207.487 ***End (x/y):*** 464.493 / 1.207.454

Slope Length (Range): 10.0 – 15.0 m ***Slope Length (Average):*** 12.0 m ***Slope Width:*** 45,8 m

Slope Surface Area: 550 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	60	330
Rills	40	220
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 81.3

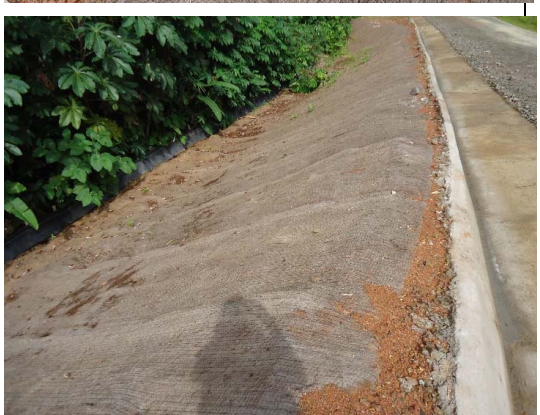
Estimated Erosion Rate (t / year): 135.8

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: yes Drainage Control: no Stabilization by Terraces: no Sediment traps: yes
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013 ***Condition in 2014***

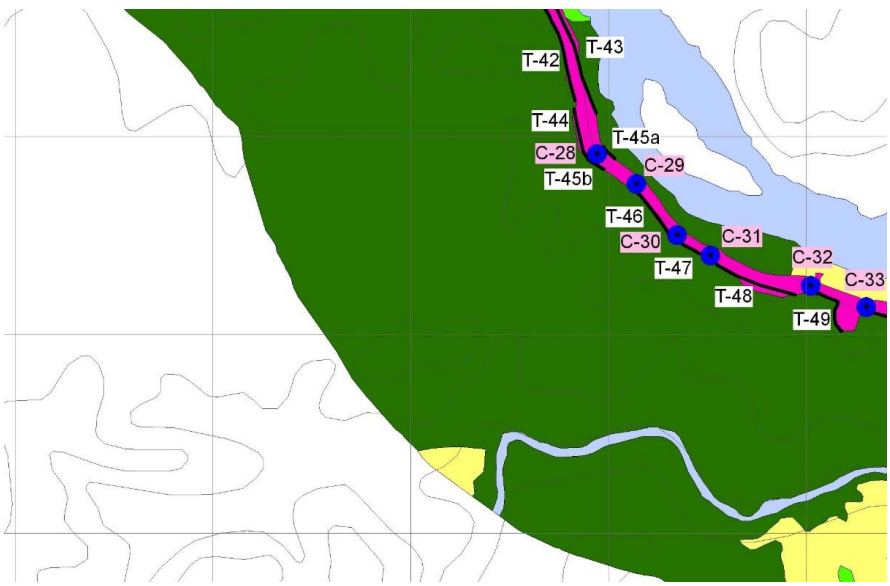


Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-45b*** ***Type:*** Fill Slope

Beginning (x/y): 464.462/ 1.207.424 ***End (x/y):*** 464.419 / 1.207.452

Slope Length (Range): 10.0 – 15.0 m ***Slope Length (Average):*** 12.0 m ***Slope Width:*** 51,1 m

Slope Surface Area: 613 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	80	491
Rills	20	123
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 88.3

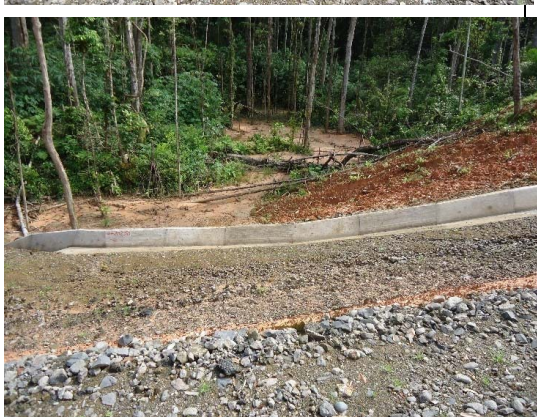
Estimated Erosion Rate (t / year): 147.5

Mitigation Measures:

Mitigation Status: Mitigation in progress – UCR Site

Geotextiles: no Drainage Control: yes Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013 ***Condition in 2014***

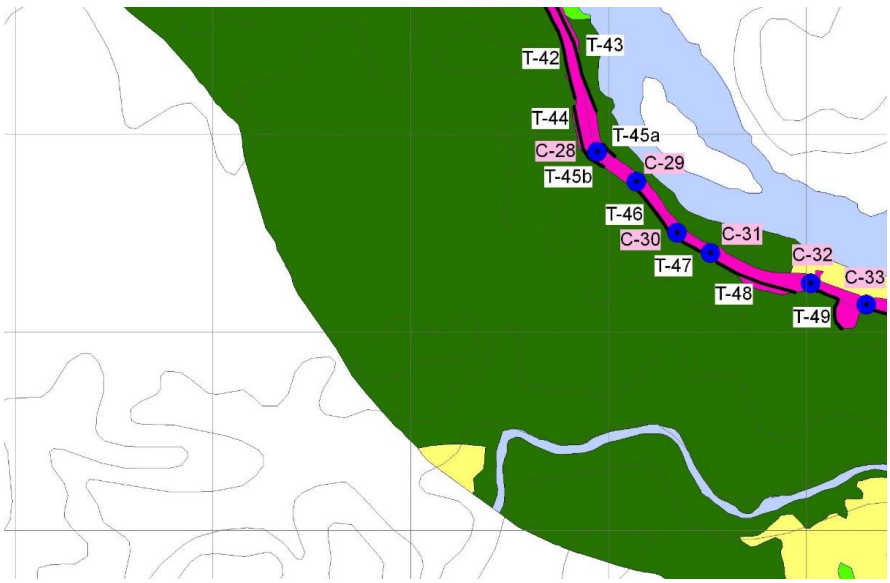


Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



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Slope: ***T-46*** ***Type:*** Cut Slope

Beginning (x/y): 464.642 / 1.207.245 ***End (x/y):*** 464.558 / 1.207.356

Elevation Difference (Range): 5.0 – 7.0 m ***Elevation Difference (Average):*** 6.0 m ***Slope Length:*** 7.3 m

Slope Angle: 55º ***Slope Width:*** 139.5 m ***Slope Surface Area:*** 1022 **m²**

Geology: Volcanic Sequence, predominantly andesites and tuffs with varying degree of hydrothermal alteration (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	25	255
Rills	30	307
Gullies	25	255
Land Slides	20	204

Estimated Erosion Rate (m³/ year): 217.6

Estimated Erosion Rate (t / year): 363.5

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: yes
Sowed Vegetation: yes Natural Vegetation: yes

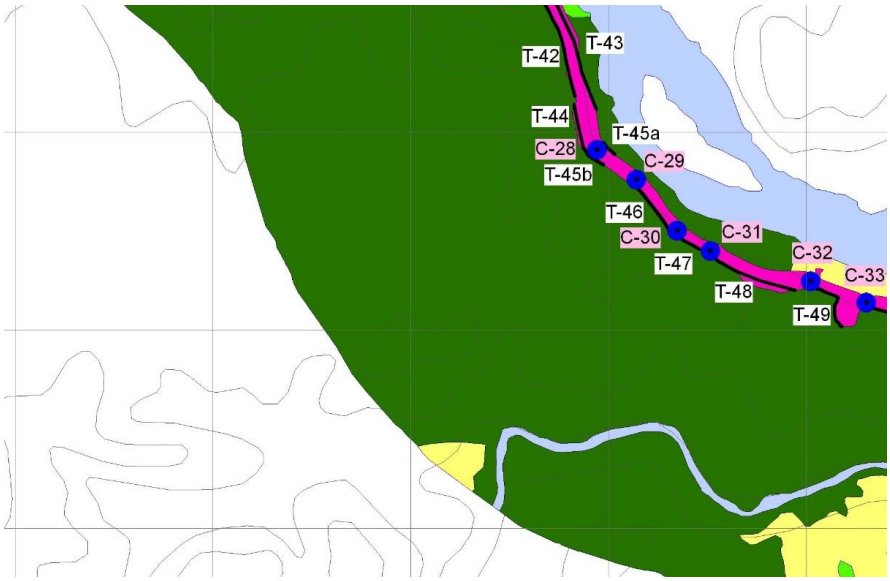
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



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Slope: ***T-47*** ***Type:*** Cut Slope

Beginning (x/y): 464.726 / 1.207.189 ***End (x/y):*** 464.679 / 1.207.216

Elevation Difference (Range): 4.0 – 5.5 m ***Elevation Difference (Average):*** 5.0 m ***Slope Length:*** 6.1 m

Slope Angle: 55º ***Slope Width:*** 53,9 m ***Slope Surface Area:*** 329 **m²**

Geology: Volcanic Sequence, predominantly andesites and tuffs with varying degree of hydrothermal alteration (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	65	214
Rills	15	49
Gullies	0	0
Land Slides	20	66

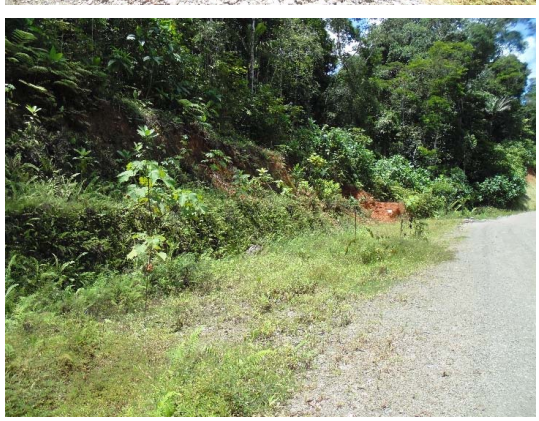
Estimated Erosion Rate (m³/ year): 49.2

Estimated Erosion Rate (t / year): 82.1

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013 ***Condition in 2014***

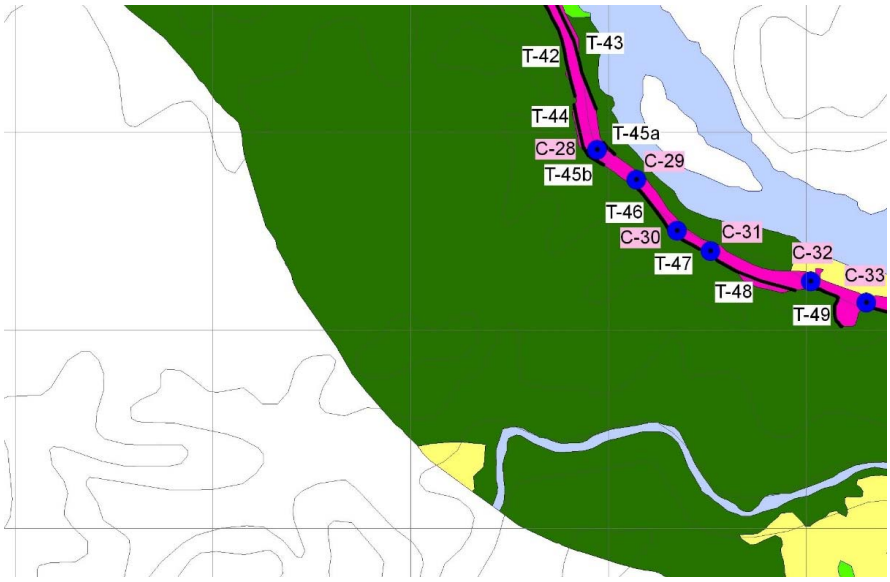


Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-48*** ***Type:*** Cut Slope

Beginning (x/y): 464.990 / 1.207.074 ***End (x/y):*** 464.775 / 1.207.158

Elevation Difference (Range): 2.0 – 5.5 m ***Elevation Difference (Average):*** 3.0 m ***Slope Length:*** 3.9 m

Slope Angle: 50º ***Slope Width:*** 232,4 m ***Slope Surface Area:*** 910 m^2

Geology: Volcanic Sequence, predominantly andesites and tuffs with varying degree of hydrothermal alteration (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	40	364
Rills	40	364
Gullies	20	182
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 132.9

Estimated Erosion Rate (t / year): 221.9

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: yes Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: yes Natural Vegetation: yes

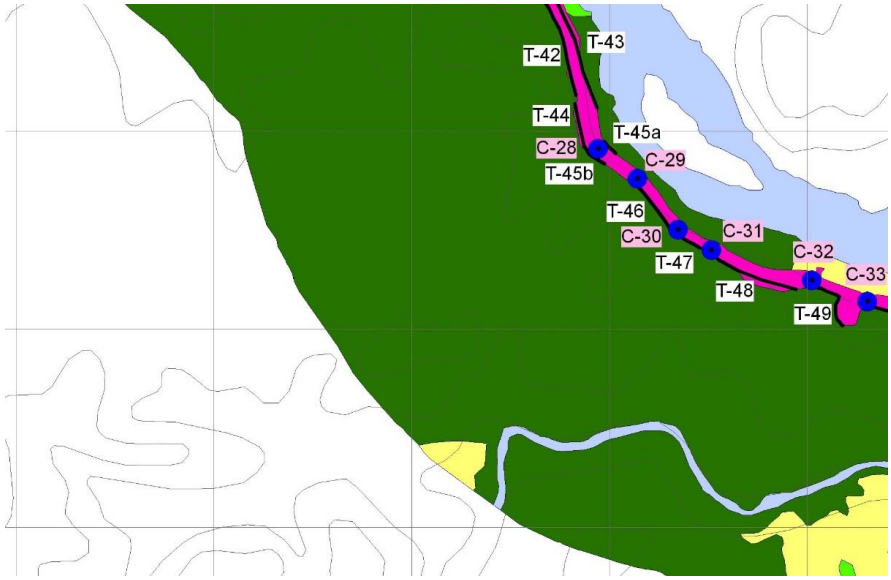
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



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Slope: ***T-49*** ***Type:*** Cut Slope

Beginning (x/y): 465.120 / 1.206.973 ***End (x/y):*** 465.049 / 1.207.078

Elevation Difference (Range): 4.0 – 12.0 m ***Elevation Difference (Average):*** 7.0 m ***Slope Length:*** 8.5 m

Slope Angle: 55º ***Slope Width:*** 156.6 m ***Slope Surface Area:*** 338 **m²**

Geology: Volcanic Sequence, predominantly andesites and tuffs with varying degree of hydrothermal alteration (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	65	870
Rills	35	468
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 135.8

Estimated Erosion Rate (t / year): 226.8

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: yes Stabilization by Terraces: yes Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

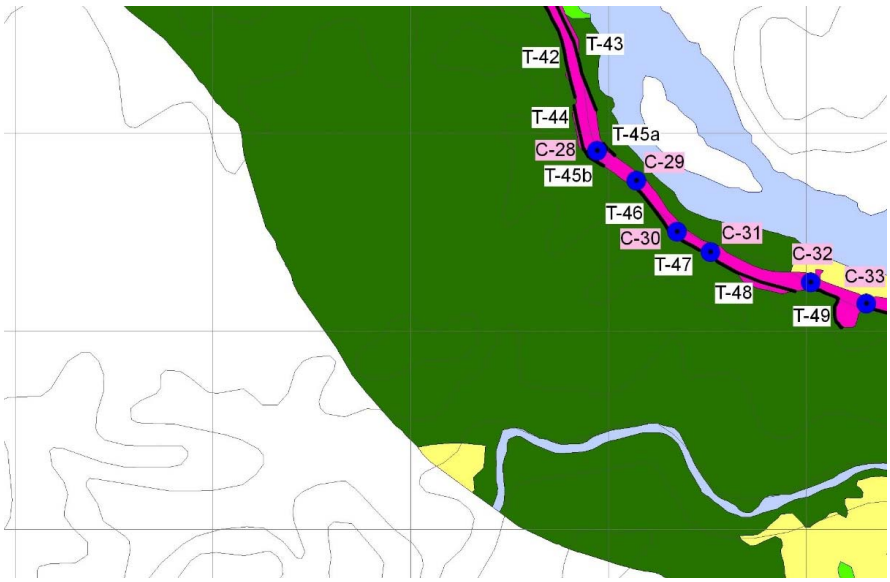
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-50*** ***Type:*** Cut Slope

Beginning (x/y): 465.401 / 1.207.002 ***End (x/y):*** 465.190 / 1.207.024

Elevation Difference (Range): 3.0 – 6.0 m ***Elevation Difference (Average):*** 5.0 m ***Slope Length:*** 6.5 m

Slope Angle: 50º ***Slope Width:*** 217,1 m ***Slope Surface Area:*** 1417 **m²**

Geology: Volcanic Sequence, predominantly andesites and tuffs with varying degree of hydrothermal alteration (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	35	496
Rills	40	567
Gullies	0	0
Land Slides	25	354

Estimated Erosion Rate (m³/ year): 267.1

Estimated Erosion Rate (t / year): 446.1

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: yes Natural Vegetation: yes

Condition in 2013

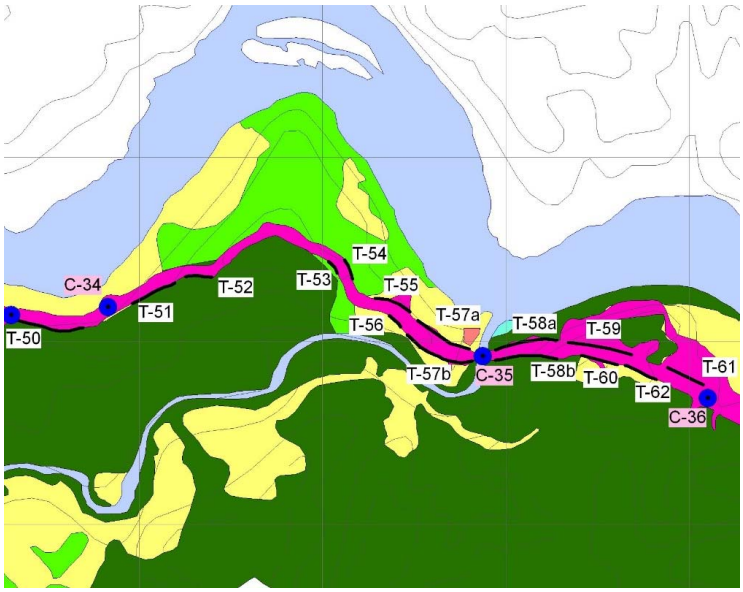
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-51*** ***Type:*** Cut Slope

Beginning (x/y): 465.674 / 1.207.136 ***End (x/y):*** 465.549 / 1.207.074

Elevation Difference (Range): 4.0 – 8.4 m ***Elevation Difference (Average):*** 7.5 m ***Slope Length:*** 9.2 m

Slope Angle: 55º ***Slope Width:*** 140,1 m ***Slope Surface Area:*** 1283 **m²**

Geology: Volcanic Sequence, predominantly andesites and tuffs with varying degree of hydrothermal alteration (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	60	770
Rills	40	513
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 136.0

Estimated Erosion Rate (t / year): 227.1

Mitigation Measures: ***Mitigation Status:*** Mitigated

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: yes Natural Vegetation: yes

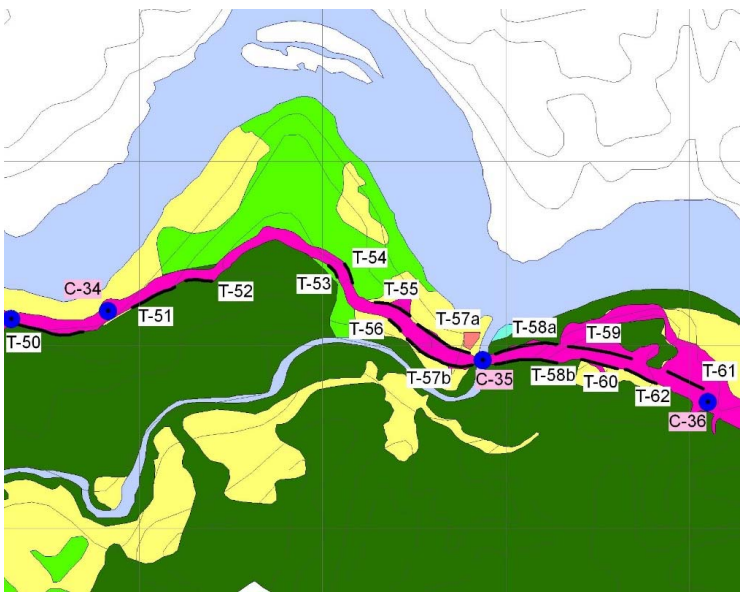
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



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Slope: ***T-52*** ***Type:*** Cut Slope

Beginning (x/y): 465.784 / 1.207.154 ***End (x/y):*** 465.706 / 1.207.155

Elevation Difference (Range): 1.5 – 2.5 m ***Elevation Difference (Average):*** 2.0 m ***Slope Length:*** 2.3 m

Slope Angle: 60º ***Slope Width:*** 78,1 m ***Slope Surface Area:*** 180 **m²**

Geology: Volcanic Sequence, predominantly andesites and tuffs with varying degree of hydrothermal alteration (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	75	135
Rills	25	45
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 16.7

Estimated Erosion Rate (t / year): 27.9

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

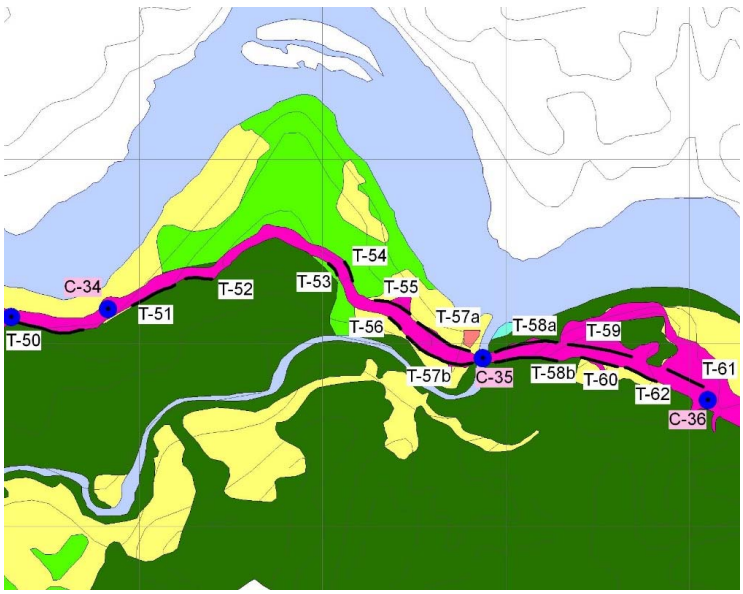
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-53*** ***Type:*** Fill Slope

Beginning (x/y): 466.159 / 1.207.165 ***End (x/y):*** 466.132 / 1.207.200

Slope Length (Range): 6.0 – 9.0 m ***Slope Length (Average):*** 7.5 m ***Slope Width:*** 45.0 m

Slope Surface Area: 338 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	10	34
Rills	50	169
Gullies	40	135
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 134.3

Estimated Erosion Rate (t / year): 224.3

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: yes
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

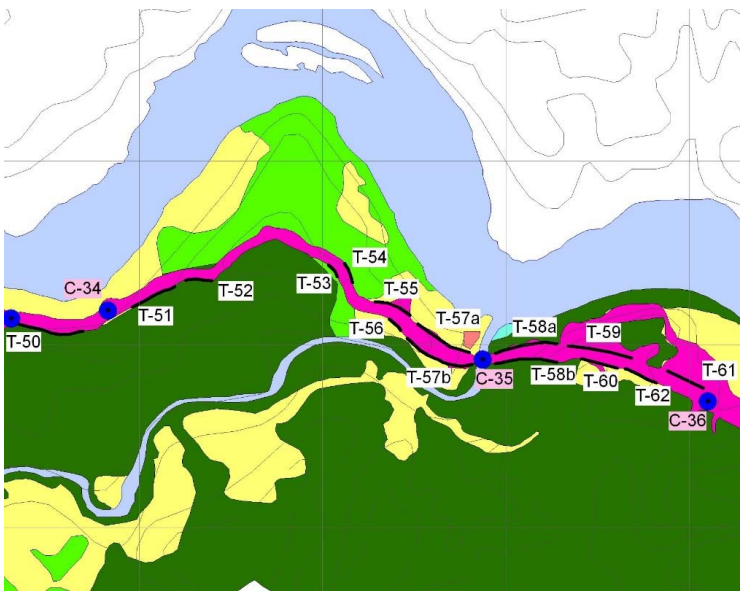
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-54*** ***Type:*** Cut Slope

Beginning (x/y): 466.180 / 1.207.205 ***End (x/y):***4 66.203 / 1.207.147

Elevation Difference (Range): 1.0 – 3.0 m ***Elevation Difference (Average):*** 2.0 m ***Slope Length:*** 2.6 m

Slope Angle: 50° ***Slope Width:*** 63.7 m ***Slope Surface Area:*** 166 **m²**

Geology: Volcanic Sequence, predominantly andesites and tuffs with varying degree of hydrothermal alteration (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	166
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 11.6

Estimated Erosion Rate (t / year): 19.4

Mitigation Measures: ***Mitigation Status:***Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

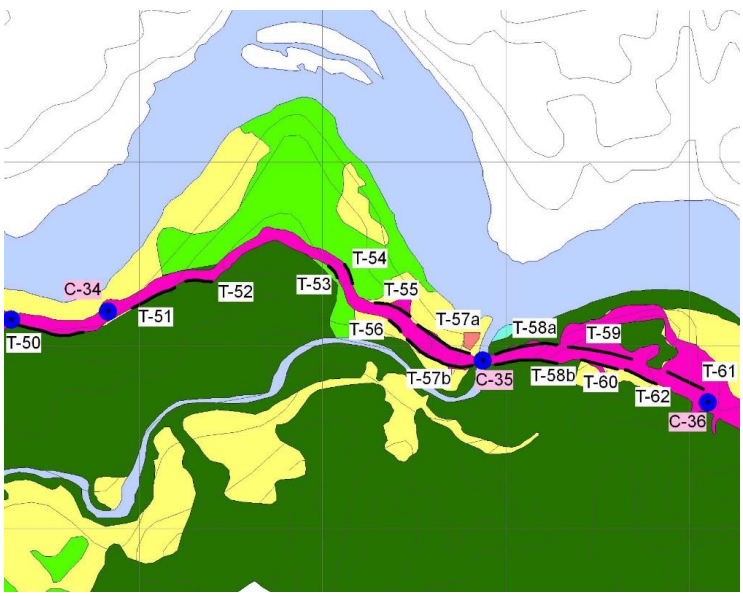
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-55*** ***Type:*** Cut Slope

Beginning (x/y): 466.271 / 1.207.089 ***End (x/y):*** 466.375 / 1.207.049

Elevation Difference (Range): 2.0 – 4.0 m ***Elevation Difference (Average):*** 3.2 m ***Slope Length:*** 4.2 m

Slope Angle: 50° ***Slope Width:*** 113,8 m ***Slope Surface Area:*** 475 **m²**

Geology: Volcanic Sequence, predominantly andesites and tuffs with varying degree of hydrothermal alteration (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	50	238
Rills	15	71
Gullies	0	0
Land Slides	35	166

Estimated Erosion Rate (m³/ year): 94.6

Estimated Erosion Rate (t / year): 158.0

Mitigation Measures: ***Mitigation Status:*** Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

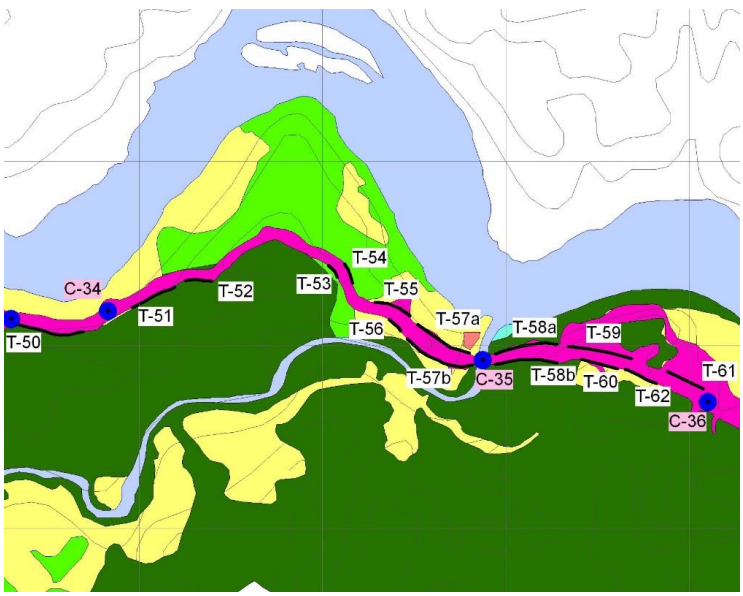
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-56*** ***Type:*** Fill Slope

Beginning (x/y): 466.215 / 1.207.068 ***End (x/y):*** 466.347 / 1.207.003

Slope Length (Range): 30.0 - 40.0 m ***Slope Length (Average):*** 35.0 m ***Slope Width:*** 154.9 m

Slope Surface Area: 5422 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	65	3524
Rills	20	1084
Gullies	15	813
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 1284.9

Estimated Erosion Rate (t / year): 2145.8

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: yes Natural Vegetation: yes

Condition in 2013

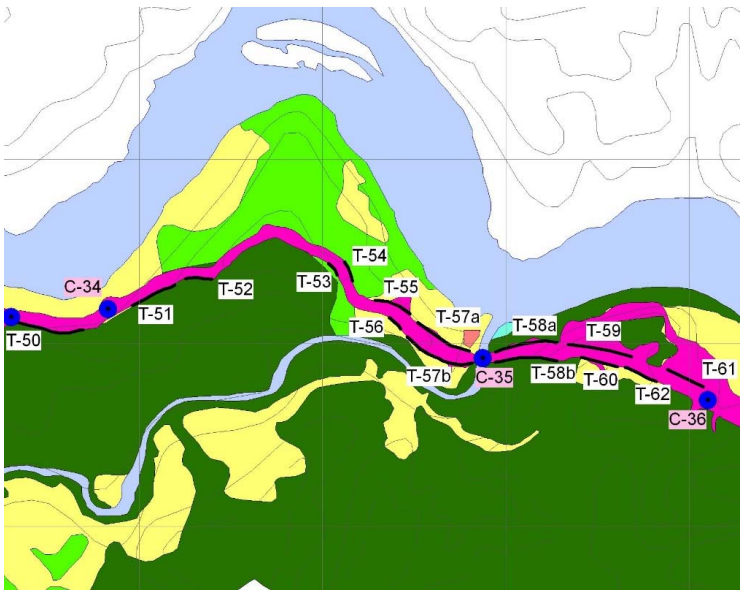
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



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Slope: ***T-57a*** ***Type:*** Fill Slope

Beginning (x/y): 466.398 / 1.207.021 ***End (x/y):*** 466.551 / 1.206.936

Slope Length (Range): 35.0 – 40.0 m ***Slope Length (Average):*** 37.0 m ***Slope Width:*** **177.4** m

Slope Surface Area: 6564 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	60	3938
Rills	20	1313
Gullies	20	1313
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 1759.1

Estimated Erosion Rate (t / year): 2937.7

Mitigation Measures:

Mitigation Status: Mitigation in progress – UCR Site

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: yes
Sowed Vegetation: yes Natural Vegetation: yes

Condition in 2013

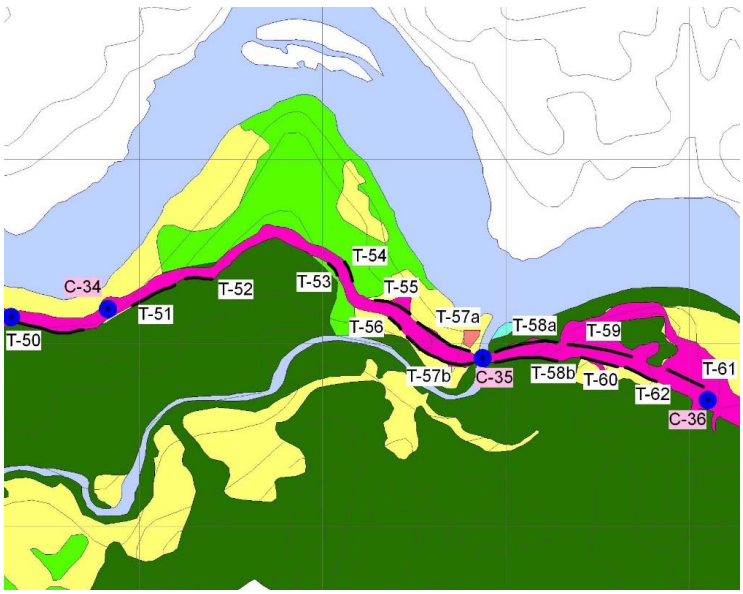
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-57b*** ***Type:*** Cut Slope

Beginning (x/y): 466.560 / 1.206.901 ***End (x/y):*** 466.367 / 1.206.979

Elevation Difference (Range): 1.0 – 4.0 m ***Elevation Difference (Average):*** 2.9 m ***Slope Length:*** 3.3 m

Slope Angle: 60º ***Slope Width:*** 219.8 m ***Slope Surface Area:*** 736 **m²**

Geology: Volcanic Sequence, predominantly andesites and tuffs with varying degree of hydrothermal alteration (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	50	368
Rills	30	221
Gullies	20	147
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 100.8

Estimated Erosion Rate (t / year): 168.4

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: yes
Sowed Vegetation: yes Natural Vegetation: yes

Condition in 2013

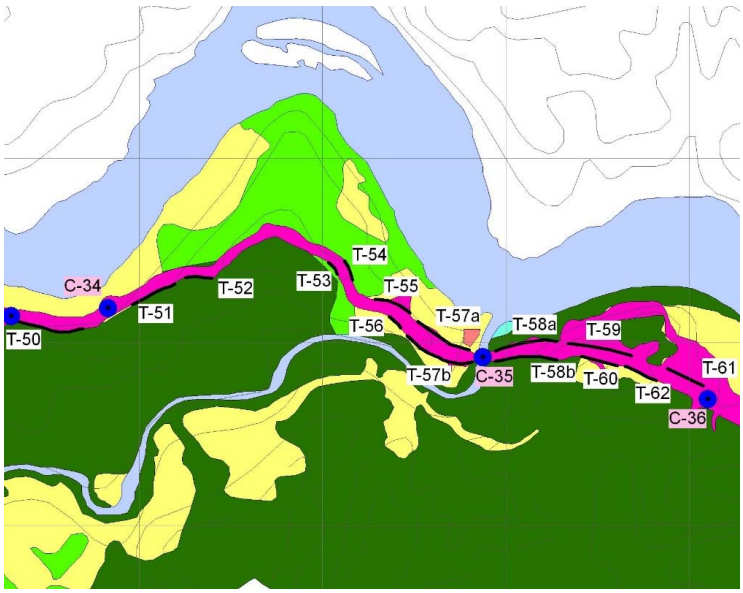
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-58a*** ***Type:*** Fill Slope

Beginning (x/y): 466.629 / 1.206.933 ***End (x/y):*** 466.813 / 1.206.962

Slope Length (Range): 20.0 – 45.0 m ***Slope Length (Average):*** 38.0 m ***Slope Width:*** 189,1 m

Slope Surface Area: 7186 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	80	5749
Rills	20	1437
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 1034.8

Estimated Erosion Rate (t / year): 1728.0

Mitigation Measures:

Mitigation Status: Mitigated – UCR Site

Geotextiles: no Drainage Control: yes Stabilization by Terraces: no Sediment traps: yes
Sowed Vegetation: no Natural Vegetation: yes

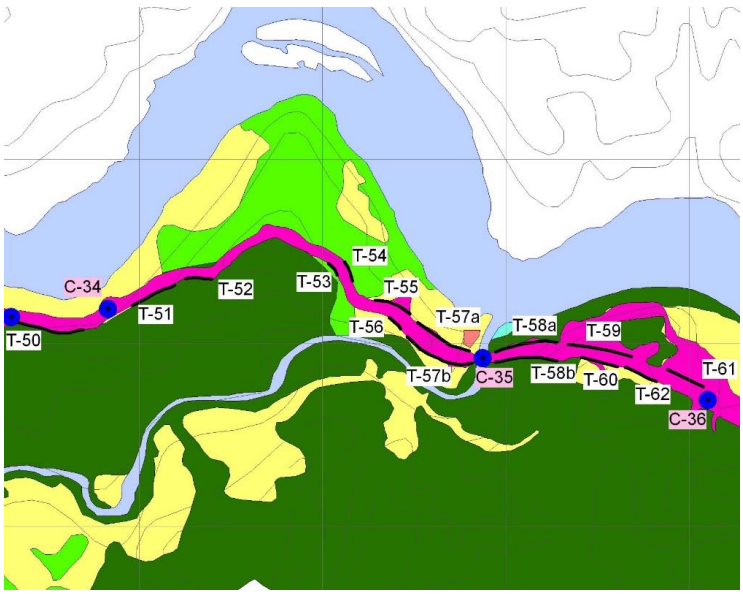
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-58b*** ***Type:*** Cut Slope

Beginning (x/y): 466.812 / 1.206.907 ***End (x/y):*** 466.629 / 1.206.902

Elevation Difference (Range): 6.0 – 12.0 m ***Elevation Difference (Average):*** 9.0 m ***Slope Length:*** 9.9 m

Slope Angle: 65° ***Slope Width:*** 184,8 m ***Slope Surface Area:*** 1835 **m²**

Geology: Volcanic Sequence, predominantly andesites and tuffs with varying degree of hydrothermal alteration (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	70	1285
Rills	10	184
Gullies	0	0
Land Slides	20	367

Estimated Erosion Rate (m³/ year): 266.1

Estimated Erosion Rate (t / year): 444.4

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: yes Stabilization by Terraces: yes Sediment traps: yes
Sowed Vegetation: no Natural Vegetation: no

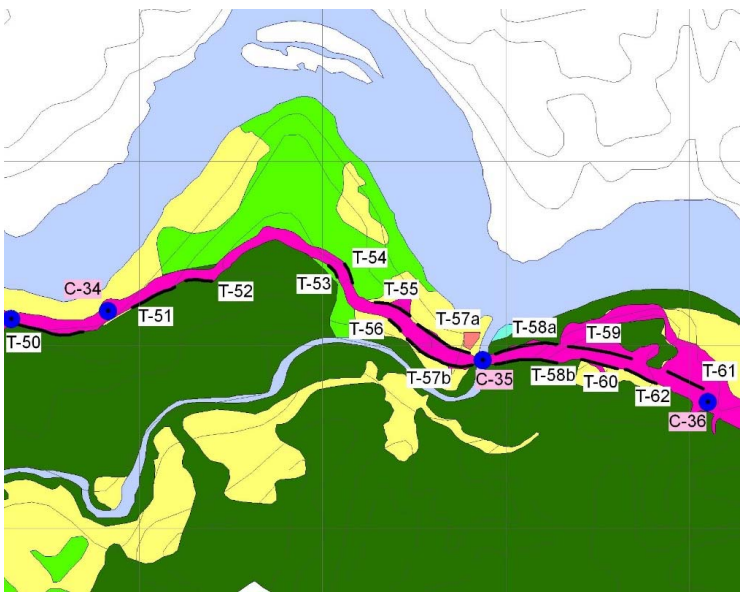
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-59*** ***Type:*** Cut Slope

Beginning (x/y): 466.847 / 1.206.955 ***End (x/y):*** 467.034 / 1.206.919

Elevation Difference (Range): 4.0 – 8.5 m ***Elevation Difference (Average):*** 7.0 m ***Slope Length:*** 8.5 m

Slope Angle: 55° ***Slope Width:*** 191.5 m ***Slope Surface Area:*** 1636 **m²**

Geology: Turbidites of Eocene to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	25	409
Rills	30	491
Gullies	20	327
Land Slides	25	409

Estimated Erosion Rate (m³/ year): 359.2

Estimated Erosion Rate (t / year): 599.9

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: yes
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

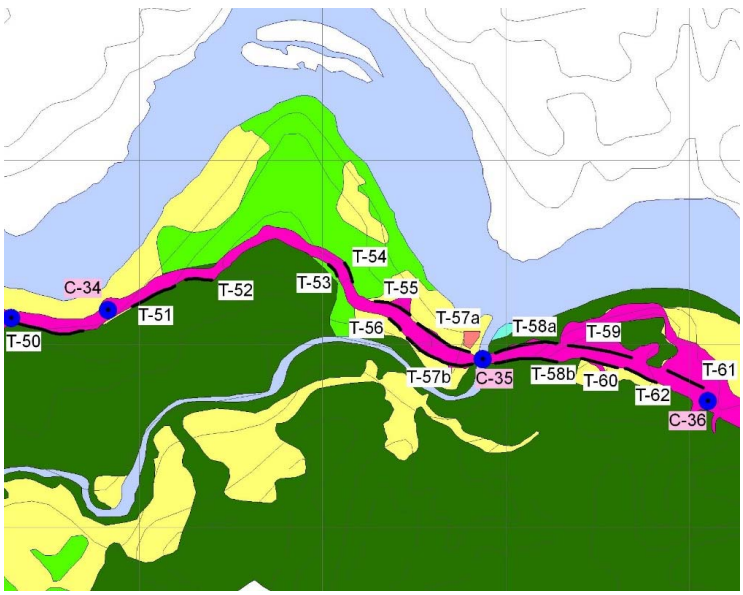
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-60*** ***Type:*** Fill Slope

Beginning (x/y): 466.992 / 1.206.889 ***End (x/y):*** 466.887 / 1.206.916

Slope Length (Range): 12.0 – 19.0 m ***Slope Length (Average):*** 16.5 m ***Slope Width:*** 109.3 m

Slope Surface Area: 1803 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	35	631
Rills	25	451
Gullies	15	271
Land Slides	25	451

Estimated Erosion Rate (m^3/ year): 369.7

Estimated Erosion Rate (t / year): 617.4

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

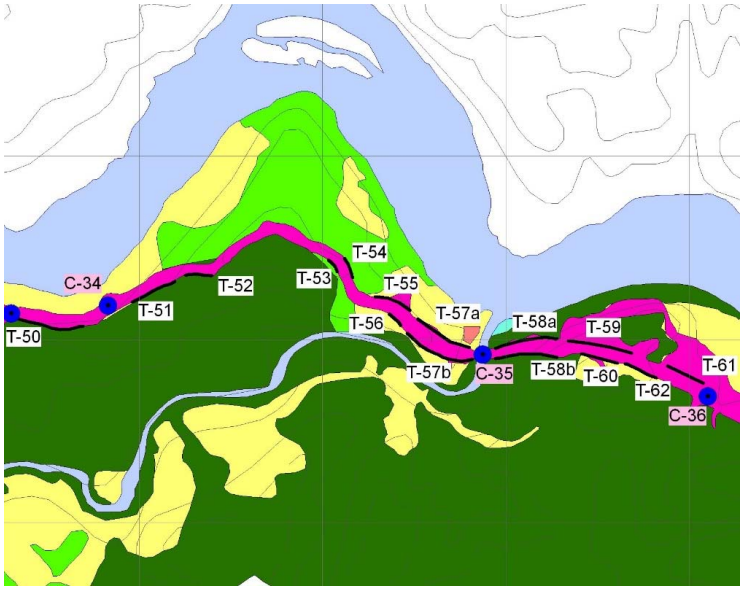
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-61*** ***Type:*** Cut Slope

Beginning (x/y): 467.142 / 1.206.879 ***End (x/y):*** 467.248 / 1.206.828

Elevation Difference (Range): 2.0 – 9.0 m ***Elevation Difference (Average):*** 7.0 m ***Slope Length:*** 9.1 m

Slope Angle: 50º ***Slope Width:*** 118.0m ***Slope Surface Area:*** 1078 **m²**

Geology: Turbidites of Eocene to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	20	216
Rills	20	216
Gullies	0	0
Land Slides	60	647

Estimated Erosion Rate (m³/ year): 308.4

Estimated Erosion Rate (t / year): 515.0

Mitigation Measures: ***Mitigation Status:*** Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

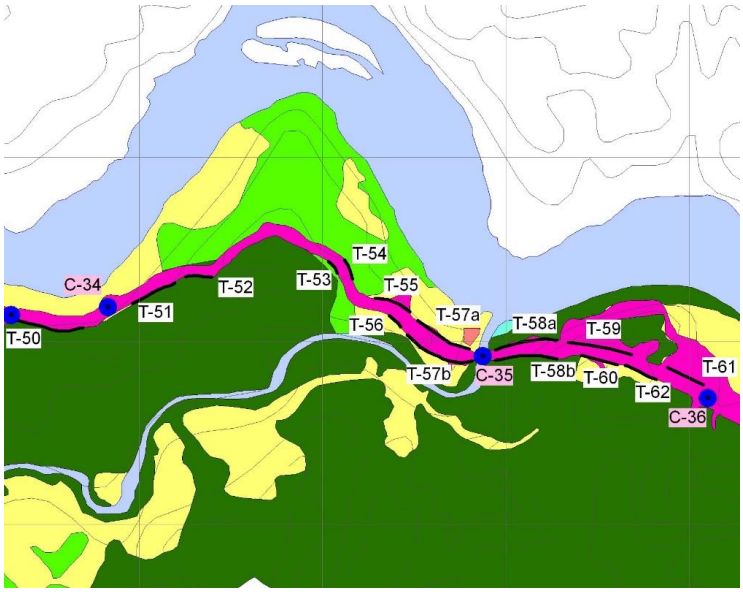
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-62*** ***Type:*** Cut Slope

Beginning (x/y): 467.108 / 1.206.844 ***End (x/y):*** 467.017 / 1.206.886

Elevation Difference (Range): 1.0 – 2.5 m ***Elevation Difference (Average):*** 1.5 m ***Slope Length:*** 1.8 m

Slope Angle: 55º ***Slope Width:*** 100.9 m ***Slope Surface Area:*** 184 m^2

Geology: Turbidites of Eocene to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	50	92
Rills	50	92
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 21.2

Estimated Erosion Rate (t / year): 35.5

Mitigation Measures: ***Mitigation Status:*** Mitigated

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

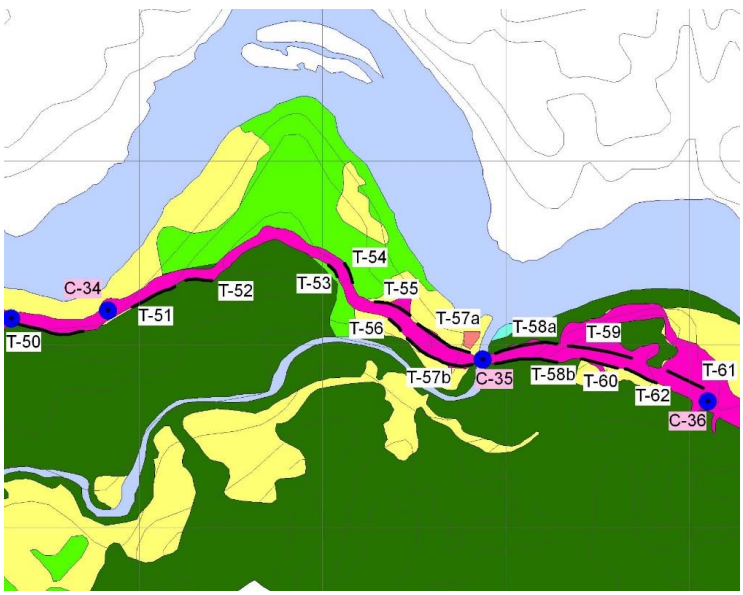
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-63*** ***Type:*** Cut Slope

Beginning (x/y): 467.269 / 1.206.784 ***End (x/y):*** 467.476 / 1.206.681

Elevation Difference (Range): ***Elevation Difference (Average):*** ***Slope Length:*** 39.2 m

Slope Angle: ***Slope Width:*** 271.4 m ***Slope Surface Area:*** 10638 m²

Geology: Turbidites of Eocene to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	65	6914
Rills	25	2660
Gullies	10	1064
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 1196.8

Estimated Erosion Rate (t / year): 1998.6

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: yes Drainage Control: yes Stabilization by Terraces: no Sediment traps: yes

Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

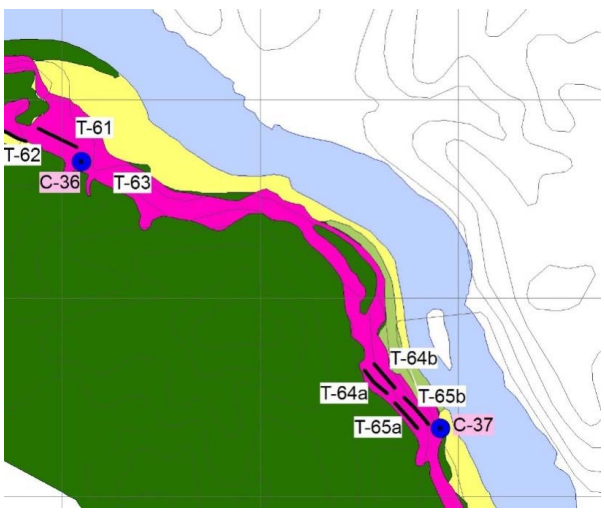
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-64a*** ***Type:*** Cut Slope

Beginning (x/y): 468.103 / 1.206.141 ***End (x/y):*** 468.041 / 1.206.205

Elevation Difference (Range): 3.0 – 6.5 m ***Elevation Difference (Average):*** 4.5 m ***Slope Length:*** 4.8 m

Slope Angle: 70º ***Slope Width:*** 89.7 m ***Slope Surface Area:*** 430 **m²**

Geology: Turbidites of Eocene to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	85	365
Rills	15	64
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 35.9

Estimated Erosion Rate (t / year): 59.9

Mitigation Measures:

Mitigation Status: Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

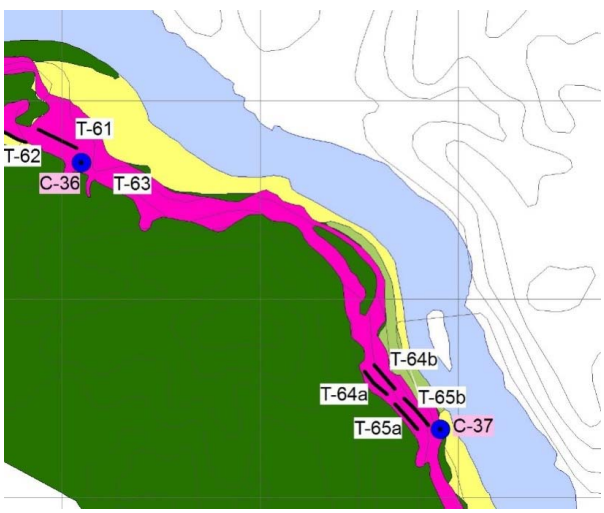
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-64b*** ***Type:*** Fill Slope

Beginning (x/y): 468.103 / 1.206.141 ***End (x/y):*** 468.041 / 1.206.205

Slope Length (Range): 28.0 – 39.0 m ***Slope Length (Average):*** 35.0 m ***Slope Width:*** 88.1 m

Slope Surface Area: 3084 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	40	1233
Rills	20	617
Gullies	40	1233
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 1208.7

Estimated Erosion Rate (t / year): 2018.6

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

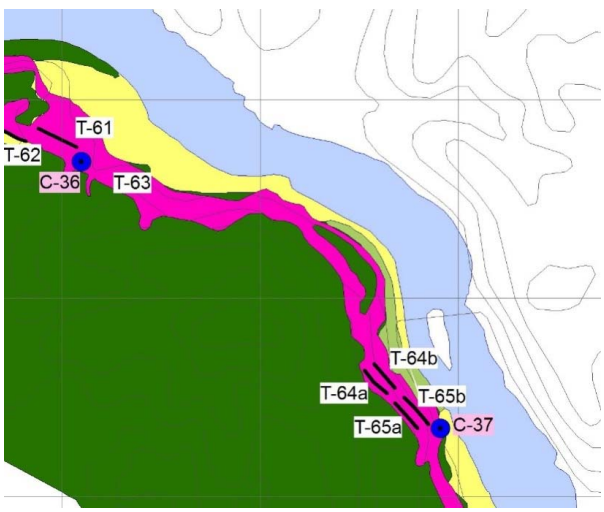
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-65a*** ***Type:*** Cut Slope

Beginning (x/y): 468.125 / 1.206.114 ***End (x/y):*** 468.187 / 1.206.044

Elevation Difference (Range): 7.0 – 14.6 m ***Elevation Difference (Average):*** 11.4 m ***Slope Length:*** 12.6 m

Slope Angle: 65º ***Slope Width:*** 94.2 m ***Slope Surface Area:*** 1185 **m²**

Geology: Turbidites of Eocene to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	75	889
Rills	10	118
Gullies	0	0
Land Slides	15	178

Estimated Erosion Rate (m³/ year): 152.3

Estimated Erosion Rate (t / year): 254.3

Mitigation Measures: ***Mitigation Status:*** Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

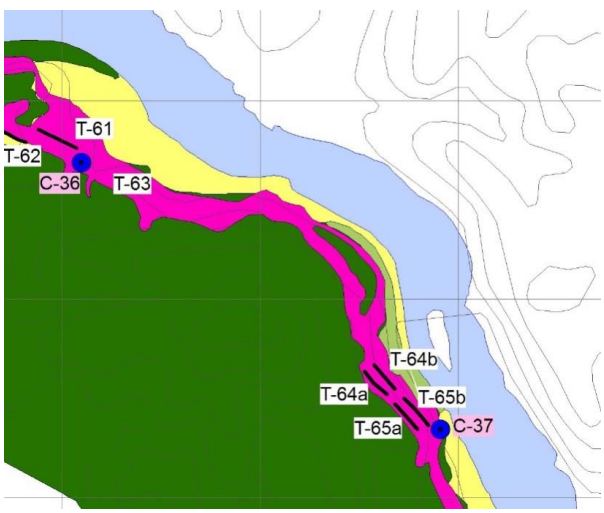
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-65b*** ***Type:*** Fill Slope

Beginning (x/y): 468.150 / 1. 206.130 ***End (x/y):*** 468.217 / 1.206.055

Slope Length (Range): 25.0 – 36.0 m ***Slope Length (Average):*** 33.0 m ***Slope Width:*** 100.7 m

Slope Surface Area: 3323 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	20	665
Rills	20	665
Gullies	60	1994
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 1714.7

Estimated Erosion Rate (t / year): 2863.6

Mitigation Measures:

Mitigation Status: Mitigation scheduled – UCR Site

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

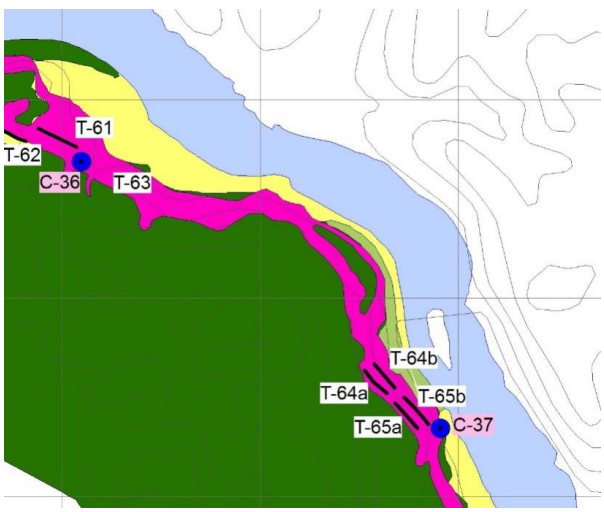
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-66e*** ***Type:*** Cut Slope

Beginning (x/y): 468.388 / 1.205.185 ***End (x/y):*** 468.431 / 1.205.101

Elevation Difference (Range): 3.5 – 4.5 m ***Elevation Difference (Average):*** 4.0 m ***Slope Length:*** 5.7 m

Slope Angle: 45º ***Slope Width:*** 94.4 m ***Slope Surface Area:*** 534 **m²**

Geology: Volcanic Sequence, predominantly andesites and tuffs with varying degree of hydrothermal alteration (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	80	427
Rills	20	107
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 47.0

Estimated Erosion Rate (t / year): 78.5

Mitigation Measures:

Mitigation Status: Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:

Slope: ***T-66d*** ***Type:*** Cut Slope

Beginning (x/y): 468.466 / 1.205.049 ***End (x/y):*** 468.510 / 1.204.990

Elevation Difference (Range): 3.5 – 4.5 m ***Elevation Difference (Average):*** 4.0 m ***Slope Length:*** 4.9 m

Slope Angle: 55º ***Slope Width:*** 72.8 m ***Slope Surface Area:*** 355 **m²**

Geology: Volcanic Sequence, predominantly andesites and tuffs with varying degree of hydrothermal alteration (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	355
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 24.9

Estimated Erosion Rate (t / year): 41.6

Mitigation Measures:

Mitigation Status: Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:

Slope: ***T-66c*** ***Type:*** Cut Slope

Beginning (x/y): 468.518 / 1.204.979 ***End (x/y):*** 468.572 / 1.204.890

Elevation Difference (Range): 3.0 – 6.5 m ***Elevation Difference (Average):*** 5.5 m ***Slope Length:*** 8.6 m

Slope Angle: 40º ***Slope Width:*** 104.1 m ***Slope Surface Area:*** 891 m²

Geology: Volcanic Sequence, predominantly andesites and tuffs with varying degree of hydrothermal alteration (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	15	134
Rills	0	0
Gullies	0	0
Land Slides	85	757

Estimated Erosion Rate (m³/ year): 312.2

Estimated Erosion Rate (t / year): 521.4

Mitigation Measures: ***Mitigation Status:*** Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:

Slope: ***T-66a*** ***Type:*** Cut Slope

Beginning (x/y): 468.711 / 1.204.666 ***End (x/y):*** 468.592 / 1.204.835

Elevation Difference (Range): 6.0 – 13.5 m ***Elevation Difference (Average):*** 10.5 m ***Slope Length:*** 13.7 m

Slope Angle: 50º ***Slope Width:*** 207,8 m ***Slope Surface Area:*** 2848**m²**

Geology: Volcanic Sequence, predominantly andesites and tuffs with varying degree of hydrothermal alteration (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	25	712
Rills	15	427
Gullies	30	854
Land Slides	30	854

Estimated Erosion Rate (m³/ year): 690.7

Estimated Erosion Rate (t / year): 1153.5

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: yes
Sowed Vegetation: yes Natural Vegetation: yes

Condition in 2013

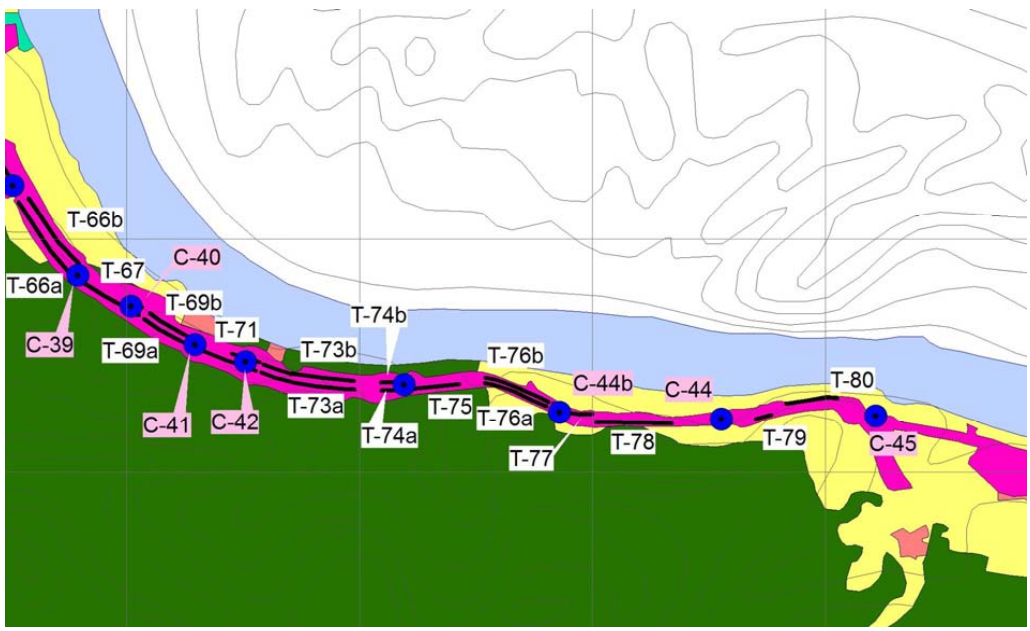
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-66b*** ***Type:*** Fill Slope

Beginning (x/y): 468.615 / 1.204.843 ***End (x/y):*** 468.733 / 1.204.687

Slope Length (Range): 29.0 – 38.0 m ***Slope Length (Average):*** 34.5 m ***Slope Width:*** 196.7 m

Slope Surface Area: 6786 m²

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	40	2714
Rills	30	2036
Gullies	30	2036
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 2253.0

Estimated Erosion Rate (t / year): 3762.5

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: yes Drainage Control: no Stabilization by Terraces: yes Sediment traps: yes
Sowed Vegetation: yes Natural Vegetation: yes

Condition in 2013

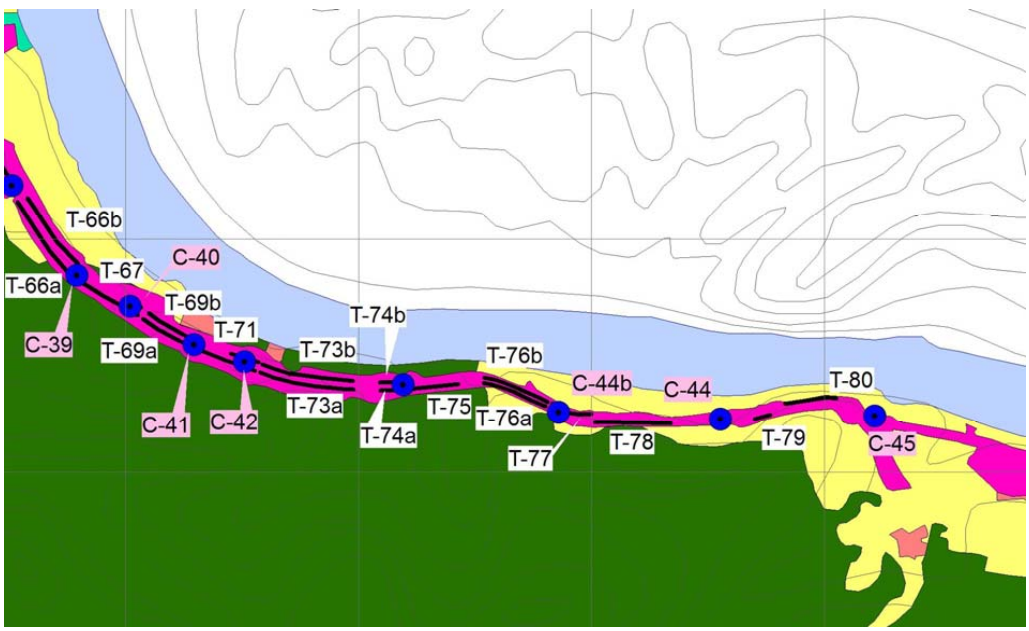
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-67*** ***Type:*** Cut Slope

Beginning (x/y): 468.747 / 1.204.640 ***End (x/y):*** 468.832 / 1.204.589

Elevation Difference (Range): 8.0 – 17.0 m ***Elevation Difference (Average):*** 14.0 m ***Slope Length:*** 15.4 m

Slope Angle: 65º ***Slope Width:*** 98.7 m ***Slope Surface Area:*** 1525**m²**

Geology: Volcanic Sequence, predominantly andesites and tuffs with varying degree of hydrothermal alteration (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	70	1067
Rills	15	229
Gullies	0	0
Land Slides	15	229

Estimated Erosion Rate (m³/ year): 202.8

Estimated Erosion Rate (t / year): 338.6

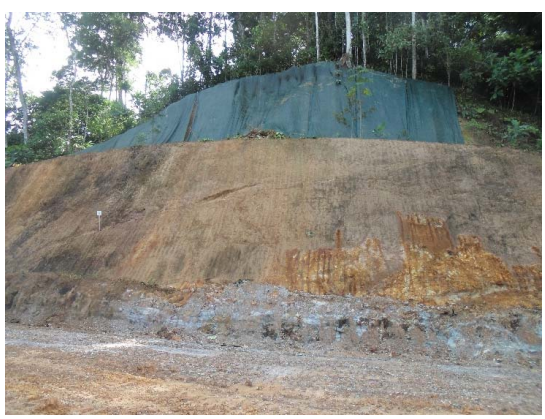
Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: yes Drainage Control: no Stabilization by Terraces: yes Sediment traps: no
Sowed Vegetation: yes Natural Vegetation: no

Condition in 2013

Condition in 2014



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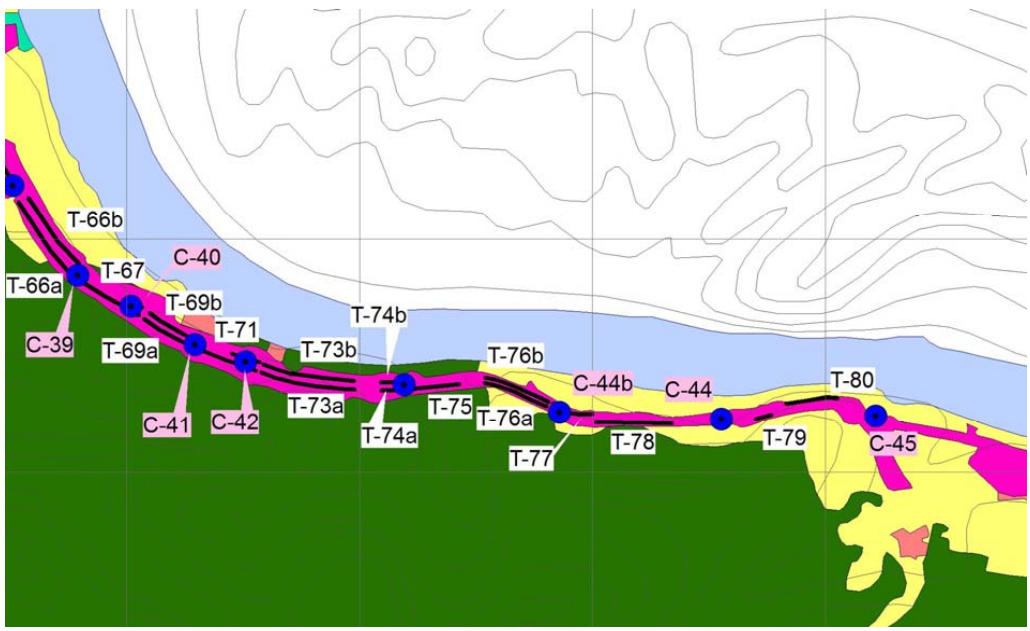
Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-68a*** ***Type:*** Fill Slope

Beginning (x/y): 468.837 / 1.204.586 ***End (x/y):*** 468.873 / 1.204.566

Slope Length (Range): 9.0 – 12.5 m ***Slope Length (Average):*** 10.4 m ***Slope Width:*** 40,4 m

Slope Surface Area: 420.0 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	20	84
Rills	20	84
Gullies	60	252
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 216.8

Estimated Erosion Rate (t / year): 362.1

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: yes Drainage Control: no Stabilization by Terraces: yes Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

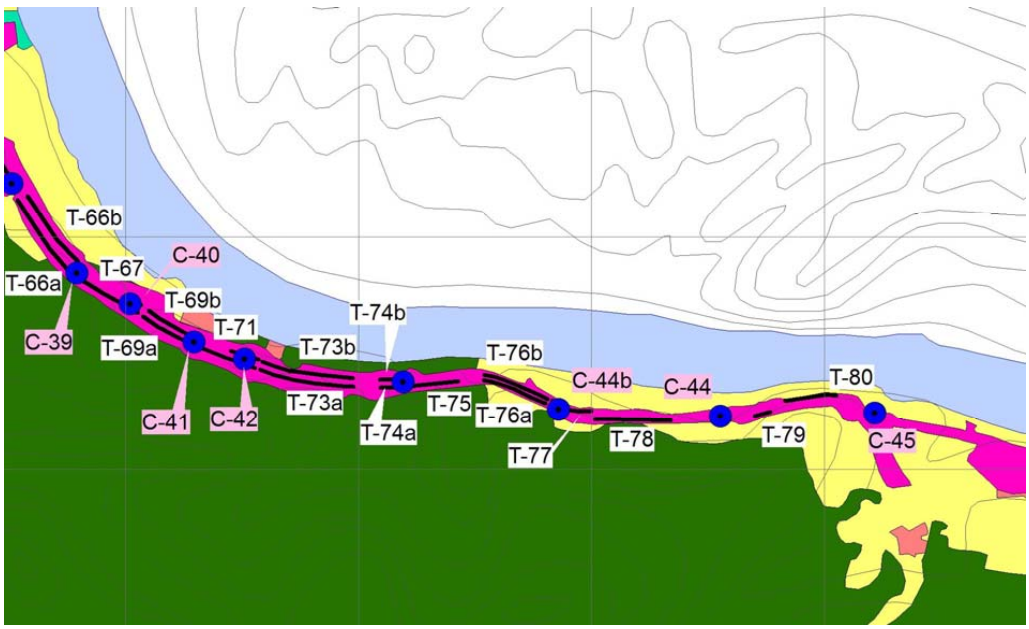
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-68b*** ***Type:*** Fill Slope

Beginning (x/y): 68.850 / 1.204.603 ***End (x/y):*** 468.881 / 1.204.585

Slope Surface Area (as calculated by UCR (2014) based upon UAV Photogrammetry): ***728 m²***

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	0	0
Rills	0	0
Gullies	100	728
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 553.3

Estimated Erosion Rate (t / year): 924.0

Mitigation Measures:

Mitigation Status: Mitigation in progress – UCR Site

Geotextiles: yes Drainage Control: no Stabilization by Terraces: yes Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

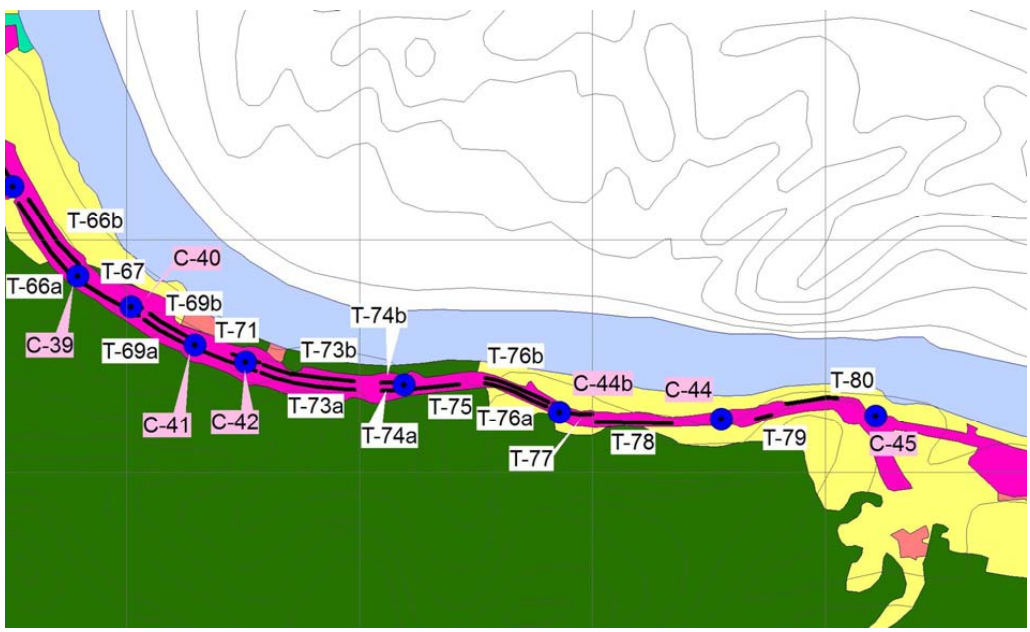
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-69a*** ***Type:*** Cut Slope

Beginning (x/y): 468.886 / 1.204.557 ***End (x/y):*** 468.971 / 1.204.505

Elevation Difference (Range): 5.0 – 16.5 m ***Elevation Difference (Average):*** 13.5 m ***Slope Length:*** 14.9 m

Slope Angle: 65º ***Slope Width:*** 99,9 m ***Slope Surface Area:*** 1488 **m²**

Geology: Volcanic Sequence, predominantly andesites and tuffs with varying degree of hydrothermal alteration (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	15	223
Rills	15	223
Gullies	50	744
Land Slides	20	198

Estimated Erosion Rate (m³/ year): 371.3

Estimated Erosion Rate (t / year): 620.0

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: yes Drainage Control: no Stabilization by Terraces: yes Sediment traps: no
Sowed Vegetation: yes Natural Vegetation: no

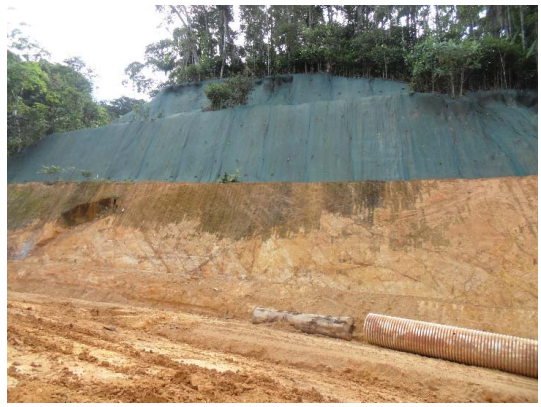
Condition in 2013

Condition in 2014

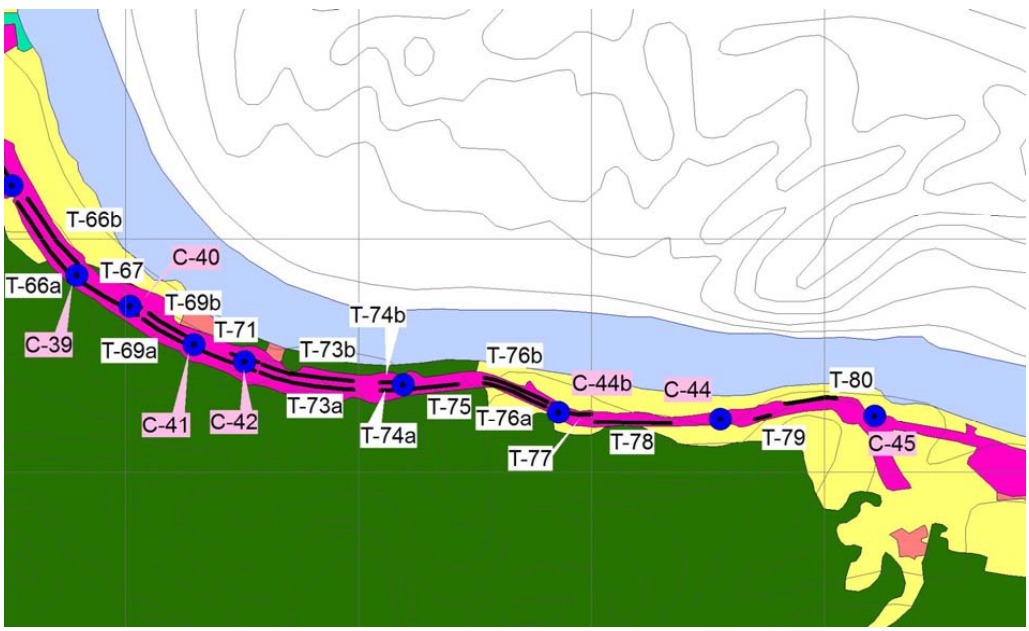
Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014



Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-69b*** ***Type:*** Fill Slope

Beginning (x/y): 468.899 / 1.204.571 ***End (x/y):*** 468.979/ 1.204.520

Slope Surface Area (as calculated by UCR (2014) based upon UAV Photogrammetry): 1292 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	0	0
Rills	0	0
Gullies	100	1292
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 981.9

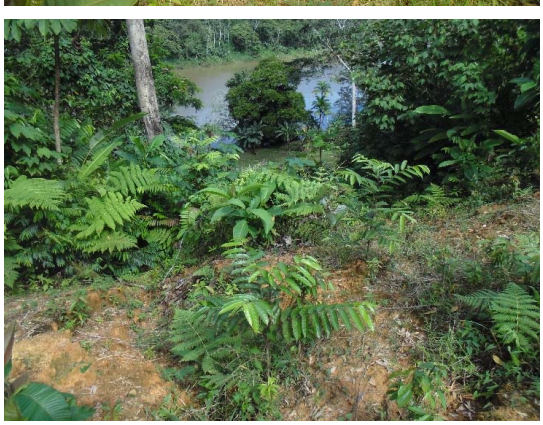
Estimated Erosion Rate (t / year): 1639.8

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013 ***Condition in 2014***

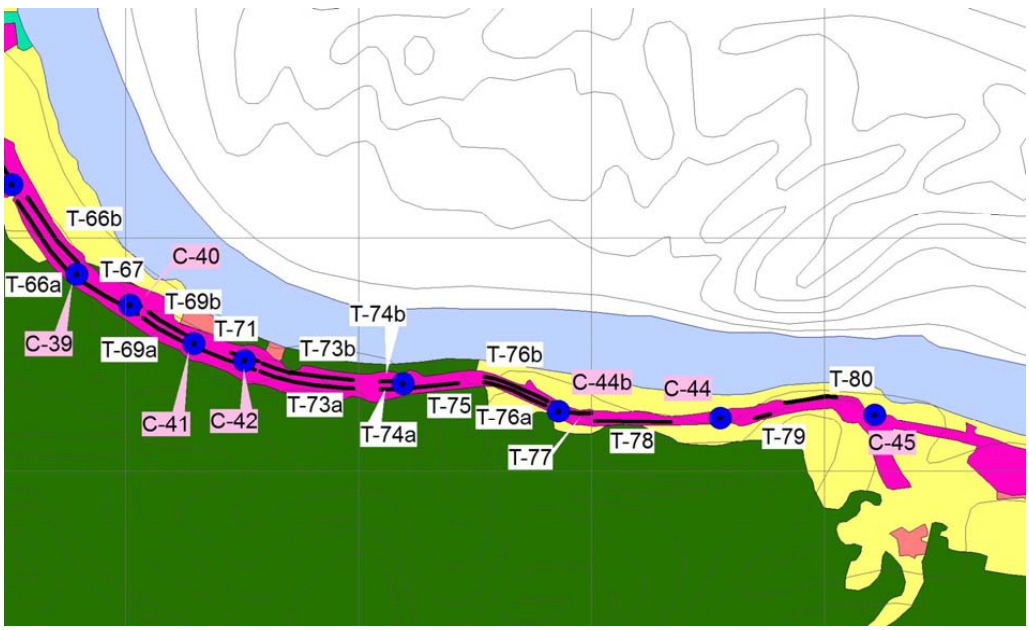


Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-70a*** ***Type:*** Fill Slope

Beginning (x/y): 468.977 / 1.204.502 ***End (x/y):*** 469.021 / 1.204.482

Slope Length (Range): 2.0 -6.0 m ***Slope Length (Average):*** 4.0 m ***Slope Width:*** 48.8 m

Slope Surface Area: 195 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	0	0
Rills	50	98
Gullies	50	98
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 89.8

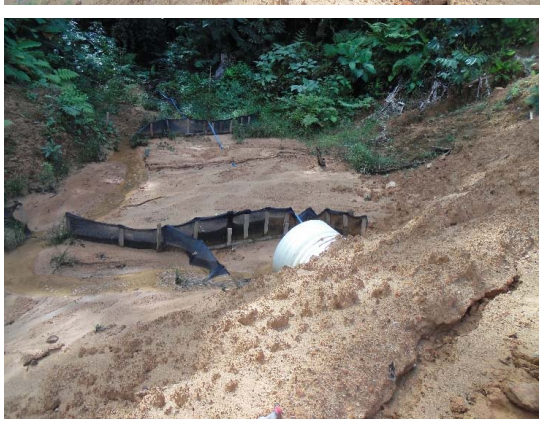
Estimated Erosion Rate (t / year): 150.0

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: yes Drainage Control: no Stabilization by Terraces: no Sediment traps: yes
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013 ***Condition in 2014***

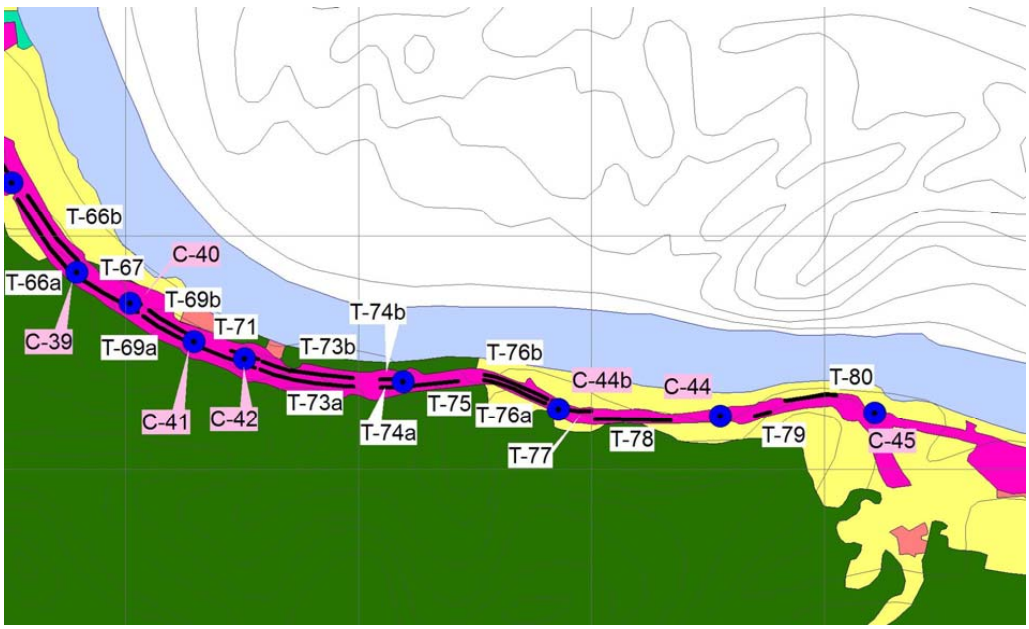


Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-70b*** ***Type:*** Fill Slope

Beginning (x/y): 468.985 / 1.204.518 ***End (x/y):*** 469.026 / 1.204.501

Slope Surface Area (as calculated by UCR (2014) based upon UAV Photogrammetry): 1809 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	0	0
Rills	0	0
Gullies	100	1809
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 1374.8

Estimated Erosion Rate (t / year): 2296.0

Mitigation Measures:

Mitigation Status: Mitigation in progress – UCR Site

Geotextiles: yes Drainage Control: no Stabilization by Terraces: yes Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

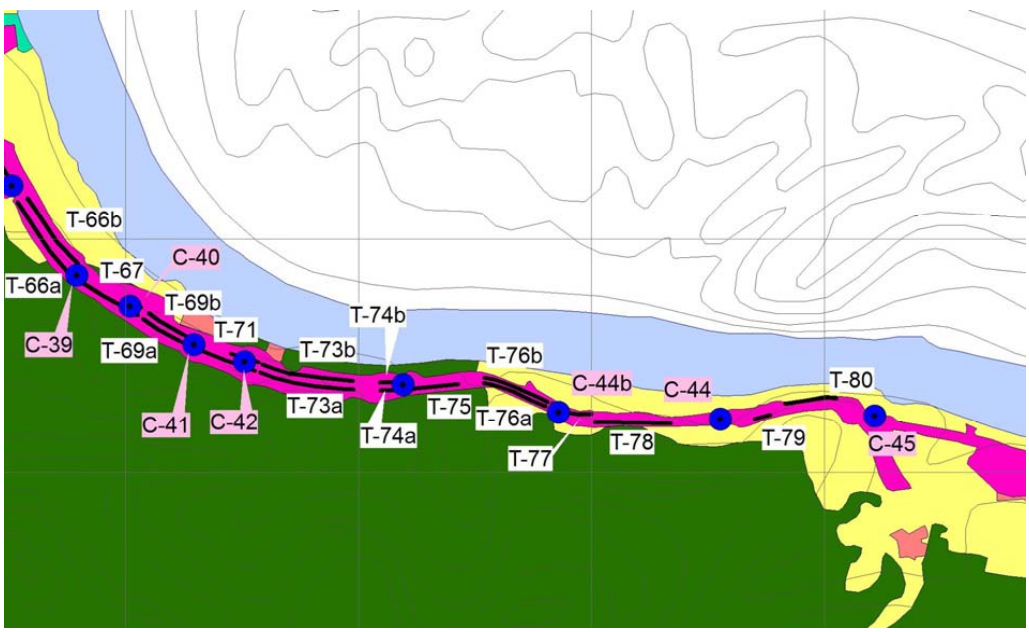
Condition in 2014

Condition in 2013

Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-71*** ***Type:*** Cut Slope

Beginning (x/y): 469.028 / 1.204.480 ***End (x/y):*** 469.081 / 1.204.458

Elevation Difference (Range): 8.0 – 20.5 m ***Elevation Difference (Average):*** 16.5 m ***Slope Length:*** 19.1 m

Slope Angle: 60º ***Slope Width:*** 57.7 m ***Slope Surface Area:*** 1099 **m²**

Geology: Volcanic Sequence, predominantly andesites and tuffs with varying degree of hydrothermal alteration (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	1099
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 77.0

Estimated Erosion Rate (t / year): 128.5

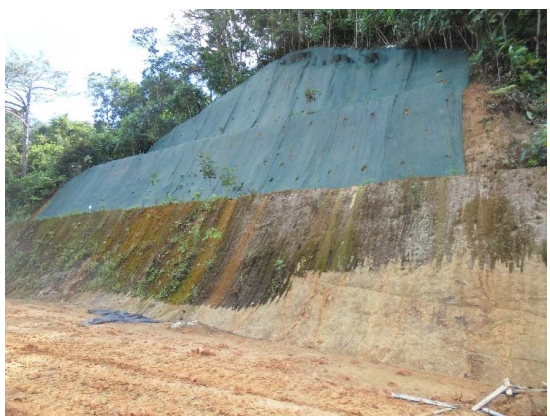
Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: yes Drainage Control: no Stabilization by Terraces: yes Sediment traps: no
Sowed Vegetation: yes Natural Vegetation: yes

Condition in 2013

Condition in 2014

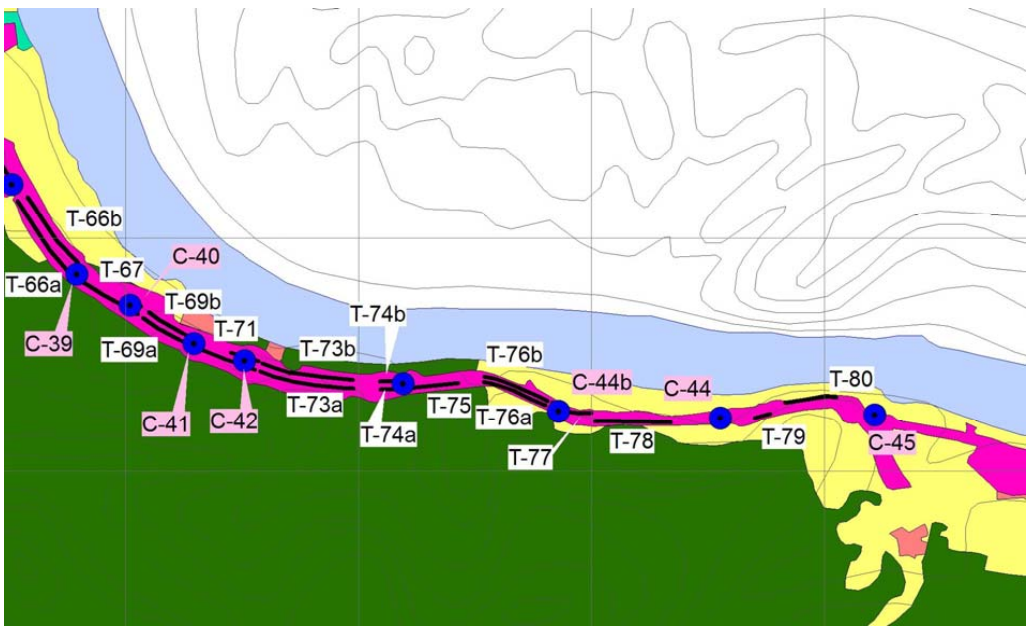


Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-72a*** ***Type:*** Fill Slope

Beginning (x/y): 469.085 / 1.204.457 ***End (x/y):*** 469.148 / 1.204.434

Slope Length (Range): 14.0 -18.0 m ***Slope Length (Average):*** 16.5 m ***Slope Width:*** 66.4 m

Slope Surface Area: 1096 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	0	0
Rills	0	0
Gullies	100	1096
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 832.7

Estimated Erosion Rate (t / year): 1390.5

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: yes Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

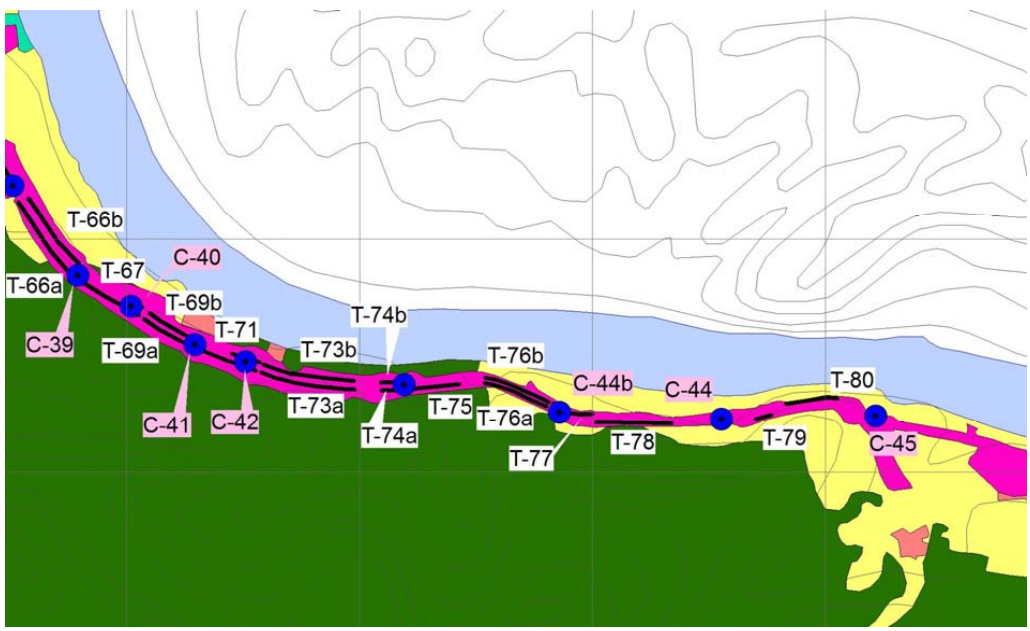
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-72b*** ***Type:*** Fill Slope

Beginning (x/y): 469.092 / 1.204.475 ***End (x/y):*** 469.157 / 1.204.454

Slope Surface Area (as calculated by UCR (2014) based upon UAV Photogrammetry): 3951 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	0	0
Rills	0	0
Gullies	100	3951
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 3002.8

Estimated Erosion Rate (t / year): 5014.6

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: yes Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

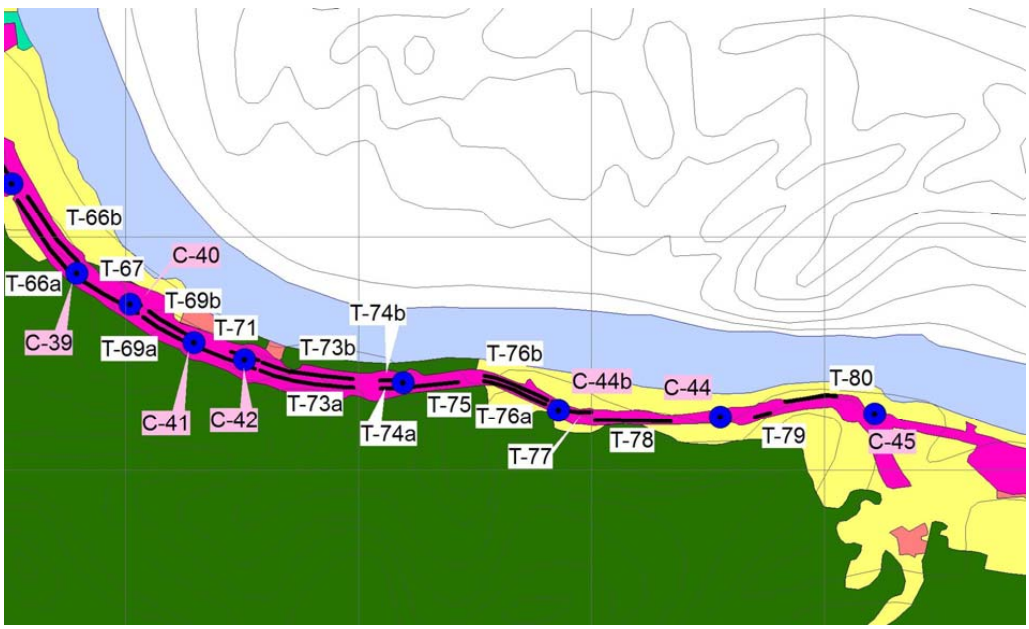
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-73a*** ***Type:*** Cut Slope

Beginning (x/y): 469.161 / 1.204.429 ***End (x/y):*** 469.379/ 1.204.389

Elevation Difference (Range): 5.0 -18.2 m ***Elevation Difference (Average):*** 10.0 m ***Slope Length:*** 11.0 m

Slope Angle: 65º ***Slope Width:*** 223.0 m ***Slope Surface Area:*** 2460 **m²**

Geology: Volcanic Sequence, predominantly andesites and tuffs with varying degree of hydrothermal alteration (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	25	615
Rills	25	615
Gullies	25	615
Land Slides	25	615

Estimated Erosion Rate (m³/ year): 553.6

Estimated Erosion Rate (t / year): 924.5

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: yes Drainage Control: no Stabilization by Terraces: yes Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

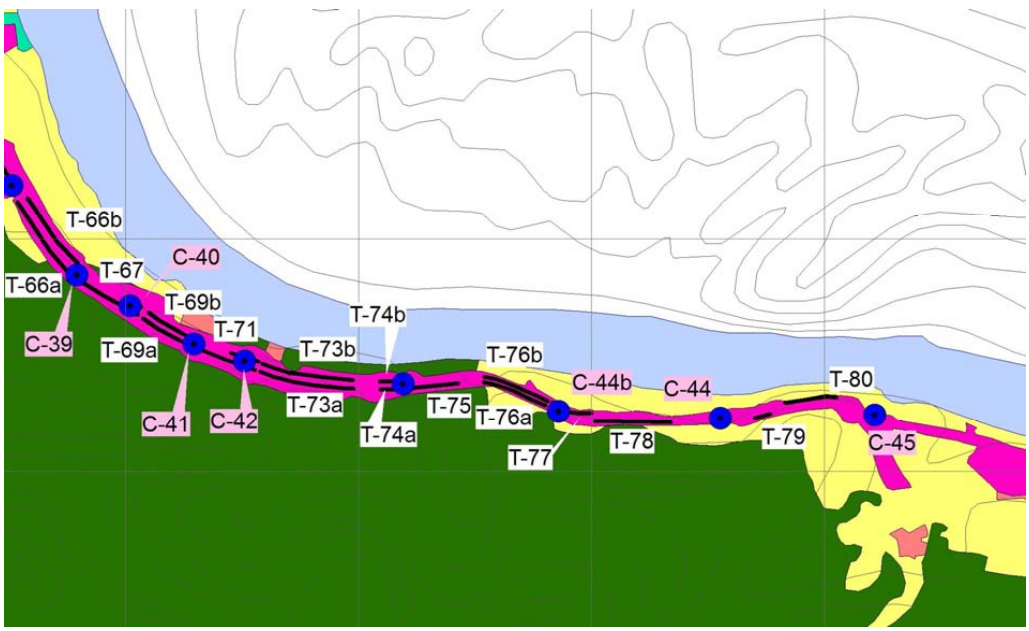
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-73b*** ***Type:*** Fill Slope

Beginning (x/y): 469.165 / 1.204.449 ***End (x/y):*** 469.377/ 1.204.410

Slope Length (Range): 28.0 – 42.0 m ***Slope Length (Average):*** 38.0 m ***Slope Width:*** 216.6 m

Slope Surface Area: 8231 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	30	2469
Rills	35	2881
Gullies	35	2881
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 2996.0

Estimated Erosion Rate (t / year): 5003.3

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

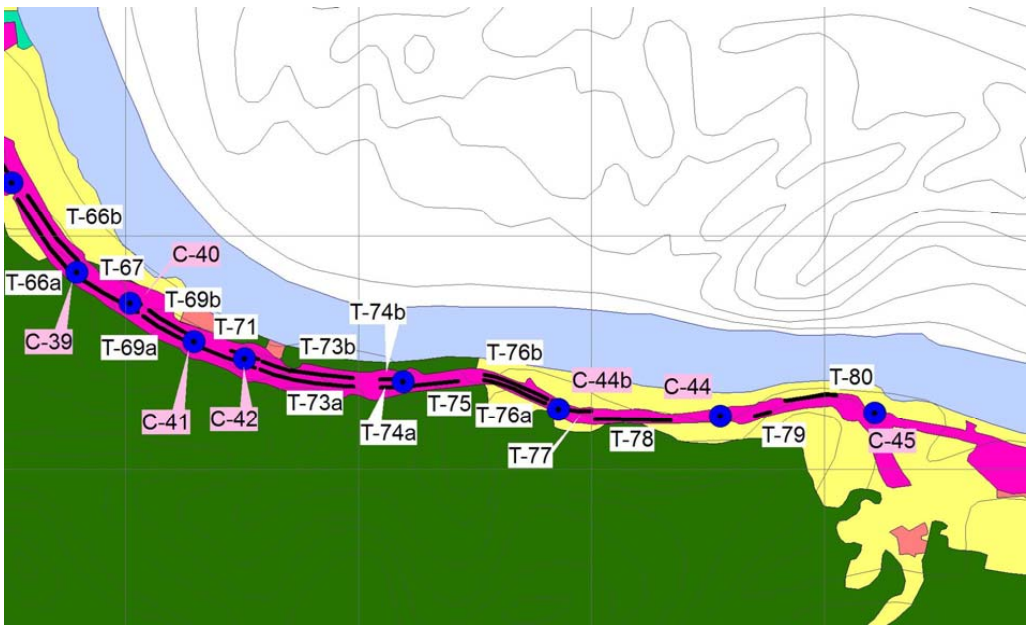
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-74a*** ***Type:*** Fill Slope

Beginning (x/y): 469.442 / 1.204.386 ***End (x/y):*** 469.506 / 1.204.388

Slope Length (Range): 3.0 – 6.0 m ***Slope Length (Average):*** 5.0 m ***Slope Width:*** 63.4m

Slope Surface Area: 317 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	40	127
Rills	20	63
Gullies	40	127
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 124.3

Estimated Erosion Rate (t / year): 207.5

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: yes Drainage Control: no Stabilization by Terraces: yes Sediment traps: yes
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

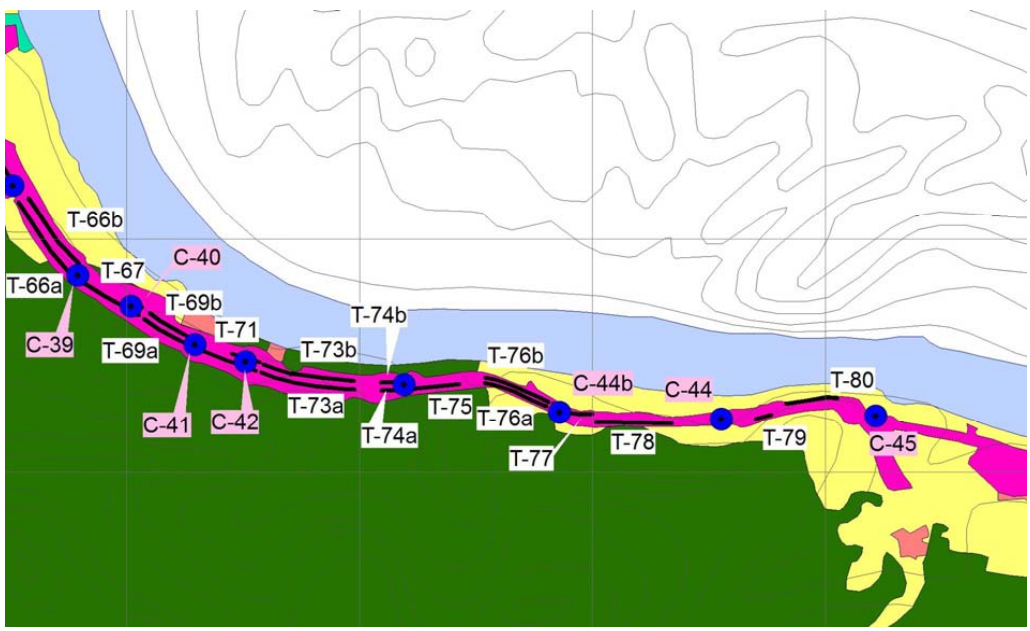
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-74b*** ***Type:*** Fill Slope

Beginning (x/y): 469.441/ 1.204.405 ***End (x/y):*** 469.503/ 1.204.407

Slope Surface Area (as calculated by UCR (2014) based upon UAV Photogrammetry): 2386 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	0	0
Rills	0	0
Gullies	100	2386
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 1813.4

Estimated Erosion Rate (t / year): 3028.3

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: yes Sediment traps: yes
Sowed Vegetation: no Natural Vegetation: no

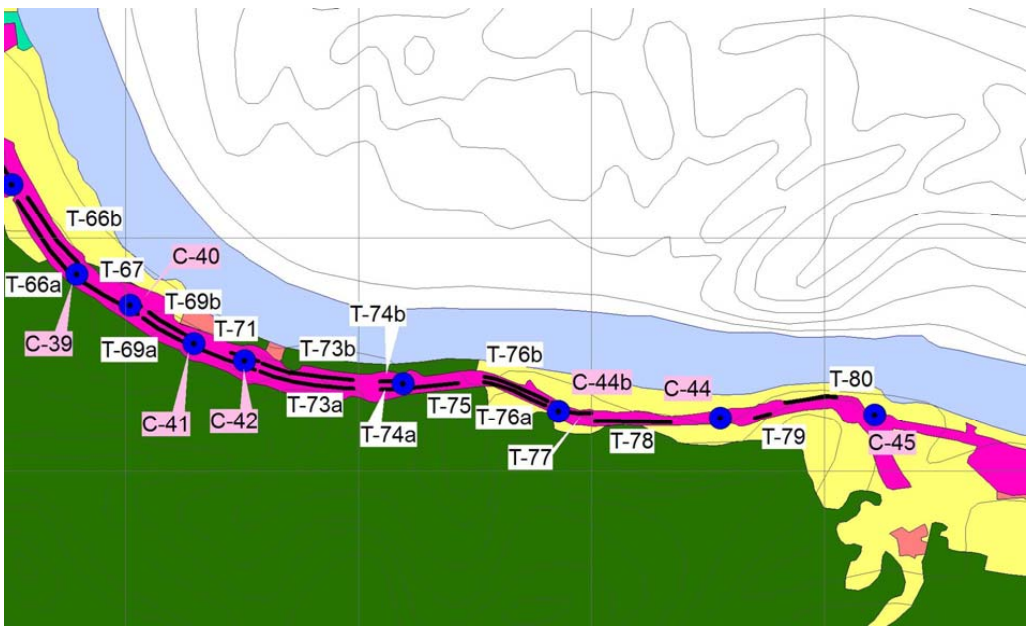
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-75*** ***Type:*** Cut Slope

Beginning (x/y): 469.513 / 1.204.390 ***End (x/y):*** 469.624 / 1.204.402

Elevation Difference (Range): 4.0 - 8.9 m ***Elevation Difference (Average):*** 7.6 m ***Slope Length:*** 8.1 m

Slope Angle: 70º ***Slope Width:*** 111.6 m ***Slope Surface Area:*** 903 **m²**

Geology: Volcaniclastic Brechas (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	50	451
Rills	30	271
Gullies	0	0
Land Slides	20	181

Estimated Erosion Rate (m³/ year): 147.1

Estimated Erosion Rate (t / year): 245.7

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: yes Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: yes Natural Vegetation: no

Condition in 2013

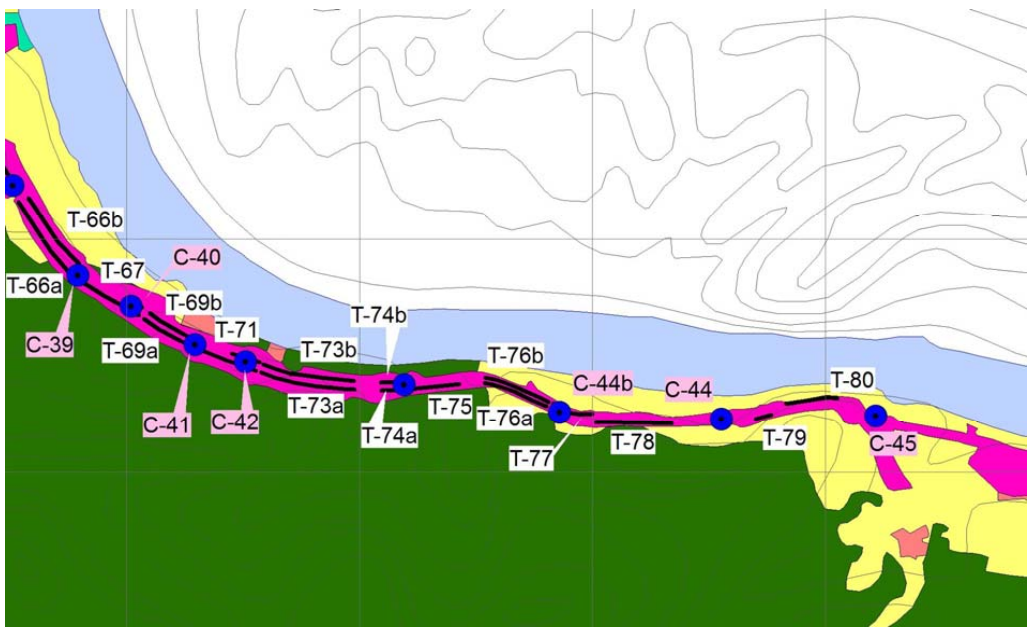
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-76a*** ***Type:*** Cut Slope

Beginning (x/y): 469.685 / 1.204.404 ***End (x/y):*** 469.829 / 1.204.348

Elevation Difference (Range): 2.0 – 4.0 m ***Elevation Difference (Average):*** 3.0 m ***Slope Length:*** 3.7 m

Slope Angle: 55º ***Slope Width:*** 151.1 m ***Slope Surface Area:*** 553 **m²**

Geology: Volcaniclastic Brechas (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	80	443
Rills	20	111
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 48.7

Estimated Erosion Rate (t / year): 81.3

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: yes Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: yes Natural Vegetation: no

Condition in 2013

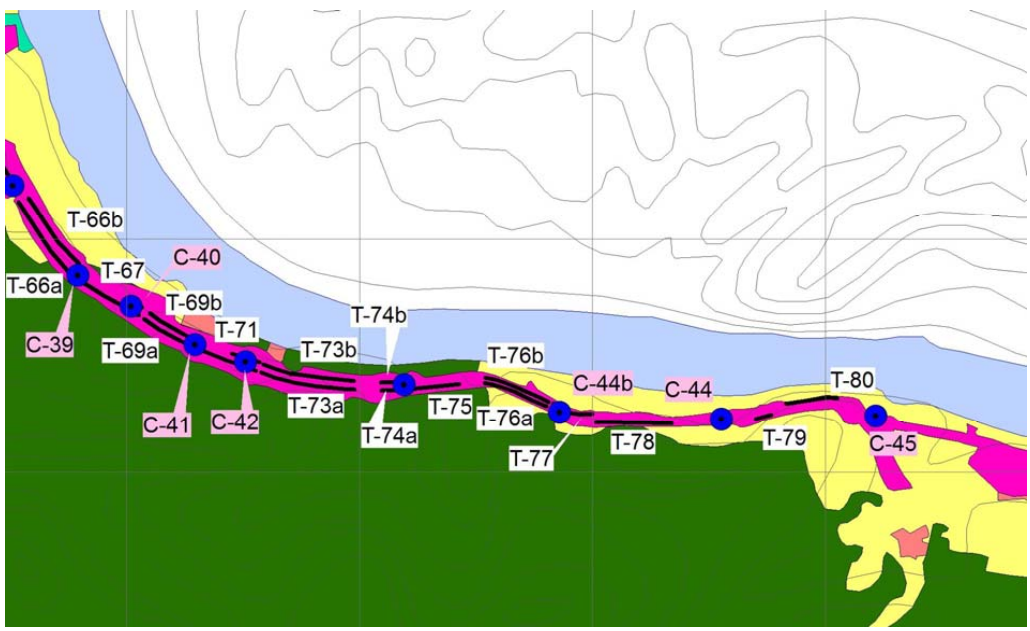
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-76b*** ***Type:*** Fill Slope

Beginning (x/y): 469.687 / 1.204.417 ***End (x/y):*** 469.834 / 1.204.359

Slope Length (Range): 8.0 – 10.0 m ***Slope Length (Average):*** 9.0 m ***Slope Width:*** 159.5 m

Slope Surface Area: 1436 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	80	1148
Rills	20	287
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 206.7

Estimated Erosion Rate (t / year): 345.2

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

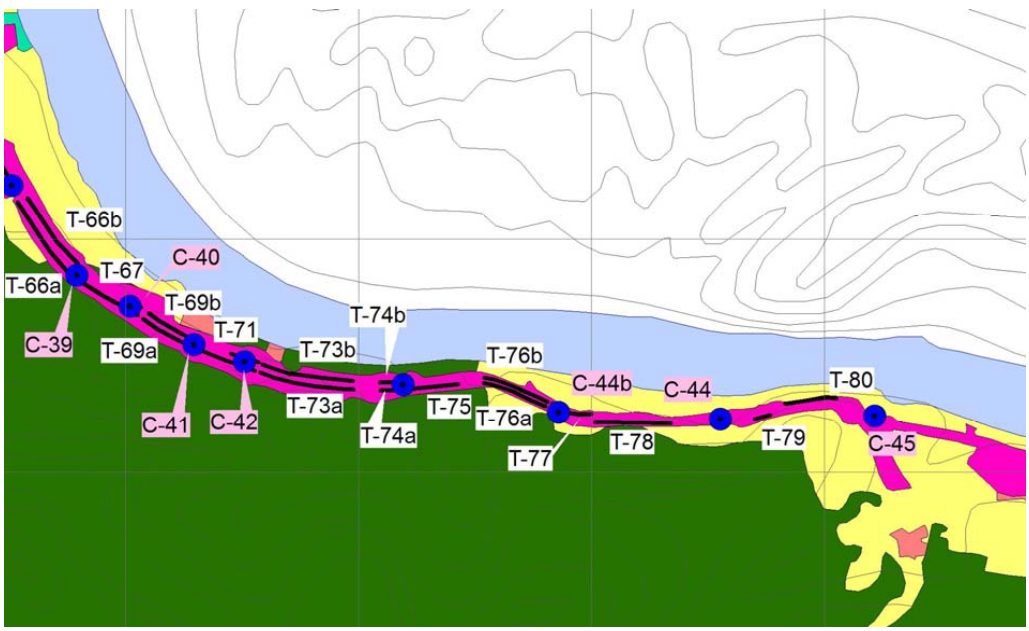
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-77*** ***Type:*** Fill Slope

Beginning (x/y): 469.846/ 1.204. 356 ***End (x/y):*** 469.937/ 1.204.330

Slope Length (Range): 3.0 – 5.0 m ***Slope Length (Average):*** 4.0 m ***Slope Width:*** 98.0 m

Slope Surface Area: 392 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	80	314
Rills	20	78
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 56.4

Estimated Erosion Rate (t / year): 94.3

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

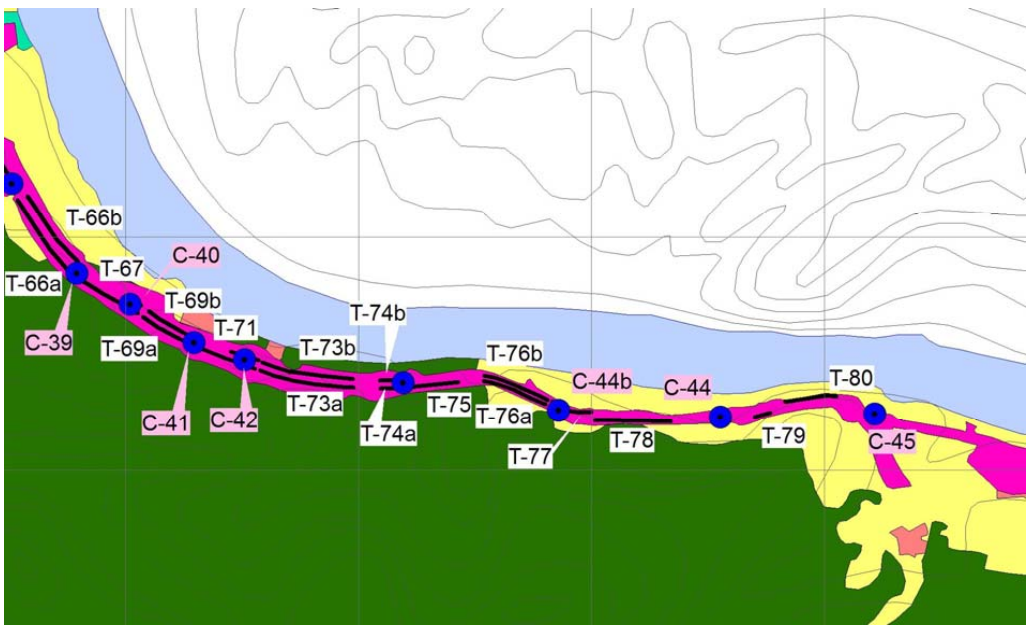
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-78*** ***Type:*** Cut Slope

Beginning (x/y): 469.946 / 1.204.311 ***End (x/y):*** 470.122 / 1.204.307

Elevation Difference (Range): 3.0 – 5.2 m ***Elevation Difference (Average):*** 4.0 m ***Slope Length:*** 4.9 m

Slope Angle: 55º ***Slope Width:*** 176.6 m ***Slope Surface Area:*** 862 **m²**

Geology: Volcaniclastic Brechas (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	90	776
Rills	10	86
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 68.1

Estimated Erosion Rate (t / year): 113.8

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

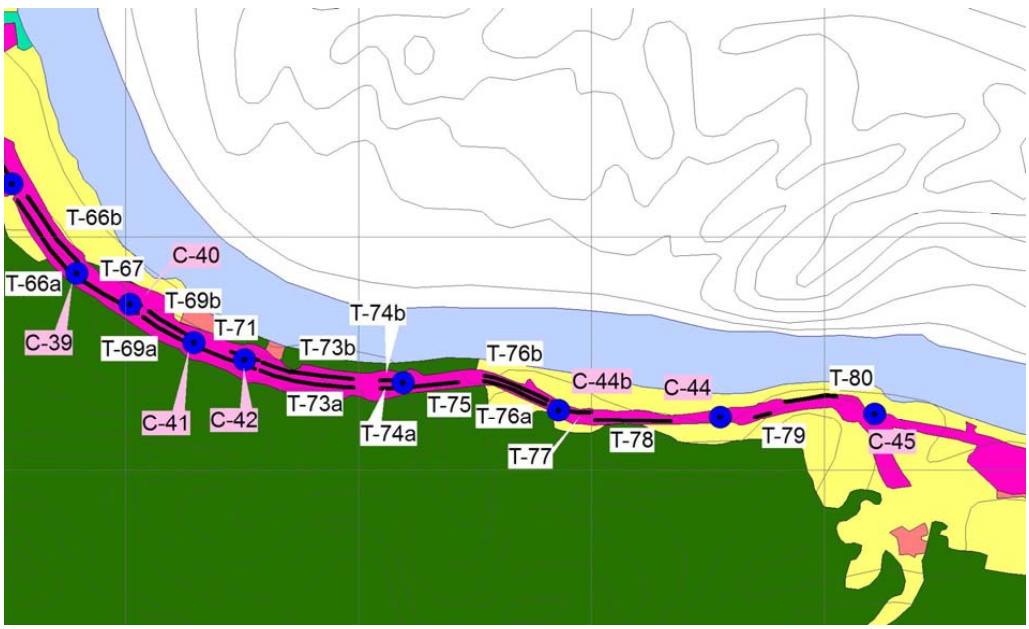
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-79*** ***Type:*** Cut Slope

Beginning (x/y): 470.320 / 1.204.318 ***End (x/y):*** 470.357 / 1.204.328

Elevation Difference (Range): 2.0 – 8.5 m ***Elevation Difference (Average):*** 6.8 m ***Slope Length:*** 7.9 m

Slope Angle: 60º ***Slope Width:*** 189.9 m ***Slope Surface Area:*** 1491 **m²**

Geology: Volcaniclastic Brechas (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	1491
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 104.4

Estimated Erosion Rate (t / year): 174.3

Mitigation Measures: ***Mitigation Status:*** Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

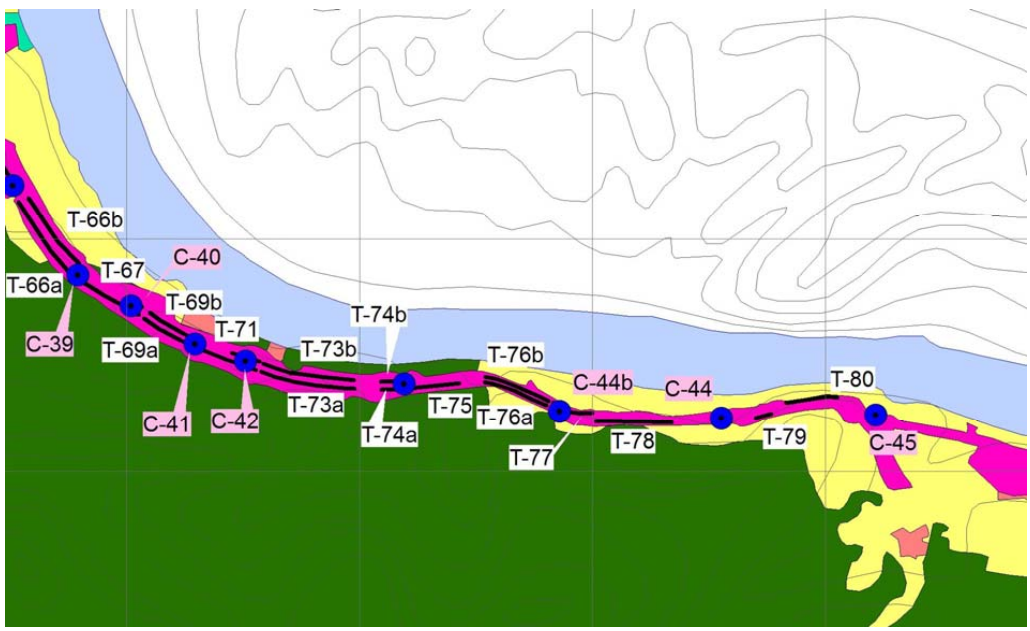
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-80*** ***Type:*** Cut Slope

Beginning (x/y): 470.392 / 1.204.354 ***End (x/y):*** 470.512 / 1.204.367

Elevation Difference (Range): 3.0 – 6.0 m ***Elevation Difference (Average):*** 4.5 m ***Slope Length:*** 5.9 m

Slope Angle: 50º ***Slope Width:*** 121.4 m ***Slope Surface Area:*** 713 **m²**

Geology: Volcaniclastic Brechas (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	713
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 49.9

Estimated Erosion Rate (t / year): 83.4

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

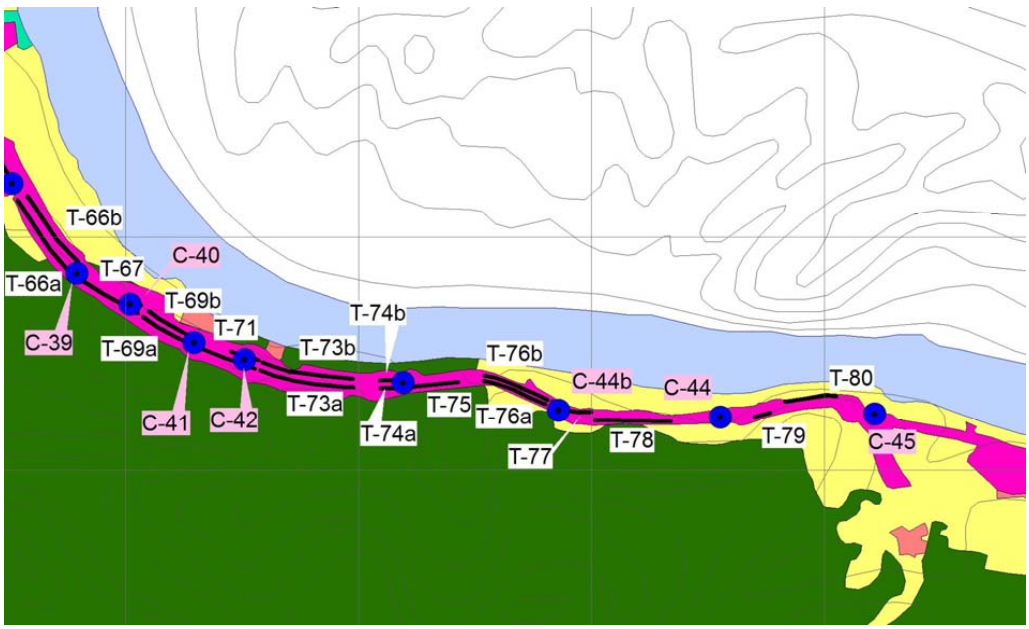
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-81*** ***Type:*** Cut Slope

Beginning (x/y): 472.263 / 1.204.028 ***End (x/y):*** 472.487 / 1.203.950

Elevation Difference (Range): 15.0 – 35.0 m ***Elevation Difference (Average):*** 23.0 m ***Slope Length:*** 30.0 m

Slope Angle: 50º ***Slope Width:*** 238.5 m ***Slope Surface Area:*** 7161 **m²**

Geology: Volcanic Sequence, predominantly andesites and tuffs with varying degree of hydrothermal alteration (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	50	3580
Rills	35	2506
Gullies	15	1074
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 941.6

Estimated Erosion Rate (t / year): 1572.6

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: yes Drainage Control: no Stabilization by Terraces: no Sediment traps: yes
Sowed Vegetation: yes Natural Vegetation: yes

Condition in 2013

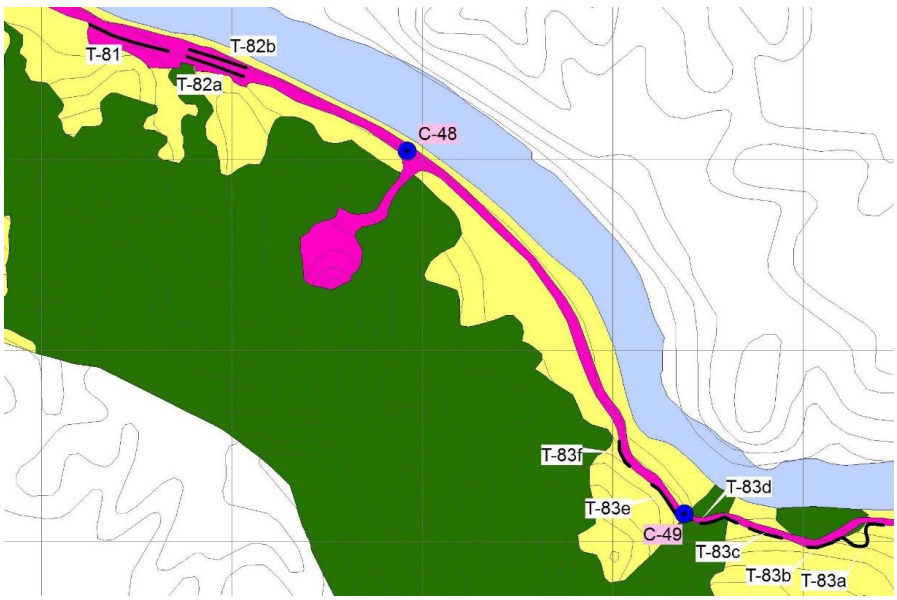
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-82a*** ***Type:*** Cut Slope

Beginning (x/y): 472.541/ 1.203.934 ***End (x/y):*** 472.703/ 1.203.877

Elevation Difference (Range): 3.0 – 8.0 m ***Elevation Difference (Average):*** 7.5 m ***Slope Length:*** 9.8 m

Slope Angle: 50º ***Slope Width:*** 171.6 m ***Slope Surface Area:*** 1680 **m²**

Geology: Volcanic Sequence, predominantly andesites and tuffs with varying degree of hydrothermal alteration (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	50	840
Rills	40	672
Gullies	10	168
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 211.7

Estimated Erosion Rate (t / year): 353.5

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: yes Drainage Control: no Stabilization by Terraces: no Sediment traps: yes
Sowed Vegetation: yes Natural Vegetation: no

Condition in 2013

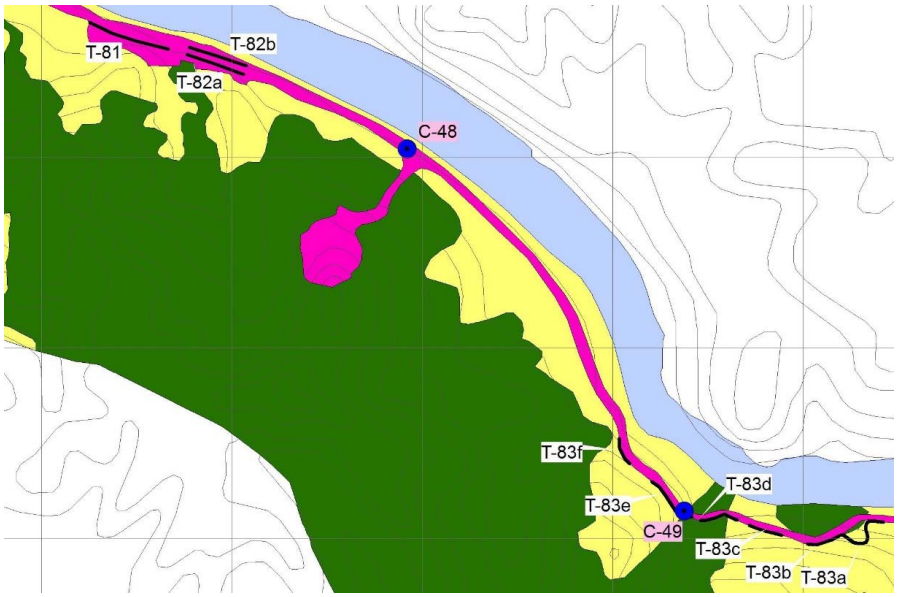
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-82b*** ***Type:*** Cut Slope

Beginning (x/y): 472.549/ 1.203.956 ***End (x/y):*** 472.711/ 1.203.902

Elevation Difference (Range): 6.0 – 14.4 m ***Elevation Difference (Average):*** 10.0 m ***Slope Length:*** 13.1 m

Slope Angle: 50º ***Slope Width:*** 170.6 m ***Slope Surface Area:*** 2227 **m²**

Geology:

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	50	1114
Rills	40	891
Gullies	10	223
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 280.6

Estimated Erosion Rate (t / year): 468.6

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: yes Drainage Control: yes Stabilization by Terraces: no Sediment traps: yes
Sowed Vegetation: yes Natural Vegetation: yes

Condition in 2013

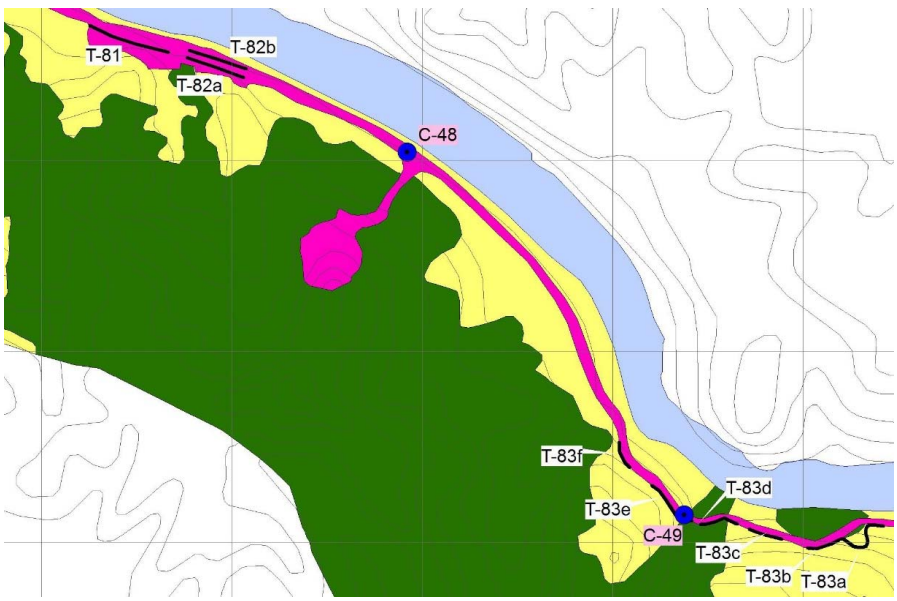
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-83f*** ***Type:*** Cut Slope

Beginning (x/y): 473.811 / 1.202.747 ***End (x/y):*** 473.781 / 1.202.818

Elevation Difference (Range): 3.0 – 3.5 m ***Elevation Difference (Average):*** 3.2 m ***Slope Length:*** 3.9 m

Slope Angle: 55ª ***Slope Width:*** 81.0 m ***Slope Surface Area:*** 316 **m²**

Geology: Volcanic Sequence, predominantly andesites and tuffs with varying degree of hydrothermal alteration (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	316
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 22.1

Estimated Erosion Rate (t / year): 37.0

Mitigation Measures:

Mitigation Status: Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

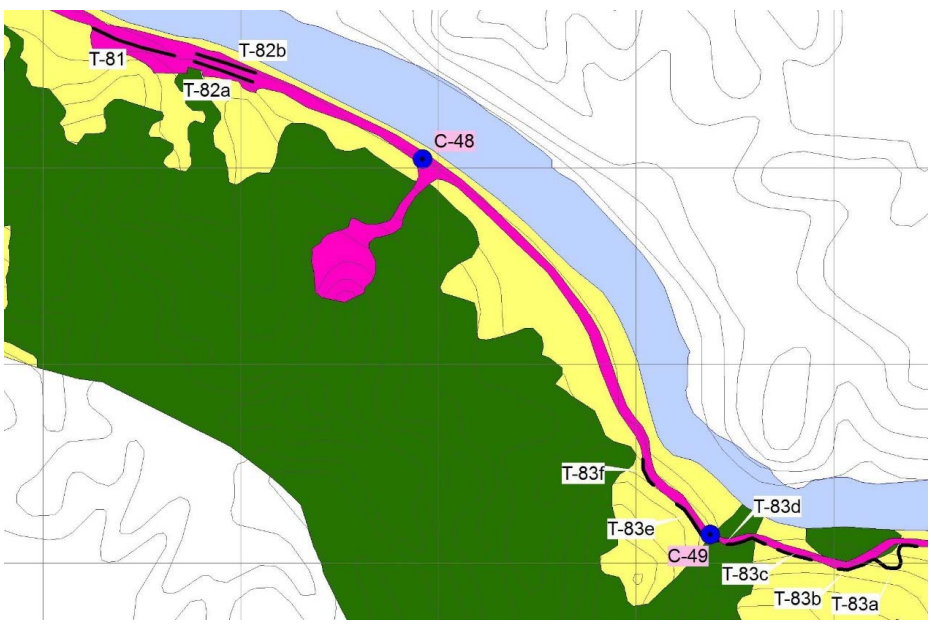
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-83e*** ***Type:*** Cut Slope

Beginning (x/y): 473.988 / 1.202.591 ***End (x/y):*** 473.874 / 1.202.694

Elevation Difference (Range): 5.0 - 8.0 m ***Elevation Difference (Average):*** 6.5 m ***Slope Length:*** 8.5 m

Slope Angle: 50º ***Slope Width:*** 160.0 m ***Slope Surface Area:*** 1358 **m²**

Geology: Volcanic Sequence, predominantly andesites and tuffs with varying degree of hydrothermal alteration (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	80	1086
Rills	0	0
Gullies	0	0
Land Slides	20	272

Estimated Erosion Rate (m³/ year): 184.6

Estimated Erosion Rate (t / year): 308.3

Mitigation Measures: ***Mitigation Status:*** Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

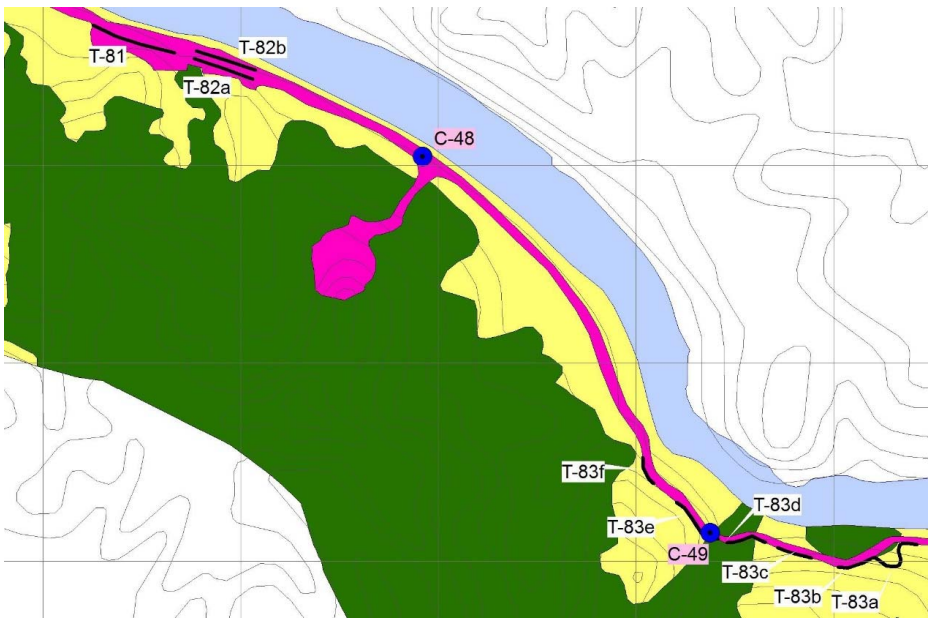
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-83d*** ***Type:*** Cut Slope

Beginning (x/y): 474.119 / 1.202.582 ***End (x/y):*** 474.014 / 1.202.580

Elevation Difference (Range): 3.5 – 8.0 m ***Elevation Difference (Average):*** 6.0 m ***Slope Length:*** 7.8 m

Slope Angle: 50º ***Slope Width:*** 111.4 m ***Slope Surface Area:*** 873 m^2

Geology: Volcanic Sequence, predominantly andesites and tuffs with varying degree of hydrothermal alteration (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	75	873
Rills	0	0
Gullies	0	0
Land Slides	25	218

Estimated Erosion Rate (m^3/ year): 133.1

Estimated Erosion Rate (t / year): 222.2

Mitigation Measures: ***Mitigation Status:*** Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

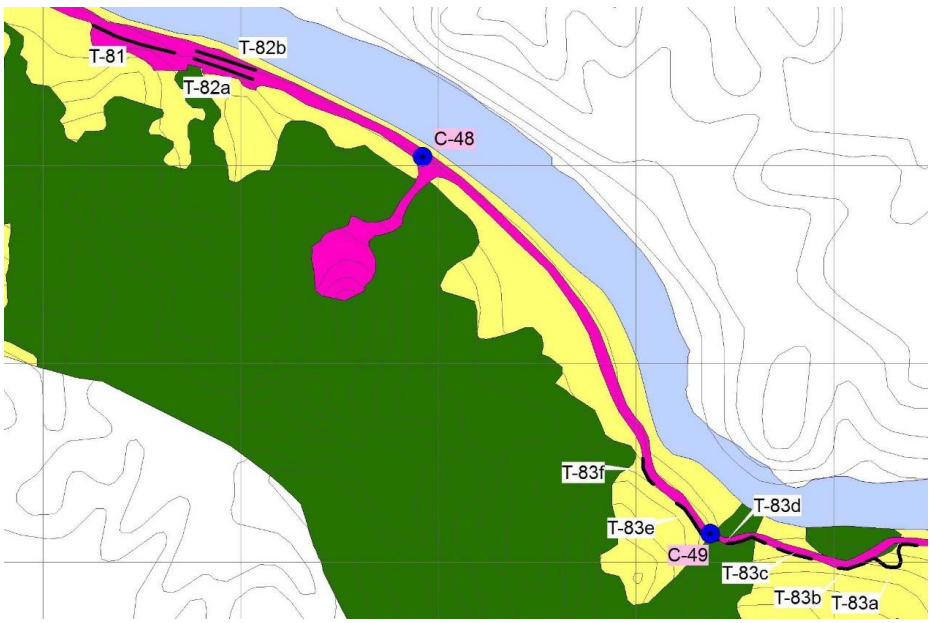
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-83c*** ***Type:*** Cut Slope

Beginning (x/y): 474.246 / 1.202.538 ***End (x/y):*** 474.153 / 1.202.566

Elevation Difference (Range):8.0 – 12.5 m ***Elevation Difference (Average):*** 9.0 m ***Slope Length:*** 11.7 m

Slope Angle: 50º ***Slope Width:*** 97.1 m ***Slope Surface Area:*** 1141 **m²**

Geology: Volcanic Sequence, predominantly andesites and tuffs with varying degree of hydrothermal alteration (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	85	970
Rills	0	0
Gullies	0	0
Land Slides	15	171

Estimated Erosion Rate (m³/ year): 136.3

Estimated Erosion Rate (t / year): 227.7

Mitigation Measures:

Mitigation Status: Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

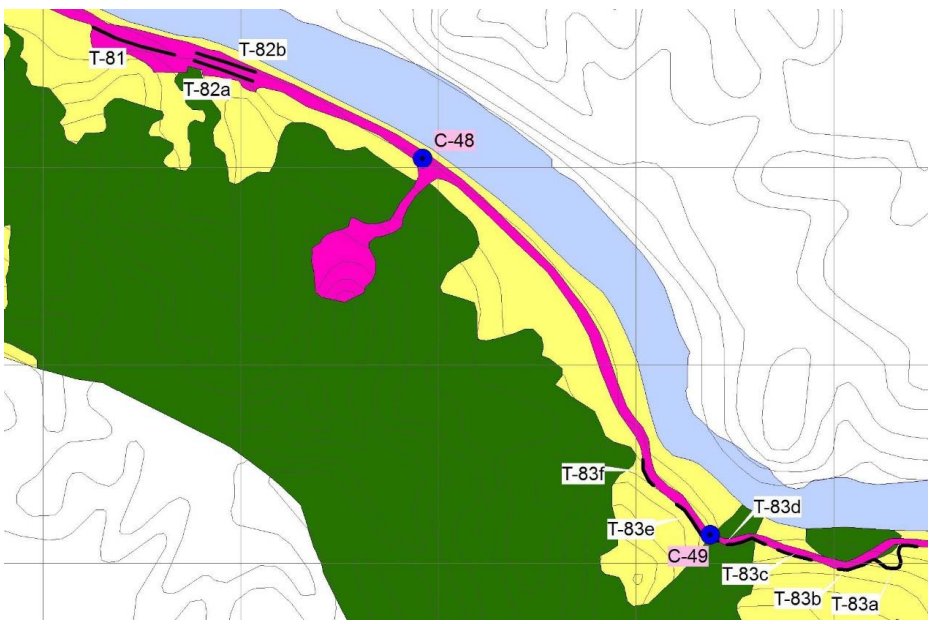
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-83b*** ***Type:*** Cut Slope

Beginning (x/y): 474.410 / 1.202.535 ***End (x/y):*** 474.322 / 1.202.512

Elevation Difference (Range): 3.0 – 5.0 m ***Elevation Difference (Average):*** 4.0 m ***Slope Length:*** 4.6 m

Slope Angle:60º ***Slope Width:*** 93.9 m ***Slope Surface Area:*** 434 **m²**

Geology: Volcaniclastic Brechas (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	90	390
Rills	0	0
Gullies	0	0
Land Slides	10	43

Estimated Erosion Rate (m³/ year): 44.7

Estimated Erosion Rate (t / year): 74.6

Mitigation Measures: ***Mitigation Status:*** Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

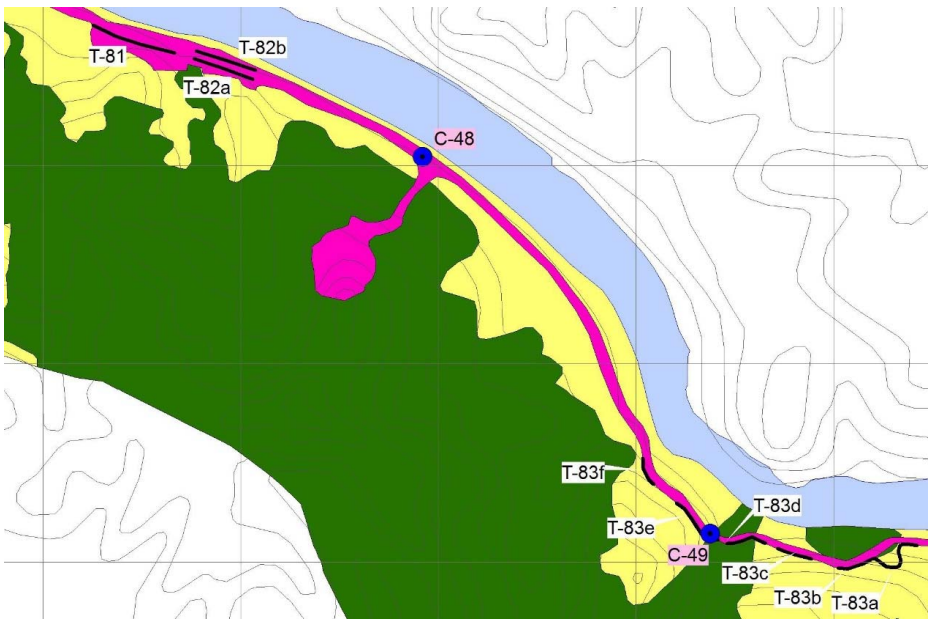
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-83a*** ***Type:*** Cut Slope

Beginning (x/y): 474.539 / 1.202.576 ***End (x/y):*** 474.415 / 1.202.538

Elevation Difference (Range): 3.0 - 34.6 m ***Elevation Difference (Average):*** 28.0 m ***Slope Length:*** 34.2 m

Slope Angle: 55º ***Slope Width:*** 189.8 m ***Slope Surface Area:*** 6488 **m²**

Geology: Volcanic Sequence, predominantly andesites and tuffs with varying degree of hydrothermal alteration (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	50	3244
Rills	30	1946
Gullies	20	1298
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 888.8

Estimated Erosion Rate (t / year): 1484.3

Mitigation Measures: ***Mitigation Status:*** Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

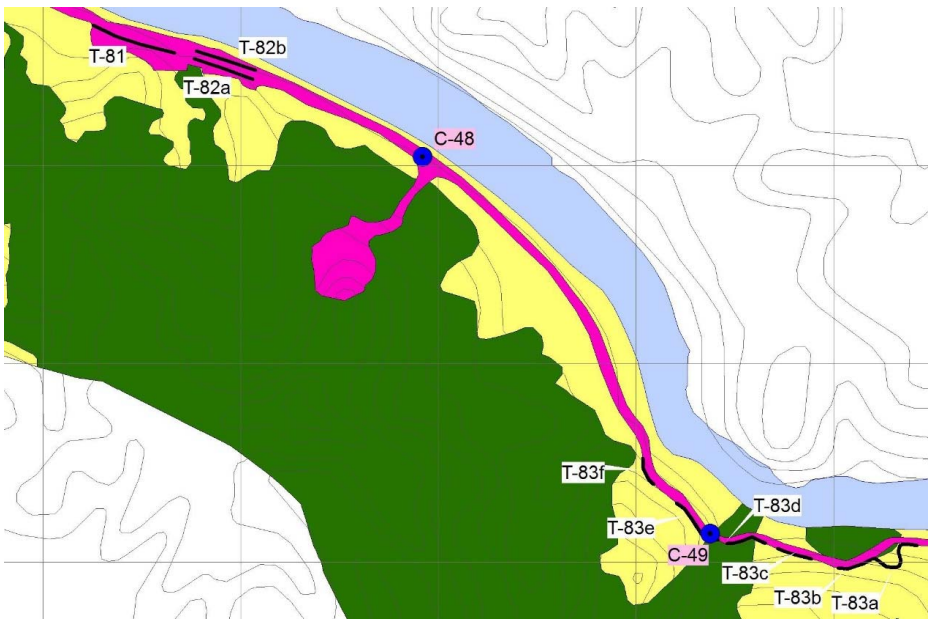
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-84*** ***Type:*** Cut Slope

Beginning (x/y): 475.639 / 1.201.693 ***End (x/y):*** 475.700 / 1.201.613

Elevation Difference (Range): 1.5 – 5.0 m ***Elevation Difference (Average):*** 4.5 m ***Slope Length:*** 5.0 m

Slope Angle: 65º ***Slope Width:*** 100.5 m ***Slope Surface Area:*** 549 **m²**

Geology: Volcanic Sequence, predominantly andesites and tuffs with varying degree of hydrothermal alteration (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	80	439
Rills	20	110
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 48.3

Estimated Erosion Rate (t / year): 80.6

Mitigation Measures: ***Mitigation Status:*** Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

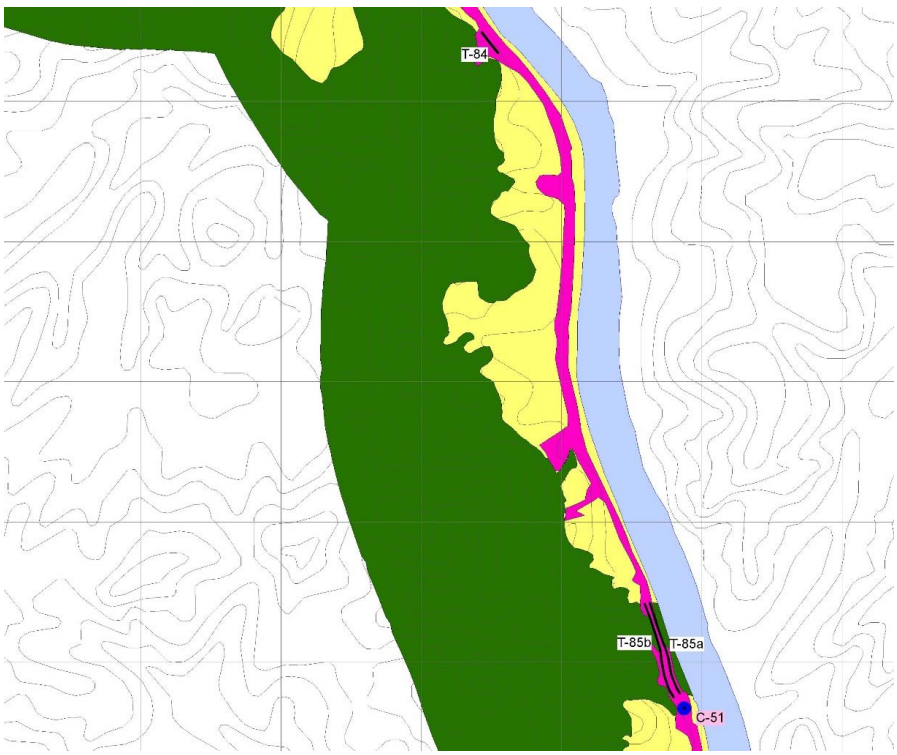
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-85a*** ***Type:*** Cut Slope

Beginning (x/y): 476.383 / 1.199.074 ***End (x/y):*** 476.271 / 1.199.439

Elevation Difference (Range): 2.5 – 12.0 m ***Elevation Difference (Average):*** 8.0 m ***Slope Length:*** 9.2 m

Slope Angle: 60º ***Slope Width:*** 375.5 m ***Slope Surface Area:*** 3469 **m²**

Geology: Volcaniclastic Brechas (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	50	1734
Rills	30	1041
Gullies	20	694
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 475.2

Estimated Erosion Rate (t / year): 793.6

Mitigation Measures: ***Mitigation Status:*** Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

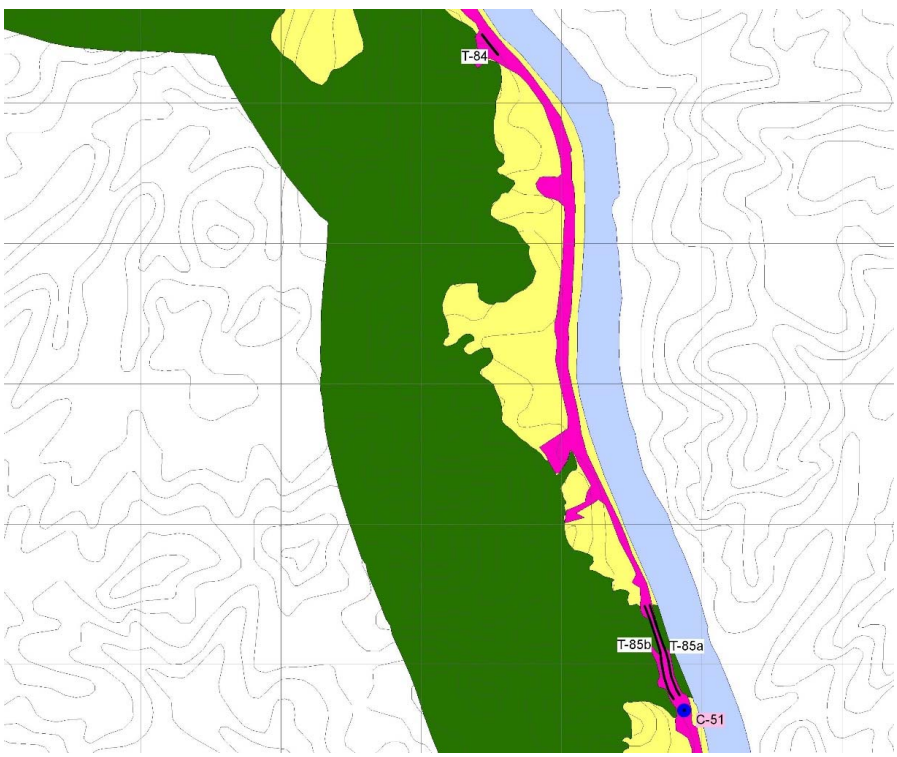
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-85b*** ***Type:*** Cut Slope

Beginning (x/y): 476.291 / 1.199.444 ***End (x/y):*** 476.407 / 1.199.088

Elevation Difference (Range): 4.5 – 20.0 m ***Elevation Difference (Average):*** 12.0 m ***Slope Length:*** 13.2 m

Slope Angle: 65º ***Slope Width:*** 375.5 m ***Slope Surface Area:*** 4972 **m²**

Geology: Volcaniclastic Brechas (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	50	2486
Rills	15	746
Gullies	15	746
Land Slides	20	994

Estimated Erosion Rate (m³/ year): 892.4

Estimated Erosion Rate (t / year): 1490.4

Mitigation Measures:

Mitigation Status: Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

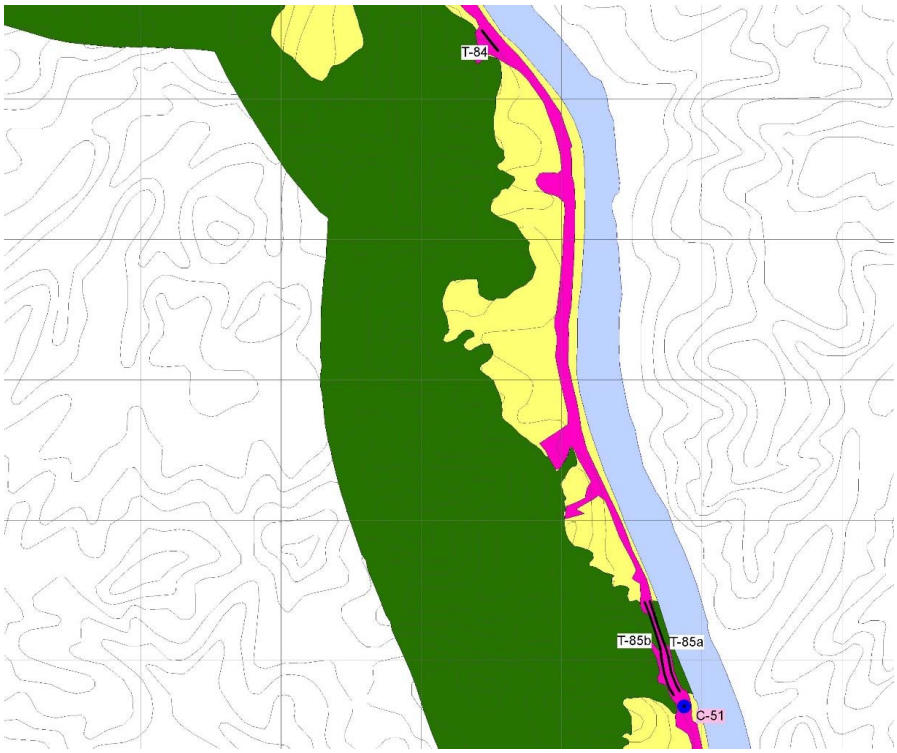
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-86*** ***Type:*** Cut Slope

Beginning (x/y): 474.632 / 1.196. 714 ***End (x/y):*** 474.943 / 1.196.753

Elevation Difference (Range): 1.0 – 3.6 m ***Elevation Difference (Average):*** 2.8 m ***Slope Length:*** 3.4 m

Slope Angle: 55º ***Slope Width:*** 332.8 m ***Slope Surface Area:*** 1138 **m²**

Geology: Volcaniclastic Brechas (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	40	455
Rills	0	0
Gullies	0	0
Land Slides	60	683

Estimated Erosion Rate (m³/ year): 304.9

Estimated Erosion Rate (t / year): 509.1

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

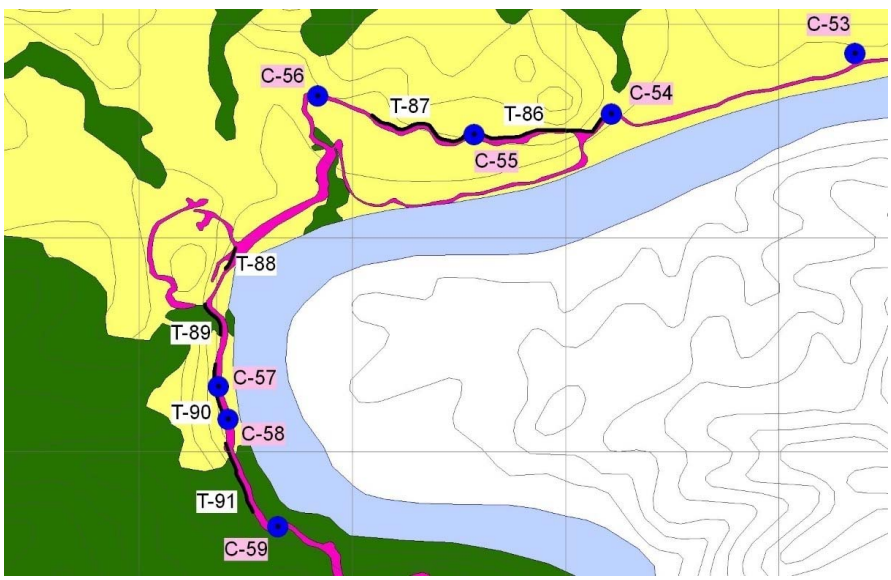
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-87*** ***Type:*** Cut Slope

Beginning (x/y): 474.354 / 1.196.763 ***End (x/y):*** 474.601 / 1.196.720

Elevation Difference (Range):2.0 – 3.0 m ***Elevation Difference (Average):***2.6 m ***Slope Length:*** 3.0 m

Slope Angle: 60º ***Slope Width:*** 289,0 m ***Slope Surface Area:*** 868 **m²**

Geology: Volcanic Sequence, predominantly andesites and tuffs with varying degree of hydrothermal alteration (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	50	434
Rills	15	130
Gullies	10	87
Land Slides	25	217

Estimated Erosion Rate (m³/ year): 161.4

Estimated Erosion Rate (t / year): 269.5

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

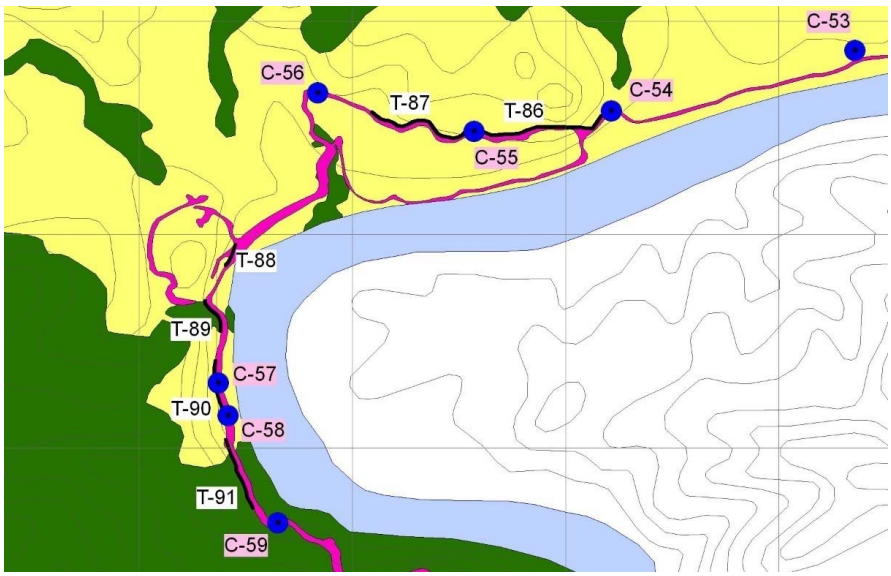
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-88*** ***Type:*** Cut Slope

Beginning (x/y): 474.004 / 1.196.420 ***End (x/y):*** 473.980 / 1.196.367

Elevation Difference (Range): 6.0 – 12.2 m ***Elevation Difference (Average):*** 8.5 m ***Slope Length:*** 10.4 m

Slope Angle: 55º ***Slope Width:*** 58.8 m ***Slope Surface Area:*** 610 **m²**

Geology: Volcanic Sequence, predominantly andesites and tuffs with varying degree of hydrothermal alteration (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	610
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 42.7

Estimated Erosion Rate (t / year): 71.3

Mitigation Measures:

Mitigation Status: Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

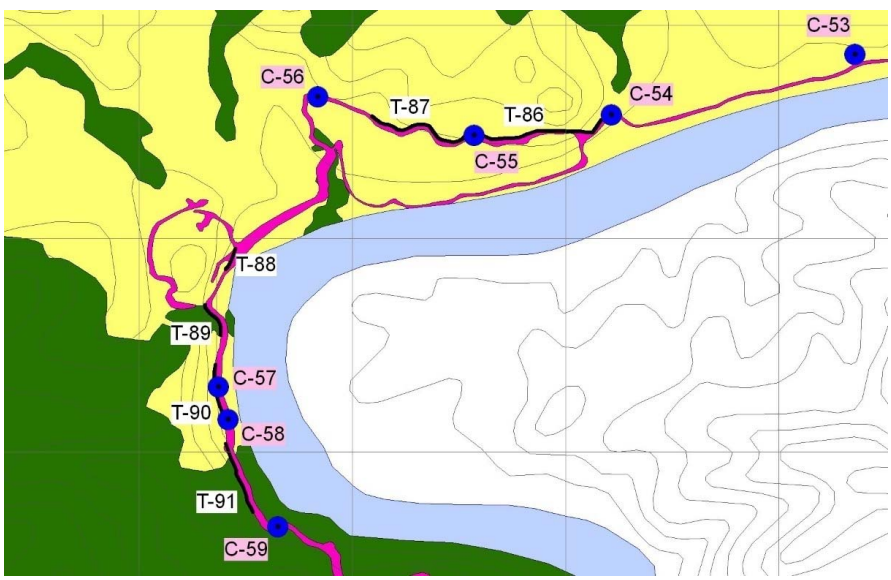
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-89*** ***Type:*** Cut Slope

Beginning (x/y): 473.967 / 1.196.195 ***End (x/y):*** 473.926 / 1.196.275

Elevation Difference (Range): 2.0 – 2.6 m ***Elevation Difference (Average):*** 2.3 m ***Slope Length:*** 2.8 m

Slope Angle: 55º ***Slope Width:*** 95.2 m ***Slope Surface Area:*** 267 **m²**

Geology: Ophiolitic Complex of Cretaceous to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	60	160
Rills	15	40
Gullies	0	0
Land Slides	25	67

Estimated Erosion Rate (m³/ year): 44.4

Estimated Erosion Rate (t / year): 74.1

Mitigation Measures: ***Mitigation Status:*** Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

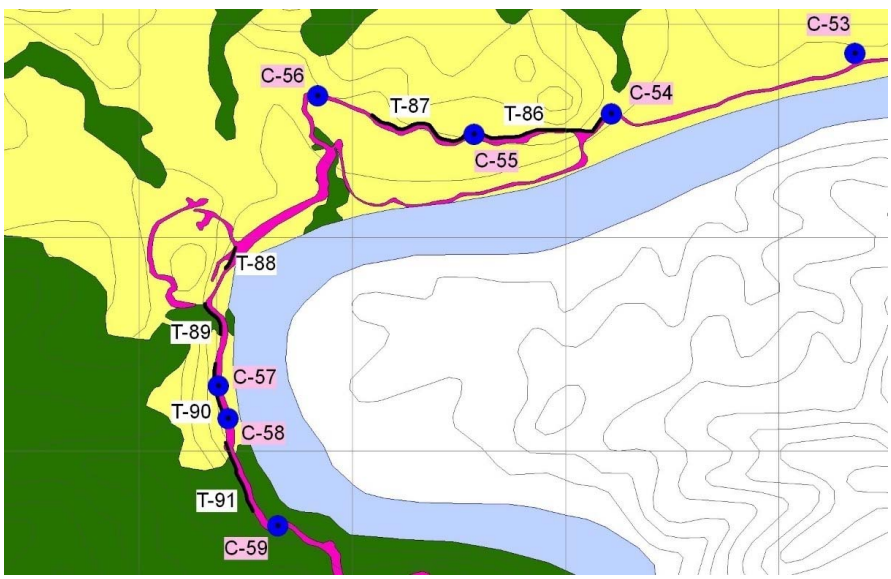
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-90*** ***Type:*** Cut Slope

Beginning (x/y): 473.973 / 1.195.987 ***End (x/y):*** 473.952 / 1.196.120

Elevation Difference (Range): 3.0 – 4.2 m ***Elevation Difference (Average):*** 3.5 m ***Slope Length:*** 4.3 m

Slope Angle: 55º ***Slope Width:*** 136.7 m ***Slope Surface Area:*** 584 **m²**

Geology: Ophiolitic Complex of Cretaceous to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	70	409
Rills	20	117
Gullies	0	0
Land Slides	10	58

Estimated Erosion Rate (m³/ year): 70.7

Estimated Erosion Rate (t / year): 118.0

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

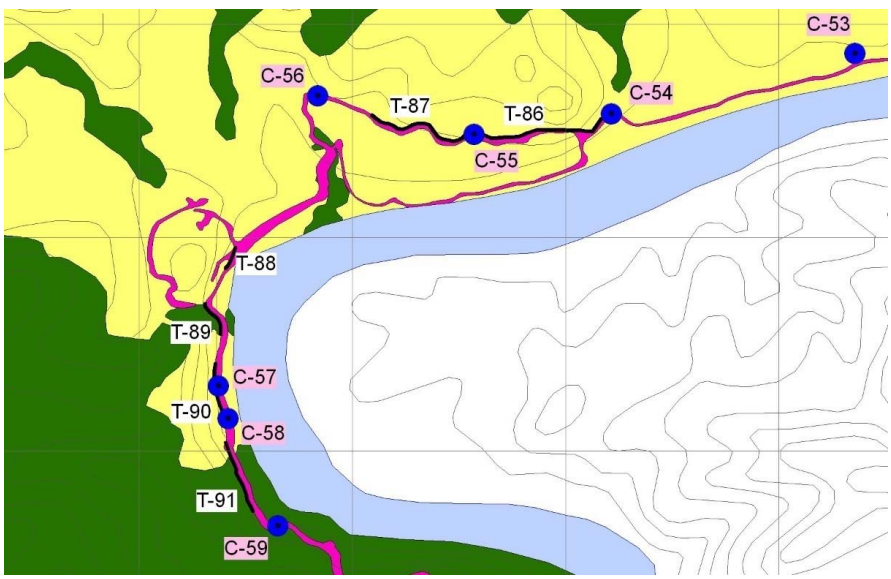
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-91*** ***Type:*** Cut Slope

Beginning (x/y): 474.049 / 1.195.738 ***End (x/y):*** 473.979 / 1.195.915

Elevation Difference (Range): 2.0 – 6.0 m ***Elevation Difference (Average):*** 4.3 m ***Slope Length:*** 5.6 m

Slope Angle: 50º ***Slope Width:*** 192.2 m ***Slope Surface Area:*** 1079 **m²**

Geology: Ophiolitic Complex of Cretaceous to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	30	324
Rills	20	216
Gullies	0	0
Land Slides	50	539

Estimated Erosion Rate (m³/ year): 273.0

Estimated Erosion Rate (t / year): 455.8

Mitigation Measures:

Mitigation Status: Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces:no Sediment traps: no

Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

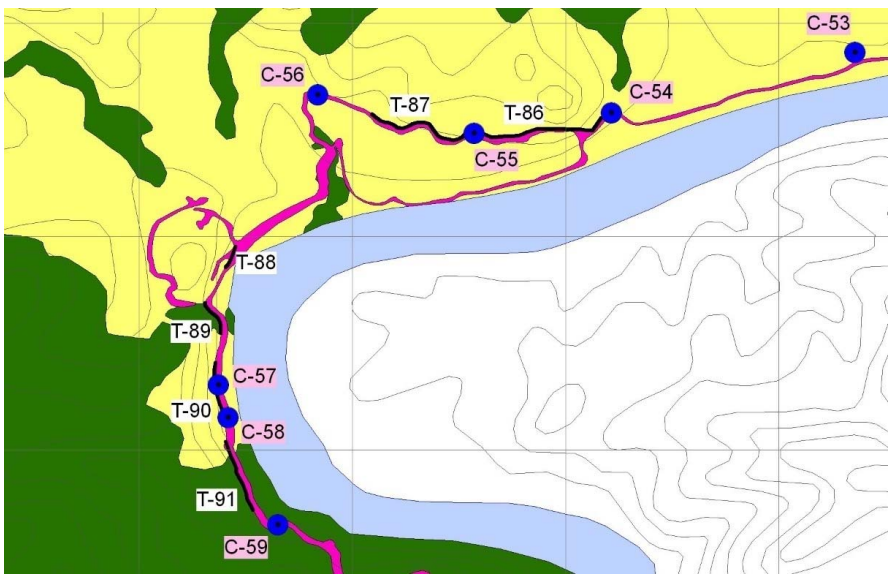
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-92*** ***Type:*** Cut Slope

Beginning (x/y): 475.269 / 1.195.738 ***End (x/y):*** 475.276 / 1.194.467

Elevation Difference (Range): 1.0 – 2.0 m ***Elevation Difference (Average):*** 1.5 m ***Slope Length:*** 1.8 m

Slope Angle: 55º ***Slope Width:*** 55.7 m ***Slope Surface Area:*** 102 **m²**

Geology: Ophiolitic Complex of Cretaceous to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	102
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 7.1

Estimated Erosion Rate (t / year): 11.9

Mitigation Measures:

Mitigation Status: Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

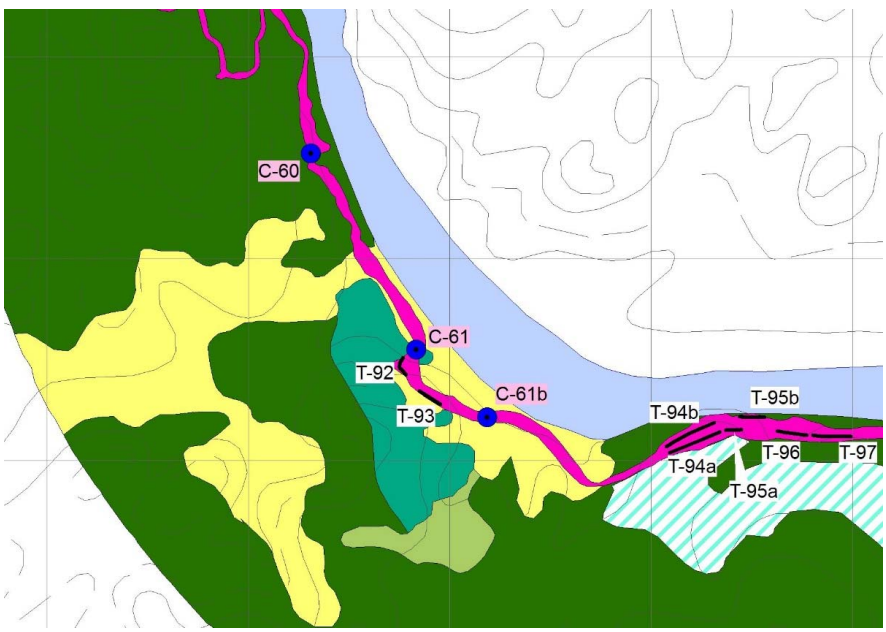
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-93*** ***Type:*** Cut Slope

Beginning (x/y): 475.312/ 1.194.423 ***End (x/y):*** 475.371/ 1.194.387

Elevation Difference (Range): 2.0 – 3.2 m ***Elevation Difference (Average):*** 2.5 m ***Slope Length:*** |3.1 m

Slope Angle: 55º ***Slope Width:*** 69.0 m ***Slope Surface Area:*** 211 **m²**

Geology: Ophiolitic Complex of Cretaceous to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	211
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 14.7

Estimated Erosion Rate (t / year): 24.6

Mitigation Measures: ***Mitigation Status:*** Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

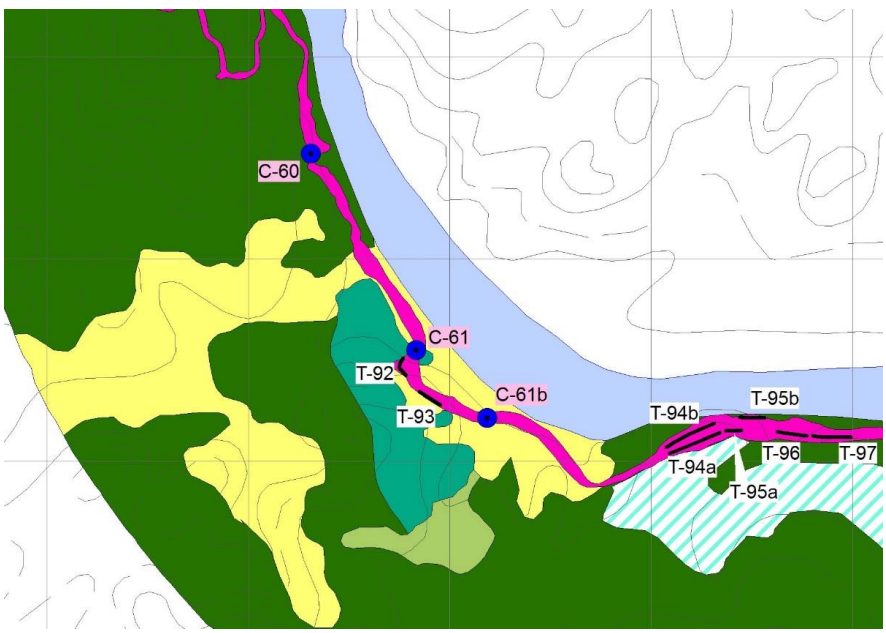
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-94a*** ***Type:*** Fill Slope

Beginning (x/y): 476.128 / 1.194.310 ***End (x/y):*** 475.992 / 1.194.254

Slope Length (Range): 2.0 – 18.5 m ***Slope Length (Average):*** 12.5 m ***Slope Width:*** 147.5 m

Slope Surface Area: 1844 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	50	922
Rills	30	553
Gullies	20	369
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 497.8

Estimated Erosion Rate (t / year): 831.3

Mitigation Measures:

Mitigation Status: Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

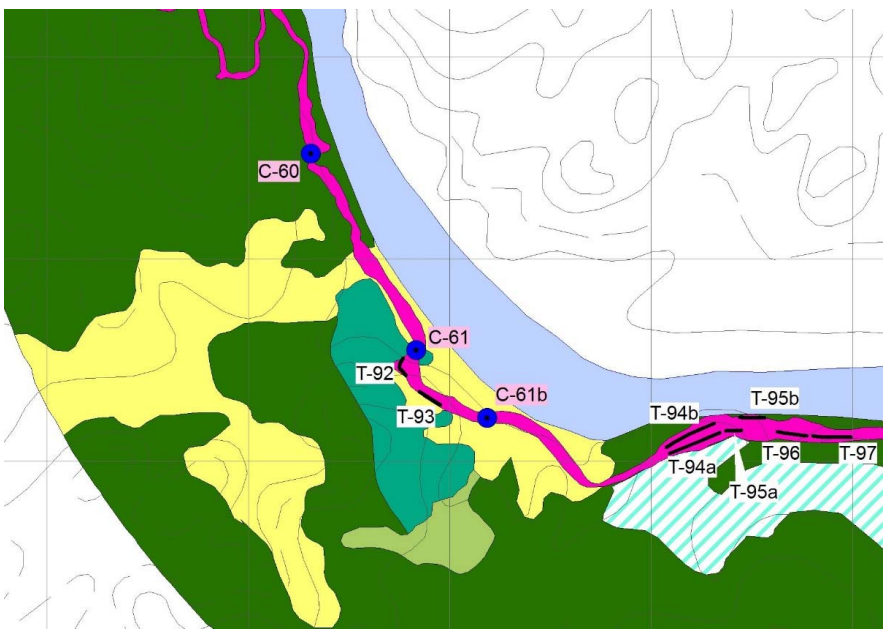
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-94b*** ***Type:*** Cut Slope

Beginning (x/y): 476.114 / 1.194.335 ***End (x/y):*** 475.983 / 1.194.270

Elevation Difference (Range): 8.2 – 1.5 m ***Elevation Difference (Average):*** 6.0 m ***Slope Length:*** 7.3 m

Slope Angle: 55º ***Slope Width:*** 146.2 m ***Slope Surface Area:*** 1071 **m²**

Geology: Ophiolitic Complex of Cretaceous to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	40	428
Rills	25	268
Gullies	35	375
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 174.0

Estimated Erosion Rate (t / year): 290.6

Mitigation Measures:

Mitigation Status: Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

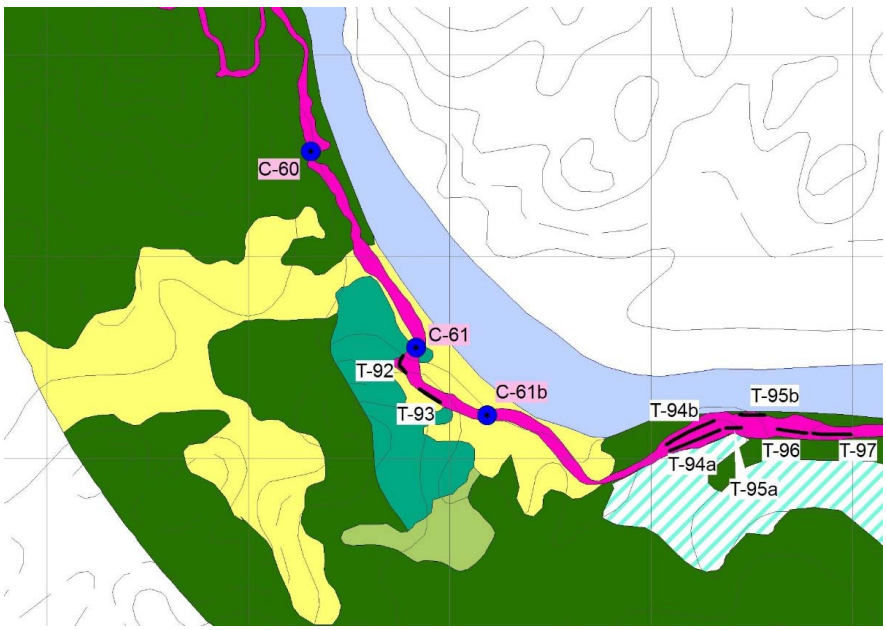
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-95a*** ***Type:*** Fill Slope

Beginning (x/y): 476.187 / 1.194.317 ***End (x/y):*** 476.145 / 1.194.315

Slope Length (Range): 12.0 – 14.0 m ***Slope Length (Average):*** 13.0 m ***Slope Width:*** 42.1 m

Slope Surface Area: 547 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	20	109
Rills	40	219
Gullies	40	219
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 216.7

Estimated Erosion Rate (t / year): 361.9

Mitigation Measures:

Mitigation Status: Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

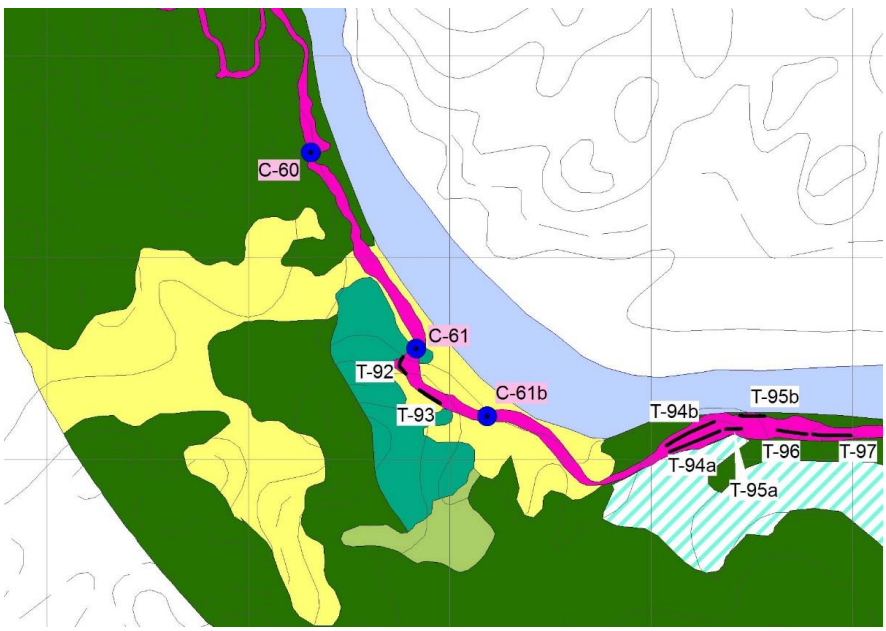
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-95b*** ***Type:*** Cut Slope

Beginning (x/y): 476.182 / 1.194.352 ***End (x/y):*** 476.250 / 1.194.350

Elevation Difference (Range): 3.0 – 5.2 m ***Elevation Difference (Average):*** 4.3 m ***Slope Length:*** 5.6 m

Slope Angle: 50º ***Slope Width:*** 68.2 m ***Slope Surface Area:*** 383 **m²**

Geology: Ophiolitic Complex of Cretaceous to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	85	325
Rills	15	57
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 32.0

Estimated Erosion Rate (t / year): 53.4

Mitigation Measures:

Mitigation Status: Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

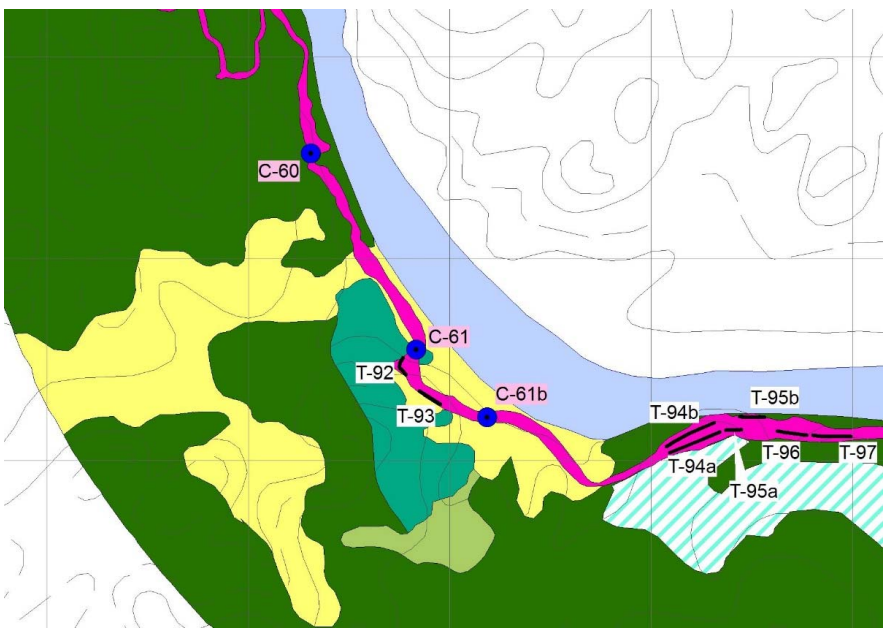
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-96*** ***Type:*** Fill Slope

Beginning (x/y): 476.364 / 1.194.301 ***End (x/y):*** 476.285 / 1.194.312

Slope Length (Range): 15.0 – 19.0 m ***Slope Length (Average):*** 16.5 m ***Slope Width:*** 80.1 m

Slope Surface Area: 1322 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	30	396
Rills	35	463
Gullies	35	463
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 481.1

Estimated Erosion Rate (t / year): 803.4

Mitigation Measures:

Mitigation Status: Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

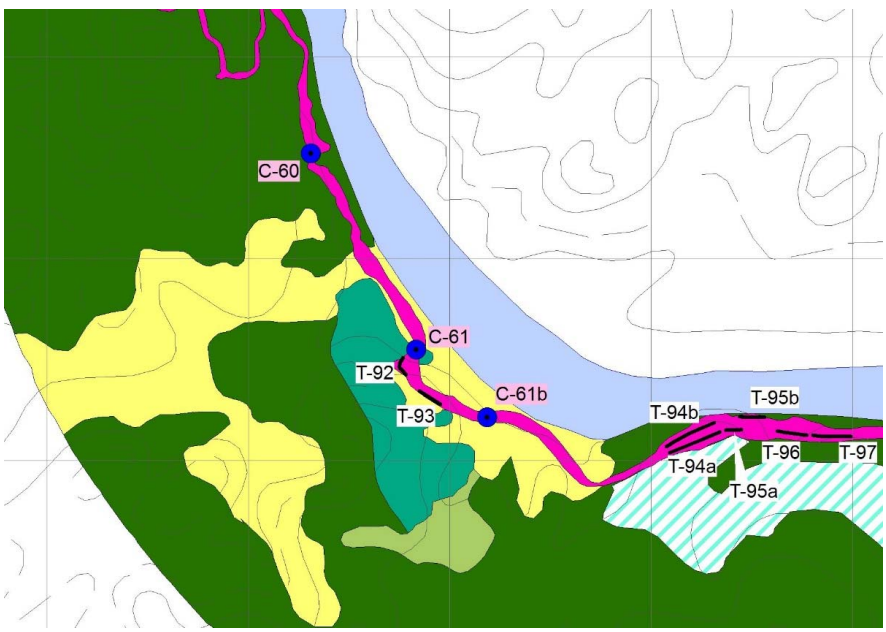
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-97*** ***Type:*** Cut Slope

Beginning (x/y): 476.484 / 1.194.298 ***End (x/y):*** 476.380 / 1.194.300

Elevation Difference (Range): 1.8 – 5.4 m ***Elevation Difference (Average):*** 3.8 m ***Slope Length:*** 4.4 m

Slope Angle: 60º ***Slope Width:*** 103,8 m ***Slope Surface Area:*** 455 **m²**

Geology: Ophiolitic Complex of Cretaceous to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	30	137
Rills	30	137
Gullies	20	91
Land Slides	20	91

Estimated Erosion Rate (m³/ year): 92.5

Estimated Erosion Rate (t / year): 154.4

Mitigation Measures:

Mitigation Status: Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

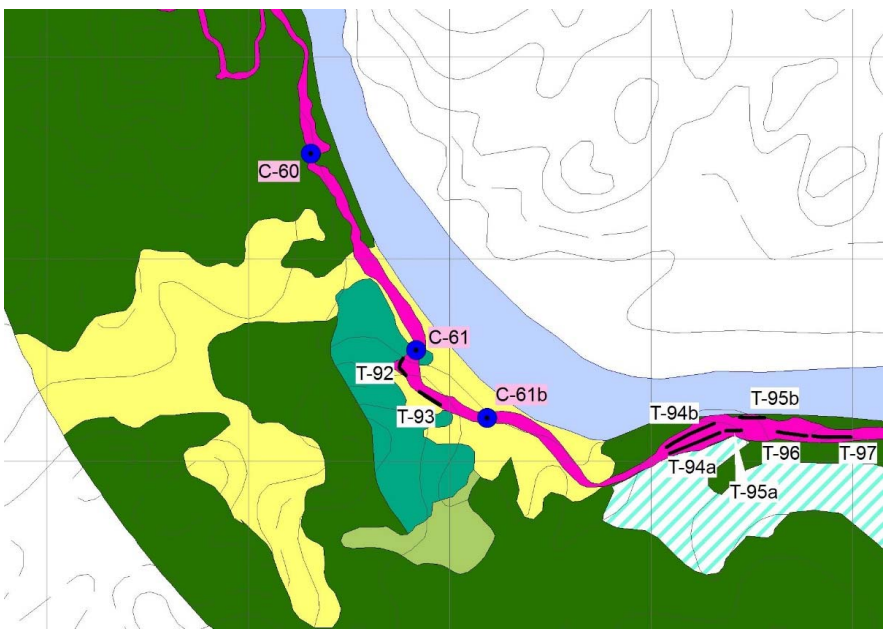
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-98*** ***Type:*** Cut Slope

Beginning (x/y): 477.167 / 1.193.349 ***End (x/y):*** 477.219 / 1.193.099

Elevation Difference (Range): 6.5 – 12.0 m ***Elevation Difference (Average):*** 10.5 m ***Slope Length:*** 14.8 m

Slope Angle: 45º ***Slope Width:*** 256.0 m ***Slope Surface Area:*** 3801 **m²**

Geology: Ophiolitic Complex of Cretaceous to Paleocene Age

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	30	1140
Rills	50	1901
Gullies	20	760
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 589.2

Estimated Erosion Rate (t / year): 984.0

Mitigation Measures: ***Mitigation Status:*** Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

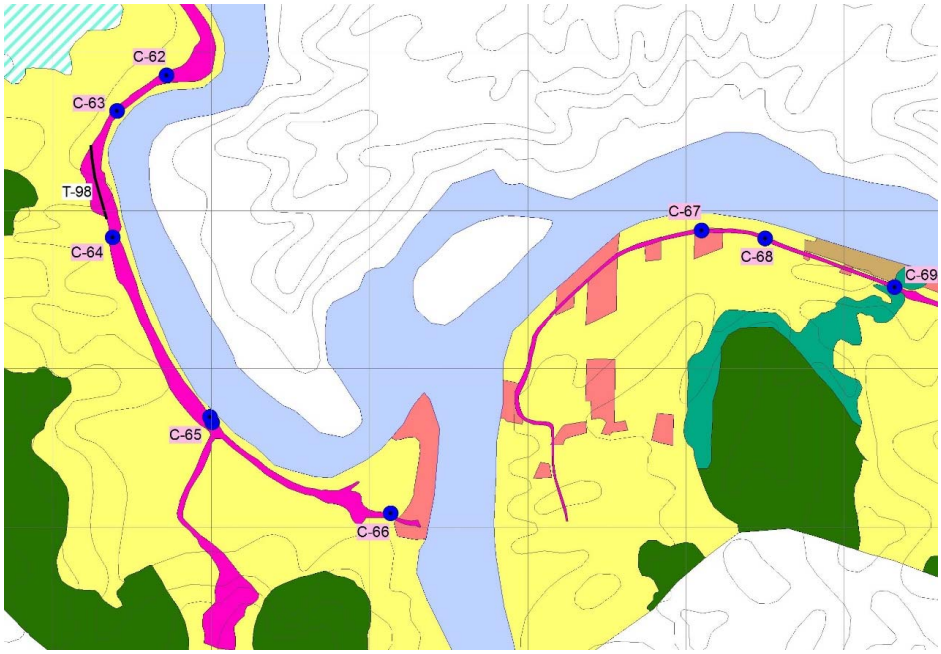
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-100*** ***Type:*** Cut Slope

Beginning (x/y): 480.510 / 1.192.670 ***End (x/y):*** 480.653 / 1.192.643

Elevation Difference (Range): 2.0 – 4.2 m ***Elevation Difference (Average):*** 3.5 m ***Slope Length:*** 4.0 m

Slope Angle: 60º ***Slope Width:*** 145.2 m ***Slope Surface Area:*** 587 **m²**

Geology: Volcaniclastic Brechas (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	587
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 41.1

Estimated Erosion Rate (t / year): 68.6

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: yes Natural Vegetation: yes

Condition in 2013

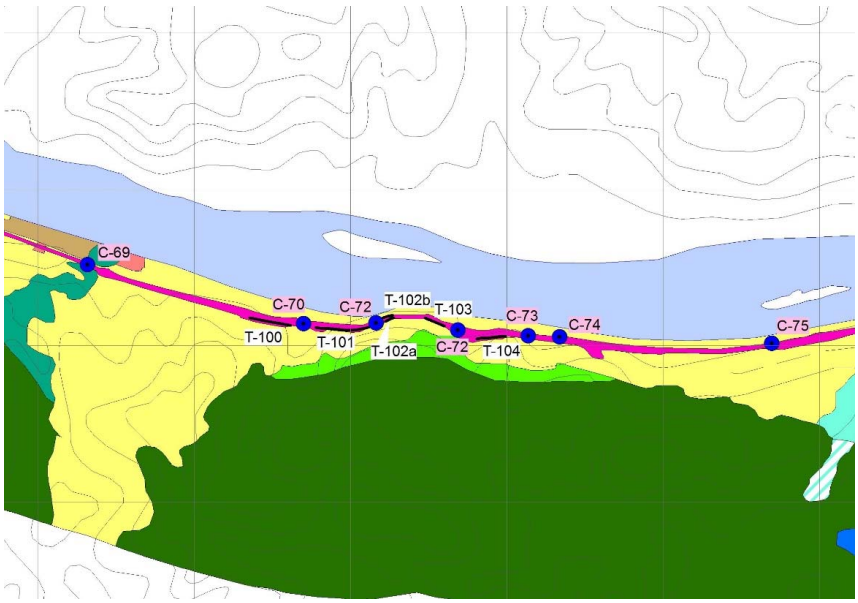
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-101*** ***Type:*** Cut Slope

Beginning (x/y): 480.938/ 1.192.641 ***End (x/y):*** 480.741/ 1.192.635

Elevation Difference (Range): 2.5 – 5.5 m ***Elevation Difference (Average):*** 4.5 m ***Slope Length:*** 5.2 m

Slope Angle: 60º ***Slope Width:*** 199.5 m ***Slope Surface Area:*** 1037 **m²**

Geology: Volcaniclastic Brechas (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	85	881
Rills	15	155
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 86.6

Estimated Erosion Rate (t / year): 144.6

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: yes Natural Vegetation: yes

Condition in 2013

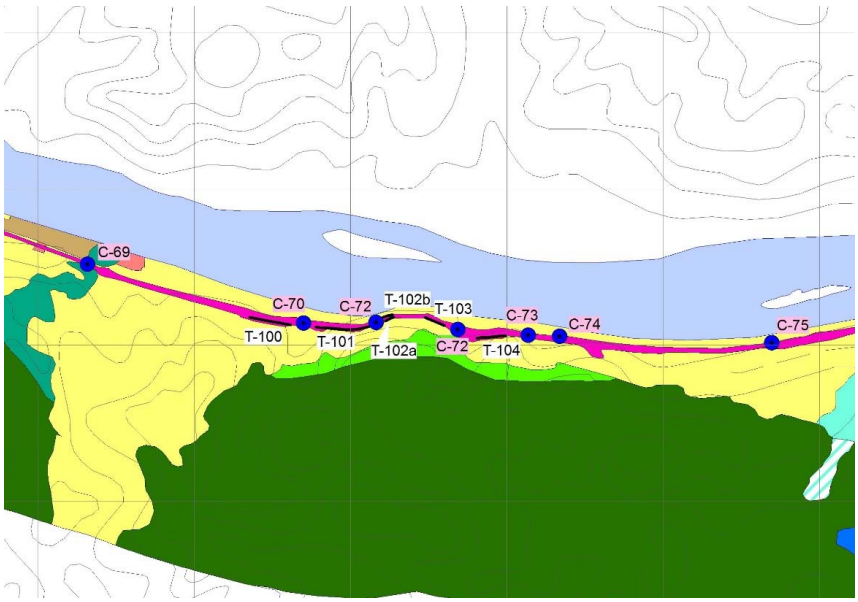
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-102a*** ***Type:*** Cut Slope

Beginning (x/y): 480.938 / 1.192.641 ***End (x/y):*** 480.741 / 1.192.635

Elevation Difference (Range): 1.0 – 2.8 m ***Elevation Difference (Average):*** .3 m ***Slope Length:*** 2.7 m

Slope Angle: 60º ***Slope Width:*** 31.8 m ***Slope Surface Area:*** 84 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	20	17
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 1.2

Estimated Erosion Rate (t / year): 2.0

Mitigation Measures: ***Mitigation Status:*** No mitigation necessary

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: yes Natural Vegetation: yes

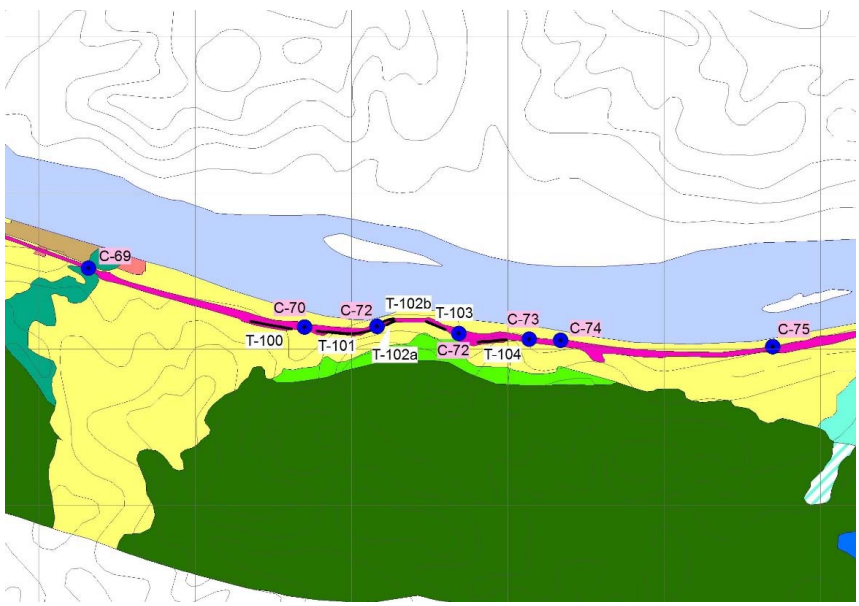
Condition in 2013

Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013	***Condition in 2014***

Location Map:



Slope: ***T-102b*** ***Type:*** Fill Slope

Beginning (x/y): 480.938 / 1.192.641 ***End (x/y):*** 480.741 / 1.192.635

Slope Length (Range): 12.0 – 28.0 m ***Slope Length (Average):*** 24.0 m ***Slope Width:*** 34.7 m

Slope Surface Area: 833 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	100	833
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 116.6

Estimated Erosion Rate (t / year): 194.7

Mitigation Measures:

Mitigation Status: Mitigated

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: yes Natural Vegetation: yes

Condition in 2013

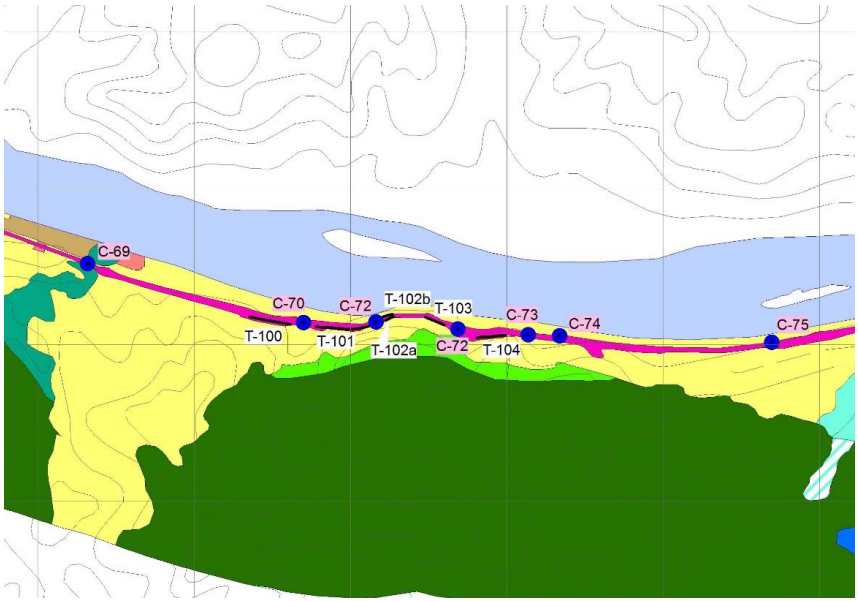
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-103*** ***Type:*** Cut Slope

Beginning (x/y): 481.191 / 1.192.640 ***End (x/y):*** 481.124 / 1.192.669

Elevation Difference (Range): 3.0 – 5.0 m ***Elevation Difference (Average):*** 4.0 m ***Slope Length:*** 4.6 m

Slope Angle: 60º ***Slope Width:*** 72.4 m ***Slope Surface Area:*** 334 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	334
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 23.4

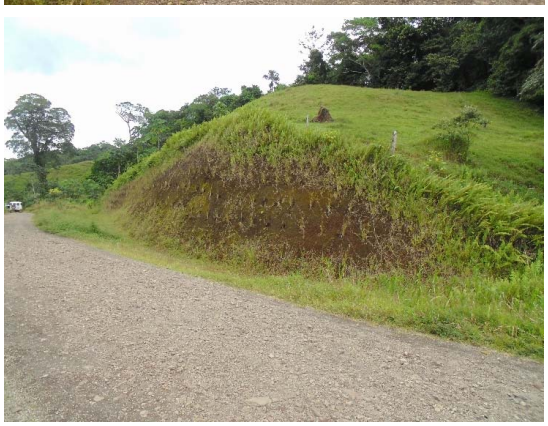
Estimated Erosion Rate (t / year): 39.1

Mitigation Measures: ***Mitigation Status:*** Mitigated

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: yes Natural Vegetation: yes

Condition in 2013

Condition in 2014

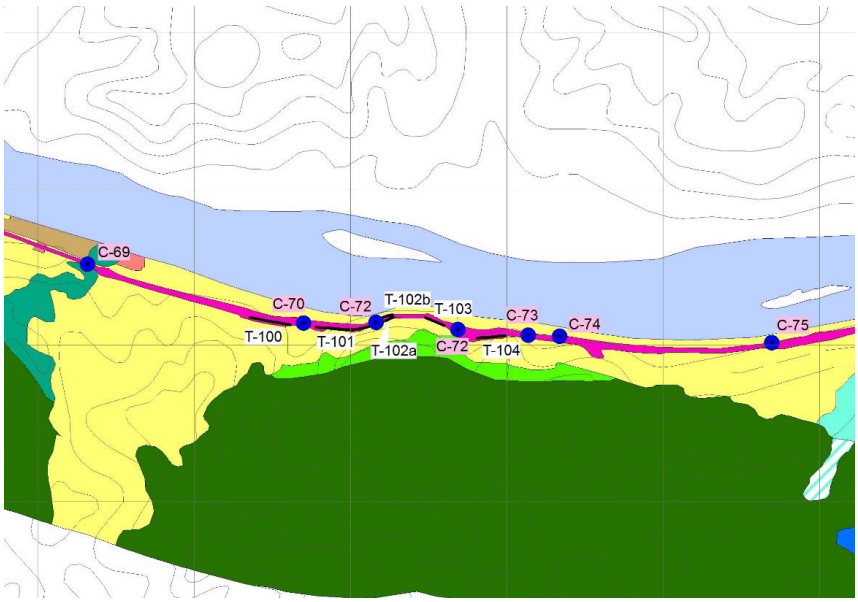


Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-104*** ***Type:*** Cut Slope

Beginning (x/y): 481.405 / 1.192.603 ***End (x/y):*** 481.304 / 1.192.594

Elevation Difference (Range): 7.0 – 16.0 m ***Elevation Difference (Average):*** 12.5 m ***Slope Length:*** 14.4 m

Slope Angle: 60º ***Slope Width:*** 101.0 m ***Slope Surface Area:*** 1458 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	1458
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 102.0

Estimated Erosion Rate (t / year): 170.4

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: yes Natural Vegetation: yes

Condition in 2013

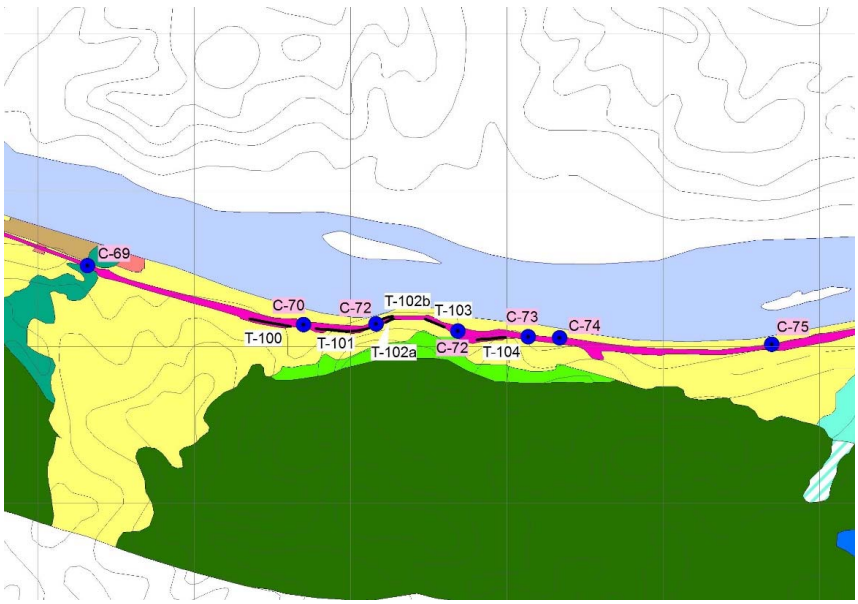
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-105*** ***Type:*** Cut Slope

Beginning (x/y): 485.557 / 1.190.993 ***End (x/y):*** 485.611 / 1.190.846

Elevation Difference (Range): 4.0 – 5.2 m ***Elevation Difference (Average):*** 4.6 m ***Slope Length:*** 6.0 m

Slope Angle: 50° ***Slope Width:*** 158.4 m ***Slope Surface Area:*** 951 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	75	713
Rills	20	190
Gullies	5	48
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 93.2

Estimated Erosion Rate (t / year): 155.7

Mitigation Measures: ***Mitigation Status:*** Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

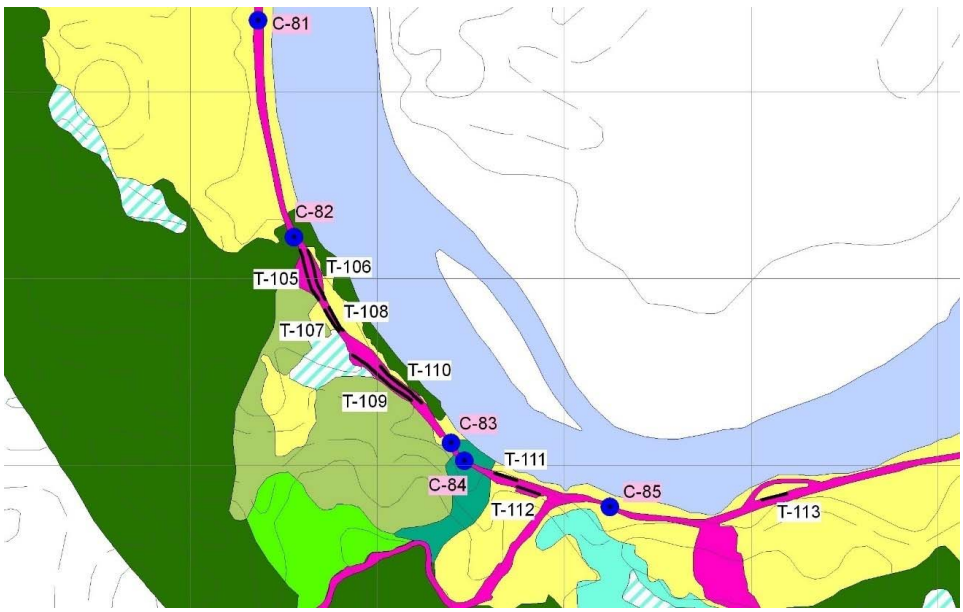
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-106*** ***Type:*** Cut Slope

Beginning (x/y): 485.579 / 1.190.991 ***End (x/y):*** 485.630 / 1.190.846

Elevation Difference (Range): 3.0 – 5.0 m ***Elevation Difference (Average):*** 4.5 m ***Slope Length:*** 5.5 m

Slope Angle: 55° ***Slope Width:*** 155.0 m ***Slope Surface Area:*** 851 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	851
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 59.6

Estimated Erosion Rate (t / year): 99.5

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

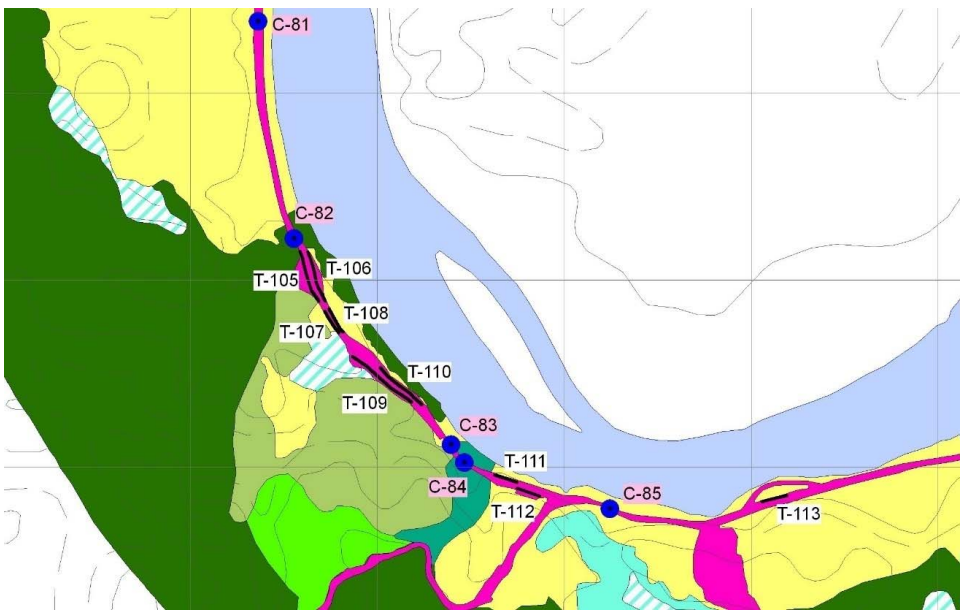
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-107*** ***Type:*** Cut Slope

Beginning (x/y): 485.629 / 1.190.816 ***End (x/y):*** 485.670 / 1.190.753

Elevation Difference (Range): 1.5 – 2.8 m ***Elevation Difference (Average):*** 2.4 m ***Slope Length:*** 2.6 m

Slope Angle: 65° ***Slope Width:*** 80.3 m ***Slope Surface Area:*** 213 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	213
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 14.9

Estimated Erosion Rate (t / year): 24.9

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

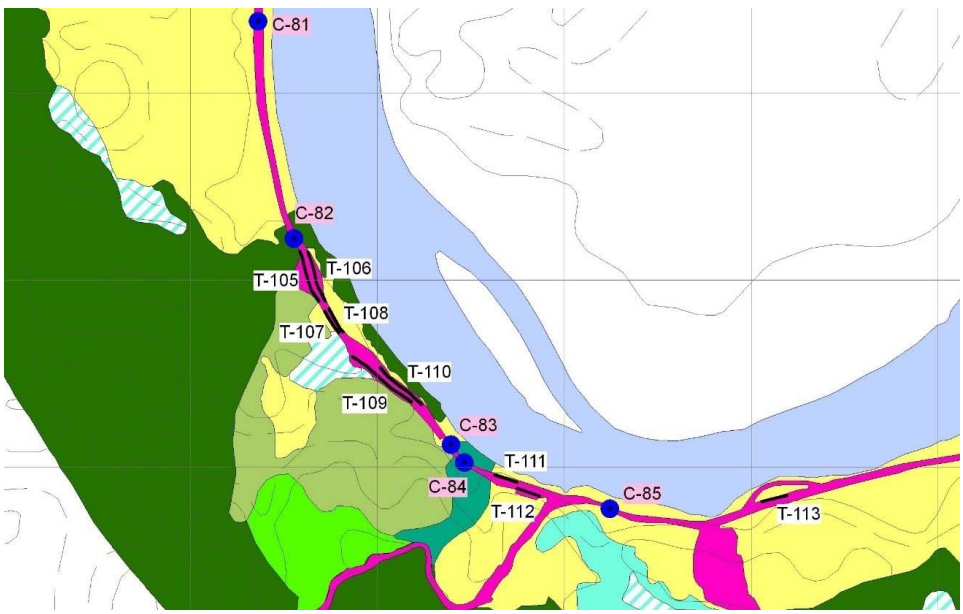
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-108*** ***Type:*** Fill Slope

Beginning (x/y): 485.634 / 1.190.840 ***End (x/y):*** 485.669 / 1.190.773

Slope Length (Range): 20.0 – 28.0 m ***Slope Length (Average):*** 24.5 m ***Slope Width:*** 75.2 m

Slope Surface Area: 1842 m²

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	60	1105
Rills	15	276
Gullies	25	461
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 549.0

Estimated Erosion Rate (t / year): 916.9

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

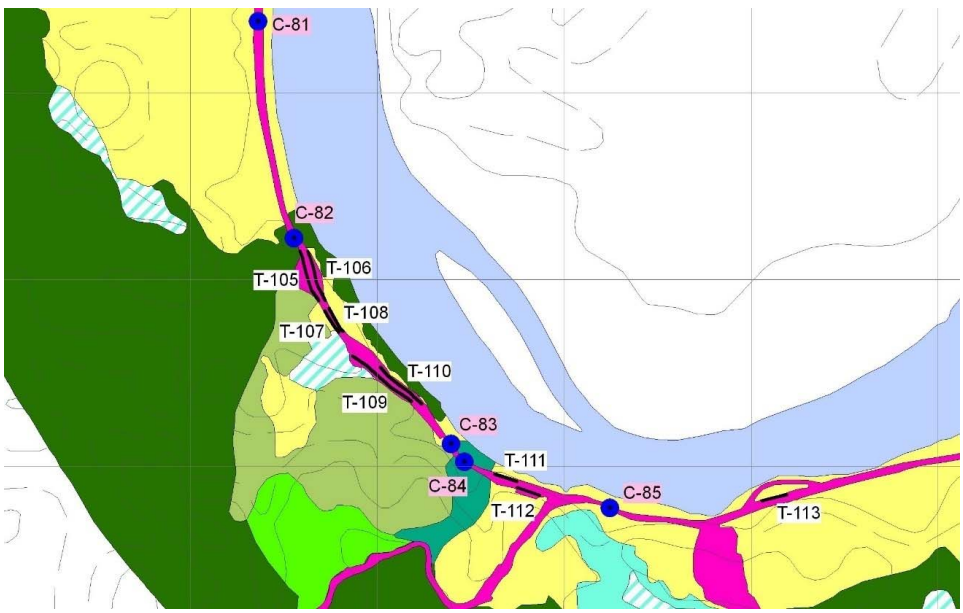
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-109*** ***Type:*** Fill Slope

Beginning (x/y): 485.710 / 1.190.682 ***End (x/y):*** 485.883 / 1.190.548

Slope Length (Range): 30.0 -50.0 m ***Slope Length (Average):*** 37.0 m ***Slope Width:*** 218.9 m

Slope Surface Area: 8099 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	25	2025
Rills	30	2430
Gullies	45	3645
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 3442.2

Estimated Erosion Rate (t / year): 5748.5

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

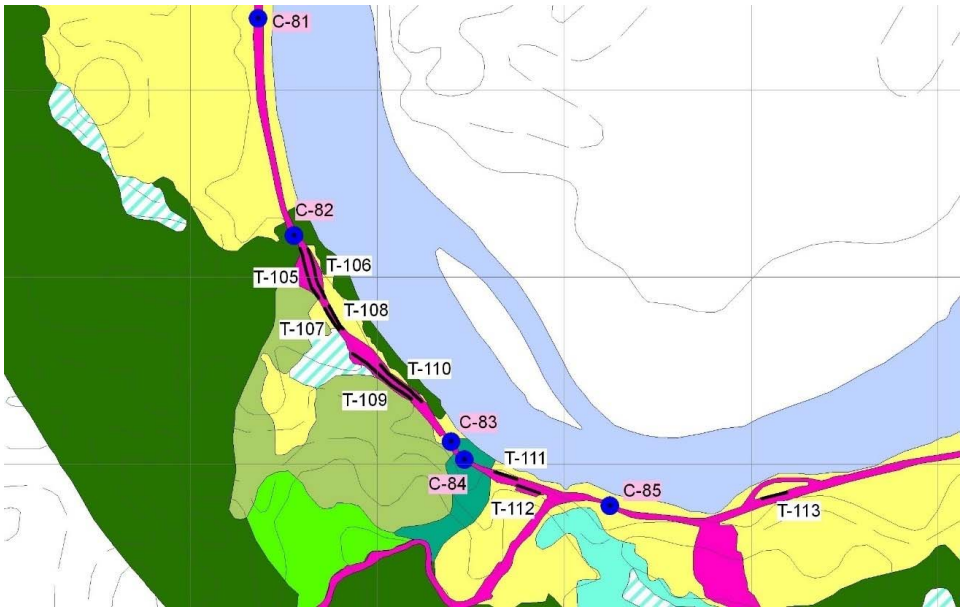
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-110*** ***Type:*** Cut Slope

Beginning (x/y): 485.791 / 1.190.648 ***End (x/y):*** 485.912 / 1.190.541

Elevation Difference (Range): 4.0 – 6.2 m ***Elevation Difference (Average):*** 5.5 m ***Slope Length:*** 6.7 m

Slope Angle: 55º ***Slope Width:*** 162.5 m ***Slope Surface Area:***1 091 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	90	982
Rills	10	109
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 86.2

Estimated Erosion Rate (t / year): 143.9

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

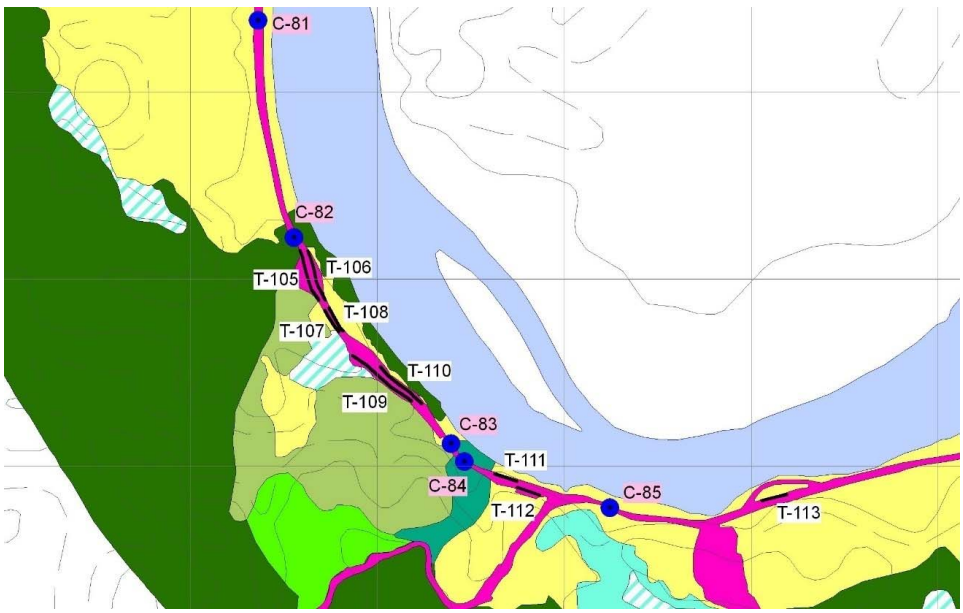
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-111*** ***Type:*** Cut Slope

Beginning (x/y): 486.126 / 1.190.331 ***End (x/y):*** 486.191 / 1.190.310

Elevation Difference (Range): 2.0 – 5.0 m ***Elevation Difference (Average):*** 3.8 m ***Slope Length:*** 4.6 m

Slope Angle: 55º ***Slope Width:*** 68.4 m ***Slope Surface Area:*** 317 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	70	222
Rills	30	95
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 30.8

Estimated Erosion Rate (t / year): 51.4

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

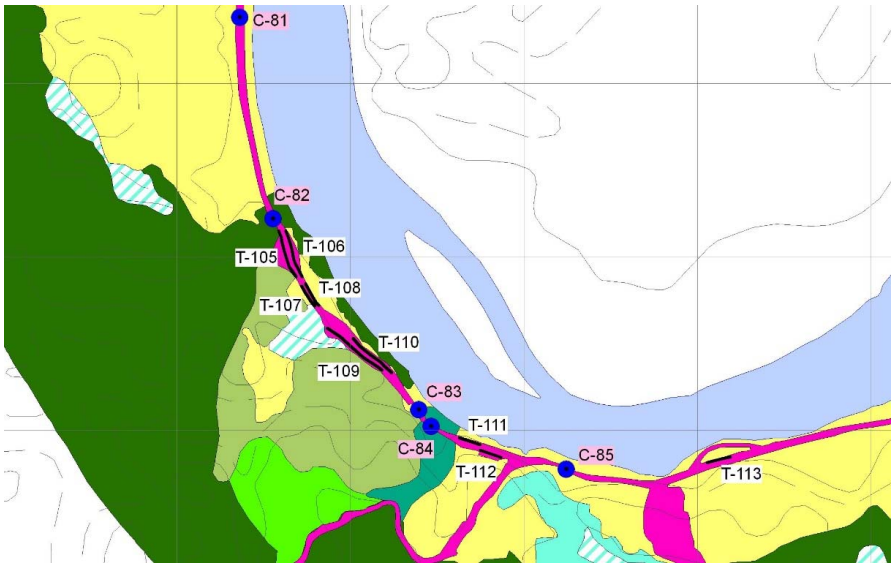
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-112*** ***Type:*** Cut Slope

Beginning (x/y): 486.192 / 1.190.293 ***End (x/y):*** 486.257/ 1.190.269

Elevation Difference (Range): 2.0 – 4.7 m ***Elevation Difference (Average):*** 3.4 m ***Slope Length:*** 5.3 m

Slope Angle: 40º ***Slope Width:*** 69.0 m ***Slope Surface Area:*** 365 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	365
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 25.5

Estimated Erosion Rate (t / year): 42.7

Mitigation Measures: ***Mitigation Status:*** Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

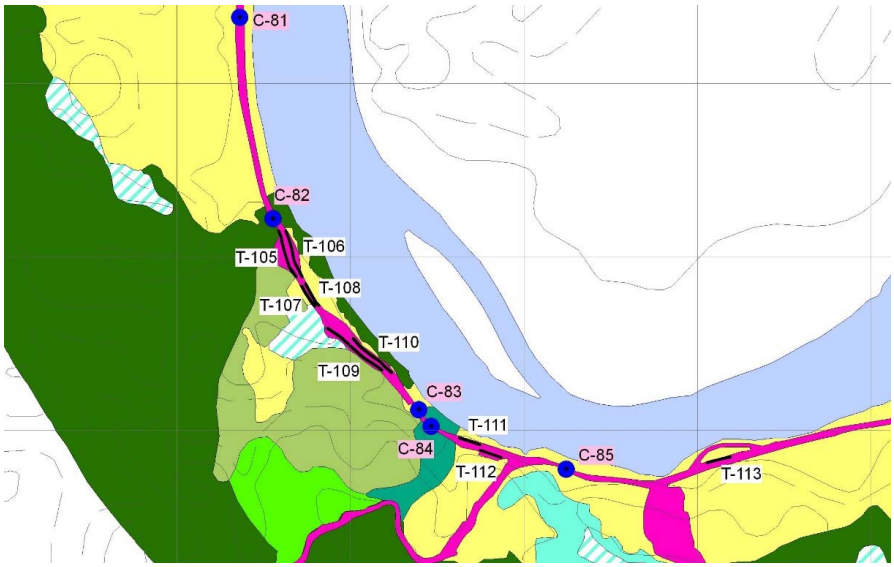
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-113*** ***Type:*** Cut Slope

Beginning (x/y): 486.908 / 1.190.253 ***End (x/y):*** 486.980 / 1.190.271

Elevation Difference (Range): 1.2 – 1.8 m ***Elevation Difference (Average):*** 1.6 m ***Slope Length:*** 2.0 m

Slope Angle: 55º ***Slope Width:*** 73.8 m ***Slope Surface Area:*** 144 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	144
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 10.1

Estimated Erosion Rate (t / year): 16.9

Mitigation Measures: ***Mitigation Status:*** No mitigation necessary

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

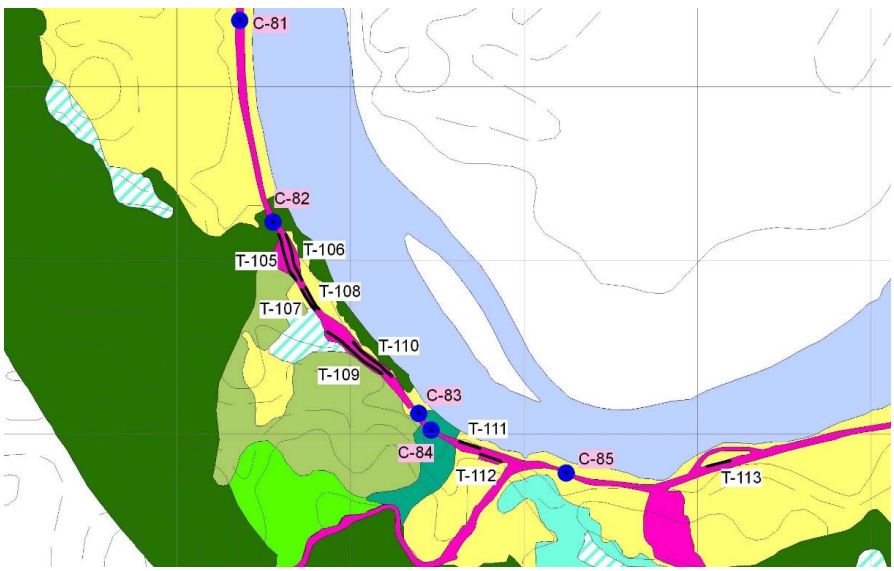
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-114a*** ***Type:*** Cut Slope

Beginning (x/y): 489.989 / 1.190.034 ***End (x/y):*** 490.009 / 1.189.931

Elevation Difference (Range): 6.0 – 12.0 m ***Elevation Difference (Average):*** 9.0 m ***Slope Length:*** 12.7 m

Slope Angle: 45º ***Slope Width:*** 106.4 m ***Slope Surface Area:*** 1354 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	20	271
Rills	20	271
Gullies	35	473
Land Slides	25	339

Estimated Erosion Rate (m³/ year): 325.7

Estimated Erosion Rate (t / year): 543.9

Mitigation Measures:

Mitigation Status: Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

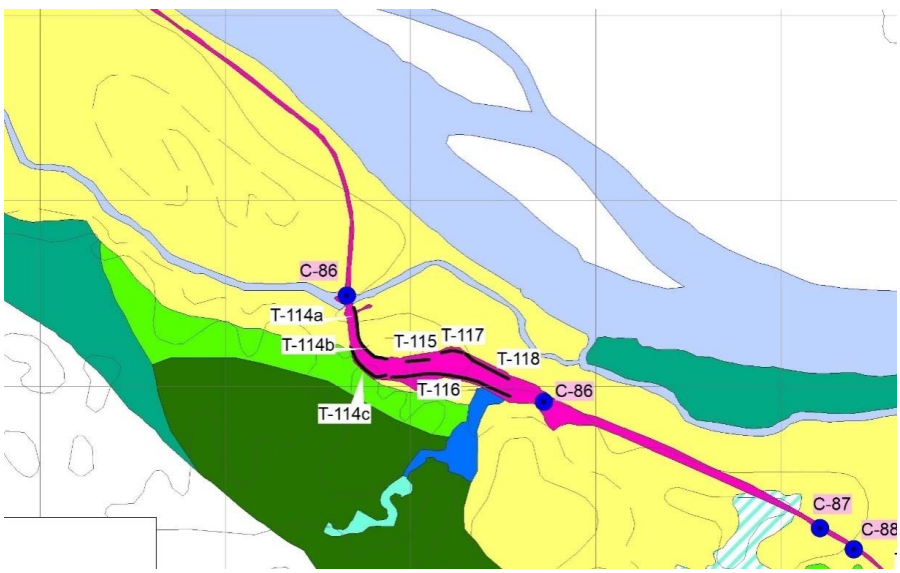
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-114b*** ***Type:*** Cut Slope

Beginning (x/y): 490.009 / 1.189.931 ***End (x/y):*** 490.086 / 1.189.883

Elevation Difference (Range): 3.0 – 5.0 m ***Elevation Difference (Average):*** 4.5 m ***Slope Length:*** 5.5 m

Slope Angle: 55º ***Slope Width:*** 95.8 m ***Slope Surface Area:*** 526 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	85	447
Rills	15	79
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 43.9

Estimated Erosion Rate (t / year): 73.4

Mitigation Measures:

Mitigation Status: Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

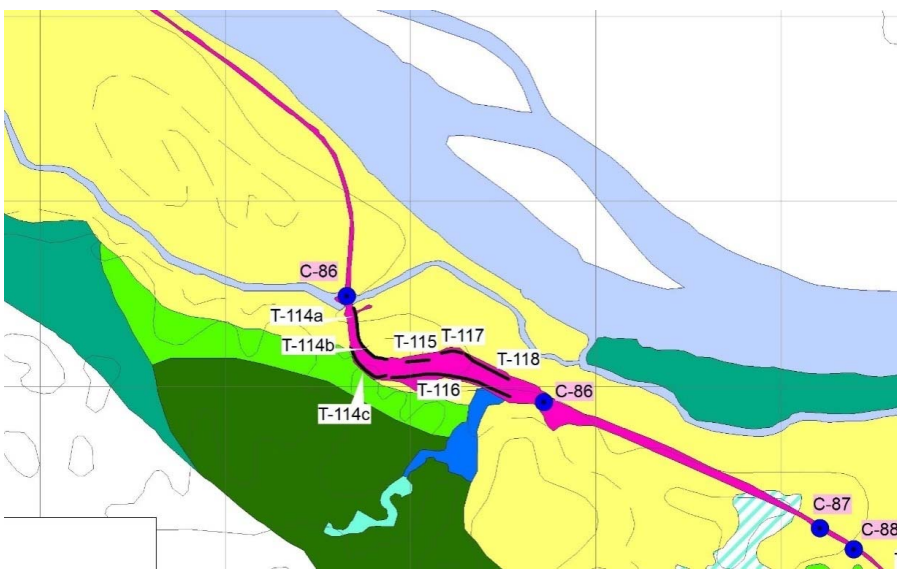
Condition in 2013

Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013	***Condition in 2014***

Location Map:



Slope: ***T-114c*** ***Type:*** Cut Slope

Beginning (x/y): 489.981 / 1.189.915 ***End (x/y):*** 490.085 / 1.189.833

Elevation Difference (Range): 1.8 – 3.5 m ***Elevation Difference (Average):*** 2.5 m ***Slope Length:*** 2.9 m

Slope Angle: 60º ***Slope Width:*** 146.8 m ***Slope Surface Area:*** 429 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	80	343
Rills	20	86
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 37.7

Estimated Erosion Rate (t / year): 63.0

Mitigation Measures:

Mitigation Status: Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

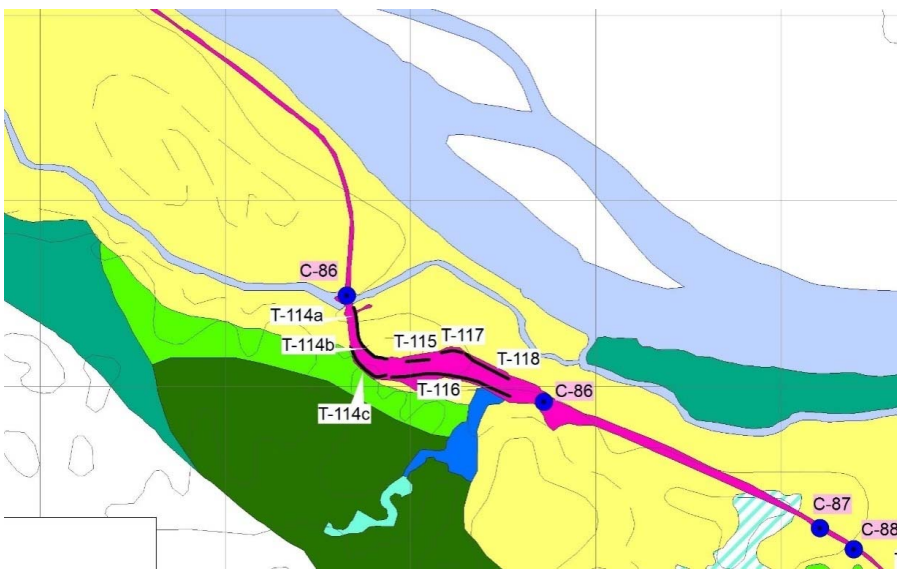
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-115*** ***Type:*** Cut Slope

Beginning (x/y): 490.145 / 1.189.874 ***End (x/y):*** 490.212 / 1.189.881

Elevation Difference (Range): 3.0 – 6.0 m ***Elevation Difference (Average):*** 4.8 m ***Slope Length:*** 6.8 m

Slope Angle: 45º ***Slope Width:*** 67.9 m ***Slope Surface Area:*** 461 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	461
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 32.3

Estimated Erosion Rate (t / year): 53.9

Mitigation Measures: ***Mitigation Status:*** No mitigation necessary

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

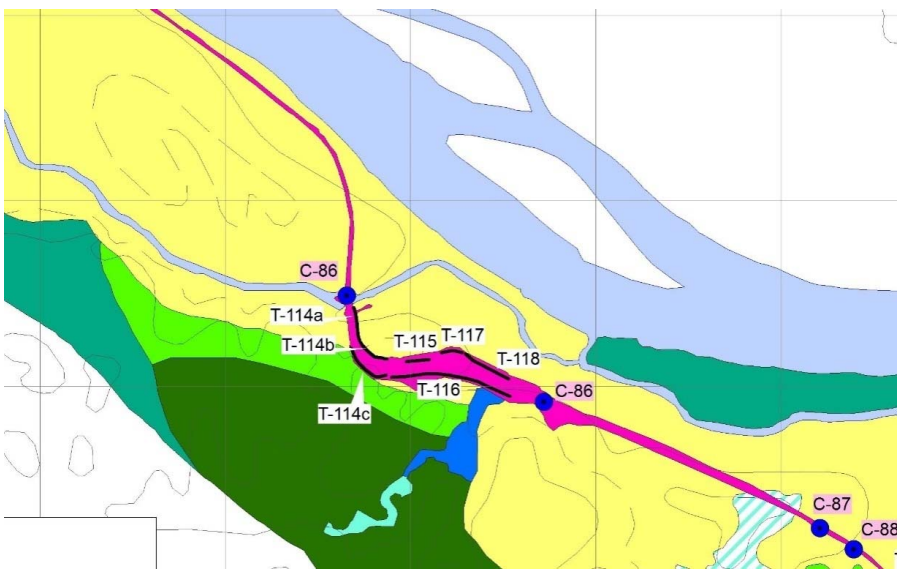
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-116*** ***Type:*** Fill Slope

Beginning (x/y): 490.100 / 1.189.827 ***End (x/y):*** 490.450 / 1.189.770

Slope Length (Range): 14.0 – 36.0 m ***Slope Length (Average):*** 27.0 m ***Slope Width:*** 362,6 m

Slope Surface Area: 9790 m²

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	0	0
Rills	25	2448
Gullies	75	7343
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 5972.0

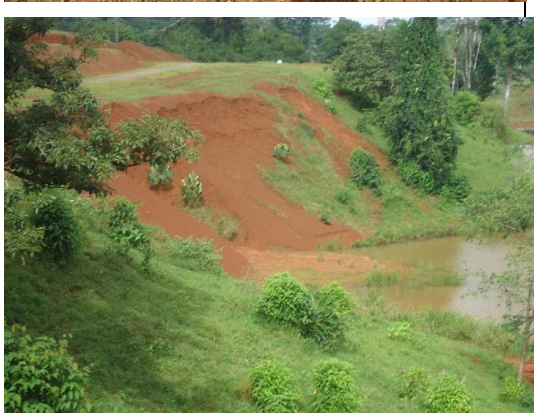
Estimated Erosion Rate (t / year): 9973.3

Mitigation Measures:

Mitigation Status: Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013



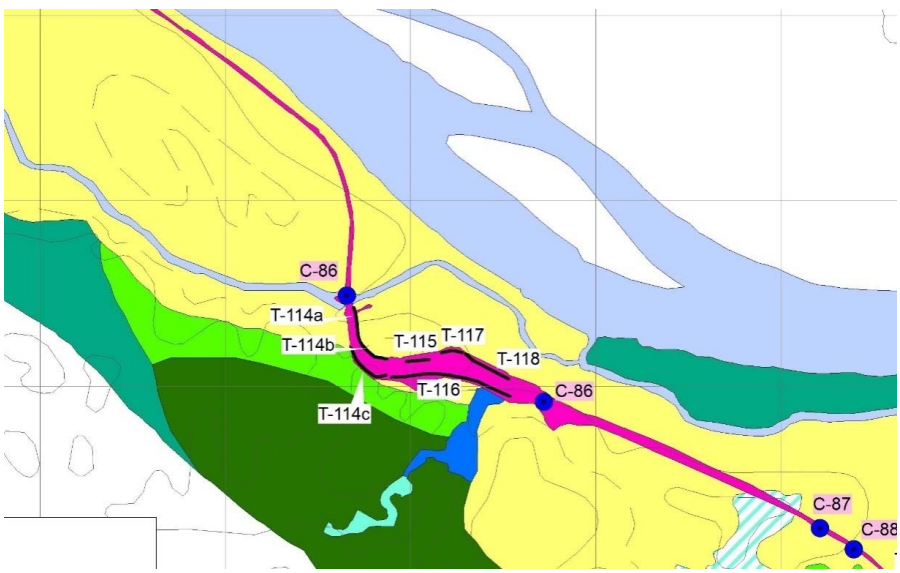
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-117*** ***Type:*** Fill Slope

Beginning (x/y): 490.248 / 1.189.901 ***End (x/y):*** 490.310 / 1.189.901

Slope Length (Range): 10.0 – 14.0 m ***Slope Length (Average):*** 12.0 m ***Slope Width:*** 62.8 m

Slope Surface Area: 754 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	60	452
Rills	30	226
Gullies	10	75
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 156.7

Estimated Erosion Rate (t / year): 261.8

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

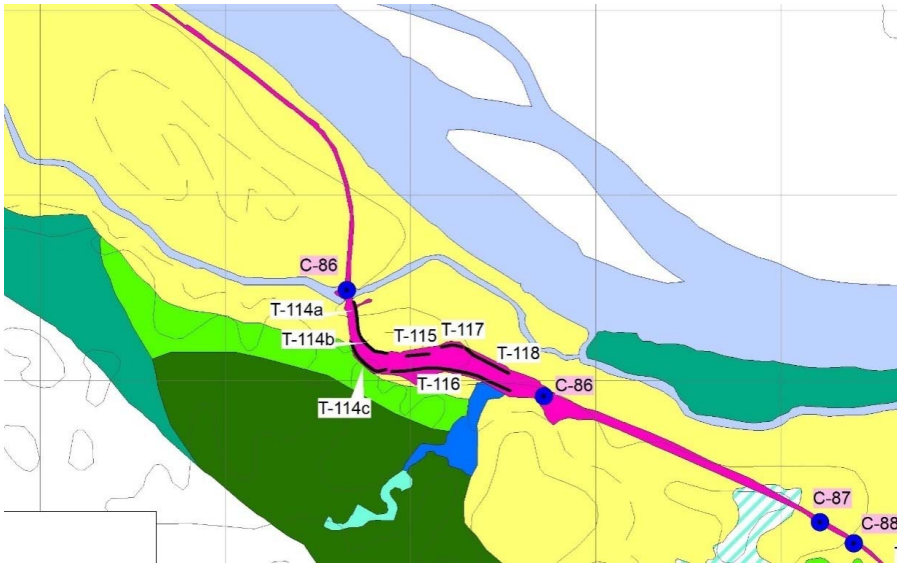
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-118*** ***Type:*** Cut Slope

Beginning (x/y): 490.320 / 1.189.897 ***End (x/y):*** 490.446 / 1.189.822

Elevation Difference (Range): 5.0 – 10.2 m ***Elevation Difference (Average):*** 8.5 m ***Slope Length:*** 11.1 m

Slope Angle: 50º ***Slope Width:*** 147.5 m ***Slope Surface Area:*** 1637 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	75	1227
Rills	25	409
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 151.4

Estimated Erosion Rate (t / year): 252.8

Mitigation Measures:

Mitigation Status: Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

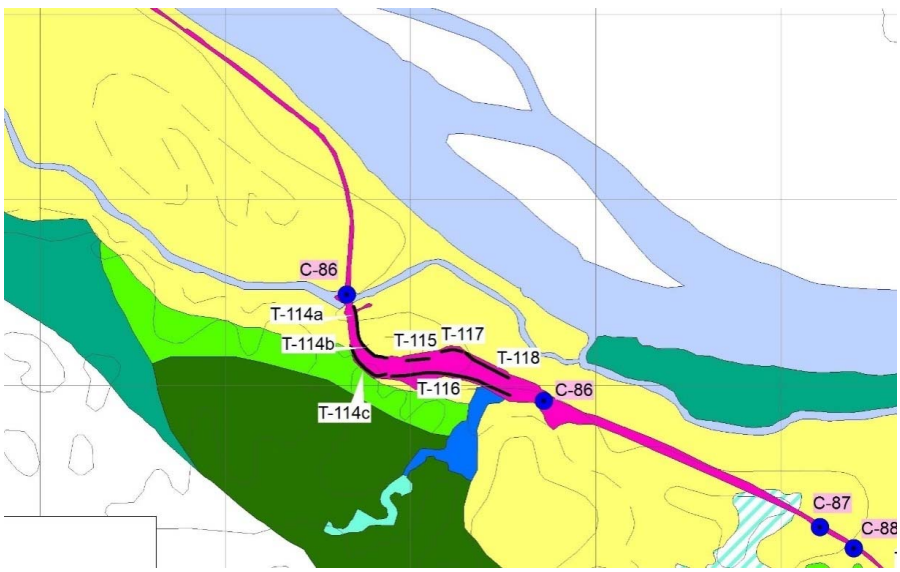
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-119*** ***Type:*** Cut Slope

Beginning (x/y): 491.647 / 1.189.165 ***End (x/y):*** 491.707 / 1.189.161

Elevation Difference (Range): 3.0 – 9.0 m ***Elevation Difference (Average):*** 7.5 m ***Slope Length:*** 10.6 m

Slope Angle: 45º ***Slope Width:*** 60.0 m ***Slope Surface Area:*** 636 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	85	541
Rills	15	95
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 53.1

Estimated Erosion Rate (t / year): 88.7

Mitigation Measures: ***Mitigation Status:*** Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

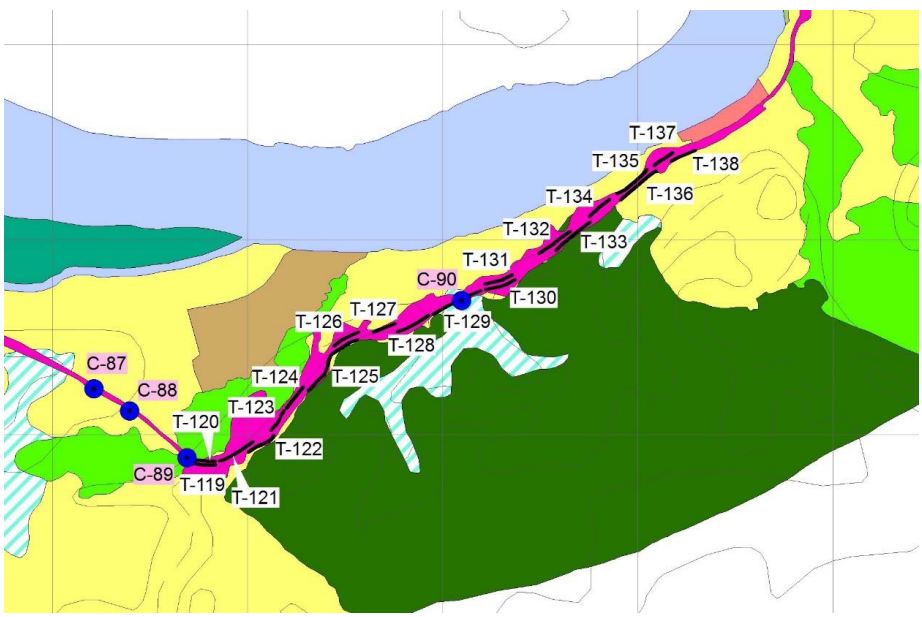
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-120*** ***Type:*** Cut Slope

Beginning (x/y): 491.706 / 1.189.171 ***End (x/y):*** 491.654 / 1.189.175

Elevation Difference (Range): 3.0 – 4.5 m ***Elevation Difference (Average):*** 3.9 m ***Slope Length:*** 5.5 m

Slope Angle: 45º ***Slope Width:*** 51.6 m ***Slope Surface Area:*** 285 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	285
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 19.9

Estimated Erosion Rate (t / year): 33.3

Mitigation Measures: ***Mitigation Status:*** No mitigation necessary

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

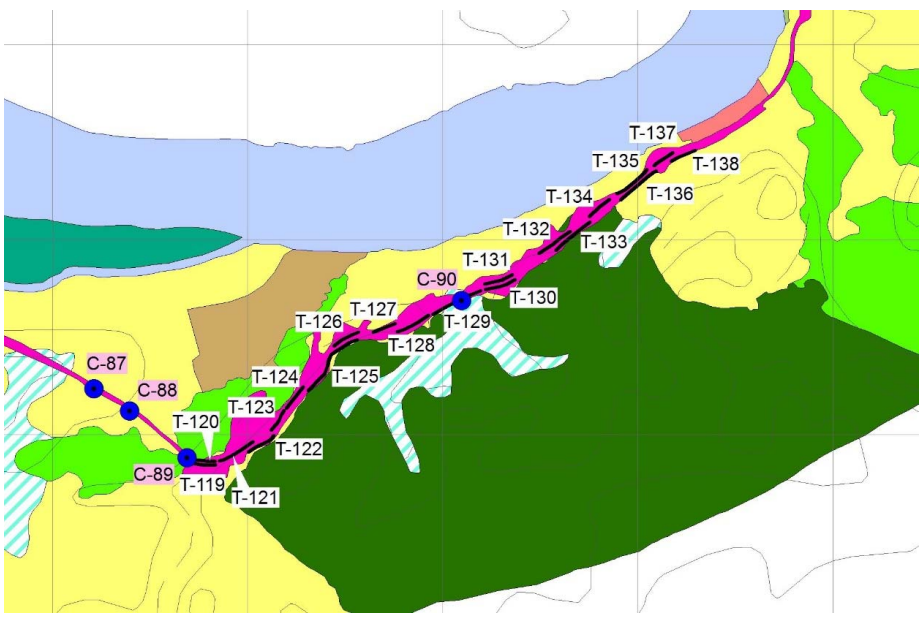
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-121*** ***Type:*** Fill Slope

Beginning (x/y): 491.812 / 1.189.227 ***End (x/y):*** 491.718 / 1.189.173

Slope Length (Range): 14.0 – 23.0 m ***Slope Length (Average):*** 19.0 m ***Slope Width:*** 109.4 m

Slope Surface Area: 2079 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	0	0
Rills	10	208
Gullies	90	1871
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 1455.0

Estimated Erosion Rate (t / year): 2429.9

Mitigation Measures:

Mitigation Status: Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

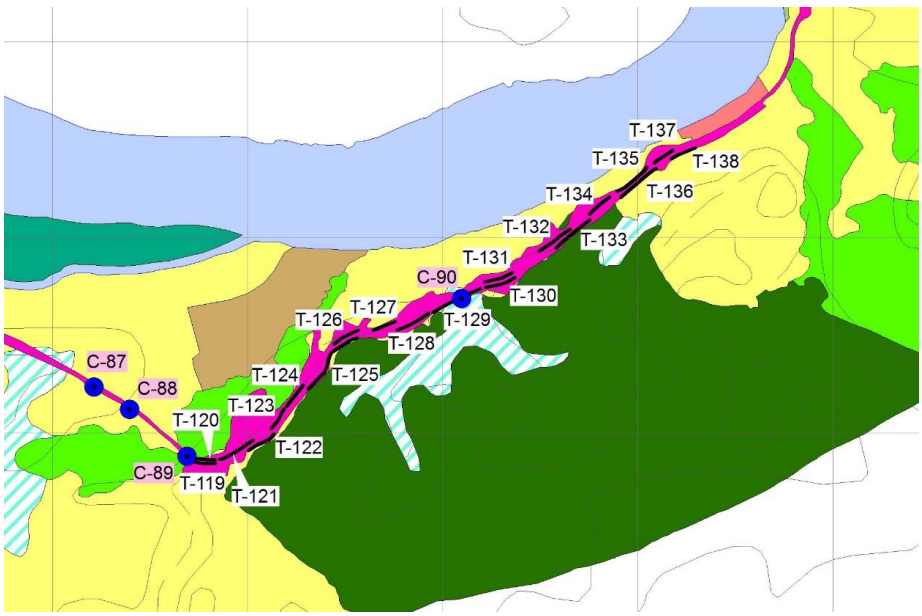
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-122*** ***Type:*** Cut Slope

Beginning (x/y): 491.871 / 1.189.244 ***End (x/y):*** 491.800 / 1.189.199

Elevation Difference (Range): 3.0 – 9.0 m ***Elevation Difference (Average):*** 7.5 m ***Slope Length:*** 9.2 m

Slope Angle: 55º ***Slope Width:*** 85.6 m ***Slope Surface Area:*** 784 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	784
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 54.9

Estimated Erosion Rate (t / year): 91.6

Mitigation Measures: ***Mitigation Status:*** Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

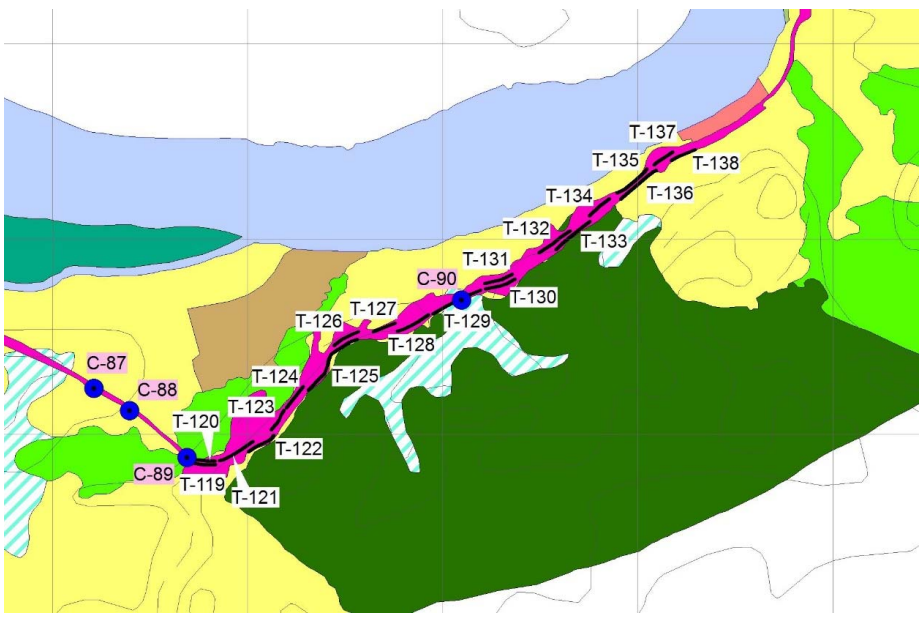
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-123*** ***Type:*** Fill Slope

Beginning (x/y): 491.899 / 1.189.315 ***End (x/y):*** 491.864 / 1.189.260

Slope Length (Range): 18.0 – 20.0 m ***Slope Length (Average):*** 19.0 m ***Slope Width:*** 66.0 m

Slope Surface Area: 1254 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	0	0
Rills	10	125
Gullies	90	1129
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 877.8

Estimated Erosion Rate (t / year): 1465.9

Mitigation Measures:

Mitigation Status: Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

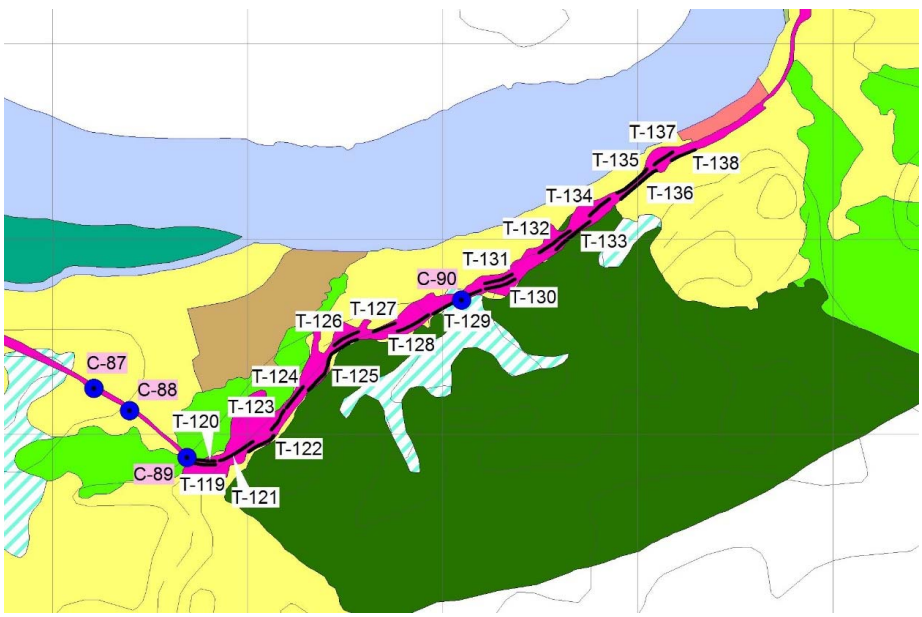
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-124*** ***Type:*** Cut Slope

Beginning (x/y): 491.953 / 1.189.382 ***End (x/y):*** 491.906 / 1.189.322

Elevation Difference (Range): 3.0 -4.6 m ***Elevation Difference (Average):*** 3.9 m ***Slope Length:*** 4.3 m

Slope Angle: 65º ***Slope Width:*** 76.5 m ***Slope Surface Area:*** 329 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	329
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 23.0

Estimated Erosion Rate (t / year): 38.5

Mitigation Measures: ***Mitigation Status:*** No mitigation necessary

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

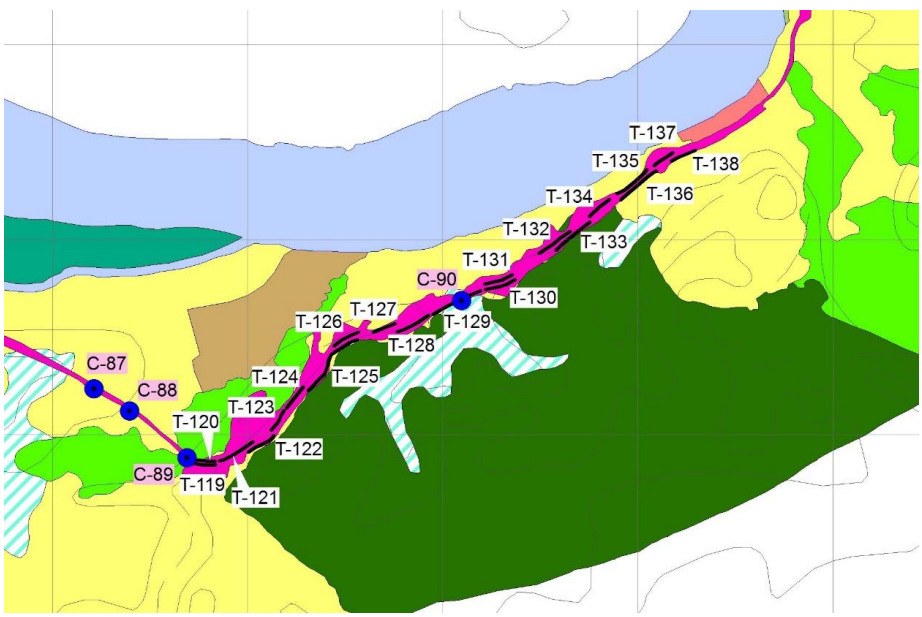
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-125*** ***Type:*** Cut Slope

Beginning (x/y): 492.104 / 1.189.517 ***End (x/y):*** 491.966 / 1.189.372

Elevation Difference (Range): 3.0 – 7.0 m ***Elevation Difference (Average):*** 5.0 m ***Slope Length:*** 7.1 m

Slope Angle: 45º ***Slope Width:*** 208.8 m ***Slope Surface Area:*** 1476 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	1476
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 103.4

Estimated Erosion Rate (t / year): 172.6

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

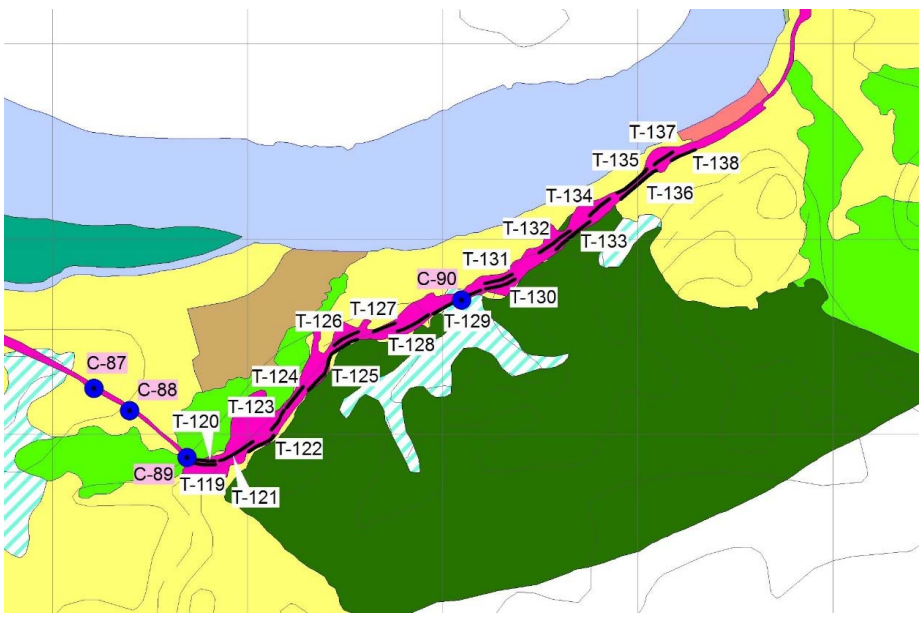
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-126*** ***Type:*** Fill Slope

Beginning (x/y): 492.108 / 1.189.538 ***End (x/y):*** 492.039 / 1.189.499

Slope Length (Range): 20.0 -30.0 m ***Slope Length (Average):*** 26.0 m ***Slope Width:*** 79.4 m

Slope Surface Area: 2064 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	60	1238
Rills	20	413
Gullies	20	413
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 553.3

Estimated Erosion Rate (t / year): 923.9

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

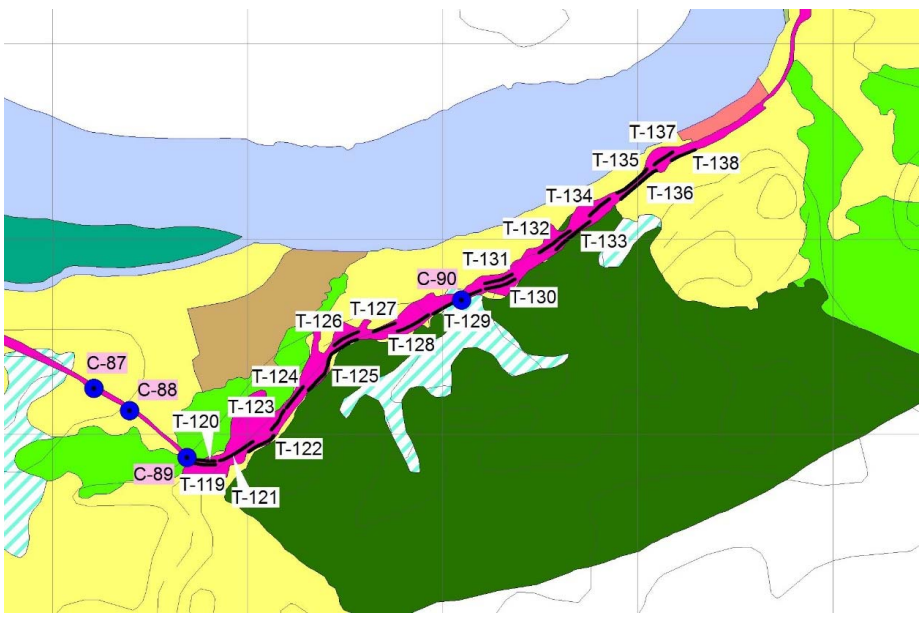
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-127*** ***Type:*** Cut Slope

Beginning (x/y): 492.149 / 1.189.538 ***End (x/y):*** 492.210 / 1.189.561

Elevation Difference (Range): 4.0 – 7.0 m ***Elevation Difference (Average):*** 5.7 m ***Slope Length:*** 7.4 m

Slope Angle: 50º ***Slope Width:*** 66.1 m ***Slope Surface Area:*** 492 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	492
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³ / year): 34.4

Estimated Erosion Rate (t / year): 57.5

Mitigation Measures: ***Mitigation Status:*** Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

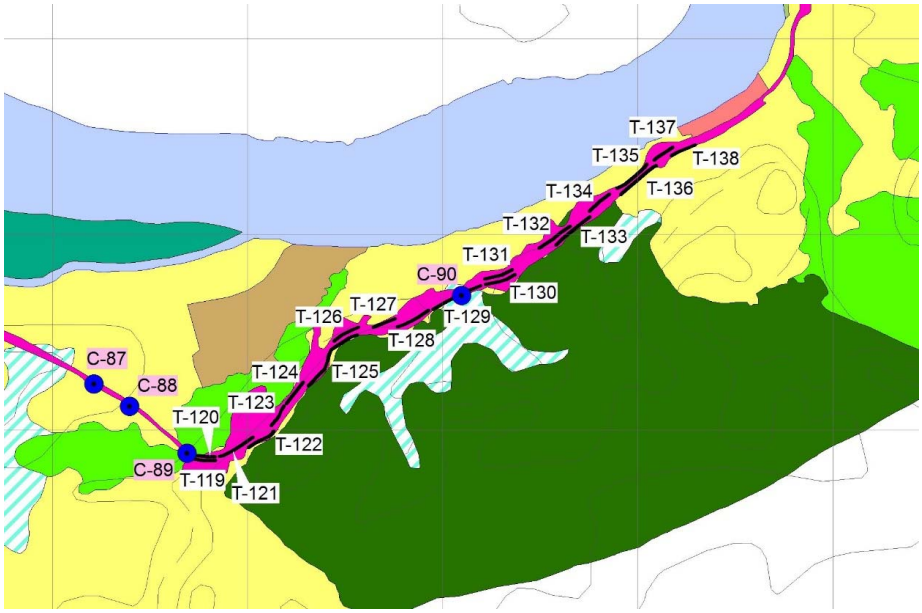
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-128*** ***Type:*** Cut Slope

Beginning (x/y): 492.304 / 1.189.586 ***End (x/y):*** 492.217 / 1.189.539

Elevation Difference (Range): 5.0 – 7.8 m ***Elevation Difference (Average):*** 7.0 m ***Slope Length:*** 6.5 m

Slope Angle: 50º ***Slope Width:*** 100.2 m ***Slope Surface Area:*** 916**m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	80	733
Rills	20	183
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 80.6

Estimated Erosion Rate (t / year): 134.6

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: yes Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

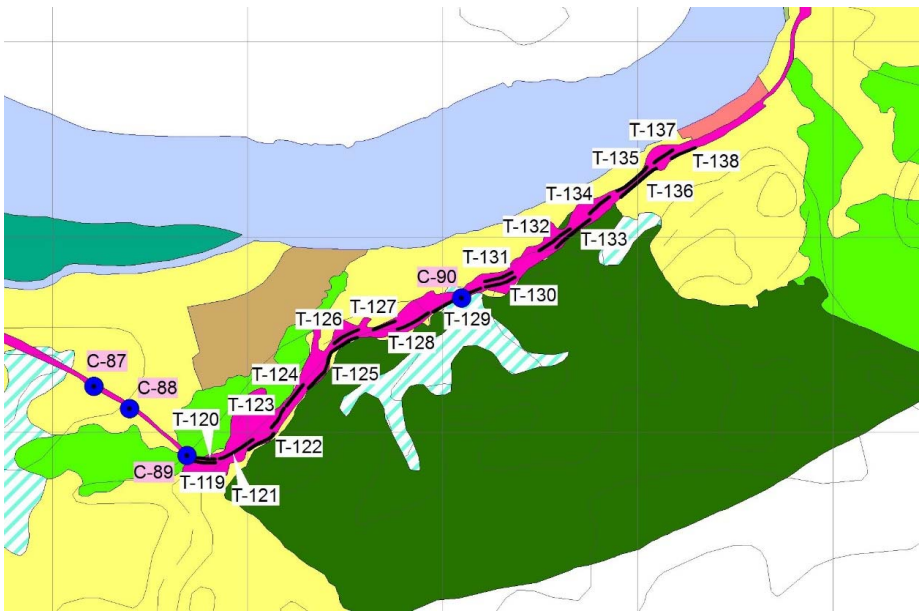
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-129*** ***Type:*** Fill Slope

Beginning (x/y): 492.304 / 1.189.586 ***End (x/y):*** 492.217 / 1.189.539

Slope Length (Range): 3.0 – 7.0 m ***Slope Length (Average):*** 5.5 m ***Slope Width:*** 149.8 m

Slope Surface Area: 824 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	85	700
Rills	10	82
Gullies	5	41
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 142.5

Estimated Erosion Rate (t / year): 238.0

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

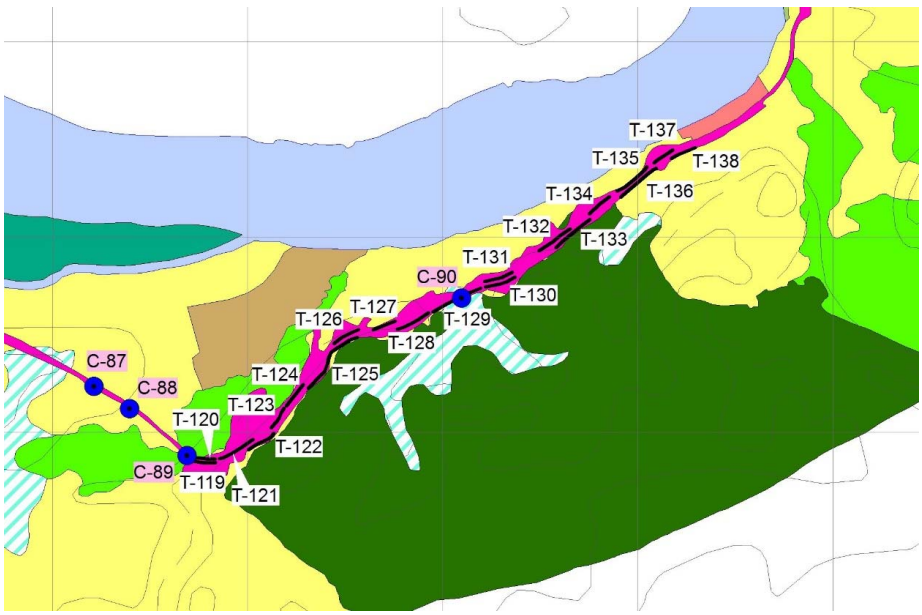
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-130*** ***Type:*** Cut Slope

Beginning (x/y):492.464 / 1.189.659 ***End (x/y):*** 492.546 / 1.189.687

Elevation Difference (Range): 4.0 – 5.2 m ***Elevation Difference (Average):*** 4.5 m ***Slope Length:*** 5.9 m

Slope Angle: 50º ***Slope Width:*** 86.3 m ***Slope Surface Area:*** 507 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	85	431
Rills	15	76
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 42.3

Estimated Erosion Rate (t / year): 70.7

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

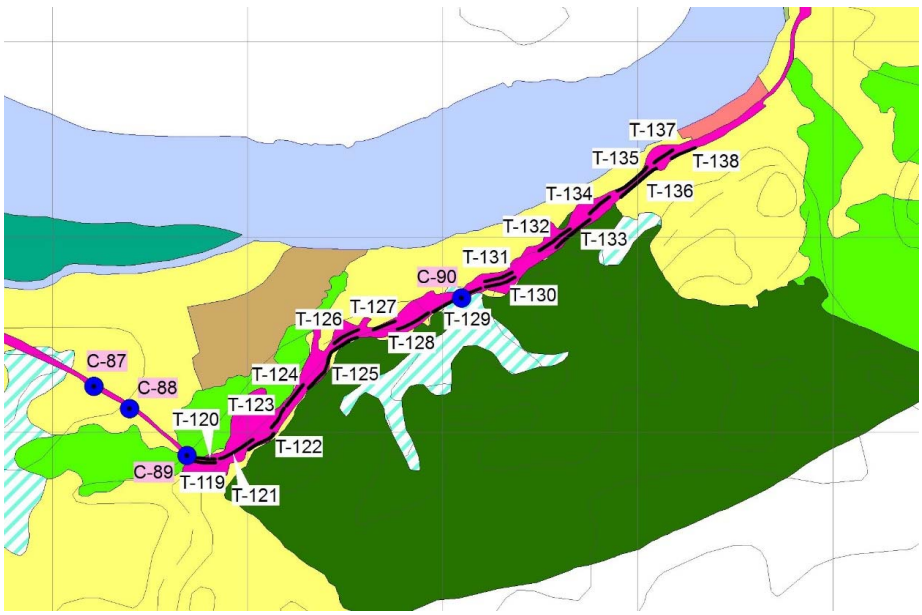
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-131*** ***Type:*** Cut Slope

Beginning (x/y): 492.461 / 1.189.674 ***End (x/y):*** 492.538 / 1.189.700

Elevation Difference (Range): 1.5 – 2.2 m ***Elevation Difference (Average):*** 1.8 m ***Slope Length:*** 1.8 m

Slope Angle: 80º ***Slope Width:*** 82.5 m ***Slope Surface Area:*** 151 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	151
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 10.6

Estimated Erosion Rate (t / year): 17.6

Mitigation Measures: ***Mitigation Status:*** No mitigation necessary

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

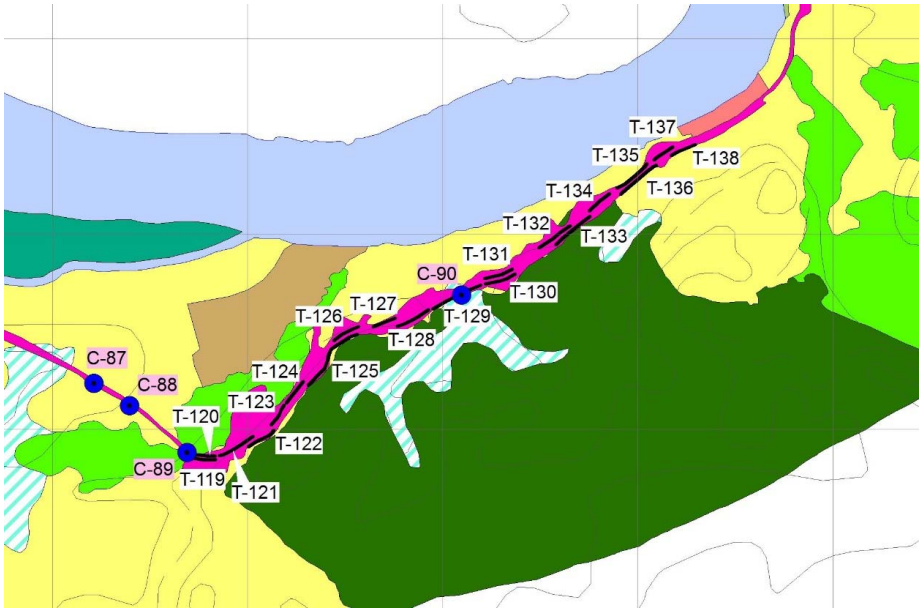
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-132*** ***Type:*** Fill Slope

Beginning (x/y): 492.702 / 1.189.823 ***End (x/y):*** 492.614 / 1.189.762

Slope Length (Range): 16.0 – 24.0 m ***Slope Length (Average):*** 20.0 m ***Slope Width:*** 107.1 m

Slope Surface Area: 2142 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	10	214
Rills	20	428
Gullies	70	1499
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 1238.1

Estimated Erosion Rate (t / year): 2067.6

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

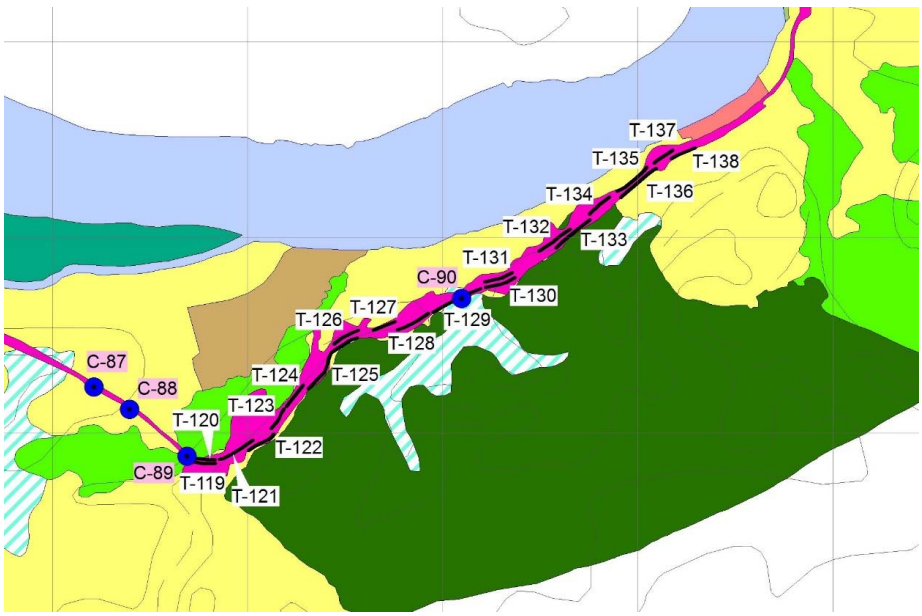
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-133*** ***Type:*** Cut Slope

Beginning (x/y): 492.661 / 1.189.770 ***End (x/y):*** 492.757 / 1.189.850

Elevation Difference (Range): 2.5 – 6.6 m ***Elevation Difference (Average):*** 5.0 m ***Slope Length:*** 7.1 m

Slope Angle: 45º ***Slope Width:*** 125.1 m ***Slope Surface Area:*** 885 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	80	708
Rills	20	177
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 77.8

Estimated Erosion Rate (t / year): 130.0

Mitigation Measures:

Mitigation Status: Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

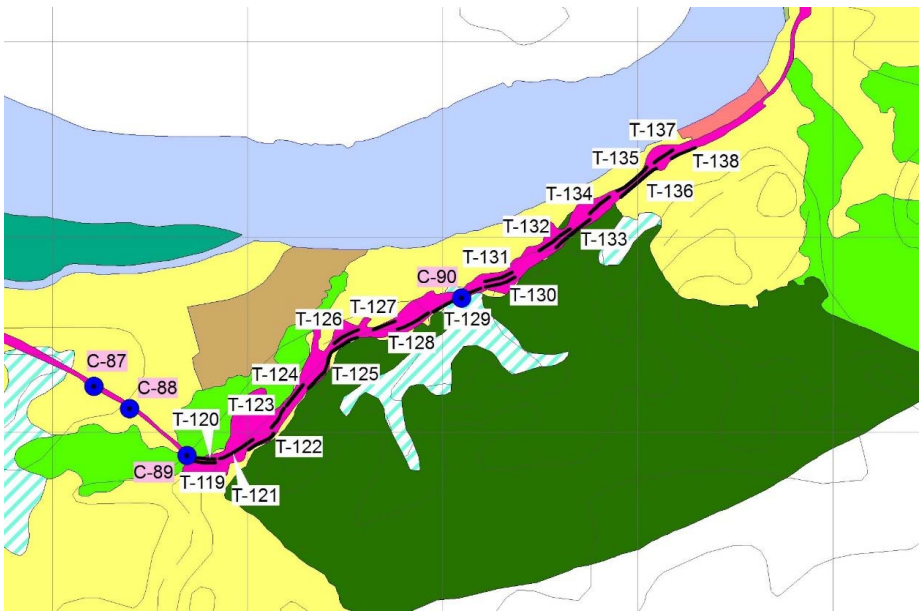
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-134*** ***Type:*** Fill Slope

Beginning (x/y): 492.811 / 1.189.914 ***End (x/y):*** 492.755 / 1.189.866

Slope Length (Range): 15.0 – 20.0 m ***Slope Length (Average):*** 17.0 m ***Slope Width:*** 73.9 m

Slope Surface Area: 1256 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	20	251
Rills	30	377
Gullies	50	628
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 572.9

Estimated Erosion Rate (t / year): 956.7

Mitigation Measures:

Mitigation Status: Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

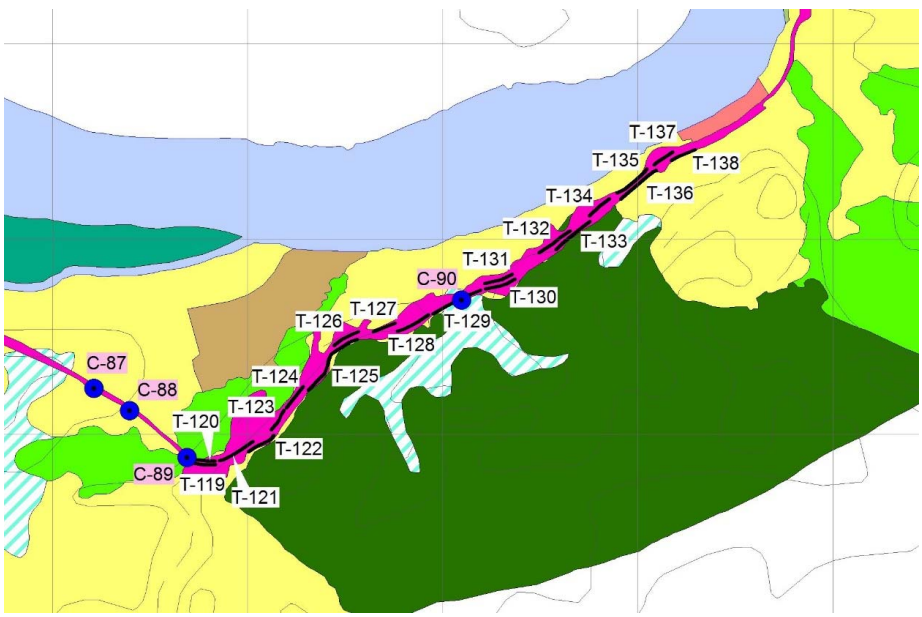
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-135*** ***Type:*** Fill Slope

Beginning (x/y): 492.916 / 1.189.998 ***End (x/y):*** 492.832 / 1.189.930

Slope Length (Range): 1.0 – 12.5 m ***Slope Length (Average):*** 8.5 m ***Slope Width:*** 109.1 m

Slope Surface Area: 927 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	40	371
Rills	10	93
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 66.8

Estimated Erosion Rate (t / year): 111.5

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

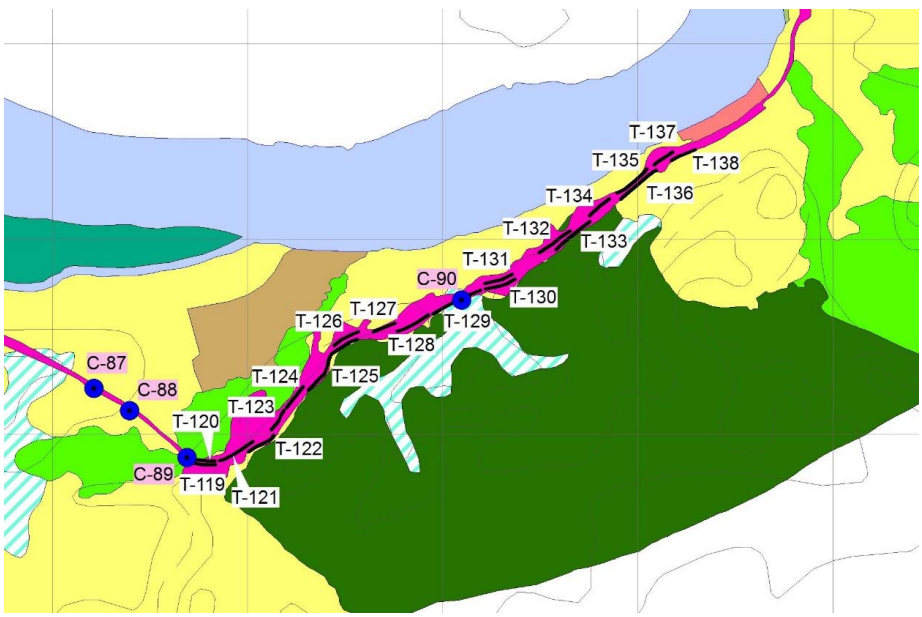
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-136*** ***Type:*** Cut Slope

Beginning (x/y): 492.842 / 1.189.913 ***End (x/y):*** 492.942 / 1.189.995

Elevation Difference (Range): 2.0 -4.2 m ***Elevation Difference (Average):*** 3.2 m ***Slope Length:*** 3.5 m

Slope Angle: 65° ***Slope Width:*** 129.8 m ***Slope Surface Area:*** 458 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	50	229
Rills	20	92
Gullies	0	0
Land Slides	30	137

Estimated Erosion Rate (m³/ year): 85.7

Estimated Erosion Rate (t / year): 143.1

Mitigation Measures: ***Mitigation Status:*** Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

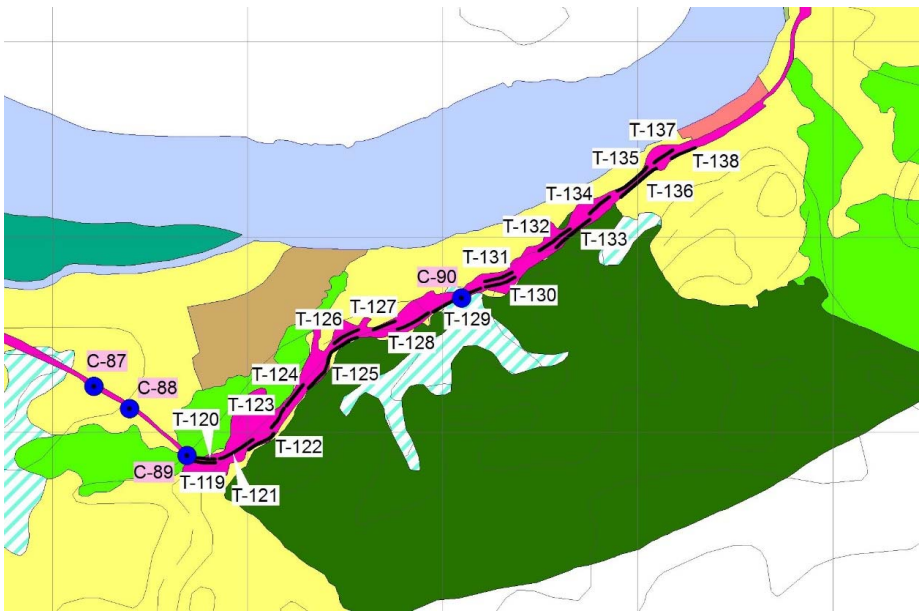
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-137*** ***Type:*** Cut Slope

Beginning (x/y): 492.989 / 1.190.047 ***End (x/y):*** 492.935 / 1.190.010

Elevation Difference (Range): 2.0 – 6.0 m ***Elevation Difference (Average):*** 3.8 m ***Slope Length:*** 4.2 m

Slope Angle: 65° ***Slope Width:*** 65.1 m ***Slope Surface Area:*** 273 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	75	205
Rills	0	0
Gullies	0	0
Land Slides	25	68

Estimated Erosion Rate (m³/ year): 41.6

Estimated Erosion Rate (t / year): 69.5

Mitigation Measures: ***Mitigation Status:*** Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

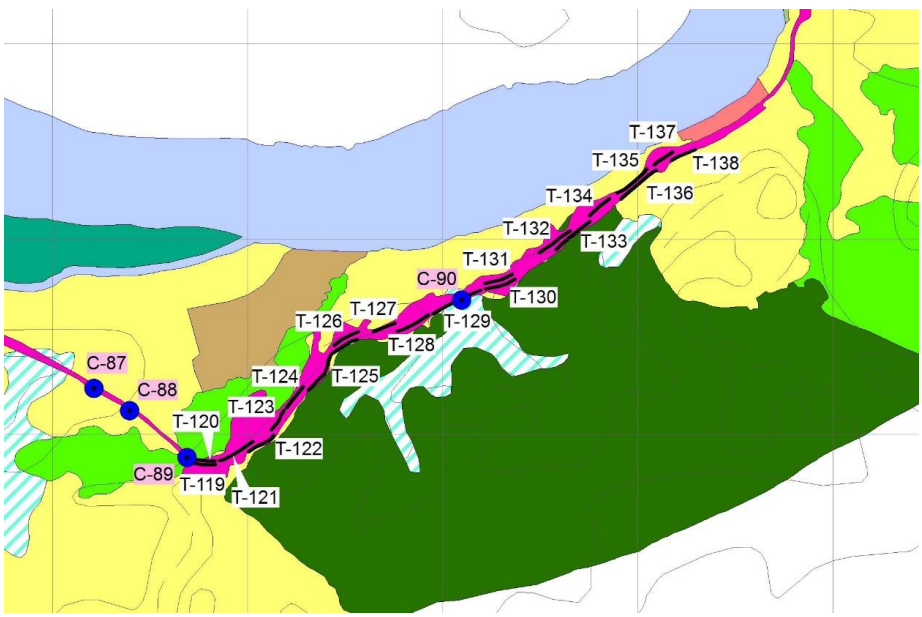
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-138*** ***Type:*** Cut Slope

Beginning (x/y): 492.989 / 1.190.047 ***End (x/y):*** 492.935 / 1.190.010

Elevation Difference (Range): 1.0 - 1.5 m ***Elevation Difference (Average):*** 1.25 m ***Slope Length:*** 1.3 m

Slope Angle: 70° ***Slope Width:*** 72.8 m ***Slope Surface Area:*** 97 m²

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	97
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 6.8

Estimated Erosion Rate (t / year): 11.3

Mitigation Measures: ***Mitigation Status:*** No mitigation necessary

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

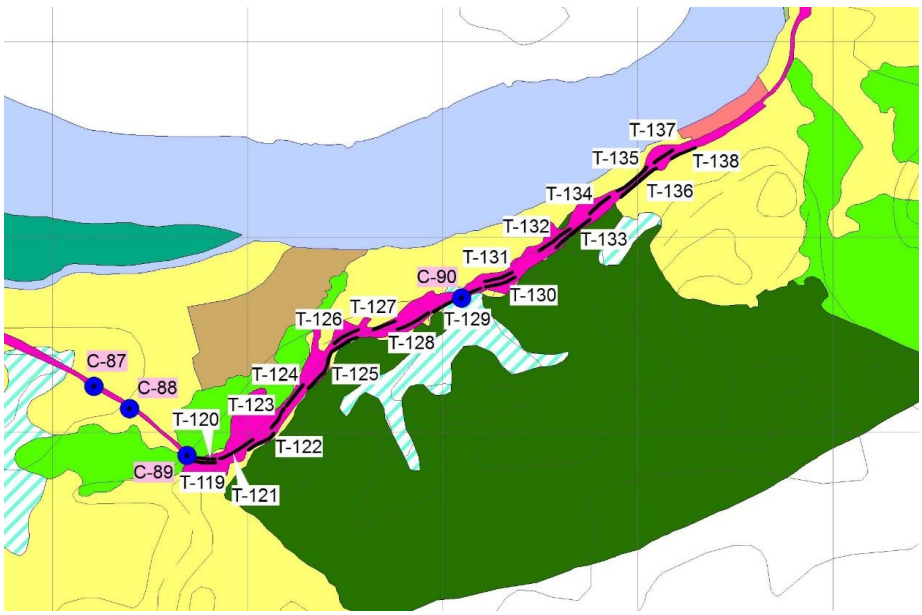
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-139*** ***Type:*** Cut Slope

Beginning (x/y): 495.400 / 1.190.827 ***End (x/y):*** 495.502 / 1.190.799

Elevation Difference (Range): 9.0 – 12.0 m ***Elevation Difference (Average):*** 11.0 m ***Slope Length:*** 15.6 m

Slope Angle: 45° ***Slope Width:***124.3 m ***Slope Surface Area:*** 1934 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	50	967
Rills	40	773
Gullies	10	193
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 243.6

Estimated Erosion Rate (t / year): 406.9

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

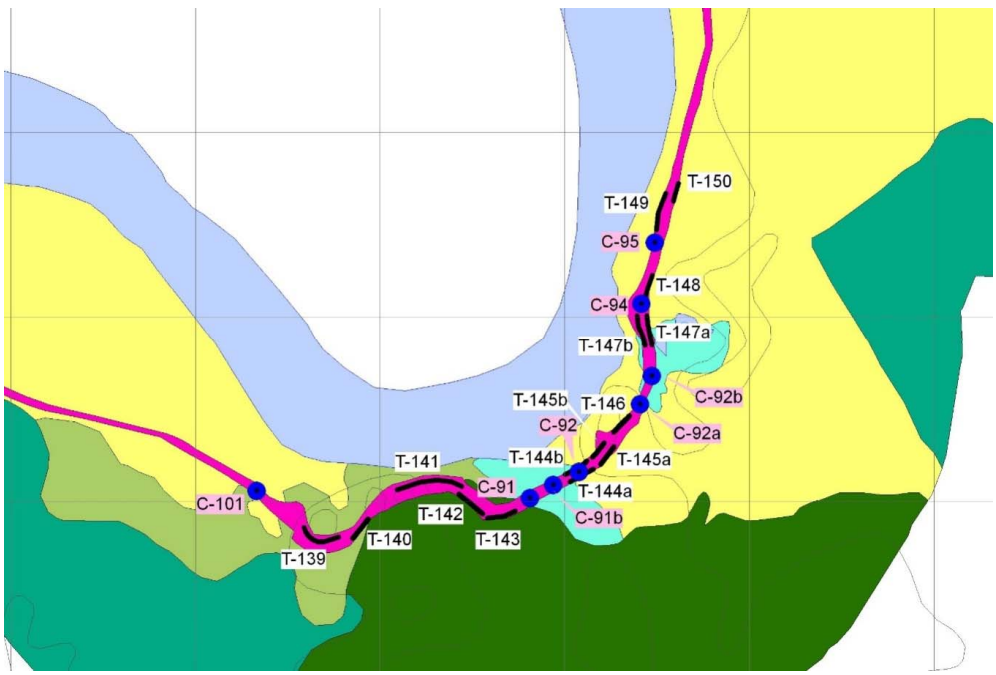
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-140*** ***Type:*** Cut Slope

Beginning (x/y): 495.544 / 1.190.794 ***End (x/y):*** 495.590 / 1.190.854

Elevation Difference (Range): 2.0 – 4.2 m ***Elevation Difference (Average):*** 3.0 m ***Slope Length:*** 3.3 m

Slope Angle: 65° ***Slope Width:*** 75.0 m ***Slope Surface Area:*** 248 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	75	186
Rills	25	62
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 23.0

Estimated Erosion Rate (t / year): 38.3

Mitigation Measures: ***Mitigation Status:*** No mitigation necessary

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

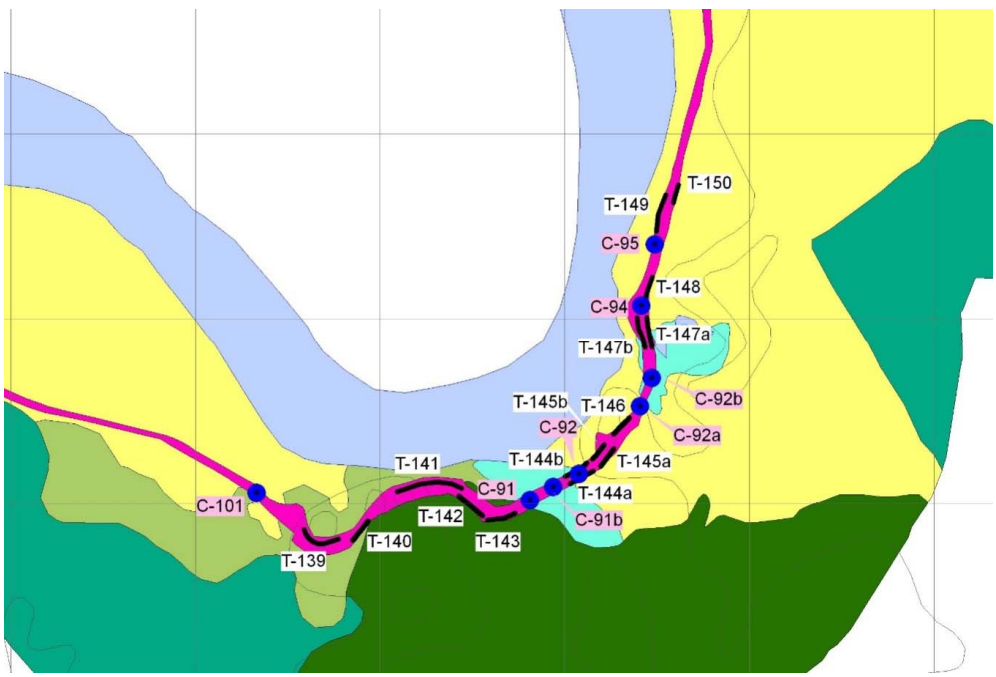
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-141*** ***Type:*** Cut Slope

Beginning (x/y): 495.544 / 1.190.794 ***End (x/y):*** 495.590 / 1.190.854

Elevation Difference (Range): 2.0 – 3.0 m ***Elevation Difference (Average):*** 2.5 m ***Slope Length:*** 3.5**m**

Slope Angle: 45° ***Slope Width:*** 198.5 m ***Slope Surface Area:*** 702 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	702
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 49.1

Estimated Erosion Rate (t / year): 82.0

Mitigation Measures: ***Mitigation Status:*** No mitigation necessary

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

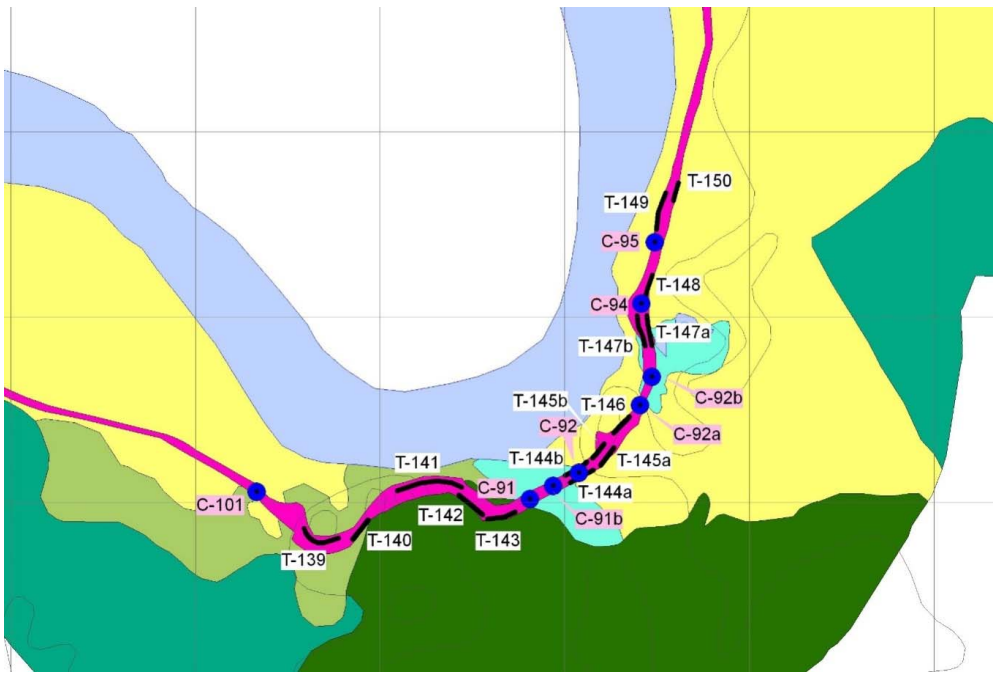
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-142*** ***Type:*** Cut Slope

Beginning (x/y): 495.858 / 1.190.927 ***End (x/y):*** 495.930 / 1.190.868

Slope Length (Range): 1.5 – 2.7 m ***Slope Length (Average):*** 2.2 m ***Slope Width:*** 93.5 m

Slope Surface Area: 206 m^2

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	80	165
Rills	20	41
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 29.6

Estimated Erosion Rate (t / year): 49.5

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

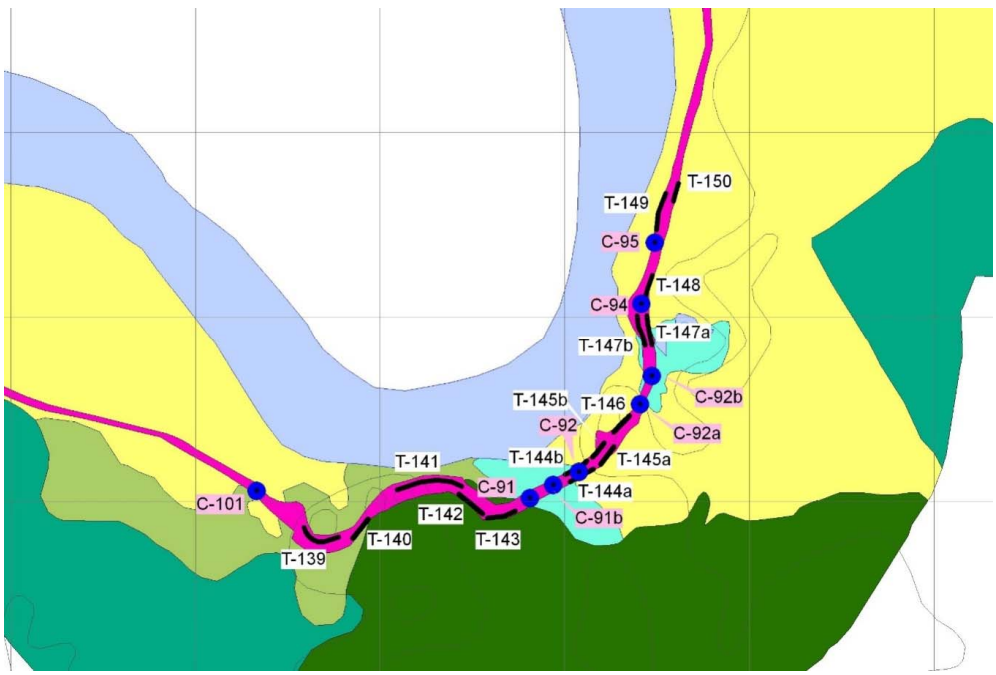
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-143*** ***Type:*** Cut Slope

Beginning (x/y): 495.943 / 1.190.856 ***End (x/y):*** 496.025 / 1.190.877

Elevation Difference (Range): 1.0 – 2.5 m ***Elevation Difference (Average):*** 1.8 m ***Slope Length:*** 2.5 m

Slope Angle: 45° ***Slope Width:*** 85.8 m ***Slope Surface Area:*** 218 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	218
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 15.3

Estimated Erosion Rate (t / year): 25.5

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

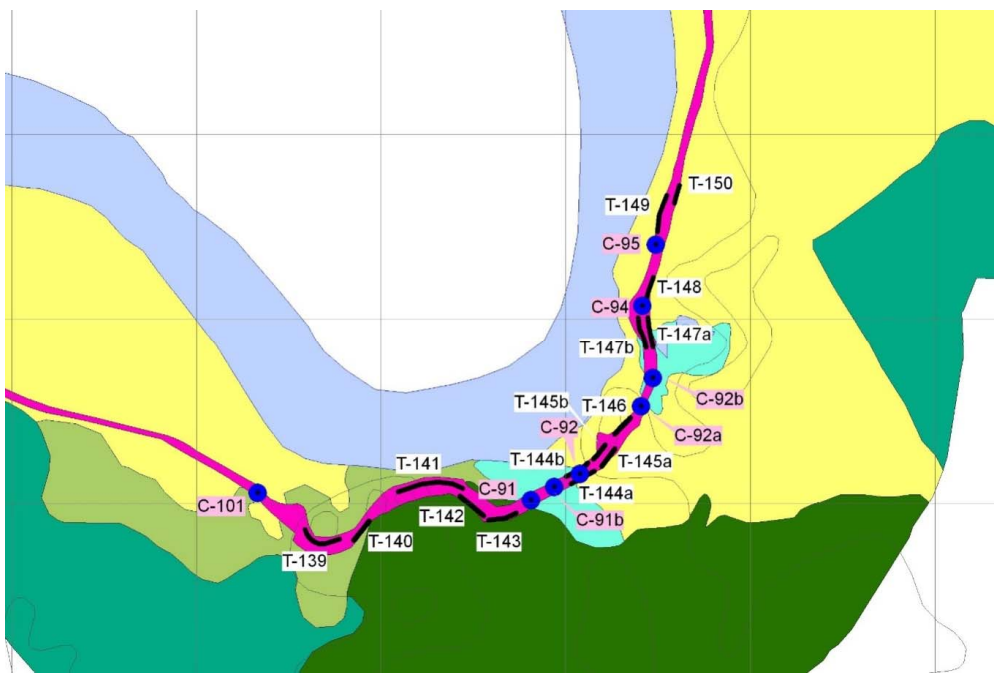
Condition in 2013

Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013	***Condition in 2014***

Location Map:



Slope: ***T-144a*** ***Type:*** Fill Slope

Beginning (x/y): 496.257 / 1.191.002 ***End (x/y):*** 496.188 / 1.190.964

Slope Length (Range): 4.0 – 8.0 m ***Slope Length (Average):*** 6.0 m ***Slope Width:*** 78.1 m

Slope Surface Area: 469 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	85	398
Rills	15	70
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 67.0

Estimated Erosion Rate (t / year): 111.9

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

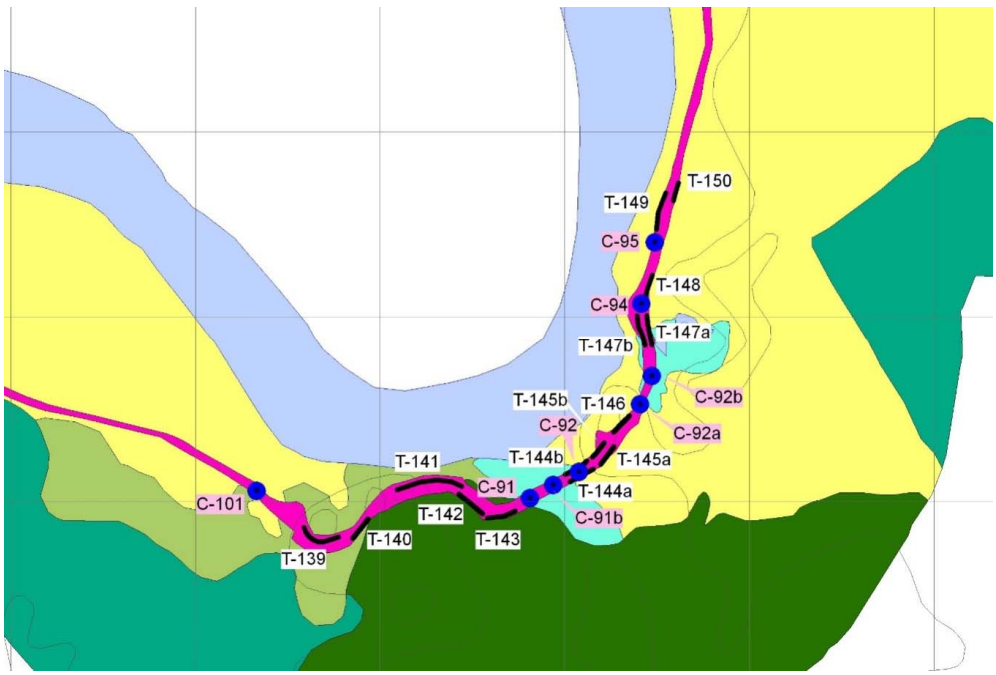
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-144b*** ***Type:*** Fill Slope

Beginning (x/y): 496.238 / 1.191.027 ***End (x/y):*** 496.173 / 1.190.985

Slope Length (Range): 3.0 – 14.0 m ***Slope Length (Average):*** 5.5 m ***Slope Width:*** 77.2 m

Slope Surface Area: 425 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	85	361
Rills	15	64
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 111.9

Estimated Erosion Rate (t / year): 101.4

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no

Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

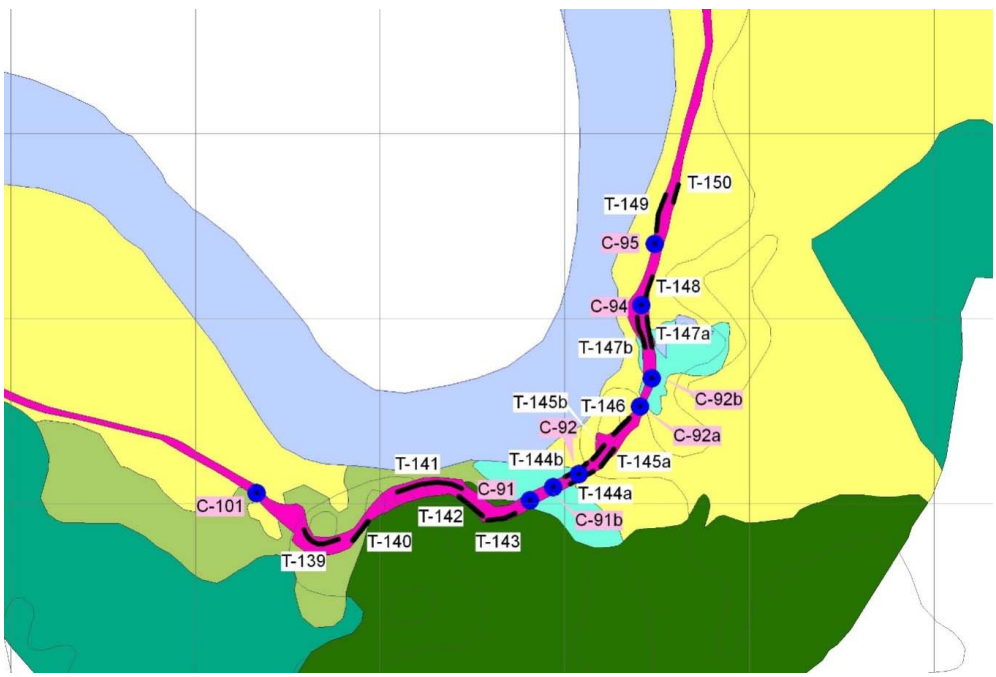
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-145a*** ***Type:*** Cut Slope

Beginning (x/y): 496.278 / 1.191.016 ***End (x/y):*** 496.318 / 1.191.069

Elevation Difference (Range): 1.0 – 2.3 m ***Elevation Difference (Average):*** 1.7 m ***Slope Length:*** 2.0 m

Slope Angle: 60° ***Slope Width:***65.5 m ***Slope Surface Area:*** 129 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	129
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 9.0

Estimated Erosion Rate (t / year): 15.0

Mitigation Measures: ***Mitigation Status:*** No mitigation necessary

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

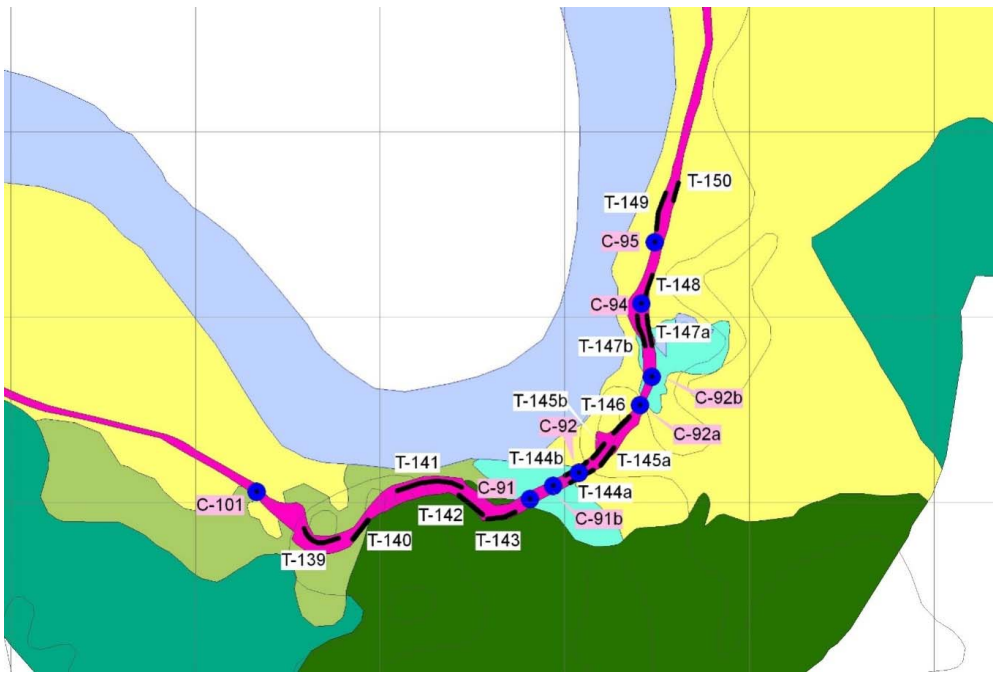
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-145b*** ***Type:*** Cut Slope

Beginning (x/y): 496.289/ 1.191.081 ***End (x/y):*** 496.254/ 1.191.038

Elevation Difference (Range): 1.5 – 3.2 m ***Elevation Difference (Average):*** 2.2 m ***Slope Length:*** 3.1 m

Slope Angle: 45° ***Slope Width:*** 55.4 m ***Slope Surface Area:*** 172 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	172
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 12.1

Estimated Erosion Rate (t / year): 20.1

Mitigation Measures: ***Mitigation Status:*** No mitigation necessary

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

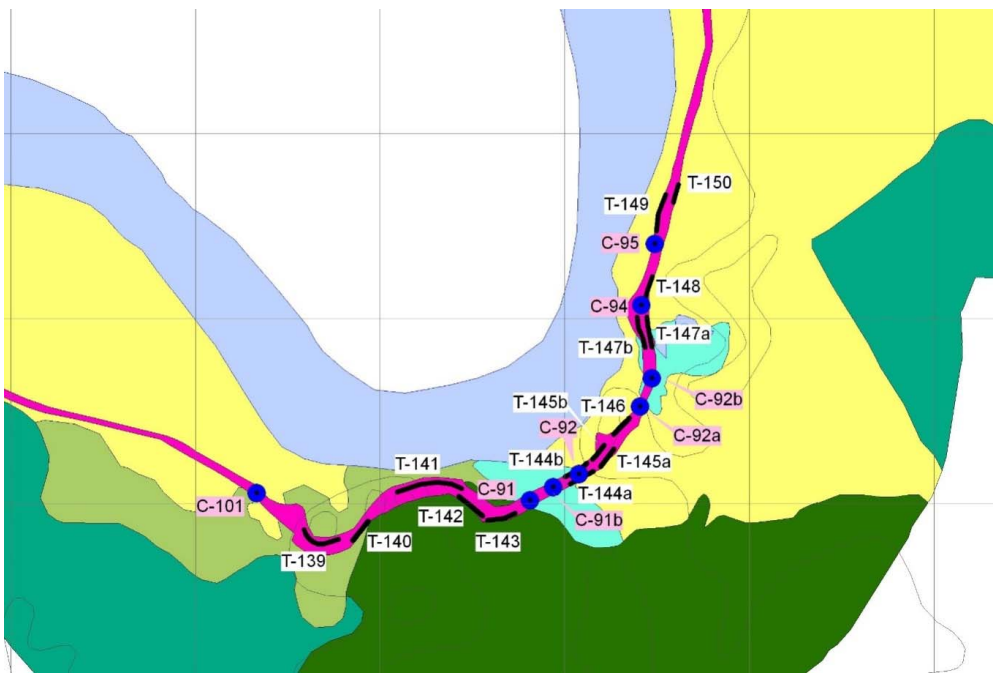
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-146*** ***Type:*** Cut Slope

Beginning (x/y): 496.364 / 1.191.161 ***End (x/y):*** 496.317 / 1.191.111

Elevation Difference (Range): 4.0 – 6.6 m ***Elevation Difference (Average):*** 5.5 m ***Slope Length:*** 7.2 m

Slope Angle: 50° ***Slope Width:*** 68.2 m ***Slope Surface Area:*** 490 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	490
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 34.3

Estimated Erosion Rate (t / year): 57.2

Mitigation Measures:

Mitigation Status: Mitigation scheduled

Geotextiles: no Drainage Control: no Geotextiles: no Drainage Control: no

Sowed Vegetation: no Natural Vegetation: no

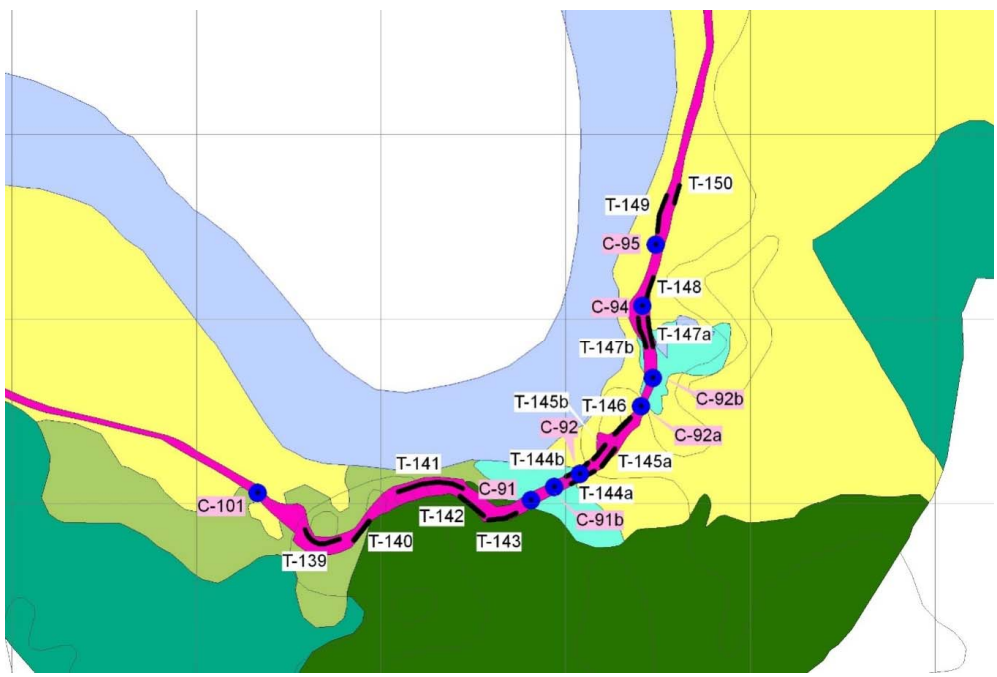
Condition in 2013

Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013	***Condition in 2014***

Location Map:



Slope: ***T-147a*** ***Type:*** Cut Slope

Beginning (x/y): 496.430 / 1.191.373 ***End (x/y):*** 496.415 / 1.191.463

Elevation Difference (Range):3.0 – 4.0 m ***Elevation Difference (Average):*** 3.5 m ***Slope Length:*** 4.9 m

Slope Angle: 45° ***Slope Width:*** 91.1 m ***Slope Surface Area:*** 451 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	451
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 31.6

Estimated Erosion Rate (t / year): 52.7

Mitigation Measures: ***Mitigation Status:*** Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

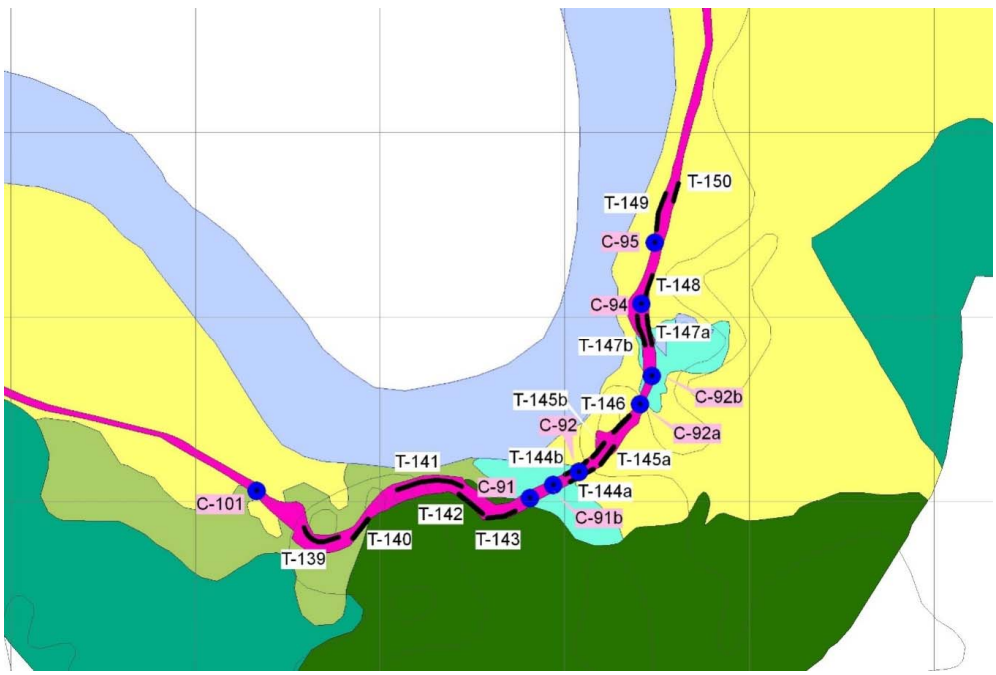
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-147b*** ***Type:*** Cut Slope

Beginning (x/y): 496.410 / 1.191.372 ***End (x/y):*** 496.386 / 1.191.463

Elevation Difference (Range): 2.0 – 3.5 m ***Elevation Difference (Average):*** 2.8 m ***Slope Length:*** 4.0 m

Slope Angle: 45° ***Slope Width:*** 95.2 m ***Slope Surface Area:*** 377 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	377
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 26.4

Estimated Erosion Rate (t / year): 44.1

Mitigation Measures: ***Mitigation Status:*** Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

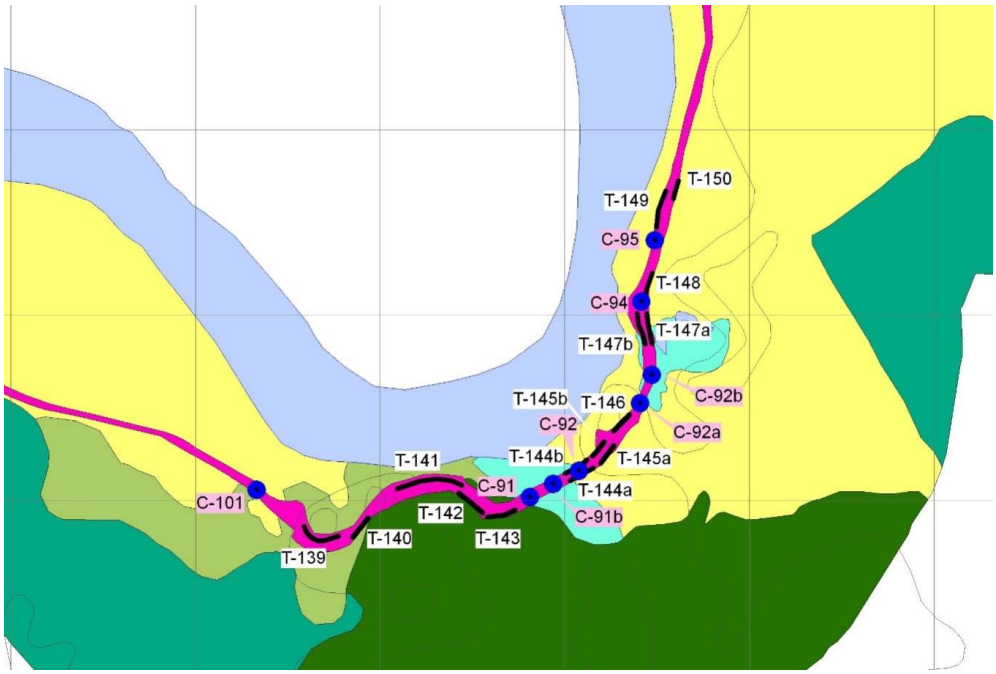
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-148*** ***Type:*** Cut Slope

Beginning (x/y): 496.410 / 1.191.518 ***End (x/y):*** 496.431 / 1.191.585

Elevation Difference (Range): 2.0 – 5.0 m ***Elevation Difference (Average):*** 3.5 m ***Slope Length:*** 4.9 m

Slope Angle: 45° ***Slope Width:*** 70,0 m ***Slope Surface Area:*** 346 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	346
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 24.3

Estimated Erosion Rate (t / year): 40.5

Mitigation Measures: ***Mitigation Status:*** Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

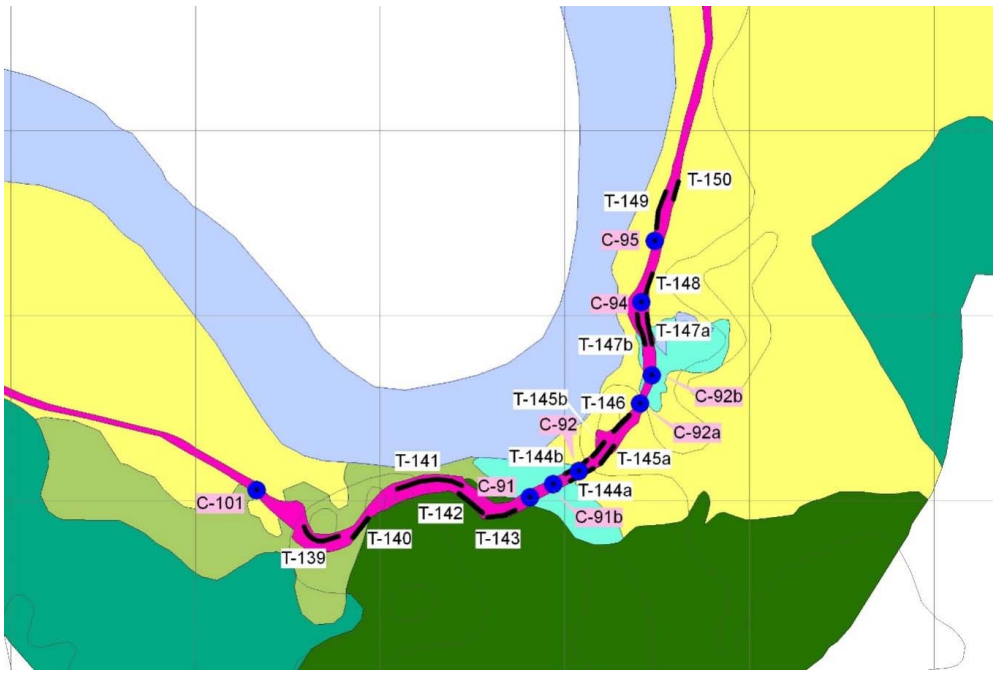
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-149*** ***Type:*** Cut Slope

Beginning (x/y): 496.472 / 1.191.829 ***End (x/y):*** 496.444 / 1.191.721

Elevation Difference (Range): 2.0 – 5.2 m ***Elevation Difference (Average):*** 4.5 m ***Slope Length:*** 5.5 m

Slope Angle: 55° ***Slope Width:*** 113.1 m ***Slope Surface Area:*** 621 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	621
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 43.5

Estimated Erosion Rate (t / year): 72.6

Mitigation Measures: ***Mitigation Status:*** Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

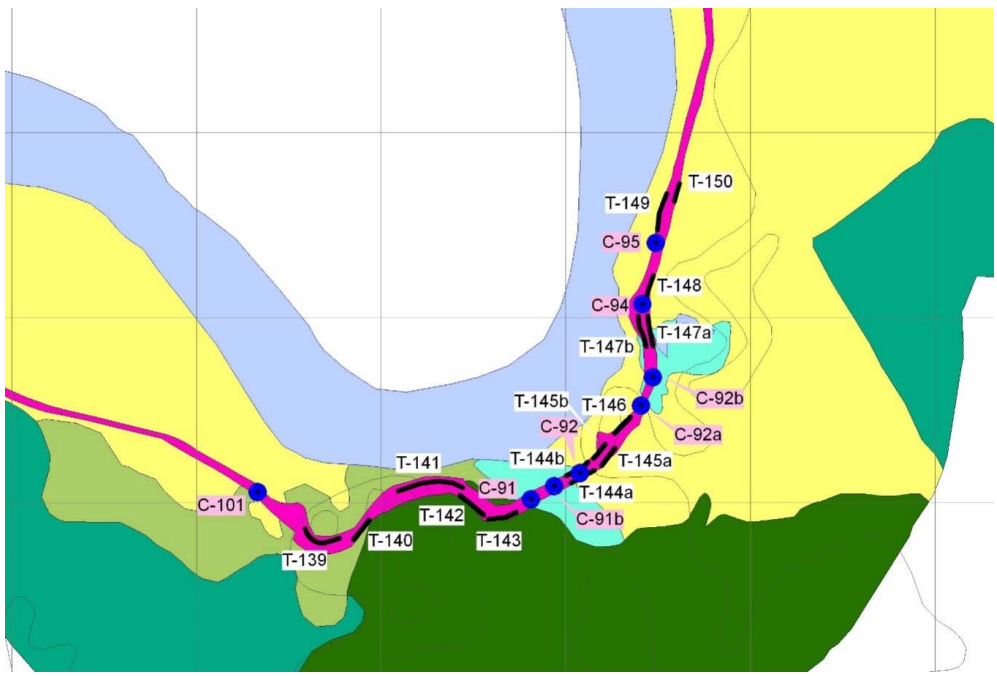
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-150*** ***Type:*** Cut Slope

Beginning (x/y): 496.509 / 1.191.859 ***End (x/y):*** 496.495 / 1.191.807

Elevation Difference (Range): 2.0 – 4.2 m ***Elevation Difference (Average):*** 3.6 m ***Slope Length:*** 4.4 m

Slope Angle: 55º ***Slope Width:*** 54.3 m ***Slope Surface Area:*** 239 m²

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	80	191
Rills	20	48
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 21.0

Estimated Erosion Rate (t / year): 35.1

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

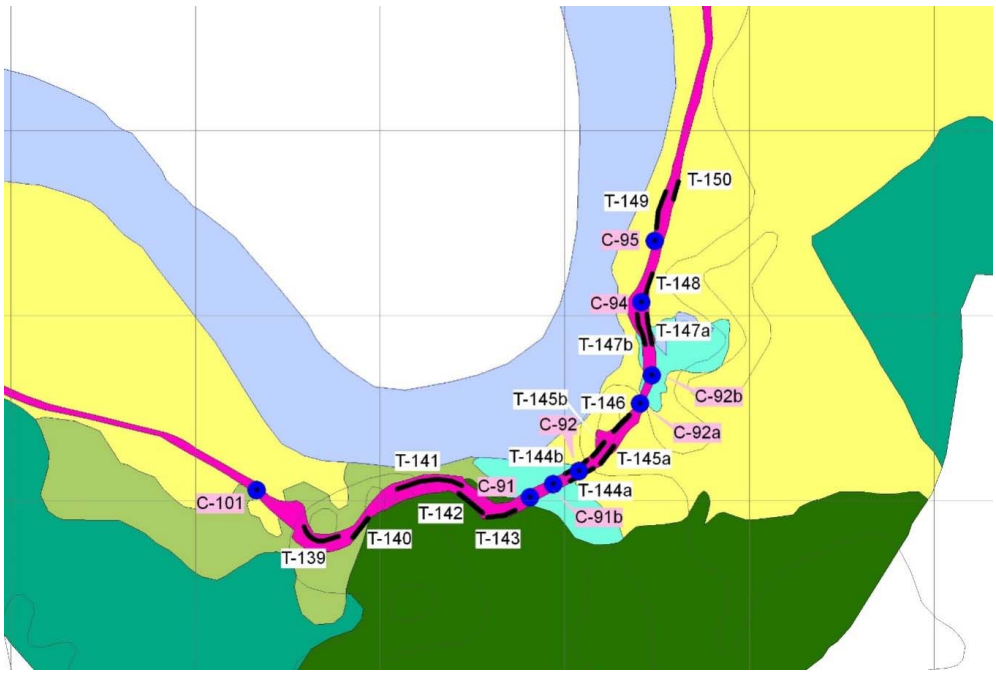
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-151*** ***Type:*** Cut Slope

Beginning (x/y): 500.239 / 1.189.624 ***End (x/y):*** 500.256 / 1.189.626

Elevation Difference (Range): 2.0 – 3.4 m ***Elevation Difference (Average):*** 2.9 m ***Slope Length:*** 3.2 m

Slope Angle: 65° ***Slope Width:*** 16.8 m ***Slope Surface Area:*** 54 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	54
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 3.8

Estimated Erosion Rate (t / year): 6.3

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

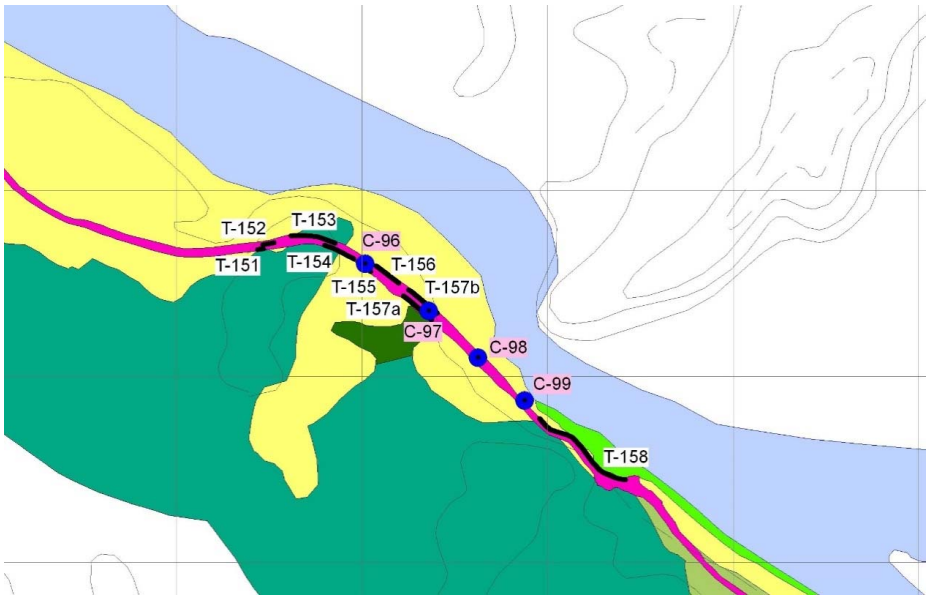
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-152*** ***Type:*** Fill Slope

Beginning (x/y): 500.255 / 1.189.639 ***End (x/y):*** 500.287 / 1.189.645

Slope Length (Range): 7.0 – 12.0 m ***Slope Length (Average):*** 10.0 m ***Slope Width:*** 33.1 m

Slope Surface Area: 331 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	50	166
Rills	25	83
Gullies	25	83
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 99.3

Estimated Erosion Rate (t / year): 165.8

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

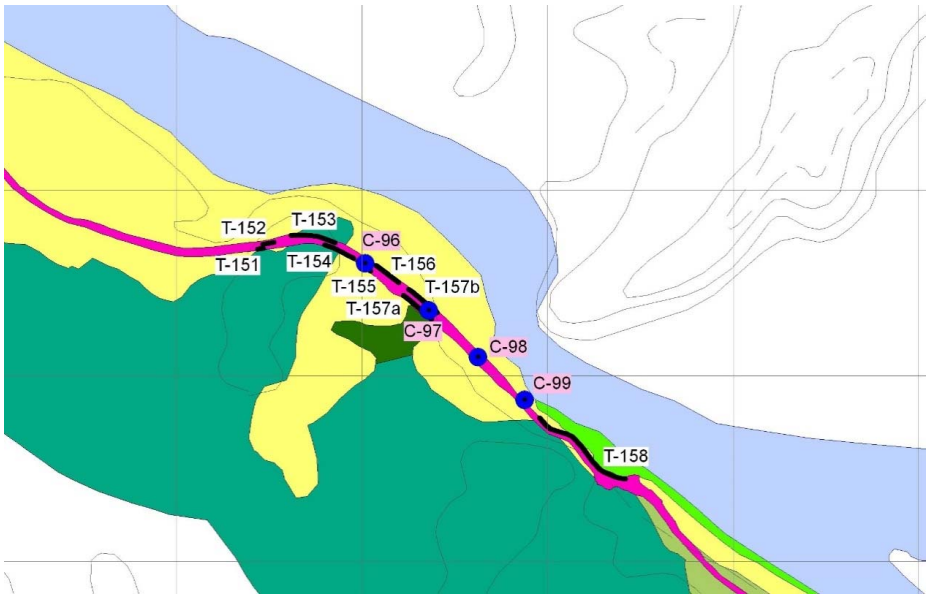
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-153*** ***Type:*** Cut Slope

Beginning (x/y): 500.338 / 1.189.665 ***End (x/y):*** 500.468 / 1.189.644

Elevation Difference (Range): 6.0 – 9.0 m ***Elevation Difference (Average):*** 7.5 m ***Slope Length:*** 8.7 m

Slope Angle: 60º ***Slope Width:*** 133,3 m ***Slope Surface Area:*** 1154 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	1154
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 80.8

Estimated Erosion Rate (t / year): 135.0

Mitigation Measures: ***Mitigation Status:*** Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

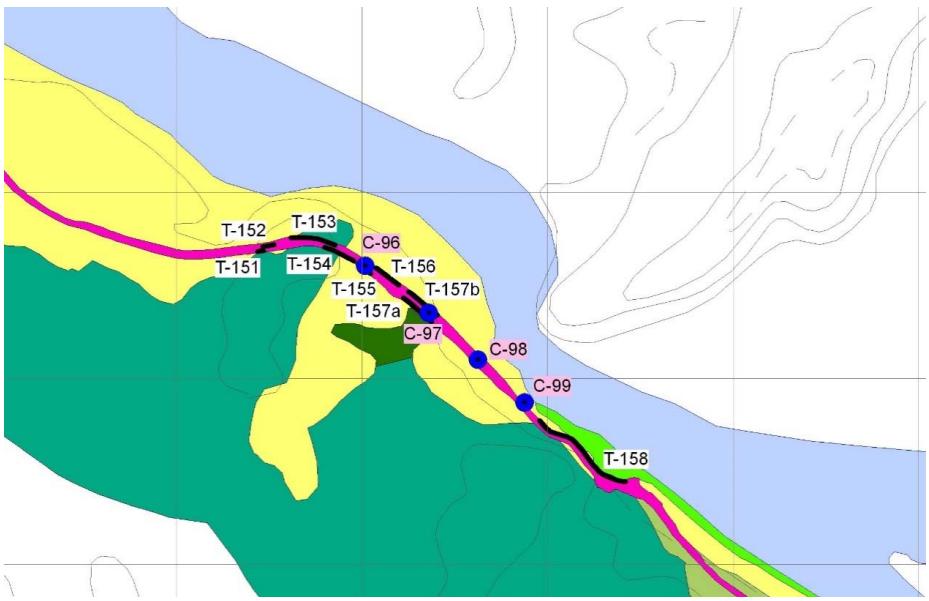
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-154*** ***Type:*** Cut Slope

Beginning (x/y): 500.436 / 1.189.636 ***End (x/y):*** 500.523 / 1.189.596

Elevation Difference (Range): 4.5 – 6.6 m ***Elevation Difference (Average):*** 5.5 m ***Slope Length:*** 7.2 m

Slope Angle: 50º ***Slope Width:*** 95.6 m ***Slope Surface Area:*** 686 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	686
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 48.0

Estimated Erosion Rate (t / year): 80.2

Mitigation Measures: ***Mitigation Status:*** Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

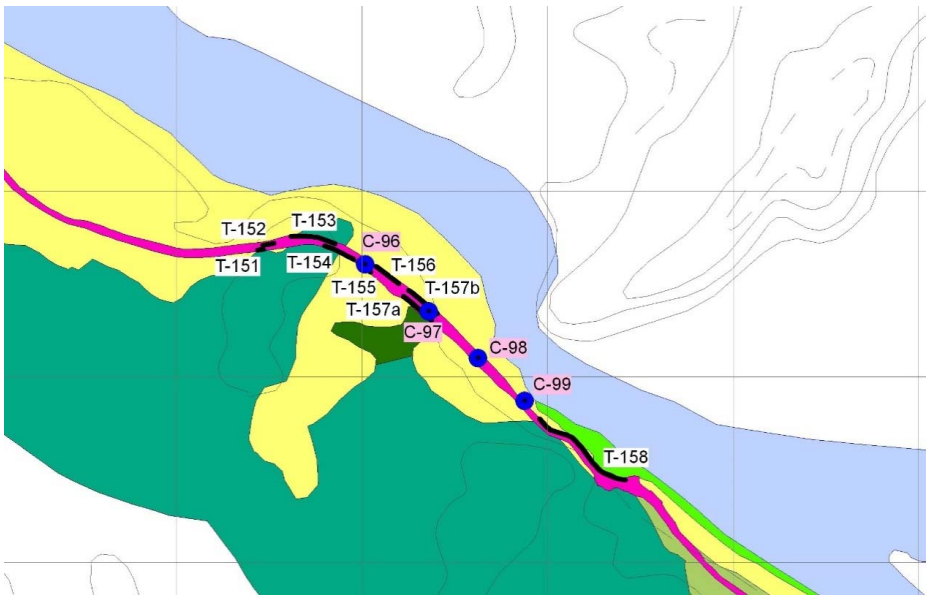
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-155*** ***Type:*** Fill Slope

Beginning (x/y): 500.536 / 1.189.587 ***End (x/y):*** 500.573 / 1.189.558

Slope Length (Range): 2.0 – 4.5 m ***Slope Length (Average):*** 3.2 m ***Slope Width:*** 47.2 m

Slope Surface Area: 151 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	50	76
Rills	20	30
Gullies	30	45
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 49.8

Estimated Erosion Rate (t / year): 83.2

Mitigation Measures:

Mitigation Status: Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

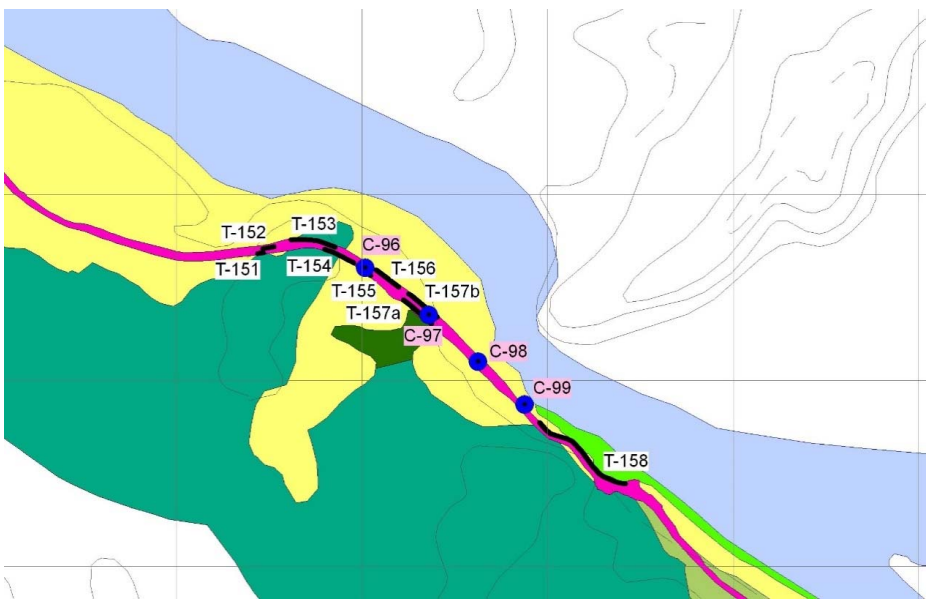
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-156*** ***Type:*** Cut Slope

Beginning (x/y): 500.588 / 1.189.574 ***End (x/y):*** 500.655 / 1.189.525

Elevation Difference (Range): 3.0 – 7.4 m ***Elevation Difference (Average):*** 5.7 m ***Slope Length:*** 7.4 m

Slope Angle: 50° ***Slope Width:*** 82.7 m ***Slope Surface Area:*** 615 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	80	492
Rills	20	123
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 54.2

Estimated Erosion Rate (t / year): 90.4

Mitigation Measures: ***Mitigation Status:*** Mitigation scheduled

Geotextiles: no Drainage Control: no| Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

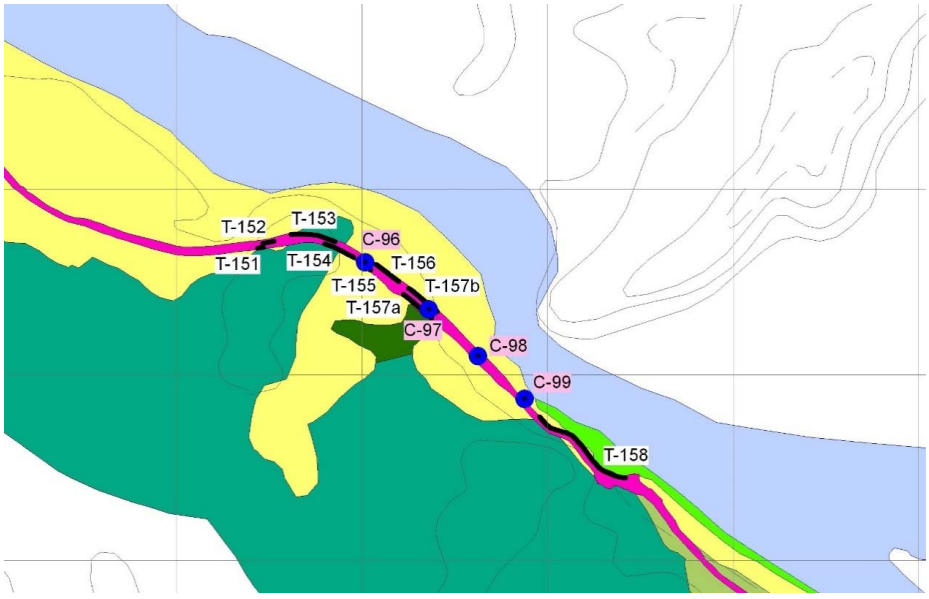
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-157a*** ***Type:*** Fill Slope

Beginning (x/y): 500.668 / 1.189.487 ***End (x/y):*** 500.752 / 1.189.416

Slope Length (Range): 2.0 – 4.5 m ***Slope Length (Average):*** 3.8 m ***Slope Width:*** 109,6 m

Slope Surface Area: 416 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	55	229
Rills	30	125
Gullies	15	62
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 99.5

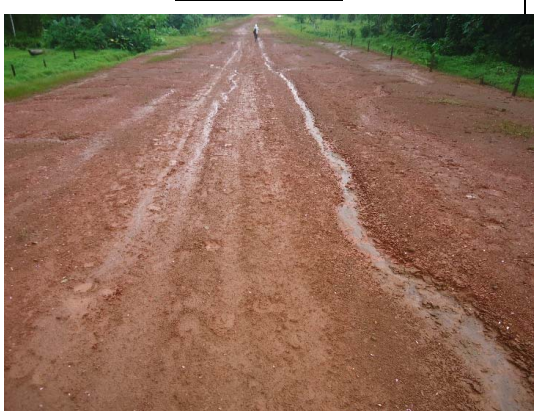
Estimated Erosion Rate (t / year): 166.2

Mitigation Measures:

Mitigation Status: Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013 ***Condition in 2014***

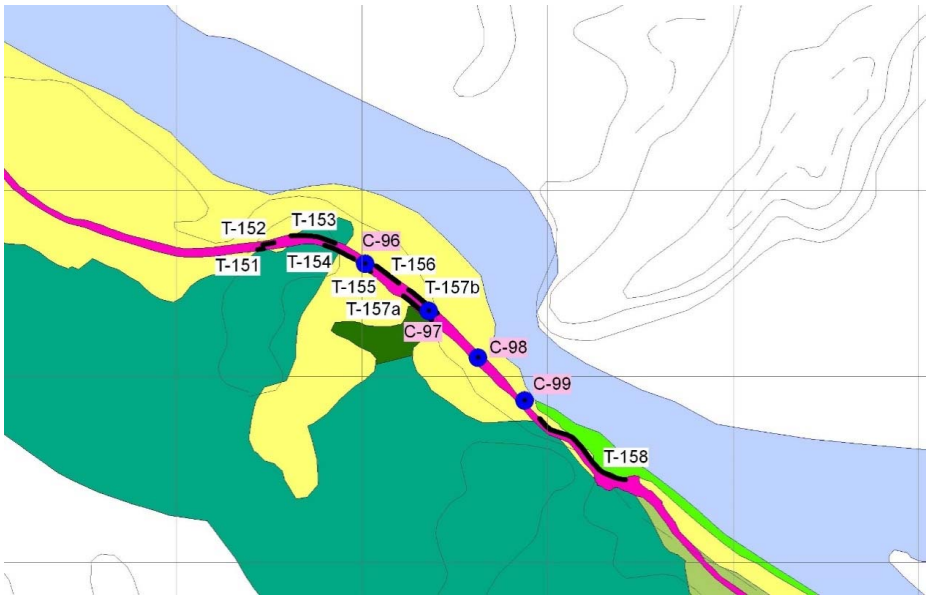


Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-157b*** ***Type:*** Fill Slope

Beginning (x/y): 500.769 / 1.189.434 ***End (x/y):*** 500.684 / 1.189.505

Slope Length (Range): 2.0 – 4.5 m ***Slope Length (Average):*** 3.8 m ***Slope Width:*** 110.1 m

Slope Surface Area: 418 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	75	314
Rills	25	105
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 60.7

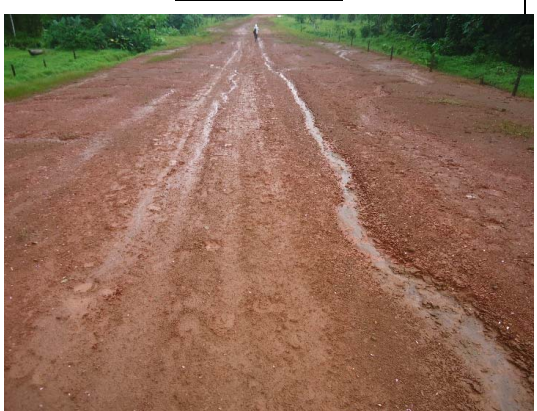
Estimated Erosion Rate (t / year): 101.3

Mitigation Measures:

Mitigation Status: Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013



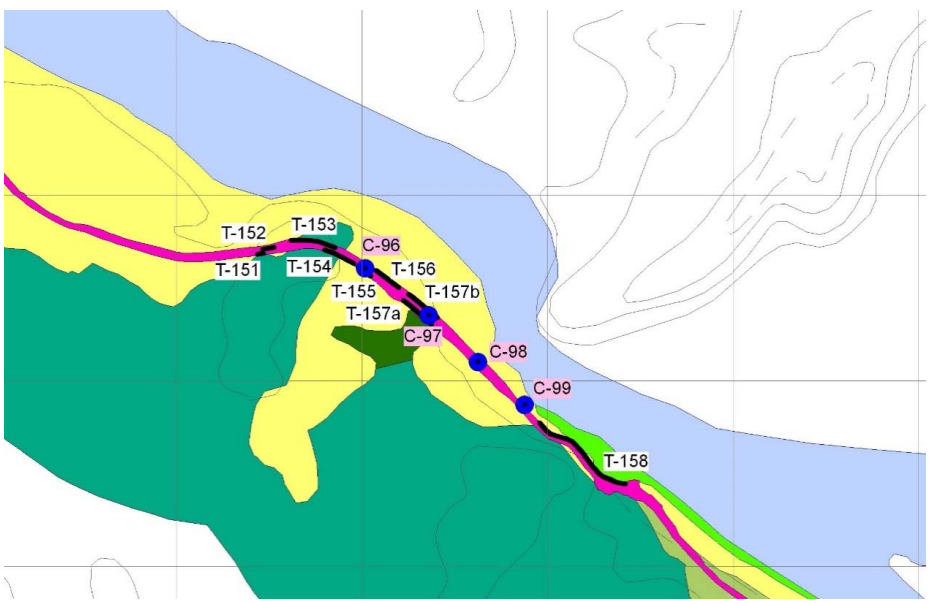
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-158*** ***Type:*** Cut Slope

Beginning (x/y): 501.069 / 1.189.121 ***End (x/y):*** 501.324 / 1.188.939

Elevation Difference (Range): 8.0 – 12.0 m ***Elevation Difference (Average):*** 10.5 m ***Slope Length:*** 21.0 m

Slope Angle: 30° ***Slope Width:*** 325.1 m ***Slope Surface Area:*** 6827 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	60	4096
Rills	30	2048
Gullies	10	683
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 798.8

Estimated Erosion Rate (t / year): 1333.9

Mitigation Measures: ***Mitigation Status:*** Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

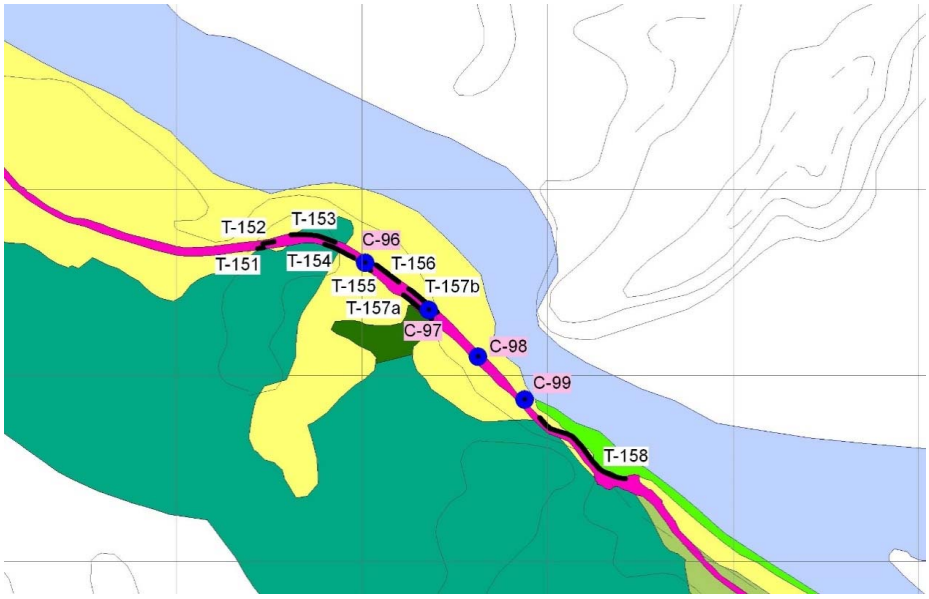
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-159*** ***Type:*** Cut Slope

Beginning (x/y): 507.619 / 1.183.582 ***End (x/y):*** 507.487 / 1.183.572

Elevation Difference (Range): 1.0 – 2.0 m ***Elevation Difference (Average):*** 1.6 m ***Slope Length:*** 2.3 m

Slope Angle: 45° ***Slope Width:*** 133.4 m ***Slope Surface Area:*** 302 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	80	241
Rills	20	60
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 26.6

Estimated Erosion Rate (t / year): 44.4

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

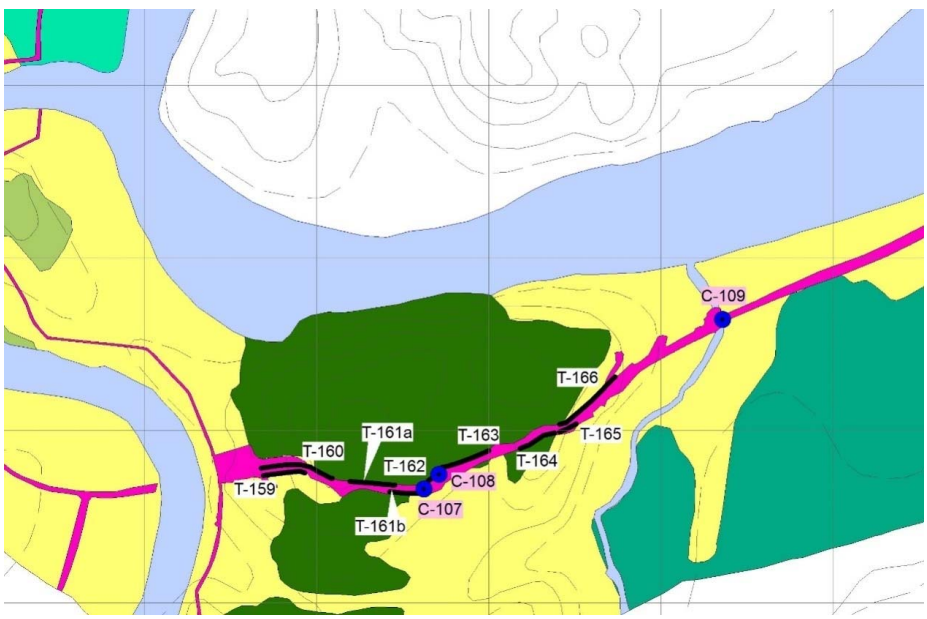
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-160*** ***Type:*** Cut Slope

Beginning (x/y): 507.480 / 1.183.596 ***End (x/y):*** 507.707 / 1.183.563

Elevation Difference (Range): 1.0 – 2.4 m ***Elevation Difference (Average):*** 1.8 m ***Slope Length:*** 2.2 m

Slope Angle: 55° ***Slope Width:*** 237.4 m ***Slope Surface Area:*** 522 **m²**

Geology: Volcaniclastic Sequence (Quaternary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	60	313
Rills	40	209
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 55.3

Estimated Erosion Rate (t / year): 92.3

Mitigation Measures: ***Mitigation Status:*** Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

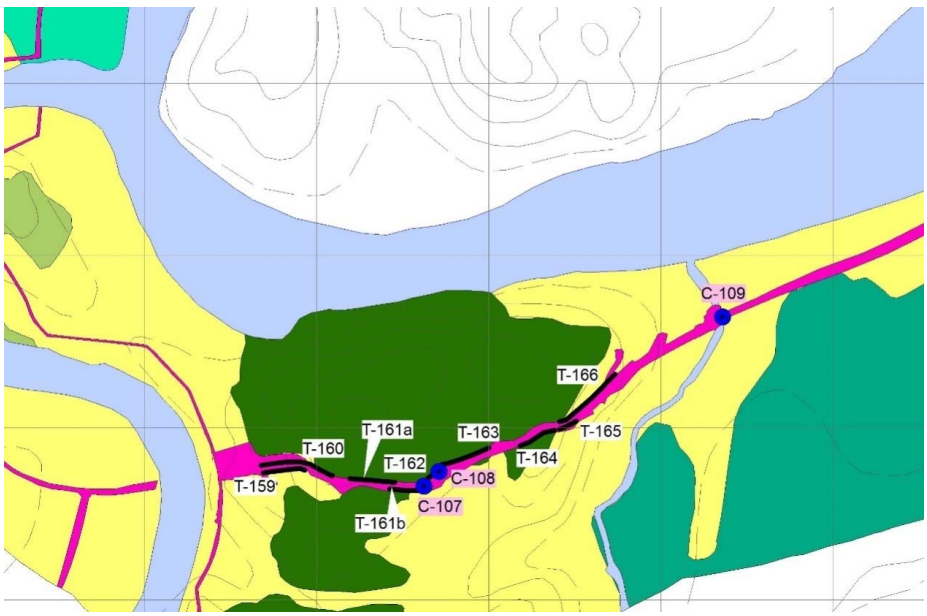
Condition in 2013 ***Condition in 2014***

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-161a*** ***Type:*** Cut Slope

Beginning (x/y): 507.905 / 1.183.542 ***End (x/y):*** 507.762 / 1.183.553

Elevation Difference (Range): 2.0 – 4.8 m ***Elevation Difference (Average):*** 3.8 m ***Slope Length:*** 4.6 m

Slope Angle: 55º ***Slope Width:*** 143.0 m ***Slope Surface Area:*** 663 **m²**

Geology: Volcanic Sequence, predominantly andesites and tuffs with varying degree of hydrothermal alteration (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	663
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 46.4

Estimated Erosion Rate (t / year): 77.5

Mitigation Measures:

Mitigation Status: No mitigation necessary

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

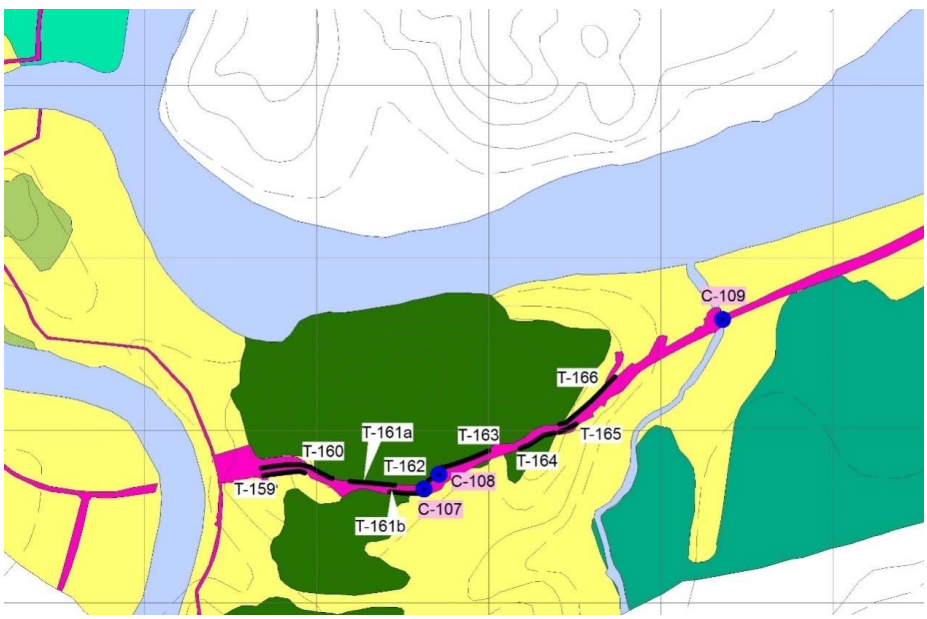
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-161b*** ***Type:*** Cut Slope

Beginning (x/y): 507.904 / 1.183.517 ***End (x/y):*** 507.823 / 1.183.530

Elevation Difference (Range): 2.0 – 3.8 m ***Elevation Difference (Average):*** 3.0 m ***Slope Length:*** 3.3 m

Slope Angle: 65º ***Slope Width:*** 81,3 m ***Slope Surface Area:*** 269 **m²**

Geology: Volcanic Sequence, predominantly andesites and tuffs with varying degree of hydrothermal alteration (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	269
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 18.8

Estimated Erosion Rate (t / year): 31.5

Mitigation Measures:

Mitigation Status: Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

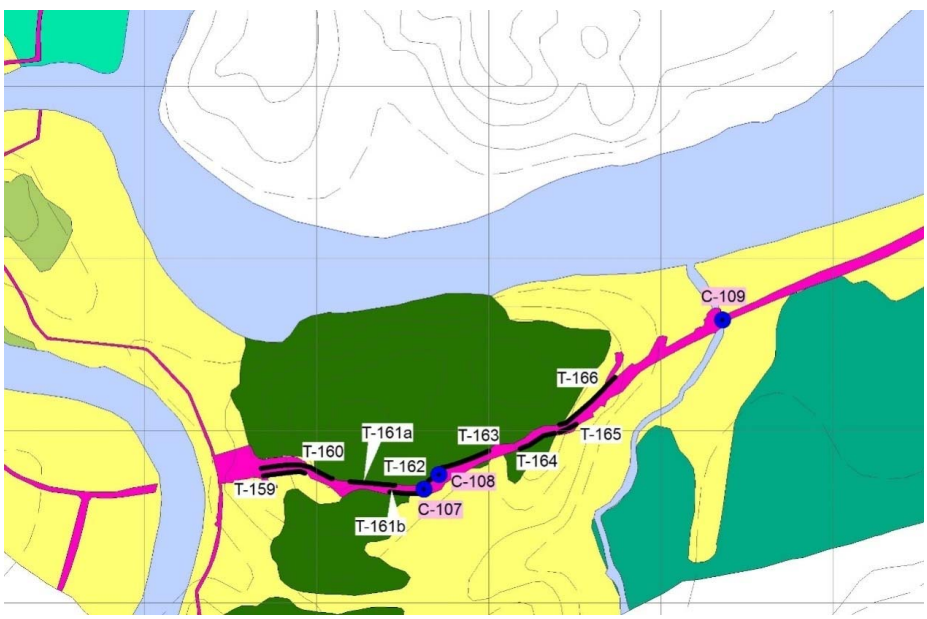
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-162*** ***Type:*** Fill Slope

Beginning (x/y): 508.001 / 1.183.547 ***End (x/y):*** 508.034 / 1.183.578

Slope Length (Range): 6.0 – 11.0 m ***Slope Length (Average):*** 9.0 m ***Slope Width:*** 45,1 m

Slope Surface Area: 406 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	100	406
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 56.8

Estimated Erosion Rate (t / year): 94.9

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

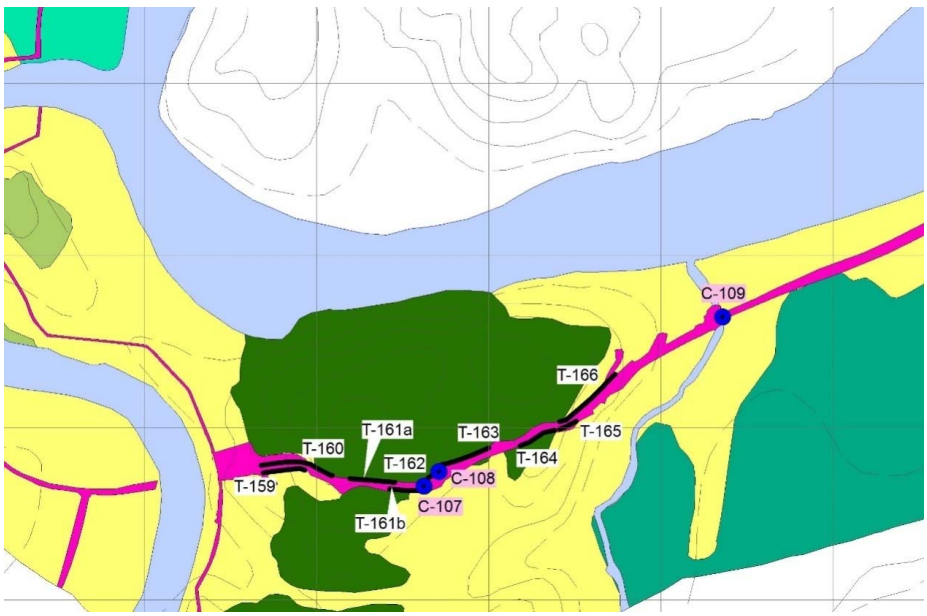
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-163*** ***Type:*** Cut Slope

Beginning (x/y): 508.055 / 1.183.599 ***End (x/y):*** 508.204 / 1.183.652

Elevation Difference (Range): 3.5 – 5.0 m ***Elevation Difference (Average):*** 4.7 m ***Slope Length:*** 5.2 m

Slope Angle: 65º ***Slope Width:*** 157.9 m ***Slope Surface Area:*** 819 **m²**

Geology: Volcanic Sequence, predominantly andesites and tuffs with varying degree of hydrothermal alteration (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	819
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 57.3

Estimated Erosion Rate (t / year): 95.7

Mitigation Measures: ***Mitigation Status:*** Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

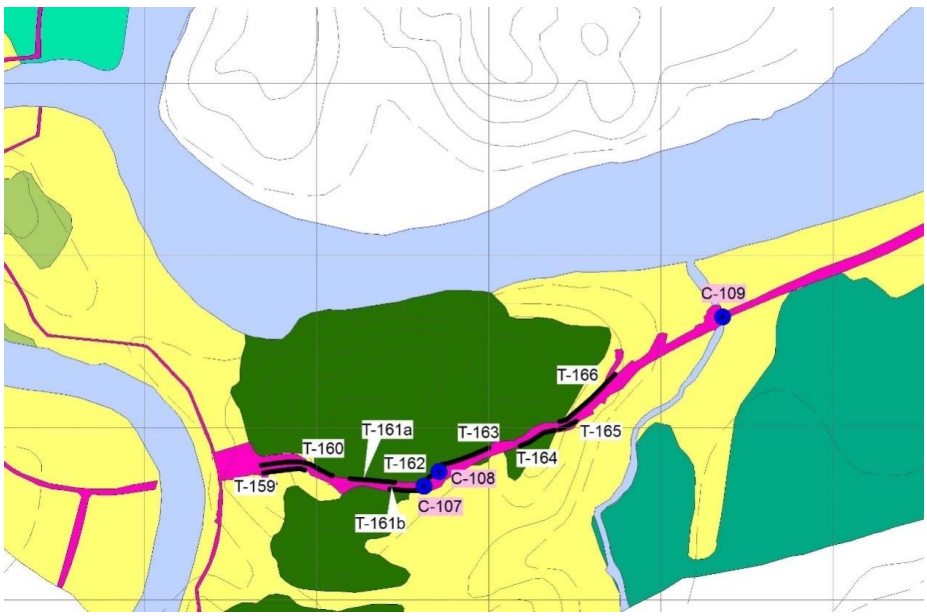
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope: ***T-164*** ***Type:*** Cut Slope

Beginning (x/y): 508.413 / 1.183.709 ***End (x/y):*** 508.303 / 1.183.660

Elevation Difference (Range): 5.0 – 7.4 m ***Elevation Difference (Average):*** 6.2 m ***Slope Length:*** 7.6 m

Slope Angle: 55º ***Slope Width:*** 121.8 m ***Slope Surface Area:*** 922 **m²**

Geology: Volcanic Sequence, predominantly andesites and tuffs with varying degree of hydrothermal alteration (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	85	784
Rills	0	0
Gullies	0	0
Land Slides	15	138

Estimated Erosion Rate (m³/ year): 110.2

Estimated Erosion Rate (t / year): 184.0

Mitigation Measures:

Mitigation Status: Mitigation scheduled

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: no

Condition in 2013

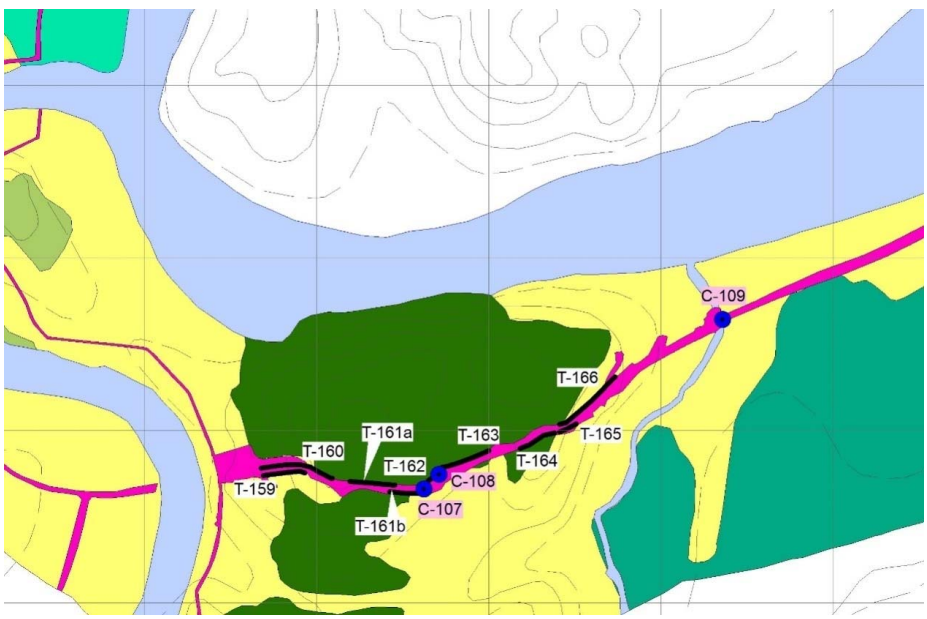
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende*(Julio 2014)*

Slope: ***T-165*** ***Type:*** Fill Slope

Beginning (x/y): 508.481 / 1.183.738 ***End (x/y):*** 508.429 / 1.183.712

Slope Length (Range):v12.0 – 18.0 m ***Slope Length (Average):*** 15.0 m ***Slope Width:*** 58.3 m

Slope Surface Area: 875 m^2

Geology: Fill

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m^2)
Sheet	100	875
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m^3/ year): 122.4

Estimated Erosion Rate (t / year): 204.5

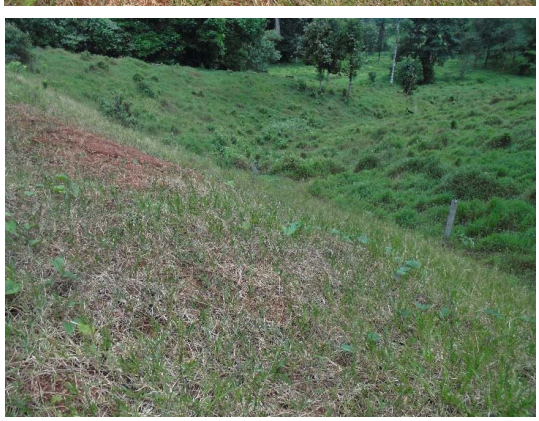
Mitigation Measures:

Mitigation Status: Mitigated

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

Condition in 2014

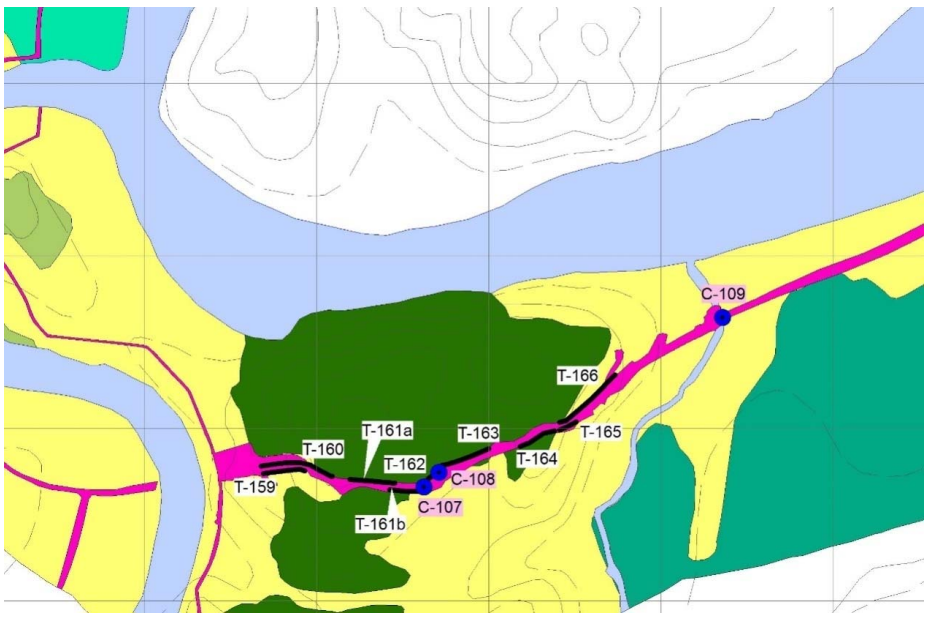


Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Slope:* T-166** ***Type: Cut Slope

Beginning (x/y): 508.428 / 1.183.737 ***End (x/y):*** 508.605 / 1.183.888

Elevation Difference (Range): 2.0 – 5.3 m ***Elevation Difference (Average):*** 4.2 m ***Slope Length:*** 5.1 m

Slope Angle: 55º ***Slope Width:*** 234.9 m ***Slope Surface Area:*** 1204 **m²**

Geology: Volcanic Sequence, predominantly andesites and tuffs with varying degree of hydrothermal alteration (Tertiary)

Erosion (conditions in 2014):

Type	Surface (%)	Surface (m²)
Sheet	100	1204
Rills	0	0
Gullies	0	0
Land Slides	0	0

Estimated Erosion Rate (m³/ year): 84.3

Estimated Erosion Rate (t / year): 140.8

Mitigation Measures:

Mitigation Status: Mitigation in progress

Geotextiles: no Drainage Control: no Stabilization by Terraces: no Sediment traps: no
Sowed Vegetation: no Natural Vegetation: yes

Condition in 2013

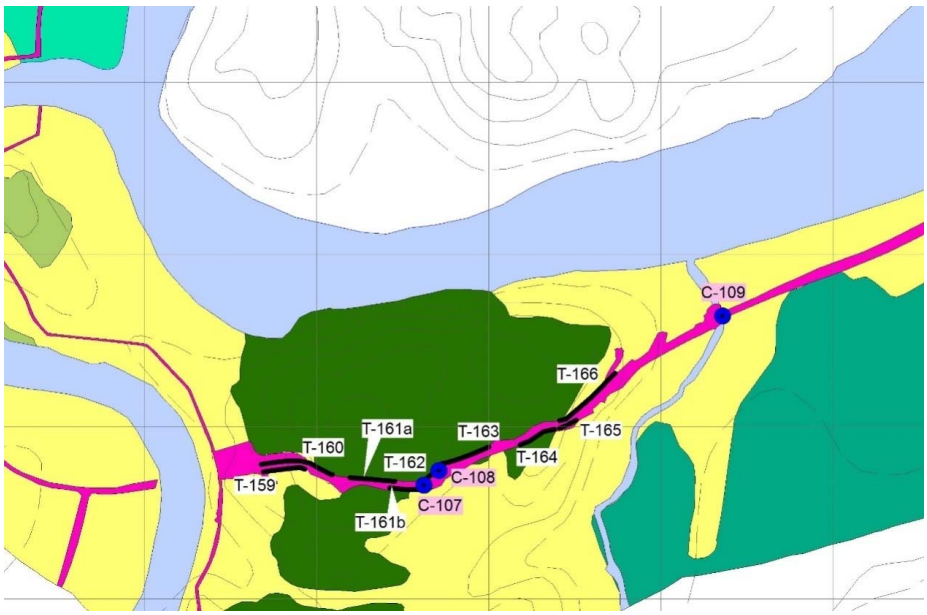
Condition in 2014

Dr. Andreas Mende*(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



Appendix C: Data Sheets for all Intersections of Watercourses along the Route 1856 between Mojón II and Delta Costa Rica

Watercourse ***C-1*** ***Location (x/y):*** 461.227 / 1.215.211 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** no mitigation necessary

Condition in 2013

Condition in 2014

Dr. Andreas Mende *(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:

Watercourse ***C-2*** ***Location (x/y):*** 461.538 / 1.215.033 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Mitigated

Condition in 2013

Condition in 2014

Location Map:

Dr. Andreas Mende *(Julio 2014)*

Watercourse ***C-3*** ***Location (x/y):*** 461570 / 1214969 ***Type:*** Culvert with fill prism

Sedimentation: present ***Erosion:*** not present ***Present Mitigation Status:*** Mitigation in progress

Condition in 2013

Condition in 2014

Location Map:

Dr. Andreas Mende *(Julio 2014)*

Watercourse ***C-4*** ***Location (x/y):*** 461600 / 1214884 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Mitigated

Condition in 2013

Condition in 2014

Location Map:

Dr. Andreas Mende *(Julio 2014)*

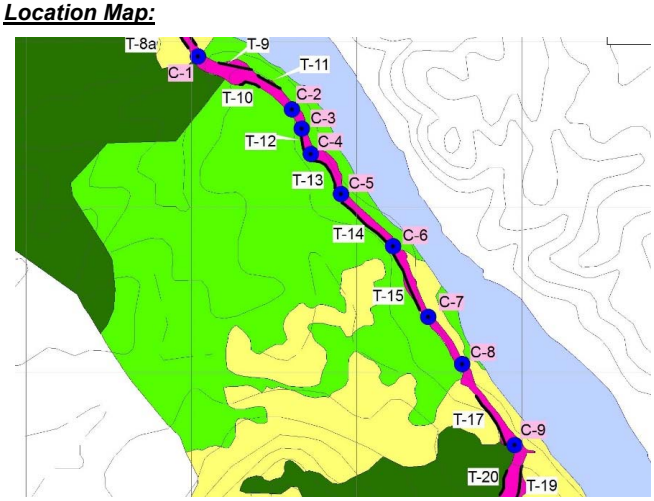
Watercourse C-5 ***Location (x/y):*** 461.699 / 1.214.751 ***Type:*** Fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Mitigation in progress

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

Watercourse ***C-6*** ***Location (x/y):*** 461.872 / 1.214.751 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Mitigated

Condition in 2013

Condition in 2014

Location Map:

Dr. Andreas Mende *(Julio 2014)*

Watercourse ***C-7*** ***Location (x/y):*** 461987 / 1214339 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Mitigated

Condition in 2013

Condition in 2014

Location Map:

Watercourse ***C-8*** ***Location (x/y):*** 462100 / 1214182 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Mitigated

Condition in 2013

Condition in 2014

Location Map:

Dr. Andreas Mende *(Julio 2014)*

Watercourse ***C-9*** ***Location (x/y):*** 462.273 / 1.213.911 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Mitigated

Condition in 2013

Condition in 2014

Condition in 2013

Condition in 2014

Location Map:

Dr. Andreas Mende *(Julio 2014)*

Watercourse* C-10** ***Location (x/y): 461.662 / 1.212.525 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Mitigated

Condition in 2013

Condition in 2014

Location Map:

Watercourse ***C-11*** ***Location (x/y):*** 461589 / 1211580 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Mitigated

Condition in 2013

Condition in 2014

Location Map:

Dr. Andreas Mende *(Julio 2014)*

Watercourse* C-12** ***Location (x/y): 461.439 / 1.211.380 ***Type:*** Bridge with no fill

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Mitigated

Condition in 2013

Condition in 2014

Location Map:

Watercourse ***C-13*** ***Location (x/y):*** 461658 / 1210857 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Mitigated

Condition in 2013

Condition in 2014

Dr. Andreas Mende *(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:

Watercourse ***C-14*** ***Location (x/y):*** 461840 / 1210757 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation in progress

Condition in 2013

Condition in 2014

Condition in 2013

Condition in 2014

Location Map:

Watercourse C-15 ***Location (x/y):*** 462.112 / 1.210.746 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Mitigated

Condition in 2013

Condition in 2014

Location Map:

Dr. Andreas Mende *(Julio 2014)*

Watercourse* C-16** ***Location (x/y): 462.304 / 1.210.652 ***Type:*** Bridge with no fill

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Mitigated

Condition in 2013

Condition in 2014

Location Map:

Watercourse ***C-17*** ***Location (x/y):*** 462.655 / 1.210.529 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Mitigated

Condition in 2013

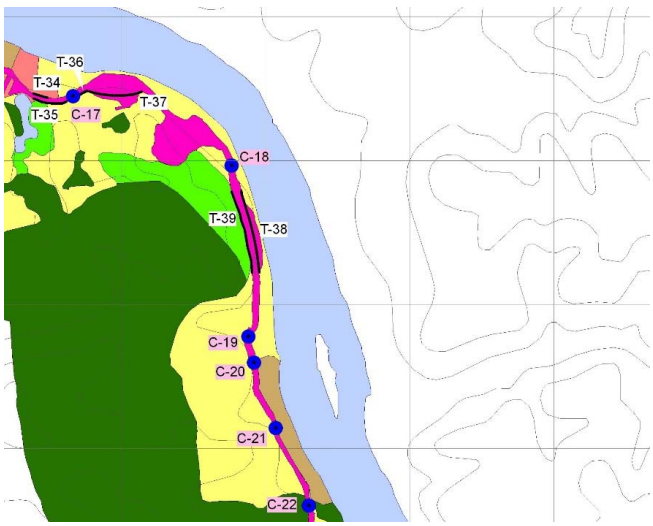
Condition in 2014

Dr. Andreas Mende *(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



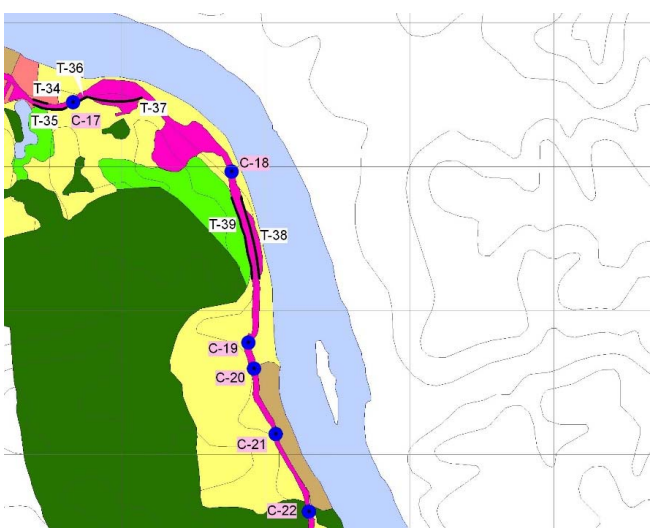
Watercourse* C-18** ***Location (x/y): 463.256 / 1.210.262 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Mitigated

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

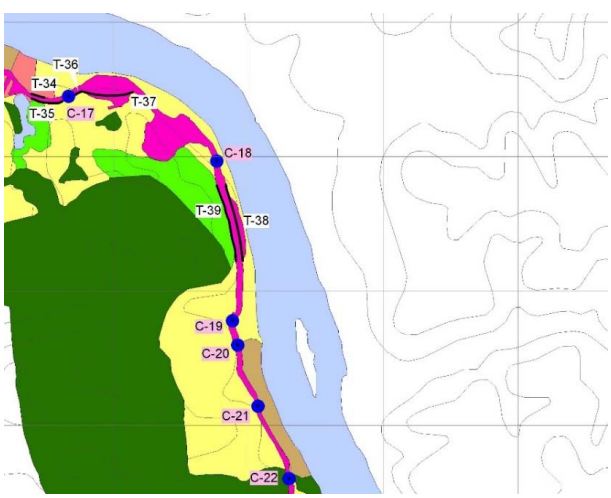
Watercourse C-19 ***Location (x/y):*** 463.319 / 1.209.605 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Mitigated

Condition in 2013

Condition in 2014

Location Map:



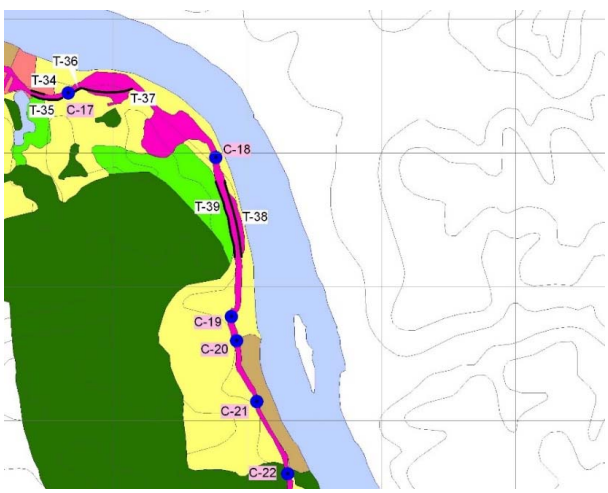
Watercourse* C-20** ***Location (x/y): 463.340 / 1.209.506 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** No mitigation necessary

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

Watercourse ***C-21*** ***Location (x/y):*** 463.422 / 1.209.254 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Mitigated

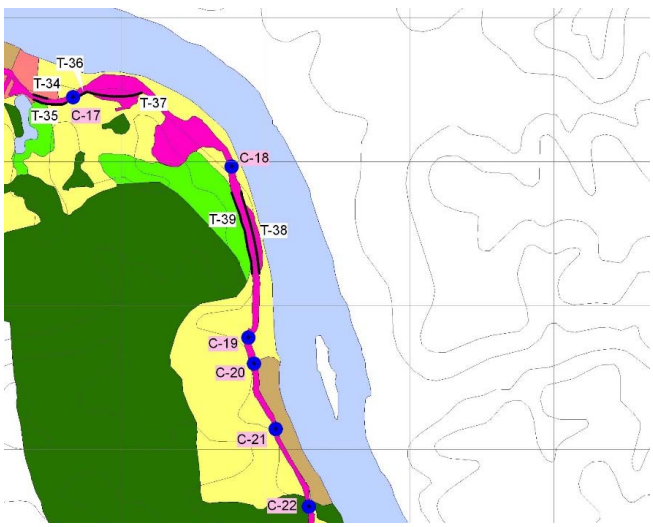
Condition in 2013

Condition in 2014

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

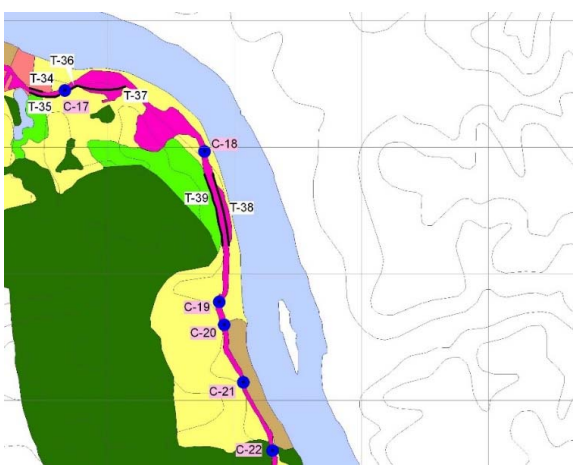
Watercourse* C-22** ***Location (x/y): 463547 / 1208955 ***Type:*** Bridge combined with fill

Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation scheduled

Condition in 2013

Condition in 2014

Location Map:



Watercourse* C-23** ***Location (x/y): 463.626 / 1.208.670 ***Type:*** Fill prism

Sedimentation: present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation scheduled

Condition in 2013

Condition in 2014

Location Map:

Dr. Andreas Mende *(Julio 2014)*

Watercourse ***C-24*** ***Location (x/y):*** 463.754 / 1.208.581 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** Mitigated

Condition in 2013

Condition in 2014

Condition in 2013

Condition in 2014

Location Map:

Dr. Andreas Mende *(Julio 2014)*

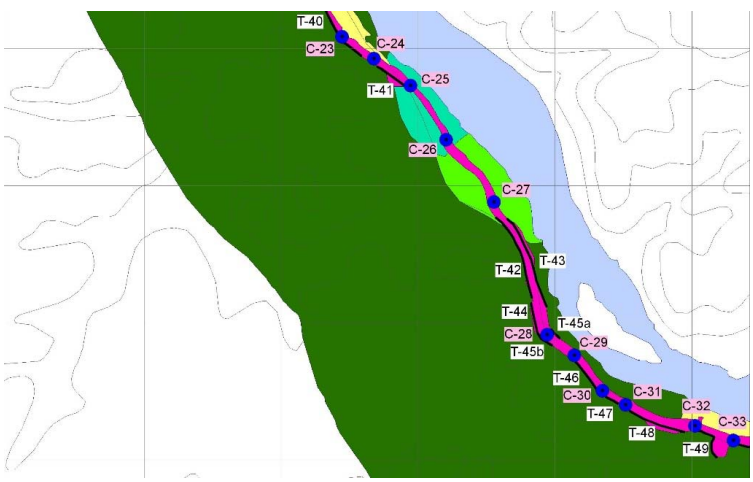
Watercourse C-25 ***Location (x/y):*** 463.899 / 1.208.473 ***Type:*** Culvert with fill prism

Sedimentation: present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation in progress

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

Watercourse* C-26** ***Location (x/y): 464.042 / 1.208.254 ***Type:*** Bridge combined with fill

Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation scheduled

Condition in 2013

Condition in 2014

Location Map:

Dr. Andreas Mende *(Julio 2014)*

Watercourse ***C-27*** ***Location (x/y):*** 464.232 / 1.208.002 ***Type:*** Culvert with fill prism

Sedimentation: present ***Erosion:*** not present ***Present Mitigation Status:*** Mitigation in progress

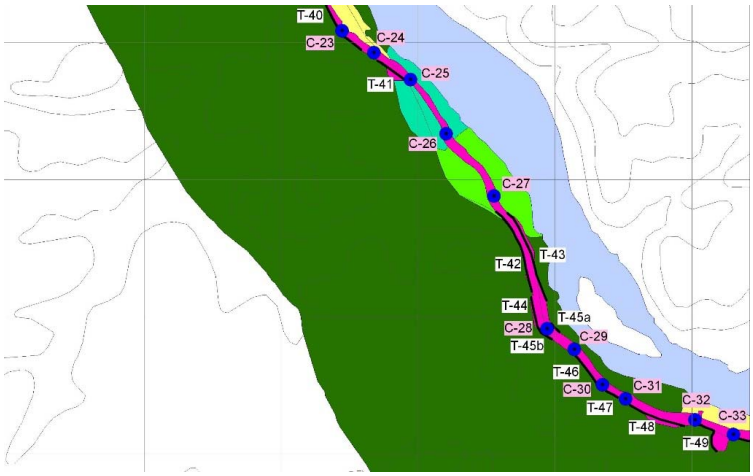
Condition in 2013

Condition in 2014

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

Watercourse* C-28** ***Location (x/y): 464.443 / 1.207.466 ***Type:*** Fill prism

Sedimentation: present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation in progress

Condition in 2013

Condition in 2014

Location Map:

Dr. Andreas Mende *(Julio 2014)*

Watercourse ***C-29*** ***Location (x/y):*** 464.552 / 1.207.383 ***Type:*** Culvert with fill prism

Sedimentation: present ***Erosion:*** not present ***Present Mitigation Status:*** Mitigation in progress

Condition in 2013

Condition in 2014

Dr. Andreas Mende *(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:

Watercourse ***C-30*** ***Location (x/y):*** 464.665 / 1.207.241 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** Mitigated

Condition in 2013

Condition in 2014

Dr. Andreas Mende *(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:

Watercourse ***C-31*** ***Location (x/y):*** 464.757 / 1.207.184 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Mitigation in progress

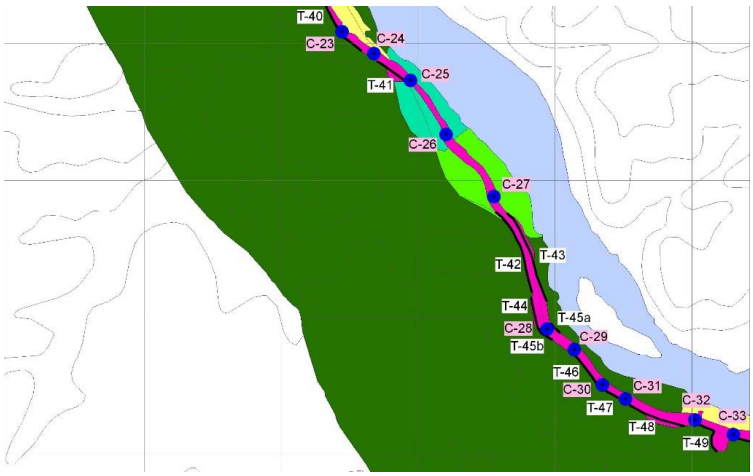
Condition in 2013

Condition in 2014

Condition in 2013

Condition in 2014

Location Map:



Watercourse* C-32** ***Location (x/y): 465.034 / 1.207.098 ***Type:*** Culvert with fill prism

Sedimentation: present ***Erosion:*** present ***Present Mitigation Status:*** Mitigated

Condition in 2013

Condition in 2014

Dr. Andreas Mende *(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:

Watercourse ***C-33*** ***Location (x/y):*** 465.187 / 1.207.039 ***Type:*** Culvert with fill prism

Sedimentation: present ***Erosion:*** not present ***Present Mitigation Status:*** Mitigated

Condition in 2013

Condition in 2014

Dr. Andreas Mende *(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:

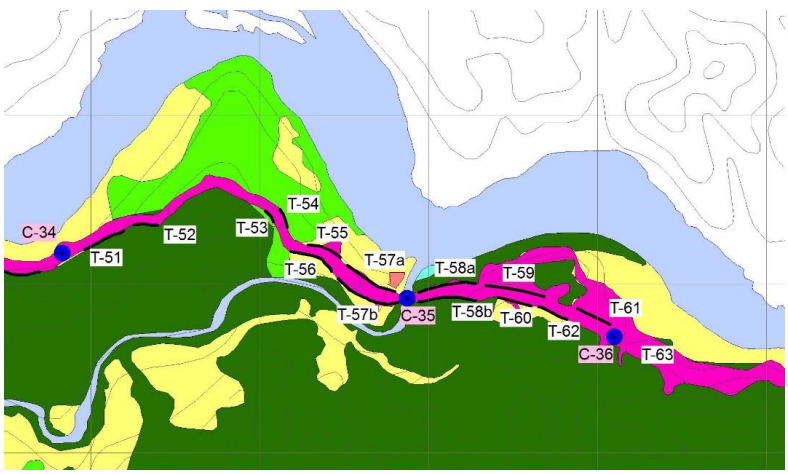
Watercourse ***C-34*** ***Location (x/y):*** 465.476 / 1.207.063 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Mitigated

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

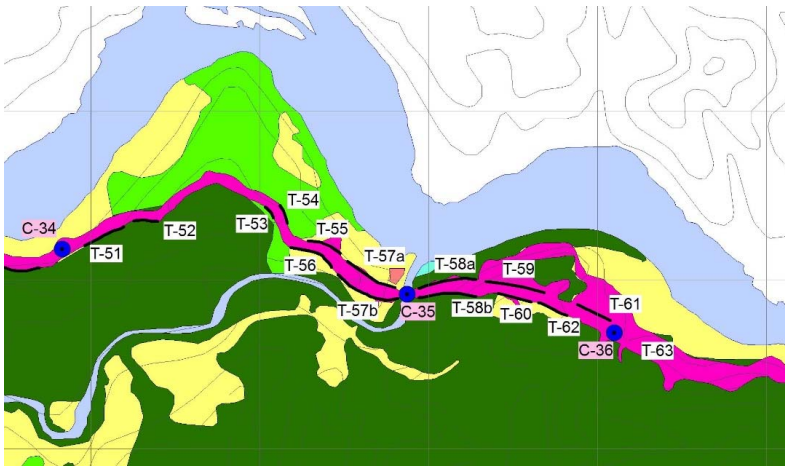
Watercourse ***C-35*** ***Location (x/y):*** 466.592 / 1.206.914 ***Type:*** Bridge combined with fill

Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation scheduled

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

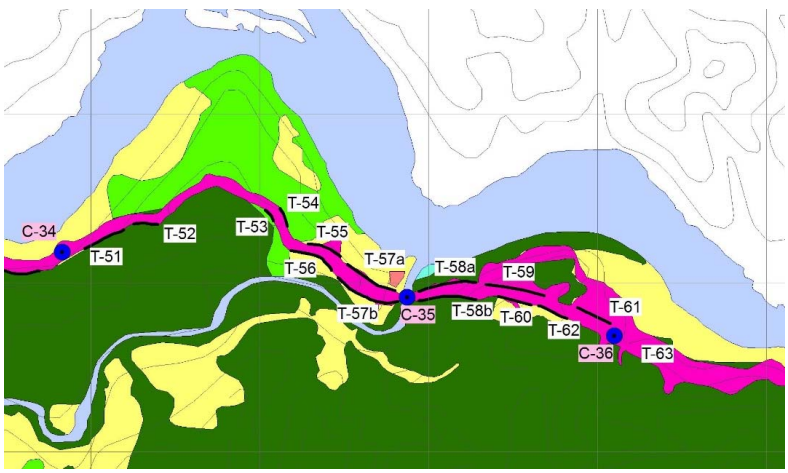
Watercourse* C-36** ***Location (x/y): 467.261 / 1.206.787 ***Type:*** No construction

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Other

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

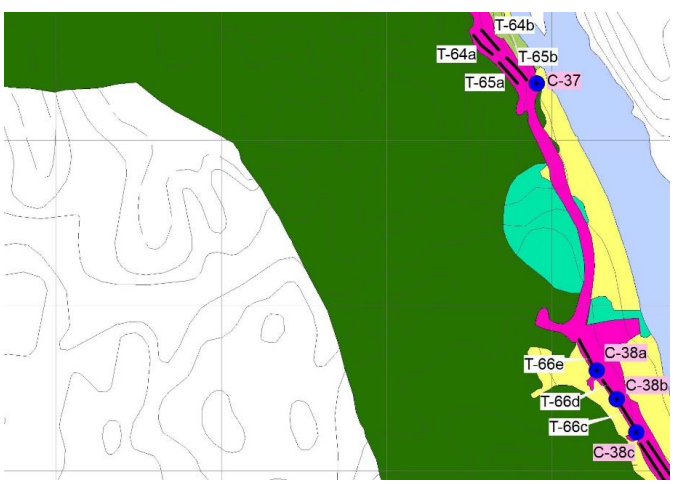
Watercourse ***C-37*** ***Location (x/y):*** 468.250 / 1.206.043 ***Type:*** Bridge combined with fill

Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** Other

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

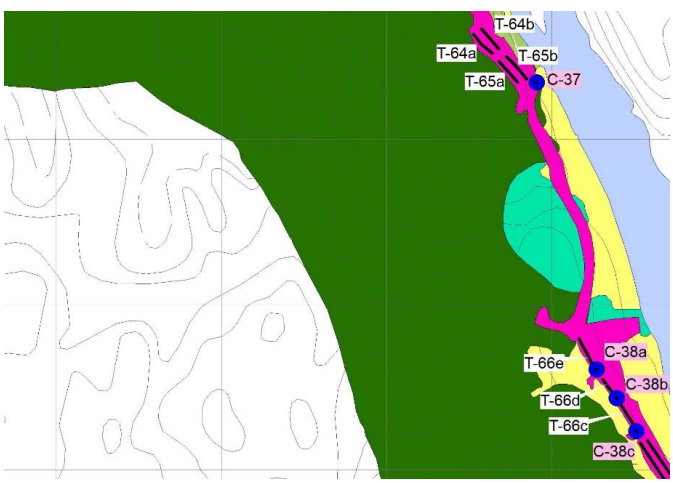
Watercourse ***C-38a*** ***Location (x/y):*** 468.448 / 1.205.082 ***Type:*** Culvert with fill prism

Sedimentation: present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation scheduled

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

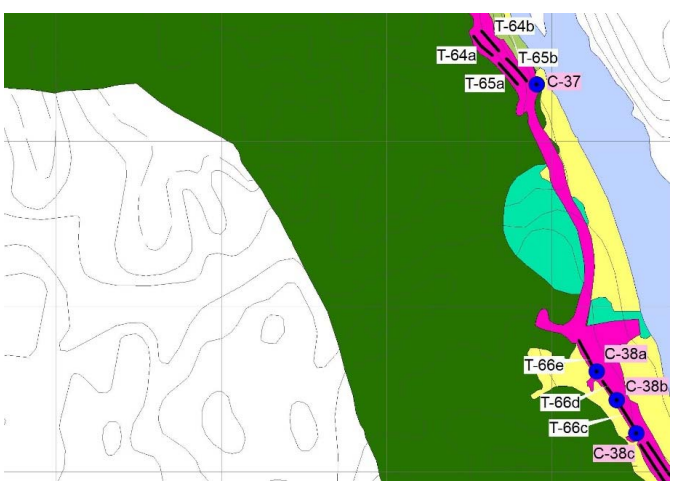
Watercourse* C-38b** ***Location (x/y): 468.514 / 1.204.985 ***Type:*** Culvert with fill prism

Sedimentation: present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation scheduled

Condition in 2013

Condition in 2014

Location Map:



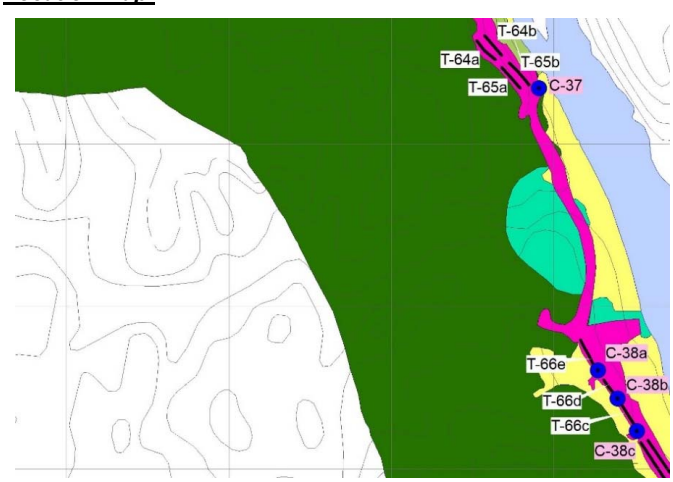
Watercourse ***C-38c*** ***Location (x/y):*** 468.579 / 1.204.874 ***Type:*** Culvert with fill prism

Sedimentation: present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation in progress

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

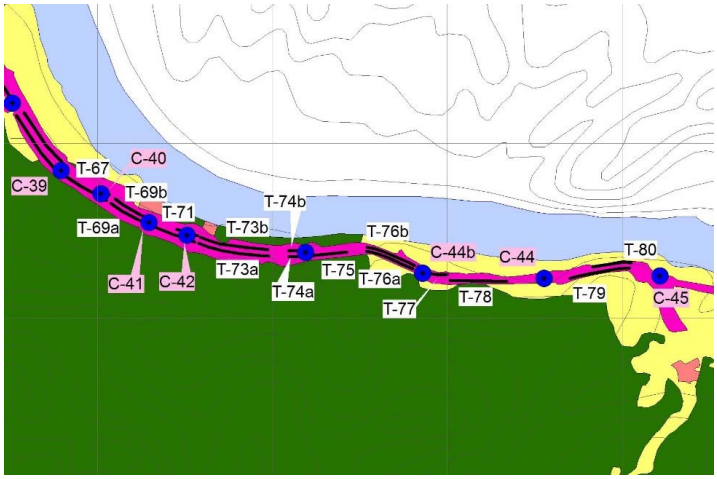
Watercourse* C-39** ***Location (x/y): 468.731 / 1.204.660 ***Type:*** No construction

Sedimentation: present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation scheduled

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

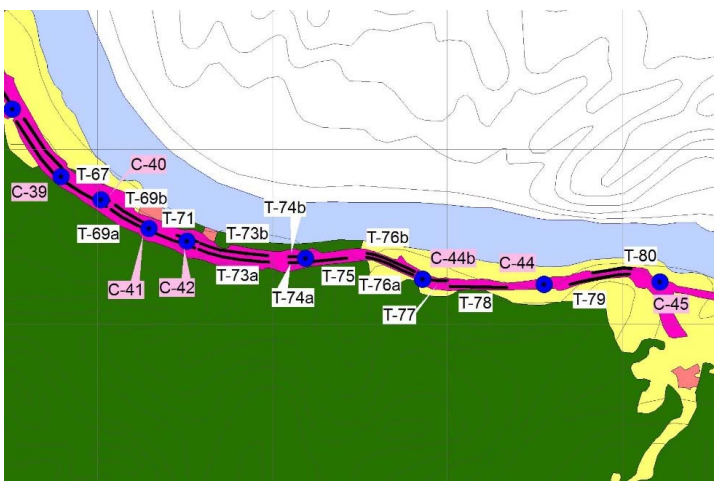
Watercourse ***C-40*** ***Location (x/y):*** 468.855 / 1.204.586 ***Type:*** Culvert with fill prism

Sedimentation: present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation in progress

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

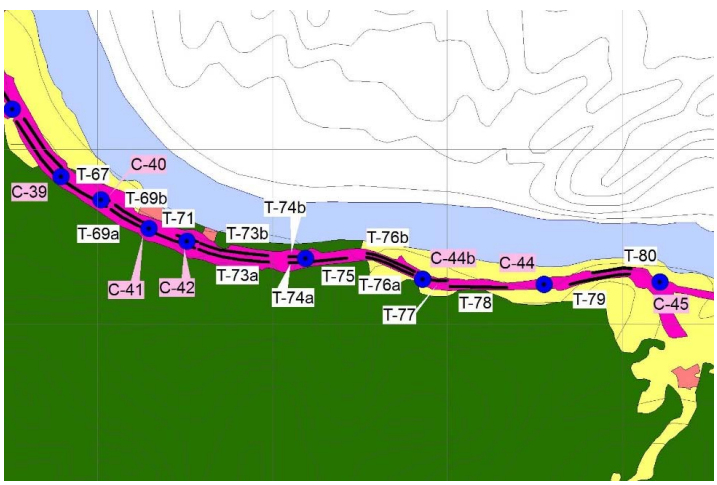
Watercourse* C-41** ***Location (x/y): 469.006 / 1.204.496 ***Type:*** Culvert with fill prism

Sedimentation: present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation in progress

Condition in 2013

Condition in 2014

Location Map:



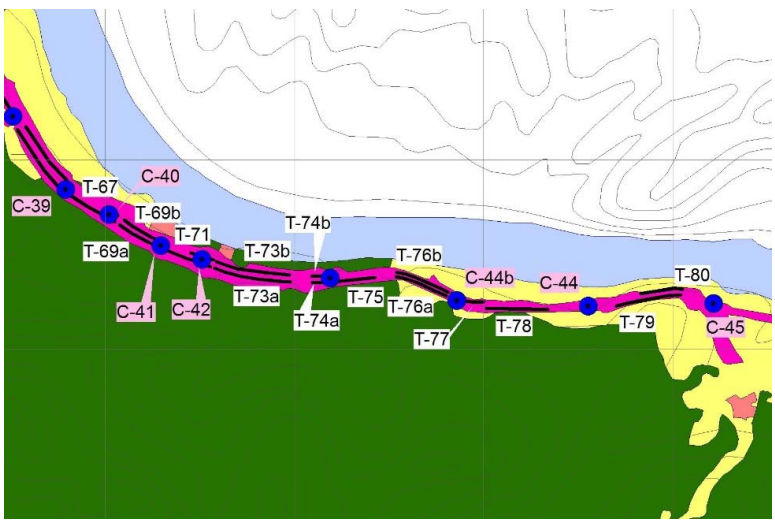
Watercourse* C-42** ***Location (x/y): 469.496 / 1.204.456 ***Type:*** Culvert with fill prism

Sedimentation: present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation in progress

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

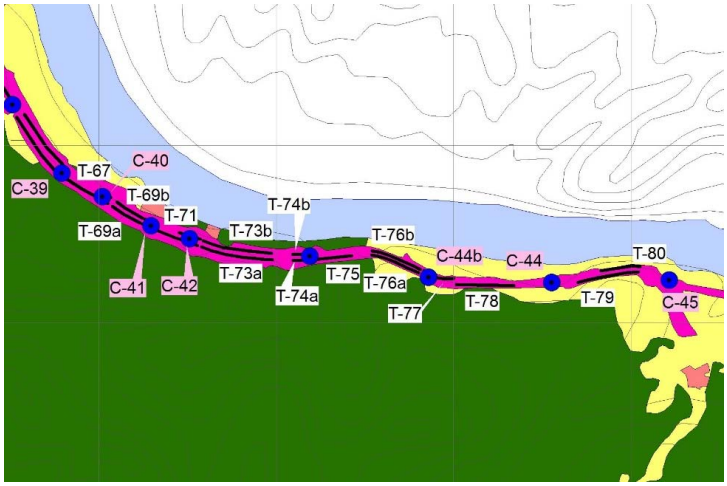
Watercourse C-43 ***Location (x/y):*** 469.496 / 1.204.401 ***Type:*** Culvert with fill prism

Sedimentation: present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation in progress

Condition in 2013

Condition in 2014

Location Map:



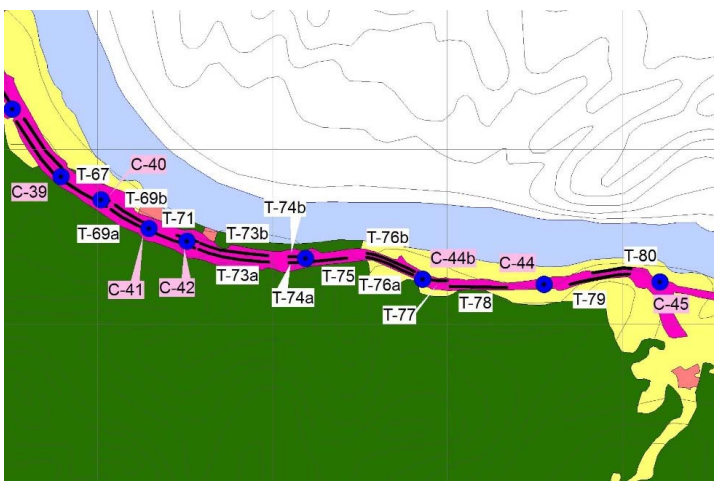
Watercourse C-44b ***Location (x/y):*** 469.861 / 1.204.335 ***Type:*** Culvert with fill prism

Sedimentation: present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation in progress

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

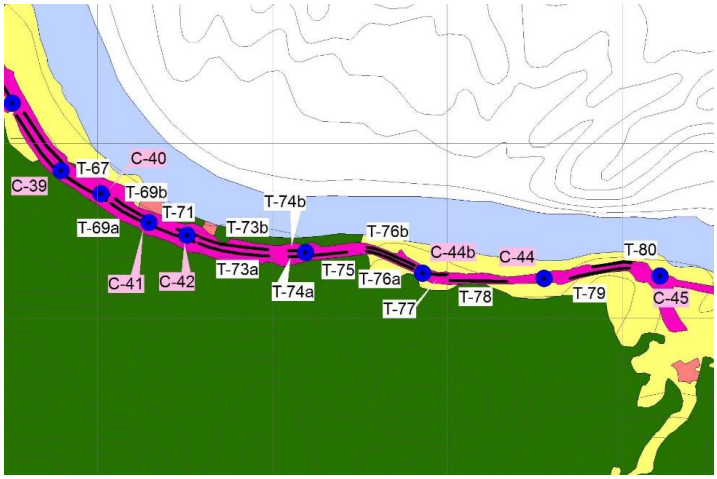
Watercourse* C-44** ***Location (x/y): ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation in progress

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

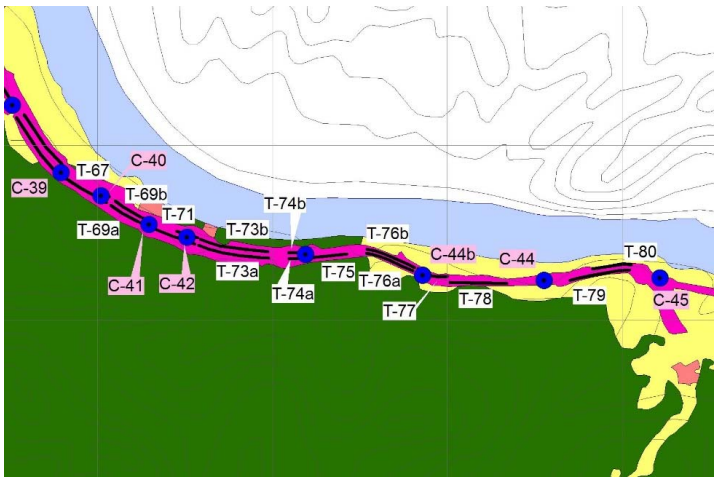
Watercourse ***C-45*** ***Location (x/y):*** 470.603 / 1.204.325 ***Type:*** Bridge with no fill

Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation in progress

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

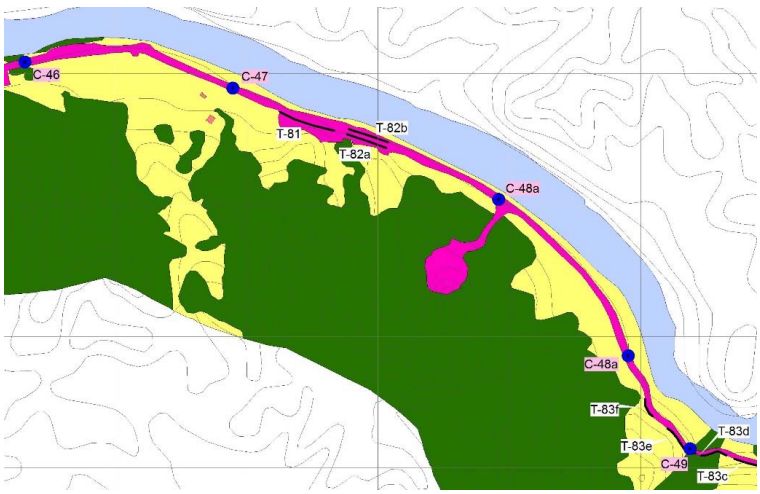
Watercourse* C-46** ***Location (x/y): 471.202 / 1.204.239 ***Type:*** Bridge combined with fill

Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation in progress

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

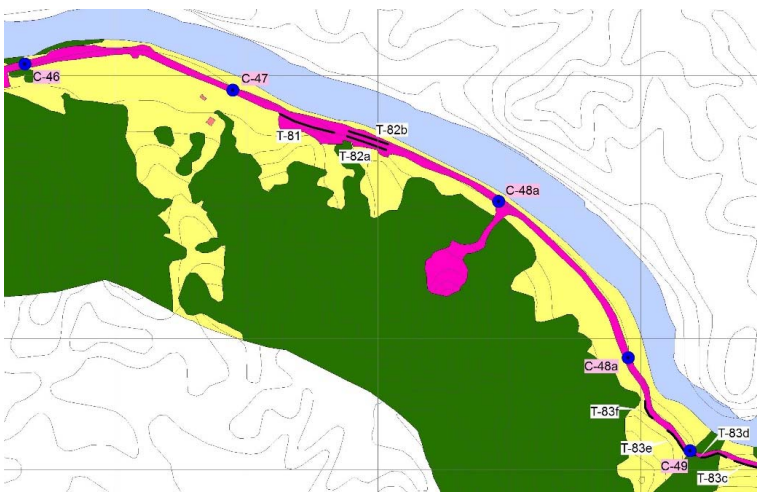
Watercourse* C-47** ***Location (x/y): 472067 / 1204129 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** No mitigation necessary

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

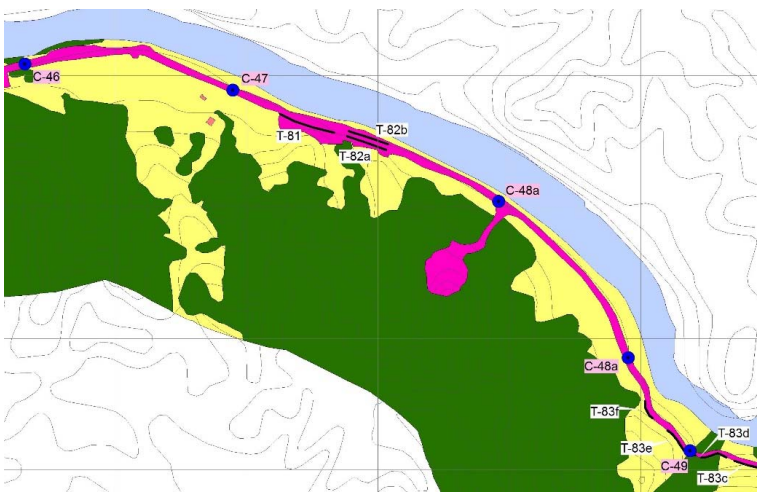
Watercourse ***C-48a*** ***Location (x/y):*** 473.173 / 1203660 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation scheduled

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

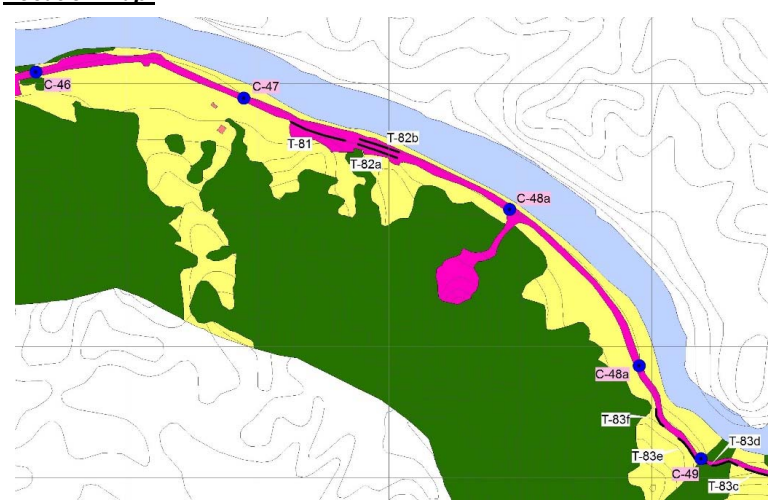
Watercourse ***C-48b*** ***Location (x/y):*** 473.712 / 1.203.001 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation scheduled

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

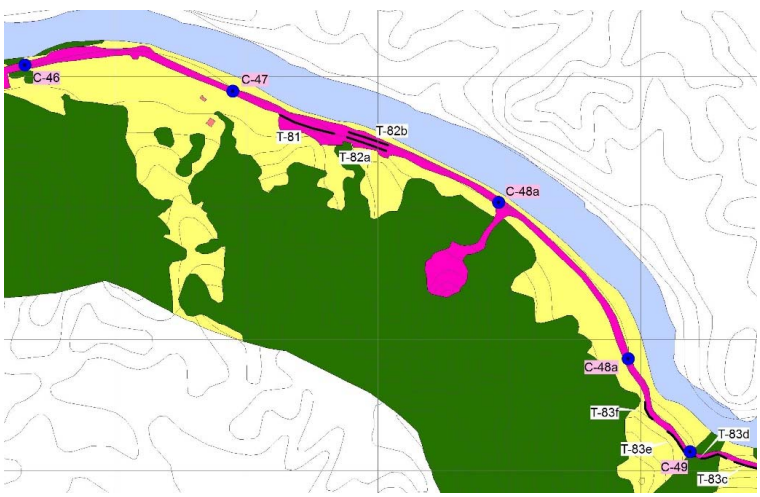
Watercourse* C-49** ***Location (x/y): 473.968 / 1.202.609 ***Type:*** Bridge with no fill

Sedimentation: present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation in progress

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

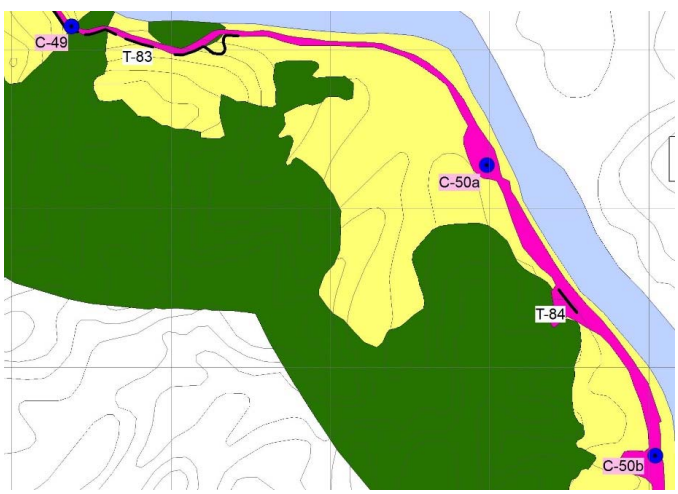
Watercourse ***C-50a*** ***Location (x/y):*** 475.393 / 1.202.126 ***Type:*** Bridge combined with fill

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** No mitigation necessary

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

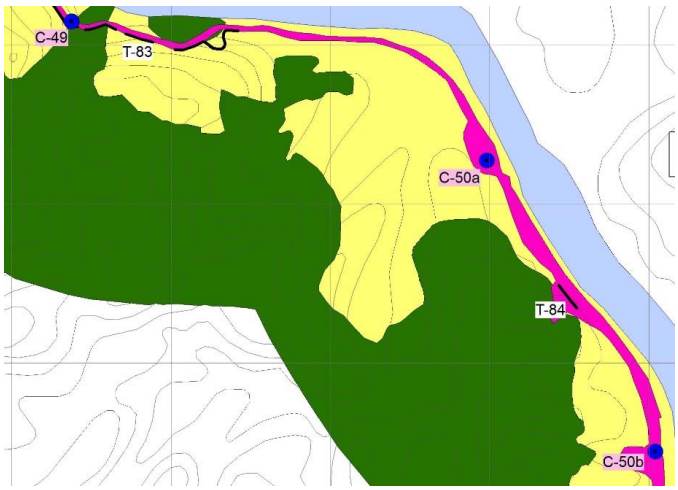
Watercourse ***C-50b*** ***Location (x/y):*** 475.969 /1.201.115 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** No mitigation necessary

Condition in 2013

Condition in 2014

Location Map:



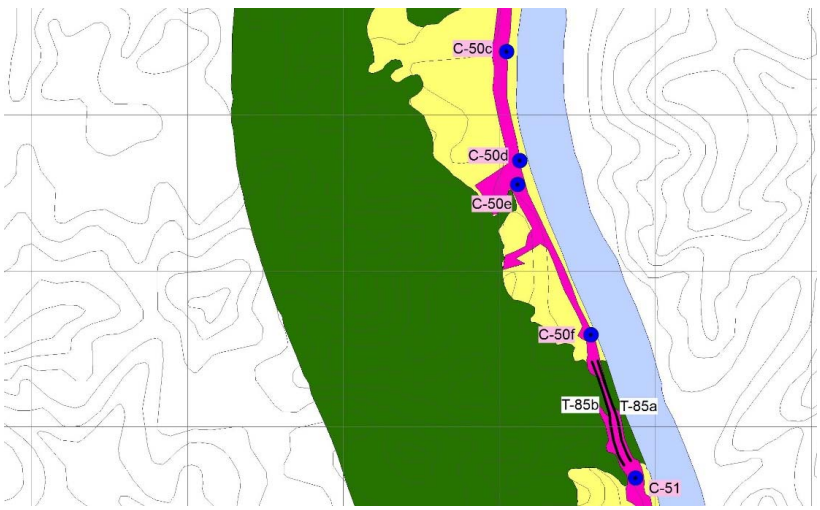
Watercourse ***C-50c*** ***Location (x/y):*** 475.973 / 1.200.541 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** Other

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

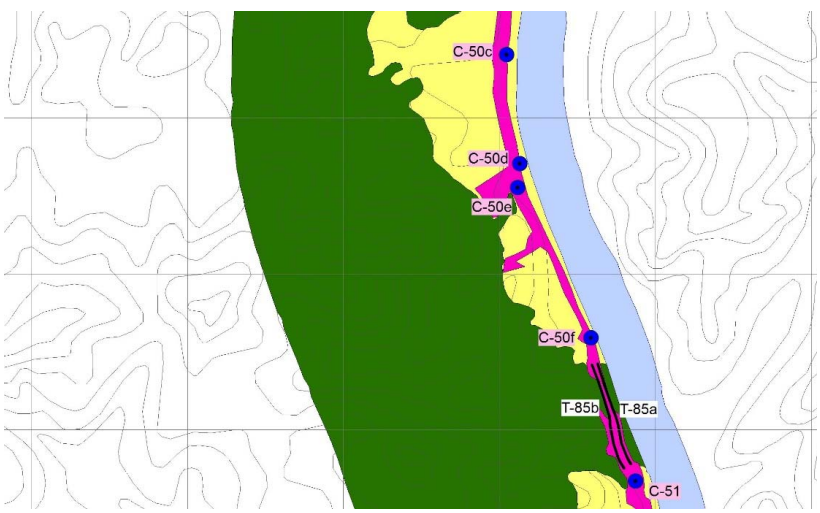
Watercourse ***C-50d*** ***Location (x/y):*** 476.019 / 1.200.154 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** No mitigation necessary

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

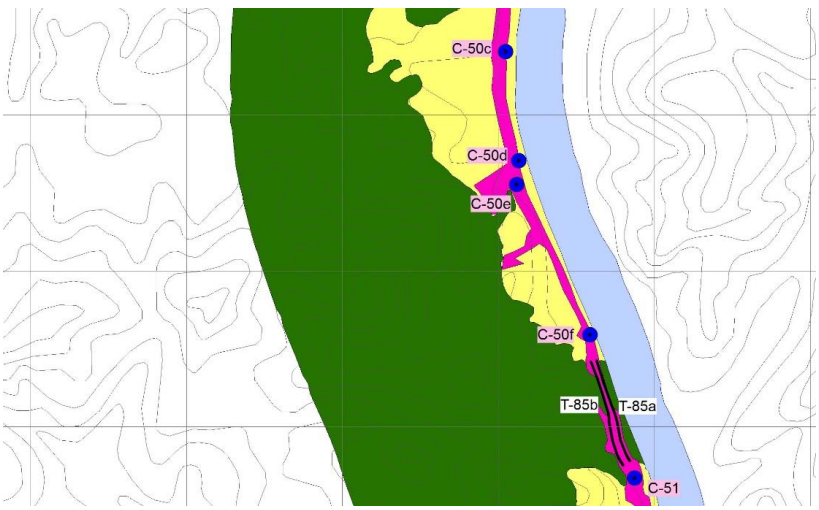
Watercourse C-50e ***Location (x/y):*** 476.011 / 1.200.069 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** Other

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

Watercourse ***C-50f*** ***Location (x/y):*** 476.268 / 1.199.536 ***Type:*** Fill prism with tree-trunks

Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** Other

Condition in 2013

Condition in 2014

Location Map:

Watercourse ***C-51*** ***Location (x/y):*** 476.424 / 1.199.028 ***Type:*** Fill prism with tree-trunks

Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** Other

Condition in 2013

Condition in 2014

Location Map:

Dr. Andreas Mende *(Julio 2014)*

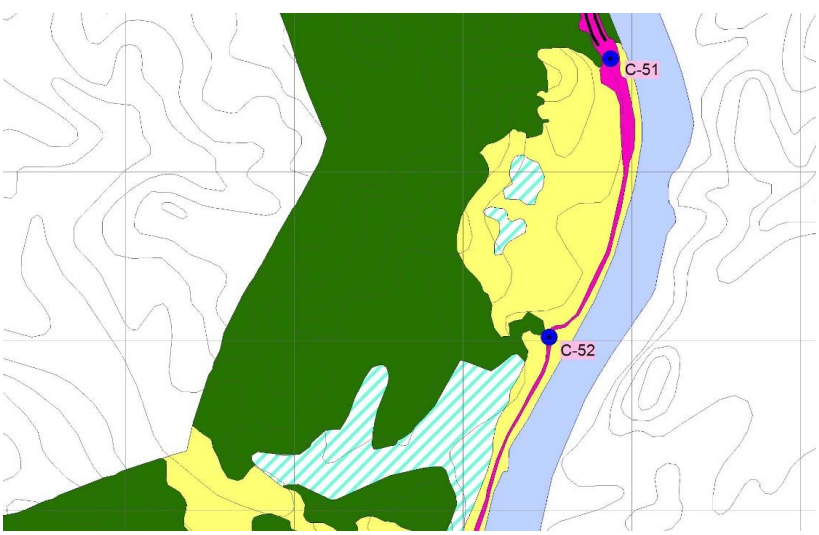
Watercourse* C-52** ***Location (x/y): 476.225 / 1.198.116 ***Type:*** Fill prism with tree-trunks

Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** Other

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

Watercourse ***C-53*** ***Location (x/y):*** 475.594 / 1.196.921 ***Type:*** No construction

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** No mitigation necessary

Condition in 2013 ***Condition in 2014***

Location Map:

Dr. Andreas Mende *(Julio 2014)*

Watercourse C-54 ***Location (x/y):*** 474.969 / 1.196.766 ***Type:*** No construction

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** No mitigation necessary

Condition in 2013

Condition in 2014

Location Map:

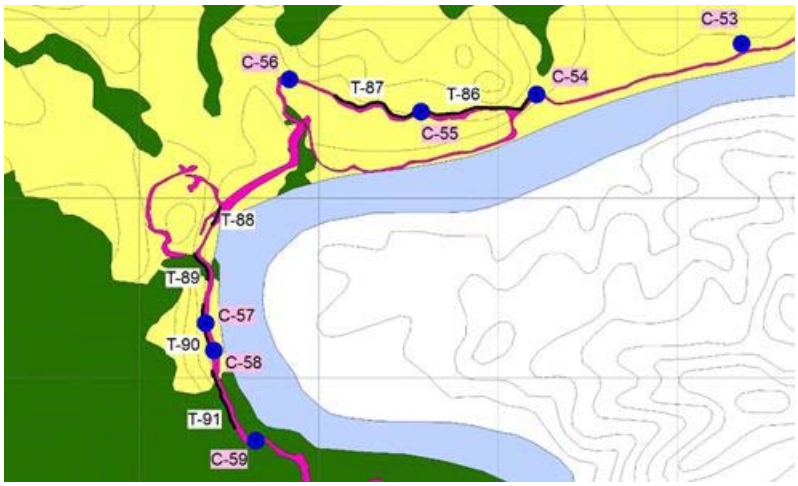
Watercourse ***C-55*** ***Location (x/y):*** 474.616 / 1.196.712 ***Type:*** No construction

Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** Other

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

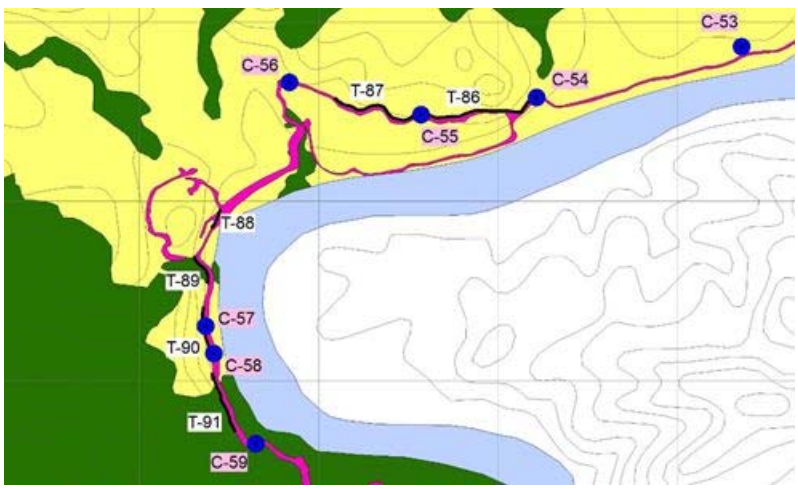
Watercourse ***C-56*** ***Location (x/y):*** 474.216 / 1.196.813 ***Type:*** Bridge combined with fill

Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** Other

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

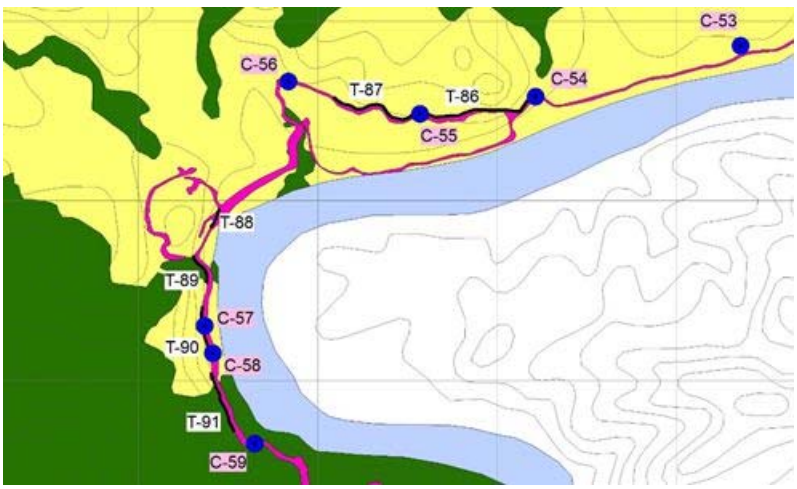
Watercourse* C-57** ***Location (x/y): 473.960 / 1.196.062 ***Type:*** No construction

Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** Other

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

Watercourse ***C-58*** ***Location (x/y):*** 473.985 / 1.195.977 ***Type:*** No construction

Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** Other

Condition in 2013

Condition in 2014

Location Map:

Dr. Andreas Mende *(Julio 2014)*

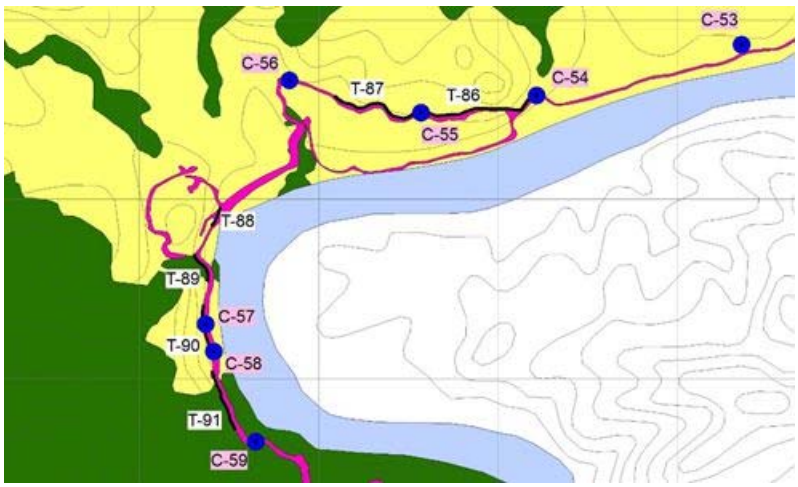
Watercourse ***C-59*** ***Location (x/y):*** 474.112 / 1.195.699 ***Type:*** Fill prism with tree-trunks

Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** Other

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

Watercourse* C-60** ***Location (x/y): 475.020 / 1.195.075 ***Type:*** Bridge combined with fill

Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** Other

Condition in 2013

Condition in 2014

Location Map:

Dr. Andreas Mende *(Julio 2014)*

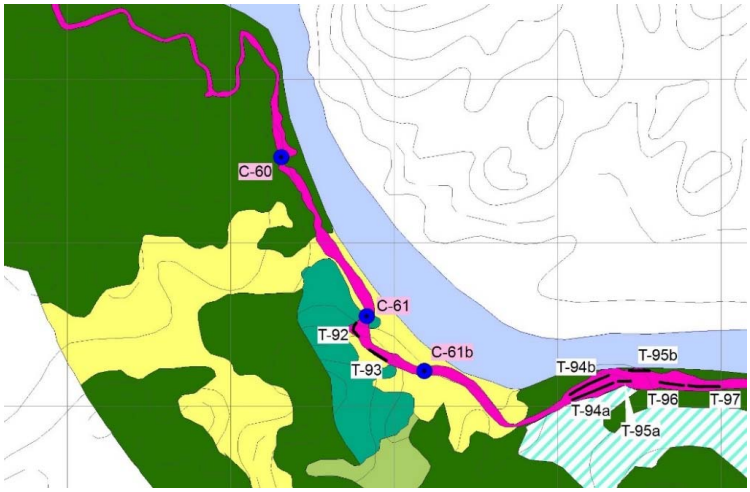
Watercourse* C-61** ***Location (x/y): 475.305 / 1.194.537 ***Type:*** Bridge combined with fill

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Other

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

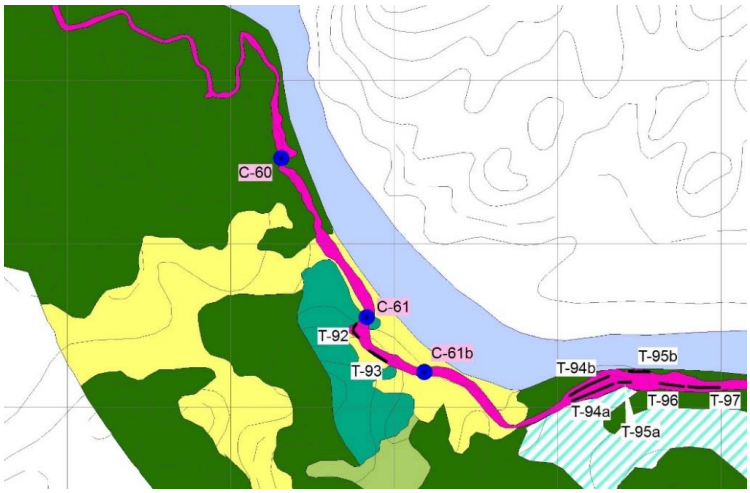
***Watercourse* C-61b** **Location (x/y):** 475.497 / 1.194.351 **Type:** Bridge combined with fill

Sedimentation: not present **Erosion:** present **Present Mitigation Status:** Other

Condition in 2013

Condition in 2014

Location Map:



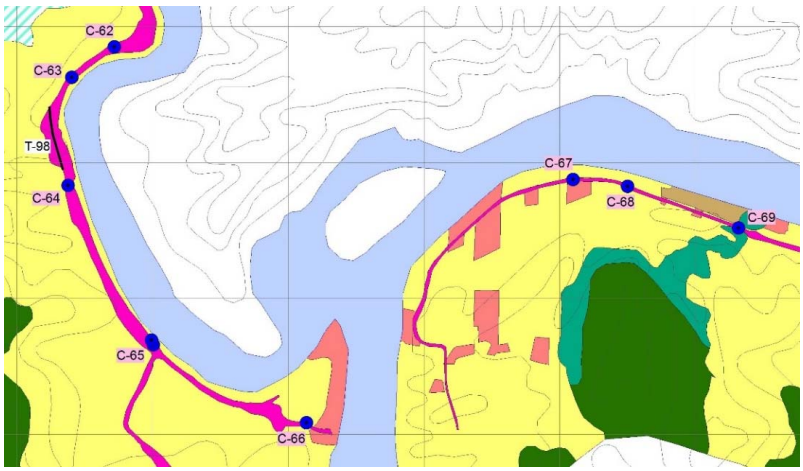
Watercourse ***C-62*** ***Location (x/y):*** 477.428 / 1.193.596 ***Type:*** Bridge combined with fill

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** No mitigation necessary

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

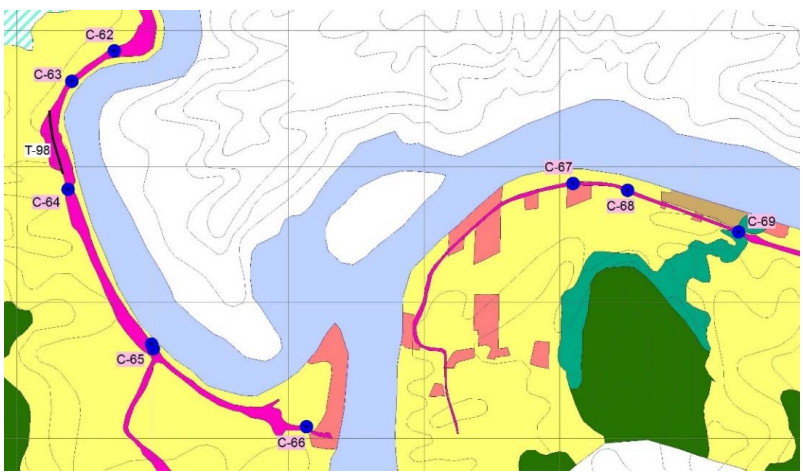
Watercourse ***C-63*** ***Location (x/y):*** 477.257 / 1.193.472 ***Type:*** Bridge combined with fill

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** No mitigation necessary

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

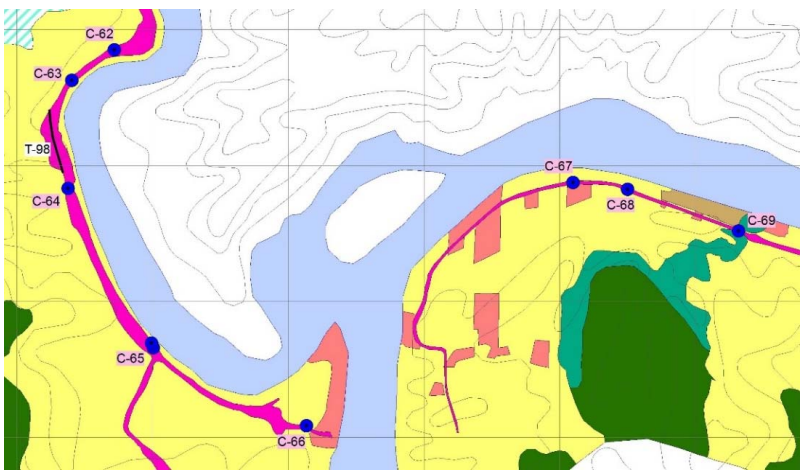
Watercourse* C-64** ***Location (x/y): 477.242 / 1.193.033 ***Type:*** Bridge combined with fill

Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation scheduled

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

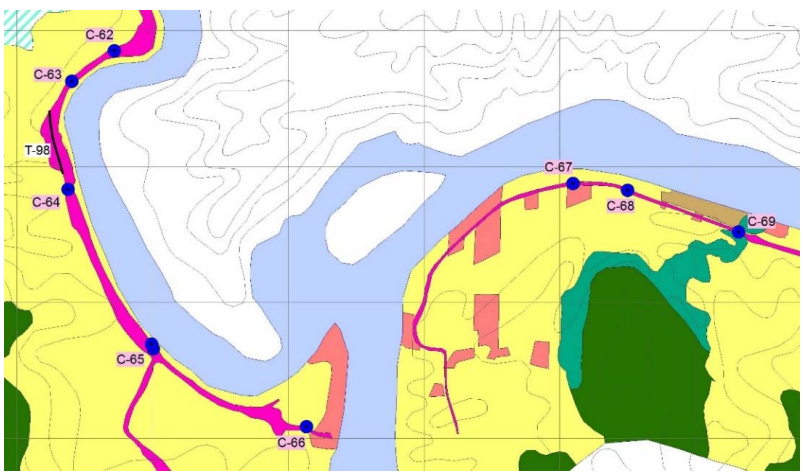
Watercourse* C-65** ***Location (x/y): 477.578 / 1.192.404 ***Type:*** Bridge combined with fill

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** No mitigation necessary

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

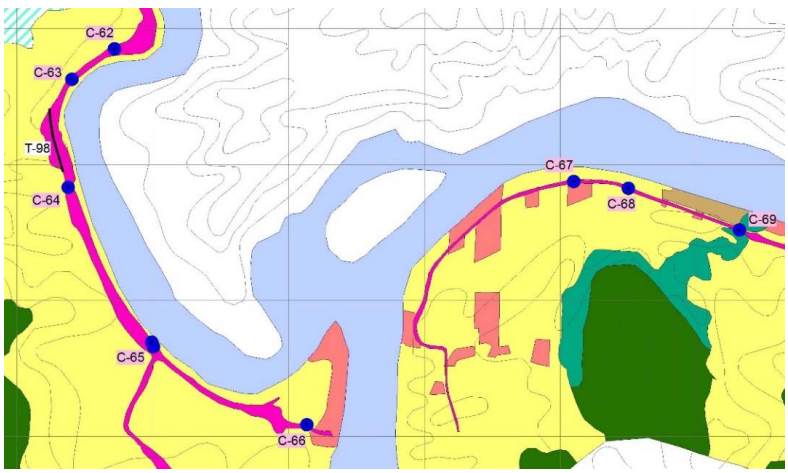
Watercourse C-66 ***Location (x/y):*** 478.201 / 1.192.067 ***Type:*** Bridge combined with fill

Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation scheduled

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

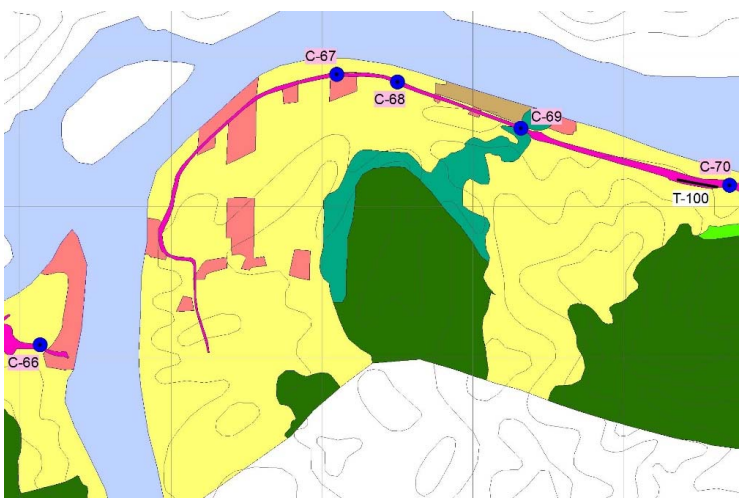
Watercourse* C-67** ***Location (x/y): 479.277 / 1.193.055 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation scheduled

Condition in 2013

Condition in 2014

Location Map:



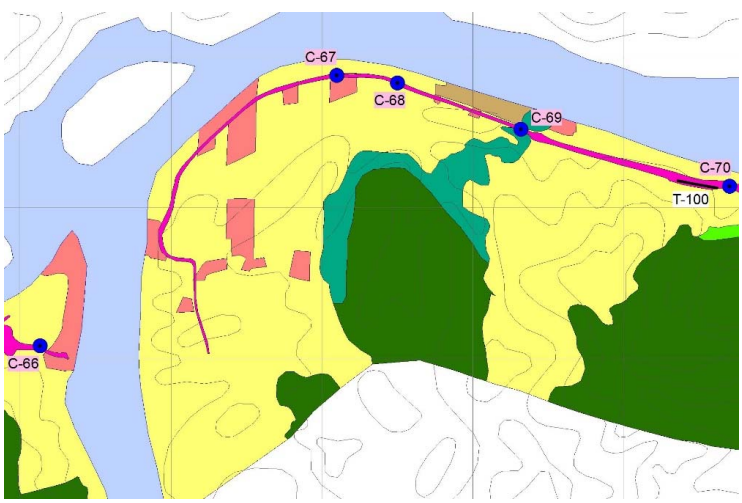
Watercourse ***C-68*** ***Location (x/y):*** 479.497 / 1.193.027 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** No mitigation necessary

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

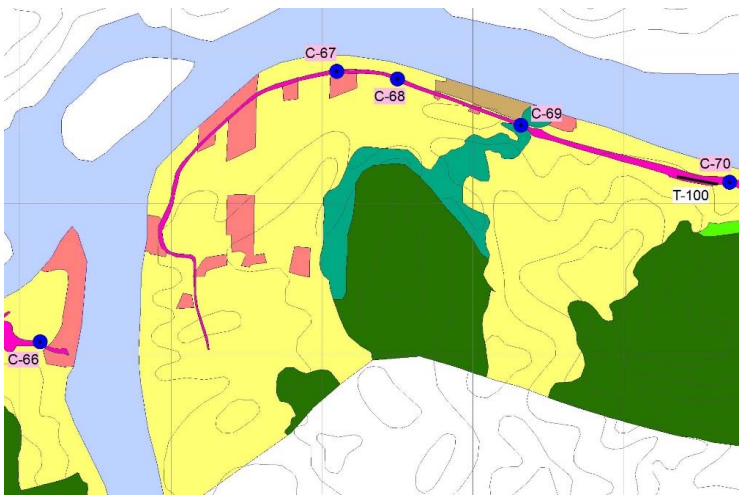
Watercourse ***C-69*** ***Location (x/y):*** 479.943 / 1.192.858 ***Type:*** Bridge combined with fill

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Mitigation in progress

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

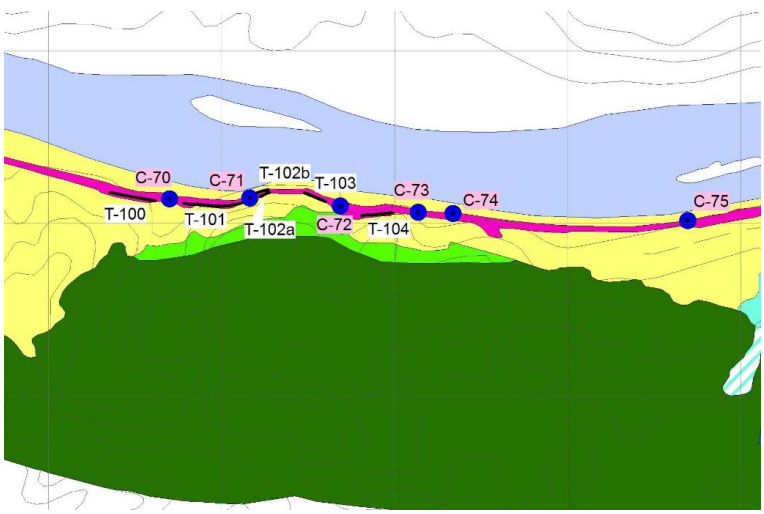
Watercourse ***C-70*** ***Location (x/y):*** 480.699 / 1.192.650 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Mitigation scheduled

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

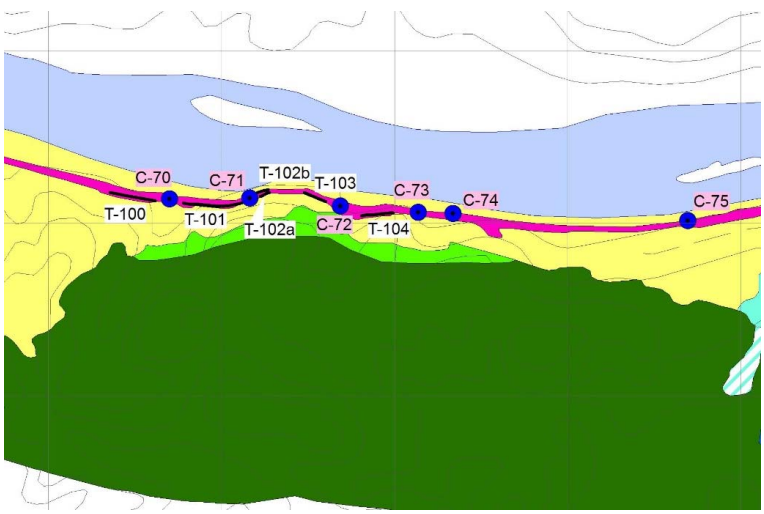
Watercourse ***C-71*** ***Location (x/y):*** 480.952 / 1.192.651 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** No mitigation necessary

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

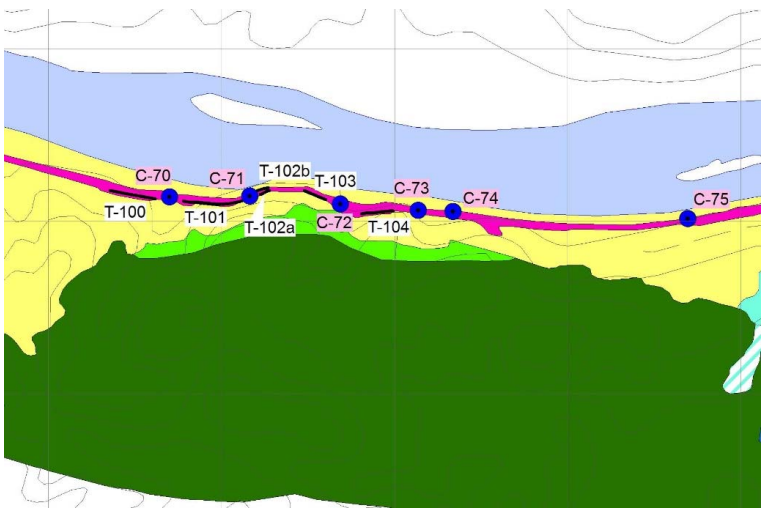
Watercourse ***C-72*** ***Location (x/y):*** 481.239 / 1.192.626 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** No mitigation necessary

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

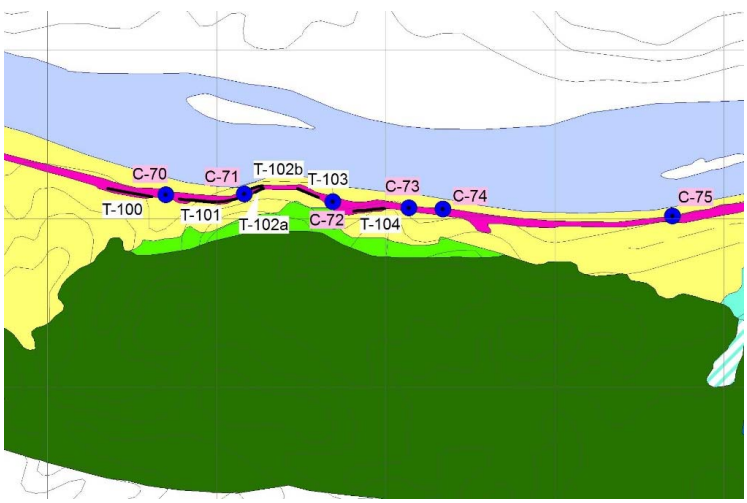
Watercourse* C-73** ***Location (x/y): 481.485 / 1.192.606 ***Type:*** Bridge combined with fill

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** No mitigation necessary

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

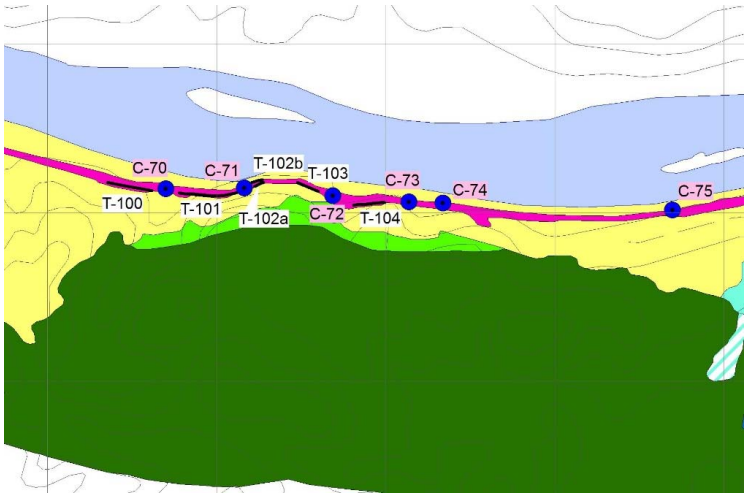
Watercourse ***C-74*** ***Location (x/y):*** 481.595 / 1.192.601 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** No mitigation necessary

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

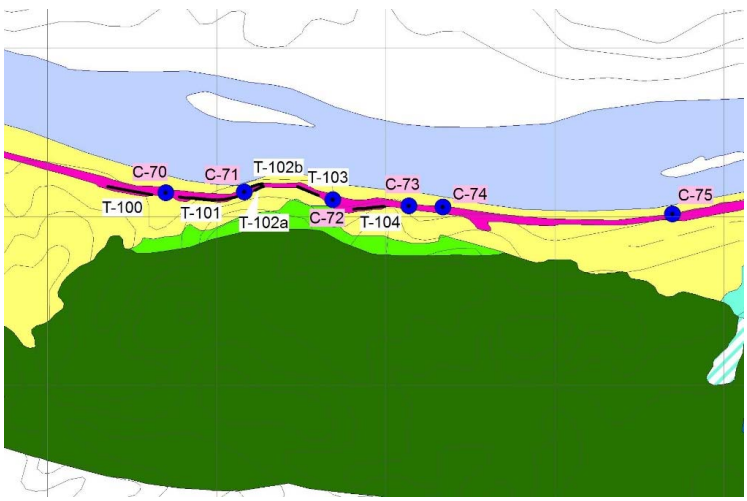
Watercourse* C-75** ***Location (x/y): 482.336 / 1.1925.79 ***Type:*** Bridge combined with fill

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** No mitigation necessary

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

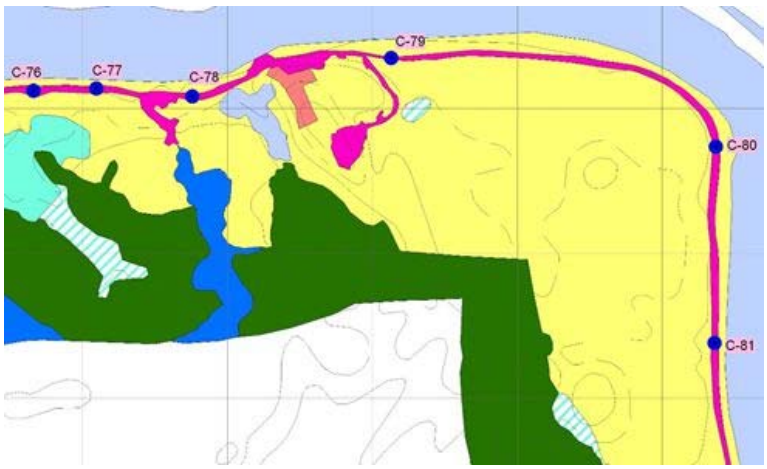
Watercourse C-76 ***Location (x/y):*** 482.865 / 1.192.636 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** No mitigation necessary

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

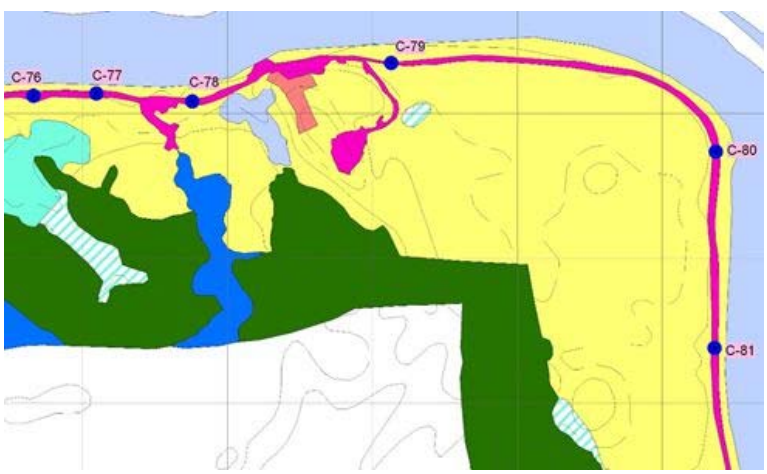
Watercourse ***C-77*** ***Location (x/y):*** 483.102 / 1.192.645 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** No mitigation necessary

Condition in 2013

Condition in 2014

Location Map:



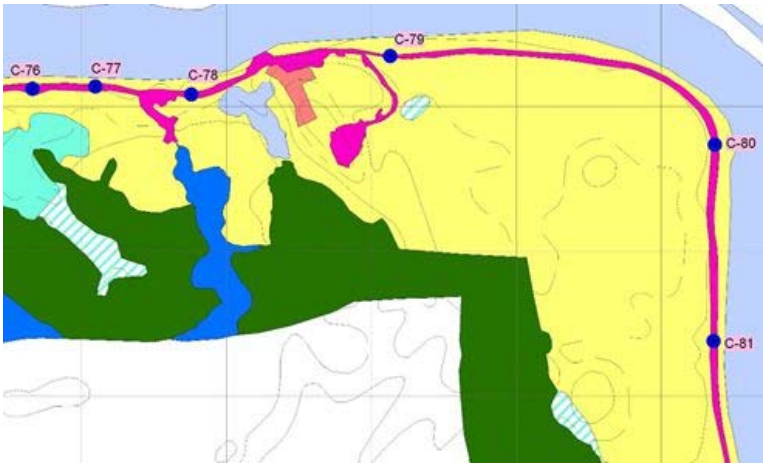
Watercourse* C-78** ***Location (x/y): 483.464 / 1.192.615 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation scheduled

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

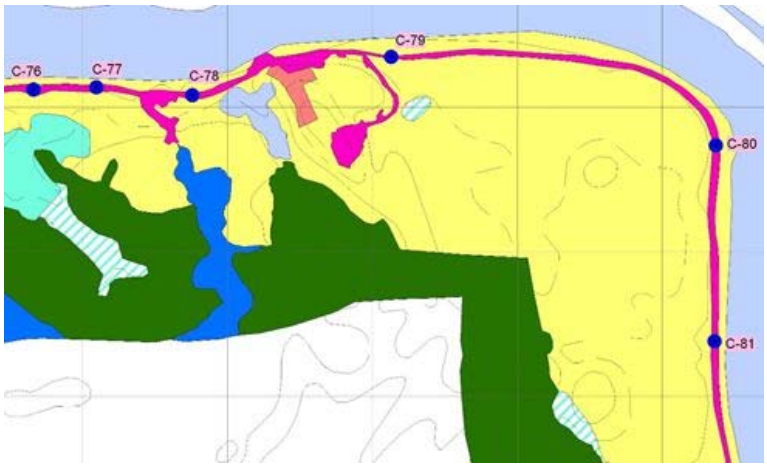
Watercourse* C-79** ***Location (x/y): 484.214 / 1.192.760 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation scheduled

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

Watercourse ***C-80*** ***Location (x/y):*** 485.440 / 1.192.422 ***Type:*** Culvert with fill prism

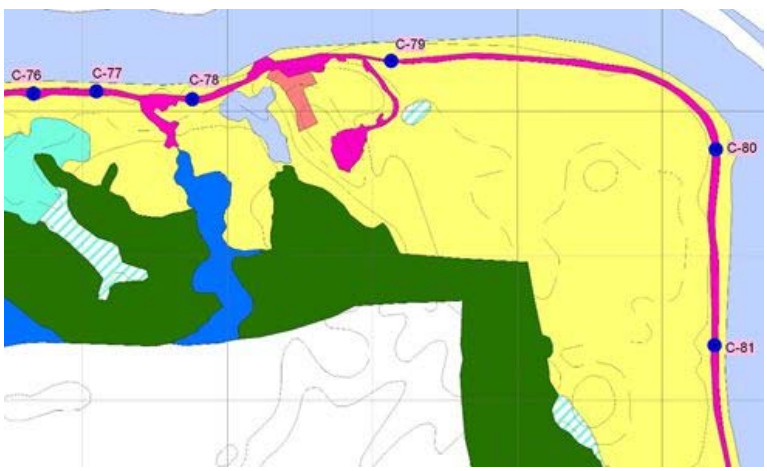
Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation scheduled

Condition in 2013

Condition in 2014

Dr. Andreas Mende *(Julio 2014)*

Location Map:



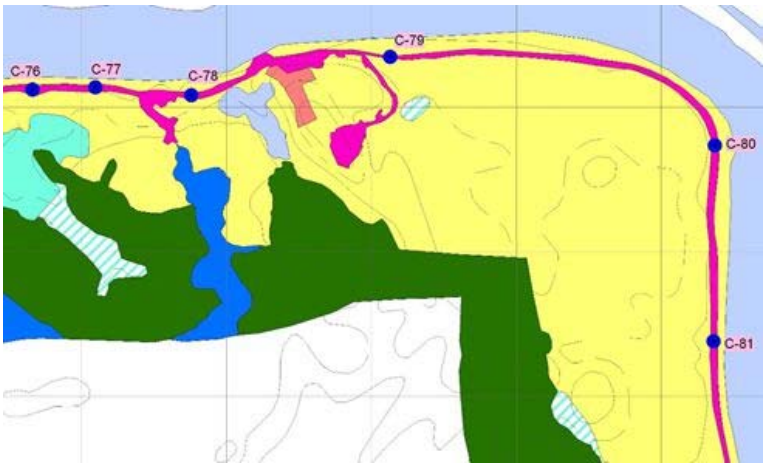
Watercourse* C-81** ***Location (x/y): 485.435 / 1.191.673 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation scheduled

Condition in 2013

Condition in 2014

Location Map:



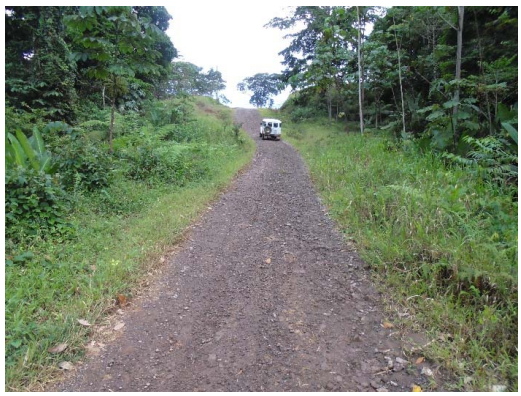
Dr. Andreas Mende *(Julio 2014)*

Watercourse* C-82** ***Location (x/y): 485.538 / 1.191.030 ***Type:*** Bridge combined with fill

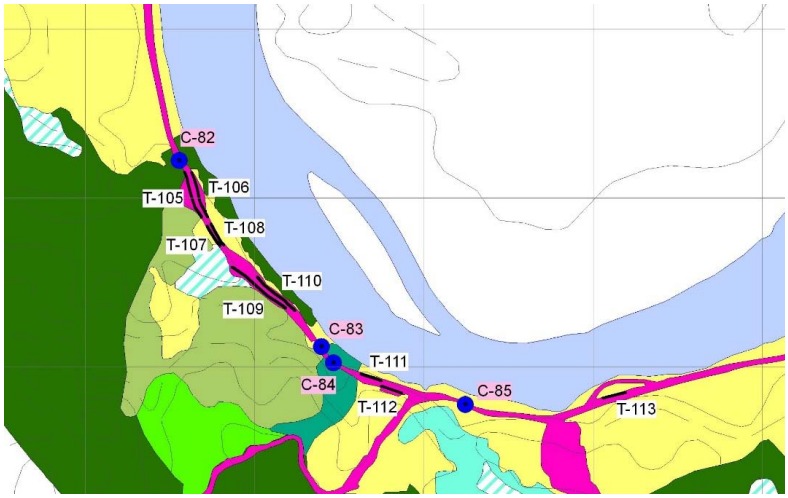
Sedimentation: present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation scheduled

Condition in 2013

Condition in 2014



Location Map:



Dr. Andreas Mende *(Julio 2014)*

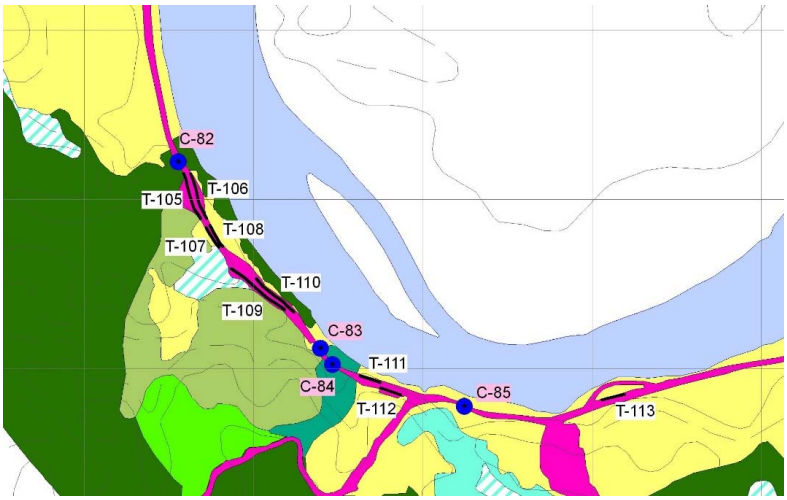
Watercourse* C-83** ***Location (x/y): 485.998 / 1.190.421 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation scheduled

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

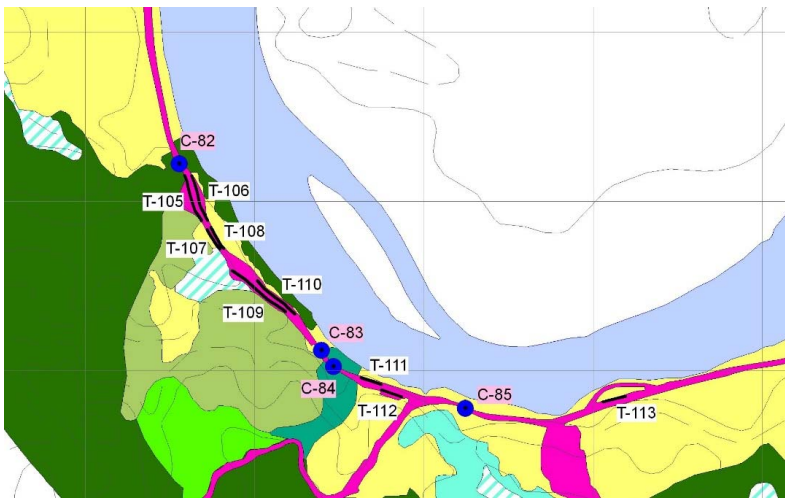
Watercourse ***C-84*** ***Location (x/y):*** 486.038 / 1.190.369 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** No mitigation necessary

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

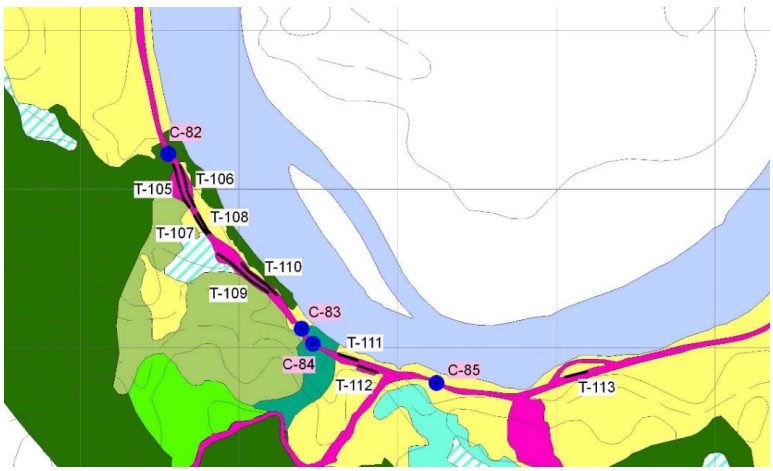
Watercourse* C-85** ***Location (x/y): 486.462 / 1.190.232 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** No mitigation necessary

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

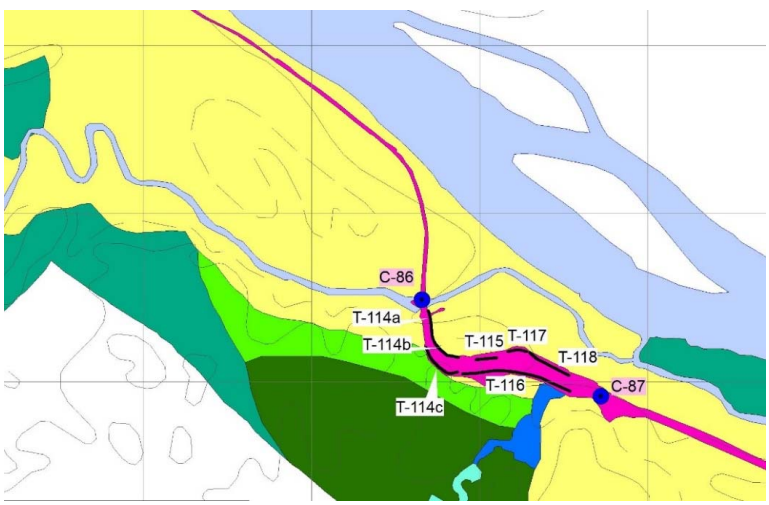
Watercourse* C-86** ***Location (x/y): 489.969 / 1.190.072 ***Type:*** Bridge combined with fill

Sedimentation: present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation in progress

Condition in 2013

Condition in 2014

Location Map:



Watercourse* C-87** ***Location (x/y): 490.552 / 1.189.754 ***Type:*** Culvert with fill prism

Sedimentation: present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation scheduled

Condition in 2013

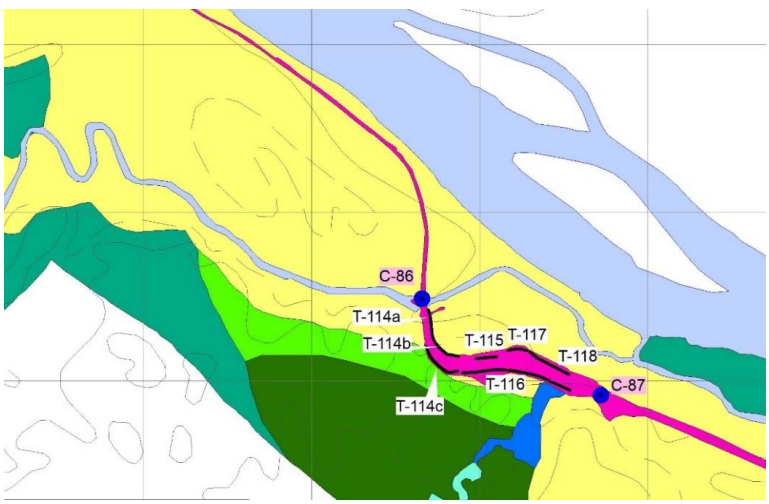
Condition in 2014

Dr. Andreas Mende *(Julio 2014)*

Condition in 2013

Condition in 2014

Location Map:



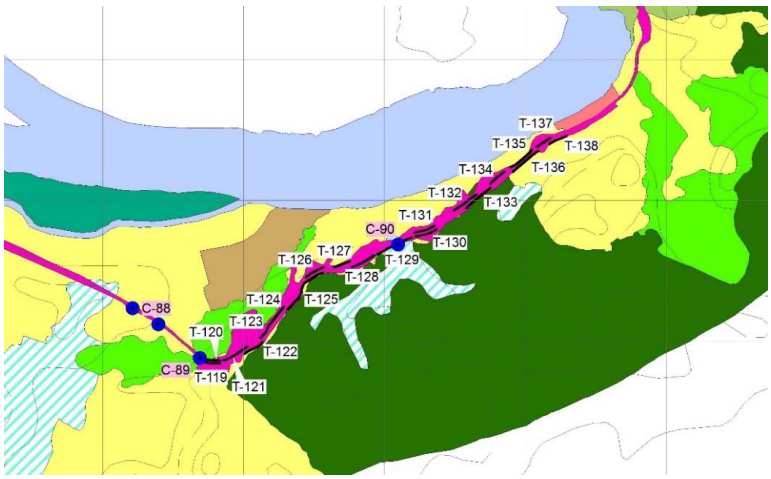
Watercourse* C-88** ***Location (x/y): 491.367 / 1.189.377 ***Type:*** No construction

Sedimentation: present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation scheduled

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

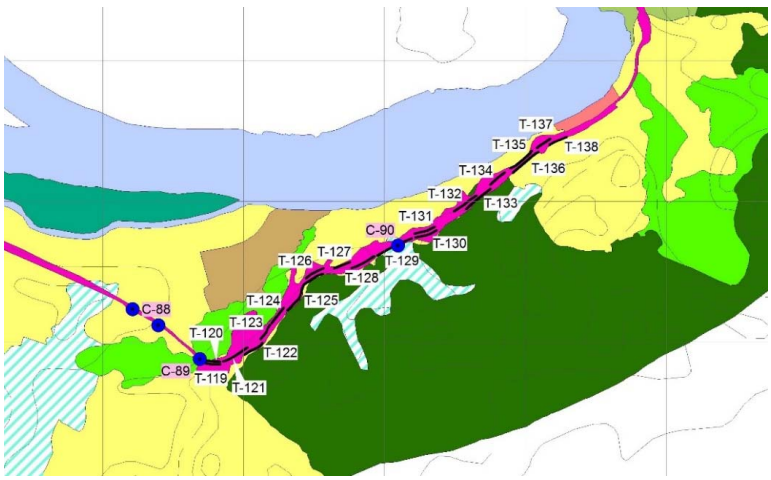
Watercourse* C-89** ***Location (x/y): 491.628 / 1.189.182 ***Type:*** Bridge with no fill

Sedimentation: present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation in progress

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

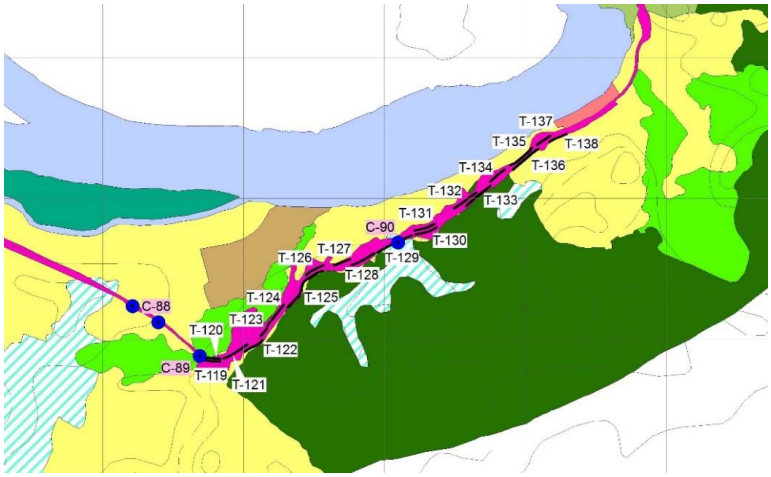
Watercourse ***C-90*** ***Location (x/y):*** 492.397 / 1.189.628 ***Type:*** Culvert with fill prism

Sedimentation: present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation scheduled

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

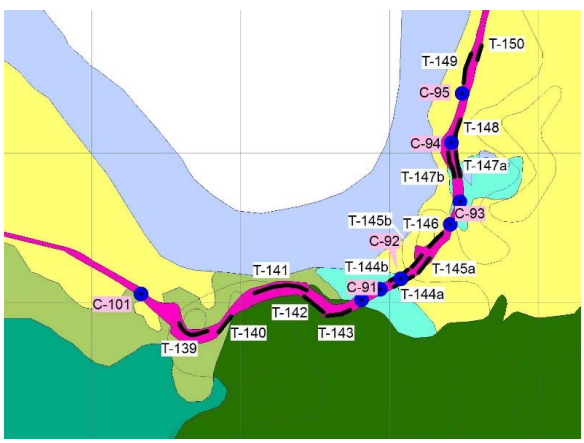
Watercourse ***C-101*** ***Location (x/y):*** 495.259 / 1.190.936 ***Type:*** Bridge combined with fill

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** No mitigation necessary

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

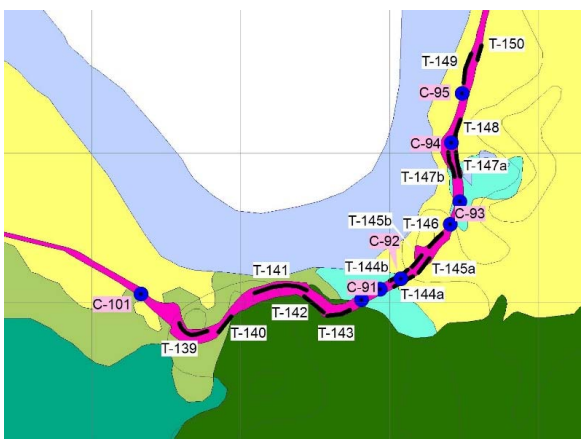
Watercourse* C-91** ***Location (x/y): 496.138 / 1.190.954 ***Type:*** No construction

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Other

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

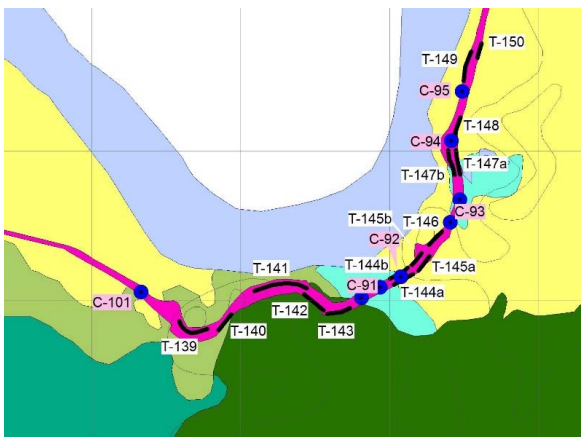
Watercourse* C-92** ***Location (x/y): 496.215 / 1.190.994 ***Type:*** Fill prism

Sedimentation: present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation scheduled

Condition in 2013

Condition in 2014

Location Map:



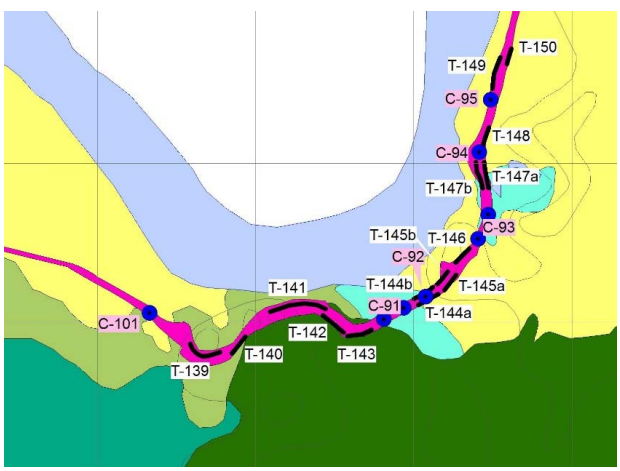
Watercourse* C-93** ***Location (x/y): 496.430 / 1.191.280 ***Type:*** No construction

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Other

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

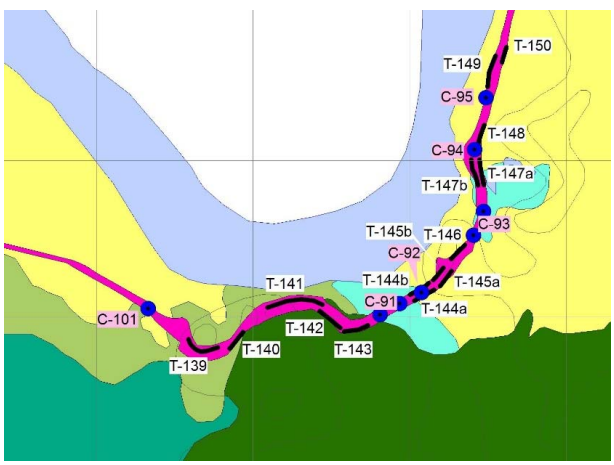
Watercourse* C-94** ***Location (x/y): 496.400 / 1.191.499 ***Type:*** No construction

Sedimentation: present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation scheduled

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

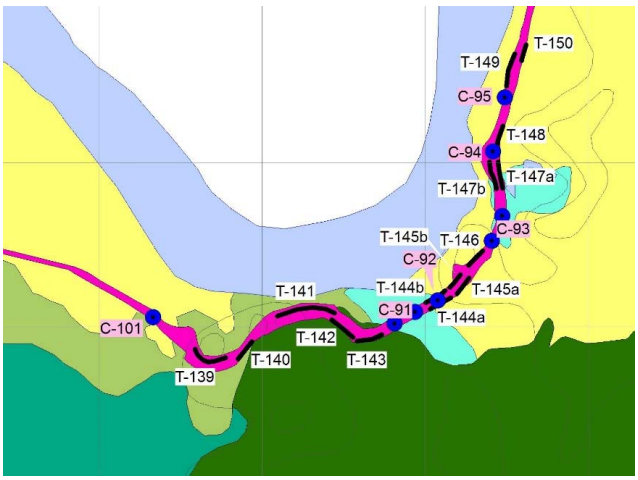
Watercourse* C-95** ***Location (x/y): 496.439 / 1.191.682 ***Type:*** No construction

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Other

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

Watercourse ***C-102*** ***Location (x/y):*** 497.004 / 1.193.228 ***Type:*** Bridge combined with fill

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Other

Condition in 2013 ***Condition in 2014***

Location Map:

Dr. Andreas Mende *(Julio 2014)*

Watercourse* C-103** ***Location (x/y): 498.088 / 1.192.451 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** Other

Condition in 2013

Condition in 2014

Location Map:

Dr. Andreas Mende *(Julio 2014)*

Watercourse C-104 ***Location (x/y):*** 498.444 / 1.191.562 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Other

Condition in 2013 ***Condition in 2014***

Location Map:

Dr. Andreas Mende *(Julio 2014)*

Watercourse* C-96** ***Location (x/y): 500.556 / 1.189.581 ***Type:*** Fill prism

Sedimentation: present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation scheduled

Condition in 2013

Condition in 2014

Location Map:

Dr. Andreas Mende *(Julio 2014)*

Watercourse* C-97** ***Location (x/y): 500.744 / 1.189.441 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation scheduled

Condition in 2013

Condition in 2014

Location Map:

Dr. Andreas Mende *(Julio 2014)*

Watercourse* C-98** ***Location (x/y): 500.888 / 1.189.302 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation scheduled

Condition in 2013

Condition in 2014

Location Map:

Dr. Andreas Mende *(Julio 2014)*

Watercourse* C-99** ***Location (x/y): 501.026 / 1.189.175 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation scheduled

Condition in 2013

Condition in 2014

Location Map:

Dr. Andreas Mende *(Julio 2014)*

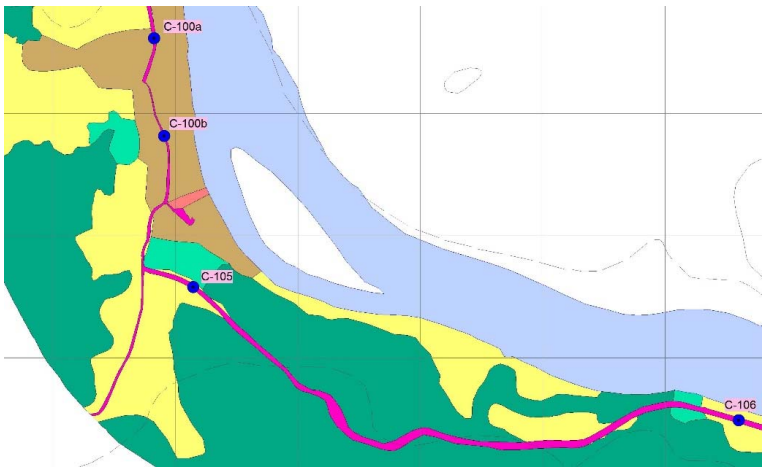
Watercourse ***C-100a*** ***Location (x/y):*** 503.186 / 1.187.376 ***Type:*** Bridge combined with fill

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Mitigation scheduled

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

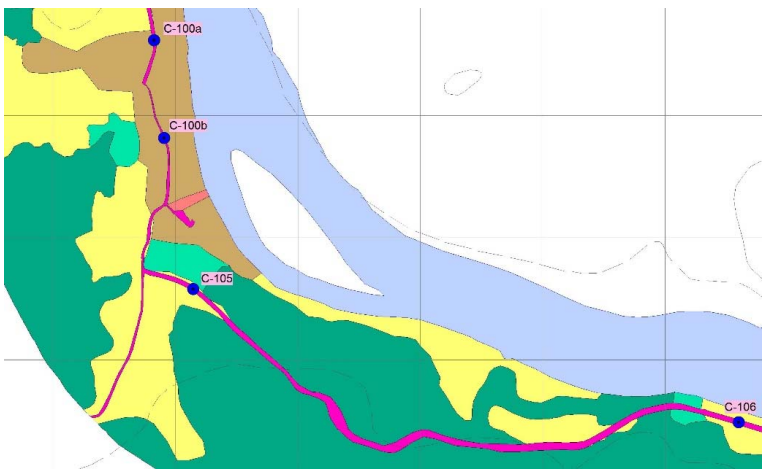
Watercourse* C-100b** ***Location (x/y): 503.231 / 1.186.933 ***Type:*** Bridge combined with fill

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Mitigation scheduled

Condition in 2013

Condition in 2014

Location Map:



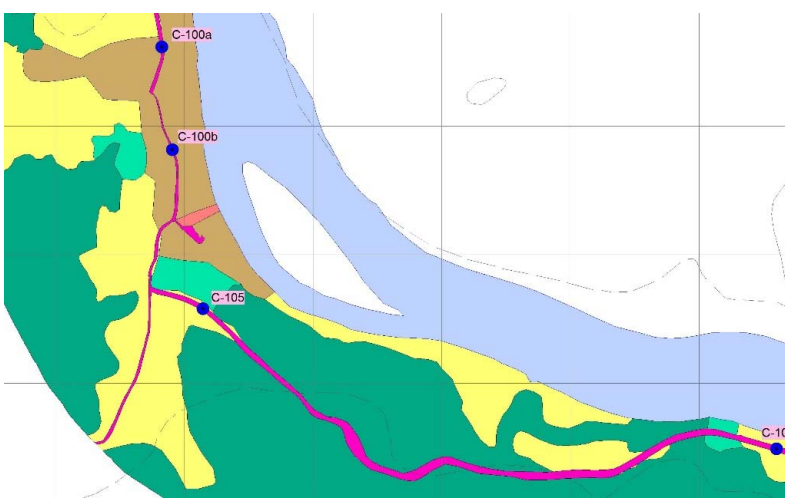
Dr. Andreas Mende *(Julio 2014)*

Watercourse C-105 ***Location (x/y):*** 503.361 / 1.186.249 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** No mitigation necessary

Condition in 2013 ***Condition in 2014***

Location Map:



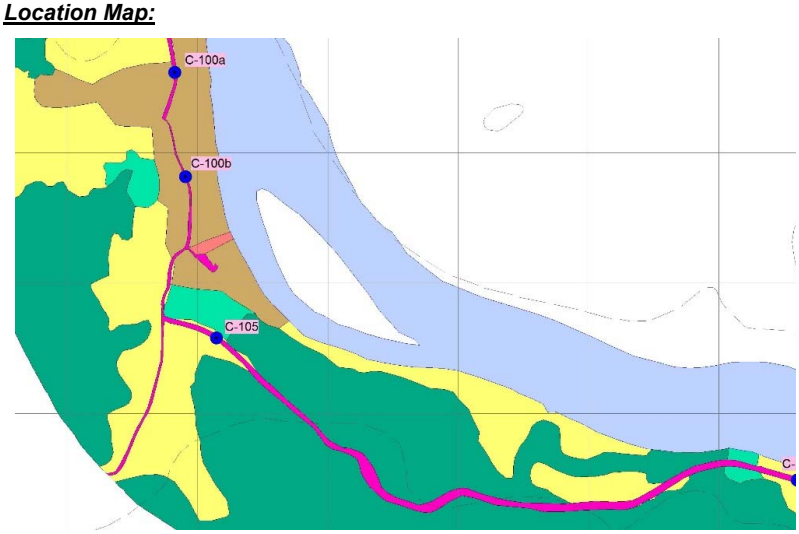
Dr. Andreas Mende *(Julio 2014)*

Watercourse C-106 ***Location (x/y):*** 505.799 / 1.185.648 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** No mitigation necessary

Condition in 2013 ***Condition in 2014***

Location Map:



Dr. Andreas Mende *(Julio 2014)*

Watercourse* C-107** ***Location (x/y): 507.998 / 1.183.530 ***Type:*** Fill prism

Sedimentation: present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation scheduled

Condition in 2013

Condition in 2014

Location Map:

Dr. Andreas Mende *(Julio 2014)*

Watercourse* C-108** ***Location (x/y): 508.046 / 1.183.577 ***Type:*** Fill prism

Sedimentation: not present ***Erosion:*** present ***Present Mitigation Status:*** Mitigation scheduled

Condition in 2013

Condition in 2014

Location Map:

Dr. Andreas Mende *(Julio 2014)*

Watercourse* C-109** ***Location (x/y): 508.947 / 1.184.072 ***Type:*** Bridge combined with fill

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** No mitigation necessary

Condition in 2013

Condition in 2014

Location Map:

Dr. Andreas Mende *(Julio 2014)*

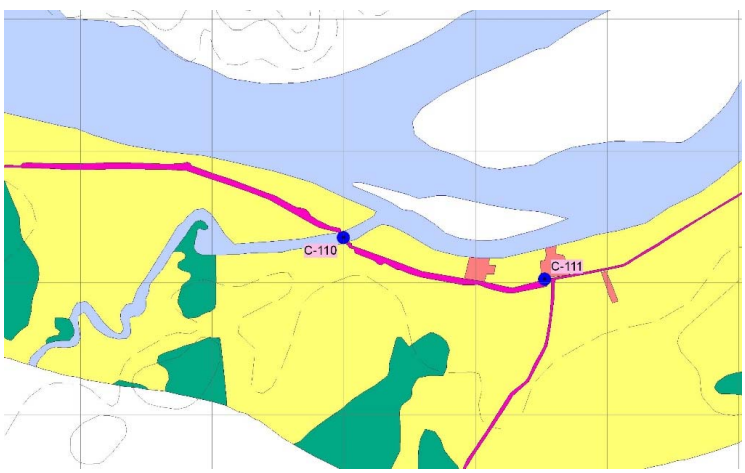
Watercourse* C-110** ***Location (x/y): 513.670 / 1.185.014 ***Type:*** Bridge combined with fill

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Mitigation in progress

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

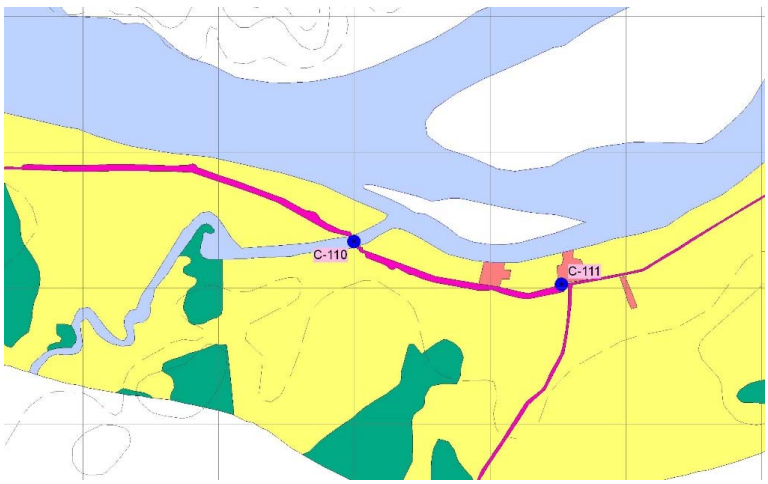
Watercourse ***C-111*** ***Location (x/y):*** 514.506 / 1.184.840 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Mitigated

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

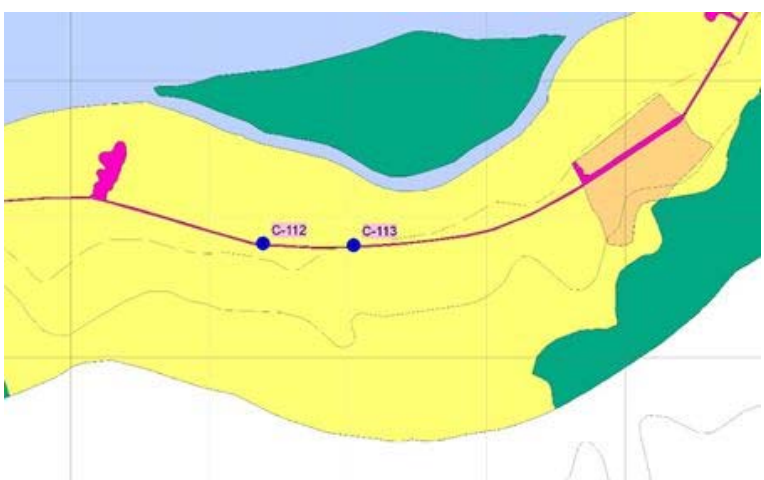
Watercourse ***C-112*** ***Location (x/y):*** 519.898 / 1.188.049 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Mitigated

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

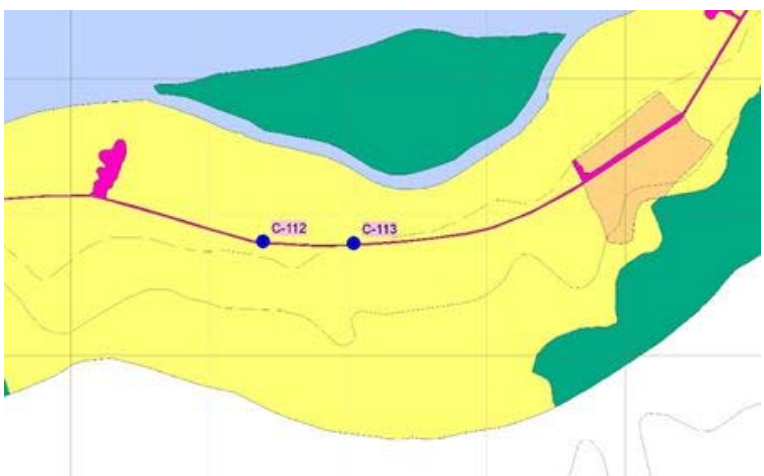
Watercourse ***C-113*** ***Location (x/y):*** 520.256 / 1.188.042 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Mitigated

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

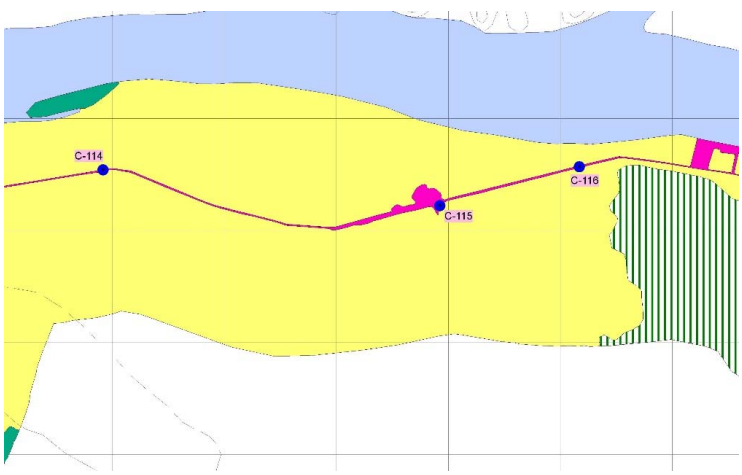
Watercourse* C-114** ***Location (x/y): 523.468 / 1.190.660 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Mitigated

Condition in 2013

Condition in 2014

Location Map:



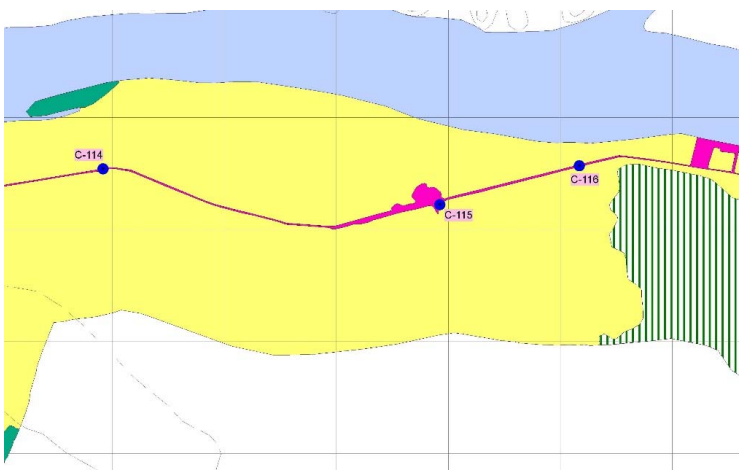
Watercourse* C-115** ***Location (x/y): 525.112 / 1.190.485 ***Type:*** Bridge combined with fill

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Mitigated

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*

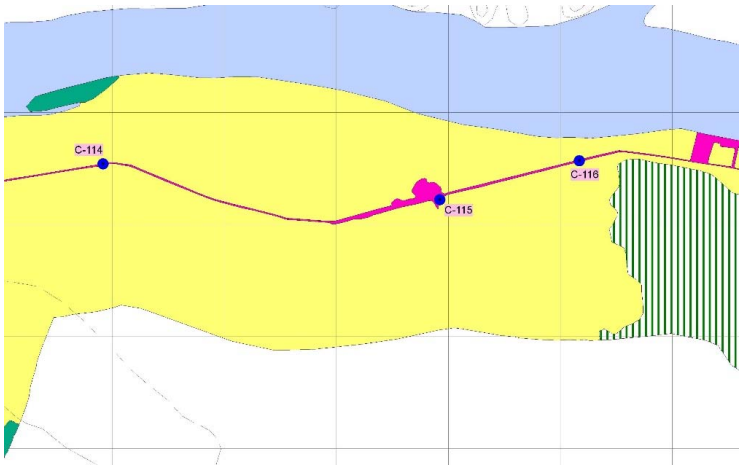
Watercourse* C-116** ***Location (x/y): 525.793 / 1.190.678 ***Type:*** Culvert with fill prism

Sedimentation: not present ***Erosion:*** not present ***Present Mitigation Status:*** Mitigated

Condition in 2013

Condition in 2014

Location Map:



Dr. Andreas Mende *(Julio 2014)*