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

(EUROPEAID/123674/D/SER/MK)

FEASIBILITY STUDY – Volume I – OHIS Plant

FEASIBILITY STUDY – Volume I – Ohis Plant

Project Title:	**Development of remediation plans with financial requirements for elimination of industrial hotspots**

Contract Number:	**06MAC01/09/103**

Contracting Authority:	**EUROPEAN AGENCY FOR RECONSTRUCTION**
Task Manager:	Mr. Ivan Borisavljevic
Address:	Makedonija street 11/1, 1000 Skopje
Phone:	+389 2 3286-731
E-mail:	ivan.borisavljevic@ear.europa.eu
Beneficiary:	**MINISTRY OF ENVIRONMENT AND PHYSICAL PLANNING**
National coordinator:	Mrs. Kaja Sukova
Address:	Drezdenska 52, 1000 Skopje
Phone:	+389 2 3066-930 extension 142
E-mail address:	k.sukova@MoEPP.gov.mk
Consultant:	**EPTISA** (in consortium with DHI)
Project Director:	Mr. Marko Cacanoski
Team Leader:	Mr. Ewald Spitaler
Address (Consultant):	Princesa 3, planta 6, 28008 Madrid, Spain
Address (Project):	III Makedonska brigada 10a, 1000 Skopje
Phone (Consultant):	+381 62 208 700
Phone/Fax (Project):	+389 2 3289-295
E-mail addresses:	mcacanoski@eptisainternacional.es espitaler@eptisainternacional.es

Date of report:	20 August 2007
Revision Number:	-- 01 --
Approved:	Mr. Ivan Borisavljevic …….

LIST OF ABBREVIATIONS

AP	Action Plan
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
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

Table of Contents

List of Tables

List of Pictures

List of Figurs

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

Поради тоа што проектот навистина истражуваше понатамошни индикатори и според тоа ги рангираше локациите, се бара дозвола за намалување на дополнителниот “base line“ извештај и да се инвестира ова време во подлабоко учество во физибилити, додека “base lining“ е секако дел на физибилити студиите.

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 приватизаиска 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. Специфичната ситуација на двата загадувачи во ОХИС ја наметнува потребата за соединување на две „feasibility“ студии во еден документ, додека двете места се проецнуваат наизменично.

Главни загадувачи на локацијата се HCH изомерите, останати од поранешното производство на Линдан и жива од поранешната фабрика за електролиза на хлор. Двете производства се затворени во доцните 80ти. Додека HCH изомерите биле контролирано одложени на две депонии и покриени, причините за загадување со жива се истекување од производството во минатото, употреба и одржување. Проценката на проецсот процени количина од 30.000 Mg на одложени HCH изомери и потенцијални 336 Mg на жива, не земајќи го во предвид епитирањето во воздухот. Големата количина на жива беше испуштена преку водниот систем во реката Вардар. Тековно загадување поради расклопување на фабриката за електролиза беше идентификувано.

Квалитативната проценка за ризикот врз здравјето, го рангираше влијанието врз здравјето.

Во ОХИС, генерално има идентификување на опасен и умерен потенцијален ризик по здравјето на вработените и на жителите на Скопје поради огромните зачувани количини на HCH изомери, како и потенцијално загадување на почвата и подземните води со жива. Во согласност со ЕН проценката соопштивме висок ризик по здравјето на луѓето за ОХИС и умерен за макстил.

Може да се каже дека сегашната операција на производните објекти на Макстил и Силмак предизвикуваат значително поголем ризик врз здравјето отколку што е акумулирано на истражуваните жешки точки. Се препорачува фокусирање на ИСКЗ постапката, со цел да се избегне и намали ризикот на прифатливо ниво.

Додека ризикот кај Макстил може да се смета за низок, ризикот кај Силмак, поради секундарни миграциони патишта (почва/површина) е значителен и треба да има приоритет.

Квалитативната проценка на ризикот по здравјето (Volume 00_A) ги опишува ризиците и влијанијата на загадувачите од фабриката. HCH изомерите одложени на локацијата Охис се претставени како опасни супстанции (Листа на видови на отпад Сл.В 100/2005). Начинот на кој што овие субстанции се одложени и управувани може да се каже дека е несоодветен, со оној начин кој што се применува во во другите инсталации за производство на HCH ширум Европа. Без разлика на овие околности, неможе да се изостави влијанието кое настанува преку секундарното задагување преку мигрирање низ подземната вода и почвата, врз основа на податоците добиени за нивната опасност како карактеристика. Во принцип изомерите на HCH се ракнирани на многу високо ниво по здравјето; сегашната состојба со Охис дозволува ранкирање кое е ниско до средно. Со отстранување на постоечкиот отпад ќе се елиминира постоечкиот ризик.

Живата е најдена во просториите на напуштената фабрика за електролиза во елементарна форма и во околната почва. Идентификуваната концентрација во подземнтата вода е далеку под дозволените концентрации и поради тој факт не е примарно земена во предвид како проблем. Поради овој факт се исклучува можноста дека во околните населени места може да настане влијание поради работата на фабриката. Како дополнение нема докази за органска жива кои доаѓаат од локацијата на Охис, како што е наведено од извештаите на околните населени

места (Драчево). Во принцип живата е една од 10-те највисоко рангирани супстанции по здравјето, додека ситуацијата во Охис е проценета дека е многу ниска.

Сумарно ранкирање

Жариште	Загадувач	Опасност	Ризик	Ранк
Охис	Жива	Висока (први 10)	Низок-Среден	2
Охис	HCH изомери	Висока (први 8)	Среден-Висок	2

Влијанието на производството во минатото и постоечката HCH депонија врз почвата, од еколошка гледна точка може да се третира како толерантно или поврзано со долгиот временски период на напуштеност на производството, како НИСКО. Резултатите покажуваат дека постојат HCH изомери и други органски загадувачи во подземната вода. Некои од резултатите покажуваат преминување над максимално дозволената концентрација според Холандските стандарди. Поради потенцијалот на HCH за биоразградување и ниската растворливост во вода, влијанието на производството во минатото и на постоечката депонија на HCH врз подзмната вода, може од еколошка гледна точка да се смета за умерено. Врз основа на овие податоци, добиени за време на работење на фабриката ОХИС и загадувањето од отпадни води беше сериозно, може да се претпостави дека не постои влијание врз површинската вода од постоечките жешки точки, по напуштање на производството. Времето на опстојување на Линдан и изомерите во воздух (вода и почва) зависи од хидро-метеоролошките услови и обично трае со месеци. Од овој аспект, влијанието на HCH депонијата врз животната средина е незначително. Штетното дејство на чистите супстанции (линдан и негови изомери, како и жива) се цени како многу високо и се наведува во табели во прилогот за линдан и жива. За среќа, во овој случај поради занемарливо малата концентрација на линдан (ако воопшто и постои денес) и на фактот дека субстанциите не вршат директно влијание врз животната средина (посебно врз водата) ризикот за животната средина и здравјето е под контрола и може да се оцени како НИЗОК.

ЛОКАЦИЈА	**Средина**	**ЗАГАДУВАЧ и КОЛИЧЕСТВО**	**ВЛИЈАНИЕ и РИЗИК**	**ВРЕМЕТРАЕЊЕ И ДИМЕНЗИИ**
ЛИНДАН: Депонија-1: Бетонски базен (50x100x5 m); покриен со почва Депонија-2: 5 индивидуалнидепонии; покриени со почва	Загадена почва Загадена вода Воздух	Линдан и изомери на HCH 35.000-40.000 t 3.000 t 20.000 m^3 Линдан и изомери на HCH, и други хлорирани органски соединенија - непознато	**Влијание:** **- Врз површинските води на Вардар и водата за пиење** - Локално загадување на воздухот со непријатен мирис – НИСКО **Опасност: ВИСОК** **Ризик: НИЗОК**	Долготрајна Локална

Како што може да се покаже, загадувањето на почвата со жива се цени како ниско. Постои индикација дека живата се насобира во подолните слоеви. Од постоечките податоци загадувањето на подземните води не може да биде занемарливо. За подетална проценка потребен е попрецизен мониторинг. Поради фактот дека

погонот за електролиза е одамна затворен, загадувањето на површинските води не би требало понатаму да биде проблем. Загадувањето на површинските води преку загадената почва, не е веројатно. Ризикот од чиста жива се цени како многу висок (види прилог за рангирање на опасноста на живата 11.6.4). За разлика од HCH изомерите, каде супстанцијата не е под директно влијание на животната средина, во случајот на жива постои директно влијание врз водата и почвата кое не можеме да го контролираме. Ризикот врз животната средина го оценуваме како ВИСОК, а врз здравјето како УМЕРЕН.

Хлор-алкална електролиза:	Загадена почва Подземна вода	Жива (Hg); 0,1-0,7 µg/kg; зависно од длабочината 8.000 m^3 2,3-2,7 µg/l	**Влијание: локално – УМЕРЕНО** **РИЗИК: ВИСОК врз животната средина** **УМЕРЕН врз здравјето**	Долго трајно Локално

Со истражување на разблажување на загадувањето со помош на геоелектрични мерења (отпорност) се утврдени главните површински загадувачи во подрачјето на депонијата на HCH изомери и во северо-источна насока, додека значително длабинско загадување постои во локацијата загадена со жива. 4 аномални зони се детектирани со длабочина од 0-15м. Покрај тоа, земени се примероци од површината на почвата, кои ги потврдуваат резултатите од геоелектричните мерења. Главно загадување околу HCH депониите потекнуваат од поранешното одлагање и секундарната миграција од депониите, додека главна загадена зона во погонот за електролиза е површината блиску до погонот која покажува загадување што сеуште трае и зголемена длабочина на загадувањето во корелација со растојанието од погонот. Изготвени се мапи и профили на разблажување и препораки аза вкупно 8 пиезометри со длабочина од 12-15м и координати каде треба да се постават.

Ризикот од земјотреси, со магнитуда 9, според меркалиевата скала, се цени како висок. Ризикот за дестабилизирање на подземјето поради оптоварување поголемо од дозволеното е присутен според пресметките. Треба да се земе во предвид како опција, намалување на висината на депонијата во случај таа да се опстане и да се прекрива со заштитен слој.

Како опции за ремедиација кои се вршат in situ, ex situ, на самото место и надвор од местото, се разгледуваат повеќе. Овие алтернативи се делат на биоремедијација, физичко-хемиски, термичи и други процеси на ремедијација. За HCH изомерите разгледувани се 9 можности и тоа: непревземање на активности, фиторемедијација, термички третман на самото место, хемиска редукција на самото место, прекривање со заштитен слој, ископување и каталитичко разградување, ископување и термичко третирање, надвор од локацијата и во странство, ископување и термичко третирање во печка за цемент и ископување и одлагање на друго место.

По извршената анализа на аспектите на животната средина, добиена е следната ранг листа:

Ископување и одлагање на друго место	– 1
Ископување и каталитичко разградување	– 2
Ископување и термички третман во печка за цемент	- 3
Ископување и термички третман во странство	– 4
Нанесување на заштитен слој	- 5

За загадувањето со жива, разгеледувани се 9 можности и тоа: непревземање на активности, For the Mercury contamination have taken 9 possibilities into account, such as no activities, фиторемедијација, електрокинетика, систем за термичка десорпција, in situ, на само место , на друго место, ископување и механичко сегрегирање на самото место, нанесување на заштитен слој, поврзување и ископување и одлагање на друго место.

По извршената анализа на аспектите на животната средина, добиена е следната ранг листа:

Ископување и одлагање на друго место	– 1
Ископување и механичка сепарација на самото место	– 2
Систем за термича десорпција на друго место	- 3
Систем за термича десорпција на самото место	– 4
Нанесување на заштитен слој	- 5

Економската проценка утврди 5 различни можности за погонот Билјана по извршената ремедијација: не превземање активности, слободна царинска зона, инкубатор за деловни активности, административен центар и пренамена во локација за живеење, меѓу кои опцијата за слободна царинска зона е оценета дека најмногу ветува. При разгледување на можноста за оценка на потенцијален поврат на капитал, при поставување на слободна царинска зона, ќе се добијат 360.000 Евра/год. директен повраток и 477.000 Евра меѓусекторски бенефит.

Трошоците за ремедијација на другите опции од горната проценка се пресметани и споредени со економскиот бенефит. Трошоците за транспорт, ракување, третман, надзор, капитализирање, инвестирање и информирање на јавноста, се разгледувани и споредени со економиката на секоја опција. Методот е примен посебно за HCH и загадувањето со жива. ROI (поврат на капитал- Revenue Of Investment) меѓу 3,4 и 24,8 за HCH активности за ремедијација и 4,4 до 16,9 за активности за ремедијација живата, додека, налошо сценарио за двете активности кога се земаат во предвид само директните податоци , се добива вредност на ROI од 7,8 години.

Економски најоправдано решение за загадувањето со HCH и жива, е ископување и одлагање на друго место. Меѓутоа, немајќи депонија за опасен отпад, се јави идеа да се испита депонијата за отпадоци во рудникот Лојане и нејзино адаптирање за одлагање на опасни отпадоци. Сметаме за многу

препрачливо да се иницира процена на влијанието врз животната средина за оваа локација

Втора алтернатива е комбинацијата со термичко разградување на HCH на друга локација (во печка за цемент) и механичко извлекување на живата од почвата на самото место. Во најлош случај ROI би изнесувал 17 години.

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 two pollutants at Ohis site makes two feasibility studies in one document necessary, while both spots are always alternating evaluated.

Main pollutants on the site are HCH isomers, remaining from former Lindane production and Mercury from former chlor electrolyses plant. Both production lines are closed since the late 80s. While the HCH isomers had been controlled disposed on two dumpsites and covered, causes the Mercury soil contamination due to spilling and droplets from former production, service and maintenance. The process evaluation evaluated an amount of 30.000 Mg of disposed HCH isomers and a potential of 336 Mg of Mercury, not taken emission into air into consideration. The major amount of Mercury was discharged through the process water system into the River Vardar. Ongoing pollution due to dismantling of the electrolyses plant has been identified.

The qualitative health risk assessment ranked the impact on health

In **Ohis**, generally there are hazard identification and **moderate-high** potential health risk due to stored HCH isomers in enormous quantities for employees and population in Skopje as well as potential local mercury contamination of groundwater and soil. In accordance with EH assessment we reported high moderate human risk for Ohis and moderate for Makstil.

It can be stated that the current operation of the production facilities of Makstil and Silmak 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 on Makstil site can be marked low, the risk on Silmak due to secondary migration paths (ground/soil) is significant and has to be given a priority.

The qualitative health risk assessment (Volume 00_A) describes risks and impacts, caused by the pollutants on the plant. HCH Isomers disposed on the Ohis plant are listed as hazard substances (waste catalogue). The manner those substances have been disposed and managed can be marked as an appropriate one compared to various well-known HCH disposal facilities in Europe. Regardless this circumstance and in respect to the hazard characteristics adverse impacts due to secondary migration paths such as groundwater and soil cannot be excluded. In principle can HCH Isomers be ranked as highly risky to health; the current situation at Ohis allows the ranking low – moderate. A removal of the existing wastes will eliminate the present risk.

Mercury has been found in the abandoned production facilities (electrolyses plant) in elemental form and in surrounding soil. The indemnified concentration in groundwater is far below the permitted levels and therefore not of primary concern. This circumstance excludes also the theory that the surrounding villages faced significant impacts by the plant. In addition no evidence of organic mercury, reported in the surrounding villages (Dracevo Case), has been detected on Ohis site. The contamination is limited to a part of the investigated site. In principle can Mercury harm human health and is ranked as one of the top 10 hazardous pollutants, while the situation on Ohis has been assessed as low to moderate.

Ranking Summary

Spot	Pollutants	Hazard	Risk	Rank
Ohis	Mercury	High (top 10)	Low-Moderate	2
Ohis	HCH Isomers	High (top 8)	Low-Moderate	2

The environmental impact of former production and existing HCH dump site on soil could be from the environmental view of point treated as tolerant or related to the long period of the abandoning of the production as LOW. Results showed the existence of HCH isomers and other organic pollutants in ground water. Some of results are exceed maximal permit concentration by Dutch standards. Because of the biodegradation potential of HCH and low solubility in water the impact of former production and likely from existing HCH dump site on ground water could be from the environmental view of point treated as moderate. Based on this data, obtained during the OHIS plant was in operation and pollution by waste water was serious, it could be assumed that the impact on surface water from the existing hotspots, after the abounding of the production doesn't exist any more. The residence time (half life time) of Lindane and isomers in air (water and soil) depends of the hydro- meteorological conditions and it is in the range of months. From this point of view, impact of HCH dump site on the environment is negligible. Hazardous risk assessment of pure substances (lindane and isomers and mercury) is estimated as very high, as it is given in tables in the appendix for lindane and for mercury. Fortunately, in the particular case, because the lindane concentration is practically negligible (does not exist any more) and that the substances are not under direct impact of environment (particularly water) the risk for the environment and health is under control and could be estimated as LOW.

LOCATION	MEDIA	CONTAMINANT and QUANTITY	IMPACT and RISK	DURATION and DIMENSION
LINDANE Plant: Dumpsite-1: Concrete pool (50x100x5 m); covered with soil Dumpsite-2: 5 individual dumps; covered with soil	Contaminated soil Ground water Air	Lindane and HCH-isomers 35.000-40.000 t 3.000 t 20.000 m3 Lindane, HCH-isomers, other chlorinated organics - unknown	**Impact:** **-** On surface water of Vardar River and potable water - Local air pollution with unpleasant odor – **LOW** **Hazard: HIGH** **Risks: LOW**	Long-term Local

As could be shown the soil pollution with mercury could be estimated as low. There is indication of accumulation of mercury in deeper layers. From the existing data pollution of groundwater cannot be negligible. For detailed estimation more precise monitoring will be needed. Because of the fact that the electrolyze plant is shout down the pollution of surface waters shouldn't be problem any more. Pollution of surface water trough polluted soil is not likely at all. Hazardous risk assessment of pure mercury is estimated as very high [see Annex Hazard Ranking of Mercury 11.6.4]. Opposite to the HCH isomers where the substances isn't under direct impact of environment, in the case of mercury there is direct uncontrolled impact of water and soil. The risk for the environment could be estimated as HIGH and on health as MODERATE.

CHLOR-ALKALI Plant:	Contaminated soil Ground water	Mercury (Hg); 0,1-0,7 µg/kg; depending on depth 8.000 m3 2,3-2,7 µg/l	**Impact: local – MODERATE** **Risks: HIGH on environment and MODERATE on health**	Long-term Local

The pollution dilution investigation referred to geoelectrical (resistivity) measures and identified mainly surface pollution in the area of the HCH isomer dumps and north eastern direction, while a significant depth pollution on the mercury contaminated site. 4 anomaly zones have been detected with a depth of 0-15m. In addition have been top soil samples conducted, which underlined the present geoelectrical result. Main pollution in the surrounding area of the HCH sites are the former storages and secondary migration paths of the dumps, while the main contamination zone within the mercury contaminated site is on the surface close to the former plant, which shows an ongoing pollution and an increased depths contamination in correlation with the distance to the plant. Maps and dilution profiles have been produced and recommendations for a total of 8 piezometers with a depths of 12 – 15m including coordinates have been stated.

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.

The remediation options have taken in situ, ex situ, on site and off site alternatives into consideration. Those alternatives have certainly been divided into bioremediation, chemical physical, thermal and other remediation processes. For the HCH isomers have taken 9 possibilities into account, such as no activities, Phytoremediation, Thermal on site treatment, Chemical reduction – on site treatment, Capping – mitigation measure, Excavation and based catalysed decomposition, Excavation and thermal treatment off site and abroad, Excavation and thermal treatment in Cement Kiln and Excavation and off site disposal.

After the environmental screening resulted in following ranking:

Excavation and off site disposal	– 1
Excavation and based catalytic decomposition	– 2
Excavation and thermal treatment in Cement Kiln	- 3
Excavation and thermal treatment abroad	– 4
Capping – mitigation measures	- 5

For the Mercury contamination have taken 9 possibilities into account, such as no activities, Phytoremediation, Electrokinetics, Thermal desorption system, in situ, on site, off site, excavation and mechanical segregation on site, capping, bounding and excavation and off site disposal.

After the environmental screening resulted in following ranking:

Excavation and off site disposal	– 1
Excavation mechanical separation on site	– 2
Thermal desorption system off site	- 3
Thermal desorption system on site	– 4
Capping – mitigation measures	- 5

The economical assessment evaluated 5 different possibities of reactivating Ohis Biljana site after remediation such as no activities, free trade zone, business incubator, administrative center and extension of residential area, while the free trade zone option has been evaluated as the most promising one. A case study has been taken into consideraton for the assessment of potential revenues out of the installation of a free trade zone with the result of potential 360.000 Euro direct revenues and 477.000 cross sector benefit per year.

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 economical outcome of various options. This method has been used once for the HCH and ones for the mercury contaminants. A ROI between 3,4 and 24,8 for HCH remediation activities and 4,4 till 16,9 for Mercury remediation activities have been calculated, while a worst case scenario for both activities and only taken direct revenues into consideration has shown an ROI of 7,8 years.

The most economical appropriate solution is for HCH and Mercury contaminants, the excavation and off site disposal. Due to the circumstance of a missing hazard waste landfill, the idea was born to investigate the tailing damn of Lojane mine and to adopt this area for the storage of hazard components. It is highly recommended to initiate an EIA for this area.

Second alternative is the combination of thermal treatment of HCH off site in the Cement Kiln and the on site mechanical separation of Mercury from Soil. The ROI will be in the worst-case scenario at about 17 years.

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 I 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 Generally Description of the Site – OHIS Plant

The Lindane complex in AD OHIS–Skopje had the plants HCH, Lindane and TCB, where HCH, Lindane, three-chlorine benzyl and hydrochloric acid were produced.

These plants were a technological unity because they were making a technological circle, i. e. technologically supporting each other.

In the HCH Plant technical hexa-chlorine-cyclo-hexane with gamma isomer of 12-14% was produced with photosynthesis of chlorine and benzyl. This technical HCH was further a material for obtaining pure gamma isomer 99,9%, i. e. Lindane, while the non-active isomers such as alpha, beta and delta which were extracted in the Lindane Plant were a material for obtaining three-chlorine benzyl and hydrochloric acid in the TCB Plant.

The process of extraction of the gamma isomer from HCH was performed with methanol as a solvent and had circle flow in the process, but didn't take part in the process itself.

The process of obtaining three-chlorine benzyl and hydrochloric acid from the non-active isomers was performed with thermal dissolution in the presence of active coal as a catalyst.

The Lindane complex was gradually put into function since 1964 and was functioning until 1977, when it was abandoned and stopped for ecological reasons and change of the market conditions and sales.

The licence issuer was the German firm C.H.BOEHRINGER SOHN from INGECHEIM A.RH.

3.1 Geographical Description of the area

OHIS is located about 5,5 km southeast of the center of Skopje, in the municipality Kisela Voda. Area which is used by this installation is 1 000 000 m^2, based on lowland on a level of 385 m above sea level. It is connected with a local traffic network.

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

3.1.1 Climate Characteristics

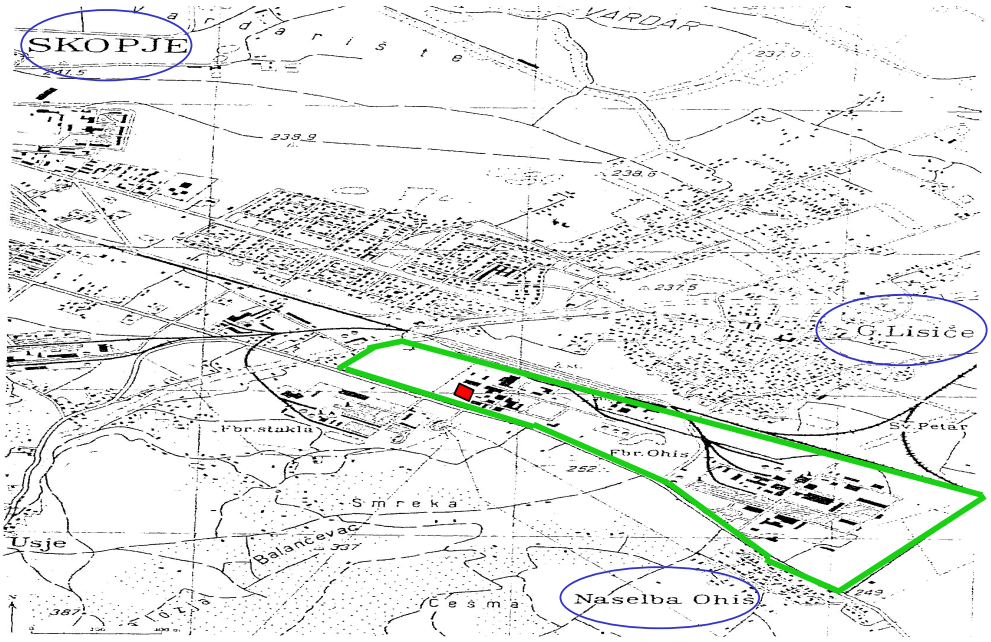
The climate characteristics on this area are based on position of the site. The average annual air temperature is 12,5 ºC, where the maximum temperature is 41,2 ºC. usually the climate during the summer period is very dry and warm, but in the winter this characteristics are moderate cold. Average cold period is in the duration of 170 days. The average quantities of rainfalls/precipitations are 502,3mm.

3.2 Topographical Description of the area

OHIS is placed in the industrial area of the city Skopje. The nearest settlements are Lisice, Pintija, and Dracevo in radius up to 2 till 5 km, with more than 50.000 inhabitants in the surrounding area.

On the north side of the installation is located river Vardar approximately 2,5 km down gradient. From the south it is surrounded by the mountain Vodno, it is based on the basin of this mountain. From its east part is the settlement Dracevo, and from the west part the city of Skopje.

The position of the installation is N 41.96637 and E 21.47477 [UTM 34T; X = 0538165; Y = 4641854]



3.3 Geological Description of the area

The surface part is composed of flood's deposits from Markova Reka, composed out of gravel of different size and sand with dust layer thick 10 – 20 m. This deposit is porous

with enhanced water permeability, having filtration coefficient of 10^{-1} cm/s and even of 10^{-0} for the pure gravel. So it is exceptionally permeable for pollutants migration.

In a substrate of this deposit, up to a depth of ca 30 m, the terrace alluvial deposit of Vardar River is present, composed of gravel and sand with dusty clay. This deposit is also with enhanced water permeability, having filtration coefficient of 10^{-1} cm/s and even of 10^{-0} for the pure gravel. So it is exceptionally permeable for pollutants migration.

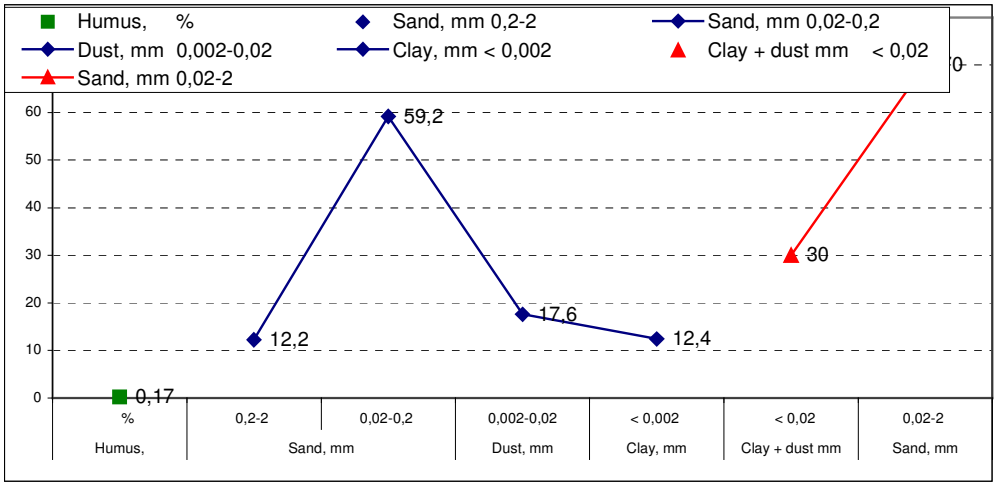
In the direction of Vardar River the total thickness of the alluvial deposit reaches a depth of ca 150 m.

The substrate of the alluvial deposit is composed of Pliocene sediments of layered, poorly bonded dust-clay sandstones, conglomerates and marls, marly clays etc. Thin layers of marls and clays are water non-permeable, while the sandstones and conglomerates are of poor water permeability (with a filtration coefficient of probably 10^{-4} or even lower).

Table 1_Texture of Soil from the Piezometer of a depth of 0,3 till 6,3 meter

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
0,3-6.7	0,17	12,2	57,8	17,6	12,4	30,0	70,0

Figure 1_Texture of Soil from a depth of 0,3 till 6,3 meter

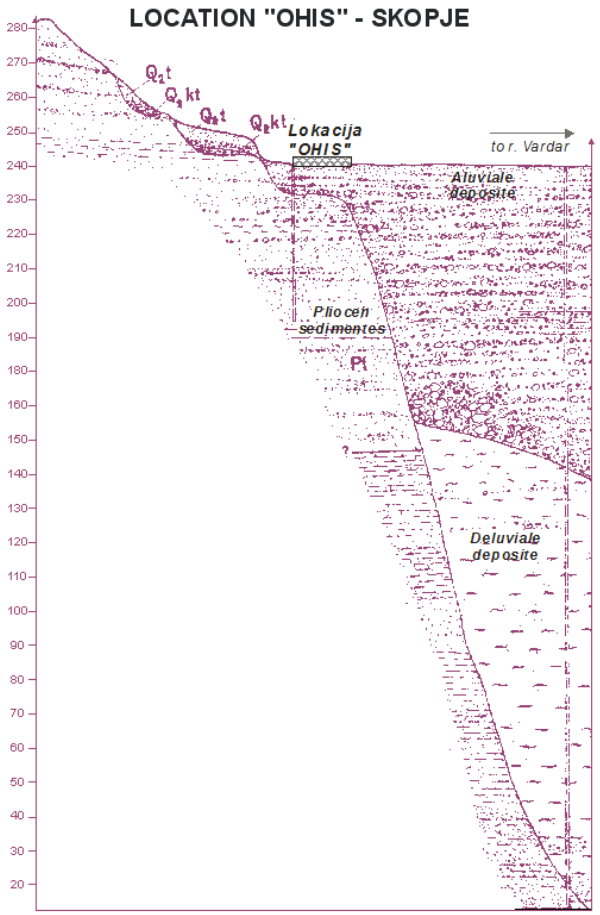


3.4 Hydro-geological Description of the area

Groundwater in this location is from the Markova River watershed, and the direction of underground flow as a part of the underground flow system in the alluvial terrace deposits, probably in parallel with the Vardar River flow.

A phreatic aquifer[4] can be found in the deposits of the alluvial terrace at the OHIS site. The deposits have a saturated thickness of 10-15 m and a capacity of 10 l/s (indicating, that 10 l/s could be an expected yield from ground water abstraction wells). Groundwater flows generally in a northeasterly direction, towards the main discharge river Vardar, which is located approximately 2,5 km down gradient.

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



3.4.1 Ground water abstraction

The alluvial deposits used to be a good source for water abstractions that served agricultural purposes. Due to a high concentration of pesticides, many abstraction wells have been inactivated. Currently is no groundwater abstracted down gradient from Ohis site.

[4] Source: UNEP; Feasibility Study for urgent risk reduction measures at hot spots in FORMER YUGOSLAV REPUBLIC OF of Macedonia; only for waste of Lindane; August 2001

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);
- 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).

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"**

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

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).

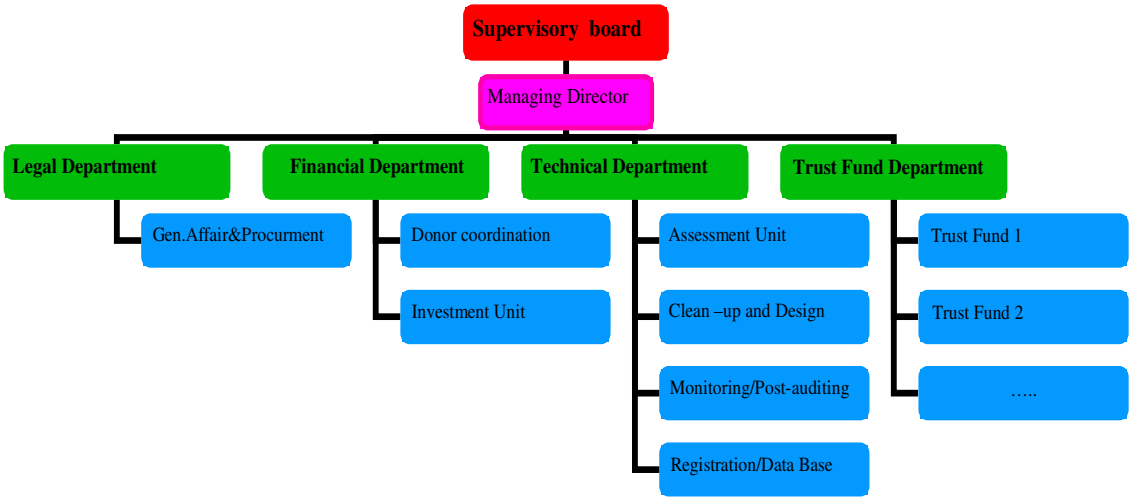
The priority remediation projects for the Fund should be established on the basis of risk assessment. Initially, the 2nd National Environmental Action Plan (NEAP) can be used for reference regarding the funding priorities. Investment strategy and priorities should be prepared by the Fund, approved by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

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

5.4 Objectives

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

5.4.1 Specific objectives are formulated as follows:

- To increase knowledge/awareness of the different target groups concerning the pollution problems in OHIS
- 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 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 in former Yugoslav Republic of Macedonia.

This draft report is structured to provide a basis for further discussion amongst the key stakeholders and NGOs

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 older population. This behavior has impact to 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.

- **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 Kisela Voda already has experience with environmental awareness raising activities, but still needs significant capacity building in this area. More specific capacity building needs of the Municipality of Kisela Voda are listed below:

- Preparation of LEAP
- Systematization and standardization of information for all projects
- Enhancement of the communication with production facilities located at the territory of Kisela Voda
- Providing required transparency and
- Deliver it to the end user

The Municipality of Kisela Voda 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. The Municipality of Kisela Voda is also primarily responsible for securing free access to environmental information.

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.

At the moment, beside EAR donors active at OHIS site is the Czech Government though its ODA - Development Agency. They are financing two years project for detail feasibility study and small-scale remediation activities for OHIS Hot Spot remediation.

The Grant approved by the Czechs Republic Government is on some 330.000,00 EUR (equivalent to a lump sum of 10 million Czechs Crones). Czechs companies will be engaged to perform the job. Three OHIS hot spot are to be covered by this sum, such as the HCH Isomer waste, Mercury spilling and Wastewater treatment unit. The beneficiary is the Directorate of inspectorate within the MoEPP.

Italian Government in a letter of the Minister for the Environment, Land and Sea, also expressed its willingness to be a partner onto the same location. Their interest is mainly focused on the clean up of these sites, elimination of HCH Isomers and examination of bio-decontamination level of the dumpsites.

The POPs Office in Skopje has promoted, initiated and coordinated donor and is informed in details about activities for remediation of OHIS site and follows further development.

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 remediation activities at OHIS factory. 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.

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), village Dracevo and on a road from Skopje to OHIS
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 Kisela Voda. Awards for the best works, should be provided

Figure 4_Proposed Public Awareness Rising Activities for the Remediation Activities in Ohis

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; OHIS	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 OHIS	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.

6 Technical Perspective - Assessments

6.1 Qualitative Health Impact Assessment

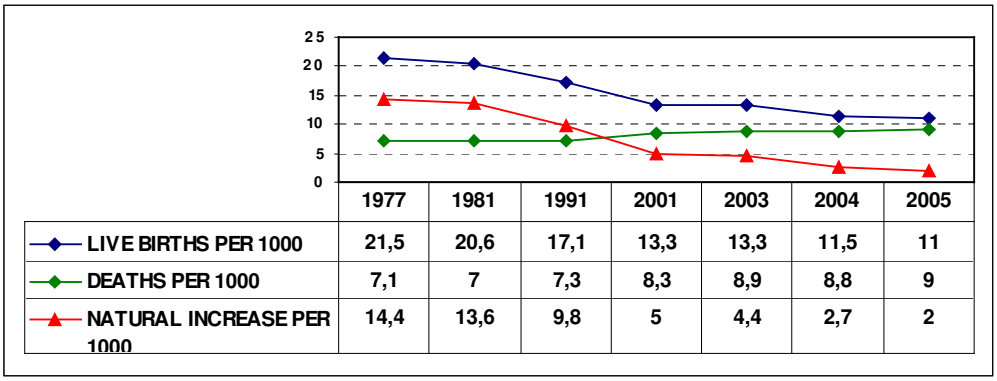
The qualitative Public Health Impact Assessment is a comprehensive study (**Volume 00_A**) about the current status and development of impacting factors on human health caused by historical and ongoing pollution. The study compared trends and tendencies of disease appearances for each site with those of Macedonia and the European Union. The following chapter focuses on the site of Ohis and the impacting situation of HCH-Isomers and Mercury.

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][5]



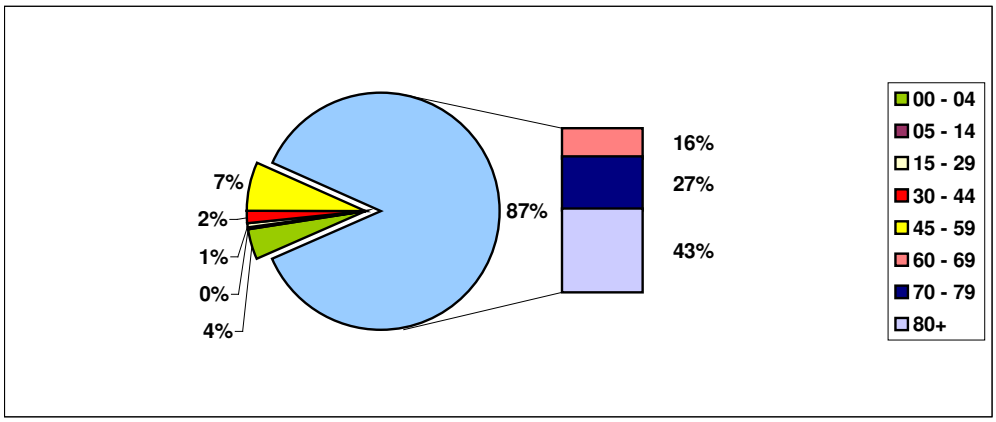
	1977	1981	1991	2001	2003	2004	2005
LIVE BIRTHS PER 1000	21,5	20,6	17,1	13,3	13,3	11,5	11
DEATHS PER 1000	7,1	7	7,3	8,3	8,9	8,8	9
NATURAL INCREASE PER 1000	14,4	13,6	9,8	5	4,4	2,7	2

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

[5] 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.

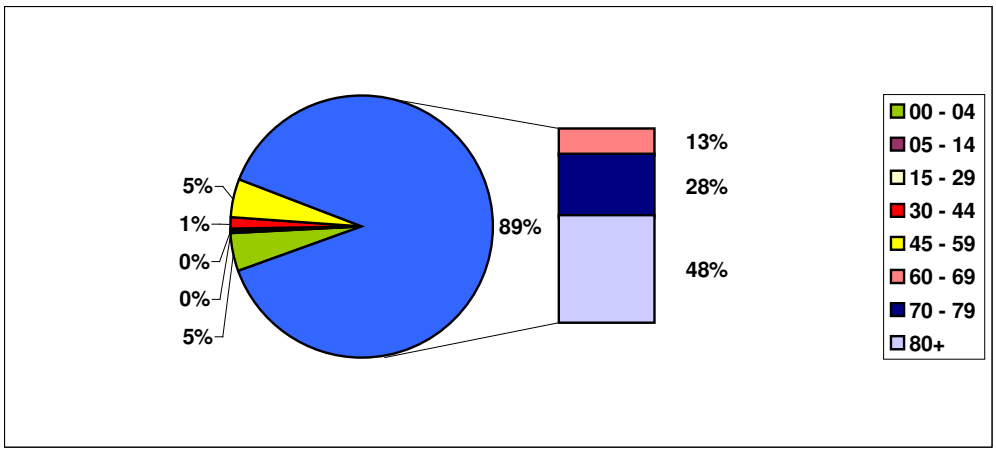
Figure 6_Years of Life Lost (YLL) by age groups among males, Macedonia 2002[6]



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[7]

[6] 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.

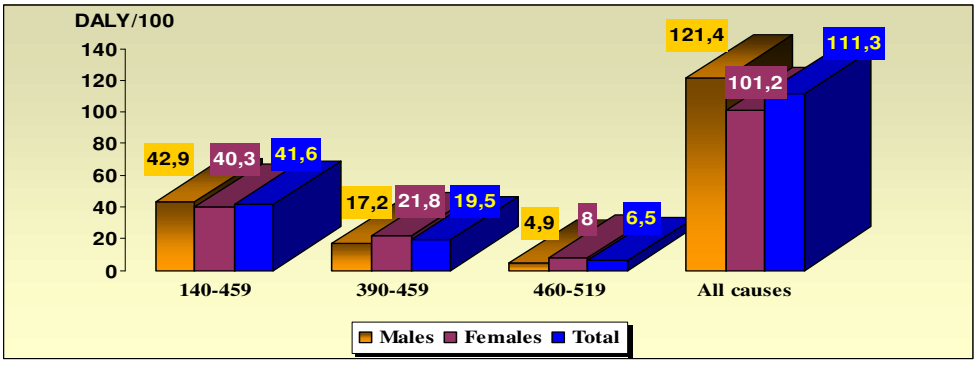
As yet this not extendedly is the case with Physical Planning and Environmental Health. However harmonization with EU Directives of the legislative framework for Regional Development has started. The same applies to the transposition of EU's Pharmaceutical Laws and Food Legislation, and specialized issues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

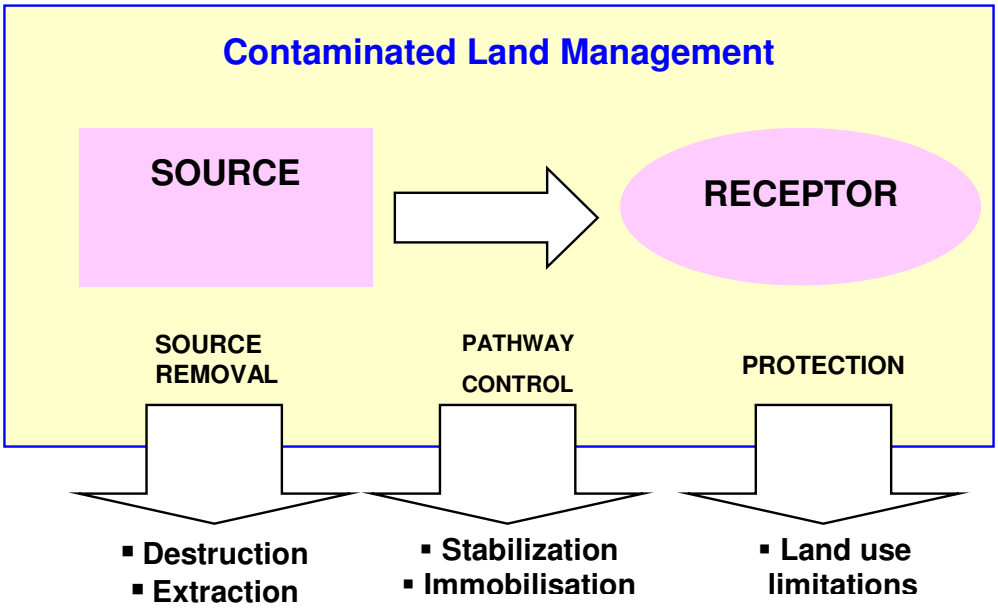
6.1.7 Methods

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 15000 t 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 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 old landfill of the former integrated steelwork is a potential source of groundwater contamination with

6.1.9 Specific Situation – OHIS - Skopje

OHIS AD has been in operation since 1964 and was one of the country's largest industrial producers manufacturing a range of chemical products and employing around 3,900 workers. It is a currently classified as a joint-stock company – around 48 per cent of the company is privately owned by individual shareholders. According to the UNEP August 2001 'Feasibility Study for Urgent Risk Reduction Measures at Hot Spots in the former Yugoslav Republic of Macedonia' at least four locations at the chemical complex pose unacceptable risks to human health and require urgent environmental clean-up. In the now-closed Lindane plant, dermal and inhalation contact with Lindane (and other HCH isomers) contaminated soil, air, water and floors are possible. The use of Lindane has been banned in a number of European countries since 1974 -1978. For over 20 years, approximately 15.000 Mg of a technical mixture of HCH isomers (hazardous chlorinated organic chemicals) has been stored onsite in several uncovered concrete basins leading to air, soil and groundwater pollution. There is a perceptible risk of inhaling HCH at this waste dump.

The former electrolysis plant used mercury and both dermal and inhalation contact with mercury contamination is possible from the soil, walls, air, floors and equipment. The large quantities of other improperly stored hazardous materials, including eight Mg of mercury, pose the risk of contaminant inhalation and soil and groundwater contamination. OHIS AD has resorted to this on-site waste dump in the absence of a proper national industrial and hazardous waste treatment facility. At all of these sites contamination has

already leached into the groundwater or may do so. The plant reportedly used two Mg of mercury a year and mercury-laden wastewater was allowed to drain directly into the river. In 2000, the Environ Group undertook a feasibility study for the rehabilitation of the wastewater treatment system. USAID has been approached to fund the US$ 4 million rehabilitation, but according to OHIS no progress has been made.

6.1.9.1 Hazard identification

6.1.9.1.1 Lindane and Isomeres

Lindane is used as an insecticide on fruit and vegetable crops. Exposure to Lindane may occur from eating contaminated food or by breathing air contaminated during formulation or use. Lindane is quite toxic to humans. The acute (short-term) effects of Lindane through inhalation exposure in humans consist of irritation of the nose and throat and effects on the blood. Chronic (long-term) exposure to Lindane by inhalation in humans has been associated with effects on the liver, blood, and nervous, cardiovascular, and immune systems. Animal studies indicate that Lindane causes reproductive effects, while developmental effects have not been noted. Oral animal studies have shown Lindane to be a liver carcinogen. EPA has classified Lindane as a Group B2/C, possible human carcinogen.

6.1.9.1.2 Mercury

Typically, mercury is released into the atmosphere in one of three forms:

- elemental mercury: can travel a range of distances, may remain in the atmosphere up to one year and may travel globally before undergoing transformation
- particle-bound mercury: can fall out of the air over a range of distances
- oxidized mercury (sometimes called ionic or reactive gaseous mercury (RGM)): found predominantly in water-soluble forms, which may be deposited at a range of distances from sources depending on a variety of factors including topographic and meteorologic conditions downwind of a source.

  Mercury is a neurotoxin. Outbreaks of methylmercury poisonings have made it clear that adults, children, and developing fetuses are at risk from ingestion exposure to mercury. When mothers with no symptoms of nervous system damage gave birth to infants with severe disabilities, it became clear that the developing fetal nervous system is more vulnerable to methylmercury than is an adult's nervous system.

6.1.9.2 Assessment of dose-response relationships

6.1.9.2.1 Acute Effects

6.1.9.2.2 Lindane Isomers

- Acute inhalation exposure to Lindane in humans has resulted in irritation of the nose and throat, effects on the blood (anaemia), and skin effects (elevated itchy patches of skin).
- The major effects noted from oral exposure to Lindane in humans are effects on the nervous system, such as seizures and convulsions. Vomiting and nausea and effects on the cardiovascular and muscular-skeletal systems have also been reported.
- Oral studies in animals have reported effects on the liver, kidney, immune, and nervous systems from acute Lindane exposure.

- Acute animal tests in mice and rats have shown Lindane to have high acute toxicity from oral exposure.

6.1.9.2.3 Chronic Effects (Non carcinogen)

- Chronic exposure to Lindane by inhalation in humans has been associated with effects on the liver, blood, and nervous, cardiovascular, and immune systems.
- Effects noted in animal studies from chronic oral exposure to Lindane include effects on the blood (decrease in numbers of red and white blood cells), immune, and nervous systems, and the liver and kidney.
- The Reference Dose (RfD) for Lindane is 0,0003 milligram per kilogram body weight per day (mg/kg/d) based on liver and kidney toxicity in rats. The RfD is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious non-cancer effects during a lifetime. It is not a direct estimator of risk but rather a reference point to gauge the potential effects. At exposures increasingly greater than the RfD, the potential for adverse health effects increases. Lifetime exposure above the RfD does not imply that an adverse health effect would necessarily occur.
- EPA has medium confidence in the principal study on which the RfD was based because it used an adequate number of animals and measured multiple endpoints; confidence in the database is medium because there are other reported chronic and sub chronic studies; and, consequently, medium confidence in the RfD.
- EPA has not established a Reference Concentration (RfC) for Lindane.
- The California Environmental Protection Agency (CalEPA) has calculated a chronic inhalation reference exposure level of 0,0003 milligrams per cubic meter (mg/m^3) based on kidney effects in rats. The CalEPA reference exposure level is a concentration at or below which adverse health effects are not likely to occur.

6.1.9.2.4 Reproductive/Developmental Effects

- Limited information is available regarding the reproductive or developmental effects of Lindane in humans. The one available study reported increased levels (not statistically significant) of follicle stimulating hormone and decreased levels of testosterone in men occupationally exposed to Lindane. It is not known whether these hormonal changes could result in diminished reproductive capability. Animal studies have reported reproductive effects, such as decreased sperm count, increased testicular weight, and disruption of spermatogenesis from oral exposure to Lindane. Disrupted ovarian cycling and reduced ovulation rate were reported in female animals exposed to Lindane by gavages (experimentally placing the chemical in the stomach).
- Lindane has not been reported to cause developmental effects, such as birth defects, in animals via oral exposure.

6.1.9.2.5 Cancer Risk

- No studies are available concerning carcinogenic effects in humans or animals following inhalation exposure to Lindane. Lindane has been demonstrated to be a liver carcinogen in mice via oral exposure.
- EPA considers Lindane to be a possible human carcinogen (cancer-causing agent) and has ranked it in EPA's Group B2/C.)
- EPA has established an oral cancer slope factor of 1,3 $(mg/kg/d)^{-1}$

- CalEPA has calculated an inhalation unit risk factor of 3,1 x 10^{-4} $(\mu g/m^3)^{-1}$

6.1.9.3 Mercury

(RfD): An estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. It can be derived from a NOAEL, LOAEL, or benchmark dose, with uncertainty factors generally applied to reflect limitations of the data used. Generally used in EPA's noncancer health assessments.

(NOAEL): The highest exposure level at which there are no biologically significant increases in the frequency or severity of adverse effect between the exposed population and its appropriate control; some effects may be produced at this level, but they are not considered adverse or precursors of adverse effects.

(LOAEL): The lowest exposure level at which there are biologically significant increases in frequency or severity of adverse effects between the exposed population and its appropriate control group

Recent human biological monitoring by the Centers for Disease Control and Prevention in 1999 and 2000 (PDF) (3 pp., 42 KB, About PDF) shows that most people have blood mercury levels below a level (5,8 µg/l of whole blood) associated with possible health effects. Consumption of fish with higher methylmercury levels can lead to elevated levels of mercury in the bloodstream of unborn babies and young children and may harm their developing nervous system. These disabilities have been documented in ability to use language, to process information, and in visual/motor integration. U.S. EPA's 2001 Reference Dose (RfD) for methylmercury was calculated to protect the developing nervous system. Currently, U.S. EPA uses a RfD of 0,1 µg/kg body weight/day as an exposure without recognized adverse effects.[8]

In U.S. EPA's Mercury Study Report to Congress (1997) EPA estimated that 7% of women of childbearing age would have blood mercury concentrations greater than those equivalent to the RfD. The estimate of 7% of women of childbearing age above the RfD was based on patterns of fish and shellfish consumption and methylmercury concentrations present in fish and shellfish. Blood mercury analyses in the 1999 - 2000 National Health and Nutrition Examination Survey (1999 - 2000 NHANES) for 16 to 49 year old women showed that approximately 8% of women in the survey had blood mercury concentrations greater than 5,8 ug/L (which is a blood mercury level equivalent to the current RfD). Based on this prevalence for the overall U.S. population of women of reproductive age and the number of U.S. births each year, it is estimated that more than 300.000 newborns each year may have increased risk of learning disabilities associated with in utero exposure to methylmercury. More recent data from the CDC support this general finding.

6.1.9.3.1 Exposure assessment

As with any other pesticide active ingredient, toxicity trials carried out in laboratories reveal a **range of acute and chronic health effects.**

Acute exposure mainly affects the central nervous system with manifested symptoms including vomiting and diarrhoea followed by convulsions. Exposure to small amounts by

[8] A description of EPA's Reference Dose for methylmercury may be found at http://www.epa.gov/iris/subst/0073.htm

skin contamination or ingestion has been known to lead to headaches, nausea, dizziness, tremors and muscular weakness. Lindane is classified by the World Health Organisation (WHO) as 'moderately hazardous' and has an oral LD50 in the rat of 88 mg/kg. This means that a dose of 88 mg of Lindane administered orally for each kg of body weight (bw) will kill 50% of a sample population of rats. Human volunteers ingesting a dose of 17 mg/kg have experienced severe toxic symptoms, and a lethal dose to an adult would be in the region of 0,7 – 1,4 g.

Several cases of human poisoning by Lindane have been reported. Children are significantly more susceptible to the toxic effects of Lindane. In one case a dose equivalent to 62,5 mg/kg proved fatal, while the LD50 in the rat is above 88 mg/kg. In adults, doses above 300 mg/kg ingested orally have proved fatal.

Since Lindane has been in very widespread use for several decades, its long-term health effects have been extensively studied. Included among the reported **chronic** effects of exposure to Lindane are nervous disorders and increased liver weight.

Trials to ascertain its carcinogenic potential have showed an increased incidence of benign and malignant liver tumours in mice when fed with doses of up to 600 mg/kg, but other animals did not produce such conclusive results. The international Agency for Research on Cancer (IARC) has concluded that Lindane is a possible human carcinogen (class 2B), and the US EPA has classified it similarly as a class B2/C possible human carcinogen.

Lindane is an endocrine disruptor, which is capable of imitating certain hormones in humans and thereby disrupting the physiological functions, which these hormones control. There is a significant body of evidence, which suggests that where Lindane is used extensively, and particularly where cattle are exposed to it, the incidence of breast cancer is higher. The UK has one of the highest rates of death from breast cancer in the world, and in Lincolnshire where Lindane is used extensively on sugar beet crops; the incidence rate of breast cancer is 40% higher than the national average.

The presence of Lindane in human milk has been reported in countries throughout the world. Lindane residues are similarly detectable in cow's milk and it is therefore clear that children, who have already been described as being more susceptible to the toxic effects of Lindane, are ingesting the chemical from birth, and probably from conception. Recent surveys of Lindane in cows milk carried out by the UK-MAFF Working Party on Pesticide Residues (WPPR) have revealed detectable residue levels in 100% of 216 samples taken. Of these over 4% exceeded the Maximum Residue Limit (MRL).

6.1.9.4 Risk characterization

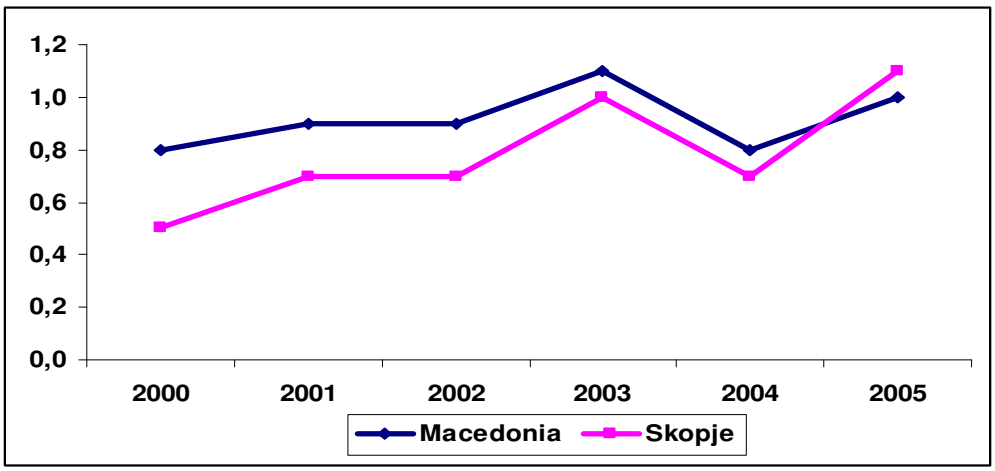
The industrial chemical plant OHIS A.D. is located in Skopje near the Vardar River. The plant produces a variety of chemical products, and for some time produced technical HCH mixture and Lindane. Approximately 15.000 Mg of technical mixture of HCH has been stored in an uncovered concrete basin for over 20 years. Management assumes the mixture was put into barrels and covered with soil. The condition of the barrels is unknown today. The geology of the storage area can be characterized as sand and gravel with a thin layer of clay. Technical HCH mixture is produced by the photo chlorination of benzene. It contains 65-70% α-HCH; 7-10% β-HCH; 14 - 15% γ–HCH (Lindane); 7% δ-HCH; 1 - 2% ε-HCH; and 1 - 2% of other chlor-organic compounds – e.g., heptachlor- and octa-chlor-cyclo-hexanes. Lindane is separated by extraction with methanol. The mixture of other HCH-isomers can be converted by thermal treatment to useful by-products like trichlorbenzene and hydrogen chloride. The average concentration of HCH isomers in agricultural soils is 0,01 mg/kg. The water solubility of α- and γ- HCH is much higher than that of β- and δ-HCH. (The water solubility of Lindane is

6 mg/l at 20°C.) In several European countries the use of Lindane has been prohibited since 1974 - 1978.

A second substantial problem at OHIS A.D. is that the factory's wastewater treatment facility does not work (the basins of the biofilter is dry). The factory's wastewater is, therefore, being discharged directly into the river without any treatment. A closed chlorine alkali electrolysis plant used mercury, and its wastewater was drained to the Vardar River. The plant also is storing tens of thousands of Mg of industrial and hazardous waste in poorly constructed storage facilities.

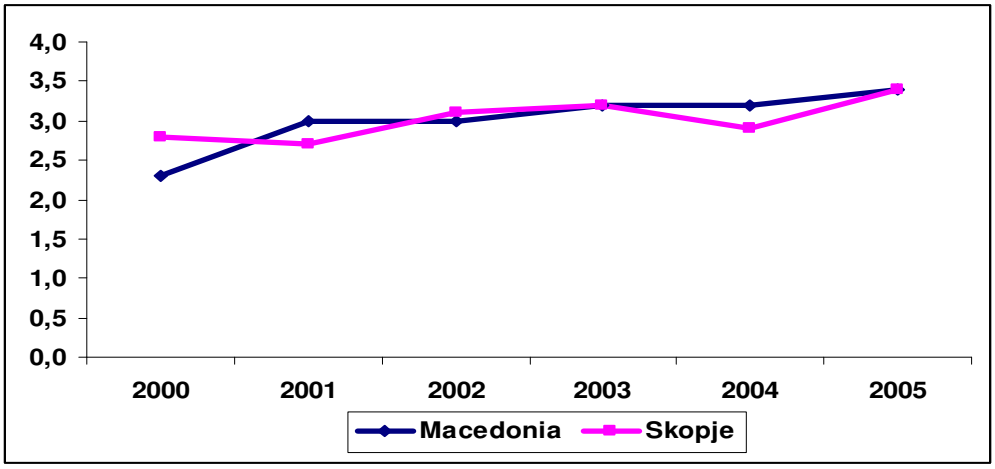
As well as occupational exposure of workers who use Lindane, and environmental exposure through residues, which persist in the environment, new data demonstrates people may be exposed to Lindane in surprisingly high quantities.
The Acceptable Daily Intake (ADI) for Lindane, which has been determined by the international authority on food residues, Codex Alimentarius, is 0,001 milligram per kilogram (mg/kg) of body weight. For a 60 kg adult therefore the maximum daily dose should not exceed 0,06 mg in total. The ADI was changed in 1997 from a previously less stringent figure of 0.008 mg/kg.
Recent data published by Codex Alimentarius shows that a person consuming an average local diet in any region of the world will exceed the ADI for Lindane by between 3,8 and 12 times. The highest consumption of Lindane in food occurs in Europe where a theoretical maximum daily intake of Lindane in a typical European diet would reach 0,742 mg, or 1237% of the ADI. The highest intake of Lindane is likely to occur from consumption of cereals, red meat and tomatoes.
People can have dermal and inhalation contact with the Lindane (and other HCH isomers) contaminating the soil, air, walls and floors. A pesticide odor was apparent in the buildings. The risk for inhalation of contaminants might be present (to be determined after further investigations).
The mercury contamination has been detected in groundwater (piezometers near to concrete basin) with concentration of 0,015 mg/l. The mercury contamination was found at the site of former electrolyses plant with 110 mg/kg. In the direction of the village Dracevo, near to railway was found elementary Hg in concentration of 7,14 mg/kg and behind railway >1 mg/kg.

Figure 10_Distribution of mortality from malignant neoplasms of liver in the former Yugoslav Republic of Macedonia and Skopje Region for the period 2000 - 2005 (rate / 10.000)



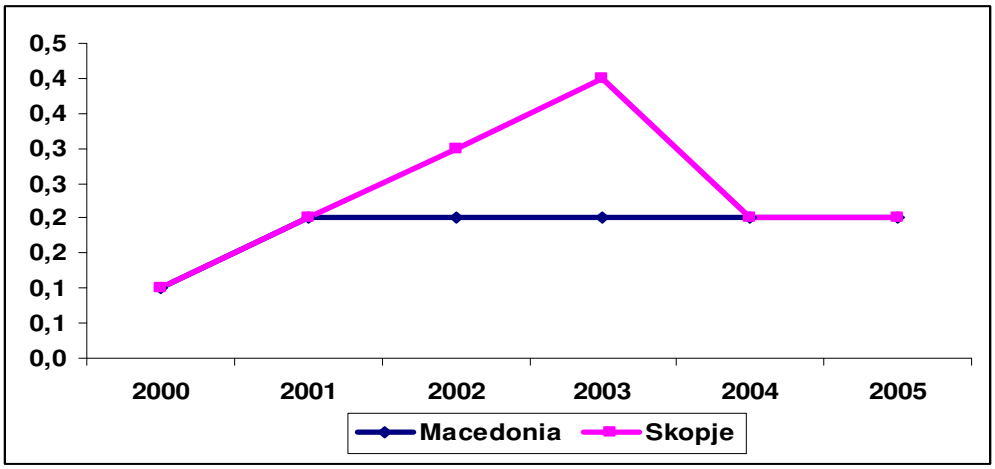
The distribution of mortality from malignant neoplasms of liver in the Republic of Macedonia and Skopje region for the period 2000 - 2005 (rate /10.000) has showed almost similar rate between Skopje and Macedonian average rate.

Figure 11_Distribution of mortality from malignant neoplasms of lung and bronchial tubes in the Republic of Macedonia and Skopje region for the period 2000 - 2005 (rate / 10.000)



The distribution of mortality from malignant neoplasms of lung and bronchial tubes in the Republic of Macedonia and Skopje Region for the period 2000 - 2005 (rate / 10.000) has showed almost similar rate between Macedonia average and Skopje.

Figure 12_Distribution of mortality from malignant neoplasms of kidneys in the Republic of Macedonia and Skopje region for the period 2000-2005



The distribution of mortality from malignant neoplasms of kidneys in the Republic of Macedonia and Skopje region for the period 2000 - 2005 showed similarity with pick in 2003 for Skopje

Generally there are hazard identification and potential health risk due to stored HCH isomers in enormous quantities for employees and population in Skopje as well as local mercury contamination of groundwater and soil.

6.1.10 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 4_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
OHIS Skopje	Organic chemical plant; HCH isomers are stores; waste water into Vardar River, Hg residuals	Carcinogenic in humans (liver, kidney and immune system diseases	470.000 inhabitants 700 workers

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

OHIS - Skopje

Contaminant Hazard:

- HCH isomers are stores
- Hg residuals

Migration Pathway:

- Contaminated soil
- Air
- Water / groundwater

Receptors: limited

Defined environmental health risk: MODERATE to HIGH

7 Process assessment – qualitative and quantitative waste assessment

7.1 Lindane production plant

Founded in 1964 for detergent and pesticides production and in 1977 starting with Lindane production. In 1980s Lindane plant's equipment was dismantled. In 1998 chlorine alkali electrolysis (chlorine mercury electrolysis) became inactive. In 1980's complex's wastewater treatment system was built up but is currently not working properly.

7.1.1 General description of the Lindane production site

The Organic Chemical Industry of Skopje manufactures a variety of chemical products, including plastics, detergents, poly-acrylic fibres, plant protection agents, cosmetics, basic chemicals (e. g., chlorine-hydrochloric acid), pharmaceuticals, and process equipment.

The one million square meters industrial complex is situated in the former floodplain of the Vardar River. Hydrological contact between the upper groundwater aquifer and the river is likely possible.

Several aspects of the OHIS A.D. facility raise strong environmental concerns. Approximately 10,000 tons of hazardous chlorinated organic chemicals (technical mixture of HCH isomers) have been stored on site in several concrete basins for the last 20 years. No detailed investigation or monitoring of the site has been carried out. Management assumes that the waste was stored in steel barrels and simply cove red with soil. One basin approximately 100 meters long, 50 meters wide and several meters high was constructed without a drainage system for collecting percolating liquids and without a cover to prevent leaching.

The area around the basin smelled of chlorinated compounds. In addition, waste is likely to be contaminating the soil used to cover the storage site, and is probably leaching into the ground water beneath and around the basins. There is a serious threat of major ground water pollution.

The absence of a proper industrial and hazardous waste treatment facility in FORMER YUGOSLAV REPUBLIC OF of Macedonia has led OHIS A.D. to store its waste on site. The stores are old and in bad condition, due mainly to poor construction and inadequate maintenance. Types and quantities of these wastes are not exactly determinate. The lack of proper collection, treatment and safe disposal of these wastes is undoubtedly causing significant pollution of the environment.

Wastewater flows partly through closed concrete canals, but these are cracked and leaking waste to the soil and groundwater. The newest part of the plant is connected to a wastewater facility for treatment prior to discharge into the Vardar River. The treatment plant, however, is not functioning at present. Other parts of the plant, such as the now-closed chlorine-alkali-electrolysis process, have never been connected to the treatment plant. This factory reportedly used two tons of mercury per year, causing mercury-laden wastewater to drain into the Vardar River. Management stated that eight tons of mercury remains stored at the plant. UNEP surface-water samples taken from a small wastewater canal close to the former chlorine-alkali-electrolysis plant did not show excessive levels of pollutants. Several naphtalates were identified in the water sample but generally only at levels of about 0,5 mg/l. Mercury was analyzed in one water sample, giving a concentration of about 65 mg/l, some 10 times over the limit value for drinking water but below limit values for natural waters. The lead concentration (500 mg/kg) in one soil sample was above the threshold value for normal soil in many countries but not over the threshold values generally applied for soil at industrial sites.

The OHIS A.D. complex also generates air pollution, principally from an oil-fueled power plant. Data supplied by management suggest that the plant emits approximately 2,240 tons of sulfur dioxide, 315 tons of nitrogen oxides, and 15 tons of dust per year. The sulfur dioxide concentration in the flue gas, at 2,220 mg/m3, exceeds the applicable 1,700 mg/m3 emission standard. An acrylic fiber plant within the complex is an additional source of concern regarding emissions[9].

7.1.2 Process Description and significant waste streams of Lindane Production

Lindane was produced in the Organic Chemicals Factory "OHIS" for only several years (from 1965 to 1972). A total of 1.545 Mg of Lindane have been produced during the lifetime of the plant. The annual production rates are given in the following table:

Table 5_Production of Lindane during the years 1965 till 1972

Year	1965	1966	1967	1968	1969	1970	1971	1972
Production [in Mg]	155	221	209	128	192	230	242	168

7.1.2.1 Process Description

Raw materials were benzene and chlorine. Chlorine was dissolved in excess of benzene and the solution was then passed through a thin-layer photo reactor where it was irradiated by intensive light sources having a high ultraviolet content. Because of the excess of benzene the product formed remains dissolved at higher temperatures. Care was taken that the reaction mixture at no point can come in contact with materials, which might catalyse substitution, such as iron.

Photochlorination of benzene leads to a complete reaction only under specific conditions. Impurities in benzene, too high temperatures, too low light output lead to undesirable substitution products such as chlorobenzenes with different degree of chlorination, which have a negative impact on the process to gain pure and also odourless lindane. The chlorination under irradiation resulted in a mix of isomers, which was practically free of chlorobenzenes, and a content of 13-14% gamma HCH.

The product mixture was washed to remove any untreated chlorine and traces of HCl that might have been formed during the process. The excess benzene was then stripped off and returned to storage. The molten product from the bottom of the distillation still was run onto a flaker, i.e. a cooled moving metal drum, on which it solidified.

The composition of the mixed product was as follows:

α – HCH 65-70%

β – HCH 7-10%

γ – HCH 10-12%

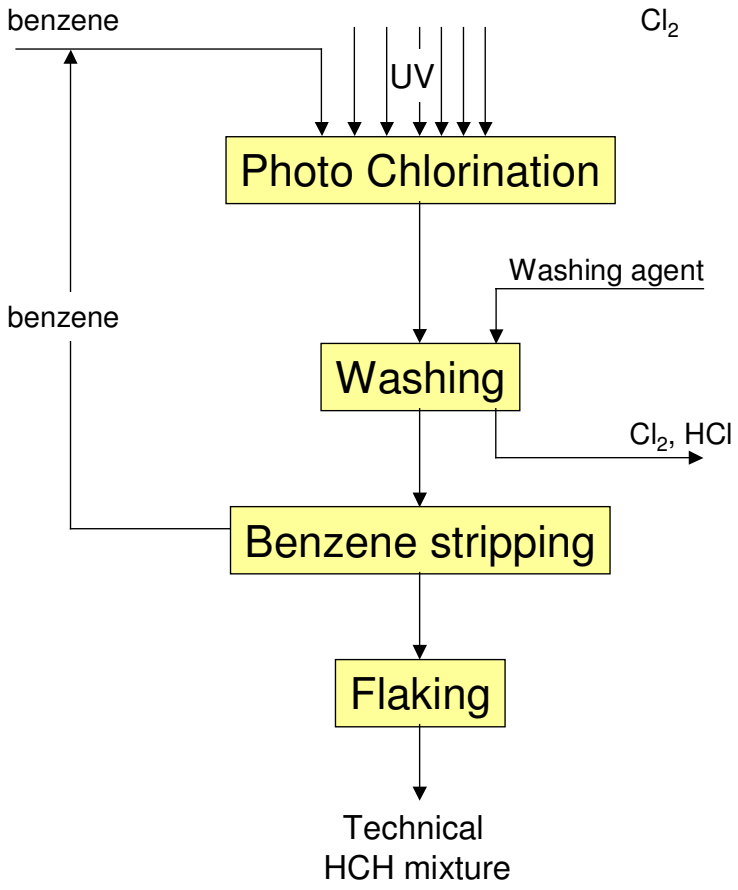
δ – HCH 7%

ε – HCH 1-2%

[9] Source: Post conflict environmental assessment UNEP, 2000

OHIS used to operate a separate plant for technical HCH which was further treated to extract γ-isomer (Lindane) thereof. A simplified flow sheet of the process of production of HCH technical mixture is given in the following figure.

Figure 13_ Flow sheet of technical HCH mixture production

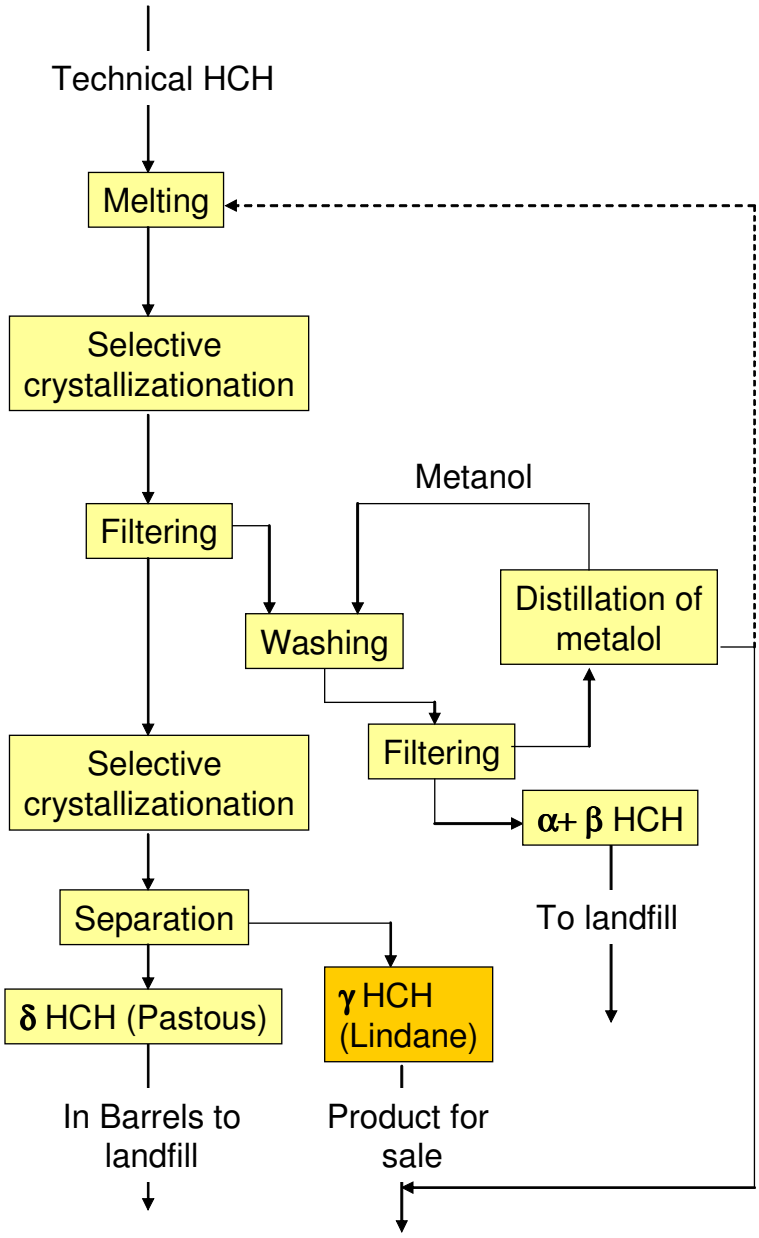


The flakes of technical HCH isomers were than transferred to the Lindane production in which selective crystallisation and distillation were applied to extract γ – HCH (Lindane).

The mixture was first re-molten and by slaw and careful decreasing the temperature of the melt, crystallisation of α and β HCH occurred. The mixture was filtered on a centrifuge and crystals washed with methanol to remove any Lindane which in turn was recovered via distillation of the methanol.

A simplified flow sheet of the process of production of HCH technical mixture is given in next figure.

Figure 14_Production of HCH technical mixtures



7.1.2.2 Products

- 17.000 Mg powdered detergents
- 5.000 Mg liquid detergents
- 10.000 Mg HCl
- 2.000 Mg NaClO
- 3.000 Mg $CH_2ClCOOH$
- 9.400 Mg acrylic fibre
- 3.400 Mg mat fibre, roving, yarn
- 3.000 Mg PVA emulsions and processing (not production)
- 14.300 Mg PVC moulding into duct, compounds, pipes and foils
- 300 Mg cosmetics
- $2{,}2 \cdot 10^6$ m^2 self adhesive tape

7.1.3 Qualitative assessment of waste streams

According to the process flow sheet α, β, δ and some ε HCH isomers make the solid waste arising from the process. δ-HCH is far more toxic than the rest of the isomers and therefore it has been deposited separately on a smaller and more secured site. All the other isomers have been disposed off on a separate site only few meters away.

A concentration of 86-88% a, 11-12% b and 1-2% γ isomers would be expected in the α–β dump pile. However, a layer of soil of approximately equal quantity is spread over each layer of solid waste. In this way, the overall concentration of waste constituents has been halved.

The contents of the smaller, delta isomer, pile should be pure δ-HCH. It was collected in barrels the integrity of which is not known

7.1.4 Quantitative Assessment of Waste

1.545 Mg of Lindane have been produced between 1965 and 1972. Having in mind that the concentration of Lindane in technical HCH was only 10%, a quantity of 13.900 Mg of rejected HCH isomers is estimated. Using the composition given above, following quantities of solid waste deposited on the two sites may be calculated:

Table 6_HCH Isomers accumulated onto two dumps (A and B)

Site A – α, β, ε HCH		**Site B – δ HCH**	
α – HCH	12.093 Mg	δ HCH	1.550 Mg
β – HCH	1.599 Mg		
ε – HCH	` 208 Mg		
Cover soil	14.000 Mg	Cover soil	1.550 Mg
Total	**27.900 Mg**	**Total**	**3.100 Mg**

7.1.5 HCH dumps

Alpha and beta isomers are dumped on one dump and gamma isomer on 5 smaller dumps (see Map 1). Landfills were constructed with supporting concrete and covered with soil. The bigger site has no bottom lining.

Technical HCH (hexa-chloro-cyclohexane) was produced by chlorine and benzene. The rest of alpha, beta and delta-isomers were dumped on site. Some of them were reused as starting material for the production of TCB (trichlorbenzene) and HCl. Total amount of alpha-, beta- and delta-isomers of HCH are **15,300 Mg**.

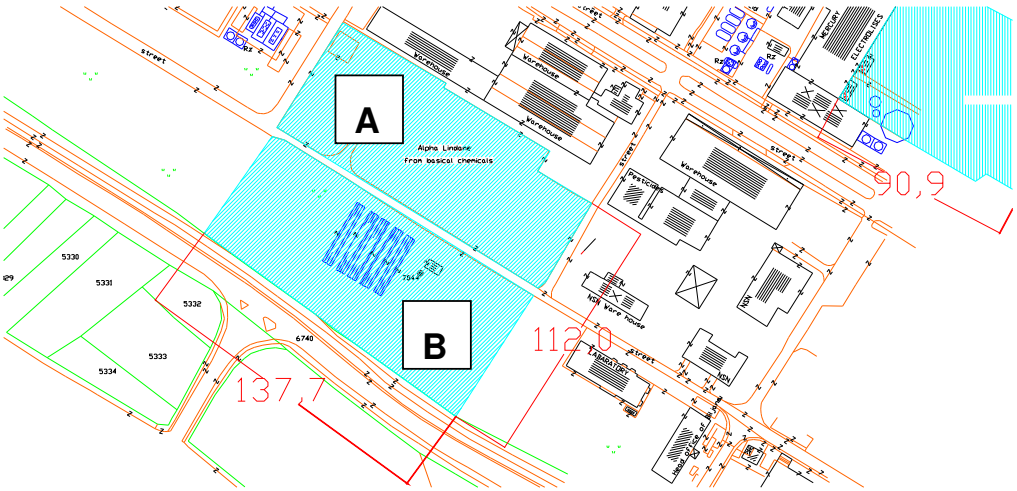
Alpha and beta isomers are dumped on one dump and gamma isomer on 5 smaller dumps. Landfills were constructed with supporting concrete and covered with soil. Landfills were constructed with concrete bottom lining. The bigger one has no bottom lining.

Bigger dump has 25,000-30,000 t (25,000 m^3) of alpha and beta isomers with cover soil (100 m x 50 m x 5 m)

Five individual dumps have effectively joined together to form one bigger dumpsite with total 30,000 t (25.000 m^3) chemicals and cover soil (35 m x 35 x 0,5 m and 4 m high).

Former Lindane plant is contaminated with HCH. This plant has 2,400 m^2 (1200 m^2) covered with buildings. The walls and floor showed signs of chemicals impregnation and contamination.

Map 1_Layout of HCH waste storage at Ohis-Biljana factory in Skopje



Picture 1_Dump A at Ohis site

Picture 2_Dump B at Ohis site

7.1.6 Relevant physically – chemical characteristics of the waste material

HCH consists of eight isomers. Only γ-HCH, α-HCH, β-HCH, and δ-HCH are of commercial significance and considered in this case, OHIS dumpsite as a hotspot. The pesticide Lindane refers to products that contain >99% γ-HCH. The α-, β-, and δ-isomers, as well as technical-grade HCH are not synonymous with γ-HCH (Farm Chemicals Handbook 1993). Technical-grade HCH is not an isomer of HCH, but rather a mixture of several isomers; it consists of approximately 60–70% α-HCH, 5–12% β-HCH, 10– 15% γ-HCH, 6–10% δ-HCH, and 3–4% ε-HCH.

Although the HCH isomers only differ in the orientation of their chlorine atoms, relatively large differences exist in their physical-chemical properties. This implies different transport and persistence characteristics. The following paragraph intends to describe the release of Lindane and other HCHs in the different environmental compartments. However, this is not an exhaustive list since in literature data on concentrations and persistence of HCHs in the various environmental compartments remain controversial. This is most likely due to the wide concentration ranges that can be found and the complex interactions that influence both biotic and abiotic removal.

Table 7_physical chemical characteristics of Lindane and Isomers

Name/Parameters	γ	α	β	δ
Molecular weight	290.83	290.83	290.83	290.83
Color	White	Brownish to white	No data	No data
Physical state	Crystalline solid	Monoclinic prism	Crystalline solid	Fine plates
Melting point ºC	112.5	159-160	314-315	141-142
Boiling point ºC	323.4 at 101.3 kPa	288 at 100.3kPa	60 at 67 Pa	60 at 48 Pa
Density (g[sm3]-1)	1.89 at 19 ºC	1.87 at 20 ºC	1.89 at 19 ºC	No data
Odor	Slightly musty	Phosgene like	/	/
Solubility:				
- in water	10 mg L^{-1} 7.3 ppm at 25 deg C, 12 ppm at 35 deg C, 14 ppm at 45 deg	1.4 mg L^{-1} (in salt water) 10 PPM IN WATER	**0.2 mg/l**	C
- in ethanol	64 g kg^{-1}	18 g kg^{-1}	11 g kg^{-1}	244 g kg^{-1}
- in benzene	289 g kg^{-1}	/	19 g kg^{-1}	414 g kg^{-1}
Degradation				
- Bio	Anaerobic conditions (63.8% biodegraded in three weeks in soil suspensions, while in clay loam soil 60% biodegraded after 15 days. anaerobe bacteria)	Aerobic, 15 to 30% removal in 23-week	90% in 4 days,	
- Aquatic reaction	<30% of Lindane remained after 16 weeks		Half time in water based on evaporation (4590 hr; 25^0 C, 1m depth) volatilization half-lives for a model river and model lake are 92 days and 2 Year	
- photo-oxidation	75 % in 45.8 hr	75% in 40 hr		
-in air	the half-life for this reaction in air is estimated to be 28 days	Halflife for this reaction in air is estimated to be 110 days	half-life for this reaction in air is estimated to be 28 days	
Log K_{ow}	3.72	3.8	3.78	4.14
Vapour pressure	5.6 10-3 Pa at 20 ºC	6.0 10-3 Pa at 25 ºC	4.8 10-5 Pa at 20 ºC	4.7 10-3 Pa at 25 ºC
Henry's law constant (atm m^3 mol^{-1})	1.4 10^{-5j}	1.06 10^{-5j}	7.43 10^{-7k}	2.1 10^{-7l}

7.1.6.1 Characteristics of the mixture of alpha + beta HCH - isomers

- Chemical formula C6H6Cl6
- Appearance white powder like substance
- Smell unpleasant, like naphthalene
- Size of particles 40-80 microns

- Molecule weight Mt – 290,9
- Thickness d=1,95
- Temperature of melting 183°C
- Solubility not soluble in water, soluble in acetone, methanol and other organic solvents

7.1.6.2 Average composition of the mixture of isomers

- Alpha isomer 84,75%
- Gamma + etta 0,55%
- Beta isomer 12,27%
- Contents of water 0,5%
- Methanol 0,5%

7.1.6.3 Characteristics of delta paste

- Appearance dark brown substance
- Smell unpleasant (of HCH)
- Solubility not soluble in water, soluble in acetone, methanol and other organic solvents
- Specific weight 0,950 at 20°C at the temperature of 50-60°C; it becomes viscose-like and liquid

2.1.6.2. Composition of the isomers of HCH in delta paste:

- Alpha 22-26%
- Beta 5- 7%
- Gamma 16-19%
- Delta 38-50%

There are also a certain percentage of chlorinated benzyls and oily substances with unidentified chemical composition.

7.1.6.4 The toxicity of some of the isomers on the rats is as follows:

- Alpha LD 500 mg / kg
- Beta LD 6000 mg / kg
- Gamma LD 125 mg / kg
- Delta LD 1000 mg / kg
- Etta LD 1000 mg / kg
- it isn't combustible
- it isn't explosive

As could be showed from the physical – chemical properties of the main waste components, despite of the fact that HCH isomers belong in hazardous waste, HCH isomers (not Lindane!) are environmental relatively indifferent one. Namely, HCH isomers

aren't soluble in water, aren't biological active (non-active), have relatively high LD for toxicity and are relatively unstable in the open environment. Degradation rates (half life time) could be determined in days and months.

7.1.7 Management of the HCH isomer - waste material

Concerning the problem of managing the non-active isomers of HCH through their burning and transforming into more valuable products acceptable for the market, contacts with more foreign firms specialized for burning has been made: RIMNICU VILCEA from Romania , KREBS , EFLUTERM from France , NITTETU from Japan , CHLOE CHIMIE from France.

They have also given their offers on the "battery limit" basis. The most appropriate and very similar were the offers from "Nittetu" and "Chloe Chimie". They offered acceptable solution: with waste burning hydrochloric acid is obtained, and steam as energy of 15 atmospheres. Unfortunately, all these offers like the previous ones gave a negative financial effect, which was crucial when bringing the decision on them.

7.1.8 Pollution Dilution of HCH - Isomers

7.1.8.1 Current ongoing pollution by HCH - Isomers

Due to the circumstance, that the production has been closed since the year 1977, a direct pollution from the production does not more occure. Ongoing pollution due to precipitation and wash out of the HCH Isomers into the soil and groundwater shows evidence. Also a diffusion of HCH Isomers (naphtalen odor) into the air has been evidenced. Former lindane plant is contaminated with HCH too. This plant has 2.400 m^2 (1.200 m^2) covered with buildings. The walls and floor showed signs of chemicals impregnation and contamination.

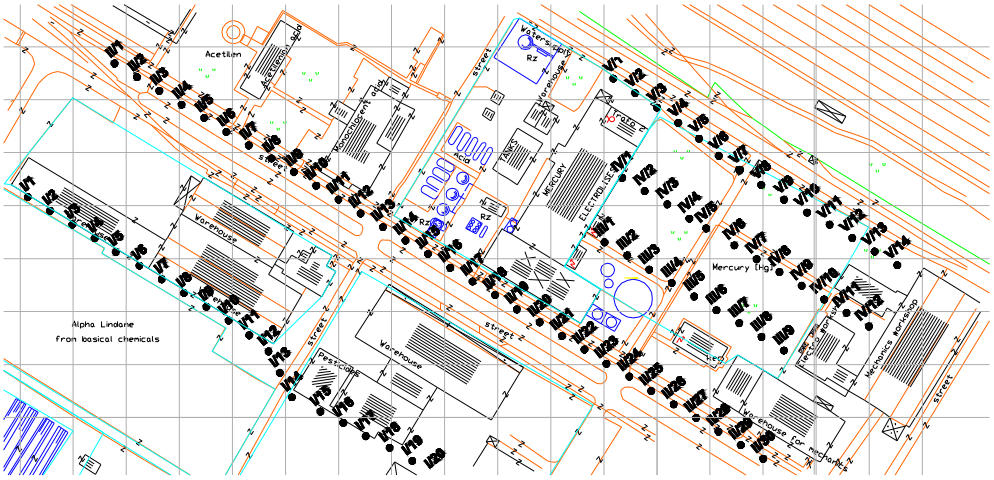
In order to evaluate the pollution dilution, caused by the HCH Isomer dumps, geoelectrical resistivity measures have been undertaken and pollution dedected. The geoelectrical investigations are performed at the area north and northeast from the waste dumps with alpha HCH Isomers (big and small), and at the area contaminated with Mercury [Hg]. In this area are situated several infrastructural and auxiliary constructions (streets, warehouses, workshops, electricity substations and others). The arrangement of the investigations is adjusted to the free area around the constructions, by using the streets. The streets are with concrete roadway, because of which for performing the testing are done bores for penetrating of the electrodes. The bores are done manually, through concrete up to entering of healthy bottom of about 0.5 m. The geoelectrical investigations are performed with the method of geoelectrical mapping of 3 depth entrances. Five profiles are performed with total of 85 points, or 165 points for all three entrances (Table 1 and Map 1 – [11.7.1]).

Table 8_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	190,00	20	17	14	11	42
II	290,00	30	27	24	21	72
III	80,00	9	6	3	-	9
IV	110,00	12	9	6	3	18
V	130,00	14	11	8	5	24
Total:	**800,00**	**85**	**70**	**55**	**40**	**165**

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 are facing on the pollution dilution of HCH Isomers.

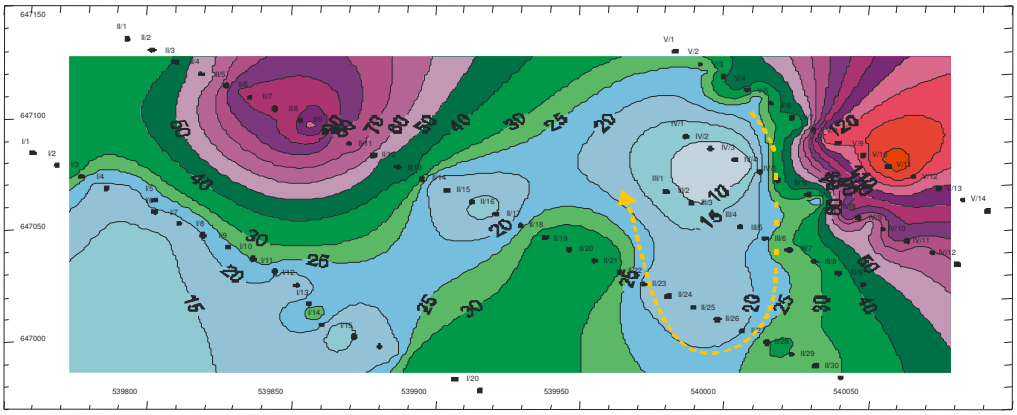
Figure 15_Profiles for pollution dilution determination at Ohis site



The presence of migrated HCH Isomers in the tested geo area of gravel should be presented with small decreasing of the values of ρp. The HCH Isomers from the dumps can migrate in the ground water by penetrating of the surface water, and probably is form as a physical and colloid solution. In accordance with that, the HCH Isomers can migrate for a long potential path, which can be shorten mainly by absorbing of the hygroscope fractions in the soil (at this location mainly clay) and trapping the grains in the moisture of the soil.

With the geoelectrical testing, summarized influence is registered from the litho composition, from the ground water and from the migration polluters in the soil and the ground water. The registered values of ρp are shown per probe profiles with regions in the following 3 intervals as demonstrated in chapter [11.7.4]. 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 16_Apparent resistivity cross section



7.2 Interpretation of pollution dilution

Due to HCH Isomers and mercury-contaminations at the OHIS-site, resistivity investigations were conducted to evaluate possible anomaly zones and the further approach for a remediation.

The surface terrain of the location of Ohis is consisted of gravel with sand and clay - silty dust fraction. At depth < 10 - 20 m in the gravel's basis can appear Pliocene sediments;

The geoelectrical testing is performed at the area north and northeast from the HCH Isomers dumps (big and small), and at the area contaminated with Mercury [Hg];

The testing is performed with electrical resistant mapping of 3 depth entrances (AB / 2 = 15, 30 and 45 m), with probe depths of above 5, 10 and 15 m;

The registered values of ρp vary in interval from 5 - 142 Ωm. The variations of the values for ρp are interpreted with the influence of the geoelectrical resistance of the present litho composition, ground water and migrated HCH Isomers and mercury in the soil and the ground water. The interpretation regarding the depth and horizontal determination of the contaminated area is a bit difficult because of missing detailed geological data, GWL and especially the underground infrastructure, that is quite developed;

The registered values of ρp are shown per probe profiles divided in 3 intervals: ρp < 50 Ωm, ρp = 25 - 50 Ωm and ρp < 25 Ωm;

The horizontal distribution of ρp is shown in depth entrances AB / 2 = 15, 30 and 45m. At the depth entrance AB / 2 = 15m, are registered two zones of ρp < 25 Ωm - along the HCH Isomers dump and at the area contaminated with Mercury [Hg]. At the depth entrance AB / 2 = 30m, the values zones of ρp < 25 Ωm separated from the previous level are confirmed, and is registered influence of the Pliocene sediments in the gravel's basis. At the depth entrance AB / 2 = 45m, the influence of the ground water is increased as well as the influence of the Pliocene sediments in the gravel's basis. The registered values zones of ρp < 25 Ωm from the previous levels, are not confirmed on this level because of the increased influence to the values of ρp from the Pliocene sediments in the gravel's basis;

As can be seen in Annex [11.7.4], the low resistivity zones between -5 to 20 ohmm are displayed in yellow 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.

Annex [11.7.2] and [11.7.3] are splitted into two figures, the first one showing an interpretation of the data which could be verified at the measurements, and five anomaly zones were introduced. 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 too the dumps, respectively on the mercury dumps.

Both figures are geo-referenced according to the GPS measurements taken at the survey and illustrate the position of the survey lines and electrode locations[10].

The results are in correlation with the conducted measures of the national public health institute and show the dilution of both contaminations:

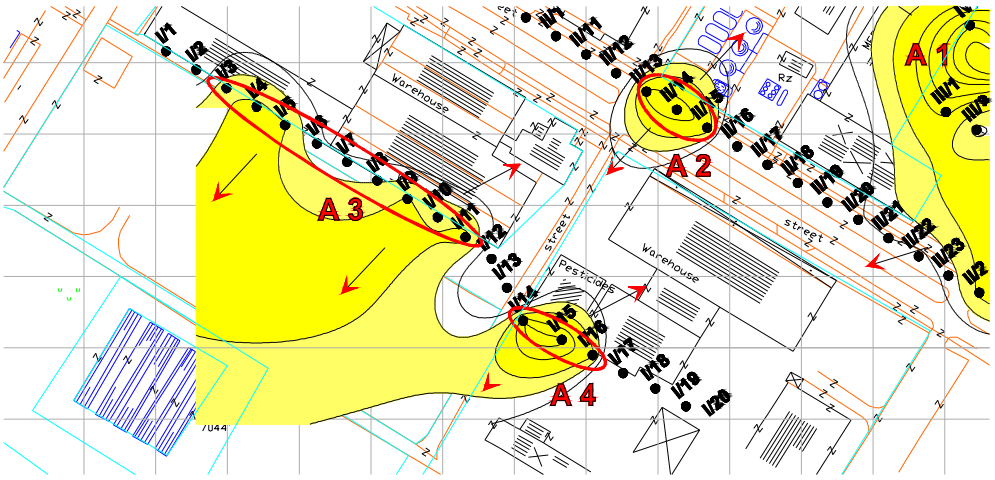
Profile 1:

Northeast of the α- and β-Isomer disposal facility in west – east direction; the profile showing a length of 200m and covers mainly the contamination related to HCH Isomers. The surface is contaminated on a length of 0-90m, with small interruption till 110m and continues from 130 till 160m. While the area 0-110m is impacted from the disposal facility can be expected, that the pollution in the area from 130 till 160 m is caused by former production activities (south of pesticide plant). Deep contaminations are concentrated on 50m, 85 till 115 (A3) and 140m (A4). Two core drills and two piezometers shall be placed. The vertical profile indicates a deeper pollution than 15 m and can be expected till to the layer between alluvial and Pliocene deposits.

Profile 2:

Northeast of the α- and β-Isomer disposal facility in west – east direction; the profile showing a length of 300 m and covers mainly the contamination related to HCH Isomers. The surface is contaminated on a length of 120-150m, with a big interruption till 195 m and continues from 215 till 250m. While the area 120-150m is impacted from former storage activities of chemicals, can be expected, that the pollution in the area from 200 till 240 m is caused by former electrolyses operation activities (south of the electrolyses plant). Deep contaminations are concentrated on 120m till 260 (A2). Two core drills and two piezometers shall be placed. The vertical profile indicates a deeper pollution than 15 m and can be expected until the layer between alluvial and Pliocene deposits. While the contamination profile on the area of 130 till 140m is homogenous into the depth, shows the contamination profile interruption of the main contamination zones at the area 200-220 in a depth of –5 till –11m and might be evidence for mercury due to the high bulk density and accumulation in deeper layers.

Figure 17_Pollution dilution from HCH – Dumps into north-eastern direction



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

7.3 Recommendations

- It is strongly recommended for the remaining three fields to take measurements at 5 m electrode spacing, since the shallow subsurface contains the most contaminant zones, especially when dealing with mercury which is a quite immobile element in soils, any organic-mercury compounds excepted. Due to the electrode spacing of 10m and the used method the shallow subsurface in the range of 0 - 2,5 m couldn't be mapped during data processing. For a highly spatial resolution of the subsurface the data taken is not sufficient.
- For chemical testing of the presence of the soil polluters and the ground water, are suggested 8 core drills with depth of < 12 - 15 m. Due to an expected change of alluvial deposits to the Pliocene deposits in 20 m, shall the depths of the drills maximum be 15m. 6 additional piezometers would be required. The Piezometers shall be located at same locations to use the reference profiling.

Table 9_Recommended locations for drills and piezometer locations

Coding	Anomaly Zone	x-coordinates[11]	y-coordinates	Remarks
P000	--	539794,3	646977,7	Existing – HCH Isomer location
P001 = P1	A1	539998,3	647089,0	Existing – Mercury contamination zone
P2	A2	539905,3	647066,9	--
P3	A3	539846,4	647032,7	--
P4	A4	539867,2	647003,7	--
P5	--	540071,3	647066,7	Inside contamination zone; d=75m from P1
P6	--	540250,6	647090,2	Private property; d=250 from P1
P7	--	540227,3	646986,6	Inside compound; d=250 from P1
P8	--	539960,0	647000,0	Within former production compound; d= 88m from P1

- No drills on the HCH isomer disposal places shall take place in order not to destroy potential layers
- More detailed investigation of the area of pesticide production and warehouse, east of the HCH isomer disposal unit.
- 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
        - Hg(0), $Hg_{(tot)}$, $Hg_{(org)}$
        - Pb

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

- Cr_{tot}

- Organic Parameters
  - α-HCH
  - γ-HCH
  - β-HCH
  - δ-HCH
  - Aldrin
  - Dieldrin
  - DDE
  - Total chlorinated organics (as Lindane)
  - Tri-chloro-ethylen
- Organoleptic Parameters
  - Temperature
  - Conductivity
  - pH
  - Oxygen saturation

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[12]). 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 518 and 1555.

A magnitude of 6.5[13] has been defined as the maximum expected magnitude. Other sources, however, indicate higher maximum expected magnitudes (6.5-7[14] and even 7.2[15]).

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-Korcha, Debar-Pishkopeya etc.) also impact the seismic profile of this particular area.

Table 10_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

[12] European Macro Seismic Intensity Scale

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

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

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

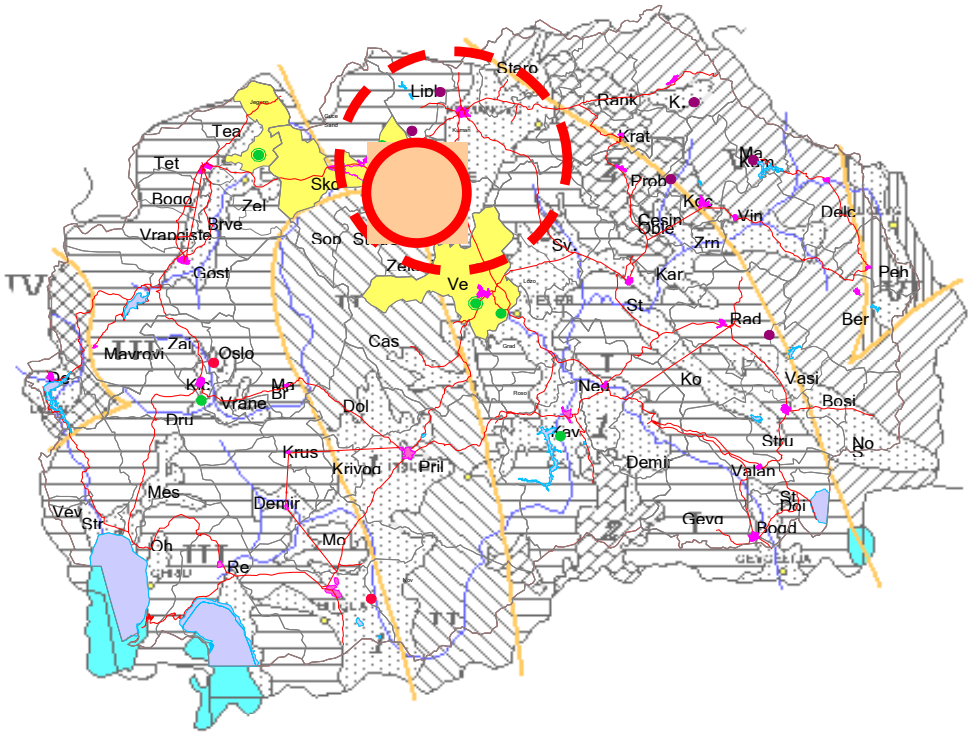
7.3.2 OHIS – Specific

OHIS 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 0,8 – 1 kg/cm² accures (equal to 8 - 10 N/cm²) which does not limit any proposed activities on site. The dumpsite stability with 0,85 kg/cm³ is on the limit of the stability, while the dump shall be flatted or removed.

7.5 Electrolysis plant

7.5.1 Generally description of the Chlorine production

From the electrolysis plant mercury is the main contaminant. In this plant, mercury has been used as a cathode in the process of electrolysis of NaCl – sodium chloride salt. The previously decomposed NaCl, and cleaned from supplements such as Ca, Mg etc., as a pure electrolyte get in the electrolytic cell. The process is carried out in an electrolytic cell consisting of separated positive and negative electrodes (anode and cathode, respectively) immersed in a NaCl electrolyte solution. The chemical reactions that are running after the electric current enters are following:

Hg cathode

$Na^+ + e^- \longrightarrow$ Na(Hg) – natrium amalgam

anode

$2Cl^- - 2e^- \longrightarrow Cl_2$

After those reactions, both ions become neutral molecules. After that, the Na(Hg) get in the device for decomposition – decomposer. At the end mercury comes out pure, and as such, circles in the process (reused in the electrolytic cell for NaCl electrolysis).

During the production 0,15 Mg/year Hg were lost, for 35 years of production, which in total is 5,25 Mg Hg.

Now in the building metallic Hg drops spread over a large part of the floor and the equipment - rough estimation of 200 Mg of metallic Hg. Large amounts of Hg might also be trapped in underground crawl spaces or inactive drain pipes.

7.5.2 Process Description and significant waste streams of Chlorine production

The chlor alkali plant of the Organic chemical industry in Skopje was in operation from 1964 to 1995. It was based on a mercury cell electrolysis and designed to produce sodium hydroxide hydrogen, chlorine and hydrochloric acid. However, during the whole period of operation only sodium hydroxide and hydrochloric acid were produced.

According to the State statistical office the following quantities of chlorine have been produced in OHIS during the operation of the plant:

Figure 18_production scheme over the years in Mg

Year	Production of Chlorine [Mg]	Year	Production of Chlorine [Mg]
1964	687	1984	1876
1965	5013	1985	1645
1966	5096	1986	1584
1967	4729	1987	1518
1968	5293	1988	2454
1969	5884	1989	2522
1970	5392	1990	3167
1971	5865	1991	2439

1972	4582	1992	2352
1973	5439	1993	2358
1974	5412	1994	2394
1975	4269	1995	2368
1976	3491	1996	2562
1977	3137	1997	349
1978	1983	1998	772
1979	2830	1999	61
1980	2944	2000	0
1981	2252	2001	1403
1982	1423	2002	730
1983	1533	2003	250
Total	**77.254**	**Total**	**32.804**

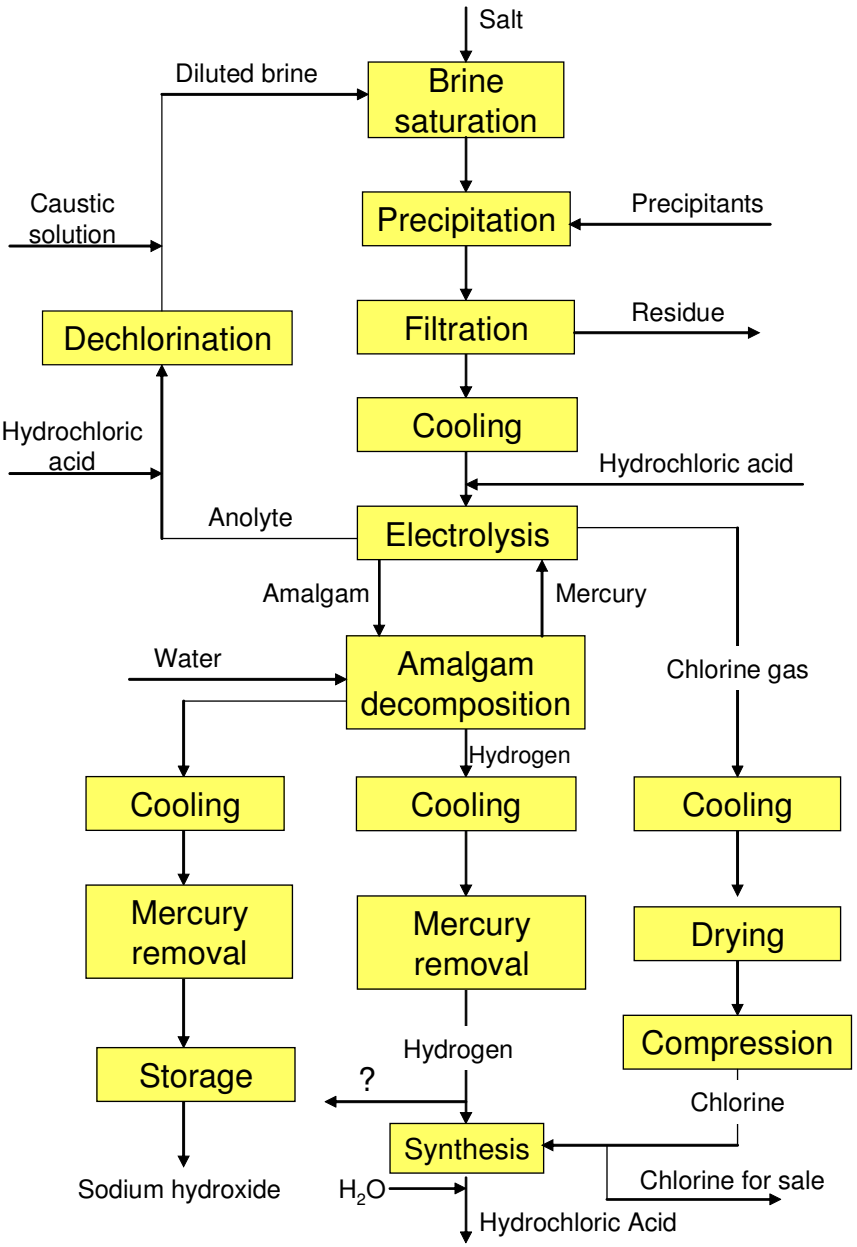
The solid salt dissolved in the salt dissolver is treated in a reactor with sodium carbonate and caustic soda to precipitate calcium carbonate and magnesium hydroxide. These precipitates are settled in a settler. The underflow carries the solid slurry, which is pumped with the rest of the liquid to the effluent treatment plant. The calcium carbonate precipitates are heavy, and drag with it the hydroxides of aluminium, magnesium, strontium, etc. The overflow from the settler, which carries ~10-50 ppm of suspended solids, is filtered. The filtered brine is heated and passed through a bed of salt in a saturator in order to increase the salt concentration before feeding it to the electrolyzers. In addition, the brine feed is acidified to improve the cell current efficiency. The acidification reduces the alkalinity, which would otherwise react with the chlorine in the anolyte compartment forming chlorate. Such a prepared brine is fed to the electrolysers

The recycled brine from the electrolysis process (anolyte) is dechlorinated and used for salt dissolution. The liquid mercury cathode and the brine enter the cell flowing concurrently. The electrolysis process creates chlorine at the anode and elemental sodium at the cathode. The chlorine is removed from the anode, cooled, dried, and compressed.

The sodium combines with mercury to form a sodium amalgam. The amalgam is further reacted with water in a separate reactor called the decomposer to produce hydrogen gas and caustic soda solution. The decomposer functions as a packed bed reactor in which the sodium/mercury amalgam contacts deionised water in the presence of a catalyst. The amalgam reacts with water liberating the mercury and yielding caustic soda and hydrogen. The caustic and mercury are separated in a trap at the end of the decomposer. The caustic and hydrogen are each transferred to ancillary treatment and the mercury is pumped back to the inlet end of the cell.

The caustic and hydrogen are separately cooled and the mercury is removed before proceeding to the subsequent operations (storage and sales of sodium hydroxide and reacting hydrogen with chlorine to form hydrochloric acid.

Figure 19_Chlor-alkali process Flowsheet in OHIS



7.5.3 Qualitative Assessment of Waste

The mercury cell process for chlorine production results in several types of waste such as: brine sludge, waste water solids (wastewater sludge if a wastewater plant is operated), carbon sludge and decomposer carbon etc. All the wastes arising from this process contain mercury. In addition, substantial amount of mercury has been found in the surrounding soil and in the cell building. This particular waste (loss) is of main concern of the Project.

It is possible that part of the mercury containing waste have been disposed of onto the mixed waste dump.

7.5.4 Quantitative Assessment of Waste

It has been estimated that the total emissions of mercury amounts 90 g per ton of chlorine produced. However, much bigger quantities have been reported in the case of OHIS. The project team estimates total mercury losses of about 350 – 400 t during the 38 year operation period. Major part of the mercury has been lost as a liquid metal through spillages or during maintenance. Regular production wastes are estimated as follows:

Waste type	**Hg content**	**Hg quantity in 38 years**
Brine sludge	150 mg/kg	
Wastewater sludge	75 g/kg	5700 kg
Carbon sludge	300 g/kg	1800 kg
Decomposer carbon	30 g/kg	200 kg
Air Emission	0,018 mg/m3	700 kg
Other		5000 kg
Total		13438 kg
Metallic mercury loss		**336.562 kg**

Major part of metallic mercury was spilled to the floor of the cell house, but droplets of mercury were found in the surface layer of the backyard of the plant.

Due to the characteristics of mercury, most of it has already found its way deep into the soil and/or to the water courses. Only a limited area remains polluted and requires remediation.

7.5.5 Relevant physical – chemical characteristics of the waste material

Mercury is a virulent poison and is readily absorbed through the respiratory tract, the gastrointestinal tract, or through unbroken skin. It acts as a cumulative poison and because it is a very volatile element, dangerous levels are rarely attained in air. Mercury vapour should not exceed 0,1 mg/m^3 in air. Air saturated with mercury vapour at 20°C contains a concentration that exceeds the toxicity limits. The danger increases at higher temperatures. It is important therefore that mercury be handled with care. Containers of mercury should be securely covered and spillage should be avoided. If it is necessary to heat mercury or mercury compounds, it should be done in a well-ventilated hood. The triple point of mercury, 38,8344°C, is a fixed point on the International Temperature Scale (ITS-90).

Table 11_physical chemical characteristics of Mercury

Chemical symbol	Hg
Atomic number	80
Atomic mass	200.59 g*mol^{-1}
Electro negativity according to Pauling	1.9
Density	13.6 g*cm^{-3} at 20℃
Melting point	- 38.9 ℃
Boiling point	356.6 ℃
Isotopes	12
Standard potential	+ 0.854 V (Hg^{2+}/ Hg)
Electronic shell	[Xe] $4f^{14}$ $5d^{10}$ $6s^2$

Appearance silvery-white liquid metal

Liquid at 298 K (the heaviest known elemental liquid)

Odours odourless

Uses Minor ore of mercury, electrical switches, thermometers, chlorin processing as electrodes

Transparency is opaque

Mercury is a compound that can be found naturally in the environment. It can be found in metal form, as mercury salts or as organic mercury compounds.

Mercury enters the environment as a result of normal breakdown of minerals in rocks and soil through exposure to wind and water. Release of mercury from natural sources has remained fairly the same over the years. Still mercury concentrations in the environment are increasing; this is ascribed to human activity.

Most of the mercury released from human activities is released into air, through fossil fuel combustion, mining, smelting and solid waste combustion. Some forms of human activity release mercury directly into soil or water, for instance the application of agricultural fertilizers and industrial wastewater disposal. All mercury that is released in the environment will eventually end up in soils or surface waters.

Mercury is both a global pollutant and a contaminant that is transformed to a potentially toxic species (methyl mercury) under natural conditions found in the environment. Each of these characteristics complicates the assessment of mercury-contaminated sites. Mercury emitted to the atmosphere is able to travel thousands of kilometres before being deposited to the earth in rain, snow or dust particles. Mercury enters aquatic and terrestrial systems from the atmosphere primarily in an inorganic form. However, under conditions that favour bacterial sulphate-reduction, inorganic mercury is methylated to form methyl mercury, a potent neurotoxin that bio accumulates in fish.

Mercury is not naturally found in foodstuffs, but it may turn up in food as it can be spread within food chains by smaller organisms that are consumed by humans, for instance through fish. Mercury concentrations in fish usually greatly exceed the concentrations in the water they live in. Cattle breeding products can also contain eminent quantities of mercury. Mercury is not commonly found in plant products, but it can enter human bodies through vegetables and other crops, when sprays that contain mercury are applied in agriculture.

Acidic surface waters can contain significant amounts of mercury. When the pH values are between five and seven, the mercury concentrations in the water will increase due to mobilisation of mercury in the ground.

Once mercury has reached surface waters or soils, micro organisms can convert it to methyl mercury (MeHg), a most toxic organic mercury compound, that can be absorbed quickly by most organisms and is known to cause nerve damage. MeHg is bio accumulating in the biota and subsequently biomagnified in the aquatic food chain, especially in fish. Fish are organisms that absorb great amounts of methyl mercury from surface waters every day. Mercury can occur in various organic forms. All organic mercury compounds “bio accumulate” or “bio magnify”, building up in the ecosystem so that the predators of the top of the food chain may have much more mercury in their bodies than plants and simple micro organisms at the bottom level of the food chain.

7.6 Mixed waste dump

The bottom of the dump site was not lined, and no leachate protection measures were taken. Now it is covered by mixed soil (clay and soil). Management reporting for 24,000 m^2 with 75,000 Mg but expert approximation for 65,000 m^2 with 88,000 Mg. The content on the waste:

- PE bags
- Paper bags, carbon black packing, other waste paper
- Plastic and still barrels and bottles
- PVC dust
- PVC waste
- PVC+fillter+stabilisator in mass
- Oil contained textile waste
- Fabrics contaminated with plasticizer or solvent
- Filtration materials
- Organic azo dyes with minerals and polymers
- Dehydrated active sludge from purification plant station

7.7 Liquid waste:

- Unknown flammable chemicals
- Solvents from equipment washing
- Waste oil and fat
- Waste filler for PVC
- Other (plasticizer, stabilizers)

The mixed waste dump and liquid wastes are currently used onto the remaining operation and are to be handled under the IPPC structure.

8 Environmental Impact Evaluation of existing contamination

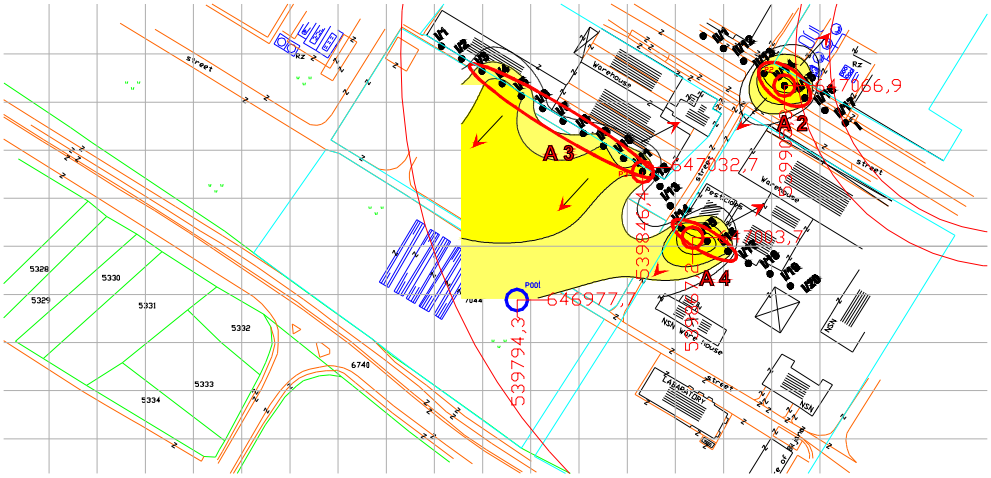
8.1 Environmental Impact of HCH Isomers

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.

Several aspects of the OHIS A.D. facility raise strong environmental concerns. Thousands tons of hazardous chlorinated organic chemicals (technical mixture of HCH isomers) and mixed solid waste have been stored on site for the last 30 years. No detailed investigation or continuously monitoring of the site has been carried out. Management assumes that the waste was stored in steel barrels and simply covered with soil. One basin approximately 100 meters long, 50 meters wide and several meters high was constructed without a drainage system for collecting percolating liquids and without a cover to prevent leaching.

As reported the area around the basin smelled of chlorinated compounds. In addition, waste is likely to be contaminating the soil used to cover the storage site, and is probably leaching into the ground water beneath and around the basins. Recent pollution dispersion indicated due to geotechnical investigation is given in next figure.

Figure 20_Pollution dilution profile



Wastewater flows partly through closed concrete canals, but these are cracked and leaking waste to the soil and groundwater. The newest part of the plant is connected to a wastewater treatment facility for treatment prior to discharge into the Vardar River. The treatment plant, however, is not functioning at present. Other parts of the plant, such as the now-closed chlorine-alkali-electrolysis process, have never been connected to the treatment plant.

The OHIS A.D. complex also generates air pollution, principally from an oil-fueled boiler plant. Data supplied by management suggest that the plant emits approximately 2.240 tons of sulfur dioxide, 315 tons of nitrogen oxides, and 15 tons of dust per year. The sulfur dioxide concentration in the flue gas, at 2.220 mg/m3, exceeds the applicable

1,700 mg/m3 emission standard. An acrylic fiber plant within the complex is an additional source of concern regarding emissions. (source: Post conflict environmental assessment UNEP, 2000). In the plant there are also sources of fugitive emissions, particularly with dust.

Following table main qualitative characteristics and impacts of Lindane plant hotspot are given.

Table 12_Qualitative characteristics and impacts of treated hotspots

LOCATION	MEDIA	CONTAMINANT and QUANTITY	IMPACT and RISK	DURATION and DIMENSION
LINDANE Plant: Dumpsite-1: Concrete pool (50x100x5 m); covered with soil Dumpsite-2: 5 individual dumps; covered with soil	Contaminated soil Ground water Air	Lindane and HCH- isomers 35.000-40.000 t 3.000 t 20.000 m3 Lindane, HCH-isomers, other chlorinated organics - unknown	**Impact:** **-** On surface water of Vardar River and potable water - Local air pollution with unpleasant odor – **LOW** **Hazard: HIGH** **Risks: LOW**	Long-term Local

8.2 Impact of HCH isomers on soil

Lindane and other HCH isomers enter the soil compartment by disposal of contaminated waste or by wet or dry deposition from the atmosphere or by direct application of the insecticide. Once in soil, HCHs are adsorbed to the soil particles, volatized to the atmosphere, taken up by crop plants or leached into the groundwater.

While in the water column, HCHs may be adsorbed to sediment or other suspended materials, which is evidenced due to the relatively high Kow values. The adsorption and desorption rate of HCHs to sediment is related to the physical characteristics of the sediment as well as to its organic carbon content.

The concentrations and persistence of HCH isomers in soil are dependent on soil types. Information that can be found in the literature (Mertens B. Microbial monitoring and degradation of lindane in soil PhD.Thesis, Ghent University, Belgium) of an analysis of two soil types, loamy sand (approximately 1–2% organic matter) and muck (approximately 27–56% organic matter), for γ-HCH residues showed that mean residues in the loamy sand soil had decreased from 95 ppb dry weight in 1971 to below the detection limit of 10 ppb in 1989; however, in muck, residues had decreased from 426 ppb in 1971 to 168 ppb in 1989.

In OHIS soil was not monitored on regularly basis. The pollution was estimated only by few separate measurements. Results given I Table 5. and 6. showed the existence of HCH isomers in soil. Some of results are exceed maximal permit concentration by Dutch standards but not extremely.

Due to a short half time of HCH Isomers can be assumed, that after a period of maximum few years most of the contaminants (if any) will have been reduced below a permitted level due to microbiological activities.

Table 13_Chemical analysis of pesticides in soil sample taken from the existing piezometer (near pesticide dump site)

Parameter	**Concentration Unit**	**MPC[16]**	**Obtained value**	**Method**
α-HCH	mg/kg	0.003	1.26	US EPA 8081A/8270
γ-HCH	mg/kg	0.00005	0.26	US EPA 8081A/8270
β-HCH	mg/kg	0.009	2.12	US EPA 8081A/8270
δ-HCH	mg/kg	-	0.11	US EPA 8081A/8270
Aldrin	mg/kg	0.00006	1.83	US EPA 8081A/8270
Dieldrin	mg/kg	0.005	0.01	US EPA 8081A/8270
DDE	mg/kg	0.01	0.01	US EPA 8081A/8270

Table 14_Chemical analysis of pesticides in soil sample taken from the existing piezometer (near to former electrolysis plant)

Parameter	Concentration Unit	MPC	Obtained value	Method
α-HCH	mg/kg	0.003	0.352	US EPA 8081A/8270
γ-HCH	mg/kg	0.00005	0.0043	US EPA 8081A/8270
β-HCH	mg/kg	0.009	0.27	US EPA 8081A/8270
δ-HCH	mg/kg	-	-	US EPA 8081A/8270
Aldrin	mg/kg	0.00006	0.06	US EPA 8081A/8270
Dieldrin	mg/kg	0.005	-	US EPA 8081A/8270
DDE	mg/kg	0.01	0.018	US EPA 8081A/8270

[16] MPC = Maximum Permitted Concentration according Dutch Standards

Pollution dispersion is indicated due to geotechnical investigation as demonstrated in Figure 20_Pollution dilution profile

The impact of former production and existing HCH dump site on soil could be from the environmental view of point treated as tolerant or related to the long period of the abandoning of the production as LOW.

8.3 Impact on Ground Water

Lindane is more soluble in water than most other organo-chlorine compounds (e.g. DDT, aldrin, endrin, dieldrin, endosulfan have a solubility of <1 mg l^{-1}), therefore has a tendency to remain in water column. Opposite to Lindane other isomers are so good as not soluble in water. In the next Table solubility in water and organic solvent of HCH isomers is given.

Table 15_Characteristics for HCH isomers and its solubility in water and organic solvent

Solubility	γ-HCH	α-HCH	β-HCH	δ-HCH
Water	17 ppm; Insoluble in water	10ppm; 69,5 mg/l at 28%C	5 ppm	10 ppm
Organic Solvents	6,4 g/100g in Ethanol; 20,8 g/100g in Benzene	Soluble in alcohol; 1,8 g/100g in Ethanol; 6,2 g/100g in Ether	1,1 g/100g in Ethanol; 1,8 g/100g in Ether; 1,9 g/100g in Benzene	24,4 g/100g in Ethanol; 35,4 g/100g in Ether; 41,4 g/100g in Benzene

Contamination of surface water can occur as a result of surface run off (as dissolved chemicals are absorbed to particles) and atmospheric depositions. Despite the high vapor pressure, evaporative loss of Lindane from surface water is not considered significant. It depends on water temperature and occurs only during the warmest months of the year. Lindane biodegradation (γ and α HCH) in aquatic eco systems is considered the most dominant process in the removal mechanism from water.

Biodegradation is believed to be the dominant degradative process for γ-HCH in aquatic systems, although hydrolysis and indirect photolysis may also occur. Groundwater half-lives for γ-HCH from degradation data are to be 3– 30, 30–300, and >300 days, respectively(Zoetemann et al., 1980) – see also Table 3.. Since HCH does not contain chromophores that absorb light >290 nm, direct photolysis is not expected to occur. However indirect photolysis, whereby a photosensitizing agent may absorb light and then transfer its excitation energy to HCH, may occur. Humic and fulvic acids are well-known photosensitizing agents and are practically ubiquitous in natural waters. Oxidants commonly found in natural waters, such as peroxy radicals, hydroxyl radicals, and singlet oxygen species, can degrade HCH in water.

In OHIS ground water was not monitored on regularly basis. The pollution was estimated only by few separate measurements. Last, representative ones, given in next tables, were made for the needs of the Project “CARDS 2003”.

Table 16_Chemical analysis of pesticides in groundwater sample taken from the existing piezometer (near pesticide dump site)

Parameter	Concentration Unit	MPC	Obtained value	Method
A-HCH	µg/L	0.01	2.40	US EPA 8081A/8270
Γ-HCH	µg/L	0.01	0.38	US EPA 8081A/8270
B-HCH	µg/L	0.01	3.20	US EPA 8081A/8270
Δ-HCH	µg/L	0.01	0.08	US EPA 8081A/8270
Aldrin	µg/L	0.003	0.08	US EPA 8081A/8270
DDE	µg/L	0.001	0.00167	US EPA 8081A/8270
(+)-cis heptahlorepoksid	µg/L	0.001	0.2	US EPA 8081A/8270
2,4'DDD	µg/L	0.001	0.004	US EPA 8081A/8270

Table 17_Chemical analysis of pesticides in groundwater sample taken from the existing piezometer (near former electrolysis plant)

Parameter	Concentration Unit	MPC	Obtained value	Method
α-HCH	mg/L	0.01	0.239	US EPA 8081A/8270
γ-HCH	mg/L	0.01	0.0252	US EPA 8081A/8270
β-HCH	mg/L	0.01	0.282	US EPA 8081A/8270
δ-HCH	mg/L	0.01	-	US EPA 8081A/8270
Aldrin	mg/L	0.003	0.3	US EPA 8081A/8270
DDE	mg/L	0.001	0.0225	US EPA 8081A/8270
(+)-cis heptachlorepoxide	mg/L	0.001	-	US EPA 8081A/8270
2,4'DDD	mg/L	0.001	-	US EPA 8081A/8270

Table 18_Concentrations of some pollutants in ground waters in OHIS plant

	III-IV class normal concentra-tion	Groundwater from piezometer in electrolysis plant	Soil from piezometer in electrolysis plants	Groundwater from the piezometer near the stock of lindan	Soil from the piezometer near the stock of linden	Sediment in the channel	In the channel in front of Vardar River	Down-stream of Vardar River
Mercury	0,1 µg/L	2,78	0,58 (12 m)	2,28	<0,1	<0,1	0,11	0,08
Lindan	0,1 µg/L	/	/	1,15	/	53,9 (0 m)	/	/
Trichlorethylene	75 µg/L	2370	127 (4-5)	1017	0,57 (3-4)	29,5 (2 m)	23,40	0,25

From the results above can be concluded that the pollution is historic because the pollution from mercury is only in the deeper layers (12 m). The obtained values of the groundwater from the piezometer near the stock of linden and from the sediment in the channel are exceeding the maximal permitted concentrations.

Table 19_Results of the chemical analysis of sediment taken from the old duct for drainage of waste water into Vardar River

Depth (m)	**Parameter**	
	Lindane (µg/kg)	Mercury (µg/g)
0.0 – 0.5	**53.90**	<0.10
0.5 – 1.0	**42.70**	<0.10
1.0 – 1.5	**11.00**	<0.10
1.5 - 2.0	**4.94**	<0.10
2.0 – 2.5	**29.50**	<0.10
3.0 – 3.5	**3.50**	<0.10
3.5 – 4.0	**4.75**	<0.10
4.0 – 4.5	**4.94**	<0.10
4.5 – 5.0	**1.22**	<0.10

Results showed the existence of HCH isomers and other organic pollutants in ground water. Some of results are exceed maximal permit concentration by Dutch standards. Because of the biodegradation potential of HCH and low solubility in water the impact of former production and likely from existing HCH dump site on ground water could be from the environmental view of point treated as moderate.

8.4 Surface Water Impacts

Bearing in mind that on the north side of the installation is located river Vardar approximately 2,5 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 landfill site will be transported via groundwater to the river. Historically data about quality of the river Vardar, as a surface body near by the "hotspot" doesn't exists.

In the next Tables some data about the former waste water quality and quality of Vardar River is given.

Table 20_Results of the chemical analysis at three measurement points [17]

Parameter	Vardar spring	Waste water from OHIS before discharging in Vardar	Vardar downstream of "OHIS"	MPC
Ammonia (mg N/l)	29.0	0.689	14.0	500
Nitrites (mg N/l)	0.02	9.18	0.23	500
Nitrates (mg N/l)	0.008	1.10	0.090	15 000
Phosphates (mg P/l)	0.89	0.10	**2.20**	0.1
Iron (mg/l)	0.04	0.43	0.24	1 000
Manganese (mg/l)	0.09	0.06	0.10	/
Lead (mg/l)	0.19	0.090	0.32	30
Mercury (µg/l)	0.050	0.11	0.080	1
Detergents (mg/l)	<0.13	/	0.10	/
Trichlorethylene (µg/l)	0.11	23.40	0.25	75
Chloroform (µg/l)	<1.0	6.9	13.40	20
1.2 Dichlorethylene (µg/l)	6.26	/	20.70	100 (1.2 DC etan)
Tetrachlorethylene (µg/l)	0.005	/	0.020	4
1.2 Dichlorobenzene (µg/l)	<0.5	0.9	<0.5	(20 Dichlorobenzene)
Benzene (µg/l)	<1.0	<1.0	<1.0	10
Xylene (µg/l)	2.5	<1.0	<1.0	100
Toluene (µg/l)	<1.0	<1.0	<1.0	100
Ethylbenzene (µg/l)	<1.0	<1.0	<1.0	100
PCB (µg/l)	<1.0	<1.0	<1.0	5 (penta-chlor-benzene)

Based on this data, obtained during the OHIS plant was in operation and pollution by waste water was serious, it could be assumed that the impact on surface water from the existing hotspots, after the abounding of the production doesn't exist any more.

[17] The table 12, also contains maximum permitted concentrations (MPC) of parameters according to Regulation of waters classification (Official Gazette of the R.M. No.18/1999). The MPC are for III class of water, because the Vardar River water flow from Skopje to the inflow of the Pcinja River is III class of water according to Regulation of waters classification.

8.5 Impact on air

The major sources of HCH isomers in the atmosphere are fugitive emissions by volatization and in more restricted manner dust particles emission from wind erosion of dump site cover.

Monitoring data does not exist. Levels of Lindane isomers in the atmosphere are seasonal and temperature dependant. On the dump site location (only in the close neighborhoods – distance in meters) there is one characteristic smelt on organic compounds.

The residence time (half life time) of Lindane and isomers in air (water and soil) depends of the hydro- meteorological conditions and it is in the range of months. From this point of view, impact of HCH dump site on the environment is negligible.

8.6 Health Impacts

See chapter Qualitative Health Impact Assessment, heading number 6.1, page number 54. In the OHIS case, the impact on health is definitely lower because there the lindane is in the present only as trace and the waste is cowered and not open to direct impact of environmental media.

Health impact of Lindane and HCH isomers is widely described in the Volume 00_A - Qualitative Health Impact Assessment.

8.7 Hazardous risk assessment

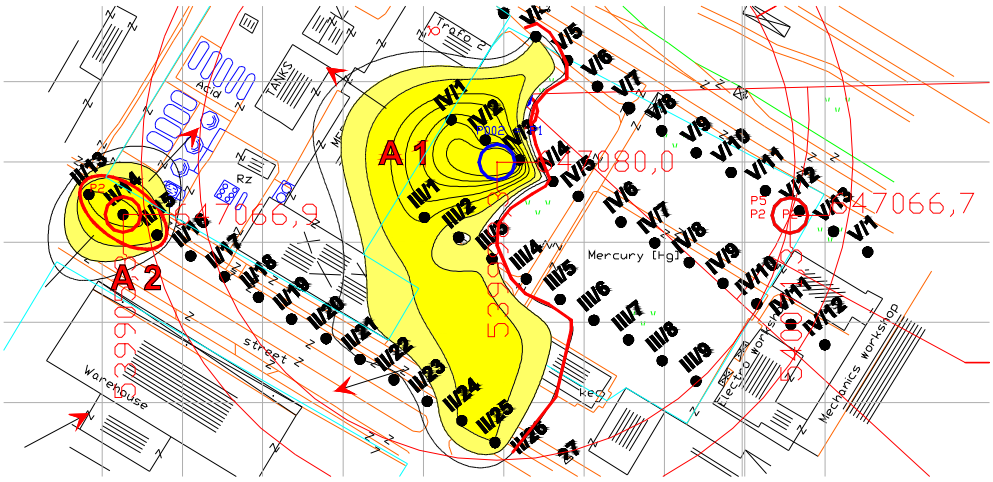
Hazardous risk assessment of pure substances (lindane and isomers and mercury) is estimated as very high, as it is given in tables in the appendix for lindane and for mercury. Fortunately, in the particular case, because the lindane concentration is practically negligible (does not exist any more) and that the substances are not under direct impact of environment (particularly water) the risk for the environment and health is under control and could be estimated as LOW.

8.8 Environmental Impact of Mercury

Opposite to the HCH's that are storage on exact location, the exact location of mercury contamination from the plant aren't known.

Broader, located area of 6.200 sqm is contaminated with mercury, because of the fact that during the production approximate 400 Mg of mercury where lost in the environment. It could to be assumed that main mercury is on the plant location as outside. Pollution dispersion is indicated due to geotechnical investigation – see next figure. Migration ways of mercury are only in deeper layers (layer between Alluvial and Pliocene ~ 20m) and outside the plant are indicated due to geotechnical investigation, see next figure. Close to the plant are traces of surface contamination due to the ongoing dismantling of the plant, while east of the electrolyses plant shows mercury a depth contamination, starting from –7m till –15m. Similar picture represents the situation in northern direction. The surface pollution reduces with the distance to the electrolyses building against 0. Groundwater layers are not present, much more infiltration (pore) water with irregular intrusion rates. A migration plant outside the plant due to groundwater cannot be observed and is based by the fact, that mercury is present in elementary form and un-dissolvable. Organic complexes including mercury cannot be assumed due to the soil texture showing no conditions for a transformation. A impact on the village Dracevo can be excluded.

Figure 21_area impacted from Mercury pollutant



Picture 3_Area impacted from Mercury pollutant

This factory reportedly used (practically lost as pollution of soil and water) six tons of mercury per year, causing mercury-laden waste water to drain into the Vardar River[18] and the soil/ground contamination.

Management stated that eight tons of mercury remains stored at the plant. (Recently sold to an Asian country)

Table 21_Qualitative characteristics and impacts of mercury hotspots

CHLOR-ALKALI Plant:	Contaminated soil Ground water	Mercury (Hg); 0,1-0,7 µg/kg; depending on depth 8.000 m3 2,3-2,7 µg/l	**Impact: local – MODERATE** **Risks: HIGH on environment and MODERATE on health**	Long-term Local

8.9 Impact of Mercury on soil

There is no information about handling with all chemicals that were used in the NaCl electrolysis. There is a possibility of large quantity of mercury loss from the site through soil. Monitoring on soil pollution by mercury wasn't performed on regularly basis.

There are different sources of single measurements. Some date was found in the available documentations that heavy metals in soil near the former electrolysis plant shows on the surface were 7 - 110 mg/kg Hg measured in 2007 from the national public health institute, which is quite high in comparison with the max allowed (0,3 mg/kg Hg[19]).

The lead concentration (500 mg/kg) in one soil sample was above the threshold value for normal soil in many countries but not over the threshold values generally applied for soil at industrial sites. Soil analysis by UNEP [2000] shows following data: 51 mg/kg Cr; 55 mg/kg Cu, 189 mg/kg Zn, 36 mg/kg Ni, 224 mg/kg Mn, **503 mg/kg Pb and 500 mg/kg Hg**, which seems very high and haven't been taken into consideration during the feasibility phase.

Table 22_Chemical analysis of soil sample taken near the existing piezometer (near pesticide dump site)

Parameter	Concentration Unit	MPC	Obtained value	Method
Lead, Pb	mg/kg	85	12,44	ISO 11885/1996
Mercury, Hg	mg/kg	0,3	0,12	ISO 11885/1996
Chromium, Cr	mg/kg	100	84,76	ISO 11885/1996

[18] UNEP surface-water samples taken from a small wastewater canal close to the former chlorine-alkali-electrolysis plant did not show excessive levels of pollutants.

[19] Dutch Standard for permitted levels of Soil contamination

Table 23_Chemical analysis of inorganic in soil sample taken near the existing piezometer (near to former electrolysis plant)

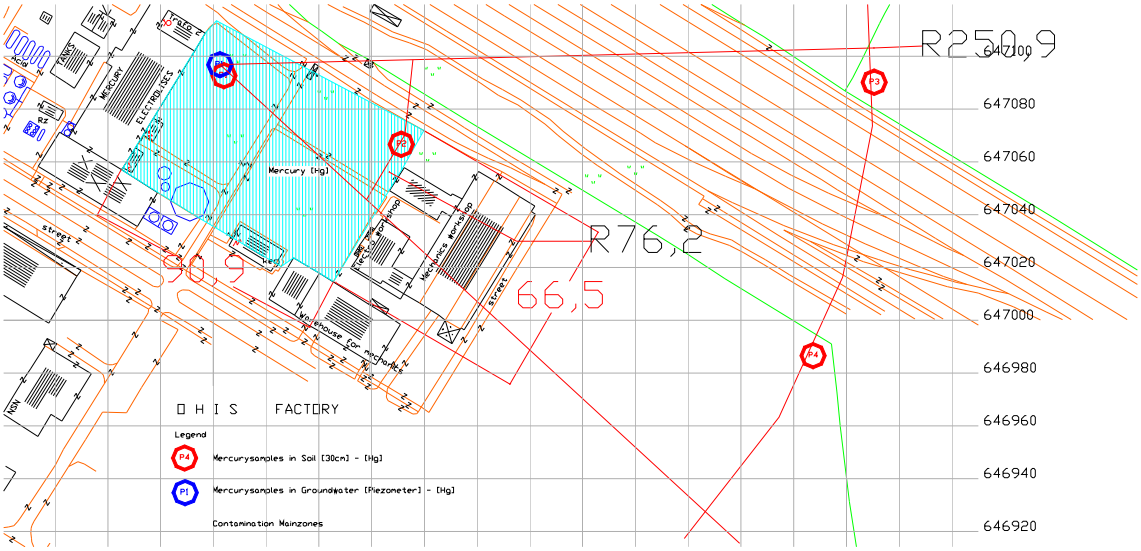
Parameter	Concentration Unit	MPC	Obtained value	Method
Lead, Pb	Mg/kg	85	14,72	ISO 11885/1996
Mercury, Hg	Mg/kg	0,3	7,00	ISO 11885/1996
Chromium, Cr	Mg/kg	100	75,2	ISO 11885/1996

In the Table 24 are given values for the same parameters recently analysed near the former electrolysis plant, on the location shown in Figure 22.

Table 24_Contamination of the soil by selected heavy metals

Parameter [mg/kg DS]	**Max. allowed**	**Measured[20]**	**Point 1[21]**	**Point 2**	**Point 3**	**Point 4**
Lead, Pb	85	12,44				
Mercury, Hg	0,3	0,12	110	7,64	2	<1
Chromium, Cr	100	84,76				

Figure 22_Map of Soil analyses (5 till 35 cm)



As could be shown the soil pollution with mercury could be estimated as low. There is indication of accumulation of mercury in deeper layers.

[20] Source: Cards 2001

[21] Source for Point 1 till 4: Cards 2006 (2007; Institute for Public Health Skopje)

8.10 Impact of Mercury on groundwater

Ground water pollution wasn't monitored on regular basis. Results from single measurements could be find, as it is shown in the next Tables.

Table 25_Chemical analysis of inorganics in groundwater sample taken from the existing piezometer (near pesticide dump site)

Parameter	**Concentration Unit**	**MPC**	**Obtained value**	**Method**
pH	-	6,5-8,5	7,70	ISO 10523
Conductivity	µS/cm	-	1291,0	ISO 7888
Lead, Pb	µg/L	10	17,519	ISO 11885/1996
Mercury, Hg	µg/L	0,2 - **Surface water** mg/l ClassI/II 0.2 ClassIII/IV 1 Class IV > 1 **Ground water** mg/l ClassI/II 0.2 **Drinking water** 0,001	0,11	ISO 11885/1996
Chromium, Cr	µg/L	50	14,49	ISO 11885/1996

Table 26_Chemical analysis of groundwater sample taken from the existing piezometer (near former electrolysis plant)

Parameter	Concentration Unit	MPC	Obtained value	Method
pH	-	6,5-8,5	8,18	ISO 10523
Conductivity	µS/cm	-	1431,0	ISO 7888
Lead, Pb	µg/L	10	4,964	ISO 11885/1996
Mercury, Hg	µg/L	0,2	1,10	ISO 11885/1996
Chromium, Cr	µg/L	50	28,42	ISO 11885/1996

Table 27_Chemical analysis[22] of groundwater sample taken from the existing piezometer (near former electrolysis plant)

Parameter	**Point I**	**Point II**	**Point III**	**Point IV**	**MLP**
Hg (elementary)	0,015				

Mercury was analyzed in only one water sample, giving a concentration of about 65 mg/l, some 10 times over the limit value for drinking water but below limit values for natural waters and latest of a value of 0,015mg/l.

From the existing data pollution of groundwater cannot be negligible. For detailed estimation more precise monitoring will be needed.

[22] sample taken and analysed from the national public health insitute

8.11 Impact of Mercury on surface waters

In the Ohis site, there are pretty shallow groundwater, that flows to the Vardar River (slightly parallel). It is probably that the mercury that will occur in the soil, through groundwater will reach to the river, which is very close. As reported in some documents, in the past, quite often the mercury surplus was directly discharged in the Vardar River. It is open question if this was even possible and if than how this happened?

In the next Table concentration of mercury (µg/L) in wastewater before the inlet and in Vardar River immediately downstream the OHIS plant is given.

Table 28_Concentration of mercury (µg/L) in wastewater before the inlet and in Vardar River immediately downstream the OHIS plant

Parameter	Wastewater before inlet in river	River water downstream the plant / Limit value for drinking water
Mercury	0,11	0,72/ 1,0

Because of the fact that the electrolyze plant is shout down the pollution of surface waters shouldn't be problem any more. Pollution of surface water trough polluted soil is not likely at all.

8.12 Impact of Mercury on air

Mercury released to the atmosphere, either directly or indirectly, may fall out near the point where it is emitted, because of its atomic mass 200,59 $g*mol^{-1}$.

There are no measurements of Hg in the air for Ohis and its environment. On the other hand, the Hg losses are not current, which means that the pollution is in depth, so there is no possibility for mercury evaporation during the temperature rise (the Hg is volatile, and its vapour is toxic).

8.13 Health impact

See chapter Qualitative Health Impact Assessment, heading number 6.1, page number 54. Inorganic mercury is toxic when humans or wildlife are exposed to high levels for a short period of time. Organic methyl mercury has a greater tendency to accumulate in the body over time, eventually causing harm, even in small amounts. Methyl mercury has the three properties that make substances particularly harmful to humans and other organisms — it persists, it bio accumulates, and it is toxic to most life forms. The health effects of mercury are described in more detail in the Volume 00_A - Qualitative Health Impact Assessment.

Health impact of Lindane and HCH isomers is widely described in the Volume 00_A - Qualitative Health Impact Assessment.

8.14 Hazardous risk assessment

Hazardous risk assessment of pure mercury is estimated as very high [see Annex Hazard Ranking of Mercury 11.6.4]. Opposite to the HCH isomers where the substances isn't under direct impact of environment, in the case of mercury there is direct uncontrolled impact of water and soil. The risk for the environment could be estimated as HIGH and on health as MODERATE.

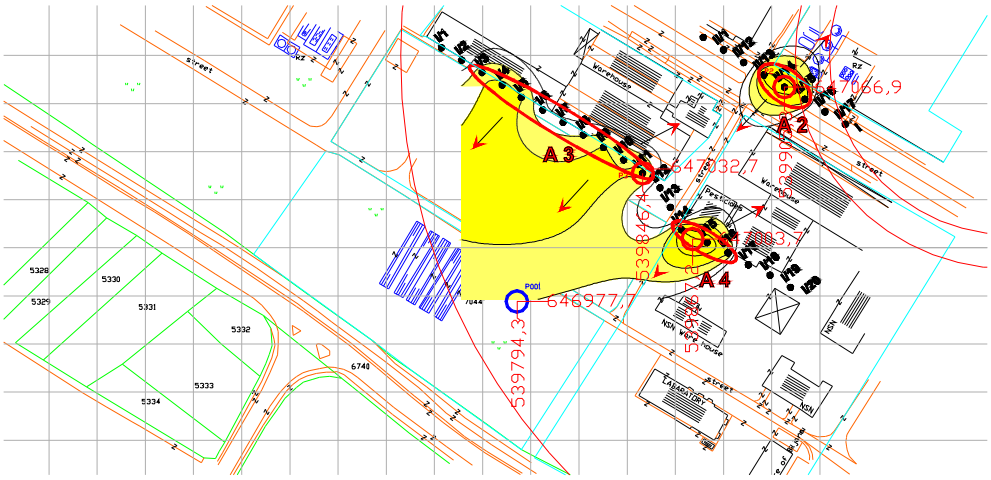
9 REMEDIATION TECHNIQUE

9.1 Specification of source of site contamination

In OHIS hotspots there are 4 types of environmentally completely different remediation problems, that means:

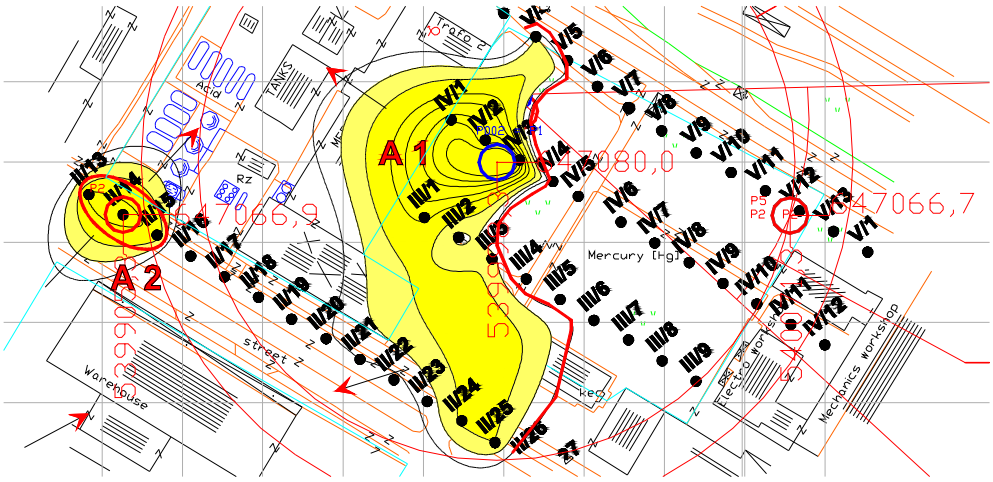
- **Dumpsites with HCH** - Dumpsite is physically fixing located. Pollution dispersion is indicated due to geotechnical investigation – see next figure. Composition of the waste is more or less known. The problem oh HCH isomers are worldwide relatively known. Some activities and remediation techniques are possible.

Figure 23_Dilution of Pollution – HCH Isomers



- **Pollution with mercury** – Broader, located area of 6.200 sqm is contaminated with mercury, because of the fact that during the production approximate 400 Mg of mercury where lost in the environment. It could to be assumed that main mercury is on the plant location as outside. Migration ways of mercury are only in deeper layers (layer between Alluvial and Pliocene ~ 20m) and outside the plant are indicated due to geotechnical investigation, see next figure. Close to the plant are traces of surface contamination due to the ongoing dismantling of the plant, while east of the electrolyses plant shows mercury a depth contamination, starting from –7m till –15m. Similar picture represents the situation in northern direction. The surface pollution reduces with the distance to the electrolyses building against 0. Groundwater layers are not present, much more infiltration (pore) water with irregular intrusion rates. A migration plant outside the plant due to groundwater cannot be observed and is based by the fact, that mercury is present in elementary form and un-dissolvable. Organic complexes including mercury cannot be assumed due to the soil texture showing no conditions for a transformation. A impact on the village Dracevo can be excluded.

Figure 24_Dilution of Pollution – Mercury



- **Mixed solid waste dump** (not mater of this project) – Dumpsite is physically fixing located. Composition of the waste isn't so precise known as in the case of HCH dumpsite, but the possible techniques and remediation technologies are known. This problem isn't the mater of this project and will be not further discussed.
- **Treatment of low contaminated soil** components (surrounding area) and **contaminated groundwater**. Due to a short half time of HCH Isomers can be assumed, that after a period of maximum 1 year most of the contaminants will have been reduced below a permitted level due to microbiological activities. Main condition is the removal of the HCH isomer dumps from Ohis location.

9.2 Selected alternatives for HCH 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.

From the environmental view of point, for the remediation of HCH dumpsites there are following possibilities:

- **No activities** – no activities will undertake. Impact on environment will remain but with slow decreasing trend. The problem will remain for decades and the location will remain a hot spot (for ever). No other use of the location will be possible. Perception of population in closer neighborhood will remain negative.
- **In situ – phytoremediation** with a bacterium Pseudomonas aeruginosa ITRC-5 that mediates the degradation of all the four major isomers of HCH under aerobic conditions, both in liquid-culture and contaminated soils. After phytoremediation can the soil be disposed on Drisla for intermediate cover. The treatment process takes longer treatment period than common ones. A dilution of the contaminated material (soil) is required from 500 g/kg to 5 g/kg in order to achieve the highest possible treatment efficiency. From this reason the alternative isn't realistic.
- **In Situ – Chemical reduction - ISCR processing** in combination with **bio-piling**, while reducing material such as Daramend will be used to reduce HCH isomers on site. The treatment will be for a minimum period of 1 year and will also consume big areas to set up piles for the aerating treatment. A dilution of the

concentration from 500 gr to 100 mg would have to be initiated which would require a dilution factor of 1:5000. The material would be able to be used afterwards as topsoil material at Drisla site. Due to the required high dilution rate, long treatment period and enormous cost generation shall this alternative isn't realistic.

- **In Situ – Thermal Treatment -** SPSH is an in situ thermal treatment technology whereby conventional 3-phase electricity is split into 6 separate electrical phases, thus providing improved subsurface heat distribution. Six electrodes are placed in a hexagonal pattern around the area to be treated. Each one of the 6 phases is delivered to a single electrode. The temperature of the soil increases due to the passing of the AC current through the soil moisture. This increased soil temperature raises the vapor pressure of volatile and semi volatile compounds, which increases their volatilization and makes them easier to be removed during the process. Heating the soil also dries out the soil moisture and creates steam, which increases the permeability of the formation (which can be helpful in low permeability materials) and strips higher boiling contaminants that may not be removed alone. The treatment period is more than one year, the cost are extreme high and the technology not available on the European market, so that this alternative isn't realistic
- **Base catalyzed decomposition -** The BCD process involves treatment of liquid and solid wastes in the presence of a reagent mixture consisting of a high boiling point hydrocarbon such as fuel oil, sodium hydroxide and a proprietary catalyst. When heated to about 300° C, the reagent produces highly reactive atomic hydrogen, which cleaves chemical bonds that confer toxicity to compounds. The residues produced from decomposition of heteroatomic compounds are carbon, and sodium salts of anions liberated during the complete decomposition reactions. After the thermal treatment reaction, the inorganic and carbonaceous solids are separated from the un-reacted oil by gravity or centrifugation. The oil and catalyst may be recovered for reuse in other treatment cycles. If it is desired to further separate the solids residues, the salts and excess base can be removed from carbon residue by washing with water. The carbon residue is nontoxic, has no heteroatoms attached and can be disposed of as any non-toxic material. The BCD process has the advantages of not requiring very high temperatures, high pressure, or energetic reagents.
- **Excavation and on site thermal treatment** - thermal treatment process employs an indirectly fired rotary kiln in which matrix material contaminated with organic substances, and the like is heated as the material is advanced through the kiln to cause components of the organics to be released as vapor. Purge gas of low oxygen content is conducted through the kiln at a relatively low velocity of from about 0,15m/sec to about 3m/sec to gently sweep the vaporized components of the organic substances from the kiln and to minimize the entrainment of solid particulates, and to produce an off gas mixture including the vaporized components. The off gas is conditioned after removal from the kiln to render it acceptable for discharge to the atmosphere. The oxygen concentration in the kiln is maintained at a sufficiently low level to substantially prevent combustion of the vaporized organic components in the kiln.
- **Excavation and ex situ thermal treatment** - waste will be excavated and transported from the location. 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.
    - **Thermal treatment in licensed incineration plant for hazard waste** – the closes incinerator for hazard waste would be the one in Simmering –

Austria. Excavation, Transport and notifications are required according Basel convention. Transport has to meet the ARD or RID criteria. The circumstance of contamination would be solved in a fast manner

- **Thermal treatment on a cement kiln** – closest cement kiln would be that of Titan Skopje. Due to the high amount of daily processed material the isomers can be probably co-incinerated. Important is the dose per hour in order not to exceed the permitted limits of Chlorine within the kiln. In addition would be the firing due to blowing of waste direct into the flame for guaranteeing long retention time with the hottest zones.

- **Capping - In situ improvement of the situation – mitigation measures** for reducing of impact will be introduced. Main measure is 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 (PHD plastic) or soil could be used. Impact on environment will be substantial reduced but the problem will remain for decades and the location will remain a hot spot (for ever). No other use will be possible.
- **Excavation and off site disposal** - excavation and safe transport required. Due to the circumstance, that in Macedonia no landfill of hazard disposal are in operation, the case of OHIS 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)

9.2.1 Environmental Ranking of various proposed methods for remediation of HCH isomer contamination

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 29_Environmental Comparison of various potential alternatives

		In Situ			On site	Ex Situ			
	No activities	Phytoremediation	Thermal treatment	Chemical Reduction	Capping – mitigation measures	Excavation and Based Catalyzed Decomposition	Excavation and thermal treatment – Extern	Excavation and thermal treatment – Cement Kiln	Excavation and off site disposal
Hazard	H[23]	M	M	M	M	L	L	L	L
Risk	H	L	L	L	M	L	L	L	L
Environmental impact – FINAL	H	L	L	L	M	L	L	L	L
Environmental impact – during the remediation	H	M	H	M	L	M	M	M	M
• **on air**	H	M	M	M	L	L	L	L	L
• **on water**	H	M	M	M	L	M	M	M	M
• **on soil**	L	L	M	L	L	M	M	M	M
Time needed to complete solve the problem	H	M	L	M	H	L	L	L	L
Monitoring needs – time and frequency	H	M	L	M	H	L	L	L	L
Best practice – world wide use of the technology – Development status	H	H	M	H	L	L	M	M	L
Technical and technology assistance needed - Macedonia is self-sufficient	L	H	H	H	L	H	H	M	L

23 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)

Sustainability - Potential use of location	H	L	L	L	M	L	L	L	L
Sensibility of the public (Acceptance)	H	L	L	L	M	L	L	L	L
SCOR	11/0/2 **21**	2/6/5 45	2/5/6 47	2/6/5 45	2/5/6 46	1/3/9 55	1/4/8 49	0/5/8 54	0/3/10 **59**
Ranked	**9**	7-8	6	7-8	5	**2**	**4**	**3**	**1**

9.2.2 Chriteria of HCH dumpsite 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 HCH odor emissions excavation must be done under shelter and in “under pressure atmosphere” with gas cleaning (absorption, burning and washing)
- 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

9.2.3 Management plan for selected alternative

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

Table 30_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

9.2.4 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 31_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	HCH 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	HCH	Soil and underground water pollution	Taking the samples and out site analysis	During the excavation on regular basis	Operator	
Transport (if any)	NO monitoring needs					
Treatment (if any)	According the selected treatment technique					
Final work	HCH	State of the virgin soil pollution	Taking the samples and out site analysis		Authority	

9.3 Selected alternatives for the remediation of Mercury contaminated areas

From the environmental view of point, for the remediation of mercury pollution there are following possibilities:

- **No activities** – no activities will undertake. Impact on environment will remain. The problem will remain for decades and the location will remain a hot spot (for ever). No other use of the location will be possible. Perception of population in closer neighborhood will remain negative. Possible impact in broader area through the migration process couldn't be excluded.
- **In situ – Phytoremediation** – with Nikotiana Tabacum, yellow poplar or salix x. The remediation is limited by the root depth and takes till 20 years. In comparison with the phytoremediation of lead contaminated soil is the experience with phytoremediation of mercury limited. Not realistic alternative.
- **In situ** – **Electrokinetics** - Mercury spilling (metal) should be given a role of electrode or of a constituent of the electrolyte. Both cases are impossible to realize on Ohis site due to non-reducible conditions of current Hg component. Agents for mobilizing the Hg might worsen the current situation, because current Hg is rather stabile and immobile. Adding of agent might contaminate the

groundwater in addition and might cause an uncontrollable situation. Not realistic alternative.

- **In Situ – Thermal desorption system** – ITDS – no excavation is needed. Soil is heated through heating sonds/probes and pollutants are vaporizing, which will be caught due to vacuum sonds/probes. The depth of the mercury "depot" is approximate 7 till 15 m deep and below the groundwater level, which makes this system not applicable. For the shallow layers (till 2,5m) is the system not sufficient enough. Not realistic alternative.
- **On site – Thermal desorption system** – excavation required, soil is heated in a rotary kiln and exhaust gas treated. The mercury will be condensated in a mercury trap. The treatment requires approximate 6 months on site.
- **Ex Situ – Thermal desorption system** – ITDS –excavation and transport required. Possible location for treatment might be Drisla site. The Soil will heated through heating sonds and pollutants are vaporizing, which will be caught due to vacuum sonds. The treated soil can afterwards be used as topsoil layer for cover purposes on the landfill Drisla. Problem will be solved in relatively limited time. Location will become attractive one.
- **Excavation and on site remediation** – waste will be excavated and treated by separation of mercury and soil due to mechanical separation – fine course of the soil will be separated due to vibration screens. Course and mercury are separated together and will be separated due to a water cyclone system, while course and Hg will be separated Problem about the estimation of polluted area, because of the mercury migration will be serious. Impact on the environment during the excavation and remediation would need particular care. Problem will be solved in relatively limited time. Location will become attractive one. A depth of 500 cm shall be taken into consideration. The groundwater level in a depth of 6m insolates the deeper located Mercury, while this compound remaining will have no negative impacts into the environment, safety or human health.
- **Capping** – only the first layer of min 1m will be excavated and refilled with high-density material and compacted. Due to the fact, that the mercury has rather stabile and immobile characteristics would be capping sufficient enough to ensure safety and reduced impacts.
- **Bounding** – in addition to capping can the area be bounded, which would need an excavation till the Pliocene layer (-20m) and a refilling with high density material, such as Bentonite. The area of contamination can be rather exact located. Main Hg compounds are in deeper layers, and "insolated" by the groundwater layer. Bounding would close the contaminated area and would make any impact impossible due to the insulation techniques used. Exacavation and transport of material is required. (all excavations will cause instability in the building foundations!) Not realistic alternative.
- **Excavation and off site disposal** - excavation and safe transport required. Due to the circumstance, that in Macedonia no landfill of hazard disposal are in operation, the case of OHIS 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). An excavation depths of 5 m shall be taken into consideration which are in total 39.000 m³, which have to be transported to a off site.

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.

9.3.1 Environmental Ranking of various proposed methods for remediation of Mercury contamination

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). General environmental relevant information's, different sustainable impacts and rough ranking of possibilities for different technical options are given in next Table.

Table 32_Environmental Comparison of various potential alternatives

		In Situ			On Site		Ex Situ	Other		
	No activities	**Phyto remediation**	**Electrokinetics**	**Thermal desorption system**	**Thermal Desorption System**	**Excavation and mechanical treatment**	**Thermal Desorption system**	**Capping**	**Bounding**	**Excavation and off site disposal**
Hazard	H[24]	M	M	M	L	L	L	M	M	L
Risk	H	M	M	M	L	L	L	M	M	L
Environmental impact – FINAL	H	M	H	M	L	L	L	M	M	L
Environmental impact	H	L	L	L	M	M	M	L	L	M
• **on air**	L	L	L	L	M	L	L	L	L	L
• **on water**	H	M	M	M	L	L	L	L	L	L
• **on soil**	H	M	M	M	L	L	L	M	M	M
Monitoring	H	M	M	M	L	L	L	M	M	L
Time needed TO SOLVE THE PROBLEM	H	M	M	M	L	L	L	H	H	L
Best practice – frequency of the technology use Development Status	H	H	H	H	M	M	M	M	M	L
Technical and technology assistance needed – Macedonia is self-sufficient	L	H	H	H	H	L	H	L	L	L

24 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)

Sustainability Potential use of location	H	M	M	M	L	L	L	H	H	L
Acceptance for the public	H	M	M	M	L	L	L	M	M	L
SCORE	**11/1/1** **18**	2/9/2 39	3/8/2 37	2/9/2 39	**1/3/9** **55**	**0/2/11** **61**	**1/2/10** **56**	2/7/4 43	2/7/4 43	0/2/11 **61**
RANKED	**10**	7- 8	9	7-8	**4**	**1-2**	**3**	5-6	6-6	**1-2**

9.3.2 Mercury 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 treated location (volume, 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
- 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

9.3.3 Management plan for selected alternative

Table 33_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
	Project design		Checking of proposed measures by Authority		
Excavation		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	Operator		
Treatment (if any)	According the selected treatment technique				
Final work	Monitoring of soil Geodetic data		Authority		Recording of final stage of the activities

9.3.4 Monitoring

Monitoring schemes according selected remediation activity and relevant existing legislation

Table 34_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	Mercury	Soil and underground water pollution	Taking the samples and out site analysis	Before the work will start	Operator to Authority	NO/According the market price
Excavation	Mercury	Soil and underground water pollution	Taking the samples and out site analysis	During the excavation on regular basis	Operator	
Transport (if any)	NO monitoring needs					
Treatment	According the selected					

(if any)	treatment technique					
Final work	Mercury	State of the virgin soil pollution	Taking the samples and out site analysis		Authority	

9.4 Conclusion

For the remediation of HCH isomer contaminated sites have following options been ranked from the environmental assessment as most appropriate for further financial and economical evaluation:

Excavation and off site disposal – 1

Excavation and based catalysed decomposition – 2

Excavation and thermal treatment in cement kiln – 3

Excavation and external thermal treatment in licensed hazard waste incinerators – 4

On site mitigation measures – Capping – 5

For the remediation of Mercury contaminated areas have following options been ranked from the environmental assessment as most appropriate for further financial and economical evaluation:

Excavation and off site disposal – 1

Excavation and mechanical / physical treatment – 1

Excavation and ex situ thermal desorption system – 3

Excavation and on site thermal desorption treatment – 4

On site mitigation measures – Capping – 5

10 Economical-Financial Evaluation on OHIS site

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[25] *<<*

10.3 Possible solutions

There a lot of possible interesting investments that can be done in the remediate space. After remediation in OHIS there will be additional 28.000 m2 [see Attachment – ref xxxxxx] [**Error! Reference source not found.**] free space which can be used for different purposes. In order to avoid complexity we have decide to chose five possible solutions and analyze them through different indicators. After this analysis, the one which is the most favorable will be analyzed in more details in with the purpose to find out how long it will take for the return of the remediation investment.

10.3.1 No activites [Option 0]

One option is taking no activites into consideration. There are no positive effects from this option.

10.3.2 Free Trade Zone [Option 1]

One of the possible solutions is to have free trade zone in this area. Free trade zone is an area with full infrastructure which can be given for different kind of business. In this area all business are tax free, which lead to very cheap and competitive end product.

10.3.2.1 Benchmarks

In 2002 there were 43 million people working in about 3000 FTZs spanning 116 countries producing clothes, shoes, sneakers, electronics, and toys. The basic objectives of FTZs are to enhance foreign exchange earnings, develop export-oriented industries and to generate employment opportunities.

The creation of special free trade zones is criticized for encouraging businesses to set up operations under the influence of often corrupt governments, and giving foreign corporations more economic liberty than is given indigenous employers who face large and sometimes insurmountable "regulatory" hurdles in developing nations. However, many countries are increasingly allowing local entrepreneurs to locate inside FTZs in order to access export-based incentives.

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

Often the government pays part of the initial cost of factory setup, loosens environmental protections and rules regarding negligence and the treatment of workers, and promises not to ask payment of taxes for the next few years. When the taxation-free years are over the corporation which set up the factory without fully assuming its costs is often able to set up operations elsewhere for less expense than the taxes to be paid, giving it leverage to take the host government to the bargaining table with more demands in order for it to continue operations in the country.

10.3.3 Business incubator (Option 2 – "Incentive System")

Another possible solution is to build facility with the purpose to used it as a business incubator incentive. With this the start-up business and entrepreneur spirit will be support.

A Business Incubator is a facility designed to assist businesses to become established and sustainable during their start up phase

Typically, they do this by providing:

- shared premises
- business advice
- business services
- access to investor, market and international networks
- mentoring
- a full-time, hands-on management team.

The incubation period for an individual business is normally two to three years.

US statistics show that business incubators increase the survival rate of start-ups from 35 percent to 87 percent.

Business incubation is a business support process that accelerates the successful development of start-up and fledgling companies by providing entrepreneurs with an array of targeted resources and services. These services are usually developed or orchestrated by incubator management and offered both in the business incubator and through its network of contacts. A business incubator's main goal is to produce successful firms that will leave the program financially viable and freestanding. These incubator graduates have the potential to create jobs, revitalize neighborhoods, commercialize new technologies, and strengthen local and national economies.

Critical to the definition of an incubator is the provision of management guidance, technical assistance and consulting tailored to young growing companies. Incubators usually also provide clients access to appropriate rental space and flexible leases, shared basic business services and equipment, technology support services and assistance in obtaining the financing necessary for company growth.

Incubators vary in the way they deliver their services, in their organizational structure and in the types of clients they serve. Highly adaptable, incubators have differing goals, including diversifying rural economies, providing employment for and increasing wealth of depressed inner cities, and transferring technology from universities and major corporations. Incubator clients are at the forefront of developing new and innovative technologies – creating products and services that improve the quality of our lives in communities around the world.

The earliest incubation programs focused on a variety of technology companies or on a combination of light industrial, technology and service firms – today referred to as mixed-use incubators. However, in more recent years, new incubators have emerged targeting

industries such as food processing, medical technologies, space and ceramics technologies, arts and crafts, and software development. Incubator sponsors have also targeted programs to support microenterprise creation, the needs of women and minorities, environmental endeavors and telecommunications.

10.3.4 Administrative and Business Center (Option 3)

Third proposal is to build up administrative center for industrial zone. In this part of the city lot of companies and production facilities are placed. But, there is missing administrative center which will have offices for rent. Here might be attracted offices of some banks, post office, offices for accounting and law consultancy services. With this whole industrial area will become more attractive for new investments.

10.3.5 Extension of Residential Area (Option 4)

Due to shrinking the industrial zone and developing residential areas in the city of Skopje another possible solution is to develop inhabited area. The surrounding of the Ohis factory is mostly consisted of residential area. This alternative has to be checked with the urban plans of the city of Skopje and detailed plans of the municipality of Kisela Voda in which the company is situiated.

10.4 Evaluation of Options

All of these five 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 35_Ranking different opportunities (+ and -)

Indicator	Option 0 No Activities	Option 1 Free Trade Zone	Option 2 Business Incubator	Option 3 Administrative Center	Option 4 Residential area
Development of the region	-	+	+	+	+
Wider development impact	-	+	+	-	-
Direct Revenue Generator	-	+	-	+	-
Low start up-costs	-	+	-	-	+
Return of Investment	-	+	+	+	-
Social impact	-	+	+	+	+
Technological impact	-	-	+	-	-
Competitive advantage	-	+	+	-	-
Capacity to organize		+	-	+	+
Sustainability	-	+	+	+	+
TOTAL	**-**	**9**	**7**	**6**	**5**
Ranking	**5**	**1**	**2**	**3**	**4**

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 36_Ranking different opportunities (from 0 to 5)

Indicator	Option 0 No Activities	Option 1 Free Trade Zone	Option 2 Business Incubator	Option 3 Administrative Center	Option 4 Residential area
Development of the region	0	3	2	5	1
Wider development impact	0	4	5	3	1
Direct Revenue Generator	0	3	4	5	2
Low start up-costs	0	5	4	3	3
Return of Investment	0	4	2	5	2
Social impact	0	5	4	2	5
Technological impact	0	4	4	2	0
Competitive advantage	0	4	5	3	0
Capacity to organize	0	5	2	5	5
Sustainability	0	3	4	5	5
TOTAL	**0**	**40**	**36**	**38**	**24**
Ranking	**5**	**1**	**3**	**2**	**4**

10.4.1 Conclusion of previous ranking:

The most economic feasible option according to positive influence to different indicators is Free Trade Zone. This option will lead not just to the development of the region, but it will have wider positive impact to the whole economy, which is very important. Positive experience in this zone will attract many other investors in our country.

Very often industries that are in the FTZ are labor intensive. This will produce a lot of new employments and social effect from this opportunity is huge. Low start-up costs come from the possibility to give the land for concession (according to the Law for FTZ) without any facility build there.

What is very interesting for this option actually is the return of investment and revenues that will generate FTZ. There are few sources of revenue that will increase different governmental (central and local) budgets. As a first source of revenue is the percentage (0.3%) from the invoiced amount that investor should paid. Beside the small percentage total amount is considerable (pls see 10.5.3.2).

With the employment openings the following positive impact will be made:

- Employees will spend their money within the country (payment of bills, home supplies, free time activities)
- personnel tax – as a income for the municipal budget
- payment for health insurance (income for the health fund – Ministry of Health)
- payment for the retirement and social insurance – income for the Social and Pension Fund
- payment for the unemployment fund – Social Fund

All these positive effects cannot be sow immediately but their effects and the benefits from this are on a long run.

10.5 Free Trade Zone (FTZ)

10.5.1 Description and evaluation

In the table bellow are all positive and negative aspects are mentinoned using remediate land as a free trade zone. This opportunity, as all others have its positive and negative sides. The most important for the government is to be aware of all of them in order to make a good decision and try to manage all not so positive aspects of choosing certain opportunity. Another important question is whether the selected opportunity is leading to achieving long term national goals.

Table 37_SWOT of Free Trade Zone

Strengths +	Weaknesses -
✓ Low start up costs ✓ To offer only land and infrastructure ✓ To offer land, facility ✓ Support of the industrial area ✓ Incentive for new FTZ ✓ Possibility to extend the FTZ area ✓ Close to the main road ✓ Close to rail way connection ✓ Close to the international airport ✓ Close to the administrative center ✓ Landuse question and property issue solved	❖ Limited area ❖ Missuse of low income situation and gaps in working safety ❖ Technological development ❖ Close to residential area (public sensitivity)
Opportunities +	**Threats -**
✓ Attracting foreign investments in a FTZ in Macedonia ✓ Development of the industry in Macedonia ✓ Increasing of the employment ✓ Increasing of the incomes in the	❖ Political influence ❖ Old regulations and manipualtive legal system ❖ Sustainability of Investment ❖ Money laundaring opportunities

governmental budget through personal and income tax ✓ Deelopment of cross economic approaches ✓ Clear statues of environmental liability	❖ Politicial misuse ❖ Corruption opportunities

10.5.2 Legal Base of Free Trade Zoning in former Yugoslav Republic of Macedonia

The Law on free economic zones (Off. Gazette no. 56/1999), regulates the conditions and the manner of founding, operating and termination of Free Economic Zones. This law includes founding conditions; spatial conditions for founding of Free Zone; the designated authority for carrying out the activities related to the development, founding and surveillance of the operating of the Free Zones (Head Office); separation and arranging of the Free Zone; founder of a Free Zone; contract on founding of Free Zone; application on founding of Free Zone; approval on founding of Free Zone; changes of the Free Zone; fulfillment of customs supervision requirements; content of decision; amendments of the decision; starting period; Free Zone operating report; Free Zone user; Free Zone utilization conditions; conditions and procedure on tax benefits; tax benefits; Free Zone movements and activities; consent on storage; import and export of goods from the Free Zone; temporary exit of goods from the Free Zone; standards, technical and quality norms and prices; applying of regulations, agreements and employment relations; customs supervision and control; declaring of goods and customs duties; inspection of goods; customs goods used as equipment in the Free Zone; keeping of evidence; termination of the operating of the Free Zone and the Free Zone user; as well as penalty provisions.

10.5.3 Example from former countries in transition - Free Trade zone in Osijek, Croatia

A Zone[26] is a part of the territory of the Republic of Croatia, enclosed and marked, in which the economic activities are carried out according to some specific conditions.

Free Zone and Free Warehouse are parts of customs area and spaces in customs area separated from the rest of customs area where

a) foreign goods are not considered being in customs area of the Republic of Croatia for the purpose of charging for import custom duty and appliance of import trade measures, with the condition that the goods are not in free turnover or they are not under any other customs procedure or use, i.e. they are not used in any other way other than the conditions stated in customs regulations,

b) domestic goods for export, under special regulations according to the position in the free zone or warehouse, are under regulations for export of such goods.

A User who builds or participates in the construction of infrastructure facilities in a Zone in the amount higher than 1.000.000 kunas (equal to 135.130 Euro[27]) shall be exempted from paying the profit tax in the first five years of operating in a Zone.

Other users in a Zone shall pay profit tax amounting to 50% of the regulated rate.

[26] source: www.szo.hr

[27] Currency rate: 1 Euro = 7,4 Croatian Kuna

10.5.3.1 Benchmarking

In order to evaluate once again the proposal for Free Trade Zone very useful will be review of the same figures from our country and Croatia i.e. from Skopje and Osijek.

Table 38_Comparisons of the potential for Free trade zone

	Skopje	Osijek
No of inhabitants	250.000	80.000
International Airport	+	-
Railway station	+	+
Profit Tax	0,3% from invoiced	50% from official tax rate
Tax free		Investment above 135.130 Euro
Landowner	Government	Government
Regulation	Law from Y2000, last review in Y2002	Law from 1998, last review in Y2001

10.5.3.2 Case Study "Benetton"

One of the factories that are in the Free Trade Zone in Osijek is Benetton. This factory is situated there since year 2000 has 200 employees with the annual turnover from 120 million Euros (in year 2002).

The figures which are interesting for all potential investors in the remediation of Ohis hot spot and later to turn it in to area which will generate incomes are the follow

The following table presents calculation of the cross sector benefits from new employments. Numbers are calculated for 200 employees with the average net salary of 300 Euro.

Table 39_Cross sector benefits

Parameter	MKD	€
Monthly income for the municipality (personel tax)	454.000	7.382
Health Fund	591.000	9.610
Pension Fund	1.292.000	21.008
Unemployment Fund	97.600	1.587
Water Fund (new from July 2007)	12.000	195
Revenue per month	**2.446.600**	**39.782**
Revenue per Year	**29.359.200**	**477.385**

Table 40_Estimate if Benetton production plant will be situated in Macedonia

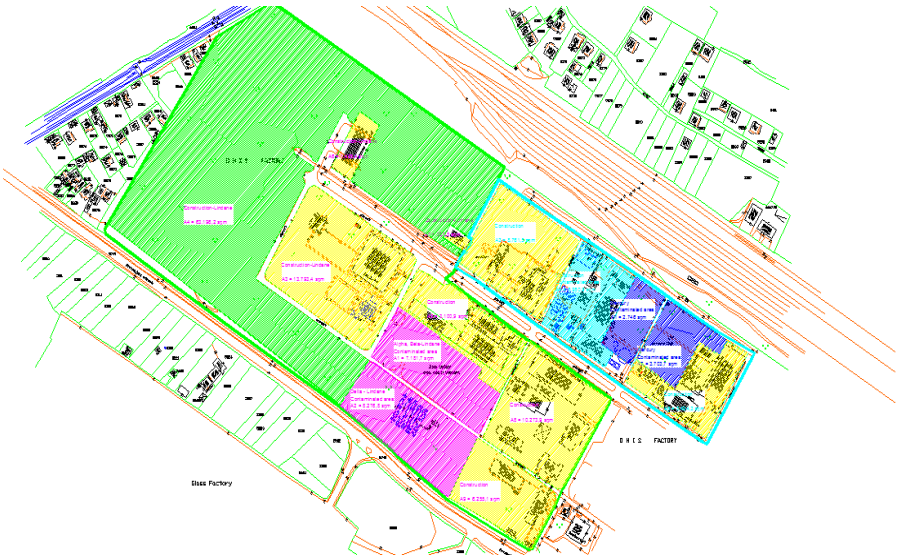
Indicators	Present situation in Benetton (FTZ Osijek)	Possible annual revenue for Macedonia (FTZ Ohis)
Number of Employees	200	200
Cross payments to governmental tax system		477.500 Euro per year in different funds
Invoiced amount	120.000.000 Euro	360.000 Euro per year

Additional shall be taken the income due to CDM activities and CO2 equ. Emission trading into consideration. Ohis can be a training model, while the income due to tradings, will not be that significant that the following results will significant be impacted. It is highly recommended to use Ohis as "training facility" for CDM mechanism and CO2 trading purposes.

10.6 Investments required for the set up of the "FTZ – Biljana"

The following map present the "Biljana" part from whole Ohis plant.

Figure 25_Biljana Area



Description of the map:

Green Area – unused field

Yellow Area – Construction

Pink Area – Contaminated area - Dumparea of HCH Isomers

Light Blue – Contaminated area - Electrolyses Plant

Dark Blue – Contaminated Construction - Electrolyses Plant

Table 41_landuse and potentials of landuse on Lindane and Electrolyses sites

Lindane Plant			Electrolyses Plant - Mercury		
Area	**sqm**	**Status**	**Area**	**sqm**	**Status**
A1	7.181,70	contaminated	A1	2.746,00	contaminated
A2	8276,8	contaminated	A2	3.703,70	contaminated
A3	13793,4	construction	A3	8761,50	construction
A4	63.196,15	unuesed field	A4	5950,90	construction contaminated
A5	3.100,90	construction	A5	5.424,30	construction
A6	1.495,40	construction	SUM	26.586,40	
A7	388,50	construction			
A8	10.273,90	construction			
A9	6.255,10	construction			
SUM	113.961,85				
SUM tot	**128.843,50**		**Sum tot**	**30.363,20**	
Streets	14.881,65		Streets	3.776,80	

At the moment we are talking about future use of two hot spots in Ohis: Lindan and Electrolyses Plant which are at the one part of the whole factory. Position of these two spots and the surroundings are presented at the enclosed map. Linden hot spot is approx 15.000 sqm and Electrolysis hot spot (contaminated plant and contaminated area) is approx 12.500sqm.

Next to this two spots there are other areas which can be put into service to the FTZ. There are old buildings which cannot be used or even reconstructed and huge green area toward the residential area.

These mean that for the ZFT can be used 160.000 sqm - out of which 19.000 sqm are streets - or 141.000 sqm.

Old buildings which are placed in this area are ruined they do not have any real market value. If they have accounting value this should be correct accordingly. Depreciation period of the buildings is from 30 to 50 years depending from the owner decision. In Ohis case buildings dated from 1964 and if the depreciation period for them was 30 years they are already written off. If this is not a case than after 7 years they can be completely depreciated from the evidence.

Calculations of the remediation alternatives are compared with the economic sollution for two hot spots in Ohis: Lindane and Mercury.

10.7 Financial Evaluation of remaiming remediation alternatives

10.7.1 Financial Evaluation of HCH Isomer 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 30.000 Mg is base for calculation due to the fact, that slightlty polluted soil after the halftime period of 300 days decomposed is and values below the required MPC show. Transportation has been calculated once with trucks (1,30 Euro/km) 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 have been handles like fix costs due to the fact, that independent from the chosen alternative, those costs will be raised.

In the case of thermo treatment in the closed by cement kiln, an investment of 500.000 Euro can be expected for the installation of a clorine trap. In the case of remaining material on site (capping) the amount of monitoring units and monitoring costs are increased. 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.

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 economical evaluated.

Table 42_Investment and cost structure of remaining treatment options

		Ex Situ			Other		Other	
	Units	Excavation and Based Catalyzed Decomposition	Excavation and thermal treatment – Extern	Excavation and thermal treatment – Cement Kiln	Capping	Excavation and off site disposal - Lojane	Factor	Unit Prices [Euro/Unit]
Ranking		2	4	3	5	1		
Amount	Mg	30.000	30.000	30.000	30.000	30.000	1	
Excavation	Mg	30.000	30.000	30.000	0	30.000	25	35
Transport	km	60	970	2	0	60		1,3
Truckloads	pcs	2.000	2.000	2.000	0	2.000	15	
Wagon Loads train	pcs	750	750	750	0	750	40	250
Treatment Surface	sqm	9.500	8.100	8.100	9.500	8.100		1,0
Capping material (0,5m)	m³	0	0	0	4.750	4.050	3,5	
Topsoil material (0,5m)	m³	0	0	0	4.750	4.050	4	
Transport Material	m³	0	0	0	9.500	8.100	10	1,3
Truckloads	m³				633	540	15	
specific treatment costs	Euro/Mg	140	280	60		30		
Depreciation Period	years			7				
Piecometers	pcs	6	4	4	6	4	15	35
Monitoring	amout	18	18	18	18	18		1700
Investment	Euro	0	0	500.000	0	0		
Depreciation	Euro/year			71.429				
Excavation costs	Euro	42.000	42.000	42.000	0	42.000		
Transport costs truck	Euro	156.000	2.522.000	5.200	0	156.000		
Transport costs train	Euro	187.500	187.500	187.500	0	187.500		
Treatment costs	Euro	4.200.000	8.400.000	1.800.000	0	900.000		
Capping material costs	Euro	0	0	0	35.625	30.375		
Material Transport costs	Euro	0	0	0	8.233	7.020		
Profiling and compacting	Euro	0	0	0	19.000	16.200		
Other Costs								
Public Awareness	Euro	10.000	10.000	10.000	10.000	10.000		
Drilling of Piecometers	Euro	3.150	2.100	2.100	3.150	2.100		
Monitoring	Euro	30.600	30.600	30.600	30.600	30.600		
Investment	Euro	0	0	500.000	0	0		
Total Operational Costs	Euro	4.441.750	8.672.200	2.389.900	106.608	1.194.295		
Supervision	Euro	133.253	260.166	71.697	3.198	35.829	3%	
Capitalisation of Invest	Euro	0	0	74.441	0	0	2%	
Total Costs	Euro	**4.575.003**	**8.932.366**	**2.536.038**	**109.807**	**1.230.124**		
specific costs	Euro/Mg	**153**	**298**	**85**	**4**	**41**		

10.7.2 Financial Evaluation of HCH Isomer 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 30.000 Mg is base for calculation due to the fact, that slightlty polluted soil after the halftime period of 300 days decomposed is and values below the required MPC show. Transportation has been calculated once with trucks (1,30 Euro/km) 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 have been handles like fix costs due to the fact, that independent from the chosen alternative, those costs will be raised.

In the case of thermo treatment in the closed by cement kiln, an investment of 500.000 Euro can be expected for the installation of a clorine trap. In the case of remaining material on site (capping) the amount of monitoring units and monitoring costs are increased. 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.

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.

Table 43_Investment and cost structure of remaining treatment options

		On Site		Ex Situ	Other			
	Unit	Thermal Desorption System	Excavation and mechanical treatment	Thermal Desorption system	Capping	tion and off site disposal	Factor	Unit Prices [Euro/Unit]
Ranking		4	1	3	5	1		
Amount	Mg	400	400	400	400	400	1	
Amount to be treated	Mg	30.960	30.960	30.960	30.960	30.960	5	
Excavation	Mg	0	30.960	30.960	6.192	30.960	25	35
Transport	km	0	0	6	60	60		1,3
Truckloads	pcs	0	0	2.064	413	2.064	15	
Waggon Loads train	pcs	0	0	774	155	774	40	250
Treatment Surface	sqm	6.192	6.192	6.192	6.192	6.192		1,0
Infill material	m³	0	30.960	30.960	0	24.768		
Capping material (0,5m)	m³	0	0	0	3.096	3.096	3,5	
Topsoil material (0,5m)	m³	0	0	0	3.096	3.096	4	
Transport Material	m³	0	30.960	30.960	6.192	30.960	10	1,3
Truckloads	m³	0	0	2.064	413	2.064	15	
specific treatment costs	Euro/Mg	180	100	120	30	30		
Depreciation Period	years	7	7	7	7	7		
Piecometers	pcs	3	3	3	3	3	15	35
Monitoring	amout	18	18	18	18	18		1700
Investment	Euro	0	0	0	0	0		
Depreciation	Euro/year			0				

Excavation costs	**Euro**	0	43.344	43.344	8.669	43.344		
Transport costs truck	**Euro**	0	0	16.099	32.214	160.992		
Transport costs train	**Euro**	0	0	193.500	38.700	193.500		
Treatment costs	**Euro**	5.572.800	3.096.000	3.715.200	185.760	928.800		
Capping material costs	**Euro**	0	0	0	23.220	23.220		
Material Transport costs	**Euro**	0	0	26.832	5.366	26.832		
Profiling and compacting	**Euro**	0	0	0	12.384	12.384		
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**	0	0	0	0	0		
Total Operational Costs	**Euro**	5.614.975	3.181.519	3.843.650	309.788	1.237.747		
Supervision	**Euro**	168.449	95.446	115.310	9.294	37.132	**3%**	
Capitalisation of Invest	**Euro**	0	0	0	0	0	**2%**	
Crash Costs	**Euro**	300.000	300.000	300.000	300.000	300.000		
Total Costs	**Euro**	**6.083.424**	**3.576.965**	**4.258.960**	**619.082**	**1.574.879**		
specific costs	**Euro/Mg**	**187**	**106**	**128**	**10**	**41**		

10.8 Economical Comparison of HCH Isomer Remediation

Table 44_Economical Comparison HCH Isomer Remediation

Economical Comparison HCH Isomer Lindane	**Units**	**Excavation and Based Catalyzed Decomposition**	**Excavation and thermal treatment – Extern**	**Excavation and thermal treatment – Cement Kiln**	**Capping**	**Excavation and off site disposal - Lojane**
area economical suitable	**(1/0)**	1	1	1	0	1
value added	**(1/0)**	1	1	1	0	1
direct revenue FTZ	**Euro**	360.000	360.000	360.000	-360.000	360.000
cross payments to tax system FTZ	**Euro**	477.500	477.500	477.500	-477.500	477.500
additional sum in money turnover FTZ	**Euro**	720.000	720.000	720.000	-720.000	720.000
return of investment FTZ	**Euro**					
calculated only with direct revenue	**Years**	**12,71**	**24,81**	**7,04**	**0,00**	**3,42**
direct revenue + cross payments	**Years**	**5,46**	**10,67**	**3,03**	**0,00**	**1,47**
ranking		**3**	**4**	**2**		**1**

From the previous ranking as the most suitable remediation solution for HCH isomer hot spot is the Excavation and off site disposal in Lojane. After this treatment the land will be

suitable for any future economic activity. Due to this, the value of the land will go up and it will be according to the market land value in this area.

If the remediated area will be used as a Free Trade Zone and only one factory will be situated in this place – based on the calculation from FTZ Osijek – Benetton Case 10.5.3, the return of the investment will be done in 3,5 years. This is tremendously timing for the return of investment.

The difference in timing for the ROI between this solution and the second one is 3,5 years.

Table 45_Economical Comparison of Mercury remediation

Economical Comparison Mercury	**Units**	**Thermal Desorption System**	**Excavation and mechanical treatment**	**Thermal Desorption system**	**Capping**	**Excavation and off site disposal**
area economical suitable	**(1/0)**	1	1	1	0	1
value added	**(1/0)**	1	1	1	0	1
direct revenue	**Euro**	360.000	360.000	360.000	-360.000	360.000
cross payments to tax system	**Euro**	477.500	477.500	477.500	-477.500	477.500
additional sum in money turnover	**Euro**	720.000	720.000	720.000	-720.000	720.000
return of investment	**Euro**					
calculated only with direct revenue	**Years**	**16,90**	**9,94**	**11,83**	**0,00**	**4,37**
direct revenue + cross payments	**Years**	**7,26**	**4,27**	**5,09**	**0,00**	**1,88**
Ranking		**4**	**2**	**3**	**5**	**1**

From the previous ranking as the most suitable remediation solution for Mercury hot spot is the Excavation and off site disposal in Lojane. As in the Lindane case again we will have land suitable for any future economic activity and of course increased value of the land.

Due to C02 emission trading can the ROI been shortened, but in the case of Ohis not that significant (within decimal).

Table 46_Worst Case Scenario

	Mercury	Lindane
	Excavation and off site disposal	**Excavation and off site disposal - Lojane**
Total Costs / per spot	**1.274.879**	**1.230.124**
Grand Total	**2.505.003**	
direct revenue	360.000	
cross payments to tax system	477.500	
additional sum in money turnover	720.000	
return of investment [in years]		
calculated only with direct revenue	7,79	
direct revenue + cross payments	**3,35**	

The ROI is for the mercury contamination activities a little higher (due to a crash costs) than for the Lindane Case and it is 4,37 years. It has to be stated, that the difference in years of the return of the investment from the first ranked to the second ranked remediation possibility is 5,57 years.

The worst case scenario is to remediate two hot spots and to have only one factory in FTZ in this huge area. In this case the both investments will be returned in 8 years, calculated only according to the direct revenue 3% from invoiced amount.

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

Work Plan

Activities:	2007 (8 9 10 11 12)	2008 (1 2 3 4 5 6 7 8 9 10 11 12)	2009 (1 2 3 4 5 6 7 8 9 10 11 12)	2010 (1 2 3 4 5 6 7 8 9)	TASK ASSIGNMENT Local Team Members TL	INSTE	TECHN	CONTR
Project Inception					●	❍	❍	
0.1 Mobilisation of the Project Team and Establishment of Project Offices						❍	❍	
0.2 Development of Detailed Project Specific Quality Assurance Plan and Control System					●	❍	❍	
0.4 Review of Existing Legal and Institutional Situation					●	❍	❍	
0.5 Assessment of Needs					●	❍	❍	
0.8 Preparation of Inception Report					●	❍	❍	
09 Steering Committee Meeting					●	❍	❍	
Submission of Inception Report: End of August					●	❍	❍	
Drafting of Legislation					●			
A1.1 Review of existing documents					●		❍	
A.1.1.1 Drafting amandments for the Law on Environment					●		❍	
A1.1.2 Drafting amandments for the Law onWaste Management					●		❍	
A1.1.3 Drafting amandments for the Law on Hazardous waste					●		❍	
A1.2 Draft a Law on soil protection					●		❍	
A1.2.1 Draft a rulbook on remediation of "hotspots"					●	❍	❍	
A1.2.2 Draft a Law on establishment of an eco trust fund					●	❍	❍	
A1.2.3 Draft Rulebook on monitoring and reporting					●	❍	❍	
Reports								
Inception Repor					●	❍	❍	
Quarterly Progress Report					●		❍	
Final Report					●	❍	❍	
Task Report					●	❍	❍	

LEGEND:
● Task Responsible
❍ Main Contribution
Full-time Activity
Period of Activity
Milestone
Report

TL: Team Leader
INSTE: Institutional Expert
ATL: Assistant Team Leader
TECHN: Local TechnicalExpert

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 OHIS.

It is expected that Mentor will help OHIS, 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 Kisela Voda 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 OHIS, 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	grajanskiekoloskiforum@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.

11.4 SAMPLES AND RESULTS

11.4.1 Ohis – Electrolyses Plant

11.4.1.1 Mercury (elementary) in soil and groundwater

The Chemical analyses have been performed in RIHP on the 12th July 2007

11.4.1.1.1 Soil

Parameter	Point 1	Point 2	Point 3	Point 4	MLP
Hg (element)	110 mg/kg	7,64 mg/kg	2 mg/kg	<1 mg/kg	

Sampling Points [see attached map]

Point 1 - Electrolysis plant (30 cm)

Point 2 - Piezometers (30 cm)

Point 3 - near railway (30 cm) onto Dracevo direction

Point 4 - after railway (30 cm)

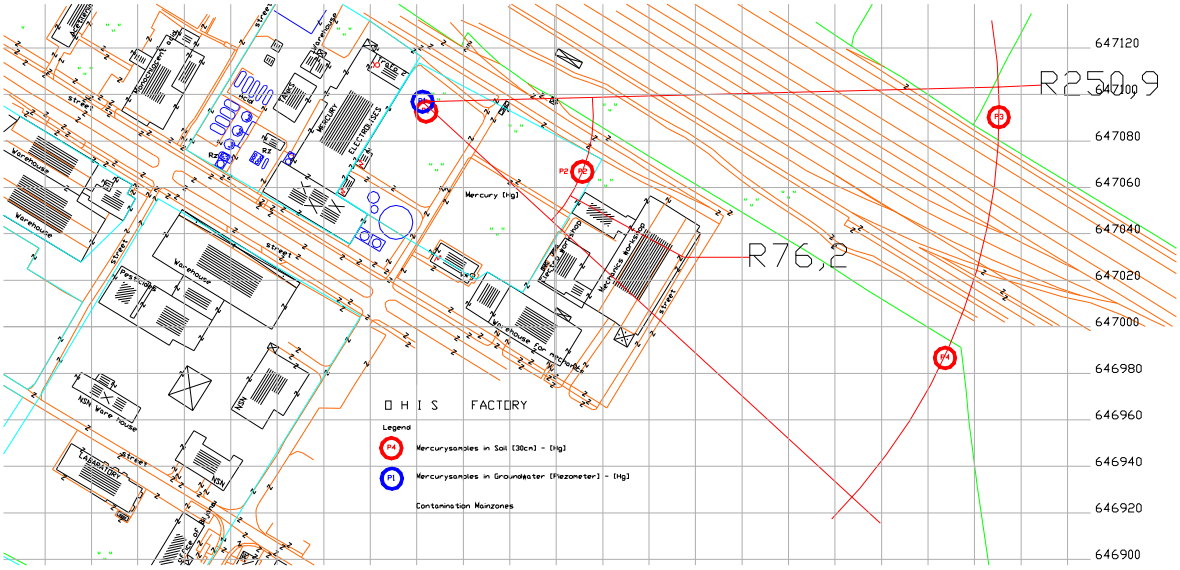
11.4.1.1.2 Groundwater

Parameter	Point I	Point II	Point III	Point IV	MLP
Hg (elementary)	0,015				

Sampling Points [see attached map 11.4.2]

Point I - Groundwater from Piezometer

11.4.2 Map Ohis – Sampling Points



11.5 Geoelectrical Profiles – Ohis Site

11.5.1 Profile I

Region: Skopje

Location: Factory Ohis "Biljana"

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: 150°

Date: 01.07.2007

Operator: Novica Stolic

Profile I:		AM=MN=NB=a=10 m					a=10m; AB/2=15 m					Control measurements			
Points	Y	X	Z	L	Elektrodes		a	K	dV	I	Ra	dV	I	R	Note
No.	(m)	(m)	(m)	(m)	AB	MN	(m)		(mV)	(mA)	(Ωm)	(mV)	(mA)	(Ωm)	
I/2-3	539772,86	647076,55	-15,00	15,00	1-4	2-3	10	62,83	175,00	315,00	34,91				
I/3-4	539781,37	647071,30	-15,00	25,00	2-5	3-4	10	62,83	20,00	64,00	19,64				
I/4-5	539794,13	647066,05	-15,00	35,00	3-6	4-5	10	62,83	22,00	81,00	17,07	23,00	84,00	17,20	
I/5-6	539802,64	647060,79	-15,00	45,00	4-7	5-6	10	62,83	35,00	103,00	21,35				
I/6-7	539806,90	647055,54	-15,00	55,00	5-8	6-7	10	62,83	39,00	140,00	17,50				
I/7-8	539815,41	647050,29	-15,00	65,00	6-9	7-8	10	62,83	29,00	100,00	18,22	28,00	102,00	17,25	
I/8-9	539823,92	647045,03	-15,00	75,00	7-10	8-9	10	62,83	45,00	124,00	22,80				
I/9-10	539832,42	647039,78	-15,00	85,00	8-11	9-10	10	62,83	69,00	176,00	24,63				
I/10-11	539840,61	647034,33	-15,00	95,00	9-12	10-11	10	62,83	92,00	228,00	25,35	92,50	225,00	25,83	
I/11-12	539848,21	647028,41	-15,00	105,00	10-13	11-12	10	62,83	120,00	430,00	17,53				
I/12-13	539854,05	647021,20	-15,00	115,00	11-14	12-13	10	62,83	62,00	215,00	18,12				
I/13-14	539858,51	647012,40	-15,00	125,00	12-15	13-14	10	62,83	66,00	142,00	29,20	65,00	140,00	29,17	
I/14-15	539866,24	647005,00	-15,00	135,00	13-16	14-15	10	62,83	63,00	385,00	10,28				
I/15-16	539876,04	647000,10	-15,00	145,00	14-17	15-16	10	62,83	110,00	370,00	18,68				
I/16-17	539884,69	646995,37	-15,00	155,00	15-18	16-17	10	62,83	100,00	410,00	15,32				
I/17-18	539893,53	646990,61	-15,00	165,00	16-19	17-18	10	62,83	87,00	148,00	36,94	85,00	150,00	35,60	
I/18-19	539902,38	646985,87	-15,00	175,00	17-20	18-19	10	62,83	115,00	182,00	39,70				

Profile I:		AM=MN=NB=a=20 m					a=20m; AB/2=30 m					Control measurements			
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)	(Ωm)	(mV)	(mA)	(Ωm)	
I/4	539785,63	647068,67	-30,00	30,00	1-7	3-5	20	125,66	51,00	180,00	35,60				
I/5	539802,64	647063,42	-30,00	40,00	2-8	4-6	20	125,66	130,00	635,00	25,73				
I/6	539802,64	647058,17	-30,00	50,00	3-9	5-7	20	125,66	110,00	393,00	35,17				
I/7	539811,15	647052,91	-30,00	60,00	4-10	6-8	20	125,66	106,00	520,00	25,62				
I/8	539819,66	647047,66	-30,00	70,00	5-11	7-9	20	125,66	170,00	740,00	28,87	175,00	740,00	29,72	
I/9	539828,17	647042,41	-30,00	80,00	6-12	8-10	20	125,66	50,00	385,00	16,32				
I/10	539836,68	647037,15	-30,00	90,00	7-13	9-11	20	125,66	55,00	320,00	21,60				
I/11	539844,54	647031,51	-30,00	100,00	8-14	10-12	20	125,66	100,00	610,00	20,60				
I/12	539851,88	647025,32	-30,00	110,00	9-15	11-13	20	125,66	63,00	402,00	19,69	60,00	420,00	17,95	
I/13	539856,23	647017,08	-30,00	120,00	10-16	12-14	20	125,66	255,00	890,00	36,00				
I/14	539860,79	647007,73	-30,00	130,00	11-17	13-15	20	125,66	146,00	660,00	27,80				
I/15	539871,69	647002,27	-30,00	140,00	12-18	14-16	20	125,66	100,00	1350,00	9,31				
I/16	539880,39	646997,93	-30,00	150,00	13-19	15-17	20	125,66	25,00	418,00	7,52	35,00	550,00	8,00	
I/17	539888,98	646992,81	-30,00	160,00	14-20	16-18	20	125,66	102,00	485,00	26,43				

Profile I:		AM=MN=NB=a=30 m					a=30m; AB/2=45 m					Control measurements			
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)	(Ωm)	(mV)	(mA)	(Ωm)	
I/5-6	539802,64	647060,79	-45,00	45,00	1-10	4-7	30	188,50	80,00	430,00	35,07	75,00	425,00	33,26	
I/6-7	539806,90	647055,54	-45,00	55,00	2-11	5-8	30	188,50	34,00	470,00	13,64				
I/7-8	539815,41	647050,29	-45,00	65,00	3-12	6-9	30	188,50	74,50	400,00	35,11				
I/8-9	539823,92	647045,03	-45,00	75,00	4-13	7-10	30	188,50	101,00	598,00	31,84				
I/9-10	539832,42	647039,78	-45,00	85,00	5-14	8-11	30	188,50	75,00	600,00	23,56				
I/10-11	539840,61	647034,33	-45,00	95,00	6-15	9-12	30	188,50	30,00	450,00	12,57	35,00	450,00	14,66	
I/11-12	539848,21	647028,41	-45,00	105,00	7-16	10-13	30	188,50	86,00	470,00	34,49				
I/12-13	539854,05	647021,20	-45,00	115,00	8-17	11-14	30	188,50	190,00	830,00	43,15				
I/13-14	539858,51	647012,40	-45,00	125,00	9-18	12-15	30	188,50	71,00	335,00	39,95				
I/14-15	539866,24	647005,00	-45,00	135,00	10-19	13-16	30	188,50	21,00	100,00	39,58				
I/15-16	539876,04	647000,10	-45,00	145,00	11-20	14-17	30	188,50	23,00	502,00	8,64	23,00	490,00	8,85	

11.5.2 Profile II

Region: ***Skopje***

Location: ***Factory Ohis "Biljana"***

Method: ***Geoelectrical mapping - resistivity***

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

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

Azimuth: ***150°***

Date: ***02.07.2007***

Operator: ***Novica Stolic***

Profile II:		**AM=MN=NB=a=10 m**					**a=10m; AB/2=15 m**				**Control measurements**			
Points	**Y**	**X**	**Z**	**L**	**Elektrodes**		**K**	**dV**	**I**	**Ra**	**dV**	**I**	**R**	**Note**
No.	**UTM (m)**	**UTM (m)**	**(m)**	**(m)**	**AB**	**MN**		**(mV)**	**(mA)**	**(omm)**	**(mV)**	**(mA)**	**(omm)**	
34,15	539805,99	647127,75	-15,00	15,00	1-4	2-3	62,83	25,00	46,00					
51,50	539814,49	647122,49	-15,00	25,00	2-5	3-4	62,83	10,00	12,20					
58,71	539823,05	647117,31	-15,00	35,00	3-6	4-5	62,83	18,50	19,80					
91,21	539831,56	647112,07	-15,00	45,00	4-7	5-6	62,83	45,00	31,00		45,00	31,50	89,76	
93,40	539840,07	647106,82	-15,00	55,00	5-8	6-7	62,83	22,00	14,80					
90,02	539848,69	647101,75	-15,00	65,00	6-9	7-8	62,83	49,00	34,20					
116,20	539857,29	647096,63	-15,00	75,00	7-10	8-9	62,83	81,00	43,80					
74,52	539865,80	647091,39	-15,00	85,00	8-11	9-10	62,83	25,50	21,50					
71,18	539874,30	647086,12	-15,00	95,00	9-12	10-11	62,83	81,00	71,50					
45,77	539882,78	647080,82	-15,00	105,00	10-13	11-12	62,83	59,00	81,00		60,00	82,00	45,97	
44,35	539891,27	647075,54	-15,00	115,00	11-14	12-13	62,83	24,00	34,00					
13,86	539899,83	647070,37	-15,00	125,00	12-15	13-14	62,83	22,50	102,00					Na T-14 elektroda e mnogu vla`na (vodena), verovatno od ispukan vodovoden kanal (cevka) koj pominuva pokraj T-13 kade e kocka.
17,90	539908,41	647065,22	-15,00	135,00	13-16	14-15	62,83	47,00	165,00					
11,98	539916,93	647060,00	-15,00	145,00	14-17	15-16	62,83	37,00	194,00					
18,50	539925,43	647054,72	-15,00	155,00	15-18	16-17	62,83	24,00	81,50					
29,45	539933,96	647049,50	-15,00	165,00	16-19	17-18	62,83	225,00	480,00		220,00	475,00	29,10	
34,80	539942,41	647044,15	-15,00	175,00	17-20	18-19	62,83	108,00	195,00					
37,08	539950,94	647038,93	-15,00	185,00	18-21	19-20	62,83	29,80	50,50					
36,73	539959,55	647033,84	-15,00	195,00	19-22	20-21	62,83	76,00	130,00					
23,27	539968,08	647028,62	-15,00	205,00	20-23	21-22	62,83	70,00	189,00					
14,79	539976,54	647023,30	-15,00	215,00	21-24	22-23	62,83	23,30	99,00		24,50	102,00	15,09	T-24 e na pat (kocka), a

														pome|u T-23 i2 4 pominuva vodovoden kanal
II/23-24	539985,10	647018,11	-15,00	225,00	22-25	23-24	62,83	40,00	135,00	18,62				
II/24-25	539993,63	647012,90	-15,00	235,00	23-26	24-25	62,83	66,00	270,00	15,36				
II/25-26	540002,10	647007,58	-15,00	245,00	24-27	25-26	62,83	128,00	498,00	16,15				
II/26-27	540010,67	647002,43	-15,00	255,00	25-28	26-27	62,83	69,00	181,00	23,95				
II/27-28	540019,20	646997,22	-15,00	265,00	26-29	27-28	62,83	120,00	225,00	33,51				
II/28-29	540027,73	646992,00	-15,00	275,00	27-30	28-29	62,83	65,00	168,00	24,31				

Profile II:					**AM=MN=NB=a=20 m**						**Control measurements**			
Points	**Y**	**X**	**Z**	**L**	**Elektrodes**		**K**	**dV**	**I**	**Ra**	**dV**	**I**	**R**	**Note**
No.	**UTM (m)**	**UTM (m)**	**(m)**	**(m)**	**AB**	**MN**		**(mV)**	**(mA)**	**(omm)**	**(mV)**	**(mA)**	**(omm)**	
II/4	539818,75	647119,86	-30,00	30,00	1-7	3-5	125,66	58,00	130,00	56,07				
II/5	539827,35	647114,76	-30,00	40,00	2-8	4-6	125,66	70,00	115,00	76,49				
II/6	539835,78	647109,38	-30,00	50,00	3-9	5-7	125,66	41,00	70,00	73,60				
II/7	539844,37	647104,26	-30,00	60,00	4-10	6-8	125,66	53,00	92,50	72,00				
II/8	539853,02	647099,23	-30,00	70,00	5-11	7-9	125,66	56,50	92,50	76,76				
II/9	539861,56	647094,03	-30,00	80,00	6-12	8-10	125,66	60,00	92,00	81,95	65,00	90,00	90,76	
II/10	539870,05	647088,75	-30,00	90,00	7-13	9-11	125,66	45,50	94,00	60,83				
II/11	539878,56	647083,49	-30,00	100,00	8-14	10-12	125,66	31,00	96,00	40,58				
II/12	539887,00	647078,14	-30,00	110,00	9-15	11-13	125,66	43,00	163,00	33,15				
II/13	539895,54	647072,94	-30,00	120,00	10-16	12-14	125,66	56,00	230,00	30,60	56,00	232,00	30,33	
II/14	539904,12	647067,80	-30,00	130,00	11-17	13-15	125,66	32,00	155,50	25,86				
II/15	539912,69	647062,64	-30,00	140,00	12-18	14-16	125,66	8,10	81,00	12,57				
II/16	539921,17	647057,35	-30,00	150,00	13-19	15-17	125,66	20,60	116,50	22,22				
II/17	539929,68	647052,09	-30,00	160,00	14-20	16-18	125,66	33,00	152,00	27,28				
II/18	539938,24	647046,91	-30,00	170,00	15-21	17-19	125,66	28,00	166,00	21,20				
II/19	539946,58	647041,39	-30,00	180,00	16-22	18-20	125,66	23,00	180,00	16,06				
II/20	539955,29	647036,46	-30,00	190,00	17-23	19-21	125,66	18,00	135,00	16,76				
II/21	539963,80	647031,21	-30,00	200,00	18-24	20-22	125,66	12,50	85,50	18,37	13,00	460,00	3,55	
II/22	539972,36	647026,03	-30,00	210,00	19-25	21-23	125,66	26,00	148,00	22,08				
II/23	539980,73	647020,56	-30,00	220,00	20-26	22-24	125,66	40,00	210,00	23,94				
II/24	539989,46	647015,66	-30,00	230,00	21-27	23-25	125,66	26,00	170,00	19,22				
II/25	539997,80	647010,13	-30,00	240,00	22-28	24-26	125,66	12,00	130,00	11,60				
II/26	540006,39	647005,02	-30,00	250,00	23-29	25-27	125,66	31,00	170,00	22,92				
II/27	540014,94	646999,83	-30,00	260,00	24-30	26-28	125,66	50,00	207,00	30,35				

Profile II:		AM=MN=NB=a=30 m									Control measurements			
Points	Y	X	Z	L	Elektrodes		K	dV	I	Ra	dV	I	R	Note
No.	UTM (m)	UTM (m)	(m)	(m)	AB	MN		(mV)	(mA)	(omm)	(mV)	(mA)	(omm)	
II/5-6	539831,56	647112,07	-45,00	45,00	1-10	4-7	188,50	37,00	130,00	53,65				
II/6-7	539840,07	647106,82	-45,00	55,00	2-11	5-8	188,50	17,50	54,00	61,09				
II/7-8	539848,69	647101,75	-45,00	65,00	3-12	6-9	188,50	14,00	41,00	64,36	30,00	83,00	68,13	
II/8-9	539857,29	647096,63	-45,00	75,00	4-13	7-10	188,50	33,00	93,00	66,89				
II/9-10	539865,80	647091,39	-45,00	85,00	5-14	8-11	188,50	72,00	180,00	75,40				
II/10-11	539874,30	647086,12	-45,00	95,00	6-15	9-12	188,50	36,00	125,00	54,29				
II/11-12	539882,78	647080,82	-45,00	105,00	7-16	10-13	188,50	39,00	182,00	40,39				
II/12-13	539891,27	647075,54	-45,00	115,00	8-17	11-14	188,50	13,00	100,00	24,50	26,00	205,00	23,91	
II/13-14	539899,83	647070,37	-45,00	125,00	9-18	12-15	188,50	8,00	70,00	21,54				
II/14-15	539908,41	647065,22	-45,00	135,00	10-19	13-16	188,50	13,00	230,00	10,65				
II/15-16	539916,93	647060,00	-45,00	145,00	11-20	14-17	188,50	7,00	97,50	13,53				
II/16-17	539925,43	647054,72	-45,00	155,00	12-21	15-18	188,50	14,00	130,00	20,30				
II/17-18	539933,96	647049,50	-45,00	165,00	13-22	16-19	188,50	20,30	162,00	23,62	20,00	160,00	23,56	
II/18-19	539942,41	647044,15	-45,00	175,00	14-23	17-20	188,50	17,00	199,00	16,10				
II/19-20	539950,94	647038,93	-45,00	185,00	15-24	18-21	188,50	30,00	570,00	9,92				
II/20-21	539959,55	647033,84	-45,00	195,00	16-25	19-22	188,50	21,00	408,00	9,70				
II/21-22	539968,08	647028,62	-45,00	205,00	17-26	20-23	188,50	23,50	340,00	13,03				
II/22-23	539976,54	647023,30	-45,00	215,00	18-27	21-24	188,50	7,00	83,00	15,90	14,00	160,00	16,49	
II/23-24	539985,10	647018,11	-45,00	225,00	19-28	22-25	188,50	23,00	285,00	15,21				
II/24-25	539993,63	647012,90	-45,00	235,00	20-29	23-26	188,50	10,00	135,00	13,96				
II/25-26	540002,10	647007,58	-45,00	245,00	21-30	24-27	188,50	10,20	180,00	10,68				

11.5.3 Profile III

Region: ***Skopje***

Location: ***Factory Ohis "Biljana"***

Method: ***Geoelectrical mapping - resistivity***

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

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

Azimuth: ***150°***

Date: ***30.06.2007***

Operator: ***Novica Stolic***

Profile: III		AM=MN=NB=a=10 m						a=10m; AB/2=15 m				Control measurements			
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)	
III/2-3	539992,85	647059,35	-15,00	15,00	1-4	2-3	10	62,83	86,00	510,00	10,60	85,00	505,00	10,58	
III/3-4	540001,36	647054,08	-15,00	25,00	2-5	3-4	10	62,83	42,00	135,00	19,55				
III/4-5	540009,94	647048,94	-15,00	35,00	3-6	4-5	10	62,83	34,00	121,00	17,66				
III/5-6	540018,46	647043,71	-15,00	45,00	4-7	5-6	10	62,83	80,00	172,00	29,22	78,00	170,00	28,83	
III/6-7	540027,06	647038,61	-15,00	55,00	5-8	6-7	10	62,83	41,00	91,50	28,15				
III/7-8	540035,65	647033,48	-15,00	65,00	6-9	7-8	10	62,83	28,00	56,00	31,42				

Profile III:		AM=MN=NB=a=20 m						a=20m; AB/2=30 m				Control measurements			
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)	
III/4	540005,66	647051,54	-30,00	30,00	1-7	3-5	20	125,66	63,00	510,00	15,52	61,50	508,00	15,21	
III/5	540014,21	647046,35	-30,00	40,00	2-8	4-6	20	125,66	46,00	329,00	17,57				

Profile III:		AM=MN=NB=a=30 m						a=30m; AB/2=45 m				Control measurements			
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)	

11.5.4 Profile IV

Region: ***Skopje***

Location: ***Factory Ohis "Biljana"***

Method: ***Geoelectrical mapping - resistivity***

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

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

Azimuth: ***150°***

Date: ***30.06.2007***

Operator: ***Novica Stolic***

Profile: IV		**AM=MN=NB=a=10 m**						**a=10m; AB/2=15 m**				**Control measurements**			
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)**	
IV/2-3	539999,66	647084,18	-15,00	15,00	1-4	2-3	10	62,83	86,00	780,00	6,93				
IV/3-4	540008,17	647078,93	-15,00	25,00	2-5	3-4	10	62,83	14,00	152,00	5,79	18,00	208,00	5,44	
IV/4-5	540015,57	647074,33	-15,00	35,00	3-6	4-5	10	62,83	87,00	205,00	26,67				
IV/5-6	540024,15	647069,19	-15,00	45,00	4-7	5-6	10	62,83	47,00	68,00	43,43				
IV/6-7	540033,77	647063,30	-15,00	55,00	5-8	6-7	10	62,83	39,00	138,00	17,76				
IV/7-8	540042,37	647058,19	-15,00	65,00	6-9	7-8	10	62,83	40,00	25,70	97,79				
IV/8-9	540050,96	647053,07	-15,00	75,00	7-10	8-9	10	62,83	11,20	13,00	54,13	23,00	28,00	51,61	
IV/9-10	540059,48	647047,83	-15,00	85,00	8-11	9-10	10	62,83	58,00	40,50	89,98				
IV/10-11	540068,03	647042,65	-15,00	95,00	9-12	10-11	10	62,83	53,00	49,00	67,96				

Profile IV:		**AM=MN=NB=a=20 m**						**a=20m; AB/2=30 m**				**Control measurements**			
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)**	
IV/4	540012,36	647076,20	-30,00	30,00	1-7	3-5	20	125,66	3,90	100,00	4,90				
IV/5	540018,78	647072,46	-30,00	40,00	2-8	4-6	20	125,66	78,00	400,00	24,50				
IV/6	540029,52	647065,93	-30,00	50,00	3-9	5-7	20	125,66	15,00	56,00	33,66				bed contact
IV/7	540038,03	647060,66	-30,00	60,00	4-10	6-8	20	125,66	40,00	295,00	17,04	39,00	280,00	17,50	
IV/8	540046,72	647055,71	-30,00	70,00	5-11	7-9	20	125,66	5,00	92,00	6,83				
IV/9	540055,20	647050,42	-30,00	80,00	6-12	8-10	20	125,66	56,00	355,00	19,82				

Profile IV:		**AM=MN=NB=a=30 m**						**a=30m; AB/2=45 m**				**Control measurements**			
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)**	
IV/5-6	540024,15	647069,19	-45,00	45,00	1-10	4-7	30	188,50	180,00	582,00	58,30	184,00	579,00	59,90	
IV/6-7	540033,77	647063,30	-45,00	55,00	2-11	5-8	30	188,50	10,50	160,00	12,37				
IV/7-8	540042,37	647058,19	-45,00	65,00	3-12	6-9	30	188,50	18,00	180,00	18,85				

11.5.5 Profile IV

Region: ***Skopje***

Location: ***Factory Ohis "Biljana"***

Method: ***Geoelectrical mapping - resistivity***

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

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

Azimuth: ***150°***

Date: ***29.06.2007***

Operator: ***Novica Stolic***

Profile: V		AM=MN=NB=a=10 m							a=10m; AB/2=15 m			Control measurements			
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)	
V/2-3	539995,83	647121,49	-15,00	15,00	1-4	2-3	10	62,83	11,00	27,50	25,13				
V/3-4	540004,04	647115,78	-15,00	25,00	2-5	3-4	10	62,83	52,00	65,50	49,88				
V/4-5	540012,07	647109,82	-15,00	35,00	3-6	4-5	10	62,83	29,00	83,50	21,82				
V/5-6	540019,82	647103,51	-15,00	45,00	4-7	5-6	10	62,83	18,00	27,50	41,13	16,00	27,00	37,23	
V/6-7	540027,47	647097,58	-15,00	55,00	5-8	6-7	10	62,83	18,00	33,00	34,27				
V/7-8	540035,55	647091,99	-15,00	65,00	6-9	7-8	10	62,83	89,00	42,50	131,58				
V/8-9	540044,12	647086,24	-15,00	75,00	7-10	8-9	10	62,83	133,00	72,00	116,06				
V/9-10	540052,87	647080,95	-15,00	85,00	8-11	9-10	10	62,83	77,00	35,00	138,23				
V/10-11	540061,58	647076,15	-15,00	95,00	9-12	10-11	10	62,83	272,00	120,00	142,42	18,00	7,30	154,93	
V/11-12	540070,19	647071,29	-15,00	105,00	10-13	11-12	10	62,83	92,00	51,00	113,34				
V/12-13	540078,77	647066,15	-15,00	115,00	11-14	12-13	10	62,83	84,00	50,00	105,56				

Profile V:		AM=MN=NB=a=20 m							a=20m; AB/2=30 m			Control measurements			
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)	
V/4	540008,09	647112,85	-30,00	30,00	1-7	3-5	20	125,66	38,00	178,00	26,83				
V/5	540016,06	647106,80	-30,00	40,00	2-8	4-6	20	125,66	31,00	175,00	22,26				
V/6	540023,59	647100,22	-30,00	50,00	3-9	5-7	20	125,66	28,00	235,00	14,97				
V/7	540031,34	647094,94	-30,00	60,00	4-10	6-8	20	125,66	59,00	109,00	68,02	16,00	27,00	74,47	
V/8	540039,76	647089,04	-30,00	70,00	5-11	7-9	20	125,66	230,00	340,00	85,01				
V/9	540048,48	647083,44	-30,00	80,00	6-12	8-10	20	125,66	146,00	350,00	52,42				
V/10	540057,26	647078,46	-30,00	90,00	7-13	9-11	20	125,66	76,00	170,00	56,18				
V/11	540065,89	647073,84	-30,00	100,00	8-14	10-12	20	125,66	156,00	225,00	87,13	150,00	220,00	85,68	

Profile V:		AM=MN=NB=a=30 m							a=30m; AB/2=45 m			Control measurements			
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)	
V/5-6	540019,82	647103,51	-45,00	45,00	1-10	4-7	30	188,50	16,50	368,00	8,45				
V/6-7	540027,47	647097,58	-45,00	55,00	2-11	5-8	30	188,50	47,00	242,00	36,61				

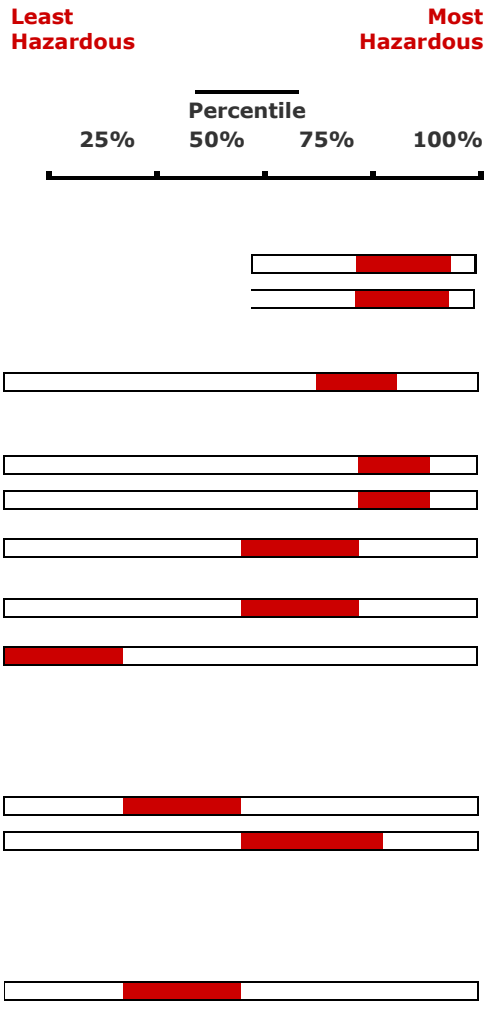
V/7-8	540035,55	647091,99	-45,00	65,00	3-12	6-9	30	188,50	65,00	255,00	48,05				
V/8-9	540044,12	647086,24	-45,00	75,00	4-13	7-10	30	188,50	14,50	71,00	38,50	20,00	110,00	34,27	
V/9-10	540052,87	647080,95	-45,00	85,00	5-14	8-11	30	188,50	66,00	285,00	43,65	65,50	282,00	43,78	

11.6 Environmental related annexes

11.6.1 Hazard Ranking of HCH Isomer - α Lindane

More hazardous than most chemicals in 8 out of 11 ranking systems

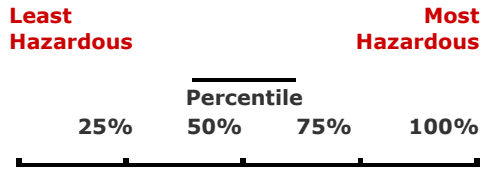
Chemical: ALPHA LINDANE
CAS Number: 319-84-6



11.6.2 Hazard Ranking of HCH Isomer - β Lindane

More hazardous than most chemicals in 5 out of 9 ranking systems

Chemical: BETA-LINDANE
CAS Number: 319-85-7



Human Health Rankings

Toxicity and persistence

- Human Health Risk Screening Score (WMPT)

Toxicity and exposure potential

- Cancer Risk Score - Air Releases (EDF)
- Cancer Risk Score - Water Releases (EDF)
- Noncancer Risk Score - Air Releases (EDF)
- Noncancer Risk Score - Water Releases (EDF)
- Worker Exposure Hazard Score (IRCH)

Ecological Health Rankings

Toxicity and persistence

- Environmental Hazard Value Score (IRCH)
- Ecological Risk Screening Score (WMPT)

Integrated Environmental Rankings

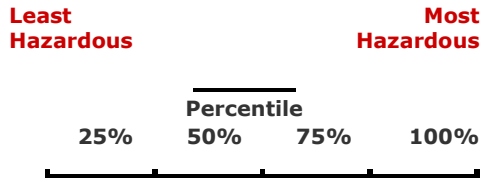
Combined human and ecological scores

- Total Hazard Value Score (IRCH)

11.6.3 Hazard Ranking of HCH Isomer - δ Lindane

Ranked as one of the most hazardous compounds (worst 10%) to ecosystems and human health.

Chemical: GAMMA-LINDANE
CAS Number: 58-89-9



Human Health Rankings

Toxicity only

- Ingestion Toxicity Weight (RSEI)
- Inhalation Toxicity Weight (RSEI)

Toxicity and persistence

- Human Health Risk Screening Score (WMPT)

Toxicity and exposure potential

- Cancer Risk Score - Air Releases (EDF)
- Cancer Risk Score - Water Releases (EDF)
- Noncancer Risk Score - Air Releases (EDF)
- Noncancer Risk Score - Water Releases (EDF)
- Worker Exposure Hazard Score (IRCH)

Ecological Health Rankings

Toxicity and persistence

- Environmental Hazard Value Score (IRCH)
- Ecological Risk Screening Score (WMPT)

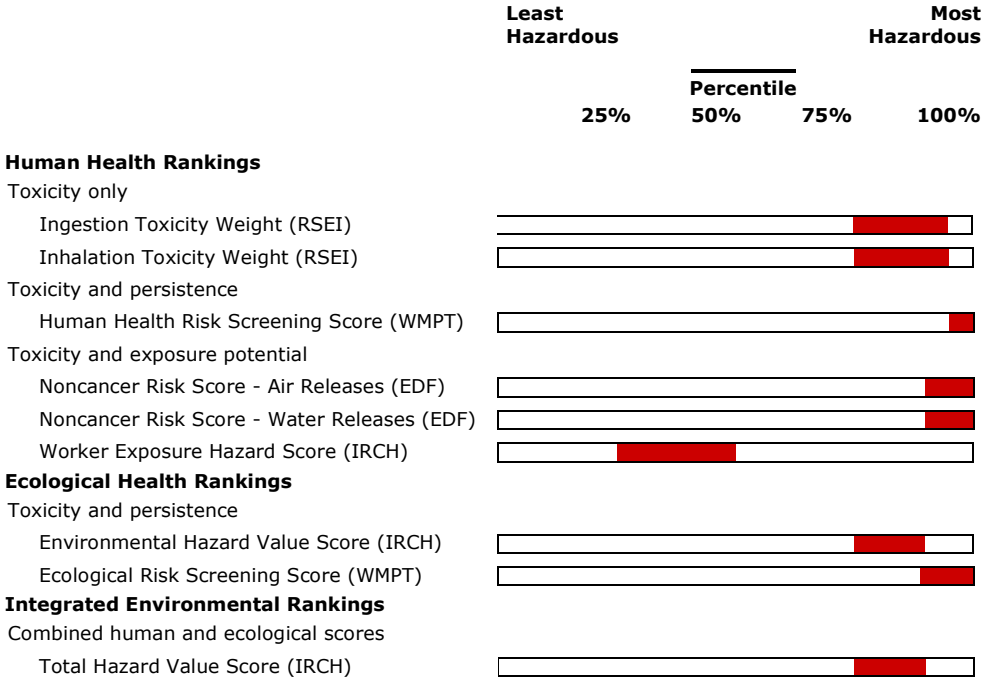
Integrated Environmental Rankings

Combined human and ecological scores

- Total Hazard Value Score (IRCH)

11.6.4 Hazard Ranking of Mercury

Mercury is ranked as one of the most hazardous compounds (worst 10%) to ecosystems and human health.



11.6.5 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
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				

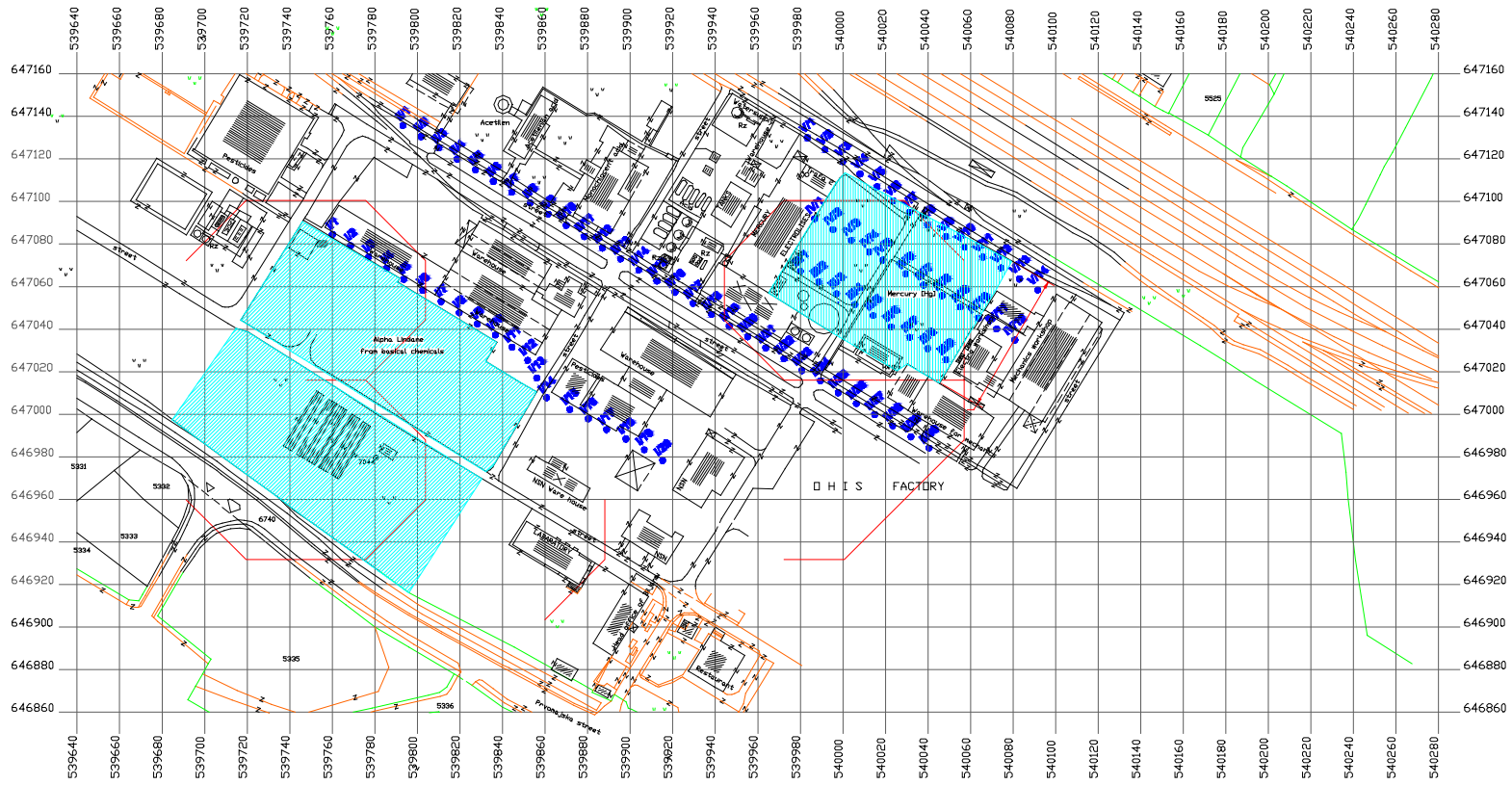
11.6.6 Data needs for treatment technologies for slag and contaminated soil

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[28]
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

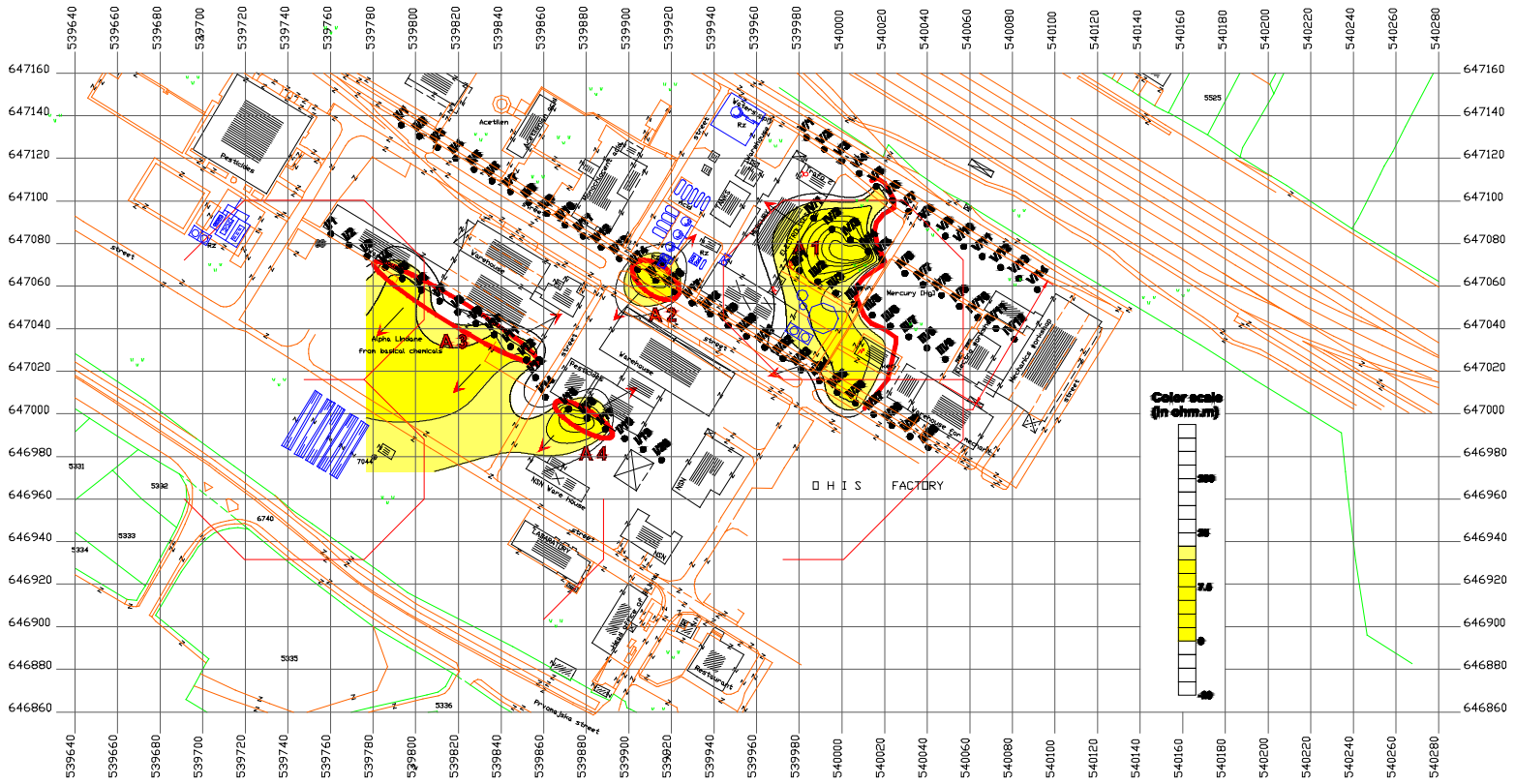
28 TCLP-Toxicity Characteristic Leaching Procedure

11.7 Maps

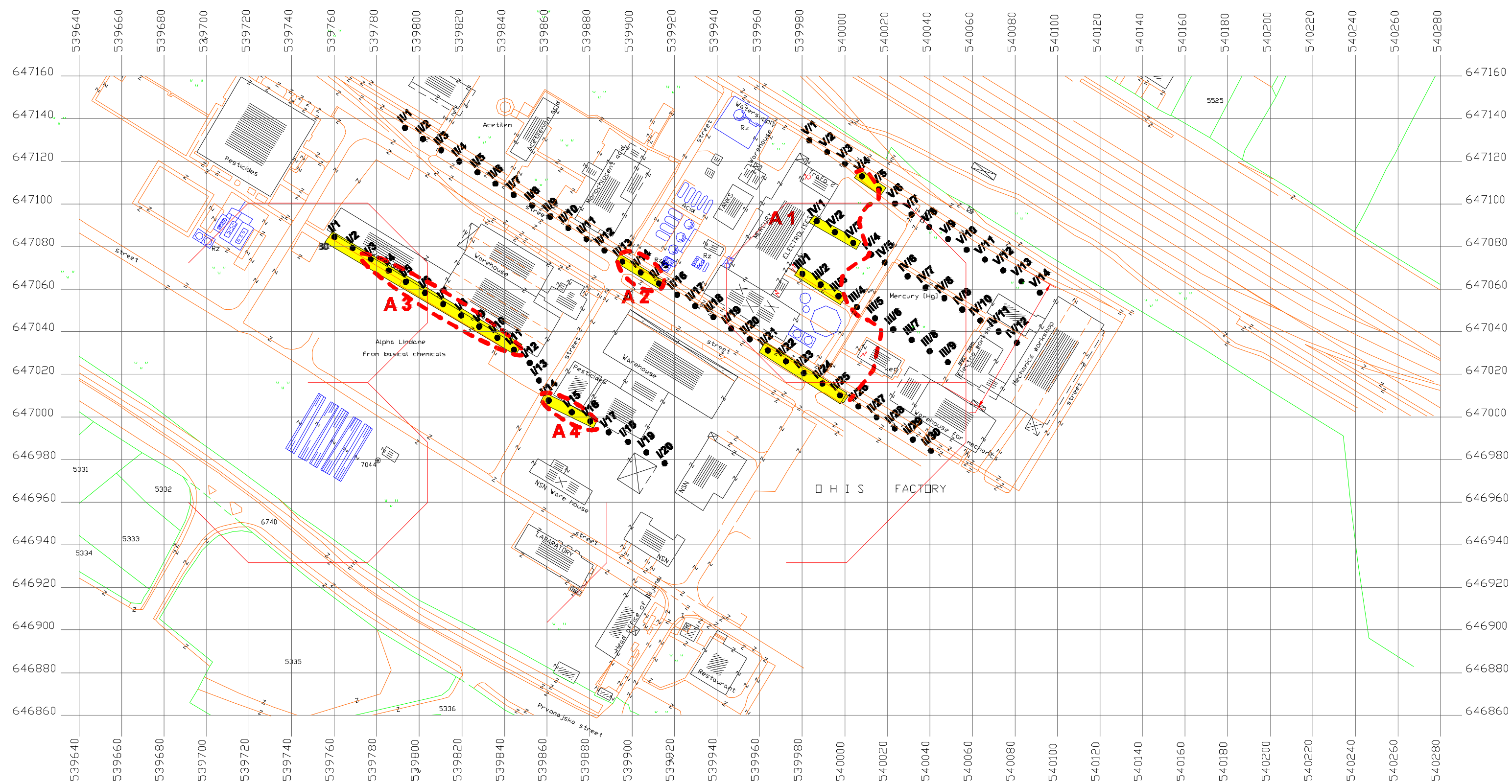
11.7.1 Maps – OHIS – Profiles I till V



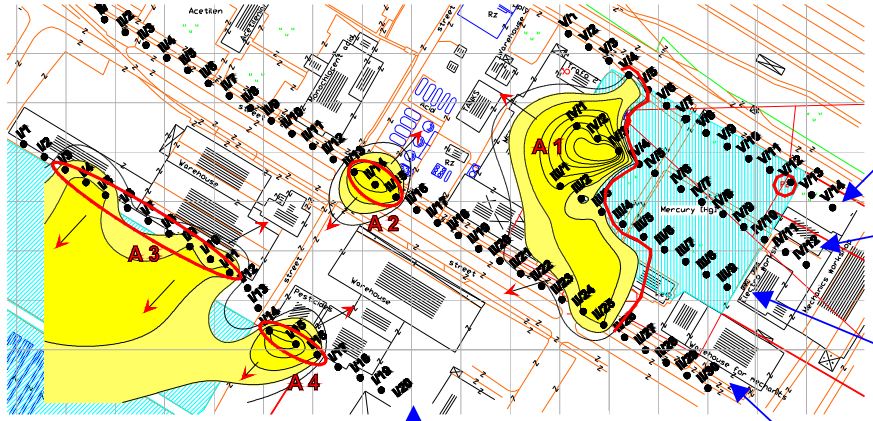
11.7.2 Maps – OHIS – Anomaly Zones

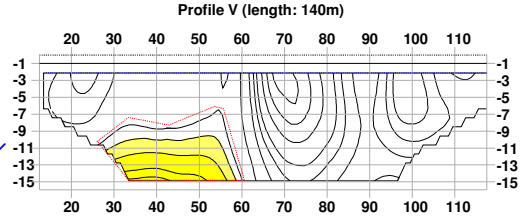


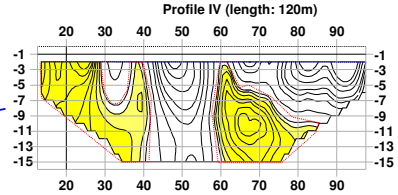
11.7.3 Maps – OHIS – Anomaly Zones

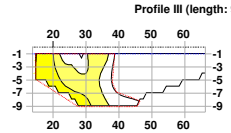


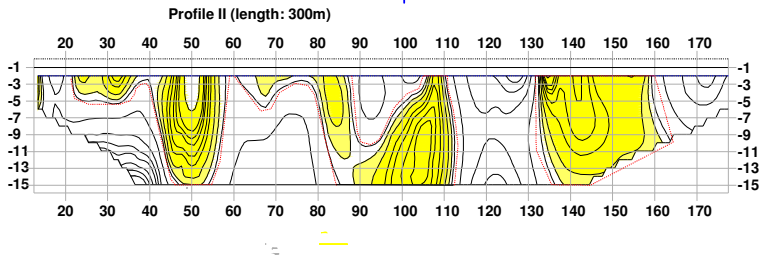
11.7.4 Maps – OHIS – Vertical Anomaly Zones

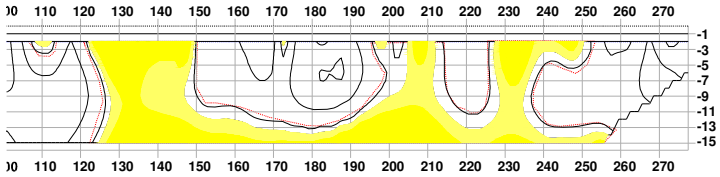




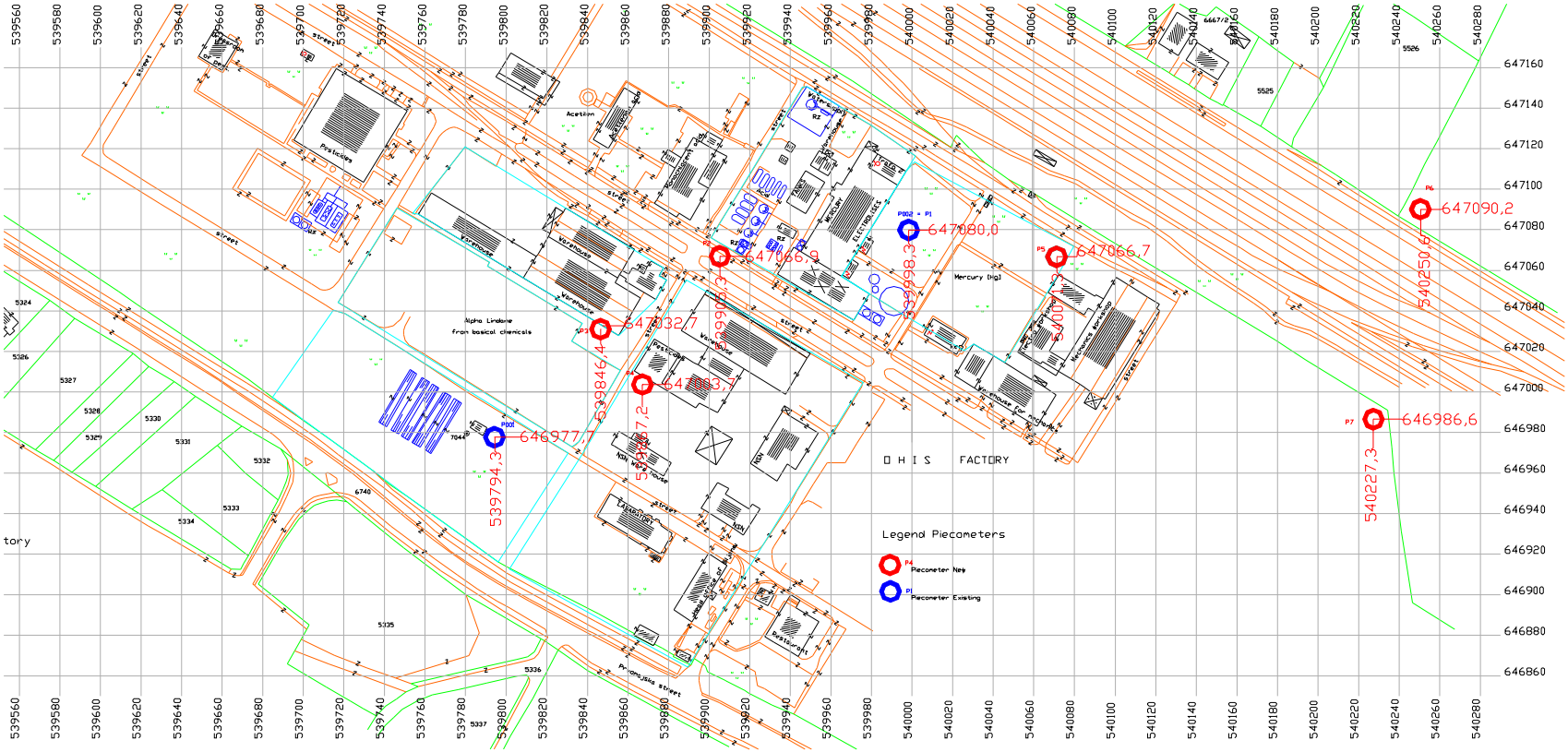








11.7.5 Proposal of core drills and piezometer



11.8 Pictures

11.8.1 Ohis – geoelectrical resistivity measurement





11.8.2 Mercury contaminated site

11.8.3 Piecometer Location

11.8.4 HCH contaminated sites