ENVIRONMENTAL ATLAS OF UZBEKISTAN

Foreword

During the last decades public has been displaying the greater interest to environmental problems in general and it is quite reasonable since they are indeed very serious and pressing, cause great concerns and their solving demands joint efforts of authorities, scientists and the public at large. Human intervention in all inmost spheres of the nature causes drastic environmental degradation that in many cases results in demise of unique natural complexes and memorials, reduction and extinction of various flora and fauna species and loss of biodiversity as such. All these irreversible alterations in geographical environment could result in unpredictable adverse effect.

Today we can say that lately ecology has started affecting the interests of actually every person of our society, therefore, it is very important to keep people informed about ecological aspects and problems and to increase the level of their awareness and environmental literacy.

State Committee for Nature Protection lays great emphasis on the necessity to inform governmental agencies and population about environmental conditions of the air, land and water resources, and of all other components of environment of the country as a whole. The Committee regularly undertakes measures to keep society informed about the existing transboundary problems and ways of their solving. These measures are based on information and data provided by ecologists. It is very important to use modern scientific approaches and technologies.

It is a great pleasure for me to offer for your consideration first edition of Atlas on the environmental state in Uzbekistan prepared as part of the Government of Uzbekistan/UNDP Joint Project. The Project "Environmental Indicators to monitor the state of the environment in Uzbekistan" and its follow-up "Enhancement of the Environmental Indicators Database with GIS application to monitor the state of the environment in Uzbekistan" is a part of the wider initiative on development of the national data collection and processing system being implemented with the UNDP support. GIS programs based environmental indicators database was developed as part of the Project, and was used as a basis for preparation of a series of maps reflecting the state of environment. The proposed collection of the environmental schematic maps clearly demonstrates the state of environment in Uzbekistan in 2000 - 2006.

The database materials display that air and water resources pollution situation is stabilizing and partially improving in a number of regions of the country. However, lots of ecological problems of the country still cause serious concern and dictate pressing necessity for their solving.

The Atlas could be very helpful in delivering activities on conservation and rehabilitation of the environment and will provide basis for monitoring of the results achieved. We do hope that this release will be useful and interesting not only for specialists and decision makers, but for a high readership as well, who is concerned about conservation of our greatest national endowment - the nature of Uzbekistan.

B. ALIKHANOV
Chairman of the State Committee for Nature Protection of the Republic of Uzbekistan

Foreword

The Environmental Atlas of Uzbekistan is an attempt to present the most significant environmental variables for the country under one cover and link those to the geographical location. It is a spin-off of the major project, Environmental Indicators of Uzbekistan, which has managed to bring together 91 environmental indicators as time series (sometimes going all the way back to the Soviet period) in a GIS-enabled database.

Similar to many ex-Soviet countries Uzbekistan exhibits some major environmental problems caused by central planning and its preoccupation with increasing economic growth with little regard to its effects on the environment or the sentiments of the people who might be living in the affected areas. The most notorious of those is the Aral Sea disaster - perhaps the first climate change of any appreciable scale caused by human action. All of Central Asia contains degraded lands, buried or open-air toxic/radioactive wastes, polluted surface or underground waters and still-operating archaic factories that spew poisonous gases to atmosphere.

Hence, it is very important that Uzbekistan and other CIS countries chart their development as independent countries to be environment friendly in order that this terrible legacy is not further compounded and act as a deterrent to higher living standards to present and future generations. Sustainable resource usage, conservation, productive modern technologies, rational waste management, respect for biodiversity, respect for the shared water and other resources must be fully considered in future development plans by the Government and the private sector. Even more important is raising the awareness of the citizens so that they demand the right standards of behavior of each other, their Government and companies.

I hope that this Environmental Atlas will help in the above regards and will be a timely complement to the Welfare Improvement Strategy that has recently been endorsed as the national development strategy for the period 2008-2010. UNDP is committed to support the people of Uzbekistan in achieving sustainable development and improving living standards throughout the country.

F. AKCURA
UNDP Resident Representative

ENVIRONMENTAL ATLAS OF UZBEKISTAN

CONTENTS

TEAM OF CONTRIBUTORS

Stewardship and Editing
Fikret Akcura
Boriy Alikhanov
Anvar Nasritdinov

Authors
A wide circle of scholars, practitioners, environmental protection, management, and utilization specialists participated in the development and analysis of the materials.
Contributors: L. Aksyonova, A. Arifbaev, F. Artikova, D. Aytbaev, I.Batalova,V. Chub, K. Damlajanov, Z. Dushdurova, A. Egamberdiev, L. Frank, N. Frolova, G. Glazyrin, N. Gorelkin, F. Hikmatov, U.Ivanov, B. Juraev, M. Kameletdinova, B. Kurbanov, Sh.Kuchkarov, U.Lesnik, T. Lee, H. Magdiev, R. Makhamadaliev, F. Maksudov, A. Mavlonov, T. Mirzaliev, M.Mode, V. Nikiforova, D. Nurbaev, V.Popov, A.Primov, B.Rakhmatov, N.Rahmatova, F.Rubinova, D.Saidova, S. Saidova, V. Savello, E. Semakova,Z. Sirlibaeva, T.Spektorman, A.Sultanov, Kh.Talipov, G. Tolkacheva, G. Trofimov, H. Turgunov, A.Tursunov, H. Toychiev, N. Umarov, R.Umurzakov, G. Vakhidova, V.Valieva, E.Vidineeva, N.Yakubova, G.Yunusov.

Technical Support
G. Akramova, A. Askarov, I. Belikov

Cover Design
"Kartografiya" State Scientific-Production Enterprise,
"Art Line Group" LTD.
Photo by D.Akhunbabaev was used for design of front cover

Contributors are grateful to all organizations, companies, and staff of research institutions for their assistance in collection of essential materials and their cartographic analysis.

Introduction

This Atlas - the State of the Environment in Uzbekistan has been prepared by the joint Project of the Government of the Republic of Uzbekistan and United Nations Development Program "Enhancement of the Environmental Indicators Database with GIS application to monitor the state of the environment in Uzbekistan".

The analysis of the current state and trends in the environmental changes are based on environmental indicators reflecting national environmental priorities in line with the international environmental approaches; based on ongoing observations; containing reliable information, which enables to predict effectiveness of the undertaken measures.

These indicators describe prioritized issues of country's environment related to climate change, current state of atmospheric air, water and land resources, biodiversity, public health, current state of the Aral Sea, and issues of waste management.

Thematic maps, tables, and graphs are prepared based on the analysis of materials in the Database of Environmental Indicators for 1991-2006 utilizing GIS-technologies. Utilizing environmental indicators along with traditional methods of mapping analysis significantly expands knowledge of the current state of the environment in the region, enabling to identify emerging issues and the ways to overcome them.

Mapping was based on development of information layers of the general geographic underpinning and thematic content of the Atlas maps. This database puts together modern data of the State Committee for Land resources, Geodesy, Cartography and State cadastre and materials of the major ministries responsible for environmental monitoring to ensure accuracy, consistency, completeness, and timeliness of information essential to support management-related decision-making. Consistency of Information was ensured by preliminary analysis and agreement of Atlas maps.

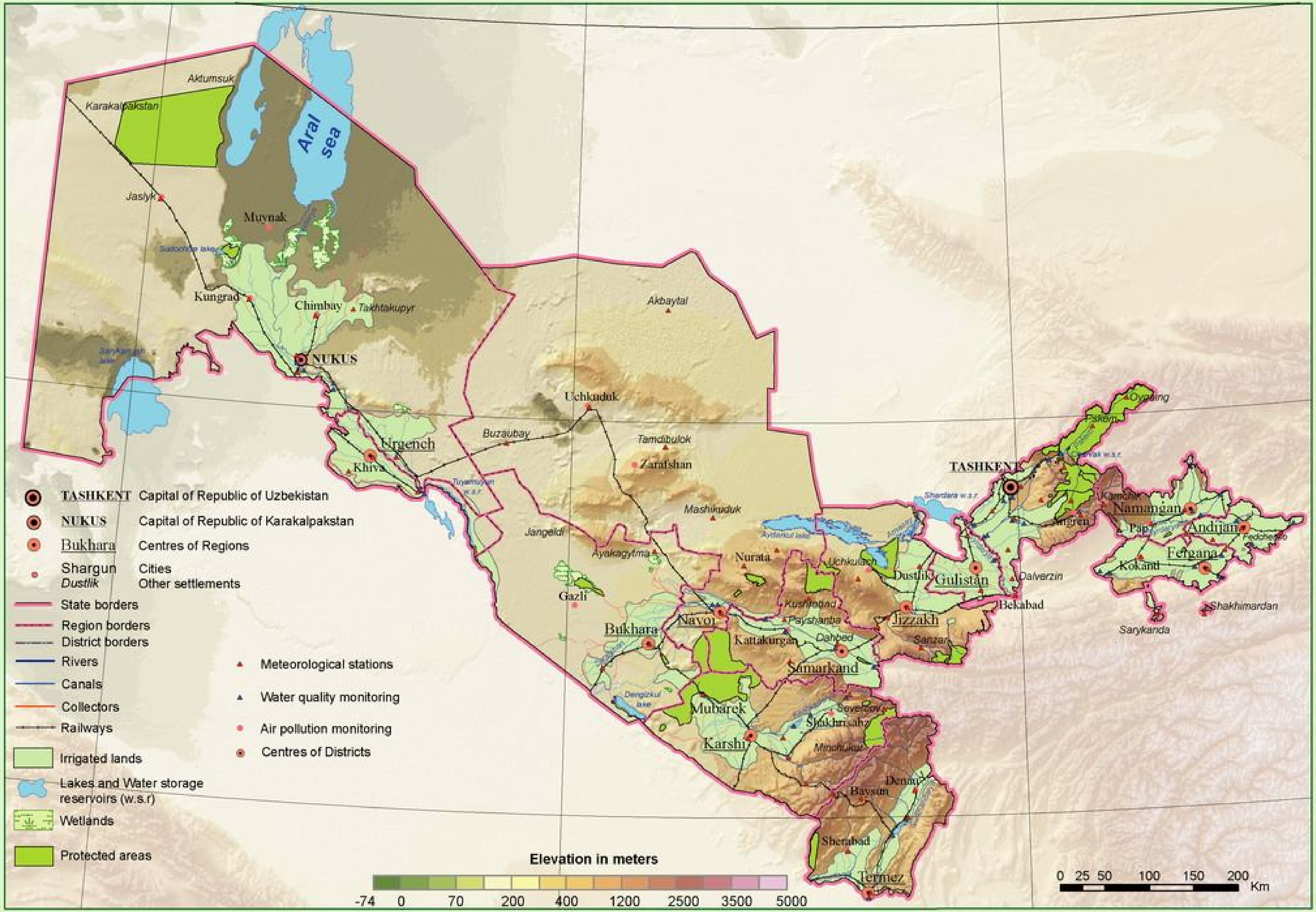
These schematic maps are arranged in three sections. The first section provides distribution of major environmental indicators nationwide. The second one outlines the quality of air, water, and land resources and features of biodiversity across regions and districts. The third one is about distribution of major hydrological characteristics of water collection area and irrigated territory of the entire basin of the Aral Sea.

Considering the important role of the assessment of the state and utilization of water resources in the Aral Sea basin for almost all components of region's environment and economics, these aspects are specified in the special section of the Atlas, encompassing the territory of the neighboring nations. The hydrological section is prepared primarily by the specialists of the Mirzo Ulugbek National University of Uzbekistan.

This publication is designed for a broad circle of users, staff of research and training centers, businesses, public organizations, local authorities as well as decision-makers and will facilitate development of effective activities to improve domestic environment and more rational utilization of its natural resources.

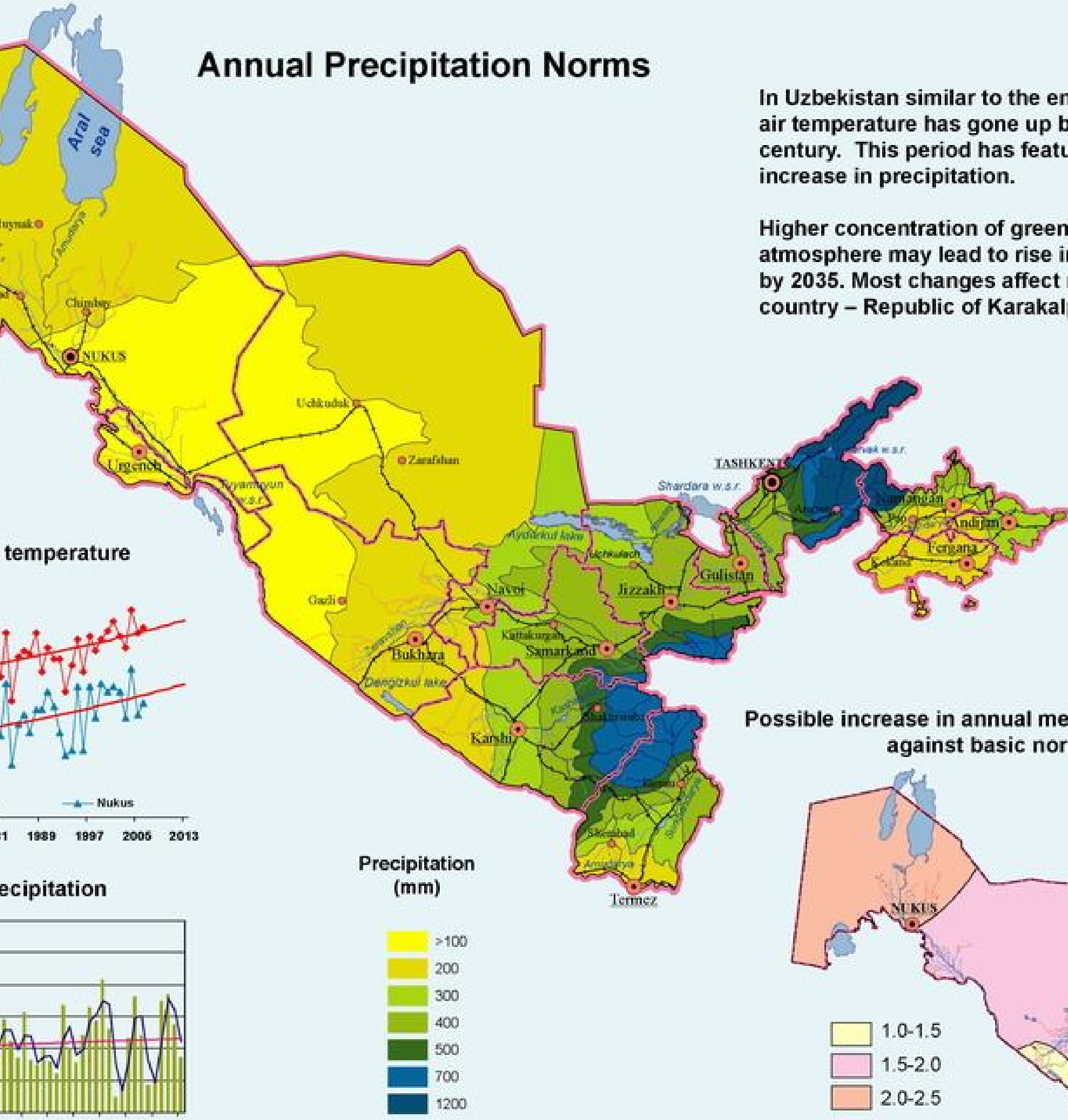
The authors are sincerely grateful to all organizations, companies, staff members of research institutions for the assistance provided in collecting and analysis of essential materials.

SELECTED ENVIRONMENTAL MAPS
OF UZBEKISTAN



Aral sea
Aktumsuk
Karakalpakstan
Jaslyk
Muynak
Sudochye lake
Kungrad
Chimbay
Takhtakupyr
Sarykamysh lake
NUKUS
Urgench
Khiva
Tuyamuyun w.s.r
Buzaubay
Uchkuduk
Tamdibulok
Zarafshan
Akbaytal
Mashikuduk
Jangeldi
Ayakagytma
Gazli
Nurata
Aydarkul lake
Shardara w.s.r.
TASHKENT
Charvak w.s.r.
Oygaing
Pskem
Angren
Namangan
Pap
Andijan
Fedchenko
Fergana
Kokand
Shakhimardan
Sarykanda
Dalverzin
Bekabad
Gulistan
Dustlik
Uchkulach
Jizzakh
Sanzar
Kushrabad
Payshanba
Navoi
Bukhara
Kattakurgan
Dahbed
Samarkand
Dengizkul lake
Mubarek
Severtzov
Shakhrisabz
Karshi
Minchukur
Denau
Baysun
Sherabad
Termez
TASHKENT Capital of Republic of Uzbekistan
NUKUS Capital of Republic of Karakalpakstan
Bukhara Centres of Regions
Shargun Cities
Dustlik Other settlements
State borders
Region borders
District borders
Rivers
Canals
Collectors
Railways
Irrigated lands
Lakes and Water storage reservoirs (w.s.r)
Wetlands
Protected areas
Meteorological stations
Water quality monitoring
Air pollution monitoring
Centres of Districts
Elevation in meters
-74 0 70 200 400 1200 2500 3500 5000
0 25 50 100 150 200 Km
57°
63°
69°
42°
38°

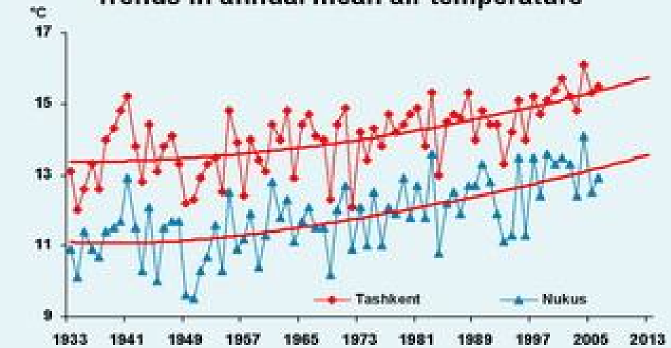
Annual Precipitation Norms



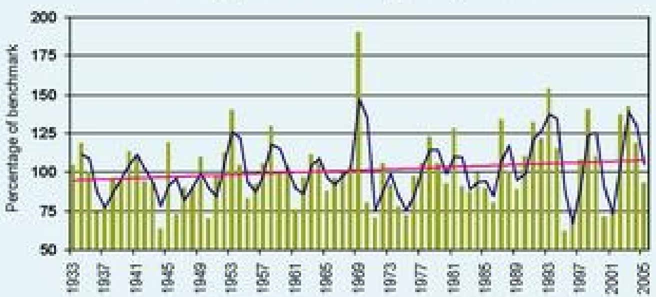
In Uzbekistan similar to the entire northern hemisphere, air temperature has gone up by 2.8 °C during the 20th century. This period has featured insignificant increase in precipitation.

Higher concentration of greenhouse gases in the atmosphere may lead to rise in temperature by 0.3 °C by 2035. Most changes affect northern areas of the country – Republic of Karakalpakstan and Khorezm Region.

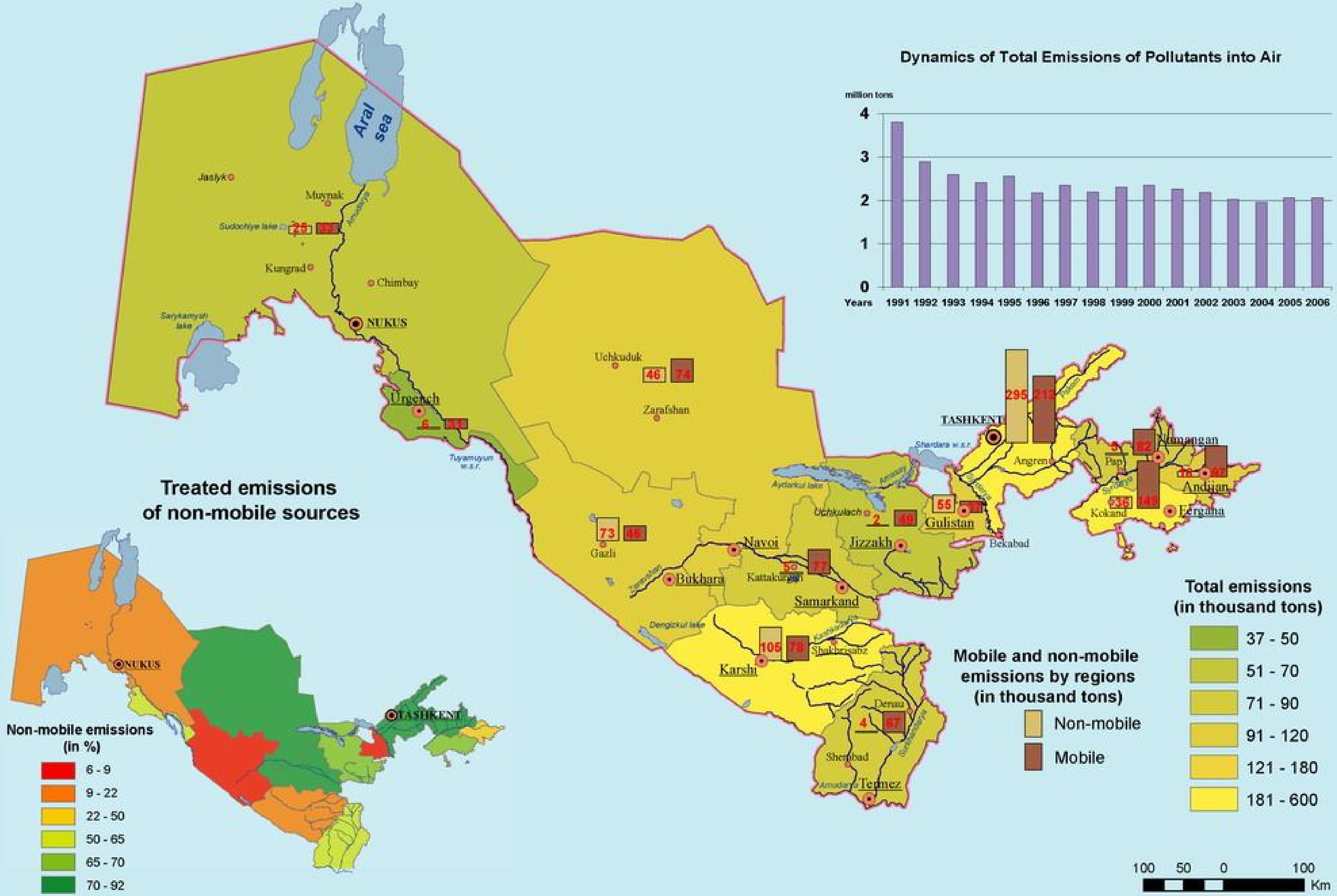
Trends in annual mean air temperature



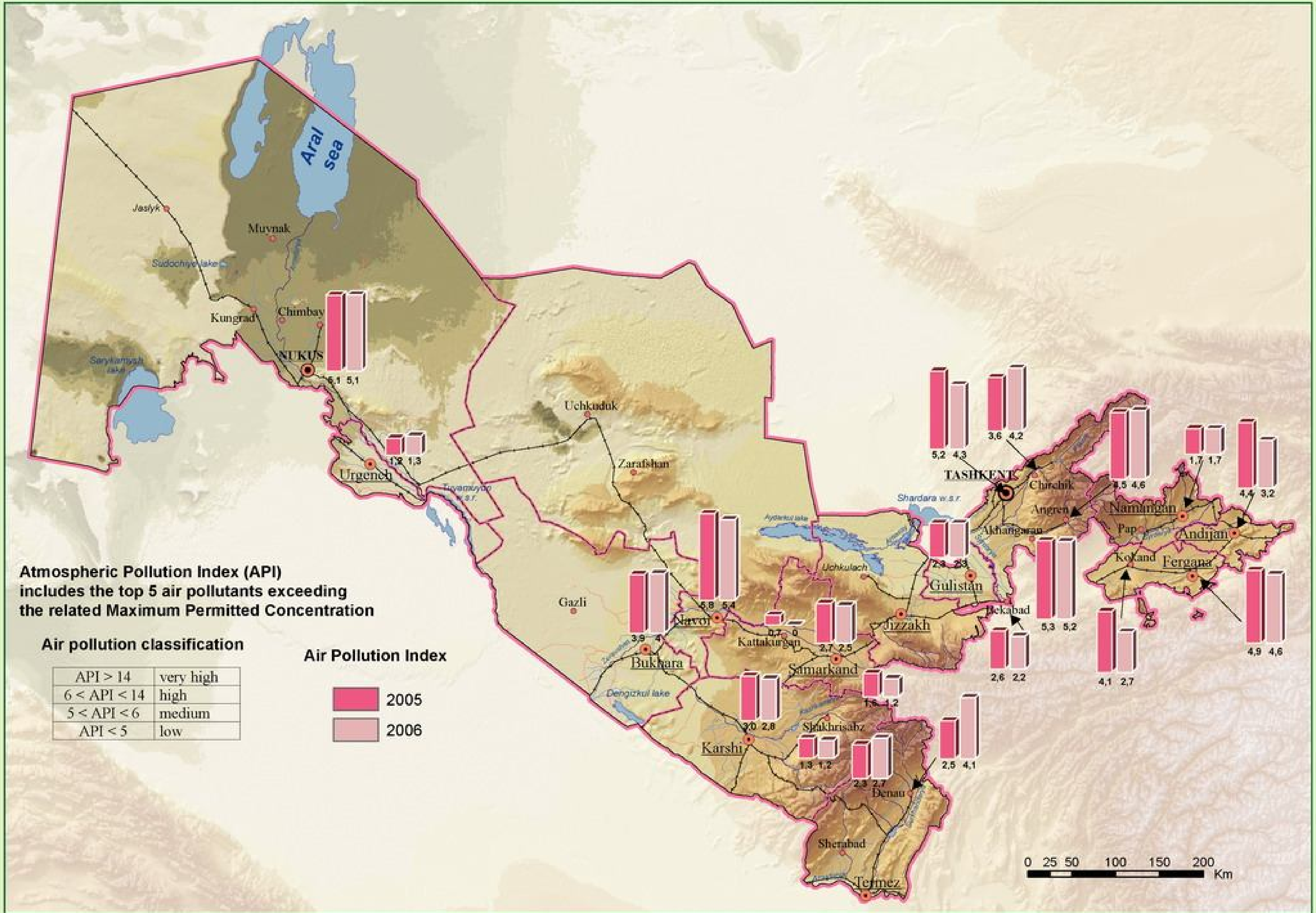
Changes in annual precipitation



Possible increase in annual mean air temperature °C by 2030 against basic norms in 1961-1990


Dynamics of Total Emissions of Pollutants into Air
million tons
4
3
2
1
0
Years
1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006
Aral sea
Jaslyk
Muynak
Sudochiye lake
25
Kungrad
Chimbay
Sarykamysh lake
NUKUS
Uchkuduk
46
74
Zarafshan
Urgench
6
Tuyamuyun w.s.r.
TASHKENT
295
212
Shardara w.s.r.
Angren
Namangan
Pap
82
Andijan
16
97
36
145
Kokand
Fergana
Aydarkul lake
Uchkulach
2
49
55
Gulistan
Jizzakh
Bekabad
73
46
Gazli
Navoi
Bukhara
Kattakurgan
5
77
Samarkand
Dengizkul lake
105
78
Shakhrisabz
Karshi
Denau
4
67
Sherabad
Termez
Mobile and non-mobile emissions by regions (in thousand tons)
Non-mobile
Mobile
Total emissions (in thousand tons)
37 - 50
51 - 70
71 - 90
91 - 120
121 - 180
181 - 600
100 50 0 100
Km
Treated emissions of non-mobile sources
NUKUS
TASHKENT
Non-mobile emissions (in %)
6 - 9
9 - 22
22 - 50
50 - 65
65 - 70
70 - 92

AIR POLLUTION INDEX ACROSS CITIES (2005-2006)

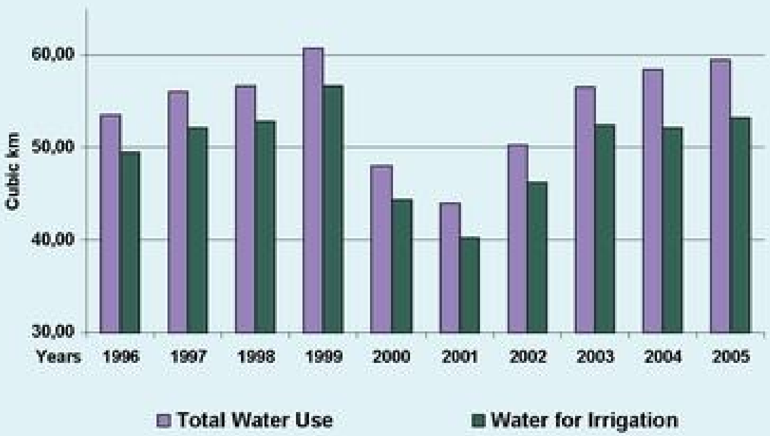


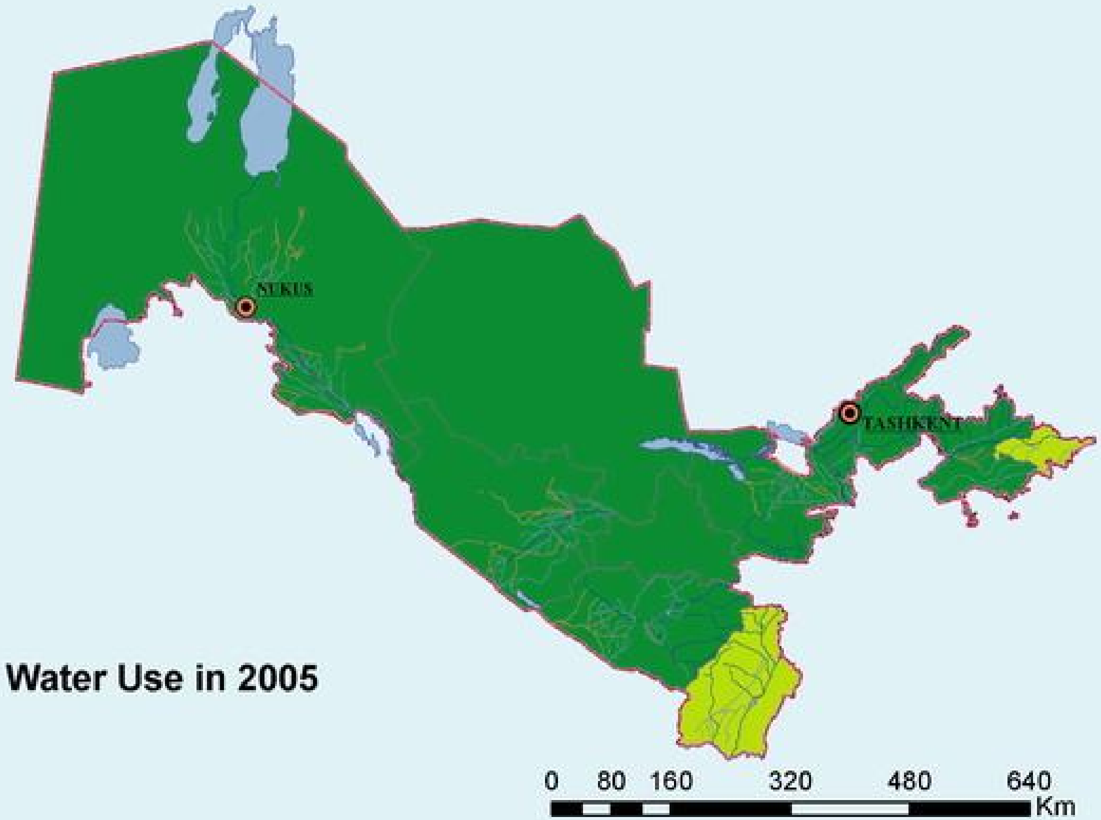
Water Use

- Catastrophic Shortage <60%
- Acute Shortage <80%
- Limited <90%
- Average Perennial – 100%

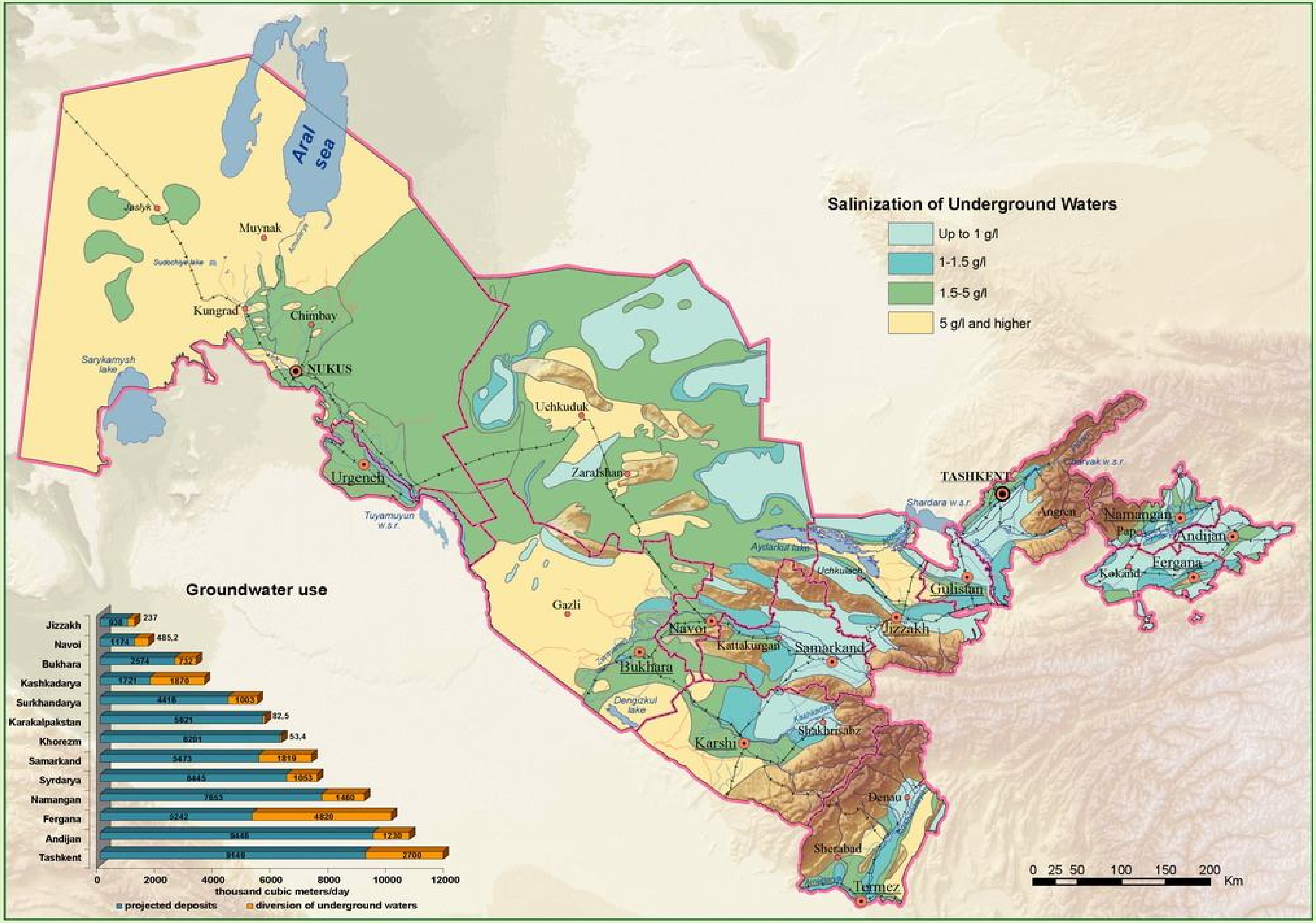
Water Use in 2001

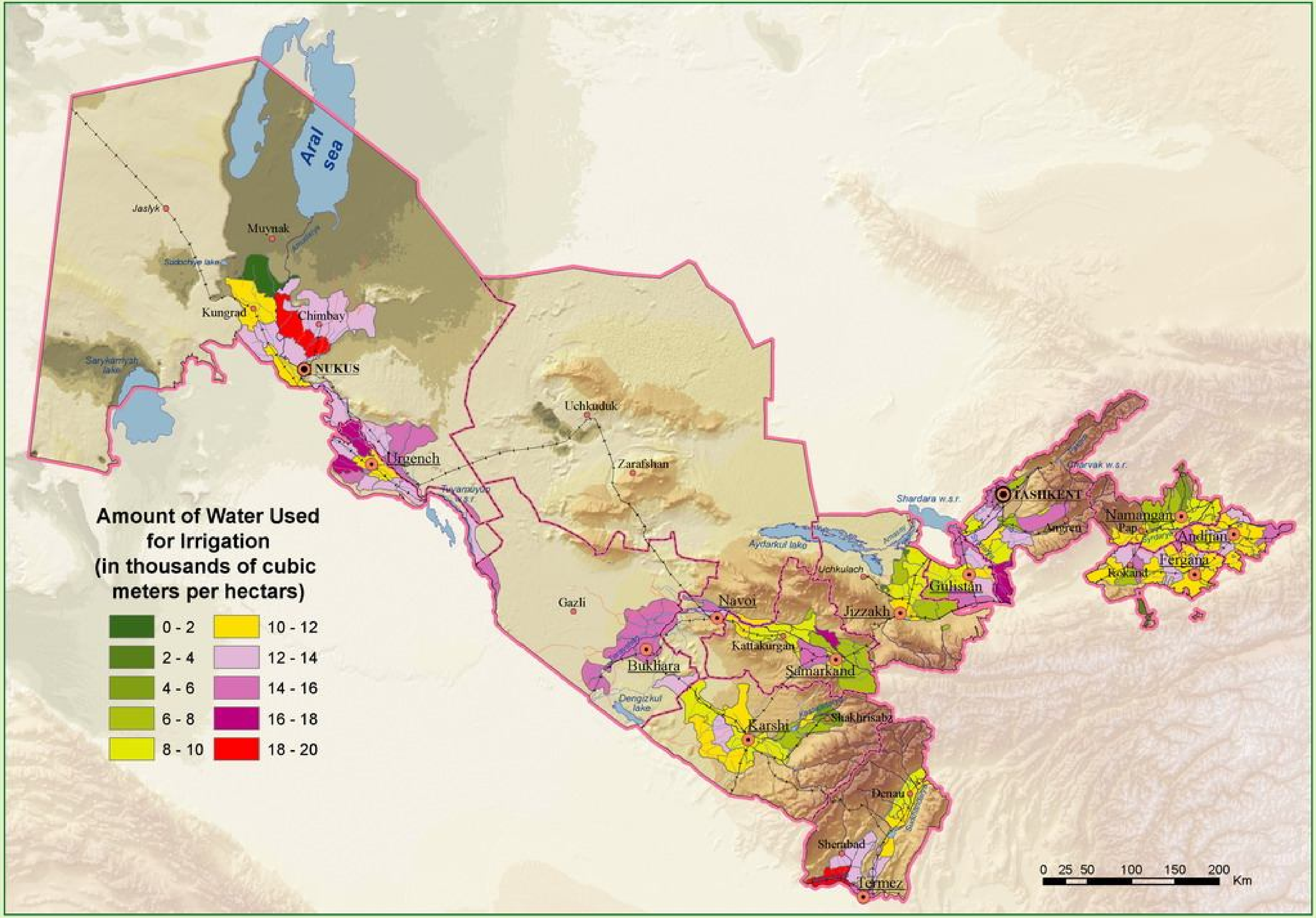
Total Water Use in Uzbekistan in 1996-2005

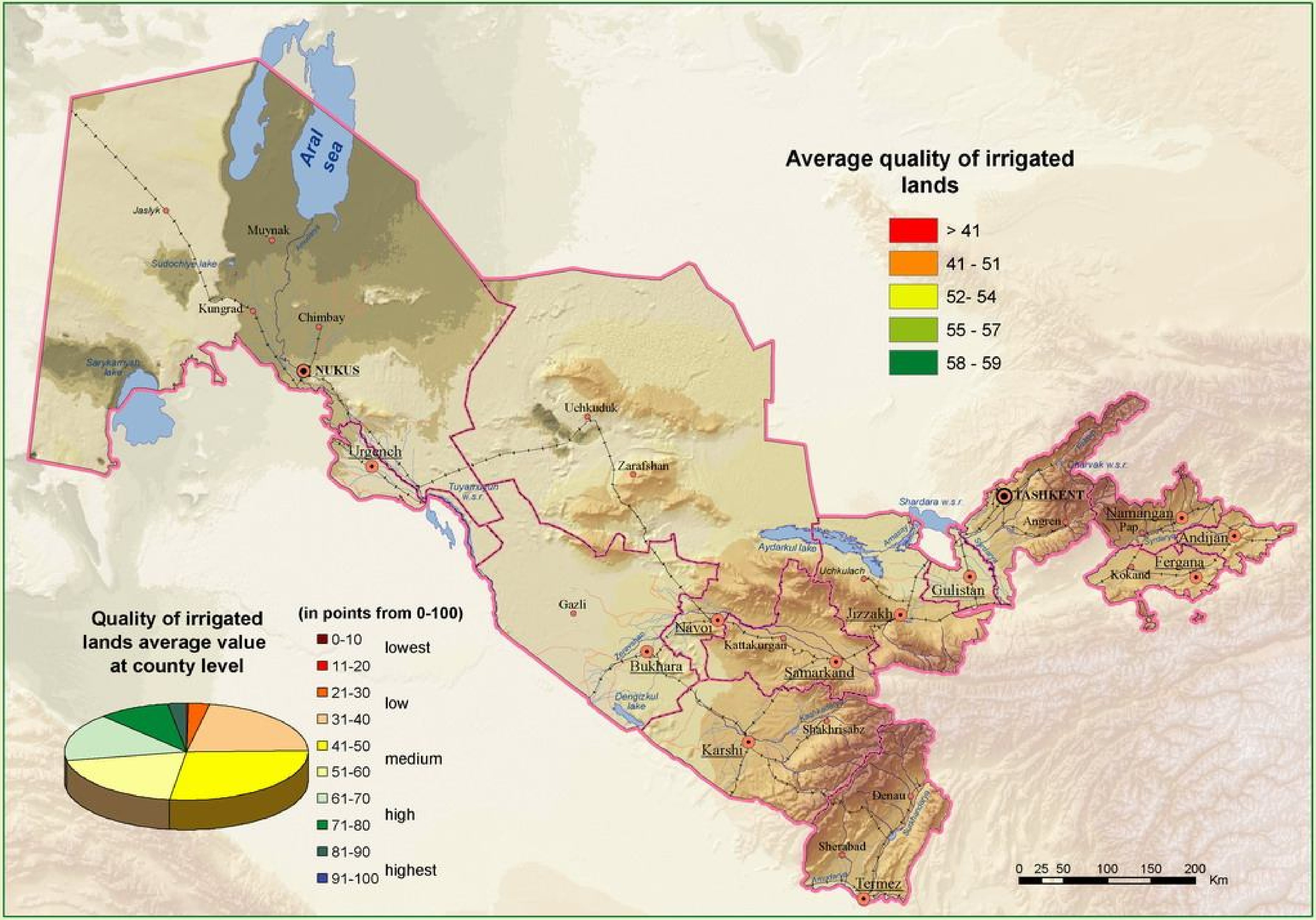


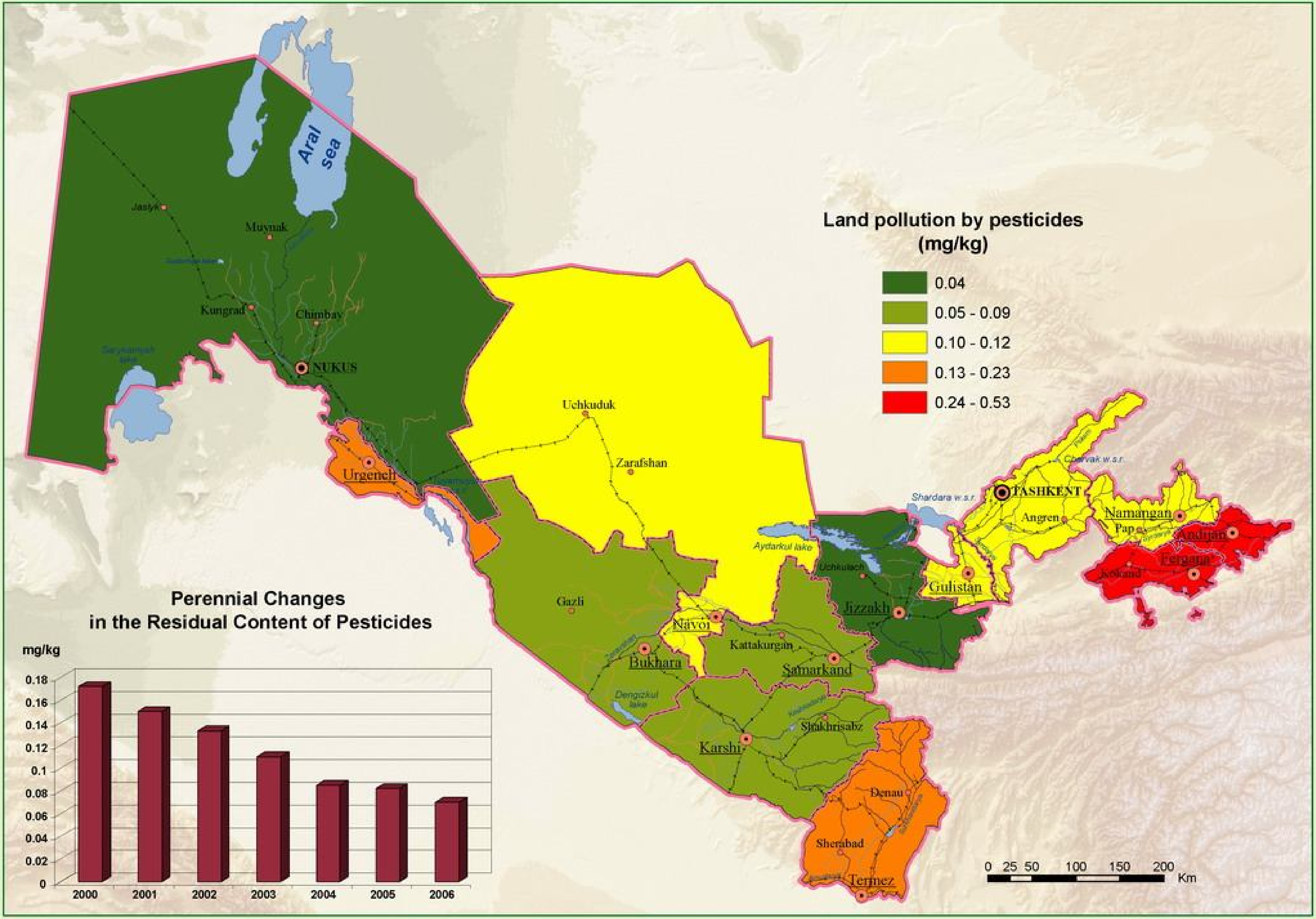


Water Use in 2005


Salinization of Underground Waters
Up to 1 g/l
1-1.5 g/l
1.5-5 g/l
5 g/l and higher
Aral sea
Jaslyk
Muynak
Sudochye lake
Kungrad
Chimbay
Sarykamysh lake
NUKUS
Uchkuduk
Urgench
Zarafshan
Tuyamuyun w.s.r.
TASHKENT
Charvak w.s.r.
Shardara w.s.r.
Angren
Namangan
Pap
Andijan
Fergana
Kokand
Aydarkul lake
Uchkulach
Gulistan
Jizzakh
Gazli
Navoi
Kattakurgan
Samarkand
Bukhara
Dengizkul lake
Shakhrisabz
Karshi
Denau
Sherabad
Termez
0 25 50 100 150 200 Km
Groundwater use
Jizzakh
Navoi
Bukhara
Kashkadarya
Surkhandarya
Karakalpakstan
Khorezm
Samarkand
Syrdarya
Namangan
Fergana
Andijan
Tashkent
938 237
1174 485,2
2574 752
1721 1870
4418 1003
5821 82,5
6201 53,4
5473 1819
6443 1053
7653 1460
5242 4820
9846 1230
9149 2700
0 2000 4000 6000 8000 10000 12000
thousand cubic meters/day
projected deposits
diversion of underground waters


Aral sea
Jaslyk
Muynak
Kungrad
Chimbay
NUKUS
Sarykamysh lake
Urgench
Uchkuduk
Zarafshan
Gazli
Navoi
Bukhara
Dengizkul lake
Kattakurgan
Samarkand
Karshi
Shakhrisabz
Jizzakh
Gulistan
Uchkulach
Aydarkul lake
Shardara w.s.r.
TASHKENT
Charvak w.s.r.
Angren
Namangan
Pap
Andijan
Fergana
Kokand
Denau
Sherabad
Termez
Amount of Water Used for Irrigation (in thousands of cubic meters per hectars)
0 - 2
2 - 4
4 - 6
6 - 8
8 - 10
10 - 12
12 - 14
14 - 16
16 - 18
18 - 20
0 25 50 100 150 200 Km

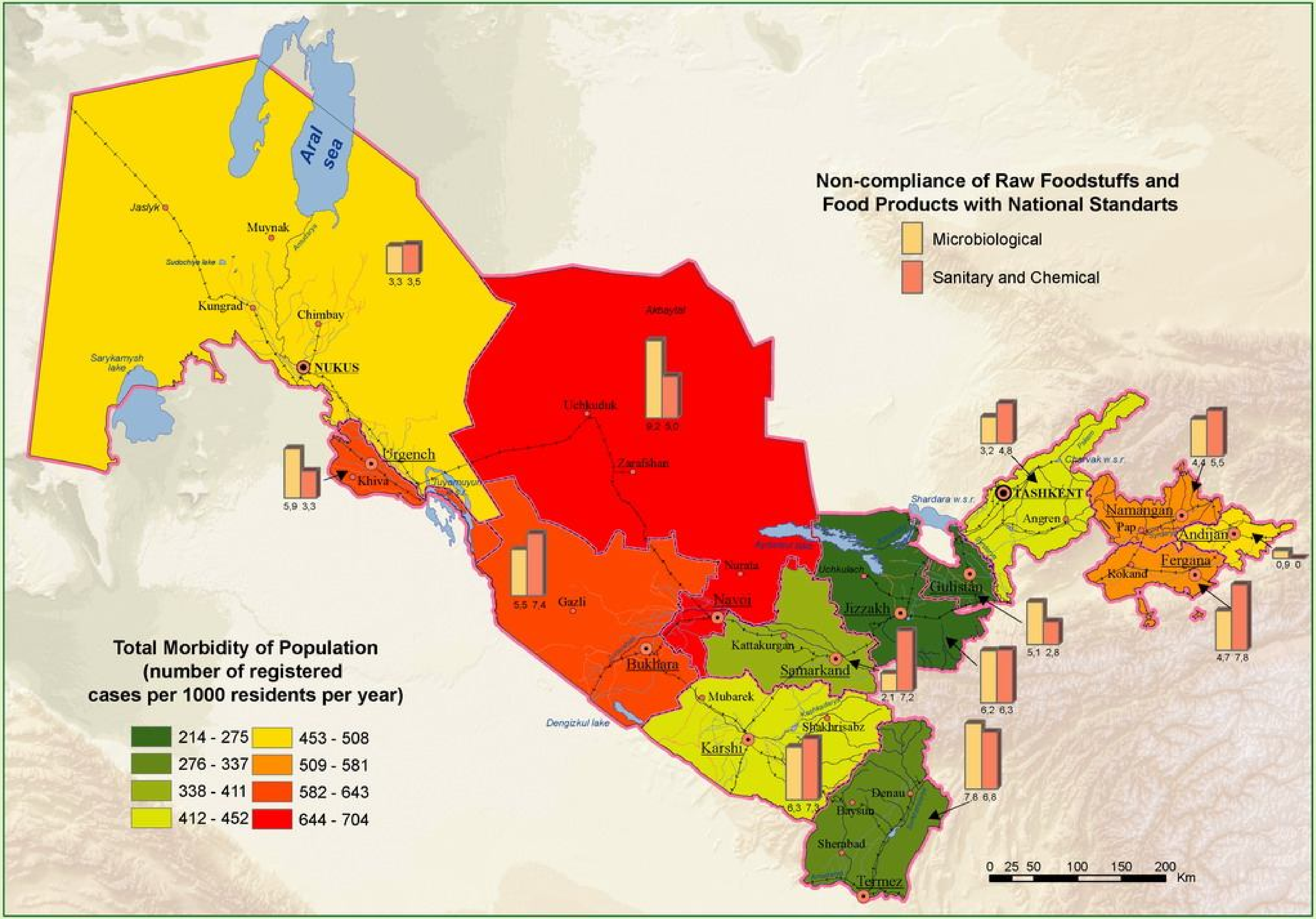

Aral Sea
Average quality of irrigated lands
> 41
41 - 51
52- 54
55 - 57
58 - 59
Jaslyk
Muynak
Sudochiye lake
Kungrad
Chimbay
NUKUS
Sarykamysh lake
Uchkuduk
Urgench
Zarafshan
Tuyamuyun w.s.r.
Charvak w.s.r.
TASHKENT
Shardara w.s.r.
Angren
Namangan
Pap
Andijan
Aydarkul lake
Kokand
Fergana
Uchkulach
Gulistan
Gazli
Jizzakh
Navoi
Kattakurgan
Bukhara
Samarkand
Dengizkul lake
Shakhrisabz
Karshi
Denau
Sherabad
Termez
0 25 50 100 150 200 Km
Quality of irrigated lands average value at county level
(in points from 0-100)
0-10
11-20
lowest
21-30
31-40
low
41-50
51-60
medium
61-70
71-80
high
81-90
91-100
highest


Land pollution by pesticides
(mg/kg)
0.04
0.05 - 0.09
0.10 - 0.12
0.13 - 0.23
0.24 - 0.53
Aral sea
Jaslyk
Muynak
Kungrad
Chimbay
NUKUS
Urgench
Uchkuduk
Zarafshan
Gazli
Navoi
Bukhara
Kattakurgan
Samarkand
Karshi
Shakhrisabz
Denau
Sherabad
Termez
Jizzakh
Uchkulach
Aydarkul lake
Gulistan
Shardara w.s.r.
TASHKENT
Angren
Charvak w.s.r.
Namangan
Pap
Andijan
Fergana
Kokand
Dengizkul lake
0 25 50 100 150 200
Km
Perennial Changes
in the Residual Content of Pesticides
mg/kg
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
2000
2001
2002
2003
2004
2005
2006

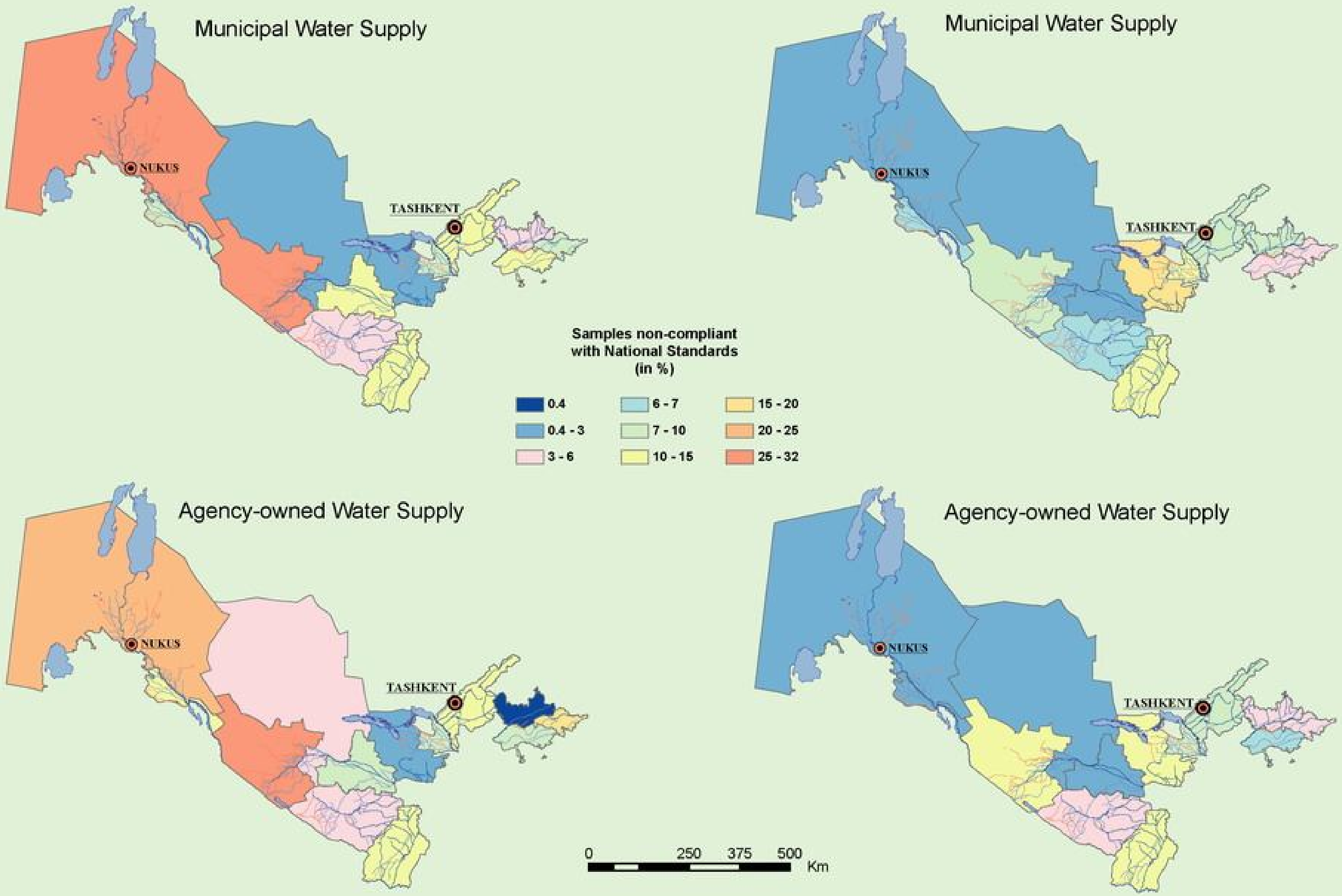
GENERATION OF SOLID INDUSTRIAL AND HOUSEHOLD WASTE (IN 2005)

More than 100 million tons of solid industrial waste is annually generated in Uzbekistan, of which about 30 %. are hazardous. Most of waste is generated by mining and processing companies located in Navoi, Tashkent, and Ferghana regions. About 10,000 hectares of land are occupied by industrial and household waste dumps.

About 2 billion tons of industrial and household waste has been accumulated in major dumps as of 2007. Environmental impact of waste in majority of regions has not been adequately assessed. There is a need for modernization and improvement of recycling, treatment, and land disposal of especially toxic waste.


Aral sea
Non-compliance of Raw Foodstuffs and Food Products with National Standarts
Microbiological
Sanitary and Chemical
Jaslyk
Muynak
Sudochye lake
Kungrad
Chimbay
Sarykamysh lake
NUKUS
3,3 3,5
Akbaytal
9,2 5,0
Uchkuduk
Zarafshan
Urgench
Khiva
5,9 3,3
Tuyamuyun
Nurata
Navoi
Gazli
5,5 7,4
Bukhara
Dengizkul lake
Uchkulach
Jizzakh
Gulistan
Kattakurgan
Samarkand
2,1 7,2
6,2 6,3
5,1 2,8
Shardara w.s.r.
TASHKENT
Angren
Charvak w.s.r.
3,2 4,8
Namangan
Pap
Andijan
Fergana
Kokand
4,4 5,5
0,9 0
4,7 7,8
Mubarek
Shakhrisabz
Karshi
6,3 7,3
Denau
Baysun
Sherabad
Termez
7,8 6,8
Total Morbidity of Population (number of registered cases per 1000 residents per year)
214 - 275
276 - 337
338 - 411
412 - 452
453 - 508
509 - 581
582 - 643
644 - 704
0 25 50 100 150 200 Km

By Sanitary and Chemical Indicators | **By Microbiological Indicators**



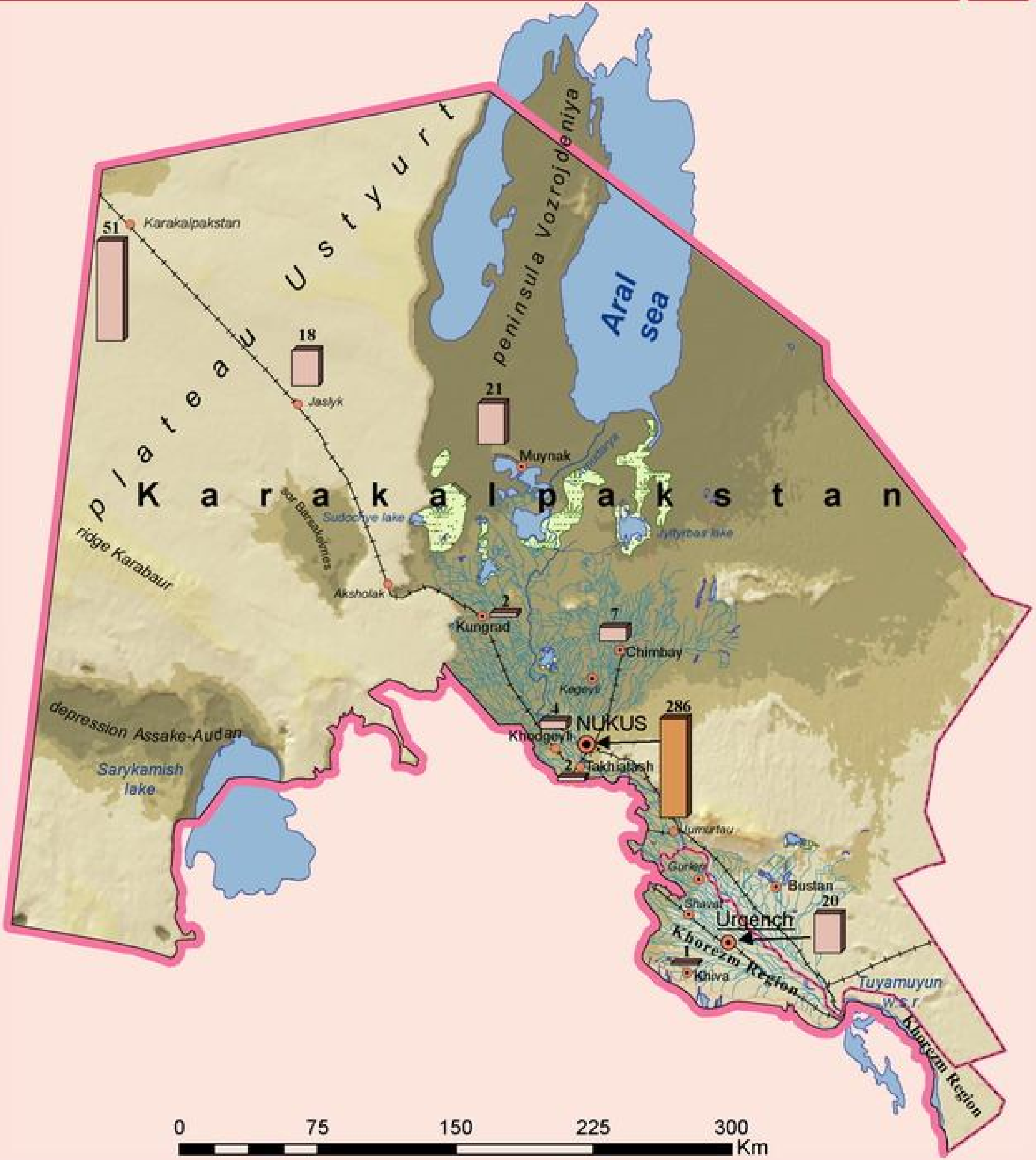
List of Protected Areas in Uzbekistan

Title (Year of Establishment, Management Body)	Location		Area, thousand ha
	Administrative	Geographic	
I. State Reserves (Corresponds to WWF Category 1)			
1. Zaamin (1928, 1960, MAWR)	Jizzakh region, Zaamin district	Pamir-Alay, Turkestan range	26,840
2. Chatkal (1947, Tashkent region khokimiat)	Tashkent region, Parkent and Bostanliq districts	Western Tian-Shian, Chatkal range	35,724
3. Baday-Tugai (1971, MAWR)	Karakalpakstan, Beruniy district	High-water bed of Amudarya	6,462
4. Kyzylkum (1971, MAWR)	Bukhara region, Khorezm region, Romitan district	High-water bed of Amudarya	10,331
5. Zarafshan (1975, MAWR)	Samarkand region, Jambay district	High-water bed of Zarafshan	2,352
6. Kitab (1979, GKGMR)	Kashkadarya region, Kitab district	Pamir-Alay, Zarafshan range	3,938
7. Nurata (1975, MAWR)	Jizzakh region, Forish district	Pamir-Alay, Nurata ridge	17,752
8. Gissar (1983, Goskompriroda)	Kashkadarya region, Yakkabog district	Pamir-Alay, Gissar ridge	80,986
9. Surkhan (1987, MAWR)	Surkhandarya region	Pamir-Alay, Kuhitang range	24,554
II. Natural Parks (Corresponds to WWF Category II)			
Total Area			**208,176**
Percentage of Country's Territory			**0.46%**
1. Zaamin People's Park (1976, MAWR)	Jizzakh region, Zaamin district	Pamir-Alay, Turkestan range	24,110
2. Ugam-Chatkal National Park (1990, Tashkent region khokimiat)	Tashkent region, Bostanlyk, Parkent, and Ohangaron districts	West Tian-Shian ridge	574,590
Total Area		**598,700**	

AIR QUALITY BY REGIONS

Dust storm in the Aral Sea Basin

http://rapidfire.sci.gsfc.nasa.gov/gallery/



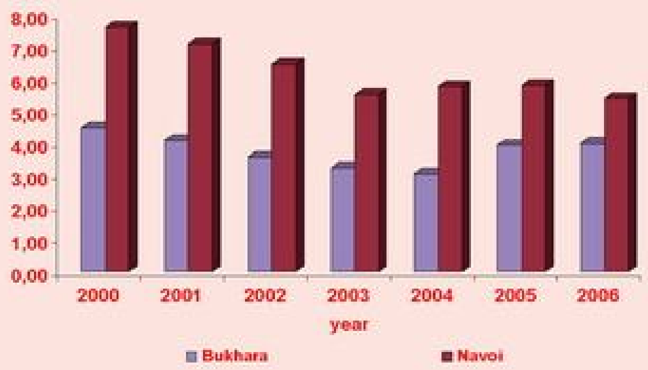
Number of days with dust storms (per year)

26

Number of days with higher content of particulate matters in city air (per year)

140

Air Pollution Index

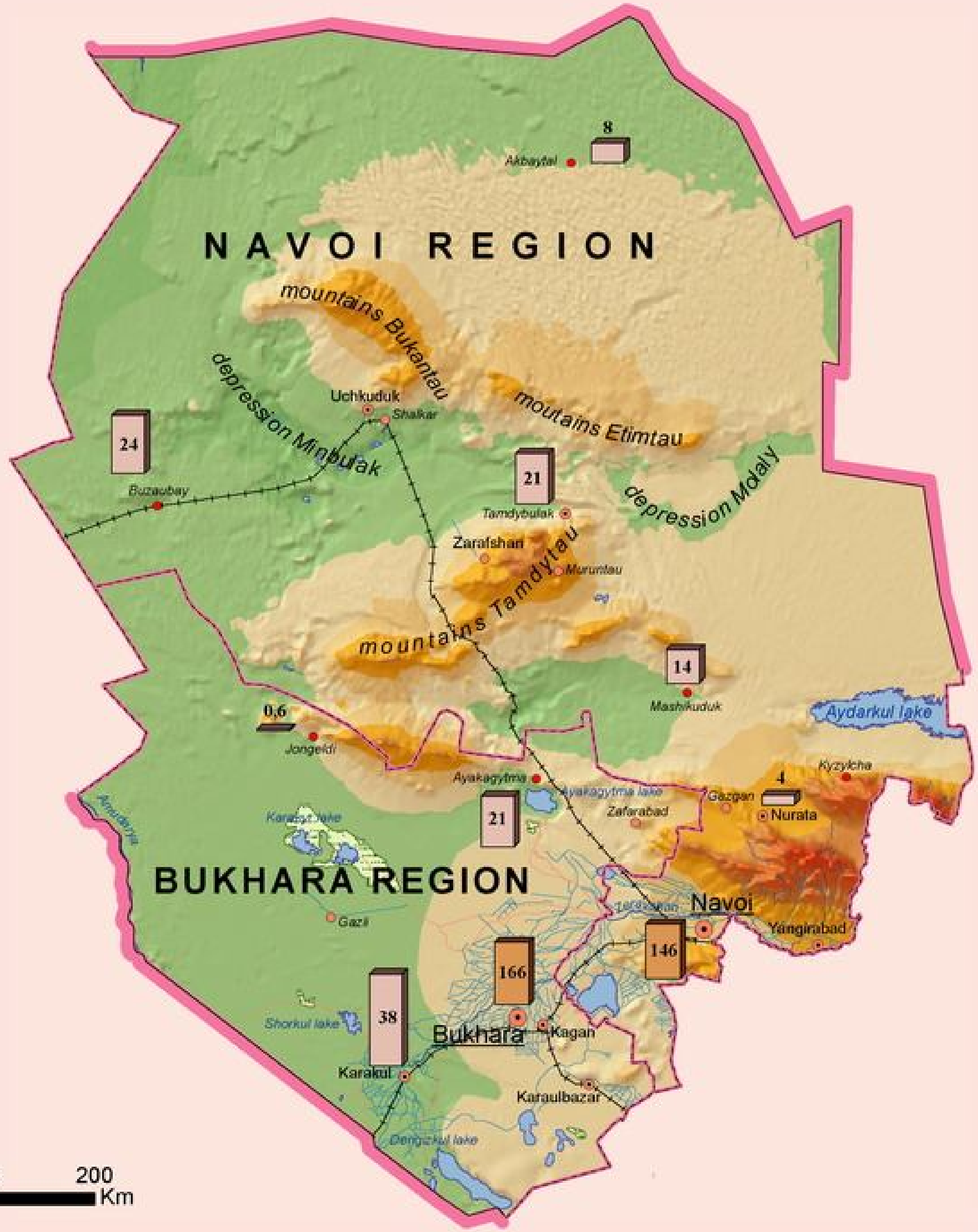


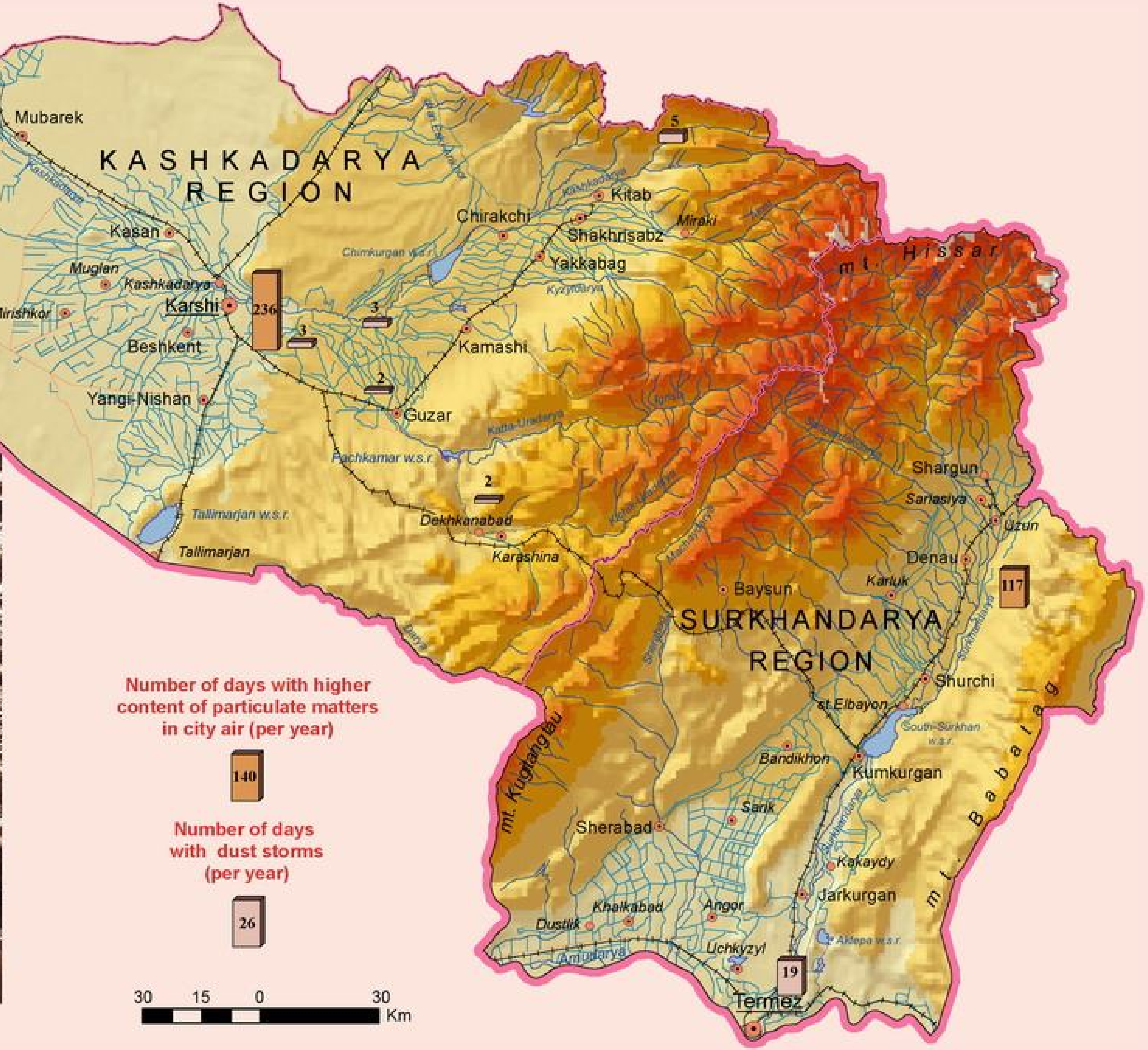
Number of days with dust storms (per year)

26

Number of days with higher content of particulate matters in city air (per year)

140





Dust Storm in Termez city

http://rapidfire.sci.gsfc.nasa.gov/gallery/

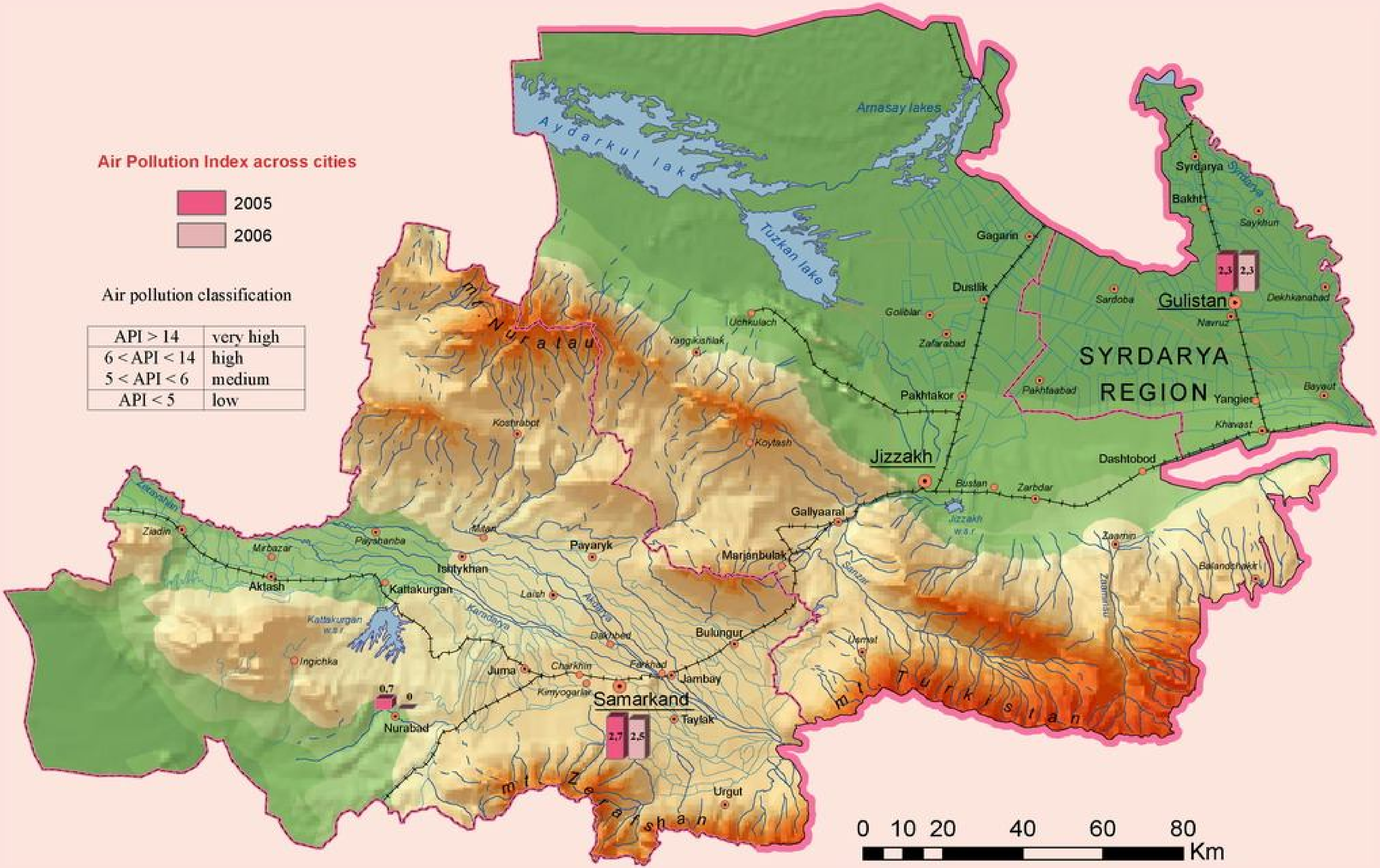
Air Pollution Index across cities

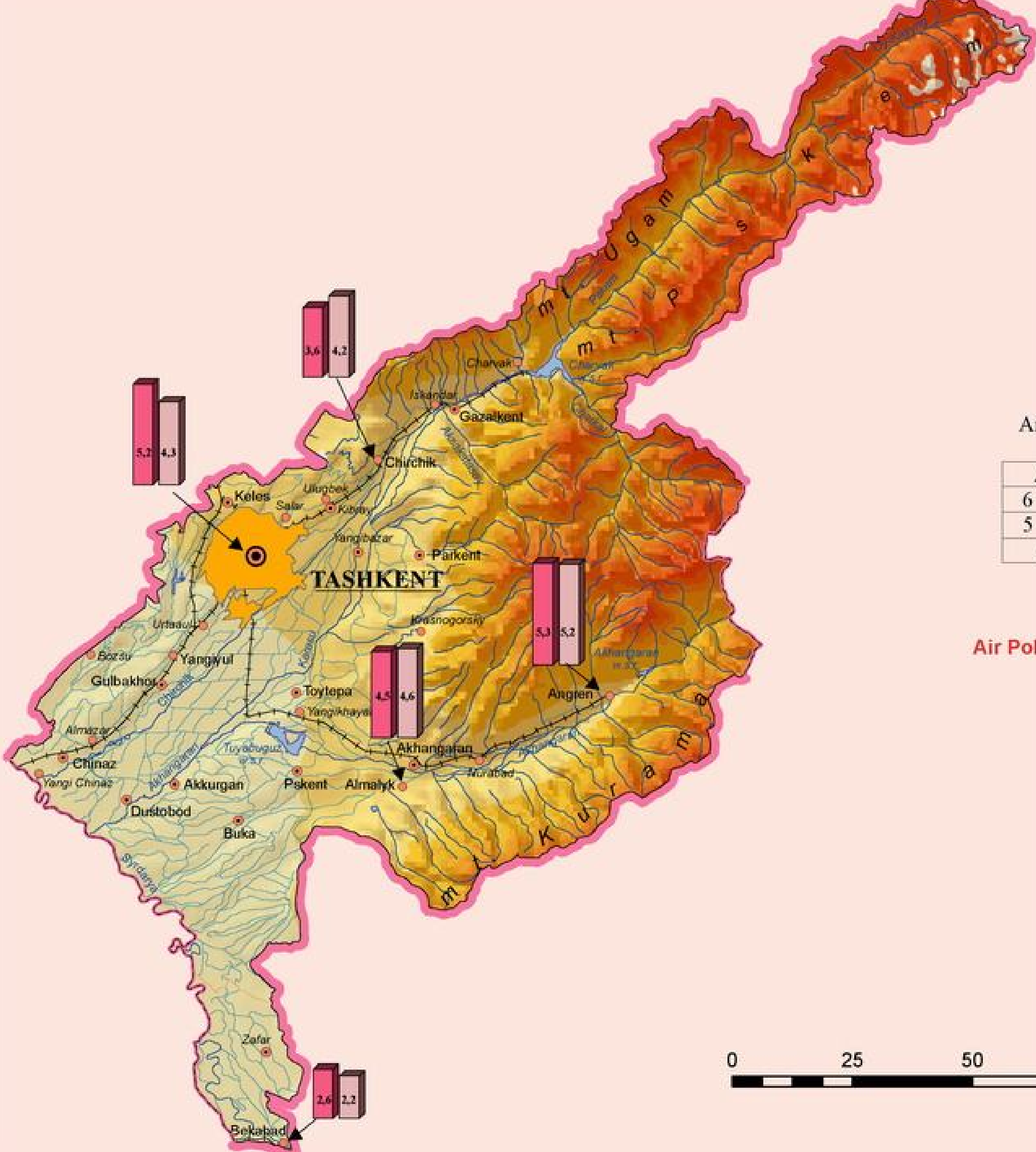
2005

2006

Air pollution classification

API > 14	very high
6 < API < 14	high
5 < API < 6	medium
API < 5	low





Air pollution classification

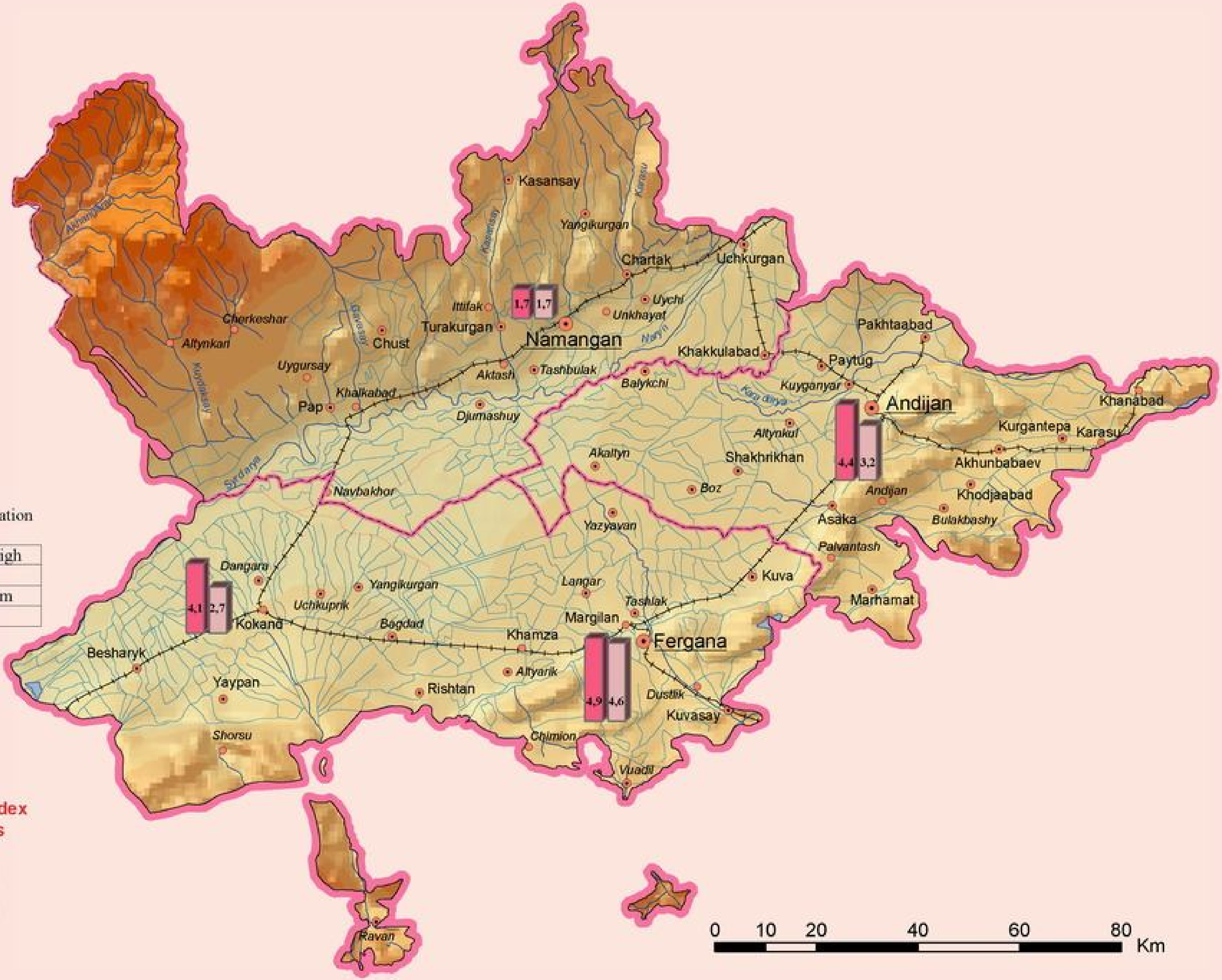
API > 14	very high
6 < API < 14	high
5 < API < 6	medium
API < 5	low

Air Pollution Index across cities

2005

2006

0 25 50 75 100 Km



Air pollution classification

API > 14	very high
6 < API < 14	high
5 < API < 6	medium
API < 5	low

Air Pollution Index across cities

- 2005
- 2006

WATER QUALITY BY REGIONS

Salinity of Underground Waters

- Up to 1g/l
- 1-1.5 g/l
- 1.5-5 g/l
- 5 g/l and higher
- Mountain ridges

Water Quality Category	Description	WPI value
I	Very clean	0.3
II	Clean	>0.3-1.0
III	Moderately polluted	>1.0-2.5
IV	Polluted	>2.5-4.0
V	Dirty	>4.0-6.0
VI	Very Dirty	>6.0-10.0
VII	Extremely Dirty	>10.0

Data on Underground Water Deposits and Their Diversion

6201 / 338 53.4

Numerator – projected reserves, 1,000 cu.m./day
Denominator – proven reserves, 1,000 cu.m/day
To the right – underground waters diverted, 1,000 cu.m/day

Salinity of Underground Waters

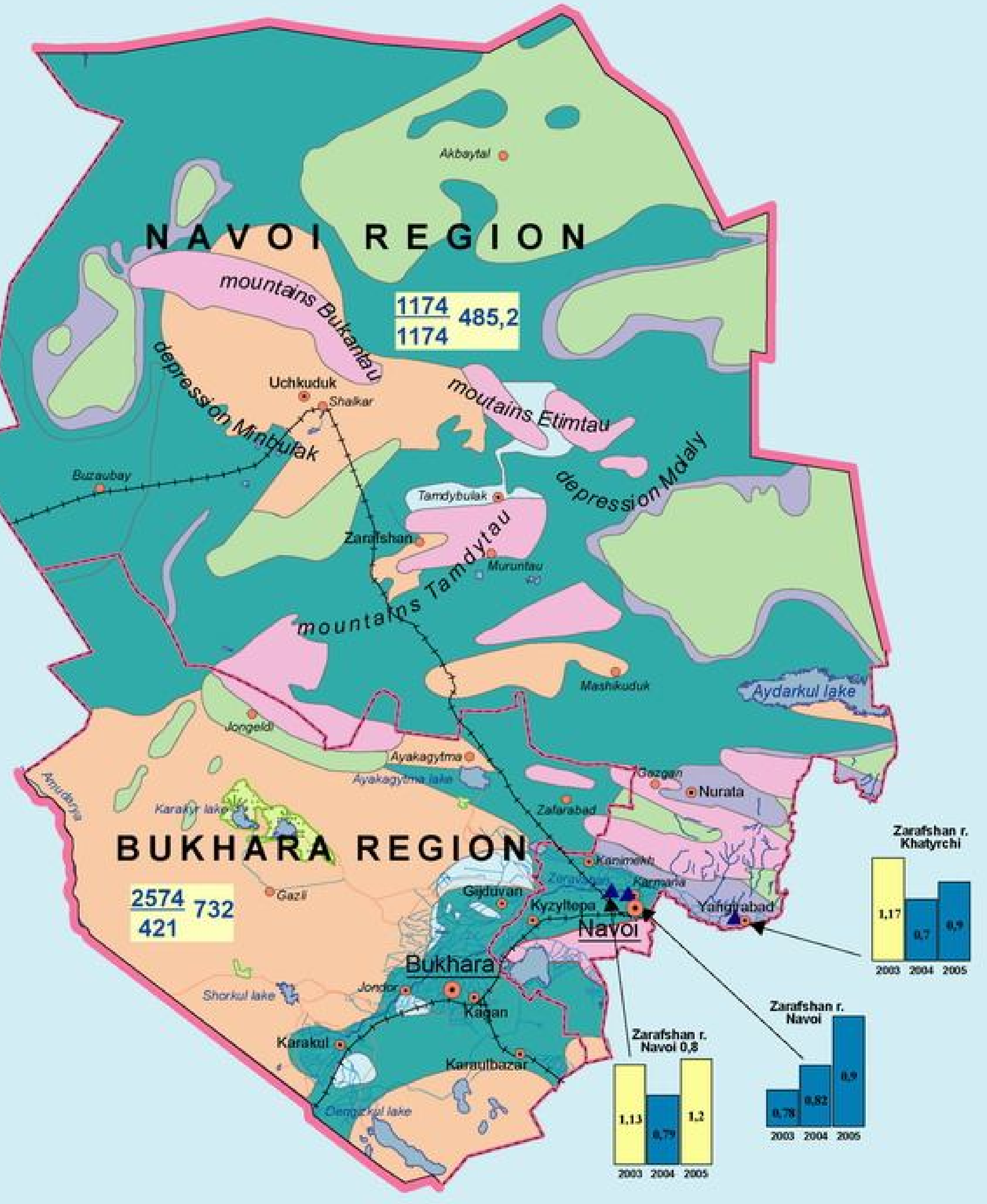
- Up to 1g/l
- 1-1.5 g/l
- 1.5-5 g/l
- 5 g/l and higher
- Mountain ridges

Water Quality Category	Description	WPI value
I	Very clean	0.3
II	Clean	>0.3-1.0
III	Moderately polluted	>1.0-2.5
IV	Polluted	>2.5-4.0
V	Dirty	>4.0-6.0
VI	Very Dirty	>6.0-10.0
VII	Extremely Dirty	>10.0

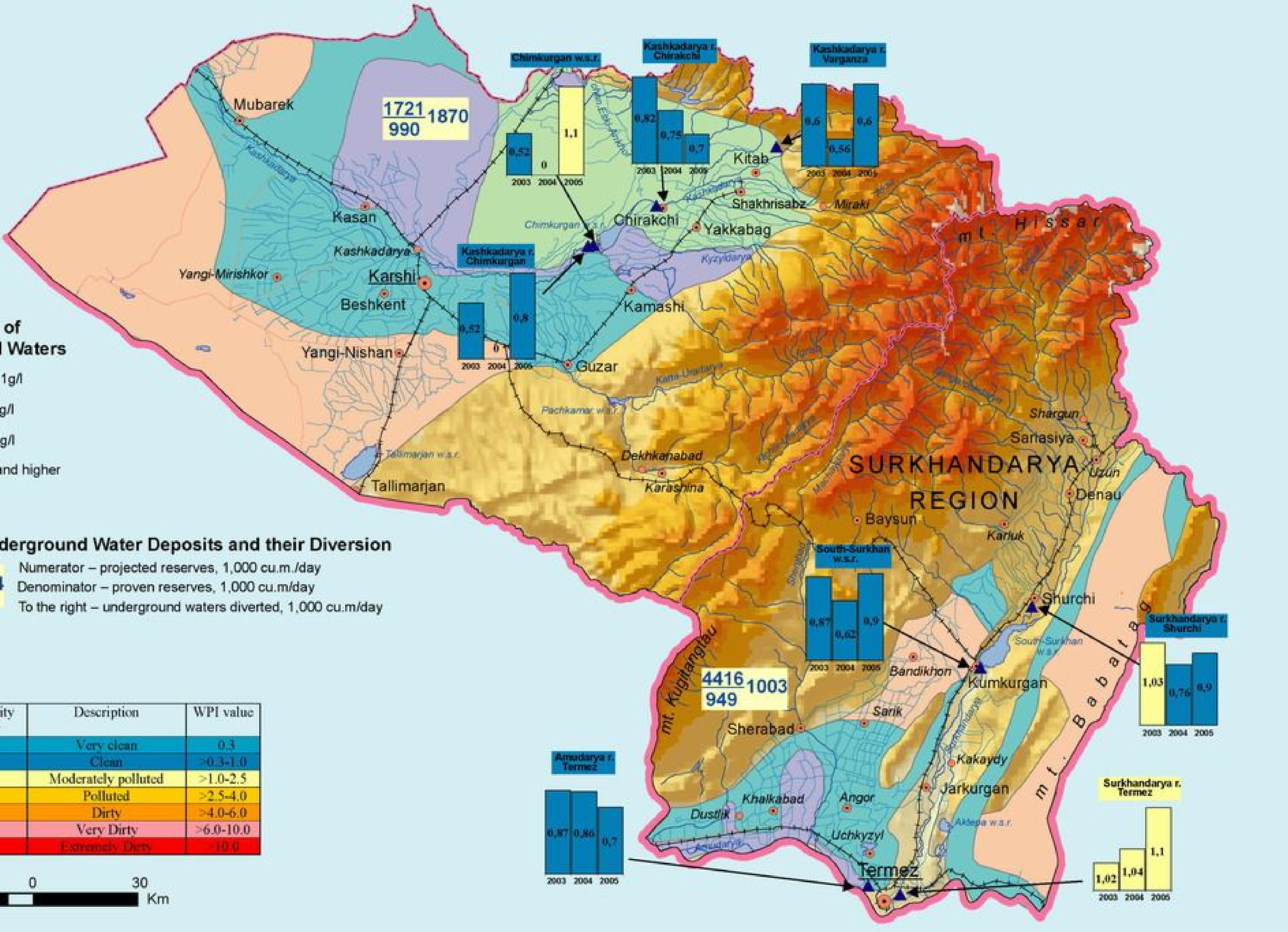
Data on Underground Water Deposits and Their Diversion

6201 / 338 53.4

Numerator – projected reserves, 1,000 cu.m./day
Denominator – proven reserves, 1,000 cu.m/day
To the right – underground waters diverted, 1,000 cu.m/day



0 25 50 100 150 200 Km



Salinity of Underground Waters

- Up to 1g/l
- 1-1.5 g/l
- 1.5-5 g/l
- 5 g/l and higher

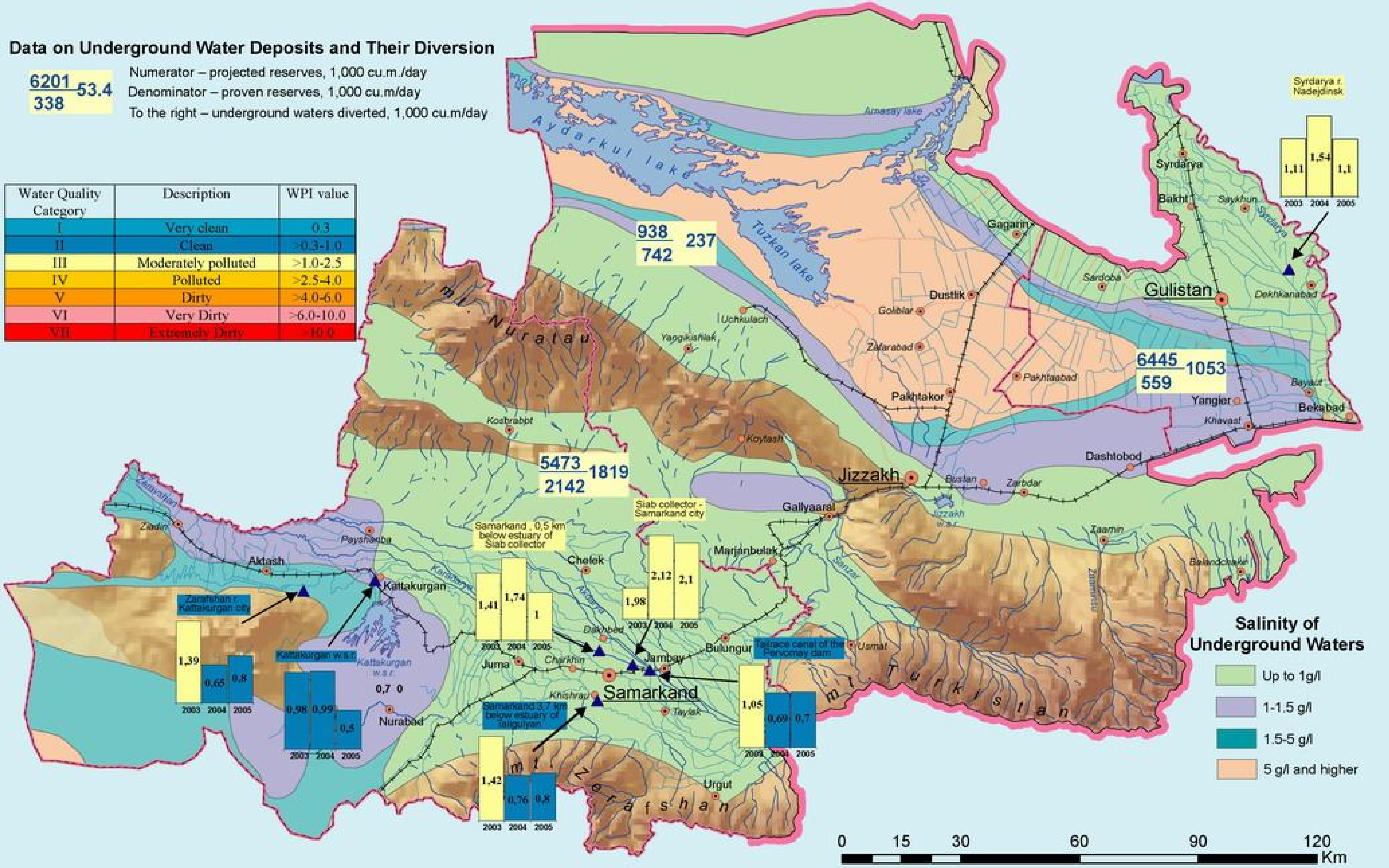
Data on Underground Water Deposits and their Diversion

6201 / 338 53.4

Numerator – projected reserves, 1,000 cu.m./day
Denominator – proven reserves, 1,000 cu.m/day
To the right – underground waters diverted, 1,000 cu.m/day

Water Quality Category	Description	WPI value
I	Very clean	0.3
II	Clean	>0.3-1.0
III	Moderately polluted	>1.0-2.5
IV	Polluted	>2.5-4.0
V	Dirty	>4.0-6.0
VI	Very Dirty	>6.0-10.0
VII	Extremely Dirty	>10.0

30 15 0 30 Km

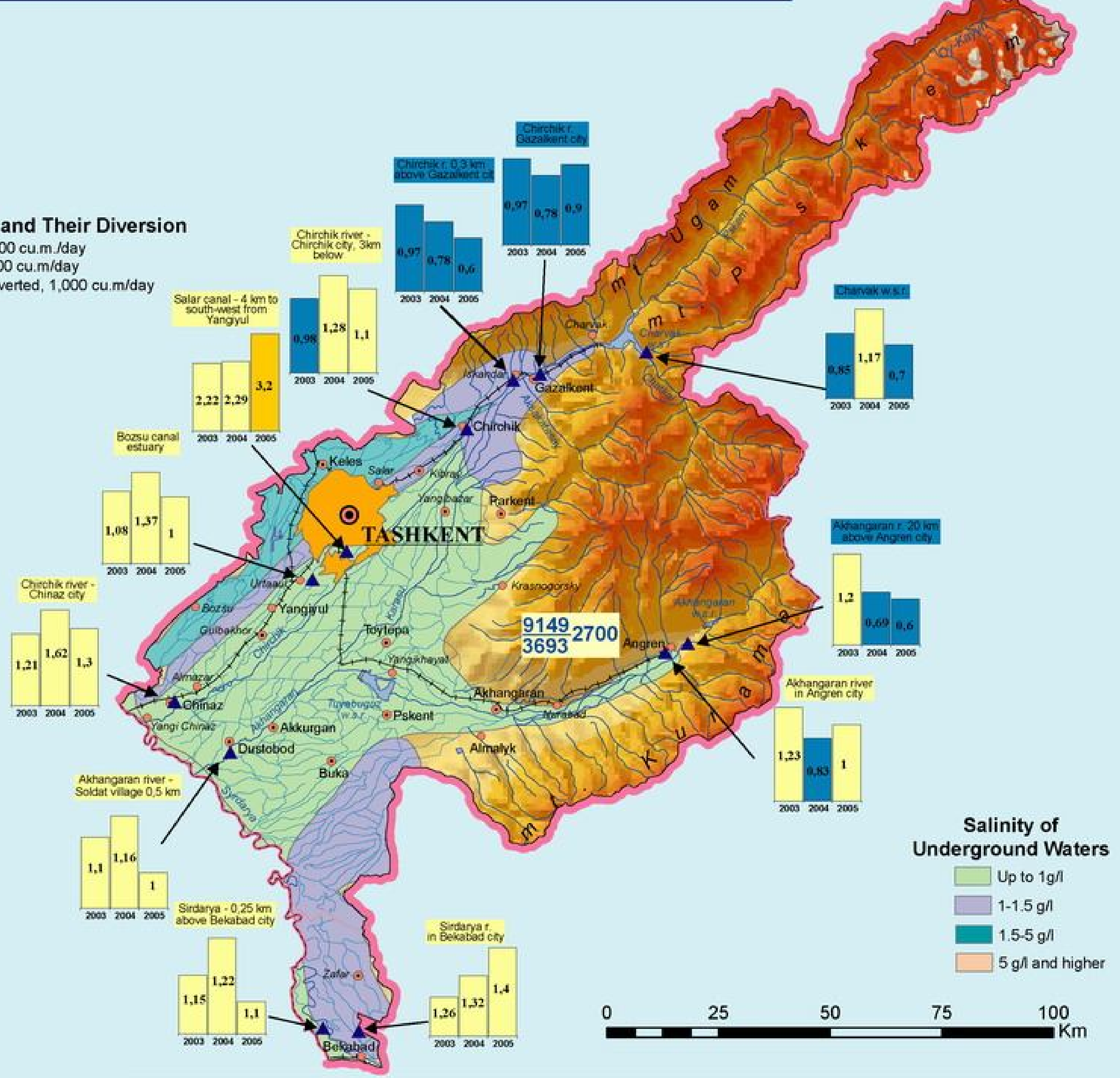


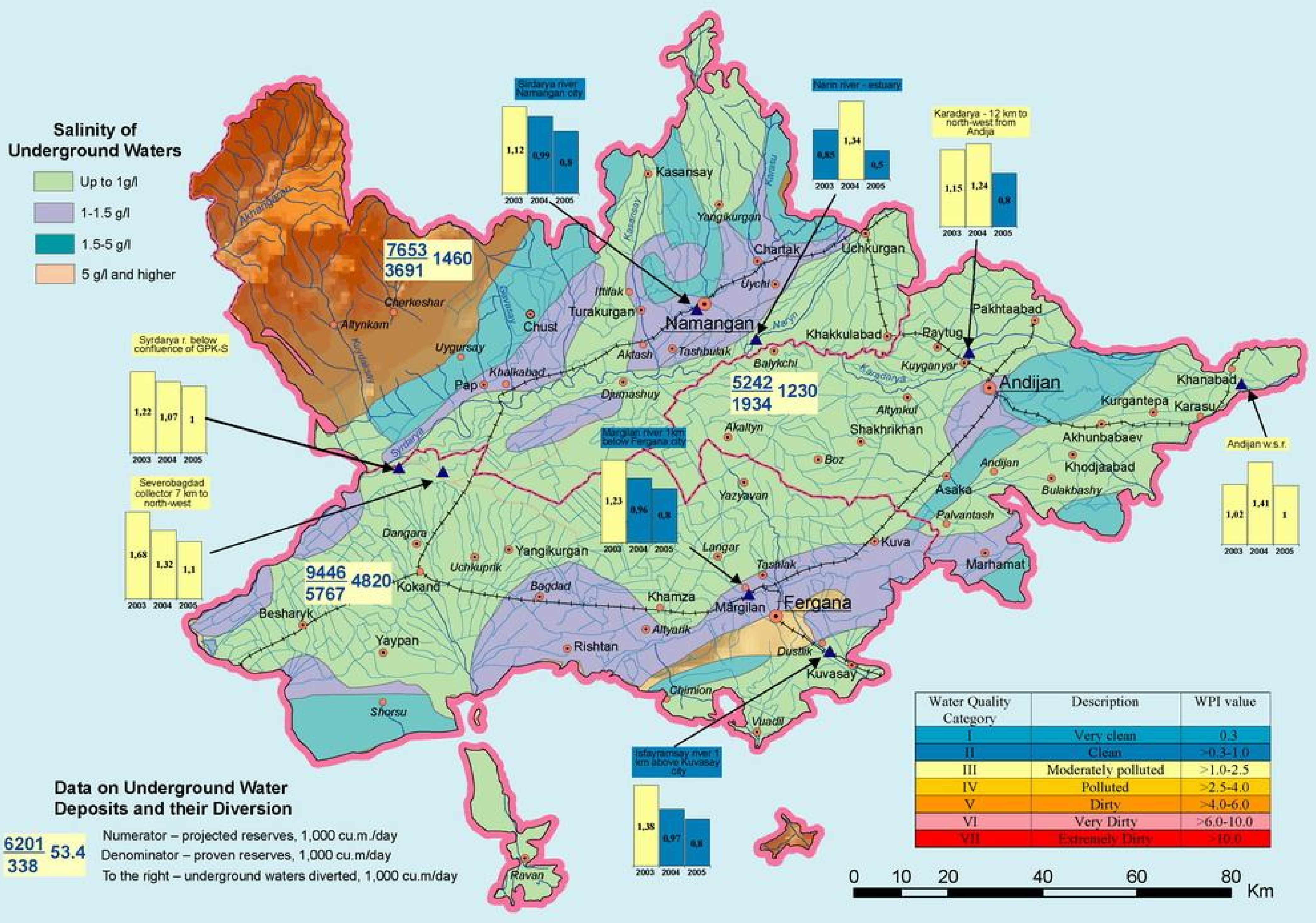
Water Quality Category	Description	WPI value
I	Very clean	0.3
II	Clean	>0.3-1.0
III	Moderately polluted	>1.0-2.5
IV	Polluted	>2.5-4.0
V	Dirty	>4.0-6.0
VI	Very Dirty	>6.0-10.0
VII	Extremely Dirty	>10.0

Data on Underground Water Deposits and Their Diversion

6201/338 53.4 Numerator – projected reserves, 1,000 cu.m./day
Denominator – proven reserves, 1,000 cu.m/day
To the right – underground waters diverted, 1,000 cu.m/day

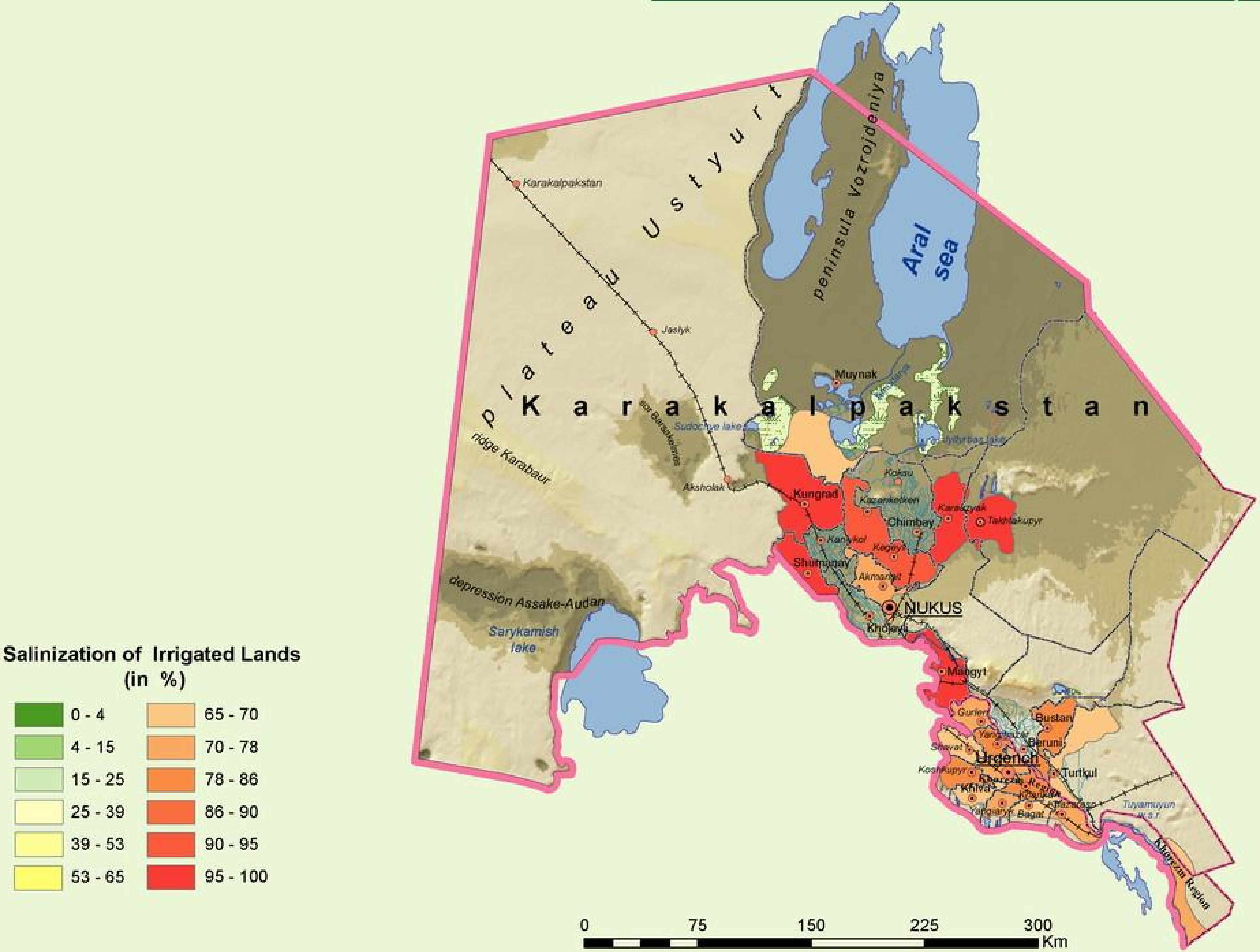
Water Quality Category	Description	WPI value
I	Very clean	0.3
II	Clean	>0.3-1.0
III	Moderately polluted	>1.0-2.5
IV	Polluted	>2.5-4.0
V	Dirty	>4.0-6.0
VI	Very Dirty	>6.0-10.0
VII	Extremely Dirty	>10.0

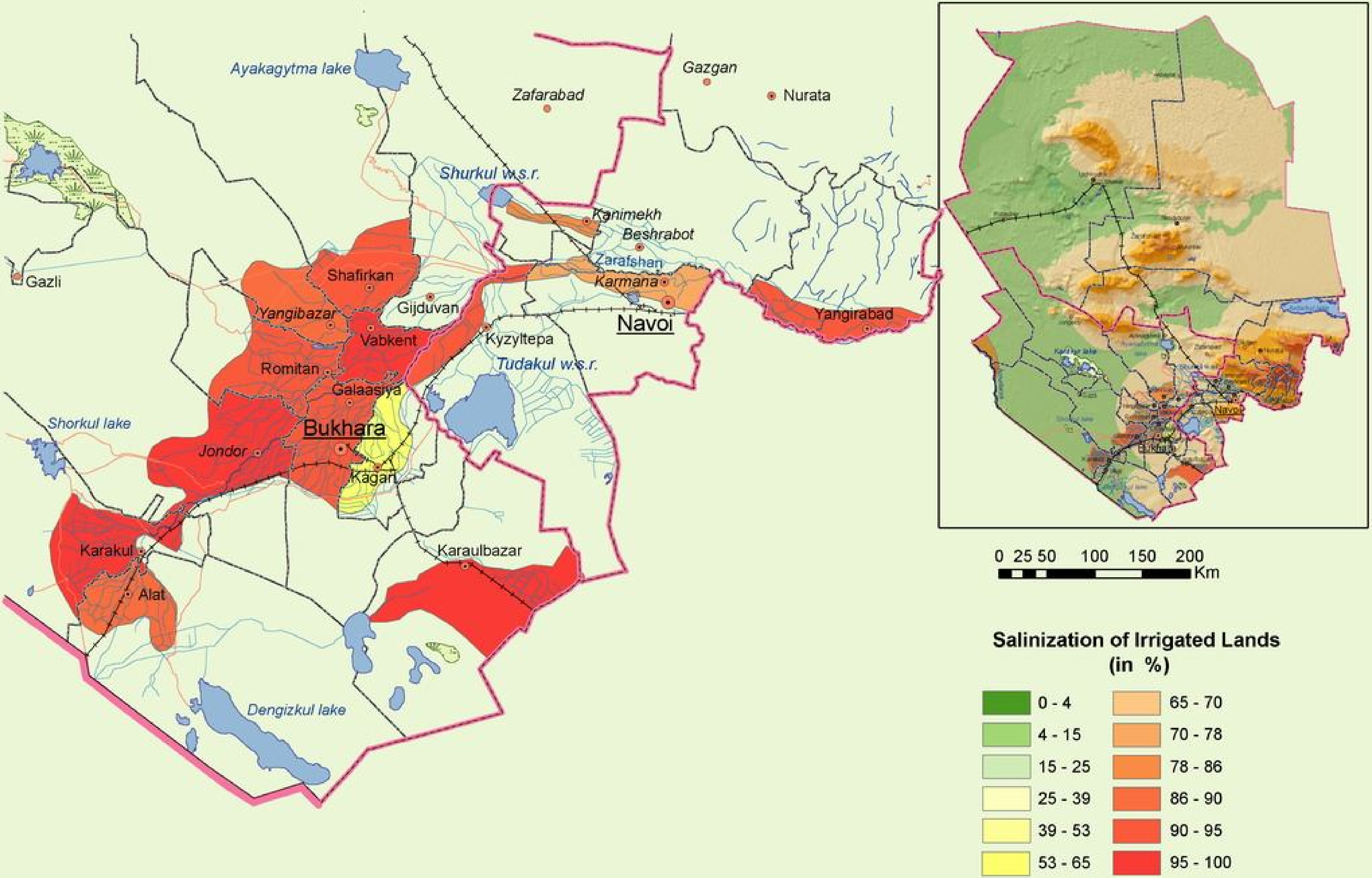


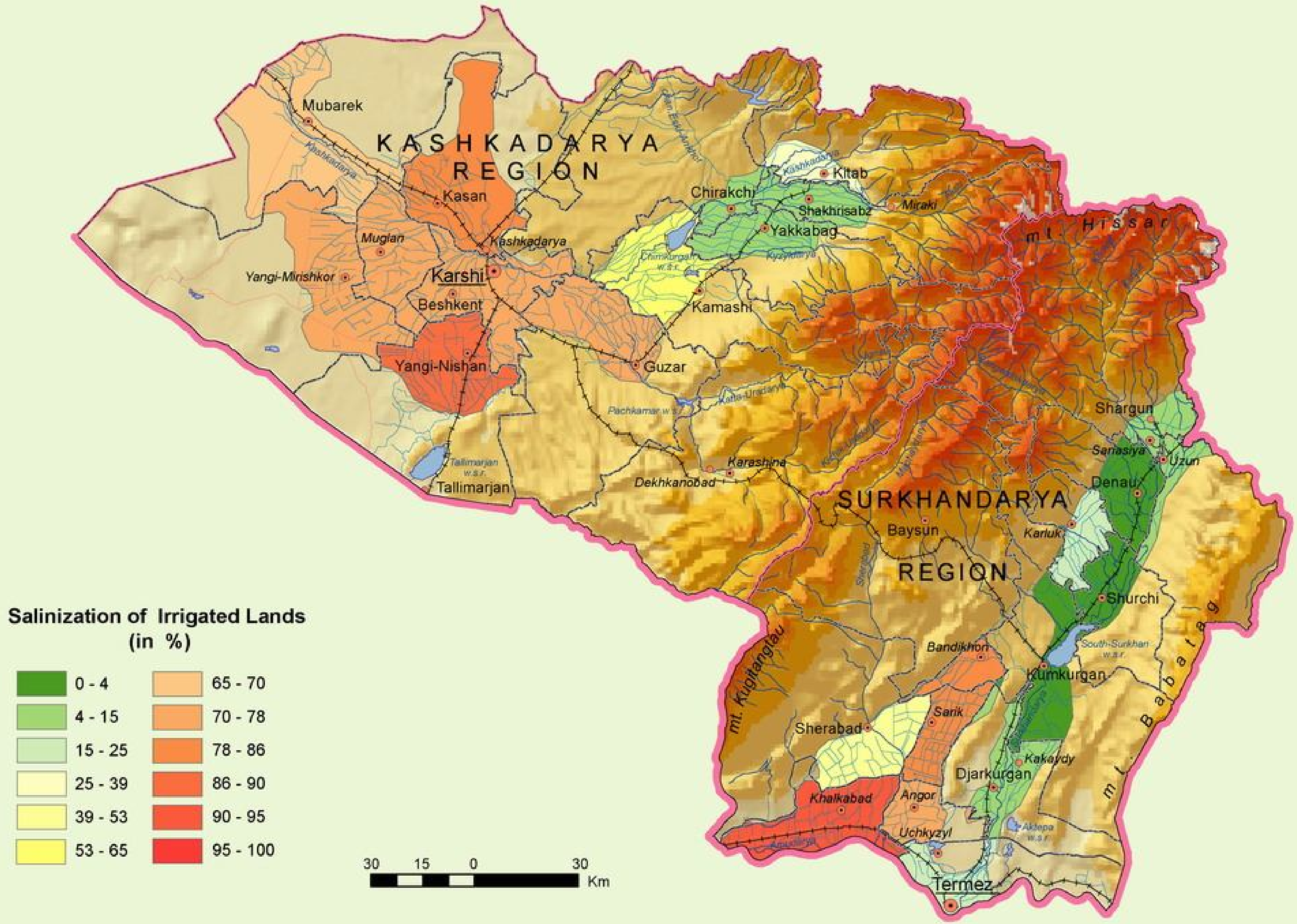


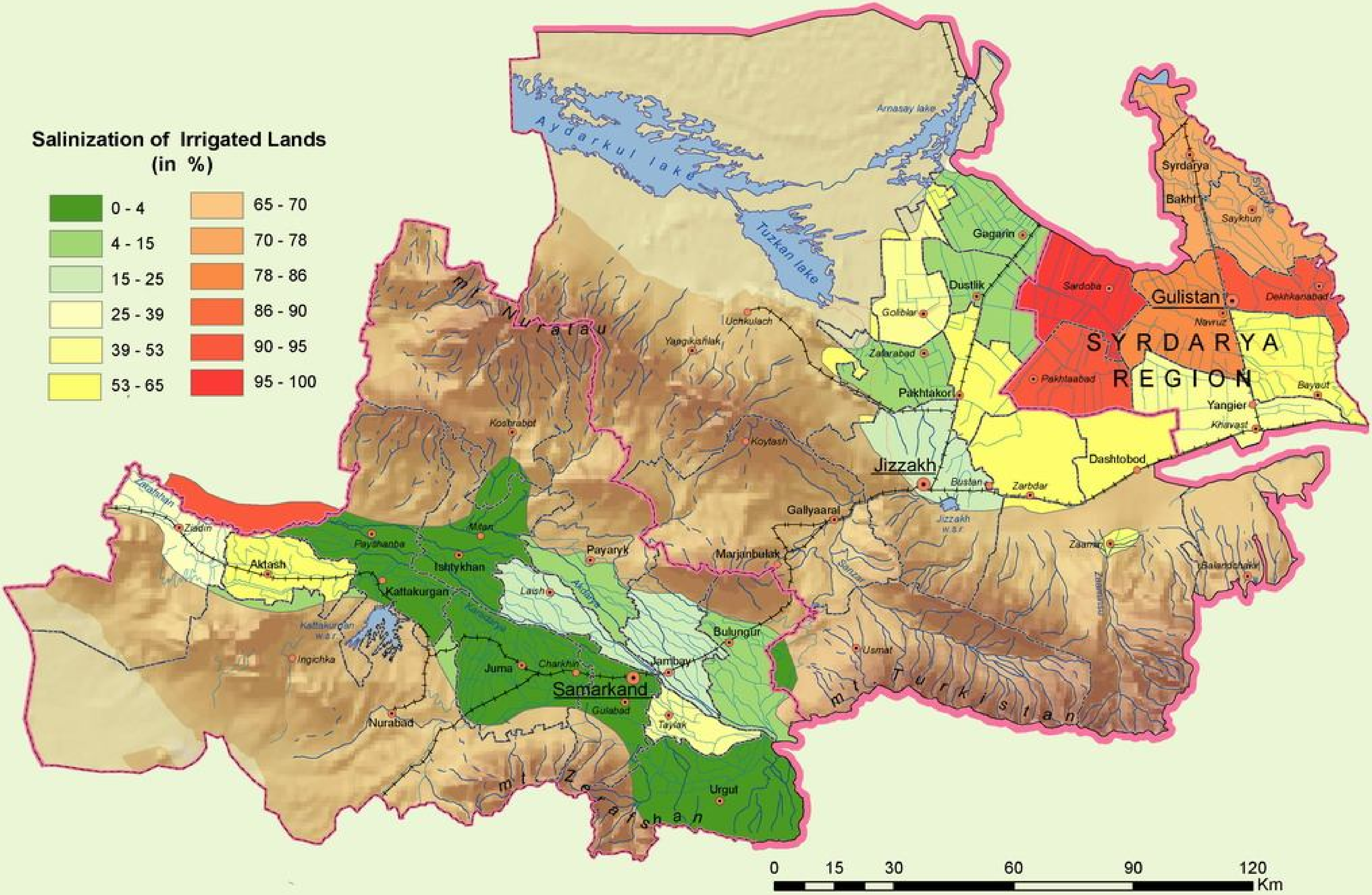
Water Quality Category	Description	WPI value
I	Very clean	0.3
II	Clean	>0.3-1.0
III	Moderately polluted	>1.0-2.5
IV	Polluted	>2.5-4.0
V	Dirty	>4.0-6.0
VI	Very Dirty	>6.0-10.0
VII	Extremely Dirty	>10.0

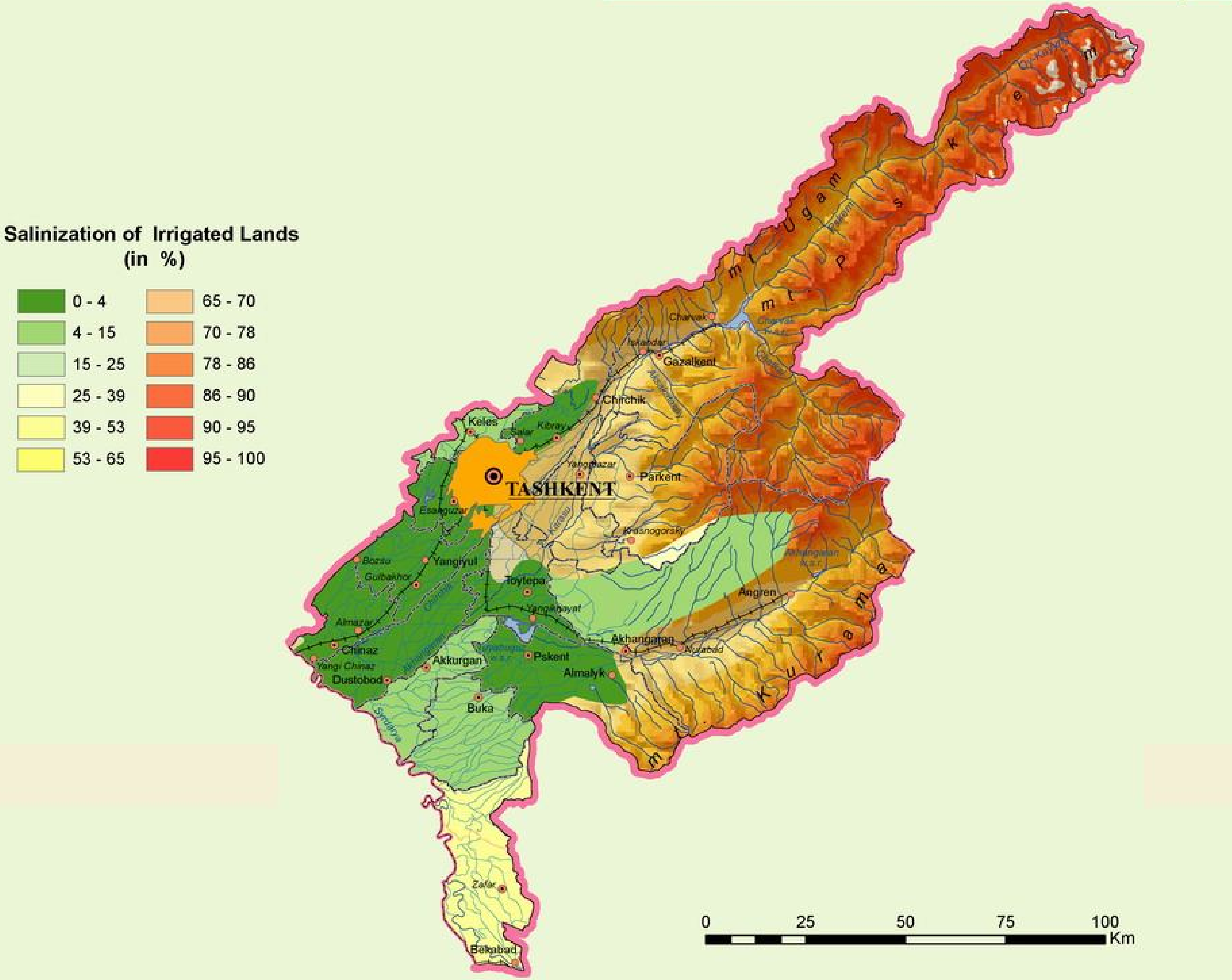
SOIL QUALITY BY REGIONS

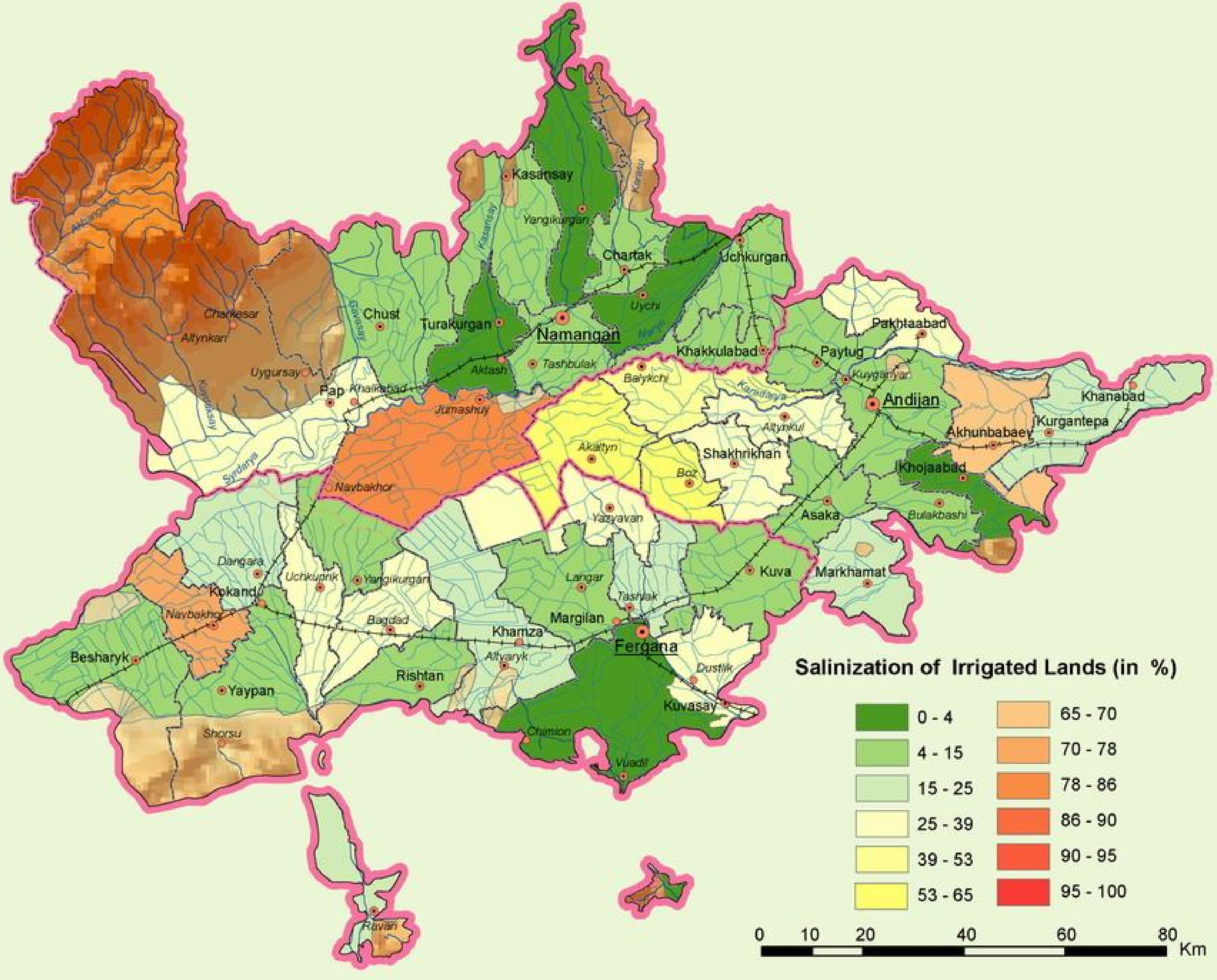

plateau Ustyurt
peninsula Vozrojdeniya
Aral sea
Karakalpakstan
Karakalpakstan
Jaslyk
Muynak
Sudochye lake
ridge Karabaur
Aksholak
Koksu
Kungrad
Kazanketken
Karauzyak
Takhtakupyr
Chimbay
Kanlykol
Kegeyli
Shumanay
Akmangit
NUKUS
Khojeyli
Mangyt
depression Assake-Audan
Sarykamish lake
Gurlen
Bustan
Yangibazar
Beruni
Shavat
Urgench
Koshkupyr
Turtkul
Khiva
Yangiaryk
Bagat
Tuyamuyun w.s.r.
Khorezm Region
Salinization of Irrigated Lands (in %)
0 - 4
4 - 15
15 - 25
25 - 39
39 - 53
53 - 65
65 - 70
70 - 78
78 - 86
86 - 90
90 - 95
95 - 100
0
75
150
225
300
Km


Ayakagytma lake
Zafarabad
Gazgan
Nurata
Shurkul w.s.r.
Kanimekh
Beshrabot
Zarafshan
Karmana
Navoi
Yangirabad
Gazli
Shafirkan
Yangibazar
Gijduvan
Vabkent
Kyzyltepa
Tudakul w.s.r.
Romitan
Galaasiya
Shorkul lake
Bukhara
Jondor
Kagan
Karakul
Alat
Karaulbazar
Dengizkul lake
0 25 50 100 150 200 Km
Salinization of Irrigated Lands (in %)
0 - 4
4 - 15
15 - 25
25 - 39
39 - 53
53 - 65
65 - 70
70 - 78
78 - 86
86 - 90
90 - 95
95 - 100


KASHKADARYA REGION
SURKHANDARYA REGION
Mubarek
Kasan
Mugian
Kashkadarya
Yangi-Mirishkor
Karshi
Beshkent
Yangi-Nishan
Guzar
Kamashi
Chirakchi
Kitab
Shakhrisabz
Yakkabag
Miraki
mt. Hissar
Tallimarjan
Tallimarjan w.s.r.
Pachkamar w.s.r.
Karashina
Dekhkanobad
Baysun
Karluk
Shargun
Sariasiya
Uzun
Denau
Shurchi
South-Surkhan w.s.r.
Bandikhon
Kumkurgan
mt. Kugitangtau
Sherabad
Sarik
Kakaydy
Djarkurgan
Khalkabad
Angor
Uchkyzyl
Aktepa w.s.r.
Termez
mt. Babatag
Salinization of Irrigated Lands (in %)
0 - 4
4 - 15
15 - 25
25 - 39
39 - 53
53 - 65
65 - 70
70 - 78
78 - 86
86 - 90
90 - 95
95 - 100
30 15 0 30
Km


Salinization of Irrigated Lands (in %)
0 - 4
4 - 15
15 - 25
25 - 39
39 - 53
53 - 65
65 - 70
70 - 78
78 - 86
86 - 90
90 - 95
95 - 100
Aydarkul lake
Tuzkan lake
Arnasay lake
mt Nuratau
SYRDARYA REGION
Syrdarya
Bakht
Saykhun
Gagarin
Dustlik
Sardoba
Gulistan
Dekhkanabad
Navruz
Goliblar
Zafarabad
Pakhtaabad
Pakhtakor
Bayaut
Yangier
Khavast
Dashtobod
Jizzakh
Bustan
Zarbdar
Jizzakh w.s.r.
Uchkulach
Yangikishlak
Koshrabot
Koytash
Gallyaaral
Marjanbulak
Zaamin
Baland chakir
Ziadin
Aktash
Payshanba
Mitan
Ishtykhan
Kattakurgan
Payaryk
Laish
Kattakurgan w.s.r.
Ingichka
Juma
Chakhin
Samarkand
Jambay
Bulungur
Gulabad
Taylak
Usmat
mt Turkistan
Nurabad
mt Zerafshan
Urgut
0 15 30 60 90 120 Km


Salinization of Irrigated Lands
(in %)
0 - 4
4 - 15
15 - 25
25 - 39
39 - 53
53 - 65
65 - 70
70 - 78
78 - 86
86 - 90
90 - 95
95 - 100
TASHKENT
Chirchik
Gazalkent
Keles
Salar
Kibray
Parkent
Yangiyul
Toytepa
Chinaz
Akkurgan
Pskent
Almalyk
Akhangaran
Angren
Dustobod
Buka
Bekabad
0
25
50
75
100
Km


Kasansay
Yangikurgan
Chartak
Uchkurgan
Uychi
Chust
Turakurgan
Namangan
Tashbulak
Aktash
Khakkulabad
Pakhtaabad
Paytug
Kuyganyar
Andijan
Khanabad
Kurgantepa
Akhunbabaev
Khojaabad
Bulakbashi
Balykchi
Altynkul
Shakhrikhan
Akaltyn
Boz
Yazyavan
Asaka
Markhamat
Kuva
Chartkesar
Altynkan
Uygursay
Pap
Khaitabad
Jumashuy
Navbakhor
Syrdarya
Dangara
Kokand
Uchkuprik
Yangikurgan
Bagdad
Navbakhor
Besharyk
Yaypan
Rishtan
Khamza
Altyaryk
Langar
Tashlak
Margilan
Fergana
Dustlik
Kuvasay
Chimion
Vuadil
Shorsu
Ravan
Salinization of Irrigated Lands (in %)
0 - 4
4 - 15
15 - 25
25 - 39
39 - 53
53 - 65
65 - 70
70 - 78
78 - 86
86 - 90
90 - 95
95 - 100
0 10 20 40 60 80 Km

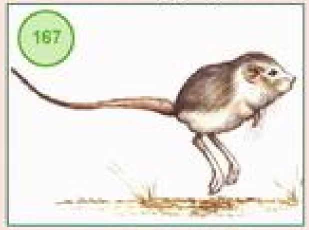
BIODIVERSITY BY REGIONS

HABITATS OF MAMMALS INCLUDED IN THE RED BOOK OF KARAKALPAKSTAN AND KHOREZM REGION

Brandt's Hedgehog
Hemiechinus hypomelas

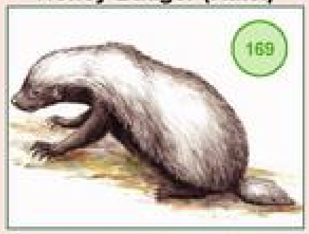
Caspian Tiger

Thick-tailed Pygmy Jerboa



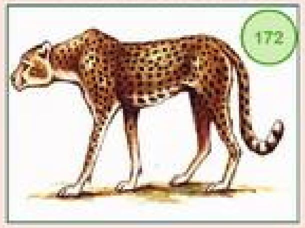
Kulan

Honey Badger (Ratel)

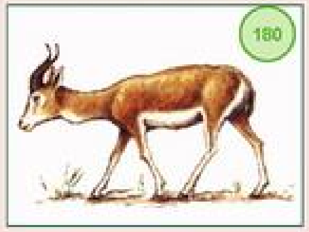


Bactrian (Bukhara) Deer

Asiatic Cheetah

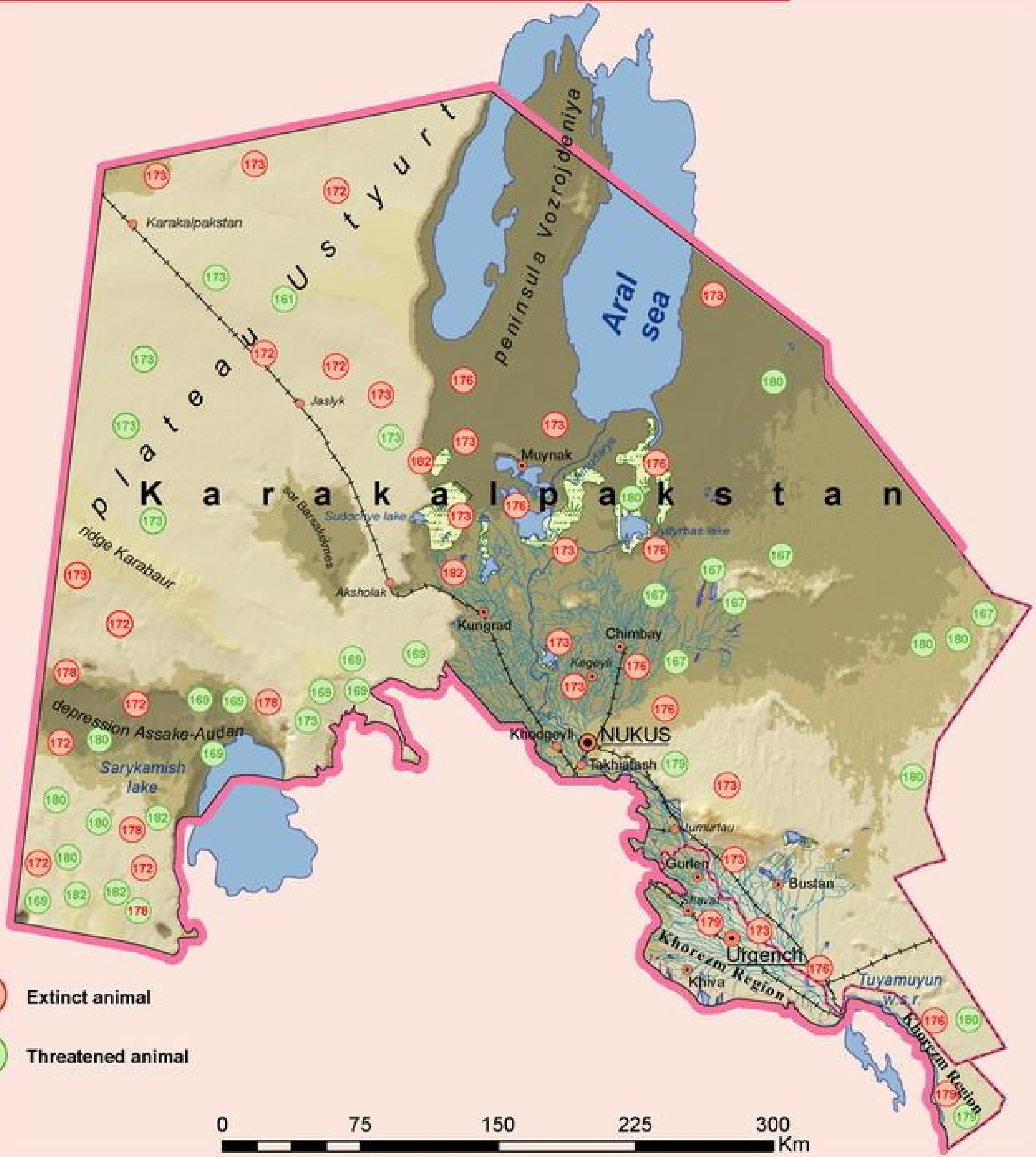


Goitred Gazelle



Turkmen Caracal (Desert Lynx)

Transcaspian (Ustyurt) Urial

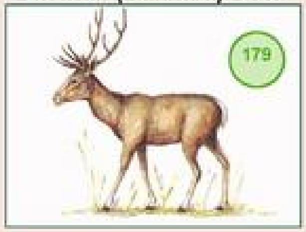


176 Extinct animal

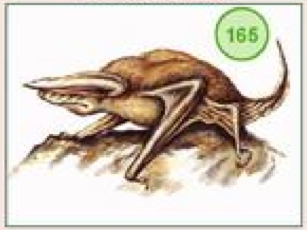
178 Threatened animal

Hemprich's Long- eared Bat

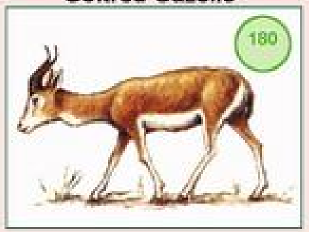
Bactrian (Bukhara) Deer



Free-tailed Bat

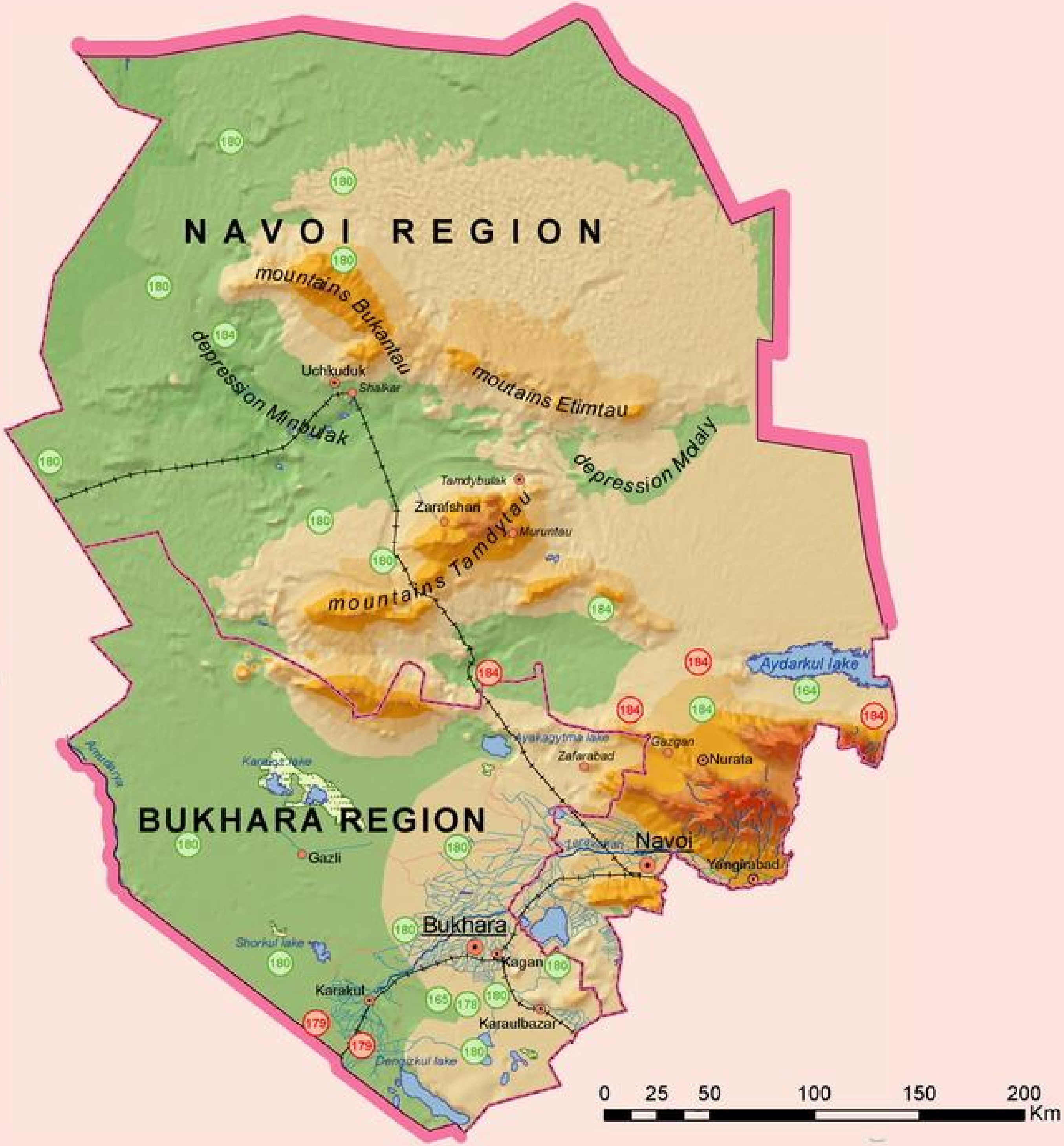


Goitred Gazelle



Kulan

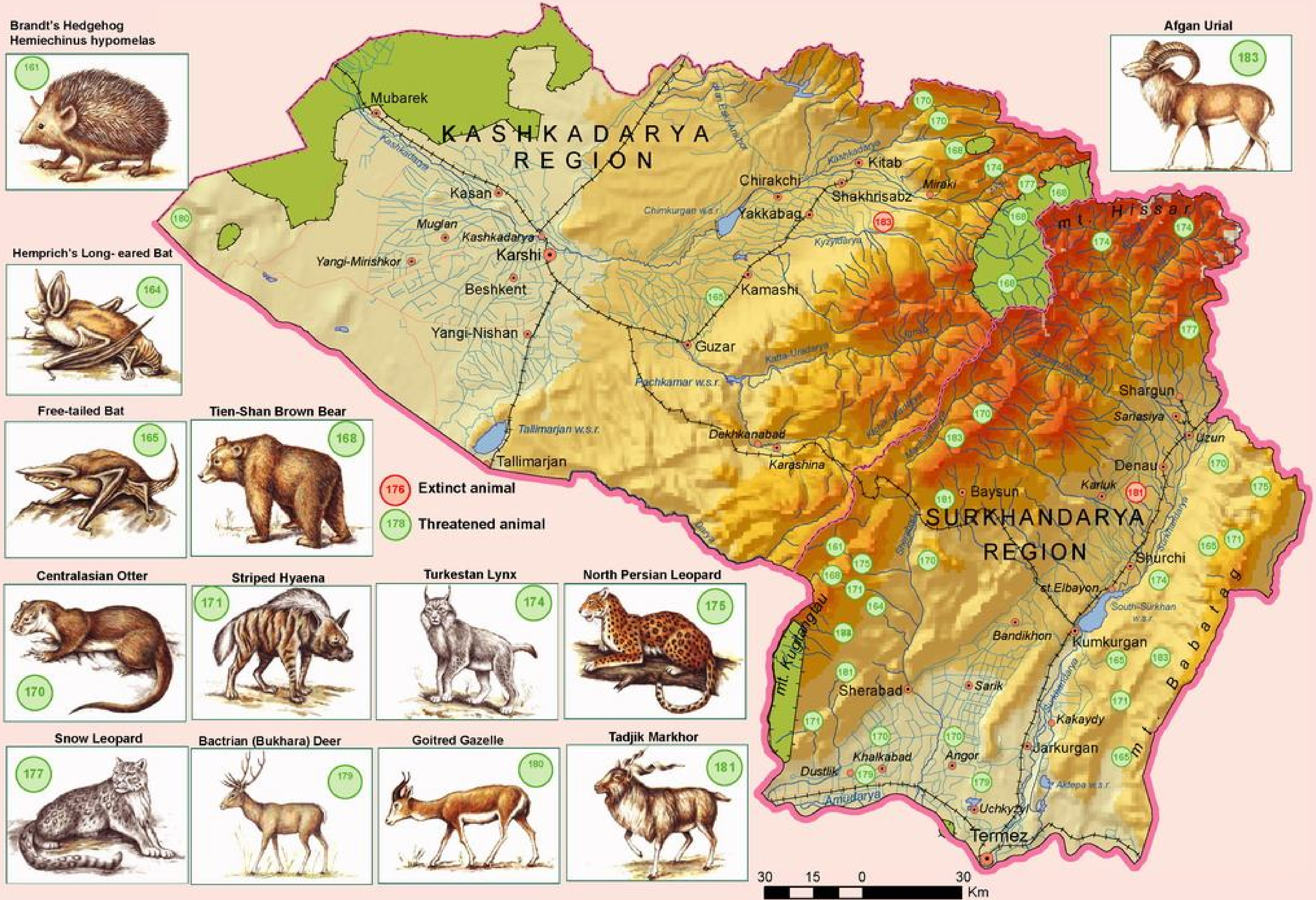
Severtsov's (Kyzylkum) Argali

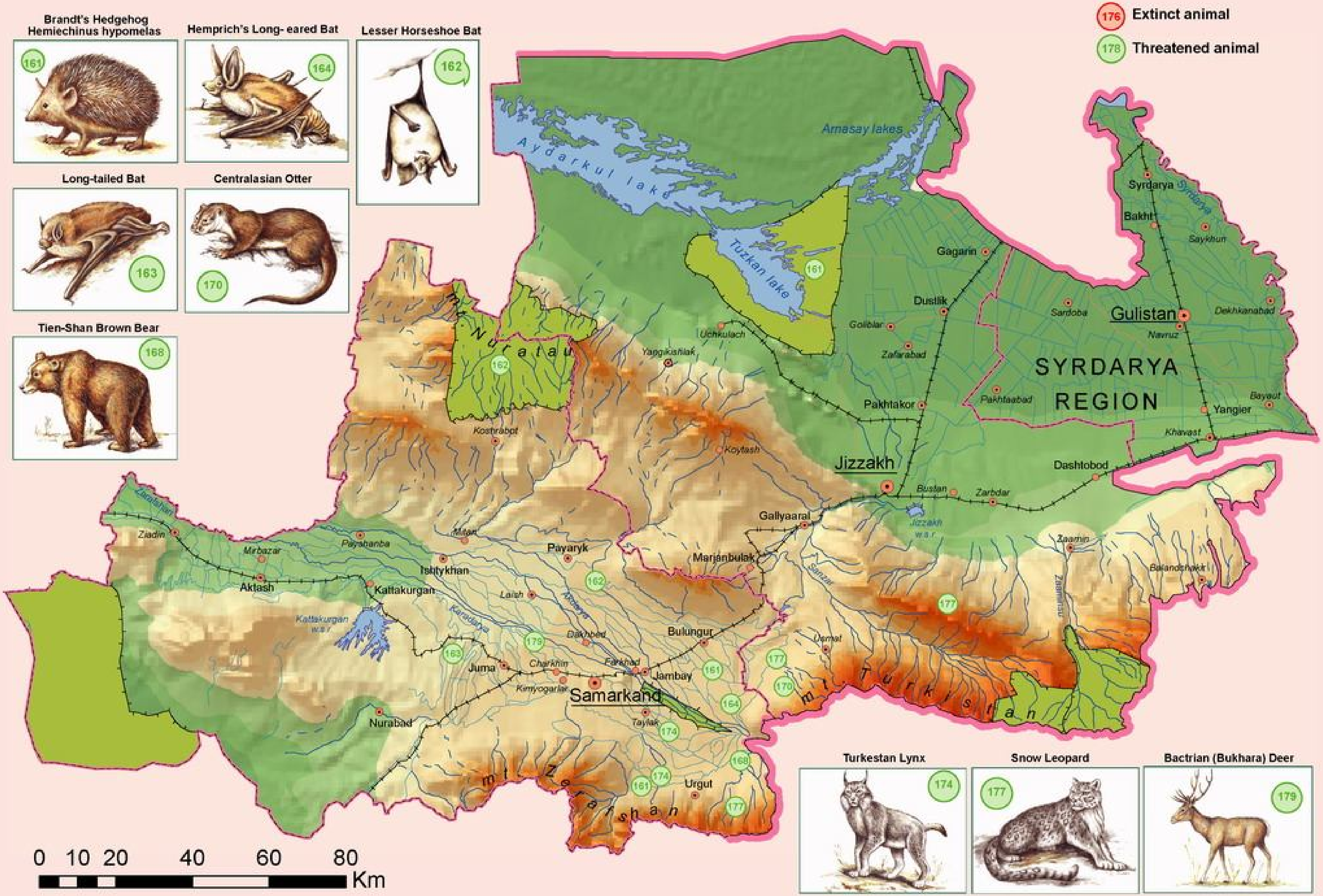


176 Extinct animal

178 Threatened animal

HABITATS OF MAMMALS INCLUDED IN THE RED BOOK OF KASHKADARYA AND SURKHANDARYA REGIONS




Brandt's Hedgehog
Hemiechinus hypomelas
161
Hemprich's Long- eared Bat
164
Lesser Horseshoe Bat
162
Long-tailed Bat
163
Centralasian Otter
170
Tien-Shan Brown Bear
168
176 Extinct animal
178 Threatened animal
Aydarkul lake
Arnasay lakes
Tuzkan lake
mt Nuratau
SYRDARYA
REGION
Syrdarya
Bakht
Saykhun
Gagarin
Dustlik
Sardoba
Gulistan
Navruz
Dekhkanabad
Goliblar
Zafarabad
Uchkulach
Yangikishlak
Pakhtakor
Pakhtaabad
Yangier
Bayaut
Khavast
Koshrabot
Koytash
Jizzakh
Dashtobod
Bustan
Zarbdar
Jizzakh w.s.r.
Gallyaaral
Zaamin
Balandshakir
Marjanbulak
Sanzar
Zaamisu
Ziadin
Mirbazar
Payshanba
Mitan
Payaryk
Ishtykhan
Aktash
Kattakurgan
Laish
Kattakurgan w.s.r.
Karadarya
Akdarya
Dakhbed
Bulungur
Usmat
Juma
Charkhin
Farkhad
Jambay
Kimyogarlar
Samarkand
Taylak
Nurabad
Urgut
mt Zerafshan
mt Turkistan
0 10 20 40 60 80
Km
Turkestan Lynx
174
Snow Leopard
177
Bactrian (Bukhara) Deer
179

Hemprich's Long- eared Bat

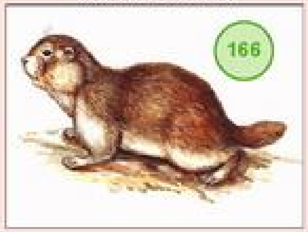
Tien-Shan Brown Bear

Lesser Horseshoe Bat

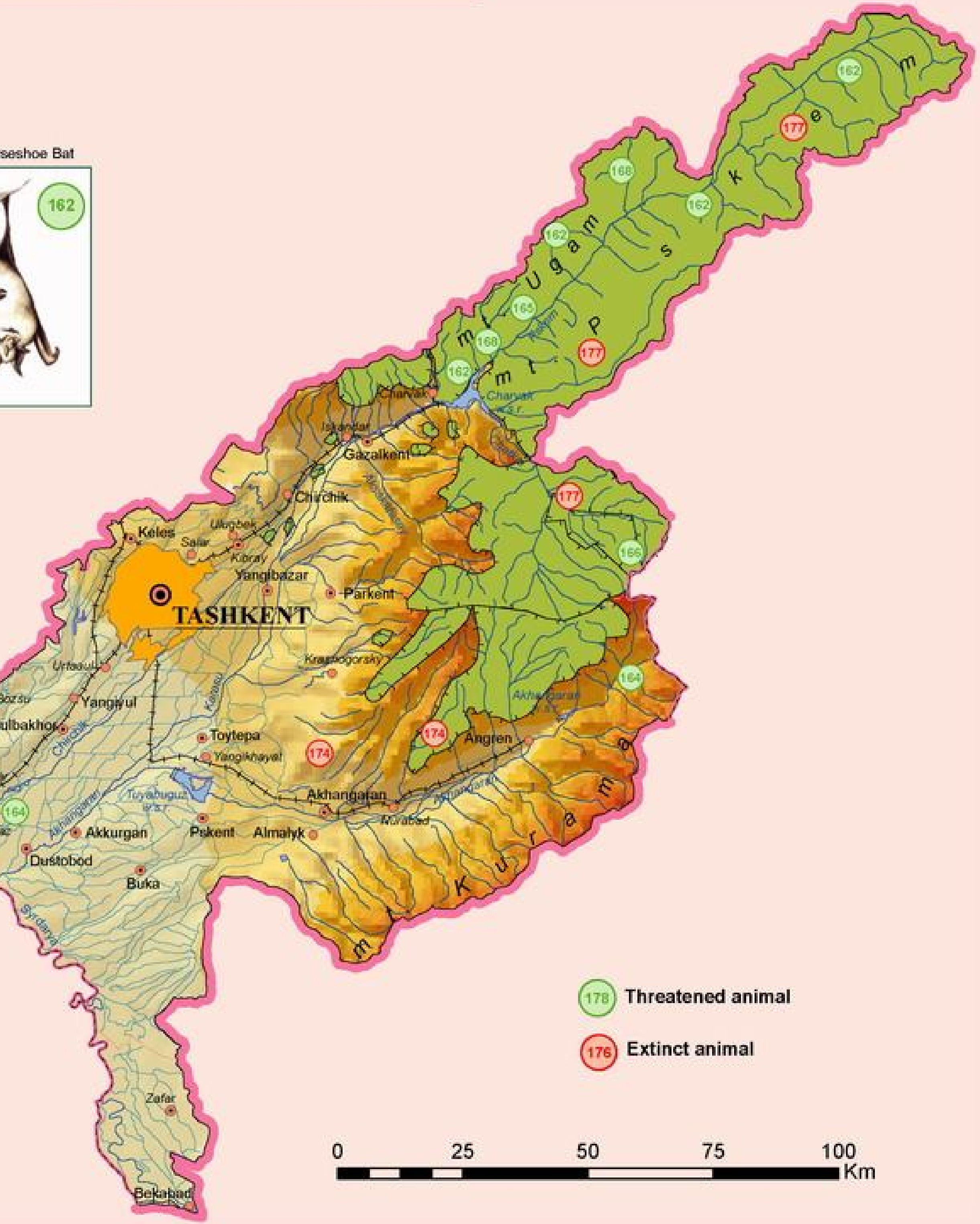
Free-tailed Bat

Turkestan Lynx

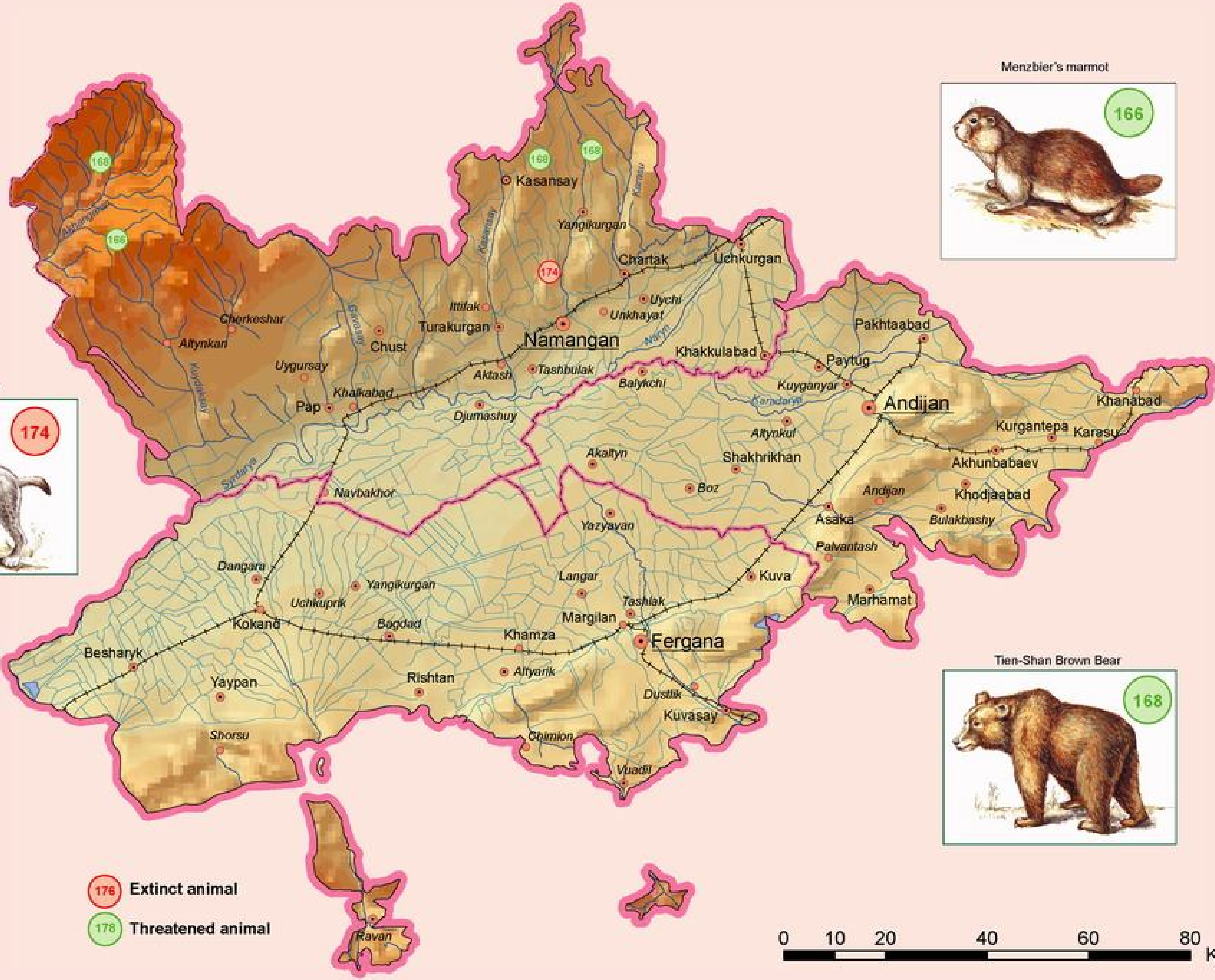
Menzbier's marmot



Snow Leopard



Menzbier's marmot



Turkestan Lynx

Tien-Shan Brown Bear

WATER RESOURCES OF CENTRAL ASIA

Surface waters of Uzbekistan

The surface water bodies are those of different kinds-rivers, says, ephemeral streams, lakes, water storage reservoirs, marshes, glaciers, as well as snow cover, located on the land surface of the earth.

The formation and distribution of surface waters over the territory of Uzbekistan is closely connected with the climatic factors, first of all, with atmospheric precipitation. The precipitation is distributed very unevenly over the territory of the republic. This peculiarity is determined by its geographical position, orographic structure and other factors. The least precipitation (less than 100 mm a year) falls on the plain part of Uzbekistan. As one approaches the mountains, the rainfall increases and in the highland areas the rainfall amounts to 1000 mm and more. Throughout the territory of the republic most of precipitation (about 80 per cent) falls in the winter-spring period. In summer on the greater part of the territory of Uzbekistan the rainfall is very slight.

The annual distribution of precipitation over the territory of Uzbekistan influences greatly the formation of the river runoff. The duration of snow cover is also changeable over the territory depending on the geographical latitude and altitude of the locality. Snow fallen in the high mountain zones remains in the form of snow fields throughout the year. Glaciers are widespread in these areas as well.

On the plain part of the republic because of slight precipitation streams with the perennial flow are not formed. However, the ephemeral overland runoff may be formed in these areas and especially in the low mountain regions Sultan-Uvais, Tamdytau, Bukantau and others in the period of snow melting or during heavy showers.

The rivers of Uzbekistan belong to the closed drainage area of the Aral Sea. The main rivers - the Syrdarya and the Amudarya, crossing the territory of the country, rise beyond the borders of the republic. 10 per cent of 38 km^3 of the runoff of the Syrdarya, and 8 per cent of 78 km^3 of the runoff of the Amudarya are formed on the territory of Uzbekistan.

The mountain part of the territory of Uzbekistan is rich in the river network. The largest rivers of them are the Chirchik, Ahangaran, Kasansay, Naryn, Karadarya, Isfayramsay, Soh, Isfara, Sanzar, Zarafshan, Kashkadarya, Sherabad, Surhandarya.

Sixteen orographic regions with different dependencies of the annual specific discharge upon the average elevation of the basin are distinguished within the mountain part of Uzbekistan. During drawing the boundaries of the orographic regions the general macroexposition of the basins, their orientation concerning humid air masses and synoptical processes were used as criteria. The correlations, obtained for different orographic regions, are given in this atlas and they were the basis for making the map of the annual normal flow and other maps.

The seasonal snow cover, glaciers and, to a lesser degree, rain water take part in the nourishment of the rivers of Uzbekistan. According to the sources of nourishment the rivers of Uzbekistan are divided into glacier-fed streams (the Soh, Isfara, Isfayramsay), snowmelt-glacier-fed ones (the Zarafshan, Tupalangdarya) snowmelt-fed ones (the Pskem) and snowmelt-rain-fed ones.

The main runoff (60-75 per cent) of glacier-fed and snowmelt-fed streams is formed between July and September and so it is very convenient to use their waters for irrigation. The runoff of snowmelt-fed and snowmelt-rain-fed streams is notable for the great interannual variability, and the flood of these streams is observed in April and May.

The amount of the seasonal river runoff is closely connected with the type of nourishment and the elevation of the basins. The following seasons can be distinguished on the rivers of Central Asia, including Uzbekistan: hydrological spring (March-September)-the period of melting the seasonal snow cover supply; hydrological summer (July-September)-the period of melting of perennial snows and glaciers; hydrological autumn (September-November) and hydrological winter (December-February). For the majority of rivers-of Uzbekistan the first two seasons fall on the flood, and the succeeding two seasons - on the period of minimum flow (low water season).

The formation of the peak runoff is also dependent on the elevation of river basins. On the low-lying river basins the flood begins early and finishes earlier. For instance, in the basins with the average elevation of the catchment area of about 2000 m the flood begins on March 10-20th and in the basins with the elevation of about 3000 m-on April 10-20th. In the low water season (low discharge of water) rivers are mainly fed by groundwater.

Rivers with the elevation of the catchment of about 2000 m and more are characterized by the autumn-winter low water stage, and the summer-autumn-winter low water stage is observed on the rivers with the relatively low elevation of the catchment.

On the says in the low mountain areas in the years with little snowfall the flood reduces down to 20-30 days, and for the rest of the year the low water stage is observed, and for the most part, the river beds dry up. On leaving the mountains for the plains, the natural river regime changes. It is caused by the diversion of water for irrigation, the availability of water storage reservoirs and the inflow of regeneration water.

The rivers of Uzbekistan are not reckoned among the most turbid ones in Central Asia. Only on some rivers (the Guzardarya and some tributaries of the Surhandarya) the annual mean turbidity exceeds 2 kg/m^3. The turbidity of the majority of rivers varies within 0.2-0.5 kg/m^3. In some rivers the turbidity is still less. For instance, in the Chiralma (the catchment area of the Pskem), the annual mean turbidity makes up only 0.01 kg/m^3. The turbidity of mud floods, formed in the foothills and low mountain areas, reaches 200 kg/m^3, and sometimes more. The annual wash modulus in the basins of mountain rivers of Uzbekistan varies within 10-650 t/km^2, and these amounts make up 0.0025-0.254 mm per year of the denudation depth.

In the plain areas of Uzbekistan the river runoff is used for irrigation of agricultural lands. Therefore this area is called the runoff scattering area. Numerous canals have been cut for the purpose of irrigation (the Great Fergana canal, Eski Angar canal and others). Some long-existing canals have acquired characteristics peculiar to the plain rivers-the meandering and the division into branches. To increase the irrigation efficiency of newly-built canals, their bed has been stabilized or covered with concrete.

On the territory of Uzbekistan numerous water-raising installations (pump stations) have been constructed on the canals, such as the Amu-Bukhara Canal, the Karshi Canal and others.

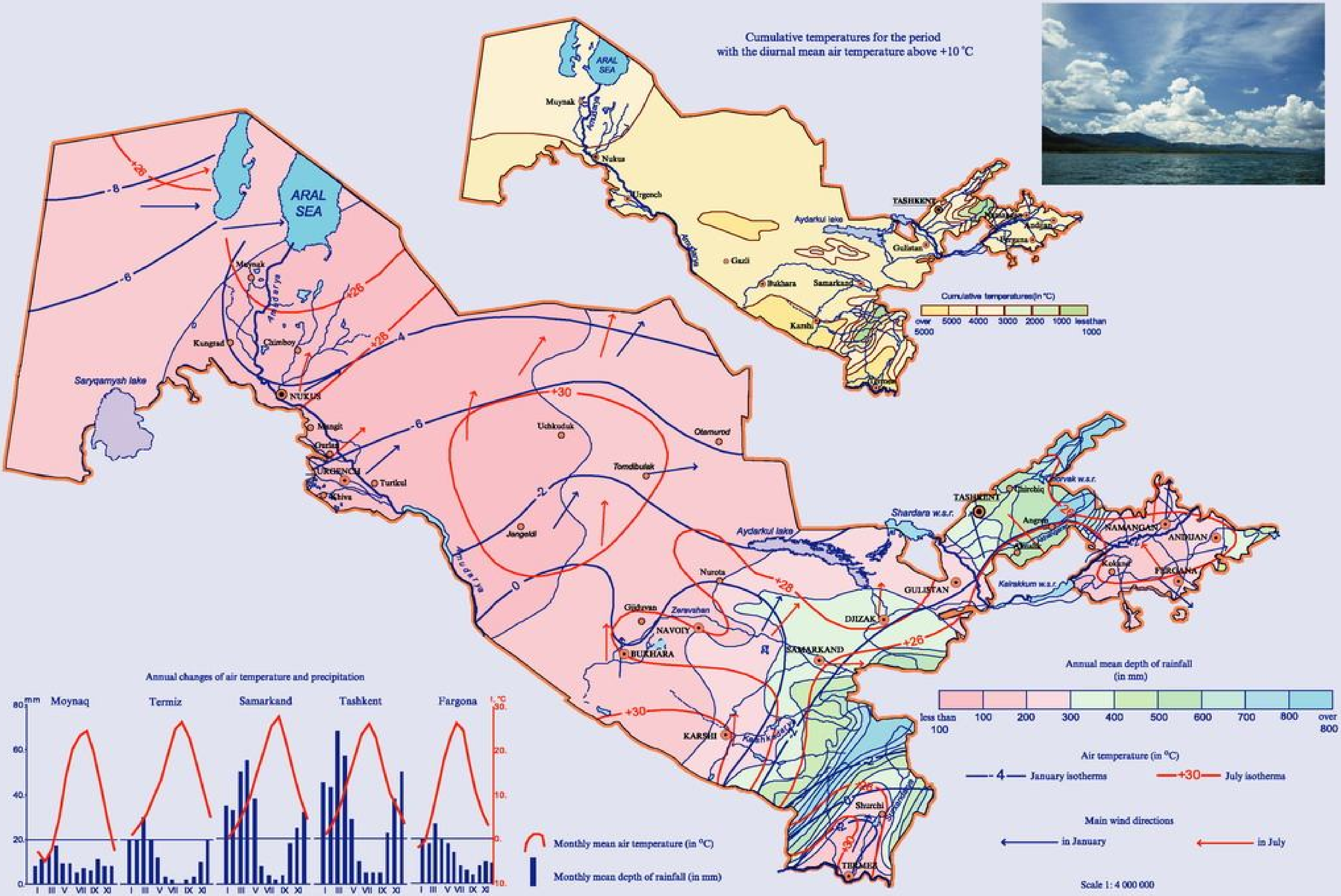
There are not many lakes on the territory of Uzbekistan. They are small in size and distributed extremely unevenly. The majority of lakes are situated in the mountain areas at the altitude of 2000-3000 m.

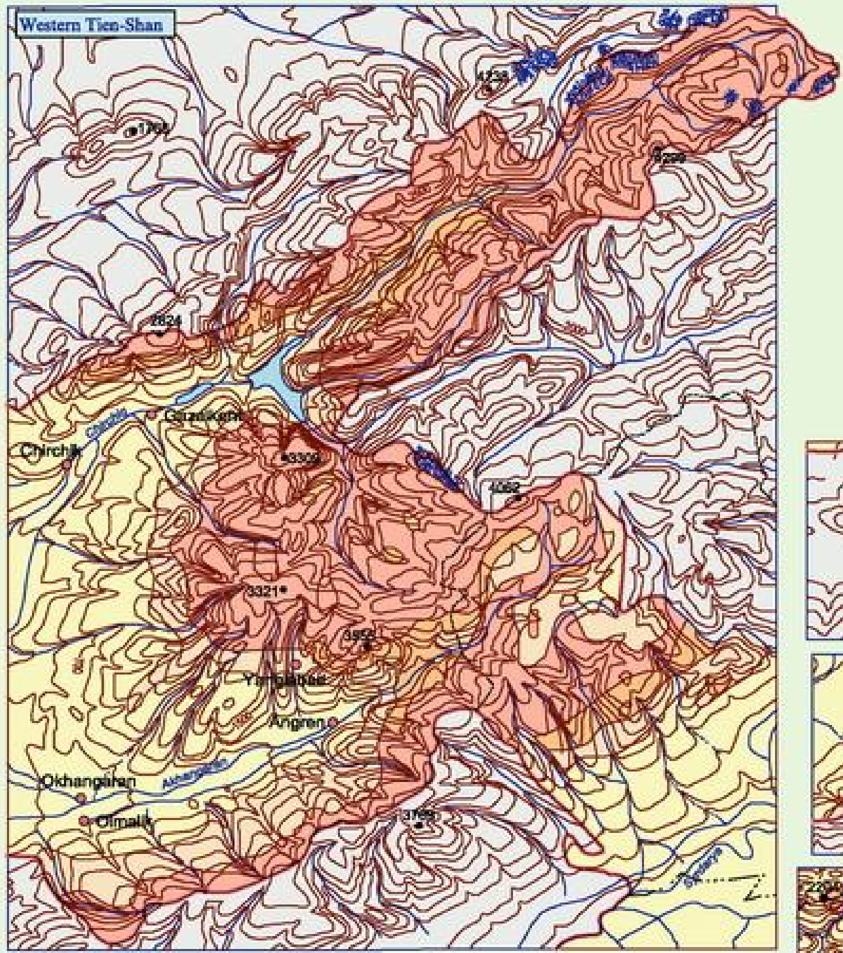
According to their genetic type most of lakes in Uzbekistan are referred to as tectonic, morainic and landslide lakes. The plain lakes are fed by river and sewage-drainage waters.

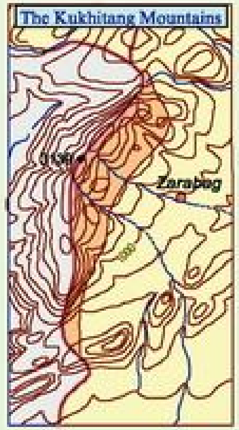
The lakes fed by river waters are divided into flood plain and deltaic lakes. The flood plain lakes are frequently met in the flood plains of the Amudarya and Syrdarya rivers. Their area does not exceed 1 km2. The deltaic lakes are widespread in the deltas of the Amudarya river. In recent years , because of the lack of water, most of them have dried up. The hydrological regime of lakes fed by the sewage -drainage and regeneration waters depends mainly on the regime of sources of nourishment. The lakes lying in the lower parts of the irrigated area of the Kashkadarya and Bukhara districts represent an example of this type.

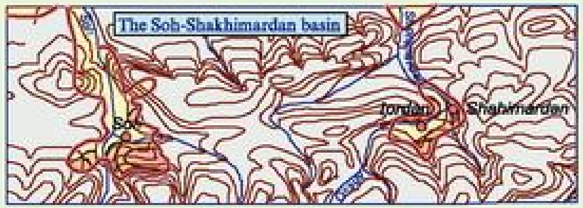
Since the middle of the last century many artificial lakes-water storage reservoirs have been built. The largest of them within Uzbekistan are the Tuyamuyun, Talimardjan, Tudakul, Kattakurgan, South-Surhan, Chimkurgan, Charvak and Kuyumazar water reservoirs. The number of water storage reservoirs is increasing from year to year. At present the Rezaksay and Kengkul water reservoirs are being built in the Namangan district, and the Tupalang and Hangaran ones in the Surhandarya district.

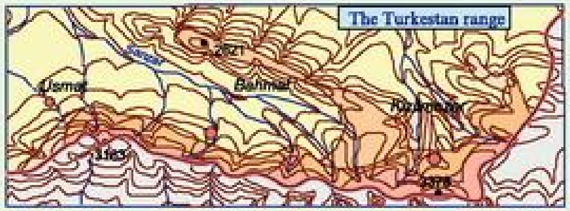
The hydrological regime of water storage reservoirs depends on the regime of rivers feeding it and on the needs of water users and hydroenergetics as well. The processes of storage and partial or full emptying are peculiar to most of them.

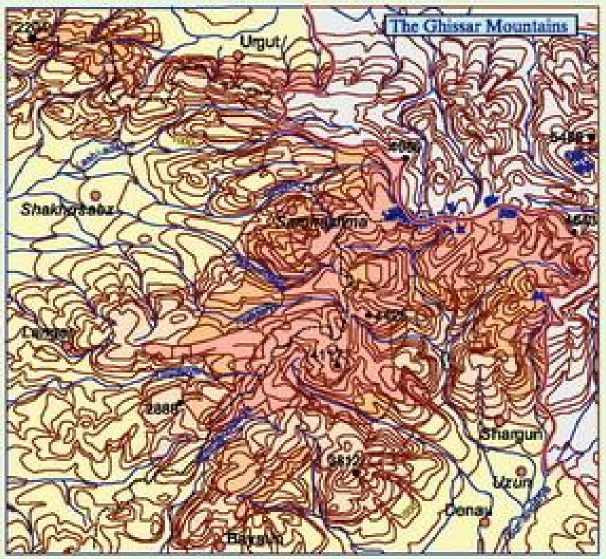

Cumulative temperatures for the period
with the diurnal mean air temperature above +10 °C
ARAL SEA
Muynak
Nukus
Urgench
Aydarkul lake
TASHKENT
Namangan
Andijan
Fergana
Gulistan
Gazli
Bukhara
Samarkand
Karshi
Termez
Cumulative temperatures(in °C)
over 5000
5000
4000
3000
2000
1000
lessthan 1000
ARAL SEA
Saryqamysh lake
Moynak
Amudarya
Kungrad
Chimboy
NUKUS
Mangit
Gurlan
URGENCH
Khiva
Turtkul
Uchkuduk
Otamurod
Tomdibulak
Jangeldi
Nurota
Aydarkul lake
Shardara w.s.r.
TASHKENT
Chirchiq
Charvak w.s.r.
Angren
NAMANGAN
ANDIJAN
Kokand
FERGANA
Kairakkum w.s.r.
GULISTAN
DJIZAK
Gijduvan
Zeravshan
NAVOIY
BUKHARA
SAMARKAND
KARSHI
Kashkadarya
Shurchi
TERMEZ
-8
-6
-4
-2
0
+26
+28
+30
Annual mean depth of rainfall
(in mm)
less than 100
100
200
300
400
500
600
700
800
over 800
Air temperature (in °C)
-4 January isotherms
+30 July isotherms
Main wind directions
in January
in July
Scale 1: 4 000 000
Annual changes of air temperature and precipitation
mm
Moynaq
Termiz
Samarkand
Tashkent
Fargona
t, °C
80
60
40
20
0
30
20
10
0
-10
I III V VII IX XI
Monthly mean air temperature (in °C)
Monthly mean depth of rainfall (in mm)

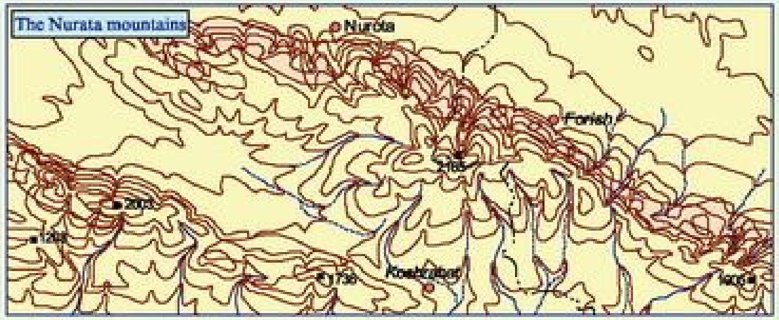










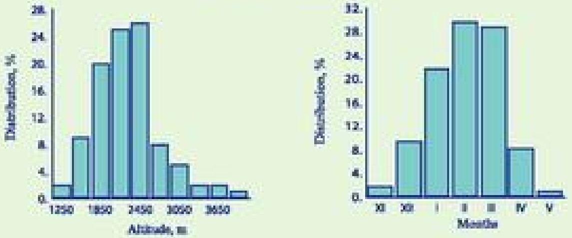


Relief cross section: 300, 400, 500, 600, 700, 800, 900, 1000, 1250, 1500, 1750, 2000, 2500, 3000, 3500, 4000 meters

Glaciers

THE DISTRIBUTION OF SNOW AVALANCHES IN THE WESTERN TEIN-SHAN ACCORDING TO THE ALTITUDE, EXPOSITION AND MONTHS

(on the Uzhydromet data)



THE DEGREE OF THE AVALANCHE DANGER

Heavy. Avalanching is observed repeatedly throughout the season. There are fire and more sources of avalanching on each km of the valley length. The degree of avalanching exceeds 0.75

Moderate. Snow avalanches are observed annually. There are 2-5 sources of avalanching on each km of the valley length. The degree of avalanching is from 0.25 to 0.75.

Slight. In some sources avalanches are observed 1-3 times annually. In other sources avalanches may not be observed. There is one or two sources of avalanches on each km of the valley length. The degree of avalanching does not exceed 0,20

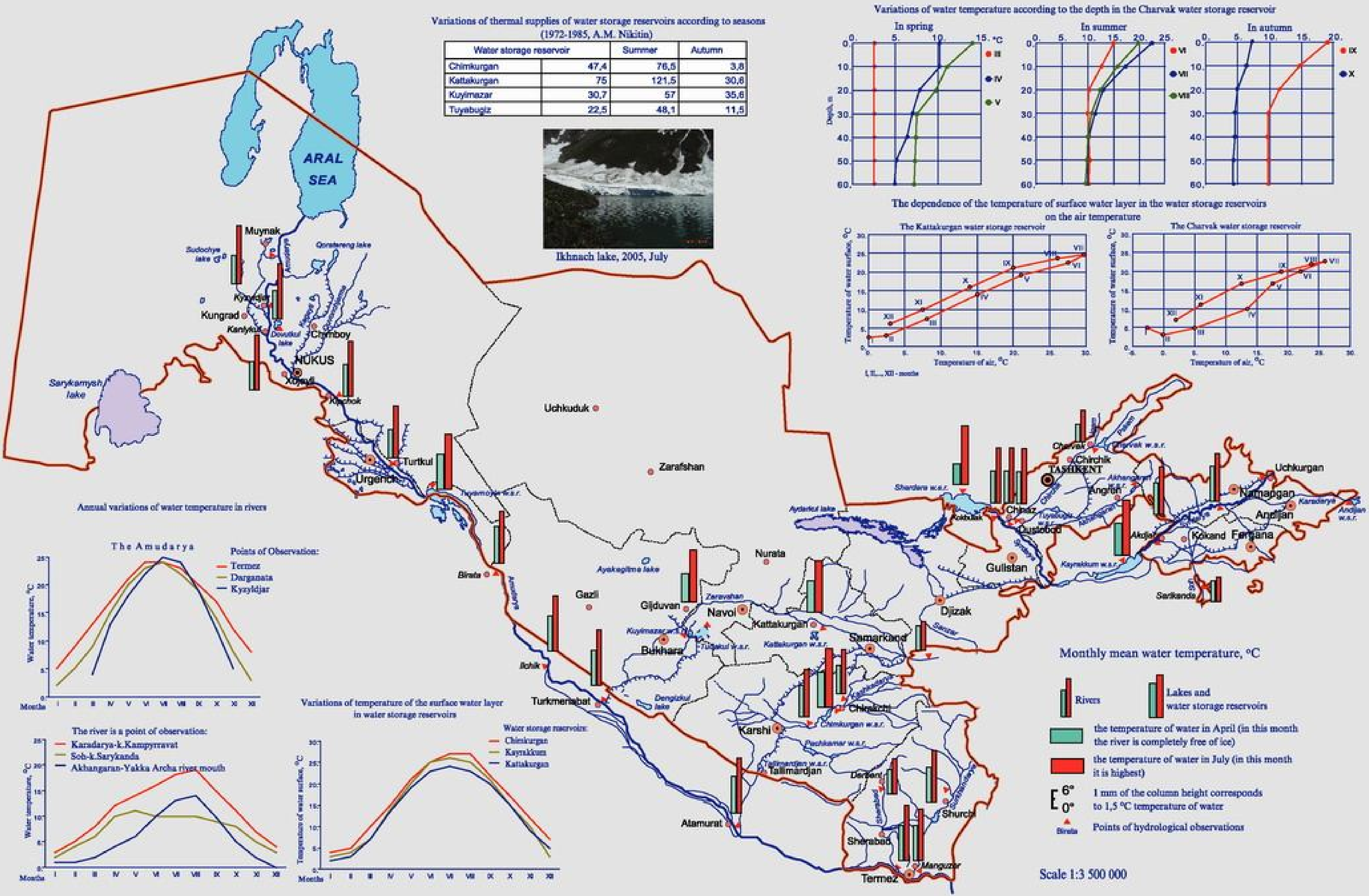
Potential avalanche danger. Separate cases of small avalanches are possible only in anomalous conditions

Non avalanche - dangerous area. There is no avalanching

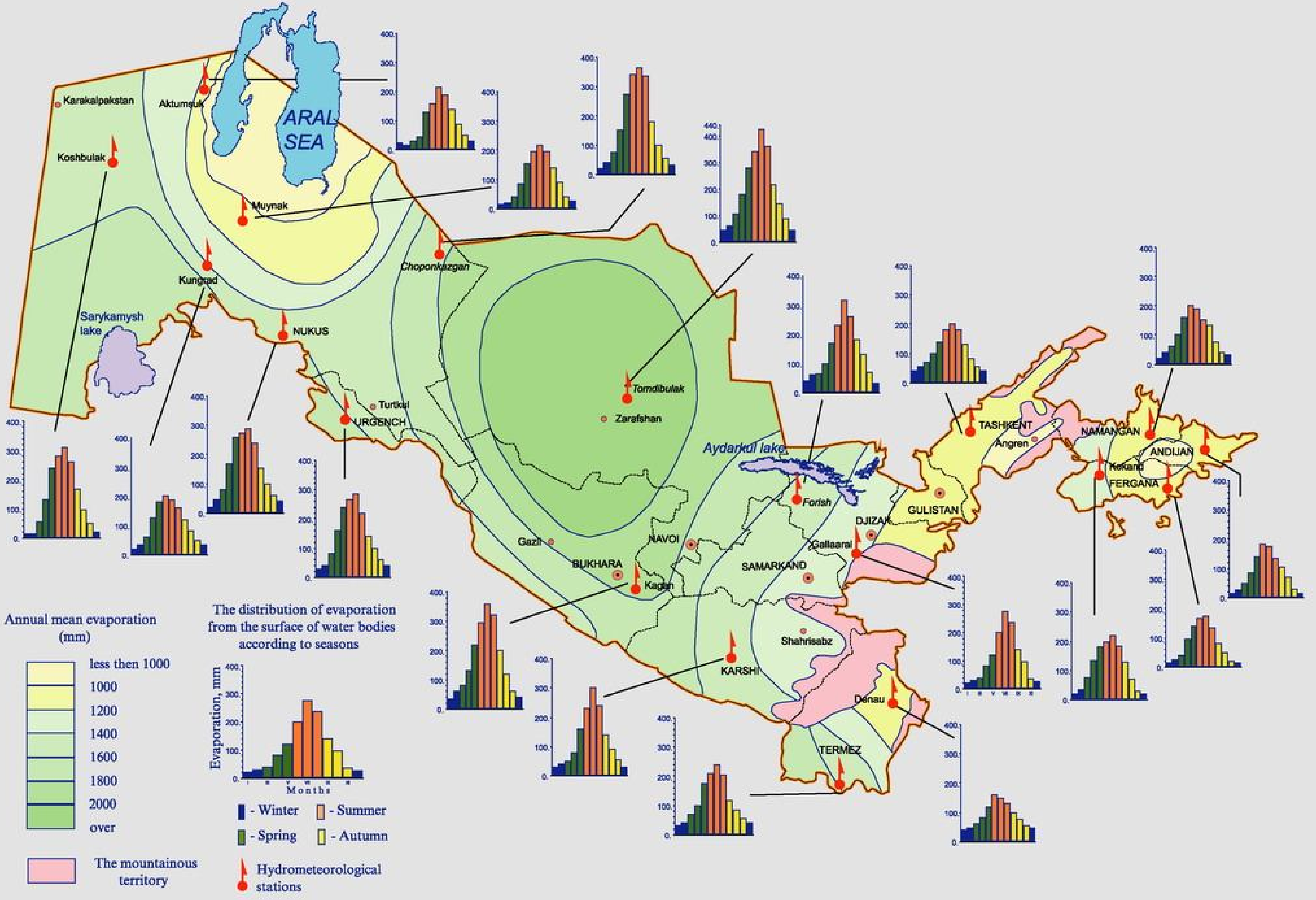
The degree of avalanching is characterized by the ratio of the affected part of the valley to its total length

Variations of thermal supplies of water storage reservoirs according to seasons (1972-1985, A.M. Nikitin)

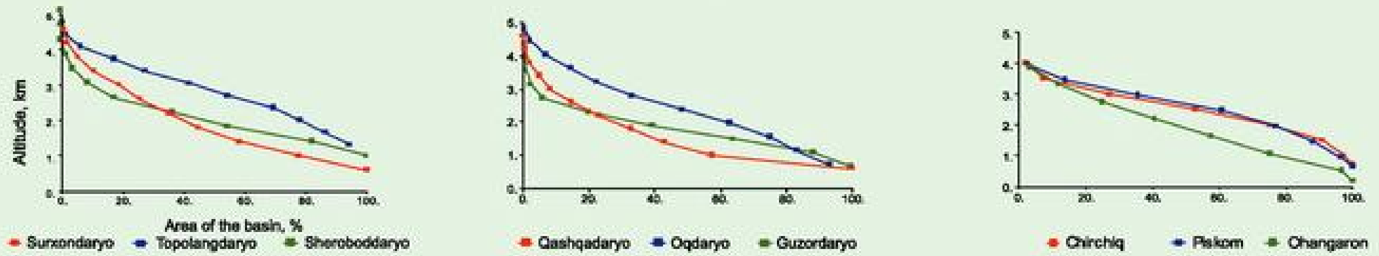
Water storage reservoir		Summer	Autumn
Chimkurgan	47,4	76,5	3,8
Kattakurgan	75	121,5	30,6
Kuyimazar	30,7	57	35,6
Tuyabugiz	22,5	48,1	11,5



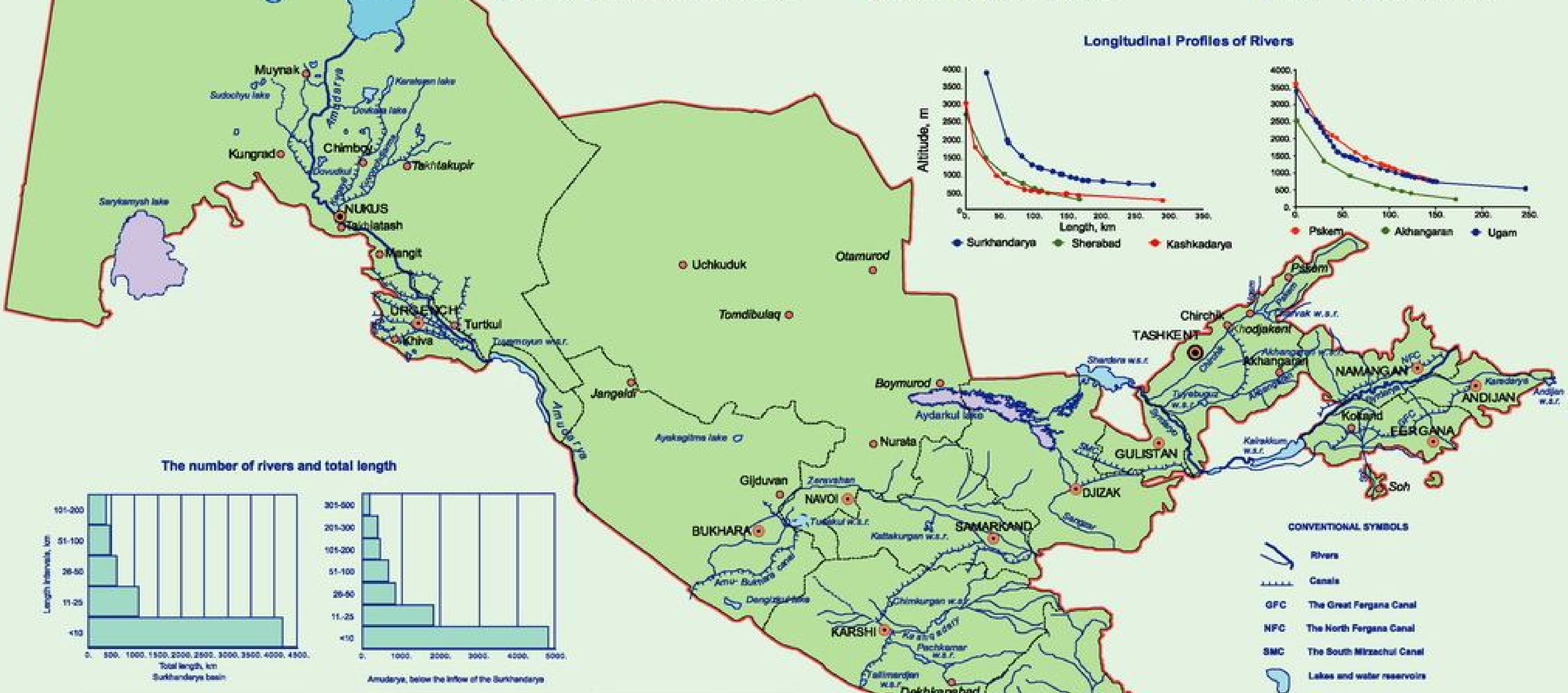
THE ANNUAL EVAPORATION FROM THE WATER SURFACE

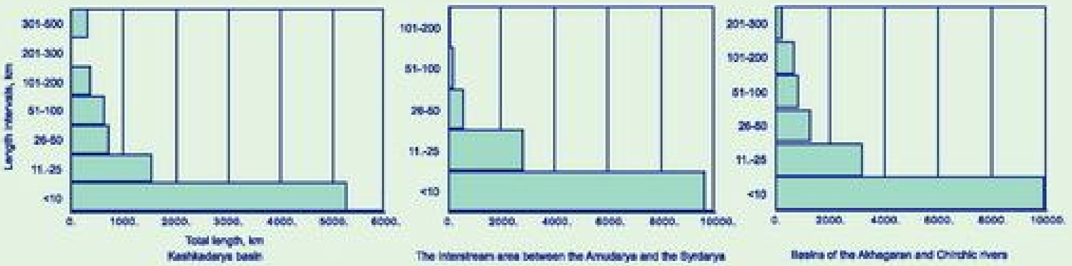


Hypsographic curves of river basins



Longitudinal Profiles of Rivers

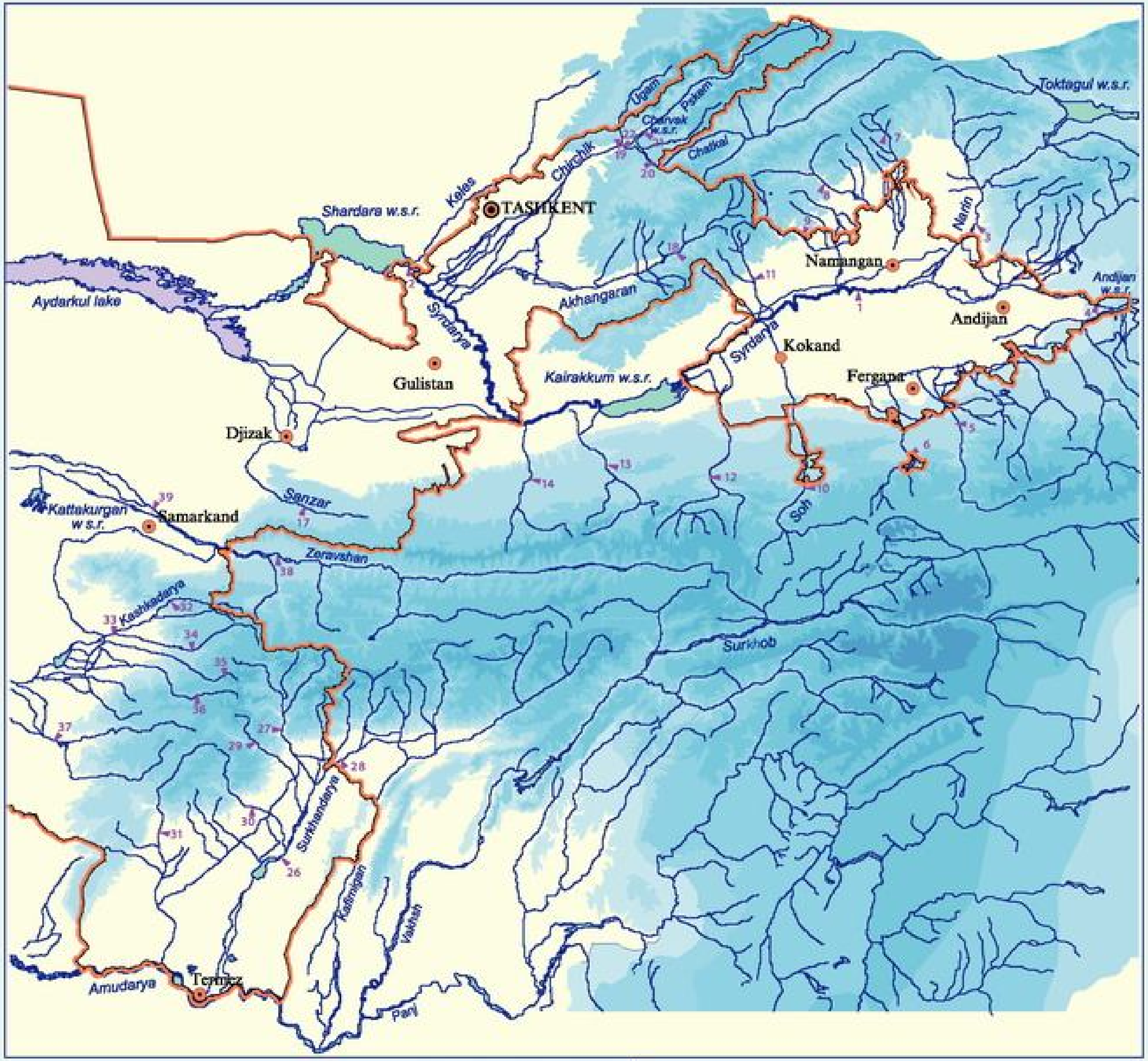




CONVENTIONAL SYMBOLS

- Rivers
- Canals
- GFC The Great Fergana Canal
- NFC The North Fergana Canal
- SMC The South Mirzachul Canal
- Lakes and water reservoirs

Sources of rivers



The specific discharges, l/sec km ^{2}

less than 1 | 5 | 10 | 20 | 30 | 40 | over

Annual Mean Discharges of Water in Rivers
(Q, m³/sec)

The Syrdarya basin

N	Rivers	Q
1	Syrdarya - k.Kal	454
2	Syrdarya - k.Kokbulak	732
3	Naryn - Uchkurgan.	376
4	Karadarya - k.Kamyrravat.	120
5	Isfairam - k.Uchkurgan	21.6
6	Shakhimardan - k.Paulgan	9.76
7	Padshaatasay - Tostu river mouth	6.02
8	Kasansay - k.Kyzyltokay	7.32
9	Gavasay - k.Gava	6.04
10	Soh - k.Sarykanda	42.2
11	Chadaksay - Djulaisay river mouth	3.88
12	Isfara - k. Tashkurgan	14.5
13	Khodjabakirgan - k.Andarkhan	10.1
14	Aksu - k.Dasgan	3.84
15	Shirinsay - k.Basmandysay	1.82
16	Zaminsu - k. Duoba	1.83
17	Sanzar - k.Kyrk	1.98
18	Akhangaran - Iertash river mouth	19.2

The Amudarya basin

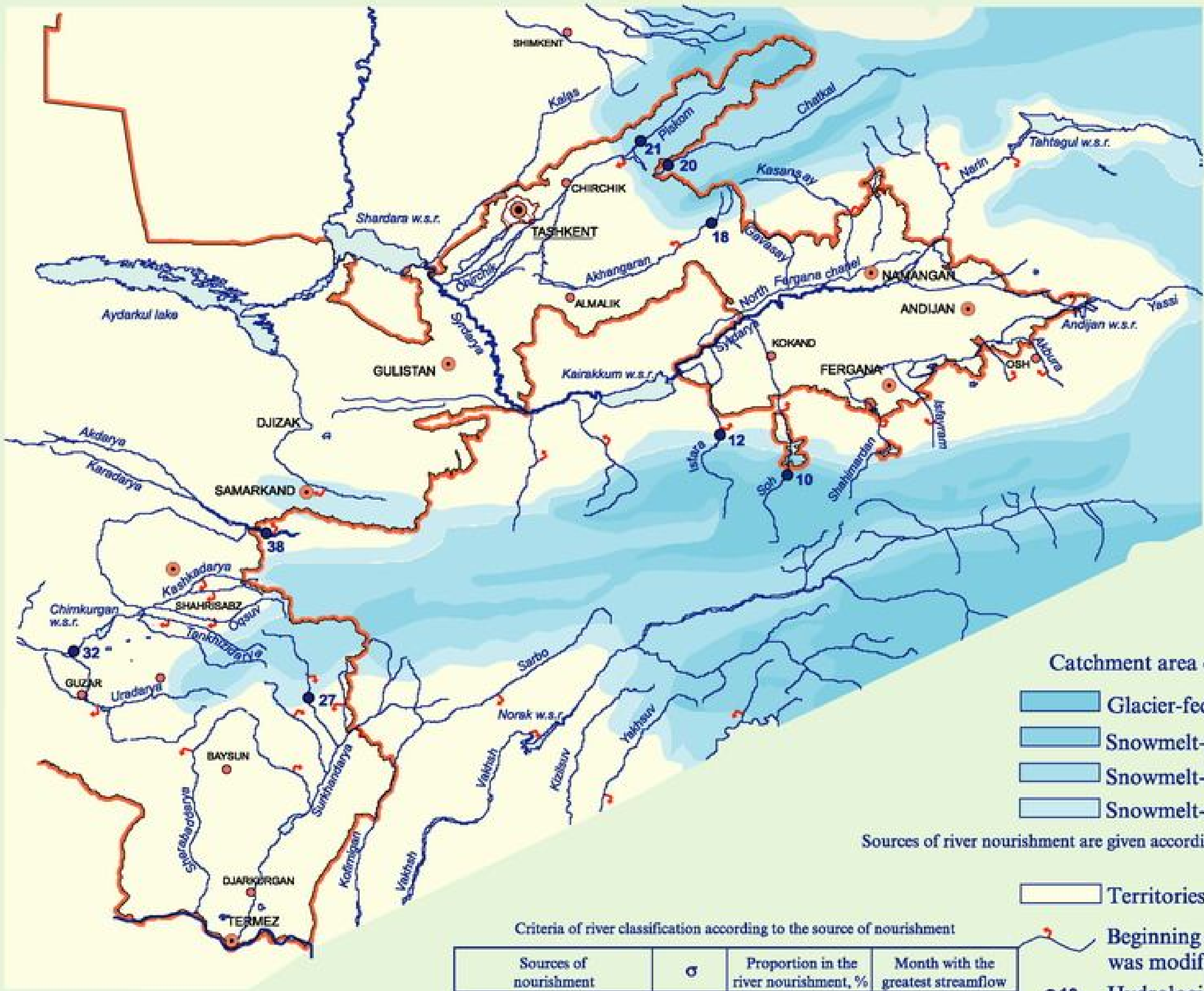
N	Rivers	Q
24	Amudarya - Kerki town	1960
25	Amudarya - k.Chatly	1460
26	Surkhandarya - k.Shurchi	68.2
27	Tupalangdarya - k.Zarchob	52.2
28	Karatag - k.Karatag	22.3
29	Sangardak - k.Kengguzar	14.5
30	Halkadjar - k.Bazardjay	6.87
31	Sherabaddarya - k.Derbent	5.4
32	Kashkadarya - k.Varganzi	5.21
33	Kashkadarya - k.Chirakchi	23.2
34	Akdarya - k.Khazarnau	12.1
35	Tanhyzdarya - k.Kattagan	4.3
36	Yakkabagdarya - k.Tatar	6.22
37	Guzardarya - k.Yartepe	5.93
38	Zerafshan - Dupuli bridge	156
39	Zerafshan - k.Ziyavutdin	97.3
40	Zerafshan - k. Khazara	83.5
41	Urgutsay - Urgut town	0.41
42	Amankutansay - k.Amankutan	0.8
43	Sazagansay - k.Sazagan	0.41
44	Tusunsay - k.Karakiya	1.92
45	Aktepasay - k.Akcha	0.31
46	Beglyarsay - k.Yangi Akchab	0.53

1 - the hydrological regime of the river is changed, discharge of water in the table is characteristic of the period before 1960

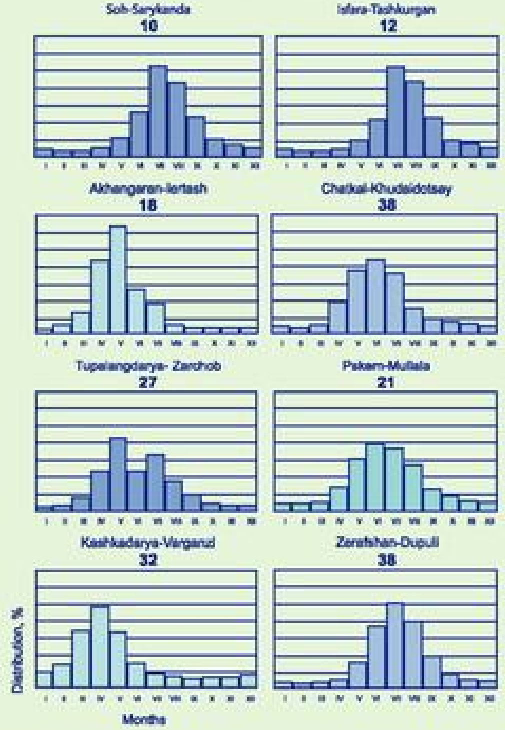
The dependence of the specific discharge on the altitude of river basins

CONVENTIONAL SYMBOLS

- The state border
- TASHKENT — The capital
- Gulistan — The district's capital
- Rivers
- Lakes
- Salty lakes
- Water storage reservoirs
- Hydrological gauges and their numbers



The Annual Distribution of the stream flow of rivers with different sources of nourishment



Catchment area of rivers

- Glacier-fed
- Snowmelt-glacier-fed
- Snowmelt-fed
- Snowmelt-rain-fed

Sources of river nourishment are given according to O.P.Shcheglova's classification

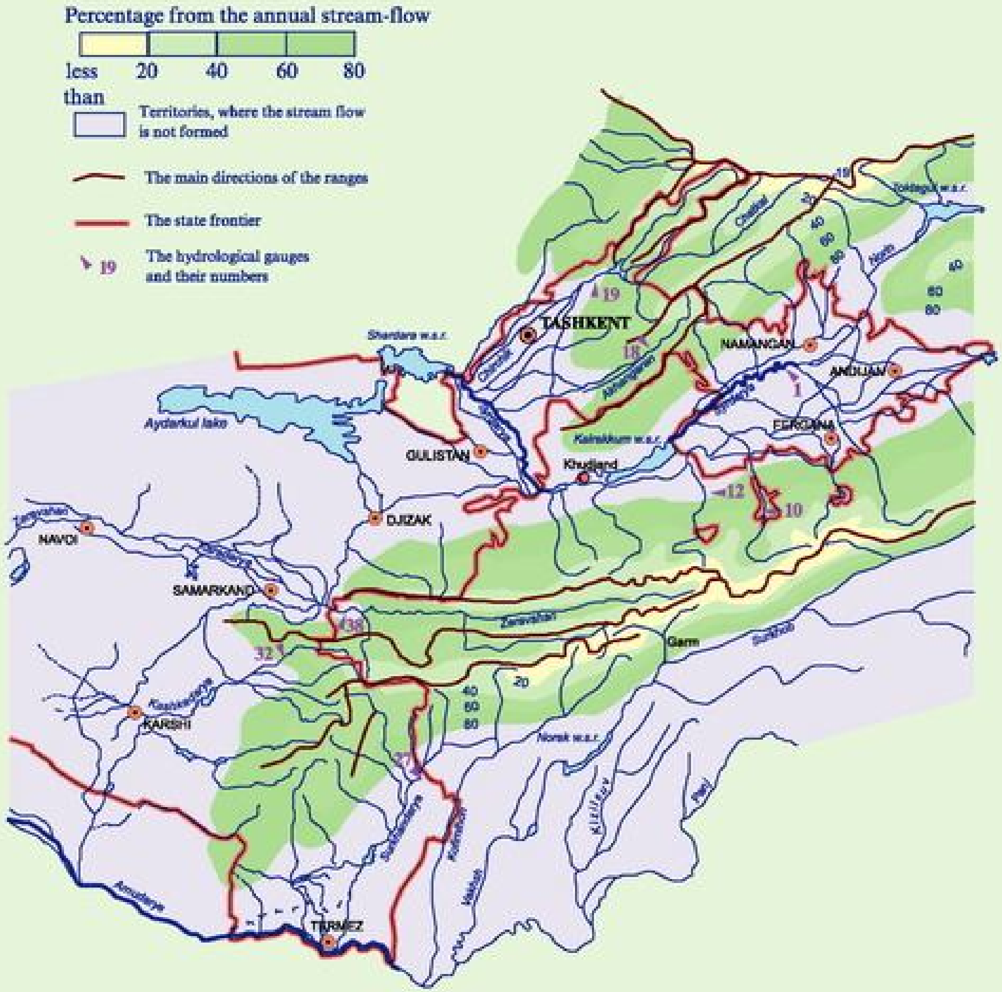
- Territories without overland flow
- Beginning of water intake and rivers whose regime was modified by the anthropogenic activities
- ●10 Hydrologic gauges and their numbers
- Capitals
- Regions centres
- Other settlements

Criteria of river classification according to the source of nourishment

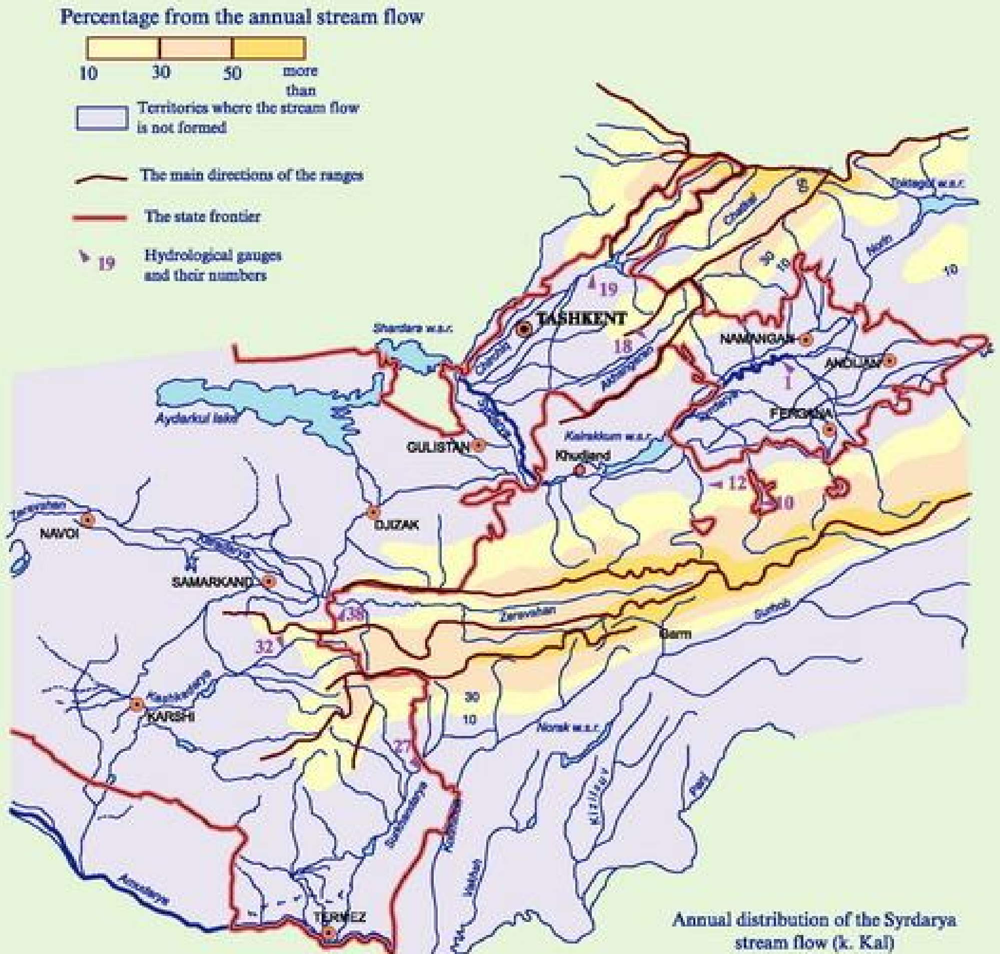
Sources of nourishment	σ	Proportion in the river nourishment, %	Month with the greatest streamflow
Glacial waters	>1.00	>38	VII, VIII
Snow- glacial waters	0.99-0.26	37-17	V, VI
Snowmelt waters	0.25-0.18	16-12	IV, V
Snowmelt-rain waters	0.17-0.00	11-0	III, IV, V

σ - streamflow ratio for July-September to the stream flow for March-June

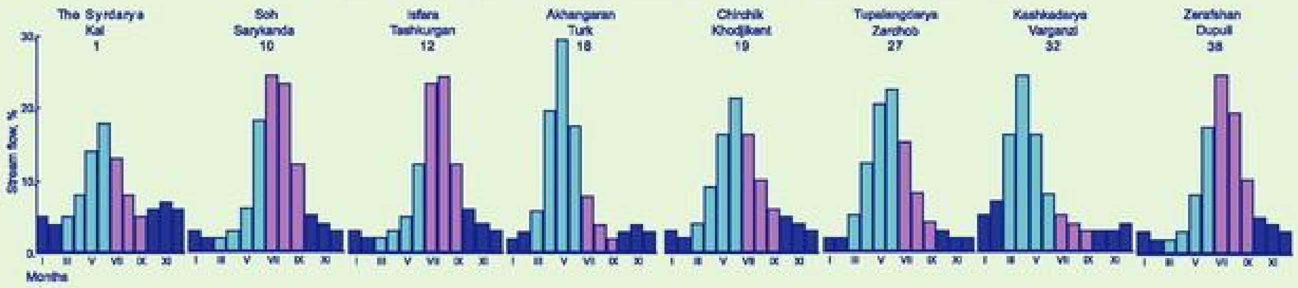
SPRING PERIOD (MARCH-JUNE)



SUMMER PERIOD (JULY-SEPTEMBER)



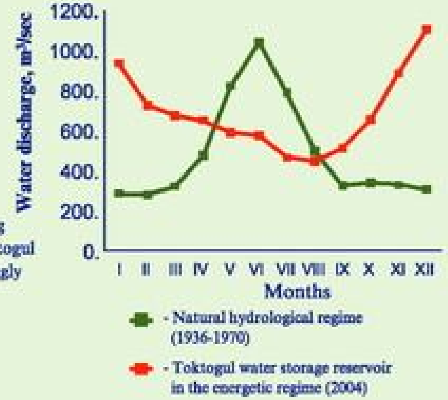
ANNUAL DISTRIBUTION OF THE RIVER STREAM-FLOW IN MONTHS AND SEASONS

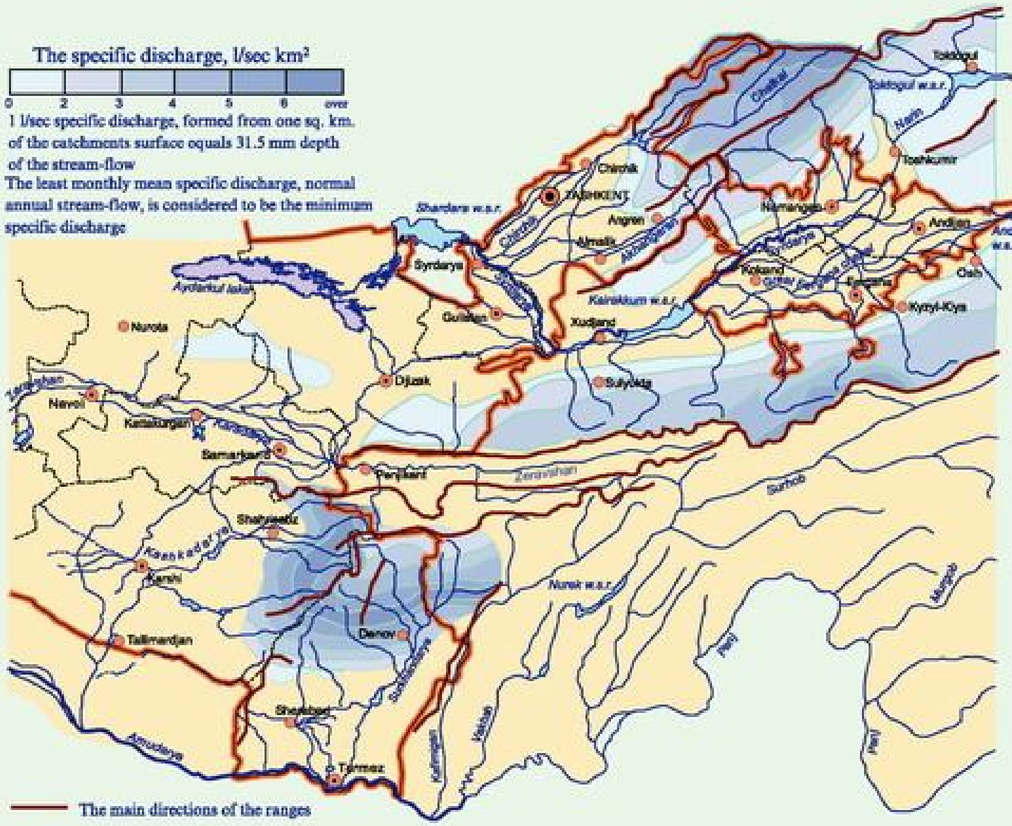


Autumn-winter period | Spring period | Summer period

1,19 - annual distribution of the stream flow is characteristic of the period before 1970.
Annual distribution of the stream flow in succeeding years depends on the regime of the work of the Toktogul and Charvak water storage reservoirs, correspondingly

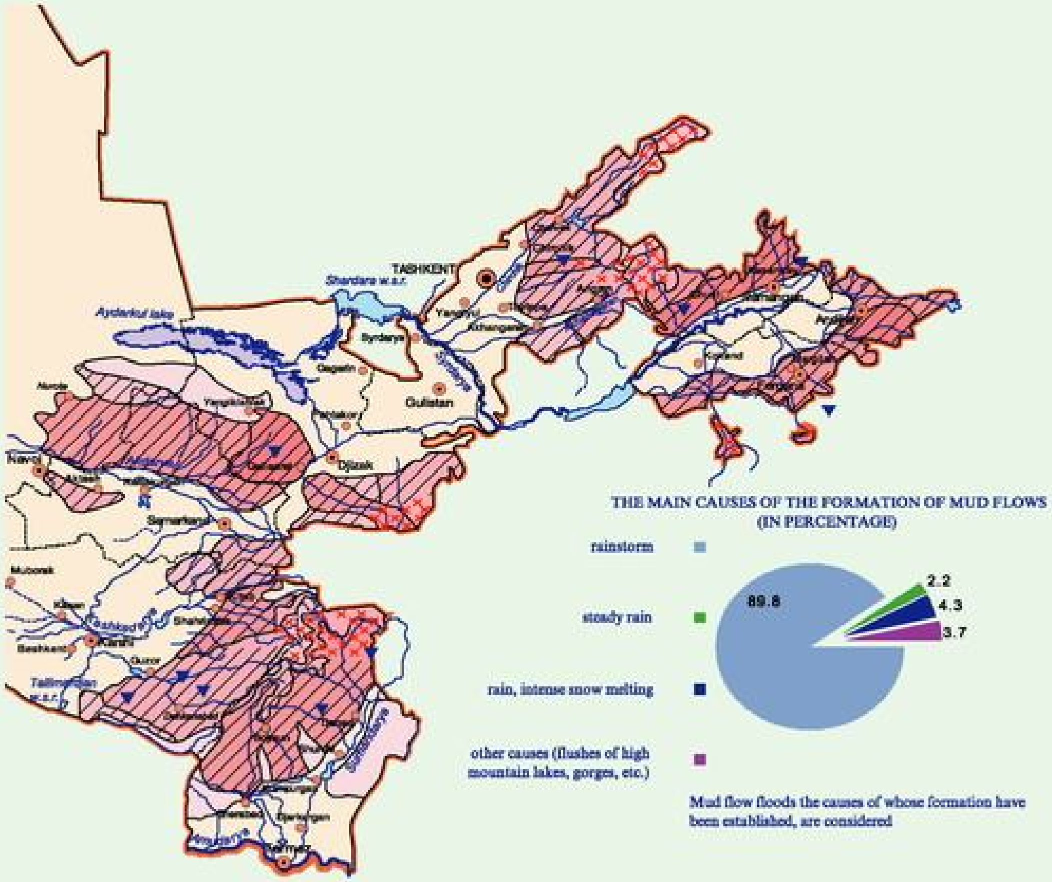
Annual distribution of the Syrdarya stream flow (k. Kal)



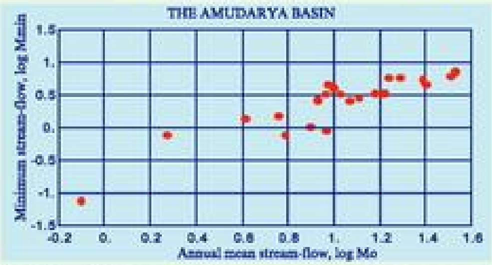


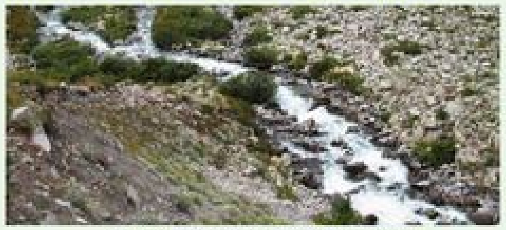
The main directions of the ranges

Territories where the stream-flow is not formed



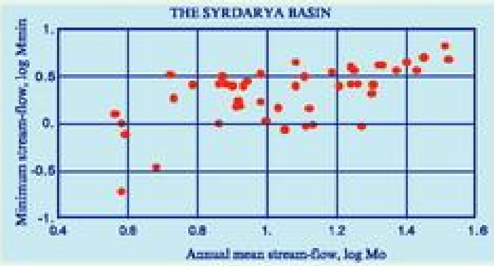
THE DEPENDENCE OF THE MINIMUM STREAM-FLOW ON THE ANNUAL MEAN STREAM-FLOW





The low water period on mountain rivers

The low water period on the Amudarya



FREQUENCY OF MUD FLOW FLOODS

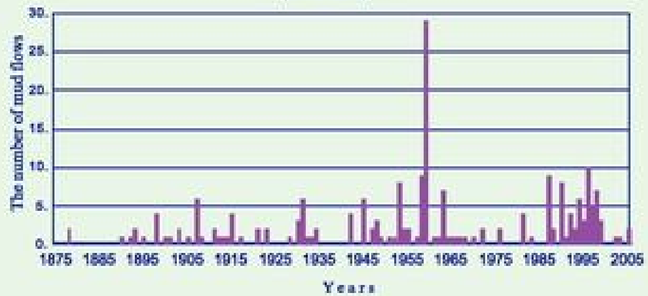
- mud flow floods are not observed
- mud flow floods are possible
- very rarely (once in 10 or more years)
- rarely (once in 4-10 years)
- frequently (once in 1-3 years)
- very frequently (once in a year and more)

THE MAIN CAUSES OF MUD FLOW FORMATION

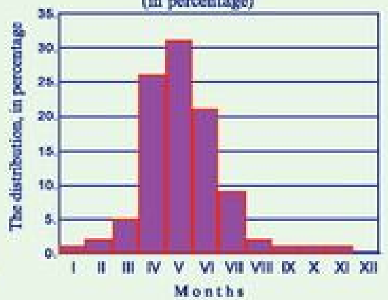
- × rainstorm
- //// rain, intense snow melting
- ▼ areas of the arising of catastrophic mud flows

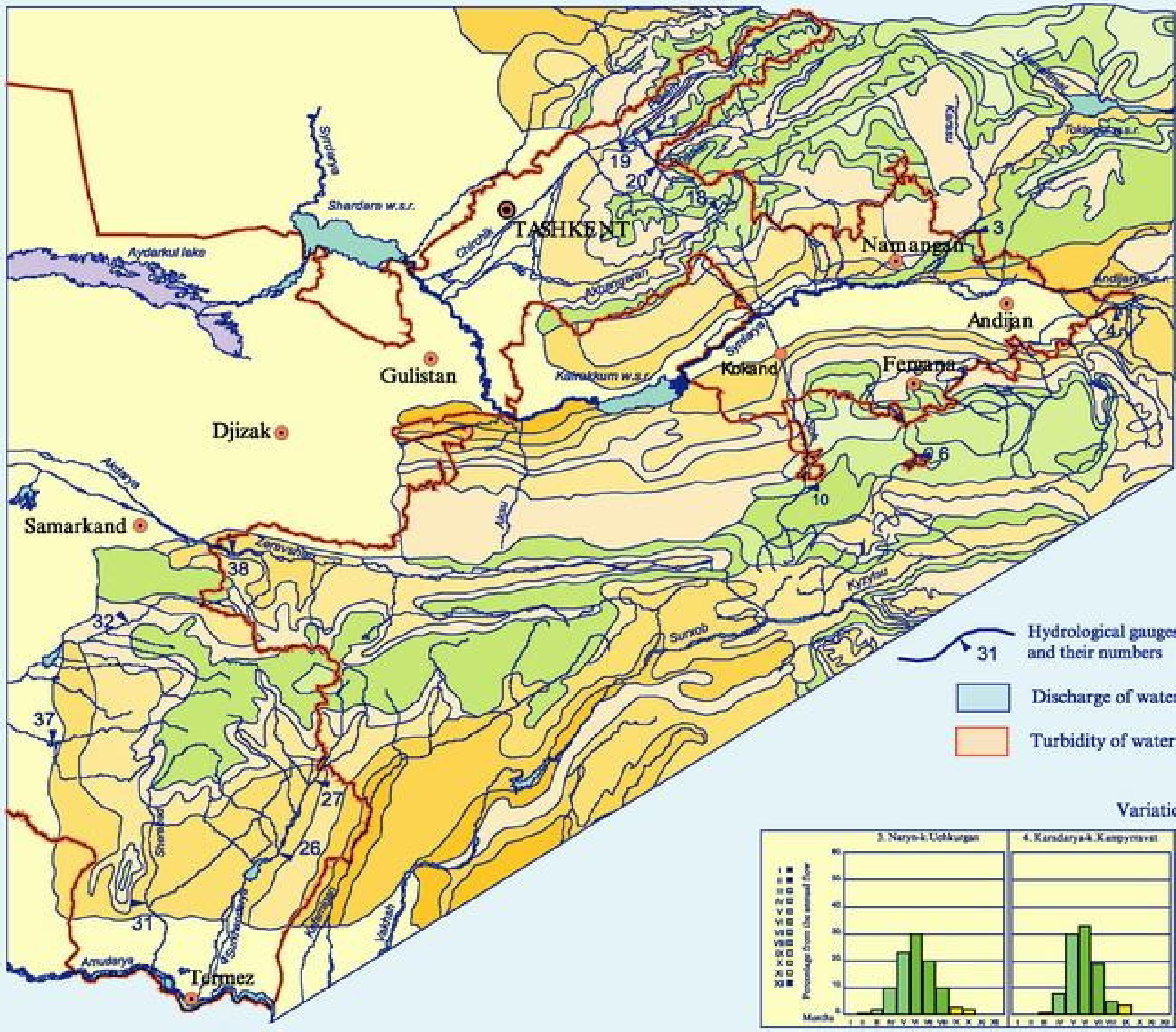
Mud flows differing in the genesis and reasons of their formation are possible on the same mud flows streams. The prevailing ones are given on the map.

Mud flows observed in the Chirchik-Akhangaran basin (1878-2005)

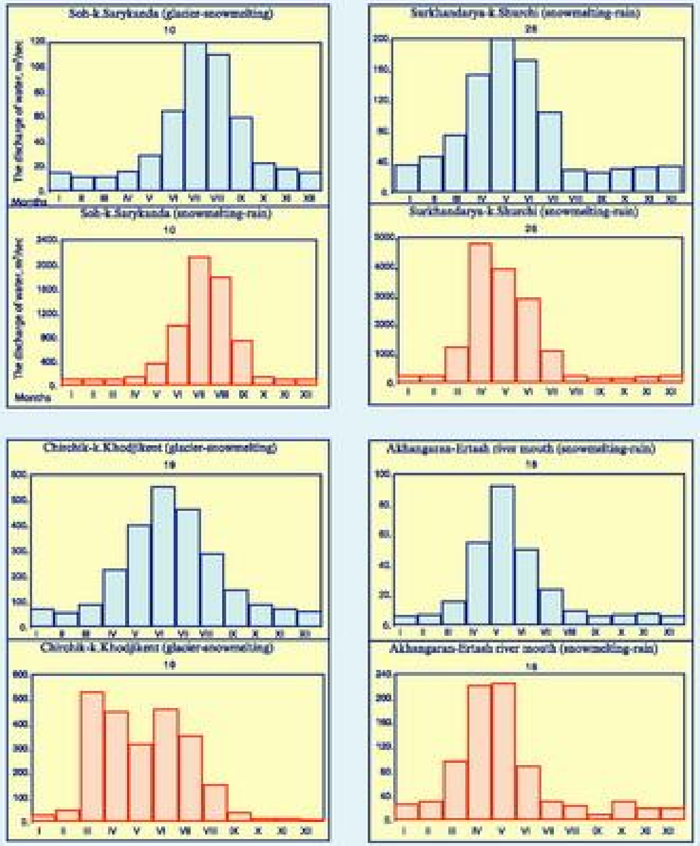


The distribution of mud flows throughout the year (in percentage)





Variations of the discharge and turbidity of river water with different sources of nourishment

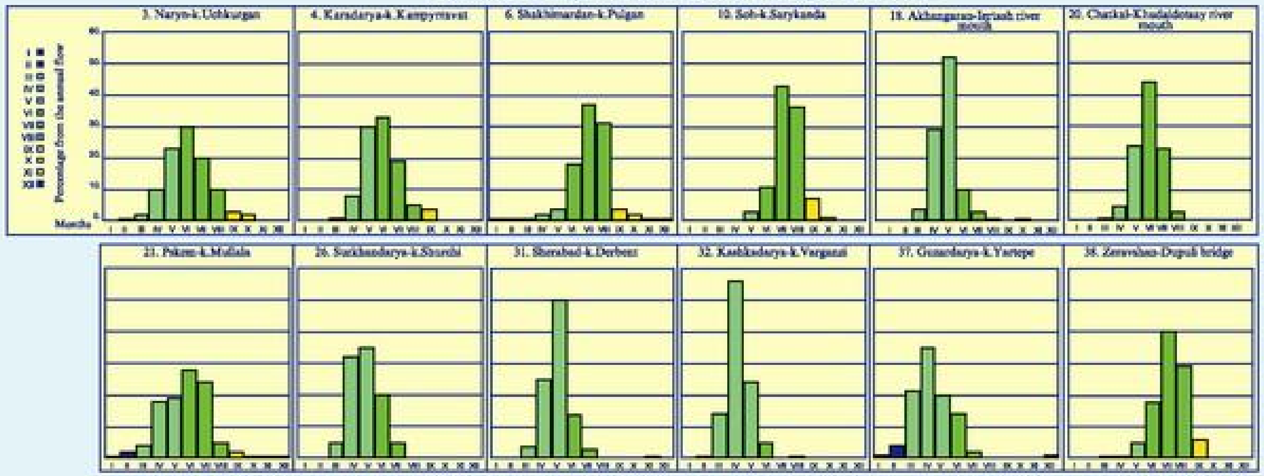


Hydrological gauges and their numbers

Discharge of water

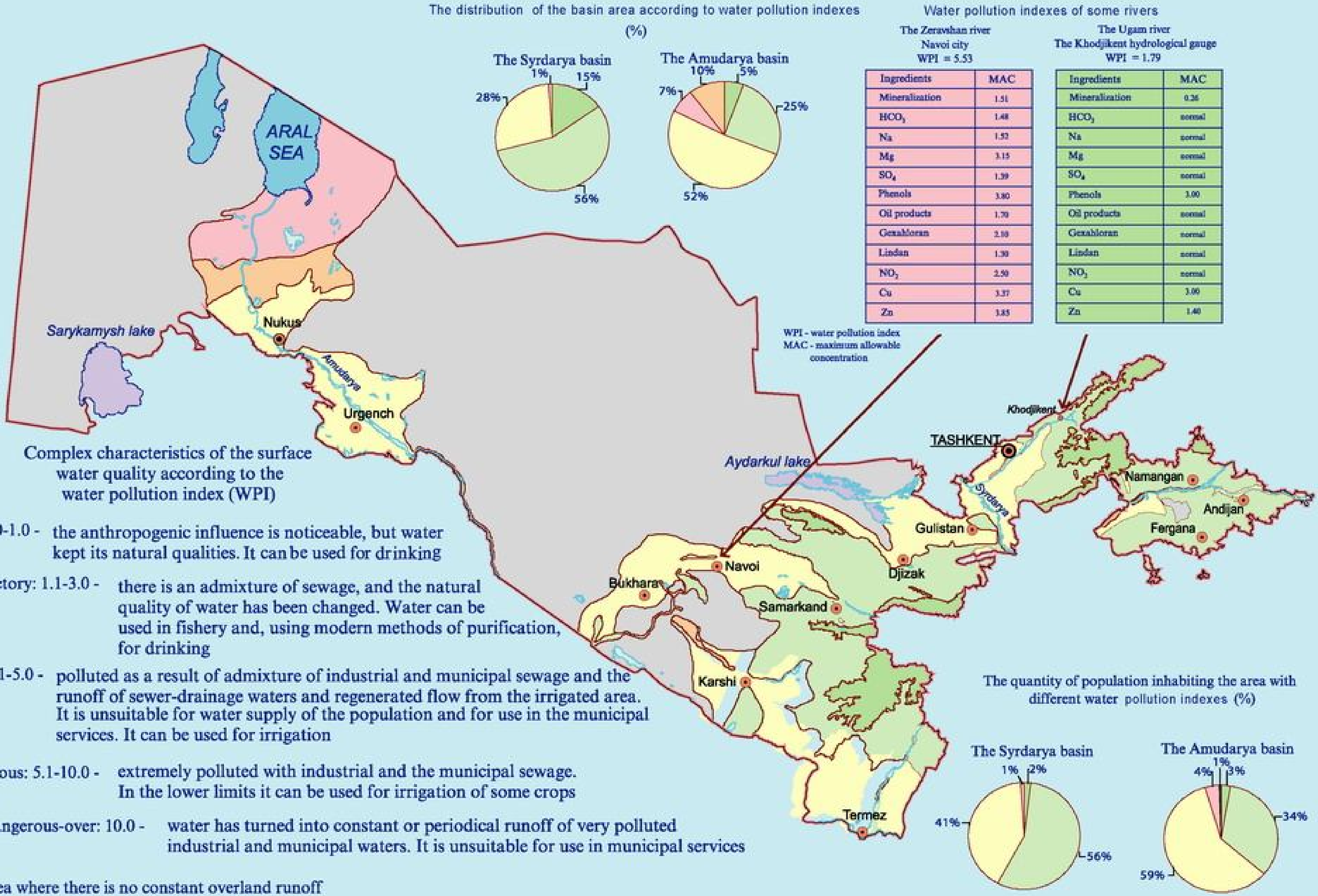
Turbidity of water

Variations of suspended load runoff throughout the year



Turbidity of river water (kg/m³)

- < 0,05
- 0,05 - 0,10
- 0,10 - 0,25
- 0,25 - 0,50
- 0,50 - 1,0
- 1,0 - 2,5
- 2,5 - 5,0
- 5,0 - 10,0
- > 10,0



Water pollution indexes of some rivers

The Zeravshan river
Navoi city
WPI = 5.53

Ingredients	MAC
Mineralization	1.51
HCO_3	1.48
Na	1.52
Mg	3.15
SO_4	1.39
Phenols	3.80
Oil products	1.70
Gexahloran	2.10
Lindan	1.30
NO_3	2.50
Cu	3.37
Zn	3.85

The Ugam river
The Khodjikent hydrological gauge
WPI = 1.79

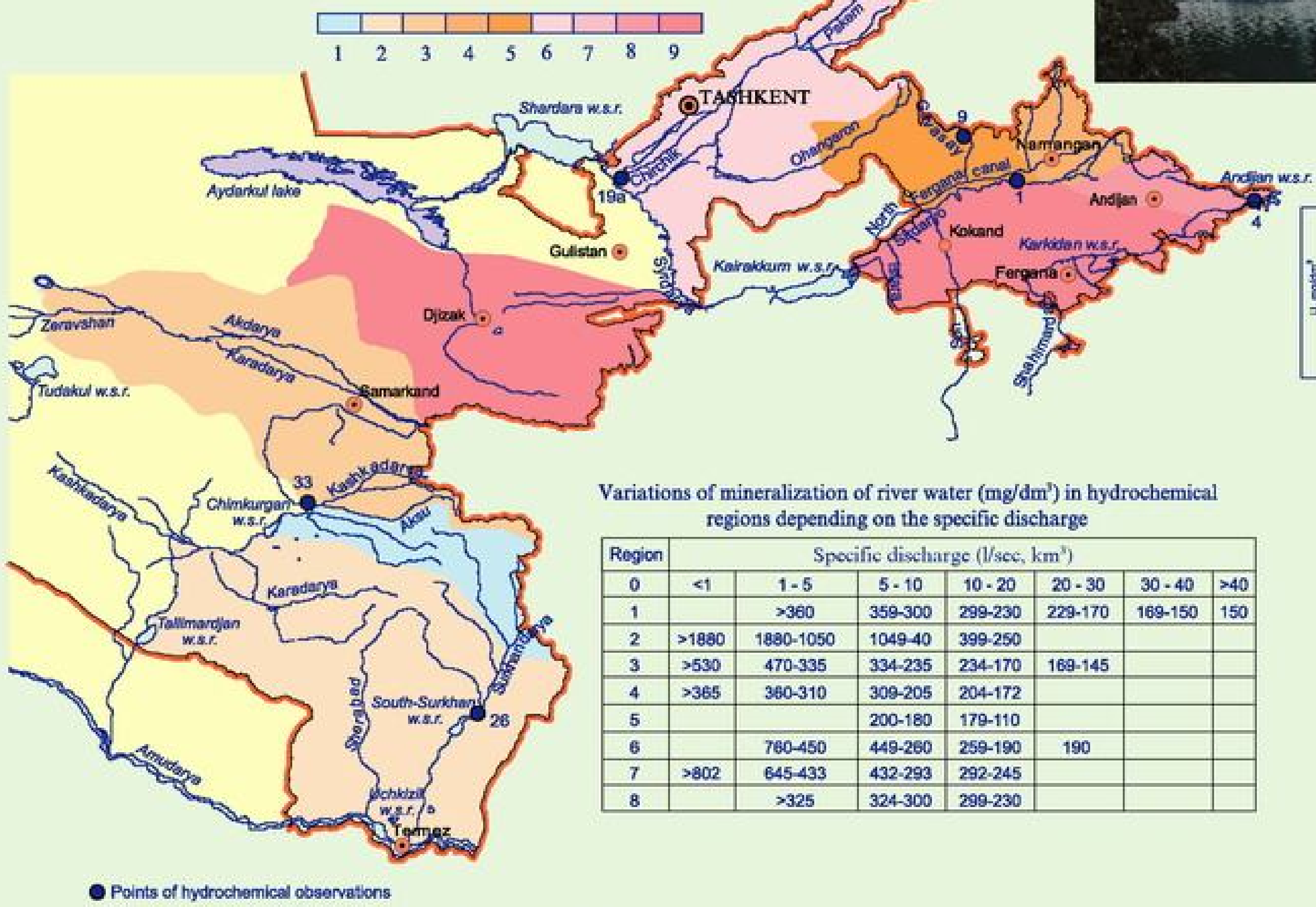
Ingredients	MAC
Mineralization	0.26
HCO_3	normal
Na	normal
Mg	normal
SO_4	normal
Phenols	3.00
Oil products	normal
Gexahloran	normal
Lindan	normal
NO_3	normal
Cu	3.00
Zn	1.40

WPI - water pollution index
MAC - maximum allowable concentration

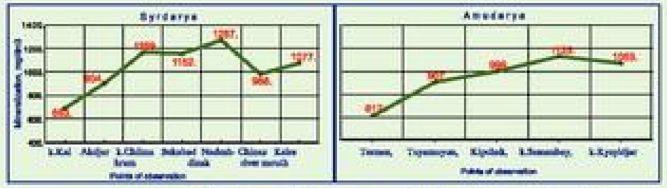
Complex characteristics of the surface water quality according to the water pollution index (WPI)

- good: 0-1.0 - the anthropogenic influence is noticeable, but water kept its natural qualities. It can be used for drinking
- satisfactory: 1.1-3.0 - there is an admixture of sewage, and the natural quality of water has been changed. Water can be used in fishery and, using modern methods of purification, for drinking
- bad: 3.1-5.0 - polluted as a result of admixture of industrial and municipal sewage and the runoff of sewer-drainage waters and regenerated flow from the irrigated area. It is unsuitable for water supply of the population and for use in the municipal services. It can be used for irrigation
- dangerous: 5.1-10.0 - extremely polluted with industrial and the municipal sewage. In the lower limits it can be used for irrigation of some crops
- very dangerous-over: 10.0 - water has turned into constant or periodical runoff of very polluted industrial and municipal waters. It is unsuitable for use in municipal services
- The area where there is no constant overland runoff

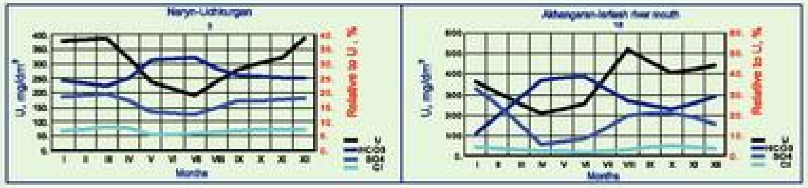
Hydrochemical regions



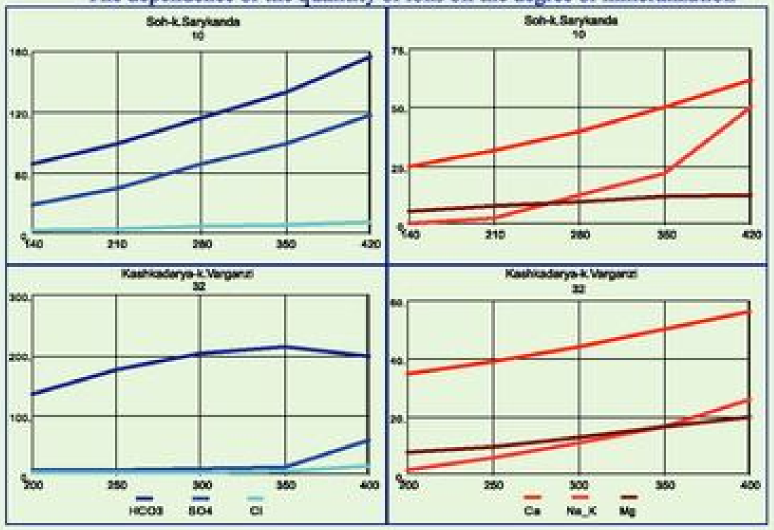
Variations of Mineralization along the length of rivers (1987-2000)



Mineralization of river water (U) and annual variations of the amount of basic anions



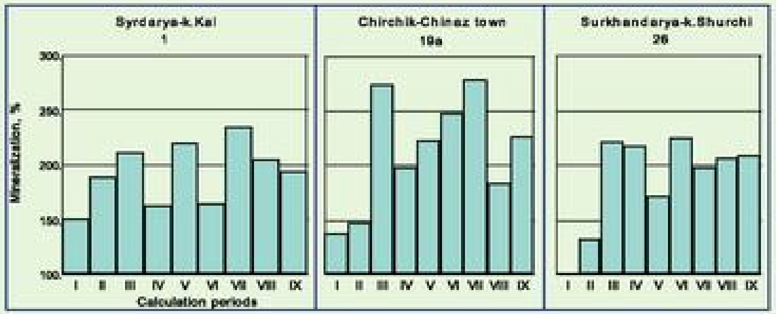
The dependence of the quantity of ions on the degree of mineralization



Variations of mineralization of river water (mg/dm³) in hydrochemical regions depending on the specific discharge

Region	Specific discharge (l/sec, km²)						
0	<1	1 - 5	5 - 10	10 - 20	20 - 30	30 - 40	>40
1		>360	359-300	299-230	229-170	169-150	150
2	>1880	1880-1050	1049-40	399-250			
3	>530	470-335	334-235	234-170	169-145		
4	>365	360-310	309-205	204-172			
5			200-180	179-110			
6		760-450	449-260	259-190	190		
7	>802	645-433	432-293	292-245			
8		>325	324-300	299-230			

Variations of mineralization relative to the zone of flow formation (%)



Calculation periods

I 1950 - 1954 II 1955 - 1959

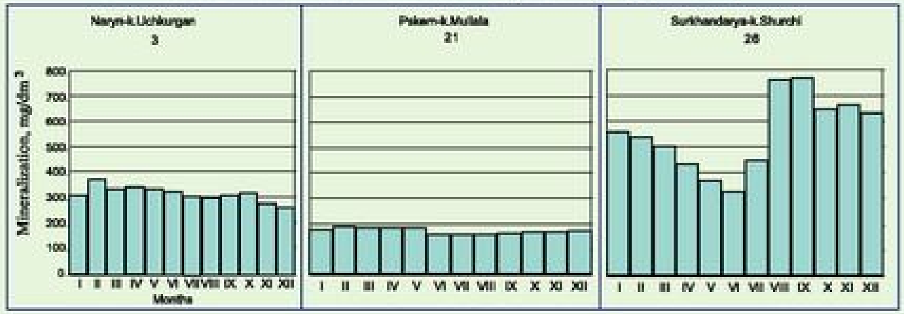
III 1960 - 1964 IV 1965 - 1969

V 1970 - 1974 VI 1975 - 1979

VII 1980 - 1984 VIII 1985 - 1989

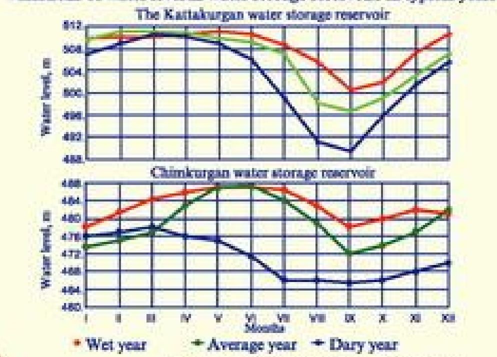
IX 1990 - 1996

Variations of mineralization of river water throughout the year (1987-2004)

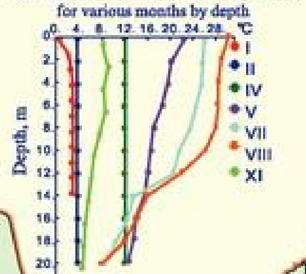


Variations of temperature of the surface water layer throughout the year

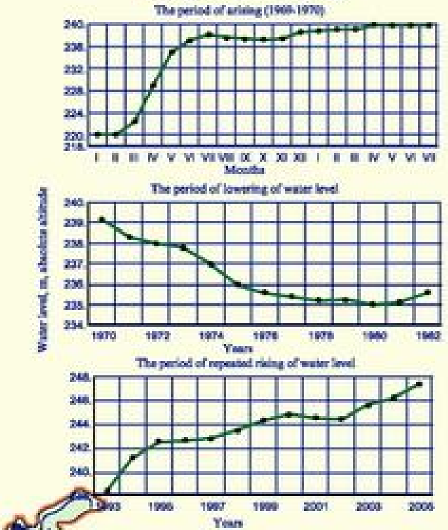
Variations of water level in water storage reservoirs in typical years

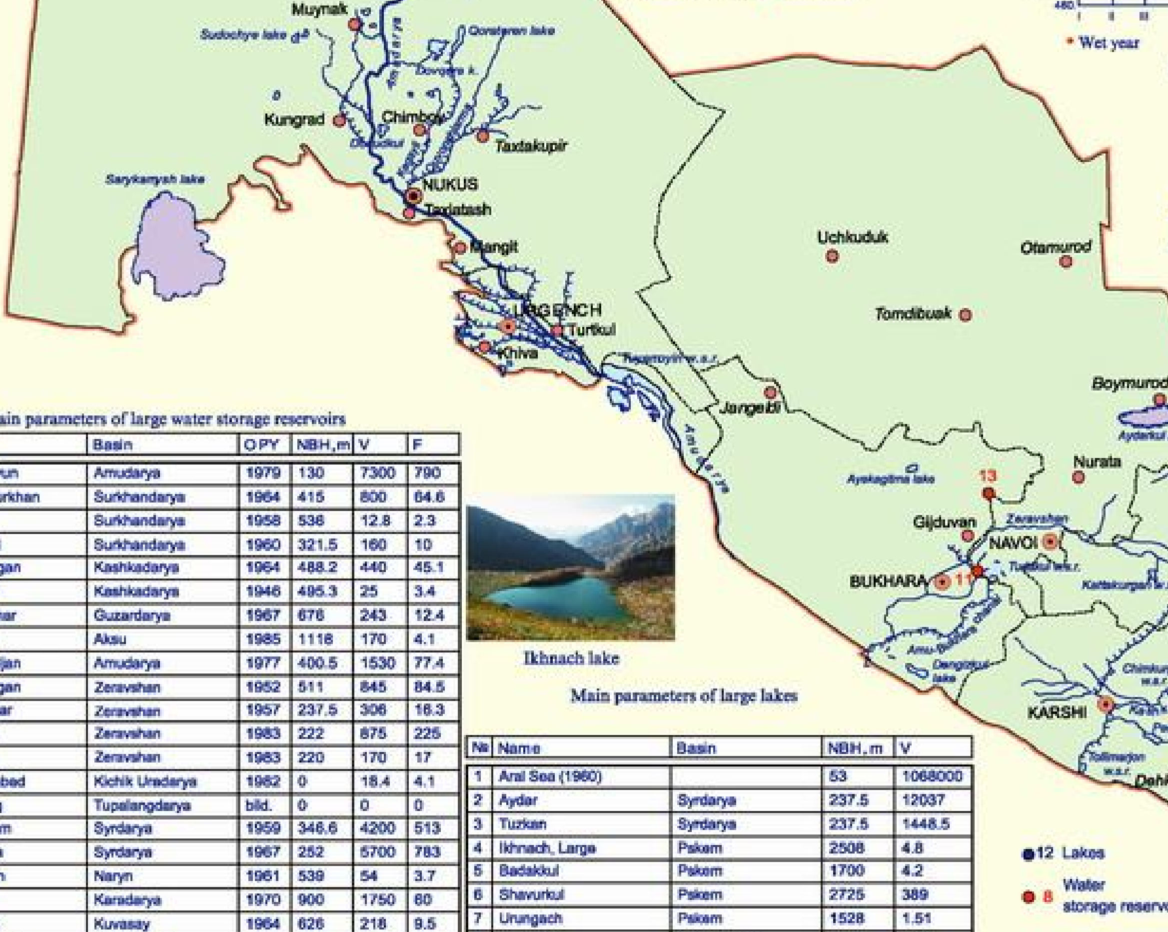


Changing the Aydarkul water temperature for various months by depth



Variations of water level in the Aydar-Arnasay lake system for many years





Ikhnach lake

Variations of water level in Ikhnach lake in summer period, 1969

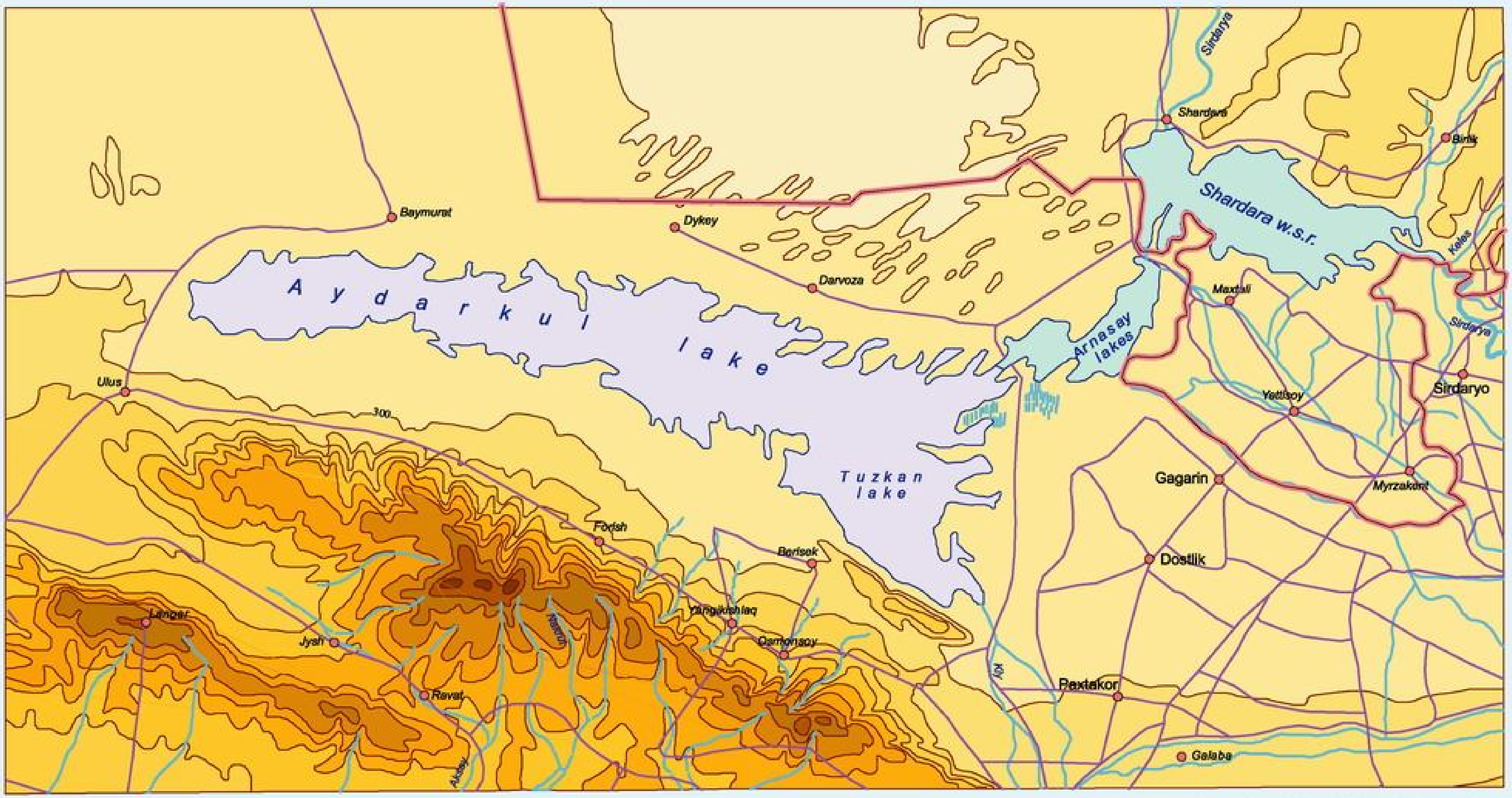
Main parameters of large water storage reservoirs

№	Name	Basin	OPY	NBH, m	V	F
1	Tuyamuyun	Amudarya	1979	130	7300	790
2	South-Surkhan	Surkhandarya	1964	415	800	64.6
3	Degrez	Surkhandarya	1958	536	12.8	2.3
4	Uchkyzyl	Surkhandarya	1960	321.5	160	10
5	Chimkurgan	Kashkadarya	1964	488.2	440	45.1
6	Kamashi	Kashkadarya	1946	495.3	25	3.4
7	Pachkamar	Guzardarya	1967	676	243	12.4
8	Gisarak	Aksu	1985	1118	170	4.1
9	Tallimardjan	Amudarya	1977	400.5	1530	77.4
10	Kattakurgan	Zeravshan	1952	511	845	84.5
11	Kuyimazar	Zeravshan	1957	237.5	306	16.3
12	Tudakul	Zeravshan	1983	222	875	225
13	Shorkul	Zeravshan	1983	220	170	17
14	Dehkanabad	Kichik Uradarya	1962	0	18.4	4.1
15	Tupalang	Tupalangdarya	bild.	0	0	0
16	Kairakkum	Syrdarya	1959	346.6	4200	513
17	Chardara	Syrdarya	1967	252	5700	783
18	Uckurgan	Naryn	1961	539	54	3.7
19	Andijan	Karadarya	1970	900	1750	60
20	Karkidan	Kuvasay	1964	626	218	9.5
21	Akhangaran	Akhangaran	1974	1100	339	8.1
22	Tuyabuguz	Akhangaran	1966	394	204	20.7
23	Charvak	Chirchik	1978	890	2000	40.3
24	Khodjikent	Chirchik	1977	741	30	2.5

Main parameters of large lakes

№	Name	Basin	NBH, m	V
1	Aral Sea (1960)		53	1068000
2	Aydar	Syrdarya	237.5	12037
3	Tuzkan	Syrdarya	237.5	1448.5
4	Ikhnach, Large	Pskem	2508	4.8
5	Badakkul	Pskem	1700	4.2
6	Shavurkul	Pskem	2725	389
7	Urungach	Pskem	1528	1.51
8	Arashan	Akhangaran	2898	1.43
9	Sarykamysh	Amudarya	4.3	28500
10	Sudochye	Amudarya	53	0
11	Dengizkul	Zeravshan	181.5	2723.4
12	Konbeshbulak	Sherabad	1618	4.84

Notes: OPY-the year of putting into operation, NBH-normal backwater horizon, m; ALA-absolute level altitude, m;
V-volume of water, mln.m , F- water table area, km ; hm-maximum depth, m.



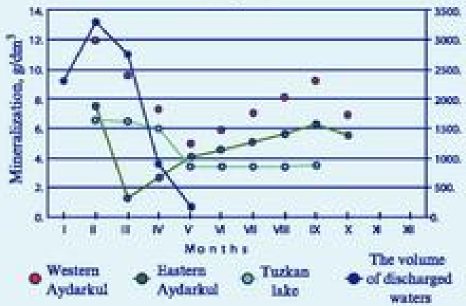
In connection with the decrease of the water discharge through the dam of the Shardara water storage reservoir, in winter period the water level begins to rise. Beginning from February of the wet year of 1969 through March 1970, the volume of water equal to 21.78 km^3 , was discharged through the dam into the Arnasay depression. As a result the Aydar-Arnasay lake system (lakes Tuzkan, Aydarkul, Arnasay) has been formed. These lakes are fed also by regenerated. Flow from the Mirzachul and Djizak steppes.

In 1971 and 1972 the volume of the water discharge was in the limits of 500 mln. km^3 . In the succeeding years there was almost no discharge of water from the Shardara into the Arnasay depression, thence the water level in the lakes gradually decreased

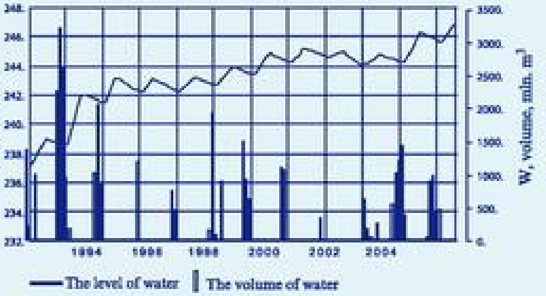
Beginning from the 90 's of the last century, the Toktogul water storage reservoir began working in the energetic regime. In this connection, the new increasing of water level began, as a result of discharge of water from the Shardara water storage reservoir into the Arnasay, mainly in the autumn-winter period. In 2005 the level of water in the lakes reached 247.4 m of sea level the area of the water table amounted to 3702 km^2 , and water volume 44 km^3 .

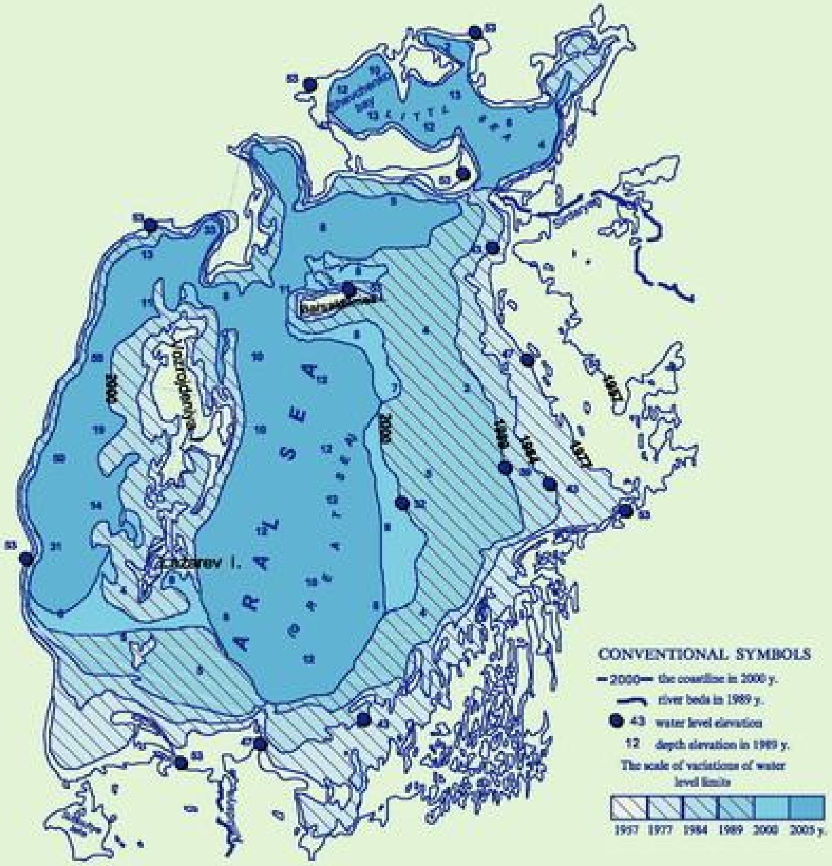
Variations of mineralization in different years

Annual variations of mineralization and the quantity of water discharged from the Shardara 1994 years



The variations of the level of the Aydar-Arnasay lakes depending on the volume of water, discharged from the Shardara water storage reservoir





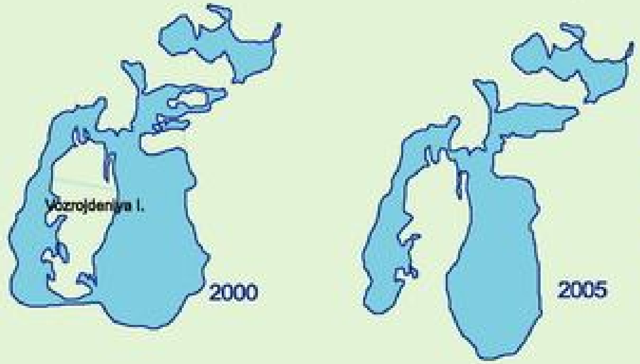
ARAL SEA DEPTH MAP

The Aral Sea appeared in the Upper Pliocene in the depression formed as a result of the downwarp of the earth's erust. The relief of the bottom without taking into account the western part, is flat. In the administrative respect, over half of the southwestern part of the sea lies the territory of the Karakalpakastan Republic, and the northeastern part-on the territory of Kazakhstan.

Before the 60 's of the last century the area of the Aral Sea, together with the islands reached about 68000 km². In area of the water table, the sea ranked fourth in the world (after the Caspian Sea, Superior lake in America and Victoria lake in Africa).

In that period the sea extended from the northeast to the south-west, its length amounted to 428 km, the widest point being 235 km. The volume of water in the sea was over 1000 km³, the mean depth being about 16.5 m. In the western part of the sea, near the Karakalpak Ustyurt, the depth reached 69 m. The southern, southwestern and eastern portions of the sea were shallow.

THE VARIATIONS OF THE WATER TABLE IN DIFFERENT YEARS

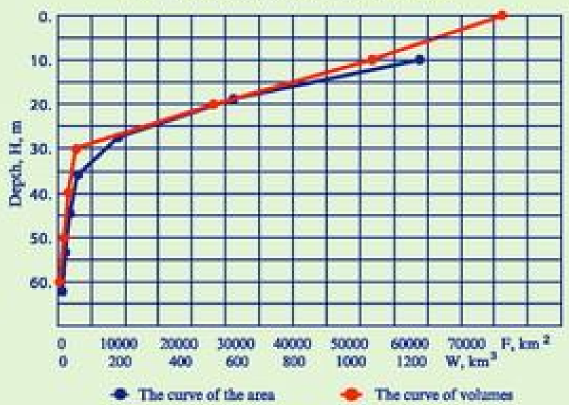


The dynamics of the inflow of river waters into the sea

The dynamics of the water table area (F) and evaporation (E)

Variations of water level (H) and salinity (S) of the sea

The curves of areas and volumes of the sea



"0" the depth corresponds to the water level of 53 m.

STATE COMMITTEE OF THE REPUBLIC OF UZBEKISTAN
FOR LAND RESOURCES, GEODESY, CARTOGRAPHY
AND STATE CADASTRE
TASHKENT 2008

The atlas prepared for print by the State Scientific-Industrial
Enterprise "Kartografiya" in 2008
Editor Ye.E. Kim
Technical åditor T.S. Gurova
Sent to press 14.12.2007
Size of paper 70õ100
Printer`s sheet 4 Conventional printer`s sheet 1,29
Order № 2 Edition size 300 copies

State Scientific-Industrial Enterprise "Kartografiya"
6, Ziyolilar Str., Tashkent, 100170

ISBN 978-9943-15-177-2

9789943151772