

図 - 3.2-30 ウォノギリダム左岸平面図

Fig. Location of Gate and Valve Inspection

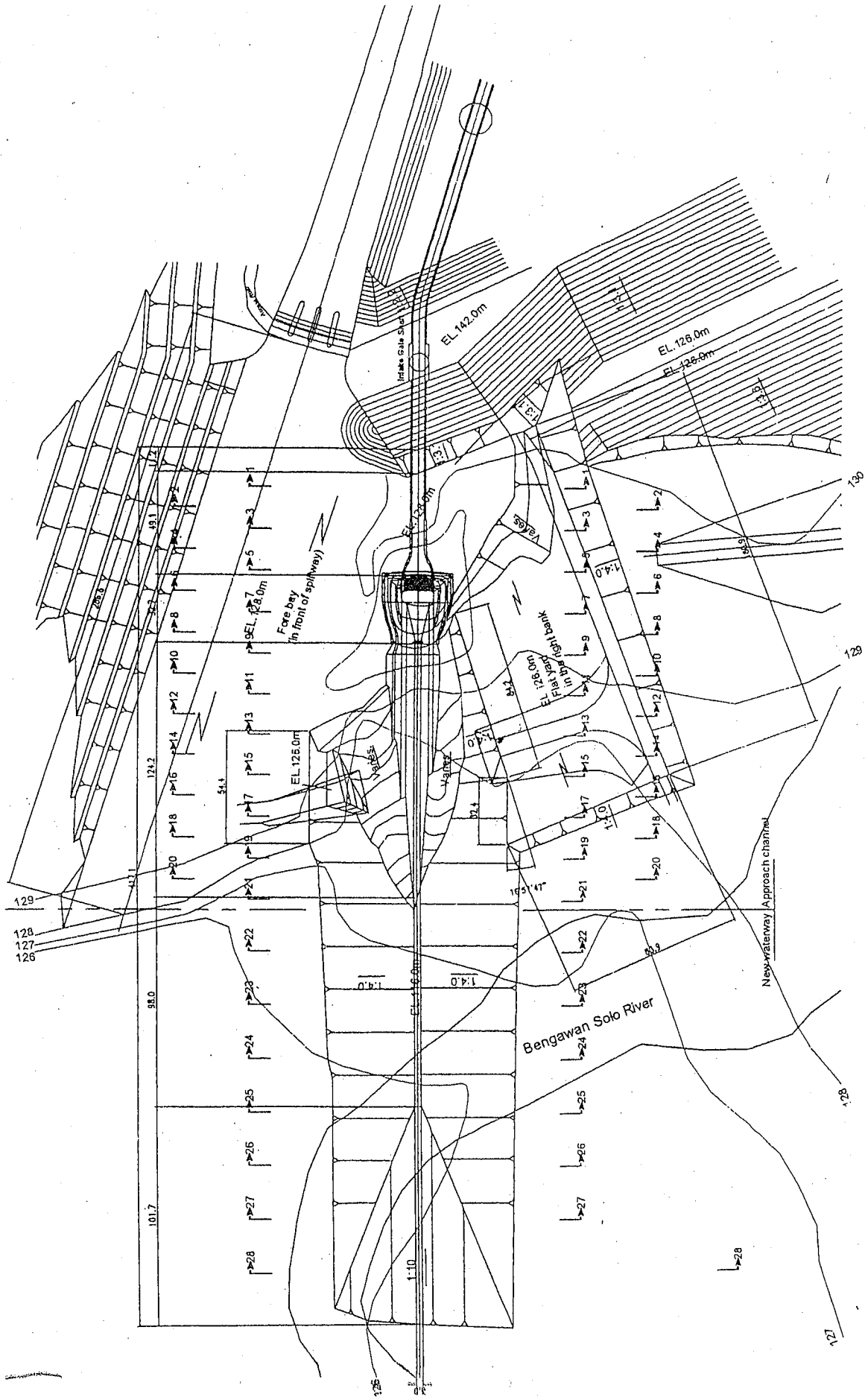
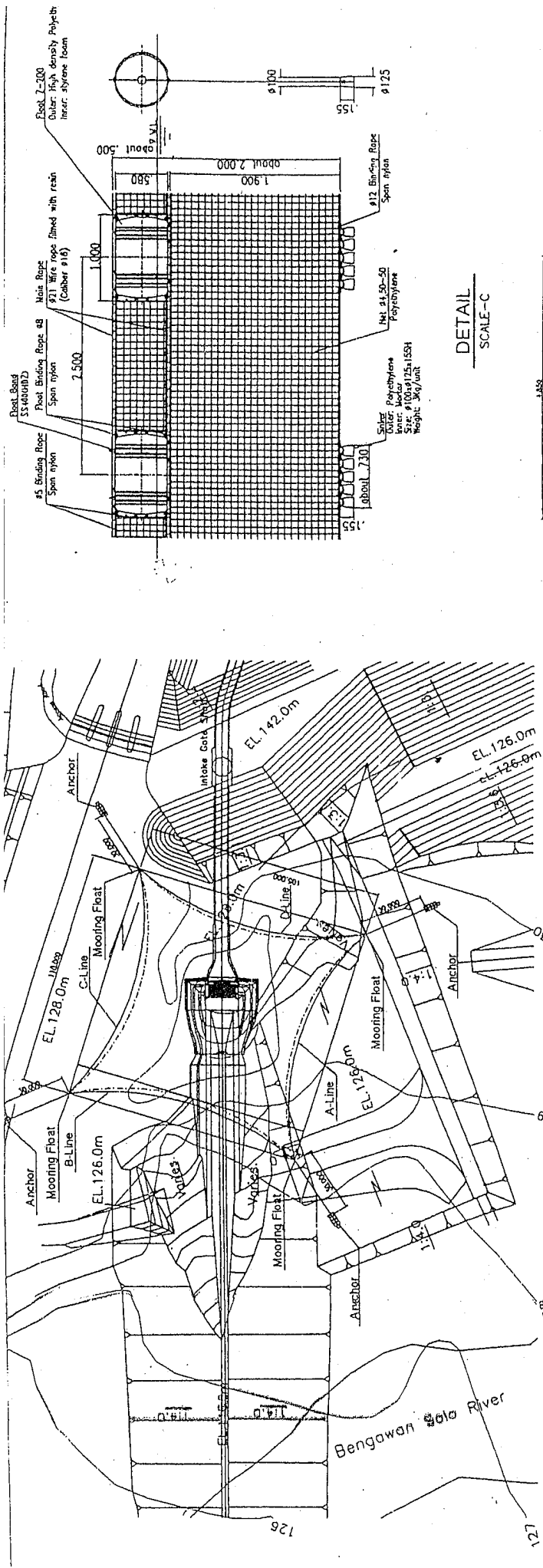
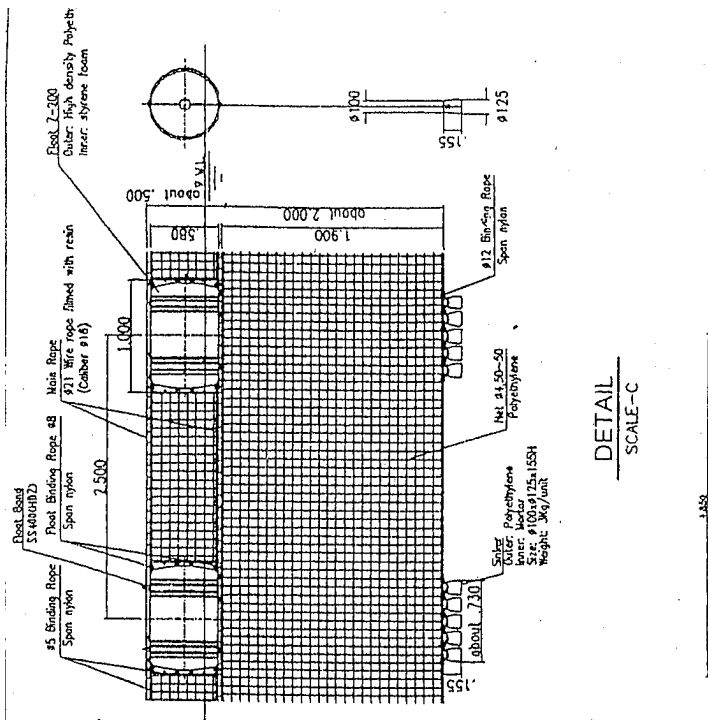


図 3-2-31 JICA 無償による取水口周りの浚渫計画

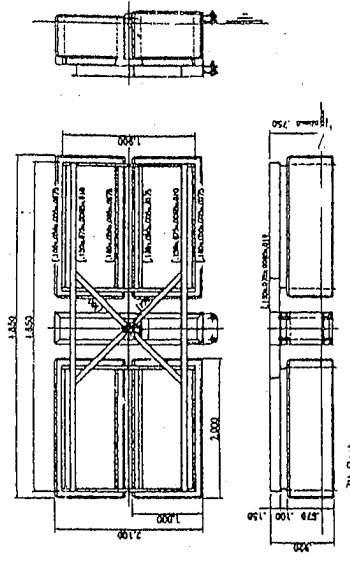
Fig. Dredging Plan



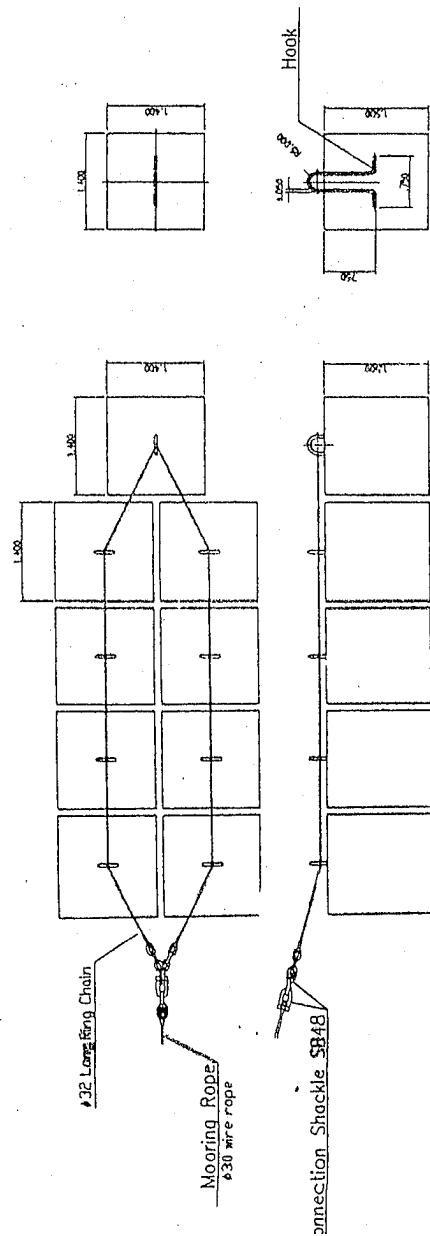
PLAN
SCALE-A



DETAIL
SCALE-C



MOORING FLOAT
SCALE-B



ANCHOR BLOCK
SCALE-B

3-2-32 網場の設計図面 (JICA 無償)

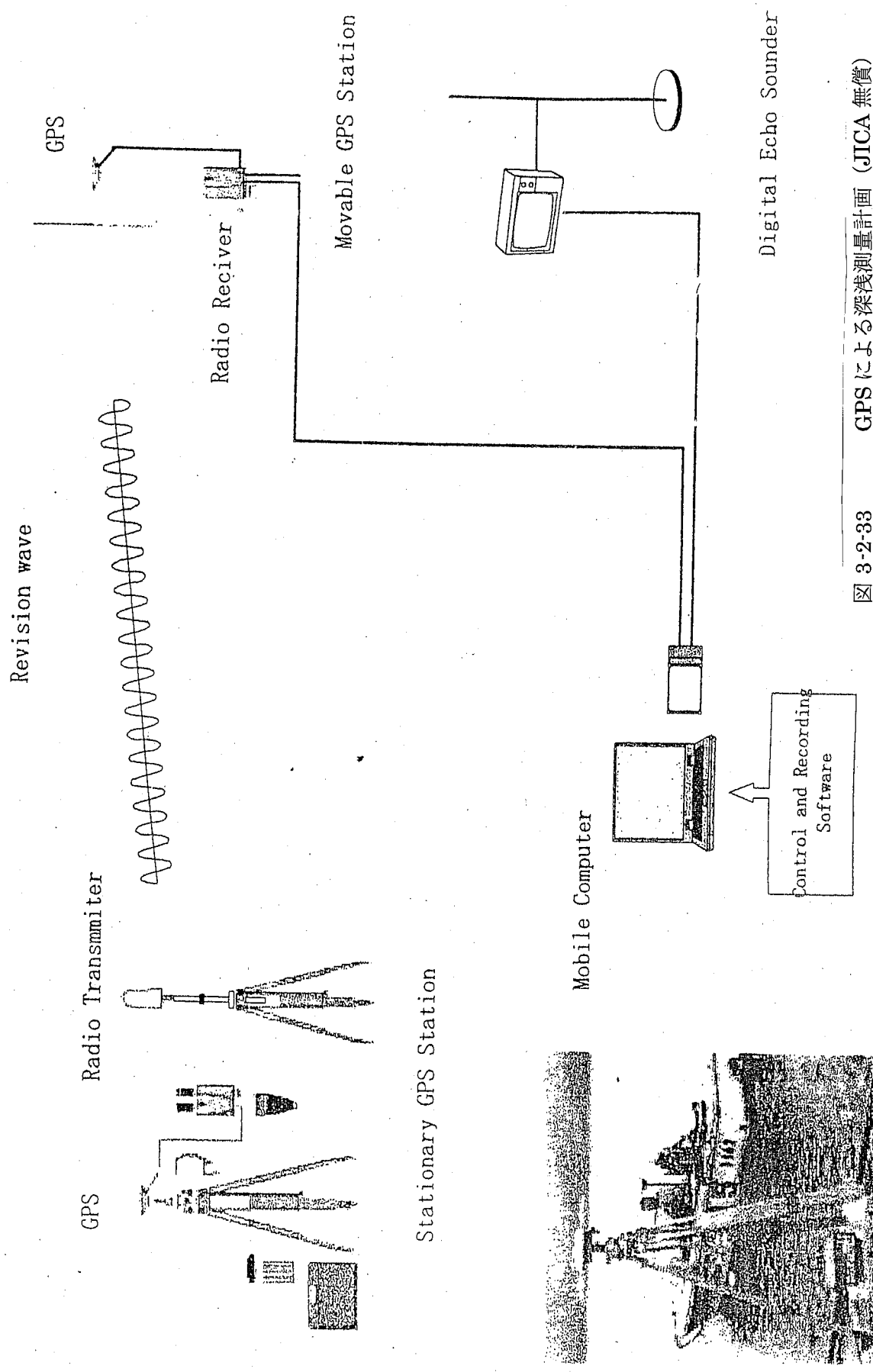
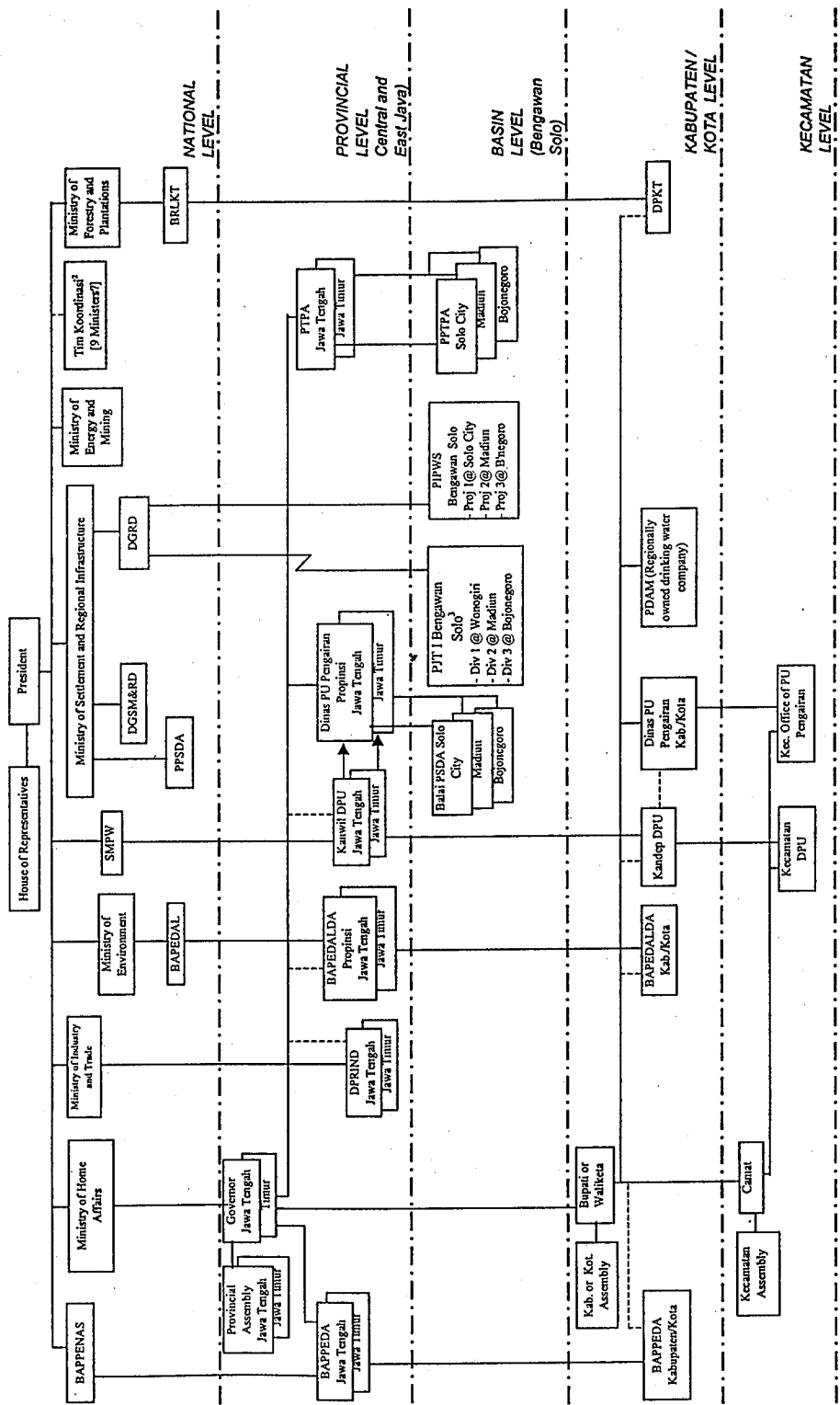


図 3-2-33 GPS による深淺測量計画 (JICA 無償)

Fig. 3-2-33 Digital Echo Sounding System with GPS



Notes: 1. With particular reference to the Bengawan Solo river basin which extends across Central and East Java provinces.
2. Ministers of Agriculture, Forestry and Plantations, Settlement and Regional Infrastructure, Mines and Energy, Industry and Trade, Home Affairs, Communications, and State Ministers for Environmental Affairs and Agrarian Affairs
3. Keppres 129/2000 issued for extension to PJI I (Brantas). Note that the line of responsibility/control passes through PJI I which has its headquarters in Malang, East Java Province

Figure Outline of Existing Government Organization in the Water Sector

**ORGANIZATION CHART OF BENGAWAN SOLO RIVER BASIN DEVELOPMENT PROJECT.
STRUKTUR ORGANISASI PROYEK INDIK PENGEMBANGAN WILAYAH SUNGAI BENGAWAN SOLO.**

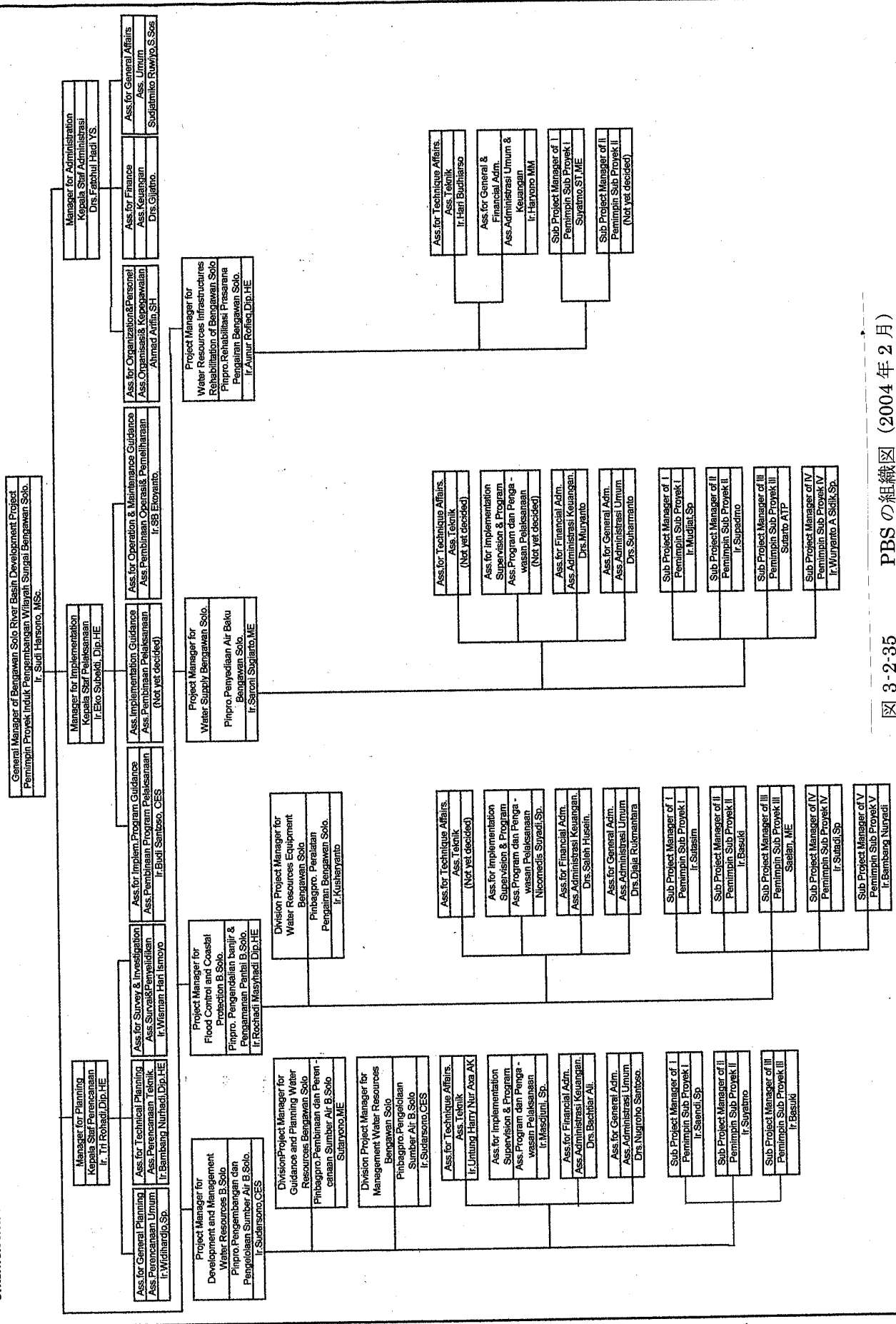


図 3-2-35 PBS の組織図 (2004 年 2 月)

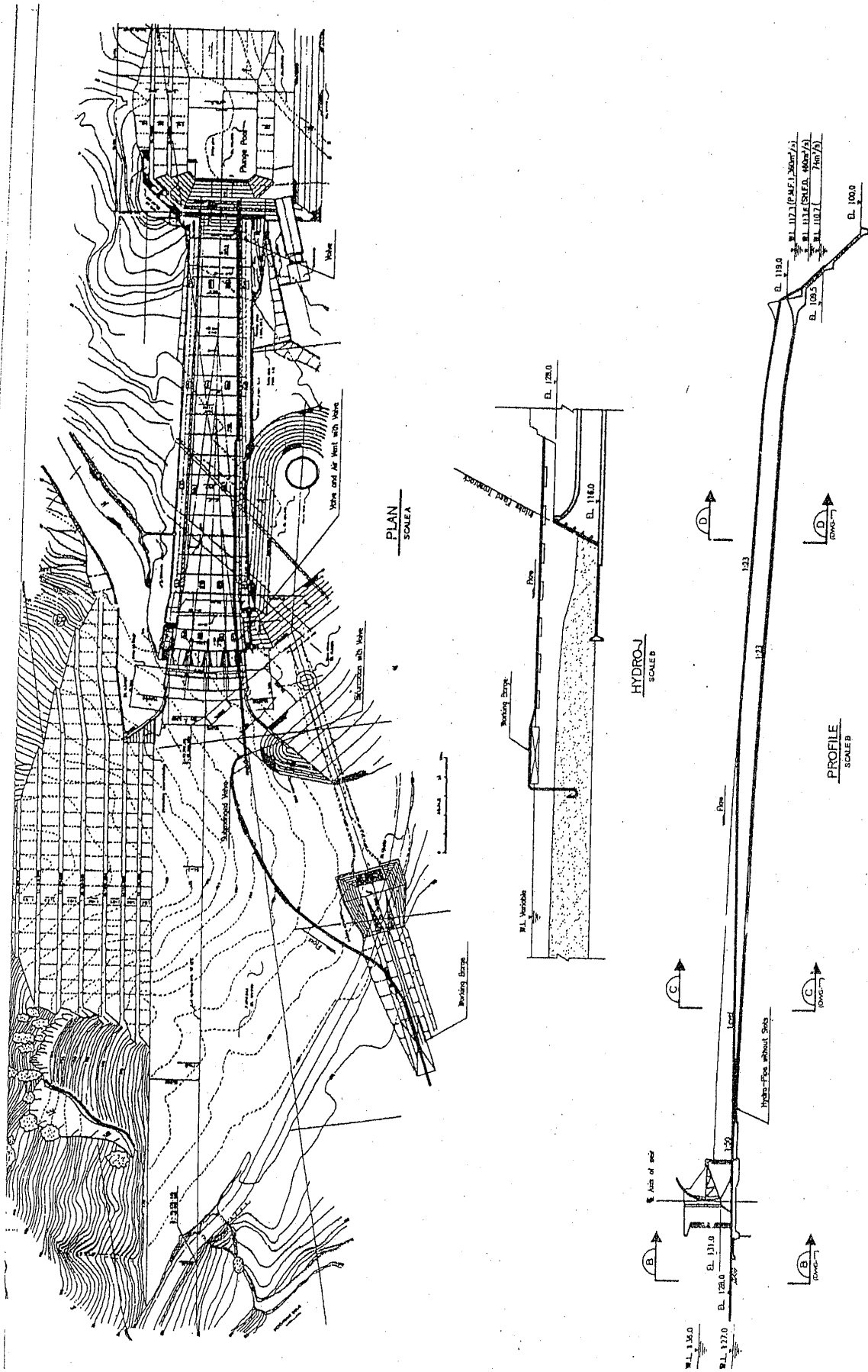
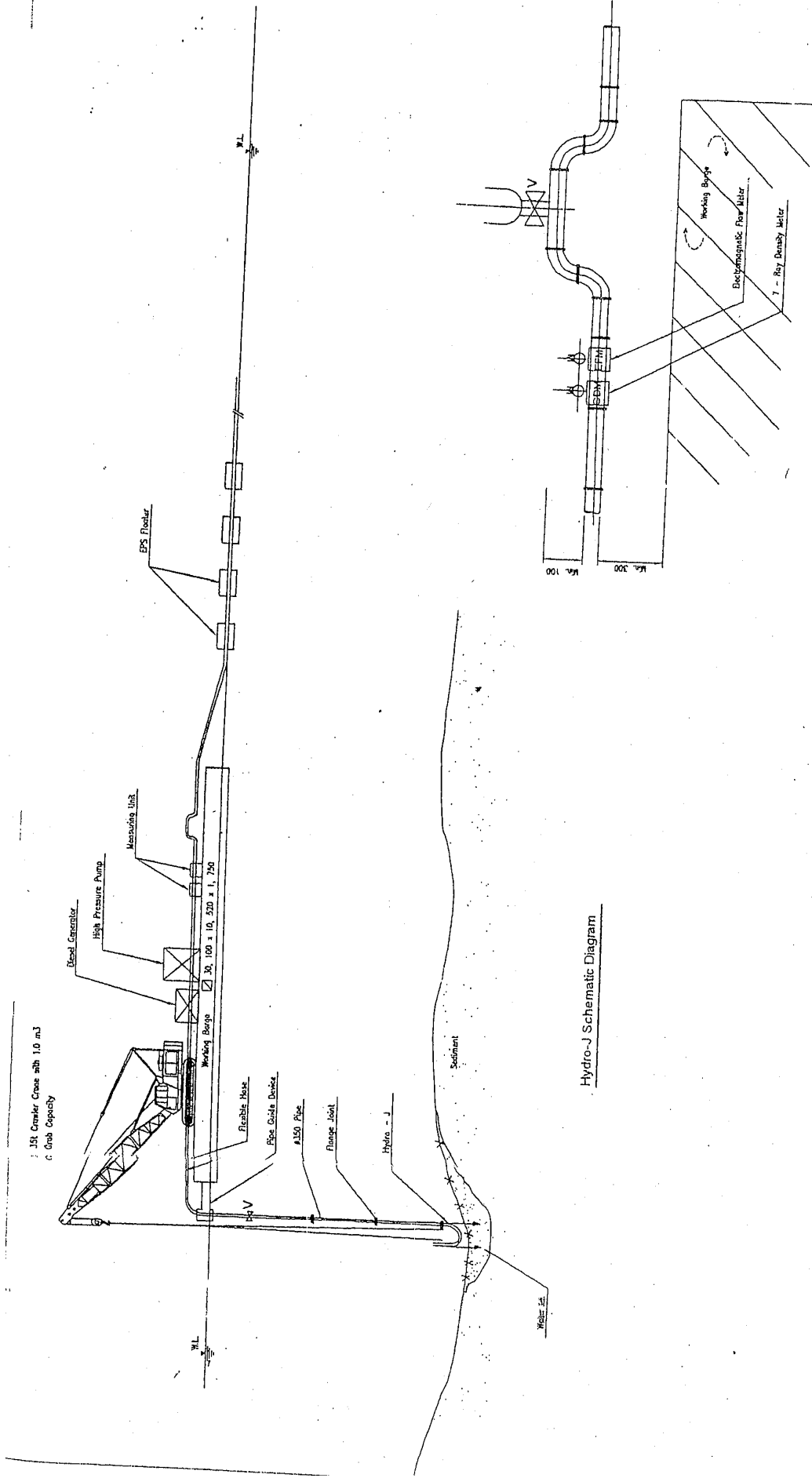


Fig. Hydro-type Sediment Discharge System (1/4)
(Hydro-J Type)

図 3-2-36 ハイドロ J 工法による排砂システム (JICA 無償による提案)



Note
 □ : 7-Res Density Meter
 ○ : Electromagnetic Flow Meter
 △ : Valve

Fig. 3-2-37 Hydro-type Sediment Discharge System (2/4)
 (Layout of Hydro-J Type)

ハイドロJ工法の概要

図 3-2-37

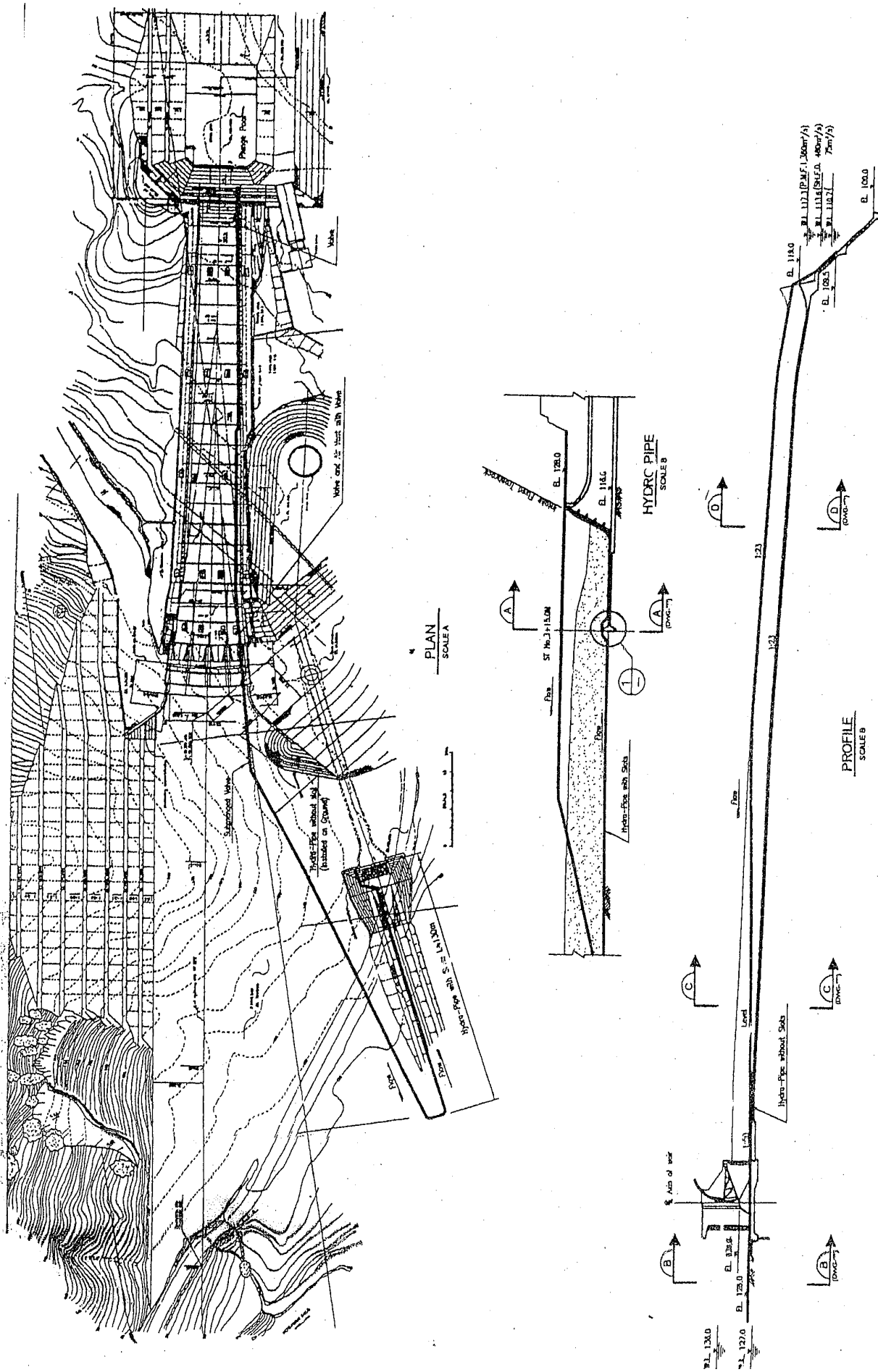


図 3-2-38 ハイドロパイプ工法による非砂システム (JICA 無償による提案)
 Fig. Hydro-type Sediment Discharge System (3/4)
 (Fixed Pipe Type)

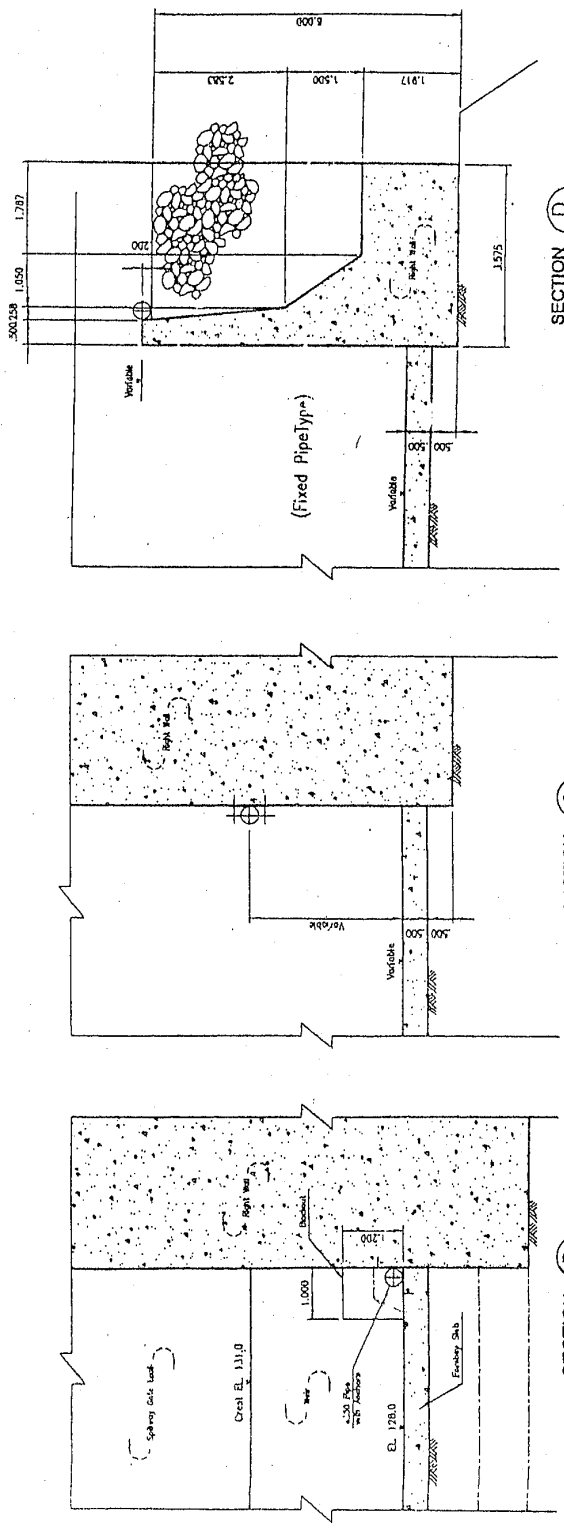
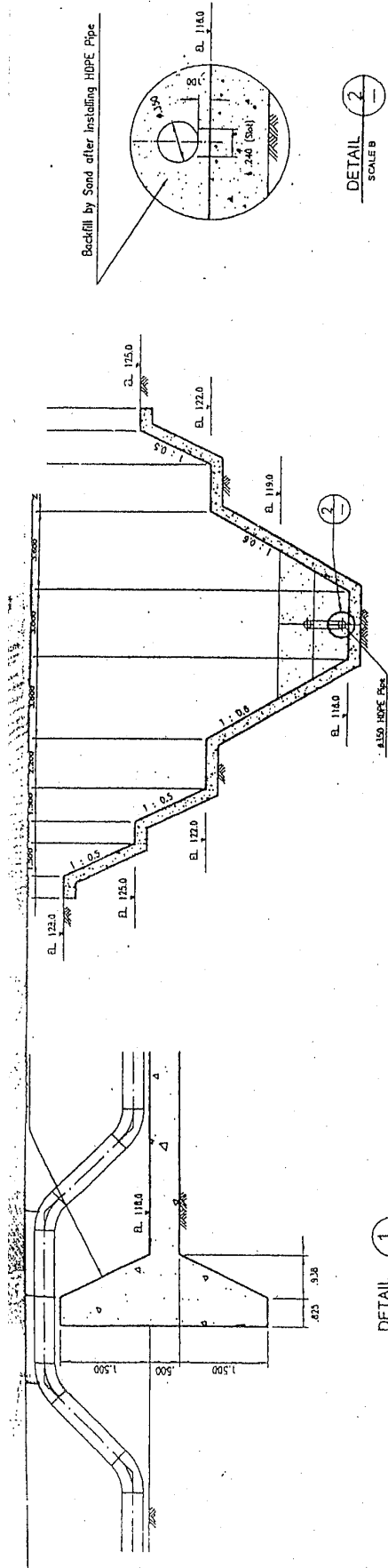
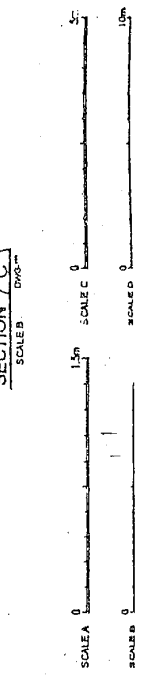
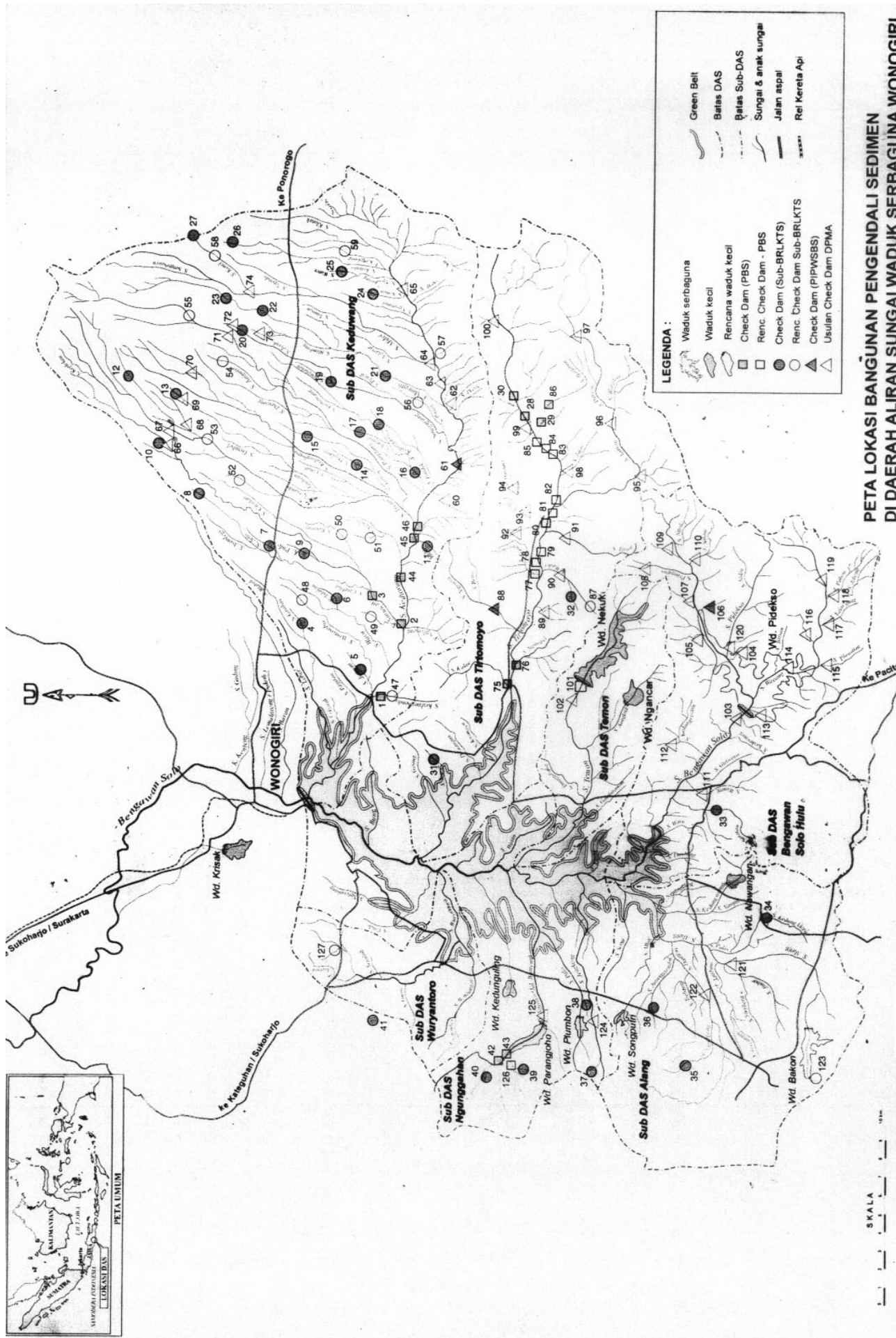


Fig. Hydro-type Sediment Discharge System (4/4)
(Section Details)



3-2-39

ハイドロパイプ工法の詳細



PETA LOKASI BANGUNAN PENGENDALI SEDIMEN
DI DAERAH ALIRAN SUNGAI WADUK SERBAGUNA WONGGIRI

図 3-3-1 既往および計画チエックダム位置図 (出典 : PBS 提供)

第4章 本格調査への提言

4 - 1 調査対象範囲

本格調査の対象範囲は、ウオノギリダム集水域及び、その下流部分の Madiun 川との合流地点までとしている(地図は、S/W に添付のとおり)。しかしながら下流部分については、対策によっては影響の出る範囲が変わるため、適宜インドネシア国側と協議の上、変更する必要がある。

4 - 2 調査により求められる成果と調査フロー

本格調査に求められるものは、第一義的には貯水池の堆砂対策である。その中でも取水口周りの堆砂問題については緊急性が高く、優先プロジェクトとして対策を立てる必要がある。また、貯水池全体へのアプローチとして、現在の堆砂問題を解決する工法の提案と流入土砂を低減する対策の提案が求められる。

これら対策検討のためのフローは次のように考えられる。

4 - 2 - 1 貯水池周辺堆砂対策

- (1) 貯水池周辺の観測計画
- (2) 観測、結果分析
- (3) 土砂沈降・浮上特性把握
- (4) 各種状況のデータベース化
- (5) 貯水池内土砂移動モデル構築、モデル検証
- (6) 将来予測
- (7) 対策プラン検討
- (8) 対策効果の検証

4 - 2 - 2 取水口周辺排砂工法

- (1) 工法検討および選定
- (2) 実証試験計画
- (3) 実証試験実施
- (4) 計画策定

4 - 2 - 3 流域保全対策

- (1) 流域内状況把握、データベース化
- (2) 土砂流出の計測
- (3) 住民社会調査

- (4) 土砂流出モデル構築、検証
- (5) 対策プラン検討
- (6) 対策効果の検証

4 - 3 要員構成

本調査には次の各分野を担当する団員が参加することを基本とする。なお、各団員の TOR は以下のとおりである

(1) 総括 / 貯水池堆砂対策

総括として調査全体の運営管理、報告書の取りまとめ、インドネシア国関係機関との協議、C/P やステークホルダー達との調整を行う。貯水池堆砂計画に係わる調査、計画の責任者として、堆砂調査、堆砂対策計画、対策施設、土砂貯水池上流域モデル、貯水池内モデル等の構築、実証試験などを統括する。

(2) 副総括 / 流域保全対策 / 土壌浸食

副総括として総括を補佐し、調査全体の運営管理にあたり、総括が現地に不在の際は総括に成り代わって調査を取りまとめる。また、ウオノギリ多目的ダム上流域の流域保全対策に係わる調査計画の責任者として、土壌浸食調査、土壌浸食モデル、侵食緩和対策計画、対策施設などを統括する。また、世界銀行が実施した流域保全のプロジェクトを評価し、本計画に反映させる。本団員は流域保全管理計画を責任者として実施した経験があることが望まれる。

(3) 取水口付近排砂工法

取水口付近の堆砂の排砂工法検討および実証試験の計画・監理を担当する。堆砂土質別の各種排砂工法の適用性、省エネルギー型の排砂工法に精通していることが求められる。

(4) 地形測量 / 堆砂測量

河川縦横断測量、貯水池内堆砂測量、構造物対策予定位置の平面測量・高低測量を担当する。一般的な測量技術に加えて、GPS 測量など最新の技術にも通じていることが期待される。

(5) 水文 / 気象 / ダム運用計画

PMF を再評価するための水文解析、堆砂対策を考慮したダムの運転管理計画作成を担当する。PMF 評価の経験を有することが望ましい。

(6) 農業 / 土壌

流域保全における農作物転換等の非構造物対策を担当する。熱帯モンスーン地域における土壌の特性、農業技術、可能栽培作物等に通じていることが求められる。

(7) 地質 / 土質

貯水池上流域の地質分布・地質構造把握、土砂生産ポテンシャルの把握、貯水池内堆砂の土質調査、構造物対策予定位置での地質調査を担当する。地すべり・砂防地質に加え、水上ボーリング、構造物基礎調査の経験があることが求められる。

(8) 河川内土砂移動

河床変動・貯水池内堆砂の実態把握、浮遊土砂量調査、流域内の土砂移動メカニズム解明、土砂貯水池内モデル、貯水池下流モデルの検討等を担当する。河川内および貯水池内の土砂移動実態・理論に精通していることが求められる。

(9) 水理数値解析

土砂移動の担当団員を補佐し、各種モデルの数値計算物理モデルの構築を担当する。土砂移動理論の知識を有することが望ましい。また、作業は国内を主とし、国内研究機関との連携の下で業務を遂行する。

(10) GIS / データベース

GIS システムを構築し、団員の収集した各種資料を GIS 上でデータベース化する。また、流域保全に関しては、GIS システム上に構築されたデータベースを利用して空間解析を行い、副総括が行う土壌浸食・土砂生産に関する量、土壌・土砂の性質の違い等を考慮した地域のゾーニング作業を補佐する。

(11) 社会調査 / コミュニティ活動

村落社会・経済調査、流域保全における啓蒙活動、コミュニティに基礎をおいた非構造物対策の実施計画を担当する。

(12) 組織 / 法制度

流域管理・堆砂対策を行う上での現況の組織体制・法制度の課題抽出および改善案の提案を担当する。

(13) 社会経済 / 財務

流域管理・堆砂対策事業実施主体の経済・財政基盤について調査し、選定されたプロジェクトの経済及び財務分析を行う。

(14) 環境社会配慮

マスタープランで提案されるプロジェクトの初期環境影響調査、実証試験に対する環境影響評価、優先プロジェクトに対する環境影響評価を担当する。ダム堆砂放流に関する環境影響評価

の経験があることが望ましい。

(15) 施設計画

総括・副総括を補佐し、ダム堆砂対策及び流域保全対策施設の位置、タイプ、レイアウト、規模、配置計画などを決定する。また、既存施設のレビュー・再評価も行う。

(16) 施設設計

提案されたプロジェクトの施設計画を実施する。

(17) 積算/工程計画

マスタープラン及びフィージビリティ調査における各プロジェクトの工事費積算及び工程計画を策定する。

4 - 4 調査実施上の留意点

調査の実施にあたっては、第二章の団長所感を参照するとともに、以下の項目についても留意し調査を実施すること。

4 - 4 - 1 堆砂対策全般

(1) ウオノギリダム貯水池の問題点

今回の調査では、以下の問題について重点的に考慮する必要がある。

支川のクドゥワン川からの土砂流入による堆砂が取水口周辺を覆っており、取水に支障が生じている。クドゥワン川の流域面積がウオノギリダム集水面積の 1/3 弱に達するとともに、流域に 3000m 級の山を有し流出土砂量が多いと推定されるのに対し、貯水池流入部から取水口までの貯水池容量が非常に小さく(河床勾配が大きいと考えられる)、貯水池全体の堆砂進行に先行して取水口部分の埋没が生じている。堆砂は、取水口周辺に既に到達しており、早急な対応が必要である。現地において最も深刻に受け取られているのは、取水口の問題である。

堆砂の進行がダム建設時の計画より遙かに速く、ダム完成の 1982 年から 2000 年の間に利水及び洪水調節容量の 30% 以上が消失し貯水池機能が損なわれている。要請書のデータによれば、年平均で 1,500 万 m³ 程度の容量損失が生じており、このまま堆砂が継続するとすれば 20 年程度で貯水池機能の大半が失われることになる。早急に対策方針を決める必要がある。

堆砂による洪水調節容量の減少により、ダムの洪水処理能力が減少しており、堤体越流に対する安全性が低下している。本ダム洪水吐きは可能最大洪水を対象に計画されており、ダムの安全性は堆砂の影響を受ける。現時点での具体的な安全性は不明であるため、堆

砂量の精度の良い把握を行うと共に、現状での安全性評価を早急に実施する必要がある。
また、貯水池が将来に亘って安全に機能するための信頼性予測手法を確立する必要がある。

(2) 堆砂対策検討上の留意事項

ウオノギリダム堆砂対策を検討する上で、以下の事項について留意する必要がある。

長期に亘り貯水池機能を維持できるものであること。

ウオノギリダムは既に広い地域に水を供給しており、用水供給機能を維持しつつ対策を講じる必要があること。

維持管理コストが小さいこと。

(3) 堆砂の性質

本調査で対象としている堆砂は、以下のような特徴を持っており、代替案の検討にはこれら特性を十分に把握した上で提案する必要がある。

土粒子のうち細粒分が主たる対象になる。

堆積土砂間に塵埃を挟んでいる可能性が高い。

ある程度深部、或いは水面上に露出した経験のある領域では、細粒分の圧密が進行している可能性がある。

4 - 4 - 2 取水口周辺の堆砂対策について

(1) 取水口周辺の工法選定について

取水口周辺の対策は、緊急を要するものであり、計画、実施の比較的容易な浚渫がその主たる候補になると思われる。この場合、維持費用の低減という点に留意してその工法を提案する必要がある。要請書にあるハイドロ式はその一つであるが、その適用の妥当性については必ずしも十分には整理されていないので、他の方法との比較を通じ再評価する必要がある。実証試験の必要性、あるいは有用性もそうした検討を通じて明確にする必要がある。

(2) 取水口周りの対策のフィージビリティ調査

取水口周りの対策については、緊急性や対策の必要性の高さから、マスタープラン全体の検討の段階においても暫定的にフィージビリティ調査を実施することも可能である。

(3) 排砂システムの環境への影響

排砂システムとして、流水のエネルギー利用を想定すると、排出土砂は下流河道に放出する必要がある。しかし、全て下流に放流すると排出濃度はかなり高くなることが予想され、環境上問

題を生じる可能性がある。このため、発電放流での希釈を考慮するなど、環境への影響を最小にする操作方法を考える必要がある。

(4) 実証試験の有効活用

緊急対策として、無償資金協力による取水口周辺の浚渫除去(5年間の機能維持対策)が実施されたところであるが、堆砂現象は年変動の激しい現象であり、大きな出水がある年の場合には短期間でその効果を失うこともあり得る。調査期間中は取水口周辺の堆砂進行状況に留意し、実証試験を取水口機能維持対策の一環として有効に活用することも考慮することが望まれる。

4 - 4 - 3 貯水池全体の堆砂対策について

(1) 貯水池の特徴と調査方法

堆砂対策の将来に亘る効果を予測するために、数値計算モデルが必要になることを想定している。このモデルは、ウオノギリダム貯水池が、貯水池面積が非常に大きく形状が複雑であり、流域面積の比較的大きい支川が複数存在することから、1次元計算では不十分の可能性もある。そのため、本調査においては貯水池内の堆砂現象を2次元モデルでシミュレーションすることを想定している。2次元計算等の数値計算等を行う際には、現地でプログラミングやモデル化を行うだけでなく、日本からの十分な支援を受けることのできる国内作業も必要と考えている。

(2) 貯水池の持続可能性の保障

貯水池の持続可能性の保障をするためには、ダム貯水池関連施設のライフサイクルマネジメントや設計アプローチを導入して、ウオノギリダム貯水池の既存施設の改善や新規施設の計画も視野に入れて総合的に検討する必要がある。

(3) 貯水池および流入支川堆砂実態の把握

流入支川の河床堆砂状況も含め、貯水池の堆砂状況を正確に把握することは、本流域における土壌浸食・土砂生産および堆砂のメカニズムを把握する上において非常に重要な基礎データとなる。しかしながら現状は、それらの基本的データが非常に乏しい状態である。そのため、本格調査では、基本データを集積し、正確なデータに基づいて実態を明らかにすることが肝要である。

(4) 貯水池堆砂の現状評価

深浅測量、河川縦横断測量による貯水池内及び支流末端での土砂堆積状況の調査、貯水池内のボーリング調査による堆砂構成物の分析などの基礎データを基に、ウオノギリダム貯水池の堆砂の現状を正確に把握し、堆砂プロセスの解明に努めることが重要である。特に、深浅測量ではGPSを利用した測定位置確認が重要であり、固定局と移動局間の無線送受信の信頼性を

確保する必要がある。

(5) 日本の研究機関との連携

堆砂現象の2次元モデルによるシミュレーションについては、その検討結果の精度を高めるため、日本の大学もしくは研究機関とも共同で取り組むことを想定している。そのためには、前提条件をある程度揃える必要があり、調査団が収集した地形や水文、土壌等の基礎データは共有することとする。また、現地調査開始までに、調査の方法、時期、内容について調査団、研究機関、当機構の3者で詳細打合せを行うこととする。

4 - 4 - 4 流域保全について

(1) 流域保全対策について

流域保全対策は根元的な対策と考えられているが、対象としている地域が面的に広がっているため、対策の完成に長期を要するとともに、効果発現の定量的な予測が困難な問題がある。しかしながら、堆砂データから土砂流出量の総量が把握可能なこと及び集水域の土砂流出形態がそれ程複雑でないことから、土砂生産量の把握、流域保全対策による土砂量低減効果の予測はある程度可能なものと思われる。

また、流域保全対策については、世界銀行による Upper Solo (Wonogiri) Watershed Protection Project(1989年～1994年)の流域保全活動を始めとして、大学・研究機関による様々な研究も行われている。そのため、大学・研究機関等との連携・協調を図りつつ、情報を効率的に収集し、調査に活用することが重要である。

(2) 貯水池上流域モデルと貯水池内モデルとの相互関係

貯水池モデルでは、流入土砂量は流量との関係で与える必要があるが、流出モデルでこうした関係を再現するのは理想的ではある一方、困難であると予想される。従って、相互のモデルの妥当性を表現するために何らかの工夫が必要であると考えられる。

(3) 土壌浸食・土砂生産量評価とダム上流域のゾーニング

土砂生産量の評価には、適切な土壌浸食および土砂生産地域のゾーニングが欠かせない。これらの検討は、収集あるいは取得したデータを利用してGISを駆使した解析を行うことになるが、その際、地域の土壌浸食・土砂生産のメカニズムを把握した上で、適切な分類を考案し、地域をゾーニングすることが大切である。また、土地登記上での森林と現実の土地利用が異なっている可能性もあるため、土地利用図、航空写真、衛星写真等からの判断だけでなく、重要ポイントは現地踏査により確認することが重要である。

(4) 自立的かつ持続的流域保全活動

流域保全に関する本件調査は、マスタープランを作成し、優先プロジェクトの選定を行うことが最終の目的ではなく、本格調査終了後、インドネシア側で自立的かつ継続的に流域保全対策が進むことが大きな目的の一つである。そのため、マスタープランの策定、優先プロジェクトの選定に際しては、十分にこれらに配慮することが求められる。また、調査という枠組みにとらわれることなく、パイロットプロジェクト等の実際の活動を調査に組み込むなど、柔軟に提案することも可能である。

4 - 4 - 5 調査全体に関する事項

(1) インドネシア国大学や調査研究機関との連携

本調査終了後、ダムの運営、流域保全はインドネシア国側が主体的に実施していくことになる。そのため、事業化後のモニタリングを継続的に実施するためには、インドネシア国内大学や調査機関を調査中から取り込み、彼らの今後の活動の一環とするなどの工夫も考えられる。このため、現在、当機構において現地大学もしくは研究機関との共同調査の体制を整えているところである。

本調査の結果をインドネシア国内に蓄積し、他の地域でも活用するためにも、大学や調査研究機関との連携は重要であり、調査期間中においても、その体制作りが求められることになる。

(2) TV 会議の利用

今回の調査は、既に確立された技術を用いるだけでなく、現在開発途上の技術の実用性の検討や、大規模貯水池全体のオペレーション計画など、高い精度の計画が求められる。そのため、調査団として重要事項を決定する際には、その内容について国内支援委員会との協議をすることが望まれる。どの時点で協議するかについては、調査開始時に当機構と交渉することとするが、調査団として協議すべきポイントが想定できれば、それを提案すること。

(3) 調査実施期間について

本調査については、インドネシア国側との協議により、取水口周辺の対策と流域保全対策については2年間で、貯水池全体の堆砂対策については3年間で結果を出すこととしている。調査内容としては、フェーズ1:マスタープラン策定、フェーズ2:フィージビリティ調査としているが、対策によってその調査期間は変わりうると考えている。そのため、本調査の計画に当たっては、レポートのタイミング等に捉われることなく、調査として適当と考えられるスケジュールを柔軟に提案すること。

(4) JBIC との連携

ソロ川の下流域では、JBIC のリハビリ維持管理改善事業(水資源セクター)が実施されており、主に河川施設の改修が成されている。本調査は結果が下流域へ影響を与えるとともに、下流域の計画・事業も考慮したダムの堆砂対策を計画する必要があるため、本格調査中における JBIC プロジェクトとの連携は必須である。また JBIC は、取水口周辺緊急対策のドナーとなる可能性も考えられるため、当機構と連絡を取りつつ連携を進めることが望ましい。

(5) プロジェクト評価手法について

本調査で提案されるプロジェクトは貯水池のリハビリ事業であるが、そのプロジェクトの評価をする際には、経済的な便益をどのように評価するのか、安全性の確保をどのように評価するのか等、貯水池堆砂対策プロジェクトを評価するための実用的な評価手法を工夫する必要がある。

(6) 調査範囲について

現時点では、調査範囲は、ウオノギリ多目的ダム全上流域およびソロ川本川のうちダム直下流からマディウン川合流点まで、としている。しかし、マスタープランで提案される対策内容によっては、調査範囲をさらに拡大する必要性が生じる可能性がある。

(7) ステークホルダー間の利害調整

本案件は、調査範囲にダム上流域の全体および下流域を含むこと、マスタープランでの提案プロジェクトは多義に渡ることが予想されること等から、ステークホルダーの多い案件になると想定される。そのため、本格調査の過程においても、出来る限りこれらのステークホルダー間の利害調整・合意形成に努める必要がある。

(8) 環境社会配慮

JICA 環境社会配慮ガイドラインでは、「幅広いステークホルダーの参加」及び「意思決定プロセスの透明性」を確保し、このための「情報公開」に努めるといった基本理念に基づき、各種の配慮事項、手続き規定が盛り込まれている。本調査においても本ガイドラインに沿って、適切な環境社会配慮がなされるよう努めることとする。なお、本ガイドラインの規定に則り、環境社会配慮に関わる一連の検討作業は、インドネシア国側の責任のもとに、JICA とインドネシア国側の共同作業として実施することとしている。

また、本調査においては、環境社会配慮にかかる記述を報告書に盛り込むだけでなく、調査中に作成した書類、インタビューシート、議事録等、協議の過程がわかるように、記録として残すものとする。

(9) 情報公開とパブリックコンサルテーション

JICA 環境社会配慮ガイドラインの趣旨を十分に踏まえ、調査の過程において十分な情報公開とパブリックコンサルテーションが行われるよう努める。情報公開については、相手国政府が主体的に行うことになっているが、調査団としてもインドネシア国政府に対しサポートを行う必要がある。なお、わが国側としての情報公開については、調査業務の一環として実施する。

また、パブリックコンサルテーションについては、その責任の所在は相手国政府に置きつつ、わが国側と相手国側の共同作業として実施することとしている。

(10) レポート作成

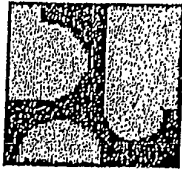
レポートは基本的に英語とするが、インドネシア政府からの要望もありインドネシア語版も作成することとしている。インドネシア語で作成する理由は、地方においてはほとんどインドネシア語しか通じないことと、今後、中央政府職員だけでなく地方職員も M/P 等を使用していくためである。インドネシア語版を作成するのは各レポートのサマリーもしくはメインレポートを想定しているが、前述の理由等と照らし、不要のものがあればそれを、またさらに必要と思われるものは、プロポーザルにて提案すること。

なお、各レポートのインドネシア語版については、英語版と同時期に先方政府に提出する必要はなく、中央政府職員とは英語のみで協議することも可能である。

(11) 資機材の選定と維持管理体制について

本調査で調達する機材は、原則として調査終了後は相手国 C/P に譲渡することとなり、その後の保守・維持管理についてはインドネシア側が実施しなければならない。そのため、本邦調達や現地調達に関わらず、本調査において調達する資機材については、代理店の有無など調査終了後においてもアフターケアサービスを受けられる方が望ましい。また、現地調査時においては、保守・維持管理を行うのが C/P であるという認識を持ち、調査活動中から資機材や施設について、常に誰が管理するのか、どのように管理するのかなどを明確にし、自ら維持管理できる体制を作ることが望まれる。

添付資料



The Republic of Indonesia
Ministry of Settlement and Regional Infrastructure
Directorate General of Water Resources

Wan

**APPLICATION FORM FOR JAPAN'S
DEVELOPMENT STUDIES / PROGRAM**

FOR

**THE STUDY ON COUNTERMEASURES FOR
SEDIMENTATION**

IN

WONOGIRI MULTIPURPOSE DAM RESERVOIR

August 2002

APPLICATION FORM FOR JAPAN'S DEVELOPMENT STUDIES / PROGRAM

Date of entry: month August year 2002

Applicant: the Government of the Republic of Indonesia

1. Project Digest

(1) Project Title: The Study on Countermeasures for Sedimentation in Wonogiri Multipurpose Dam Reservoir

(2) Location (Province/county name): Central Java Province/ Indonesia
(City/town/village name): Wonogiri city, Kabupaten Wonogiri
From the metropolis: about One (1) hours' flight to Surakarta (Solo) and about 1 hour ride from Surakarta (See attached Location Map as Figure 1)

(3) Implementing Agency

Name of the Agency: Solo River Basin Development Office (PIPWSBS), Directorate General of Water Resources, Ministry of Settlement and Regional Infrastructure (KIMPRASWIL)

Number of Staff of the Agency: Permanent Staff of PIPWSBS: 459 (Technical: 328, Non-technical: 131), Temporary Staff: 345 (Technical: 163, Non-technical: 182). As of April 2002

Budget allocated to the Agency: Rp. 127,940,000,000- (1999/2000)
(See attached organizational chart and allocated budget for 1999/2000 in Tables 1, 2 and 3)

In addition to the implementing agency, it is expected that the future watershed preservation will be implemented by the following agencies:

- a. Provincial Government of Central Java
 - BAPPEDA,
 - BAPPEDALDA,
 - Forestry Services,
 - Water Resources Services,
 - Mining Services, and
 - Agriculture and Livestock Services.
- b. Regional Government of Wonogiri Regency
 - BAPPEDA,

- Environment, Forestry and Mining Office (DLHKP),
 - Public Works Services,
 - Water Resources, Services, and
 - Agriculture and Livestock Services.
- c. Ministry of Forestry
- Directorate General of Land Rehabilitation and Social Forestry (DGLRSF),
 - Watershed Management Unit for Solo River Basin (BPDAS),
 - Watershed Management of Research and Technical Unit for Solo River Basin (BTPDAS), and
 - Perum Perhutani, the State Forestry Company (PERHUTANI).
- d. Ministry of Settlement and Regional Infrastructure (KIMPRASWIL)
- Perum Jasa Tirta I Public Corporation Bengawan Solo Branch (PJT-I BS).

A steering committee for the Study will be organized among the above agencies to achieve consensus for the formulation of the master plan and the future smooth implementation of the Study results. This steering committee hopefully is to be charged by the BAPPEDA of Central Java Province. KIMPRASWIL will be nominated as the executing agency for overall coordination of the Study, taking into accounts that PIPWSBS has responsibilities for the development and management, and PJT-I Bengawan Solo has responsibilities for the operation and maintenance works, of water resources within the Wonogiri reservoir watershed, respectively.

(4) Justification of the Project

4-1) Present Conditions of the Sector:

Wonogiri Multipurpose Dam

The Wonogiri Multipurpose Dam is the sole large storage reservoir in the mainstream of the Bengawan Solo River. The Bengawan Solo River, which flows through Central and East Java Provinces, is the largest river in Java with a watershed area of around 16,100 km² and a length of about 600 km.

The Wonogiri Multipurpose Dam was constructed in 1982 under the technical cooperation of former OTCA & JICA and financial assistance from GOJ (Yen loan of former OECF). Its function regulating the flood discharge, generating the electricity, and supplying water for irrigation, domestic, and industrial use to the downstream area.

Principal features of the Wonogiri Multipurpose Dam are summarized below.

Principal Features of Wonogiri Multipurpose Dam Reservoir

Facility	No.	Item	Feature
Dam (main dam)	1.	Dam type	Rockfill
	2.	Dam height	40 m
	3.	Crest length	830 m
Spillway	4.	Embankment volume	1,223,300 m ³
	5.	Design flood discharge	5,100 m ³ /sec
Reservoir	6.	PMF	9,600 m ³ /sec
	7.	Gross storage capacity	735 million m ³
	8.	Active storage capacity	
		Flood control	220 million m ³
		Irrigation & hydropower	440 million m ³
Hydropower generation	9.	Installed capacity	12.4 MW
	10.	Design head	20.4 m
	11.	Max. discharge	75 m ³ /sec (=2x37.5 m ³ /sec)
	12.	Annual energy output (6-hour peak operation)	32,600 MWh
Flood Control	13.	Flood inflow discharge	4,000 m ³ /sec
	14.	Flood outflow discharge	400 m ³ /sec
River outlet	15.	Max. discharge	35 m ³ /sec

Wonogiri Reservoir Watershed

The total Wonogiri dam catchment covers 1,350 km² consisting of approximately 90 km² of reservoir surrounded by 1,260 km² of watershed, and it is drained by six main rivers as shown in Figure 2. The majority of the Wonogiri watershed administratively belongs to Kabupaten Wonogiri (1,822 km²). The Wonogiri watershed covers 24 districts (Kecamatan) and 224 villages (Desa).

In 1985, about 70% of the watershed (dry-land farming and home yard area) is categorized as highly fragile to surface erosion. Forest covers only 13.2% of the watershed. These values reflect a high population density in the watershed. The current watershed population is estimated to be around 710,000 based on 1998 Kecamatan data, or 6 persons per hectare.

Since the above land use figures were compiled, the population has increased significantly. This will probably have had a negative effect on land use as the increasing population strives to feed itself. Such intensive cultivation coupled with poor land management has caused high rates of soil erosion and much gully erosion as shown in Photo 1. The eroded materials are the main source of sediment deposited in the Wonogiri reservoir as shown in Photo 2. The estimated average watershed erosion rate was 11 mm/year (Source: Basic Design Study Report for Urgent Countermeasures for Sedimentation in Wonogiri Multipurpose Dam Reservoir, December 2001).

Sedimentation in Wonogiri Reservoir

A number of surveys to evaluate the reservoir sedimentation have been completed since the 1980s. The current reservoir capacity was estimated on the assumption that the reservoir sedimentation rate since 1993 has been somewhat reduced as shown in Figure 3. The estimated capacity loss is summarized below.

Estimated Capacity Loss of Wonogiri Reservoir Storage Zones

Storage Zone	Elevation Range (m)	Reservoir Capacity in		Capacity Loss	
		1980 (mil. m ³)	2000 (mil. m ³)	Volume (mil. m ³)	Of Original (%)
Flood Control	135.3 – 138.3	220	146	74	34
Effective	127.0 – 136.0	440	270	170	39
Sediment	Below 127.0	120	39	81	68

The present condition of the Wonogiri reservoir in low water level is shown in Photo 3. The present effective storage capacity of the reservoir is roughly estimated to have decreased to nearly 64% of its original value. It means that the Wonogiri dam is not safe condition against Probable Maximum Flood (PMF) because of decreasing of storage capacity for flood control.

According to the surveys for reservoir sedimentation, the profile shows sediment blocking had occurred to more than 80% of the level of the intake at the trash racks as shown in Figure 4. As a result, frequent power generation stoppages have occurred due to partial blockage of the water intake. The intake located in the fore-bay that provides water to the power house and downstream irrigation system is severely affected by such sediment deposits. The intake is shut down on a regular basis to allow for the removal of sediment.

Japan's On-going Grant Aid Project

In order to cope with the above sedimentation problem in the Wonogiri reservoir, the Government of Indonesia (GOI) requested further aid from Japan's Grant Aid Project. The request was to cover:

- (a) Construction of two check dams (sand storage volume in total: about 550,000 m³) on the Keduang River to mitigate sediment inflow into the reservoir.
- (b) Urgent sediment dredging of about 100,000 m³ in front of the intake to assure the continuing water supply, and
- (c) Establishment of a permanent dredging system to allow sustainable maintenance dredging of sediment deposited in front of the intake.

In response to the above request, GOJ dispatched the JICA Team since June 2001 to December 2001. JICA Team and the Ministry of Settlement and Regional Development (KIMPRASWIL) agreed on the following scope of works for the Assistance Project based on the field survey and held discussions during the basic design study.

- (a) Inspection and repairing of gates and valve (see attached Figure 5),
- (b) Urgent dredging works and removal of garbage (see attached Figure 6),
- (c) Provision of floating log boom (see attached Figure 7), and
- (d) Establishment of echo sounding survey system with GPS navigation equipment (see attached Figure 8).

JICA Team has carried out the detailed design including preparation of tender documents for the

above scope of works since March 2002 until July 2002, and the urgent countermeasures for sedimentation is scheduled to commence since October 2002 for 2 years.

4-2) Sectoral Development Policy of the National/Local Government:

Relation with the government's national development plan

Name of the plan : National Development Plan (PROPENAS)

Period : from 1999 to 2004

The National Policy Guidelines (GBHN: Garis-Garis Besar Haluman Negara) were issued on December 19, 2000 by the new Government established in October 1999. GBHN stipulates the strategic directions in which national economic development should be undertaken. GBHN highlights

- (i) Promotion of free market mechanism,
- (ii) Promotion of healthy and fair competition,
- (iii) Promotion of public transparency, and
- (iv) Development of national economic competitiveness in any economic development program.

Under these directions, the Government has put emphasis on the following policies,

- (i) Stabilization of macro-economic environment required for making a better ground for operation of the national economy,
- (ii) Relief of current economic hardships faced by poor people and programs for a social safety net, and
- (iii) Enabling the national economy to move forward.

Based on the stipulation in GBHN, the National Development Plan during the period 1999-2004 (PROPENAS) has been approved. The economic targets of PROPENAS are,

- (i) To achieve fast economic recovery,
- (ii) To assure the availability of stable supplies and medicines within a reasonable price range,
- (iii) To decrease the unemployment level and total population living in poverty, and
- (iv) To increase the competitiveness and efficiency of national business activities.

Relation with the sector comprehensive/overall program

Name of the plan : Self-reliant Movement for Expansion of Agricultural Production (GEMA Plan)

Period : from 1999 to 2004

After the economic crisis in 1997-1998, the Government launched the GEMA Plan (Gerakan Mandiri Peningkatan Produksi) to expand the production of food crops, livestock and fisheries. The

objective of the GEMA Plan is

- (i) Acceleration in the production of various crops, animal products and fisheries,
- (ii) Generation of substantial jobs and income for poor people,
- (iii) Increase of export revenues through the exportation of agricultural products,
- (iv) Diversification of nutrient status excessively relying on rice,
- (v) Development of national food security,
- (vi) Improvement of farmer's independence and power to operate their farming business to the greatest possible extent and to improve their product competitiveness.

Among the current irrigation systems in the Bengawan Solo River basin, the Wonogiri irrigation system has the highest rice production with three cropping per year contributing significantly to self-sufficiency in rice production.

4-3) Problems to be solved in the Sector:

Japan's Grant Aid Project has, as its main focus, the avoidance of serious blockage of the water intake by means of urgent dredging works and associated works. It might be said that the likelihood of intake blockage is not fully avoided but is prolonged by around 5 years by completion of the Project. However, the following problems are still remaining for Wonogiri multipurpose dam after the completion of the ongoing urgent countermeasures:

- The dam is not safe condition against PMF because of the decreasing of storage volume, and
- The intake facility would be blocked in near future because of the sedimentation.

The short, middle, and long term countermeasures shall be timed to complete at the latest 5 years after the scheduled completion of the Assistance Project in March 2004:

4-4) Outline of the Project:

A comprehensive approach for the Wonogiri watershed management would be the best solution against reservoir sedimentation issues, although it will require a relatively long lead-time and large expenditure towards the completion say more than 10 years. Restoration of the Wonogiri reservoir shall be based on technically sound measures:

The Study is composed of two main components:

Component 1: Formulation of master plan for permanent countermeasures for sedimentation problems in the Wonogiri multipurpose dam reservoir

Component 2: Undertaking of feasibility study on the selected priority projects

Particular concern shall be paid to a careful review on the safety of Wonogiri dam against PMF. If assessed to be crucial, securing the dam safety should be given a top priority. Technically

conceivable measures shall be proposed and implemented to eliminate the potential for overtopping of the dam (dam failure) due to occurrence of PMF.

In this study, a verification test of hydro-type dredging system will be highlighted. In view of budgetary limitation for continuous maintenance dredging, a hydro type dredging system (see attached Figure 9) and the installation of a mechanical raking system on the screen of the intake (see attached Figure 10) is recommendable as a short-term measure. However it must be subject to justification from the economic and technical aspects under the master plan study.

4-5) Purpose (short-term objective) of the Project:

The short-term objective is to provide permanent sediment removal system to secure the water intake function of the Wonogiri dam with the continuing sediment inflow. The system shall be allowing continuous maintenance dredging of the intake fore-bay to avoid impending intake stoppages without less O&M cost.

4-6) Goal (long-term objective) of the Project:

The full recovery of the Wonogiri reservoir should be given top priority. In order to secure the dam reservoir space for water utilization and flood control in the long-term, there is a need to study mid- and long-term countermeasures such as watershed conservation, in-reservoir sediment management, and structural measures to prevent sediment flowing into the reservoir.

4-7) Prospective Beneficiaries:

Area that will benefit from the project

The Wonogiri reservoir is a life line facility for the Bengawan Solo River basin in that it provides a stable water supply in the dry season. The reservoir is supplies water to:

- Wonogiri irrigation system (nearly 30,000 ha),
- Other downstream pumping irrigation areas in five Kabupaten (nearly 14,000 ha in total),
- Domestic water to three Kabupaten, and
- Industrial water to Kabupaten Gresik, part of the Surabaya Metropolitan Area.

As a result, the whole Bengawan Solo River basin, an area of approximately 16,100 km², will benefit from the project.

Population that will benefit (directly and indirectly)

The total population of around 17 million within the Bengawan Solo River basin will directly and indirectly benefit from this project. It is noted that the Wonogiri reservoir is also used for flood control to regulate the design flood peak discharge of 4,000 m³/sec to only 400 m³/sec. This flood

discharge regulation brings about significant flood control effect at Surakarta City, one of the core industrial and commercial centers of Central Java Province.

Expected social and economic effects

- i) Contribution to the national and regional socio-economic developments
- ii) To secure water supply for irrigation, drinking and industry

4-8) The Project's Priority in the National Development Plan/Public Investment Program:

The five-year National Development Program (PROPENAS, 1999-2004) was released in August 2000 as a high level program of the Government of Indonesia (GOI). The objectives of good maintenance and administration of industrial infrastructure (including those of water resources development), assurance of a stable food supply, and increasing farmers' income are set in Chapter 4 of PROPENAS. In line with this policy, the target of this Project is to solve the sedimentation problems in the Wonogiri multipurpose dam reservoir and to continuously maintain the original functions of the dam for irrigation, power generation, and flood control.

(5) Desirable or Scheduled Time of the Commencement of the Project:

month June year 2003

(6) Expected Funding Source and/or Assistance (including external origin) for the Project:

JICA Study

JICA will be required to provide funds of about 500 million Japanese yen, consisting of 360 million yen for the remuneration of experts and 140 million for direct costs.

Implementation

Grant aid funds of about 300 million Japanese yen would be required from JICA for the construction of a hydro-type dredging system and mechanical raking system. In addition, a loan of about 5 billion Japanese yen would be required from JBIC for the construction of structural measures such as check dams, gully plugs, etc. in the watershed.

(7) Other Relevant Projects, if any.

Watershed Protection Project funded by a World Bank

The Upper Solo (Wonogiri) Watershed Protection Project funded by a World Bank loan was conducted by the Watershed Management Technology Center of Surakarta (within the Ministry of Forestry) from 1989 to 1994. The project objective was to reduce the soil erosion rate from the Wonogiri watershed and therefore increase the life of the reservoir. Soil conservation practices were adopted by means of improving farming techniques to reduce sheet and rill erosions and

providing civil structures and vegetation to reduce gully and river bank erosions.

The project concluded that the conservation practices introduced during the 1989-1994 period had significantly reduced the rate of sediment inflow into the reservoir, thereby increasing the life of Wonogiri from 27 to 50 years. However the current state of sedimentation in Wonogiri reservoir suggests that a significant reduction in soil erosion and delivery rate to the reservoir or improved land use practice of the large agricultural population has not occurred as reported.

Improving and changing current land use practice to reduce the erosion rate seems a near impossible task given the high population and the present economic climate. The construction of gully erosion and sediment control facilities by the project is commendable. However, the structures are too small in view of the high sediment production from the Wonogiri watershed.

2. Terms of Reference of the Proposed Study

(1) Necessity/Justification of the Study:

Wonogiri multipurpose dam reservoir, aiming at flood control, irrigation water supply (30,000 ha), domestic water supply and power generation (13,000 kW), is the largest reservoir in the Solo river basin in Java island. The dam was formulated as high priority project in the Master Plan for water resources development in the Solo River basin in 1974, and the construction has been completed in 1981. After completion of the Wonogiri dam, the Solo river basin down-stream of the dam has been continuously improved by irrigation development and river channel improvement.

However, during this period, land reclamation has also continued in the Wonogiri watershed through resettlement of people from the reservoir area, and consequently 80% of the watershed is now under cultivation. Accordingly, erosion in the watershed has accelerated, and large volumes of eroded material and garbage due to agricultural activity have flowed into the Wonogiri dam reservoir. As a result, the effective volume of the reservoir, which plays a key role in the development of the Solo river basin, has been decreased by up-to about 64%.

Maintaining the functions of the Wonogiri multipurpose dam reservoir is indispensable to sustain the economic activity of the people living down-stream of the dam.

The Project on Urgent Countermeasures for Sedimentation in the Wonogiri Multipurpose Dam Reservoir has been under-way since June 2001 under the grant aid scheme of Japan. However, this entails dredging near the intake channel and portal portions (about 250,000 m³) to secure the water intake function of the dam for 5 years (the project lifetime).

Even if the ongoing JICA grant aid project is completed, sedimentation in the Wonogiri reservoir

will still be occurring at a high rate affecting both the flood control and water utilization capacities because soil erosion in the watershed is unchanged. The Wonogiri watershed area has been recognized as one of the most critical watersheds in the Solo River Basin showing high rate of soil erosion resulting from current land use practice sustaining the large agricultural population.

A study on permanent countermeasures to reduce the sediment volume flow into the reservoir and to secure the water intake function of the dam is strongly recommended.

(2) Necessity/Justification of the Japanese Technical Cooperation:

Water resources development in the Bengawan Solo River basin has been closely related to the technical and financial assistance program of Japan. Since the establishment of Solo River Basin Development Office (PIPWSBS), various studies and projects have been implemented under the technical cooperation of JICA and financial assistance of JBIC (formerly OECF) as described in Section 10-2).

When sedimentation issues in the Wonogiri reservoir arose in 2000, the Government of Indonesia requested the Government of Japan extend a grant aid for urgent countermeasures, noting that Japan had extensive experience in the rehabilitation of reservoirs suffering from huge sedimentation such as the Wonogiri reservoir. The Project on Urgent Countermeasures for Sedimentation in Wonogiri Multipurpose Dam Reservoir has now been ongoing since June 2001 under the Japan's Grant Aid.

As a continuation of this project, the accumulated knowledge and experiences of Japan regarding watershed management and reservoir restoration would be of great help in the execution of the Study.

(3) Objectives of the Study:

The objectives of the Study are to:

- i) Formulate a master plan for permanent countermeasures for sedimentation problems in the Wonogiri multipurpose dam reservoir,
- ii) Carry out the verification testing of hydro-type dredging system, and
- iii) Carry out a feasibility study of the selected priority project.

Transfer knowledge on technological measures for rehabilitation of reservoirs and watershed management to the Government personnel and counterparts who would participate in the Study.

It is recommended that a feasibility study be undertaken on the selected short-term project that would be implemented as the subsequent part of the on-going Japan's Grant Aid Project. To achieve full recovery of the Wonogiri reservoir, comprehensive watershed management approach is necessary. The master plan should thus be formulated to take into account both structural and

non-structural elements. For the non-structural element, public involvement to encourage soil conservation practices by local farmers in the Wonogiri watershed would be of great importance to reduce the erosion rate from dry land farming and to relieve the burden of maintenance dredging in the Wonogiri reservoir.

(4) Area to be covered by the Study:

The Study area is 1,350 km² covering the entire catchment of the Wonogiri dam. The area comprises 1,260 km² of watershed and 90 km² of the reservoir surface area.

(5) Scope of the Study:

The Study comprises the following two phases:

- Phase 1: Formulation of master plan
- Phase 2: Feasibility study of the selected priority project

Major work items of each phase are summarized below.

Phase 1: Formulation of Master Plan

- 1) Study of countermeasures for the reservoir & dam facilities
 - Sedimentation survey in the Wonogiri reservoir
 - Investigation and evaluation of current status of sedimentation at the existing check/sabo dams
 - Evaluation of current status of sedimentation in the Wonogiri reservoir
 - Projection of sediment inflow and sedimentation in the Wonogiri reservoir
 - Collection of hydro-meteorological records as well as reservoir operation records
 - Hydrological analysis on PMF
 - Evaluation of performance of historic reservoir operations
 - Evaluation and countermeasures on dam safety against PMF
 - Evaluation of lifetime of reservoir & dam facilities
 - Study on conceivable countermeasures for reservoir & dam facilities
 - Study on re-utilization of dredged sediments
- 2) Preparation of verification test of hydro-type dredging system
 - Preparation of layout plan, working plan and cost estimate
 - Preparation of tender document
 - Tendering
- 3) Study of countermeasures for watershed conservation
 - Aerial photo shooting and topographic mapping for the Wonogiri watershed
 - Satellite image analysis for land use change
 - GIS analysis for land use mapping

- GIS analysis for watershed zoning in view of soil erosion
 - Investigation and evaluation of previous watershed management plans and activities
 - Evaluation of soil erosion and delivery rates to the Wonogiri reservoir
 - Investigation for socio-economic situation of households in the watershed
 - Market survey for agro-forestry and agro-industry
 - Study on conceivable countermeasures for watershed conservation and land rehabilitation
- 4) Study on operation & maintenance and watershed conservation
- Review and evaluation of present O&M activities
 - Review of institutional framework of watershed management
 - Study on conceivable countermeasures for O&M strengthening
 - Study on conceivable countermeasures for institutional strengthening
- 5) Formulation of master plan
- Planning for reservoir & dam facilities
 - Planning for watershed conservation
 - Planning for O&M strengthening for dam facility
 - Planning for institutional strengthening for watershed management
 - Cost estimation
 - Project evaluation
 - Preparation of implementation schedule
 - Selection of priority projects

Phase 2: Feasibility Study of the Selected Priority Project

- 1) Additional survey and additional field investigation
- Topographic survey
 - Geological investigation
 - Hydrological survey
 - Environmental survey
- 2) Execution and evaluation of verification test of hydro-type dredging system
- Verification test of hydro-type dredging system
 - Monitoring and observation of performance of hydro-type dredging system
 - Evaluation of verification test
- 3) Facility design and study
- Optimization study of the project and layout design
 - Feasibility design of the project facilities
 - Estimate of project cost
 - Economic and financial analysis
 - Preparation of project implementation program

4) Preparation for watershed preservation

- Preparation of community empowerment plan (containing the process of micro planning, awareness raising and environmental education, group formation of local people, social safety net, gender consideration, etc.)
- Preparation of monitoring plan (on erosion and sedimentation, water quality, water balance, and watershed information system employing GIS and satellite images, etc.)
- Preparation of plan implementation program

(6) Study Schedule:

The envisaged works flow-chart and work schedule for the Study is shown in Figure 11 and Table 4. The total study period is expected to be 24 months.

The following team of foreign experts will be required for the Study:

- Team Leader / Civil, Countermeasures for Reservoir Sedimentation
- Co-team Leader / Watershed Preservation
- Aero- photo Mapping Expert
- GIS Expert
- Surveyor / Topographic survey & Reservoir Sedimentation Survey
- Hydro-type dredging System Expert
- Geologist
- Social Environmentalist
- Natural Environmentalist
- Hydrologist
- Civil Engineer / Dam & Related Facility
- Watershed Preservation Facility Expert
- Agriculture / Soil Expert
- Afforestation Expert
- Construction Planner & Cost Estimator
- Legislation / Social-structure Expert
- Socio-economist

The manning schedule for foreign experts is shown in Table 5, and the total amount of man-months required is assumed to be 160.

(7) Expected Major Outputs of the Study:

Permanent Sediment Removal System for the Intake Facilities in the Wonogiri Multipurpose Dam

In order to maintain the water intake function of the Wonogiri dam reservoir, establishment of a permanent sediment removal system that would allow continuous maintenance dredging of fore-bay in front of the intake facility would be proposed. A hydro-type dredging system (see attached

Figure 9) associated with a mechanical raking system on the intake-screen (see attached Figure 10) is strongly recommended.

Framework for Rehabilitation and Conservation in the Wonogiri Watershed

Soil erosion is a natural process on the slopes, and it is impossible to stop erosion completely. However, appropriate control measures would be able to maintain soil loss below a threshold level to decrease the rate of the Wonogiri reservoir sedimentation. A framework will be established for rehabilitation and conservation of critical lands in the Wonogiri watershed with a main focus on the watershed conservation through sustainable land use.

(8) Possibility to be Implemented / Expected Funding Resources:

It is expected that Japan's Grant Aid funding to set up a hydro-type dredging system and install a mechanical raking system would be available because these are considered to be part of the ongoing Japanese assistance project for the urgent countermeasures for Wonogiri dam. Funding for the other major outputs should be from Indonesian Government funds or loans from donor agencies.

(9) Request for the Study to Other Donor Agencies, if any:

None

(10) Other Relevant Information

10-1) Beneficiaries

Irrigation Water Supply

The Wonogiri multipurpose dam supplies irrigation water to the 29,590 ha of Wonogiri irrigation system as shown in Figure 12, which is the benefit area of this Project. The number of beneficiaries is estimated at 45,200 households. By the implementation of this Project, it is possible to maintain the cropping area and harvest shown in the following table. However, if this Project is not implemented, the intake of the dam will be completely blocked and the cropping area and yield will be reduced as shown in the below table. The loss due to the reduced harvest will be annually Rp. 187×10^9 at the present market price of 1,220 Rp./kg. This is considered to be the direct effect of this Project.

List of Cropping Area and Yield with and without
the Countermeasures for Sedimentation in Wonogiri Reservoir

Index	The Present	The Intake of the Dam being Blocked
Land use		
Paddy field (Irrigation)	27,356 ha	21,100 ha
Sugarcane field		2,100 ha

Index	The Present	The Intake of the Dam being Blocked
Paddy field (Rain-fed) Upland field	2,233 ha	
Project area	29,589 ha	23,200 ha
Paddy Area (Irrigation)		
Rainy Season	26,523 ha	19,000 ha
Dry season-I	26,360 ha	19,000 ha
Dry season-II	23,142 ha	11,600 ha
Annually irrigated area	76,025 ha	49,600 ha
Cropping area		
Paddy (rainy season)	28,756 ha	19,000 ha
Paddy (dry season-I)	26,360 ha	19,000 ha
Paddy (dry season-II)	23,142 ha	11,600 ha
Palawijia & Others	1,444 ha	2,100 ha
Annual cropping area	79,702 ha	51,700 ha
Cropping intensity		
Paddy (rainy season)	97 %	82 %
Paddy (dry season-I)	89 %	82 %
Paddy (dry season-II)	78 %	50 %
Palawijia & Others	5 %	9 %
Annual cropping intensity	269 %	223 %
Yield of irrigated paddy	5.5 t/ha	5.5 t/ha
Annual rice production	425,950 t	272,800 t

Source: WATSAL Feed back study

As an index to assess the effect of the implementation of this Project, the cropping area for each cropping season will be measured. For the yield of irrigated paddy, there are variations between cropping seasons and large differences between official yields and those based on direct reports from farmers. Therefore, the yield of irrigated paddy will not be used as an index.

Water Supply for Power Generation

Power stations in the islands of Java and Bali are connected by one power supply system (Java-Bali power supply system) and all electricity is supplied through the united power supply market. Therefore, there is no specific beneficiary area of the Wonogiri hydropower station. However, the longer the power transmission lines, the bigger the transmission loss, so the beneficiary area is primarily considered to be central Java province. Also, dividing the annual power generation energy of the Wonogiri power station (50,000 MWh) by the annual power consumption of an average household (820 kWh), the number of beneficiaries is estimated at 61,000 households.

It will be possible to maintain the annual power generation of 50,000 MWh after the completion of this Project. However, if this Project is not implemented, the intake of the dam will be fully blocked

with power generation becoming impossible. The loss will be annually Rp. 10×10^9 , estimated by multiplying the electricity sale price of 200 Rp./kWh at September in 2001 by the annual power generation energy of 50,000 MWh. This is considered to be the direct effect of this Project.

Further, the indices adopted to assess the effect of this Project are the annual power generation energy by the month, the maximum intake of water, and the number of stoppage days of power generation each month.

10-5) Water Resources Development Projects in Bengawan Solo River Basin

The land and water resources in the Bengawan Solo River basin have been developed from ancient times. In the 19th and the early 20th Centuries, when the land was ruled by the Dutch administration, great efforts were made to develop the basin's water resources by constructing small irrigation dams, irrigation intake weirs and irrigation facilities. Most of the existing irrigation systems in the basin were conceived during this period.

Around 1880, the river mouth of the Bengawan Solo River was diverted away from the Surabaya Strait in a northern direction to the Java Sea. This was to prevent sediment built up from the huge volumes of sediment conveyed and deposited by the river at the strait.

The Bengawan Solo River Basin Development Office (Proyek Bengawan Solo) was established in 1969 after the independence of Indonesia, focussing on irrigation development and flood mitigation in the basin. A variety of water resources development projects have so far been undertaken by PIPWSBS. Table 6 summarizes the history of the Bengawan Solo River basin development showing major projects in chronological order. The location map of major projects is also presented in Figure 13.

OTCA Master Plan

Water resources development in the Bengawan Solo River Basin started in 1969 with remedial measures in response to serious flood damage that occurred in 1966 and 1968. In 1972, an overall survey and study of the whole river basin commenced as the first step in the development under the technical assistance of OTCA, and the development master plan was then formulated in 1974.

PIPWSBS has implemented major water resources development projects under the technical cooperation of JICA and with the financial assistance of JBIC (former OECF) as listed below.

List of Major Water Resources Development Projects in Solo River Basin

No	Project Name	Stage	Period	Agency Cooperated
1.	Wonogiri Multipurpose Dam Project	F/S	1974-1975	JICA
		D/D	1976-1978	OECF
		C	1977-1982	OECF
2.	Wonogiri Irrigation Project	F/S	1975-1976	JICA
		D/D	1977-1979	OECF
		C	1980-1987	OECF
3.	Upper Solo River Improvement Project	F/S	1975-1976	JICA
		D/D	1983-1985	OECF
		C	1987-1994	OECF
4.	Madiun River Urgent Flood Control Project	F/S	1980	JICA
		D/D	1983-1985	OECF
		C	1987-1995	OECF
5.	Lower Solo River Improvement Project (on-going)	F/S	1983-1986	CIDA
		D/D	1992-1994	OECF
		C	1996-	OECF

Note: F/S: Feasibility Study, D/D: Detailed Design, C: Construction

10-3) Establishment of Autonomous River Basin Management Corporation for Bengawan Solo River Basin

During 1997 and 1998, Indonesia has undergone an economic and social crisis, resulting in political change that has led to radical and decisive reforms in many sectors, including the water resources sector. In order to overcome the crisis, the Government has introduced a wide spectrum de-regulation policy, which put the new Law No. 22 of 1999 on Regional Government and Law No.25 of 1999 on Financial Balance between Central and Regional Government into effect. These laws concern regional administration and fiscal equalization between the central and regional government and redefine the role of Government.

Accordingly, the Central Government has initiated new water resources policy formulation including institutional and legal reforms within the wider context of national reform and basic changes in public administration including a structural adjustment program.

In the course of the on-going water resources sector reform program, improving the current water resources management is highlighted in the selected the six highly developed strategic river basins within Indonesia. The policy goal is to establish the organizational and financial framework for sustainable (self-financing) and autonomous river basin management corporations compatible with regional autonomy legislation. Along this line, PIPWSBS has been re-organized to be a self-financing river basin management corporation.

At the present, PIPWSBS tasks are to develop and manage of large-scale structures. PJT-I Bengawan Solo has been established in April 2002 in accordance with presidential decrees (No.

129/2000). PJT-I Bengawan Solo has been adopted by PJT-I Malang under control by the State Ministry of State Owned Cooperation. PJT-I Bengawan Solo has responsibilities for operation and maintenance (O&M) for twenty five rivers including the Bengawan Solo river in the Solo river basin

To gain proper finance for the above O&M with due regard for the necessity for a stable water supply to the public by the public utilities, the O&M works of the Wonogiri multipurpose dam is undertaken by PJT-I Bengawan Solo.

The corporation is intended to perform financially sustainable integrated river basin management based on water allocation and equity rights for both consumptive and non-consumptive uses, i.e., corporate financing is to be achieved from bulk water supply fees and waste water discharge fees. The Wonogiri reservoir is the sole and primary storage reservoir for the new corporation supplying various water uses within the Bengawan Solo River basin.

Special attention will be given to the O&M activities of water resources infrastructure as well as budget allocation. Considering that the Wonogiri Multipurpose Dam is the sole large storage reservoir supplying various water uses, it is of utmost importance that sustainable O&M of the dam be borne by the corporation. Therefore, allocation of budget to the sediment removal system will be a high priority.

3. Facilities and Information for the Study

(1) Assignment of Counterpart Personnel of the Implementing Agency for the Study:

The following counterpart personnel of the implementing agency will be required for the Study:

- Chief counterpart / Civil, Countermeasures for Reservoir Sedimentation
- Co-chief counterpart / Watershed Preservation
- Aero- photo Mapping Expert
- GIS Expert
- Surveyor / Topographic survey & Reservoir Sedimentation Survey
- Hydro-type dredging System Expert / Mechanical
- Geologist
- Social Environmentalist
- Natural Environmentalist
- Hydrologist
- Civil Engineer / Dam & Related Facility
- Watershed Preservation Facility Expert
- Agriculture / Soil Expert

- Afforestation Expert
- Construction Planner & Cost Estimator
- Legislation / Social-structure Expert
- Socio-economist

Their total amount of man-months required is assumed to be 160.

(2) Available Data, Information, Documents, Maps, etc. Related to the Study:

Table 7 shows the available data, information, documents, maps, etc. related to the Study.

(3) Information on the Security Conditions in the Study Area:

No security problems are expected to occur in and around the study area.

4. Global Issues (Environment, Gender, Poverty, etc.)

(1) Environmental components (such as pollution control, water supply, sewage, environmental management, forestry, biodiversity) of the Project, if any.

Watershed management is one of the main components of this Study. The objective is to reduce the soil erosion rate from the watershed and therefore to prolong the life of the Wonogiri dam reservoir. Soil conservation practices to be adopted include improved farming techniques to reduce gully and river bank erosion.

(2) Anticipated environmental impacts (both natural and social) by the Project, if any.

If the hydro-type dredging system to continue the dredging works in front of the intake facility is eventually adopted for Wonogiri dam reservoir, much of the dredging material from the reservoir will flow down-stream of the Solo River. It would contribute to the recovery of the natural environmental conditions of the Solo River. However, water pollution of the Solo River down-stream of the Wonogiri dam and an increase in sediment flowing into the two main irrigation canals at Colo intake weir of the Wonogiri irrigation system would create a negative impact. Appropriate countermeasures against this problem should be taken.

(3) Women as main beneficiaries or not.

Not.

(4) Project components which require special considerations for women (such as gender difference, women's specific role, women's participation), if any.

None.

(5) Anticipated impacts on women caused by the Project, if any.

None.

(6) Poverty alleviation components of the Project, if any.

Indirect benefit of the watershed management of this Study is to contribute to the national and regional socio-economic development in the watershed area of the Wonogiri dam reservoir.

(7) Any constraints against low-income people caused by the Project.

None.

5. Undertakings of the Government of the Republic of Indonesia

In order to facilitate the smooth and efficient conduct of the Study, the Government of the Republic of Indonesia shall take necessary measures:

- (1) to secure the safety of the Study Team,
- (2) to permit the members of the Study Team to enter, leave and sojourn in the Republic of Indonesia in connection with their assignment therein, and exempt them from foreign registration requirements and consular fees,
- (3) to exempt the Study Team from taxes, duties and any other charges on equipment, machinery and other materials brought into and out of the Republic of Indonesia for the conduct of the Study,
- (4) to exempt the Study Team from income tax and charges of any kind imposed on or in connection with the implementation of the Study,
- (5) to provide necessary facilities to the Study Team for remittance as well as utilization of the funds introduced in the Republic of Indonesia from Japan in connection with the implementation of the Study,
- (6) to secure permission for entry into private properties or restricted areas for the conduct of the Study,
- (7) to secure permission for the Study Team to take all data, documents and necessary materials related to the Study out of the Republic of Indonesia to Japan, and,
- (8) to provide medical services as needed. Its expenses will be chargeable to members of the Study Team.

6. The Government of the Republic of Indonesia shall bear claims, if any arise against member(s) of the Japanese Study Team resulting from, occurring in the course of or otherwise connected with the discharge of their duties in the implementation of

the Study, except when such claims arise from gross negligence or willful misconduct on the part of the member(s) of the Study Team.

7. The Solo River Basin Development Office (PIPWSBS), Directorate General of Water Resources, Ministry of Settlement and Regional Infrastructure shall act as counterpart agency to the Japanese Study Team and also as the coordinating body in relation with other governmental and non-governmental organizations concerned for the smooth implementation of the Study.

8. The PIPWSBS will, as the executing agency of the project, take responsibilities that may arise from the products of the Study such as in the case of a Detail Design Study being requested.

The Government of the Republic of Indonesia assures that the matters referred to in this form will be ensured for the smooth conduct of the Development Study by the Japanese Study Team.

Signed: _____

Title: _____

On behalf of the Government of the Republic of Indonesia

Date: August 2002

ATTACHMENT

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