

Remediation

CONTAMINATION ASSESSMENT AND REMEDIATION

- LEGISLATION AWARENESS**
- DUE DILIGENCE/ AUDIT**
- CLEAN-UP
BIOREMEDIATION AND
REVEGETATION**
- WASTE OIL RECOVERY AND
SALE COST BENEFIT
ANALYSIS**

About EcoSocio Analysts

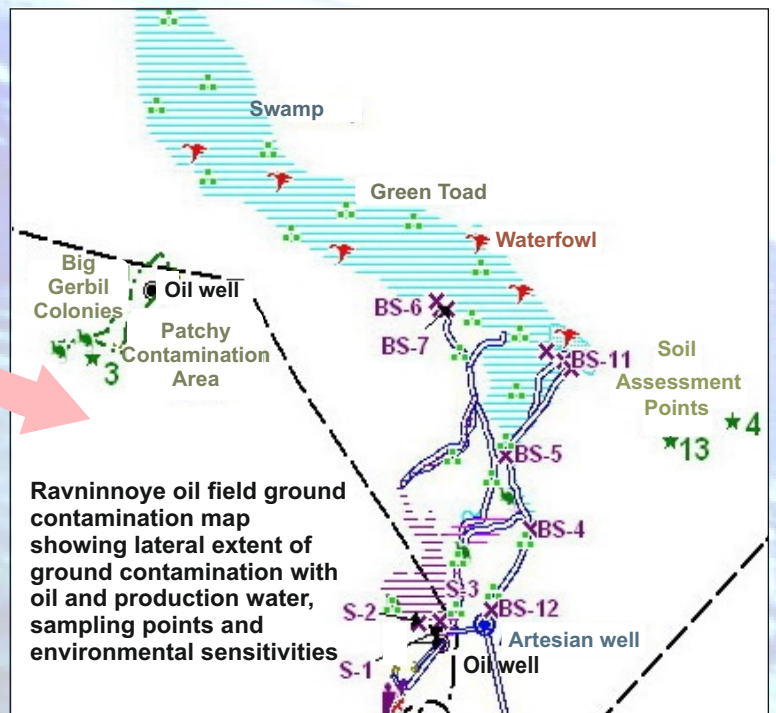
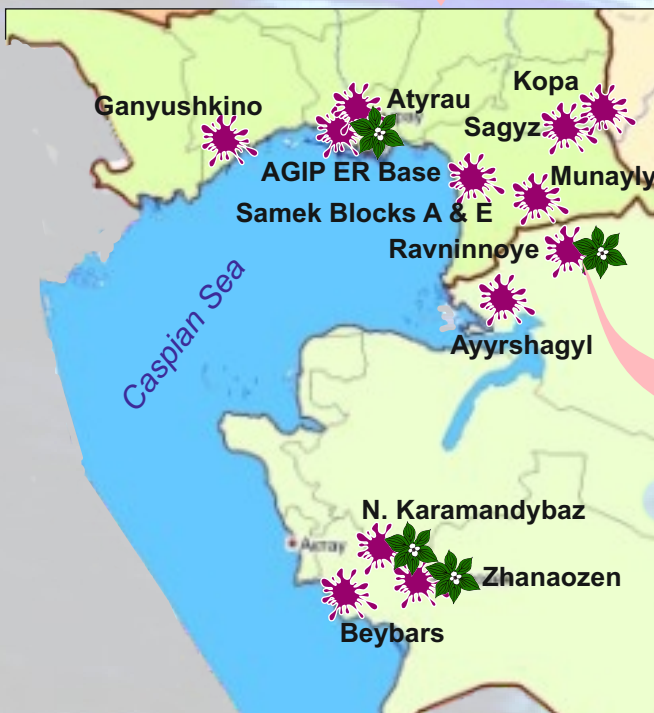
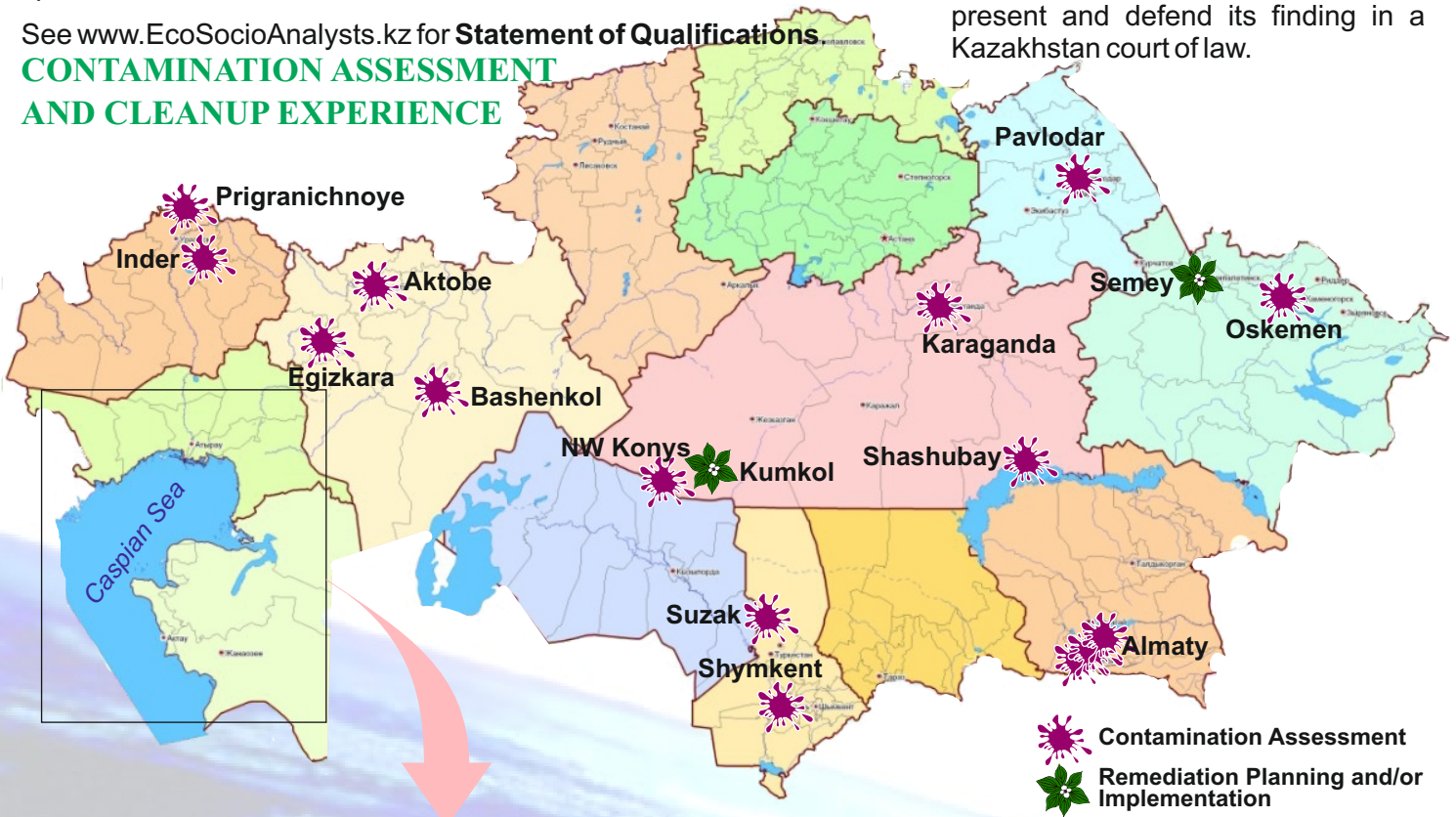
Established in 2014 EcoSocio Analysts LLC (ESA) is a successor of CaspiEcology Environmental Services formed in 2001. We provide full spectrum of health, safety, environmental and socioeconomic services including HSE due diligence, impact assessment, management systems and monitoring; stakeholder engagement, information disclosure, resettlement and livelihood restoration, contamination assessment, cleanup, revegetation and waste management. We communicate and produce reports in the required language be so the English, Russian or Kazakh.

Our blend of western education with local experience has allowed us to provide commendable work for the international lending organizations like the HSBC, EBRD and IFC and the companies that apply for their loans or for listing on the London Stock Exchange. When we lack specific experience for a project we join with our long-term partners from UK, Germany, Italy, Spain and other countries as well as contract international free-lance experts. This allows us to accumulate experience in practically all industrial sectors present in the Central Asia despite specialisation on the international investors.

ESA is licensed to conduct audits and present and defend its finding in a Kazakhstan court of law.

See www.EcoSocioAnalysts.kz for **Statement of Qualifications**.

CONTAMINATION ASSESSMENT AND CLEANUP EXPERIENCE



UNDERSTANDING OBLIGATIONS

Payments for contaminated land is taken annually. The cleanup plan has to be prepared, approved by the regional environmental protection department and implemented. Fines are levied each year for failure to adhere to the plan. Recently the environmental and sanitary epidemiological authorities obtained considerable control over activities related to development. Government authorities can now levy heavy fines and have significant power to postpone an operation. Environmental non-compliance can be used by the government as a tool to enforce its objectives.

Similarly to the EU, cleanup requires application of the best available techniques (Environmental Code of RoK, Chapter 31, Article 217, Clause 1 Environmental Requirements Applicable to Land Use) and cleanup standards.

All investors want to know if their money is safe. If the environment is safe, or is contaminated, or in danger of being contaminated from ongoing operations, there is a real danger of fines, delays, and huge expenditures. Therefore, invested money may not be secure.

International organizations like EBRD and EU have strict rules concerning the environment and will not invest in a company unless the environmental conditions meet their requirements. Markets like the London AIM require a report from a reputable environmental company before they will consider listing a new company.

SOURCES OF POLLUTION IN ECOSOCIO ANALYSTS PROJECTS



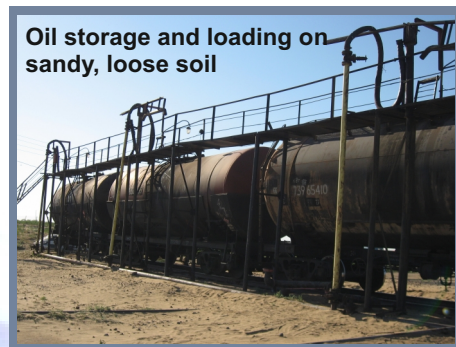
Kerosene under an old airstrip



Abandoned chemicals leaks into the ground



Sand massive on the Emba River Flood Plain is unprotected from oil over spills from a temporary storage tank during well development



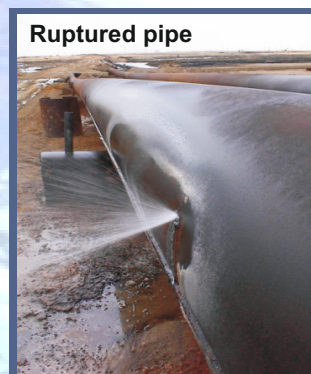
Oil storage and loading on sandy, loose soil



Leaking well



Unlined fuel drum storage



Ruptured pipe

Client Comments:

Temujin International Ltd. (Law Partner): "We appreciate the reliable, intelligent reports you have provided on various occasions and particularly thank you for your insight on environmental conditions in oil fields...."

World Bank (Lead Economist & Energy Specialists) commenting on the Uzen oil field: "... We appreciate the significant progress that has been made and note that it's in keeping with the Bank's policy of sustainable development and promotion of social development...."

STEP II: ENVIRONMENTAL DUE DILIGENCE

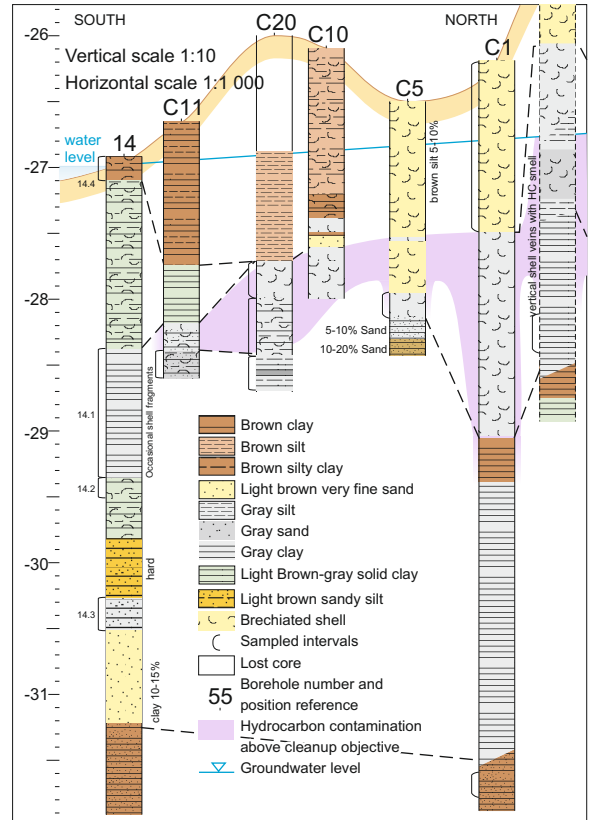
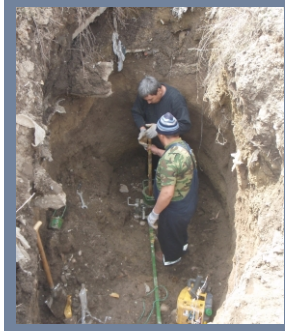
Environmental Due Diligence is conducted to identify key compliance, environmental and social issues associated with the current condition and the development plans. For international recognition they should be undertaken by an independent international environmental consultant.



Ground and groundwater contamination analysis at an old municipal dump for construction of a large retail centre



Window ground core sampler with a hand-held pneumatic hammer is used to assess contamination down to 10m in inaccessible for a drilling rig places



Window sampling cross section of a 60 year old diesel plume in the Ural River delta - basis for cleanup method selection and cost evaluation

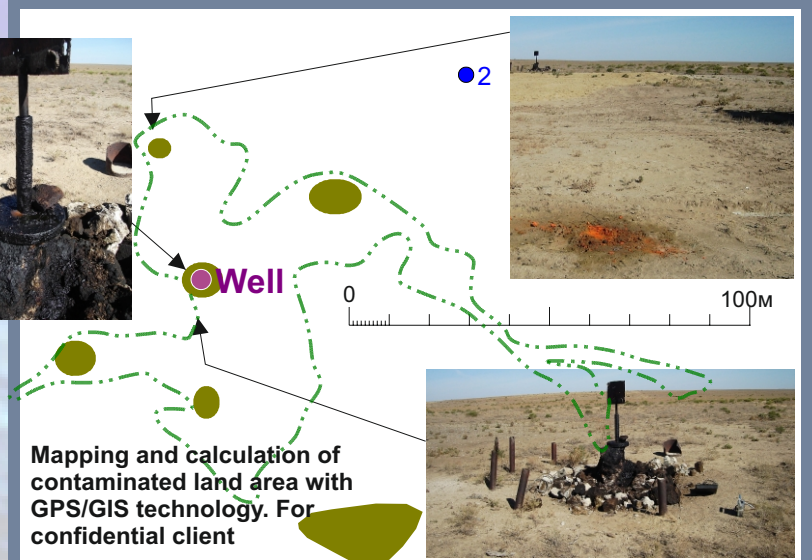
Client Comments:

Audit of 2 oil terminals, 2 oil fields, and a plant (Specialist, Environ, UK): *"I am very happy indeed with your work and will always contact you... EBRD sound delighted with our tenacity."*

Uzenmunaygas Oil Field (Project Coordinator): *"Your team did a superior job in completing of an environmental audit on a portion of the Uzenmunaygas oil field... I understand the regional environmental authorities proclaimed it to be -the best environmental study they have ever seen-...."*



Sampling for contamination to 5m depth at an old petrol station



Mapping and calculation of contaminated land area with GPS/GIS technology. For confidential client

AUDIT OF 33 ABANDONED AND SHUT OIL WELLS IN SAMEK BLOCKS A & E AT CASPIAN SEA SHORE

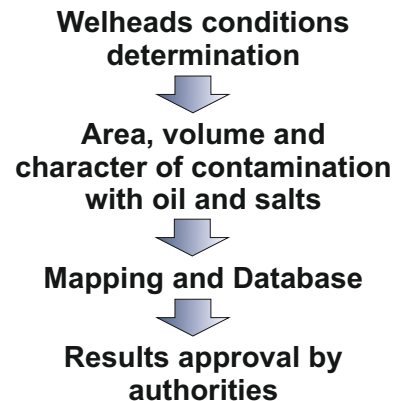
To determine 'recognised environmental conditions' ASTM (American Society for Testing and Materials) standards were used. Wellhead integrity and protection were assessed according to the internationally recognised guidelines on well abandonment and conservation.

The report was used to develop cleanup and containment tactics and to determine financial offsets in the case of selling the field.

Bird trapped in seeping oil at a incorrectly shut wellhead



PROJECT STAGES



AUDIT OF 11 ABANDONED AND SHUT OIL WELLS AT AYRSHAGYL OIL FIELD NEAR CASPIAN SEA SHORE

Blowout signs were detected around several shut off wells drilled 30-50 years ago



The aim was to develop a step-by-step cleanup plan that will enable with low cost and disturbance to operation timely and qualitative rehabilitation of contaminated land.

Proximity to the sea wetland was the cause for urgency in determining the sources and character of contamination and its ability to move towards the sensitive receptors



Fresh spills at the adjacent fields are adding to historic contamination



Client Comment: "The IFC was very impressed by the data-pack." Director, Innovation & Technology

FOREST PROTECTION AND REFORESTATION

The Environmental Assessment and Management Plan was part of the Forest Protection and Reforestation Project in Kazakhstan, funded by IBRD and GEF. Together with Helsinki Consulting Group, EcoSocio Analysts specialists assessed ecology of pests in relict pine strip forests of Irtys, pest control practices and suggested forest rehabilitation procedures. Stakeholders were identified and their opinion accounted

Seeding at the strip forest edges was proved to be more effective, less damaging and cheaper than seedlings planting



Our Experience

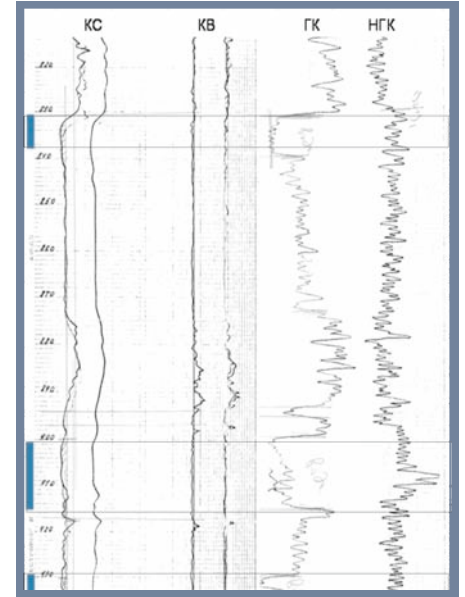
INOVATIVE APPROACH TO ASSESSMENT

WELL LOGGING AS A METHOD FOR POLLUTION EVALUATION

Improperly sealed abandoned wells leak oil, production water and gas to the surface



Drilling logs are used to identify porous rocks from where oil, production water and gas may enter the well and then seep through the seals and corroded parts of the casing into the water aquifers that are either used by man or connected to the sea. When seepage occurs at the surface of periodically inundated well, contamination enters the Caspian Sea.



Our engineers and geologist have in total some 150 years of experience drilling and investigating Soviet wells

INVESTIGATING INACCESSIBLE AREAS

Percussion drilling and window sampling was used to investigate ground contamination with minor disturbance to vegetation and wildlife in the Ural Delta flooded, reed chocked wetland nature reserve.

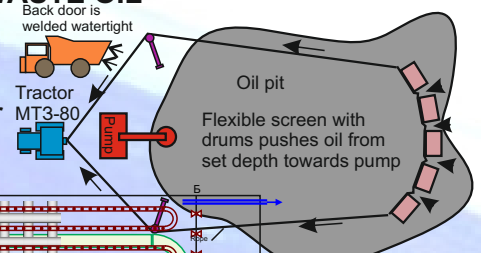


COLLECTING, RECOVERING AND BIODEGRADING HIGH PARAFIN WASTE OIL

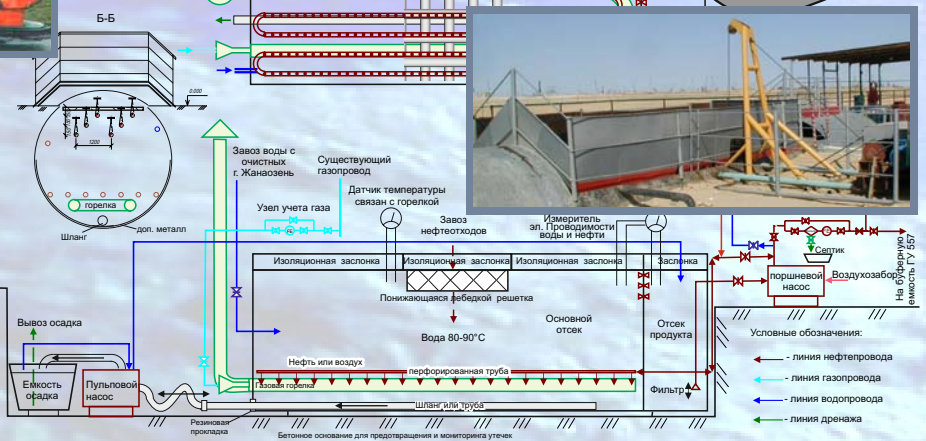
This rotary pump can cope with solid oil and sludge



Modernising thick oil and sludge collection from pits and passive gravity separator to reduce water use and breaks for cleaning



Combining fire drills with bioremediation plot watering



STEP II: SELECT THE BEST WASTE UTILIZATION STRATEGY



EXPERIENCE

Waste utilization strategies have been developed for:

- Uzenmunaigas
- UMC Energy
- AGIP KCO
- Roxi Petroleum
- PetroKazakhstan

See *Journal of Oil & Gas of Kazakhstan*, 5-6, 2002 for full discussion.

PROCEDURES

- Screening of Cleanup Methods
- Cost Benefit Analysis of selected methods
- Detailed design of the most cost effective method

Selected Methods Cost Benefit Analysis

Waste Type	Source	Cleanup method	Area m ²	Average depth m	Volume m ³	Rel. density	Weight (t)	Recoverable oil (t)	Min cleanup cost \$	Max cleanup cost \$	Gross benefit from oil recovery \$
Oil and top oil sludge	Oil pits in field	Gravity separator /	604 938	1	302 469	1	302 469	258 611	-10 483 576	-10 344 000	19 124 283
	Oil pits at CPPN		1 068 749	0	427 499	1	427 499	365 512	-14 817 132	-14 619 862	27 029 617
	Lake	Soil washing	8 530 149	0	1 364 824	1	1 364 824	1 166 924	-47 304 792	-46 674 991	86 294 054
	Oil spills		1 715 090	0	343 018	1	343 018	293 280	-11 889 004	-11 730 717	21 688 085
Bottom oil sludge	Oil pits in field	Therm desorp/	604 938	1	423 457	1	465 802	167 689	-10 512 168	-22 938 669	12 400 588
	Oil pits at CPPN	soil washing	1 068 749	0	427 499	1	470 249	169 290	-10 612 532	-23 157 673	12 518 981
Contaminated ground	Large spills	Landfarming	1 715 090	0	514 527	1	617 432	0	-3 070 011	-3 070 011	0
	Pits and small spills	Composting	604 938	0	181 481	1	217 778	0	-1 246 777	-1 246 777	0
	Oil pits at CPPN		1 068 749	0	320 625	1	384 750	0	-2 202 691	-2 202 691	0
	Lake		8 530 149	0	2 559 045	1	3 070 854	0	-17 580 636	-17 580 636	0
Contaminated and waterlogged grdn	Block 3A depression	Immobilization /compost	370 283	0	111 085	1	144 410	0	0	0	0
					6 975 529	0	7 809 085	2 421 306	-129 719 320	-153 566 028	179 055 608

Cost of 1t of waste cleanup (\$)

Oil and top oil sludge with gravity separator	-34,66
Bottom oil sludge with thermal desorption	-22,57
Landfarming	-4,97
Composting	-5,73

Net benefit from oil field cleanup

Maximum	49 336 288
Minimum	25 489 579

From EcoSocio Analysts Cleanup plan for a West Kazakhstan Oil Field Client

Client Comment

PetroKazakhstan (Karaganda Regional Environmental Administration, Head of State Expert Review and Audit Department)... "A high professional and quality level of submitted technical project documentation... in particular the review of methods for the oil contaminated soils re-cultivation with both positive and negative aspects for each technique, and selection of the most effective and economically efficient method..."

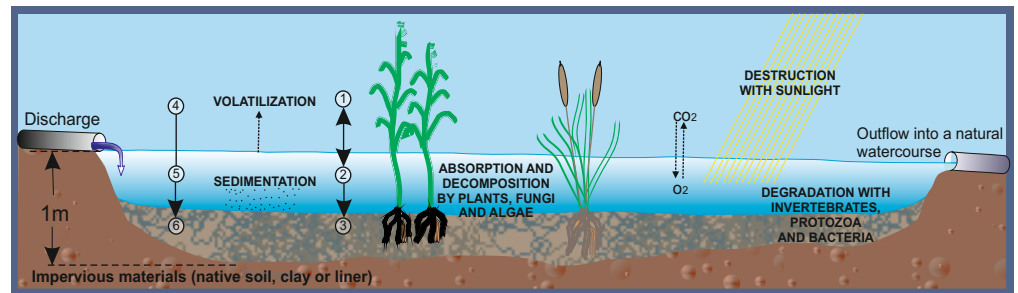
STEP III: IMPLEMENTATION OF YOUR STRATEGY

When selecting a method of land reclamation, we take the following into account:

- The nature of surface disturbance within the land plot;
- Physical and chemical soil properties;
- Geographical and ecological conditions in the area where the site is located;
- Social and economic constraints and the area development perspectives;
- Environment protection legislation requirements;

Constructed wetlands are an innovative and inexpensive treatment approach with the potential to treat organic and inorganic compounds in a broad range of wastewater sources (municipal; industrial; storm water contaminated with metals, oils; and agricultural).

WETLANDS CONSTRUCTION TO CLEANUP WASTE WATER



Contaminants removal mechanisms in constructed wetlands

BIOREMEDIATION

Advantages:

- Comparably inexpensive to implement especially with respect to traditionally used removal and landfill methods
- fines and payment for contamination are not levied on the land that is being remediated;
- Achievement of required cleanup targets in 1-2 seasons;
- Impact is eliminated rather than transferred elsewhere.

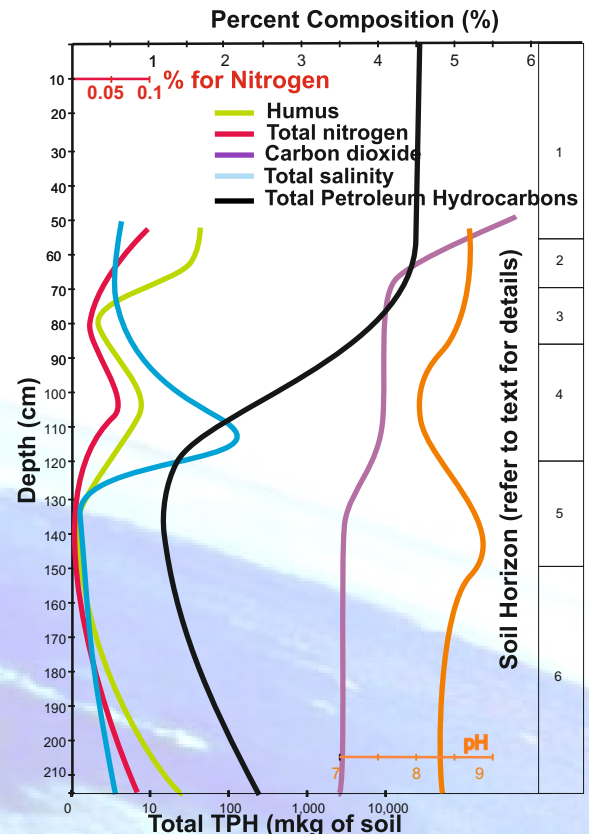
Disadvantages:

- No oil recovery,
- on average two summer seasons are required.

Principal: Ideal conditions are created and maintained for soil hydrocarbons degrading bacteria activity and proliferation. After the main volume of hydrocarbons are degraded, the bacteria numbers decline to the background level.

Main questions:

- What contaminants in what concentration are present?
- Will aeration and watering leave to hydrocarbons mobilisation and contamination of underlying soil, surface or groundwater?
- Does the soil contain hydrocarbons oxidizing bacteria?
- What is the main limiting factor of this bacteria activity (nutrients, temperature, moisture, oxygen, presence of rival bacteria)?



Determination of interrelation between soil properties and petroleum hydrocarbons concentration at Kumkol oil field

Client Comment Roxi Petroleum (COO):


“Great job, the due diligent reports you compiled on each of our seven oil fields met all requirements of the Alternate Investment Market (AIM) as well as our investors. The environmental and social baseline (ESIA) work you submitted was equally appreciated by our team as is your ongoing oil field microbiological remediation efforts. We hope we can continue to work with you into the future.”

BIOREMEDIATION AND REVEGETATION PROCESS

PHASE I: Cleanup Plan Approval by the Ministry of Environmental Protection

КАЗАКСТАН РЕСПУБЛИКАСЫ
КОРШАҒАН ОРТАНЫ ҚОРҒАУ
МИНИСТРЕЛІГІ
АТЫРАУ ОБЛАСТЫҚ АУМАҚТЫҚ
КОРШАҒАН ОРТАНЫ ҚОРҒАУ
БАСҚАРМАСЫ

090011, Атырау қаласы, Б. Кулимов көшесі, 137 үй
Тел: 8 (3122) 21-30-35, факс: 21-26-23
№ 8/104 - 20 - 07, 2007 ж.



РЕСПУБЛИКА КАЗАХСТАН
МИНИСТЕРСТВО ОХРАНЫ
ОКРУЖАЮЩЕЙ СРЕДЫ
АТЫРАУСКОЕ ОБЛАСТНОЕ
ТЕРРИТОРИАЛЬНОЕ
УПРАВЛЕНИЕ ОХРАНЫ
ОКРУЖАЮЩЕЙ СРЕДЫ

090011, город Атырау, улица Б. Кулимова, 137
Тел: 8 (3122) 21-30-35, факс: 21-26-23

Вывод

Атырауское областное территориальное управление охраны окружающей среды, рассмотрев «План очистки и рекультивации загрязненного участка у скважины XX месторождения XXXXXXXX», согласовывает его с условием обязательного выполнения предложенной госэкспертизы.

Главный государственный экологический эксперт области, начальник отдела экологической экспертизы

Acceptance letter of the remediation plan by the Regional Ministry of Environmental Protection
ENGLISH TRANSLATION

Conclusion:
After having considered the "Plan of clean-up and rehabilitation of the polluted site located near the Well XX of the XXXXXXXX field", Atyrau District Environmental Protection Department approved it under the condition that the State Ecological Expert Review procedures proposed shall be executed.

Chief State Ecological Expert of the District,
Ecological Expert Review Department, Head.



EcoSocio Analysts' Soil Bio-remediation by landfarming at a PreCaspian Region Oil Field. Soil aeration by ploughing.



Maintaining the desired soil moisture is a challenge in the arid climate. Perforated hose watering the landfarmed plot

PHASE II: Conducting Remediation and Revegetation



Contamination characterization

Aeration of the heavily contaminated soil and oil sludge arranged in windrows at Uzen Oil Field



Measuring bacterial activity via soil CO₂ respiration rate and soil temperature change

PHASE III: Measuring Results, Reporting, Results Approval and the Land Removal from the Contaminated Land List



Following remediation the animals have a source of safe drinking water

CO₂ soil respiration (g/m²/hour) as indicator of bacteria activity

Sites	July 2008			September 2009		
	Min	Max	Average	Min	Max	Average
Control plot	0.03	0.30	0.13	0.03	0.16	0.06
Plowed plots	0.22	0.98	0.81	0.04	0.60	0.31
Plowed and watered plots	0.56	0.90	0.77	0.08	0.48	0.36



EcoSocio Analysts crew inspecting the day's work

Comparison of total petroleum hydrocarbons (TPH) concentration in soil of treated sites. The maximum permitted concentration of TPH in clean soil is 100mg/kg. Concentrations in **Red** are above the MPC

Plots/sampling points	Sampling depth, cm	TPH mg/kg		
		2007	2008	2009
Top /S1	0-20	875	Not analyzed	<5
	30-40	53	Not analyzed	<5
Top /S2	0-30	>1000	27 141.16	<5
	40-50	16,4	46.78	<5
Transitional /S3	0-30	>1000	Not analyzed	<5
	40-50	Not analyzed	Not analyzed	<5
Bottom /S4	0-30	250-350	27.0	Not analyzed
	40-50	Not analyzed	23.76	Not analyzed



A portion of the field after tilling



Revegetation of an Oil Field in the North Caspian region

Client Comments

European Bank for Reconstruction and Development

EBRD (Senior environmental advisor)

- 1) What a heroic effort turning this around so quickly, thanks!!
- 2) "...As a result of our meeting, the references you sent about the experts and my review of the Atash Marine Base EIA. I can say there will not be a need for a Gap Analysis by an external party."
- 3) "I am very pleased to hear that you will be monitoring the project implementation. As I have always said I had been very pleased with the quality of your work and your cooperation during the EDD. I hope our close relation will continue during the implementation stage."
- 4) "I reviewed the Resettlement Action Plan... you have done a very good job on it!"
- 5) "The overall quality of the work done is very good. Nicely written in a concise manner, but without omitting important details."



Ministry of Environmental Protection Office, Kyzyl Orda (Head of the State Environmental Expertise)

"We would like to note the high professionalism and quality of the project and analytical data of the prepared **cleanup and recultivation plan**. The

cleanup methods screening, accounting for all positive and negative aspects and the cost-benefit analysis for each screened method particularly impressed me. I hope that the diligence and professionalism of your specialists will serve for the welfare of our Republic and the health of the people of Kazakhstan. Thank you."

Regional Center in Central Asia (CAREC) (Director)



"...thanks for your cooperation and support of sub-regional seminar on **"Strengthening of the Central Asia countries potential in the Assessment of Environmental Impact in transboundary context"**. Your contribution has made the seminar useful in a practical manner.



Price-WaterhouseCoopers (Project Manager)

"... very pleased with **Assessment of Risk from Environmental Regulations** you did..." The work was used for technical assistance to three major Kazakhstan banks that were reviewed by EBRD as financial intermediary.



Datoba Construction LLP (Director)

"We appreciate the special effort you put into its work, its ability to communicate and respond to the particularly demanding issues associated with construction work. Datoba is **happy to include you in all our related work** from extensive **high-level international projects for companies like McDermott and Halliburton** to projects associated with local construction firms and related laws and regulation of Kazakhstan."



ILF GmbH (Senior Consultant)

"Thank you for the fine preEIA for the **Crude Oil Pipeline Kenkiyak-Atyrau** (which) is very impressive with special regards to the data collected, the evaluation of the results... and the professional interpretation and handling of the environmental issues addresses. To **accomplish** such work in the



THE **World Bank** (Lead Economist and Lead Energy Specialist)

"...We appreciate the significant progress that has been made in a **pilot cleanup and oil recovery** (under the Uzen oil field rehabilitation project loan supported by the government of Kazakhstan) and note that it is in keeping with the Bank's policy of sustainable development and promotion of social development."



Agip KCO OKIOC(Agip KCO) (HSE Manager Greg Cresswell)

"... prepared for the MENR the **Review of the North Caspian Sea Exploration Project EIA** is a very constructive tool for implementing exploration drilling. Because of the **exceptional quality** and usefulness of this product, OKIOC accepts and commits to implement all your comments to improve the Project."



UzenMunayGas (Environmental Project Coordinator)

"Together with Ecology & Environment, Inc (USA) your team did a superior job in completing an **environmental audit** on a portion of the Uzenmunaigas oil field that was significantly complex in nature and contaminated from variety of sources. I understand the regional environmental authorities proclaimed it to be **'...the best environmental study they have ever seen'**. Professional work of this nature deserves to be complemented and I am happy to do so".



ENVIRON Environ, UK (Senior Consultant)

"I am very happy indeed with you helping in audit of 2 oil terminals, 2 oil fields and a chemical plant and will always contact you when we get future projects in Kazakhstan... **EBRD sounds delighted** with our tenacity."



ATKINS WS Atkins (Associate Water and Environment)

"I would like to thank you for all your efforts in undertaking the audit and generating the report, which was **received very well by EBRD**. It was an **achievement to meet the very tight timescales** on this one."



Roxi Petroleum (COO)

"**Great job!** The **due diligence** reports you compiled on each of seven of our oil fields **met all requirements of the Alternate Investment**

Market (AIM) as well as our investors. The **ESIA** was equally appreciated by our team as is your oil field **microbiological remediation** efforts. We hope we can continue to work with you into the future."



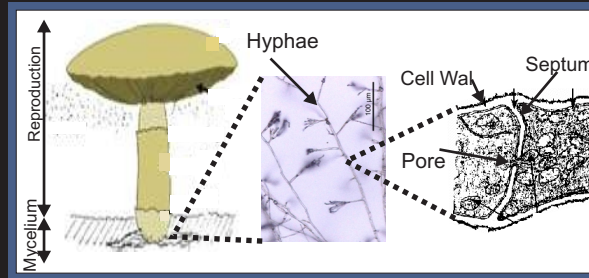
CASPIAN SERVICES INC. Balykshi, a subsidiary of Caspian Services (Director).

"Thank you for providing continuous and **very reliable services** to our development company for the past two years. Your ability to solve problems, work with local people and organizations like the European Bank of Reconstruction and Development (EBRD) is commendable. We hope we will be able to work together for many years to come."

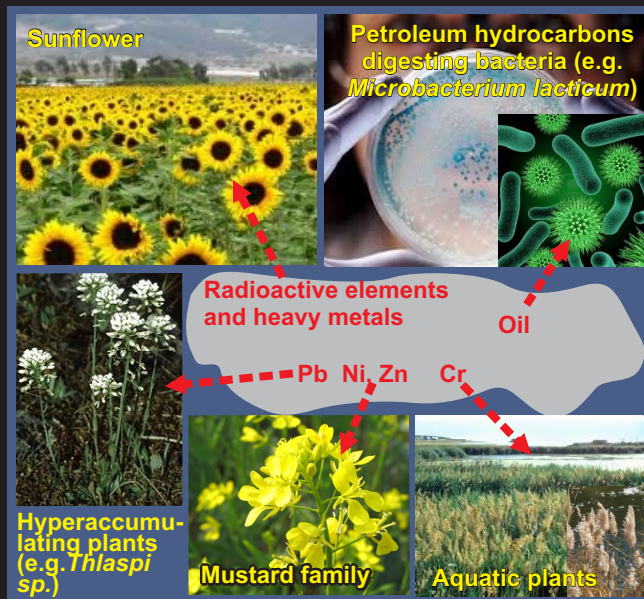
**WHAT NEXT?
 CALL US FOR:
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 BIOREMEDIATION CONSULTATION**

EcoSocio Analysts Clean-up Publications

**New Technology:
 Mushrooms may Help
 Heal Contaminated
 Land.** *Journal of Oil &
 Gas of Kazakhstan*; 1,
 2008



**Examples of
 organisms utilised for
 remediation of soil
 and groundwater and
 phytomelioration.
 Brownfield Evaluation
 And Bioremediation.**
*Journal of Oil & Gas of
 Kazakhstan.*



See www.EcoSocioAnalysts.kz for Statement of Qualifications and other brochures:

- Socioeconomic Assessment and Stakeholder Engagement
- Monitoring, Surveys and Investigations
- Civil and Industrial Construction
- Environmental Management
- Energy and Energy Sources

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