

FINAL REPORT

CONTRACT

between

Pacific Geographical Institute

Far Eastern Branch of Russian Academy of Sciences

and

Research Institute for Humanity and Nature

Inter-University Research Institute Corporation

National Institutes for Humanities

on

"Creation of GIS for Amur River Basin" for July, 2006 – March, 2007

Creation of digital information data layer for soil map of Amur River Basin.

Creation of digital information data layer for the Map of Amur River Basin's

Zoning Into Sub-basins"

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EXPLANATORY NOTE
ON THE LEGEND OF THE DIGITAL LAYER “SOIL” OF THE AMUR RIVER BASIN
AT SCALE 1:2.5 M

The complex and specific soil cover of the Amur River basin is due to the combination of contrasting natural conditions (climate, relief, vegetation, parent material) within the territory.

The pedogeographical division (Pedogeographical..., 1962) places the territory of the Amur River basin in two soil-bioclimatic belts which are the boreal (temperate cold) belt and the subboreal (temperate warm) belt. The oceanic part (the Eastern part) of the territory in both belts is characterized by monsoon climate. Monsoon climate gradually changes to continental arid climate with the transition from the coastline to the inner continental part of the territory.

Soil cover of the territory in question fully reflects the specificity of its bioclimatic conditions.

The soil cover of the boreal belt area in the Eastern part of the river basin is that of cold long-frozen soil facies. The soils of this area develop their specific characteristics due to the domination of podzol-forming process, combined with humus-illuvial and peat-forming processes. The soil cover of the boreal belt area in the Western part of the territory is that of cold cryogenic soil facies. This area is dominated by taiga podburs and deep-permafrost sod-podzolics that form mainly due to cryogenic processes.

The soil cover of the subboreal belt area in the Eastern part of the Amur River basin is that of temperate frozen and temperate long-frozen soil facies. Burozem-forming process dominates other pedogenic processes in this area. The Western part of the subboreal belt area that includes the bordering steppe zone areas of Zabaikalie, China, and Mongolia is characterized by chernozems and chestnuts. The soil cover of this area is highly complex.

The notes above show the complexity and diversity of the soil cover of the Amur River basin. The complex character and diverse nature of its soil cover is also highlighted on the electronic layer “Soil”.

The digital layer “Soil” of the Amur River basin is based on the soil maps of the Russian Soviet Federative Socialist Republic, the Mongolian People’s Republic, and the People’s Republic of China. The maps were compiled over the years by different soil science schools at different scales.

1. The Soil Map of the Russian Soviet Federative Socialist Republic at scale 1:2.5 M. / Ed. by V.M. Fridland, VASHNIL. Moscow: GUGK USSR, 1988.

2. The Soil Map of the Mongolian People’s Republic at scale 1:2.5 M. / Ed. by N.V. Nogina, V.V. Egorov, V.M. Fridland, I.M. Komissarova. Moscow: GUGK USSR, 1980.

3. The Soil Map of the People’s Republic of China at scale 1:1 M, as compiled in collaboration with the Chinese soil scientist-consultants.

In addition the following sources were used for the purpose:

1. The Soil Map of Asia (for FAO-UNESCO Soil Map of the World project) / Ed. by V.A. Kovda, E.V. Lobova. Moscow: GUGK USSR, 1971.

2. The Soil Atlas of China. / Add. for: Hseung Yi., Institute of Soil Science, Academia Sinica. Beijing, 1986.

3. The Soil Map of the People’s Republic of China at scale 1:10 M. Institute of Soil Science, Academia Sinica, Soil Institute of USSR Academy of Science, 1959.

4. The Soil Map of the World at scale 1:10 M. / Ed. by V.A. Kovda, E.V. Lobova. Moscow: GUGK USSR, 1975.

5. Stolbovoi V.S., Savin I.Y., Sheremet B.V. Soils [electronic resource] / Stolbovoi V., McCallim I. Land Resources of Russia. 2002. Available at: <http://www.iiasa.ac.at>

When producing the digital layer “Soil” of the Amur River Basin at scale 1:2.5 M, the compilers upheld the principle of preserving the source map data in the fullest.

1. For the Russian part of the Amur River basin the soil mapping polygons of the source map were coded and included into the database.

2. For the Mongolian part of the Amur River basin the soil mapping polygons of the source map were coded and included into the database.

3. For the Chinese part of the Amur River basin the soil mapping polygons of the source map at scale 1:1 M were generalized to fit the map at scale 1:2.5 M, and they were included into the database.

It was necessary to generalize the fine and complex geometry of soil mapping polygons that is characteristic of the Soil Map of the People's Republic of China at scale 1:1 M. The source map polygons of size less than 0,2 cm² were combined when the polygon areas contain related soils. The average number of soils in the united polygon areas varies from 2 to 3 and the maximum is 3-4 soils per area. The source map polygons were combined in accordance with the rule that the extent percentage of soils in the polygon areas of a source map must be preserved on a target map (Compilation..., 1987). In a number of cases small polygons were preserved in their areas in order not to lose important data on distribution and properties of soils in the researched territory.

Notes on the legend of the digital layer "Soil" of the Amur River basin

When producing the legend of the digital layer "Soil" of the Amur River basin at scale 1:2.5 M, the compilers paid attention to the difference in soil nomenclature of the source soil maps of the Russian Soviet Federative Socialist Republic, the Mongolian People's Republic, and the People's Republic of China.

The legend of the Soil Map of the RSFSR includes soil names of two nomenclatures – the one used when the map in question was compiled (Classification..., 1977) and the one used before it (Guidelines..., 1967). The legend also has a number of soil names that were newly accepted in the Russian soil science school of that time. These new soil names were either retained in later classifications and nomenclatures of soils of Russia or were given at least partial correspondences in them (Russian..., 1997).

In order not to make the legend of the electronic layer "Soil" of the Amur River basin too complex the compilers use the soil names of the soil nomenclature accepted for the soil map of the RSFSR. However, there are some cases in the legend when a soil name listed under "Russian Name" is accompanied by synonyms.

As for the soil nomenclature for the Mongolian part of the Amur River basin, the soil names of the soil map of the Mongolian People's Republic generally coincide with the soil names of the Soil Map of the RSFSR as both maps were edited by V. M. Fridland. The legend of the soil map of the Mongolian People's Republic also has a number of outdated soil names that were omitted in later classifications and nomenclatures of soils of Russia (Russian..., 1997; Classification..., 2004). The compilers believe it necessary that the soil nomenclature of the source map should be fully retained in the legend of the electronic layer "Soil" in order to avoid discrepancy between the soil names of the source and the target legends.

The soil names for the Chinese part of the Amur River basin come from several sources. Many soils found in the Chinese soil classification correspond to Russian soils, and such soils are listed in the legend of the electronic layer "Soil" under their common name (Chernozems, Chestnuts, Grey forests). Other soils found in the Chinese soil classification (Chinese..., 1994) do not correspond directly to Russian soils, but they have correlates in Russian soil classification. In the present legend they are listed under the names accepted for their correlates in Russia while the Chinese soil names are given in parenthesis (Brownzems (Ch. Brown earths)). This is also true of the Chinese soils that were included in the source map legend under unofficially accepted (traditional) names. The soils with traditional Chinese names were correlated to the soils listed in the Chinese soil classification (Chinese..., 1994), and their correlates were found in the Russian soil classification. In the present legend the soils are listed under the names accepted for their correlates in Russia while the official and the traditional Chinese names are given in parenthesis (Chernozem-likes (Ch. Black earth or chetu)).

In case the soils of mountainous regions of the Amur River basin belong to the same soil

classification taxon as the soils of plains both the source map legends and the present legend do not list them as soils of mountainous regions. The soils listed as soils of mountainous regions in the present legend are those not found in piedmonts and plains of the Amur River basin. Therefore, the electronic layer “Relief” is added to the electronic layer “Soil” of the Amur River basin.

English names of the soils in the present legend are accepted translations of their Russian names (English-Russian..., 1967; Soil Nomenclature..., 1974).

The legend of the digital layer “Soil” of the Amur River basin is correlated to the Revised legend of the FAO-UNESCO Soil Map of the World (FAO-UNESCO..., 1990). The correlation of the legends is based on literary data (Stolbovoi V.S., Sheremet. B.V., 1995, 2000; Soil Science..., 1988; Lozet J., Mathieu C., 1998) and electronic resource data (Stolbovoi, V.S., Savin, I.Y., Sheremet, B.V., 2002; FAO..., 2002).

The legend of the digital layer “Soil” of the Amur River basin is correlated to the soil nomenclature of the World Reference Base for Soil Resources (WRB). The correlation is based on literary data (Soil Nomenclature..., 1999) and electronic resource data (Stolbovoi, V.S., Savin, I.Y., Sheremet, B.V., 2002; FAO..., 2002).

Thus, the legend of the digital layer “Soil” of the Amur River basin includes the soil names of the soil nomenclature of Russia and the corresponding soil names accepted in soil nomenclatures of Mongolia and China. Beside this, the soil nomenclature of this legend is correlated to the soil nomenclature of FAO-UNESCO and WRB.

Notes on geographic distribution of soils of the Amur River basin

(Soil names are given in the following order: FAO name/names, WRB name/names, name in English)

Soils of tundra

Soils of tundra are represented in the researched territory by Gelic and Ferric Podzols (Cryosols Haplic; tundra podburs). They cover small areas in the North-East of the basin, and they are found under larch forests on elevated elements of relief. Tundra podburs occupy 7792km² of the basin territory.

Soils of taiga and coniferous and broad-leaved forests

Gelic Gleysols (Cryosols Histic; gleyzems) are widespread taiga soils of the territory. Gelic Gleysols (Cryosols Histic; weak-gley peaty-humic taiga gleyzems) and Gelic Gleysols (Cryosols Histic; peaty-muck taiga gleyzem) cover vast territories in the North-East of the basin. These soils are found under larch peatmoss bog forests. They occupy 59662km² of the basin territory.

Gelic Cambisols (Cryosols Histic; peaty-muck high-humic non-gleyic taiga soils) cover areas in the North of the basin. They replace Gelic Gleysols (Cryosols Histic; gleyzems) on more elevated elements of relief. These soils occupy 19362km² of the basin territory.

Eutric and Gleyic Podzoluvisols (Albeluvisols Umbric and Gleyic; podzolised brownzems) are spread in the South-East of the Amur River basin. They cover ouval tops and slopes as well as high terraces. Their areas are concentrated in Primorsky Krai, the South of Khabarovsk Krai, and the bordering territory of China. These soils occupy 80731km² of the basin territory. Non-gleyic subtypes of these soils are most widespread, and they occupy 32734km² of the basin territory. All these soils are widely used for agriculture both in Russia and in China.

Areas of Haplic and Gleyic Podzols (Podzols Carbic, Haplic, Histic, Gleyic; podzols) fringe the Amur River basin in the North as they stretch from the Eastern oceanic part of the basin up to the border between Russia and Mongolia. They are soils of taiga, and they form under condition of free external and internal drainage. Haplic Podzols (Podzols Carbic; humic-illuvial podzols) and Haplic Podzols (Podzols Haplic; illuvial-humic-ferruginous podzols) are most widespread; they occupy 23630km² and 89928km² of the basin territory. Haplic Podzols (Podzols Histic; dry-peaty podzols) are considerably less spread, and they cover 4013km².

Cambic Podzols (Podzols Entic; taiga podburs) are widespread in the taiga zone of Zabaikalie where they occupy 54672 km². Cambic Podzols (Podzols Histic; dry-peaty podburs) are found in the North-East of the Amur River basin. They occupy 17684km² of the basin territory.

Dystric and Gleyic Cambisols (Cambisols Dystric and Gleyic; raw-humic brownzems) are most widespread in the East and the North-East of the basin. They form under dark coniferous forests in Priomorsky Krai and under both dark coniferous forests and larch forests in Khabarovsk Krai and Amurskaya oblast. Their area occupies 189900km².

Dystric, Eutric, and Gleyic Cambisols (Umbrisols Haplic, Cambisols Eutric and Gleyic; sod-brownzems) are mostly found in the North-West of the basin that is in Zabaikalie and China. These soils form under larch forests. They occupy 160195km². Eutric Cambisols (Cambisols Eutric; weakly-unsaturated and saturated sod-brownzems) are most widespread; they occupy 147875km² of the basin territory, mainly in China. The area of Dystric Cambisols (Umbrisols Haplic; acid sod-brownzems) is rather small – these soils occupy 9539km². Gleyic Cambisols (Cambisols Gleyic; gleyic and gley sod-brownzems) have the smallest area of these soils, and they occupy 2781km² of the basin territory.

There are also Haplic, Umbric, and Mollic Andosols (Andosols Haplic, Umbric, and Mollic; ash volcanic soils) in the basin. They cover small areas in China, and their total area occupies 518km².

Soils of broad-leaved forests and wooded steppe

Dystric, Eutric, and Gleyic Cambisols (Cambisols Dystric, Eutric, and Gleyic; brownzems) are often found in the East of the basin, mainly in Priomorsky Krai and Khabarovsk Krai. These soils form under broad-leaved forests (mainly oak forests). They are mostly Dystric Cambisols (Cambisols Dystric; acid brownzems) (31575km²), Eutric Cambisols (Cambisols Eutric; weakly-unsaturated brownzems) (37702km²), and Gleyic Cambisols (Cambisols Gleyic; gleyic and gley brownzems) (28502km²). Podzolised subtypes of these soils are rare in the basin (6257km²).

Eutric, Dystric, Haplic, and Gleyic Cambisols (Umbrisols Haplic, Albic, and Gleyic; dark brownzems) are some of the most widespread soils in the Amur River basin. They are found in China where they cover vast territories on bald mountain tops and slopes. These soils occupy 258939km².

Haplic Greyzems (Luvisols Albic, Phaeozems Luvic; grey forest soils) are found in transition from forest to steppe in the North-West of the basin. They form elongated band-like areas in China and the South of Zabaikalie. These soils occupy 31282km². Haplic Greyzems (Phaeozems Greyi-Luvic, dark-grey forest soils) are often found in China (16967km²) and Haplic Greyzems (Phaeozems Luvic; non-podzolised grey forest soils) are found in the South of Zabaikalie (13824km²).

Umbric-Gelic Leptosols (Umbrisols Gelic; deeply frozen meadow-forest soils) cover piedmonts and ouvals in the West of the basin, in Mongolia. They form areas in transition from forest to meadow and steppe, their total area is 4849km².

Soils of steppe

Luvic, Haplic, and Calcic Chernozems, Luvic Phaeozems (Chernozems Luvic, Chernic, Calcic, Haplic, Phaeozems Luvic; chernozems) form in the steppe zone of the basin that is the South of Zabaikalie and the bordering territories of China and Mongolia. These soils occupy 116468km² of the basin territory. These soils vary greatly within the basin. The Russian part of the basin is dominated by Haplic Chernozems (Chernozems Chernic; deeply-effervescing and noncalcareous chernozems) and by Calcic Chernozems (Chernozems Calcic; meal-calcareous chernozems including leached, typical, ordinary, and southern chernozems). Their total area occupies 27631km². There is also one big area of Luvic Chernozems (Chernozems Luvic; solonchic chernozems) in the Russian part of the basin (289km²). Haplic Chernozems

(Chernozems Chernic; noncalcareous chernozems (mostly contactly-meadowish)) and Haplic Chernozems (Chernozems Haplic; meal-calcareous contactly-meadowish chernozems) are found in the Mongolian part of the basin. They occupy 27979km². Haplic Chernozems (Chernozems Haplic, shallow meal-calcareous chernozems) are also found in the territory, they cover 2175km² of the basin. The Chinese part of the basin has areas of Haplic Chernozems (Chernozems Chernic; typical chernozems) (26247km²), Calcic Chernozems (Chernozems Calcic; calcareous chernozems) (9702km²), Luvic Chernozems (Chernozems Luvic; luvic chernozems) (4295km²), and Luvic Phaeozems (Phaeozems Luvic; light chernozems) (16019km²). There are also small areas of Luvic Chernozems (Chernozems Luvic; solonchakous chernozems) there (2132km²).

Haplic Phaeozems (Phaeozems Gleyic; meadow-chernozemic soils) cover the total of 31247km² in the steppe zone of the Amur River basin (in the bordering territories of Southern Zabaikalie and China and Mongolia). Their areas are rather humid.

Gelic Phaeozems (Phaeozems Gleyic; deeply frozen meadow-chernozemic soils) are found in piedmonts and ouvals in Mongolia where they occupy 1082km².

Gleyic Phaeozems (Phaeozems Gleyic; “Amur prairie” meadow-chernozem-like soils) are found in Amurskaya Oblast. These soils are widely used in agriculture, and they cover 8924km² of the basin territory.

Haplic, Gleyic, Albic, and Stagnic Phaeozems (Phaeozems Haplic, Gleyic, Albic, and Stagnic-Epigleyic; chernozem-like soils) are spread in the Chinese part of the Amur River basin. They form elongated band-like areas on more elevated elements of relief. They cover 58134km², most of them are Haplic Phaeozems (Phaeozems Haplic; typical chernozem-likes) (52243km²). Their Chinese name is black earths, and their traditional Chinese name is chetu. These soils are used in agriculture.

Soils of dry steppe

Calcic and Haplic Kastanozems (Kastanozems Calcic and Haplic; dark chestnut soils) are found mainly in Mongolia. They are Calcic Kastanozems (Kastanozems Calcic; meal-calcareous dark chestnuts) (37687km²), Calcic Kastanozems (Kastanozems Calcic; meal-calcareous contactly-meadowish dark chestnuts) (7562km²), and Calcic Kastanozems (Kastanozems Calcic; meal-calcareous residual-meadow dark chestnuts) (6665km²). The areas of Haplic Kastanozems (Kastanozems Haplic; dark chestnuts) also cover 17396km² in China. They are not found in the Russian part of the basin.

Haplic, Calcic, and Luvic Kastanozems (Kastanozems Haplic, Calcic, and Sodic; chestnut soils) occupy the total of 47782km². Haplic Kastanozems (Kastanozems Haplic; typical chestnuts) (17710km²) and Haplic Kastanozems (Kastanozems Haplic; chestnut-like soils) (5584km²) form areas in China, but most areas of these are located in the South Zabaikalie (21826km²). There are also area of Calcic Kastanozems (Kastanozems Calcic; shallow meal-calcareous chestnuts) (824km²) and Mollic Leptosols (Leptosols Mollic; weakly developed chestnuts on loose sands) (1211km²) in Mongolia.

Haplic and Calcaric Phaeozems (Phaeozems Gleyic, Calcaric-Gleyic, and Calcaric; meadow-chestnut soils) are spread in the West of the basin in the territory Mongolia and the bordering areas of Southern Zabaikalie in Russia. They form elongated band-like areas bordering the areas of Fluvisols (hydromorphic soils). Calcaric Phaeozems (Phaeozems Calcaric-Gleyic; meal-calcareous meadow-chestnuts) are widespread in the basin (8669km²). There are also smaller areas of Calcaric Phaeozems (Phaeozems Calcaric; heating meal-calcareous meadow-chestnuts) (6116km²) and Haplic Phaeozems (Phaeozems Gleyic; meadow-chestnuts without subdivision) (4614km²) there.

Haplic Arenosols (Arenosols Haplic; aeolian soils) form areas in the South-West and in the central part of the basin – in the Chinese territory. They cover small areas which border large areas of Chernozems, Kastanozems, and Gleysols (chernozems, chestnuts, and meadow soils). Haplic Arenosols (Arenosols Haplic; grassland aeolian sands) occupy 9613km², and Haplic Arenosols (Arenosols Haplic; meadow aeolian sands) cover the area of 5057km².

Hydromorphic soils

These soils occupy 193914km² of the basin territory. Mollic Planosols (Planosols Luvic; differentiated meadow soils) (12877km²) and Umbric Gleysols (Gleysols Humic; meadow soils without subdivision) (6632km²) are spread in the Russian part of the basin. Haplic Phaeozems (Phaeozems Haplic; typical meadow soils) form large areas on river terraces in China. They occupy 165440km². Their areas are mixed with small areas of Luvic Phaeozems (Phaeozems Luvic; albic meadow soils) (1878km²), Calcic Gleysols (Phaeozems Calcic; calcareous meadow soils) (4466km²), and Umbric Gleysols (Gleysols Humic; gley meadow soils) in humid areas (2620km²). Mollic Gleysols (Gleysols Sodic; solonchakous and solonetzic meadow soils) are usually in complexes with Luvic Chernozems (Chernozems Luvic; solonetzic and solonchakous chernozems). There are also small areas of Gelic Gleysols (Gleysols Gelic; cryogenic meadow soils) in intermontane depressions in Mongolia (640km²).

Areas of Mollic Gleysols (Gleysols Histic; meadow-boggy soils) are found all over the territory of the Amur River basin. They cover 22625km² of the basin territory, mostly the areas in transition from soils of meadows to soils of bogs. Gelic Gleysols (Gleysols Gelic; cryogenic meadow-boggy soils) cover areas in intermontane depressions in Mongolia (797km²).

Fibric and Terric Histosols (Histosols Terric, Fibric, Sapric; bog soils) cover vast areas of the basin territory (148506km²). They form large areas in the North-West and the North-East of the basin. Fibric Histosols (Histosols Fibric, typical bog soils) cover 48168km² in China.

Saline soils

Haplic and Gleyic Solonetz (Solonetz Humic, Gleyic, and Haplic; solonetztes) occupy 10555km² and Haplic and Gleyic Solonchaks (Solonchaks Haplic, Moli-Gleyic, and Gleyic; solonchaks) occupy 2029km² of the Amur River basin territory. They form small areas on low elements of relief. Their areas are mixed with the areas of areas of Chernozems, Kastanozems, and Gleysols (chernozems, chestnuts, and meadow soils). These soils are mostly Gleyic Solonetz (Solonetz Gleyic; meadow solonetztes) (2706km²), and Gleyic Solonchaks (Solonchaks Moli-Gleyic and Gleyic; meadow solonchaks (880km²) and shor solonchaks (689km²)).

Alluvial soils

These soils occupy areas along rivers. They cover 65101km² of the basin territory. Umbric Fluvisols (Fluvisols Umbric; meadow alluvial soils) occupy 27207km² and Dystric Fluvisols (Fluvisols Dystric; acid alluvial soils) occupy 17563km² in the Russian part of the basin. Fluvisols (Fluvisols; typical alluvial soils) are found in China and Mongolia (12138km²).

Anthropogenic soils

There are small areas of Cumulic Anthrosols (Anthrosols Hydragric and Gleyic; paddy soils) in China. They occupy 6077km².

Soils of mountainous regions

These soils usually form small areas. They occupy the highest elements of relief in the basin. Gelic Gleysols (Gleysols Gelic; tundra mountain soils) (279km²) and Gelic Cambisols (Cryosols Turbic; permafrost taiga mountain soils) (3036km²) are found in Mongolia. Dystric Leptosols (Leptosols Dystric; high-mountain baldy-soddy soils) occur in Russia, mostly in Zabaikalie (218km²). There are several small scattered areas and one large area (about 2000km²) of Lithic Leptosols (Leptosols Lithic; primitive mountain soils) in the North of the basin. In China mountain tops are covered with small areas of Lithic Leptosols (Leptosols Haplic; primitive shallow mountain soils on dense rock) (323km²) and Lithic and Eutric Leptosols (Leptosols Lithic and Eutric; primitive shallow mountain soils on loose sands) (2060km²).

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LEGEND OF THE SOIL MAP OF THE AMUR RIVER BASIN
Map Scale 1:2500000

SOIL COMPENDIUM

Soil code	Soil Name		Name in the World Reference Base for Soil Resources, 1998	
	Name in English	Name in the Revised legend of the Soil Map of the World FAO-UNESCO, 1990	Name in the World Reference Base for Soil Resources, 1998	
SOILS OF TUNDRA				
1	Podburs light tundra	Gelic Podzols (PZi)	Cryosols (CRha)	Haplic
2	Podburs tundra (without subdivision)	Ferric Podzols (PZf)	Cryosols (CRha)	Haplic
SOILS OF TAIGA AND SOILS OF CONIFEROUS AND BROAD-LEAVED FORESTS				
3	Gleyzems weak-gley peaty-humic taiga	Gelic Gleysols (GLi)	Cryosols Histic (CRhi)	
4	Gleyzems peaty-muck taiga	Gelic Gleysols (GLi)	Cryosols Histic (CRhi)	
5	Taiga peaty-muck high-humic non-gleyic	Gelic Cambisols (CMi)	Cryosols Histic (CRhi)	
6	Podzolics, mostly shallow podzolics	Dystric Podzoluvisols (PDd)	Albeluvisols (ABha)	Haplic
7	Podzolic-gleys peat and peaty	Gleyic Podzoluvisols (PDg)	Albeluvisols (ABhi)	Histic
9	Sod-pale-podzolics and podzolised brownzems	Eutric Podzoluvisols (PDe)	Albeluvisols (ABum)	Umbric
10	Podzolised brownzems (Beijang bleached)	Eutric Podzoluvisols (PDe)	Albeluvisols (ABum)	Umbric
11	Sod-pale-podzolics and podzolised brownzems deep-gleyic and gley	Gleyic Podzoluvisols (PDg)	Albeluvisols (ABgl)	Gleyic
12	Podzolised brownzems meadow (Beijang bleached meadow)	Gleyic Podzoluvisols (PDg)	Albeluvisols (ABgl)	Gleyic
13	Podzolised brownzems gley (Beijang bleached gley)	Gleyic Podzoluvisols (PDg)	Albeluvisols (ABgl)	Gleyic
15	Podzols humic-illuvial	Haplic Podzols (PZh)	Podzols Carbic (PZcb)	
16	Podzols illuvial-humic-ferruginous (without subdivision)	Haplic Podzols (PZh)	Podzols Haplic (PZha)	
17	Podzols dry-peaty	Haplic Podzols (PZh)	Podzols Histic (PZhi)	
18	Podzols gley peaty and peat, mostly humic-illuvial	Gleyic Podzols (PZg)	Podzols Gleyic (PZgl)	
20	Podburs taiga (without subdivision)	Cambic Podzols (PZb)	Podzols Entic (PZet)	
21	Podburs dry-peaty	Cambic Podzols (PZb)	Podzols Histic (PZhi)	
22	Podburs ochric	Cambic Podzols (PZb)	Podzols Rustic (PZrs)	
23	Brownzems raw-humic illuvial-humic	Dystric Cambisols (CMd)	Cambisols (CMdy)	Dystric
24	Brownzems raw-humic	Dystric Cambisols (CMd)	Cambisols (CMdy)	Dystric
25	Brownzems raw-humic gley	Gleyic Cambisols (CMg)	Cambisols (CMgl)	Gleyic
26	Sod-brownzems acid (Grayed and albic browns coniferous forest)	Dystric Cambisols (CMd)	Umbrisols (UMha)	Haplic
27	Sod-brownzems weakly-unsaturated and saturated (Browns coniferous forest)	Eutric Cambisols (CMe)	Cambisols (CMeu)	Eutric
28	Sod-brownzems gleyic and gley	Gleyic Cambisols (CMg)	Cambisols (CMgl)	Gleyic
29	Sod-taiga deep-permafrost (including residual-calcareous)	Eutric-Gelic Cambisols (CMe-i)	Cambisols Gelic (CMeu-ge)	Eutric-
30	Sod-calcareouses (including leached and podzolised)	Rendzic Leptosols (LPk)	Leptosols (LPz)	Rendzic

31	Volcanics ash typical	Haplic Andosols (ANh)	Andosols (ANha)	Haplic
32	Dark volcanics ash	Umbric Andosols (ANu)	Andosols (ANum)	Umbric
33	Volcanics ash on basic rock	Mollic Andosols (ANm)	Andosols (ANmo)	Mollic
SOILS OF BROAD-LEAVED FORESTS AND WOODED STEPPE				
34	Brownzems acid	Dystric Cambisols (CMd)	Cambisols (CMdy)	Dystric
35	Brownzems acid podzolised	Dystric Cambisols (CMd)	Cambisols (CMdy)	Dystric
36	Brownzems weakly-unsaturated (Brown earths)	Eutric Cambisols (CMe)	Cambisols (CMeu)	Eutric
37	Brownzems weakly-unsaturated podzolised	Eutric Cambisols (CMe)	Cambisols (CMeu)	Eutric
38	Brownzems gleyic and gley	Gleyic Cambisols (CMg)	Cambisols (CMgl)	Gleyic
39	Dark brownzems	Eutric Cambisols (CMe)	Umbrisols (UMha)	Haplic
40	Dark brownzems grayed	Dystric Cambisols (CMd)	Umbrisols (UMha)	Haplic
41	Dark brownzems albic	Dystric Cambisols (CMd)	Umbrisols (UMab)	Albic
42	Dark brownzems meadow	Haplic Cambisols (CMh)	Umbrisols (UMha)	Haplic
43	Dark brownzems gley	Gleyic Cambisols (CMg)	Umbrisols (UMgl)	Gleyic
44	Dark brownzem-like	Haplic Cambisols (CMh)	Umbrisols (UMha)	Haplic
46	Grey forests	Haplic Greyzems (GRh)	Luvisols Albic (LVab)	
47	Greys forest non-podzolised	Haplic Greyzems (GRh)	Phaeozems (PHlv)	Luvic
48	Dark-grey forests	Haplic Greyzems (GRh)	Phaeozems Luvic (PHgz-lv)	Greyi-
49	Fine forest sands	Cambic Arenosols (ARb)	Arenosols (ARpr)	Protic
50	Meadow-forests deeply frozen	Umbric-Gelic Leptosols (LPu-i)	Umbrisols (UMge)	Gelic
SOILS OF STEPPE				
51	Chernozems luvic	Luvic Chernozems (CHl)	Chernozems (CHlv)	Luvic
52	Light chernozems	Luvic Phaeozems (PHl)	Phaeozems (PHlv)	Luvic
53	Chernozems deeply-effervescing and noncalcareous on sandstones and sands)	Haplic Chernozems (CHh)	Chernozems (CHch)	Chernic
54	Chernozems noncalcareous (mostly contactly-meadowish)	Haplic Chernozems (CHh)	Chernozems (CHch)	Chernic
55	Chernozems typical	Haplic Chernozems (CHh)	Chernozems (CHch)	Chernic
56	Chernozems calcareous	Calcic Chernozems (CHk)	Chernozems (CHce)	Calcic
57	Chernozems meal-calcareous	Calcic Chernozems (CHk)	Chernozems (CHce)	Calcic
58	Chernozems meal-calcareous, including leached, typical, ordinary, southern (chernozems washed)	Calcic Chernozems (CHk)	Chernozems (CHce)	Calcic

59	Chernozems meal-calcareous contactly-meadowish	Haplic (CHh)	Chernozems	Chernozems (CHha)	Haplic
60	Chernozems meal-calcareous shallow	Haplic (CHh)	Chernozems	Chernozems (CHha)	Haplic
61	Chernozems solonetzic	Luvic (CHI)	Chernozems	Chernozems (CHlv)	Luvic
62	Chernozems solonchakous	Luvic (CHh)	Chernozems	Chernozems (CHlv)	Luvic
64	Meadow-chernozemics (Chernozems meadow)	Haplic (PHh)	Phaeozems	Phaeozems (PHgl)	Gleyic
65	Meadow-chernozemics deeply frozen	Gelic	Phaeozems (PHi)	Phaeozems (PHgl)	Gleyic
66	Meadow-chernozem-likes "Amur prairie"	Gleyic (PHg)	Phaeozems	Phaeozems (PHgl)	Gleyic
67	Chernozem-likes (Blacks, Chetu)	Haplic (PHh)	Phaeozems	Phaeozems (PHha)	Haplic
68	Chernozem-likes (Blacks meadow)	Gleyic (PHg)	Phaeozems	Phaeozems (PHgl)	Gleyic
69	Chernozem-likes (Blacks albic)	Albic	Phaeozems (PHa)	Phaeozems (PHab)	Albic
70	Chernozem-likes (Blacks surface-gleyed)	Stagnic (PHj)	Phaeozems	Phaeozems Epigleyic (PHst-pgl)	Stagni-
71	Meadows heating	Haplic (PHh)	Phaeozems	Phaeozems (PHha)	Haplic
SOILS OF DRY STEPPE					
72	Dark chestnuts	Haplic (KSh)	Kastanozems	Kastanozems (KSha)	Haplic
74	Dark chestnuts meal-calcareous	Calcic (KSk)	Kastanozems	Kastanozems (KScC)	Calcic
75	Dark chestnuts meal-calcareous contactly-meadowish	Calcic (KSk)	Kastanozems	Kastanozems (KScC)	Calcic
76	Dark chestnuts meal-calcareous residual-meadow	Calcic (KSk)	Kastanozems	Kastanozems (KScC)	Calcic
77	Dark chestnuts meal-calcareous and noncalcareous shallow	Haplic (KSh)	Kastanozems	Kastanozems (KSha)	Haplic
78	Chestnuts typical	Haplic (KSh)	Kastanozems	Kastanozems (KSha)	Haplic
79	Chestnuts meal-calcareous shallow	Calcic (KSk)	Kastanozems	Kastanozems (KScC)	Calcic
80	Chestnuts meal-calcareous without subdivision (chestnuts leached)	Calcic (KSk)	Kastanozems	Kastanozems (KScC)	Calcic
81	Chestnuts weakly developed on loose sands	Mollic	Leptosols (LPm)	Leptosols (PLmo)	Mollic
82	Chestnuts solonchakous	Luvic (KSl)	Kastanozems	Kastanozems (KSso)	Sodic
83	Chestnut-likes	Haplic (KSh)	Kastanozems	Kastanozems (KSha)	Haplic
85	Meadow-chestnuts (Chestnuts meadow)	Haplic (PHh)	Phaeozems	Phaeozems (PHgl)	Gleyic
86	Meadow-chestnuts meal-calcareous	Calcaric (PHc)	Phaeozems	Phaeozems Gleyic (PHca-gl)	Calcaric-Gleyic
87	Meadow-chestnuts meal-calcareous heating	Calcaric (PHc)	Phaeozems	Phaeozems (PHca)	Calcaric
89	Sands aeolian grassland	Haplic	Arenosoils (ARh)	Arenosoils	Haplic

90	Sands aeolian meadow	Haplic Arenosoils (ARh)	(ARha) Arenosoils (ARha)	Haplic
HYDROMORPHIC SOILS				
92	Meadows (without subdivision)	Umbric Gleysols (GLu)	Gleysols (GLhu)	Humic
93	Meadows typical	Haplic Phaeozems (PHh)	Phaeozems (PHha)	Haplic
94	Meadows calcareous	Calcic Gleysols (GLk)	Phaeozems (PHcc)	Calcic
95	Meadows albic	Luvic Phaeozems (PHl)	Phaeozems (PHlv)	Luvic
96	Meadows gley	Umbric Gleysols (GLu)	Gleysols (GLhu)	Humic
97	Meadows differentiated (including solodic)	Mollic Planosols (PLm)	Planosols (PLlv)	Luvic
98	Meadows solonetzic and solonchakous	Mollic Gleysols (GLm)	Gleysols Sodic (GLso)	
99	Meadows solonchakous	Mollic Gleysols (GLm)	Gleysols Sodic (GLso)	
100	Meadows solonetzic	Mollic Gleysols (GLm)	Gleysols Sodic (GLso)	
102	Meadows cryogenic	Gelic Gleysols (GLi)	Gleysols Gelic (GLge)	
103	Meadow-boggies (Bogs meadow)	Mollic Gleysols (GLm)	Gleysols Histic (GLhi)	
104	Meadow-boggies cryogenic	Gelic Gleysols (GLi)	Gleysols Gelic (GLge)	
106	Gleyzems peaty and peat boggy	Dystric Gleysols (GLd)	Gleysols Histic (GLhi)	
107	Peats boggy (without subdivision)	Histosols (HS)	Histosols Fibric (HSfi)	
108	Bogs typical	Fibric Histosols (HSf)	Histosols Fibric (HSfi)	
109	Bogs muck-humic	Terric Histosols (HSs)	Histosols Terric (HSstr)	
111	Peats high moor	Fibric Histosols (HSf)	Histosols Fibric (HSfi)	
112	Peats transitional moor	Terric Histosols (HSs)	Histosols Fibric (HSfi)	
113	Peats low moor	Terric Histosols (HSs)	Histosols (HSsa)	Sapric
114	Bogs cryogenic	Gelic Histosols (HSi)	Histosols Gelic (HSge)	
SALINE SOILS				
115	Solonetztes automorphic	Haplic Solonetz (SNh)	Solonetz (SNhu)	Humic
116	Solonetztes meadow (hydromorphic)	Gleyic Solonetz (SNg)	Solonetz Gleyic (SNgl)	
117	Solonetztes meadow solonchakous	Gleyic Solonetz (SNg)	Solonetz Gleyic (SNgl)	
118	Solonetztes steppe	Haplic Solonetz (SNh)	Solonetz (SNha)	Haplic
119	Solonchaks typical	Haplic Solonchaks (SCH)	Solonchaks (SCha)	Haplic
120	Solonchaks meadow	Gleyic Solonchaks (SCg)	Solonchaks Moli-Gleyic (SCmo-gl)	
121	Shor Solonchaks	Gleyic Solonchaks (SCg)	Solonchaks (SCgl)	Gleyic
123	Solonchaks boggy	Gleyic Solonchaks (SCg)	Solonchaks (SCgl)	Gleyic
124	Solonchaks solonchakous	Haplic Solonchaks (SCH)	Solonchaks (SCha)	Haplic
ALLUVIAL AND MARSHY SOILS				
125	Alluvials	Fluvisols (FL)	Fluvisols (FL)	
126	Alluvials acid	Dystric Fluvisols (FLd)	Fluvisols (FLdy)	Dystric
127	Alluvials weak-acid and neutral	Eutric Fluvisols (FLe)	Fluvisols (FLeu)	Eutric
128	Alluvials compact	Eutric Vertisols (VRe)	Fluvisols (FLvr)	Vertic

129	Alluvials swamp meadow	Umbric Fluvisols (FLu)	Fluvisols (FLhi)	Histic
130	Alluvials meadow	Umbric Fluvisols (FLu)	Fluvisols (FLum)	Umbric
132	Deposits recent typical	Umbric Fluvisols (Flu)	Fluvisols (FLum)	Umbric

ANTHROPOGENIC SOILS

133	Paddies typical	Cumulic (ATc)	Anthrosols (ATHg)	Hydragric
134	Paddies overflowed	Cumulic (ATc)	Anthrosols (Algl)	Gleyic
135	Paddies gleyed	Cumulic (ATc)	Anthrosols (ATgl)	Gleyic

SOILS OF MOUNTAINOUS REGIONS

137	Mountain tundra	Gelic Gleysols (GLi)	Gleysols Gelic (GLge)	
138	High-mountain baldy-soddy	Dystric Leptosols (LPd)	Leptosols (PLdy)	Dystric
139	Mountain dark-brown soddy	Umbric Leptosols (LPu)	Leptosols (LPhu)	Humic
140	Mountain permafrost taiga	Gelic Cambisols (CMi)	Cryosols (CRtu)	Turbic
142	Mountain primitive	Lithic Leptosols (LPq)	Leptosols Lithic (LPli)	
143	Mountain shallow neutral on dense rock	Lithic Leptosols (LPq)	Leptosols (LPha)	Haplic
144	Mountain shallow on loose sands	Lithic Leptosols (LPq)	Leptosols Lithic (LPli)	
145	Mountain shallow neutral on loose sands	Eutric Leptosols (LPe)	Leptosols (LPeu)	Eutric
148	Mountain forest-meadows	Umbric Leptosols (LPu)	Leptosols (LPhu)	Humic

NONSOIL FORMATIONS

149	Nonsoil formations			
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EXPLANATION NOTE

TO THE MAP OF AMUR RIVER BASIN'S ZONING INTO SUB-BASINS
COMPILED BY YERMOSHIN V.V.

The creation of the map included a definition of procedures for Amur River basin's zoning into sub-basins of lower orders of several ranks, drawing of sub-basins borders in format of ArcView shape-files, and compiling of ArcInfo electronic coverage.

The following information sources have been used to reveal and to draw the sub-basins borders:

1. A relief digital model (DEM) in resolution of 8 arcseconds that has been made on the base of remote sensing SRTM in the first phase of the project
2. Digital coverage 'Rivers' compiled in the first phase of the project
3. Scanned and adjusted in working co-ordinates topographic maps in the scale of 1:1,000,000 and 1:500,000 for the whole Amur River basin practically including the territories of China and Mongolia.

According to the Terms of References and Supplement 1 to the Contract, the following algorithm for direct zoning into sub-basins of different ranks has been developed and implemented.

a. At the first stage, the basins borders of rivers flowing into Amur River were drawn. In case if the areas of these basins were within 5-20 thousand square kilometers, their names corresponding to the rivers names were put into Basin_1 field of attributive table of the coverage. Then, if the areas of defined basins were over 20 thousand square kilometers, the latter were divided into sub-basins of lower order. Two variants of zoning have been used for the areas of the basins less 5 thousand square kilometers. If such a basin was alone, it was joined to a larger basin. If several small basins were situated side by side; they were united into integral one, but not more 20 thousand square kilometers in the area. The latter aggregated basin was double-named (names of two largest watercourses on its territory), and this name was put into Basin_2 field of attributive table, but 'Amur' word was placed into Basin_1 field.

b. For Amur River basin as a whole, the sub-basins of the areas over 20 thousand square kilometers were divided into sub-basins of lower ranks practically through the same way like in paragraph (a). The basin of confluent with the area within 5-20 thousand square kilometers has not been handled then, and its name was put into Basin_2 field. In case of exceeding of the area over 20 thousand square kilometers, the basins have been divided into sub-basins of lower order. The rest area of the basin has been divided into larger fractional units according to the hydrological principles, but not over 20 thousand square kilometers. Their names were also put into Basin_2 field of attributive table. Their names usually were taken from the names of the main river of the sub-basin with addition of characteristics of its location, namely - low, middle, and upper part of the river basin.

c. The sub-basins with the area over 20 thousand square kilometers remained after the second stage, have been divided according to the paragraph (b). Their names were put into Basin_3 field of attributive table.

Totally, four levels of sub-basins have been defined.

The borders of sub-basins were drawn along watersheds divisions. Exceptions were made for flat waterlogged, developed with numerous channels, territories of China and partly of Russia, and for drainless and deserted areas of Mongolia and Inner Mongolia. Drawing of sub-basins borders there was not always unambiguous.