

# Analysis on process management of soil and water conservation design for transmission line projects in Qinghai Province

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**Abstract.** The first part is a brief introduction of soil and water conservation (SWC) and loss condition of transmission line projects and in Qinghai Province; In the second part, based on the Qinghai Yuqia-Toesu 750 kV line project, and combined the experience and methods concluded during the soil and water conservation (SWC) design work, the process management for SWC design in Qinghai's transmission line projects is analyzed; The third part is the conclusion and the suggestion. Through the introduction and analysis of the three parts, the thinking pattern of SWC design of transmission lines in Qinghai Province are clearer, which can be a reference for Qinghai' SWC designer.

**Keywords:** Soil and water conservation, Process management, Transmission line projects, Qinghai Province

## 1. Overview

### 1.1 Brief analysis of SWC work of transmission line projects

China is one of the countries which has the most severe soil and water loss, and construction projects cause very large proportion of the loss. To slow down the process, China attaches great importance to the SWC work, and regard SWC as the basic State Policy. In recent years, the electric power industry has developed rapidly, as the basic industry and public service for China's national economy and social development, the electric power industry should even more actively respond to the idea of innovation and sustainable development, and pay close attention to ecological and environmental issues.

Transmission line projects have the characteristics of wide span and dispersive disturbance points. For a single transmission tower, the disturbance to the ground is point-like, the construction of the tower occupies a relatively small area, so the damage to the ground is also small; For a whole project, the disturbance is linear, some projects are easy to cross environmentally sensitive areas, nature reserves and other key ecological functional areas. Due to the span of transmission line is long, the disturbed landform is complicated, and the boundary is relatively open, the prevention and control is difficult.

The SWC work in transmission line projects should be carried out according to the rule of 'Prevention and protection first, comprehensive planning and management, adapting measures to local conditions, highlighting key points, scientific management, and focus on effectiveness'. The SWC measures are generally listed in different categories for different construction areas. Normally the construction areas can be classified as tower and tower construction areas, stretch field, crossing needed construction area, road area and cableway area when need cableway transport. The SWC methods can be classified as engineering method, plant method, and temporary protective method.

### 1.2 Overview of SWC situation in Qinghai Province

Qinghai Province is in the north-west of China, and in the east-west part of Tibet Plateau. The average altitude is 3000~5000m. The terrain gradually decreases from west to east and from south to north, as shown in Figure 1. In Qinghai, the landform includes the Tibet Plateau, inland arid basin, and the Loess Plateau, with 4/5 of the land is plateau.

Qinghai Province provides plenty of water resources for the whole country and even for Southeast Asia, and contains the word's unique biological resources. Meanwhile, the ecological

environment in Qinghai is fragile and is prone to degenerate under the influence of natural and human factors. Therefore, the SWC is essential for the transmission line projects in Qinghai Province.

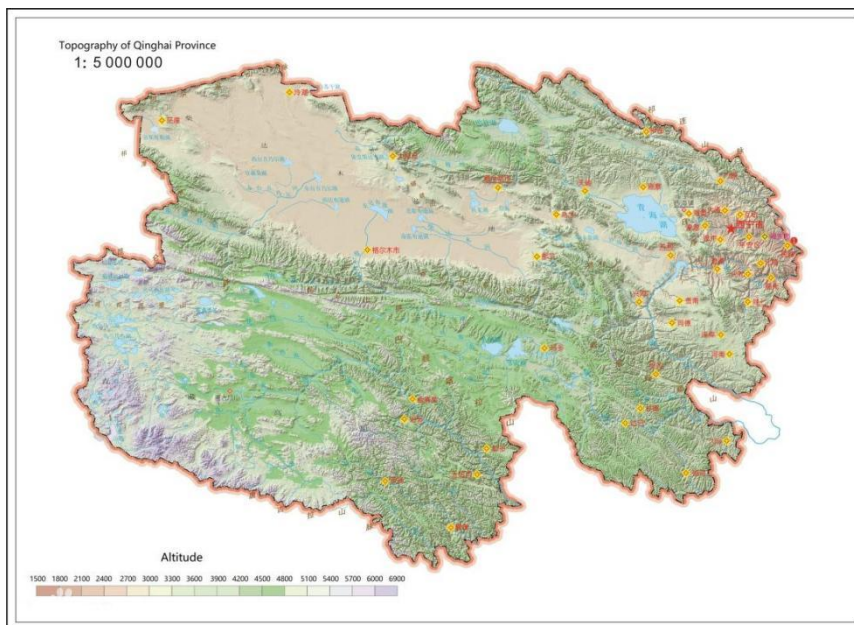


Figure 1. Topography of Qinghai Province (From Baidu Website)

According to the analysis of the Bulletin of Soil and Water Conservation in Qinghai Province in 2018-2020, the hydraulic erosion and wind erosion conditions are shown in Figure 2. wind erosion area is much larger than hydraulic erosion area, and the total erosion area is decreasing slightly year by year. The freeze-thaw erosion area is the largest, which is 150 thousand km<sup>2</sup> (The overall area in Qinghai is 722 thousand km<sup>2</sup>). The degree of erosion in Qinghai Province is shown in Figure 3. The slight erosion area is the largest.



Figure 2. Qinghai Province hydraulic erosion and wind erosion (From Bulletin of Soil and Water Conservation in Qinghai Province)

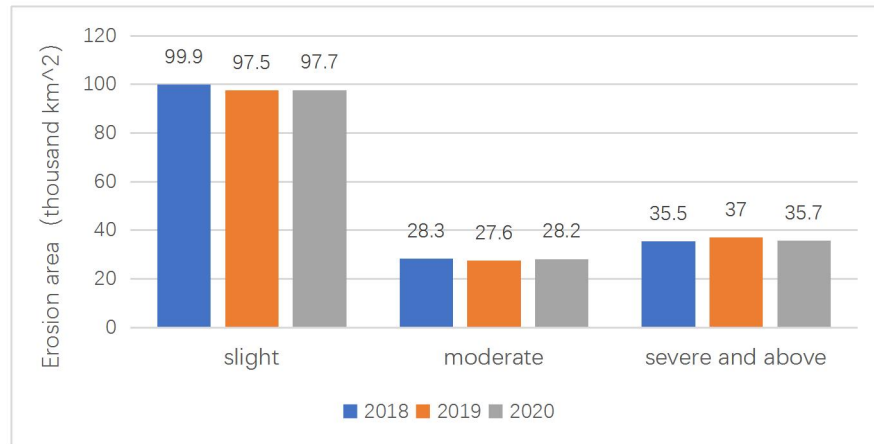


Figure 3. Qinghai Province erosion area of different level  
 (From Bulletin of Soil and Water Conservation in Qinghai Province)

Qinghai Province has 3 national and 4 provincial key water and soil loss prevention and control areas, as shown in Figure 4.

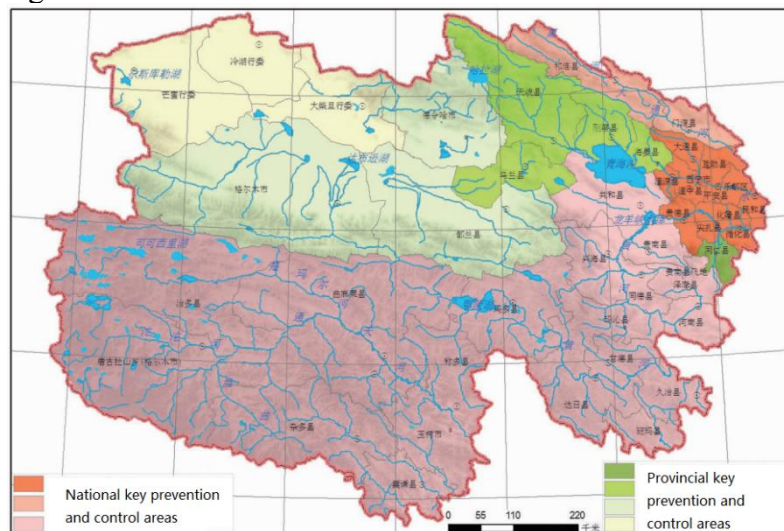


Figure 4. Qinghai Province key soil and water loss prevention and control areas  
 (From Bulletin of Soil and Water Conservation in Qinghai Province)

The comprehensive control of soil and water loss in Qinghai Province should pay special attention to comprehensive control of small watersheds, Comprehensive governance of sloping farmland, Reinforcement of silt dams, windbreak and sand fixation.

## 2. Process management of SWC design

This article takes the Yuqia-Toesu 750kV transmission line project as example, analyses the process management of SWC design. The Yuqia-Toesu project is a double circuit line, with the length of each is 167 km. The terrain is relatively flat, with part of the hilly area has some fluctuation.

The design process can be considered according to following steps:

### 2.1 Fully understand the approval opinions of the SWC plan

Administrative department would organize related specialists and units to conduct a technical review when they receive the ‘report of SWC plan’ submitted by proprietor company, and form review opinions, which mainly include:

The scope of liability for prevention and control of SWC is divided into project construction area and direct influenced area, the responsibility in Qinghai's transmission line generally belongs to proprietor company - State Grid Corporation of China.

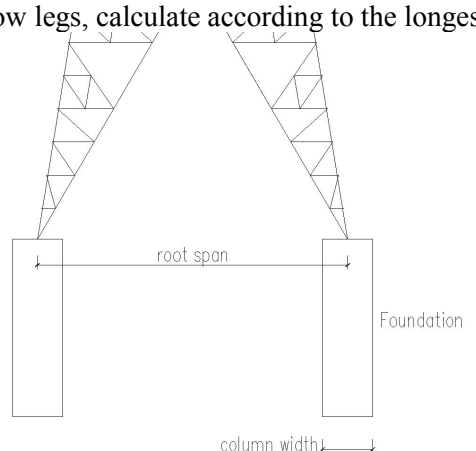
According to <Qinghai Province SWC Planning (2016-2030)> and < Standard of Soil and Water Loss Prevention and Control for Construction Projects > (GB/T50434-2018), and according to soil and water loss prevention and control area and regional SWC ecological function importance, the standard of SWC prevention and control can be determined. This project is construction project first-level standard of the Tibet Plateau region.

According to factors such as the degree of drought, soil erosion intensity, topography difference, project disturbance characteristics and so on, the soil and water loss prevention and control objectives can be determined. For this project, the comprehensive prevention and control target of soil and water loss is: the soil and water loss governance degree is 90%, control ratio of soil loss is 80%, residuum protection rate is 90%, topsoil protection rate is 90%, quantitative requirements of recovery rate and coverage rate of forest and grass are not required.

After above steps, the zoning of soil and water loss prevention and control areas and the measures in different areas need to be confirmed. For this project, according to topography and surface material composition, the first level zone can be classified as: gravel Gobi area, sand area, low hilly area, and desert area. The second level zone can be classified as tower and tower construction area, stretch field, crossing needed construction area, and road area.

To lay out measures more precisely and inclusively in different areas, the calculation principle in different construction areas in Qinghai' transmission line projects are concluded, as shown in Table 1.

**Table 1. The calculation principle in different zoning areas**

classification	zoning	Calculation principle
Permanent occupation area	Tower area	$S (\text{area}) = (\text{foundation root span} + \text{main column width} + 2 \text{ meter})^2$ For high-low legs, calculate according to the longest leg. 
	Stretch field	For ground wire stretch area: 110 kV: one site per 6 km along the transmission line, the area is 1000 m <sup>2</sup> 330 kV: one site per 6 km, the area is 1200 m <sup>2</sup> 750 kV: one site per 6 km, the area is 1400 m <sup>2</sup> If wiring in advance or there are three spans, increase ground wire stretch area. For grounding electrode stretch area: one site for per 6 km along the transmission line, the area is 700 m <sup>2</sup>
Temporary occupation area	Tower construction area	Hilly region: $S = (\text{foundation root span} + \text{main column width} + 2 \text{ meter} + 14 \text{ meter})^2$ - permanent occupation area (non-mechanized construction tower ) plain area, plateau desert area, plateau grassland and meadow area: $S = (\text{foundation root span} + \text{main column width} + 2 \text{ m} + 20 \text{ m})^2$ - permanent occupation area (non-mechanized construction tower )
	Crossing needed construction area	Provided by designer according to on-site survey, mainly include crossing of grounding pole lines, transmission lines of 110kV and above, highways (high-speed, provincial and national highways), and railway, 400 m <sup>2</sup> for each site.
	Road area	Considering according to actual design length in final survey and positioning, differentiate newly built mechanical access road, flattened and widened mechanical access road and manual handling needed road (the road required for manual handling of equipment up to the mountain for construction).

The quantity and whereabouts of waste residue should also be considered. For flat area, the residual soil should be leveled on site after construction. For position with large slope, the slag retaining wall should be built on the downhill side as protection, and the surface soil should be covered on top. If the terrain situation is special and the residual soil need to be transported, comprehensive utilization should be considered first, such as paving of roadbed. If there is no approach to use the soil, the waste slag disposal site should be selected according to the <Technical Standard of Soil and Water Conservation Design for Construction Engineering>.

## **2.2 Carry out SWC design according to SWC plan.**

### **2.2.1 Design work for construction**

The SWC plan compiling unit need to do technical disclosure for the ‘report of SWC plan’ and the reply document of Ministry of Water Resources. The design unit should do technical disclosure to proprietor unit, construction unit and supervision unit about the ‘SWC specialized design’, and attach the written document formed in the early stage for inspection.

The measures and the investment determined in the SWC plan and the reply document should be included in the following design document. The SWC specialized chapter should be included in the preliminary design and construction design, especially the disposal of residual soil, installation of retaining wall and drainage ditch in hilly area. The drawings of SWC measures should be focused on in following design stage.

### **2.2.2 Acceptance check requirements for soil and water conservation facilities**

State Grid Corporation of China should organize and complete construction organization design of SWC part according to prevention and control measures proposed in SWC design. In the construction organization design, the construction requirement of earthwork, construction progress, technology and timing arrangement should be explicit. Avoid raining and gale day when construct and avoid destroy original topography outside the boundary of land acquisition.

The scope of SWC facility acceptance check should be coincide with the ‘report of SWC plan’ and the reply document. Water Administration Departments of the People's Government at or above the county level, or departments entrusted by them take the responsibility of the organization, conduction, supervision and management of SWC facility acceptance check of construction projects. Besides, these departments should supervise the implementation of SWC plan and the running condition of SWC facility on time.

## **2.3 Redesign of soil and water conservation plan**

After the understanding of the suggestion in the review meeting, the SWC measures should be redesigned. The compiling unit and the main work design unit should strengthen communication, and the main work design unit need to provide specific information about the site condition.

For this project, the design unit should further optimize the route, avoid drinking water source protection area and nature reserves. Design unit should also actualize the newly increased SWC measures to project design, such as topsoil stripping and recovery and paving cloth of colored strip. In hilly area, the end of intercepting and draining ditch should be linked with natural channel in relatively flat area and set energy dissipation measures on the end of draining ditch to alleviate the scour to the primary surface.

## **2.4 On-site technical service**

### **2.4.1 organization and management**

To ensure the implementation of the soil and water conservation plan, it is necessary to clarify the soil and water loss prevention and control responsibility in the contract, and the leading group for SWC implementation should be built according to law. Besides, SWC work manager is needed, who makes the rules of SWC management and cooperate with Water Administrative Department to do the acceptance check of SWC. SWC work manager should consciously accept the supervision of Water Administrative Department. Before construction, sufficient compensation fee for soil and water conservation should be paid in time, and construction information and SWC progress should be reported on time.

SWC work archives should be established according to the National Archives Law. SWC construction records and other information (such as video and photograph) should also be managed and archived.

### 2.4.2 On-site design representative service

If the SWC quantity or measures changed, on-site design representative should notice the construction company to inform proprietor unit, supervision unit, SWC plan compiling unit and design unit in written form, analyze the change reason and form written document.

## 3. Conclusion and suggestion

After analysis of this article, Qinghai Province has rich resources, however, the ecological environment is vulnerable. Therefore, the SWC work is a focus. Qinghai Province transmission line SWC design process should be considered as follows: First, the approval opinion of SWC plan should be fully understood; Than the specific SWC design should be done according to the plan, in this article, Qinghai Province transmission line SWC zoning area calculation principle is concluded; After the suggestion of review meeting, the SWC work should be redesigned; Besides, the on-site service is also important.

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