DEVELOPMENT OF REMEDIATION PLANS WITH FINANCIAL REQUIREMENTS FOR ELIMINATION OF INDUSTRIAL HOTSPOTS

(EUROPEAID/123674/D/SER/MK)

FEASIBILITY STUDY – Volume IV – Makstil – Ferro Slag Dumpsite - Skopje

Development of Remediation Plans with Financial Requirements for Elimination of Industrial Hotspots
An EU-funded project managed by the European Agency for Reconstruction

FEASIBILITY STUDY – Volume IV – Makstil – Ferro Slag Dumpsite - Skopje

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LIST OF ABBREVIATIONS

AP	Action Plan
maSl	meter above Sea level
BAT	Best Available Techniques
BATNEEC	Best Available Techniques Not Entailing Excessive Costs
CARDS	Community Assistance, Reconstruction, Development and Stabilisation
CE	Central-East
CHIP	Chemicals Hazard Information & Packaging
COSHH	Control of Substances Hazardous to Health
DALY	Disability Adjusted Life Years
DS	Dangerous Substances
EAR	European Agency for Reconstruction
EIA	Environmental Impact Assessment
EBRD	European Bank for Reconstruction and Development
EC	European Commission
ESC	Environmental Steering Committee
€	Euro
EIONET	European Environmental Information and Observation Network
EU	European Union
GIS	Geographic Information System
GLPs	Good Laboratory Practices
GoM	Government of Macedonia
GPS	Global Positioning System
GTZ	Gesellschaft fuer Technische Zusammenarbeit
HWL	Hazardous Waste List
HZW	Hazardous Waste
HZWM	Hazardous Waste Management
IFI	International Financial Institution
ISC	Inter-ministerial Steering Committee
ISPA	Instrument for Structural Policies for Pre-accession
IPH	Institute for Health Protection
IPPC	Integrated Pollution Prevention and Control
ISIC	International Standard of Industrial Classification Rev. 2 1968 (UNIDO)
KfW	Kreditanstalt für Wiederaufbau (German Bank for Reconstruction)
LOAEL	Lowest-Observed-Adverse- Effect Level
LoW	List of Wastes

LSG	Local Self Government
LWM	Law on Waste Management
maSl	meter above Sea level
MoEPP	Ministry of Environment and Physical Planning
MoH	Ministry of Health
MoF	Ministry of Finance
MoE	Ministry of Economy
MoTC	Ministry of Transport and Communication
NACE	The EC statistical office (Eurostat) classification scheme of economic activities. ('Nomenclature générale des Activités économiques dans les Communautés Européennes' [General Industrial Classification of Economic Activities within the European Communities])
NE	North-East
NEAP	National Environmental Action Plan
NOAEL	No-Observed-Adverse-Effect Level
NWMP	National Waste Management Plan
REC	Regional Environmental Centre for Central and Eastern Europe
REReP	Regional Environmental Reconstruction Programme
RfD	Reference Dose
POPs	Persistent Organic Pollutants
REReP	Regional Environmental Reconstruction Program for South Eastern Europe
PPP	Public Private Partnership
RIHP	Republic Institute for Health Protection
SAA	Stabilisation and Association Agreement
SC	Steering Committee
SMEs	Small and Medium Size Enterprises
SoEs	Social owned entities
SW	Solid Waste
SWM	Solid Waste Management
TA	Technical Assistance
TCLP	Toxicity Characteristic Leaching Procedure
TNA	Training Needs Analysis
ToR	Terms of Reference
UNDP	United Nation Development Programme
UNEP	United Nation Environmental Programme
WHO	World Health Organization
WG	Working Group

WWT Waste Water Treatment

YYL Years of life lost

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Volumes related to this feasibility study:

Volume I	Feasibility Study – OHIS - Skopje
Volume II	Feasibility Study – MHK Zletovo – Smelter – Veles
Volume III	Feasibility Study – SILMAK – Jegunovce
Volume IV	Feasibility Study – MAKSTIL – Skopje
Volume V	Legal Gap Analyses for the Remediation Issues of polluted and contaminated sites
Volume VI	Funding Mechanism and institutional set up for the Remediation of contaminated and polluted sites

Sub Volumes related to this feasibility study:

Volume 00_A	Qualitative Health Risk Impact Assessment
Volume 00_B	Process Assessment
Volume 00_C	Environmental Impact Assessment

Volume 00_D Public Information Assessment and Action Plan

Volume 00_E Geotechnical Assessment

Volume 00_F Geo referencing and Mapping

Volume 00_G Samples and Analyses

Volume 00_H Economical and Financial Evaluation

Извршно резиме

Главната цел на проектот е да помогне во елиминацијата на индустриските жешки точки во земјата, преку развој на 4 санациски планови со финансиски барања. Проектот е финансиран од ЕУ и извршуван од шпанската компанија Eptisa со Министерството за животна средина и просторно планирање како главен корисник .

Во моментот, поранешната југословенска Република Македонија нема системски пристап или политика заремедијација на овие жешки точки. Нивното влијание не е целосно познатао,трошоците за расчистување, не се систематски проценети; финансирањето за најголем дел е недостапно; институциите за имплементација не се поставени, дури и сопственоста на овие еколошки товари во пост приватизациска поставеност е нејасна. Што се однесува до контролата на индустриско загадување и управување со ризикот, МЖСПП има собрано список од инсталациите кои ќе бидат подложни на интегрирани еколошки дозволи, но интегрирано спречување и контрола од загадување треба да стане оперативно. Некои елементи од ES легислативата во областа на контрола на хаварии кои вклучуваат опасни супстанции се транспонирани во националното законодавство, но сепак целосна транспозиција сеуште не е остварена. Капацитетоттреба да се зајакне. на МЖСПП и други заинтересирани страни (локална самоуправа, претпријатија итн.) за имплементирање на мерки за контрола на индустриско загадување и управување со ризикот треба да се зајакне. Во 2003 година, земјата започна со хармонизација на националното законодавство од областа на животната средина со законодавството на ЕУ. Пет основни закони (Закон за животна средина, Закон за управување со отпад, Закон за води, Закон за природа и Закон за квалитет на амбиентниот воздух) и неколку подзаконски акти (ИСКЗ Уредба за определување на инсталации за кои е потребна интегрирана еколошка дозвола и временски распоред за предавање на оперативните планови; ИСКЗ Уредба за постапката за А интегрирана еколошка дозвола; Правилник за транспорт, записник и известување за отпад; Правилник за листа на отпад) беа подготвени. Сите горе споменати закони и подзаконски акти се однесуваат целосно или во некоја мера на отпад и управување со опасен отпад, но ниеден од нив директно ги споменува или регулира „индустриските жешки точки”.

Методологијата е базирана на :

- Проценка за ризикот по здравјето,
- Геотехнички истражувања,
- Проценка на јавната свест и информирање,
- Проценка на процесот и квалитативна и квантитативна идентификација на токовите на отпадот, проценка на влијанието врз =ивотната средина,
- Идентификација на опции за третман,
- Еколошко рангирање на идентификуваните опции за третман,
- Идентификација на економски индикатори,
- Финансиска евалуација на разни опции за ремедијација и економска евалуација на истите.

Во сите случаи се земени во предвид најдобрите можни пракси за поранешната Југословенска Република Македонија. Методологијата се состои наизменично од процедура на проверка и рангирање..

Главни фактори на локацијата кои влијаат, се манганот и прашината од претходното производстви на челик и депонирањето. Делови од депонијата на троска од железо се покриени, додека некои останууваат отворени. Вкупна количина од 6.367.000 Mg (што е еднакво на 2.546.800 m³) на троска со остаток од 220.000 Mg на отпаден материјал се депонирани помеѓу 1967 и 1999. Како резултат на плитки аквифери во северните и источните околни облсти, може да се очекува благо навлегување и влијание на манган. Нема докази за постоење на троска од железо сулфат. Тековно загадување главно се случува како резултат на непокриена површина и прашина. Влијанието на реката Вардар е занемарливо.

Квалитативната проценка на ризик по здравјето (Volume 00_A) опишува ризик и влијание, предизвикано од загадувачите на локацијата. На Макстил депонијата за троска од железо, во главно постои идентификација на опасност, како резултат на влијанието на манганот и е означено како **Ниско до Умерено,** додека влијанието врз човековото здравје е идентификувано како **Ниско**. Без оглед на околностите и во смисол на негативните влијанија на опасните карактеристики, како резулта на секундарни миграциони патишта, како што се подземна вода и почва не можат сосем да се исклучат. Може да се каже дека моменталната активност на производствените единици на Макстил, предизвикува значајно поголем ризик по здравјето, отколку отпадот акумулирана на истражуваното место. Се препорачува да се фокусира на ИСКЗ процедурите за да се избегне и намали ризкт на прифатливо ниво. Ризикот од историската локација Макстил може да се обележи како низок. Отсранување на постоечкиот отпад или покривање на областа ќе го елиминира сегашниот ризик.

Резиме на рангирање

Локација	Загадување	Опсност	Ризик	Влијание	Ранг
Макстил	Троска, Манган	Висока (Топ 10)	Ниско-Умерено	Ниско	4

Неколку аспекти на Макстил локацијата предизвикаа силни еколошки загрижувања, како постоење на троска од железо и сулфур, додека за време на истрагата, не се откриени такви докази. Милиони на Mg на троска со останата железна содржина се складирани на површина од 133.000 m со нето висина од 19 m. Троската содржи силикати, оксиди, знемарливи траги од олово и други тешки метали. Содржината на железо е до 1%, што не може повеќе да се рециклира.Значтелен е доказот на манган што може дасе разгради во почвата и подземните води како резултат на непокриени и отворени пвршини на депонијата. Манганот може да се најде во почвата и подземната вода, во коилчина која не може да се смета за значајна и опасна, поради тоа што нема докази за апстракција на вода за пиење од подземната вода. Ситуацијата со површинската и подземната вода е доста плитка, така што се случува постојан контакт со материјалот, особено во мочуришните области. Ризикот и влијанието врз животнатасредина може да се смета за **НИЗОК**.

ЛОКАЦИЈА	МЕДИУМ	КОНАМИНАТ и КВАЛИТЕТ	ВЛИЈАНИЕ и РИЗИК	ВРЕМЕТРАЕЊЕ И ДИМЕНЗИЈА
Депонија: Троска од фабриката за железо и челик Површина на депонија 133.000 sqm Делумно покриен со почва	Загадена почва Подземна вода Површинска вода Воздух	Метал што содржи троска 2.546.800 m³ (=6.367.000 Mg) Докази за манган Докази за манган 10 – 20 Mg Прав/год	- на почва во северен и источен правец– НИСКО **- На површинска вода на Вардар и подвижна вода** – Ниско - Локално загадување на воздух како резултат на прав-НИСКО **Опасност-НИСКА** **Ризик-Низок**	Долготрајно Локално

Истражувањето на разградување на загадувањето, се однесува на геоелектрични (отпорност) мерки (Volume 00_E) и идентификуваше главно површински влијанија северно и источно од депонијата на троска од железо, додека значајно длабоко влијание е идентификувано во област од 0—7m, предизвикано од постојаниот контакт на плиткиот аквиферски систем со долниот дел на депонијата на троска. Главно влијание на околните области на депонијата се резултат на секундарните миграциони патишта на депониите. Направени се мапи и профили на разградување и се прпорачуваат вкупно 3 пиезометри со длабочина од најмногу 15m вклучувајќи ги координатите. Влијанието може да се смета за **НИСКО.**

Сеизмичкиот ризки како резултат на магнитуда од 9 по меркалиевата скала се смета за висок. Евидентен е ризикот од дестабилизација на подземјето како резултат на повисок товар од дозволениот. Ќе се намали висината на локацијата во случај на опцијата на прекривање. Ќе биде потребна површина 4 пати поголема од моменталната.

Истрагата за реупотреба и рециклирање на материјалот покажува дека главното количество на троска може да се употреби за производство на Портланд цемент во индустријата за цемент, додека останатиот отпаден метал ќе се оддели, според потребите на пазарот.

Санациските опции ги земаа в предвид алтернативите ex situ, на и надвор од локација и комбинациите со одделување на отпаден метал. Тие алтернативи се поделени на термички и други сананциски процеси. За резидуите од троска, земени се во предвид 6 можности, како 0 активности, ископување и реупотреба надвор од локација во индустријата за цемент, покривање со и без одделување на отпаден метал и депонирање надвор од локација со и без одделување на отпаден метал.

По оценувањето на животната средина, следеше следнот рангирање :

Ископување и ex situ третман (печка за цемент) + одделување на отпаден метал – 1

Санациски мерки на локација – покривање + одделување на отпаден метал – 2

Санациски мерки на локација – покривање без одделување на отпаден метал – 3

Без активности - 4

Ископување и депонирање надвор од локација – без одделување на отпаден метал - 5

Ископување и депонирање надвор од локација – со одделување на отпаден метал - 6

Економската проценка пресмета 5 различни можности за реактивирање на сегашната депонија на троска, како што се 0 активности, развој на зелена зона, изградба на елитна населба, реактивација за земјоделски намени, развој на депонија за инертен отпад и продолжување на индустриските активности. Развојот на депонијата за инертен отпад е најмногу ветувачка. Пресметка на потенцијал и потребни инвестиции покажа капацитет од 500.000 m³ за првата фаза и инвестиција од 1,6 Euro/m³ за првата и 1,4 Euro/m³ за втортата фаза .

Санациските трошоци на останатите опции од еколошката пресметка се пресметани и споредени со економската корист. Земени се во предвид трошоци за превоз, манипулативни трошоци, трошоци за третман, надзор, капитализција, инвестиции и трошоци за јавно информирање и споредени се со директниот потенцијаел приход како резултат на рециклирање и реупотреба, понатаму со економскиот исход на различни опции. Споредувајќи ги финансиските инпути и аутпути, може да се направи следното рангирање. [Euro/Mg]

Ископување и третман надвор од локација (печка за цемент) + одделување + 30

Правење профили и покривање - одделување – 1,21

Правење профили и покривање + одделување – 4,23

Ископување и депонирање надвор од локација – одделување – 8,0

Ископување и депонирање надвор од локација + одделување – 16,0

Заклучок:

Економската евалуација на еколошки и финансиски рангираните алтернативи на третман овозможува препорака на комбинирање на комисионирање на троска за производство на Портланд цемент, одделување и комерцијализција на отпаден метал и развој на депонија за инертен отпад, на североситочниот дел од депонијата. Комисионата такса е пресметана со 0,15 Euro / Mg за количина поголема од 6 Mio Mg, што овозмжува да се покриат инвестициските трошоци за развој на депонијата. Капиталните трошоци ќе бидат покриени со такси за депонирање. Втора финансиски можна опција е покривање на локацијата, со цел да се избегне влијание врз животната средина, без

одделување на отпаден метал . Инвестиција од повеќе од 7 Mio. Euro ќе биде потребна во овој случај.

Препорака :

- **Да се избриќе депонијата на Макстил за троска од железо, од листата на жешки точки (листа од 16) како резултат на ниско влијание но висок економски потенција. Депонијата да биде на листа на активности за управување на отпад, кои треба да бидат преземени во бнаредните 10-15 години**
- **Да се идентификуваат вредности, стандарди за манганот за подземни, површински води, вода за пиење и почва**
- **Дасе подржи решението во врска со прашањето за сопственоста северо-источно од општина Гази Баба и да се разјаснат односите во врска со давање дозволи и концесии на потенцијалните заинтересирани лица (Фабриката за цемент, Макстил, РЖ Троски)**

Executive Summary

The main purpose of this project is it to assist in the elimination of industrial hotspots in the country through the development of remediation plans for 4 hotspots with financial requirements. The project is financed by EU and executed by the Spanish Company Eptisa with the Ministry of Environment and Physical Planning as main beneficiary.

Currently, the former Yugoslav Republic of Macedonia has no systematic approach or policy for addressing and remediation of these environmental hotspots. Their impact is not fully known, clean up costs are not systematically estimated; funding for the most part is unavailable; implementing institutions not set up and even “ownership” of these environmental burdens in a post- privatised setting is not clear. Regarding industrial pollution control and risk management, the MOEPP has compiled an inventory of installations to be subject to integrated environmental permits, but integrated pollution prevention and control system has yet to become fully operational. Some elements of EU legislation on the control of major accident hazards involving dangerous substances appear to have been transposed into national law, but full transposition still has to be completed. The capacity of the MOEPP and other concerned parties (local governments, enterprises, etc.) to implement industrial pollution control and risk management measures needs to be strengthened. In 2003, the country started the harmonisation of the national environmental legislation with the legislation of EU. Five basic laws (Law on the Environment, Law on Waste Management, Law on Waters, Law on Nature and Law on Ambient Air Quality) and several sub-laws (IPPC Decree for determining the Installations for which an Integrated permit is required and time schedule for submission of the adjustment plans, IPPC Ordinance regulating the procedure for A integrated environmental permit, Regulation on Transportation, Recording and Reporting on Wastes, List of Wastes,) were prepared. All abovementioned laws and sub-legislation refer completely or to some extent to waste and hazardous waste management, but none of them directly mentions or regulates “industrial hotspots”.

The methodology is based on

- The assessments of health risk impact,
- Geotechnical investigation,
- Public awareness and information assessment,
- Process assessment and the identification of qualitative and quantitative waste streams, the environmental impact assessment,
- The identification of treatment options,
- The environmental ranking of identified treatment options,
- The identification of economical indicators,
- The financial evaluation of various remediation options and the economical evaluation of those.

In all cases have been taken best practise possibilities for former Yugoslav Republic of Macedonia into consideration. The methodology consists of a alternating procedure of screening and ranking. The site-specific situation of all pilot sites made a split into four feasibility studies necessary, due to the different content, point of view, pollutant characteristics and priorities.

Main impacting factors on the site are Manganes and dust from the former steel production and disposal activities. Parts of the Ferro slag dump have been covered, while some are still remaining open. A total amount of 6.367.000 Mg (which is equal to 2.546.800 m³) of slag with a remaining amount of 220.000 Mg of scrap metal has been disposed between 1967 and 1999. Due to shallow aquifers in the northern and eastern surrounding areas can slightly infiltration and impact through Manganese be expected. There is no evidence of the presence of ferro sulphuric slag. Ongoing pollution mainly occurs due to open surface and dust. The impact on the river Vardar is neglectable.

The qualitative health risk assessment (Volume 00_A) describes risks and impacts, caused by the pollutants on site. On Makstil Ferro slag dumpsite, generally there are hazard identification due to impact of Mangenes and is marked as **Low to Moderate,** while the impact on human health has been identified as **Low**. Regardless this circumstance and in respect to the hazard characteristics adverse impacts due to secondary migration paths such as groundwater and soil cannot completely be excluded. It can be stated that the current operation of the production facilities of Makstil causes significant higher Health Risks than the wastes accumulated on the investigated spot. It is recommended to focus on IPPC procedures in order to avoid and reduce the risk to a acceptable limit.The the risk of the historical Makstil site can be marked low. A removal or of the existing wastes or capping (cover) of the area will eliminate the present risk.

Ranking Summary

Spot	Pollutants	Hazard	Risk	Impact	Rank
Makstil	Slag, Manganese	High (top 10)	Low-Moderate	Low	4

Several aspects at the Makstil site raised strong environmental concerns, such as the existence of ferro sulphuric slag, while during the investigation no evidence has been indentified. Millions of Mg of slag with remaining ferro content has been stored on a surface of 133.000 m with a net height of up to 19 m. The slag is containing silicates, oxides, negliable traces of Lead and other heavy metals. The iron content is up to 1%, which is not more recyclable. Significant is the evidence of Manganese, which might be diluted into the soil and groundwaters due to uncovered and open surfaces onto the dump. Manganese could be found in soil and groundwater in an amount, which cannot be identified as critical or harmful, also due to the fact, that there is no evidence of drinking water extraction out of groundwater. The surface and groundwater situation is rather shallow, so that a permanent contact to the material, especially in the swampy areas occure. The environmental risk, whereas the environmental impact can be stated as **LOW.**

LOCATION	MEDIA	CONTAMINANT and QUANTITY	IMPACT and RISK	DURATION and DIMENSION
Dumpsite: Pile, Slug from Iron&steel plant Surface of dumpsite: 133.000 sqm Partially covered with soil	Contaminated soil Ground water Surfacewater Air	Metal containing slag 2.546.800 m³ (=6.367.000 Mg) Manganese evidence Manganese evidence 10 – 20 Mg Dust/year	- on soil in north and eastern direction – **LOW** **-** On surface water of Vardar River and potable water – **LOW** - Local air pollution due to dust – **LOW** **Hazard: LOW** **Risks: LOW**	Long-term Local

The pollution dilution investigation referred to geoelectrical (resistivity) measures (Volume 00_E) and identified mainly surface impacts in the northern and eastern area of the Ferro slag dump, while a significant depth of impact identificaton occurred in a zone of 0—7m, caused also by shallow aquifier system in permanent contact with the bottom of the slag dump. Main impact in the surrounding area of the dumpsite are from secondary migration paths of the dumps. Maps and dilution profiles have been produced and recommendations for a total of 3 piezometers with a depths of maximum 15m including coordinates have been stated. The impact can be stated as **LOW**.

The seismic risk due to the magnitude of 9 on the Mercali Scale can be evaluated as high. The risk on destabilisation of the underground to due a higher load than permitted is calculative evident. A reducing of the height of the site in case of remaining and capping option shall be undertaken. A surface of 4 times that the current one would be required.

Investigation of reuse and recycling options of the material show, that the main amount of the slag can be used for the production of Portland cement in the cement industry, while the remaining scrap metal shall be segregated due to market relevance.

The remediation options have taken, ex situ, on site and off site alternatives and combinations with scrap metal segregation into consideration.

Those alternatives have certainly been divided into, thermal and other remediation processes. For the slag residues have been taken 6 possibilities into account, such as no activities, Excavation and off site reuse in the cement industry, capping with and without scrap segregation, and off site disposal with and witout scrap segregation.

After the environmental screening resulted in following ranking:

Excavation and ex situ treatment (cement kiln) + scrap segregation	– 1
On site mitigation measures – Capping + scrap segregation	– 2
On site mitigation measures – Capping without scrap segregation	– 3
No activities as the current ones	- 4
Excavation and off site disposal – without scrap segregation	- 5
Excavation and off site disposal – with scrap segregation	- 6

The economical assessment evaluated 5 different possibities of reactivating of the current slag dumpsite, such as o activities, green area development, elite residential area development, reactivating for agriculture purposes, development of a C&D waste landfill site and the extension of industrial activities. The development of a C&D waste landfill has been evaluated as the most promising one. A calcuation of potentials and required investments stated a capacity of 500.000 m³ for phase I and an investment of 1,6 Euro/m³ for the first and 1,4 Euro/m³ for the second phase.

The remediation costs of the remaining options from the environmental assessment have been calculated and compared with the economical benefit. Transport cost, manipulation costs, treatment costs, supervision, capitalisation, investments and public information costs have been taken into consideration and compared with the direct potential income due to recycling and reuse activities and further with the economical outcome of various

options. Comparing financially in- and output can following financial ranking be stated [Euro/Mg]

Excavation and off site treatment (Cement Kiln) + segregation	+ 30
Profiling and capping - segregation	– 1,21
Profiling and capping + segregation	– 4,23
Excavation and off site disposal – segregation	– 8,0
Excavation and off site disposal + segregation	– 16

Conclusion:

The economical evaluation of the environmental and financial ranked treatment alternatives alow the recommendation of a combination of commissioning the slag material for Portlandcement production, the segregation and commercialisation of scrap metal and the development of a C&D waste landfill on the northeastern part of the site. The break even commission fee is calculated with 0,15 Euro / Mg for an amount of more than 6 Mio Mg, which allows to cover the investment costs for the development of the landfill site. The depreciation and capitalisation costs shall be covered by disposal fees. Second financial feasible option is the capping of the site in order to avoid impacts on the environment without srap segregation. An investment of more than 7 Mio. Euro would be required in this case.

Recommendation:

- **to delete Maskstil Ferro Slag Dumpsite officially from the list of Hotspots (List of 16) due to the significant low impact but economical high potential. The site shall be listed within waste management activities within the next 10 – 15 years**
- **to identify values for Manganese within the surface, ground, drinkingwater and soil standards**
- **to support a solution regarding property issues northeast of the Gazi Baba municipality and to clarify the licensing and concessioning relationship with potential partners (Cement Factory, Makstil, RSH Troski)**

1 Introduction

The Stabilisation and Association Agreement (SAA) signed with the EU (in 2001and enforced since 2004) places new obligations on the administration in the vital task of combating environmental degradation. The Ministry of Environment and Physical Planning (MOEPP) has the responsibility to define environmental tasks, responsibilities and mandates and to arrange sufficient staffing to meet its obligations.

The former Yugoslav Republic of Macedonia faces similar problems in the environmental sector to those of many other former command economies in Central and Eastern Europe. In particular, inadequate solid waste management and numerous industrial hotspots (including historical industrial pollution sites) have in some cases led to threatened public health and environmental implications.

In the last two years, the MOEPP has worked on the development of five environmental laws, including the Law on Environment as a framework law in the area of environment, which transposes the *Acquis Communautaire* into the national legislation. The Law on Environment was adopted by Parliament in July 2005, and incorporates the basic principles of environmental protection, on the basis of which the relevant environmental management procedures are regulated.

Environmental management in the former Yugoslav Republic of Macedonia is guided by the second National Environmental Action Plan adopted by the Government in March 2005.

1.1 Current state of affairs in Industrial Hotspots Management

The lack of suitable infrastructure hampers adequate waste disposal in general and disposal of hazardous waste in particular. There is only one licensed (though not acquis-compliant) landfill in the country compared to around a thousand illegal dump sites, there are no incineration (except for medical waste), no composting and few recycling facilities. Hazardous waste is exported in accordance with the Basel Convention[1]. A register and maps for pollutants and polluting substances for solid and hazardous waste and wastewaters were completed in September 2005.

Regarding industrial pollution control and risk management, the MOEPP has compiled an inventory of installations to be subject to integrated environmental permits, but integrated pollution prevention and control system has yet to become fully operational. Some elements of EU legislation on the control of major accident hazards involving dangerous substances appear to have been transposed into national law, but full transposition still has to be completed. The capacity of the MOEPP and other concerned parties (local governments, enterprises, etc.) to implement industrial pollution control and risk management measures needs to be strengthened.

Environmental burdens left behind by state-controlled industry have now been transferred over to new owners, in most cases without clear specification of environmental liability. Old environmental contaminated industrial sites represent a serious risk for humans who live in or near the contaminated areas, because of either their direct negative impact on the human health or, indirectly, through pollutants in the food chain production. Currently, the former Yugoslav Republic of Macedonia has no systematic approach or policy for addressing and remediation of these environmental hotspots. Their impact is not fully known, clean up costs are not systematically estimated; funding for the most part is

[1]Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal

unavailable; and even "ownership" of these environmental burdens in a post- privatised setting is not clear.

Decades of industrialization and extensive exploitation of natural resources have left certain number of areas in the country heavily polluted. Since independence no significant concrete investments in this regard have taken place for the protection of the environment. As a result many uncontrolled municipal, as well as industrial landfills and wild dumps proliferated.

In the frame of CARDS 2001 project for development of National Waste Management Plan with Feasibility Studies 16 Industrial Contaminated Sites - "hotspots" were identified and ranked according environmental indicators. In the frame of Cards 2006, the project took additional indicators into consideration, such as:

- Environmental Indication from the Cards 2001
- Exclusion Criteria
    - Ongoing Donor Activities; avoiding of overlaps and replication; overwhelming factors
- Public Health
- Public Sensitivity
- Seismic and geotectonic Risk
- Climate impacting factors
- Cross Border pollution prevention in accordance with Cards 2003
- Economical Benefit and Impacts

Taken those indicators into consideration the project proposed to focuses on 4 prioritised "hotspots":

- **OHIS A.D (organic chemical industry) - Skopje**
- **MHK Zletovo (lead and zinc smelter) - Veles**
- **Silmak Ferro-silicon plant (former HEK Jugochrome) – Jegunovce / Tetovo**
- **Makstil (iron & steel plant) – Skopje**

2 Objectives / Results / Scope

"The overall objective of the project is to support the remediation of industrial hotspots on a environmentally and financially sustainable manner by promoting donor funding to the sector"

2.1 Specific objectives

The purpose of this contract is to assist in the elimination of industrial hotspots in the country through the development of remediation plans for 4 hotspots with financial requirements

2.1.1 Results to be achieved by the Consultant

- Baseline conditions at 4 Industrial Hotspots identified with project data room and Industrial Hotspot database established
- Qualitative human health and environmental risk assessment related to historical contamination at 4 Industrial Hotspots performed
- Remediation feasibility studies for 4 Industrial hotspots performed
- Pilot site selected based on applying additional prioritisation criteria
- Technical design/ technical specification documents, financial / economical appraisals of remediation alternatives and EIA (if needed) and ToR for remediation of selected pilot site prepared
- ToR for supervision services for remediation works on selected pilot site prepared

2.1.2 Scope of the work

2.1.2.1 Project description

The project will:

- Identify baseline conditions at 4 Industrial Hotspots through collection and analysis of existing data and performing additional site investigation
- Put a strong emphasis on training and capacity building of local stakeholders in the field of contaminated site assessment and remediation
- Estimate possible impacts to human health and environment through performance of risk assessment
- Include relevant stakeholders in the process of prioritising the sequence and identifying the extent of remedial action at individual hotspots
- Provide a prioritised and cost schedule of remedial actions needed to be performed at 4 Industrial Hotspots to mitigate human health and environmental risks
- For all the sites, evaluate the immediate need for implementation of heavy-cost site remediation investments as recommended in NWMP, identifying to whom those costs would accrue (whether public bodies or private sector companies) the current status of possibly ongoing remedial investment and the need for further investment as well as the likely sources of investment funding.
- Adopt clearly defined processes of internal quality assurance and external approval for all outputs.

The overall approach to implementing the project would involve:

- Preparation of Background Site Assessment Reports for 4 priority sites presenting the available data and findings of site visits and results of qualitative human health and environmental risk assessment
- Preparation of feasibility studies for remediation of 4 industrial hotspots, to include detailed evaluation of remedial alternatives and cost schedule for performing the additionally needed site investigation and undertaking the remedial action.
- Prioritising the sequence of remedial action for 4 Industrial Hotspots and selection of pilot site

2.1.3 Target groups

The ultimate target group is the population of the country, which will benefit from a clean environment developed by hot spots remediation activities. In particular, the status of population, of the area distressed by targeted industrial sites, as well as the industrial waste management entities whose capacities to manage waste management in the project area will be significantly enhanced.

2.2 Phases of the Project

The project is facing two phases:

- Inception Phase (Phase I)
- **Assessment and Feasibility Phase (Phase II)**
- Development of Terms for one selected site (Phase III)
- [Implementation Phase – not foreseen by this Project – Phase IV]

Within the implementation phase there are several stages, where decision-making process through the steering committee (SC) is required. The project is currently in phase II.

2.3 Contents of the Study

This Study is Volume IV of various volumes and contains the Baselining including Qualitative Public Health Risk Assessment, Reevaluation of the former process and quantitative and qualitative assessment of the contaminants which can be expected, geophysical investigation, qualitative EIA of the current situation, Public Sensitivity assessment and institutional public information scheme, technical objectives of reuse and treatment potentials, EIA of various treatment options and financial/economical evaluation of various steps. The study comprises assessments, evaluations and conclusions. The legal and institutional part (funding mechanism and implementation body) is only short mentioned and can be referred to Volume V[2] and Volume VI[3]. This feasibility study is prepared in accordance with Fidic Guidelines for Reporting (2001).

[2] Feasibility Study – Volume V - Legal Gap Analyses for the Remediation Issues of polluted and contaminated sites

[3] Feasibility Study – Volume VI – Funding Mechanism and institutional set up for the Remediation of contaminated and polluted sites

3 Generally Description of the Site – Makstil – Ferro Slag Dumpsite

Steel production in Iron & Steel Works **RUDNICI I ZELEZARNICA SKOPJE** – Skopje started in 1967. In the first five years steel was produced only by a converter process, while since 1972 operation of an electric arc furnace started. It took five years for the steel-production in the converters to reach the volume of 250.000 Mg/y. In the next years it varies between 150.000 and 250.000 Mg/y with a record of 327.000 Mg/y registered in 1974. By the end of 1990 converter operation was practically stopped.

Due to Electric arc furnace the company increased its volume of production to approximate 150.000 Mg/y in the first ten years and to ca 200.000 Mg/y in the next ten years, followed with a period of stagnation in the years after the collapse of state-controlled industry.

By the end of this period the record of 472.600 Mg/y total production (converters + electric arc furnace) was achieved in 1986, while the volume of total production in the period 1967-1999 reaches 8,400,000 Mg.

Since 1998, when steel-making process was restarted by the private company 'Makstil', productivity again registers continuous growth and from 171.000 Mg by the year 2000, its recent highlight is 430.000 Mg in the year 2006, but produced exclusively in an electric arc furnace.

The slag in an amount of 6.367.000 Mg/y has been disposed on the Slag dumpsite, located in the northern part of the facility, while the recently used site, which is located within the boundary of the facility is clear part of the Makstil IPPC licensing procedure and has within this feasibility not to be taken into consideration for remediation purposes.

Currently has a concession been given for the extraction of remaining ferro materials (linkers and scrap) to the stock exchange company Rudnizki Troska.

3.1 Geographical Description of the area

Plant is located in the valley of a small creek in the Gazi Baba Municipality in the eastern part of the Skopje Valley about 4 km north-east of the center of Skopje, between the two settlements of Zelezara and Avtokomanda [see Figure 1]. The total area which is used by this facility is arround 419.765 sqm. Makstil facilities are based on lowland on a level of **~268 maSl** and is connected with a local traffic network.

Figure 1_Geographical Location of Masktil Premisses

3.1.1 Climate Characteristics

The climate characteristics on this area are based on position of the site. The surrounding area of Makstil (east part of the Skopje Valley) is with different hydro-meteorological characteristics in comparation with other city area. The climate characteristics on this area are based on position of the site. The average annual air temperature is **12,2 ºC**. The climate during the summer period is usually very dry and warm, and in the winter moderate cold in the duration of in average 170 days. The average quantities of rainfalls/precipitations in the Skopje Valley are **515 mm/year**.

3.2 Topographical Description of the area

MAKSTIL is situated in the north-eastern part of Skopje (eastern part of the Skopje Valley), on the left bank of Vardar River. The location of the stockpile is situated northeast from the current operating steel factory of "Makstil", at an area of 133.000 m² with dimensions of 500 x 270m.

The position of the facility is N 42°00′46.48″ (42,013°) and E 21°26′30.87″ (21,442°). [UTM 34T; X = 0536597,96; Y = 46513114,08]

3.3 Geological Description of the area

The terrain of the location of the stockpile is built of modern and old proluvial sediments.

The modern proluvial sediments are presented with permeable clay-dust sand and gravel with small thickness - around 10 m. Inside of them is formed phreatic aquifer with inter-grained type of porosity. According to some old data, the depth of the groundwater at the area north and northeast from the stockpile can be expected at depth of 6 ÷ 10 m. The flat section around the creek is filled out with a rather new pro-alluvial material brought by the creek, i.e. mixture of sand, gravel, dust and clay. The layer is thick 5-10 m. Due to its composition, the layer is porous and water permeable, the filtration coefficient being 10^{-1} – 10^{-2} cm/s. So, it is suitable for migration of pollutants.

Bellow the young pro-alluvial deposit there is an old pro-alluvial deposit composed of red clay with presence of sand and gravel is built of weakly to water-resistant red silty-dust clay with sand and gravel. In the basis of the proluvial sediments appear thick, low permeable Pliocene sediments presented with weakly diagenesis silty-dust and clay sandstones and conglomerates, marls and clay stones. Is deposit is not present in the upper part of the valley, while above the plant it reaches a depth of ca 30 m. Such a deposit is with lower water permeability (the filtration coefficient is probably smaller than 10^{-3} cm/s), and migration of pollutants through it is not so easy. The main part of the pro-

alluvial deposit is built out of Pliocene sediments of layer-forming loosely bonded dust-clayish sandstones, conglomerates and marls, marl clays etc. The incorporated thin layers of marls and clays are watertight, while sandstones and conglomerates allow only low water permeability, having filtration coefficient of probably 10^{-4} or less.

The surrounding area shows density values from 10^{-0} till 10^{-4} m/sec. The permitted load can be assumed with 1 to 1,2 kg/cm² [equal to 12 N/cm²].

Table 1_Soil texture 0,3 to 6,3 m

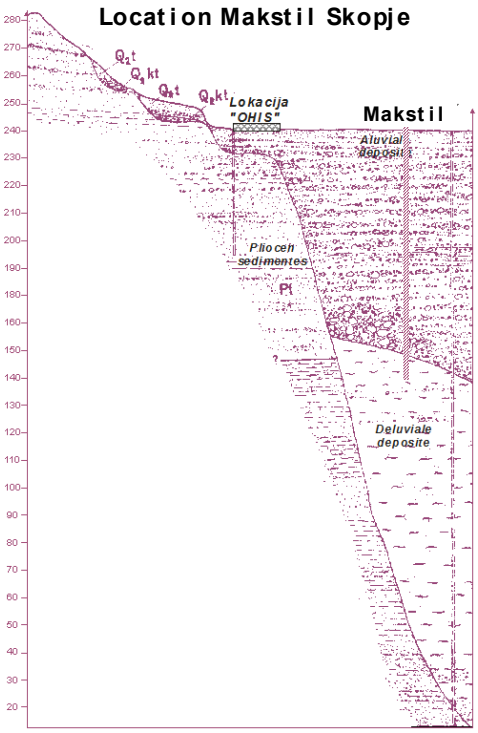
Piezometer	Humus,	Fractions bellow 2 mm					
		Sand		Dust	Clay	Clay+dust	Sand
core, m	%	0,2-2 mm	0,02-0,2 mm	0,002-0,02 mm	<0,002 mm	<0,02 mm	0,02-2 mm
0,3-4,3	1,48	4,6	28,5	23,3	43,6	66,9	33,1
4,3-6,3	0,11						

3.4 Hydro-geological Description of the area

Groundwater in this location is from the Skopska Crna Gora (mountain) watershed. The investigated terrain presents small depression with fall towards east. The ground water moves generally in direction N-S directed towards the alluvium of Vardar River. Because of the uncontrolled leaking of the polluted water from the smelter and because of the presence of the water-resistant clay basis, along the northeast side of the stockpile are formed swamps in the direction W-E.

This area is segment of the former lake phase of development of the Skopje basin. The huge lake sediments are evidence for this claim. The heterogenic granulometric composition of the main sediments causes quite variable hydro-geological characteristics. That is why these geological parts of the Skopje valley can not provide enough quantities of water for water supplying of a wider range, with modest 2-5 l/s. It is clear here that the operations of industrial complex Makstil can not have any negative impact of that water source, which is mostly shallow, i.e. at depths of maximum 40 m.

Figure 2_Geological profile at Makstil site into the direction of Vardar River



4 Legal Perspective

The purpose of this chapter is to present the summary of the legal analysis regarding Industrial Hotspots. The legislation which has been taken into consideration for the purpose of this analysis is the following and has been detailed described within the **Volume V** "Legal Gap Analyses for the Remediation Issues of polluted and contaminated sites".

- Law on Waste Management (Off. Gazette no. 6/2004) and amendments (Off. Gazette no. 68/2004; 71/07; 107/07)
- Law on Environment (Off. Gazette no. 53/05 and 81/05);
- Law on Privatisation (Off. Gazette no. 37/96; 25/99; 81/99; 49/2000; 6/2002; 74/05);
- The draft Law on Hazardous Waste (which is being produced in the CARDS 2004 Programme, and was provided by them).
- Law on Budgets (Official Gazette of the Republic of Macedonia no. 79/93; 3/94; 71/96; 46/2000;11/2001, 93/2001; 46/2002; 24/2003; 85/2003 and 96/2004 and Decision of the Constitutional Court no. 180/98 (Official Gazette of the Republic of Macedonia no. 15/99)

The following subsequent Legislation was also reviewed:

- Decree on the criteria and manner for B IPPC permit (Off. Gazette no. 04/2006); Decree on the level of charges for A IPPC permit (Off. Gazette no. 04/2006);
- IPPC Ordinance - A permits (Off. Gazette no. 4/06);
- IPPC Ordinance - Adjustment permits (Off. Gazette no. 04/2006);
- IPPC Ordinance - B permits (Off. Gazette no. 4/06);
- Rulebook on the form and content of the application form, and the content of the permit for collecting and transporting urban and other types of non-hazardous waste as well as on the minimum technical requirements for performing the economic activity of collecting and transporting urban and other types of non-hazardous waste (Off. Gazette no. 23/2007);
- Rulebook on the format and the content of the Journal for records keeping on the waste handling, the format and the content of the forms for the annual report on waste handling by legal entities and natural persons and the format and the content of the annual report on waste handling by the mayor (Off. Gazette no. 7/2006);
- Rulebook on the functioning methods and conditions of the integrated waste disposal network (Off. Gazette no. 29/2007);
- List of Waste Types (Off. Gazette no. 100/05);
- The Law on the ratification of the Basel Convention (Off. Gazette no.49/97); Rulebook on the form and contents of the forms for transboundary movement of hazardous waste (Off. Gazette no. 37/03 and 38/03);
- Law on Mineral Resources (Off. Gazette no. 24/2007); the content comprises the subject of regulation of the Law on mineral resources. The analysis of this law discovered that the subject of regulation of the law is general, and there is no relevance to remediation purposes of hotspots;

- C&D Waste Landfill; The Law on Waste Management (Off. Gazette no 6/2004; 68/2004; 71/2004) regulates the matter of landfills, their classification, the conditions that need to be fulfilled by the landfill, conditions for establishment and construction of the landfill. Article 78 from the law, classifies the landfills into 3 categories: 1. Landfills for hazardous waste; 2. Landfills for non-hazardous waste; 3. Landfills for inert waste. Article 80, paragraph 2, proscribes that a landfill for non-hazardous and inert waste may be established by one or more Municipalities or the City of Skopje or by a domestic and/or foreign legal entity if the establishment of the landfill is in accordance with the Waste Management Plan of the Republic of Macedonia, by submitting a request for landfill establishment to the body of the public administration responsible for environmental affairs. Paragraph 7, from the article provides a legal base for a separate regulation, regarding the form and content of the request for establishment of a landfill for inert waste. Article 85, regulates the construction of the landfills (for this procedure article 30 from this law, regarding construction permits for installations for processing, treatment, storage and disposal of waste, shall apply). The Law on Waste Management, in article 88, paragraph 1 forbids the disposal of waste in inappropriate classes of landfills, and of waste that had not been subjected to treatment. The landfills for inert waste shall be used only for landfilling of inert waste. As an exception, the inert waste can be disposed of on landfills for non hazardous waste, if the treatment and processing thereof is technically unfeasible or economically non-worthy.

It has also been taken into account several Tables of Concordance (TOC), produced by the Ministry of Environment and Physical Planning, and the CARDS 2005 Programme. Those are the TOC's for the Waste Framework Directive; the Landfill Directive; the Directive for PCB's and PCT's, Hazardous Waste Directive; IPPC Directive. (It should be noted that I've tried to get the TOC on Mineral Resources, and was promised to get it, however this was not delivered from the Ministry). References were also taken from the National Waste Management Plan (NWMP), as well as the National Environmental Action Plan (NEAP) and the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their disposal, adopted by the Conference of the Plenipotentiaries on 22 March 1989. There is a lack of regulatory provisions both in the privatisation law and in environmental law, as well as lack of the institutional framework and funding mechanism.

As a result of this legal gap analysis the following conclusions and recommendations are made:

- A lot of interpretation is required to identify direct links to the terminology of industrial hotspots. The terminology of hotspots is not clear. Definitions for industrial hotspots and hotspots closely related issues are missing. Terminology regarding "hotspots' can be found only in the Waste Management Plan, but without any legal meaning. It is recommended to include these definitions in the existing Law on Environment, Law on Waste Management, Draft Law on Hazardous Waste. Another recommendation is adoption of a framework Law on soil contamination, which has not been adopted so far. Such a law will give a legal base for subsequent legislation, which could be in the form of technical guideline for remediation of contaminated sites. Such a rulebook could contain the terminology regarding "hotspots", remediation plans, and the question of environmental liability and funding.

- Subsequent legislation on protection from pollution from priority substances is missing, however the Draft Law on Waters provides a legal base for such a rulebook (Article 107, paragraph 2).

- The question of responsibility for environmental liability should be clearly stated and solved. So far this issue was open for negotiations, which cannot remain the case. A

cut off date after which any pollution arising is the liability of the installation, is also missing. Amendment of the law on Environment (in the chapter for environmental damage) is recommended to state whether the Government will be responsible or the potential buyer, as well as the time frame of clean up responsibility, or as mentioned, a new rulebook should be issued, for remediation of the contaminated sites, where the environmental liability will also be tackled.

- The monitoring and reporting system regarding the industrial hotspots is relatively poor. This can be understood, because the legal system of the country tackles very little of the hotspots issue. A standard for monitoring and elf-monitoring and reporting procedures is needed (sub-laws, forms, guidebooks).

- There is a lack of an appropriate funding mechanism. No earmarked or dedicates fee or charges to be made to industries are presently being considered or have been considered in the past. Appropriate funding mechanism needs to be established. That is why it is proposed to create a separate law on trust funds, which will enable the establishment of an earmarked fund, under the MOF, independent from the MOEPP.

- So far Law on Soil Protection hasn't been adopted. Such a law could be a legal base for subsequent legislation for remediation of hotspots, which could include technical guidelines for remediation of "hotspots", terminology regarding "hotspots", also the question of environmental liability.

4.1 Gap analyse

The legal framework of the country does not give a clear picture and solutions for remediation of these industrial hotspots, and the purpose of this analysis is to identify the gaps and give some recommendations concerning the legal aspect of this matter.

4.1.1 Gap Identification

1. Crucial gaps have been identified within the legal framework related to industrial contaminated sites such as: missing definitions (example: definition of “hotspots”; “dumpsite”; “secure landfill” “sanitary landfill”, “contamination”). These definitions can only be found in the NWMP- Annex 9, Special Study E, and nowhere in the environmental legislation. Clear distinction between the terms “polluted” and “contaminated” is not made, very often a mistake is made with identification of both terms having the same meaning.

2. Another gap, within the terminology, is the incompliance of the existing definitions with the EU Directives

3. The issue of pollution from priority substances is not yet solved, however in the Draft Law on Waters there is a legal base for adoption of subsequent legislation for regulating this matter.

4. The monitoring system should be further developed. There are monitoring provisions found in the Law on Environment, Law on Waste Management, Draft Law on Waters, Law on Ambient Air Quality, IPPC Ordinances, however standards for monitoring and self-monitoring and reporting procedures is needed (sub-laws, forms, guidebooks). Inadequate secondary legislation (existing secondary legislation is not following the requirements of European directives, absence of emission limit values, outdated standards and limits Also there are overlaps in the institutional responsibilities and activities regarding some environmental media

5. The main gap is the clear statement regarding environmental liability, which might be handed over from the Government to a potential buyer of industrial sites within the privatisation activities. None of these articles (listed above) tackles directly the question of historical industrial contamination, or states clearly who is responsible for the clean up of the contaminated sites. A cut off date after which any pollution arising is the liability of the new owner of an installation, is also missing

5. In case of funding the costs for remediation of contaminated industrial sites, the possibilities are to be considered limited, since no earmarked or dedicates fee or charges to be made to industries are presently being considered or have been considered in the past. A new law for a trust (remediation) fund is missing

6. There is no Law on soil protection; No legislation on Remediation of “hotspots”

7. There is no time frame in the NWMP, till when the “hotspots” should be remediated

4.1.2 Gap Summary

1. **Unclear, and missing terminology**
2. **Lack of regulation for protection from pollution of priority substances**
3. **Lack of monitoring and reporting regulations**
4. **Missing environmental liability**
5. **Lack of fund establishment and procedure regulations**
6. **Missing legislation on soil contamination**
7. **Missing time frame for remediation of "hotspots"**
8. **Property and Ownership at current stage**

4.2 Terms of References

- Terms of References, staff-, time and budget schedule is developed in accordance with the required input to minimize the legal gaps. The ToRs, Time schedule and budget calculation can be seen in Annex 11.1.1. The expertise and timeframe shall be as following
- Foreign Institutional Expert- 4 months within 9
- Local Legal Expert- 6 months within 9
- Local Institutional Expert- 3 months within 9
- Local Technical Expert- 3 months within 9

4.3 Property of Land

Due to the fact, that the boundary of the cadastre area moves straight through the slag dumpsite of Makstil, the property in the north and north east part has to be clarified in order to address liability and support decisions of a reasonable time framing and remediation methodology (Law on territorial organization of the local self government of R.Macedonia Off. Gazette no. 55/2004; amended 12/05).

4.4 Ammendments on the law of waste management

There have not been significant changes in respect of remediation and rehabilitation of contaminated sites, therefore are the terms of references, developed also for the purpose of Makstil valid.

5 Institutional Perspective

5.1 Funding Mechanism and set up of an implementation agency

The overall objective of this chapter is to propose an approach to building an effective financing and institutional system for remediation of industrial hotspots and is described in detail in the **Volume VI "Funding Mechanism and institutional set up for the Remediation of contaminated and polluted sites"**.

It is to achieve the greatest hand in hand environmental and economy benefits given the available resources and institutional capacity. It is apparent that the approach to building an effective financing system for remediation of contaminated sites is inextricably linked with the legal provision for environmental liability, with the privatisation process (since the value of property assets is directly linked to environmental conditions and obligations) and with the institutional framework for pollution control. On-going problems in environmental protection are encountered in connection with unclear ownership relations to properties, especially old environmental burdens and the limited capacity to date to evaluate environmental damage and environmental benefits of cleanup. It is proposed that environmental liabilities for historical pollution are clearly defined in legislation. Pros and cons of various approaches to environmental liabilities for past pollution are presented. It is acknowledged that application of the polluter pays principle is a precondition for an effective and fair remediation system. It is proposed that regarding the privatised sites that require cleanup, the state is liable for remediation and that a system of pollution taxes should be introduced to raise revenue for cleanup works. In case of sites that are subject to privatisation, it is proposed that the new owners introduce measures to contain contamination (if necessary) and the state assumes environmental liabilities for a limited period of time (10 years) during which time cleanup should be completed by the state. After remediation, all liabilities should be transferred to new owner. Privatisation receipts should cover the costs of cleanup. Priority sites of limited commercial value, and hence not subject to privatisation, should be remediated using state funds (pollution taxes and budgetary sources).

Various funding mechanisms are presented and discussed including their pros and cons for the specific Macedonian context. Remediation Fund is proposed as the most viable option for financing of cleanup works in Macedonia. The sources of financing and institutional aspects of the Remediation Fund are proposed. Estimation of the potential level of funding available from national sources is presented. It is estimated that some 3,5 M Euros can be raised from landfill tax for solid and for hazardous waste. In addition, part of the privatisation revenue and the donor funds are expected to contribute to financial basis of the Fund. Funding from the latter two sources is expected to vary substantially from year to year.

The Remediation Fund should have clearly defined and transparent financing strategies, expenditure priorities, operating procedures. Operation of the Fund should be supervised by the Supervisory Body (chaired by the MoEPP). The MoEPP should have a decisive role in establishing strategic directions of the Fund. Yet, the Fund should be independent and free of political influences that affect project selection procedures. The Fund's operation should be based on a long-term investment strategy and annual operating plans. Donor funding can be channelled to the Fund as individual trust funds or as direct contribution to the Fund's budget. This report is concluded with a simplified SWOT of the

The Cards 2001 project has addressed in their Annex 9 of the Waste Management Plan the need of a legal clarification, set up of institutional system for a sufficient implementation and establishment of funding mechanism.

Similar needs and requirements have been identified by the Cards 2006 program, which finances a project "Development of Remediation Plans with Financial Requirements for Elimination of Industrial Hotspots". Investigations during the inception phase discovered the need of 4 pillars

- Legal Framework (Legal) – PILLAR I
- Funding Mechanism (Financial / Economical) – PILLAR II
- Implementation Body (institutional) – PILLAR III
- Technical set up (technical) – PILLAR IV

While the program is working on the Pillar IV, all other pillars have been identified as gaps. Funding mechanism and a strong implementing body, which can be an agency, a working group, departments or the funds integrated working unit have to be set up. Base for all the efforts is Pillar I (legal part), which is described in Volume V of the programme.

Taking a required investment volume of 200 – 250 Mio Euro for the rehabilitation of contaminated and/or polluted sites into consideration is an investment (funding) mechanism (Pillar II) required, which shall on the one hand guarantee a national (local) source of income for remediation purposes and on the other hand to attract donor and investment agencies and institutions to contribute within this framework.

Pillar III shall form the work- and implementation force, which shall develop remediation programs, request sufficient budget out of the funding pool, tender, contract, supervise and monitor all remediation related works.

Volume VI demonstrates models, case studies and propose the most appropriate one for the current situation of MK taken the technical most feasible and economical most affordable structure into consideration with the final output of an action plan for the stepwise implementation approach.

5.1.1 Recommendation for the Most Appropriate Financing Model for former Yugoslav Republic of Macedonia

5.1.1.1 Selection criteria and principles

Several alternative approaches can be applied to establishing an effective financing system for remediation of contaminated sites in Macedonia. Selection of the most appropriate financing system should be made taking into account international experience and the national conditions:

- The legal framework for environmental liabilities for past pollution.
- The stage of the privatisation process.
- The existing system of environmental financing.
- Experience with the operation of the Environmental Fund.
- Potential sources of revenue from pollution taxes and environmental fees.
- Potential sources of revenue from privatisation of state owned companies.
- Potential sources of funding from bilateral donors, international organisation and the EU.
- The existing human capacity for preparation and cleanup of contaminated sites.

The key principles that can be applied to develop an effective financing system include:

- **The polluter pays principles** - should be applied where feasible. Consequently, regarding the liability for past pollution the state should be liable for cleanup
- **The principle of earmarking** - Environmental revenues from various pollution and environmental taxes, user fees etc should be spent on environment (including cleanup of contaminated sites)
- **The principle of concentration of funding sources** - Ideally, all earmarked environmental funds and donor assistance funding should be concentrated in one Fund that will disperse the funds in an efficient way and at relatively low operating costs

5.2 Institutional Framework for the Remediation Fund

The main objective of this chapter is to put the recommendations from chapter 2 (legal framework and environmental liabilities) and chapter 3 (financing system) in a sound and coherent institutional framework.

5.2.1 Overview of existing institutional situation in Macedonia regarding remediation

The existing institutional arrangements for remediation of industrial hot spots in Macedonia have been influenced by constitutional changes, new legislation, and changes of ownership (privatisation). As a result, a number of overlaps, gaps and inefficiencies have been created that are hindering the process of remediation. This section provides an overall review of the institutional context. Table 5 presents summary of the key institutional weaknesses of the present system.

Table 2_Summary of key institutional weaknesses regarding remediation

Areas	Problems
Policy and legislative	Not clear remediation policy and environmental liabilities Incomplete legislation Lack of monitoring and enforcement
Institutional aspects	Lack of government implementation body Unclear roles and responsibilities of stakeholders Weak institutional implementation capacity within the government Insufficient communication between the national and local level Inappropriate conditions for Private Sector Participation No arrangements for financial / economic instruments in place
Economic/financial Issues	Lack of funds for industrial Hotspots remediation Sustainable financing instruments have not been introduced
Public Information	Lack of communication at all stakeholder levels

5.2.2 Selection of institutional set up for the Macedonian Remediation Fund

5.2.2.1 Selection principles

The institutional set up for the Remediation Fund has to accommodate the recommended financing system, and the proposed environmental liability arrangements. The following principles were applied to select the most appropriate institutional set up for the Remediation Fund:

- The MoEPP takes strategic decisions regarding the Remediation Fund
- Operational independence from MoEPP
- Clearly defined operation strategy
- Adequate level of funding
- Closer working with ministries & other funding agencies
- Clearly defined management structures
- Appropriate and adequately trained staff
- Open and transparent project selection procedures
- Regular monitoring & reporting on projects & programmes
- Formal and independently audited annual reports

5.2.2.2 Management of the Remediation Fund

The Remediation Fund should be established as an independent institution with clear formal institutional links to the government, and cooperating closely with donors. The mission of the Remediation Fund should be efficient disbursement of funds for remediation of contaminated sites.

Remediation Fund will be a specialised environmental financing institution that determines and follows criteria for funding in accordance with the state environmental policy. The Fund's independence should be ensured through clear operating and decision-making procedures. The government (the MoEPP) should have an important role in strategic decisions of the Fund but not in daily operations. The Fund will play a key role in the hot spot remediation through development of a pipeline of projects and implementing them. It is also expected to attract funding sources additional to those provided by environmental taxes and the privatisation revenue (in particular donor funding).

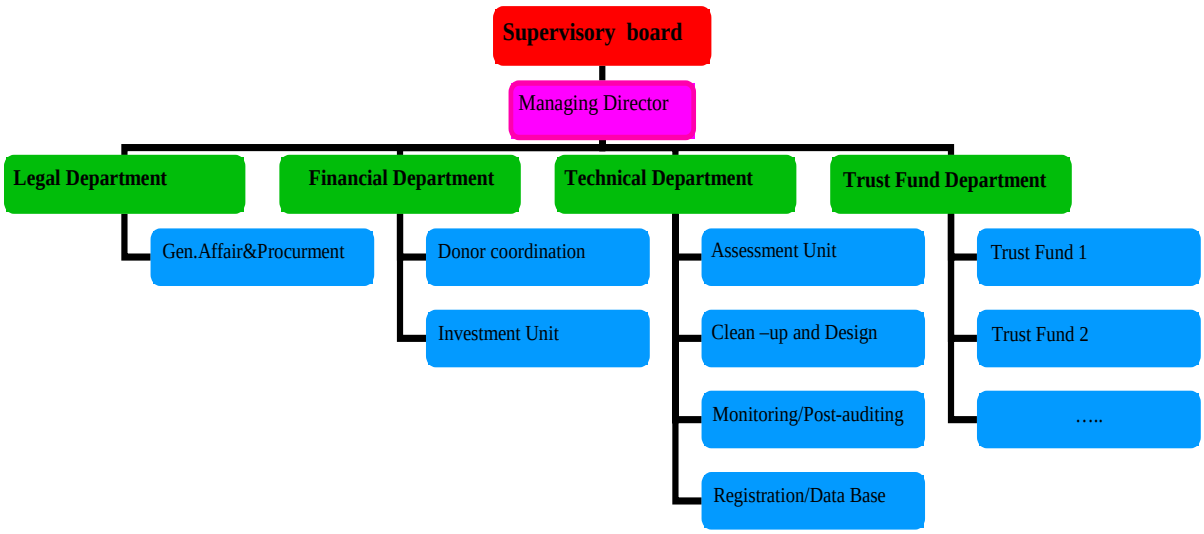
The priority remediation projects for the Fund should be established on the basis of risk assessment. Initially, the 2nd National Environmental Action Plan (NEAP) can be used for reference regarding the funding priorities. Investment strategy and priorities should be prepared by the Fund, approved by the Management Board of the Fund, made widely available, and regularly reviewed.

The Remediation Fund should be supervised by the Management Board, represented by the following institutions (see figure 2)

- Ministry of Environment and Physical Planning (chairperson)
- Ministry of Finance
- Ministry of Economy
- Ministry of Local Self Government

- Ministry of Health
- Ministry of Agriculture Forestry and Water Economy
- International donors

Figure 3_Recommended organizational Chart of the Remediation Fund



Establishing of the Remediation Fund can be divided into 3 operational phases:

- Phase 1 (12 months), with the key objective of establishing a framework (legal basis, funding, director, staff, procedures, priorities) that will ensure that the Fund is capable of operating effectively as an independent agency;
- Phase 2 (30 months), of demonstrating the credibility and effectiveness as an independent agency, and its impact on the (environmental investment) market;
- Phase 3 (3 years), develop the links between the Fund and other funding agencies in order to provide a wider range of financing options that will increase its impact in the market.

5.2.3 Operational procedures of the Remediation Fund

The project cycle operating procedure should become the main operating manual of the Fund. The simplified procedural steps (based on international experience) are presented below:

- **Site identification**
  - Sites, which have been previously identified and investigated, are included in the database
  - Other sites will require environmental audit to evaluate environmental damage
  - The site owner in case of the privatized companies covers the costs of environmental audit. The Fund will cover audit expenses for the state owned sites
  - The MoEPP evaluates the audit results. When approved, the site is included in the database. The Remediation Fund covers all subsequent costs
- **Ranking and registration of sites**
  - Risk assessment study is prepared by the Fund. The results are included in the database of past environmental damages
  - Sites in the database are ranked according to a prioritization methodology (based on risk assessment) prepared by the Fund and approved by the Supervisory Board
- **Design of remediation strategy**
  - The Fund proposes priority sites for remediation in the Annual Operation Plan (the list of priorities should much the funding available)
  - The MoEPP approves by the Supervisory Board and the Annual Operating Plan. The Plan should include cleanup target criteria, time schedule and remediation method
  - ToR for remediation project is prepared and approved (field investigation may be required) by the MoEPP (the Inspectorate of Environment)
  - Tendering of remediation works is initiated by the Fund
  - Selection of supervisory body by the Fund (approval by the Supervisory Board)
- **Post-auditing and site deletion procedures**
  - Remediation works are conducted and supervised by the Fund
  - Verification of remediation works by the Fund. The verification report to be approved by the Supervisory Board and the MoEPP
  - Post-remediation monitoring and supervision conducted by the Fund
  - Completion of remediation process and deletion of the site from the register (approval by the Supervisory Board and the MoEPP)

5.3 Public Awareness and Information

Besides a thorough diagnosis of Makstil pollution and remediation needs, the important tool to ensure the successful implementation of the proposed measures is public consultation and participation. This chapter is required in order to achieve understanding of the key issues of concern to stakeholders/actors in the remediation process. It intends to facilitate the attempts of the MOEPP and its Public Relation Office to deliver information to relevant stakeholders and support a public awareness campaign to the new regulatory structure and how they will interact with it. While the technical aspects are of great importance, it is recognized that public involvement and participation is of equal importance. This public awareness programme report has been produced following discussions within the Ministry of Environment and Physical Planning, representatives of the municipality Gazi Baba City of Skopje and local NGOs.

5.4 Objectives

Overall objective of this Chapter is to facilitate the attempts of the Project to develop public awareness campaign in order to raise public awareness and inform and educate citizens about mitigation measures and solutions of main environmental problems in Makstil Skopje.

5.4.1 Specific objectives are formulated as follows

- To increase knowledge/awareness of the different target groups concerning the pollution problems in Makstil
- To develop a Public Awareness Campaign (PAC) approach at local level

5.5 Approach

In general, the measures to increase public awareness and participation that are proposed should both support Macedonian's progress through the process of economic transition, and support the process of alignment with the EU environmental acquis. Member states (and the accession countries) have had the latitude to inform and involve public in decision-making and to enhance public participation in the planning.

The approach has been followed here is in favor of stepwise, incremental changes that build on existing resources and capacity.

5.5.1 Core Issues related to public awareness

The general level of environmental awareness within former Yugoslav Republic of Macedonia is low, and there is an insufficient understanding of environmental issues. This is largely caused by

a) Gaps in formal environmental education in schools, etc; and

b) Limited informal education or dissemination of environmental information.

c) Insufficient capacity within the Ministry of Environment and Physical Planning (MOEPP) to promote and facilitate better environmental education and awareness related to environmental issues

d) Insufficient and improper information transfer through or by media

e) Lack of understanding of the local authority in enforcement of public information (Aarhus perspectives) systems

5.5.2 The core issues related to PA can be summarized as follows

- Low public information and awareness in general and poor public participation
- People are not aware of the industrial pollution problems and the effect on their environment and health
- Lack of understanding of importance to pay for ”cleaner environment”. For example, high percentage of population not paying the fees for waste collection (in Skopje – 30 per cent of population, outside of Skopje – this figure might be 70 – 90 per cent).
- Companies responsible for pollution do not pay enough attention to public awareness
- Lack of information and access to public information
- Public acceptance of illegal dumping of waste, including hazardous waste.
- Current negative perceptions based on bad local experience
- Many isolated, not coordinated PA activities financed by different donors
- Insufficient institutional capacity to cope with and to promote of the public awareness and environmental education.
- Misuse of environmental topics for political issues

5.6 Experiences of past Public Awareness activities in the Skopje region

Previous activities aimed on strengthening of public awareness on environment protection issues in the region, mainly are performed as a side activities within the bigger international projects. Usually target groups are general public, civil sector, pupils, etc.

The most frequent used communication tools are as follows:

1. Publication of brochures and leaflets,
2. Lectures and workshops,
3. Media coverage,
4. Articles in newspapers

The effects of the activities focused on general public are not really measured until now (indicators missing). The citizens are familiar with topics for environment protection, but those topics are still under foreign responsibility (shifting of responsibilities).

The PA campaigns focused to children can be treating as a complementation of formal education for protection of the environment. The general impression is that the protection of the environment is not important issue for elder population. This behavior has impact on the behavior of young population.

Measurable progress is achieved in capacity building on smaller groups, such as agriculture unions, collectors of raw materials etc. Those activities were depending on investor’s program and not all direct reflect the really necessity and needs of local population. This is one of the reasons for non-continuation of activities after finishing of the projects (missing sustainability)

Economical Ecology vs. Ecological Economy – no environment protection without economical solid base.

5.7 Target Groups, Information Needs, Communication Techniques

5.7.1 General public

People need to see that their government, neighbors and community leaders will join the pro-environmentally sound activities.

- **Information needs:** This target group demands regular information about environmental issues, problems, success stories and proposals how individuals can contribute to preservation of environment. Electronic and printed media could play the important role for public environmental awareness raising, mainly through presentation of collected and processed relevant information in this respect.
- **Communication techniques:** Since it is hard to reach the general public directly, useful communication technique could be combination of media campaign that will ask citizens to initiate proactive action at personal level. For the maximum benefit of the environmental public awareness campaign it is extremely important to provide new possibilities that will offer to people how to change their current behavior into more environmentally friendly. In the media campaign that should follow after these possibilities are provided, simple explanations for the environmental, health and financial benefits should be addressed.
- Local communities of the villages are good tool for individual proactive action. All citizens in an interactive action show their commitment for cooperation in every project they see important for their life.

5.7.2 Schools

School children are very important target group as they represent the future population; therefore the local, national and international efforts for conservation of this area have to ensure building of the future human resources in appropriate way.

- **Information needs:** This target group has need for permanent education about environmental issues and problems at local, national and global level. Different ages of pupils need different types of information.
- **Communication techniques:** Pupils need to learn through well-designed and interactive approach using outdoor experiments. These practical exercises should be combined with messages that adults are personally responsible for growing and development of their society, whereas their pro-environmentally behavior largely contributes to the community. Establishment of local education / visitor centers can be a useful tool for generating interest among young people and demonstrating environmental activities. Specific training and education can be organized for the teachers and their cooperation with local or specialized NGOs can be facilitated.

5.7.3 National (Central) Government

Governmental Ministries (Ministry of Economy, Ministry of Transport and Communication, Ministry of Agriculture and water management, Ministry of Education and Science) Agencies and relevant bodies and local authorities are specific target group that needs to recognize that environmental problems should be posted on their priority agenda.

- **Information needs:** This target group needs explanatory information which will help it to understand why is it necessary to consider that environment should be put in the list of top priorities. It is important to simply explain the environmental policy at local and global level where environment is given same level of priority

as to political, economic and social issues. Environmental problems need to be linked with the impact to the economic development, social and health issues. Finally, specific information should be provided how decision-makers could think in environmental friendly manner when making their decisions and how they can benefit from it.

- **Communication techniques:** The first step will be to get the attention of these institutions to environmental issues. This can be achieved indirectly through the awareness raising of the general public, success stories on specific projects, initiative of NGOs or through their involvement in the activities of the Ministry of Environment and Physical Planning. Especially the local authorities will need serious capacity building efforts to be able to perform all their environmental duties foreseen in the new legislation on local self-government. MOEPP can lead by example and produce practical manuals and guides for implementation of national environmental policies as a useful tool for achieving the environmental objectives.

5.7.4 Media

It is evident that media are playing the key role for distribution of environmental information to the public and for raising of its awareness, it is necessary to recognize that this is a target group of special importance and specific information needs and requirements.

- Information needs: Media need to have broad access to the results of the different Project activities, Local and national Authorities - including the goals, work, strategies, pilot-projects, achievements and failures. In this way they will consider these structures as trustworthy sources of information in the long term. Second type of very important information for media is the state of environment in the country and globally.
- Communication tools: Media should be treated as partners, not as negative observers and criticizers. Press conferences should become part of the regular agenda of Local Authorities. Special attention should be given to the editors in relation to their recognition for importance on environmental coverage in the media.

5.7.5 NGOs

The NGOs are among the best-organized environmental stakeholders in the country and they have collected a significant track record in awareness raising activities. They can serve as important partners of the Local Authorities and PPP in future activities, but they still need capacity building for designing and implementing well defined, targeted and topical campaigns with careful, detailed analysis of the problem and adequate responses for its solving. They also need more stable and long term funding sources to be able to focus on longer-term priorities rather than on short-term access to donor-funded projects. The capacity of NGOs can be improved by their involvement as partners in the planning and implementation of awareness raising activities of the PPP, Local authorities and other stakeholders.

- **Information needs:** The NGOs most urgently need free access to environmental information according to the Aarhus Convention. They also need regular information about the activities of other actors in the country in order to be able to coordinate activities and set their own priorities.
- **Communication tools:** The NGOs can be informed through specialized environmental magazines, news services or electronic networks such as EKONET in Macedonia. There should be regular events that provide opportunity

for informal communication with the NGOs. To facilitate formal communication i.e. public participation in environmental decision-making, the Strategic Environmental Assessment of plans programs and policies should be introduced.

(See Annex [11.2.4] - List of NGO's in Skopje)

5.7.6 Business sector

Currently there is little environmental communication with the business sector in the country, apart from occasional inspection visits and the permitting process. The experience shows on the other hand, that the business sector can be a very effective partner in solving environmental problems and raising environmental awareness. The mainstakeholder in this respect might be the acting operator of the dumpsite the company RSH Troski.

- **Information needs:** The business sector needs information about the legal requirements and procedures, about the state of environment, environmental technologies and in particular market opportunities in the field of environment. In drafting new laws and regulations, it is important that the business sector is informed about the new requirements early enough, so that they can adapt to these requirements within their regular investment cycle.
- **Communication tools:** The environmental experts /managers in the companies can be invited to join the communication networks with the local authorities and NGOs, or to create their own network. Regular business conferences, trade fairs and similar events can provide an important opportunity for informal communication. Strategic Environmental Assessment on the other hand also provides an opportunity for the business sector to participate in the policy debates in a transparent way.

5.7.7 Local Authorities

The Municipality of Gazi Baba already has experience with environmental awareness raising activities, but still needs serious capacity building efforts to be able to perform all their environmental duties foreseen in the new legislation on local self-government. The Municipality should be better staffed with specialists for environmental awareness activities, such as trainers, environmental experts and PR experts. This should enable it to continuously plan and implement awareness raising activities and community engagement actions. More specific capacity building needs of the Municipality of Gazi Baba are listed below:

- Systematization and standardization of information for all projects implemented on the territory of Gazi Baba
- Enhancement of the communication with production facilities located at the territory of Gazi Baba
- Providing required transparency and
- Deliver it to the end user

The Municipality of Gazi Baba is also primarily responsible for securing free access to environmental information about main polluting facilities on its territory, including information for Makstil

5.7.8 Ministry of Environment and Physical Planning (MOEPP)

As a support for the thematic areas under the responsibility of MOEPP, it is recommended to continue the operation of the Eco-Caravan (a Road Show including

Public Relations office). It would be a very practical and useful tool for supporting awareness raising activities in different parts of the municipality and in relation to a variety of topics.

- There is a need for more strategic and planned approach for designing and printing MOEPP promotion materials and for improvement of their quality in terms of text (slogan, messages, information) and design.
- The web site of the MOEPP should be regularly up-dated with permanent and fresh information about the status of environment. One way how this communication tool can help citizens to raise their awareness is that in every section of the website information, a special attention can be given to advise citizens what they personally can do and how they can contribute to the particular effort of the MOEPP.
- The Public Relation Office currently manages the media relations and other public relations of the Ministry. Ministry should dedicate sufficient resources to such a programme that could include: regular press conferences; regular press releases; media service to respond to specific requests of the journalists; and information about specific activities in the regular newsletter of the Ministry.
- MOEPP should give technical input in preparation of curriculum for environmental education
- With such a service the Ministry can improve its image in the eyes of the journalists, become a trustworthy source of information and gradually establish more close cooperation with media in the field of awareness raising.
- The Ministry should invest in internal formal and informal communication regarding the messages it would like convey to the public and other stakeholders. Only if all the staff share the vision and positions of the Ministry as an organization, they will be able to present them to the public, defend them if necessary and actively implement them in their work.

5.7.9 Donor

Several donors are providing technical assistance in the Republic of Macedonia in terms of Hot Spots remediation or mitigation measures for industrial contamination.

The most active donors in this field are:

- EAR - One of the Projects managed by EAR within the Programme CARDS 2006 is current one: “Development of Remediation Plans with Financial Requirements for Elimination of Industrial Hotspots”
- the Dutch Embassy driving force with a SEE regional programming for the remediation of industrial hotspots. Implementing agency is UNDP. Feasibility studies for two locations, Lojane and Bucim, are planned to be conducted.
- The Austrian Development Agency (ADA) supports a regional program (Envsec) for the remediation of abandoned mining areas. Implementing Agency for this program is UNEP Grid. Sasa and Toranica mines are focal areas.
- JICA (Japan International Cooperation Agency) in cooperation with the Ministry of Agriculture, Forestry and Water Economy (MAFWE) is presently working in phase two of the study on “Capacity Development for Soil Contamination Management related to Mining in the Republic of Macedonia” with focus on Zletovo mining area.

- SECO, the Swiss Donor Agency is mainly involved in the construction and operation of waste water treatment plants.
- IFC (International Finance Cooperation) is in cooperation with ADA involved in strengthening the recycling market due to direct disbursement and micro crediting. The WB has signalised an interest in future financing strategies.

Currently are no donor activities and intentions on the historical industrial site of Makstil Ferro Slag dumpsite.

5.8 Key aspects of Public awareness rising

The mechanisms of public awareness rising and communication are an important tool for better understanding of the problem, its acceptance and involvement of the citizens in the solution making. Thus, the way of implementation of public awareness rising campaign is crucial.

There are two principles in the campaign conducting:

- Awareness rising and participation increasing and
- Triggering behavioral change public

The messages that should be pointed out to the target groups are not only for how to protect the environment, but as well why it should be protected. The campaign must transfer information and stress the public motives to do that.

- The message should be simple, understandable for general public and accompanied by a slogans

5.8.1 Communication techniques in small groups

In case of small target group, the following communication techniques are proposed:

Interviews - Meetings between the stakeholders organized in order to get information of the public opinion, public participation perspectives and building of consensus programs. The interview provides an opportunity for getting direct information for public interest and gives possibility of asking questions. Enable to learn the best communication practice with the public and can be used for city committee members' assessment. Disadvantage is that interviews demand time. The invitation for the interview have to be encouraging, in opposite we are facing the risk of potential participants to refuse the interview. When possible the interviews should be taken head to head.

Small meetings with previously defined target groups or meetings related to other happenings. When organizing such meetings there is an opportunity to get an agenda and to plan the discussion in advance. Small meetings, if they are well organized, provide replacement of extensive informing such as a lecture to wider audience. The disadvantage of small meetings is that they can be too selective and important target groups can be left out. For such meetings it is important to know the audience previously. Small meetings give an opportunity for direct contact before or after the formal part of the meeting.

Visits and personal checking are organized to provide the available data. The checking is made by previously standardized questionnaires or methodology. The approach is “head to head” or to closely focused target groups. The advantage is that this approach provides a representative sample of examinees, but this is the expensive way. In this respect, we should have in mind that, sometimes, these focused groups could have a promotive approach. That’s why we have to be sure in the purpose of the results before the data collecting technique is determined.

Coffee-chat: Small meetings between the neighbors usually in domestic atmosphere. The advantage of this type of communication is the relaxed surrounding, suitable for effective dialogue. Maximum communication from both sides is obtained. But, these activities demand too much effort if we want to approach many people.

5.8.2 Techniques for large groups participation

In communication with large groups the following techniques are proposed:

Public meetings: Formal meetings with presentations give an opportunity to speak in front of the public without denial. Public convocations satisfy the legal requirements but by them the dialog is not upgrading and there is little chance for discussion. In this form of communication, if the agenda is not precisely defined, there is a possibility of long, undesirable speeches. Detailed minutes that exactly reflect the meeting are usually made.

Leaflets/Survey leaves/Poster/Announcement/Billboard: Leaflets often include facts and other information of public interest. By this technique participation of the citizens that does not want to attend meetings is enabled. The existence of the mechanism that will provide regular up dating and extension of the address book for sending the leaflets is an important pre-condition for this form of communication. If feedback leaflet is required for certain information from the citizens, we should have in mind that there is a possibility of mistakes and results sophistication. The probability that leaflets will be sent back is bigger if the post tax is paid in advance.

Telephone contact: Random choice telephone contacts are useful for getting specific information for statistical analysis. This technique provides participation of individuals who do not want to attend meetings and individuals who are not in the address book of the organization that makes the survey and/or informing. Telephone calls provide bigger response compared to survey leaves sent by mail, but this is more expensive and it is harder to process them. The telephone surveys give opportunity for prejudice if the questions are not carefully formulated. Before investing in this kind of communication, it should be clear that statistically valid data are needed. The questionnaire used in telephone surveys has to be professionally made, to avoid possible prejudices. This way is recommendable for assessment of general attitudes.

5.9 Public awareness rising program

Activities for realization of PA Campaign:

1. Defining of general slogan for public awareness campaign;

Defining of sub-slogan for each of the topics in the public awareness campaign

When forming the slogan we should always think about:

- · what is the target group?
- · What should the message mean?
- · What will the public opinion to that message?
- · What actions will the public undertake from that message?

It is proposed the UNDP office in Resen to announce public call for the best slogan (sub-slogans). The best slogans should be awarded.

2. Preparation of Leaflet: To contain information for the Remediation Project and its significance for the region; The leaflet should in simple and understandable way explain the term "hazardous waste" to the young population, where and when it is

generated; to point out the advantages of separation and its treatment. A number of 1000 copies are proposed.

3. Designing and broadcasting of radio clips: Local Radio Stations have experience in designing and broadcasting of radio clips, but the implementer of this activity should have the rights to provide broadcasting of the radio clips to other national and local radio stations by which the number of listeners will increase.

During the realization of these activities the following tasks should be fulfilled:

- at least eight texts for radio clips to be prepared (two for each of the campaign's themes). The clips should last between 20 and 30 seconds.
- Recording the radio clips.
- Broadcasting according to the agreed media plan with the implementer

4. Realization of debate programs on National TV Station with the possibility to involve listeners in live programme.

At least two debate programs are proposed to be hold for all topics of the public awareness rising campaign for environment protection activities at Makstil dumpsite and Troski activities. The following activities are proposed:

- Making of program scenario
- To determine the guests in the studio for each of the debates
- Making on time announcements for the debate programs in main terms

5. Survey on satisfaction of the population from the activities undertaken. The outcomes of the survey can serve for measuring of the effects from PA campaign and to direct the additional activities. This activity should be coordinate by PR department of Makstil and the current operator RSH Troska.

The survey can be enforced in two ways:

- By telephone calls and
- Questionnaires

6. Billboards making: Billboards as a way of communication have advantages compared to other methods because through them it's easy to reach the general public. It is very important billboards to be made by a professional organization and/or experienced individuals. It is a custom to make a simple message on the billboard that will affect the local population. Often those are messages that appeal on protection of natural heritage and/or messages that provoke sustainable development. The billboards should be placed on frequent places in the city of Skopje (3 billboards), on the main roads at the entrance of Municipality Gazi Baba (2 billboards) and in the settlement Zelezara (2 billboards)
7. Round tables: To improve the campaign significance it is recommended to organize round tables to as higher as possible level. It is good if the Mayor has a conversation with the stakeholders of the public awareness rising activities. In that way mutual confidence will be achieved and the stakeholders will be motivated to continue with the activities in progress. It is proposed four meetings to be realized during the year
8. NGOs meetings: Regular meetings (at least once a month) where the PA activities of local NGOs will be briefly presented. It is useful the representatives of village communities and Municipality to attend these meetings
9. Activities in educational institutions - art exhibitions, show

10. Detailed plan and the separate activities in which the pupils will be included will be defined by the local NGOs as they are directly included in the realization. It is proposed to organize art exhibitions with awards in all elementary schools in the Municipality, and the chosen ones to participate in the group exhibition in the tracts of Municipality Gazi Baba. Awards for the best works, should be provided.

Figure 4_Proposed Public Awareness Rising Activities for the Remediation Activities at Makstil Ferro slag dumpsite

Activity	**Implementation**	**Stakeholders**	**Time frame (in months)**	**Predicted budget (in Euros)**
Defining of general slogan and sub-slogans	Municipality; Local NGOs in cooperation with professional companies	Local self-government; Business community; Local population	0-2	250
Preparation and distribution of leaflets	Local NGOs in cooperation with professional companies	Local self-government; Business community; Local population	2 - 4	2000
Designing and broadcasting of eight radio clips	Experts; Local and national radio stations	Local self-government; Business community; Local population; The schools; Makstil, Troksi	2 - 12	800
Debate programs on National TV	Experts and Local radio	NGOs; Local self-government; Business community; Local population;	4-8	800
Billboards designing	Municipality, experts and professional companies	Local self-government; Business community; Local population; The schools	2-12	3000
Organizing of round tables	Municipality; experts	NGOs; Local self-government; Business community; Local population	3-12	100 (expenses for meetings organization)
Local NGOs meetings	Experts; Local NGOs	NGOs; Local self-government	0 - 12	250 (expert costs)
Afforesting actions	NGOs; Local population; Schools; Municipality	Local self-government; Business community; Local population; The schools	4-8	250 (expert costs)
To determine and organizing “open day” at Makstil dump area	NGOs; PE Proleter	Local self-government; Business community; Local population; The schools	4-8	2000 (expenses for organization)
Organizing of the shows and art exhibitions in school	NGOs; Schools	Local self-government; Business community; Local population; The schools	6-12	550 (awards for the best works)

A budget of approximate **10.000 Euro** is required to perform a sufficient public awareness and information campaign supported by various experts and in cooperation with the central and local authorities and involved companies. A timeframe of **one till two years** seems sufficient to involve the public in remediation activities with the related companies involvement such as Makstil and Troska.

6 Technical Perspective - Assessments

6.1 Qualitative Health Impact Assessment

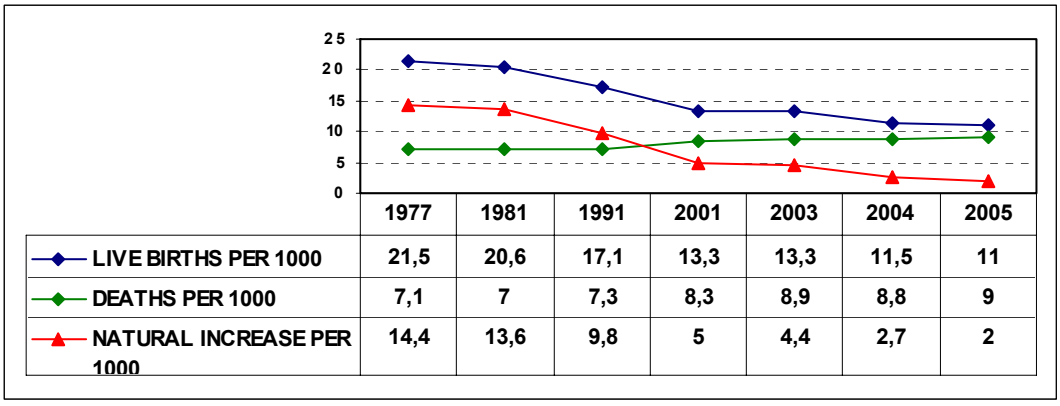
The qualitative Public Health Impact Assessment is a comprehensive study (**Volume 00_A**) about the current status and development of impacting factors on human health caused by historical and ongoing pollution. The study compared trends and tendencies of disease appearances for each site with those of Macedonia and the European Union. The following chapter focuses on the site of Makstil Ferro Slag dump, which is currently operated by RSH Troska.

6.1.1 Background- General profile of the Country

In demographic terms, Macedonia is an extremely heterogeneous area. The large demographic differences, especially if observed from higher down to lower regional levels in the country, are in essence a consequence of largely differentiated directions of the natural and migration component of the total population. According to the data of the population census in 2002, Macedonia has 2.022.547 citizens of whom around 60 % live in urban areas, with an average population density of 78.6 inhabitants/km^2. The number of citizens increased by 76,615 or by 3.9 percent as compared to the previous census of 1994. The average annual population growth rate in the period amounted to 0.48 percent.

The average life expectancy is 73,5 years (Females 76 years, and males 71 years). The demographic, economical, social, ecological and health characteristics of the population showed significant differences among urban and rural areas. The birth rate in Macedonia for 2005 is 11 per 1,000 populations, and the mortality rate 9 per 1,000, resulting in a natural increase of 2 per 1.000. The distribution of deaths by age shows the highest proportion of total deaths for age 75 and over (43,6%). Age group 65-74 accounts for 28%, and age group 55-64 for 13,4% of the deaths.

Figure 5_Natural demographic changes [1977-2005][4]



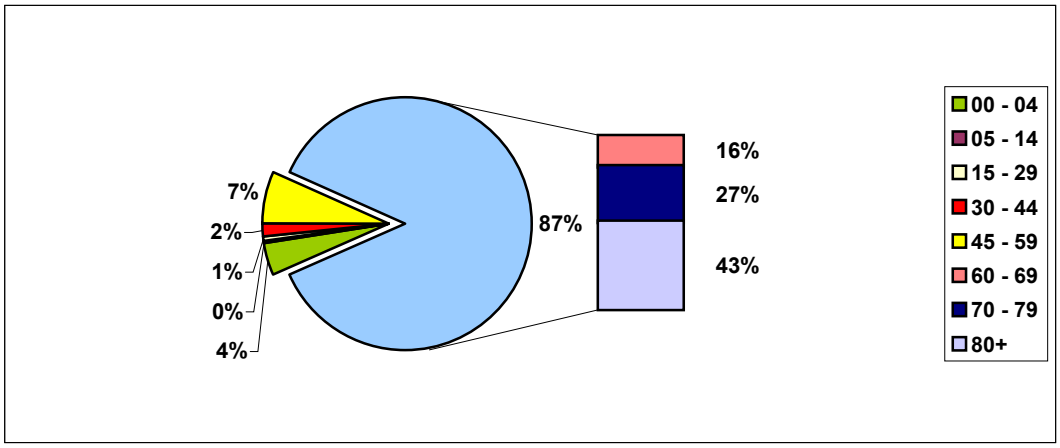
	1977	1981	1991	2001	2003	2004	2005
LIVE BIRTHS PER 1000	21,5	20,6	17,1	13,3	13,3	11,5	11
DEATHS PER 1000	7,1	7	7,3	8,3	8,9	8,8	9
NATURAL INCREASE PER 1000	14,4	13,6	9,8	5	4,4	2,7	2

From 1990 to 2005 the percentage of the population over 65 years of age increased from 7,97 to 11 % (males 4,8% and females 5,8%), while the population from 0-14 years decreased to 21% (males 10,8% and females 10,2%). Such tendencies have the negative influence to the transformation of age structure of the population, i.e. the process of continuing ageing is strengthening. In the demography aging process, except

[4] Source: Statistical Yearbook of the Republic of Macedonia, 2006

natural, the big influence has the migration component of the increasing of the population. Notwithstanding the increase in the proportion of the elderly population, the population is still relatively young in comparison with the averages for the EU and for Central and Eastern European countries. However, figures also suggest that the trend towards an ageing population is far less pronounced in the Republic of Macedonia than in most neighboring central and southeastern European countries (in 2003 only Albania had a younger population with 7,87% over 65 years) or the EU (in 2003 the percentage of the population over 65 years on average amounted to 16,13%, in 2004 it was 16,42%). This is further confirmed by the healthy life expectancy estimated at 62,2 years and the Disability-Adjusted Life Expectancy of 63,7. The UNDP Human Development Index for the Republic of Macedonia is 0,799 for 2004.

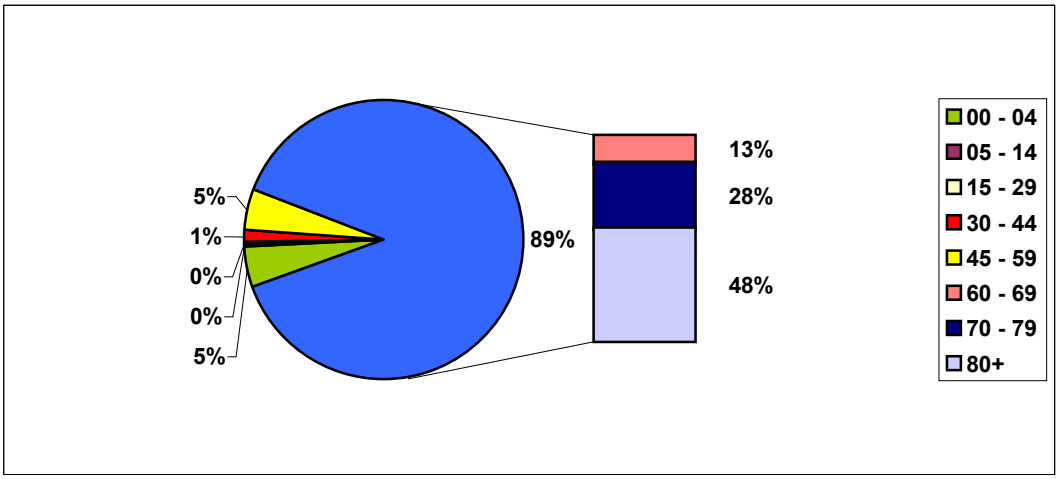
Figure 6_Years of Life Lost (YLL) by age groups among males, Macedonia 2002[5]



The distribution of years of life lost among age groups in Macedonia is similar to that of the WHO EURO region. The age distribution was 87% in older ages for males and 89% for females, and 4% for males and 5% for females in age group from 0-4, respectively.

Figure 7_Years of Life Lost (YLL) by age groups among females, Macedonia 2002[6]

[5] Source: Kendrovski V, Gjorgjev D. The Burden of disease in the Republic of Macedonia, 2005



The per capita Gross Domestic Product for 2004 was US$ 2,382. The unemployment rate in Macedonia in 2005 was 36.5% of the total labour force, placing Macedonia among countries with an extremely high unemployment rate in Europe. The relative poverty in the former Yugoslav Republic of Macedonia for 2004 is expressed with a Poverty Gap Index - the average proportionate expenditures shortfall for the total population - of 9,4, and with a Head Count Index - the percentage of persons living below the poverty line - of 29,3% (source: State Statistical Office, 2005). The population groups identified as being most at risk of poverty are the unemployed, socially imperilled households, pensioners and farmers. Larger households in rural areas, particularly those with members that are unemployed or have low educational levels, are identified as a specific risk together with the unemployed in urban areas. Poverty has a serious impact on the health status of the population and on the access to health services.

Figure 8_(Some indicators for the Republic of Macedonia in the period 2003-2005)

DEMOGRAFIC, VITAL AND SOME HEALTH INDICATORS IN THE REPUBLIC OF MACEDONIA, 2003, 2004, 2005

	2003	2004	2005
Area Km2	25713	25713	25713
Population places	1753	1753	1753
Municipalities	123	123	84
Population per 1Km2	78,82	79,05	79,21
Population			
Total	2026773	2032544	2036855
Male	1017274	1019903	1021772
Female	1009499	1012641	1015083
Urban	1207848	1211514	1215140
Rural	818925	821030	821715
0-6 age	174136	170418	167164
7-19 age	411441	404975	397289
20 +	1441196	1457151	1472402
20 - 64 age	1224459	1236642	1247537
65 +	216737	220509	224865
female 15-49 age	524156	525682	526456
female 15 +	805991	813769	820675
Vital indicators			
Natality per 1.000 population	13,3	11,5	11,0
Mortality per 1.000 population	8,9	8,8	9,0
Natural increase per 1.000 population	4,4	2,7	2,0
Infant mortality per 1000 livebirdhs	11,3	13,2	12,8
-Urban	13,5		
-Rural	8,6		
- Perinatal mortality	15,3	18,4	16,9
- Neonatal mortality	8,4	9,6	9,6
= early neonatal mortality	6,7	7,4	7,3
= late neonatal mortalityr	1,7	2,2	2,3
= post neonatal mortality	2,9	3,6	3,2
Morty natality	8,6	11,0	9,6
Maternal mortality	7,4	12,8	13,3
Health care personnel			
Physicians	4448	4490	4392
Dentists	1132	1134	706
Pharmacists	319	322	205
Health care personnel with higher level qualification	756	762	753
Health care personnel with mid level qualification	9773	9749	8967
Number of population per one:			
Physician	455,7	452,7	463,8
Dentist	1790,4	1792,4	2885,1
Pharmacist	6353,5	6312,2	9935,9
Hospital beds			
Total number	9743	9699	9569
Hospital beds per 1,000 population	4,8	4,8	4,7

One of the very positive developments in the Republic of Macedonia in the last decade concerns the infant mortality rate (IMR) that continued to fall and has halved, from 28,25 infant deaths per 1000 live births in 1991 to 12,8 in 2005. However, this figure is still three times higher than the EU average of 4,75. A decrease in IMR up to 2002 can partly be attributed to the many policy interventions carried out: significant outcomes have been achieved with the Perinatal Project (1999–2001) as part of the Health Sector Transition Project.

6.1.2 Legal Framework and Institutions

Article 43 of the Constitution affirms the right of every person to a healthy environment. The Law on Health Protection (Official Gazette Nos. 38/91, 46/93 and 55/95) sets the foundations for the current health care system in the country, including the health insurance system, the rights and responsibilities of service users and service providers, the organizational structure of health care and its funding. The State is responsible for the provision of preventive care for the population through the Public Health Institutes and for ensuring that health services are available. The Health Insurance Law of April 2000

underscores the basis of the health service funding process, establishes a compulsory health insurance scheme and confirms the independence of the Health Insurance Fund and its management board. The Law on Health Protection also provides the legal framework for the Programme for Human Preventive Health Protection, which is adopted yearly by the Government upon the proposal of the Ministry of Health. The Programme forms the basis for vertical primary prevention programmes as well for monitoring the population's health and for monitoring food, drinking water, air and ionising radiation. Health indicators are monitored on the basis of the relevant legislation, including:

- The Programme for Statistical Health Research for 1998-2000 (Official Gazette Nos. 64/97, 11/00 and 54/01);
- The Law on Health Records (Official Gazette Nos. 22/78 37/79, 18/88 and 15/95);
- The Law on Health Protection;
- The Law on Protection at Work (Official Gazette No. 13/98); and
- The Health Insurance Law (Official Gazette Nos. 25/00, 34/00 and 69/00).

The Republic Institute for Health Protection is the national centre for public health and the main body responsible for environmental health. It is involved in teaching at the medical faculty, supervises and oversees the activities of ten regional Public Health Institutes, and provides technical services to the clinical centres and to the country as a whole. Its main functions are:

- The collection of data on health for all indicators;
- Monitoring the health status of the population;
- Reporting and analysing the health status and the organization of the health care system;
- Epidemiological surveillance;
- Immunization;
- Environmental monitoring (air, food, drinking water, radiation);
- Surveillance of environmental health risks;
- Drug control; and
- Advising the Ministry of Health on matters related to health policy.

The ten regional Institutes have a total of 21 branch offices that provide services in the communities. Since 1993, the Institutes have been separate from health service delivery and, amongst other functions, are charged with the delivery of vertical primary prevention programmes such as that for HIV/AIDS. The regional Institutes are located in the major municipalities: Bitola, Kochani, Kumanovo, Ohrid, Prilep, Strumica, Skopje, Tetovo, Veles and Shtip. Each regional Institute employs around 100–150 staff. The 21 branch offices, or hygiene epidemiological surveillance stations, are located in health centres throughout the country. These also provide clinical laboratory services. The Public Health Institutes have four basic functions: microbiology, hygiene, epidemiology and social medicine. In addition to these functions, the Republic Institute for Health Protection provides virological, pharmacological, and toxicological and radiation protection services to the whole country. Although their functions are similar, the different institutions have different capabilities and equipment. This difference is partly compensated by the Republic Institute for Health Protection, which provides the others with technical and analytical assistance on those aspects, with which cannot be dealt directly (e.g. for analysis of

heavy metals). A form of coordination and planning of the activities of the 11 institutes takes place when the "Programme for Human Preventive Health Protection" is drawn up.

There is also an Institute of Occupational Health. It conducts health, methodological, educational and scientific activities following a multidisciplinary approach. It is a national coordination centre for the programme on Health, Environment and Safety Management in Enterprises (HESME) and is a base of the Medical Faculty Chair of Occupational Health. Occupational health comprises 146 occupational health specialists, other physicians, chemists, psychologists and other medical personnel. It has a network of 53 occupational health units as dispensaries, in health centres at municipal level, in industrial facilities, in governmental and inspection bodies as well as in private organizations. Their function is more curative than preventive. So the establishment of an adequately organized occupational health service providing monitoring, protection and the promotion of health at the workplace should be considered as an important goal for the health sector reforms.

In addition to the above structures, the Ministry of Health has inspection services, which receive expertise and technical and analytical support from the Republic Institute for Health Protection and other regional Public Health Institutes. At present, the main functions of the Inspectorate are the inspection of water (drinking and recreational), health care facilities (except medical waste), the surveillance of communicable diseases, food safety, cosmetic products, hygiene and epidemiological conditions in facilities and workplaces, drugs and medical devices, and the factories that manufacture them. In the past, the Inspectorate was also involved in the assessment of air pollution, waste and pollution from factories and in the system of permits for new activities. However, following the establishment of the Ministry of Environment and Physical Planning, the new Environment Inspectorate has in practice taken over those functions. As the redefinition of the responsibilities of each of the two Inspectorates has not yet been agreed, the consequent lack of clarity is occasionally a cause of conflict and competition between them. Total expenditure on health is around 5 per cent of GDP. More than 95 per cent of official health care finance is derived either from contributions levied by the health insurance fund or from user charges. Of the remainder, half is derived from the State budget (funding vertical primary prevention programmes, including environmental health and the care of the needy) and the other half comes from other sources such as international aid.

6.1.2.1 Approximation

By signing the Agreement for Stabilization and Association between the Republic of Macedonia and the European Union and its member countries on April 9, 2001 in Luxemburg, entering into force in June 2001, the Government of the Republic of Macedonia has undertaken activities for approximation of the national legislation to the EU legislation.

The approximation of the *Law on Air Protection* dated from 1974 was done in 2002 with technical support by the GTZ and the new Law on Air Quality was prepared. The new Law on Air Quality was adopted by the Parliament on 15th September 2004. Other environmental legislation related to air is in the process of adoption.

The EU requirements and standards in the water sector, prompted the preparation of a draft *Law on Water,* which is transposing six water related EU Directives, including the Water Framework Directive.

The *Law on Waste Management* transposes two Framework Directives *(75/442/EEC and 91/689/EEC)* has been adopted by the Parliament. MoEPP's and other entities' commitment in implementing the solid waste legislation will be strengthened by NEAP. That will not deny that implementation is hard and very costly. NEAP will pledge for strong support from the International Community to achieve this.

The *Law on Nature Protection* has been adopted in September 2004 and the draft Law for Environment is under the governmental procedures. Several secondary regulations for protection of nature are under preparation, inspired by EU's sixth EAP.

The *Law on Local Self Government* makes local communities responsible for the preparation and adoption of the urban plan for the settlement and the spatial plan for the municipality. The preparation of urban plans is a regular practice but depends on financiers. All the cities and big settlements have adopted urban plans. Municipalities have not prepared spatial plans since 1990. Spatial plans have to be prepared in compliance with the Law for Spatial and Urban Planning, which is under development.

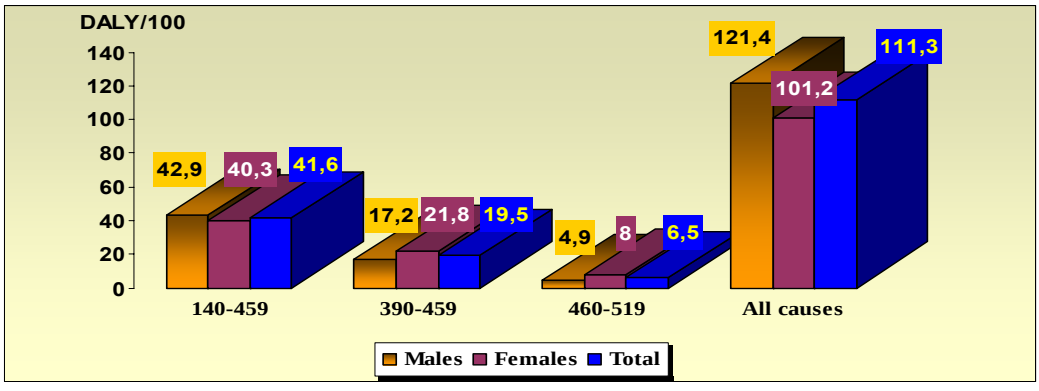
As yet this not extendedly is the case with Physical Planning and Environmental Health. However harmonization with EU Directives of the legislative framework for Regional Development has started. The same applies to the transposition of EU's Pharmaceutical Laws and Food Legislation, and specialized issues connected to chemicals, radiation, and GMOs.

The approximation of EU's laws for the protection of the environmental media is close to completion in the country. Now by-laws and directives are being transposed for air, water, waste and biodiversity.

6.1.3 State of the Environment and Health in the former Yugoslav Republic of Macedonia

The environment in which people live, work and play is an important determinant of health and well being, but the extent of its importance in developed economies is difficult to quantify. The non-communicable diseases present the biggest burden to public health analyzed by direct cost to the society as well as to the governance from aspect of disability adjusted life years (DALY) indicator. Due to fact that more and more citizens are elderly and because of that are more exposed to non-communicable diseases and disability, the needs for data, which will reflect the life quality, including the influence of environmental risk more precisely is essential. The summary measure of the population health and the methodology for the burden of diseases estimation nowadays is extraordinary indicators for the public health policy development as well as for actions needs for its reduction. The total burden of most frequent diseases in the Republic of Macedonia: circulatory, malignant and respiratory are estimated to 60,7% to DALY from all cause mortality, which is different than the percentage from the year of life lost, i.e. 52,4% respectively.

Figure 9_Total DALY for the Republic of Macedonia



The structure of deaths by cause shows that the highest number of deaths is due to circulatory diseases which present 58,4% of total number of deaths for 2005.

The standardised death rate (SDR) per 100.000 inhabitants for circulatory diseases has increased from 527/100,000 in 1991 to 599/100,000 in 2004. Overall mortality from malignant neoplasm as the second most important cause of death has also increased over the past ten years, from SDR 140 / 100.000 in 1991 to 165 / 100.000 in 2004, which is more than double that of the EU average. Injuries and poisoning are the third leading cause of death with same percentage as respiratory diseases 2003.

The most common diseases in the Republic of Macedonia – heart and circulatory diseases, cancer, respiratory diseases, injuries and non defined symptoms – have many causes which are often interconnected; including genetics, the condition people are in (via diet, exercise etc.), and the environmental circumstances to which they are exposed. Identifying cause-and-effect relationships is therefore very difficult, especially if the impact of the environment on health is delayed, or is the product of many perhaps small, environmental factors acting together.

The cancer incidence in the Republic of Macedonia has seen an increasing trend, though, unfortunately, during the last decade there have been flaws in its recording. However, the increase has been particularly notable in cancer of the lung and prostate among men, and cancer of the breast and cervix among women. Mortality from cancer related to tobacco and alcohol abuse has increased rapidly in the last decade, reflecting changes in consumption. Given the long lag phase in the progression of many types of cancer, it can be expected that rates will continue to rise for some years to come.

During the 1990s the incidence of tuberculosis (TB) decreased significantly, reaching the lowest rate of 27,61 per 100 000 inhabitants in 1999. Supported by the WHO and the World Bank, the Republic of Macedonia has successfully implemented the directly observed treatment (DOT) strategy, halving the number of patients with active tuberculosis between 1997 and 2001, and reducing the average length of hospital stay in both general and specialist hospitals by more than 20%. However, the Kosovo crisis and the conflict in the country resulting in a rise in the number of refugees and displaced citizens have had negative impacts on the health of the population, such as an increase in the incidence of TB, among other effects. In 2004 the incidence of TB was 31,72 per 100.000, representing a rate almost three times higher than the EU average of 11,85.

In international comparison the available data on lifestyle factors in the Republic of Macedonia do not seem to be very reliable and further field surveys should be conducted to consolidate these data. However, currently available data suggest that citizens of the Republic of Macedonia are less frequently victims of traffic accidents, drink much less alcohol, and eat slightly better (fewer calories, less fat, more fruits and vegetables), for example. Accurate data on smoking habits are missing. The low and overall decreasing trend regarding traffic accidents observed since 1996 (with a death rate of 8 per 100.000) seems to reflect more a stagnation of road traffic than improved road safety: the incidence of road injuries (95 per 100 000 in 2003) is three times lower than the EU average of almost 297 per 100 000 in 2004. Traffic traumatism in children and youths is a priority public health problem. The most recent mortality data show that road traffic injuries covers an amount of 30 – 50% of all injuries causing death in children and adolescents in different age groups. Severe traffic injuries are the leading cause of hospitalization (10%) and in 10% of cases the most severe traffic injuries have left children and youths disabled. A study in the year 2000 suggests that children and youths up to the age of 24 represent 43,6% of all injured people and 26,5% of casualties dying in car or traffic accidents. Over the coming years traffic is expected to increase and already a positive correlation between number of drivers, vehicles, accidents and deaths can be observed, whereas in western European countries the number of accidents and injured is higher but the death rate is much lower, owing to effective preventive interventions.

The state of oral health of the population in general and of children in particular is far from adequate. In some epidemiological studies in 2000, the registered index for decayed,

missing and filled teeth (DMFT-12) is over 5 *(13).* In comparison, in 2000 the DMFT-12 index was 1,47 in the 15 countries belonging to the EU prior to May 2004 and 3,71 in the 10 countries joining the EU in May 2004 (see European Health for All databases, January 2006. Against this background there is a need at national level for properly organized preventive programmes to improve dental hygiene.

Traditional public health activities working in concert with pre-school health protection programs have maintained vaccination coverage rates above 95%. Also, during the same period, no cases of neo-natal tetanus were reported and there have only been 27 cases of measles and 5 of pertussis. The certification for eradication of malaria has been achieved in 1973. The reported malaria cases were due to imported cases from countries where malaria existed. Since 1976 in the country there were no reported diphtheria cases and since 1987 there was no reported case of acute poliomyelitis, i.e. since 2002 the WHO has announced the Republic of Macedonia as polio free country and no cases of polio have been reported in the last five years.

Deaths due to diarrhoeal diseases among children under 5 years peaked to 100,6 per 100.000 in 1992 and have reduced to 16,4 per 100.000 in 2000. Much progress remains to be made, however, as these rates are still four times higher compared to the CEE average and almost thirty times higher compared to those of the European Union.

The Typhoid and Para-Typhoid is not an epidemiological problem in the Republic of Macedonia anymore because there has been registered only a sporadic cases during the period 1990-2003. The average registered cases for this decade were 4.1 cases per year. The Para-Typhoid was registered by 1 case per year. The Dysentery in the period 1990 - 2000 has been registered with average 258 cases per year and still presents a significant epidemiological problem, with higher registered number in 1998 (388 cases). The average morbidity rate of dysentery for the period 1990 - 2000 was 12,8 per 100.000. In 2001, only 107 cases where reported which shows a 7,3% decreasing compared with the year 2000.

This disease for the period 1990 - 2005 was registered with average 6.853 cases per year and average morbidity rate of 347,7 per 100.000 and enterocolitis is still a significant epidemiological problem in the Republic of Macedonia. The higher reported cases is detected in 2002 (Mb 335,3 per 100.000) and the smallest number in 1993. Disagreeing in criteria, methodology in practices and diagnostically procedures make some difficulties in proper definition of health condition for the diagnostics of entrocolitis. In the bigger part of the country there are laboratory capacities for its diagnostic. Therefore, there is relative high number of reported cases as well as the difference by years – 9.484 in 2000 and 3.007 in 1993.

The Hepatitis A diseases are actual epidemiological problem in the Republic of Macedonia with registered relatively high number of cases and showed high morbidity rate, too. The average number of registered cases was 1.075 per year and average morbidity rate was 53,6 per 100.000. The existing problem in the viral hepatitis diagnosed procedure is lack of markers for completely testing in some laboratories during the some period of the year, which resulted with registered a high number of so call "undiagnosed" Hepatitis (mostly Hepatitis A). The number of registered cases of Hepatitis A in 2005 was 706 registered cases.

The Republic of Macedonia adopted the “Health for All” policy after joining the World Health Organization in 1993. Cooperation with WHO started in 1992 when the WHO Humanitarian Assistance Office was opened. The WHO Liaison Office was established in Skopje in 1996.

6.1.4 Health Risk Impacting factors

There is a serious lack of data and information on exposures, effects and biological models that connect them. Therefore considerable uncertainty surrounds many issues of concern, such as air pollution, noise, water contamination, waste, climate change, chemicals (including endocrine disruptors and antibiotics), ionising and non-ionising radiation.

In many cases, however there is sufficient evidence to take preventive action, particularly where the impacts may be serious, large-scale and irreversible – circumstances which merit the use of the precautionary principle. Preventive action on many of the environmental hazards covered in this chapter is being taken, but more integrated and effective action is being proposed to reduce threats to health and well-being.

Risk and hazard are two distinct, but interrelated, concepts. A *hazard* represents a chemical, physical, or biological substance that has the potential to produce harm to health if it is present in the environment and comes into contact with people. The hazardous properties of an environmental agent are defined according to the nature and severity of its harmful consequences. Fortunately, many hazards can be either contained or avoided, so not every potential environmental hazard poses an actual health risk. A *ris*k, in turn, is defined as the likelihood of adverse health effects arising from exposure to a hazard in a human population, which is conceptually expressed as the product of two factors: the probability of exposure and the severity of the consequences.

Environmental health risk assessment is an essential element in environmental management and an important condition in precise priority setting to the necessary actions for its sanitation. At present there are not sufficient scientific data available for a large number of health-related environmental hazards representing risk on human health. In addition, even with the best possible information available on the nature and level of pollutants in the environment and about population exposure to different pollutants, environmental health risk assessment may not be complete because of difficulties in analysing the complexity of possible interactions in the case of multiple exposures. Even more complex is the assessment and comparison of costs and benefits of health risk elimination. This is partly because environmental health risk assessment is still limited in its effectiveness by the inadequacy of the information available, especially on exposure. In addition, even with the best possible information, an environmental health risk assessment may not be complete because of difficulties in analysing the complexity of possible interactions in the case of multiple exposures.

The country has a few environmental hot spots, characterized by high levels of pollution (air, water and soil), due to emissions from industrial facilities.

6.1.4.1 Air pollution

According the NEAP 2 there is a direct correlation between the air pollution and human health based on a number of research works performed in the period 1997 - 2002. The positive correlation was found between the monthly average concentrations of the black smoke and SO_2 and the increased respiratory morbidity for the children at the age 0-6 and 7-14. The air pollution problem is more acute in the winter period due to the effects of temperature inversion and climate circumstances in the country; this is supported by the 32% of all sold drugs being under the respiratory diagnosis, as reported by the Pharmacy Information System. Air pollution affects approximately 60% of the population, in particular those living in the cities of Skopje, Veles, Bitola and Tetovo.

According to the available data 66% of the total annual SO_2 air emissions originate from the combustion and transformation of energy. The major contributor to the total emissions of NO_x are energy production and mobile sources with 73% and the production processes are the main dust emission source with 85% of the total annual dust emissions in 2003.

The major source for CO emissions is the road traffic with approximately 65% of the total emissions in 2003.

In regard to the industry sector, obsolete equipment and non-existent modern technologies result that this sector represents a major air polluter. The main pressure on environment (in particular air quality) originates from the metallurgy sector (until 2003 the lead and zinc smelter MHK Zletovo in Veles and Ferro-alloy SILMAK in Jegunovce, MAKSTIL, FENI Industries-Kavadarci), and the chemical industry- refinery OKTA, OHIS chemical complex and TITAN cement factory.

Large metallurgical installations, oil refining plants, tanning and production of chemicals and cement are the main sources of pollution within the industrial sector.

Most probably due to reduced volume of production, the share of industry in overall environmental pollution is limited. However, some installations are big polluters creating severe problems to the environment and the health of the surrounding population:

- OKTA, the oil refinery, is the biggest source of VOCs emission and in addition some 3600 Mg/y SO2 are emitted into the air from the petrol desulphurisation plant;
- Huge amount of dust (9000 to 17000 Mg/y) is being emitted by Ferro-alloys plant Silmak near Tetovo. 312000 m^3/h of exhaust gas containing 2 - 6 g/m^3 dust are released without treatment.
- Until closure of MHK Zletovo in 2003, the lead and zinc smelting plant located in Veles operates a single absorption sulphuric acid plant with no additional treatment of the exhaust gas leading to an emission quantity of about 2100 t/y of SO_2. Additional 1800 Mg/y of SO2 and 2.5 Mg per year of lead have been emitted through the ventilation system and the fugitive sources.
- While in operation, the shaft furnace of the Zletovo Smelter generates about 45.000 Nm3/h low calorific value gas (LCV) containing 21% CO and about one third of it is released to the atmosphere.
- Considerable amounts of ammonia have been released to air from the mono ammonium phosphate production unit of the MHK Zletovo fertilizer plant. Both MHK Zletovo plants are closed at the moment, but their restarting is only a matter of time.
- Energy production in thermal power plants (especially significant is REK Bitola because it covers approximately 75 % of the total national demand) and in district heating facilities is an additional sector that severely impacts the environment.
- Emissions from mobile sources in the bigger cities with a high population density are also a big pressure on the environment. Air emissions from the mobile sources have been directly related to the fuel quality and the number and age structure of the vehicles. The total number of vehicles in Macedonia is about 220 per 1000 inhabitants. The average age of the vehicles is around 15,5 years, and around 51% of these vehicles were produced 20 or more years ago.

Main POPs air emission pollutants are inventoried and reported in the National Implementation Plan on reduction and elimination on Persistent Organic Pollutants

In Veles a significant correlation has been found between the emissions of lead, zinc and cadmium as well as SO_2 in the air and the health of inhabitants. The higher concentration of the lead in the blood was registered and it has been connected with occurrence of cancer, respiratory diseases, miscarriages and birth defects. The direct correlation has been found by the medical experts between the particulate matters with small dimensions ($PM_{2.5}$) in the form of dust originated by the REK Bitola Power Plant and health problems

with respiratory system at adults as well as bronchia at the children age. Although there are no any study in Macedonia presenting the direct correlation between the lead from mobile sources and human health, the medical experts uses the series of publications worldwide that confirms the harmful effect of lead.

6.1.4.2 Indoor air pollution

Indoor pollution in homes is not monitored. One Study in 1999 has carried out in Bitola the second largest city in Republic of Macedonia by RIHP and 352 selected children (aged – 9 - 10 years) where distributing in two groups in separated areas according to previous data for air pollution. Health data about respiratory (allergic and non-allergic) diseases; social - economic factors, passive smoking, cooking, etc. were collected prospectively by questionnaires. 135 children from both groups were chose randomly for Spirometry. In this Case-Control Study was examined the relation between prevalence of bronchitis and runny/stuffed nose with analysed risk factors. There were found statistically significant differences ($p < 0,05$) between cases of bronchitis and air pollution; association ($p < 0,05$) between bronchitis cases and runny/stuffed nose with cooking by gas and woods, and also association between Spirometry FEV_1 Parameter between two groups.

The use of asbestos is no longer allowed, but it is still present in buildings, which have been neither cleaned up nor demolished. Any problems of exposure to asbestos are considered to be of an occupational nature. Substantial health risks come from asbestos when, the crushed asbestos crystals are aerosolised and inhaled. It is important what the size and structure of the crystal is because it determines how far down in the lungs the crystals can get before getting stuck there and causing symptoms. Since the airways in the lungs get smaller as you get deeper into the lungs, smaller crystals will go farther. Also, if the structure of the crystal is very sharp, it will be better able to penetrate the tissues and get stuck there.

Smoking prevalence was assessed in a survey among 1.203 medical doctors (i.e. about 25 per cent of the total) in 1999. The survey estimated that approximately 36 per cent of the population over 15 years of age were regular smokers, with a higher prevalence among males (40 per cent) than females (32 per cent).

6.1.4.3 Drinking water

Approximately 60 per cent of the drinking water is supplied from karstic springs, 20 per cent from surface waters, and 20 per cent from groundwater. Current control measures, frequency and standards are not in compliance with EU regulations and WHO Drinking Water Guidelines. The chemical quality of drinking water varies with the origin of drinking water sources. Almost all karstic and surface water, and significant amounts of well water, are notably short in fluoride. Some wells in Veles, Shtip and Kochani have relatively high contents of iron and manganese, and nitrates range between 1 and 5 mg/l. During the summer higher nitrate concentrations have been found in wells in Prilep and Radovis (10 - 15 mg/l). Both wells are situated in regions where the land is intensively used for agriculture. The nitrite content is generally below 1 mg/lt. Toxic parameters, such as lead, arsenic, chromium and cadmium concentrations, meet WHO- standards. A few wells in rural settlements have unusual levels of for ammonia, nitrite, nitrate and $KMnO_4$. Five per cent of all wells assessed by the Public Health Institute are microbiologically contaminated. From 1970 to 1997, there were several water-borne epidemics, caused by serious failures in the distribution networks combined with poor local hygiene practices.

Management of the sewage systems is the responsibility of the same public utilities as the drinking water supply. Only 12 cities have constructed separate sewage systems. City of Skopje has constructed separate system for wastewater (56%) and for precipitation

water (18%). Collector network of City of Skopje is 280,6 km and 1.239,1 km of sewage network on national level.

6.1.4.4 Water for recreation purposes

The most seriously polluted waterways are reportedly the central and lower sections of the Vardar, Pcinja, Bregalnica and Crna rivers. Polluted groundwater is also an issue near Skopje, and especially in Veles. The most serious water pollution concerns are the discharge of untreated wastewater from mining and industry, as well was wastewater from urban centres and livestock breeding farms. Reportedly, only 6% of wastewaters in Macedonia are treated prior to their discharge in rivers

Mineral and thermal mineral water springs are used as spas, for tourism, and as a source of bottled water. Water quality and safety meet national standards. Only some artesian wells presented high mineralisation with the presence of iron, manganese and inorganic ammonia.

6.1.4.5 Wastewater discharges

Discharge of wastewater without treatment into aquatic recipients (especially groundwater) represents a serious health risk for the population in Macedonia taking into consideration very limited number of properly designed wastewater treatment plants and realistically low sewage network coverage. In practice the only treatment plants in the country are installed and operating in the areas around the three big lakes (Ohrid, Prespa, Dojran).

Consumed water by the industry is very variable, from year to year, without defined trend. It is also very important to emphasize that large number of industry facilities are not operating, due to difficult economic situation in the country. Some of the factories are closed, some of them are working with reduced capacities and other change their production. According to the data, totally consumed water for industry (water for cooling and of TPP and other industries) decreased from 240.000 m3/year in 1998 for 75% in 2002 on 67 000 (not including cooling water). The largest consumers are chemical industry, food processing, non-ferrous metal production, and textile fibre and fabric industry. Water used for production of electric energy, except for cooling of the thermo plants, is not actually spent or polluted, because it only passes through the turbines, without changing it quantity or quality. Existing thermo plants "REK-Bitola" and "REK-Oslomej", use technological water with re-circulation water supply systems. In these systems raw water is used only for covering the water losses. Thermo plant in Negotino is using running water from river Vardar. The cooling water consumption decrease in last years fro the same level as industrial water. There is no data on quality of the used water, whether that industry has water permission for abstraction of water, and if it has, whether it is respected, how much water is used for unit of product etc. Industry wastewater is one of the most dangerous polluter of the surface and groundwater. The quantity and quality are rather variable and depend on the technology process and capacity of the industry.

There is small number of industry wastewater treatment plants constructed in the Republic of Macedonia. Most of them have only mechanical treatment, while only limited number has mechanical and chemical (biological) treatment. Some of them are not under operation due to malfunction, there are no spare parts or it is too expensive to run. Even where wastewater treatment plant is functioning, the results are not meeting the requirements.

6.1.4.6 Waste

The current condition in the waste sector such as lack of integrated waste management system, illegal dumping sites or problems with the hazardous waste represent a serious health risk.

In their 2004 State of Environment Report (Republic of Macedonia, 2004), the Ministry of Environment and Physical Planning indicate that waste is a serious issue in Macedonia. They indicate that at least 150 x 106 Mg of mine waste (principally tailings containing Pb, Cd, Zn, Cu, and organic flotation reagents) are held on mine sites; that at least 6 x 106 t of metallurgical slag and cinder has been produced by smelters, and that the two largest mining-power generation complexes so far have produced about 330 x 106 Mg of waste (mine spoil/tailings, cinder and ash). Generally, this source indicates that some data on pollution and waste (and its speciation) is available, but that the affected areas have not been adequately delineated.

6.1.4.7 Noise

The current conditions in the country recognise insufficient attention to problems of noise abatement in Macedonia:

- No systematic questioning of the population about noise nuisances as an indicator of existing stage
- Sufficient attention is not given to the noise problem at early stages of planning, reducing it to general instructions which are not an adequate basis for effective implementation of the protection.

Introduction of noise abatement and protection in late stage of planning has only the nature of remediation. Measures recommended at that point are more expensive and less effective. Cross – sectional study was performed in 2002 with aim to assess community noise exposure in schoolchildren who live and study in Skopje and to make risk assessment of community noise in this vulnerable group. This study was performed by Ministry of health, Republic Institute for health protection, Clinic for paediatric diseases and Central Laboratory within the Ministry for environment and spatial planning. Noise measurements, performed within this study, showed that school children who live and study in mixed residential – administrative – market area are exposed to elevated noise level. School children who live and study in residential area in suburban area of Skopje are exposed to noise level below WHO guidelines for prevention of adverse health effects. Psychological testing of schoolchildren with aim to make assessment of mental health in those two study groups showed that schoolchildren exposed to elevated noise level have behavioural disorders (decreased social adaptability and increased opposing behaviour).

6.1.4.8 Food safety

About 25.000 samples of food are tested annually for their microbiological safety, 40 per cent of which are from imported foods and 60 per cent from domestic production. In 2006, 4,7% of domestically produced food samples of industrial origin and 11,5% of food samples from small enterprises were found to be contaminated and 14,5% of contamination cases occurred in the distribution chain. The large number of private farmers and small production enterprises, as well as the enormous number of small trade and catering firms make legal controls very difficult. Due to the ambiguity of the law, a number of those entities do not have suitable premises, equipment, staff, professional skills or standard hygiene conditions. The conditions prevailing in traditional markets are unhygienic.

6.1.5 Occupational Health

There are no official data on occupational diseases in the Republic of Macedonia, despite the numerous studies carried out by the Institute of Occupational Health. The official register for occupational diseases (under the Ministry of Labor) has not been updated to cover all relevant occupational diseases (in line with EU regulation).

6.1.5.1 Radioactivity

Exposure to ionising radiations in principle is limited to occupational exposures of health care workers, some researchers and workers in some industries where radioisotopes are used. The Ministry of Health has the responsible of controlling and authorizing the use of ionising radiations sources, with technical assistance by the RIHP. The Radiation and Dosimetry Department of the RIPH maintains the national registry of radioactive sources and controls occupational exposures. The Department participates in international projects led by the IAAE, such as one aiming at improving radiation protection. Next to the Radiation and Dosimetry Department, the Department of Radio-Ecology of the RIPH has the responsibility of monitoring ionising radiations in the environment and working areas. It also monitors radioactive contamination in domestic and imported/exported food, cosmetics, drugs and construction material, and issues certificates of compliance. Approximately 2000 samples / year are analysed, mostly for alpha- and beta-activity; others for total uranium. The Department of Radio Ecology prepares annual report on the results of his monitoring activities, provides information to the public and services to factories, municipalities, etc.

6.1.6 Health Risk Assessment Methodologies

In the context of environmental health, the risk management process can be organized into several distinct activities. The three core activities that constitute the essential decision-making steps in the risk management process are each involved in examining different aspects of the risk problem:

- Risk Estimation
- Risk Evaluation
- Risk Control

6.1.6.1 Risk estimation

The use of science-based risk information and analytical methods to characterize the nature and extent of environmental health risks in the human population;

6.1.6.2 Risk evaluation

Consideration of the economic, social, political, and legal factors that influence a decision to adopt a particular course of action to reduce health risks - in some risk frameworks, the quantitative economic analysis of the benefits and costs of risk reduction is combined with results of the risk estimation process, so that a, risk assessment may subsume part or all of risk evaluation;

6.1.6.3 Risk control

The selection of options and the commencing of actions intended to reduce risk to an acceptable or tolerable level; this activity is often referred to as risk management, but the term risk control is more specific and better reflects the objectives of the activities it denotes.

Risk assessment is the process of estimating the potential impact of a chemical, physical, microbiological or psychosocial hazard on a specified human population or ecological system under a specific set of conditions and for a certain timeframe. Risk assessment is intended to provide complete information to risk managers, specifically policymakers and regulators, so that the best possible decisions are made. There are uncertainties related to risk assessment and it is important to make the best possible use of available information.

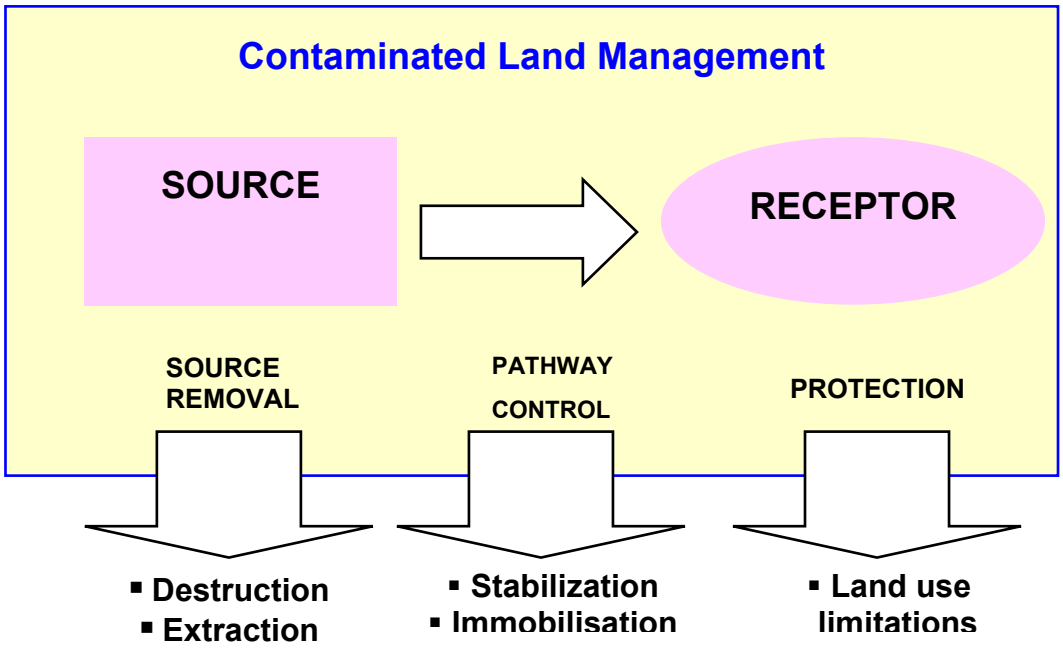
6.1.7 Methods

Retrospective epidemiological method was used in order the following four distinct and essential components of the risk assessment paradigm to be addressed:

1. Hazard identification - identification of the inherent capability of a substance to cause adverse effects by sides;
2. Assessment of dose-response relationships - involves characterization of the relationship between the dose of an agent administered or received and the incidence of an adverse effect;
3. Exposure assessment - the qualitative and/or quantitative assessment of the chemical nature, form and concentration of a chemical to which an identified population is exposed from all sources (air, water, soil and diet);
4. Risk characterization is the synthesis of critically evaluated information and data from exposure assessment, hazard identification and dose-response considerations into a summary that identifies clearly the strengths and weaknesses of the database, the criteria applied to evaluation and the validation of all aspects of methodology, and the conclusions reached from the review of scientific information.

The logical consequence of the process of assessment of potential risk is the application of the information to the development of practical measures (risk management) for the protection of human health. All available studies, articles and reports related to defined hotspots from 2000 to 2007 are included in the assessment.

The general approach for the identification of sources of contamination, associated hazards, migration pathways and sensitive receptors are as follows:



6.1.7.1 Advantage of various Methods

Many organisations are now actively involved in Environmental Risk Assessment, developing methodologies and techniques to improve this environmental management tool. Such organisations include OECD, WHO and ECETOC. One of the major difficulties concerning the use of risk assessment is the availability of data and the data that is available is often loaded with uncertainty. The risk assessment may include an evaluation of what the risks mean in practice to those affected. This will depend heavily on how the risk is perceived. Risk perception involves people's beliefs, attitudes, judgements and feelings, as well as the wider social or cultural values that people adopt towards hazards and their benefits. The way in which people perceive risk is vital in the process of assessing and managing risk. Risk perception will be a major determinant in whether a risk is deemed to be "acceptable" and whether the risk management measures imposed are seen to resolve the problem. The procedures, methods and techniques for regulatory risk assessment of chemicals in the EU is described in both legislation and supporting Technical Guidance Documents. Implementation is supported by the European Chemicals Bureau, part of the Joint Research Centre, in Ispra.

Most methodologies for human health risk assessment of chemicals are based on the NAS model. A number of methodologies exist due to differences in the toxic mechanisms exerted by different classes of chemical and the toxicological end-point being assessed. The end-point being assessed could be death, or a specific pathological condition relating to exposure to a chemical. When attempting to assess the risks from an immuno-suppressant toxin, specific end-points may be difficult to determine, as may be the role of other agents and stressors on the body. This will lead to risk assessment methodology for immuno-suppressants being different from assessments for irritants for instance. All human health risk assessments of chemicals include hazard identification, dose-response assessment, and exposure assessment and risk estimation/characterisation. If the assessment is site-specific, then a release assessment would be required in the absence of good data of environmental levels or to account for non-routine, accidental releases.

6.1.7.2 Risks and Constrains of various Methods

Risk assessments may assess individual or population risks. Individual risks may be for the average (i.e. typical) individual or the highly exposed or particularly susceptible individual and the risks may be estimated for various duration of exposure (e.g. per year or per lifetime) or for different locations. Individual risk can only be assessed for a hypothetical individual with assume characteristics. Assessing the risk for any real individual will be frustrated by the fact that risk predictions for an individual can never be validated by experience. Any real individual will either experience the negative outcome or will not. Neither of these results can validate any risk prediction other than a probability of one or zero. Population risk may relate to the number of adverse health effects (eg. fatalities, cancers, or illnesses) in a population over a specified period of time or the rate of adverse effects for a given location or sub-population.

The UNEP/ILO/WHO International Programme on Chemical Safety (IPCS), in collaboration with the US Environmental Protection Agency (US EPA), the European Commission (EC), the Organization for Economic Cooperation and Development Cooperation, and other international and national organizations developed a working partnership to foster the integration of assessment approaches to evaluate human health and ecological risks. The overall goal of this project was to promote international understanding and acceptance of the integrated risk assessment process. Three specific objectives were identified to meet this goal: 1) enhance understanding of the benefits of integration, 2) identify and understand obstacles to integration, and 3) engage key scientific organizations to promote discussion of an integrated approach to risk assessment

A generic framework and associated documentation were developed to communicate how an integrated risk assessment could be conducted. Recognizing the similarities in risk assessment frameworks currently in use internationally, the integrated risk assessment framework is based on US EPAs framework for ecological risk assessment and its associated terminology (US EPA 1998). Ecological risk assessment frameworks have greater general applicability than do human health frameworks (or those environmental frameworks derived directly from human health frameworks) in that they 1) were developed to deal with a range of environmental stressors beyond toxic chemicals, 2) must describe the nature and role of the environment in the risk assessment process, and 3) must explicitly identify the endpoint to be assessed. Further, a well-developed body of concepts and terminology exist in the literature treating ecological risk assessment that supports integration. The integrated framework consists of three primary assessment phases. During the first of these, ***Problem Formulation***, the overall goals, objectives, scope, and activities of the assessment are delineated. The *Analysis* step consists of data collection and modelling exercises to characterize exposure in time and space, and to define the effects on humans and ecological systems resulting from exposure. The methods appropriate for the Analysis step may be stressor-specific, but also depend upon the nature of the systems identified to be at risk. Exposure and effect information are synthesized as estimates of risk in the ***Risk Characterization*** step. Ideally, these estimates are quantitative with respect to the level of risk expected under different exposure scenarios, although only qualitative estimates of risk may be possible in some circumstances. The integrated risk assessment framework treats the relationships among risk assessment, risk management, stakeholder input, and data collection activities in a general parallel and concurrent manner. Essentially, risk characterisation is a summary of the data compiled in the risk assessment process including the uncertainties associated with each stage and the presentation of a risk estimate.

6.1.7.3 Parameters and Indicators for choosing a methodology

Risks can be managed in many ways. They can be eliminated, transferred, retained or reduced. Risk reduction activities reduce the risk to an "acceptable" level, derived after taking into account a selection of factors such as government policy, industry norms, and economic, social and cultural factors. It is important to note that although risk assessment is used extensively in environmental policy and regulation it is not without controversy. This is also true for risk management.

There are various criteria for assessing risk assessment including:

The logical soundness of the method is eg. its justification based on theoretical arguments or scientific knowledge, and the validity of the underlying methodological assumptions.

- **Completeness** - (e.g. whether it can address all aspects of the problem and the degree to which it excludes issues because they are hard to accommodate).
- **Accuracy** - (e.g. the precision reflected in the confidence level associated with the results; biases resulting from undue weight given to specific interests or considerations; and the sensitivity of results to untested or untestable assumptions).
- **Acceptability** - (e.g. compatibility with existing processes; whether it is viewed as rational and fair; the level of understanding for all parties affected by it; and the confidence and familiarity of those who will use it).
- **Practicality** - (e.g. the level of expertise, time and input data required).
- **Effectiveness** - (e.g. usefulness of results; range of applicability across different risks and problem areas; the generalisability of the conclusion to other problem areas; and effectiveness and efficiency of linkage with other types of methods).

The level of risk can be described either qualitatively (i.e. by putting risks into categories such as ‘high’, ‘medium’ or ‘low’) or quantitatively (with a numerical estimate). Current risk assessment methods do not enable accurate quantitative estimates of risk for low levels of exposure to environmental hazards. Numerical estimates of risk will rarely be feasible because of variability in the agent and population and limitations in toxicological and exposure data that will be reflected in the uncertainty assessment, but a degree of quantification may be possible for some components such as data collection and exposure assessment.

6.1.7.4 Qualitative Risk Assessment Matrix

Regarding human health, the assessment was focused on exposure routes, both direct and indirect. For each of the sites we established what exposure routes exist and what routes are significant. We also established the number and type of people that may be affected to a significant extent, depending upon location, age and profession. Finally, using an expert judgement method the conclusions are based of principles used during a qualitative risk assessment for each of 4 hotspot sides.

Table 3_Illustration of principle, used during a qualitative risk assessment

Contaminant Hazard
- Significant (H)
- Moderate (M)
- Minimal (L)

Migration Pathway
- Evident (H)
- Potential (M)
- Confined (L)

Receptors
- Identified (H)
- Potential (M)
- Limited (L)

Contaminant Hazard Factor	Receptor Factor	Migration Pathway		
		Evident	Potential	Confined
Significant	Identified	HHH	HHM	HHL
	Potential	HHM	HMM	HML
	Limited	HHL	HML	HLL
Moderate	Identified	HHM	HMM	HML
	Potential	HMM	MMM	MML
	Limited	HML	MML	MLL
Minimal	Identified	HHL	HML	HLL
	Potential	HML	MML	MLL
	Limited	HLL	MLL	LLL

6.1.8 Site Specific Risk Assessment

6.1.8.1 Background

The structure of the Macedonian industry is in a favour of creating large amounts of waste. The biggest generators of waste in the industrial sector of Macedonia are: ferrous and non-ferrous metals production plants and solid fuel combustion units within the industry sector. Liquid waste is also generated from industrial operations. Most frequently it is oil or oil rich emulsion. There is no clear policy on the final faith of oily waste and some operators have been advised bay the authorities to pack liquid waste in barrels and dispose them on the nearest municipal landfill. It is estimated that about 5,5 Mt of waste are produced each year, out of which 4,5 Mt are flotation tailings. The air and water pollution as well as the waste generation contribute to the pollution of soil. During previous CARDS 2001 Project, 16 identified contaminated industrial sites were analysed and based on various environmental criteria 3 classes were developed: low, medium and high risk contaminated industrial sites. Methods for closure / remediation were developed and (unit) cost estimates made. The total remediation costs are estimated at € 70 million from the Cards 2001 project, while the Cards 2006 project estimates a budgetary need of € 200 million taking all locations into consideration requiring remediation.

This Project is a follow-up project with objective to further investigate the total pollution and health environmental impact per 4 defined sites as well as to provide a more detailed specification of the proposed remediation/closure methodology and the related costs. As a primary task for this Project the health impact assessment was done for **4 marked** as "hotspots" Macedonia sites:

- OHIS, a chemicals producing company, has accumulated and disposed on site over 15.000 Mg of α, β and δ HCH isomers. Considerable amount of mercury has been either discharged with the wastewater or leaked from the process equipment contaminating the former chlorine electrolysis plant site soil .
- The soil in a wide area around Veles has been contaminated with zinc, lead and cadmium arising from the lead and zinc smelter operation from 1973-2003. Due to the high mobility of airborne cadmium it has been found in even wider area.

  In addition to the smelter area, the region of Veles is affected by the gypsum landfill of the fertilizer plant located some 11 km south of the town of Veles.
- Huge amount of mono-chromate containing sludge has been deposited on a landfill near to the SILMAK (a ferroalloys smelting company) in the area of the village Jegunovce. This sludge is the solid waste produced during the operation of the sodium bi-chromate production plant. The Government of Macedonia has already undertaken measures to eliminate the risk of contaminating the river Vardar and the potable water springs.
- **Iron and steel work in Skopje due to dust emission from the steelwork's EAF and the ferroalloys electric arc furnaces along with oily scale from the hot rolling mills is a significant source of pollution and in addition, it will be very difficult to control it because of the number of different operators and is currently under IPPC procedures.**
- **The old Ferro Slag site of the former integrated steelwork is a potential source of groundwater contamination with Manganese and air pollution due to dust emission.**

6.1.9 Specific Situation – Makstil – Ferro Slag Dumpsite

Makstil AD, the country's largest steel producer, received a seven-year US$15 million loan in 1998 from EBRD for modernization, in particular the installation of continuous casting, which will result in reduced dust emissions and improved energy efficiency.

6.1.9.1 Hazard identification

6.1.9.1.1 Iron

Iron is the second most abundant metal in the earth's crust, of which it accounts for about 5%. Elemental iron is rarely found in nature, as the iron ions Fe^{2+} and Fe^{3+} readily combine with oxygen- and sulfur-containing compounds to form oxides, hydroxides, carbonates, and sulfides. Iron is most commonly found in nature in the form of its oxides

6.1.9.2 Environmental Levels and human exposure

6.1.9.2.1 Air

In remote areas, iron levels in air are about 50 – 90 ng/m3; at urban sites, levels are about 1,3 µg/m3. Concentrations up to 12 µg/m3 have been reported in the vicinity of iron- and steel producing plants.

6.1.9.2.2 Water

The median iron concentration in rivers has been reported to be 0,7 mg/l. In anaerobic groundwater where iron is in the form of iron (II), concentrations will usually be 0,5 – 10

mg/liter, but concentrations up to 50 mg/liter can sometimes be found. Concentrations of iron in drinking-water are normally less than 0,3 mg/liter but may be higher in countries where various iron salts are used as coagulating agents in water-treatment plants and where cast iron, steel, and galvanized iron pipes are used for water distribution.

6.1.9.2.3 Food

Iron occurs as a natural constituent in plants and animals. Liver, kidney, fish, and green vegetables contain 20 – 150 mg/kg, whereas red meats and egg yolks contain 10 – 20 mg/kg. Rice and many fruits and vegetables have low iron contents (1 – 10 mg/kg).

6.1.9.2.4 Estimated total exposure and relative contribution of drinking-water

Reported daily intakes of iron in food — the major source of exposure — range from 10 to 14 mg. Drinking water containing 0,3 mg/liter would contribute about 0,6 mg to the daily intake. Intake of iron from air is about 25 µg/day in urban areas.

6.1.9.2.5 Kinetics and metabolism in humans

Iron is an essential trace element in living organisms. The data in this section are derived from studies in humans only; laboratory animals are not acceptable models because they have much higher intakes than humans and do not absorb iron compounds in the same way. Most iron is absorbed in the duodenum and upper jejunum. Absorption depends on the individual's iron status and is regulated so that excessive amounts of iron are not stored in the body. Total body iron in adult males and females is usually about 50 and 34 – 42 mg/kg of body weight, respectively. The largest fraction is present as hemoglobin, myoglobin, and haem-containing enzymes. The other major fraction is stored in the body as ferritin and haemosiderin, mainly in the spleen, liver, bone marrow, and striates muscle. Daily losses of iron in adults are small (1 mg/day) and due mainly to cell exfoliation. About two-thirds of this loss occurs from the gastrointestinal tract and most of the remainder from the skin. Iron losses in urine and sweat are negligible. In adult females, there is an additional iron loss of about 15 – 70 mg each month in menstrual blood.

6.1.9.3 Manganese

Manganese is one of the more abundant elements in the earth's crust and is widely distributed in soils, sediments, rocks, water, and biological materials. The major sources of man-made environmental pollution by manganese arise in the manufacture of alloys, steel, and iron products. Other sources include mining operations, the production and use of fertilizers and fungicides, and the production of synthetic manganese oxide and dry-cell batteries. Organo-manganese fuel additives, though only a minor source at present, could significantly increase exposure, if they come into widespread use. Average manganese concentrations in soils range from about 500 to 900 mg/kg and concentrations in seawater range from 0,1 to 5 µg/litre. Surface waters may have manganese content of 1 - 500 µg/litre, but in areas where high concentrations of manganese occur naturally, levels may be considerably higher. Average manganese levels in drinking water range from 5 to 25 µg/litre. Manganese is present in all foodstuffs, usually at concentrations below 5 mg/kg. However, concentrations in certain cereals, nuts, and shellfish can be much higher, exceeding 30 mg/kg in some cases. Levels in finished tealeaves may amount to several hundred mg/kg.

Manganese has been found in measurable quantities in practically all air samples of suspended particulate matter. Annual average levels in ambient air in unpolluted urban and rural areas vary from 0,01 to 0,07 µg/m^3. However, in areas associated with the manganese industry, annual averages may be higher than 0,5 µg/m^3, and have occasionally exceeded 8 µg/m^3. About 80% of the manganese in suspended particulate matter is associated with particles having a mass median equivalent diameter of less than 5 µm, i.e., particles within the respirable range. This association with small particles favours the widespread airborne distribution of manganese.

6.1.10 Exposure assessment

Iron and steel work in Skopje due to dust emission from the steelwork's EAF and the ferroalloys electric furnaces along with oily scale from the hot rolling mills is a significant source of pollution and in addition, it will be very difficult to control it because of the number of different operators. The surveys among the workers in Zelezara, Skopje done by the Institute of occupational medicine during the 1998 and 1999 has showed statistically significant differences between exposed group of workers from Zelezara and the control group in several blood and urine parameters due to manganese pollution.

Table 4_Correlation table of average annual concentration of heavy metals in air for 2006 at four measuring points nearby MAKSTIL and OHIS by control area without industrial pollution (mg/m^2)

Heavy metals	MAKSTIL	N. ZELEZARA	Nearby OHIS	N. Gjorce Petrov
Pb	0,46517	0,21827	0,00773	0,0210
Cd	0,01057	0,00603	0,00823	0,0006
Fe	3,1907	1,65265	0,68039	1,04208
Mn	0,65628	0,36393	0,13525	0,11728
Cu	0,11219	0,12639	0,0235	0,09434
Zn	0,70872	1,07717	0,13188	0,11985
Co	0,00503	0,00566	0,0039	0,00212
Ni	0,00953	0,00637	0,00599	0,0051
Cr	0,01175	0,01009	0,00268	0,05391
Sr	0,01113	0,01093	0,01395	0,0099

In accordance with the registered results from average annual concentration of heavy metals in air for 2006 at four measuring points nearby MAKSTIL and OHIS by control area without industrial pollution can be noticed that in Makstil area and Naselba Zelezara the registered values of all parameters were significantly higher compared to Naselba Gjorce Petrov

6.1.10.1 Risk characterization

A.D. MAKSTIL is an electric arc furnace based steelworks in which the process starts with preparation of the scrap for production of liquid steel and slabs casting up to production of plates. All raw materials and other materials necessary for steel liquid production before they are charging into the Electric furnace, first of all they have to be prepared. This especially refers to the scrap, which, as a basic raw-material with the highest quantitative participation, has to be separated (aggregated), before charging into the Electric furnace, out of all undesirable materials, to be cut in appropriate dimensions and to fill it correctly in baskets and to be measured, as well. The Makstil Company (steel works) continuously produces steel sheets. The raw material used in the process is scrap iron collected in the territory of the Republic of Macedonia and from import. The designed capacity is 600.000 Mg/year, with a utilization rate of around 50 % in 2002 / 2003.

Generally there are hazard identification and potential health risk due to open dumped residues from former steel works in enormous quantities for employees and population in Skopje as well as a remarkable contamination of Manganese in

soil and groundwaters. It can be stated that the current operation of the production facilities of Makstil causes significant higher Health Risks than the wastes accumulated on the investigated hotspots.

It is recommended to focus on IPPC procedures in order to avoid and reduce the risk to a acceptable limit, while the risk of the historical dump site can be marked as LOW.

6.1.11 Summary of Assessment Results

Environmental health risk assessment is an essential element in environmental management and an important condition in precise priority setting to the necessary actions for its sanitation. Risk assessment is intended 'to provide complete information to risk managers, specifically policymakers and regulators, so that the best possible decisions are made'. There are uncertainties related to risk assessment and it is important to make the best possible use of available information. Environmental Health Risk Assessment provides a tool for appraising health risks in the broader process of Health Impact Assessment.

Harm Potential damage to people, property, or the biophysical, social, or cultural environment associated with the primary industrial risks from affected hotspots. Found in this report include: chronic health effects associated with heavy metals poisoning in humans. The types of damage listed here have the potential to occur at site, local, sub-regional, regional and/or trans-boundary levels.

Likelihood The probability and frequency of the types of defined events that can cause harm and probability of specific outcomes were not assessed in this Report. However, as many pollution incidents have occurred, and many are ongoing, the likelihood of damage of the types discussed above (harm) are very high or certain in many instances. Further, the high number and common occurrence of "warning signals" as listed in the summary, indicate that many factors are present contributing to increased likelihood of incidents in site areas.

Hazards Many sources of potential harm and situations with a potential for harm were found in the study. Examples include: dissolved heavy metals; metals smelter stacks emitting near population centres; waste dumps for toxic materials located over groundwater resources; large uncovered toxic dust generating surfaces near agricultural land and population centres, and so forth and so on.

Consequence(s) The intermediate or final outcome(s) of events or situations affecting elements of the biophysical spheres observed in the study include: increased human mortality, and developmental problems in children;. Outcomes affecting elements of the social sphere include: rising opposition to mining and minerals processing from citizens; increased scrutiny and coordinated opposition from NGOs especially in Veles.

Risk The likelihood of damage to people, property, or the biophysical, social, or cultural environment listed above appears to be high. While only qualitative comments can be passed based upon this analysis, the fact that chronic damage is ongoing in many areas and that many major incidents resulting in acute effects have occurred, should underline the seriousness of the risks observed in this study.

Large quantities of industrial waste are generated in the mining, metallurgical, fertilizer, and chemical industries, as well as in the coal-fired power plants. Most of the larger industries have their own industrial waste sites.

The Table shows distribution of hazards, possible health effects and potential number of excised people by hazardous sides.

Table 5_Distribution of hazards, possible health effects and potential number of excised people by hazardous sides

Hazardous site	Hazards	Possible health effects	Potential number of excised people
MAKSTIL Skopje	Iron and steel plant; groundwater contamination by dump; air pollution	Heavy metals contamination	800 workers 470.000 inhabitants

Regarding human health, the assessment is focus on exposure routes, both direct and indirect as well as establishes the number and type of people that may be affected to a significant extend:

Contaminant Hazard

- Significant (H)
- **Moderate (M)**
- Minimal (L)

Migration Pathway

- Evident (H)
- **Potential (M)**
- Confined (L)

Receptors

- Identified (H)
- Potential (M)
- **Limited (L)**

Contaminant Hazard Factor	Receptor Factor	Migration Pathway		
		Evident	Potential	Confined
Significant	Identified	HHH	HHM	HHL
	Potential	HHM	HMM	HML
	Limited	HHL	HML	HLL
Moderate	Identified	HHM	HMM	HML
	Potential	HMM	MMM	MML
	Limited	HML	**MML**	MLL
Minimal	Identified	HHL	HML	HLL
	Potential	HML	MML	MLL
	Limited	HLL	MLL	LLL

MAKSTIL - Skopje

Contaminant Hazard:

- Heavy metals / Iron / Manganese

Migration Pathway

- Contaminated soil
- Water/groundwater

Receptors: **limited**

Defined environmental health risk: LOW – MODERATE

Defined environmental health impact: LOW

7 Process assessment – qualitative and quantitative waste assessment

7.1 Iron production plant

Steel production in Iron & Steel Works of Skopje started in 1967. In the first five years steel was produced only by a converter process, while since 1972 operation of an electric arc furnace started. Electric arc furnace increased the production up to approximate 150,000 Mg/y in the first ten years and to approxiate 200.000 Mg/y within the following ten years, followed with a period of stagnation in the years after the collapse of state-controlled industry. Since 1998, when steel-making process was restarted by the private company 'Makstil', productivity again registers continuous growth up to 430.000 t in the year 2006, but produced exclusively in an electric arc furnace.

Table 6_historical development of ownership, process and production

Indicators/Years	1967	1972	1974	1982	1986	1990	1998	2000	2006
Ownership	State	State	State	State	State	State	Makstil	Makstil	Makstil
Cadastre Activities			Mapping						Supreme Court
Converter System									
Electro Arc Furnace									
Productivity [000 Mg/y]	150-250	150-250	327	327	472	150-250	150-250	170	430

7.1.1 Process Description and significant waste streams of primary and seconduary matalurgical production and processing

Steel was produced in the steel factory Makstil (former RUDNICI I ZELEZARNICA SKOPJE) from 1967 for a period of 30 years. The total production within the period 1967 to 1999 was recorded with 8.400.000 Mg. Records from steelproduction from 1967 – 192 are given in the table below.

Table 7_Processing of steel and metal during the years 1967 till 1992

Year	Production of pig iron [Mg]	Year	Production of pig iron [Mg]
1967	27000	1980	181000
1968	89000	1981	244000
1969	170000	1982	175000
1970	139000	1983	212000
1971	226000	1984	252000
1972	113000	1985	235000
1973	248000	1986	280000
1974	285000	1987	194000
1975	239000	1988	117000
1976	161000	1989	142000
1977	237000	1990	53000
1978	202000	1991	0
1979	122000	1992	13000
Total			**4.356.000**

Electric arc furnace

The scrap iron is delivered through railway and road transportation. At the entrance gate the level of its radioactivity is controlled. The scrap iron arrives already classified (class I, II, III, bale, bernies, cast iron - scrap iron) or mixed. The large pieces are cut. Afterwards, it is fed in charging basket according to an appropriate order, but measuring the weight of each party.

The charging of scrap usually takes 3 baskets (2 to 4) depending on the scrap quality. During the melting process oxygen is blown by means of water-cooled spear. Coke and limestone are added through the additives system. When melting of the scrap iron is completely finished at 1570 - 1580°C a sample is taken and eventually Si-Mn for corrections is added.

The refining is performed mostly in a ladle furnace. At a given temperature the liquid steel is cast into a casting boiler that is put using a casting crane on an appropriate carriage on the boiler of the ladle furnace. By putting down the cover above the boiler, the three electrodes are also being put down and the process of heating and preparation of the steel starts. The ladle furnace allows the following operations:

- Treatment of the liquid steel using an inert gas, homogenization and deoxidation;
- Desulphurization;
- Creation of fluid slag with added fluxes by desulphurization of the liquid steel;
- Fine alloying;
- Treatment of the liquid steel with CaSi;
- Increasing or maintenance of the temperature.

Continuous casting

Casting of steel is performed on a proper device. The cover is opened and the boiler is loaded with liquid metal. When filled, the monoblock is lifted, and crystallizer is filled with liquid metal. The casting powder is put in the crystallizer in small portions over the whole metal surface during a given time period.

Rolling mill for thick plate

Preparation of slabs is done with a half-automatic knife for flame cutting and manual flame guns. Prepared slabs are then heated in heating furnaces for their further plastic deformation. The heat that is needed to heat the slabs is provided by burning natural gas. The rolling of the slabs is made on a universal recurrent quarto rolling machine produced by Davy United from England. Depending on the quality of steel, slabs arrive at the rolling machine heated at 1150°C to 1200°C. The rolling of the slabs is made on a universal rolling machine which is consisted of a vertical and horizontal rolling machine. Afterwards, the rolled plate through a cylinder transporter goes to a smoother, and from there is being transported on the cutting line where the plate is cleaned, cut and measured.

The cooling chamber consists of: plate cooler, visual control of the surface, marking in of all the necessary information, transportation system, line of knives, cutting of the plates with thickness of 40mm. Thicker plates are cut with half-automatic and automatic knives. A visual plates control is being performed by controllers.

Sandblasting, painting and drying is performed with continuous sanding, painting and drying of the plates (See figure 3). Sanding is performed using steel balls (buck shots), and surface of the plate is cleaned from the metal oxides thus producing fine, flat surface. Cleaned plate is then painted with a primer, in order to be protected from corrosion. Painting chamber possesses a filter for cleaning out the air. The Drying chamber is used for fast drying of the paint by means of a burner with natural gas.

7.1.1.1 Inputmaterial

Table 8_Input and raw material

Name of the raw material			Unit	2004
Electric arc furnace	Anthracite (C)		kg/year	2189000,00
	Coke (C)		Mg/year	377,00
	FeMn		kg/year	443000,00
	FeSi		kg/year	552000,00
	SiMn		kg/year	2634000,00
	Al		kg/year	346000,00
	Lime (CaO)		kg/year	11053000,00
	Fluorite ($CaAlF_2$)		kg/year	288000,00
	Dolomite (CaO анд MgO)		kg/year	3197000,00
	Electrodes (C)		kg/year	940000,00
	Fireproof material (MgO 97%)		kg/year	316000,00
Ladle furnace	Electrodes		kg	160150,00
	Argon		m^3	137707,00
	Lime		kg	1176500,00
	Fluorite		kg	114740,00
	Carbide		kg	59900,00
	Bauxite		kg	166300,00
	Al block		kg	134900,00
	Al wire		kg	190700,00
	SiCa		kg	259900,00
	SiMn		kg	1797654,20
	FeSi		kg	667200,70
	FeMn		kg	2840701,50
	Anthracite		kg	802469,10
	FeNi		kg	786655,80
	FeCr		kg	1642653,80
	FeV		kg	112171,30
Compressed air		Steel mill	m^3	14746,00
		Rolling mill for thick plates		18675,00
Nitrogen (N_2)		Steel mill	m^3	373707,00
		Rolling mill for thick plates		62784,00
Argon		Steel mill	m^3	146835,00
O_2		Steel mill	m^3	14188092,00
		Rolling mill for thick plates		1427790,00
Paint		Rolling mill-Chamber for painting	l	57074,00
Solvent			l	5330,00
Steel buckshot		Rolling mill-Chamber for sanding	kg	29000,00

7.1.1.2 Size preparation of raw materials

Ore, mainly iron oxide minerals (**hematite**, Fe_2O_3, **magnetite**, Fe_3O_4, **limonite**, $Fe_2O_3.nH_2O$) was crushed and grinded and homogenized. Flux, limestone and lime were size reduced up to 30 mm as well and lignite coal was stored in stock houses.

7.1.1.3 Production of pig iron

Raw-materials were fed into a rotary kiln for calcinations and partial reduction, while in an electric arc furnace the reduction of iron oxides was completed and melting at the temperature above 1600 Centigrade takes place.

Typical reactions of reduction of iron oxides and formation of metallic iron are, e.g.:

$2Fe_2O_3 + 3C \rightarrow 4Fe + 3CO_2$

$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

Coke and other types of coal, as lignite in this case, are the reduction agents. They are transformed into gases, e.g. CO and H_2 that directly perform the reduction. The reactions are, e.g.:

$C + O_2 \rightarrow CO_2$

$CO_2 + C \rightarrow 2CO$

or

$C + H_2O \rightarrow CO + H_2$

After smelting is completed, liquid pig iron (or cast iron) is poured out of the furnace and separated from liquid slag.

Produced metallic iron contains a lot of impurities and should be refined in order to get steel. Main impurities and/or alloying elements are: carbon, manganese, silicon, phosphorous, etc. **Molten slag is disposed on a dumpsite**.

7.1.1.4 Steel production

Whereas the production of iron is basically a reduction process (converting iron oxides to metallic iron), the conversion of iron to steel is essentially an oxidation process in which the unwanted impurities are removed from the iron by reaction with oxygen gas. Pressurized oxygen gas is introduced above the molten metal and manganese, phosphorus and silicon, as well as the excess carbon, reacts with oxygen to form the oxides. These oxides are then reacted with fluxes, e.g. CaO or SiO_2 to form slag.

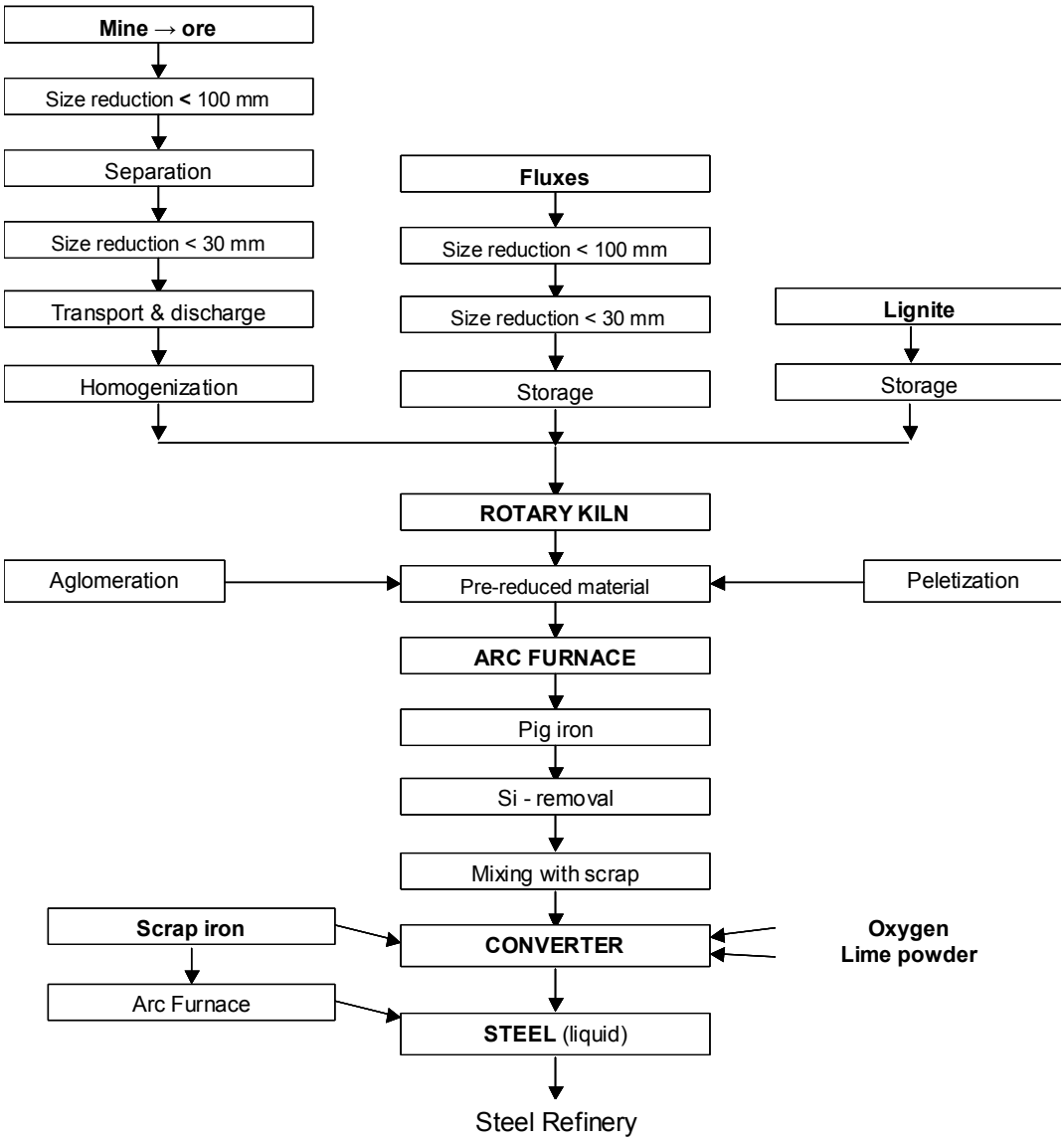
So, the impurities are transformed into $CaSiO_3$, $Ca_3(PO_4)_2$ or $MnSiO_3$.

Part of these by-products, as e.g. phosphates possess commercial value and are utilized, while the rest ended at the dumpsite.

At the end, argon is purged through the smelt to remove dissolved oxygen and the final product (unalloyed steel) was cast in ingots or slabs.

Solid waste from steelmaking process is composed mainly of slag and waste refractory materials. Waste refractory material was principally returned as a secondary raw-material to the producers of refractory.

Figure 10_ Flow sheet of steel production



7.1.1.5 Steel finalization

Final treatment of produced still is performed in so called 'Hot Mills' and 'Cold Mills'.

In Hot Mills product's thickness is reduced first by hot milling up to 40 mm, and further to coils or sheets up to 2 mm thick.

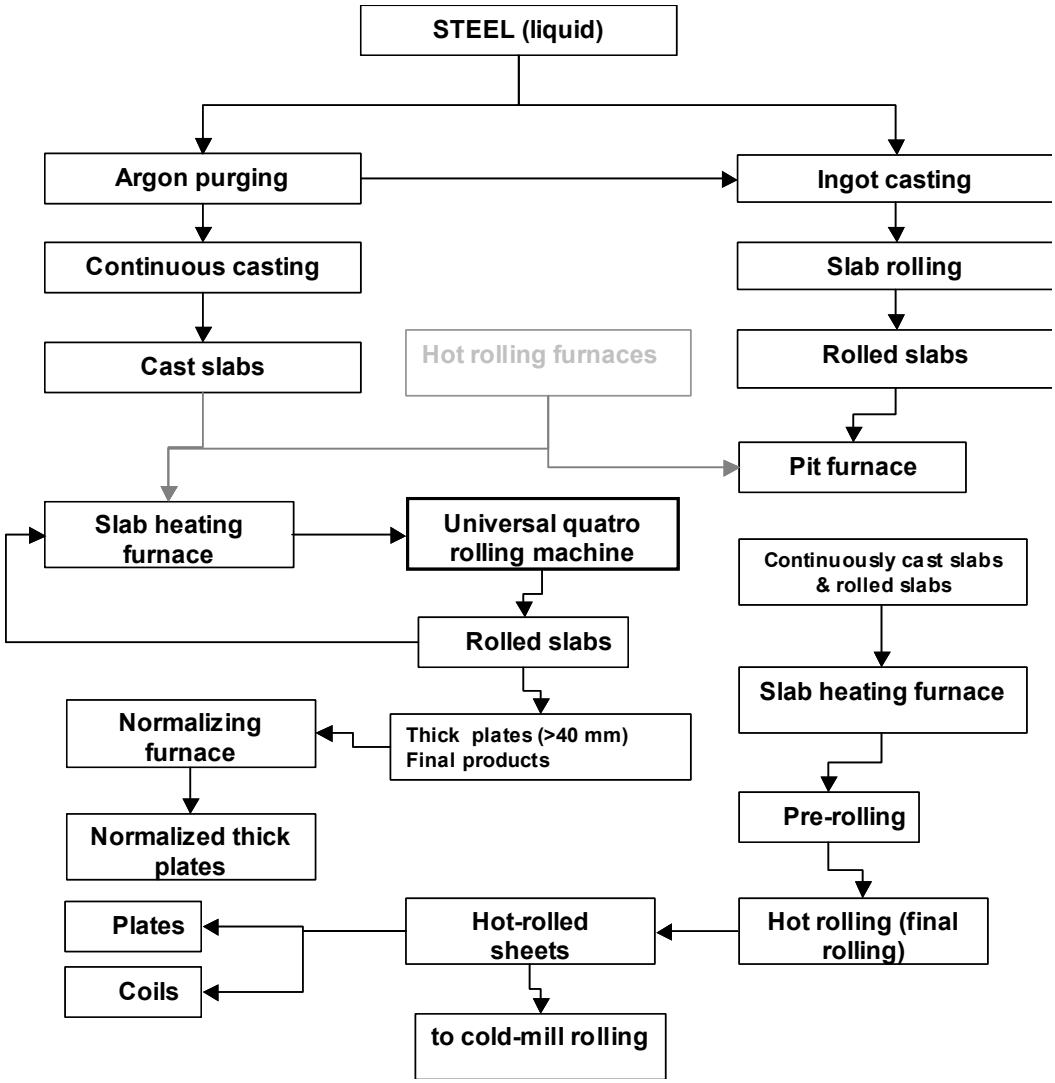
Solid waste that is formed during this operation is oxide scale that is reused. Only small part of it ends at the dumpsite.

In Cold Mills further reduction of thickness is performed, but also surface properties were improved by means of galvanizing (immersing in hot zinc) or galvanizing + plasticizing.

Prior to galvanizing, coils were leached with H_2SO_4 or HCl in order to remove the oxides from their surface. Only part of them was galvanized and even less plasticized.

Iron sulfates and iron chlorides generated in this process were disposed as solid waste at a small dumpsite, separate from the main one. Latter on, these valuable by-products were collected and used as raw-materials for other purposes.

Figure 11_steel_secondary treatment and refinery



7.1.1.6 Products

- Steels for general and construction purpose were produced according to EN 10025, ASTM, DIN 17100, ASME, BS 4360, UNI 7070 and JUS C.BO.500.
- Non-alloyed, as well as low-alloyed boiler steels according to EN 10028, DIN 17155, JUS C.BO.414, ASTM and ASME.
- Weathering steels according to DIN 17135 and JUS.BO.508.
- Steels for pipes to be welded according to API 5L and DIN 17172.
- Boat steels up to 50 mm according to ABS, LR, GL, BV, DNV, RINA, CR and JR registers.
- Fine grained construction steels according to DIN 17102

Technical unit	Name of the product	Measuring unit	Project	Annual
Rolling mill for thick plate	thick plate	(Mg/year)	50-51 Mg/h	319.883,90

7.1.1.6.1 By-products

Technical unit	Name of the product	Total manufacture (Mg/year)		Quantity used as a product or processed in the installation (Mg/year)		
		2004	2003	-	-	-
Steel mill	slab	309.149,09	291.354,00	-	-	-
Description (characteristics and use)						
Slab is a product manufactured in the section Steel mill. It's been produced from liquid steel in an electrical furnace. Afterwards, the slab goes on a finishing in the Rolling mill section for thick plate.						

7.1.2 Qualitative assessment of waste streams

In case of **iron production from the ore**, components that end in the slag are:

- tailings present in the ore (tailings were present in the ore ca 1.5 times more than iron did),
- added fluxes (mainly limestone)
- ashes that remain after the coal burns.

Solid waste generated in the steel-making process consists of oxides, e.g. SiO_2, CaO, MnO, MgO, Al_2O_3, Fe_2O_3, but also, sulfides, silicates, aluminates, phosphates as e. g. $CaSiO_3$, $Ca_3(PO_4)_2$, $MnSiO_3$.

Limestone decomposes in the furnace and gives calcium oxide (lime). Calcium oxide reacts with the impurities in the ore, mostly sand, SiO_2 and aluminum oxide, Al_2O_3:

$$\mathbf{CaO}\textit{(s)} + \mathbf{SiO_2}\textit{(s)} \rightarrow \mathbf{CaSiO_3}\textit{(l)}$$

$$\mathbf{CaO}\textit{(s)} + \mathbf{Al_2O_3}\textit{(s)} \rightarrow \mathbf{Ca(AlO_2)_2}\textit{(l)}$$

The mixture of calcium silicate and calcium aluminates **remains molten at the furnace temperature**. It is known as ***slag***. It is main component in the accumulated solid waste in the landfill.

Table 9_Slag Composition

Component	Min. Range in %	Max. Range in %
FeO	20,	25
SiO_2	15	20
CaO	35	40
MgO	7	9
MnO	6	8
Al_2O_3	5	6

7.1.3 Quantitative Assessment of Waste

In total, this means that some 1,5 Mg of slag were created when 1 Mg of iron was produced. (If we take into account refractory and other waste materials that end on the dumpsite as well, the figure is even bigger in favor of slag mass.)

In case of **iron production from the secondary iron** (scrap iron), the situation is quite different. Only 6% of each arc furnace batch ends on the dumpsite as a slag, so that in this case the mass of slag that is generated during production of 1 Mg of iron is only 0,06 Mg. (If we take into account refractory and other waste materials that end on the dumpsite, the figure is some higher).

One should point out that scrap iron was added in converters, in order to speed up its cooling and utilize its excess heat content. Scrap iron quantity is estimated as a difference between the mass of produced steel and the mass of produced iron. The amount of slag formed during the steel-making process in the converter is also taken to be 6% of the produced steel.

According to available data, it the period 1967-2000, following quantities were processed:

1. Pig Iron in Electric Arc Furnaces: 3.782.800 Mg

2. Steel in Converters: 4.754.300 Mg

For the sake of simplicity, let's assume rounded figures, i.e.:

1. Pig Iron production from ore with ca 40% Fe content 4.000.000 Mg

2. Added Scrap Iron 1.000.000 Mg

3. Produced Steel in the converter, with formation of 6% slag 5.000.000 Mg

Then the quantity of waste disposed at the dumpsite in these 34 years is equal to:

Source of Waste production	**Waste in Mg**
1. Slag from Pig Iron production = 150% of the produced pig iron = 1,5 x 4.000.000 Mg =	6.000.000
2. Slag from Steel-making in converter = 6% of produced steel = 0,06 x 5.000.000 Mg =	300.000
3. Refractory and other consumable materials = ca 10 kg/Mg slab, per normative (or 1% of produced steel) =	50.000
4. Other waste = (civil engineering scrap etc.), 500 Mg/year =	17.000
Total waste at the dumpsite:	**6.367.000 Mg**
At waste density of 2.5 Mg/m^3	**2.546.800 m³**

7.1.4 Ferro Slag Dumpsite "Troski Dump"

The dumpsite used for disposal of former productin residues has a surface of 132.718 sqm [A] and a perimeter of 1.835 m and is split by a virtual fence, drawn in the year 1974. Neither the ownership of the southwestern, nor of the northeastern part is clear. Currently it is used for the recovery of Ferro slag under the license of the stock exchage company RSH Truska.

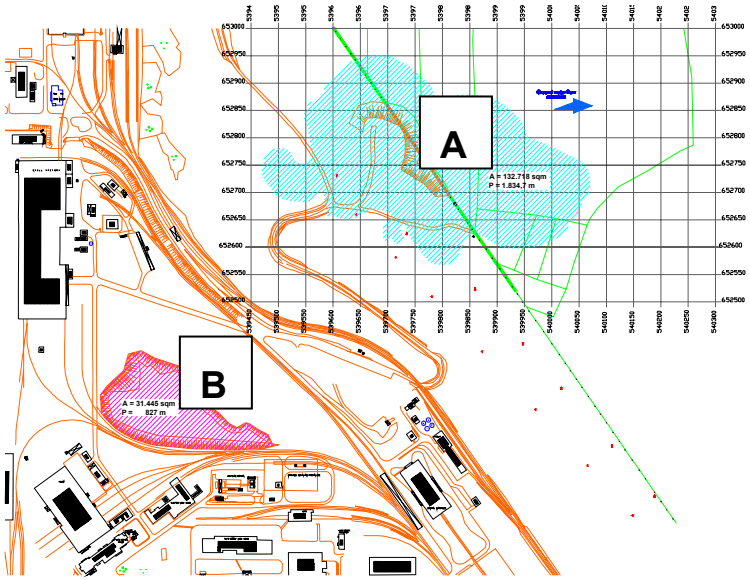
The topography of former records showing altitudes between 303 and 194 m. The current site has a height of average 25 – 30 m, while the net height of the slag dump is in average 19 m.

132.718 sqm x 19 m = 2.500.000 m³, which underlines the former waste quantity calculation. A total amount of 6,4 Mio Mg of slag from former production is disposed, which consists of approximate 3% of reuseable ferro components, which is an calculated amount of 223.000 Mg. Those ferro components are collected by the company Rsh Truska and currently sold abroad.

Another dumpsite currently used on the property of Makstil is under IPPC process [B] and not topic of this feasibility study. The site shows a surface of 31.445 sqm and a perimeter of 827 m and is located close to the production facility.

Map 1_Topographical layout and altitudes

Map 2_Layout of Ferro slag dumpsite in Makstil and boudaries



Picture 1_Ferro Slag Dumpsite in North Direction

Picture 2_Ferro Slag Dumpsite in North East Direction

7.1.6 Relevant physically – chemical characteristics of the waste material

7.1.6.1 Characteristics of Manganese

Chemical symbol	Mn
Atomic number	25
Atomic mass	54,938 g*mol^{-1}
Electro negativity according to Pauling	1,55
Density	7,4 g*cm^{-3} at 20°C
Melting point	1.517 °C
Boiling point	2.235 °C
Isotopes	1

Appearance grey-pink metal

Odours odourless

7.1.6.2 Average composition of the slag

Source of the waste		Quantity in Mg 2004	Chemical composition
Steel mill	**Slag**	**34300**	**FeO 20-25%, SiO_2 15 - 20%, CaO 35-40%, MgO 7 - 9%, MnO 6-8%, Al_2O_3 5 - 6%**
	Fireproof materials	1320	Dolomite and magnesite
	Dust from the filter line	5000	Fe_2O_3 30-40%, SiO_2 4-5%, MgO ≈10%, MnO ≈ 10%, Al_2O_3 1-4%, ZnO 6-10%, PbO 2-4%, S 0.6-1%
	Waste oils	15	-
	Barrels 180 l	270 barrels	-
Rolling mill for thick plate	Metal oxides from the rolling mill	6800	Fe oxides (FeO, Fe_2O_3 i Fe_3O_4) with Fe_{total}62.9%
	Fireproof material	100	
	Mud from the deposit	200 m^3	Fe oxides (FeO, Fe_2O_3 and Fe_3O_4) with Fe_{total}62.9%
	Barrels	800 barrels	-
	Dust from sanding	100	Fe oxides and steel buckshot
	Plastic cans	5760 cans	-
	Steel cans	5760 cans	-

7.1.6.3 The toxicity of some of Manganese

- Manganes $LD_{50(rat)}$ >21,5 mg / kg

7.1.7 Pollution Dilution and Undergound Conditions

7.1.7.1 Current ongoing pollution from ferro slag

Due to the circumstance, that the dumping has been stopped since the year 1998, a direct pollution from the production does not more occure. Ongoing pollution due to precipitation and wash out of **Manganese [Mn]** into the soil and groundwater shows evidence. Also a diffusion of dust due to a not covered surface into the air of approximate 10-20 Mg/year has been evidenced. The dump has a surface of 133.000 sqm and is accessable through the steel factory Makstil.

In order to evaluate the pollution dilution, caused by the Ferro slag dump, geoelectrical resistivity measures have been undertaken and potential pollution dedected.

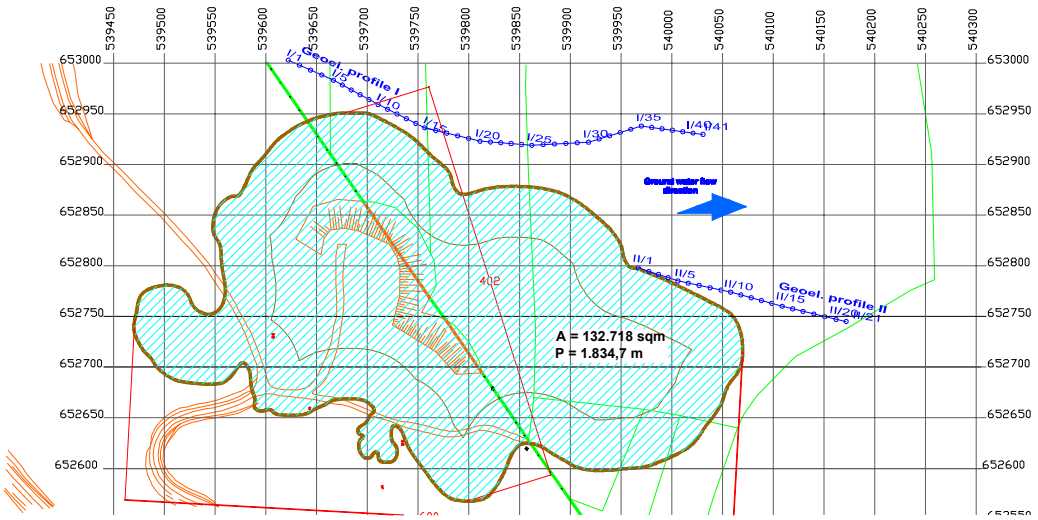
The geo-electrical investigation has been performed on the region east from the disposal area and tests are done at the area around the waste dump. The geoelectrical testing is performed with the method of geoelectrical mapping of 3 depth entrances. Symmetrical four-electrode Wener arrangement (A-M-N-B) was used, with distance between neighbouring electrodes of 10, 20 and 30 m, which approximately refer to the depth entrances of about 5, 10 and 15 m. Two profiles have been performed with total 55 points, which is equal to 128 points for all three entrances (Table 1 and Map 1 – [11.6.1]).

Table 10_Scope of performed geoelectrical measuring

Profile	Length L (m)	Number of points	Points per depth entrances AB/2			
			AB/2=10m	AB/2=20m	AB/2=30m	Σ
I	430,00	41	38	35	32	105
II	212,00	21	18	15	12	45
Total:	**642,00**	**62**	**56**	**50**	**44**	**150**

The terrain measurements are consisted of measuring of specific electrical resistance of the bottom, by emission of direct current in the ground (per two deliverable current steel electrodes A and B) and measuring the accepted voltage on the terrain surface (per two potential copper electrodes M and N). As a source for supply are used dry batteries with maximal voltage of 300 V. Profile I and II reflecting current underground conditions and identify a groundwater stream into north-northeast direction towards the river Vadar.

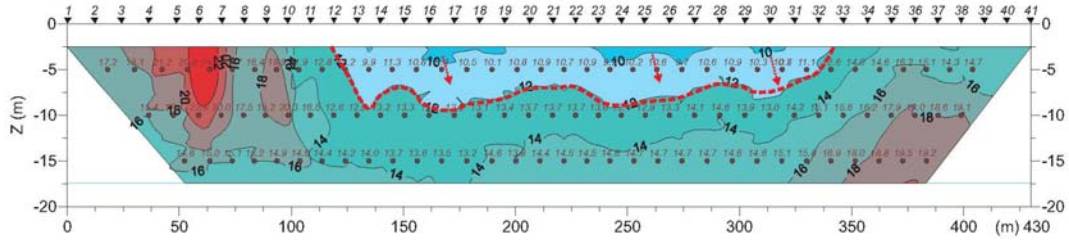
Figure 12_Profiles for pollution dilution determination at Makstil slag dumpsite



The presence of the pollution in the investigated geo-area, caused mostly by Manganese [Mn], Ferro [Fe] and other metals from the slag **on** the disposal place, should be reflected with reducing of the values ρ_ρ. With penetration of the surface water, these metals from the disposal can migrate in the underground water in the hydro collectors. Because of the bigger volume weight, they are settling in the smooth grain fractions of the soil through which the underground water filtrates.

With the geo-electrical investigations, it is registered summary influence of the lithological structure, of the underground water and the migrated polluters in the soil and the underground water. The registered values of ρ_p are shown per probe profiles with regions in 3 intervals as demonstrated in chapter [11.6.3]. During the data processing the data was transformed into an adequate format and inverted with RES2DINV (industry standard) to obtain the true depth of the resistivity data. At 2,5 m depth, the shallowest depth, which could be mapped, data from the profile was taken and a contour map rendered, for a illustration of the low resistivity zones, which could be possible contamination zones.

Figure 13_Apparent resistivity cross section



7.2 Interpretation of pollution dilution

7.2.1 Profile Ma I

- is located on the north side of the stockpile (on the north side of the swamp), in order to define the contaminated area and the direction of movement of the groundwater and the pollution and the depth of the underground profile (including inclination of slope)The profile is 430 m long.

At this profile are registered values of ρ_ρ from 9,4 ÷ 24,4 Ωm (average of 14,5 Ωm). The anomaly zone with low values of ρ_ρ < 12 Ωm, which can refer to lower density (tipping area) area, appears in the middle section of the profile from point 12 to point 33, from the surface of the terrain sown to depth of 7 ÷ 10 m. In the frames of this zone, the lowest values are registered at points 16 ÷ 19, 23 ÷ 28 and around 30, which refers to lowest density of the area and the most impacted zone from the enclosed slag dump. The shape of the contour lines refers to a horizontal layered area built mainly of silty dust-clay-sandy material. Exception from that is the west part of the profile, between the points 5 and 7, where are registered the higher values of ρ_ρ >20 Ωm, which refer to presence of sandy material.

As can be seen in Annex [11.6.3], the low resistivity zones between -5 to 20 ohmm are displayed in bright blue and could be potential contaminated zones, and are marked with red lines. Due to measurement geometry (trapezoidal) and the lacking depth of the investigations, further areas, which could be possible contamination zones are noted with question marks.

7.2.2 Profile Ma II

- is located on the northeast side from the stockpile, in order to indicate the depth of migration of the impact in the area between the stockpile and the swampy area.

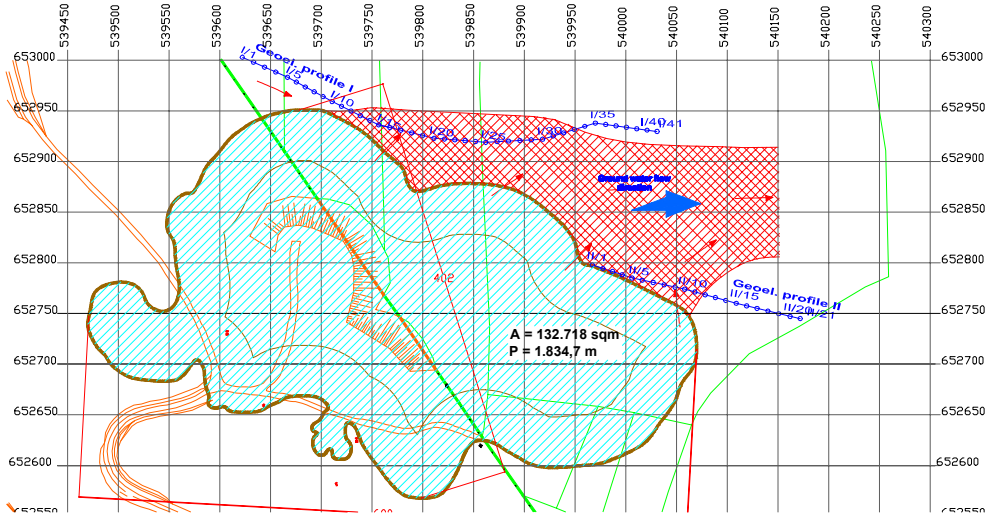
This profile has been conducted at a length of 212 m. Values of ρ_ρ are registered in the interval from 5,2 ÷ 16,8 Ωm (average of 9,5 Ωm) and are lower in relation to the previous profile, which refers to bigger presence of clay-marled material and to pollution that is more intensive.

On this profile also, is registered anomaly zone, from the beginning of the profile to point 15. As a difference from the previous profile, the zone is registered deeper from the surface of the terrain down to depth of 11 ÷ 16m and it is not closed on the east side. The lowest values, which refer to most intensive impact, are registered around point 6 and from 8 ÷ 15. The low values of ρ_ρ at the part of the profile from point 15 to 21 define clay material.

Annex [11.6.2] shows an interpretation of the data which could be verified at the measurements, and a significant anomaly zones was idemnified. The red lines show the measured spreading of these zones, while the arrows indicate a possible migration, but can't be verified by measurements. The gap between the profiles, ranging from 30 to 60 m makes an interpolation not possible, since nothing is known of the sites facilities an and the sediment covering the plot, which is probably made of river-sediments, which is going by close to the site, and fits with an interpretation of mainly sand and gravel and there typical resistivity distribution which was obtained. For an easier overlook and display only the low resistivity zones are colored. The lower figure shows the verified low resistivity zones on the plot. Please mind the coherence of low resistivity data close to, respectively on the dumpsite.

All figures are geo-referenced according to the GPS measurements taken at the survey and illustrate the position of the survey lines and electrode locations[7].

Figure 14_Pollution dilution from the slug dump into eastern direction



7.3 Recommendations

The geoelectrical investigations of the migration of impacts from the stockpile of Ferro Slag waste at the location "Makstil" - Skopje, are realized in the frames of the Project for investigations of the most interesting four "hotspots" in the Republic of Macedonia.

With geoelectrical investigations is investigated the terrain east and northeast from the stockpile, where it is expected the most intensive pollution of the soil and the groundwater in the surrounding area of the stockpile.

The terrain at the location "Makstil" - Skopje is consisted of pro-alluvial sediments (red clay with dust, sand and gravel). In the basis on them are present Pliocene sediments (dusty and clay-sands and gravels, marls, sandstones and conglomerates).

The registered values of ρ_p vary in interval from 6,2 ÷ 24,4 Ωm (average value of 13 Ωm). The variations of the values for ρ_p are interpreted with the influence of the electrical resistance of the present litho composition, ground water and migrated pollution with Fe and other materials in the soil and the ground water.

The geoelectrical investigations state anomaly zones, which probably result from that kind of impact. At the geoelectrical profile Ma I, the horizon of impact is registered from point 12 to point 33, from the terrain surface down to the depth of 7 ÷ 10m, while the profile Ma II from point 1 to point 15, from the surface of the terrain to the depth 11 ÷ 16 m.

The results show that the pollution it is most likely to come from the northeast side from the stockpile, which further deposits in the depression (swamp) and leads into the direction West East towards the artificial water pond.

It is recommended, in the frames of the impacted zones to perform at least 3 piezometric installations in order to define the following:

[7] All coordinates are in Gauss-Krueger (Potsdam Date)

- lithological composition, the level of the chemicals and
- composition of the groundwater, as well as to provide monitoring of the possible impact.
- The monitoring intervals shall be within the first year monthly, within the first year after remediation two-monthly, within the second year after remediation quarterly and shall included following parameter:
    - Heavy Metals
        - Mn
        - Cu
        - Zn
        - Cd
    - Organoleptic Parameters
        - COD
        - Temperature
        - Conductivity
        - pH
        - Oxygen saturation
    - Anionic and cationic parameters
        - Fe
        - SO4—
        - Cl-

The first piezometer shall be located at the profile Ma I near point 1 (P1), the second at the same profile can be at point 26 (P2), both with a minimum depth of 10 m; and the third at the profile Ma II between points 5 and 10 (P3) in the direction of the watershed [see attachment 11.6.4] with a minimum depth of 15 m.

Table 11_Recommended locations for drills and piezometer locations

Coding	Impacting Zone	x-coordinates[8]	y-coordinates	Remarks
P1	Iz 1	539611	652961	Depth of min. 10 m
P2	Iz 1	539873	652920	Depth of min. 10 m
P3	Iz 2	540032	652779	Depth of min. 15m

[8] all coordinates are in Gauss-Krueger (Potsdam date)

7.3.1 Seismic Characteristics and Risk Assessment of Skopje Field

The wider area of the city of Skopje is exposed to earthquakes originating from local, regional and remote seismic hot spots, having different impact on the terrain and the constructions.

The Skopje epicenter area is located in a contact zone of opposite tectonic movements, more precisely, in the zone of crossing of the fault in the Vardar direction with the East-West one. Vertical and some left oriented horizontal movements dominate these faults.

The Skopje epicenter area is one of the most active in Macedonia. Earthquakes of IX° (EMS98[9]). On July 26, 1963 an earthquake of magnitude M=6.1, epicenter intensity I_0=IX° EMS98 and depth h=5km took place having catastrophic effect on the city of Skopje. According to historical data, earthquakes with the same intensities happened in 1518 and 1555.

A magnitude of 6.5[10] has been defined as the maximum expected magnitude. Other sources, however, indicate higher maximum expected magnitudes (6.5-7[11] and even 7.2[12]).

The sources of Skopje earthquakes lay along the fault line which, in depth of 2 – 10 km stretches from south to north of Skopje Valley.

Earthquakes originated from remote (Romania, Greece, Bulgaria, Albania and Montenegro) and neighboring local seismic hot spots (Pehchevo-Kresna, Valandovo, Ohrid-Korca, Debar-Pishkopeja etc.) also impact the seismic profile of this particular area.

Table 12_Expected seismic intensity within defined return periods

Epicenter Area	Return Period (Years)					
	50	100	200	500	1000	∞
Expected mean level of the basic EMS98 seismic intensity (I_{os})						
Skopje (lokal)	6.9	8.0	8.4	8.7	8.8	9.1
Neighbouring and Remote	6.1	6.3	6.5	6.7	6.8	7.0
Expected regional accelerations of the base rock (α_0), in g, g=9.81 m/s^2						
Skopje (lokal)	0.129	0.190	0.251	0.324	0.364	0.460
Neighbouring and Remote	0.086	0.102	0.115	0.128	0.136	0.140

[9] European Macro Seismic Intensity Scale

[10] Haxievski D., "Seizmi~nost na teritorijata na SR Makedonija", Seizmolo{ka opservatorija, Skopje, 1976

[11] UNDP/UNESCO Project "Survay of the seismicity of the Balkan Region", 1974

[12] Papazachos, B. i A. Papaioannou, "Seismogenetic Sources of Shallow Earthquakes in Greece and Surrounding Area", Thessaloniki, 1997.

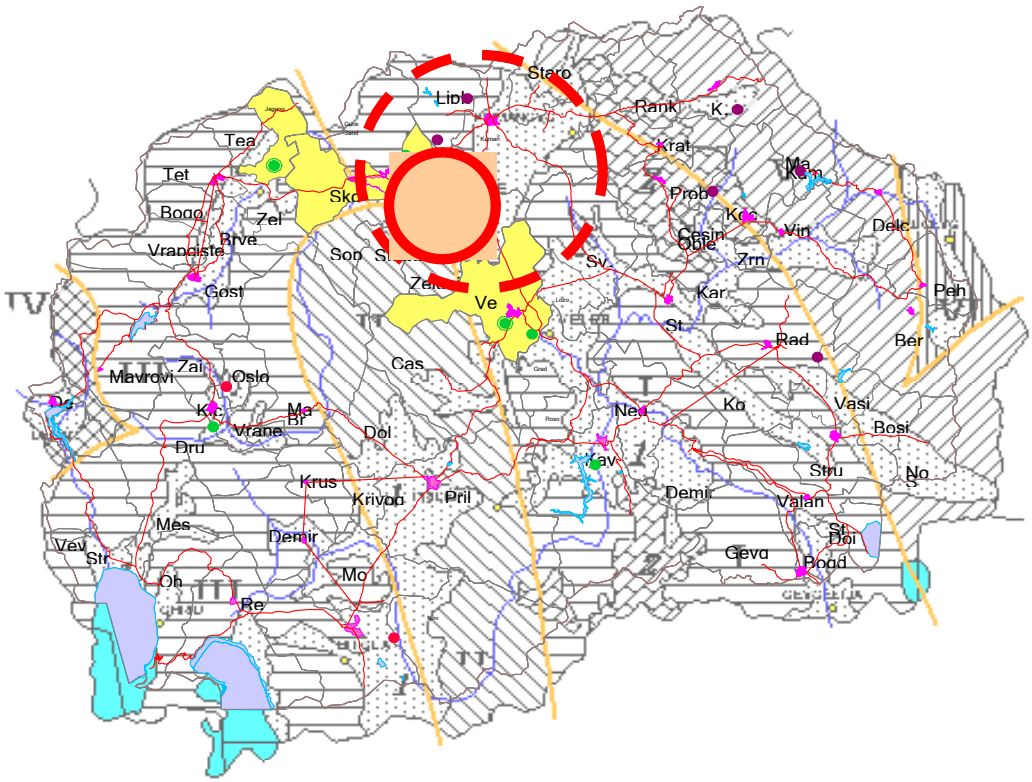
7.3.2 Makstil Location – Specific

Makstil is located on deposits of the alluvial plane of Skopje valley, made of well positioned granulated gravel of a significant depth. Such terrains are reported as most favorable in the broader surrounding urban area.

In the micro regionalization of Skopje this site has been marked as most favorable with I_{bas} = VIII° EMS98.

No detailed seismologic investigations on this site have been carried out (it has already been urbanized before the earthquake of 1963) and its potential of amplitude frequency modification of the regional seismic movement is not known enough.

7.3.3 Seismic Map



7.3.4 Conclusion

According to the building code have all buildings to be constructed to resist an earthquake rank 9 on the Mercali Ranks. The seismic risk can be evaluated as moderate till high.

7.4 Site Stability, E-module and permitted loads

Investigation have shown, that a permitted load of 1 – 1,2 kg/cm² accures (equal to 10 - 12 N/cm²) which does not limit any proposed activities on site. The dumpsite stability with 47,5 kg/cm³ is 4 times higher than the stability allows, while the dump shall be flattened or removed.

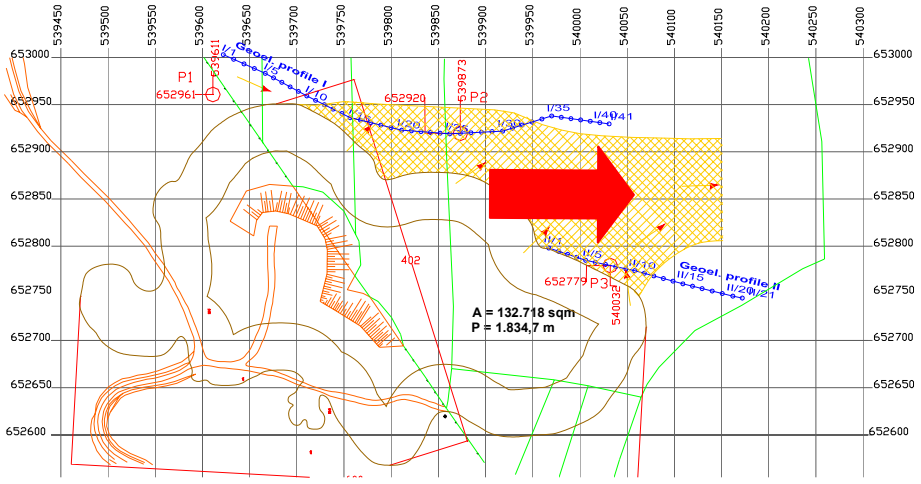
8 Environmental Impact Evaluation of existing contamination

8.1 Environmental Impact of disposed slag

As mentioned above, industrial complex is situated in the former floodplain of the Vardar River. Deposit is porous with enhanced water permeability, having filtration coefficient of 10^{-1} cm/s and even of 10^{-0}. Ground is exceptionally permeable for pollutants migration, so that hydrological contact between the upper groundwater aquifer and the river is likely possible due to shallow till swampy conditions.

Several aspects at the Makstil site raised strong environmental concerns, such as the existence of ferro sulphuric slag, while during the investigation no evidence has been indentified. Millions of tons of slag with remaining ferro content has been stored on a surface of 133.000 m with a net height of up to 19 m. The slag is containing silicates, oxides, negliable traces of Lead and other heavy metals. The iron content is up to 1%, which is not more recyclable. Significant is the evidence of Manganese, which might be diluted into the soil and groundwaters due to uncovered and open surfaces onto the dump. Manganese could be found in soil and groundwater in an amount, which cannot be identified as critical or harmful, also due to the fact, that there is no evidence of drinking water extraction out of groundwater. The surface and groundwater situation is rather shallow, so that a permanent contact to the material, especially in the swampy areas occure. Recent impacting dispersion indicated due to geotechnical investigation is given in next figure.

Figure 15_Pollution dilution profile



Waters flow on the surface into shedding areas into the direction of the swamp. Due to precipitation leads infiltration to an increased value of Manganese in the groundwater and therefore also due to shallow aquifiers into the surrounding soil. The levels are above the Dutch standars, but neither critical nor hazard.

In the next Table main qualitative characteristics and impacts of treated hotspots are given. It seems that dumpsite doesn't present any significant impact on environment.

Table 13_Qualitative characteristics and impacts of treated hotspots

LOCATION	MEDIA	CONTAMINANT and QUANTITY	IMPACT and RISK	DURATION and DIMENSION
Dumpsite: Pile, Slug from Iron&steel plant Surface of dumpsite: 133.000 sqm Partially covered with soil	Contaminated soil Ground water Surfacewater Air	Metal containing slag 2.546.800 m³ (=6.367.000 Mg) Manganese evidence Manganese evidence 10 – 20 Mg Dust/year	- on soil in north and eastern direction – **LOW** - On surface water of Vardar River and potable water – **LOW** - Local air pollution due to dust – **LOW** **Hazard: LOW** **Risks: LOW**	Long-term Local

8.2 Impact of the slag disposals on soil

There is no direct investigation/analysis of any kind of waste in the soil. There is a possibility for indirect pollution from the deposited slag from the ore smelting from the time when the former ZELEZARA (now MAKSTIL) was operating. This is hystorical pollution and MAKSTIL have no obligation to handle it. As current potentials for pollution are:

▪ Slag from the Electric arc furnace – 33.000 Mg/year, and from the Caldron furnace 5.400 Mg/year (the composition of slag is given in the Tables 2 and 3, given above);

▪ Filter dust 5.400 Mg/year, with average composition according to the analyses of RZ Tehnicka kontrola AD - Skopje:

FeO_2 36 %, SiO_2 4 %, CaO 10 %, MgO 15 %, Al_2O_3 1.5 %, MnO 3 %, S 36 %, PbO 6 %,

ZnO 11 %, CuO 0.2 %, FeO 1.8 %, Fe 0.5 %, C 2 %;

▪ Waste from the settling basins 250 m^3/year;

▪ Waste from repairs of Electric arc furnace 245 Mg/year and additional waste 35 Mg/year which will be recycled within the plant

▪ Waste from Konti liv 1.670 Mg/year, with next content: isolation of steel 150 Mg/year, protective overflows 160 Mg/year, immersed overflows 25 t/year, monoblocks 40 Mg/year, bricks 220 Mg/year, mass for coating of Inter-Caldron 550 Mg/year, mass for tamping 120 Mg/year, probes and patrons 5 Mg/year, molten powder 200 Mg/year, Slag 200 Mg/year;

▪ primary and secondary iron waste 5.000 Mg/year, of which primary 1.500 Mg/year, and secondary 3.500 Mg/year (all this iron waste is sold to "Silmak" Jegunovce).

Table 14_Chemical analysis of soil sample taken near slag dupm site

Parameter	Unit	MPC[13]	Obtained value	Method
Lead, Pb	mg/kg	85	15,72	ISO 11885/1996
Zinc, Zn	mg/kg	140	109,72	ISO 11885/1996
Copper, Cu	mg/kg	36	30,60	ISO 11885/1996
Manganese, Mn	mg/kg	-	887,60	ISO 11885/1996
TPH	mg/kg	50	4,23	US EPA 418.1

Table 15_Chemical analysis of soil sample taken near Famord

Parameter	Unit	MPC	Obtained value	Method
Lead, Pb	mg/kg	85	20,52	ISO 11885/1996
Zinc, Zn	mg/kg	140	95,96	ISO 11885/1996
Copper, Cu	mg/kg	36	31,28	ISO 11885/1996
Manganese, Mn	mg/kg	-	728,00	ISO 11885/1996
TPH	mg/kg	50	4,76	US EPA 418.1

It can be seen from the content of deposited waste, slag and other inert material, that this waste is not toxic waste and there does not show hazard for soil contamination.

Because the waste is compact mass with high specific mass, there is less of its dispersion in the atmosphere with wind. This is the reason for exception of charter for air pollution in this document. Current Risk and Impact from the slag dumpsite on soil can be stated as LOW

[13] According Dutch Standard

8.3 Impact on Ground Waters

In the following Table results of the ground water analysis are given. Only Manganese concentration is exceeding the MPC concentrations for drinking water.

Table 16_Chemical analysis of groundwater sample from the new piezometer

Parameter	Unit	MPC	Obtained value	Method
pH	-	6,5 – 8,5	7,70	ISO 10523
Conductivity	µS/cm	-	1705,00	ISO 7888
Lead, Pb	µg/l	10	0,31	ISO 11885/1996
Zinc, Zn	µg/l	100	8,96	ISO 11885/1996
Copper, Cu	µg/l	10	1,14	ISO 11885/1996
Manganese, Mn	µg/l	50	214,45	ISO 11885/1996
TPH	mg/l	-	1,2	US EPA 418.1

The only problem is the higher manganese concentration in the relation to the drinking water standards, but not to the ground and surface water standards. It can be concluded from the data above that there is no significant impact on the groundwaters from the dumpsite because there is no risk for usage of the water as a drinking water.

Results showed the existence of Manganese in ground water. Other results are not exceeding the maximal permit concentration by Dutch standards. Therefore it can be stated the existing risk and the current impact as LOW

8.4 Surface Water Impacts

Bearing in mind that on the north side of the installation is located the main river Vardar approximately 1 km down gradient and from the south it is surrounded by the mountain Vodno, it is based on the basin of this mountain, it can be assumed that pollution from the dumpsite will be transported via groundwater or surface waters to the river. Historically data about quality of the river Vardar, as a surface body near by the "hotspot" doesn't exists. Therefore are taken leakage tests from residues with an higher potential impact into consideration. This method allows to correlate the results with the residues from former disposal activities.

Table 17_Chemical analysis of filter dust

Parameter	In mg/kg
Pb	63588
Zn	232600
CU	2133,2

Table 18_Chemical analysis in leachate from filter dust sample at pH=4 and pH=7 (TCLP EPA 1311)

Parameter[14]	mg/l	mg/kg	Method
Lead, Pb **Surface water -** mg/l ClassI/II 10 ClassIII/IV 30 ClassIV >30 **Groundwater -** mg/l ClassI/II 10 **Drinkingwater –** 0,01 mg/l	98,9 0,066	1978 1,331	ISO 11885/1996
Zinc, Zn **Surface water** - mg/l ClassI/II 100 ClassIII/IV200 ClassIV >200 **Groundwater -** mg/l ClassI/II 100 **Drinking water –** 0,1 mg/l	382,4 0,00121	7648 0,0242	ISO 11885/1996
Copper, Cu **Surface water** mg/l Class I/II 10 Class III/IV50 Class IV > 50 **Ground water** mg/l Class I/II 10 **Drinking water –** 0,1 mg/l	0,272 <0,001	5,44 <0,020	ISO 11885/1996

As it is shown the slag is relatively (very) stable on the leaching tests by pH 7. By pH = 4 results exceeded MPC.

The impact of leaching waters from the existing dumpsite onto surface and groundwaters could be estimated as (very) low. **The slag from the MAKSTIL dumpsite isn't hazardous one and could be practically managed and disposed as inert one. The Impact on groundwaters can be stated as LOW**

8.5 Impact on air

The major sources of the slug dumpsite into the atmosphere is dust particles emission from wind erosion. A 13 ha area allows to estimate a yearly dust emission of 10 - 20 Mg.

Monitoring data does not exist. Levels of dust in the atmosphere are seasonal and temperature dependant.

The air emission of the slug dumpsite is limited to dust from open surfaces. Risk and Impact can be current stated as LOW due to the fact, that more than 50% of the disposal area is covered. An additional emission is caused by the ongoing recycling activities on site.

8.6 Health Impacts

See chapter Qualitative Health Impact Assessment, heading number 6.1, page number 53. In the Makstil case, the impact on health is due to the ongoing production higher, than

[14] Standard Leaching rate for municipal landfill 1.0

the impact caused by the existing and former used ferro slag dumpsite. A singular effect due to dust could be expected from open disposal site surfaces and can easily be reduced due to remediation or reclamation activities.

Health impact of slag from the Maktil disposal site is widely described in the Volume 00_A - Qualitative Health Impact Assessment.

8.7 Hazardous risk assessment

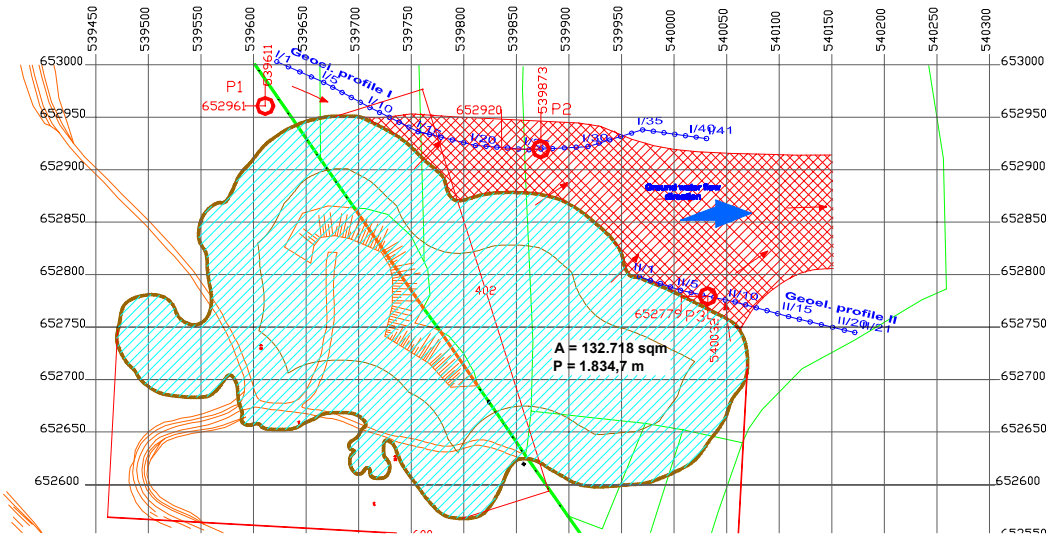
The environmental risk assessment is estimated as low, and the enviromental helth risk is limited. The hazardous risk assessment of metals is estimated as limited (not high), because the results of analysis of taken semples of water and soil, shows that only the manganese has exceeded the MPC only for drinking water (samples for groundwater). It is obvious that usage of this water as a drinking water is not possible, so it can be concluded that although the manganese is ranked as one of the most hazardous compounds (worst 10%) to human health (see Appendix – Manganese hazardous ranking), the possible impact of manganese at human health will be LOW.

9 Remediation Technique

9.1 Specification of source of site contamination

From the environmental point of view can the slag dumpsite not be stated as risky source of pollution. The composition of the waste is more or less known and potential pollution dispersion was indicated due to geotechnical investigation.

Figure 16_Potential dilution of Pollution from Slag Dumpsite



9.2 Selected alternatives for recycling and slag dumpsite remediation

Independent from the selected remediation technique on the long-term time permitted levels in soil and groundwater, according the existing standards (given in Annex) have to be reached and following possibilities taken into consideration:

9.2.1 Identification of recycling and reuse potential

A relatively recent idea in waste management has been to treat the waste material as a resource to be exploited, instead of simply a challenge to be managed and disposed of. There are a number of different methods by which resources may be extracted from waste: the materials may be extracted and recycled, or the calorific content of the waste may be converted to electricity. There are a number of methods of recovering resources from waste materials, with new technologies and methods being developed continuously.

There is also a growing acknowledgement that simply disposing of waste materials is unsustainable in the long term, as there is a finite supply of most raw materials.

The current composition of the slag dump is known and consists of two main streams

Table 19_Composition of the disposed material

Material	Unit	Amount
Slag	Mg	6.144.155
Scrap iron	Mg	222.845

Total Disposal	Mg	6.367.000

9.2.1.1 Potential Reuse of scrap iron

While the level on iron in the slag is maximum 1%, has scrap iron an reasonable iron content, which is currently collected and sold by RSH Troska. The total amount can be estimated with more than 200.000 Mg, while RSH Troska is currently collecting 200 Mg/year. The efficiency of the collection and treatment could be increased by a combination of slag and scrap recycling.

9.2.1.2 Potential Reuse of remaining slag

There are several possibilities of slag reuse:

- Cement industry; as a raw material (Portland cement contains up to 70 % of slag)
- Road construction material
- Fertilizer in agriculture

There are no specific technological requirements for the reuse of slag or scrap iron or treatment alternatives.

9.2.1.2.1 Slag in cement industry

Portland cement is the most common type of cement in general usage, as it is a basic ingredient of concrete, mortar and most non-speciality grout. The most common use for Portland cement is in the production of concrete. Portland Blastfurnace Cement contains up to 70% ground granulated blast furnace slag, with the rest Portland clinker is increased, early strength is reduced, while sulfate resistance increases and heat evolution diminishes. Taken the cover material into consideration as none recyclables, remains an amount of 6.070.000 Mg for the reuse in the cement kiln. The closest cement kiln is that of Skopje, just 6 km far from the Makstil plant. Infrastructure such as road or rail connection is existing.

9.2.1.2.2 Slag as construction material

Due to its mechanical properties and inertness slag is an ideal material in road construction, but as well in many others civil engineering activities.

9.2.1.2.3 Slug as fertilizer in agriculture

Certain types of converter slag, those containing phosphorous, are used in agriculture as a fertiliser. Due to the content of phosphorous in the pig iron produced, a LDAC converter was used to burn it together with, sulphur and carbon. Thomas powder was produced, packed and sold countrywide during the operation of the integrated steelwork. Therefore, there is no slag suitable for use in agriculture on the current landfill.

Generally the use of slag as fertilizer in agriculture is limited and depends on:

- Type of the soil
- Phosphorous content in the slag

9.2.2 Treatment Alternatives

Following possibilities for treatment, removal or simple capping can be taken into consideration:

- **No activities** – no activities will undertake. Impact on environment will remain at it is – very low. The visual impact will reduce by ongoing natural planting. No

other use of the location will be possible. Perception of population in closer neighborhood will remain negative.

- **Excavation and ex situ treatment** - waste will be excavated and transported from the location to the close by cement kiln for Portland cement production. During this process of excavation most of the scrap will be segregated, collected and sold and/or recycled. Impact on the environment during the excavation and minimal during the transport would need particular care. Problem will be solved in relatively limited time. Location will become attractive one.
- **Capping - In situ improvement of the situation – mitigation measures including segregation of scrap** for reducing of impact will be introduced. Main measure is to profile and to cover the dumpsite with hermetic cover to minimize the intrusion of atmospheric water and leaching of soluble part of the waste. Also the air emission will be minimized. In parallel to the profiling measures will scrap metal be collected, while the amount is limited to the amount of profiled material. The slopes will have to be profiled with a gradient of 1:2,5 to 1:3. This leads to an amount of 2.123.000 Mg (or 850.000 m³) which has to be manipulated. The results of scrap metal collection will be limited to maximum of 63.650 Mg. For the purpose of capping either artificial material (HDP plastic) or high dense material could be used. The enclosed standards for capping have to be followed [. Impact on environment will be in long term substantial reduced but the site will remain for decades and the location will remain with no further possible usage.
- **Capping - In situ improvement of the situation – mitigation measures without segregation of scrap** for reducing of impact will be introduced. Main measure is to profile and to cover the dumpsite with hermetic cover to minimize the intrusion of atmospheric water and leaching of soluble part of the waste. Also the air emission will be minimized. For this purpose the artificial material (HDP plastic) or high dense material could be used. Impact on environment will be substantial reduced but the site will remain for decades and the location will remain with no further possible usage.
- **Excavation and off site disposal including segregation of scrap** - excavation and safe transport required. Due to the circumstance, that in Macedonia no landfill of hazard disposal are in operation, the announced cases dealt by Cards 2006 might be a perfect start up to take those options of preparation of abandoned sites into consideration. (e.g. Lojane tailing dam for final disposal and capping). During the excavation will scrap be collected and reused, recycled or sold. An amount of 6.367.000 Mg has to be excavated, while 200.000 Mg of Scrap could be collected. Remaining top soil of approximate 66.500 m³ will stay on site for top (reclaiming layer) cover as base for tree planting. The remainig material will be transported to Lojane for covering of the abandoned tailing dam. Problem will be solved in relatively limited time. 6,1 Mio Mg will have to be transported over 60 km. Location will become attractive one.
- **Excavation and off site disposal without segregation of scrap** - excavation and safe transport required. The whole material, except topsoil (reclaiming layer) will be transported without any recycling or reuse activities to Lojane for the cover of the abondonded tailing dam. An amount of 6,3 Mio Mg will have to be transported over 60 km. Problem will be solved in relatively limited time. Location will become attractive one.

9.2.3 Environmental Ranking of various proposed methods for remediation of Makstil ferro slag dumpsite

In the evaluation of different options (even not realistic one), environmental impact was evaluated according the international practice (see e.g. EPA USA) and enlarged in the broader content of sustainability. Evaluation was done only in the relation to present location and Macedonian availability. General environmental relevant information's, different sustainable impacts and rough ranking of possibilities for different technical options are given in next table.

From the environmental point of view different, almost equal options are possible. From sustainable one (possible use of location for other purposes, sensibility of public, technical possibilities of Macedonian economy and practice), the best practice is excavation and final treatment (on or outside the location) or disposal (outside the location).

Table 20_Environmental Comparison of various potential alternatives

		Ex situ	On site		Off Site	
	No activities	**Excavation and thermal treatment – Extern**	**Capping – mitigation with measures Segregation**	**Capping – mitigation without measures Segregation**	**Excavation and off site disposal segregation**	**Excavation and off site without disposal segregegaion**
Hazard	L[15]	L	L	L	L	L
Risk	L	L	L	L	L	L
Environmental impact – FINAL	L	L	L	L	L	L
Environmental impact – during the remediation	L	M	M	M	H	H
• **on air**	L	H	M	M	H	H
• **on water**	L	L	L	L	L	L
• **on soil**	L	L	L	L	L	L
Time needed to complete solve the problem	H	M	L	M	H	M
Monitoring needs – time and frequency	M	M	M	M	M	M
Best practice – world wide use of the technology – Development status	H	L	L	L	H	H
Technical and technology assistance needed - Macedonia is self-sufficient	L	L	L	L	L	L
Sustainability - Potential use of location	H	L	H	H	L	L
Sensibility of the public (Acceptance)	H	M	H	H	H	H
SCOR	4/1/8 **47**	1/4/8 53	2/3/8 51	2/4/7 49	5/1/7 43	4/2/7 **45**
Ranked	**4**	**1**	2	3	**6**	**5**

15 H - HIGH – Always means most unfavourable or worse alternative/solution/costs (scored as 1) ; M – MODERATE – something between H and L (scored as 3); L – LOW - Always means most favourable or best alternative/solution/costs (scored as 5)

9.2.4 Chriteria of slag removal - remediation technique

As it was mentioned before, from the environmental view of point different, almost equal options are possible. From sustainable one (possible use of location for other purposes, sensibility of public, technical possibilities of Macedonian economy and practice), the best practice is excavation and final treatment (on or outside the location) or disposal (outside the location).

Before the final decision basic data about the dump site (volume, quantities, shape, monitoring data) shall be carefully recorded. Treatment should be performed based on main project design approved by authorities.

Treatment technology should be practice only with the equipment with all needed environmental protection measures, whereby the emission standards particularly on air must be fulfilled. Before the introduction of any treatment technology, operator must submit relevant evidence about the compliance to the environmental standards. If requested trough the technology, monitoring of emissions should be installed.

Main pollution during any on or outs site treatment process will probably occur during the excavation so that adequate measures need to be implemented as e.g.:

- For the excavation appropriate project must be prepared
- Whole process should recorded
- Open (excavation) dump area should be keep a small as possible
- Intrusion of water should be prohibited and eventually entered one should be treated
- In case of high dust emissions excavation must be done under shelter and sprinkling
- Chance finds of hazardous waste or other interested materials should be recorded, temporary safe storage and safe dispose
- Adequate monitoring of underground water and soil should be introduce
- The excavation should be executed until the virgin unpolluted soil will be remain
- Final geodetic measurements should be done

9.2.5 Management plan for selected alternative

Mitigation Activities - include it in decision-making process on construction or reconstruction, and during Conceptual Design Draft

Table 21_Mitigation and Environmental Management Plan

Phase	Issues – Activities	Mitigation measure and possible impact	Responsibility	Costs	Comment
Preliminary estimation of the site	Monitoring data Geodetic data Others	NON	Operator	Cover by operator	Data should be recorded present situation
	Checking of odor emissions by preliminary excavation	Impact on proposed measures	Operator		
	Project design		Checking of proposed measures by Authority		
Excavation		Sheltered excavation if needed	Operator		
		Small open spaces Control of water intrusion	Operator		
	Chance finds of hazardous waste	Temporary storage and safe disposal	Operator and Authority		
Transport (if any)	Loading and transporting	Closed lories or big bag In case of higher odor emissions close containers	Operator		
Treatment (if any)	According the selected treatment technique				
Final work	Monitoring of soil Geodetic data		Authority		Recording of final stage of the activities
Segregation	Dust control if any	Sheltered excavation if needed Small open spaces			

9.2.6 Monitoring

Monitoring schemes according selected remediation activity and relevant existing legislation Development of a monitoring plan (Monitoring Activities- during construction and use**)** including cost structure (monitoring action plan)

Table 22_Monitoring Plan

Phase	**What** **- parameter is to be monitored?**	**Where** ***is the parameter to be monitored?***	**How** ***is the parameter to be monitored/ type of monitoring equipment?***	**When** ***is the parameter to be monitored- frequency of measurement or continuous?***	**Who** **Responsibility and Reporting**	**How much** **Costs** **Investment /** **Operational**
Preliminary estimation of the site	Manganese Odor emission	Soil and underground water pollution -Close to dump site Organoleptic	Taking the samples and out site analysis	Before the work will start	Operator to Authority	NO/According the market price
Excavation	Dust emission	Air	Permanent sampling	During the excavation on regular basis	Public health insitute	According administrative fee
Transport (if any)	NO monitoring needs					
Treatment (if any)	According the selected treatment technique					
Final work	Manganese	State of the virgin soil pollution	Taking the samples and out site analysis		Authority	

9.3 Conclusion

For the remediation of Makstil ferro slag dumpsite have following options been ranked from the environmental assessment as most appropriate for further financial and economical evaluation:

Excavation and ex situ treatment (cement kiln) + scrap segregation – 1

On site mitigation measures – Capping + scrap segregation – 2

On site mitigation measures – Capping without scrap segregation – 3

No activities as the current ones - 4

Excavation and off site disposal – without scrap segregation - 5

Excavation and off site disposal – with scrap segregation - 6

10 Economical - Financial Evaluation on Makstil Slag Dumpsite

10.1 Site specific Economical Evaluation

10.2 Objective

>>Designing an ecological end-use as an integral component of the remediation system will realize more pronounced benefits from the remediation process, and in no way is intended to jeopardizeor compromise the selected remediation goals and objectives. Incorporation of ecological enhancements can benefit multiple stakeholders, such as regulatory agencies, the regulated community (industry), local communities, and the general public[16]*<<*

10.3 Possible solutions

Zelezara Factory, when was formed in year 1967, was placed at the Skopje's suburb. After the decades of fast city growing and expanding today this factory is placed in municipality of Gazi Baba, neighboring the Center Municipality, in other words it is placed in the center of the city. (FI - These two municipalities are parts of Skopje city). As the result from this very specific and important location it is curtail to find the solution which will be acceptable for the municipality and as well as for the city.

After the remediation there will be 133.000 m2 land which can be used for different purposes. Having residential, agriculture and industrial area close to the site which need to be remediated opens wide range of opportunities. Some of them will be analyzed in the text bellow.

10.3.1 No activites [Option 0]

One option is taking no activites into consideration. There are no positive effects from this option. The removal and remediation of the area is not taken into consideration

10.3.2 Green Area [Option 1]

This opportunity should include growing different kind of trees, bushes and all floras that can be suitable for the location. Direct benefit from this will have all citizens in this part of the city.

One possible sub-option is to cultivate this land with the threes which can be used in furniture industry. These will lead to a future income from selling of these woods. Of course detailed analysis from wood industry expert is needed.

The remediation (covering and greening) by profiling, but none removal of the material is required.

[16] Source: "Planning and Promoting of Ecological Re Use of Remediated Sites " prepared by Interstate Technology and Regulatory Council ITRC#

10.3.3 Elite Residential Area [Option 2]

Part of the city where the hot spot is placed is called “Zelezara”. This is the settlement build up after the earthquake in 1964 and it is placed in the Municipality of Gazi Baba. Today this is urban area with hospital, business center, buildings and nice houses and this municipality has 72.222 inhabitants according to census from 2002. The price of the m2 of apartment space is going up and up the remediated land can be used for the increasing of the residential area. The price of the houses including yard in this area is 200 euro per m2.

These days are very attractive to build up elite residential areas and placing them in the hills around the city. The hot spot is placed exactly in one small hill with a nice view and a nice elite residential area can be developed there. This area can be divided from the industrial capacities with the “trees zone”.

The removal of the material is required.

10.3.4 Agriculture Land [Option 3]

From the other side of hot-spot the area northeast of the boundary (A2 – not Makstil owned) is used as a agriculture land. The municipality of Gazi Baba is placed in 92 km2 from which 65% is using for agriculture purposes. The price of the land in neighboring area is 4,5 Euro / m². This means that the value of agriculture reactivated “hot-spot” area will be: 4,5 * 68.711 m² = 309.000 Euro

The removal of the material is required.

10.3.5 Landfillsite for construction waste (C&D Waste) [Option 4]

Present situation with the building waste is the following: if somebody has construction waste he has to ask the municipality where to store it. Usually municipalities are filling the holes in their area and nobody control it afterwards. With the digging of this Makstil hot-spot we will have a flat area of approxmate 68.000 m² (only area outside the Masktil property). This are can be used as a dump site for construction waste with a maximum capacity of 423.425 m³ for the municipality or for the city of Skopje. The second solution (if the entire city can use it) is much favorable, because this will lead to control over this kind of waste for all enclosed municipalities. In additon would the waste management plan in regard to special waste streams be implemented.

The removal of the material is required.

10.3.6 Industrial Land Use [Option 5]

10.3.6.1 External Solution [Option 5.1]

The municipality of Gazi Baba is the biggest industrial zone in Skopje and in Macedonia. The vast variety of industries is placed in this region, starting with metal and pharmaceutical industries, storage houses and universities. Due to this industrial orientation, this place might be interesting for some industrial capacity compatible with the existing one in Zelezara. This means to sell the land to some compatible industry, which will use final products of production in Zelezara as their raw material. This opportunity depends from many external factors

10.3.6.2 Internal solution - Selling for extension of business in “Zelezara” [Option 5.2]

Depending on the internal business and extension plans of Makstil, Leguri Skopje, Mittal and RSH Troska, the area shall be offered to be taken into consideration for such purposes.

This opportunity again depends on somebody else decision, but it worth's evaluation. The "Makstil", "Leguri Skopje" and "Mittal" business plan and strategic plan have to be reviewed, in order to be aware of future development of these factories. If the some of these factories are planning fast grow up of their business in future and if it requires additional capacities to build, this land might be a necessity for them.

10.4 Evaluation of Options

All of these six former mentioned options are valued according to the certain indicators which are presented in the table number 1, presented bellow.

In this table with the sign minus "-" is marked if the presented option does not have any positive effect on the presented indicator and with plus "+" if there are influence of the option to the certain indicator.

Table 23_Ranking different opportunities (+ and -)

Indicator	Option 0 No Activities	Option 1 Green Area	Option 2 Elite residential Area	Option 3 Agriculture Area	Option 4 C&D Waste Landfill	Option 5.1 Industrial Park	Option 5.2 Sell it to existing business
Development of the region	-	-	+	+	+	+	+
Wider development impact	-	-	-	-	+	-	-
Direct Revenue Generator	-	-	+	+	+	+	+
Low start up-costs	-	+	-	+	+	-	-
Return of Investment	-	-	+	+	-	+	+
Social impact	-	-	+	+	+	+	-
Technological impact	-	-	-	-	-	+	+
Positive environmental impact	-	+	+	+	+	-	-
Capacity to manage		+	+	+	+	-	+
Sustainability	-	+	+	+	+	-	-
TOTAL	**-**	**4**	**7**	**8**	**8**	**5**	**5**
Ranking		**4**	**2**	**1**	**1**	**3**	**3**

Influence of the different options to the indicators is presented through numbers from 0 which mean without any influence to 5 which means high influence.

Table 24_Ranking different opportunities (from 0 to 5)

Indicator	Option 0 No Activities	Option 1 Green Area	Option 2 Elite residential Area	Option 3 Agriculture Area	Option 4 C&D Waste Landfill	Option 5.1 Industrial Park	Option 5.2 Sell it to existing business
Development of the region	0	2	5	4	4	5	5
Wider development impact	0	1	2	3	5	4	3
Direct Revenue Generator	0	1	2	3	5	4	4
Low start up-costs	0	4	1	4	5	3	3
Return of Investment	0	1	2	2	3	4	5
Social impact	0	2	2	5	2	5	5
Technological impact	0	1	1	2	2	4	4
Positive environmental impact	0	5	4	4	5	1	1
Capacity to manage	0	5	3	5	4	3	4
Sustainability	0	4	5	4	5	3	3
TOTAL	**0**	**26**	**27**	**36**	**40**	**36**	**37**
Ranking		**5**	**4**	**3**	**1**	**3**	**2**

10.4.1 Conclusion of previous ranking:

The most economic feasible option according to positive influence to different indicators is Dump Site for construction waste. This option has low start-up costs and very positive environmental impact. It does not lead to wider development or technological impact, but the huge problem with this kind of waste will be solved.

At the moment there is no organized dump for construction waste in the City of Skopje, neither in the Skopje municipalities. The total benefit considerable is shown in Table 28.

10.5 C&D Waste Landfill

10.5.1 Description and evaluation

10.5.2 Description and evaluation

In the table bellow are all positive and negative aspects are mentinoned using remediate land as a dump site. This opportunity, as all others have its positive and negative sides which should be taken into consideration for all future steps.

Table 25_SWOT of Landfilling

Strengths +	Weaknesses -
✓ Organized storage of construction waste ✓ Low start up costs ✓ Low running costs ✓ Dump site for wider region ✓ Control of the logistics ✓ Use of the joint administrative services ✓ Strategical fulfillment of the approximation of landfill of C&D waste according EU standard ✓ Fullfillment of waste management plan (NWMP II/2006) → special waste streams ✓ Enforcement of legislation (Wastemanagment law related legislation) ✓	❖ Close to residential area (public sensitivity) ❖ Infrastructure ❖ Question of Property
Opportunities +	**Threats -**
✓ Experience for future organization of dump ✓ Establishing Eco-balance ✓ Future use of this area ✓ Long-term planning for green area and agriculture purposes	❖ Political influence ❖ Limited time frame ❖ Potential inadequate management ❖ Negative environmental impact ❖ Development of ineadequate technology due to budget constrains ❖ Reject through open property question

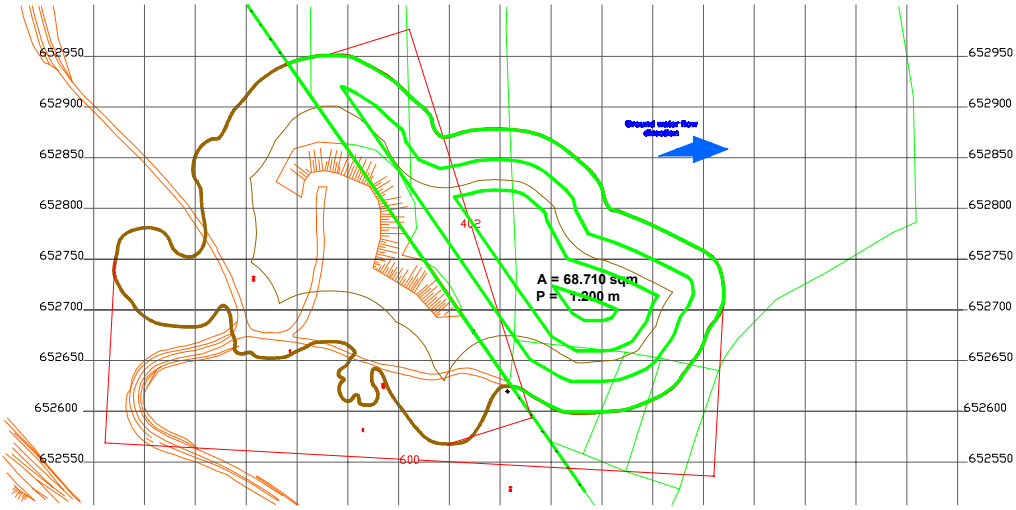
10.5.3 Legal Base for the development of a C&D Waste Landfill in former Yugoslav Republic of Macedonia

C&D Waste Landfill; The Law on Waste Management (Off. Gazette no 6/2004; 68/2004; 71/2004) regulates the matter of landfills, their classification, the conditions that need to be fulfilled by the landfill, conditions for establishment and construction of the landfill. Article 78 from the law, classifies the landfills into 3 categories: 1. Landfills for hazardous waste; 2. Landfills for non-hazardous waste; 3. Landfills for inert waste. Article 80, paragraph 2, proscribes that a landfill for non-hazardous and inert waste may be established by one or more Municipalities or the City of Skopje or by a domestic and/or foreign legal entity if the establishment of the landfill is in accordance with the Waste Management Plan of the Republic of Macedonia, by submitting a request for landfill establishment to the body of the public administration responsible for environmental affairs. Paragraph 7, from the article provides a legal base for a separate regulation, regarding the form and content of the request for establishment of a landfill for inert waste. Article 85, regulates the construction of the landfills (for this procedure article 30 from this law, regarding construction permits for installations for processing, treatment, storage and disposal of waste, shall apply). The Law on Waste Management, in article 88, paragraph 1 forbids the disposal of waste in inappropriate classes of landfills, and of waste that had not been subjected to treatment. The landfills for inert waste shall be used only for landfilling of inert waste. As an exception, the inert waste can be disposed of on landfills for non hazardous waste, if the treatment and processing thereof is technically unfeasible or economically non-worthy.

10.6 Investments required for the construction of a C&D Waste Landfill

The following map present the potential extension area of the site for C&D waste disposal purposes.

Figure 17_Makstil Phase I area



Description of the map:

Green Area – first potential area of site construction (A=68.710 sqm, P=1.200m)

Braun Area – Continuation of remediation (A=64.008 sqm)

Table 26_landuse and potentials of landuse on Lindane and Electrolyses sites

C&D Waste Landfill Phase I	Remediation Purposes Phase II

Area	sqm	Status	Area	sqm	Status
A1	**68.710**	Planned site	A2	**64.008**	construction contaminated
SUM	**132.718**				

The limiting factor on the site is the permitted load of the underground. A factor of 1,2 kg/cm² allows a maximum net height of 10m. Taken a sloping of 1:3 into consideration is a final surface of 35.940 sqm for greening and agriculture puroses available.

The capacity of phase one is:

35.940 sqm x 10 = 359.400 m³

68.710 – 35.940 = 32.770 sqm x 10/2 = 163.850 m³

Total available capacity of phase I = 523.250 m³

The recultivated area (reclaimed) of 68.710 sqm is after final shape of the C&D landfill available for partly agriculture purposes such as energy forest, energy plants or even meadows.

Investment Required[17]:

Variable costs, which are depending on the surface, are: 693.700 Euro

Installation costs, which are occurring in any case, are: 155.500 Euro

Required input for first phase: 849.200 Euro

Required input for second phase: 624.300 Euro

[17] not included are operation costs, which are between 80 and 100.000 Euro per year

10.7 Financial evaluation of various proposed remediation alternatives

Table 27_Investment, cost and benefit structure of remaining treatment options

MAKSTIL - Financial Evaluation of various Alternatives						
		Ex Situ	On Site		Off Site	
	Units	Excavation and treatment – Cement Kiln	Capping with Recycling	Capping	Excavation and off site disposal with Recycling	Excavation and off site disposal - Lojane
Ranking		1	3	2	5	4
Total Amount of Slag	Mg	6.367.000	6.367.000	6.367.000	6.367.000	6.367.000
Excavation	Mg	6.144.155	2.122.333	2.122.333	6.144.155	6.367.000
Transport Distance	km	6	0	0	60	60
Truckloads for Slag Transport	pcs	409.610	0	0	409.610	424.467
Waggon Loads for Slag	pcs	153.604	0	0	153.604	159.175
Treatment Surface	sqm	133.000	133.000	133.000	133.000	133.000
Capping material (0,5m)	m³	0	66.500	66.500	66.500	66.500
Topsoil material (0,5m)	m³	66.500	66.500	66.500	133.000	133.000
Transport Cover Material	m³	66.500	133.000	133.000	199.500	199.500
Truckloads	m³	4.433	8.867	8.867	13.300	13.300
Transport Scrap Material	Mg	222.845	63.670	0	222.845	0
Truckloadas for Scrap Transport	pcs	11.142	3.184	0	11.142	0
specific treatment costs	Euro/Mg	20	10	0	10	0
Depreciation Period	years	7	7	7	7	7
Piecometers	pcs	3	3	3	3	3
Monitoring	amount	18	18	18	18	18
Investment	Euro	100.000	100.000	0	100.000	0
Depreciation	Euro/year	14.286	14.286	0	14.286	0
Excavation costs	Euro	8.601.817	2.971.267	2.971.267	8.601.817	8.913.800
Transport costs Slag (Truck)	Euro	10.240.250	0	0	31.949.580	33.108.426
Transport costs Slag (Train)	Euro	38.400.969	0	0	38.400.969	39.793.750
Transport costs Scrap (Truck)	Euro	8.913.800	2.546.800	0	8.913.800	0
Treatment costs	Euro	127.340.000	21.223.333	0	61.441.550	0
Capping material costs	Euro	266.000	498.750	498.750	764.750	764.750
Material Transport costs	Euro	310.333	3.724.000	3.724.000	5.586.000	5.586.000
Profiling and compacting	Euro	266.000	266.000	266.000	532.000	532.000

Other Costs						
Public Awareness	**Euro**	10.000	10.000	10.000	10.000	10.000
Drilling of Piecometers	**Euro**	1.575	1.575	1.575	1.575	1.575
Monitoring	**Euro**	30.600	30.600	30.600	30.600	30.600
Investment	**Euro**	100.000	100.000	0	100.000	0
Total Operational Costs	**Euro**	156.080.375	31.372.325	7.502.192	117.931.672	48.947.151
Supervision	**Euro**	4.682.411	941.170	225.066	3.537.950	1.468.415
Capitalisation of Invest	**Euro**	14.888	1.750	0	1.750	0
Total Costs	**Euro**	**160.777.675**	**32.315.245**	**7.727.257**	**121.471.372**	**50.415.566**
specific costs	**Euro/Mg**	**25**	**5**	**1,21**	**19**	**8**
Output Scrap	**Mg**	**222.845**	**63.670**	**0**	**222.845**	**0**
Output Portland Raw material	**Mg**	**5.529.740**	**0**	**0**	**0**	**0**
Income Scrap	**Euro**	**18.941.825**	**5.411.950**	**0**	**18.941.825**	**0**
Income Portland Cement	**Euro**	**331.784.370**	**0**	**0**	**0**	**0**
Total Income	**Euro**	**350.726.195**	**5.411.950**	**0**	**18.941.825**	**0**
specific income	**Euro/Mg**	**55**	**1**	**0**	**3**	**0**
specific turn over	**Euro/Mg**	**30**	**-4,23**	**-1,21**	**-16**	**-8**
Financial Ranking		**1**	**3**	**2**	**5**	**4**

10.7.1 Financial Evaluation Makstil slag dump site remediation alternatives

Those treatment methods, which have been evaluated as environmental accepted and ranked from 1 till 5 have been taken further into consideration for the financial evaluation. An amount of 6.367.000 Mg is primary base for calculation. Transportation has been calculated once with trucks (1,30 Euro/km above a distance of 30km, below 25 Euro/load) and once with wagons (250 Euro/wagon), while a critical distance of 100 km has been taken into consideration (above 100 km by train, below by truck). The costs for public awareness and a two year monitoring program have been handles like fix costs due to the fact, that independent from the chosen alternative, those costs will be raised.

In the cases of segregation of scrap metal, an investment of 100.000 Euro can be expected for the implementation of additional equipment, required for screening and segregation. In addition have for those options also a specific treatment price of 10 Euro per Mg been taken into consideration.

In all cases have the installation and monitoring costs been placed. Monitoring wells have to have a maximum depths of 15 m, while the costs are 35 Euro/meter. The supervision of the activities have been calculated with 3% of the total operational costs (investments included). The costs have been capitalised with 2,5 % per anu for a period of 7 years, which indicates the depreciation period.

Scrap metal prices have been taken with 85 Euro / Mg and Portland cement with a worst case factor of 70 Euro / Mg.

For the options of off site disposal has the factor capping and recultivation been taken into consideration, but not a fee for disposal due to the fact, that the material is not

hazard and can be used for capping and covering purposes and due to the high content on Ca components as immobilisation additive.

The various options are not ranked at this stage due to the fact, that not always the cheapest alternative is also the most economical one. The figures (total costs) will be economical evaluated.

10.8 Economical Comparison of Makstil slag dumpsite remediation options

Table 28_Economical Comparison of Makstil slag dumpsite remediation

		Ex Situ	On Site		Off Site	
Economical Comparison Ferro Slag Dumpsite	**Units**	**Excavation and treatment – Cement Kiln**	**Capping with Recycling**	**Capping**	**Excavation and off site disposal with Recycling**	**Excavation and off site disposal - Lojane**
area economical suitable C&D Landfill	**(1/0)**	1	0	0	1	1
value added land	**(1/0)**	1	0	0	1	1
revenue from consessioning		**955.050**	**0**	**0**	**0**	**0**
Remediation Cost		**0**	**-26.901.545**	**-7.727.257**	**-102.527.797**	**-50.415.566**
investment for C&D landfill – capitalised with 2,5%		**-922.500**			**-922.500**	**-922.500**
Other Costs		**-43.440**	**-43.440**	**-43.440**	**-43.440**	**-43.440**
Remaining Revenues/Costs		**-10.890**	**-26.944.985**	**-7.770.697**	**-103.493.737**	**-51.381.506**
direct revenue /year	**Euro**	201.209	0	0	201.209	201.209
cross payments to tax system	**Euro**	25.000	0	0	25.000	25.000
additional sum in money turnover C&D Landfill	**Euro**	226.209	0	0	226.209	226.209
return of investment C&D	**Euro**					
calculated only with direct revenue	**Years**	**0**	**0**	**0**	**514**	**255**
direct revenue + cross payments	**Years**	**0**	**0**	**0**	**458**	**227**
ranking		**1**	**3**	**2**	**5**	**4**

It can be shown, that the most appropriate combination is the concessioning of the material for cement production, the scrap segregation and commercialisation and the development (construction) of a landfill for C&D waste. The capitalised costs for the landfill construction are 922.500. Yearly operation costs of 100.000 Euro have been taken into consideration. Capitalised investment will be covered by the commissioning fee. A break even value of minimum 0,15 Euro per Mg is recommended. Depreciation, captialisation, operation costs and overhead will be covered by disposal fees, which have to be 4,9 Euro per m³ (or equal to 3,1 Euro per Mg). This has an additional ecomonical benefit due to the fact, that disposal of C&D waste shall neither be disposed on sanitary landfills, nor on fly tip areas. The cross benefit for future safings of cleaning and

remediation costs of illegal disposed C&D waste can only be mentioned, but not calculated. Additional cross benefit of 25.000 Euro per year can be assumed due to employment structure and other income generating activities, which will lead to taxpayments. The scrap removal is only feasible, if the total amount of scrap material can be gathered and collected. Partly segregation and commercialisation of the activities, which would be caused by the treatment methods of capping are neither financial nor economical feasible. This activities are recommended to keep it unter the RSH Troski obligation. The whole system requires following stakeholders: Government, Municipality of Gazi Baba, Makstil, RsH Troski and interested companies in slag material trading.

Table 29_Revenue Calculation

Revenue Calculation	Unit	qty	unit price	total
Commissioning fee from slag material	Mg	6.367.000	€ 0,15	€ 955.050,00
Cross benefit	€/year	1	€ 25.000,00	€ 25.000,00
Fee from C&D waste dipsosal	m3/year	41.063	€ 4,9	€ 201.208,70
SUM				**€ 1.181.258,70**

The economical evaluation of the environmental and financial ranked treatment alternatives alow the recommendation of a combination of commissioning the slag material for Portlandcement production, the segregation and commercialisation of scrap metal and the development of a C&D waste landfill on the northeastern part of the site. The break even commission fee is calculated with 0,15 Euro / Mg for an amount of more than 6 Mio Mg, which allows to cover the investment costs for the development of the landfill site. The depreciation and capitalisation costs shall be covered by disposal fees. Second financial feasible option is the capping of the site in order to avoid impacts on the environment without srap segregation. An investment of more than 7 Mio. Euro would be required in this case.

11 Attachments

11.1 Legal frame

11.1.1 Terms of Reference for Legal, Institutional and Technical Expert

Beneficiary country

The former Yugoslav Republic of Macedonia

Contracting authority

Ministry of ……..

11.1.2 Team staff

- Foreign Institutional Expert- 4 months within 9
- Local Legal Expert- 6 months within 9
- Local Institutional Expert- 3 months within 9
- Local Technical Expert- 3 months within 9

11.1.3 Position: Legal Expert

The legal gap analysis made within the project identified crucial gaps in missing hotspots" terminology, unclear environmental liability, no guidelines and solutions for "hotspots" remediation, set up of an earmarked environmental trust fund. Therefore the obligations and responsibilities for the Legal Expert Position will include: amending existing laws in the area of environment, more particularly the Law on Environment, Law on Waste Management, Draft Law on Hazardous Waste. Not only law amendments are needed, but also drafting new legislation, for example Law on soil protection, Law on establishment of trust funds, Rulebook on Remediation of "hotspots", Rulebooks on monitoring, Rulebook on protection from pollution from priority substances. The issue of environmental liability is not clear, therefore the legal expert will need to recommend how this question will be solved, whether the state is responsible, and for how long or the new owner. The Legal Expert will need to cooperate closely with Institutional, as well as with an technical expert, when drafting the changes of the laws or drafting new laws. The cooperation with the Institutional expert will be considerable especially in the area of the funding mechanisms. The technical expert will be needed to provide inputs when drafting the laws and especially the rulebooks which will be in form of technical guidelines (monitoring, remediation, soil protection). The legal expert will have to write progress reports, as well as inception and final reports.

The Legal expert should have: a degree in law (preferably environmental law group), professional experience of minimum 10 years in law related fields, drafting of legislation; making of analysis. The legal expert also should have a knowledge of the national legislation (especially in environment and finance, because most of the changes required are in those fields), intensive knowledge of local (national) legal structure and related stakeholders, as well as institutional set up knowledge. Cards program and procedure experience would be considered an asset. He/she should be familiar especially with the Hotspots issue, environmental liability, funding mechanisms. Regarding the language skills, proficiency in oral and written English is required.

The general requirements for such an expert include analytical capability to deal with legislation; good interpersonal skills; team player; presentation skills; able to follow rules of confidentiality and independent and free from conflicts of interest in the responsibilities accorded to them; skilled in Microsoft Office (Word, Excel, PowerPoint);

The terms of engagement for the Legal Expert will be 6 within 9 months (132 working days), starting from xxxx 2008. The main beneficiary will be the Ministry of Environment and Physical Planning, and the contractor will be the EAR (European Agency for Reconstruction).

11.1.4 Position: Institutional Expert

The responsibilities of the Institutional Expert will be making proposals and solutions for the existing institutional gaps; develop a regional or national funding mechanism for hot spot remediation activities, and cooperate with the legal expert regarding legal matters for the needed funding mechanism. He will describe responsibilities, interlinks between various institutions, evaluate the various budget sources in accordance with national and international institutional, legal and economical principals such as polluter or risk related fees. Development of an institutional strategy for the implementation of further remediation works, and establishment of an implementation body, as well as describing responsibilities of such a body. The Institutional Expert will have to help the legal expert in drafting legislation, as well as preparation of a presentation workshop, together with the legal expert.

The Institutional Expert should have a degree in social or natural science, professional experience of minimum 10 years in environmental management and related activities; knowledge in international funding facilitation and institutional set ups (international networking); relevant knowledge of national legislation related to Public Information and international related conventions (Aarhus Convention), and be familiar with the legislation on funding mechanisms. Cards program and procedure experience will be considered as an asset. Proficiency in oral and written English is required as well as knowledge of Microsoft Office (Word, Excel, PowerPoint);The general requirements are analytical capability to deal with environmental assessment; able to follow rules of confidentiality and independent and free from conflicts of interest in the responsibilities accorded to them; performing of field and office work; good interpersonal skills; The terms of engagement will be 3 months (66 working days), starting from xxxx 2008. The main beneficiary will be the Ministry of Environment and Physical Planning, and the contractor will be the EAR (European Agency for Reconstruction).

11.1.5 Position: Technical Expert

A technical expert will closely cooperate with the legal and institutional expert, in execution of the technical and legal parts. The required expertise will mainly be technical, but some environmental law expertise will also be needed. The responsibilities of the Technical Expert will include supporting the legal expert in drafting legislation in the environmental area by providing technical input during the entire project. He should contribute in the preparation of the new legislation that is recommended to be adopted (Law on soil protection, Rulebook for remediation of “hotspots” as well as the drafting of the changes of the legislation that need to be done. Also the technical expert will participate in writing the reports (Inception, Progress, and Final). The qualifications required for the technical expert are the following: a degree in life science, engineering, minimum 10 years of working experience in the relevant environmental area (Waste, Water, Air, IPPC), knowledge of the situation of the country regarding the “hotspots” matter, as well as knowledge of the waste sector, water sector, air sector. Preferable is to have some knowledge of the environmental legislation, as the tasks will be changes in the environmental legislation. Cards program and procedure experience will be considered as an asset. Proficiency in oral and written English is required as well as

knowledge of Microsoft Office (Word, Excel, PowerPoint);The general requirements are analytical capability to deal with environmental assessment; able to follow rules of confidentiality and independent and free from conflicts of interest in the responsibilities accorded to them; performing of field and office work; good interpersonal skills; The terms of engagement will be 3 months (66 working days), starting from xxxx 2007 within a period of 3 months. The main beneficiary will be the Ministry of Environment and Physical Planning, and the contractor will be the EAR (European Agency for Reconstruction).

11.1.6 Position: Foreign Institutional Expert

The overall objective of the Foreign Institutional Expert will be to coach and support the project team in their legal and institutional needs. The Expert will support the local institutional expert in the proposals and solutions for the existing institutional gaps; in developing the regional or national funding mechanism for hot spot remediation activities, support the legal expert regarding legal matters for the needed funding mechanism. He will help in the development of an institutional strategy for the implementation of further remediation works, and the establishment of an implementation body. He will have to report to the project team and develop a final report. The expert shall have: a degree in social or natural science, professional experience of minimum 10 years in environmental management and related activities in a country that has passed successfully the transitional development process (experience throughout the transitional period, and after); knowledge in international funding facilitation and institutional set ups. The foreign Expert should possess relevant knowledge of national legislation related to Public Information and international related conventions (Aarhus Convention), as well as relevant knowledge in relevant European Directives and International Standards and Legislations. He should also be proficient in oral and written English, and have analytical capability to deal with environmental assessment; good communication skills, excellent knowledge of Microsoft Office (Word, Excel, PowerPoint);

The foreign Expert will be based in Skopje (Project Office), The period of activity will be 4 months within 9.

11.1.7 Office Accommodation

Office accommodation of a reasonable standard and of approximately 10 square metres for each expert working on the contract is to be provided by the beneficiary. This will include basic furnishings and communication lines (at least two fixed telephone lines with hand-sets and the technical possibility for the consultant to establish high speed internet access) as well as electricity, air conditioning, heating, water and general cleaning and maintenance. The consultant's experts will be located in the same building or as near as possible to the MEPP core functions to be supported under this contract.

The beneficiary will also provide desktop computers, printers, a fax machine and a photocopier for use by the consultants. These will remain the property of the beneficiary. However, the suitability and reliability of these machines cannot be guaranteed, and all associated operating and maintenance costs will be borne by the contractor and included within fee rates. Any additional equipment (for example laptop computers) will also be provided by the consultant at no cost to the project (i.e. included within fee rates).

11.1.8 Facilities to be provided by the beneficiary

The Consultant is responsible for organizing the project office space provided by the beneficiary and for providing any additional furnishings and equipment needed to provide an appropriate working environment for all members of the Consultant's staff funded under this contract, and to allow Working Groups of up to ten people to meet and operate as necessary. The Consultant will ensure that all members of its team in fYR Macedonia

are equipped with adequate computing, document processing and dedicated electronic mail facilities and other means required to perform the tasks requested under these ToR.

The consultant will moreover ensure the mobility of all his/her staff for all work related purposes. In particular he/she shall ensure that there is sufficient administrative, secretarial and interpreting provision to enable experts to concentrate on their primary responsibilities.

The cost of all of these inputs must be included in the fee rates. In particular, the Consultant shall make available, within the fee rates of its experts, the necessary resources for:

- . office equipment,
- . backstopping services at headquarters;

11.1.9 Equipment

No equipment is either to be purchased on behalf of the beneficiary country as part of this service contract or transferred to the beneficiary country at the end of this contract. Any equipment related to this contract, which is to be acquired by the beneficiary country, must be purchased by means of a separate supply tender procedure.

11.1.10 Reporting requirements

All reports shall be written in UK English, and, where necessary, working documents and reports should be translated into the local language(s) as described below. Standard reporting formats to be used are attached to this ToR.

The Consultant shall prepare and submit the following reports:

An Inception Report shall be submitted 2 months after the commencement date of the project The report shall clearly define the aims, objectives and methodology of the contract; set out a detailed work plan for the provision of each activity, area of expertise and list of deliverables; identify the experts and local personnel required, the management of the project and any possible commitments required from the beneficiary etc. The inception report shall show all activities pertaining to results and outputs in a cart highlighting milestones. The report will list and comment on any developments (legal, institutional, other donor activities etc.) that have taken place since these ToR were drafted and which might have an impact on project design and relevance of activities to be developed under it. The use of locally available moderators familiar with this methodology is strongly recommended. The inception report will feature an extended executive summary in English and Macedonian language providing decision makers with sufficiently detailed information to understand concept and implications and form an opinion. The main report will not exceed 25 pages of text.

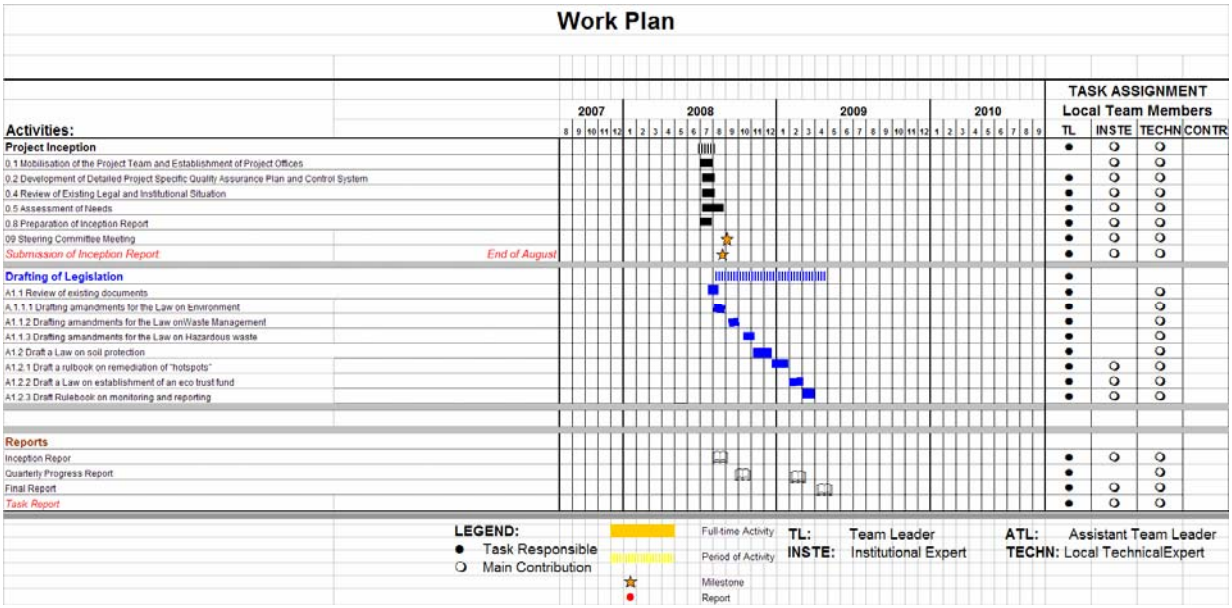
Quarterly Progress Reports shall be submitted within two weeks after the end of each three-month period. The first Quarterly Progress Report shall be delivered at the end of the third month after the inception period. Quarterly progress reports will feature an extended executive summary in English and Macedonian, highlighting project progress against each output, key activities undertaken, obstacles hampering project progress and proposed solutions, consumption of contract inputs and essentials of the work plan for the following quarter, including recommendations and requests (ToRs, Specifications and Tender Dossiers). The Quarterly Progress Report will also identify relevant progress and general developments in the sector in general and in the specific thematic areas covered by this contract (legislative, institutional, activities of other donors, private sector initiatives and others of interest) and, as far as these developments affect contract implementation and/or validity, of its objectives and outputs.

The Final Report will contain prioritised follow up proposals to the activities developed under this contract for funding consideration under the project. They will contain a description of all documents prepared under the contract (reports, proceedings from conferences, minutes of relevant meetings, findings from workshops), all previously approved reports, documents and other on CD-ROM. The main reports shall not exceed 50 pages. The exact table of contents of the draft final and final report is subject to approval by the contracting authority. The draft final and final report shall contain an extended executive summary in English and Macedonian language(s).

The Draft Final Report is due one month before the end of the contract. The Final Report will be delivered within one month after the completion of the contract. The Final Report shall be provided on CD - ROM as well. The Final Report must be accompanied by the final invoice and an audit certificate (as defined in Article 30 of the General Conditions and in accordance with the template in Annex VI of the contract) confirming the final certified value of the contract.

The reports shall be submitted to the MEPP National Project Co-ordinator (for the beneficiary) and the EAR Project Manager (for the contracting authority). Approval of all reports rests solely with the EAR Project Manager. The beneficiary shall communicate his observations on all reports to the consultant and to the Contracting Authority within 15 calendar days of receipt of the report in question. The Project Manager when requesting amendments to the report, and prior to its approval shall take these into account.

11.1.11 Action Plan



11.2 Institutional

11.2.1 Action Plan for setting up the Remediation Fund

Action	Implementing Institution	Time frame	Resources required
Definition of Terms of References for local and international assistance (experts)	MOEPP; Donor	2007	Local / international expert
Tendering and recruiting national and international experts	Donor	2007	Procurement officer
Revision of legislation regarding environmental liabilities for past pollution.	MoEPP, MoE	2007	6 man-months of local and int. experts
Introduction of economic instruments (sources of funding for the Remediation Fund).	MoEPP, MoF	2007	6 man-months of local and int. experts
Introduction of cleanup standards and recommended guidelines.	MoEPP, MoA	2007	man-months of local and int. experts
Drafting and adoption the Law on establishing the Remediation Fund.	MoEPP	2007	2 man-month of local and int. experts
Establishment of the Fund's Management Board and Technical Committee.	MoEPP	2008	N/A
Recruitment/appointment of the General Director, Financial Director and Technical Director.	MoEPP	2008	N/A
Hiring and training of staff.	Fund's Director	2008	N/A
Development of operating procedures for the Fund.	Fund	2008	Fund's staff, int. experts
Setting up data base of contaminated sites	Fund	2008-2009	Fund's staff, Information Centre of Environment
Development of prioritisation methodology (risk assessment based)	Fund	2008	Fund's staff, int. experts
Preparation of draft investment strategy, work programme, and business plan.	Fund	2008-2009	Fund's staff
Establishment of the Fund' website.	Fund	2009	Fund's staff
Preparation of the first annual operating programme.	Fund	2009	Fund's staff

11.2.2 Terms of Reference for Short Term Consultant for Public Awareness Campaign (PAC)

11.2.2.1 Background

"Development and support of Implementation of a public information system in regard to Remediation Plans with Financial Requirements for Elimination of Industrial Hotspots"

The overall objective of the project is to support the remediation of industrial hotspots on a environmentally and financially sustainable manner for an improved life quality of the population of the former Yugoslav Republic of Macedonia.

11.2.2.2 Scope of the Work

This ToR describes the work that should be done by the mentor during implementation of separate activities within the PA Campaign on remediation activities at Makstil Ferro slag dumpsite.

It is expected that Mentor will help Makstil, Municipality and local NGOs in preparation and realization of particular activities focused on PA rising.

11.2.2.3 Beneficiary

Main beneficiary is the potential impacted population

Duties and Responsibilities

1. To continue with the training of local NGOs and municipal staff for preparing applications for certain PA raising activities related to the proposals in the Report on Public Awareness
2. Building the link between various intuitions (focal point) and responsible for information dissemination
3. Support of the MoEPP and Municipality of Gazi Baba to define certain PA activities, staff-, budget and time scheduling (Action Plan)
4. Support the local stakeholders (NGOs, Local Self Government, schools etc.) in realization of the activities
5. Identification of Indicators
6. To prepare a questionnaire and to initiate a yearly public satisfaction study within the project area in close cooperation with independent survey staff
7. Evaluation of the survey results and using it as a planning tool for further activities
8. Preparation of various presentation
9. To be present on the place of realisation of the activities
10. To make evaluation of realisation of the separate activities and to deliver the evaluated reports to the MoEPP
11. Activity-, indicator-, project result-, and cost control (supervisory function)

11.2.2.4 Output:

- List of Indicators
- To deliver 6-month progress reports and forecast planning with specific activities to MOEPP

- Information Dissemination plan followed
- Yearly satisfaction study and form of representation
- Consultant should submit detail report on previous realized activities in accordance with Terms. Special attention should be paid on problems appeared and achievements from realized activities. The reports should contain results, proposals for follow up activities, constrains and needs and requirements
- The reports and supporting material shall be prepared and submitted to MOEPP in Macedonian (and English if required)

11.2.2.5 Required Expert Input:

- National expert and/or consultant company, no more than 180 working days in a period of one year and 100 in the second year
- Consultant should travel in the region in order to conduct meetings with relevant stakeholders (NGOs, village communities, schools etc.) and to provide specific training and directions for realization of activities.
- Consultant should closely cooperate with MAKSTIL, relevant Ministries and impacted local authorities to specify certain activity, time, budget, and staff input scheduling

11.2.2.6 Qualifications

- University degree in the fields relevant to the project;
- Minimum 5 years of relevant experience in developing of institutional schemes
- Strong communication and interpersonal skills;
- Prior experience in working with local governments and NGO's;
- Previous experience in developing and realization of PAC;
- Team management and moderator skills;

11.2.3 Sample Plan for Public Participation

Subject	Example
What is the basic activity?	Public participation in the EIA procedure concerning the proposed clean up of the XXXX site
Objectives: what effect has to be obtained?	• Notifying the public about the project and the possible decisions • Notifying the public about the ways in which it may participate in the procedure and about the authority competent for making a decision • Notifying the public about the course of the public participation procedure • Enabling the public to submit comments and recommendations • Examining the submitted comments and recommendations during the project's evaluation before issuing the decision
Dates of initiating and finalizing the procedure	• Initiation: date • Notification of the public: date • Press release: date • Distributing the leaflets: date • Visiting the site: date • Meeting interested parties: date • Administrative trial with the public participation: date • Analysing the documentation and comments submitted by the public: date • Making the decision • Finalisation: date
Results and activities What are the expected results? What activities have to be concluded?	• Plan of public participation • Notifying the public • Press release • Leaflet directed to the public • Members of public visit the site • Interested parties visit the site • Meeting with the members of public • Seminar for the interested parties

	• EIA report • Assessment of EIA report • Decision made • Note on the outcome of the public participation procedure
Responsibilities of the team and resources needed	• Xx hours project manager • Xx hours cleanup expert • Xx hours for journalism • Xx hours for technical editor • Xx hours for inspector • Xx hours for facilitator
Financial resources needed	

11.2.4 Environmental active NGOS in the Region of Skopje

No.	NAME	Contact person	Address	Telephone	E - mail address
01	Pro Aktiva - Skopje	Vlatko Trpeski, Slavjanka Miladinova		tel/fax 02 3215-881	info@proaktiva.org.mk
02.	Kitka - Skopje	Pero Stojcevski	st. Dracevska no.96; Skopje	tel. 02 2594 939	edkitka@mt.net.mk
03.	Opstanok - Skopje		st. Vasil Gjorgov no.39 Skopje	tel. 02 3113 823	
04.	DEM - Skopje		st. Vasil Gjorgov no.39 Skopje	tel. 02 220 518 fax. 02 128 075	bimadem@mt.net.mk
05.	Society for Nature protection -Skopje	Vasil Anastasovski	st.Gjorce Petrov no. 26 b 4/6 Skopje	tel. 02 335 326	sasojord@mol.com.mk
06.	ERINA - Skopje	Fani Mihajlovska, Marijana Ivanova	st. Lermontova 3/3 Skopje	tel. 02 3238 404	centarerina@hotmail.com
07.	Ekoloski Pres Centar (EPC) - Skopje	Tanja Atanasovska	st.Dimitrija Cuposki; Skopje	tel. 02 138 660	ecopress@ecopresscenter.org
08.	Bio Eko , Skopje	D-r Svetozar Petkovski	st.Briselska no.12; Skopje	tel. 02 3073 588 fax. 02 3077 077	bioeko@unet.com.mk
09.	Makedonsko Ekolosko Drustvo (MED) - Skopje	Prof. D-r Ljupco Melovski	P.fah 162 Skopje	tel. 02 3117-055 ext.611	melovski@iunona.pmf.ukim.edu.mk
10.	NOVINA - Skopje	Prof. D-r Ljubica Petrusevska	st. Apostol Guslarot no.3 Skopje	tel. 02 3124 327 fax 02 3133 765	estek@mt.net.mk
11.	Society for examination and protection of the birds in Makedonija	Prof. D-r Branko Micevski	PMF – Gazi Baba b.b Skopje	tel. 02 3117 055	brankom@ukim.edu.mk
12.	Eko-svest, Skopje	Ana Colovic	Kozara 68/3-9 Skopje	02 3070 779	ana@ekosvest.com.mk
13.	Eko-misija Skopje	Petar Bosevski	Naroden front no. 25/59	02 3211 965	eko_misija@hotmail.com
14.	PAUN Skopje		p.fah 270 Skopje	075 543 836	ngopaun@yahoo.com
15.	Civil Environmental Forum	Dr. Josif Tanevski	Kicevska 1, Skopje	02 2031 193	gragjanskiekoloskiforum@yahoo.com

11.3 References

11.3.1 References – Legal Frame

[1]… National Waste Management Plan (NWMP)

[2]… National Environmental Action Plan II (NEAP II)

[3]… Law on Waste Management (Off. Gazette no. 6/2004);

[4]… Law on Environment (Off. Gazette no. 53/05 and 81/05);

[5]… Law on Privatisation (Off. Gazette no. 37/96; 25/99; 81/99; 49/2000; 6/2002; 74/05);

[6]… The draft Law on Hazardous Waste (which is being produced in the CARDS 2004 Programme, and was provided by them).

[7]… Law on Ambient air Quality (Off. Gazette no. 67/2004);

[8]… Draft Law on Waters

[9]… Law on Budgets (Official Gazette of the Republic of Macedonia no. 79/93; 3/94; 71/96; 46/2000;11/2001, 93/2001; 46/2002; 24/2003; 85/2003 and 96/2004 and Decision of the Constitutional Court no. 180/98 (Official Gazette of the Republic of Macedonia no. 15/99)

[10]… Decree on the criteria and manner for B IPPC permit (Off. Gazette no. 04/2006); Decree on the level of charges for A IPPC permit (Off. Gazette no. 04/2006);

[11]… IPPC Ordinance - A permits (Off. Gazette no. 4/06);

[12]… IPPC Ordinance - Adjustment permits (Off. Gazette no. 04/2006);

[13]… IPPC Ordinance - B permits (Off. Gazette no. 4/06);

[14]… Rulebook on the form and content of the application form, and the content of the permit for collecting and transporting urban and other types of non-hazardous waste as well as on the minimum technical requirements for performing the economic activity of collecting and transporting urban and other types of non-hazardous waste (Off. Gazette no. 23/2007);

[15]… Rulebook on the format and the content of the Journal for records keeping on the waste handling, the format and the content of the forms for the annual report on waste handling by legal entities and natural persons and the format and the content of the annual report on waste handling by the mayor (Off. Gazette no. 7/2006);

[16]… Rulebook on the functioning methods and conditions of the integrated waste disposal network (Off. Gazette no. 29/2007);

[17]… List of Waste Types (Off. Gazette no. 100/05);

[18]… Waste Framework Directive;

[19]… Landfill Directive;

[20]… Directive for PCB's and PCT's;

[21]… Hazardous Waste Directive;

[22]… IPPC Directive.

[23]… Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their disposal

11.3.2 References – health risk assessment

[24]… Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for Chromium. U.S. Public Health Service, U.S. Department of Health and Human Services, Atlanta, GA. 1998

[25]… American Conference of Governmental Industrial Hygienists (ACGIH). 1999 TLVs and BEIs. Threshold Limit Values for Chemical Substances and Physical Agents, Biological Exposure Indices. Cincinnati, OH. 1999.

[26]… California Environmental Protection Agency (CalEPA). Technical Support Document for the Determination of Noncancer Chronic Reference Exposure Levels. Draft for Public Comment. Office of Environmental Health Hazard Assessment, Berkeley, CA. 1997.

[27]… California Environmental Protection Agency (CalEPA). Air Toxics Hot Spots Program Risk Assessment Guidelines: Part II. Technical Support Document for Describing Available Cancer Potency Factors. Office of Environmental Health Hazard Assessment, Berkeley, CA. 1999.

[28]… Occupational Safety and Health Administration

[29]… Environmental Protection Agency. Guideline for exposure assessment, Washington, 1992

[30]… http://www.health.gov.au/internet/wcms/publishing.nsf/Content/ohp-ehra-2004.htm~ohp-ehra 2004-background.htm

[31]… http://reports.eea.europa.eu/GH-07-97-595-EN-C2/en/chapter1h.html

[32]… http://www.who.int/ipcs/publications/ehc/methodology_alphabetical/en/index.html

[33]… http://www.who.int/ipcs/publications/ehc/ehc_numerical/en/index.html

[34]… IARC monographs on the evaluation of the carcinogenic risk of chemicals to humans - Some halogenated hydrocarbons, IARC, October 1979.

[35]… Kendrovski V., Gjorgjev D. The burden of diseases in the Republic of Macedonia. I-st International Congress of Occupational Medicine, Ohrid, 2006

[36]… National Environmental Action Plan. Government of the Republic of Macedonia, Skopje, 1996

[37]… National Health Environmental Action Plan. Government of the Republic of Macedonia, Skopje, 1999

[38]… National Waste Management Plan 2006-2012. Government of the Republic of Macedonia, Skopje, 2005

[39]… National Environmental Protectoral Council. Guideline of human risk assessment methodology. Canberra, Australia,1999

[40]… National Institute for Occupational Safety and Health (NIOSH). Pocket Guide to Chemical Hazards. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention. Cincinnati, OH. 1997.

[41]… Rai D. et all. Environmental chemistry of chromium., Total Environ., 25, 807-816, 1989.

[42]… Republic Institute for Health Protection. Yearbook of preventive programs in the Republic of Macedonia, 2007

[43]… Republic Institute for Health Protection. Internal data on request, Department for Social Medicine, 2007

[44]… Republic Institute for Health Protection. Internal data on request, Department for Hygiene and Environmental Health, 2007

[45]… State Statistical Office. Statistical Yearbook of the Republic of Macedonia, Skopje, 2000,2001,2002,2003,2004,2005,2006

[46]… The Second National Environmental Action Plan. Government of the Republic of Macedonia, Skopje, 2005

[47]… UN - Environmental Performed Review for FYR of Macedonia, 2002

[48]… UNEP.Post-Conflict Environmental Assessment—FYR of Macedonia, Geneva, 2000.

[49]… UNEP. Feasibility Study for urgent Risk Reduction Measures at hot spots In FYR of Macedonia, Geneva, 2001.

[50]… U.S. Department of Health and Human Services. Registry of Toxic Effects of Chemical Substances (RTECS, online database). National Toxicology Information Program, National Library of Medicine, Bethesda, MD. 1993.

[51]… WHO. Biomarkers and risk assessment: Concept and principles. Environmental Health Criteria 155, 1993

[52]… WHO. Assessing human risk of chemical: Derivation of guideline values for health based exposure limits. Geneva, Environmental Health Criteria 170, 1994

[53]… WHO. International Programme on Chemical Safety, The WHO recommended classification of pesticides by hazard and guidelines to classification 1994-1995, UNEP/ILO/WHO 1994

[54]… S. Hadzi Jordanov et all, Steel Production in Makstil – Skopje, A Report (in Macedonian), Faculty of Technology and Metallurgy, University Skopje, Skopje 2002,68 pp,

[55]… Van Nostrand's Scientific Encyclopedia, 8th edition, Vol. 1, D.M. Considine and G.D. Considine, Eds., Van Nostrand Reinhold N.Y. et all, 1995, p.1763,

[56]… R. Chang, Chemistry, 4th edition, McGraw-Hill, Inc., N.Y. et all. 1991, p.825.

[57]… Encyclopedia of Science and Technology, McGraw-Hill, 1977, ***Iron Manufacture***, Vol. 7, p. 293,

[58]… Encyclopedia of Science and Technology, McGraw-Hill, 1977, ***Steel Manufacture***, Vol. 13, p. 101,

11.4 Geoelectrical Profiles – Makstil Slug Dump Site

11.4.1 Profile Ma I

Region: **Skopje**

Location: **Makstil – Ferro Slag Dump - Skopje**

Method: **Geoelectrical mapping - resistivity**

Arrangement: **Wenner: AM=MN=NB=a=10, 20, 30 m**

Instruments: **Resistivity meter type IC/1B made in Serbia; Geophysical institute - Belgrade**

Azimuth: **114-87°**

Date: **14.08.2007**

Operator: **Novica Stolic**

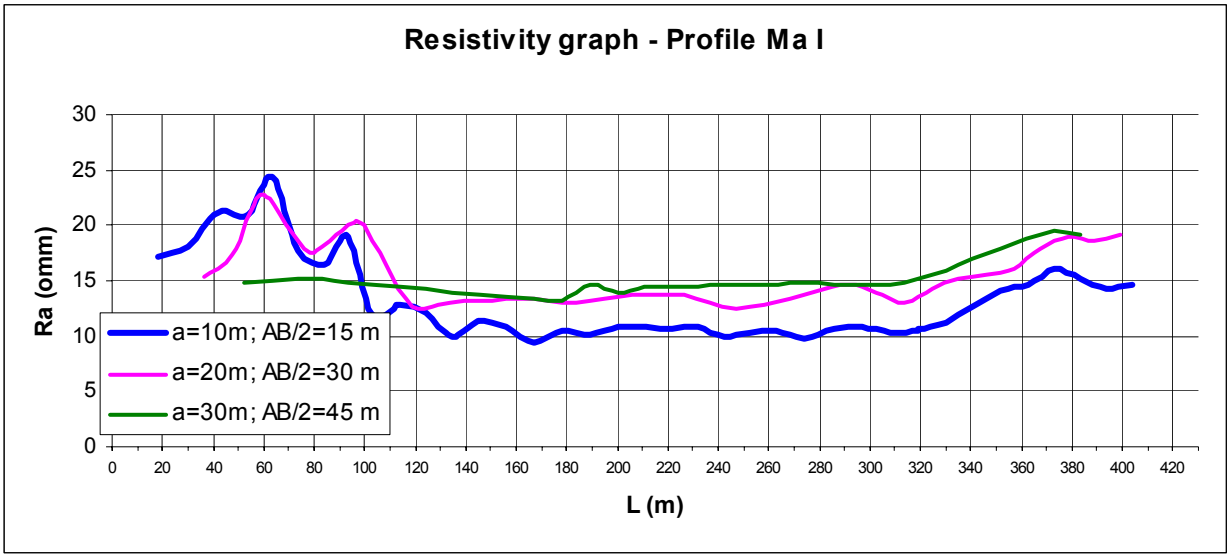
Profile I:		AM=MN=NB=a=10 m					a=10m; AB/2=15 m					Control measures			
Points	Y	X	Z	L	Elektrodes		a	K	dV	I	Ra	dV	I	R	Note
No.	UTM (m)	UTM (m)	(m)	(m)	AB	MN	(m)		(mV)	(mA)	(ohmm)	(mV)	(mA)	(ohmm)	
I/2-3	539638,5	652995,7	-5,0	18,0	1-4	2-3	10,0	62,8	9,8	35,8	17,2	21,7	77,8	17,5	
I/3-4	539649,4	652990,8	-5,0	30,0	2-5	3-4	10,0	62,8	18,7	65,0	18,1				
I/4-5	539660,7	652985,8	-5,0	42,3	3-6	4-5	10,0	62,8	34,0	101,0	21,2				
I/5-6	539670,9	652980,8	-5,0	53,7	4-7	5-6	10,0	62,8	36,0	108,0	20,9				
I/6-7	539679,6	652976,1	-5,0	63,7	5-8	6-7	10,0	62,8	49,0	126,0	24,4	48,0	125,0	24,1	
I/7-8	539688,4	652971,3	-5,0	73,7	6-9	7-8	10,0	62,8	62,2	221,0	17,7				
I/8-9	539697,2	652966,5	-5,0	83,7	7-10	8-9	10,0	62,8	61,5	235,0	16,4				
I/9-10	539706,0	652961,7	-5,0	93,4	8-11	9-10	10,0	62,8	66,0	219,5	18,9				
I/10-11	539715,1	652956,9	-5,0	103,3	9-12	10-11	10,0	62,8	42,0	222,0	11,9				
I/11-12	539724,4	652952,3	-5,0	113,7	10-13	11-12	10,0	62,8	56,5	278,0	12,8	56,0	275,0	12,8	
I/12-13	539733,7	652947,6	-5,0	124,1	11-14	12-13	10,0	62,8	45,0	232,0	12,2				
I/13-14	539743,0	652943,0	-5,0	134,5	12-15	13-14	10,0	62,8	30,0	191,0	9,9				
I/14-15	539752,1	652938,4	-5,0	145,0	13-16	14-15	10,0	62,8	40,5	225,0	11,3				
I/15-16	539761,9	652934,9	-5,0	155,8	14-17	15-16	10,0	62,8	38,0	221,0	10,8				
I/16-17	539772,8	652932,3	-5,0	167,0	15-18	16-17	10,0	62,8	25,0	167,0	9,4	24,5	166,0	9,3	
I/17-18	539783,6	652929,7	-5,0	178,3	16-19	17-18	10,0	62,8	25,0	149,0	10,5				
I/18-19	539794,4	652927,0	-5,0	189,5	17-20	18-19	10,0	62,8	32,5	202,0	10,1				
I/19-20	539805,4	652924,4	-5,0	200,7	18-21	19-20	10,0	62,8	41,0	239,0	10,8				
I/20-21	539816,1	652922,6	-5,0	211,4	19-22	20-21	10,0	62,8	26,0	150,0	10,9				
I/21-22	539826,3	652921,8	-5,0	221,7	20-23	21-22	10,0	62,8	29,0	170,0	10,7	28,0	168,0	10,5	
I/22-23	539836,5	652921,0	-5,0	231,9	21-24	22-23	10,0	62,8	27,0	156,0	10,9				
I/23-24	539846,7	652920,2	-5,0	242,1	22-25	23-24	10,0	62,8	17,7	112,0	9,9				
I/24-25	539856,9	652919,4	-5,0	252,4	23-26	24-25	10,0	62,8	20,0	123,0	10,2				
I/25-26	539867,6	652919,3	-5,0	263,1	24-27	25-26	10,0	62,8	19,0	113,0	10,6				
I/26-27	539878,8	652919,9	-5,0	274,3	25-28	26-27	10,0	62,8	21,6	140,0	9,7				
I/27-28	539890,0	652920,5	-5,0	285,5	26-29	27-28	10,0	62,8	20,2	120,0	10,6	20,1	120,0	10,5	
I/28-29	539901,2	652921,1	-5,0	296,8	27-30	28-29	10,0	62,8	20,0	115,0	10,9				

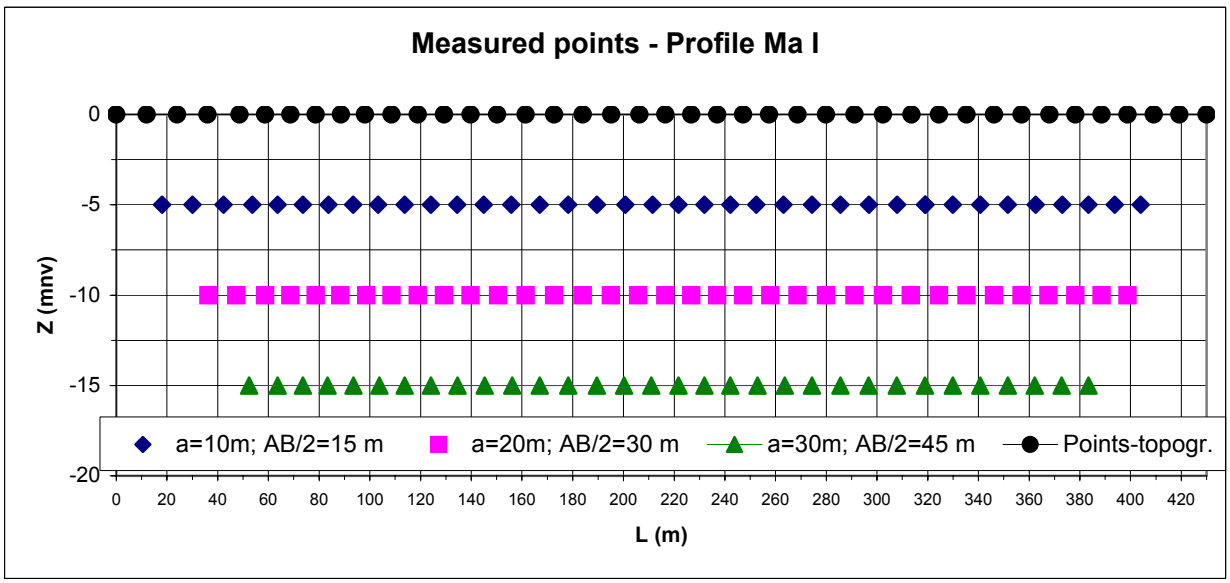
I/29-30	539912,4	652921,7	-5,0	308,0	28-31	29-30	10,0	62,8	25,0	152,0	10,3	49,0	301,0	10,2	
I/30-31	539923,2	652923,6	-5,0	319,0	29-32	30-31	10,0	62,8	31,0	185,0	10,5				
I/31-32	539923,2	652923,6	-5,0	319,0	30-33	31-32	10,0	62,8	26,2	154,0	10,7				
I/32-33	539933,6	652926,8	-5,0	329,9	31-34	32-33	10,0	62,8	39,0	220,0	11,1	38,0	218,5	10,9	
I/33-34	539944,0	652930,0	-5,0	340,8	32-35	33-34	10,0	62,8	47,0	235,0	12,6				
I/34-35	539954,4	652933,2	-5,0	351,6	33-36	34-35	10,0	62,8	48,0	215,0	14,0				
I/35-36	539964,8	652936,4	-5,0	362,5	34-37	35-36	10,0	62,8	42,0	181,0	14,6				
I/36-37	539975,1	652937,3	-5,0	373,1	35-38	36-37	10,0	62,8	62,0	241,0	16,2				
I/37-38	539985,3	652935,9	-5,0	383,4	36-39	37-38	10,0	62,8	67,5	281,0	15,1				
I/38-39	539995,5	652934,5	-5,0	393,7	37-40	38-39	10,0	62,8	46,5	205,0	14,3	46,1	204,0	14,2	
I/39-40	540005,7	652933,1	-5,0	404,0	38-41	39-40	10,0	62,8	48,0	205,0	14,7				

Profile I:	**AM=MN=NB=a=20 m**						**a=20m; AB/2=30 m**					**Control measures**			
Points	**Y**	**X**	**Z**	**L**	**Elektrodes**		**a**	**K**	**dV**	**I**	**Ra**	**dV**	**I**	**R**	**Note**
No.	**UTM (m)**	**UTM (m)**	**(m)**	**(m)**	**AB**	**MN**	**(m)**		**(mV)**	**(mA)**	**(ohmm)**	**(mV)**	**(mA)**	**(ohmm)**	
I/4	539654,9	652988,4	-10,0	36,3	1-7	3-5	20,0	125,7	3,8	31,0	15,4				
I/5	539666,5	652983,2	-10,0	47,3	2-8	4-6	20,0	125,7	10,2	73,5	17,4				
I/6	539675,2	652978,5	-10,0	58,7	3-9	5-7	20,0	125,7	21,1	116,0	22,9	19,9	115,7	21,6	
I/7	539684,0	652973,7	-10,0	68,7	4-10	6-8	20,0	125,7	19,6	123,0	20,0				
I/8	539692,8	652968,9	-10,0	78,7	5-11	7-9	20,0	125,7	18,1	130,0	17,5				
I/9	539701,6	652964,1	-10,0	88,4	6-12	8-10	20,0	125,7	24,1	158,0	19,2				
I/10	539710,5	652959,2	-10,0	98,6	7-13	9-11	20,0	125,7	30,0	186,0	20,3	39,0	238,0	20,6	
I/11	539719,8	652954,6	-10,0	108,5	8-14	10-12	20,0	125,7	24,0	183,0	16,5				
I/12	539729,1	652949,9	-10,0	118,9	9-15	11-13	20,0	125,7	18,0	180,0	12,6				
I/13	539738,4	652945,3	-10,0	129,3	10-16	12-14	20,0	125,7	19,6	191,3	12,9				
I/14	539747,7	652940,6	-10,0	139,8	11-17	13-15	20,0	125,7	21,2	202,5	13,2	21,0	202,0	13,1	
I/15	539756,5	652936,2	-10,0	150,6	12-18	14-16	20,0	125,7	19,6	185,8	13,3				
I/16	539767,4	652933,6	-10,0	161,4	13-19	15-17	20,0	125,7	18,0	169,0	13,4				
I/17	539778,2	652931,0	-10,0	172,7	14-20	16-18	20,0	125,7	19,5	185,5	13,2				
I/18	539789,0	652928,4	-10,0	183,9	15-21	17-19	20,0	125,7	21,0	202,0	13,1				
I/19	539799,8	652925,7	-10,0	195,1	16-22	18-20	20,0	125,7	20,9	196,0	13,4				
I/20	539811,0	652923,0	-10,0	205,8	17-23	19-21	20,0	125,7	20,7	190,0	13,7				
I/21	539821,2	652922,2	-10,0	216,6	18-24	20-22	20,0	125,7	18,4	168,5	13,7				
I/22	539831,4	652921,4	-10,0	226,8	19-25	21-23	20,0	125,7	16,0	147,0	13,7	31,0	285,5	13,6	
I/23	539841,6	652920,6	-10,0	237,0	20-26	22-24	20,0	125,7	17,3	167,0	13,0				
I/24	539851,8	652919,8	-10,0	247,3	21-27	23-25	20,0	125,7	18,5	187,0	12,4				
I/25	539862,0	652919,0	-10,0	258,0	22-28	24-26	20,0	125,7	18,3	178,5	12,9				
I/26	539873,2	652919,6	-10,0	268,7	23-29	25-27	20,0	125,7	18,0	170,0	13,3	17,5	168,0	13,1	
I/27	539884,4	652920,2	-10,0	279,9	24-30	26-28	20,0	125,7	20,8	186,0	14,1				
I/28	539895,6	652920,8	-10,0	291,1	25-31	27-29	20,0	125,7	23,5	202,0	14,6				
I/29	539906,8	652921,4	-10,0	302,4	26-32	28-30	20,0	125,7	19,5	176,0	13,9				
I/30	539918,0	652922,0	-10,0	313,4	27-33	29-31	20,0	125,7	15,5	150,0	13,0				
I/31	539928,4	652925,2	-10,0	324,4	28-34	30-32	20,0	125,7	19,5	172,5	14,2				

I/32	539938,8	652928,4	-10,0	335,3	29-35	31-33	20,0	125,7	23,5	195,0	15,1	23,0	191,0	15,1	
I/33	539949,2	652931,6	-10,0	346,2	30-36	32-34	20,0	125,7	20,8	167,5	15,6				
I/34	539959,6	652934,8	-10,0	357,1	31-37	33-35	20,0	125,7	18,0	140,0	16,2				
I/35	539970,0	652938,0	-10,0	367,7	32-38	34-36	20,0	125,7	26,5	186,0	17,9				
I/36	539980,2	652936,6	-10,0	378,3	33-39	35-37	20,0	125,7	35,0	232,0	19,0				
I/37	539990,4	652935,2	-10,0	388,6	34-40	36-38	20,0	125,7	43,0	290,0	18,6	42,5	288,4	18,5	
I/38	540000,6	652933,8	-10,0	398,9	35-41	37-39	20,0	125,7	44,0	289,0	19,1				

Profile I:		**AM=MN=NB=a=30 m**					**a=30m; AB/2=45 m**					**Control measures**			
Points	**Y**	**X**	**Z**	**L**	**Elektrodes**		**a**	**K**	**dV**	**I**	**Ra**	**dV**	**I**	**R**	**Note**
No.	**UTM (m)**	**UTM (m)**	**(m)**	**(m)**	**AB**	**MN**	**(m)**		**(mV)**	**(mA)**	**(ohmm)**	**(mV)**	**(mA)**	**(ohmm)**	
I/5-6	539670,9	652980,8	-15,0	52,3	1-10	4-7	30,0	188,5	28,2	358,0	14,8	28,0	357,5	14,8	
I/6-7	539679,6	652976,1	-15,0	63,7	2-11	5-8	30,0	188,5	38,1	478,7	15,0				
I/7-8	539688,4	652971,3	-15,0	73,7	3-12	6-9	30,0	188,5	48,1	599,3	15,1				
I/8-9	539697,2	652966,5	-15,0	83,4	4-13	7-10	30,0	188,5	58,0	720,0	15,2				
I/9-10	539706,0	652961,7	-15,0	93,6	5-14	8-11	30,0	188,5	62,7	793,3	14,9				
I/10-11	539715,1	652956,9	-15,0	103,8	6-15	9-12	30,0	188,5	67,3	866,7	14,6				
I/11-12	539724,4	652952,3	-15,0	113,7	7-16	10-13	30,0	188,5	72,0	940,0	14,4	72,0	938,0	14,5	
I/12-13	539733,7	652947,6	-15,0	124,1	8-17	10-14	30,0	188,5	70,3	933,3	14,2				
I/13-14	539743,0	652943,0	-15,0	134,6	9-18	10-15	30,0	188,5	68,7	926,7	14,0				
I/14-15	539752,1	652938,4	-15,0	145,4	10-19	13-16	30,0	188,5	67,0	920,0	13,7				
I/15-16	539761,9	652934,9	-15,0	156,2	11-20	14-17	30,0	188,5	58,0	803,3	13,6				
I/16-17	539772,8	652932,3	-15,0	167,0	12-21	15-18	30,0	188,5	49,0	686,7	13,5				
I/17-18	539783,6	652929,7	-15,0	178,3	13-22	16-19	30,0	188,5	40,0	570,0	13,2				
I/18-19	539794,4	652927,0	-15,0	189,5	14-23	17-20	30,0	188,5	39,8	513,3	14,6				
I/19-20	539805,4	652924,4	-15,0	200,2	15-24	18-21	30,0	188,5	33,7	456,7	13,9				
I/20-21	539816,1	652922,6	-15,0	211,0	16-25	19-22	30,0	188,5	30,5	400,0	14,4	30,0	398,0	14,2	
I/22-22	539826,3	652921,8	-15,0	221,7	17-26	20-23	30,0	188,5	29,7	387,3	14,5				
I/22-23	539836,5	652921,0	-15,0	231,9	18-27	21-24	30,0	188,5	28,8	374,7	14,5				
I/23-24	539846,7	652920,2	-15,0	242,1	19-28	22-25	30,0	188,5	28,0	362,0	14,6	27,5	361,0	14,4	
I/24-25	539856,9	652919,4	-15,0	252,9	20-29	23-26	30,0	188,5	29,7	382,0	14,7				
I/25-26	539867,6	652919,3	-15,0	263,6	21-30	24-27	30,0	188,5	31,3	402,0	14,7				
I/26-27	539878,8	652919,9	-15,0	274,3	22-31	25-28	30,0	188,5	33,0	422,0	14,7				
I/27-28	539890,0	652920,5	-15,0	285,5	23-32	26-29	30,0	188,5	36,7	471,5	14,7				
I/28-29	539901,2	652921,1	-15,0	296,7	24-33	27-30	30,0	188,5	40,3	520,5	14,6				
I/29-30	539912,4	652921,7	-15,0	307,8	25-34	28-31	30,0	188,5	44,0	570,0	14,6	8,6	115,0	14,1	
I/30-31	539923,2	652923,6	-15,0	318,8	26-35	29-32	30,0	188,5	39,7	495,0	15,1				
I/31-32	539933,6	652926,8	-15,0	329,9	27-36	30-33	30,0	188,5	35,3	420,0	15,8				
I/32-33	539944,0	652930,0	-15,0	340,8	28-37	31-34	30,0	188,5	31,0	345,0	16,9	30,6	342,0	16,9	
I/33-34	539954,4	652933,2	-15,0	351,6	29-38	32-35	30,0	188,5	37,3	391,0	18,0				
I/34-35	539964,8	652936,4	-15,0	362,2	30-39	33-36	30,0	188,5	43,7	437,0	18,8				
I/35-36	539975,1	652937,3	-15,0	372,8	31-40	34-37	30,0	188,5	50,0	483,0	19,5	49,5	481,0	19,4	
I/36-37	539985,3	652935,9	-15,0	383,4	32-41	35-38	30,0	188,5	49,0	480,0	19,2				


Resistivity graph - Profile Ma I
Ra (omm)
L (m)
a=10m; AB/2=15 m
a=20m; AB/2=30 m
a=30m; AB/2=45 m


Measured points - Profile Ma I
Z (mnv)
L (m)
a=10m; AB/2=15 m
a=20m; AB/2=30 m
a=30m; AB/2=45 m
Points-topogr.

11.4.2 Profile Ma II

Region: **Skopje**

Location: **Makstil – Ferro Slag Dump - Skopje**

Method: **Geoelectrical mapping - resistivity**

Arrangement: **Wenner: AM=MN=NB=a=10, 20, 30 m**

Instruments: **Resistivity meter type IC/1B made in Serbia; Geophysical institute - Belgrade**

Azimuth: **108-102°**

Date: **15.08.07**

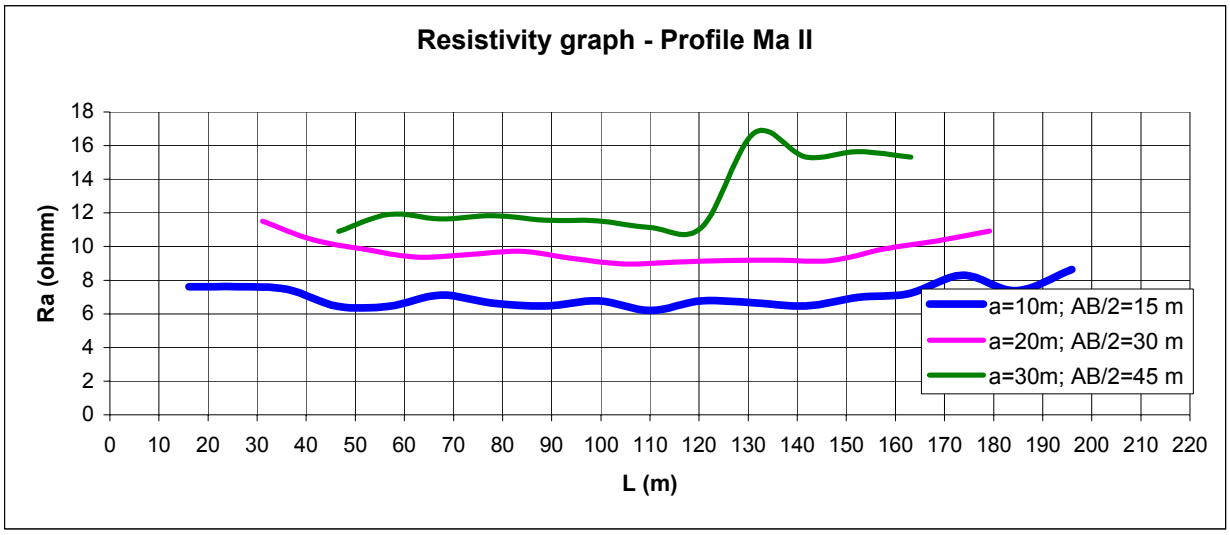
Operator: **Novica Stolic**

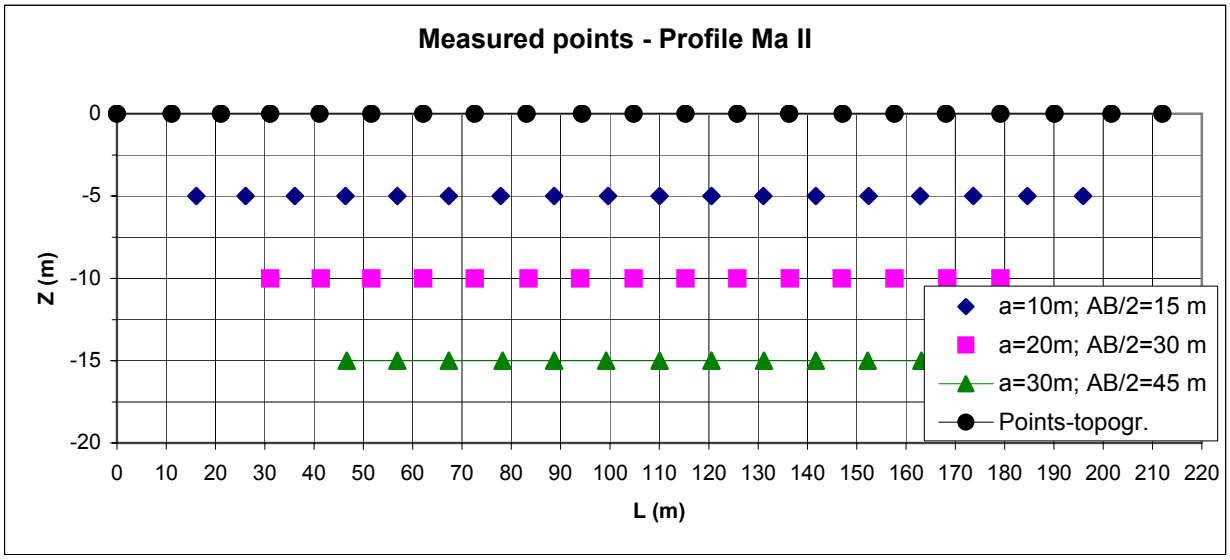
Profile II:		AM=MN=NB=a=10 m					a=10m; AB/2=15 m					Control measures			
Points	Y	X	Z	L	Elektrodes		a	K	dV	I	Ra	dV	I	R	Note
No.	UTM (m)	UTM (m)	(m)	(m)	AB	MN	(m)		(mV)	(mA)	(ohmm)	(mV)	(mA)	(ohmm)	
II/2-3	539982,2	652792,9	-5,0	16,1	1-4	2-3	10,0	62,8	70,0	578,0	7,6				
II/3-4	539991,7	652789,8	-5,0	26,1	2-5	3-4	10,0	62,8	70,0	578,0	7,6	70,0	579,0	7,6	
II/4-5	540001,2	652786,6	-5,0	36,1	3-6	4-5	10,0	62,8	35,0	295,0	7,5				
II/5-6	540011,1	652783,9	-5,0	46,4	4-7	5-6	10,0	62,8	39,0	380,0	6,4				
II/6-7	540021,7	652781,7	-5,0	56,9	5-8	6-7	10,0	62,8	37,0	360,0	6,5	36,5	359,0	6,4	
II/7-8	540032,4	652779,4	-5,0	67,4	6-9	7-8	10,0	62,8	19,8	175,0	7,1				
II/8-9	540043,2	652777,1	-5,0	77,9	7-10	8-9	10,0	62,8	19,0	180,0	6,6				
II/9-10	540053,3	652775,0	-5,0	88,7	8-11	9-10	10,0	62,8	28,0	272,0	6,5	28,5	272,0	6,6	
II/10-11	540063,1	652772,6	-5,0	99,6	9-12	10-11	10,0	62,8	15,2	141,0	6,8				
II/11-12	540073,2	652769,8	-5,0	110,1	10-13	11-12	10,0	62,8	23,0	233,0	6,2				
II/12-13	540083,3	652767,1	-5,0	120,6	11-14	12-13	10,0	62,8	32,3	300,0	6,8	32,0	298,0	6,7	
II/13-14	540093,4	652764,3	-5,0	131,1	12-15	13-14	10,0	62,8	23,0	217,0	6,7				
II/14-15	540103,8	652761,4	-5,0	141,7	13-16	14-15	10,0	62,8	34,0	330,0	6,5				
II/15-16	540114,1	652758,8	-5,0	152,4	14-17	15-16	10,0	62,8	30,0	270,0	7,0	29,5	268,5	6,9	
II/16-17	540124,3	652756,3	-5,0	162,9	15-18	16-17	10,0	62,8	31,0	270,0	7,2				
II/17-18	540134,7	652753,7	-5,0	173,7	16-19	17-18	10,0	62,8	18,5	140,0	8,3	19,0	140,0	8,5	
II/18-19	540145,4	652751,1	-5,0	184,7	17-20	18-19	10,0	62,8	28,0	238,0	7,4				
II/19-20	540156,4	652748,4	-5,0	195,9	18-21	19-20	10,0	62,8	33,0	240,0	8,6				

Profile II:		AM=MN=NB=a=20 m					a=20m; AB/2=30 m					Control measures			
Points	Y	X	Z	L	Elektrodes		a	K	dV	I	Ra	dV	I	R	Note
No.	UTM (m)	UTM (m)	(m)	(m)	AB	MN	(m)		(mV)	(mA)	(ohmm)	(mV)	(mA)	(ohmm)	
II/4	539996,4	652788,2	-10,0	31,1	1-7	3-5	20,0	125,7	1,1	12,0	11,5	1,1	11,8	11,7	
II/5	540006,0	652785,0	-10,0	41,4	2-8	4-6	20,0	125,7	60,0	725,0	10,4				
II/6	540016,3	652782,8	-10,0	51,6	3-9	5-7	20,0	125,7	62,5	797,5	9,8				
II/7	540027,0	652780,6	-10,0	62,1	4-10	6-8	20,0	125,7	65,0	870,0	9,4				
II/8	540037,8	652778,3	-10,0	72,6	5-11	7-9	20,0	125,7	50,5	667,0	9,5				
II/9	540048,6	652776,0	-10,0	83,5	6-12	8-10	20,0	125,7	36,0	465,0	9,7	36,5	468,0	9,8	
II/10	540058,0	652774,0	-10,0	94,0	7-13	9-11	20,0	125,7	39,5	534,0	9,3				

II/11	540068,1	652771,2	-10,0	104,8	8-14	10-12	20,0	125,7	43,0	603,0	9,0				
II/12	540078,3	652768,4	-10,0	115,3	9-15	11-13	20,0	125,7	46,5	644,0	9,1				
II/13	540088,4	652765,7	-10,0	125,8	10-16	12-14	20,0	125,7	50,0	685,0	9,2	49,0	680,0	9,1	
II/14	540098,5	652762,9	-10,0	136,5	11-17	13-15	20,0	125,7	31,8	435,0	9,2				
II/15	540109,0	652760,0	-10,0	147,0	12-18	14-16	20,0	125,7	13,5	185,0	9,2				
II/16	540119,2	652757,5	-10,0	157,7	13-19	15-17	20,0	125,7	16,3	208,0	9,8				
II/17	540129,4	652755,0	-10,0	168,4	14-20	16-18	20,0	125,7	19,0	231,0	10,3	19,0	230,0	10,4	
II/18	540140,1	652752,4	-10,0	179,2	15-21	17-19	20,0	125,7	20,0	230,0	10,9				

Profile II:		**AM=MN=NB=a=30 m**					**a=30m; AB/2=45 m**					**Control measures**			
Points	**Y**	**X**	**Z**	**L**	**Elektrodes**		**a**	**K**	**dV**	**I**	**Ra**	**dV**	**I**	**R**	**Note**
No.	**UTM (m)**	**UTM (m)**	**(m)**	**(m)**	**AB**	**MN**	**(m)**		**(mV)**	**(mA)**	**(omm)**	**(mV)**	**(mA)**	**(omm)**	
II/5-6	540011,1	652783,9	-15,0	46,6	1-10	4-7	30,0	188,5	57,0	985,0	10,9	57,0	980,0	11,0	
II/6-7	540021,7	652781,7	-15,0	56,9	2-11	5-8	30,0	188,5	43,0	680,0	11,9				
II/7-8	540032,4	652779,4	-15,0	67,4	3-12	6-9	30,0	188,5	44,5	720,0	11,7	44,0	715,0	11,6	
II/8-9	540043,2	652777,1	-15,0	78,2	4-13	7-10	30,0	188,5	59,0	940,0	11,8	31,0	498,0	11,7	
II/9-10	540053,3	652775,0	-15,0	88,7	5-14	8-11	30,0	188,5	46,0	750,0	11,6				
II/10-11	540063,1	652772,6	-15,0	99,2	6-15	9-12	30,0	188,5	41,0	670,0	11,5				
II/11-12	540073,2	652769,8	-15,0	110,1	7-16	10-13	30,0	188,5	26,0	440,0	11,1	25,0	435,0	10,8	
II/12-13	540083,3	652767,1	-15,0	120,6	8-17	11-14	30,0	188,5	29,0	490,0	11,2				
II/13-14	540093,4	652764,3	-15,0	131,2	9-18	12-15	30,0	188,5	32,0	360,0	16,8				
II/14-15	540103,8	652761,4	-15,0	141,7	10-19	13-16	30,0	188,5	39,0	480,0	15,3	38,5	478,0	15,2	
II/15-16	540114,1	652758,8	-15,0	152,2	11-20	14-17	30,0	188,5	39,0	470,0	15,6				
II/16-17	540124,3	652756,3	-15,0	163,2	12-21	15-18	30,0	188,5	13,0	160,0	15,3				

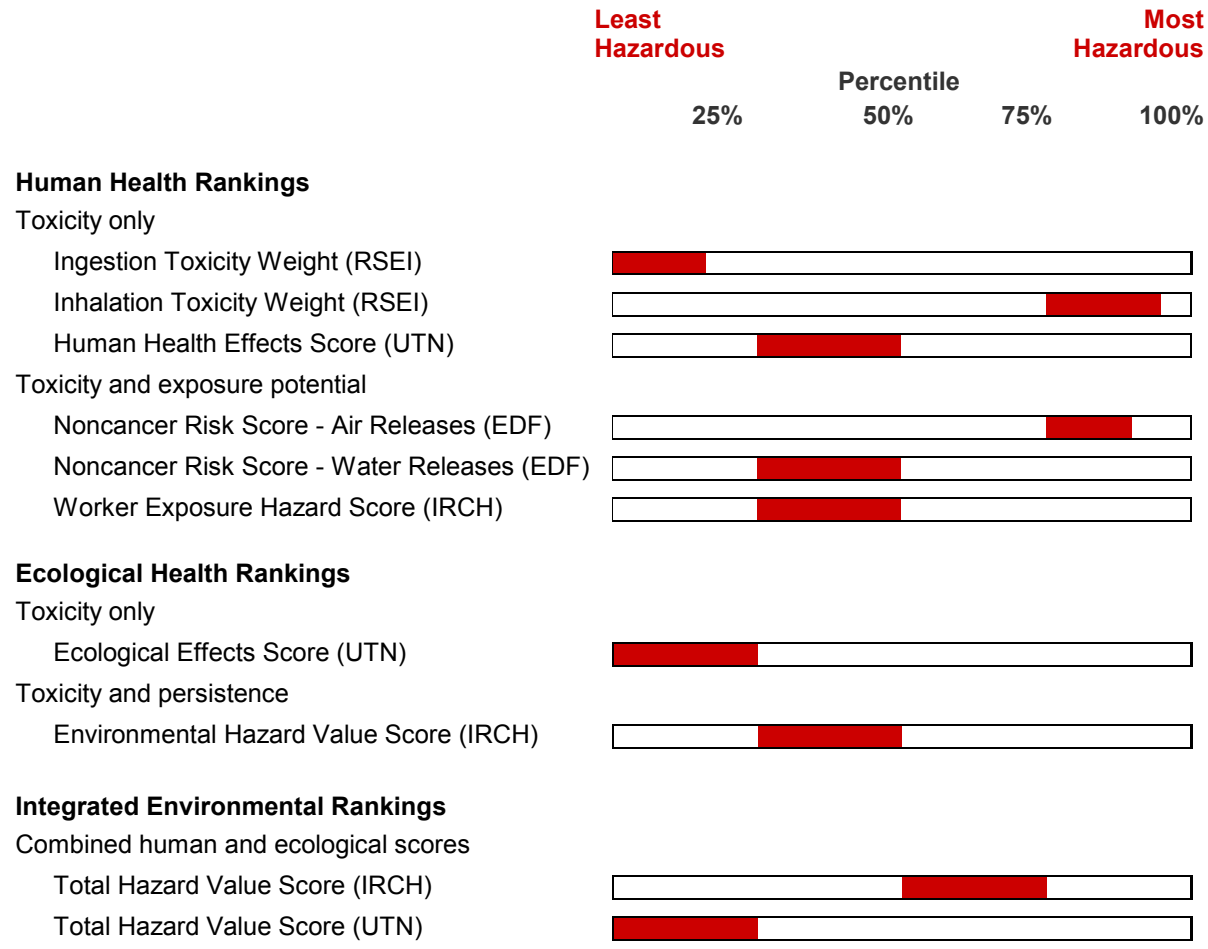



Measured points - Profile Ma II
Z (m)
0
-5
-10
-15
-20
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220
L (m)
a=10m; AB/2=15 m
a=20m; AB/2=30 m
a=30m; AB/2=45 m
Points-topogr.

11.5 Environmental related annexes

11.5.1 Hazard Ranking of Manganese

More hazardous than most chemicals in 3 out of 10 ranking systems
Ranked as one of the most hazardous compounds (worst 10%) to human health.



11.5.2 Permit level for waters and soil and disposal

Parameter	Surface Water	Groundwater	Drinking Water	Soil (Dutch)	Landfill Directive EU Limit values for non-hazardous wast	
					L/S = 2 l/kg	L/S= 10 l/kg
Cu	µg/l Class I/II 10 Class III/IV50 Class IV > 50	µg/l Class I/II 10	0,1	190	25	50
Hg	µg/l ClassI/II 0.2 ClassIII/IV 1 Class IV > 1	µg/l ClassI/II 0.2	0,001	???	0.05	0.2
Cd	µg/l ClassI/II 0.1 ClassIII/IV 10 ClassIV >10	µg/l ClassI/II 0.1	0,005	12	0.6	1
Cr	µg/l ClassI/II 10 ClassIII/IV 50 ClassIV >50	µg/l ClassI/II 10	Cr(VI) 0,05 Cr(III) 0,10	100	4	10
Pb	µg/l ClassI/II 10 ClassIII/IV 30 ClassIV >30	µg/l ClassI/II 10	0,01	530	5	10
Zn	µg/l ClassI/II 100 ClassIII/IV200 ClassIV >200	µg/l ClassI/II 100	0,1	720	25	50
Ni	µg/l Class I/II 50 ClassIII/IV 100 ClassIV >100	µg/l Class I/II 50	0,01	210	5	10
Mn	µg/l Class I/II 50 ClassIII/IV 100 ClassIV >100	µg/l Class I/II 50	0,01	???		
α-HCH		1		0,003		
γ-HCH		.1		0,00005		
β-HCH		1		0,009		
δ-HCH		1		0,00006		
Aldrin		,0,003				
Dieldrin		0,001		0,005		
DDE		0,001		0,01		
DDD		0,001				
$CHCl_3$		2				
CCl_4		2				
C_2HCl_3		3				
$CHCl_2Br$		2				
C_2Cl_4		2				
$CHBr_3$		2				
Naphtalene		1				
Fenantrene		5				
Acenaphtene		5				
Antracene		5				
Fluorantrene		0,01				
Pyrene		0,01				
Benz antracene		0,01				
Krizen		0,01				
Benz(b)fluorantrene		0,01				
Benz(k)fluorantrene		0,01				
Benz(a)pyrene		0,01				
Indeno(1,2,3,cd)pyrene		0,01				
Dibenz(a,h)antracene		0,01				

Benzo(g,h,i)perylene		0,01				

11.5.3 Data needs for treatment technologies for slag and contaminated soil

Technology	Data requirement
Capping	• Extent of contamination • Depth of ground water table • Climate conditions • Waste volume
Solidification/stabilization	• Material concentration • Moisture content • Bulk density • Grain size distribution • Waste volume • Inorganic salt content • Organic content • Debris size and type • Toxicity-TCLP
Soil washing/acid leaching	• Soil type and uniformity • Moisture content • Bulk density • Moisture content • Clay content • Metal concentration/species • pH • Cation exchange capacity • Organic mater content • Waste volume • Mineralogical characteristics • Debris size and type • Toxicity-TCLP[18]
Off-site land disposal	• Soil characterization as dictated by the landfill operator and the governing regulatory agency • Waste volume • Toxicity-TCLP
Reuse/Recycling	• Potential buyer/user • Waste volume/weight • Metal content for acceptance by smelter

18 TCLP-Toxicity Characteristic Leaching Procedure

11.5.4 Required Standards for Capping

The landfill rehabilitation should include the following components.

- Landscaping of slopes and surfaces to a conductive and stable profile
- The completion of the final capping layer system
- The construction of access roads on the Landfill
- The construction of surface water drains
- The supply, installation and maintenance of vegetative covering.

11.5.4.1 Landfill capping system

The capping system should be considered as comprising the respective composite layers between the final level of the waste and the final topsoil cover to be seeded and planted upon completion and closure of the landfill.

It is recommended that the maximum use is to be made of locally available earthen material for this purpose.

- Foundation trimming and profiling of the top slag layer
- Compacted Clay Layer permeability **< 1 x 10^{-8} m. s^{-1}**
- Granular soil drainage Layer
- Sub-soil cover
- Vegetative topsoil layer

No	Layer Zone Top - Down
1	Vegetative topsoil layer
2	Sub – soil cover (optional)
3	Granular soil drainage Layer (optional)
4	Compacted Clay Layer permeability **< 1 x 10^{-7} ms^{-1}**
5	Slag – Waste

11.5.4.2 Foundation trimming and profiling of the top slag layer (gradient 3%)

Trimming and profiling (compacting if necessary) of the top slag layer determine the design and the final shape of the rehabilitated landfill.

11.5.4.3 Compacted Clay layer

- The natural clay liner **(total 500mm thickness)** shall be placed in two layers each 250mm. The upper surface of each layer shall be parallel to the final design of the liner as appropriate. If any layer of the mineral liner will not be covered with a subsequent layer **within 24 hours** of its placement, then measures should be taken to prevent damage to or desiccation of the mineral liner until such time as the cover is placed. The liner constructed on slopes, construction shall take place from the bottom of the slope, upwards.

- All joints between adjacent areas of material placed at different periods shall be benched into by the depth of each layer and overlapped by **at least 500 mm per layer.**
- **The moisture content of the material at the point of deposition shall lie within the range of the OMC, to OMC+5%.The material should be compacted to at least 95% of Standard Proctor maximum dry density.**
- The contracting company shell submit a Method statement detailing the proposed sources and processing of materials and the plant to be employed in its placement and compaction for approval of the owner companies representative consultant.
- Compaction field trials shall be carried out by the contractor under the supervision and to the acceptance of the representative consultant, prior to the acceptance of any material for inclusion in the capping layer..
- The position and level of each test or sampling location on the mineral liner shall be surveyed.

11.5.4.4 Drainage Layer - optional

A 300 mm thick layer of drainage sand or suitable granular material has to be placed to discharge infiltrated storm water to the storm water drainage placed at the outside borders of the landfill.

11.5.4.5 Sub-soil cover

A 750 mm layer of subsoil is required in order to provide further protection for the mineral liner. This protection is required against the possibility of establishment of self sown plants with deep root system and to minimize the impacts of borrowing animals. The layer will also help with the uptake of excessive rainfall on the surface of the Landfill

11.5.4.6 Vegetative Topsoil

The topsoil shall be taken from on-site and off-site stockpiles or borrow pits wherever available. The total thickness of the topsoil shall be a **minimum of 150 mm.**

The topsoil shall have been temporarily stored, placed and handled in a manner so as not adversely affect its vegetation supporting qualities and characteristics.

Topsoil operations shall commence within one week of completion of placement of the underlying subsoil layer.

11.5.4.7 Access Roads and surface water drainage

Access roads shall be designed and installed on the restored cap

11.5.4.8 Surface Drainage ditches

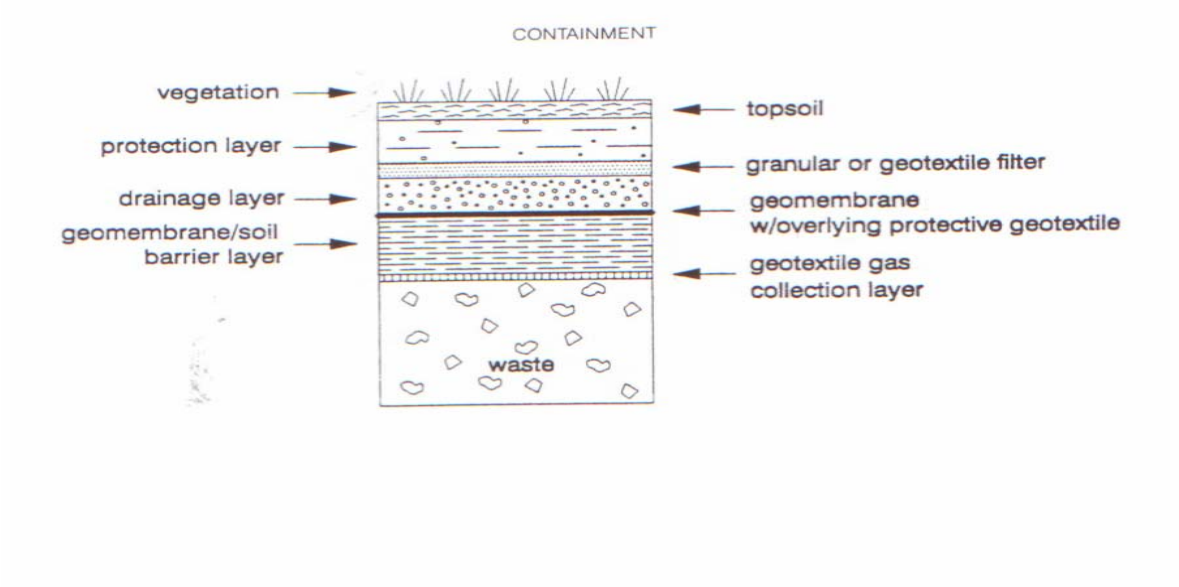
Surface water ditches shall be constructed either side of access roads to **a maximum depth of 600 mm** with a cross sectional area of 0,30 m².

11.5.4.9 Erosion measures

The access roads and surface water drains shall be constructed immediately after the placement of topsoil to ensure that no erosion may occur.

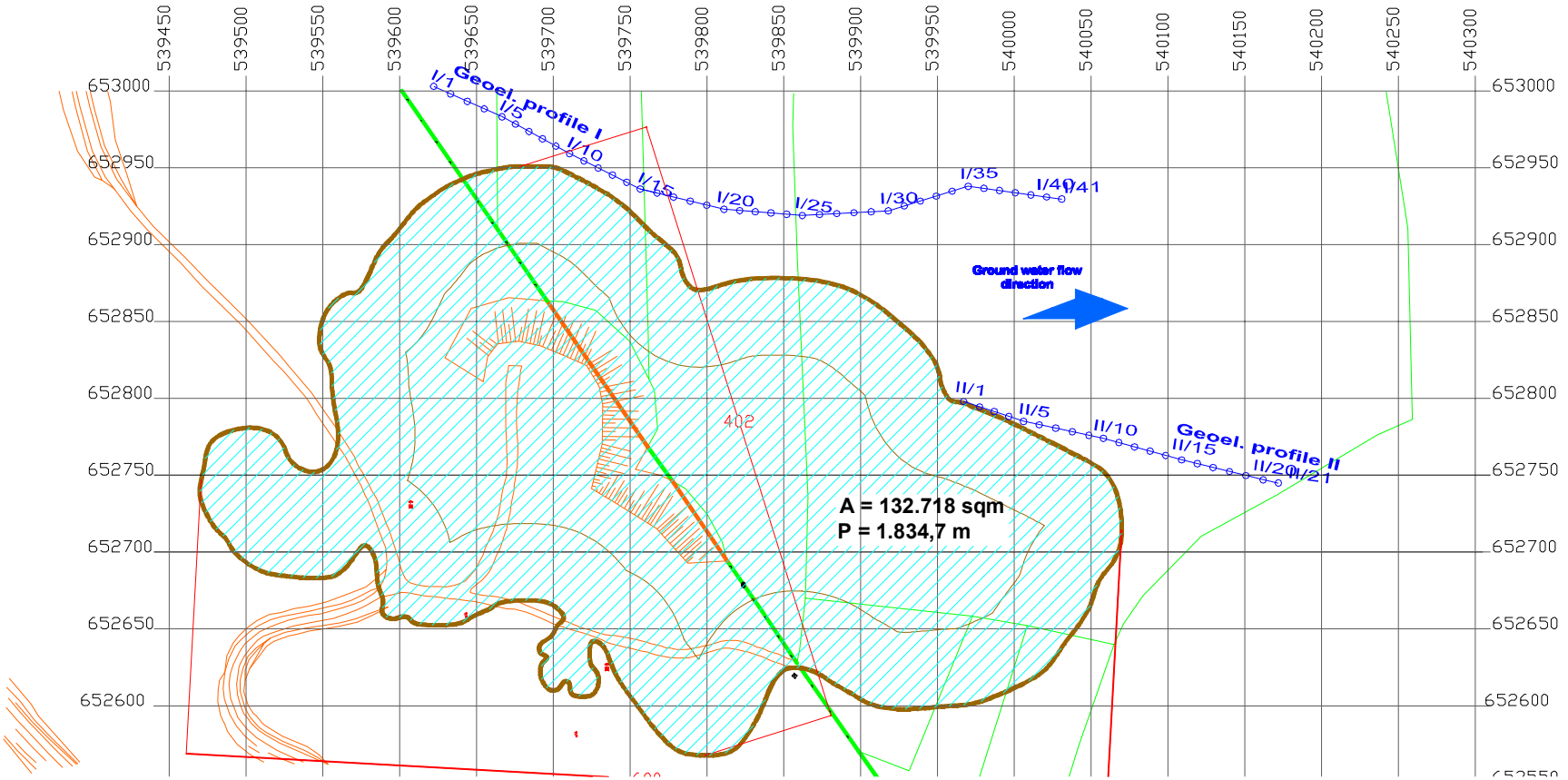
11.5.4.10 Vegetation on Landfill

- Establish an erosion control program to stabilize the soil soon after final capping of the landfill, in order to prevent erosion.
- Determine the soil nutrient status; before or during grass and ground cover trials soil tests
- Should be carried out to determine; ph, major nutrients content (nitrogen, potassium and phosphorus.
- Determine soil bulk density, since cover soil is frequently compacted by Landfill equipment during spreading operations increasing bulk densities, and this could severely restrict plant root growth.
- Modify soil cover is required: The soil over the entire planting area should be modified with lime, fertilizer in accordance with results of soil tests carried out prior to planting. These measures should be incorporated into the **top150mm of soil.**
- Select Landfill-tolerant species: Grass and other ground covers can be selected for planting in the soil cover by evaluating the results of the environmental plots established earlier to determine such Landfill-tolerant species.
- Plant grass and ground covers: It is generally desirable to embed the seed in the soil. Mulches can be used as an alternative to embedding the seed.

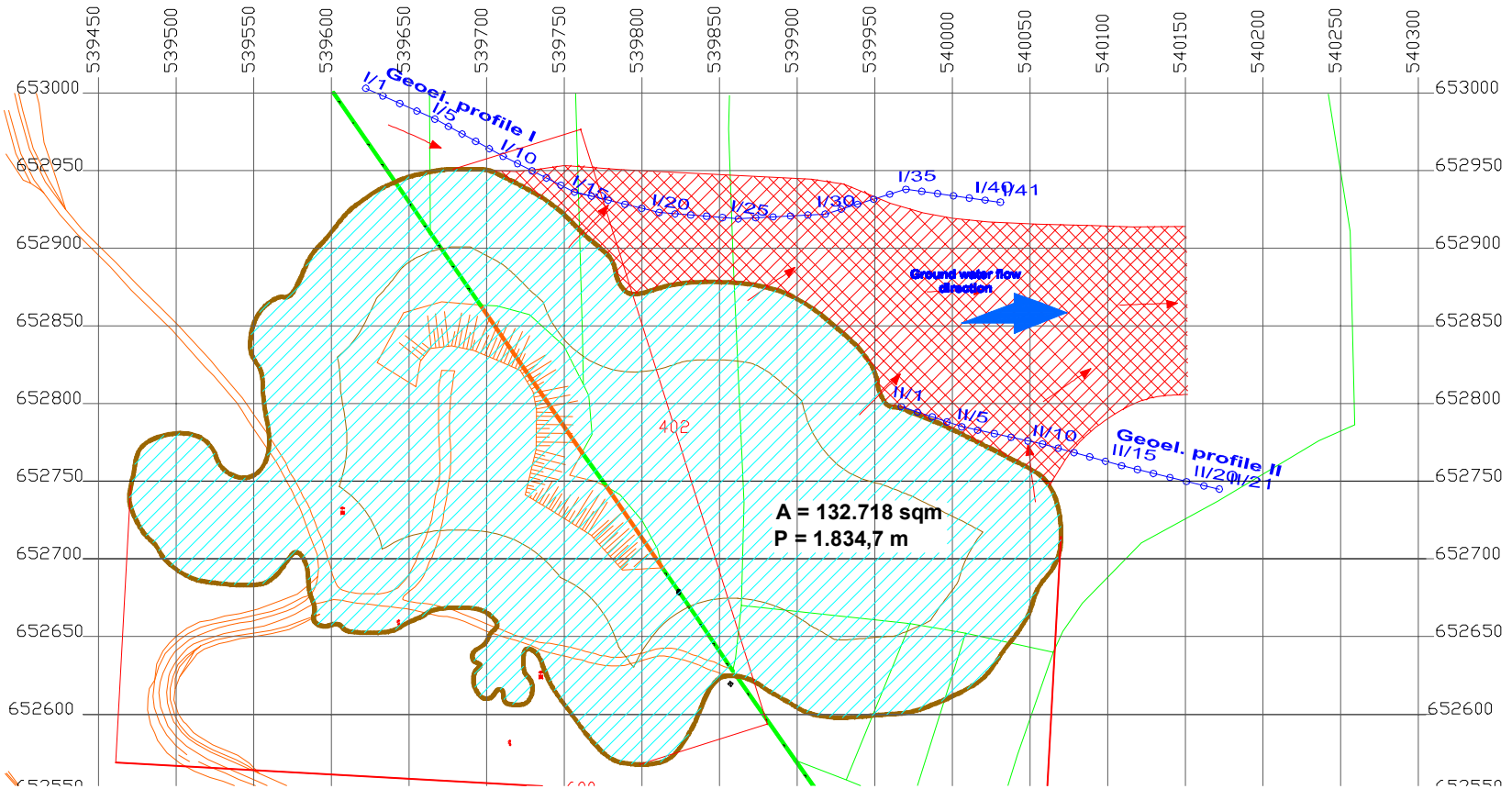


11.6 Maps

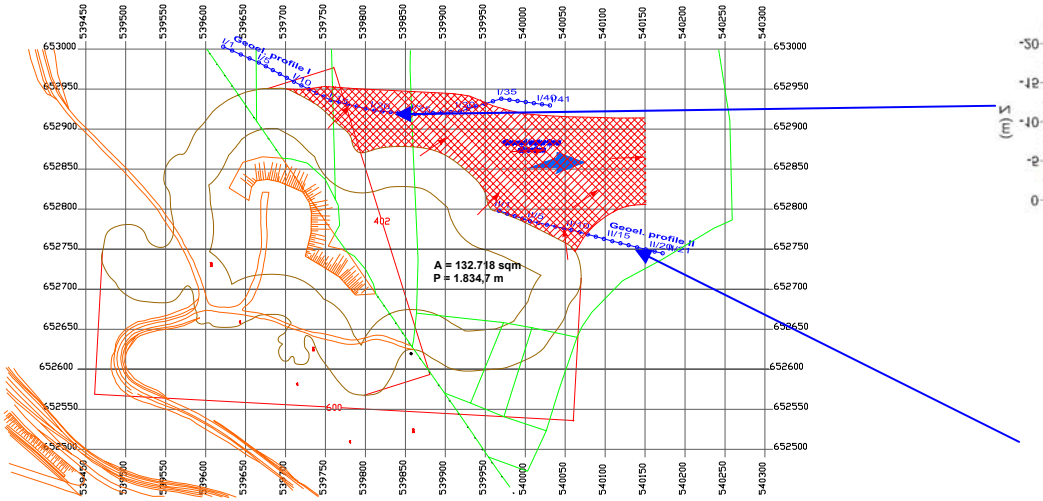
11.6.1 Maps – Makstil slag dumpsite – Profiles I and II

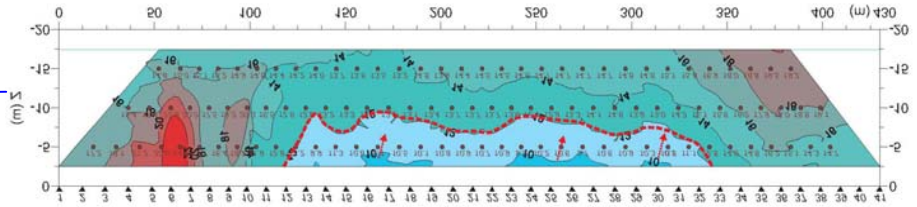


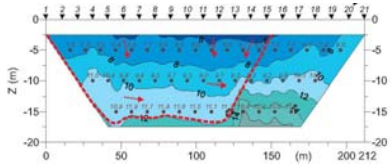
11.6.2 Maps – Makstil Slag Dumpsite – Anomaly Zone



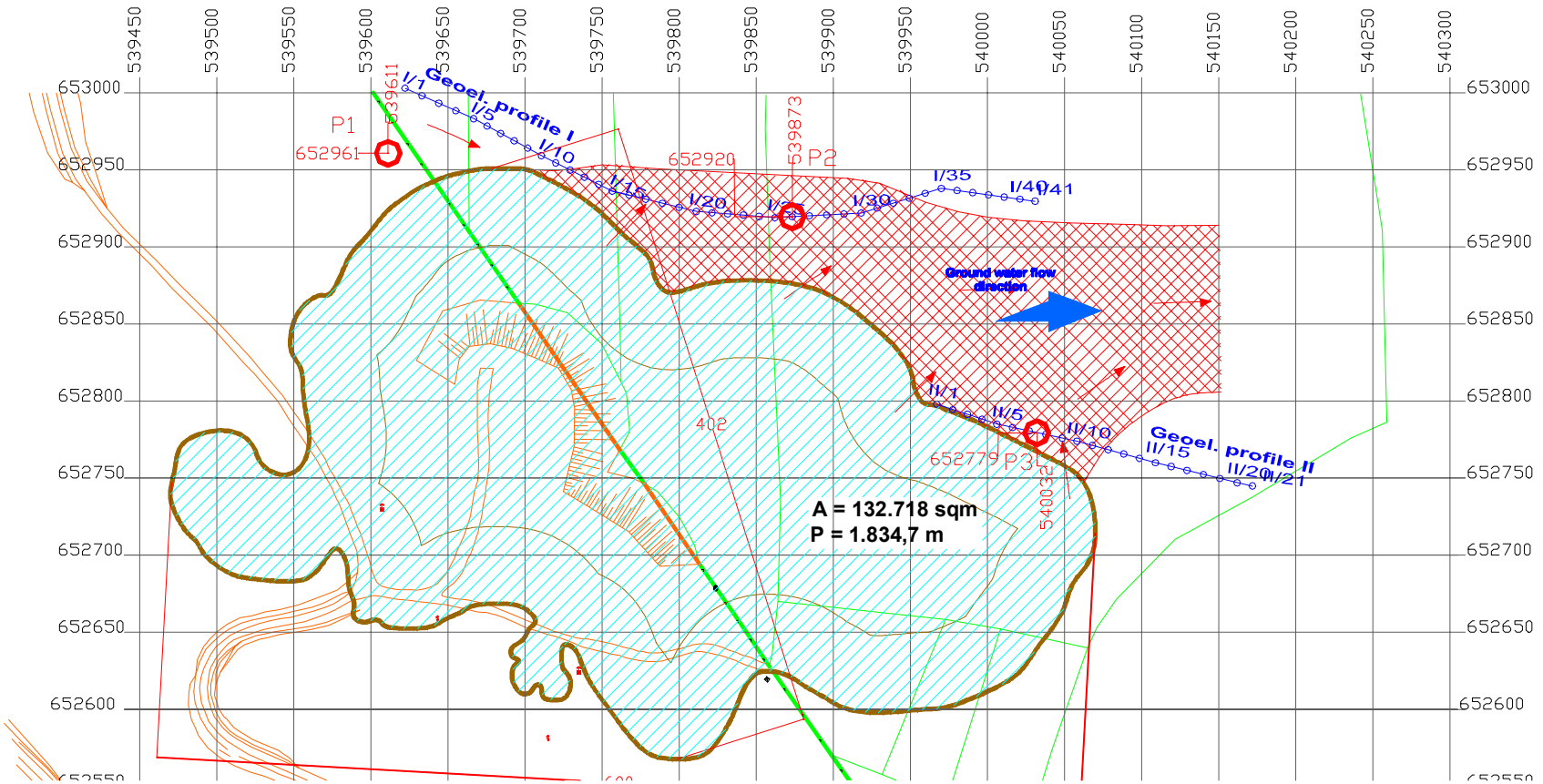
11.6.3 Maps – Makstil Slag Dumpsite – Vertical Anomaly Zones







11.6.4 Proposal of core drills and piezometer



11.7 Pictures

11.7.1 Makstil slag dumpsite

North West

North

North East

South

West

South towards the IPPC site

11.7.2 Recycling activities on site




11.7.3 Piecometer Location