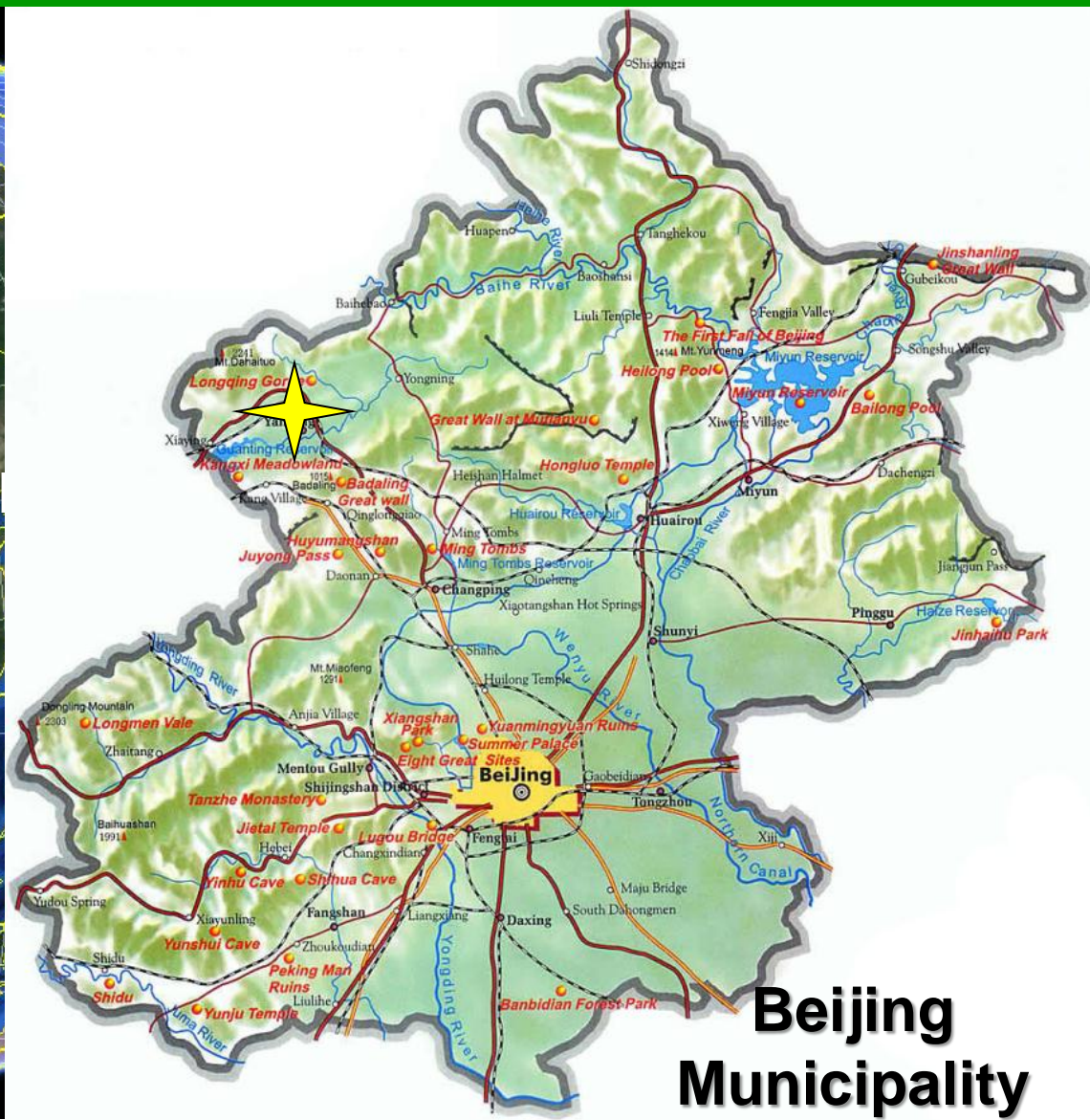# Restoration of Sand Mined Wetlands in the Wild Duck Lake Natural Reserve, Beijing: Approaches and Evaluation

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Location

CHINA

Beijing Municipality

the project area(Google Earth Sep. 2007)

- **10 kilometers to the west of Yanqing County**

- **A small village**

- **Inside Wild Duck Lake Nature Reserve**

- **about 56 ha**

Site selection

Potential risks

- **Recommended by Beijing Municipal Bureau of Landscape and Forestry & Yanqing County Forestry Bureau.**

- **Confirm with the land ownership**

- **Confirm the tenure**

Human activities

Disturbance statement

● **Sand Mining**

Severely damaged

Native vegetation

Sandy soils

Organic matter content

Declining biodiversity

Erosion

Ecological Condition

- **Gravel soil with poor water-retention capacity .**

- **Native vegitaitons:**
  - **reed, sedge and cattail community, Nymphoides communities;**
 - **tree species are Populus, Salix, Ulmus and other.**

Climate condition

- **The Temperate continental monsoon climate**
- **The average temperature is 8 ℃**
- **The Annual precipitation is 493 mm with large annual variation (274mm-747.1mm), Annual evaporation is more than 1700mm.**

Hydrological conditions

- **a group of separated water bodies of different sizes,**

- **water supply is mainly from natural precipitation and underground seepage.**

- **Low-lying area**
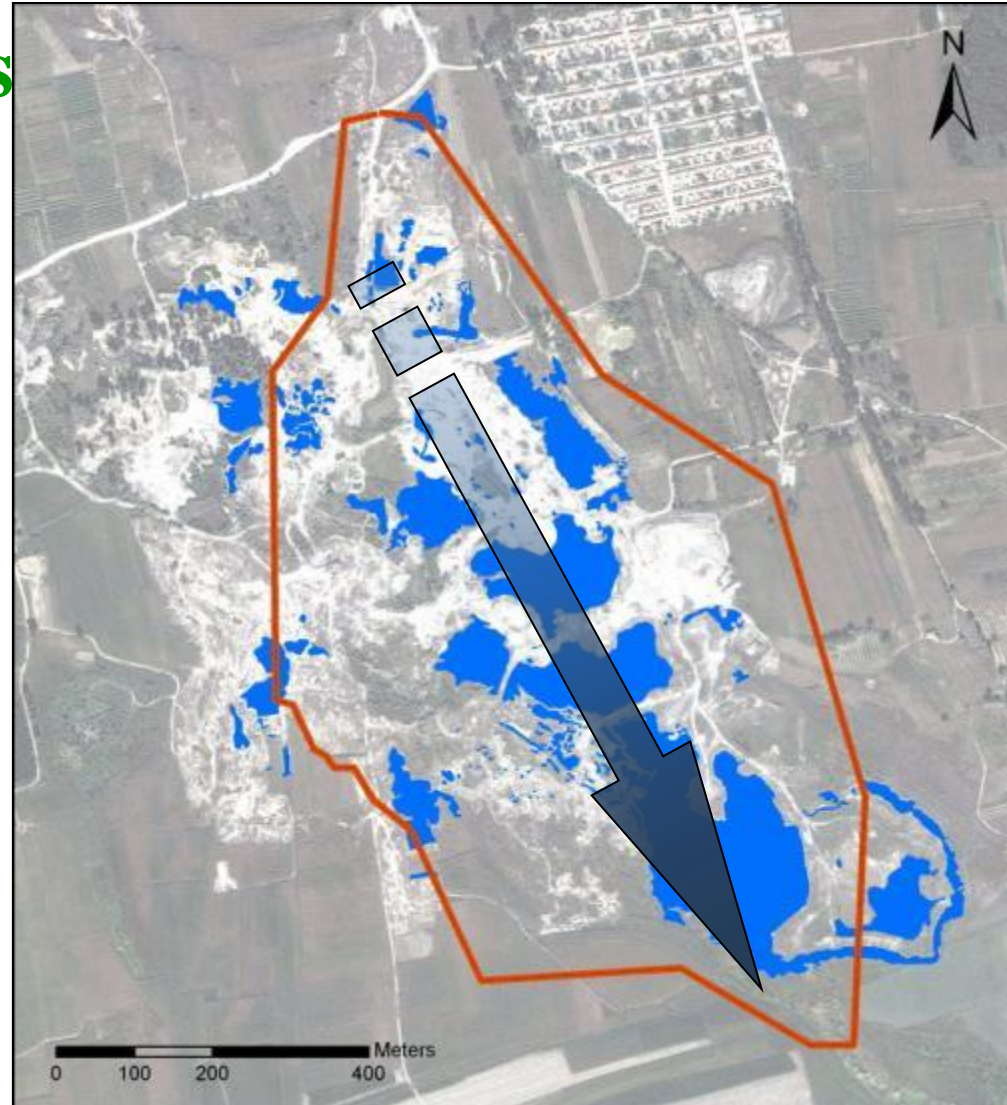
Hydrological conditions

Land covers	Area（ha）	Percent %
Bare soil	15.13	27.0
Sand mining slash	10.70	19.1
Wetland vegetation	1.36	2.4
Open water	10.56	18.9
Terrestrial vegetation	11.26	20.1
Agricultural land	7.01	12.5
Total	56.02	100

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**Potential
risk analysis**

**Ecological
status analysis**

**Disturbance
analysis**

It is feasible!

- **Artificial promotion and the ecological restoration**
  - ➢ Habitat transformation, self-design, mainly select native species

- **From nature, beyond nature**
  - ➢ Function optimization, landscaping, assisting update

- **Be suitable for local conditions, cost savings**
  - ➢ Abide by the natural conditions, water storage, adaptive management

__Be ecological, natural and economical__

Base repairing

↓

Hydrology adjustment

↓

revetment strengthening

↓

vegetation reconstruction

↓

adaptive management

- **The overall objective of restoration :**

  Normal ecological functions of wetlands;

  Symbolic function selection (water bird habitat);

  Abundant biodiversity

- **Target ecosystems:**

  Vegetation(artificial promotion) + Animals (natural recovery)

  Shrubs (Artificial) - Herbal (Natural) Wetland

  Simulation of natural wetlands succession process

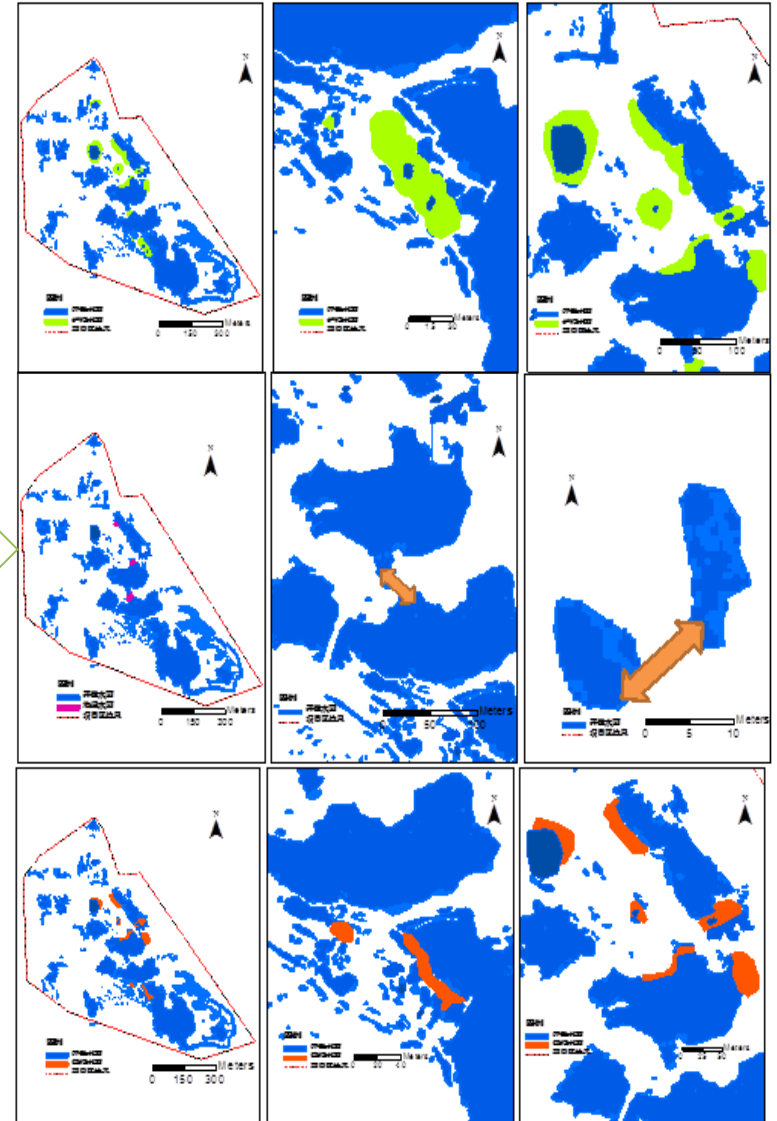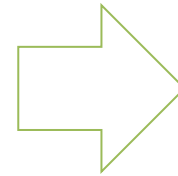 Achieve functional restoration through structure restoration

- **Restored hydrological regimes**
- **Micro-topography modeling**
- **Soil organic matter recovery**
- **Vegetation planting**
- **Construction of ecological revetments**

Restored hydrological regimes

- *Small water body enlarging*
- *Small water body connection*
- *Partial deep digging*
- *Partial impede water flow*

Micro-topography modeling and reshaping

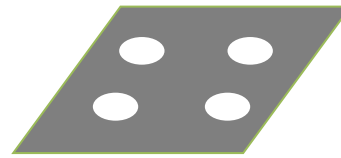*Shoal Construction*

Small water surface regulation

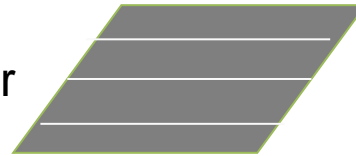*Habitat island creation*

Soil organic matter recovery

- Layered backfill

- Plant hole backfill

- Plant trough backfill

volume of earthwork: 10,000 Cubic meter loam soil

Application

Vegetation planting

- Small water surface vegetation planting
- Large water surface vegetation planting
- vegetation exposed from beach in normal water level
- vegetation planting below Normal water level

Vegetation planting

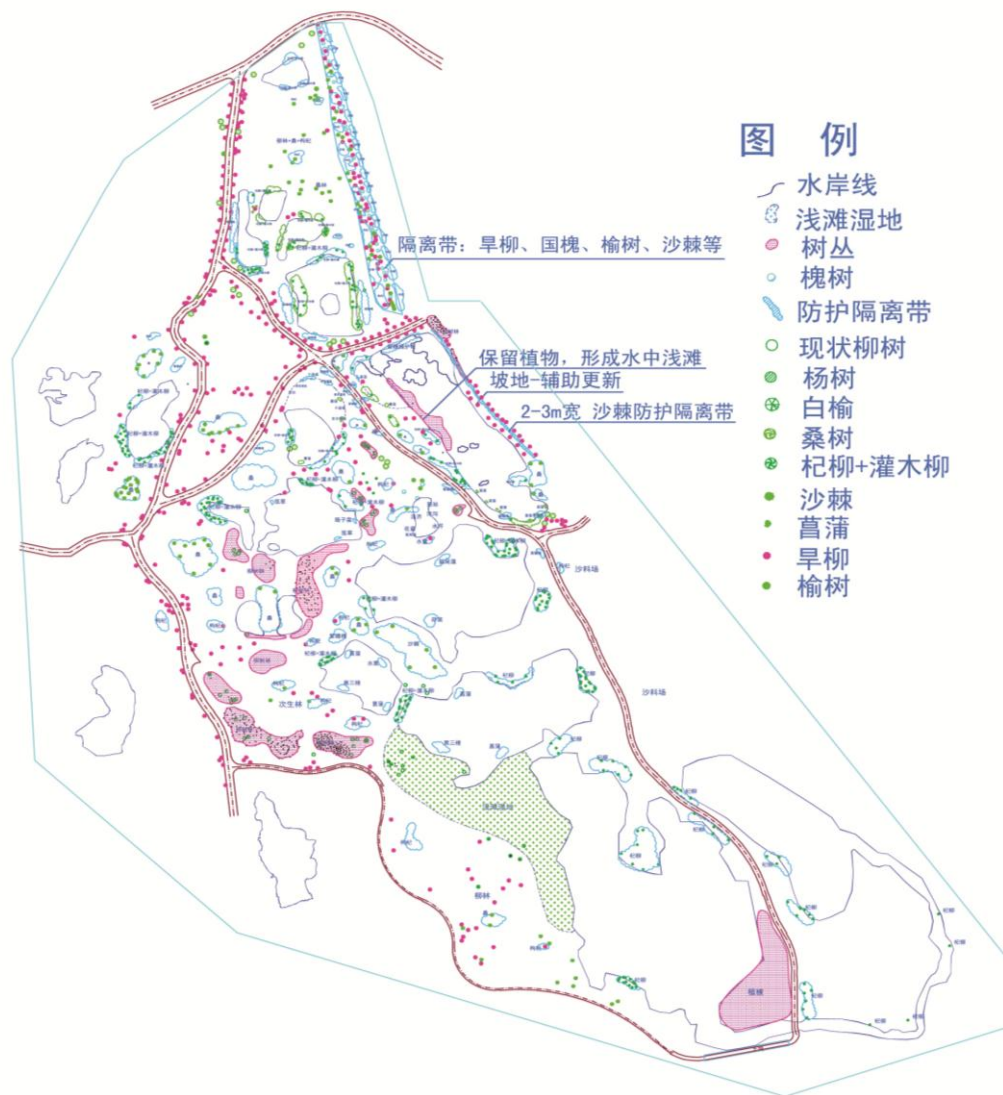- Waterfront vegetation planting
- Buffer zone vegetation planting
- slope protection vegetation planting

Restoration technique

Construction of ecological revetments

- **Timber pile slope protection**
  - **Willow timber pile**

- **Rock slope protection**
  - **Difference size**

- **Eco-bags slope protection**
  - **Long-life(anti ultraviolet rays)**

- **Ecological concrete slope protection**

- After the basic completion of restoration project, certain signs points should be set according to the monitoring requirements to regularly collect water samples and soil samples, and to monitor the effectiveness of restoration project implementation.

- Set a number of sample plots, to observe the biodiversity of wetlands, plant growth, the number of animals (including soil fauna), plant water use data, and to assess the ecological functions of vegetation.

- Use the mobile weather station to observe the specific periods of meteorological data (including precipitation and wetland water level changes).

Soil organic content significantly increased after the restoration

Through the investigation of soil organic matter content in the recovery area and the contrast area in 2009, the soil organic matter content of 0-10cm is higher than that in the control area.

Depth (cm)	Types	Sample plots					
		1	2	3	4	5	6
Surface soil	Contrast area*	12.85	12.73	12.12	12.84	12.47	12.82
	Recovery area	13.12	13.16	13.26	13.07	13.17	13.28
0～10	Contrast area*	12.94	12.70	12.24	12.73	12.96	12.59
	Recovery area	13.16	12.84	12.81	13.05	13.30	13.21
10～20	Contrast area*	13.04	12.08	12.60	12.91	13.10	12.98
	Recovery area	13.04	12.87	12.63	13.06	13.14	13.28

Soil animal diversity significantly increased after the restoration

Period	Samplt plots	Shannon Wiener Index（H'）	Hmax	Uniformity index(J')	Dominance index（D）	1/D
Fall	Contrast area	0.588	0.602	0.976	0.253	3.960
	Natural wetlands	0.790	1.146	0.690	0.223	4.477
	Restoration area	0.718	0.954	0.752	0.218	4.579
Winter	Contrast area	/	/	/	/	/
	Natural wetlands	0.391	0.477	0.819	0.393	2.545
	Restoration area	0.359	0.602	0.596	0.560	1.786

Vegetation types and cover significantly increased after the restoration

Wetland vegetation cover: 3%　　→ ⬜ 49%

Water surface area: 18.9%　　→ ⬜ 26%。

Plant species: 74　→　204

(38 kinds of aquatic plants, 90 kinds of wetland plants 90)

Evaluation

The species and quantity of wetland birds significantly increased

Chinese name	scientific name	Before	After
戴胜	*Upupa epops*	＋	＋＋(2009)
灰斑鸠	*Streptopelia decaocto*	＋	＋(2009)
灰椋鸟	*Sturnus cineraceus*	＋	＋＋(2009)
小鹀	*Emberiza pusilla*	＋	＋＋(2009)
苍鹭	Grey heron(*Ardea cinerea*)	－	＋(2009)
大白鹭	Great Egret (*Ardea alba*)	－	＋(2009)
灰鹤	Common crane(*Grus grus*)	＋	＋＋(2009)
绿头鸭	Mallard Duck(*Anas platyrhynchos*)	＋	＋＋(2009)
赤麻鸭	Ruddy shelduck(*tadorna ferruginea*)	＋	＋＋(2009)
白腰草鹬	Green Sandpiper(*Tringa ochropus*)	-	+(2011)
小䴙䴘	Little Grebe(*T. ruficollis*)	-	+(2011)
红脚隼	Amur Falcon(*Falco vespertinus*)	-	+(2011)
扇尾沙锥	Common Snipe(*G. gallinago*)	-	+(2011)

2007.9

2011.5

- **This case study on the post-mining restoration techniques and success can provide a suitable guide for the restoration of other similar degraded wetlands.**

Thank you for your attention!