經濟部

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112 年度水庫庫區與集水區水質檢驗分析計畫成果報告書

2023 Reservoir and Catchment Water-Quality Monitoring and Analytic Report

主辦機關：經濟部水利署南區水資源分署

執行單位：財團法人成大研究發展基金會

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摘　要

經濟部水利署南區水資分署(以下簡稱南水分署)為瞭解轄區五個水體(曾文水庫、牡丹水庫、阿公店水庫、高屏溪攔河堰、甲仙攔河堰)之水質狀態、並透過水質研判分析計畫，利用空間性趨勢分析、Mann-Kendall Trend Test 分析、統計方法之主成份分析，以瞭解水質變化情形，以及水質參數與環境因子間之相關性，以作為水庫管理之依據。

本計畫取樣內容及檢驗項目包含曾文水庫及集水區、牡丹水庫、阿公店水庫、高屏溪攔河堰、甲仙攔河堰等 39 處 45 個樣品之每月例行性取樣及檢測。本計畫除一般水質檢驗外，依實際需要進行水體臭味強度分析(季)、藻類計數檢驗分析(季)、藻毒檢驗分析(季)、農藥分析(半年)及水庫攔河堰魚體捕撈檢驗(半年)、底泥品質檢測(年)、放射性物質檢驗(半年)及阿公站水庫水域生態調查分析(季)。

本計畫為民國 112 年 1~12 月每月例行性取樣及檢測分析，並定期繳送檢驗月報，並依約定頻率進行特殊項目的檢測及調查，本計畫截至 12 月底前已完成 1~12 月水質採樣作業。

一、曾文水庫(15 個測站)

1.1 單項水質分析

曾文水庫 1~12 月乙類水質標準合格率之項目 pH 為 100%、懸浮固體為 77.8%，溶氧為 98.8%，生化需氧量為 96.5%，氨氮為 100%，總磷為 90.1%，錳為 90.6%，大腸桿菌群 98.2%。

1.2 河川污染指標 RPI(定義詳見 2.2)：

曾文水庫集水區河川污染指標 RPI，平均為 1.57，1~12 月未(稍)受污染等級佔大多數，其中 4 月曾文五號橋因前幾日有管線作業水量過少，懸浮固體濃度較高，當月為中度污染等級，而後趨於平穩。而今年 1~2 月初，有河道邊坡整頓工程影響，故 RPI 皆為輕度至中度污染等級。從 110 年~112 年觀測值而言，以河川降雨量為水質數據主要影響因子。

1.3 優養指標 CTSI(定義詳見 2.2)：

優養指標 CTSI 介於 42.1~60.4 間，屬貧養至優養等級。

葉綠素-a 濃度指標介於 1.4~8.6 μg/L 間，屬貧養至優養等級。從 110 年~112 年觀測值而言，透明度影響變小，CTSI 指標有變好的情況，持續觀察。

1.4 藻類分析：

整體藻類計數介於 1900~8940 個/mL 間，1~3 季主要優勢種為藍綠藻。

1.5 藻毒分析：

所有測值皆符合 WHO 限量標準 1.0 μg/L。

1.6 臭味分析：

1~3 季 2-MIB 測值超過日本所定標準，其餘 2-MIB 與 Geosmin 測值均符合日本所定之標準(2-MIB＜20ng/L、Geosmin＜10ng/L)。

1.7 魚類調查：

上半年調查結果共記錄魚類 4 科 6 種 39 尾，分別為鯝、鯉、團頭魴、翹嘴鮊、豹紋翼甲鯰、小盾鱧及雜交吳郭魚。

下半年調查結果共記錄魚類 4 科 7 種 37 尾，分別為鯝、鯉、團頭魴、翹嘴鮊、豹紋翼甲鯰、小盾鱧及雜交吳郭魚。

1.8 農藥分析：

所有測值低於偵測極限。

1.9 原水輻射監測:

監測結果皆符合行政院原子能委員會「商品輻射限量標準」與「飲用水中放射性含量限制要點」規範。

1.10 底泥監測結果：

本年度曾文水庫底泥未符合品質指標的測項有，重金屬鎳測值分別為 44.0、43.5、41.5mg/kg 超過下限值；重金屬砷測值分別為 13.3、12.5mg/kg 超過下限值，其餘皆符合底泥品質指標下限值。

1.11 空間性趨勢分析：

統計 112 年 1 月至 12 月曾文水庫流域之水溫、pH、濁度、懸浮固體、葉綠素-a、溶氧、大腸桿菌群、氨氮、總磷等數據進行討論分析。

曾文水庫流域從達邦橋到草蘭溪便橋為集水區段，進入庫區後水溫從均溫 18.5 度上升至 27.2 度；pH 介於 7.1 至 8.7 之間，呈現穩定狀態；濁度、懸浮固體在達娜伊谷有最高測值，出水口測站上游有

暫存淤泥，容易造成濁度及懸浮固體偏高的情形，對於東口取水水質影響不大;葉綠素-a 在河川段因水力停留時間短，測值較低，進入庫區內水體流動較慢，測值較高；溶氧平均為 8.1 維持在 6.5 以上，是相當優良的水質；大腸桿菌群為出水口測值為最高，因近期降雨量低，為靜止水體導致測值較高；氨氮平均濃度皆低於乙類水質水體標準 0.3 mg/L。總磷平均濃度為 0.028 mg/L，低於乙類水質水體標準 0.05 mg/L。

1.12Mann-Kendall Trend Test 分析：

統計 104 年 1 月~112 年 12 月曾文水庫 CTSI 數據，Mann-Kendall 趨勢檢定結果顯示，最低值為 25.8，最高值為 67，平均數為 47.78，中位數為 47.1，趨勢檢定結果 Approximate p-value 為 0.000000051292，斜率為 0.0093，有上升趨勢。

1.13 總結

總結曾文水庫水質特性，以今年 1 至 3 季單項水質指標而言，各項數據都維持穩定良好的狀態，1 至 7 月期間雖無降雨水質仍保持良好且無優養的狀態，8 至 9 月接連卡努颱風與蘇拉颱風，平均日降雨量皆低於 200 毫米，無達到豪雨等級，在水庫提升水位的同時，對水質的影響也較小，就空間性趨勢分析而言，無異常極端值產生。

Mann-Kendall 趨勢檢定結果顯示 CTSI 有上升趨勢，仍需持續觀察。主成分分析之結果顯示第一影響因子，多為土壤沖刷因素。

二、牡丹水庫(6 個測點)

2.1 單項水質分析

1~12 月牡丹水庫甲類水體水質標準合格率 pH 為 95.2%、懸浮固體為 82.5%、溶氧為 82.5%，生化需氧量為 93.7%、氨氮為 98.4%、總磷為 20.6%，錳為 61.9%、大腸桿菌群為 41.3%。

2.2 河川污染指數 RPI：

集水區部分 RPI 平均為 1.2，屬於未(稍)受污染等級。

從 110 年~112 年觀測值而言，河川水質持續保持良好。

2.3 優養指標 CTSI：

優養指標 CTSI 指標值介於 42.2~65.8 間，平均值為 53.2 為優養等級。

葉綠素-a 濃度指標介於 1.1~32.4 μg/L 間，屬貧養至優養等級。

從 110 年~112 年觀測值而言，112 年 CTSI 指標較為良好。

2.4 藻類分析：

藻類計數介於 3560~9300 個/mL 間，第 1~3 季主要優勢種為藍綠藻。

2.5 藻毒分析：

所有測值皆符合 WHO 限量標準 1.0 μg/L。

2.6 臭味分析：

2-MIB 濃度與 Geosmin 濃度測值皆符合日本所定之標準(2-MIB＜20ng/L、Geosmin＜10ng/L)。

2.7 魚類調查：

上半年調查結果共記錄魚類 2 科 3 種 14 尾（表 3），分別為斑駁尖塘鱧、花身副麗魚及雜交吳郭魚。

下半年調查結果共記錄魚類 1 科 1 種 8 尾，為雜交吳郭魚，另外調查中發現有少量的鰲於水面活動，但於陷阱調查均未捕獲，為目擊記錄。

2.8 農藥分析：所有測值低於偵測極限。

2.9 原水輻射監測：

監測結果皆符合行政院原子能委員會「商品輻射限量標準」與「飲用水中放射性含量限制要點」規範。

2.10 底泥監測結果：

本年度牡丹水庫未符合品質指標的測項有重金屬鎳，測值分別為35.2、38.3、40.4mg/kg 超過下限值；重金屬砷測值 12.2mg/kg，其餘皆符合底泥品質指標下限值。

2.11 空間性趨勢分析：

統計 112 年 1 月至 12 月牡丹水庫流域之水溫、pH、濁度、懸浮固體、葉綠素-a、溶氧、大腸桿菌群、氨氮、總磷等數據進行討論分析，牡丹水庫流域分為牡丹溪流域及汝仍溪流域，水體均溫為 24.6 度；pH 介於 7.8 至 8.86 之間，平均為 7.17；濁度、懸浮固體測值穩定；葉綠素-a 測值穩定；庫區內溶氧都維持在 6.5 以上，是相當優良的水質，路口二號橋的部分因有人為活動導致溶氧較低的情形；大腸桿菌群由新保將橋有村落與人為活動因素，測值為最高；氨氮平均值為 0.047 mg/L 小於 0.1 mg/L(甲類陸域地面水體水質標準)，總磷為常見超標因子，平均值為 0.038 mg/L 高於 0.02 mg/L(甲類陸域地面水體水質標準)。

2.12Mann-Kendall Trend Test 分析：

統計 104 年 1 月~112 年 12 月牡丹水庫 CTSI 數據，Mann-Kendall 趨勢檢定結果顯示，最低值為 31.1，最高值為 75.7，平均數為 48.94，中位數為 47.9，趨勢檢定結果 Approximate p-value 為 0.00028043，斜率為 0.0154，有上升趨勢。

2.13 總結

總結牡丹水庫水質特性，以今年 1 至 3 季單項水質指標而言，各項數據都維持穩定良好的狀態，牡丹水庫劃分為甲類陸域地面水體水質標準，就空間性趨勢分析而言，常見的超標因子為總磷(甲類標準為≦0.02 mg/L、乙類標準為≦0.05 mg/L)、大腸桿菌群(甲類標準為≦50 CFU/100mL、乙類標準為≦5000 CFU/100mL)。

Mann-Kendall 趨勢檢定結果顯示 CTSI 有上升趨勢，主要影響因素為 SD 即透明度。而在主成分分析之結果顯示第一影響因子，多為土壤沖刷，由此可知牡丹水庫水色透明度方面較容易影響水庫的優養化判斷。

三、阿公店水庫(6 個測點)

3.1 單項水質分析

本年度 1~12 月阿公店乙類水體水質標準合格率 pH 為 100%、懸浮固體為 46.3%，溶氧為 90.7%，生化需氧量為 63.0%、氨氮為 98.1%，總磷為 51.9%，錳為 74.1%，大腸桿菌群為 75.9%。

3.2 河川污染指標 RPI：

平均值為 2.21，集水區 RPI 為輕度污染等級。

從 110 年~112 年觀測值而言，RPI 趨勢一致。

3.3 優養指標 CTSI：

優養指標 CTSI 為 46.8~72.8 間，平均值為 62.1，屬優養等級。

葉綠素-a 濃度指標介於 2.3~94.9 μg/L 間，屬貧養至優養等級。

從 110 年~112 年觀測值而言，112 年 CTSI 指標於估水期葉綠素-a 測值較以往高，須持續觀察。

3.4 藻類分析：

整體藻類計數為 1840~53940 個/mL 間，第 1~3 季主要優勢種為藍綠藻。

3.5 藻毒分析：所有測值皆符合 WHO 限量標準 1.0 μg/L。

3.6 臭味分析：

臭味物質成分(2-MIB 及 Geosmin)之調查結果除 3 季 2-MIB 外，其餘測值皆符合日本所定之標準。

3.7 魚類調查：

上半年調查結果共記錄魚類 4 科 6 種 76 尾（表 4），分別為鯉、圍頭魴、鬍鯰、豹紋翼甲鯰、橘色雙冠麗魚(紅魔鬼) 、雜交吳郭魚。

下半年調查結果共記錄魚類 4 科 6 種 74 尾，分別為鯉、圍頭魴、鬍鯰、豹紋翼甲鯰、橘色雙冠麗魚及雜交吳郭魚。

3.8 農藥分析：所有測值低於偵測極限。

3.9 原水輻射監測：

監測結果皆符合行政院原子能委員會「商品輻射限量標準」與「飲用水中放射性含量限制要點」規範。

3.10 底泥監測結果：

本年度阿公店水庫無規劃底泥採樣監測。

3.11 空間性趨勢分析：

統計 112 年 1 月至 12 月阿公店水庫流域之水溫、pH、濁度、懸浮固體、葉綠素-a、溶氧、大腸桿菌群、氨氮、總磷等數據進行討論分析，阿公店水庫流域分為旺萊溪流域及濁水溪流域，水體均溫為 25.9 度；pH 介於 7.13 至 8.9 之間；濁度、懸浮固體檢測數值在月眉堰及白嶺箱涵表現較高；葉綠素-a 則與懸浮固體成對比狀態，部分測

點因靜止水域測值相對較高；溶氧於新興橋測值較低，代表水質環境較差，其他點位均值可保持在 6.5 以上；大腸桿菌群於新興橋、月眉堰及白領箱涵測值較高，顯示有人類活動之廢水；氨氮平均值為 0.086 mg/L 低於 0.3 mg/L(乙類陸域地面水體水質標準)；總磷平均值為 0.197 高於 0.05 mg/L(乙類陸域地面水體水質標準)，主要來自於人類活動。

3.12Mann-Kendall Trend Test 分析：

統計 104 年 1 月~112 年 12 月阿公店水庫 CTSI 數據，Mann-Kendall 趨勢檢定結果顯示，最低值為 37.3，最高值為 89.3，平均數為 60.42，中位數為 58.4，趨勢檢定結果 Approximate p-value 為 0.148，斜率為 0.0069，無顯著性趨勢。

3.13 總結

總結阿公店水庫水質特性，以今年 1 至 3 季單項水質指標而言，各項數據都維持穩定良好的狀態，阿公店水庫劃分為乙類陸域地面水體水質標準，就空間性趨勢分析而言，常見的超標因子為總磷、生化需氧量、大腸桿菌群、懸浮固體，阿公店水庫集水區因土質多為泥岩區，多為裸露無任何植生導致水庫中收集多為泥水。

Mann-Kendall 趨勢檢定結果顯示 CTSI 無明顯趨勢。而在主成分分析之結果顯示第一影響因子，多為土壤沖刷，主要因子為錳、濁度、懸浮固體、透明度等等多與泥水有關聯。

四、高屏溪攔河堰(8 個測點)

4.1 單項水質分析

本年度 1~12 月高屏溪攔河堰乙類水體水質標準合格率 pH 為 100%，懸浮固體為 38.5%，溶氧為 95.4%，生化需氧量為 75.4%，氨

氨為 89.2%，總磷為 30.8%，錳為 30.8%，大腸桿菌群為 49.2%

4.2 河川污染指標 RPI：

河川污染指標 RPI 介於 1~5.0 間屬未(稍)受至中度污染等級。平均值為 2.53 屬未(稍)受污染等級。

從 110 年~112 年觀測值而言，RPI 趨勢一致。

4.3 藻類分析：

整體藻類計數為 1110~2840 個/mL 間，主要優勢種為藍綠藻。

4.4 藻毒分析：所有測值皆符合 WHO 限量標準 1.0 μg/L。

4.5 臭味分析：

臭味物質成分(2-MIB 及 Geosmin)之調查結果除第 3 季 2-MIB 外，其餘測值皆符合日本所定之標準。

4.6 農藥分析：所有測值低於偵測極限。

4.7 原水輻射監測：

監測結果皆符合行政院原子能委員會「商品輻射限量標準」與「飲用水中放射性含量限制要點」規範

4.8 底泥監測結果：

本年度高屏溪攔河堰無規劃底泥採樣監測。

4.9 空間性趨勢分析：

統計 112 年 1 月至 12 月高屏溪攔河堰流域之水溫、pH、濁度、懸浮固體、溶氧、大腸桿菌群、氨氮、總磷等數據進行討論分析，高屏溪流域分為荖濃溪流域、楠梓仙溪流域及隘寮溪流域，水溫平均為

23.9 度；pH 介於 7.03 至 8.41 之間；濁度、懸浮固體各測站數值相近；溶氧在興田里測值較低；總磷、大腸桿菌群、氨氮於興田里數值較高，表示有人為活動之廢水。

4.10 總結

總結高屏溪攔河堰水質特性，以今年 1 至 3 季單項水質指標而言，各項數據都維持穩定良好的狀態，高屏溪攔河堰劃分為乙類陸域地面水體水質標準，高屏溪攔河堰集水區之河川流域甚廣且複雜，就空間性趨勢分析而言，常見的超標因子為懸浮固體、總磷、錳、大腸桿菌群。

在主成分分析之結果顯示第一影響因子，多為土壤沖刷，主要因子為錳、濁度、懸浮固體、透明度等等有關聯。

五、甲仙攔河堰(4 個測點)

5.1 單項水質分析

本年度 1~12 月甲仙攔河堰甲類水體水質標準合格率 pH 為 100.0%，懸浮固體為 100.0%，溶氧為 100%，生化需氧量為 100%，氨氮為 100.0%，總磷 100.0%，錳為 100.0%，大腸桿菌群 35.0%。

5.2 河川污染指標 RPI：

河川污染指標 RPI 值為 1 屬未(稍)受污染等級。整體 RPI 平均為 1 屬未(稍)受污染等級。

從 110 年~112 年觀測值而言，RPI 趨勢一致，河川降雨量為水質數據主要影響因子。

5.3 藻類分析：

整體藻類計數，整體藻類計數為 160~1760 個/mL 間，藻類數第 1、3 季藍綠藻、第 2 季綠藻為優勢種。

5.4 藻毒分析：所有測值皆符合 WHO 限量標準 1.0 μg/L。

5.5 臭味分析：

2-MIB 與 Geosmin 測值均符合日本所定之標準(2-MIB＜20ng/L、Geosmin＜10ng/L)。

5.6 農藥分析：所有測值低於偵測極限。

5.7 原水輻射監測: 監測結果皆符合行政院原子能委員會「商品輻射限量標準」與「飲用水中放射性含量限制要點」規範。

5.8 底泥監測結果：

本年度甲仙溪攔河堰無規劃底泥採樣監測。

5.9 空間性趨勢分析：

統計 112 年 1 月至 12 月甲仙攔河堰流域之水溫、pH、濁度、懸浮固體、溶氧、大腸桿菌群、氨氮、總磷等數據進行討論分析，甲仙溪流域分為楠梓仙溪流域及甲仙攔河堰堰區，水體水溫平均為 23 度；pH 介於 7.43 至 8.47 之間；濁度、懸浮固體、總磷、大腸桿菌群趨勢穩定；氨氮皆低於甲類水體水質標準 0.1 mg/L。

5.10 總結

總結甲仙攔河堰水質特性，以今年 1 至 3 季單項水質指標而言，各項數據都維持穩定優良的狀態，甲仙攔河堰劃分為甲類陸域地面水體水質標準，甲仙攔河堰長年水質皆為優良的狀態，就空間性趨勢分析而言，常見超標因子為大腸桿菌群，平均值為 665 CFU/100mL。(甲類標準為≦50 CFU/100mL、乙類標準為≦5000 CFU/100mL)。

在主成分分析之結果顯示第一影響因子，多為土壤沖刷，主要因子為錳、濁度、懸浮固體、透明度等等有關聯。

Abstract

Keyword：1. Reservoir 2. River 3. Water quality monitoring

purpose

As Southern Region Water Resources Branch Water Resources Agency of the Ministry of Economic Affairs, WRA, MOEA, (hereafter called, SRWRO"), aims at understanding the water quality status of the five bodies of water under its jurisdiction, i.e., Tsengwen Reservoir, Mutan Reservoir, Akongtien Reservoir, Kaoping River Weir, and Chiahsien Weir, and the changes in water quality, and the evidence between the water-quality parameters and environmental factors, through water assessment analysis plan with statistical ingredient analysis, to generate the basis for its reservoir management.

Execution method

The sample content and testing items of this research include the monthly regular sampling and testing of the 45 samples from 39 locations across Tsengwen Reservoir, Mutan Reservoir, Akongtien Reservoir, Kaoping River Weir, and Chiahsien Weir. In addition to the general water quality testing, this research aims to carry out quarterly water-body stench odor intensity analysis, quarterly algae count testing analysis, quarterly algae toxin-level testing analysis, quarterly agricultural chemical analysis, and half-yearly reservoir fish testing, annual reservoir-base mud quality testing, half-yearly radioactive substance testing, and quarterly Agongchan Reservoir waterway ecological study analysis.

As this research has carried out monthly routine sampling and testing analysis from January to December 2023, and submitted

monthly testing reports, while carrying out testing and study of selected items with designated frequency, it has completed the water-quality sampling work of January to December by the end of 2023.

Implementation results

Tsengwen Reservoir (15 Testing Stations)

Single-Item Water-Quality Analysis

The pH value of the Category-B water quality compliance rate was 100%, floating solid rate was 77.8%, oxygen dissolution rate was 98.8%, Biological requirement for Oxygen rate was 96.5%, ammonia-helium rate was 100%, total phosphor rate was 90.1%, manganese rate was 90.6% and the coliform rate was 98.2%.

River Pollution Indicator

The RPI at the catchment area of Tsengwen Reservoir was averaging 1. So overall, the water quality was at the rating of slightly unpolluted.

The River Pollution Index (RPI) in the Tsengwen Reservoir watershed has an average value of 1.57. From January to December, the majority of months are classified as not (or slightly) polluted. However, in April, the Tsengwen Wuhao Bridge experienced a moderate level of pollution. This was attributed to a low water volume resulting from pipeline operations in the preceding days, leading to a higher concentration of suspended solids. The pollution level then stabilized in the subsequent months.

In the early months of this year (January to February), the RPI was influenced by riverbank slope rectification projects, resulting in mild to moderate pollution levels. From observations between the years 2021 and 2023, it is evident that river rainfall is the primary influencing factor on water quality.

Entropic Indicator

The CTSI was between 42.1 and 60.4 (rating of Mesotrophic to Entropic), with mostly of rating of Entropic.

The Chlorophyll-a index was between 1.4 and 8.6 μ g/L. (rating of Oligotrophic to Entropic)

Algae Analysis: The overall algae count was between 1900 and 8940 per mL, with the dominant algae for the first, second, and third quarters being Blue-Green Algae, the fourth quarter being Green Algae.

Algae Toxin Analysis: All measured values were compliant with WHO Standard Limit of 1.0 μg/L.

Stench Odor Analysis: Beside the second and fourth season of 2-MIB were 42.9 and 25.75 ng/L. The 2-MIB and Geosmin values measured were compliant with Japanese standard of 2-MIB＜20ng/L、Geosmin＜10ng/L.

Fish Species Study:

The result of the first half of the year study was of the seven

recorded biodiversity index was 1.76, evenness index was 0.90, lack of species richness, which was no dominant species.

The result of the second half of the year study was of the seven recorded biodiversity index was 1.47, evenness index was 0.82, lack of species richness, which was no dominant species.

Agricultural Chemical Analysis: All the measured values were below the lower limit of detection.

Monitoring and Measurement of the radioactive level of the Indigenous Water:

All the monitored and measured results were compliant with the “Permitted Radioactive Level of Commercial Products” and “Limitations on the Radioactive Content in Drinking Water” Standards of Atomic Energy Council of Executive Yuan.

Base Mud Monitoring and Measurement Results:

For the current year, the sediment in the Tsengwen Reservoir does not meet the quality standards for certain parameters. The measured values for the heavy metal nickel are 44.0, 43.5, and 41.5 mg/kg, exceeding the lower limit. Similarly, the measured values for the heavy metal arsenic are 13.3 and 12.5 mg/kg, surpassing the lower limit. However, all other parameters meet the lower limit values for sediment quality standards.

Spatial Trend Analysis:

From January to December of the year 112, statistical data for various water quality parameters in the Tsengwen Reservoir watershed were analyzed. The discussion and analysis are as follows:

1. Water Temperature : In the watershed from Dabang Bridge to the Caolan Creek Bridge, entering the reservoir area, the water temperature increased from an average of 18.5 degrees to 27.2 degrees Celsius.

2. pH : The pH ranged between 7.1 and 8.7, indicating a stable condition.

3. Turbidity and Suspended Solids: The highest values for turbidity and suspended solids were observed in the Danaei Valley. Upstream of the outlet station, there was temporary sedimentation, potentially leading to elevated levels of turbidity and suspended solids. However, it had a minimal impact on the water quality for the East Outlet water intake.

4.Chlorophyll-a:Chlorophyll-a values were lower in the river section due to the short hydraulic residence time. Upon entering the reservoir area where water flow is slower, chlorophyll-a values increased.

5. Dissolved Oxygen :The average dissolved oxygen concentration

was 8.1, maintaining a level above 6.5, indicating excellent water quality.

6. Coliform Bacteria : The highest coliform bacteria values were recorded at the outlet station, likely influenced by low recent rainfall, leading to stagnant water and higher measurements.

7. Ammonia Nitrogen : The average concentration of ammonia nitrogen was below 0.3 mg/L, which is lower than the Class B water quality standard.

8. Total Phosphorus : The average total phosphorus concentration was 0.028 mg/L, below the Class B water quality standard of 0.05 mg/L.

Overall, the water quality in the Tsengwen Reservoir watershed during this period appears to be generally good, with a few considerations for turbidity and suspended solids in specific locations and increased chlorophyll-a values within the reservoir area.

Mann-Kendall Trend Test:

The Mann-Kendall test shows a statistically significant upward trend in CTSI values over the specified period. The p-value is very small (0.000000051292), indicating strong evidence against the null hypothesis of no trend. The positive slope (0.0093) further suggests an increasing trend in the CTSI values for the Tsengwen Reservoir from 104 to 112.

Summarizing the water quality characteristics of the Tsengwen Reservoir, in terms of individual water quality indicators during the

first three quarters of this year, all data have consistently maintained a stable and good condition. Despite the absence of rainfall from January to July, water quality remained good and non-eutrophic. In August and September, consecutive typhoons Kano and Sura occurred with average daily rainfall below 200 millimeters, failing to reach heavy rainfall levels. The elevation of the reservoir's water level had a relatively minor impact on water quality. Regarding spatial trend analysis, no abnormal extreme values were observed.

The results of the Mann-Kendall trend test indicate an upward trend in the Composite Trophic State Index (CTSI), suggesting a need for ongoing monitoring. The outcomes of principal component analysis reveal that the primary influencing factor is often related to soil erosion factors.

In conclusion, the water quality in the Tsengwen Reservoir has demonstrated stability and excellence in the short term. However, the upward trend in CTSI suggests the necessity of continuous observation. Additionally, the primary component analysis emphasizes the importance of factors associated with soil erosion.

Mutan Reservoir (6 Testing Stations)

Single-Item Water-Quality Analysis

The pH value of the Category-A water quality compliance rate was 95.2 %, floating solid rate was 82.5%, oxygen dissolution rate was 82.5%, Biological requirement for Oxygen rate was 93.7%, ammonia-helium rate was 98.4%, total phosphor rate was 20.6%, manganese rate was 61.9%, and the coliform rate was 41.3%.

River Pollution Indicator:

The RPI at the catchment area of Mutan Reservoir was averaging 1.2.

Entropic Indicator:

The CTSI was between 42.2 and 5.8, averaging 47.4, with mostly of rating of Entropic.

The Chlorophyll-a index was between 1.1 and 32.4 μ g/L. (rating of Oligotrophic to Entropic)

Algae Analysis: The overall algae count was between 3560 and 9300 per mL.

Algae Toxin Analysis: All measured values were compliant with WHO Standard Limit of 1.0 μg/L.

Stench Odor Analysis: The 2-MIB and Geosmin values measured were compliant with Japanese standard of 2-MIB＜20ng/L、Geosmin＜10ng/L.

Fish Species Study:

The result of the first half of the year study was of the seven

recorded biodiversity index was 0.96, evenness index was 0.87, lack of species richness, which was no dominant species.

The result of the second half of the year study was of the seven recorded biodiversity index was 0.73, evenness index was 0.66, lack of species richness, which was no dominant species.

Agricultural Chemical Analysis: All the measured values were below the lower limit of detection.

Monitoring and Measurement of the radioactive level of the Indigenous Water:

All the monitored and measured results were compliant with the “Permitted Radioactive Level of Commercial Products” and “Limitations on the Radioactive Content in Drinking Water” Standards of Atomic Energy Council of Executive Yuan.

Base Mud Monitoring and Measurement Results:

For the current year, there are parameters in the sediment of the Mudan Reservoir that do not meet the quality standards. Specifically, the measurements for the heavy metal nickel are 35.2, 38.3, and 40.4 mg/kg, exceeding the lower limit. The measurement for the heavy metal arsenic is 12.2 mg/kg, while all other parameters meet the lower limit values for sediment quality standards.

Spatial Trend Analysis:

Discussing and analyzing the data for the Mudan Reservoir watershed , the watershed is divided into the Mudan Creek basin and the Rurong Creek basin. Here are the key findings for various water quality parameters:

Water Temperature:

The average water temperature in the water bodies is 24.6 degrees Celsius.

pH:

pH values range from 7.8 to 8.86, with an average of 7.17.

Turbidity and Suspended Solids:

Measurements for turbidity and suspended solids remain stable.

Chlorophyll-a:

Chlorophyll-a values are consistently stable.

Dissolved Oxygen:

Dissolved oxygen levels within the reservoir remain above 6.5, indicating excellent water quality. However, the area near Bridge No. 2 at the intersection shows slightly lower dissolved oxygen levels due to human activities.

Coliform Bacteria:

Coliform bacteria levels are highest near the Xinbao Bridge, influenced by the presence of villages and human activities.

Ammonia Nitrogen:

The average ammonia nitrogen value is 0.047 mg/L, which is below the standard of 0.1 mg/L for Class A terrestrial surface water.

Total Phosphorus:

Total phosphorus is a commonly exceeded parameter, with an average value of 0.038 mg/L, exceeding the standard of 0.02 mg/L for Class A terrestrial surface water.

Summarizing the water quality characteristics of the Mudan Reservoir, in terms of individual water quality indicators during the first three quarters of this year, all data maintain a consistently good and stable condition. The Mudan Reservoir is classified under Class A terrestrial surface water quality standards. In terms of spatial trend analysis, common factors that exceed the standards include total phosphorus (Class A standard: ≤0.02 mg/L, Class B standard: ≤0.05 mg/L) and coliform bacteria (Class A standard: ≤50 CFU/100mL, Class B standard: ≤5000 CFU/100mL).

Akongtien Reservoir (6 Testing Stations)

The pH value of the Category-B water quality compliance rate was 100%, floating solid rate was 46.3%, oxygen dissolution rate was 90.7%, Biological requirement for Oxygen rate was 63.0%, ammonia-helium rate was 98.1%, total phosphor rate was 51.9%, manganese rate was 74.1%, and the coliform rate was 75.9%.

Water Quality Indicators insider the Reservoir:

River Pollution Indicator:

The RPI at the catchment area of Akongtien Reservoir was averaging 2.21.

Entropic Indicator (For a detailed definition, please see 2.2)

The CTSI was between 46.8 and 72.8, averaging 62.1.

The Chlorophyll-a index was between 2.3 and 94.9 μ g/L. (rating of Oligotrophic to Entropic)

Algae Analysis:

The overall algae count was between 1840 and 53940 per mL, with the dominant algae being Blue-Green Algae and Green Algae.

Algae Toxin Analysis: All measured values were compliant with WHO Standard Limit of 1.0 μg/L.

Stench Odor Analysis: The 2-MIB and Geosmin values measured were compliant with Japanese standard of 2-MIB＜20ng/L、Geosmin＜10ng/L.

Fish Species Study:

The result of the first half of the year study was of the seven recorded biodiversity index was 1.08, evenness index was 0.78, lack of species richness, which was no dominant species.

The result of the second half of the year study was of the seven recorded biodiversity index was 1.21, evenness index was 0.88, lack of species richness, which was no dominant species.

Agricultural Chemical Analysis:

All the measured values were below the lower limit of detection.

Monitoring and Measurement of the radioactive level of the Indigenous Water:

All the monitored and measured results were compliant with the “Permitted Radioactive Level of Commercial Products” and “Limitations on the Radioactive Content in Drinking Water” Standards of Atomic Energy Council of Executive Yuan.

Discussing and analyzing the data for the water temperature, pH, turbidity, suspended solids, chlorophyll-a, dissolved oxygen, coliform bacteria, ammonia nitrogen, and total phosphorus in the Agongdian Reservoir watershed from January to December 112, the watershed is divided into the Wanglai Creek basin and the Dazhong Creek basin. Here are the key findings:

1. Water Temperature:

The average water temperature in the water bodies is 25.9 degrees Celsius.

2. pH:

pH values range from 7.13 to 8.9.

3.Turbidity and Suspended Solids:

Elevated turbidity and suspended solids values are observed at the Yanmei Weir and the Bailing Box Culvert.

4. Chlorophyll-a:

Chlorophyll-a levels show a contrasting pattern with suspended solids, with some points showing higher values due to stagnant water conditions.

5.Dissolved Oxygen:

Lower dissolved oxygen levels are observed at the Xinxing Bridge, indicating poorer water quality. Other locations maintain averages above 6.5.

6.Coliform Bacteria:

Higher coliform bacteria levels are observed at the Xinxing Bridge, Yanmei Weir, and Bailing Box Culvert, suggesting the presence of wastewater from human activities.

7.Ammonia Nitrogen:

The average ammonia nitrogen value is 0.086 mg/L, which is below the standard of 0.3 mg/L for Class B terrestrial surface water.

8. Total Phosphorus:

The average total phosphorus value is 0.197, exceeding the standard of 0.05 mg/L for Class B terrestrial surface water, primarily due to human activities.

In summary, the water quality in the Agongdian Reservoir watershed exhibits various characteristics, with some points indicating potential human-related impacts, particularly in terms of dissolved oxygen,

coliform bacteria, ammonia nitrogen, and total phosphorus levels.

Summarizing the water quality characteristics of the Agongdian Reservoir, in terms of individual water quality indicators during the first three quarters of this year, all data maintain a consistently good and stable condition. The Agongdian Reservoir is classified under Class B terrestrial surface water quality standards. In terms of spatial trend analysis, common factors that exceed the standards include total phosphorus, biochemical oxygen demand, coliform bacteria, and suspended solids. The Agongdian Reservoir watershed, being predominantly composed of mudstone, features exposed, vegetation-free areas, resulting in the collection of sediment-laden water in the reservoir.

The Mann-Kendall trend test results indicate no significant trend in the Composite Trophic State Index (CTSI). Meanwhile, the results of principal component analysis reveal that the primary influencing factor is often related to soil erosion, with manganese, turbidity, suspended solids, and transparency being key factors associated with sediment-laden water.

In summary, the water quality in the Agongdian Reservoir demonstrates stability and adherence to Class B terrestrial surface water quality standards. The common exceedances in certain factors are attributed to the nature of the watershed, characterized by a prevalence of mudstone and limited vegetation cover, leading to sediment-related water quality concerns.

Kaoping River Weir (7 Testing Stations)

Single-Item Water-Quality Analysis

The pH value of the Category-B water quality compliance rate was 100%, floating solid rate was 38.5%, oxygen dissolution rate was 95.4%, Biological requirement for Oxygen rate was 75.4%, ammonia-helium rate was 89.2%, total phosphor rate was 30.8%, manganese rate was 30.8%, and the coliform rate was 49.2%.

River Pollution Indicator (For a detailed definition, please see 2.2)

The RPI at the eastern exit and the discharge area of Kaoping River Weir was between 1 and 5 (rating of Slightly Unpolluted to Intermediately Polluted), as the floating solid rate increased due to water discharge at the discharge area, in addition to rainfall, which rendered the RPI to go from slightly unpolluted to lightly and intermediately polluted, but with slightly unpolluted accounting for most of the occurrence, averaging 2.21, so overall, the water quality was at the rating of slightly unpolluted.

Algae Analysis: The overall algae count was between 1000 and 10130 per mL, with the dominant algae being Blue-Green Algae.

Algae Toxin Analysis: All measured values were compliant with WHO Standard Limit of 1.0 μg/L.

Stench Odor Analysis: The 2-MIB and Geosmin values measured were compliant with Japanese standard of 2-MIB＜20ng/L、Geosmin＜10ng/L)

Agricultural Chemical Analysis: All the measured values were below the lower limit of detection.

Monitoring and Measurement of the radioactive level of the Indigenous

Water:

All the monitored and measured results were compliant with the “Permitted Radioactive Level of Commercial Products” and “Limitations on the Radioactive Content in Drinking Water” Standards of Atomic Energy Council of Executive Yuan.

Discussing and analyzing the data for water temperature, pH, turbidity, suspended solids, dissolved oxygen, coliform bacteria, ammonia nitrogen, and total phosphorus in the Kaoping River Weir Basin from January to December 112, the Kaoping River Basin is divided into the Laonong Creek basin, the Nanzih Xianxi basin, and the Ailiao Creek basin. Here are the key findings:

1. Water Temperature: The average water temperature in the water bodies is 23.9 degrees Celsius.

2. pH: pH values range from 7.03 to 8.41.

3. Turbidity and Suspended Solids: Turbidity and suspended solids values at various stations are similar.

4.Dissolved Oxygen:Lower dissolved oxygen levels are observed at the Xingtianli station.

5.Total Phosphorus, Coliform Bacteria, and Ammonia Nitrogen:Higher values of total phosphorus, coliform bacteria, and ammonia nitrogen are observed at the Xingtianli station, indicating the presence of wastewater from human activities.

In summary, the water quality in the Kaoping River Weir Basin demonstrates various characteristics, with some stations showing potential impacts from human-related activities, particularly in terms of dissolved oxygen, total phosphorus, coliform bacteria, and ammonia nitrogen levels at the Xingtianli station.

Summarizing the water quality characteristics of the Kaoping River Weir, in terms of individual water quality indicators during the first three quarters of this year, all data maintain a consistently good and stable condition. The Kaoping River Weir is classified under Class B terrestrial surface water quality standards. The watershed of the Kaoping River Weir is extensive and complex. In terms of spatial trend analysis, common factors that exceed the standards include suspended solids, total phosphorus, manganese, and coliform bacteria.

The results of principal component analysis reveal that the primary influencing factor is often related to soil erosion, with manganese, turbidity, suspended solids, and transparency being key factors associated with sediment-laden water.

Chiahsien Weir (4 Testing Stations)

Single-Item Water-Quality Analysis

The pH value of the Category-A water quality compliance rate was 100%, floating solid rate was 100%, oxygen dissolution rate was 100%, Biological requirement for Oxygen rate was 100%, ammonia-helium rate was 100%, total phosphor rate was 100%, manganese rate was 100%, and the coliform rate was 35.0%.

River Pollution Indicator (For a detailed definition, please see 2.2)

The RPI at the eastern exit and the discharge area of Chiahsien Weir was 1.

Algae Analysis: The overall algae count was between 160 and 1760 per mL, with the dominant algae being Blue-Green Algae.

Algae Toxin Analysis: All measured values were compliant with WHO Standard Limit of 1.0 μg/L.

Stench Odor Analysis: The 2-MIB and Geosmin values measured were compliant with Japanese standard of 2-MIB＜20ng/L、Geosmin＜10ng/L.

Agricultural Chemical Analysis:

All the measured values were below the lower limit of detection.

Monitoring and Measurement of the radioactive level of the Indigenous Water:

All the monitored and measured results were compliant with the “Permitted Radioactive Level of Commercial Products” and “Limitations on the Radioactive Content in Drinking Water” Standards of Atomic Energy Council of Executive Yuan.

Summarizing the water quality characteristics of the Jiaxian Weir, in terms of individual water quality indicators during the first three quarters of this year, all data maintain a consistently excellent condition. The Jiaxian Weir is classified under Class A terrestrial surface water quality standards. The water quality at the Jiaxian Weir has remained excellent throughout the years. In terms of spatial trend analysis, the common factor exceeding standards is coliform bacteria, with an average value of 665 CFU/100mL. (Class A standard: ≤50 CFU/100mL, Class B standard: ≤5000 CFU/100mL).

The results of principal component analysis indicate that the primary influencing factor is often related to soil erosion, with manganese, turbidity, suspended solids, and transparency being key factors associated with sediment-laden water.

第七章 結論

7.1、曾文水庫

水體水質標準合格率

本計畫水質監測112年度曾文水庫整體乙類水體水質標準合格率(合格次數/監測次數，詳見表 7.1-1) pH 為 100%、懸浮固體為 77.8%，溶氧為98.8%，生化需氧量為96.5%，氨氮為100%，總磷為90.1%，錳為90.6%，大腸桿菌群98.2%。

由表7.1-1中112年1~12月累積75%測值可知，所有表列水質項目觀測時間之平均值及 75%測值除懸浮固體平均值外，其餘皆能符合乙類水體水質標準，顯示曾文水庫之水質是穩定且優良。

表7.1-1 曾文水庫112年度1~12月乙類水質目標合格率及75%累積值

項目 年度	pH	懸浮固體	溶氧	生化需氧量	氨氮	總磷	錳	大腸桿菌群
單位	-	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	CFU/100mL
乙類標準	6.5~9.0	≦25	≧5.5	≦2.0	≦0.3	≦0.05	≦0.05	≦5000
平均值	8.0	21.6	7.9	1.2	0.07	0.024	0.02	424
次數	209/209	171/209	206/209	195/209	209/209	191/209	192/209	205/209
達成率	100.0%	81.8%	98.6%	93.3%	100.0%	91.4%	91.9%	98.1%
累積75%測值	8.3	18	8.5	1	0.08	0.028	0.022	200
標準偏差	0.4	48	0.9	0.5	0.040	0.020	0.02	1822

註:1.水體水質目標的合格率，以「合格次數/監測次數」表示
2.**粗體**表示當年度平均值及累積75%測值不符合乙類地面水體水質標準

河川污染指標(RPI)

曾文水庫東口、曾文五號橋河川污染指標 RPI 介於 1~3.25 屬未(稍)受~中度污染等級，1~12 月未(稍)受污染等級佔大多數，平均為 1.57，其中 4 月曾文五號橋因前幾日有管線作業水量過少，懸浮固體濃度 較高，當月為中度污染等級，而後趨於平穩。整體而言水質為中度污染至未(稍)受污染等級。

曾文水庫集水區河川污染指標 RPI，平均為 1.45 屬未(稍)受污染等級，整體而言水質狀況介於中度污染至未(稍)受污染等級。

卡爾森優養指標(CTSI)

優養指標 CTSI 介於 42.1~60.4 間，屬貧養至優養等級。呈現優養化現象皆為透明度影響，不論適逢枯水期，測點水深偏淺，易受水面擾動使底泥沉積物、懸浮固體上揚，或是降雨沖刷，使水體混濁，透明度變差，都是造成 CTSI 值偏高之原因。

葉綠素濃度指標介於 1.4~8.6 μg/L 間，屬貧養至普養等級。葉綠素濃度指標屏除透明度因子之影響，曾文水庫多為普養。

水體品質指標(WQI)

曾文水庫表層，WQI 為 68.8~93.4 間屬良好至優良等級，表層平均為 85.1 為優良等級。

非表層 WQI 為 69.4~91.7 間屬良好至優良等級，非表層平均為 84.8 為良好等級。

東口和曾文五號橋(出水口)部分 WQI 為 70.2~91.1 間屬良好至優良等級，平均 82.1 為良好等級。

集水區部分 WQI 為 71.1~91.6 間屬良好至優良等級，平均 84.4 為良好等級。

由 WQI 指標可知，曾文水庫區內表層、非表層和集水區水質介於中等

至優良等級，整體而言，本年度 1~12 月 WQI 平均值為 84.4，屬水質優良等級之水域。

藻類及臭味物質檢驗分析

整體藻類計數介於 1900~397840 個/mL 間，主要優勢種為藍綠藻。

藻毒濃度監測，其濃度皆低於世界衛生組織(WHO)建議淨水後安全限值 1.0 ug/L。

臭味物質濃度第 1~3 季 2-MIB 測值超過標準值外，其餘月份的 2-MIB 與 Geosmin 測值均符合日本所定之標準(2-MIB＜20ng/L、Geosmin＜10ng/L)。

魚類調查分析

上半年調查結果共記錄魚類 4 科 6 種 39 尾，分別為鯇、鯉、圓頭魴、翹嘴鮊、豹紋翼甲鯰、小盾鱧及雜交吳郭魚。

下半年調查結果共記錄魚類 4 科 7 種 37 尾，分別為鯇、鯉、圓頭魴、翹嘴鮊、豹紋翼甲鯰、小盾鱧及雜交吳郭魚。

農藥調查分析

所有測值低於偵測極限。

放射性物質檢驗分析

原水輻射監測，監測結果皆符合行政院原子能委員會「商品輻射限量標準」與「飲用水中放射性含量限制要點」規範。

底泥檢驗分析

本年度曾文水庫底泥未符合品質指標的測項有，重金屬鎳測值分別為 44.0、43.5、41.5mg/kg 超過下限值；重金屬砷測值分別為 13.3、12.5mg/kg 超過下限值，其餘皆符合底泥品質指標下限值。

7.2、牡丹水庫

水體水質標準合格率

本計畫水質監測112年度牡丹水庫整體甲類水體水質標準合格率(合格次數/監測次數，詳見表7.2-1) pH為95.2%、懸浮固體為82.5%、溶氧為82.5%，生化需氧量為93.7%、氨氮為98.4%、總磷為20.6%，錳為61.9%、大腸桿菌群為41.3%。

由表7.2-1中112年1~12月累積75%測值可知，除總磷、錳和大腸桿菌群外，其他均能符合甲類水體水質標準。

表7.2-1 牡丹水庫112年度1~12月甲類水質目標合格率及75%累積值

項目 / 年度	pH	懸浮固體	溶氧	生化需氧量	氨氮	總磷	錳	大腸桿菌群
單位	-	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	CFU/100mL
甲類標準	6.5~8.5	≦25	≧6.5	≦1.0	≦0.1	≦0.02	≦0.05	≦50
平均值	7.7	15.3	7.7	1.1	0.04	0.05	0.05	2422
次數	74/77	66/77	66/77	71/77	76/77	18/77	49/77	31/77
達成率	96.1%	85.7%	85.7%	92.2%	98.7%	23.4%	63.6%	40.3%
累積75%測值	7.87	11.6	8.45	1	0.06	0.061	0.09	3200
標準偏差	0.4	30	1.0	0.4	0.02	0.045	0.06	4076

註:1.水體水質目標的合格率，以「合格月次數/監測月次數」表示

2.**粗體**表示當年度平均值及累積75%測值不符合甲類地面水體水質標準

河川污染指標(RPI)

集水區部分 RPI 平均為 1.2，屬於未(稍)受污染等級。

卡爾森優養指標(CTSI)

優養指標 CTSI 指標值介於 42.2~65.8 間，平均值為 53.2 為優養等級。

葉綠素濃度指標介於 1.1~32.4 μg/L 間，屬貧養至優養等級。

水體品質指標(WQI)

庫區表層 WQI 為 69.8~93.6 間屬優良等級，平均值 85.5 為優良等級，表層水質為優良等級。

庫區非表層 WQI 為 68.8~90.9 間屬良好至優良等級，平均值 81.3 為良好等級，底層水質為良好等級。

集水區 WQI 為 75.2~84.3 間屬良好至優良等級，平均值 84.3 為良好等級，集水區水質為良好等級。

由 WQI 可知，牡丹水庫 WQI 平均值為 84.4 整體水質為良好等級水體。

藻類及臭味物質檢驗分析

藻類計數介於 560~9300 個/mL 間，第 1~3 季主要優勢種為藍綠藻。

藻毒測值符合世界衛生組織(WHO)建議淨水後安全限值 1.0ug/L。

臭味分析 2-MIB 濃度與 Geosmin 濃度測值皆符合日本所定之標準(2-MIB＜20ng/L、Geosmin＜10ng/L)。

魚類調查分析

上半年調查結果共記錄魚類 2 科 3 種 14 尾（表 3），分別為斑駁尖塘鱧、花身副麗魚及雜交吳郭魚。

下半年調查結果共記錄魚類 1 科 1 種 8 尾，為雜交吳郭魚，另外調查

中發現有少量的鱟於水面活動，但於陷阱調查均未捕獲，為目擊記錄。

農藥調查分析

所有測值低於偵測極限。

放射性物質檢驗分析

原水輻射監測，監測結果皆符合行政院原子能委員會「商品輻射限量標準」與「飲用水中放射性含量限制要點」規範。

底泥檢驗分析

本年度牡丹水庫未符合品質指標的測項有重金屬鎳，測值分別為 35.2、38.3、40.4mg/kg 超過下限值；重金屬砷測值 12.2mg/kg，其餘皆符合底泥品質指標下限值。

7.3、阿公店水庫

水體水質標準合格率

本計畫水質監測 112 年度阿公店水庫整體乙類水體水質標準合格率(合格次數/監測次數，詳見表 7.3-1) pH 為 100%、懸浮固體為 46.3%，溶氧為 90.7%，生化需氧量為 63.0%、氨氮為 98.1%，總磷為 51.9%，錳為 74.1%，大腸桿菌群為 75.9%。

由表 7.3-1 中 112 年 1~12 月累積 75%測值可知，除懸浮固體、生化需氧量、總磷、錳外，其餘水質項目 (至少 75%的觀測時間)均能符合乙類水體水質標準。

表 7.3-1 阿公店水庫 112 年度 1~12 月乙類水質目標合格率及 75%累積值

項目 / 年度	pH	懸浮固體	溶氧	生化需氧量	氨氮	總磷	錳	大腸桿菌群
單位	-	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	CFU/100mL
乙類標準	6.5~9.0	≦25	≧5.5	≦2.0	≦0.3	≦0.05	≦0.05	≦5000
平均值	7.7	186.0	7.1	2.0	0.08	0.170	0.0594	4004
次數	63/66	37/66	56/66	34/66	65/66	35/66	51/66	53/66
達成率	95.5%	56.1%	84.8%	51.5%	98.5%	53.0%	77.3%	80.3%
累積 75%測值	8.1	44	8.0	2.675	0.0975	0.089	0.048	2350
標準偏差	0.6	659	1.4	1.17	0.093	0.515	0.14	11546

註:1.水體水質目標的合格率，以「合格月次數/監測月次數」表示

2.**粗體**表示當年度平均值及累積 75%測值不符合乙類地面水體水質標準

河川污染指標(RPI)

集水區 RPI 為 1~5.25 屬未(稍)受~中度污染等級，平均值為 2.21，集水區 RPI 為未(稍)受污染等級。

卡爾森優養指標(CTSI)

優養指標 CTSI 為 46.8~72.8 間，平均值為 62.1，屬優養等級。

葉綠素濃度指標介於 2.3~94.9 μg/L 間，屬貧養至優養等級。

水體品質指標(WQI)

阿公店水庫區 WQI 為 68.9~91.0 間屬中等至優良等級，平均值為 81.2 屬於良好等級，整體水質為優良等級。

集水區 WQI 為 44.5~88.2 間屬中等至優良等級，平均值為 73.1 屬於良好等級，整體水質為良好等級。

阿公店水庫 WQI 平均值為 77.1，整體水質為良好等級。

藻類及臭味物質檢驗分析

整體藻類計數為 1840~294240 個/mL 間，第 1~4 季主要優勢種為藍綠藻。

逐季進行藻毒濃度監測，其濃度皆低於世界衛生組織(WHO)建議淨水後安全限值 1.0ug/L。

臭味物質成分(2-MIB 及 Geosmin)之調查結果測值除 3~4 季 2-MIB 外，其餘皆符合日本所定之標準。

魚類調查分析

上半年調查結果共記錄魚類 4 科 6 種 76 尾（表 4)，分別為鯉、團頭魴、鬚鯰、豹紋翼甲鯰、橘色雙冠麗魚(紅魔鬼) 、雜交吳郭魚。

下半年調查結果共記錄魚類 4 科 6 種 74 尾，分別為鯉、團頭魴、鬚鯰、

豹紋翼甲鯰、橘色雙冠麗魚及雜交吳郭魚。

農藥調查分析

農藥所有測點測值皆低於偵測極限。

放射性物質檢驗分析

原水輻射監測監測結果皆符合行政院原子能委員會「商品輻射限量標準」與「飲用水中放射性含量限制要點」規範。

底泥檢驗分析

本年度阿公店水庫無規劃底泥採樣監測。

7.4、高屏溪攔河堰

水體水質標準合格率

本計畫水質監測112年度高屏溪攔河堰乙類水體水質標準合格率(合格次數/監測次數，詳見表 7.4-1) pH 為 100%，懸浮固體為 38.5%，溶氧為95.4%，生化需氧量為75.4%，氨氮為89.2%，總磷為30.8%，錳為30.8%，大腸桿菌群為49.2%。

由表7.4-1中112年1~12月累積75%測值可知，除懸浮固體、氨氮、總磷、錳和大腸桿菌群外，其餘水質項目多數的觀測時間(至少75%的觀測時間)均能符合乙類水體水質標準。

表7.4-1 高屏溪攔河堰112年度1~12月乙類水質目標合格率及75%累積值

項目 / 年度	pH	懸浮固體	溶氧	生化需氧量	氨氮	總磷	錳	大腸桿菌群
單位	-	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	CFU/100mL
乙類標準	6.5~9.0	≦25	≧5.5	≦2.0	≦0.3	≦0.05	≦0.05	≦5000
平均值	7.7	668.9	7.9	1.8	0.17	0.320	0.2584	31837
次數	79/79	31/79	76/79	61/79	70/79	25/79	25/79	40/79
達成率	100.0%	39.2%	96.2%	77.2%	88.6%	31.6%	31.6%	50.6%
累積75%測值	8.0	764	8.6	1	0.095	0.412	0.3675	20500
標準偏差	0.4	1152	1.2	1.9	0.365	0.421	0.33	82801

註:1.水體水質目標的合格率，以「合格月次數/監測月次數」表示
2.**粗體**表示當年度累積75%測值不符合乙類地面水體水質標準

河川污染指標(RPI)

河川污染指標 RPI 介於 1~5.0 間屬未(稍)受至中度污染等級。平均值為 2.53 屬輕度污染等級。

水體品質指標(WQI)

水體品質指標 WQI 介於 41.7~90.5 間屬中等至優良等級。平均值為 70.6，屬良好等級之水域。

藻類及臭味物質檢驗分析

整體藻類計數為 700~2840 個/mL 間，主要優勢種為藍綠藻。

藻毒所有測值皆符合世界衛生組織(WHO)建議淨水後安全限值 1.0ug/L。

第 1~4 季沉砂池入口臭味物質成分(2-MIB 及 Geosmin)之調查結果除第 3 季 2-MIB 外，其餘皆符合日本所定之標準(2-MIB＜20ng/L、Geosmin＜10ng/L)。

農藥調查分析

農藥所有測點測值皆低於偵測極限。

放射性物質檢驗分析

原水輻射監測監測結果皆符合行政院原子能委員會「商品輻射限量標準」與「飲用水中放射性含量限制要點」規範。

底泥檢驗分析

本年度高屏溪攔河堰無規劃底泥採樣監測。

7.5、甲仙攔河堰

水體水質標準合格率

本計畫水質監測 112 年度甲仙攔河堰整體甲類水體水質標準合格率(合格次數/監測次數，詳見表 7.5-1)pH 為 100.0%，懸浮固體為 100.0%，溶氧為 100%，生化需氧量為 100%，氨氮為 100.0%，總磷 100.0%，錳為 100.0%，大腸桿菌群 35.0%。

由表 7.5-1 中 112 年 1~12 月累積 75%測值可知，除大腸桿菌群累積 75%測值未符合甲類水體水質標準。其餘所表列水質項目均符合甲類水體水質標準。

表 7.5-1 甲仙攔河堰 112 年度 1~12 月甲類水質目標合格率及 75%累積值

項目 / 年度	pH	懸浮固體	溶氧	生化需氧量	氨氮	總磷	錳	大腸桿菌群
單位	-	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	CFU/100mL
甲類標準	6.5~8.5	≦25	≧6.5	≦1.0	≦0.1	≦0.02	≦0.05	≦50
平均值	8.0	63.4	8.4	1.0	0.04	0.038	0.0443	565
次數	44/44	32/44	44/44	44/44	43/44	21/44	35/44	14/44
達成率	100.0%	72.7%	100.0%	100.0%	97.7%	47.7%	79.5%	31.8%
累積 75%測值	8.4	53	8.6	1	0.06	0.043	0.037	213
標準偏差	0.4	140	0.4	0.0	0.02	0.050	0.07	1256

註:1.水體水質目標的合格率，以「合格月次數/監測月次數」表示
2.**粗體**表示當年度累積 75%測值不符合甲類地面水體水質標準

水體品質指標(WQI)

水體品質指標 WQI 介於 76.7~92.3 間屬良好至優良等級。整體而言本年度 WQI 平均值為 88.5 屬優良等級。

河川污染指標(RPI)

河川污染指標 RPI 值為 1 屬未(稍)受污染等級。整體 RPI 平均為 1.75 屬未(稍)受污染等級。

藻類及臭味物質檢驗分析

整體藻類計數，整體藻類計數為 160~1760 個/mL 間，藻類數第 1、3 季藍綠藻；第 2 季綠藻；第 4 季為矽藻為優勢種。

藻毒濃度監測，其濃度皆低於世界衛生組織(WHO)建議淨水後安全限值 1.0ug/L。

臭味 2-MIB 與 Geosmin 測值，均符合日本所定之標準(2-MIB＜20ng/L、Geosmin＜10ng/L)。

農藥調查分析

農藥所有測點測值皆低於偵測極限。

放射性物質檢驗分析

原水輻射監測監測結果皆符合行政院原子能委員會「商品輻射限量標準」與「飲用水中放射性含量限制要點」規範。

底泥檢驗分析

本年度甲仙溪攔河堰無規劃底泥採樣監測。

7.6、綜合建議

1. 整體而言曾文水庫低蓄水率對於庫區上游烏埔、大埔水質測站影響較明顯，主要仍是透明度不佳（水位低底泥擾動），而總磷亦有相對較高；取水塔於低蓄水率時之水質變化稍微平緩升高，於 9 月反而是水質最不好，應該也是上游降雨沖刷流達至取水塔所導致 TSI(TP)緩步升高至 55.8，高蓄水率時水面流動較慢故葉綠素 a 導致 TSI(chl-a)從 39.2 升高至 45.4。
2. 高屏堰屬堰型取水口，水質改善建議以 BOD、氨氮為主，不過高屏堰仍會引水至澄清湖水庫，澄清湖水庫常年屬優養水庫，環境部亦相當關注，建議相關分析結果提供給澄清湖水庫管理單位，作為研擬水質改善之基礎資料。
3. 第六章各水庫主成分分析以水質項目為主，本計畫有統計採樣前之降雨情形及蓄水量，建議未來可納入相關環境因子，進一步探討氣候因子對水質之影響。
4. 各庫區卡爾森優養指標(CTSI)經主成分分析均呈現「土壤沖刷」為第一影響因子，均與濁度透明度有關。在第六章水質綜合分析中，在空間性趨勢中，濁度與總磷的圖樣(pattern)大致類似，而與葉綠素 a 則有較大差異。故土壤沖刷除引起濁度而致透明度導致優養判斷外，亦應同時留意總磷的問題。此分析可指向水庫集水區水土保持(減少土壤沖刷)對水質保護之重要，業管單位亦應加強相關之管理，以確保水質。
5. 少部份測站水質劣化，常歸因於降雨量，但較無量化數據加以佐證，建議可建立河川流量與降雨量間之相關性，因流量資料較無法即時取得，可藉由降雨量估算河川流量，進行校正迴歸，以瞭解河川流量對測站水體水質之衝擊及影響程度。另越域引水量和水質等亦可研析其對測站水質之影響程度。
6. 經歷年調查監測已累積許多數據量，建議可加以彙整研析，篩選出各水庫和集水區之指標(敏感)測站和水質及生態指標，作為後續管理決策及應變規劃之參考。
7. 高屏攔河堰有歷年懸浮固體、濁度與沿線降雨量之變化圖，嘗試找出其迴歸曲線，讓管理中心後續參採。本建議為加值項目，或可列於後續年度項目。
8. 在生態調查報告中檢討與建議說明針對外來種的建議，源頭控製甚為重要，除加強巡邏與進行民眾宣導外，可建立早期預警機制及外來種的追蹤等。

9. 有關阿公店水庫浮力式光電系統對水質水庫安全影響調查事項，建請於光電太陽能板清洗後能作一次即時採樣檢驗。
10. 阿公店水庫尖山二濕地有高市水利局沉澱式淨化槽水質淨化設施可否增設該處檢驗點位以為驗証其效果。
11. 重金屬異常可能受懸浮固體所攜帶的重金屬所影響，因溶解性重金屬毒性方會影響飲用水安全，建議重金屬應加做溶解性重金屬。