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Final Report for CHN 017 Surveillance of Water Quality in the Songhua River System in Heilongjiang Province, P.R. of China CHN 017

Norwegian Institute for Water Research

REPORT

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Abstract

The report describes the main events of the project work performed during the total project period from November 1996 to June 2000 on CHN 017 "Surveillance of Water Quality in the Songhua River System in Heilongjiang Province, P.R. of China". Four automatic monitoring stations were installed in the Songhua River System. Instruments for a mobile monitoring station were also delivered. The monitoring instruments cover continuos measurements of water quality, with special emphasise on nutrients and organic load. The monitoring results are transferred to the Heilongjiang Environmental Monitoring Central Station in Harbin (HEMCS) and stored in the ENSIS system, an Environmental Surveillance and Information System, which now is fully operating. Installation of ENSIS, training in operation, and use of the system as an environmental management tool were important parts of the project. After finalisation of the project ENSIS also holds environmental information from the last 12 years of work by HEMCS. Necessary hard and software for the Chinese partners to run ENSIS were delivered as part of the project. Also an ion chromatograph and an atomic absorption spectrophotometer (AAS) have been installed in the laboratory at HEMCS. A summary description of the abatement strategy for the Mudanjiang catchment is presented, combined with information on project workshops, meetings and project costs.

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4. Sluttrapport	4. Final Report

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Final Report for CHN 017 - Surveillance of Water Quality in the Songhua River System in the Heilongjiang Province, P.R. of China

Preface

The project "Surveillance of the Water Quality in the Songhua River System in Heilongjiang Province, P.R. of China" was launched in November 1996, when an agreement was signed between the Norwegian Agency for Development Co-operation (NORAD) and the Chinese State Science and Technology Commission (SSTC). The Chines executive institutions of the project were the Heilongjiang Environmental Protection Bureau (HEPB) and the Heilongjiang Environmental Monitoring Central Station (HEMCS). From Norway the co-operative institute are the Norwegian Institute for Water Research (NIVA) and the NORGIT Centre.

Being amongst the first projects under the agreement between China and Norway for co-operation on environmental matters, this project, in addition to the normal project activities, has contributed in establishing management routines for project handling. These activities have taken both time and consideration, but are important activities that hopefully will be of benefit for the future co-operative projects between China and Norway.

This report describes the main efforts throughout the project from November1996 to June 2000.

Participants in the project team were:

Ms Kjersti Dagestad,	NIVA
Mr Tor Haakon Bakken	NIVA
Mr Stig Borgvang	NIVA
Mr Jon Lasse Bratlie	NIVA
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Oslo, 3. May 2001

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Summary

The project "Surveillance of the Water Quality in the Songhua River System in Heilongjiang Province, P.R. of China" was launched in November 1996, when an agreement was signed between the Norwegian Agency for Development Co-operation (NORAD) and the Chinese State Science and Technology Commission (SSTC). SSTC changed name during the project period to the Ministry of Science and Technology (MOST).

The Chinese executive institutions of the project were the Heilongjiang Environmental Protection Bureau (HEPB) and the Heilongjiang Environmental Monitoring Central Station (HEMCS). From Norway the co-operative institutes were the Norwegian Institute for Water Research (NIVA) and the NORGIT Centre.

Installation of the ENSIS system, training in operation, and use of the system as an environmental management tool were thr most important parts of the project. After finalisation of the project ENSIS also holds environmental information from the last 12 years of work by HEMCS. Necessary hard and software for the Chinese partners to run ENSIS were delivered as part of the project.

During the project period, four automatic monitoring stations were installed in the Songhua River catchment in Harbin, Qiqihar, Mudanjiang and Jiamusi. Instruments for a mobile monitoring station have also been delivered. The monitoring instruments cover continuous measurements of water quality, with special emphasise on nutrients and organic load. The monitoring results are transferred by telephone lines to HEMCS and stored in the ENSIS system, an Environmental Surveillance and Information System, which now is fully operational.

An ion chromatograph and an atomic absorption spectrophotometer (AAS) have been installed in the laboratory at HEMCS. Focus has been on quality assurance throughout the analytical work, i.a. there have been intercalibration exercises between the laboratories at NIVA and three Chinese Environmental Monitoring Centres (in Harbin, Mudanjiang, and Yantai).

A special case study on abatement strategy has been carried out for Mudanjiang River, a sub catchment of the Songhuajiang River system. The results of this study are described in a separate report. All reports produced by the project are listed in this report.

The project run from November 1996 until June 2000, when the Final Workshop of the project was organised in Harbin, Heilongjiang Province. The total project budget granted by NORAD was NOK 11.78 mill, of which NOK 5.28 mill was dedicated to the Chinese partners.

This report describes the main events during the project.

Contents

1. Background

The project "Surveillance of the Water Quality in the Songhua River System in Heilongjiang Province, P.R. of China" was launched in November 1996, when an agreement was signed between the Norwegian Agency for Development Co-operation (NORAD) and the Chinese State Science and Technology Commission (SSTC). SSTC is now the Ministry of Science and Technology (MOST).

The executive institutions of the project were:

- from China, the Heilongjiang Environmental Protection Bureau (H/EPB) and the Heilongjiang Environmental Monitoring Central Station (HEMCS).
- from Norway, the Norwegian Institute for Water Research (NIVA) as main partner, in co-operation with the NORGIT Centre.

A map showing the Heilongjiang Province and the Songhua River catchment of the project is shown in figure 1.

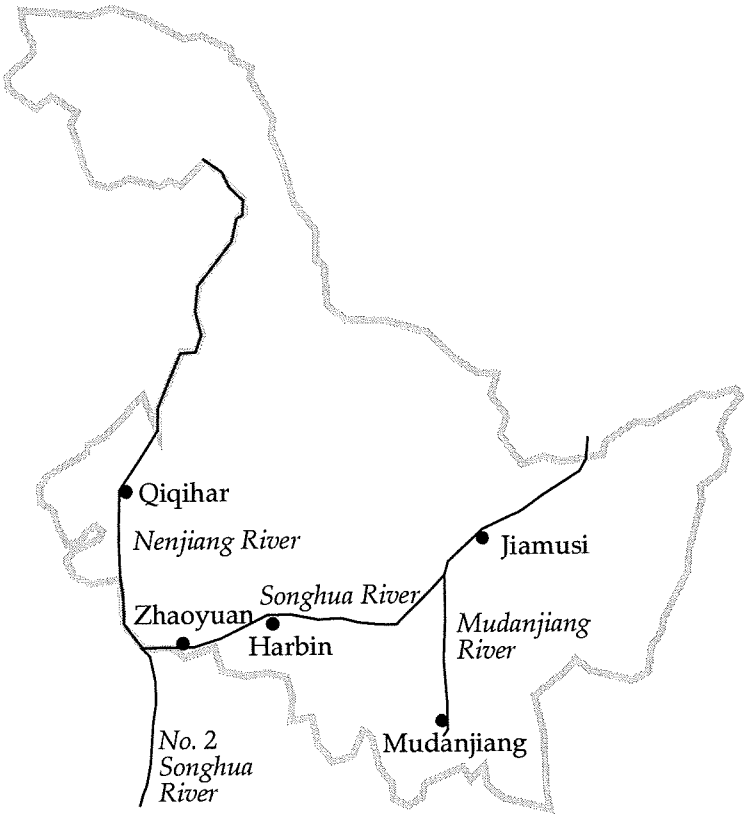


Figure 1. Heilongjiang Province and the Soghua River catchment.

2. Revised Summary Work Plan

The original project plan is described in detail in the Project Proposal: "Surveillance of Water Quality in the Songhuajiang River System in the Heilongjiang Province, P.R. of China", dated January 1996. A more detailed project plan was prepared as part of the start-up seminar in Harbin in November 1996 and reported in 1997 (Wathne et al. 1997, SNO 3615-97).

Based on the original plans for the different tasks on surveillance of water quality and development of the information technology, the project work was delayed from six months for some tasks to almost two years for others. The installation of monitoring instruments for water quality was delayed almost two years, but intensive work during spring 1999 was carried out to minimise the problems due to this delay. In accordance with the revised project plan, the project terminated in June 2000.

2.1 Phase 1 (November 1996–March 1997)

Phase 1 was carried out according to plans. The following tasks were planned and completed during the first phase of the project:

1. Project start-up seminar in Harbin
2. Detailed planning and preparations for the water monitoring and surveillance programme
3. Planning of the discharge data base, the basis of the pre-feasibility study
4. Start of discharge data inventory
5. Collection of other relevant available information on water quality
6. Evaluation of existing monitoring network
7. Institutional assessment, man power, infrastructures and equipment
8. Evaluation of laboratory equipment
9. Data model adaptation

All activities were completed as planned during phase 1, and by the end of the first phase, preparations for phase 2 were performed.

2.2 Phase 2 (April 1997–May 1999)

Phase 2 was planned as a continuation of activities from phase 1, with the addition of new activities as shown below. Phase 2 project work was delayed from six months to almost two years compared to the original plan. The following tasks were and completed during project phase 2:

1. Start sampling and continuous monitoring at the river stations
    a. system for automatic sampling, analysis and data handling
    b. system for manual sampling, analysis and data handling
    c. quality control
2. Installation of 1 server and 2 workstations
3. The telecommunication was made operational
4. First data for the river model for the Songhuajiang River system systematised and main discharge points located
5. Visit of 4 key operators and 2 key administrative staff from China in Norway

6. Training in Harbin in:

    a. operation and maintenance of monitoring instruments
    b. maintenance of the computer system
    c. system operation
7. Evaluation of the existing monitoring system, considering a possible need for extensions
8. Abatement strategy planning, 1st step

A Workshop for training on the first version of the ENSIS system was held in Oslo in January 1999.

In April 1999, the water quality monitoring instruments were installed at the four river sites along Songhuajiang River the in Harbin, Qiqihar, Mudanjiang and Jiamusi.

The first complete version of the ENSIS system was installed in Harbin in April 1999, at the same time as a workshop was organised to finalise phase 2 of the project.

2.3 Phase 3 (June 1999–June 2000)

Phase three contained mainly improvements and finalisation of the tasks described in phase 2. A complete version of the integrated ENSIS system, containing measurements, quality control, model, statistics and GIS presentations were installed and adapted to the local conditions. A final training session was performed in Harbin in the year 2000 to ensure that the system was fully understood and that the local personnel could operate the system.

The following tasks were completed in phase 3:

1. The model was made operational
2. Installation of the complete ENSIS system at HEMS
3. Further training of the staff at HEPB/HECMS in operating the ENSIS system
4. Finalisation the first abatement strategy report for Mudanjiang catchment, as a case study on abatement strategy for the Songhua River catchment
5. Finalisation the plan for extensions and new project activities for the water monitoring and surveillance

In addition to work performed by ENSIS personnel in Heilongjiang, a final workshop was organised with:

- Presentation of the technical ENSIS surveillance system
- Presentation of how to operate the ENSIS system
- Dissemination of project results
- Discussion on needs for local personnel for further operating and maintenance of the monitoring and data systems
- Discussion of further needs for collaboration
- Preparations of the content of the final report, distribution of responsibilities

2.4 Revised Summary Time Schedule

The plans for the total project are given in the following table.

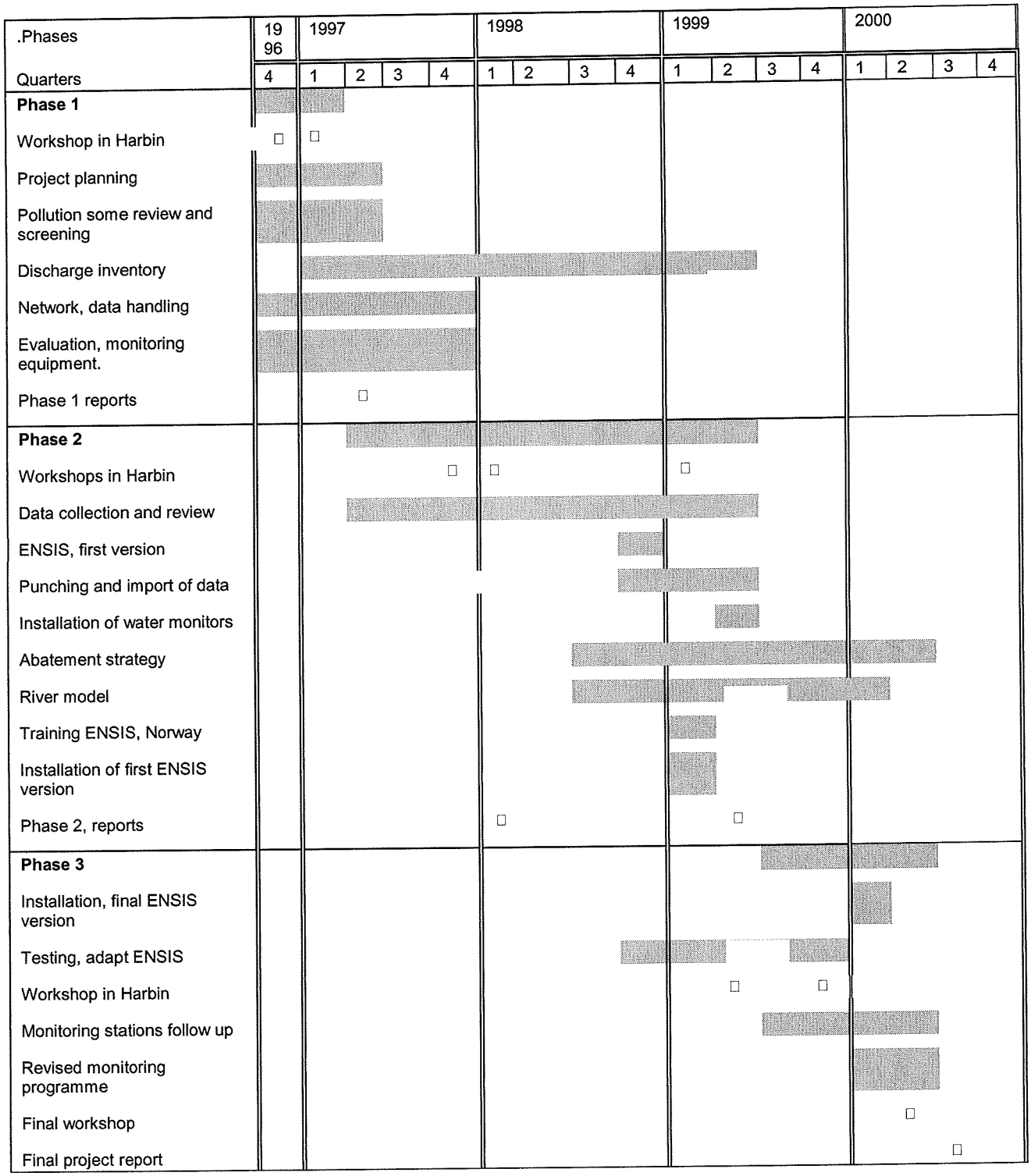


Table 1. Revised Summary Time Schedule.

3. Project work 1996 - 2000

3.1 A year by year summary of the main project events

3.1.1 Main events 1996/1997

Project work was developed both in China and Norway through 1996/1997, and the following main events took place:

- November 1996, Signing of Project contract and organisation of the start-up seminar in Harbin
- February 1997, the first Workshop Report was published, listing important agreements and project plans outlined at the start-up seminar
- March 1997, Project Meeting in Harbin
- March 1997, an agreement was reached between SSTC and NORAD as regards changes in the original project plan, such as to discard the issue of air monitoring in the project; and to allocate the funds of this part of the project to water monitoring purposes.
- June 1997, visit of a Chinese delegation in Oslo (Norway), the Chinese and Norwegian partners meet in order to settle outstanding budgetary issues, resulting in the signing, by HEPB and NIVA, of the agreed project budget for phase 2 of the project (1997-1998);
- September 1997, an Addendum to the Agreement between SSTC and NORAD was signed. This Addendum determined and approved the budget for 1997.
- November 1997, Project Meeting in Harbin

3.1.2 Main events 1998

Project related work was carried out both in China and Norway throughout 1998, and the following main events took place:

- March 1998, Workshop and project meeting in Harbin
- June 1998, short visit of the Chinese project leader in Oslo (Norway) in order to discuss the project plans for 1998
- September 1998, Digitising of paper copy maps
- September-December 1998, Configuration of the ENSIS system
- September- December 1998, Input of data and maps into the ENSIS system
- September-December 1998, Preparation for the training on the ENSIS system in Oslo
- October - November 1998, Delivery of the water quality monitoring equipment in Harbin

3.1.3 Main events 1999

The main events of the project related work carried out both in China and Norway throughout 1999 are listed in the following:

- January 1999, ENSIS training in Oslo of Chinese experts
- February -April, 1999, Adaptation and testing of the Chinese version of ENSIS in Norway
- March 1999, ENSIS installation on PC for training in Harbin
- April 1999, Workshop in Harbin/Mudanjiang, including installation of the first part of the Chinese version of ENSIS
- April 1999, Installation of, and training on water quality instruments
- May - October 1999, Modification of ENSIS

- September 1999, Mission to Mudanjiang for case study on abatement strategy
- October 1999, Workshop on data input and training in Harbin
- November 1999, Project meeting in Harbin

3.1.4 Main events 2000

The finalisation of the project was accomplished in 2000, and the following main events took place:

- April 2000, Training in Harbin, in use of the ENSIS system
- Final Abatement Strategy report drafted, the draft discussed during the Final Workshop in June
- January-June 2000, Monitoring stations, follow up,
- June, 2000 Installation of the water model and the complete Chinese version of ENSIS
- June 2000, Final Workshop
- December 2000, Installation of the final complete Chinese version of ENSIS

3.2 Administration and project organisation

A general feature as regards this project is that the administration activities have been considerably more time consuming than originally predicted. This is due to project reorganising and budget revisions, e.g. removal of the air monitoring part of the project. An addendum to the contract between SSTC and NORAD was signed in September 1997. This addendum approved, i.a., the final project budgets, listing also in more detail the allocations for 1997 and 1998. Some financial details were still discussed through 1999, but an agreement on these matters was reached, and the remaining budget for the project was concluded.

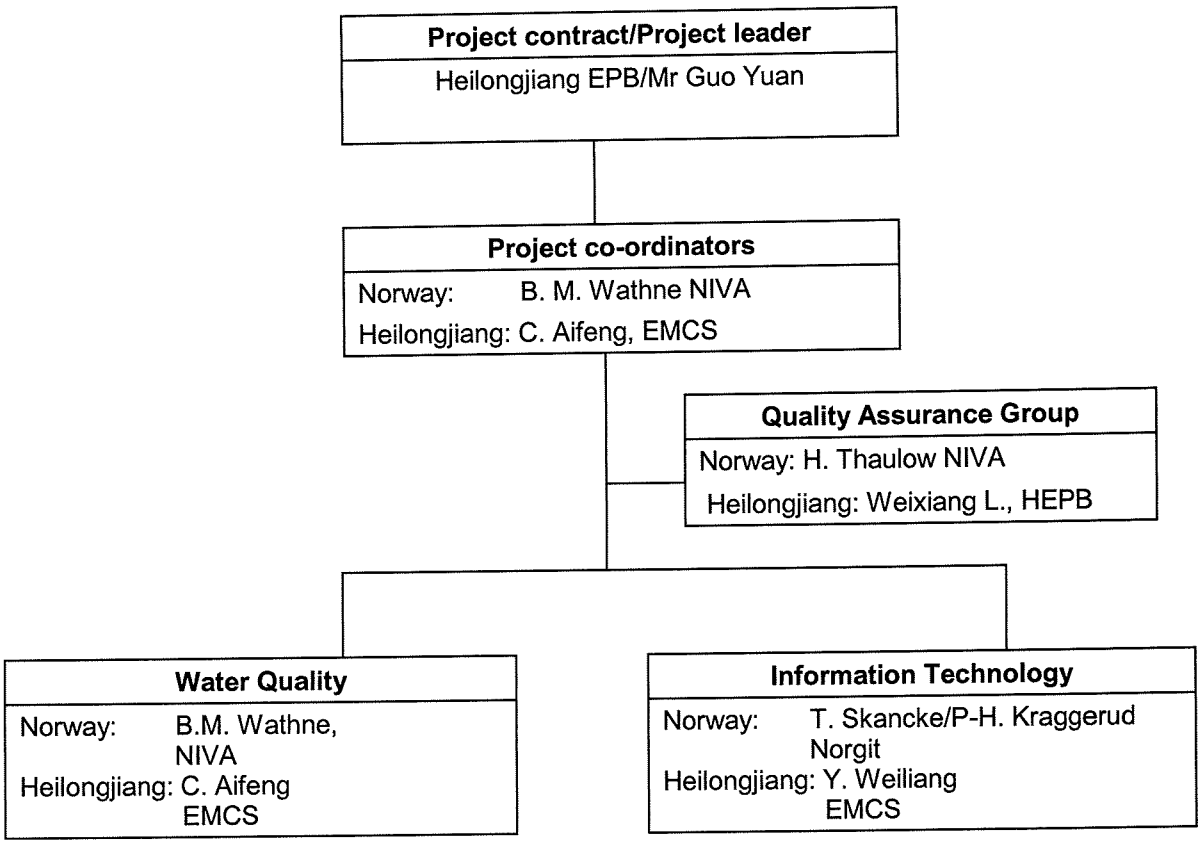
The total project has been divided into one main part for Water Quality and one for Information Technology, as shown in the overview of the project organisation in figure 2. Each main part has been divided into sub projects and each sub project had a Norwegian sub project leader and a corresponding Chinese responsible. The following sub-projects have been defined:

Table 2. Sub projects under the Water Quality and Information Technologhy

Water Quality sub projects	Information Technology sub projects
Screening river water data and performing Quality Assurance	Telecommunications
Water discharge inventory	Database
Water monitoring on-line system	User system applications
Water modelling	
Water pollution abatement strategy	
ENSIS training and follow up	
Data management, configuration and testing	
Intercalibration activities	

A 6 months delay in the project work in 1997 affected the further total time schedule of the project, i.e. the agreed original work plan was revised for the remaining project work. The project terminated in June 2000 according to the revised plan.

Figure 2.. Project organisation for CHN 017 Surveillance of the Water Quality in the Songhua River System in Heilongjiang Province, P.R. of China



3.3 Training in Norway

A joint group from HEPB/HEMCS and the Yantai Environmental Protection Bureau and Monitoring Centre (connected to CHN 014) visited NIVA and the Norwegian Institute for Air Research (NILU) 18-31 of January 1999 for training, exchange of knowledge and project discussions. The group consisted of 13 key administrative and operational staff within air and water protection departments in Heilongjiang (water) and Yantai (air and water).

From "Surveillance of Water Quality in the Songhua River, Heilongjiang Province, China - Project CHN 017" the following experts were part of the delegation:

1. Mrs Lin Shujie	Senior engineer, Supervision and Monitoring Division of Heilongjiang Provincial Environmental Protection Bureau (H/EPB)
2. Mrs Zhang Tieying	Senior engineer, Environmental Information Center of H/EPB
3. Mr Dong Xianfeng	Project officer, Foreign Cooperation Division of H/EPB
4. Mrs Chen Aifeng	Senior engineer/vice Director of Heilongjiang Environmental Central

	Monitoring Station (HEMCS)
5. Mr Chen Jiahou	Senior engineer, Heilongjiang Environmental Central Monitoring Station (HEMCS)
6. Mr. Li Jiming	Senior engineer, Heilongjiang Environmental Central Monitoring Station (HEMCS)

The training comprised both theoretical lessons and practical exercises. The most important topics covered during the visit were:

- ENSIS terminology and the user manual
- Definitions in ENSIS and search criteria
- Geographical Information System (GIS) in ENSIS
- Basic concepts of the monitoring database
- Monitoring stations and Data series
- Quality assurance and Graphics
- Statistics used for both water and air
- Demonstration of ADACS
- Abatement strategy and planning

The programme was condensed, and to some extent it was necessary to divide the group in two and work in parallel for air and water themes. The group followed an intensive training programme for the ENSIS system and also had the opportunity to visit the State Pollution Control Authority (SFT) and NORAD. These visits gave basis for a fruitful exchange of knowledge.

3.4 Abatement strategy

3.4.1 General background and selection of working area

During discussions between the HEPB, HEMCS and NIVA, it was suggested to single out one sub-catchment as a case catchment for abatement Strategy planning principles in the Songhua River catchment. After consideration, the Mudanjiang catchment appeared to be appropriate for the purpose of the co-operation project. The criteria used in the selection process were, *inter alia*, the presence of:

- A certain number of industrial activities (small and large plants)
- Agricultural activities
- Planned construction of wastewater plants
- Existing chemical and hydrological monitoring stations
- A number of user interests linked to the river system
- Varying land-cover
- Appropriate catchment size

Furthermore, the Mudanjiang catchment includes a natural lake and one artificial reservoir and has local expertise about the catchment, which facilitated the work of NIVA.

The selection of the Mundanjiang meant that the sub-project "Abatement strategy" focused on this catchment only, but that the procedures applied would be valid for any other catchment in the Songhua River catchment.

Mr Stig A. Borgvang visited the Mudanjiang Environmental Protection Bureau (MEPB) for a first preliminary study of the river catchment in April 1999. In September 1999 both Mr Stig A. Borgvang

and Mr Jon Lasse Bratli visited in Mudanjiang, as described in NIVAs Consolidated Mission reports from April and September – November 1999.

A separate report on abatement strategy principles has been prepared, describing in detail the results of the activity within this part of the project. (Borgvang and Dagestad, 2001). In the following some of the main findings are summarised.

A map showing the Mudajiang catchment is shown in figure 3.

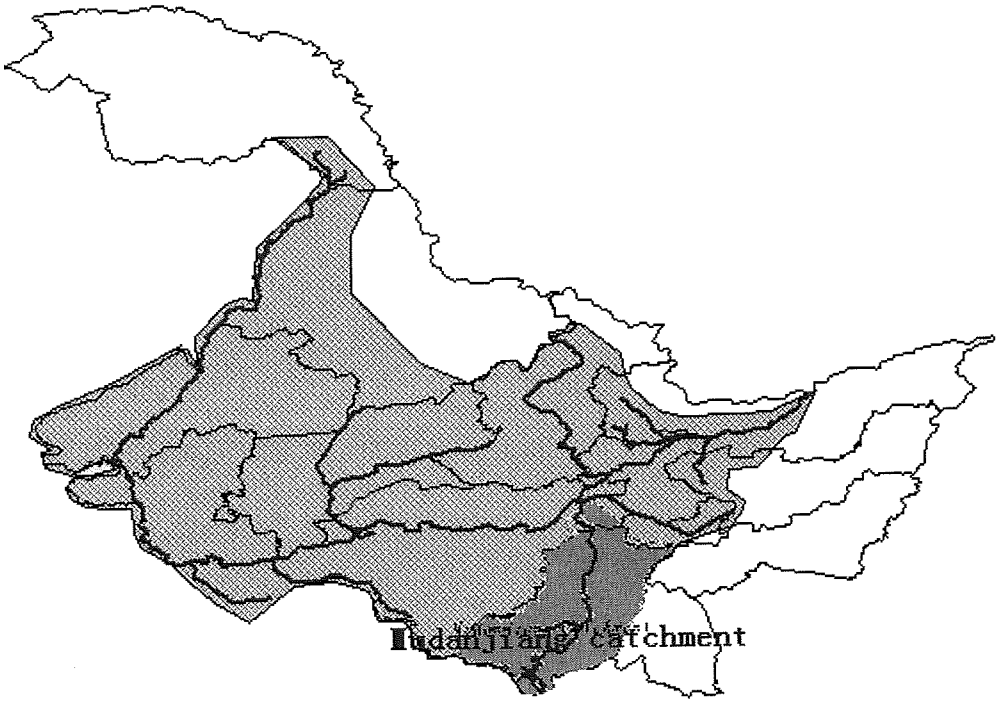


Figure 3. Mudajiang catchment.

3.4.2 Environmental problems and goals for Mudanjiang

According to Mudanjiang Environmental Authorities, the pollution due to organic matter is perceived as the main problem in the Mudanjiang River and its tributaries. It is shown by high values of COD.

The goals for user interests are set by HEPB and thereafter approved by the Heilongjiang government. The Mudanjiang River is currently categorised as class II in the upper part, class III in the middle part and class IV in the lower part (according to the Chinese National Water Classification System)

The current objectives concerning the water quality of the Mudanjiang are as follows:

- To reach water quality class II for the river stretch down to Mudanjiang city, including the lake Jin Bo Hu that has already water quality class II;
- To reach water quality class III for the river stretch from Mudanjiang city to the site where the Mudanjiang river flows into the Songhua Jiang,

3.4.3 Recommendations

This recommendation are given to launch a dialogue to advise environmental authorities on strategies for the management of water resources. Advice should be given on how to organise the planning process and how to prepare cost-effective pollution abatement strategies.

It is important to ensure that the identification of "what are the main problems in the catchment" has been carried out, taking all main user interests into account. This identification will determine which substances may represent thr major problems, and thereby also which parameters should be monitored. It is therefore also important to identify the most important sources for the identified water related problem.

The next steps in the abatement strategy planning will be to make the list of measures more exhaustive, to prioritise amongst the possible measures (cost-effectiveness analysis) and to propose timetables for implementing the selected measures.

In general terms, it may be appropriate for the future work dealing with water quality of the identified main water bodies in the Mudanjiang watershed to acquire better field and "in-house" equipment, and to gain improved monitoring performance, improved laboratory performance, improved knowledge of user interests, improved knowledge of the actual environmental problems in the catchment, and improved implementation of cost-effective measures.

3.5 Data collection and input to the ENSIS system

To gain full value and operational efficiency of the ENSIS system, collection and input of existing data from the important environmental activities by HEMCS were necessary. In the following information are given of the different data types registered in the ENSIS system.

3.5.1 Activities the Songhua River Catchment

Industry
HEPB provided paper copy maps for presentation of industrial pollution sources, data on discharges and other relevant information from the industrial plants in the catchment area of the Songhua River. The Excel tables of industries contained considerable information. HEPB reorganised the data according to the specification in ENSIS. HEPB also geo-referenced the sources with help of ENSIS.

Waste water treatment and Population
HEPB provided paper copy maps for presentation of personal equivalents per administrative statistical unit from each of the 11 main cities in thr province. On the basis of the information provided NIVA, in collaboration with HEPB, calculated the organic load and the load of phosphorus and nitrogen from domestic and industrial sewage. HEPB informed NIVA that it could not provide information about domestic wastewater discharges per sub-catchment, only per administrative district. The estimated average discharge of wastewater was estimated to 75 litres per person and day.

Agriculture
HEPB provided data on:

- the use of pesticides and artificial fertiliser,
- agriculture coverage,
- type and coverage of cereals and vegetable production
- total number of 7 different domestic animals in 11 administrative areas.

On the basis of the information provided, NIVA endeavoured, in collaboration with H/EPB, to quantify the organic load and the load of phosphorus and nitrogen from agricultural activities in the Mundanjiang catchment.

Land coverage
The issue of relevant maps was revisited several times through the project working period, before the final map was agreed. NIVA learn to understand that maps represented a difficult topic to handle. HEPB collected the data for information on land coverage.

User interests
NIVA received a map scale 1:1000 000, indicating the Songhua River catchment and three types of user interests. NIVA prepared the ENSIS system on the basis of this information. The user interests are visualised in ENSIS as a river link dataset.

3.5.2 Monitoring data

Water chemistry and monitoring sites
All monitoring data from 46 monitoring stations in lakes and rivers were exported from the Chinese FoxPro database and converted into Excel files and then imported into ENSIS. The files for the individual years contained all stations and all parameters for the year in question. From 1986 to 1997, there are, all in, 8404 routine data sets, 19970 selected data sets are converted and imported into ENSIS.

This issue was developed by NIVA and H/EPB with the aim of assessing:
- the water quality of the Songhua river and its tributaries
- the current chemical monitoring programme.

Rivers and Catchments
NIVA received a paper map with scale 1:1.000 000, where the Songhua River catchment, lakes and tributaries to the Songhua River and the monitoring stations were indicated. Based on the map, NIVA digitised the entire river in system and entered this into the ENSIS system. The catchment of Songhua River was also digitised. The Mundangjiang River catchment was selected, in agreement with HEPB, for abatement strategy purposes. The sub-project 'Abatement strategy' focused on the Mundanjiang catchment only, but that the procedures applied would be valid for any other catchment in the Songhua River catchment.

Water flow
Water flow data is essential in pollution load calculations and the development of an abatement strategy. It is understandable that such data is difficult to obtain in view of the considerable seasonal differences in river water flow (riverbed changes).

Biological Monitoring
NIVA received biomass data from the flooding season in the Nei river for 1995 and 1996, i.e. data on zooplankton, phytoplankton and benthic organisms.

Quality Control Procedures

HEPB informed NIVA about their instructions and methods for sampling and analysis at laboratories, which have been adopted by H/EPB to increase quality of the analysed parameters.

Water Quality classification
The ENSIS version installed in Harbin contains a functionality to classify water quality data according to the Chinese water quality classification criteria (based on yearly averages).

3.5.3 Data for abatement strategy for the Mudanjiang catchment

In addition to monitoring results from the water quality and biology surveillance of the Mudanjiang catchment, information on industrial activities and municipal wastewater were necessary to prepare the abatement strategy. The necessary data for an abatement strategy for the Mudanjiang catchment were delivered from the local authorities in the Mudanjiang Environmental Protection Bureau (MEPB) to the Norwegian project partners.

3.6 Water Monitoring equipment

Within the project, monitoring instruments have been delivered both for continuos measurements at river sites and for laboratory work at the analytical laboratory at HECMS in Harbin. The opportunity for the Chinese project partners to purchase laboratory instruments came due to the budget revisions after the removal of the air part with original projectplan.

3.6.1 Evaluation and selection of Monitoring equipment

It was NIVA's responsibility to find the best equipment for the water quality monitoring of the Songhua River, and much effort was put into the evaluation and selection process. The evaluation process was built on NIVA's extensive experience in instrumentation for water quality assessment.

The parameters selected for continuous monitoring were pH, conductivity, temperature, nitrate, ammonium, and COD (Chemical Oxygen Demand); all measured after standard procedures. A "complete station" was equipped with instruments to cover all parameters and a "reduced station" got instruments to measure pH, conductivity, temperature and ammonium.

Products from a number of producers were screened. An in depth evaluation was performed, and the results based on whether the instruments could meet the criteria set. This evaluation process was completed by the end of February 1997, i.e. before the March 1997 annual meeting between NORAD and SSTC in Beijing. NIVA's recommendations were presented before the said meeting. As the agreement for the 1997 budgets was signed as late as in September 1997, the ordering process to follow the instrument selection was delayed.

3.6.2 Installation of instruments at the monitoring stations

Due to delays in the ordering process, the monitoring instruments were only delivered late 1998. At that time of the year installation was not possible due to climatic factors, so the installation therefore took place during 12 - 23 April 1999.

The instrument installation was carried out by Mr. Arne Veidel and Mr. Morten Willbergh from NIVA, with assistance from HEPB and the Chinese local personnel at the monitoring sites in Harbin, Qiqihar, Mudanjaing, and Jiamusi. The installation process started at the Harbin Waterplant, and all

the personnel from the other monitoring sites were present for training purposes. They later assisted in the same process at their own site. Installation was completed at Harbin Waterplant, Qiqihar Waterplant, Mudanjaing Waterplant and Jiamusi Powerplant. At the same time, more specific training of the local personnel was undertaken.

The mobile monitoring station has not yet been put together, but all the instruments are delivered. Configuration and installation were carried out after a running-in period with the instruments. The installation process is described in detail in the Consolidated Summary Report of NIVA's mission to Harbin in April 1999 (Wathne et al. 2000, SNO 4164-2000).

3.6.3 Installation of instruments for analytical labs

AAS (atomic absorption spectrophotometer) Hitachi Z-500 and ion chromatograph Shimadzhi HIL-14A, have been installed in the lab at HEMCS. They are used respectively for analysis of Cu, Pb, Cd, Mn, Cl, F and SO_4 respectively.

3.7 Laboratory Inter-comparison

A laboratory inter-comparison was organised in 1998 between NIVA and the co-operative laboratories in Harbin and Yantai, Shandung Province (CHN014). The results indicated that it would be very important to carry out a more comprehensive inter-comparison, which would encompass all major components. On this basis, it was decided to carry out a more comprehensive inter-comparison during 1999, including all major components. The participating laboratories in this intercompariosn were NIVA and the laboratories in Harbin, Mudanjiang and Yantai, Shandung Province. The intercomparison was carried out during November and December and the results are reported in Appendix A.

3.8 Information technology

An important part of the project was to establish a computer platform, and adapt and install the ENSIS system in the Heilongjiang Province. This part of the project was NORGIT's responsibility.

The procedure regarding procurement and import of necessary equipment in the project was unclear during the first phase of the project and it was only defined one year after the project started. The process started in November 1996 with an agreed project plan, signed by NORAD and SSTC. This plan was based on very definite conditions with regard to time schedules and availability of equipment.

3.8.1 Data equipment

NORGIT needed data equipment to modify the ENSIS applications, test the equipment to be sent to China, and for training Chinese colleagues in Norway.

In December 1996 an agreement was made between China and Norway about the data equipment necessary for the project. The hardware list was sent to China for approval. Technical discussions between NILU, NIVA, NORGIT and HEPB took place. NORGIT also discussed the equipment issues with various companies.

To obtain progress and fulfil the time plan in the project, NORGIT borrowed the necessary hardware. This made it possible for NORGIT to accomplish both the "Factory acceptance test" (FAT) and part

of the "Site acceptance test" (SAT) in Norway. The installation could easily be compared with the basic ENSIS-system, which was an important task in quality assurance of the system. Installation and testing in Norway was also very efficient. Installation and testing done by different people are also considered to be important tasks in quality assurance of the system.

3.8.2 Configuration and training in Norway

Configuration and testing in Norway was the basis for the project plan and budget. Installation in China would have enhanced the project costs considerably and new allocations for this activity would have been needed. The project plan would also have had to be revised according to the extra time and costs.

Training of Chinese experts took place in Norway. The training was carried out using Chinese hard-/software. It was then easier for the users to start using "ENSIS" in China when they were already familiar with part of their own system from the training in Norway.

3.8.3 Adjustment of "ENSIS version-2.0" to Chinese conditions

The ENSIS-data model was modified to satisfy the Chinese requirements. The analysed data from the Chemical Laboratory were entered into the system through a Manual Data Acquisition System (MDACS). This application makes it possible for the user to record data manually. The examples from laboratory data have been used to modify the MDACS according to HEPBs requirements. In co-operation with NIVA and NILU, NORGIT completed the ENSIS 2.0 system. The work focused on the development of the main module and some technical co-ordination of the model work.

3.8.4 Data handling

In the ENSIS database the following themes were entered:

- ✓ Administrative Regions
- ✓ Monitoring Stations
- ✓ Rivers (river nodes, river links and river chains)
- ✓ Lakes
- ✓ Roads (road nodes, road links)
- ✓ Stacks

Furthermore, the original maps NIVA obtained from HEPB, were applied to create the following shapes:

- ✓ Land Use (agricultural area, mountain area and forest)
- ✓ User interests (points for irrigation and groundwater abstraction)
- ✓ Coastal area

During the Workshop and NIVA's visit to Harbin in April 1999, further work on these issues was performed.

3.8.5 Installation of ENSIS

The installation of ENSIS on the main server was planned for March 1999, but due to delay in the transport of the server, the installation was only possible on the computer at the time of NORGIT's visit in March 1999. The complete version of "ENSIS 2.02" was therefore installed at HECMS in Harbin in April 1999. This includes a new version of the "User Database Administrative Tool".

During 1999 NORGIT also developed "ENSIS" to handle languages, i.e. both English and Chinese. The first version of "ENSIS" in Chinese was sent to China for testing in December 1999.

3.8.6 Automatic transmission of data - ADACS

The ADACS system was developed to handle automatic transfer of water quality data from the monitoring sites to the central ENSIS database in Harbin. During 1999, there were some problems with "ADACS" concerning communication with the loggers and measurement position, but a new installation in April 2000 solved the problems.

3.8.7 Maps

NORGIT prepared some new detailed maps received from Harbin HEMCS, and some map-themes were installed in Harbin during the Workshop in October/November 1999.

3.8.8 Training in Harbin

NORGIT visited Harbin in March, April and November 1999. At these occasions, training in the use of "ENSIS" and "ADACS" were carried out. NORGIT has also trained Chinese personnel in the use of "ORACLE" (database) and "ArcView" (GIS/map-management).

3.8.9 Documentation

In November 1999, NORGIT delivered an update or first version of the following documentation:

- "ADACS"
- "User Database Application for Administrator"
- The part "File" (includes Import/Export) of the "ENSIS user manual"
- "System management"
- "Report Generator".

3.9 Workshops and project Meetings

3.9.1 Project start-up seminar in Harbin, November 1996

The project start-up seminar was held in Harbin, 17 – 22 November 1996. The project contract was signed between Heilongjiang EPB and NIVA, and detailed work plans for the project were discussed. (Wathne et al. 1997, SNO3615-97)

3.9.2 Project Meeting in Harbin, February/March 1997

A workshop was held in Harbin from 26 February to 3 March 1997. The workshop report from the meeting outlines important information on administrative matters, as well as a detailed and agreed workplan for the project (Wathne et al. 1997, SNO 3641-97)

3.9.3 Project Meeting in Harbin, November 1997.

Changes in the original project plans, such as to discard the issue of air monitoring in the project and reallocation of the funds for this part of the project, needed special attentions and administrative discussions. Also the addendum to the contract between SSTC and NORAD signed in September 1997 was a topic at the meeting. Details from the project meeting are described in the status report for 1997, (Borgvang et al. 1997, SNO3805-98).

3.9.4 Water Quality Workshop, March 1998

A workshop was held in Harbin 23 – 26 March 1998, covering the following issues:

Data collection
Biological monitoring
Instrument list
Quality assurance procedures
Laboratory Intercomparison
Future co-operation

A Summary report from the Workshop was prepared by Mr. Stig A. Borgvang and agreed between the project partners. The results of the Workshop are described in more detail in the input to the Annual Report 1998. (Dagestad et al. 1999, SNO 4018-99).

3.9.5 Project Workshop and ENSIS installation April 1999

During a mission to Harbin and Mudanjiang in April 1999, a workshop was held in Harbin 19 – 23 April, covering the following issues:

- Project management
  1. Annual Report discussions
  2. Project extensions and further co-operation
- Data collection
- Training and ENSIS installation
- Abatement strategy planning for Mudandjiang catchment

A visit to Mudanjiang was included as the first preliminary study of the river catchment.

A Summary report from the Workshop is included in the Consolidated Summary Report of NIVA's mission to Harbin in April 1999 (Wathne et al. 2000, SNO 4164-2000).

3.9.6 Project Meeting in Mudanjiang

In the period 31 August – 10 September 1999 a project meeting was held in Mudanjiang, when both Mr Stig A. Borgvang and Mr Jon Lasse Bratli from NIVA visited the catchment. The main topic for the visit was the case study on abatement strategy for the Mudanjiang catchment and drafting the report for the area. Participants from Mudanjiang Monitoring centre were: Mr Sun Zi Meng, Mr Ye Dan, Mr Niu Xian Chun, and Ms Yu Shi Hong. From HEPB Ms Qu Mo Li, participated. The results are described in NIVA's Consolidated Mission reports from April and September – November, (Wathne et al. 2000, SNO 4205-2000). The visit showed the importance of working in close contact with people genuinely concerned by the environmental problems of the area where they live.

3.9.7 Workshop in Harbin in October 1999 for data input and ENSIS training

During a workshop in Harbin 7 – 14 October 1999, emphasis was on training and data input for the ENSIS system for Heilongjiang Province. The goals for the workshop were to:

- Synchronise the local database with the most recent version of the ENSIS database
- Install an updated version of the ENSIS application
- Discuss questions and problems encountered in the period since the previous training session

- Export all the monitoring data within the Songhua River Catchment from FoxPro to Excel, and convert the data to ENSIS format
- Build a complete monitoring database by importing converted data to ENSIS, and enter other necessary data for the system
- Discuss pollution source data and how to proceed within the project.

The results and conclusions from the workshop are described in more detail in the Consolidated Mission reports from September – November 1999 (Wathne et al. 2000, SNO 4205-2000).

3.9.8 Project Meeting in Harbin in November 1999

During 1 - 4 November the last project meting in 1999 was held in Harbin. The main themes were:

- Administrative matters,
- Project status, and plans for 2000
- The water monitoring stations and their management,
- Plans for the annual report
- Project extensions and further co-operation
- Intercalibration activities
- Support and service for the ENSIS system

A more detailed report from the project meeting is given in the Consolidated Mission reports from September – November 1999 (Wathne et al. 2000, SNO 4205-2000).

3.10 Final Project Workshop

A final workshop was held in Harbin in June 2000 covering the following topics:

- Presentation of the technical ENSIS surveillance system
- Presentation of how to use the ENSIS system
- Presentation of the monitoring system and how it is working
- Presentation of the laboratory equipment granted by the project and its performance in the lab
- Dissemination of results
- Discussion on needs for local personnel for further operating and maintenance of the monitoring and data system
- Discussion of further needs for collaboration
- Preparations of the content of the final report, distribution of responsibilities

Representatives from the local authorities were present together with the responsible staff from the monitoring sites and Monitoring Stations/Centres in Harbin, Qiqihar, Mudanjaing, and Jiamusi. Mr. Leiv Landro represented the Norwegian Embassy in Bejing. He also addressed the Workshop after a warm welcome by Mr. Li Weixiang, head of Heilongjiang Environmental Protection Bureau.

A meeting with Madam Ma Shujie Vice Governor for Heilongjaing Province was held at the Heilongjiang Province Government Building as part of the official workshop.

The Final Workshop Programme is shown in Appendix B.

A project meeting was held during the workshop and minutes from the project meeting are given in Appendix C.

4. Project costs

4.1 General overview

The total budget for the project was in the original Project Plan **NOK 11.590.007.** (See Annex II in the Agreement between NORAD and SSTC, signed November 8 1996). The project budget was divided into three phases:

Project Phases	**Period**	**Costs**
Phase 1	(November 1996 – March 1997)	NOK 1.500.000.
Phase 2	(April 1997 – September 1998)	NOK 8.244.007.
Phase 3	(October 1998 – September 1999).	NOK 1.551.000
Project expenses		NOK 295.000
Total		**NOK 11.590.007**

Phase 1 was carried through according to plans, and the costs spent were **NOK 1.500.102.** According to information from NORAD, NOK 1.500.000 was transferred to MOST during phase 1. Of this amount **NOK 778.105** was remunerated from China to the Norwegian experts, leaving **NOK 721.997** to the Chinese partners. The rest of the amount to cover the Norwegian expenses in phase 1 was remunerated directly from NORAD, due to changes in the financial procedures and handling routines for the project.

After the Annual Meeting between MOST (MSTC/SSTC) and NORAD in 1997, the Project plan was changed, as the air part was removed from the plans.

In 1997, NORAD and MOST agreed that the Chinese side should purchase data equipment and water monitors for the project. It was later also agreed that installation of the ENSIS system should be performed in Norway due to practical reasons. After reallocation, the total budget was **NOK 5.029.800** to the Chinese side and **NOK 3.182.000** to the Norwegian side for phase 2 of the project. Of this allocation, a total amount of **NOK 4.600.000** was transferred directly to China in 1997. There was no transfer of money to China in 1998 or 1999.

From the phase 3 budget, **NOK 60.000** was reallocated from the original Norwegian budget to the Chinese budget to cover the expenses of the final workshop. This was agreed as part of the budget revisions after removal of the air part of the project in 1997, and part of the agreement for the budget signed for phase 2 in June 1997.

There has been a long history of negotiations and changes of financial procedures and handling routines during the running of this project, which have made the financial handing and overview difficult for all parties. During a project evaluation started by NORAD in 1999, it was revealed that a too large proportion of the project funds had been transferred to MOST. A letter sent by NORAD on financial matters explained this fact and asked that an additional amount of **NOK 191.095** should be made available for NIVA from the money transferred to MOST.

The Chinese project partners stated that MOST had not yet agreed to the overall budget referred to in NORAD's letter, and the transferred money were spent on project related issues, with the understanding that the amount was correct. It appeared that it was very difficult, at this stage, to

reallocate the money. Therefore in 2000, the before mentioned amount of NOK 191.095 was accepted as an additional grant increasing the total budget to **NOK 11.781.102,** and the total budget to **NOK 5.280.895** to the Chinese side.

4.2 Project costs in 2000

Detailed accounts for each sub-project year are given in the Annual Reports. For the year 20000, the last project year, the actual projects costs were as shown below:

Table 3. The Norwegian acutal project costs for 2000. All amounts in NOK.

Nr	Task	Total
1	**Administration**	
1.1	Consulting services	189.200
1.2	Travelling expenses	207.279
2	**Final report**	49.075
3	**Workshop**	50.050
4	**Monitoring**	
4.1	Consulting services	59.115
5	**River Modelling**	308.466
6	**Abatement strategy**	2.275
7	**ENSIS training/follow up**	384.131
8	**Installation**	
9	**Configuration and test**	28.226
10	**Intercalibration**	15.600
	Total	**1.293.417**

The detailed invoices for the year 2ooo are shown in Appendix D.

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5. Reports from the project produced by NIVA.

Wathne. Bente M. Surveillance of Water Quality in the Songhua River System in Heilongjiang Province – Pre-feasibility study – 1995.Travel report from, Heilongjiang Province, China, October/November 1995. Report SNO 3523-96

Chen, Aifeng, Wathne, Bente M., Skancke Torsetin, Bøhler Trond. Project Proposal. Surveillance of Water Quality in the Songhua River System in Heilongjiang Province, P.R. of China. January 1996.

Wathne Bente M., Veidel Arne, Olafsson, Finnur, Bøhler Trond, Skancke Torstein, Guo Yuan. Workshop Report from Surveillance of Water Quality in the Songhua River System in Heilongjiang Province, P.R. of China, Harbin, Heilongjiang 17 - 22 November 1996. Report SNO 3615-97

Wathne Bente M., Borgvang, Stig A., Dagestad, Kjersti. Summary Report. Surveillance of Water Quality in the Songhua River System in Heilongjiang Province, P.R. of China, Harbin, Heilongjiang 26 February - 3 March 1997 Report SNO 3641-97

Borgvang, Stig A., Wathne Bente M., Dagestad, Kjersti, Veidel Arne, Skancke Torstein, Status Report 1997. Surveillance of Water Quality in the Songhua River System in Heilongjiang Province, P.R. of China. Report SNO 3805-98

Dagestad, Kjersti Borgvang, Stig A., Wathne Bente M., Surveillance of Water Quality in the Songhua River System in Heilongjiang Province P.R. of China. CHN 017. Input to the Annual Report 1998. Report SNO 4018-99

Wathne Bente M., Borgvang, Stig A., Dagestad, Kjersti, Veidel, Arne. Surveillance of Water Quality in the Songhua River System in Heilongjiang Province P.R. of China. CHN 017. Consolidated Summary Report of NIVA's mission to Harbin April 1999. Report SNO 4164-2000

Wathne Bente M., Borgvang, Stig A., Dagestad, Kjersti, Bakken, Tor Haakon, Veidel, Arne. Surveillance of Water Quality in the Songhua River System in Heilongjiang Province P.R. of China. CHN 017. Consolidated Summary Report of NIVA's missions to Mudandjiang and Harbin September - November 1999. Report SNO 4205-2000

Wathne Bente M., Surveillance of Water Quality in the Songhua River System in Heilongjiang Province P.R. of China. CHN 017. Input to the Annual Report 1999. Report SNO 4206-2000

Borgvang, Stig A., Dagestad, Kjersti. Surveillance of Water Quality in the Songhua River System in Heilongjiang Province P.R. of China. Mudanjiang River catchment. Abatement Strategy. Principles and some examples Report SNO 4378-2001

Wathne Bente M. Final Report for CHN 017. Surveillance of Water Quality in the Songhua River System in Heilongjiang Province P.R. of China. Report SNO 4373-2001.

Appendix A. Intercomparison results

The Analytical Results (2000, HEMCS)

Item	Sample	Concentration	Method
pH	B	5.76	Glass electrode method
	D	5.36	
Ammonium-nitrogen (mg/L)	B	0.025	Nessler's reagent colorimetric
	D	0.558	
Total Phosphorous (mg/L)	B	0.047	Nitrogen-alkaline potassium persulfate spectrophotometric method with stannous chloride
	C	0.268	
COD_{Mn} (mg/L)	B	2.47	Acid potassium permanganate
	D	7.16	
Conductivity (ms/m)	B	2.30	Conductivity gauge method
	D	3.90	
Nitrate (mg/L)	B	0.05	Spectrophotometric method with phenol disulfonic acid
	C	1.28	
Sulfate (mg/L)	B	<0.1	IC
	D	<0.1	
Chloride (mg/L)	B	0.271	IC
	D	1.151	

After the report on the intercomaprison exercise was finished, Ms Chen Aifeng relised there were some misteakes in the results sent to NIVA, and used as basis for the report. On 2000/8/21 the following mail was sent to Norwegian experts to correct the analytical results:

Mr. Havard Hovind,

I have received the report on the intercomparison of chemical analyses, 1999, between four laboratories in China and NIVA Norway. I am the laboratory no.3. There are some mistakes in the results of analyses I wrote to you before. I correct the mistakes to be right, now.

1.There are mistakes on the instruments the results of conductivity are not right. The results are blank out.

2.There are mistakes with the calculation of COD, the right results are 0.25 mg/l (sample B) and 0.72 mg/l (sample D).

3.It's the right results of nitrate, 0.765 mg/l (sample C) with IC method, and 0.75 mg/l (sample C) and 1.28 mg/l (sample D) with spectrophotometric method with phenol disulfonic acid.

The analytical results, 1999, Mudanjiang

Item	A	B	C	D
pH	6.80	6.45	5.59	5.22
Ammonium-nitrogen mg/L	<0.05	<0.05	0.379	0.474
TP mg/L	0.05	0.05	0.27	0.23
COD_{Mn} mg/L			0.78	0.67
Conductivity μs/cm	4.02	3.96	23.6	25.5

Report on the intercomparison of chemical analyses, 1999, between four laboratories in China and NIVA in Norway.

Mr. Håvard Hovind, Norwegian Institute for Water Research (NIVA), Oslo, Norway

1. General

1.1. Introduction

Through years of experience with projects in different countries, with the organisation and evaluation of intercomparisons, we have learned that different laboratories very often use different analytical methods, or use different versions of the same analytical method for chemical analysis of water samples (as well as for sediments and biological materials). There may be different reasons for the laboratories' choice of analytical method, but once a method works on a routine basis, our experience is that there is very little willingness to change the method.

All analysts working with chemical methods know that different methods or different versions of methods, may lead to different analytical results. Therefore, when comparing chemical data from several laboratories, it is very important to have a documentation of the comparability between laboratories. One way to obtain such documentation of the comparability between two or more laboratories in a simple way, is to perform parallell analysis or intercomparison tests.

Intercomparisons of analytical methods are easily carried out by analysing sample aliquots taken from the same sample and sent to all the participating laboratories. If only two laboratories are involved in the comparison, it is usually called parallell analysis. The best way to select samples is to take a series of samples from the water bodies in the monitoring area. Therefore, such a set of samples should be sent to the laboratories involved in the intercomparison test. However, if this is difficult to organise samples may, as an alternative, be sent from the organising laboratory, which endeavours to select samples being comparable with the samples in the relevant water bodies.

1.2. Intercomparison of analytical methods

The analytical variables to be determined in the intercomparison should be the same as the ones included in the respective monitoring programmes. There are different ways to handle the results however, for water samples the most commonly used method is to produce one analytical result for each variable in each sample.

2. Current Project

2.1 Background

As an introduction to a more comprehensive intercomparison exercise in the future for the analytical programmes connected to the NORAD projects in China, the NIVA laboratory together with four laboratories in China, performed an intercomparison exercise in 1999. The results of this

intercomparison will be a good basis for the proposed future exercises. The 1999 intercomparison exercise was partly funded by NIVA.

2.2. Preparation of samples

Stock solutions were prepared by weighing exact quantities of stoichiometric compounds into volumetric flasks, dissolving the compounds and diluting to the mark. Given volumes of these stock solutions were pipetted into 5 litre volumetric flasks and diluted to the mark with deionised water. The concentration of these synthetic samples were calculated from the weighed amount of compound and the dilution factors. These "true values" are given in the tables on the following pages, together with the results received from the participating laboratories. The samples were mailed to the laboratories 15. November 1999.

2.3. Treatment of data

The analytical results were sent to NIVA, which recorded all the results for statistical calculations. For water samples where only one result is reported for each variable and sample, and three or more laboratories are participating, it is normal to calculate the median value, the arithmetic mean and the standard deviation between the laboratories. For some of the analytical variables it is possible to calculate the true value from the weighed amount of material and the volume of the stock solution used for the preparation of the samples. As the exact true value of some other of the analytical variables are not known, it is suggested that the median value is used as basis for the comparability tests, as this value is normally less affected by outliers than the mean value. However, whenever only three laboratories have sent results for some of the analytical variables, this is not the case, and the problem needs to be discussed.

Some plots of the results have been made as bar diagrams, where the analytical results of the participating laboratories are plotted along the y-axis, and the sample number A -D along the x-axis. For each sample the laboratories are represented by a column, vizualised by different column shadings. The Figures 1 - 8 illustrates the comparability between the laboratories. When only three laboratories are compared, it is possible to prepare correlation plots between two and two laboratories. However, this type of plot is more valuable if several samples, with varying concentration of the determinand, have been analysed at the laboratories involved.

It creates a problem that one of the laboratories, number 3, has returned results only for one sample in a sample set. That means that there are reported results for sample B in sample set AB and for sample D in sample set CD, and not for the other sample in the sample set.

Some time after this compilation of data, a meeting should be organised for the participating laboratories to discuss the results and try to explain the varying results. Criteria to be used for establishing acceptance limits for comparability should also be discussed.

2.4. Analytical results from the participating laboratories

The analytical results reported by the participating laboratories are compiled in the following tables, together with the calculated median value, the mean value, the standard deviation and the calculated "true value" of the synthetic samples for the analytical variables where this is possible. In cases where the results from one laboratory are strongly deviating from the other two laboratories,

the results from this laboratory normally is excluded from the calculation of the mean value. Because very few laboratories participated in this intercomparison, this is not done here.

2.4.1. pH

There are some differences between the three laboratories as regards reported pH values. For the samples A and B, and partly C, laboratory no. 2 has reported much higher results than the other two laboratories. For sample D the results from the three laboratories are much more comparable. It should also be noticed that the samples were analysed at rather different periods of the month at the three laboratories, and this different storage time may have affected the pH determination. However, the similarity in composition between the samples indicates that there should not be expected any differences in the comparability from one sample to another, any systematic deviation should more likely be the same for all four samples. Differences between samples indicates that the error affecting the results is random.

2.4.2 Conductivity

For conductivity, the comparability is good between two laboratories, however, one laboratory (no. 3) has reported a very low result for sample D. This analytical variable is greatly affected by the temperature in the solution during measurement. Thus the conductivity is increasing with about 2 % per degree at room temperature. However, this does not explain the very low result of laboratory no. 3, which should check their instrument and electrode for malfunctioning.

2.4.3. Phosphate-phosphorous, mg/l

Three laboratories reported results for phosphate in the samples A - D. There is very good comparability between the laboratories for sample A, which has a low content of phosphate. For sample B, laboratory no. 4 has reported a slightly too high result compared to the two other laboratories. The results for the samples C and D are of acceptable comparability. The median and mean values are close to the calculated theoretical values.

2.4.4. Total phosphorous, mg/l

For total phosphorous the comparability is good for the results of the samples C and D, which had the highest concentrations of phosphorous. The results of the samples A and B are differing much more. Thus laboratories no. 2 and 3 reported results being too high compared with the other laboratories, which results are close to the calculated value for total phosphorous. This difference at low concentrations may be caused by problems with the blank values, which is dependent on the calibration of the instrument, or there may be problems with contamination from the reagents or the surroundings.

2.4.5. Nitrate-nitrogen, mg/l

For this analytical variable, laboratory number 4 has reported too high values for all four samples, both when the comparison is made with the other laboratories, and with the calculated values. The

result from laboratory no. 3 is slightly too low for sample B, when compared to the calculated value for nitrate. For sample C the result from laboratory no. 3 is missing, but the comparability between laboratories 1 and 3 is very good for sample D, and the reported values are very close to the calculated ones. To find a reasonable explanation for the observed differences, more detailed information about the methods used for the determination of nitrate is necessary.

2.4.6. Ammonium-nitrogen, mg/l

For this analytical variable, the comparability of the results is varying considerably from one sample to another. For samples C and D the comparability of the reported results may be considered acceptable. This analytical variable is rather difficult to determine with high precision at very low concentrations, because from experience at many laboratories that contamination may represent a severe problem in the very low concentration range.

2.4.7. Total nitrogen, mg/l

Three laboratories reported results for total nitrogen, however, the comparability was rather varying. Laboratory no. 4 reported far too high results for all four samples when compared to the calculated value. The difference compared with the other laboratories is visualised very clarly in Figure 7. The comparability between the other laboratories is good, taking into consideration the extremely low concentrations of nitrogen in samples A and B.

2.4.8. Chemical oxygen demand, COD-Mn

It appears as if the permanganate oxidation is performed under rather different conditions at the participating laboratories, as the results are varying considerably. The calculated values for total organic carbon is 0,83, 1,03, 6,16, and 5,13 mg/l, respectively, and it was expected that the COD results should correlate in a simple manner to these values. One complicating factor is the fact that the concentrations are very low at least in two of the samples, i.e. A and B. In addition to this, the use of potassium phthalate as a carbon source may represent some problems as it is not allways completely digested during the oxidation process. The oxidation degree is strongly dependent on the reaction conditions. In the future it is necessary to use another organic compound which is more easily digested as carbon source.

3. Conclusions

The preparation of this report was strongly delayed because of the difficulties to get all the results from the participating laboratories. This problem led to a situation where we have written the report from the intercomparison, without letting the participants have the possibility to comment on a draft report. In the future, the participating laboratories must comply with with the planned time schedule.

It appears obvious that there are different analytical method used at the participating laboratories. This is shown in the table of results for phosphorous and ammonium, when considering the different detection limits used. This fact may partly explain the relatively great variations in the reported results at the low concentration ranges. In addition to this there may also be a problem in controlling the contamination risk when performing analyses at low concentrations, especially for analytical variables such as ammonia and phosphate.

The relative deviation (%) from the calculated theoretical value for phosphorous and nitrogen compounds.

		Laboratory number				
Analytical variable	**Sample**	**1**	**2**	**3**	**4**	**5**
PO4-P	A	4,3			- 4,3	4,3
	B	- 2,9			**46**	7,9
	C	- 0,3			- 6,6	2,8
	D	0,4			- 17,3	4,3
TOT-P	A	0	**54**		<	4,3
	B	0	**43**	**34**	<	5,7
	C	- 0,3	- 6,6	- 7,3	- 10,0	3,1
	D	- 0,4	- 0,4		- 13,4	4,3
NO3-N	A	- 1,6			**163**	
	B	1,3		**35**	**381**	
	C	- 1,7		**66**	**185**	
	D	0,2			**90**	
NH4-N	A	0	<		**- 47**	
	B	- 5,0	<	**- 25**	**280**	
	C	- 1,7	- 6,0		- 0,7	
	D	0,2	- 5,4	10,9	2,2	
TOT-N	A	- 0,6			**139**	-15,7
	B	2,0			**375**	**- 55,6**
	C	0,3			**129**	- 1,4
	D	3,3			**63**	- 1,7

In the table above the relative deviation from the calculated theoretical value is given for each analytical variable. Internationally it is very common to use as a general rule, that when a deviation from the "true" value is less than ± 20 %, the analytical result reported is considered as acceptable. Using this rule as a basis for the evaluation of the reported results, the deviation being greater than ± 20 % is given in bold letters in the table. In these cases the laboratory should check the analytical routine to find an explanation of the great deviation, and perform corrective actions to avoid such errors in the future.

An important following-up step should be an evaluation meeting between representatives of the participating laboratories involved. At such a meeting the results should be discussed, and emphasis should be put on explaining the discrepancies in the results. For this purpose it is necessary to have a detailed description of the analytical methods used at each of the participating laboratories.

On the basis of the conclusion drawn after the explanations have been found, it would be valuable to carry out a more comprehensive intercomparison, including all the major components, such as conductivity, alkalinity, chloride, sulfate, calcium, magnesium, sodium, and potassium, and possibly some metals such as iron, aluminium, manganese, lead, copper, zinc, cadmium, and mercury. The samples should cover a wider range of concentrations, because this gives better information about the reasons for observed differences, and because the water quality of the water bodies in the monitoring programme may vary considerably.

Appendix B. Agenda for the Final Workshop

Final Workshop Agenda

The Final Workshop covered the following themes:

- **Welcome** *Mr. Li Weixiang*
- **Speech by the Environmental Counsellor at the Norwegian Embassy in Beijing** *Mr. Leiv Landro*
- **Project background and accomplishment** *Ms. B.M. Wathne*
- **Instrumentation and monitoring stations** *Mr. A. Veidel and Ms Chen Aifeng*
- **Transport to the Province Governmen Building of Heilongjiang Province**
- **Meeting with Madam Ma Shujie, Vice Gouvernor of the Heilongjiang Province**
- **Banquet with Madam Ma**
- **ENSIS** *Ms K. Dagestad and Mr. P.-H. Kraggerud*
- **Abatement strategy** *Ms B.M. Wathne*
- **Evaluation, summing up and further plans** *Ms B.M. Wathne*
- **Tansport to the Monitoring Center**
- **ENSIS demonstration at HEMCS** *Mr. Li Jiming and Ms Li Fen*

Appendix C. Signed Minutes from the Final Project Meeting

Project meetings and Final Workshop in Harbin Heilongjiang June 14 – 20 2000.

for

Surveillance of water Quality in the Songhuajiang River System in heilongjiang Province, P.R. of Chnia CHN 017

Minutes from the Project Meeting June 15 at HEPB

Participants from HEPB:
Mr. Guo Yuan
Mr. Dong Xianfeng

Participants from NIVA and Norgit/ENSYS A/S:
Ms. Bente M Wathne
Mr. Torstein Skancke (last part of the meeting)

Mr. Guo opened the meeting by welcoming the Norwegian colleagues to Harbin again, and agreement was made that the main topic for the day should be the programme for the Final Workshop on Monday June 19, and general administrative matters.

1. Final Workshop arrangement and programme

Mr. Guo informed that invitations have been sent to the Norwegian Embassy in Beijing, to Environmental Councellor Mr. Leiv Landro, to MOST, SEPA, the Heilongjiang Planning Commision and the monitoring stations taking part in the project. In total we can expect 20 – 30 persons at the Workshop, which will be held at a newly decorated conference room at HEPB.

The Vice-Governor for Heilongjiang Province Madam Ma Shujie will meet and give a banquet for the Norwegian guests as part of the Final Workshop. The Final Workshop Programme is shown in Annex A.

2. Consolidation activities and further co-operation

Ms. Wathne informed about the meeting she had with Ms Tori Tveit and Mr Lasse Nymoen from NORAD, before she left for Heilongjiang. It is NORADs intention to support consolidation activities for the project for two more years, if this is accepted by the Chinese authorities. NORADs intention is to support in the same way consolidation of the projects CHN 014 ENSIS for Yantai and CHN 013 Guangzhou, and wants to co-ordinate some of the activities in common for all three projects.

The first proposal for a project extension was made and sent to NORAD in May this year, but the basis for that proposal is an extension of the project for one year. A new proposal shall be prepared on the basis of this first proposal, extending the working period to two years, and putting emphasis on Abatement Strategy, using ENSIS as a tool. Also the work and input from Chinese side have to be described as a part the total project activities. A service and maintenance agreement for the ENSIS system shall be part of the consolidation project.

It was agreed to try and finish the new proposal in early autumn (first half of September), hoping that the handling time with Chinese authorities and NORAD will be short. We could then plan for a project start of the consolidation work in October/November 2000.

3. The Abatement Strategy Report

A draft of the Abatement Strategy Report was discussed, and some questions were asked in connection with the facts presented from the Mudanjiang catchment. Some questions were solved at the spot, but some questions have to be solved by the local staff from Mudanjiang EPB. When the missing information has been received a draft of the report will be sent to HEPB/MEPB for their approval. When the Abatement Strategy report is finished it will be combined and be a part of the Final Report.

4. The Final Report

It was agreed that the Final project report should be prepared mainly after the same form as the Annual report. The input from the Norwegian side should be ready 1. September this year.

5. Administrative matters

Mr Guo confirmed that the invoice from the Norwegian side for the first quarter 2000 was received, and that Ms Wathne could bring the signed version of it back to Norway.

6. Service and maintenance agreement

The main issues in a draft service and maintenance agreement were discussed. As mentioned under topic 2 above, such an agreement for the ENSIS system shall be part of the consolidation project.

Harbin 2000-06-20

Guo Yuan

Bente M. Wathne

Bente M. Wathne

Appendix D. Project invoices for 2000

Surveillance of Water Quality in the Songhua River, Heilongjiang Province, China - Project Invoices for 2000

For 1st quarter 2000 the following account has been prepared. Total sum for the project expenses are NOK 207.911 as shown in the table below.

Nr	Task	Total 1. quarter	Norgit 1. quarter	NIVA 1. quarter
1	**Administration**			
1.1	Consulting services	81.425	27.950	53.475
1.2	Travelling expenses	1.880	716	1.164
2	**Final report**			
3	**Workshop**			
4	**Monitoring**			
4.1	Consulting services	2.700		2.700
5	**River Modelling**	92.380		92.380
6	**Abatement strategy**			
7	**ENSIS training/follow up**		29.250	
8	**Installation**			
9	**Configuration and test**	276		276
10	**Intercalibration**			
	Total	**207.911**	**57.916**	**149.995**

As the final project invoice for the project CHN 017, given by November 2000 the following account has been prepared. Total sum for the project expenses are NOK 1.084.123 as shown in the table below:

Nr	Task	Total	Norgit	NIVA
1	**Administration**			
1.1	Consulting services	79.925	34.850	62.925
1.2	Travelling expenses	222.743	104.602	100.797
2	**Final report**	58.840	10.000	49.075
3	**Workshop**	50.000		50.050
4	**Monitoring**			
4.1	Consulting services	56.379		56.415
5	**River Modelling**	215.670		216.086
6	**Abatement strategy**	2.204		2.275
7	**ENSIS training/follow up**	354.938	219.175	135.706
8	**Installation**			
9	**Configuration and test**	27.974		27.950
10	**Intercalibration**	15.450		15.600
	Total	**1.085.506**	**368.627**	**716.879**

Of this total amount **NOK 892.513** is accounted for by the original budget from NORAD.
An additional grant of **NOK 191.095** is given directly from NORAD.