Statement on Water Flow Increase of Heihe River in Recent Years

by Zhangye City Hydrology and Water Resource Survey Bureau in Gansu Province

Yingluo Gorge Hydrological Observation Station, a national Class A hydrological station, founded in 1943, is the Heihe runoff control station. It owns complete hydrological series reference covering water level, water flow, sediment, precipitation, evaporation and meteorological aids etc. All hydrological data are measured, processed and collected strictly according to requirements of national “Hydrological Measurement Standard” and “Hydrological Data Processing Standard”. The outcomes are true and reliable. The station recorded the complete hydrological data of Heihe River from 1944 to 2010.

I、The formation and annual distribution of Heihe runoff

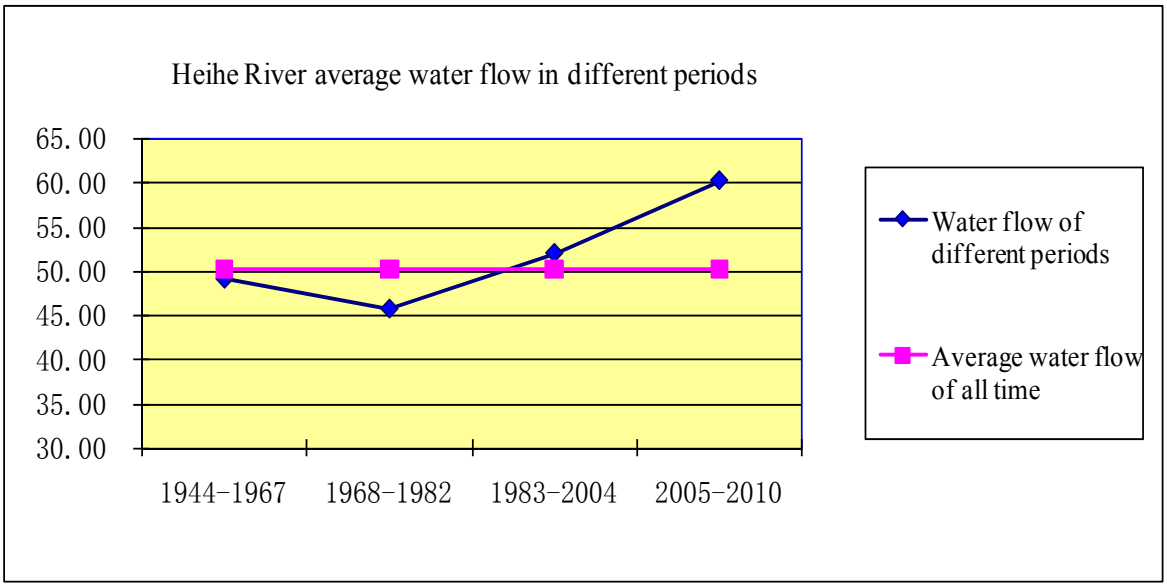
The upstream runoff of Heihe River is mainly formed by precipitation. The deluge in main flood season during May to September is formed by mountain heavy rains, among which there are partial meltwater caused by solid rainfall in winter and spring and partial glaciers meltwater; the flow in non flood season is mainly recharged by underground water from mountainous areas and meltwater from ice and snow. Therefore, the flow of Heihe River is mainly concentrated in flood season. The runoff recharge from 3 types of sources: ice, snow meltwater and underground water.

Constrained by recharge conditions, distribution of Heihe annual runoff is very uneven: from November to the next March, runoff is supplied by underground water, which is accounting for 13.3% of annual flow; after April, with the temperature rising obviously, snow in river area melted and the frozen ice in river is thawing, then they form spring flood, therefore the flow increases obviously. The runoff during April and May accounts for 11.6% of the total amount; summer and autumn are the seasons concentrated most of annual precipitation and also season’s incidental of flood. The water flow from June to September accounts for 68.5% of the total amount; from October the precipitation declines, the river flow gradually reduced, the runoff accounts for 6.6% of the total amount.

II、Analysis on historical annual flow of Heihe River

Through analyzing hydrological statistical data of Heihe River over the 67 years, it clearly shows in “Time Series of Annual Runoff of Heihe Yingluo Gorge”, from 1944 to 1967, Heihe water flow keeps at a comparatively balanced period, and it is the normal year of Heihe water flow; from 1968 to 1982, water flow of Heihe river is lower than the historical average water flow, and it is the dry period; from 1983 to 2004, water flow of Heihe river return to balanced period, and it is again a medium period; from 2005 till now, water flow of Heihe river is always higher than the historical average water flow. At present time, this period falls in the wet period, the first wet period since 1944 when our bureau started recording the water flow statistics. It is possible the water flow remain in the wet period in the following several years.

Name	Average water flow in normal year from 1944 to 1967 (m^3/s)	Average water flow in dry period from 1968 to 1982 (m^3/s)	Average water flow in normal year from 1983 to 2004 (m^3/s)	Average water flow in wet period from 2005 to 2010 (m^3/s)
Average water flow in wet period and dry period (m^3/s)	49.11	45.77	52.01	60.16
Average value in historical years (m^3/s)	50.2	50.2	50.2	50.2



III、Reason analysis on the high annual flow from 2005 to 2010

1、Increased precipitation: Heihe River drainage area is 69000km^2. It is divided into four geologic units including deep and light mountain areas, irrigation area and desert region for statistics and analysis. The deep and hillside mountain areas are the main formation region of river runoff. From 1994 to 2004, the rainfall of deep mountain area in Heihe drainage keeps at 400-500mm, and the rainfall in hillside area keeps at 250-450mm. During 2005-2010, the precipitation of deep mountain area keeps at 460-560mm, and the precipitation in hillside area is between 300-500mm. The ground precipitation increases obviously, which becomes the key reason for average value of water flow of Heihe River rising compared with the year before 2004. In addition, because the snowfall is increasing and the temperature is rising after April, the melting snow in drainage increased the runoff. Thus it makes the monthly water flow in April and May

increase compared with 2004. The whole years' monthly water flow distribution is comparatively even.

2、The speed of glaciers melting accelerated: The research of the Chinese Academy of Sciences shows that with the climate warming, Qilian Mountain glaciers shall be melted dramatically. In recent years the average annual melting glacier is above 6m and after 2050 it will basically disappear. The volume of melting ice and snow each year is about 1 billion cubic meters, which equals to the volume of Beijing Miyun reservoir[1]. Analyzed from the monitoring data, the temperature of Qilian mountain region from 1960s to 1980s has increased about 0.1C, the temperature from 2000 to 2005 has increased about 1.17C compared with 1960s. From 2006 till now, the temperature is continuing increasing. Large volume increasing of melting glaciers has become another key reason that the water flow of Heihe River keeps at a comparatively high level in recent years.

IV、Summary

1、The main reason of Heihe River water flow from 2005 to 2010 keeping at a comparatively high level is that under a background of global climate warming, the temperature is continuously rising, the speed of glaciers melting is accelerating, together with the increasing rainfall, thus leads the annual increased river water flow. This situation is caused by the objective factors and it is unforeseeable and out of human control.

2、The water flow of Heihe River in following years will vibrate up and down. It is possible that it remain in the wet period in the next several years. But due to the continuously rising temperature, the accelerated melting speed of the glaciers stored in Qilian Mountain, the glaciers may be gradually exhausted in the future. This may in turn reduce the amount of melting water from glacier and reduce the water flow in the Heihe River.

3、The increase of water flow of Heihe River caused the exceeding power generation for the newly built power plants on the river in recent years, therefore, the excess power generation of Xiaogushan plant is not an exceptional case, it is a common phenomenon in the Heihe River and surrounding areas across the region.

Hereby the statement.

December 8th, 2011

Zhangye City Hydrology and Water Resource
Survey Bureau

[1] http://news.163.com/photoview/05RQ0001/14207.html#p=7281L3V305RQ0001

甘肃省张掖水文水资源勘测局文件

甘肃省张掖市水文水资源勘测局
关于黑河近年来水量持续处于丰水期的说明

莺落峡水文站是黑河径流控制站，建于1943年，属国家一级水文站，具有水位、流量、泥沙、降水、蒸发及气象辅助等完整的水文系列资料，该站各项水文数据都是严格依据部版《水文测验规范》和《水文资料整编规范》规定的测量、整编程序收集整理的，成果真实可靠。该站记录了黑河1944年至2010年完整的水文资料。

一、黑河径流的形成和年内分配。

黑河上游径流主要由降水所形成，5－9月份的主汛期大洪水过程一般由山地暴雨所形成，其中还有部分高山地带冬春季固体降水的融水量及部分冰川融水量；非汛期来水量主要由山区地下水补给和冰雪融水量补给。因此，黑河来水主要集中在汛期，径流补给有降水补给、冰雪融水补给和

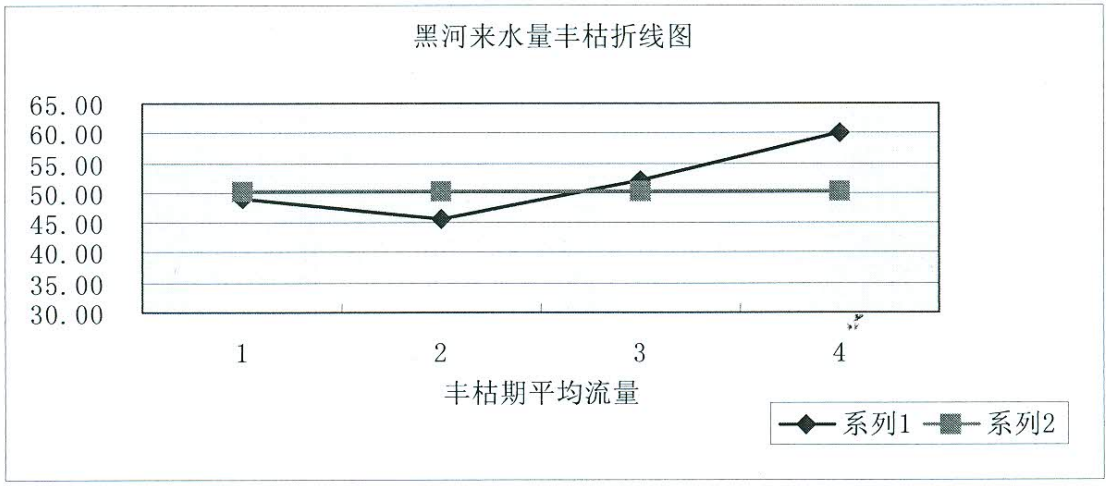
地下水补给三种类型。

黑河径流受补给条件的影响，年内分配极不均匀：当年 11 月到次年 3 月，径流由地下水补给，来水量占年总量的 13.3%； 4 月以后气温明显升高，流域积雪融化和河网储冰解冻形成春汛，流量明显增大，4 至 5 月径流量占年来水量的 11.6%；夏秋两季是流域降水较多而且集中的时期，也是河流发生洪水的时期，6 至 9 月来水量占年径流量的 68.5%；10 月流域内降水量减少，河流来水量逐渐回落，径流量占年来水量的 6.6%。

二、黑河历年来水量分析

1、对黑河 67 年的水文统计资料分析，从“黑河莺落峡年径流量时序图”可以清晰地看出，1944 年到 1967 年期间，黑河来水量处于增减较为平衡时期，是黑河来水量的平水期；1968 年到 1982 年期间，黑河来水量低于历年平均来水量，处于黑河来水量的枯水期；1983 年至 2004 年期间，黑河来水量再次处于增减较为平衡时期，是黑河来水量的平水期；从 2005 年至今，黑河来水量一直高于历年平均来水量，从目前来看，这一阶段正好处于黑河来水量的丰水期，而且这种状况在今后几年持续下去的可能性仍存在。

名称	1944-1967 年平水期平均流量 (m^3/s)	1968-1982 年枯水期平均流量 (m^3/s)	1983-2004 年平水期平均流量 (m^3/s)	2005-2010 年丰水期平均流量 (m^3/s)
丰枯期平均流量 (m^3/s)	49.11	45.77	52.01	60.16
历年均值 (m^3/s)	50.2	50.2	50.2	50.2



三、2005 年至 2010 年来水量居高不下的原因要析。

1、降水增多。黑河流域面积 10009Km^2，分为深山区，浅山区，绿洲灌溉区和荒漠区四个地质单元进行统计分析。深山区和浅山区为河流径流主要形成区。1994 年至 2004 年黑河流域深山区降水量在 400-500mm 之间，浅山区降水量在 250-450mm 之间。而 2005 年至 2010 年，深山区降水量在 460-560mm 之间，浅山区降水量在 300-500mm 之间，地表降水明显增多，这成为黑河来水量较 2004 年之前的平均值整体提高的关键原因。加之冬季降雪量增多，4 月以后气温升高的，流域积雪融化增加了径流量，使 4-5 月份的月度来水量较 2004 年之前有所提高，全年月度来水量分布较原来均匀。

2、冰川消融速度增快。中科院研究显示随着气候变暖，祁连山冰川或将大幅消融，近几年平均消融 6 米以上，2050 年前基本消失，每年融化的冰雪约 10 亿立方米，约等于一个北京密云水库水量[1]。分析监测数据，祁连山区 20 世纪 60 年代到 80 年代之间，气温上升了 0.1℃，2000 年到 2005 年的气温与 60 年代相比，升高了 1.17℃，2006 年至今，气温仍在持续增高。冰川融水的较大幅度增加，成为黑河近几年来水量一直维持在较高水

[1] http://news.163.com/photoview/05RQ0001/14207.html#p=7281L3V305RQ0001

平的另一重要原因。

四、结论。

1、2005年至2010年黑河来水量一直维持在较高水平的主要原因是在全球气候变暖的大背景下，气温持续升高，冰川消融速度加快，加之降雨增加，致使河流年来水量增加。这种情况的出现是因客观因素造成的，具有不可预见性，人为不可控制。

2、黑河以后年份的来水量，仍会沿水平方向呈锯齿状上下振荡，但因气温的持续升高，祁连山蕴藏的冰川随着消融速度的加快，未来将会日渐枯竭，冰川融水减少，补给黑河的水量同样减少，有可能会导致黑河来水量在未来呈逐年下降趋势。

3、黑河来水量增加致使流域所建电站电量在近几年内超发，小孤山电站电量超发并非个案，在黑河流域及西北地区其它流域电站普遍存在。

特此说明。

甘肃省水文水资源勘测局

二〇一一年十二月八日