THE STATE GOVERNMENT OF UTTAR PRADESH
THE REPUBLIC OF INDIA

PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT IN THE STATE OF UTTAR PRADESH, INDIA

FINAL REPORT

(3/3)

June 2017

JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)

NJS CONSULTANTS CO.,LTD.

NIPPON KOEI CO.,LTD.

APPENDICES

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1. Supplements of main part

2. Minutes

会 議 議 事 録

会議名	ガンジス川浄化事業準備調査　ICR 説明	場　所	JICA 本部 2B 会議室
日　時	平成 27 年 9 月 16 日（月）11：30－13：00	記録者	富士

出席者

<JICA>
市川　建作　　南アジア部南アジア第一課
佐々木　　資金協力業務部
千葉　周　　インド事務所調査役　（TV にて参加）

＜コンサルタント＞

美和　いく男	総括／下水道計画	㈱NJS コンサルタンツ
冨士　孝	下水処理場計画 A	㈱NJS コンサルタンツ
中村　一彦	副総括／積算調達	㈱NJS コンサルタンツ
花房　政英	下水管渠 B	㈱日本工営
阿辺山　一輝	下水処理場計画 B	㈱NJS コンサルタンツ
向野　能里子	住民啓発	㈱NJS コンサルタンツ
池田　正昭	経済財務分析 1	㈱NJS コンサルタンツ
中込　昭弘	経済財務分析 2	㈱NJS コンサルタンツ
名取　哲平	業務調整	㈱NJS コンサルタンツ

資料等

1. 業務計画書　（コンサルタント）
2. Inception Report　（コンサルタント）
3. Service levels in urban water and sanitation sector status report(抜粋)等その他補足資料
4. 案件形成（JICA）
5. キックオフミッション（JICA）

議題次第

1. ICR 説明・コメント等
2. 調査スケジュール
3. 案件形成スケジュール
4. キックオフミッション

内容

1. 業務計画書に基づいて ICR 説明実施（コンサルタント）
2. 課題：
   (1) TOR に記載 11DPR のうち 6DPR が未入手。
   (2) ムガルサライの処理場用地に問題の懸念。
   (3) 「バラナシ市環境改善に関する情報収集・確認調査」の調査団との連携。
   (4) パイロット事業について、プロポーザル提案の手法に加えて、群馬高専 小島博士の提案方法について、適用を検討。
   (5) 京都市との連携について、PWC を主体に検討。
   (6) 本プロジェクト実施体制については、現地で関係者と協議の上、提案。
3. フェーズ 2 対象都市は、汚濁負荷量等を検討の上、プライオリティを明確にして提案。
4. セクターローンの本事業への優位性とその適用の説明（JICA）
   予定：2015 10 月 審査、2015 12 月事前通報、2016 2 月 E/N, L/A
5. 渡航後の予定
   9/18　JICA デリー事務所 10：00「バラナシ市環境改善に関する情報収集・確認調査」の調査団とのミーティング、11：00 ガンジス川浄化事業準備調査 打ち合わせ、15：00 NMCG 協議

●協議内容：調査概要説明、案件形成スケジュール、セクターローン説明、L/A までのアクションプラン提示、審査頭出し

以上

THE PREPARATORY SURVEY ON
GANGA REJUVENATION PROJECT
IN THE STATE OF UTTAR PRADESH, INDIA

Minutes of Meeting
for
INCEPTION MEETING

Venue: **Conference Room, 1st Floor Rivatas Hotel, Varanasi City**
Time & Date: **11.30 am – 14.30 pm, Monday 21st September 2015**

Attendees:

JICA Delhi

Mr. M P Singh	Additional Chief Development Specialist

UPJN

Mr. R K Dwivedi	Chief Engineer
Mr. J B Rai	General Manager
Mr. S K Barman	Project Manager

VNN

Mr. S C Singh	Executive Engineer
Mr. B K Dwivedi	Additional M C VNS

Jal Kal Varanasi

Mr. B K Singh	Executive Engineer

Project Management Consultants

Mr. U N Tiwari	DTL (IDP)
Mr. B N Sharan	DTL (Non Sewerage)
Mr. B R Gupta	DTL (Sewerage)

NJS Consultants

Mr. T Fuji	Sewage Treatment Plant A
Mr. K Nakamura	Cost Estimates/ Procurement
Mr. K Abeyama	Sewage Treatment Plant B

Refer to the attached list of the attendees.

Agenda:

1. Explanation of Outline of the Project
2. Schedule of project formation
3. Explanation of Sector Loan
4. Presentation of Action Plan by L/A
5. Preparation for Appraisal

	Minutes	Action
1	**Objective** Presented by Mr. Singh from JICA Delhi.	
2	**Survey Outline and Schedule** Presented based on the Inception Report by Consultant. In the discussion, Status of the DPRs was discussed and concluded as follows: (1) Mirzapur: 2DPRs are expected in total. 1DPR done, 1 DPR will be submitted by the end of Sept 2015. (2) Chunar: 1DPR in total and done. (3) Ramnagar:1DPR is expected and it will be submitted by the end of Sept 2015. (4) Varanasi: 5DPRs are expected in total. 3DPRs done, 2DPRs will be submitted by the end of Sept 2015.. (5) Saidpur: 1DPR is expected and it will be submitted by the end of Sept 2015. (6) Ghazipur: 1DPR is expected and it will be submitted by the middle of Oct 2015. (7) Mugahalsarai: No submission of DPR due to issues of STP lot 11DPRs in total for six cities will be submitted for review. 5 DPRs were already submitted, 5 DPRs will be submitted by the end of Sept 2015. 1 DPR will be submitted by the middle of Oct 2015. Thus, scope was changed from the original scope of work, but the quantity was remained same as the original.	NMCG and concerned municipalities
3	**Project Formulation** Presented by Mr. Singh from JICA Delhi. Sector Loan was recommended for immediate and timely commitment.	
4	**Request for Indian Side** Official loan request, confirmation of implementation structure before L/A signing and immediate DPR submission were requested by JICA.	GoI
5	**What to be agreed at appraisal** Explanation of Implementation plan, Selection Criteria, Selection Procedure, Implementation structure, Candidate sub-projects and Total Project cost were presented by Mr. Singh.	
6	**Schedule** Appraisal Mission: Oct. 2015 Pledge: Dec. 2015 E/N, L/A: Feb. 2016 Effectuation of L/A: within 120 days after L/A	
7	**JICA ODA LOAN** Details were presented by Mr. Singh.	
8	**Key Actions before L/A signing** Details were presented by Mr. Singh.	

THE PREPARATORY SURVEY ON
GANGA REJUVENATION PROJECT
IN THE STATE OF UTTAR PRADESH, INDIA

Minutes of Meeting
for
MEETING ON DPRS

Venue: **Chief Engineer Room, UPJN Bhagwanpur Office, Varanasi City**
Time & Date: **15:00 – 16:00, Friday 27th November 2015**

Attendees:

UPJN

Mr. R K Dwivedi	Chief Engineer
Mr. J B Rai	General Manager
Mr. S K Singh	Project Manager (Varanasi, Mirzapur, Chunar)

JICA Study Team

Mr. I. Miwa	Team Leader
Mr. T Fuji	Sewage Treatment Plant A
Mr. V. Sontakke	Sewer Network A
Mr. M. Hanabusa	Sewer Network B
Mr. K Nakamura	Cost Estimates/ Procurement

Project Management / DPR Consultants

Mr. B R Gupta	DTL (Sewerage)
Mr. Renganathan K.	Engineer (DPRs Varanasi, Mirzapur, Chunar)

Refer to the attached list of the attendees.

Agenda:

1. Discussion for selection from 1) Interception Diversion & Treatment (ID&T), 2) Comprehensive, 3) Combination of ID&T and Comprehensive
   * JICA requested to choose option-3
2. Necessary adjustments for combination of ID&T and comprehensive for said cities if agree to select combination
3. Current idea and schedule of DPR for ID&T or combination by UPJN for Saidpur and Ghazipur Cities
4. Necessary steps for final decision by NMCG for the selected (proposed) policies

	Minutes	Action
1	**Discussion for selection from 1) Interception Diversion & Treatment (ID&T), 2) Comprehensive, 3) Combination of ID&T and Comprehensive** (1) CE of UPJN explained that MOUD issued an official letter with regard to clean Ganga on 21st August, 2015 with following contents; 1) The Class-I cities having population of 1 lakh and above as per 2011 census shall be developed with two projects comprising of ID&T method controlled by NMCG and following sewerage network controlled by MOUD, 2) Components of two projects should match each other in each city, 3) The other cities can be developed with only ID&T method, 4) The DPRs for sewerage networks shall be approved by MoUD before March 2016. The cost incurred by the States to prepare/revise DPRs for sewerage networks can be reimbursed from MoUD in consultation with NMCG. (2) CE explained that Varanasi, Mirzapur, and Ghazipur are Class-I cities (ID&T with sewer networks) and Chunar, Ramnagar, and Saidpur are the other cities (only ID&T).	N/A
2	**Necessary adjustments for combination of ID&T and comprehensive** (1) CE explained that combination of ID&T and comprehensive in one DPR is not possible at this stage due to the above reasons concerning supervising ministries and domestic funds. (2) However, the possibility of JICA fund at one project to the works under two ministries and the clarification of fund allocations should be discussed in Delhi between NMCG, MOUD and JICA.	N/A JICA/GoI
3	**Current idea and schedule of UPJN for Saidpur and Ghazipur Cities** (1) Based on the above rules stated in 1, the current status and next actions for Saidpur and Ghazipur with other target cities are as follows; 1) Varanasi: Has developed and designed with comprehensive method (no change of policy) 2) Mirzapur: both of ID&T and comprehensive were prepared and sewer network part by MOUD can be confirmed with comprehensive. (revisions of comprehensive into only sewer network and ID&T to match with sewer network are better but no urgent actions would be taken so far) 3) Chunar, Ramnagar: To be developed with existing DPRs ID&T 4) Saidpur: To be developed with ID&T (DPR ID&T would be prepared by end of December) 5) Ghazipur: To be developed with ID&T and sewer network (Existing DPR comprehensive should be revised with update of base year from 2015 to 2020 and split into two DPRs of NMCG and MOUD parts: No clear mention about deadline) (2) CE requested JICA Study Team to give suggestions to UPJN as much as possible to improve the qualities of new DPRs for Saidpur and Ghazipur to be prepared based on ongoing survey results of nala elevations by the team.	UPJN JICA Study Team
4	**Necessary steps for final decision by NMCG for the selected (proposed) policies** As stated in 2(2) above, the project scope under JICA project, the implementation structure, and the fund allocations should be discussed and concluded in Delhi.	JICA/GoI

THE PREPARATORY SURVEY ON
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Minutes of Meeting
for
MEETING ON DPRS

Venue: **UPJN Bhagwanpur Office, Varanasi City**
Time & Date: **15:00 – 17:00, Wednesday 9th December 2015**

Attendees:

UPJN

Mr. S. K. Barman	Project Manager (Varanasi, Ramnagar, Saidpur, Ghazipur)
Mr. Attur Gupta	Junior Engineer

JICA Study Team

Mr. K Nakamura	Cost Estimates/ Procurement
Mr. M. Hanabusa	Sewer Network B

DPR Consultants

Mr. Renganathan K.	Engineer (DPRs Varanasi, Mirzapur, Chunar)

Refer to the attached list of the attendees.

Agenda:

1. DPR Ramna STP, Ramnagar
2. DPR Saidpur
3. DPR Ghazipur
4. DPR Varanasi District-I, III

	Minutes	Action
1	**DPR Ramna STP, Ramnagar** (1) Soft copies including original calculations sheets (technical, financial) of Ramna STP, Ramnagar comprehensive and ID&T were provided by Mr. Barman. (2) The rising main alignment for Ramnagar ID&T was confirmed on the map.	N/A
2	**DPR Saidpur** (1) Mr Barman assured that the DPR Saidpur ID&T will be prepared by UPJN by end of January 2016. (2) UPJN has conducted the site survey in Saidpur and prepared a drawing of roads and drains with hand writing. It was provided to JICA survey team for scanning the data. It will be returned to UPJN as soon as possible. (3) JICA Survey Team stressed that the flow survey of drains should be done by UPJN but the topographic survey for interceptor and rising main route and drains can be carried out by outsourced topographic surveyor. Mr Gupta will give instruction to surveyor in Saidpur on the route and locations on December 15.	UPJN JICA Survey Team UPJN/JICA Survey Team
3	**DPR Ghazipur** (1) The soft copies of DPR Ghazipur comprehensive have not been submitted by local consultant. (2) DPR Ghazipur is still issue how to revise the DPR. UPJN cannot fix the schedule for preparation of DPR ID&T. Since interception is difficult in Ghazipur there is a possibility to proceed with the current DPR comprehensive. If UPJN will prepare the DPR ID&T it will be prepared by end of March 2016.	UPJN
4	**DPRs Varanasi District-I and III** (1) Desilting work for Old Trunk Sewer is included in BOQ of District-I but it has been started under GAP-II. It should be removed from the DPR. Basically the desilting work is only for existing branch sewer network. (2) Reroute of Assi Secondary Interceptor due to the collapse beside Ganga River will be also conducted under GAP-II. But UPJN will not revise the DPR District-III since it is negligible.	UPJN/JICA Survey Team N/A

PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT

MINUTES OF THE MEETING

Date: 10 December 2015

Meeting 1:

Time: 1200H – 1400H

Agenda Explanation on the Role of SPMG;

Place: Office of the Technical Adviser, SPMG

Present:

1	Mr. Jawed Ansari	Technical Adviser, SPMG
2	Ms. Consuelo Estepa	Institution A
3	Ms. Edna Bayan	Environmental Specialist
4	Mr. Siddiqur Rehman	National Institution Specialist / Researcher

	DESCRIPTION	REMARKS
1	**Welcome** Mr. Ansari welcomed the group to his office. Ms. Estepa introduced the members of the JICA Survey Team to Mr. Ansari and the agenda for the meeting.	
2	**On SPMG's role** with focus during the implementation stage in similar projects as the Ganga Rejuvenation Project under NMCG	• SPMG's major role is that of oversight on the Projects being implemented in the State that are under the auspices of NMCG. It has technical review over the projects to ensure that it complies with State and NMCG regulations. • It has also *coordinative role* over the projects within the State. • The *monitoring role* as to completion based on physical progress of the projects.
3	**On linkages / relationship** with of state government organizations / agencies	• SPMG operates as the State Ganga River Conservation Agency, which is under the Urban Development Department. • Projects in all cities in the State which are funded by NMCG under the Ministry of Water Resources, River Development

		and Ganga Rejuvenation are being monitored by SPMG. However, the monitoring does not come with any kind of authority over the Projects' implementation.
4	**On Ganga Rejuvenation projects** under Ministry of Urban Development and MoWR RD&GR	On the national or central government level, Ganga rejuvenation projects are undertaken by two ministries: – • MoUD projects for Ganga Rejuvenation are implemented under AMRUT or Atal Mission for Rejuvenation and Urban Transformation; and • MoWR RD&GR projects for Ganga Rejuvenation are implemented under the NMCG. AMRUT takes over the projects implemented under JnNURM.
5	**On Compliance on No Objection Certificate**	It was discussed during the meeting with SPMG that UPJN will be responsible in securing NOC on behalf of the Local Body which is consider the owner or proponent of the project. If JICA Survey Team will initially prepare those checklists, UPJN will do the assistance and provide the information needed.
6	**On Environmental Management and Monitoring Plans**	With regards to EMP and EMoP, a monitoring report should be prepared stating the monthly environmental status of the project. This will be done by the proponent and be submitted to the Pollution Control Board.
7	**On Letters of Mr. Nagai** to UPJN MD and Secretary UDD	The letters were given to Mr. Ansari who said these will be delivered to the offices which were addressed in the letter. Note that the Secretary of UDD is the ex-officio Head of SPMG.
8	**Adjournment** Meeting was adjourned at 1400	

By: Consuelo B. Estepa, PhD

会議議事録

会議名	ガンジス川浄化事業準備調査　第二回帰国報告会	場　所	JICA 本部 219 会議室
日　時	平成 27 年 12 月 22 日（月）15：00－16：15	記録者	富士
出席者	<JICA> 須之内　龍彦　南アジア部南アジア第一課　主任調査役 市川　建作　南アジア部南アジア第一課 佐々木　稔　資金協力業務部　技術主任 <コンサルタント> 美和　哉男　総括／下水道計画　㈱NJS コンサルタンツ 富士　孝　下水処理場計画 A　㈱NJS コンサルタンツ 中村　一彦　副総括／積算調達　㈱NJS コンサルタンツ 花房　政英　下水管渠 B　㈱日本工営 阿辺山　一輝　下水処理場計画 B　㈱NJS コンサルタンツ 夏井　明生　プラント機械　㈱NJS コンサルタンツ 新飯田　豊　プラント電気　㈱NJS コンサルタンツ 池田　正昭　経済財務分析 1　㈱NJS コンサルタンツ 中込　昭弘　経済財務分析 2　㈱NJS コンサルタンツ 名取　哲平　業務調整　㈱NJS コンサルタンツ		
資料等	1. Agenda（JICA） 2. 説明資料（パワーポイント）　（コンサルタント） 3. 現地入手レター　コピー（コンサルタント） 4. バラナシコンベンションセンター資料		
議題次第	1. 第二次現地調査報告 2. SPV、Annuity イシューへの対応・今後の調査への影響 3. 今後のスケジュール 4. バラナシコンベンションセンター		
	1. 第二次現地調査報告 1）対象区域 2）GAP II 現況 3）DPR プロジェクト概要 4）処理方式まとめ 5）下水道施設維持管理方式 6）事業費算定方法 7）ガンジス川流況 8）ガンジス川水質現況 9）処理場用地取得状況 10）タリフ 11）現況下水道管理体制・組織及び提案内容 12）JICA Phase II 対象都市 13）新水質基準 14）課題：新水質基準への対応、プロセス変更の影響、SPV への対応 15）パイロットプロジェクト 16）第二次現地調査の課題と今後の対応 2. 須之内主任調査役コメント 1）積み上げ方式とはどのような方式を指すか。費用関数と比べると積み上げ方式は二倍になっているとされているが、積み上げ方式を採用したときの対策は考えている		

か。
→積算書の費目が工事全体をカバーしているかを確認する。ガバメントレートの妥当性を確認する

2) JICA Phase II 対象都市
ドナー間のプロジェクトの争奪があることに留意。他州も取り込む可能性があるので資料の収集に当たっては考慮のこと。
候補地が UA、AP の二州に限定されているが、ガンジス川流域全体に拡げて検討すべきである。
→プロジェクトの取り合い、他州の取り込みを考慮し、今回渡航では対象範囲を拡大すること・その効果を検討する。

3) セクターローンのアイデア
Annuity 方式の適用について情報収集のこと
→現地で他ドナーの進捗状況・SPV・Annuity について情報収集し検討する。

4) Comprehensive と ID&T の取り扱い
SPV において上記の両者を包括的に実施することも考えられるので、念頭に置いて調査のこと
→包括的実施を考慮の上、調査を進める

3. 佐々木主任コメント

1) 新基準だとどのような処理方式が考えられるか
→窒素基準をクリアするために、A2O あるいは循環法になるのではないかと考えている。循環法が DPR の一部で採用を考慮されているので、適用しやすい。A2O については、リンの基準が厳しくないので必ずしも適当でない。(冨士)

2) Mirzapur （234000 人）には、ID&T・comprehensive の両者が入っているが取り扱いをどうするか（花房）
→Mirzapur は人口 10 万人以上で comprehensive となるが、実際の事業は ID&T が先行している。Ghazipur は ID&T 方式は難しい。(花房)

4. 市川担当コメント

1) バラナシコンベンションセンター
現地の意向としてバラナシコンベンションセンターの建設が上がっている。必要に応じて支援を検討する。
→現地で必要性を確認のうえ、対処すべき対象を検討の上、先方と協議する。

2) Phase -I プロジェクト対象都市
GoI からの 2 都市採択の提案があったが、6 都市採択でどうかという逆提案を行って、返答待ちになっている。
→現地確認

3) SPV 方式
その詳細について GoI からの返答待ちになっている。
→現地確認

4) Annity 方式
Annity 方式の検討を実施のこと
→現地確認

5.今後のスケジュール
→第三次現地調査は 2016/1/20 に渡航とする。

以上

会議議事録

会議名	ガンジス川浄化事業準備調査　第三回渡航前対処方針会議	場　所	JICA 本部 2F 会議室
日　時	平成 28 年 1 月 15 日（金）10：30－12：00	記録者	富士
出席者	<JICA> 須之内　龍彦　南アジア部南アジア第一課　主任調査役 市川　建作　南アジア部南アジア第一課 <コンサルタント> 美和　彧男　総括／下水道計画　㈱NJS コンサルタンツ 富士　孝　下水処理場計画 A　㈱NJS コンサルタンツ 中村　一彦　副総括／積算調達　㈱NJS コンサルタンツ 阿辺山　一輝　下水処理場計画 B　㈱NJS コンサルタンツ 池田　正昭　経済財務分析 1　㈱NJS コンサルタンツ 名取　哲平　業務調整　㈱NJS コンサルタンツ		
資料等	1. 説明資料（パワーポイント）　（コンサルタント） 2. SPV 資料（インド国鉄道省） 3. 団員 M/M 予定表 4. 平成 27 年 12 月 22 日　会議議事録		
議題次第	1. 第三次渡航前　各課題への対処方針 2. 今後のスケジュール		
	1. 第三次渡航前　対処方針資料説明 配布資料及びパワーポイント 1）SPV 貴機構より質問状既送付、回答待ち 2）新放流水質基準への対応 循環法・UV 滅菌で提案 3）プロセス選定 循環法で提案 4）用地 ・プロセスの変更により、追加購入・用地の変更が必要となる ・加えて、測量・土質追加調査が必要 →要協議 5）実作業への支障 →要協議 6）スケジュール 大幅な工期延長が必要 →先方と方針協議、貴機構と協議 7）概算工事費 →先方と協議 8）Phase I　プロジェクトの方針 →採択都市（6 都市 or　2 都市）について現地確認 JICA インド Mr.Sin 9）バラナシコンベンションセンター →進捗状況、現地確認。JICA 支援の在り方について協議・確認 2. コメント 1）SPV		

体制組織―SPV の意思決定ルート要確認
―組織図・権限、要確認
―構成メンバー　要確認
―人数・規模　要確認
―SPMG の教訓の活かし方

・Hybrid Annuity の PPP モデルとすれば、JICA の関与する額はどの程度か確認
（新聞報道では、政府負担額は 40％）

・既往プロジェクト―ADB ルーラルウォータカルナタカの例を確認
―ヒアリング実施　世銀（PPP、Mr Rajesh Barman）
及び　元日本工営 松本氏
・所管官庁・責任分担方法の確認
・ディスバースの実例を確認
・JICA 標準入札図書がどのように使用可能か確認

2）コンベンションセンター
具体化しつつある模様。詳細を確認する。

3.今後のスケジュール
→第三次現地調査は 2016/1/20 に渡航とする。

以上

THE PREPARATORY SURVEY ON
GANGA REJUVENATION PROJECT
IN THE STATE OF UTTAR PRADESH, INDIA

Minutes of Meeting
for
MEETING ON DPRS

Venue: **UPJN Bhagwanpur Office, Varanasi City**
Time & Date: **11:00 – 12:30, Monday 8th February 2016**

Attendees:

UPJN

Mr. S. K. Singh	General Manager
Mr. S. K. Barman	Project Manager (Varanasi, Ramnagar, Saidpur, Ghazipur)

JICA Study Team

Mr. M. Hanabusa	Sewer Network B
Mr. Manjunath Bendigeri	Support Engineer (Sewer Network)
Mr. Ram Kishan	CAD Operator

Refer to the attached list of the attendees.

Agenda:

1. DPR Varanasi District-I, II and III
2. DPR Saidpur
3. DPR Ghazipur
4. Nala names in Ghazipur
5. DPR Mirzapur
6. DPR Ramnagar
7. STP Land Acquisition in Saidpur

	Minutes	Action
1	**DPR Varanasi District I, II and III**	
	(1) DPR District-II was submitted to UPJN by the consultant and UPJN has given comment on some narrow road with difficulty to install major sewer line with big diameter and deep pipe. The consultant has to reroute the alignment (or propose the micro tunnelling).	DPR consultant
	(2) DPR District-I is under preparation by the consultant and UPJN is waiting for the submission.	DPR consultant
	(3) DPR District-III was submitted to central government. However, the cost should be revised with new SOR Basically UPJN will revise the cost.	UPJN(/DPR consultant)
	(4) These projects are expected to funded by JICA as NMCG projects but if JICA would not fund for them AMRUT scheme (UPJN) would be adopted.	N/A
2	**DPR Saidpur**	
	(1) Flow survey of nalas in Saidpur was done by UPJN on last May.	N/A
	(2) UPJN has been preparing DPR I&D and would complete on middle of March.	UPJN
	(3) UPJN has been utilizing the base map which was provided by JICA study team with route survey result and there is no problem so far.	UPJN
3	**DPR Ghazipur**	
	(1) UPJN would like to proceed with DPR comprehensive due to the difficulty of interception in the city but NMCG has insisted on preparing DPR I&D. Therefore, UPJN Ghazipur Office would prepare the said DPR. For that purpose the flow survey of nalas should be carried out but the coordination for the work has not been progressed yet.	UPJN
	(2) Due to the difficulty to coordinate with central government and UPJN Ghazipur office, the preparation of DPR is still pending and left with same urgency with one for Mugalsarai (excluded from JICA scope) without any deadlines. The flow surveys of nalas in Ghazipur and Mugalsarai would be carried out in the similar timings.	UPJN
	(3) Like the case of Mirzapur the existing DPR comprehensive will be utilized for future sewer network after I&D. However, the original files of the DPR have not been submitted from the consultant and UPJN recommended JICA study team to ask the Executive Engineer of UPJN Ghazipur Office if it is necessary for JICA study report.	JICA Study Team
4	**Nala names in Ghazipur**	
	(1) JICA study team requested UPJN to provide the list of nalas and the locations again for the purpose of existing drains in JICA study report. UPJN suggested that UPJN Ghazipur Office may have the information. JICA Study Team would contact to Executive Engineer of UPJN Ghazipur Office.	JICA Study Team
5	**DPR Mirzapur**	
	(1) The coordination meeting on I&D and comprehensive (adjustment of interceptor depth) was held between UPJN and DPR consultant on last December. But UPJN has not received any revised output of DPR. UPJN called DPR consultant and instructed to inform the status to JICA study team.	DPR consultant
6	**DPR Ramnagar**	
	(1) UPJN setup some allowance for interceptor diameter to cope with the future wastewater inflow from industry or other area.	N/A
	(2) UPJN left Hanuman Ghat Nala without interception since it is far and very little flow where is almost dry in sunny days.	N/A

	Minutes	Action
7	**STP Land Acquisition in Saidpur (for Survey Purpose)** (1) UPJN has been trying to obtain the letter of consent with land owner of proposed STP site but it takes more time due to some local procedure (Saidpur Nagal Palika matter). JICA study team requested UPJN to obtain it within February together with site for access road to STP. (2) JICA study team also requested UPJN to inform the team if there is any progress and UPJN accepted.	UPJN UPJN

会 議 議 事 録

会議名	ガンジス川浄化事業準備調査-情報収集	場　所	E&Y 会議室
日　時	平成 28 年 2 月 9 日（火）13：30－15：30	記録者	池田・冨士
出席者	＜コンサルタント＞ 美和　いく男　総括／下水道計画　㈱NJS コンサルタンツ 池田　正昭　経済財務分析 1　㈱NJS コンサルタンツ（補強 EY） 冨士　孝　下水処理場 1　㈱NJS コンサルタンツ Mr. Rajesh　EY・India Mr.Gaurav　EY・India		
資料等	—		
議題次第	1. 概況説明 2. SPV・Annuity 方式意見聴取		
内容	●SPV/Annuity Scheme についての今までの経緯と一般論 ・当初のインドの PPP モデルの大半は BOT モデル。Financing は 100%、Private-Sector。コマーシャルリスクの大半が Private Sector へ移転された。 ・大半のプロジェクトは失敗した。セクタが成熟していなかったこと、セクタがリスクを取らなかったこと等が原因。 ・2005 年頃から BOT-Annuity-model が採用されるに至った。これにより、Commercial-Risk が Private Sector に及ばなくなり、成功。 ・さらにそれに加えて PPP に Government がファンディングする、ハイブリッドモデルが出現。70-80%が政府、Private sector が残り 20-30%。建設期間 2 年間。 ・成功事例：Nagpur のケース（Hybrid BOT Annuity Model）： このセクタは政治的性格があるので（Private sector の関与はセンシティブなので）20 ゾーンから 1 つを選定・適用した。月額の Fixed-Payment とパフォーマンスベースの Various-Payment で構成。他の Zone へも展開することとした。 ・今回プロジェクトは Treated-Effluent のバルクユーザーへの利用提供などが特徴の 1 つになると考えられる。 ・SPV が Program レベルか Project レベルなのか（双方なのか）確認する必要がある。 Project レベル：SPV に対して State と Private が出資。前者は土地と投資。後者は Financing と Management を提供。双方でリスクとレベニューを共有 以上		

会議議事録

会議名	ガンジス川浄化事業準備調査　WB 協議	場　所	WB 1F会議室
日　時	平成 28 年 2 月 9 日（火）16：00－17：00	記録者	池田・富士
出席者	＜World Bank＞ 松本　順　　水資源管理 ＜JICA　India＞ 千葉　周　（JICA　デリー）　　JICA ＜コンサルタント＞ 美和　いく男　総括／下水道計画　　㈱NJS コンサルタンツ 池田　正昭　　経済財務分析 1　　㈱NJS コンサルタンツ（補強 EY） 富士　孝　　下水処理場 1　　㈱NJS コンサルタンツ Mr. Rajesh　　EY・India Mr.Gaurav　　EY・India		
資料等	—		
議題次第	1.　概況説明 2.　SPV・Annuity 方式意見聴取		
内容	●SPV/Annuity Scheme についての今までの経緯と一般論 ・JICA には 6 都市の中でバラナシと ラムナガールを除く所に PPP スキームの要望が来ている。WB の PPP チームが以前からこの件に関してインド政府と検討していると聞いていたので情報提供をお願いしたく伺った。 ・松本氏に Cabinet Note を提供。（会議時、JICA より情報提示） ・PPP-Financing Scheme の話は 1 年ほど前に来た。しかし、WB の$1billion の予算の中において SPV モデルを承認、合意する段階まで至っていない。WB パトナプロジェクトについては、PPP だが大きな遅れが問題となっている。また WB カンプールプロジェクトも PPP で、未着手。先行している他セクターでの PPP とは違い、Sewerage でのレベニュースキームが不明確な点が課題。（松本氏） ・WB はカルナタカ州バンガロールで PPP について取り組む。今月中にその検討を終える予定。SPV や Annuity モデルについては、WB として検討結果や計画書ドラフトを持っていない。（松本氏） ・この新しい Model については WB と JICA が一緒に検討するのも一案か。 ・PPP をどのように Water/Sewerage-Sector に適用するかは要検討。 ・個人的には、PPP のファイナンススキームよりも従来の EPC が好ましい。（松本氏） 以上		

会 議 議 事 録

会議名	ガンジス川浄化事業準備調査	場　所	NMCG 2F 会議室
日　時	平成 28 年 2 月 10 日（水）11：30－13：00	記録者	池田・冨士
出席者	＜NMCG＞ Mr Rajat Guputa　Sen. S W M Speialist　NMCG ＜JICA　India＞ 千葉　周　（JICA　デリー）　JICA Mr M P Singh（JICA　デリー）　JICA ＜コンサルタント＞ 美和　いく男　総括／下水道計画　㈱NJS コンサルタンツ 池田　正昭　経済財務分析 1　㈱NJS コンサルタンツ（補強 EY） 冨士　孝　下水処理場 1　㈱NJS コンサルタンツ Mr. Rajesh　EY・India Mr.Gaurav　EY・India		
資料等	1. Agenda		
議題次第	1. 新放流水質基準 2. 処理方式 3. プロジェクト用地 4. DPR 5. スケジュール 6. SPV/Annuity 7. Phase I Project 8. コンベンションセンター		
内容	1. 新放流水質基準 1.1 周知予定 実施することは既定だが、日程は決まっていない 1.2 放流水質基準 10 mg/l of BOD, SS, N、大腸菌 100MPN/100ml 達成可能な方式を採用すればよい。GoI に腹案はない。 1.3 新基準における急速砂ろ過あるいは MBR の必要性について 必要に応じて設置すればよい 2. 処理方式 2.1 特別な処理方式の必要性 1.2 の通り 3. プロジェクト用地 3.1 サイドプル用地の取得は難航中（報告事項） 3.2 処理場によっては処理方式の変更による用地不足の懸念（報告事項） 4. DPR		

4.1 ガジプルについて ID/T の採用の指示があったが、既提出の DPR の通り comprehensive で提出してよいか。
本プロジェクトは NMCG の所管であるので、NMCG の指示に従うこと。ID/T プランを採用のこと。

4.2 SPV 方式であれば、NMCG、MoUD のいずれからも独立したプランとできるのではないか
NMCG 所管である。NMCG の指示に従うこと。

5. スケジュール

5.1 DPR 完成のスケジュール
コンサルタントは、新水質基準に合わせた DPR の修正・入札方式等の SPV/annuity 方式への適応のため、6 か月の工期延伸を JICA に申請中である。

5.2 DPR 作成のための追加契約
GoI は ULB の DPR 作業のためのファンドがあり使用可能である。

5.3 Annuity 方式の詳細
GoI において検討中である。この件のステークホルダーミーティングを 2/24 に開催予定。

5.4 バラナシ・ラムナガール
申請承認手続き中であるので 2 都市の DPR 作業を早く完了させること（JICA→コンサルタント）

6. SPV/Annuity

・SPV、Annuity モデルについてはインド政府が決定、発表。建設完了時（例えば 2 年後）にキャピタル投資額の上限 40%がインド政府から支払われ、残額は最長 20 年間、毎年または半年毎に Annuity モデルとして支払われる。
・資金の支払やコンセッショナーとの契約は SPV が行う。また SPV の資金の源泉は、インド政府である。
・今後インフラ投資の案件は EPC ではなくハイブリッドモデルで実施予定。
・但し小規模の町では BOT 方式もありえる。ケースバイケースで ESC（Empowered Steering Committee）が決める予定。
・本スキームの狙いは必ずしもファイナンスの視点ではなく、長期のアカウンタビリティの確保、サステイナビリティの維持である。
・Annuity でのレベニューストリームでは、バイプロダクトである処理水の販売がある（＝ボーナスの位置付け）。想定利用者は農業セクター、鉄道セクター、電力セクター等。
・ガンガプロジェクトで水道所管は NMCG ではないので、SPV スキームには水道計画は含めない。
・本件のビジネスモデル、ファイナンスプラン、ビジネスプランの詳細検討は、2016 年 3 月までに（GoI の Agency 実行中）完了予定。よって本日時点では詳細内容は出せない。

7. Phase I Project

7.1 2 or 6 cities
バラナシ・ラムナガール 2 都市採択、プラス残り 4 都市 PPP 予定
2 都市については GAP に入れるか、本プロジェクトに入れるかは検討中。
PPP についてはプロジェクトごとに Annuity 方式適用の可能性を検討。

8. コンベンションセンター

別枠で検討中

会議議事録

会議名	ガンジス川浄化事業準備調査　TV 会議	場　所	JICA 2F 会議室
日　時	平成 28 年 2 月 10 日（水）14：00－15：20	記録者	池田・富士
出席者	＜JICA　India＞ 千葉　周　（JICA　デリー）　JICA ＜JICA　東京＞ 市川　建作　JICA ＜コンサルタント＞ 美和　いく男　総括／下水道計画　㈱NJS コンサルタンツ 池田　正昭　経済財務分析 1　㈱NJS コンサルタンツ（補強 EY） 富士　孝　下水処理場 1　㈱NJS コンサルタンツ		
議題次第	1.　協議結果報告 2.　今後の見通し		
内容	1.　NMCG 協議結果報告 1.1 新放流水質基準 a.　周知予定：実施することは既定だが、日程は決まっていない b.　放流水質基準 10 mg/l of BOD, SS, N、大腸菌 100MPN/100ml：達成可能な方式を採用すればよい。GoI に腹案はない。 c.　新基準における急速砂ろ過あるいは MBR の必要性について：必要に応じて設置すればよい 1.2 処理方式 d.　特別な処理方式の必要性：1.2 の通り 1.3 プロジェクト用地 e.　サイドプル用地の取得は難航中（報告事項） f.　処理場によっては処理方式の変更による用地不足の懸念（報告事項） 1.4DPR g.　ガジプルについて ID/T の採用の指示があったが、既提出の DPR の通り comprehensive で提出してよいか。：本プロジェクトは NMCG の所管であるので、NMCG の指示に従うこと。ID/T プランを採用のこと。 h.　SPV 方式であれば、NMCG、MoUD のいずれからも独立したプランとできるのではないか：NMCG 所管である。NMCG の指示に従うこと。 1.5 スケジュール i.　DPR 完成のスケジュール：コンサルタントは、新水質基準に合わせた DPR の修正・入札方式等の SPV/annuity 方式への適応のため、6 か月の工期延伸を JICA に申請中である。 j.　DPR 作成のための追加契約：GoI は ULB の DPR 作業のためのファンドがあり使用可能である。 k.　Annuity 方式の詳細：GoI において検討中である。この件のステークホルダーミーティングを 2/24 に開催予定である。 l.　バラナシ・ラムナガー：2 都市の DPR 作業を早く完了させること（JICA→コンサルタント） 1.6　SPV/Annuity ・SPV、Annuity モデルについてはインド政府が決定、発表。建設完了時（例えば 2 年後）にキャピタル投資額の上限 40%がインド政府から支払われ、残額は最長 20 年間、毎年または半年毎に Annuity モデルとして支払われる。 ・資金の支払やコンセッショナーとの契約は SPV が行う。また SPV の資金の源泉は、インド政府である。		

・今後インフラ投資の案件はEPCではなくハイブリッドモデルで実施予定。
・但し小規模の町では BOT 方式もありえる。ケースバイケースで ESC（Empowered Steering Committee）が決める予定。
・本スキームの狙いは必ずしもファイナンスの視点ではなく、長期のアカウンタビリティの確保、サステイナビリティの維持である。
・Annuity でのレベニューストリームでは、バイプロダクトである処理水の販売がある（＝ボーナスの位置付け）。想定利用者は農業セクター、鉄道セクター、電力セクター等。
・ガンガプロジェクトで水道所管はNMCGではないので、SPV スキームには水道計画を含めない。
・本件のビジネスモデル、ファイナンスプラン、ビジネスプランの詳細検討は、2016 年 3 月までに（GoI の Agency 実行中）を完了予定。よって本日時点では詳細内容は出せない。

1.7 Phase I Project

・2 or 6 cities
バラナシ・ラムナガール 2 都市採択、プラス残り 4 都市 PPP 予定

1.8 コンベンションセンター

・今後の検討

2. 追加 TOR
・メール資料受領、確認。延伸工期、確認
・MM スケジュールについて詳細は、プロポーザル中で検討・提示する（全 MM は貴機構方針通りとする）ことを確認。

以上

THE PREPARATORY SURVEY ON
GANGA REJUVENATION PROJECT
IN THE STATE OF UTTAR PRADESH, INDIA

Minutes of Meeting
for
MEETING ON DPRS

Venue: **UPJN Bhagwanpur Office, Varanasi City**
Time & Date: **12:30 – 13:30, Friday 19th February 2016**

Attendees:

UPJN

Mr. S. K. Singh	General Manager
Mr. S. K. Barman	Project Manager (Varanasi, Ramnagar, Saidpur, Ghazipur)

JICA Study Team

Mr. Vidyadahl Sontakke	Sewer Network A
Mr. M. Hanabusa	Sewer Network B

DPR Consultant

Mr. Renganathan K.	Engineer (DPRs Varanasi, Mirzapur, Chunar)
Mr. Manish Bansal	Engineer (DPRs Varanasi, Mirzapur comprehensive)

Refer to the attached list of the attendees.

Agenda:

1. DPR Varanasi District-II
2. DPR Varanasi District-I
3. DPR Varanasi District-III
4. DPR Mirzapur
5. DPR Chunar

(Prepared by M. Hanabusa)

	Minutes	Action
1	**DPR Varanasi District II**	
	(1) For the commented section by UPJN with much deep sewer in narrow and congested road (around 1.5km) the DPR consultant proposed to adopt trenchless method since there is no space for additional pumping station and laying by open cut is impossible after site visit with UPJN. UPJN accepted the proposal.	N/A
	(2) DPR consultant will revise the DPR by 25th February and UPJN will submit to central government immediately.	DPR consultant /UPJN
2	**DPR Varanasi District I**	
	(1) DPR consultant will submit the DPR by 5th March. UPJN will submit to central government immediately.	DPR consultant /UPJN
3	**DPR Varanasi District III**	
	(1) UPJN accepted the proposal by DPR consultant that branch sewers will cross the upstream in tributary of Assi Nala since it is a few flow.	N/A
	(2) Including the remodelling of sewer networks to avoid crossing of Assi Nala DPR consultant will revise a set of drawings, BOQs and cost estimates after the submission of DPRs District-I and II. The output will be utilized by JICA Study Team for their proposal.	DPR consultant/JICA Study Team
4	**DPR Mirzapur**	
	(1) The coordination between comprehensive and I&D will be re-discussed in JICA study team office on 20th Feb so that future sewer network can be connected to interceptor.	All party
5	**DPR Chunar**	
	(1) JICA study team asked UPJN the reason why now UPJN tries to intercept the wastewater toward Jargo River despite it had been left because of no inflow of wastewater to River Ganga ultimately (use of water for irrigation). UPJN answered that NMCG commented the wastewater may inflow to River Ganga through Jargo River in future. Particularly Nala Number 21 (Ganda Nala) with much flow was raised as issue. Now UPJN would like to add another interceptor for Jargo River (basically with gravity).	UPJN
	(2) The detail will be discussed in JICA study team office on 20th Feb	UPJN/JICA Study Team

THE PREPARATORY SURVEY ON
GANGA REJUVENATION PROJECT
IN THE STATE OF UTTAR PRADESH, INDIA

Minutes of Meeting
for
MEETING ON DPRS

Venue: **UPJN Bhagwanpur Office, Varanasi City**
Time & Date: **13:00 – 14:00, Saturday 20th February 2016**

Attendees:

UPJN

Mr. S. K. Singh	General Manager
Mr. Sanjith Katiyar	Project Manager (Mirzapur, Chunar)

JICA Study Team

Mr. Vidyadahl Sontakke	Sewer Network A
Mr. M. Hanabusa	Sewer Network B
Mr. T. Fuji	STP A

DPR Consultant

Mr. Renganathan K.	Engineer (DPRs Varanasi, Mirzapur, Chunar)
Mr. Manish Bansal	Engineer (Ditto)

Refer to the attached list of the attendees.

Agenda:

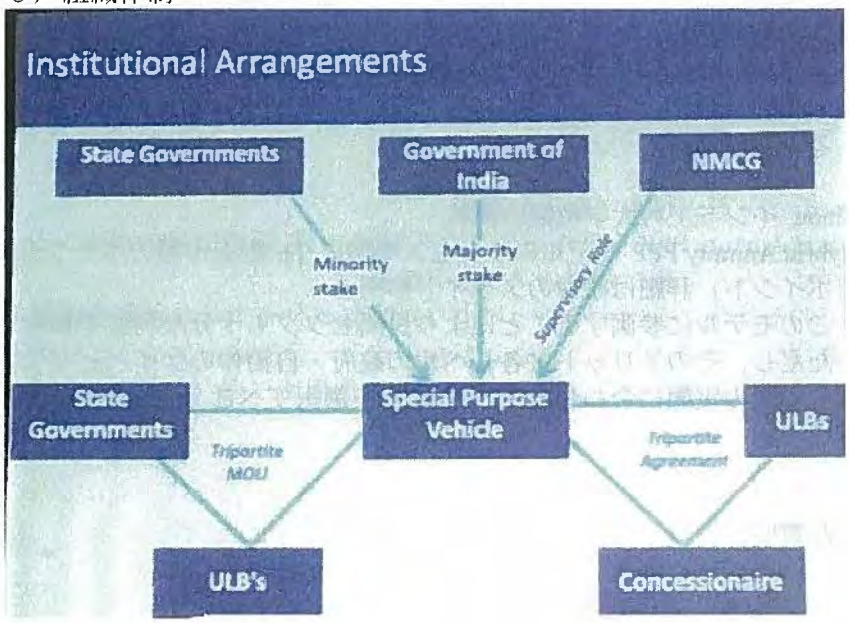
1. DPR Mirzapur
2. DPR Chunar

(Prepared by M. Hanabusa)

	Minutes	Action
1	DPR Mirzapur	
	(1) The tapping points will be adjusted to Ganga River to intercept the wastewater at the downstream of habitation area as much as possible.	DPR Consultant
	(2) The connection sewers from tapping points to interceptor will be utilized as branch sewer in one side of nala and another branch sewer will be laid in another side of nala in future as comprehensive work.	Ditto
	(3) After the adjustments for the above works the depth of interceptor should be less than 10m.	Ditto
	(4) The revision of DPR (I&D, comprehensive) will be finished by March 15.	Ditto
2	DPR Chunar	
	(1) UPJN informed that there were following comments from NMCG for submitted DPR draft. Without the revision for this the approval of DPR Chunar I&D by NMCG will be difficult. 1. The Jargo River side also should be intercepted. 2. The septic tank areas also should be revised to interception as much as possible	N/A
	(2) In order to take action to the above issues, mainly the following actions will be taken after careful consideration of GLs. 1. The location of proposed IPS-1 would be changed to any location in nearby septic tank area (low land). 2. Additional interceptor will be laid for Jargo River side. Due to the low GL in some nalas, the same proposed P/S with comprehensive case would be proposed.	DPR consultant
	(3) The availability of lands for the said P/Ss will be checked with Chunar Nagar Palica by Project Manager, UPJN and the result will be informed to DPR consultant.	UPJN
	(4) The revision of DPR I&D will be finished by March 15.	DPR Consultant
3	DPR Schedule	
	(1) JICA Study Team requested UPJN and DPR consultant to keep the time of above schedule including ones for Varanasi which was discussed in previous day (District-II: Feb 25, District-I: Mar 5, District-III: try to finish with same day with District-I but Dist-I should never be delayed due to Dist-III). UPJN and DPR consultant accepted.	UPJN/DPR Consultant

会議議事録

会議名	ガンジス川浄化事業準備調査　Market Conference	場　所	Bigyan Bahwan 3F 会議室
日　時	平成 28 年 2 月 24 日（水）9：00－11：00－13：15	記録者	持田・池田・富士
出席者	＜GOI＞ Shasi Shekhar　Secretary　Ministry of WR,RD and GR Puskal Upadhay　Additional Mission Director,　NMCG Harihar Mishra Director Finance, NMCG NV Satish Seemakurti Director Technical1, NMCG Sundeep Director Technical-2, NMCG <IIT> Dr. Vinod Tare　Professor, IIT Kanpur ＜JICA　India＞ 坂本威午　（JICA デリー、　所長）、千葉　周　（JICA　デリー）、Mr M P Singh（JICA　デリー） ＜WB＞ Mr. Rajesh Balasubramanian　Senior Water and Sanitation Specialist ＜コンサルタント＞ 持田　圭介　経済財務分析 1　㈱NJS コンサルタンツ（補強 EY） 池田　正昭　経済財務分析 1　㈱NJS コンサルタンツ（補強 EY） 富士　孝　下水処理場 1　㈱NJS コンサルタンツ Mr. Rajesh　EY・India Mr.Gaurav　EY・India ＜その他の参加者＞ 約 250 名の現地及び海外のコンサルタント、コントラクタ等		
資料等	説明資料（パワーポイント）　（NMCG）		
議題次第	1. Sateesh Director より開会挨拶 2. Shasi Shekar 水資源・河川開発・ガンジス河再生省セクレタリーよりプレゼンテーションに先立ち基調スピーチ 3. Puskal AMD より Hybrid Annuity PPP for STP についてプレゼンテーション 4. Vinod 教授より海外におけるサクセス事例と処理水のリサイクルに関するプレゼンテーション 5. 質疑応答		
	＜概要＞ １．インド国水資源保全省の Shri Shashi Shehkar 長官コメント NMCG では、Namami Gange プログラムの下、下水処理インフラ整備のためのハイブリッドアニュイティベースの PPP モデルの SPV モデルを来月中に構築する予定である。 このモデルはプログラムにより多くの市場性を導入し（リスクに見合ったリターンを提供して）、参加者のすそ野を広げてより大きなチームで大きなミッションを達成する”Achieve Big task with big team”という意味で非常に重要である。 ２．主要タイムライン 2016 年 3 月末　RFP for Transaction Advisory Service の発行 SPV の組成		

	2016年4月　Condition Study Reportの回収開始 2016年6月　Transaction Advisor選定プロセス開始 2016年12月　Transaction Advisorの成果物（プロジェクト計画）完成 2017年1月-3月　コンセッショネア選定プロセス ３．まとめ 長官及びNMCG幹部からの前向きなコメントの一方で、参加者からは多くの質問や懸念が寄せられ、一部については議論中であることが明らかになるなど、未だPublic commentの収集段階のような印象もあった。また、Hybrid Annuity PPPモデルについてもスキームの詳細は提示されたとはいえず、情報収集を継続する必要がある。（これに先立つミーティングで3月末にビジネスモデル等が公表されるとのNMCG幹部の説明があった）
	＜プレゼンテーション及び質疑応答の内容＞ 1. Hybrid Annuity PPP Model for STP プレゼン：NMCG Puskal 氏 １）流域の下水処理にこれまでRs.4000Crore以上を費やしてきたが、未だ十分に機能しておらず、ガンジス川流域11州の下水処理需要と処理能力には6300MLD以上のギャップがある。このため河川水質汚染は改善されていない。現場のモニターの結果、下水処理は30%しか機能しておらず、94%は水質基準を満たしていなかった。Medium termにおけるMunicipal Sewage Management として、政府はさらに4000MLDの下水処理能力の増強を計画中である。全投資額の63%が下水関係。 ２）Hybrid Annuity Model Construction Phase(想定2年)：最大40%までのCapital Costを政府が拠出 O&M Phase(最大20年)：Annuity－残りのCapital cost、毎年のO&Mコスト、パフォーマンス基準に応じたインセンティブ、TE(Treated Effluent, 処理水)買い取り収益 ３）組織体制  SPVへの出資：GOIがマジョリティ、州政府がマイナー出資 ２つの3者間契約：SPV-ULB‐コンセッショネア、SPV-州政府-ULB ４）役割 SPV：コンセッショネア選定の推進、建設コストの調達、TEの質に応じたパフォーマンスペイメントによるO&Mコストの回収、TE販売マーケットの開発 州政府：用地確保に関する必要な承認の事項、コンセッショネア選定プロセスへの参画、タリフ体系及びガイドラインを通じたTE再利用の促進、SPVへのマイナー出資

ULB：SPV に対して必要な権限の委譲、コンセッショネア選定プロセスへの参画、O&M コストに見合ったタリフ体系の導入
コンセッショネア：インフラの建設、コンセッション期間における STP の運転管理、TE の水質基準への適合、TE 販売市場開発

5）アニュイティ支払確保の仕組みについて
・SPV が支払を行う
・一般会計からの予算サポートを含め 2 年分の支払金額を確保した特別会計で管理
・必要に応じて Clean Ganga Fund その他の Fund からの追加的支援も実施

6）施設整備内容
・市中の下水処理
・既存下水施設の維持管理
・既設施設の補修・更新
・新規処理場・ID/T の建設
・20 年間の維持管理
・可能な場合、施設統合

7）その他
SPV は各都市につき一つ
TE 販売マーケットのポテンシャルに関する調査が世界銀行により実施中
（長官からの補足コメント）
・既存の進行中プロジェクトを除き、今後 Namami Ganga プログラムの下で行われる STP プロジェクト（管路含む）は全てこの Hybrid Annuity モデルで実行する
・TE 再利用は、近い将来法的に義務付けられる予定で、政府としてもその準備を始めている。5 月までに 2－30 市のプロジェクトを発表する予定である。発電所ではすでに、半径 50km 以内に STP がある場合には TE 購入が義務付けられる。鉄道・石油関連との協定も結ばれる。
・TE 販売収益をどの程度見込むのかについては入札の評価基準とはしない予定だが、TE 販売収益が多く見込めるほど、プロジェクトの経済性は向上するので、政府としてもその点を期待している。

2. Vinod インド工科大学教授の講演
Hybrid Annuity PPP モデルのサクセス事例と TE 販売市場のポテンシャルについて
（ポイント）詳細は添付のスライド参照
・このモデルに参画することにより民間セクタも十分な利益を確保できる
・ただし、そのメリットは各レベルの政府・自治体のケイパビリティに依存する
・その国の実態に合わせた PPP モデルを選択すべき（シンプルなスキームから開始する）

3. 主な質疑応答
1. コンセッショネアの評価はだれがするのか
→関連する州政府、ULB が行う

2. 最大 40%の出資金額は、どのようにして決まるのか
→Transaction Advisor の検討結果に基づき決定する

3. Concession Agreement に関するポリシーは全国共通なのか、州によって違うのか
→基本的には共通だが、プロジェクトによって適用される条項が異なるということはありうる

	4. Annuity の支払に関して政府の保証はあるのか →パフォーマンスを満たす限り、Annuity は支払われるので、コンセッショネアのリスクは適切に担保されていると考えている。Guarantee の有無、内容については検討中。 5. Annuity の保全のための Escrow Account は用意するのか →プレゼンにあった通り、2 年分のアニュイティ相当額を Namami ganga Fund が拠出する別会計で保全する。さらにそれとは別に TE 売却収益を Escrow アカウントで保全する。 6. コンセッショネアの選定基準は →Annuity の Net Present Value である。 7. TE マーケットが未開拓の現状では Hybrid Annuity PPP モデルは実行困難ではないのか →民間事業者へのメリットを明確にすることで多くの業者に参入を促し、同時に市場の開発も進めていくというアプローチであり、早く参入すれば得られるメリットもより大きい。 長官からカンファレンス参加者に対して、月 Rs.10 を Namami Ganga Program に寄付をするように呼びかけた。 以上

PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT

MINUTES OF THE MEETING

Date:	5 August 2016
Time:	1100H – 1500H
Agenda	Follow up on: • Water Supply: Service hours per day against service level benchmark • Billing and Collection of water tariff: System, collection mode and collection efficiency • Complaint Redressal: Efficiency rate per annum
Place:	Office of : • The Executive Officer - Ghazipur Nagar Palika Parishad • The Executive Engineer Office - UPJN Ghazipur.

Present:

1	Mr. Bijay Sankar	Tax Superintendent, Ghazipur Nagar Palika Parishad
2	Mr. S. K. Yadav	Executive Engineer, UPJN Ghazipur
3	Ms. Consuelo Estepa	Institution A
4	Mr. SiddiqurRehman	National Institution Specialist / Researcher

	DESCRIPTION	REMARKS
1	**Welcome** Mr. Bijay Sankar welcomed the group to the Nagar Palika Parishad Office.	
	Ms. Estepa introduced the members of the JICA Survey Team to Mr. Bijay Sankar and Mr. S. K. Yadav and the agenda for the meeting.	
2	**On Water Supply provided by Ghazipur NPP** - Service hours per day against service level benchmark (SLB) 24/7	• It was ascertained that water supply is intermittent. Total hours of water supply during the day is nine hours with a supply of five hours in the morning between 0400H-0900H and four hours in the evening between 1600H-1900H. • Exceptions do occur sometimes due to disruption in electricity supply and break down of pumps or equipments.
3	**On billing and collection** (Water Supply)	• Follow paper-based manual billing and collection system. • Collection of water supply tariff is done using 11 bill collectors (bill collectors along with collection of water tariff also collects other taxes of NPP) and 1 dedicated water tariff collector clerk posted in the NPP office. • Collection efficiency is ascertained at 80% of demand. It was communicated that due to under staffing in the office, collection efficiency fails to meet efficiency benchmark of 90%.

4	**On Complaint Redressal of Water Supply Service** (Average redressal efficiency rate per annum)	Complaint redressal for water supply stands at 90% against the benchmark of 80% per annum.
5	**Discussion with Executive Engineer, UPJN-Ghazipur**	• Mr. S.K Yadav, Executive Engineer joined the office on 17 July 2016. As such he has very little insight into the development of proposed STP at Ghazipur. • In the meeting, he was updated on the STP strength and sewerage network length for Ghazipur. • He also mentioned he was in talks regarding the Saidpur DPR which we informed is no longer included in the JICA scope of work. He remarked that he would explore the possibility of developing a DPR for Saidpur under his initiative. • He further assured support to the survey if required.
6	**Adjournment** Meeting was adjourned at 1500H.	

Prepared by:
Siddiqur Rehman

Noted:
Consuelo B. Estepa, PhD

PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT

MINUTES OF THE MEETING

Date: 08 August 2016

Meeting Time: 1030-1145 H

Agenda:

1) Experience of SPMG in selection of private institutions for *special purpose vehicles* and/or the formation of SPVs.
2) The draft project implementation framework indicating SPMG as the "project management unit" and the resource wise and people wise capacity to implement projects under the JICA programme
3) Coordinative nature of SPMG in the implementation of the projects sanctioned by NGRBA / NMCG in UP State with State departments and organizations and the urban local bodies
4) Procurement role of SPMG

Place: Office of SPMG Finance Director, Lucknow, U.P.

Present:

1	Mr. Jawed Ansari	Technical Adviser, SPMG
2	Mr. Mumtaz Ahmad	Finance Director, SPMG
3	Ms. Consuelo Estepa	Institution A, JICA Study Team
4	Mr. Siddiqur Rehman	National HR Specialist, NJSEI

	DESCRIPTION	REMARKS
1	**Welcome** Mr. Ahmad welcomed the team to his office. Ms. Estepa, on the other, thanked Mr. Ansari and Ahmad for receiving her and Mr. Rehman, and explained the agenda of the meeting.	During the first visit in December 2015, the idea of implementing the Project through SPV / HAM-PPP was not yet brought up by GoI ad JICA, hence the need for a second meeting, precisely to discuss this development.
2	On the **experience of SPMG in selection of private institutions for *special purpose vehicles*** and/or the formation of SPVs for project implementation.	• Mr. Ansari said that UPSGRCA / SPMG has not selected and/or formed SPVs to implement infrastructure projects under NGRBA/ NMCG programme. • Ms. Estepa asked if there were any other SPVs formed and operating in the State, to which Mr. Ansari answered in the affirmative. He mentioned said that there was one in the transport (metro) sector; but none in the water supply or sewerage sector.
3	On the **draft project implementation framework** indicating SPMG as the "project management unit" and its readiness to assume the proposed role.	• Mr. Ansari reiterated the role of SPMG as a monitoring body (which was described in the Interim Report). He added that SPMG, as the name suggests, manages projects, particularly those being implemented under the World Bank programme. Under this scenario, SPMG is the "proper office in the State" to undertake the role of Project Management Unit for projects to be implemented under the JICA programme. • Mr. Ansari said that they are in agreement with attaching the Project Management Consultants (PMC) to the SPMG during project implementation phase, as indicated in the draft implementation framework. • Mr. Ansari said that SPMG has currently 21 personnel. But people and resource wise, SPMG is ready for the role to be given under JICA programme.

4	On the **coordinative nature of its work** with State departments and organizations and the urban local bodies n the implementation of the projects sanctioned by NGRBA / NMCG in U.P.	• Mr. Ansari said that SPMG does not implement projects but it coordinates the implementation of projects on the field works' level through State departments and organizations, as well as with urban local bodies. • For example, the DPRs for sewerage projects are prepared by UPJN; then these are coursed through SPMG, which in turn submits the same to NMCG for funding.
5	On **procurement functions / role of SPMG** in projects under NGRBA / NMCG	• Mr. Ahmad and the procurement officer explained that SPMG's role in procurement is basically on procurement planning only. It is the channel in the State level that receives and then submits the technical and financial requirements, such as the DPRs, for sanction to NMCG under its programme of work. In effect, is sees to it that all requirements are met by the State implementation agency before submission to the executing agency, which is the NMCG. For sewerage projects, U.P. Jal Nigam prepares the DPR; for river front projects, the development authorities prepare DPR; while for solid waste projects, DPRs are prepared by the ULBs, that is, the Nagar Nigam or the Nagar Palika Parishad. • There is a Procurement Manual (revised in 2013) that governs the procurement process for projects funded under the World Bank (WB) in NMCG. Embedded in the procurement process are three levels of approvals through a "no objection certificate" or NOC before a project sees actual implementation. - The State, through State departments or organizations, prepares and submits particular DPR through the SGRCA, which examines the compliance to technical and financial feasibility of said proposed project, to the NMCG and WB. If everything is in order, the latter then issues the first NOC. - The NMCG, through the empowered committee, then gives the administrative sanction or approves the proposed project, upon which the second NOC is issued. - Before the project is up for bidding, the WB approves the procedure plus the terms and conditions for bidding, in the same manner as the DPR is approved. - Then NMCG and the WB evaluate the bids technically and financially, after which the winning bidder is announced. The third NOC is issued together with a letter of acceptance. • According to Mr. Ahmad, the entire process takes from six to eight months to complete.
6	**Adjournment** There being no other matter to be discussed, the meeting was adjourned at 1145H	

Prepared by:

Consuelo Estepa, PhD
Institution A

PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT

MINUTES OF THE MEETING

Date:	08 August 2016
Meeting Time:	1200-1300 H
Agenda:	1) Experience working / collaborating with SPMG for such NGRBA / NMCG projects 2) Status of vacancies at UPJN 3) Streamlining decision-making process in tendering
Place:	Office of Chief Engineer Ganga, UPJN Lucknow, U.P.

Present:

1	Mr. S.K. Sinha	Chief Engineer, Ganga
2	Ms. Consuelo Estepa	Institution A, JICA Study Team
3	Mr. Siddiqur Rehman	National HR Specialist, NJSEI

	DESCRIPTION	REMARKS
1	**Welcome** Mr. SInha welcomed the team to his office. Ms. Estepa, on the other, thanked Mr. Sinha for receiving her and Mr. Rehman, and explained the agenda of the meeting.	
2	On the **experience on working / collaborating with SPMG** in implementing NMCG programme of work	• Mr. Sinha said that UPJN has good working relationship with SPMG thus far. • For example, on the appraisal of DPRs submitted by UPJN: - He explained that the role of SPMG is that of a State channel before reaching NMCG on the central government level to ensure that DPRs are "approval-ready". - The evaluation the DPRs is actually done through "third party appraisal" composed of a consortium of IIT graduates on behalf of NMCG. - Said DPRs are strictly appraised both on the technical and financial sides. There are times that some components are curtailed to reduce project costs. • He said that slight problem of delays in the payment to project contractors and consultants. He explained that all requests for payments go through SPMG, which in turns submits the same to NMCG. When it comes to payments, there is the so-called "mother-child" accounts wherein the NMCG releases payments to the SPMG (mother account). However, there is a gap in the release of the payment to UPJN (child account) from SPMG side, which triggers delays also to the payments released to contractors or consultants.

3	On **SPV and HAM-PPP as the mode of implementation** for JICA projects	• Mr. Sinha commented that SPV may not be required for the project because of the following: - ULBs are not ready for SPV. Getting them ready will "create another problem" rather than solving a problem. - There may not be many PPP operators for STPs - There may not be revenue streams available for PPP proponents as water is readily available in U.P. considering that one source of revenue for the PPP proponent is the sale of treated water. - It will be difficult to impose proper tariff, as shown in resistance of the people even in a economically better off ULB like Lucknow. What more for other less affluent ULBs? - The NPPs receive financial subsidy for O&M of STPs through the 14th Finance Commission and such budget is allocated to UPJN for maintaining 50 STPs in the State of U.P.
4	On the **status of vacancy** in the technical posts in UPJN	• Mr. Sinha mentioned that there is very clear progress in this area. He said that the State has approved the following: - Recruitment of 727 junior engineers posts is on-going; - Recruitment of 100 assistant engineer posts in also on-going. • He said that full strength will be achieved by November to December this year as recruitment is in full swing, taking anywhere from three to four months.
5	On the **streamlining the decision making process** in tendering	• We discussed the tendering process, which Mr. Sinha described as very transparent. We went through the activities in procurement process, and came up with desired duration / time to complete each activity in the process.
6	**Adjournment** There being no other matter to be discussed, the meeting was adjourned at 1300H	

Prepared by:

Consuelo Estepa, PhD
Institution A

3. Ground survey report

TABLE OF CONTENTS

1. Ramna STP (Varanasi)

VISHWA BHUMI TECHNOLOGIES

PROJECT NO. 93

REPORT ON

GEOTECHNICAL SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT

SUBMITTED TO

NJS CONSULTANTS CO. LTD

1ST FLOOR, R.H. TOWER, THE MALL ROAD, CANTONMENT, VARANASI

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CONTENTS

1.0 INTRODUCTION

M/s NJS CONSULTANTS CO. LTD has planned Geotechnical Survey for preparatory survey on Ganga rejuvenation project in Varanasi, India.

M/s VISHWA BHUMI TECHNOLOGIES has carried out the geotechnical survey.

2.0 BRIEF DESCRIPTION OF GEOLOGY AND TYPE OF STRUCTURE

Ramna is a Village in Chiraigaon Tehsil in Varanasi District of Uttar Pradesh State, India having Coordinates 25°13'58"N 83°0'43"E. It belongs to Varanasi Division . Ramna is located 10 Km towards South from District head quarters Varanasi, 17 Km from Chiraigaon and 319 Km from State capital Lucknow

This Place is in the border of the Varanasi District and Chandauli District. Chandauli District Chahniya is North towards this place.

3.0 SCOPE OF WORK

3.1 The scope of the geotechnical investigation work consisted of the following activities.

Carrying out the soil investigation by drilling two no. of 150 mm diameter boreholes of 20.0m depth below existing ground level or up to Refusal ('N' value > 100) whichever occurs earlier in all types of soil strata.

a) At every 1.0m intervals standard penetration test shall be carried out in order to determine at load bearing capacity of different strata. If the N-value of 50 is encountered continues 5m, boring test can be stopped.

b) Depth of each boring shall be 20 m or refusal. Refusal is defined as SPT value exceeding 100 blows for 30 cm penetration or 25 blows for 2.5 cm or less penetration.

c) Collected samples are to be logged descriptively indicating the soil types and stratigraphic characteristics to evaluate the suitability for construction of the structure

d) The depth of water table shall be measured from the surface of the boreholes. The level of the water shall be measured and recorded daily.

4.0 EXECUTION OF FIELD WORK

4.1 Location of boreholes: The client gave the location of two boreholes. These were marked on the ground and all the field tests were conducted in the presence of site engineer of the client.

4.2 Methodology:

a) **Making of Boreholes**: The bore holes of 150mm diameter were made by shell & auger method up to 20 m depth respectively. All the borings were carried out as per IS: 1892 - 1979. The boreholes were terminated on meeting the specified depth. Following field tests / samplings were carried out during the progress of the bore holes.

b) **Standard Penetration Test (SPT):** SPT are conducted as per IS 2131. For this a standard split spoon sampler is driven at the bottom of the hole. The penetration resistance in terms of blows for 150mm penetration of the split spoon sampler is measured. The blows are impacted by a standard weight of 63.5kg falling through a height of 750 mm. The resistance is measured for 150 mm, 300 mm and 450 mm. The resistance of first 150 mm is ignored and the resistance of next 300 mm is recorded as standard penetration value 'N'

c) **Undisturbed Soil Samples (UDS):** The Undisturbed soil samples are collected at regular interval of 3.0m depth. The work was carried out according to IS 2132. For this an open drive tube sampler is pushed / driven into the soil strata at the bottom of the bore hole in progress. The diameter of the sampler is 100 mm. The sampler with the undisturbed soil sample inside is gently withdrawn. The sampler is cleaned externally, properly sealed with wax at both ends, labeled and transported to the laboratory for conducting tests.

d) **Disturbed Soil Sample (DS):** Disturbed soil samples are collected generally from the split spoon samples of SPT test. The samples is extracted from the sampler, packed, labeled and transported to the laboratory for testing

e) **Summary of Borcholes**

Borehole No	Depth of overburden soil (m)	Final depth (m)	Water table depth Below EGL. (m)
(BH-1)	20.0	20.0	16.0
(BH-2)	20.0	20.0	16.5

Layer wise Properties of encountered subsoil strata

BH-1

Depth (m)		Properties
From	To	
0.0	1.0	Filledup
1.0	3.0	γ_{eff} = 1.55 gm/cc, C = 0 kg/cm^2, Φ = 27.0°
3.0	4.5	γ_{eff} = 1.57 gm/cc, C = 0 kg/cm^2, Φ = 27.5°
4.5	15.0	γ_{eff} = 1.59 gm/cc, C = 0 kg/cm^2, Φ = 28.0°
15.0	20.0	γ_{eff} = 1.85 gm/cc, C = 0 kg/cm^2, Φ = 32.0°

BH-2

Depth (m)		Properties
From	To	
0.0	1.0	Filledup
1.0	1.5	γ_{eff} = 1.53 gm/cc, C = 0 kg/cm^2, Φ = 26.5°
1.5	4.5	γ_{eff} = 1.56 gm/cc, C = 0 kg/cm^2, Φ = 27.0°
4.5	7.0	γ_{eff} =1.61 gm/cc, C = 0 kg/cm^2, Φ = 28.0°
7.0	20.0	γ_{eff} = 1.84 gm/cc, C = 0 kg/cm^2, Φ = 32.5°

5.0 LABORATORY TESTING

The relevant laboratory tests were conducted on representative subsoil samples in our well equipped laboratory as per relevant IS codes mentioned above.

a) Dry density/Bulk Density	as per IS: 2720, pt-IX, 1992
b) Particle size analysis	as per IS: 2720, pt-IV, 1985
c) Atterberg's limits	as per IS: 2720, pt-V, 1985
d) Classification of soil	as per IS: 1498, 1987
e) Specific gravity of soil	as per IS: 2720, pt-III, 1997
f) Moisture content	as per IS: 2720, pt-II, 1973

6.0 FINDINGS OF THE GEOTECHNICAL INVESTIGATION

Site Stratification

(BH-1)

The subsoil stratum from 0.0 to 1.0 m depth consists of Filled up, from 1.0 to 3.0 m depth consists of Silty Sand classified as SM, from 3.0 to 4.5 m depth consists of Sandy Silt classified as ML and from 4.5 to 20.0 m depth consists of Fine Sand classified as SP-SM.

(BH-2)

The subsoil stratum from 0.0 to 1.0 m depth consists of Filled up, from 1.0 to 1.5 m depth consists of Silty Sand classified as SM, from 1.5 to 4.5 m depth consists of Sandy Silt classified as ML, from 4.5 to 7.0 m depth consists of Fine Sand with clay traces classified as SP-SM and from 7.0 to 20.0 m depth consists of Fine Sand classified as SP-SM.

6.1 Ground Water: The ground water table was encountered at 16.0 m in BH-1 and 16.5 m in BH-2 up to the depth of exploration in the bore holes below existing ground level during boring activities at site.

7.0 PROPOSED FOUNDATIONS AND THEIR DEPTHS

Depending on the field and laboratory observations of subsoil strata, test results and the type of structures proposed at site, the types of foundations, depths and net safe bearing capacities recommended for design purposes are given in the following table. The net SBC/API in the following table are the lower of the values obtained from shear failure criterion as per IS: 6403 and settlement failure criterion as per IS 8009, Part-I. The permissible settlements are as below:-

(a) Strip footings of width 2.0, 3.0 & 4.0m cast at 5.0 & 15.0m depth below existing ground surface.

(b) Isolated footings of size 2.0, 3.0 & 4.0m cast at 5.0 & 15.0m depths below existing ground surface.

(c) Raft footings of width 6.0m and above cast at 5.0 m, & 15.0 m depth below existing ground surface.

8.0 COMPUTATION OF SAFE /ALLOWABLE BEARING CAPACITY:

Shear and settlement failure criteria as per IS: 6403- 1981 , IS : 8009 (part-1) -1976 and IS: 1904-1986 have been considered to compute the safe allowable bearing capacity of underlying soil strata for isolated footings, Strip footings & Raft footings. The safe/allowable bearing capacity from both criteria is given as follows:

The net safe bearing capacity of sub-soil strata has been computed by considering Interpolated shear failure using the following equation for calculating the net ultimate bearing capacity ;

$Q_{ns} = 2/3\ c.N_c\ s_c.d_c.i_c + q(N_q'-1).s_q.d_q.i_q + 1/2\ B\ .\gamma\ .N\gamma'.s\gamma.d\gamma.i\gamma.W'$

.....for local shear

$Q_{ns} = c.N_c\ s_c\ d_c\ i_c + q(N_q-1).s_q.d_q.i_q + 1/2\ B\ .\gamma\ .N\gamma.s\gamma.d\gamma.i\gamma.W'$

.....for general shear

$$Qns = \text{Local SBC} + \frac{(\text{General SBC} - \text{Local SBC})}{0.75 - 0.55} \times (0.75 - e0)$$

.....for interpolated SBC

The Factor of safety has been considered as 2.5

Shape factors have been taken as follows:-

$s_c = s_q = s_\gamma = 1.0$ -for Strip footing

$s_c = 1.3$, $s_q = 1.2$, $s_\gamma = 0.8$ -for Isolated footing

$s_c = s_q = 1+0.2B/L = 1.2$, $s_\gamma = 1-0.4\ B/L = 0.6$ -for Raft footing

Depth factors:

$d_c = d_q = d_\gamma = 1.0$ for shallow foundations

Using the above equation and parameters, the following values of net safe bearing capacity have been computed:

(BH-1 & BH-2)Net Safe Bearing capacity (t/m^2))

Depth of foundation Below existing ground Surface/ depth Below (m)	Type of Foundation	Size / Width of foundation (m)	Net Safe Bearing capacity (t/m^2)	
			BH-1	BH-2
5.0	Strip footings	2.0	18.67	18.91
		3.0	19.49	19.73
		4.0	20.30	20.56
	Isolated footings	2.0 x 2.0	21.76	22.03
		3.0 x 3.0	22.41	22.69
		4.0 x 4.0	23.06	23.35
	Raft footings	≥6.0	23.38	23.68
15.0	Strip footings	2.0	253.01	257.87
		3.0	258.60	263.62
		4.0	264.19	269.37
	Isolated footings	2.0 x 2.0	304.11	304.85
		3.0 x 3.0	308.58	309.44
		4.0 x 4.0	313.05	314.04
	Raft footings	≥6.0	310.32	316.34

8.1 **SETTLEMENT FAILURE CRITERION**:

The settlement of sandy layers below the foundation level and up to the zone of Influence are computed by using the chart of settlement V/s SPT 'N' given on page 17 of IS 8009.

For Isolated footings, Strip footings & Raft footing the zone of influence below the foundation depth is considered as 2.0B, where B is the width of foundation

The total permissible settlement for Strip footing = 60mm

The total permissible settlement for isolated footing = 50mm

The total permissible settlement for raft footing = 75mm:

The layer wise properties of the sub soil strata are as follows:

The depth wise SPT values of the subsoil strata (observed/corrected) are as below:-

BH-1

Depth below existing ground level (m)	SPT Values Observed	SPT Values Corrected	Effective Density (gm/cc)
1.0	7.0	11.38	1.55
2.0	5.0	6.97	1.55
3.0	9.0	11.31	1.57
4.0	11.0	12.75	1.57
5.0	14.0	15.17	1.59
6.0	16.0	16.35	1.59
7.0	18.0	17.45	1.59
8.0	23.0	21.26	1.59
9.0	27.0	23.89	1.59
10.0	31.0	26.33	1.59
11.0	31.0	25.33	1.59
12.0	34.0	26.79	1.59
13.0	37.0	28.15	1.59
14.0	42.0	30.91	1.59
15.0	42.0	29.79	1.85
16.0	46.0	23.54	0.85
17.0	49.0	24.31	0.85
18.0	54.0	25.74	0.85
19.0	58.0	26.78	0.85
20.0	63.0	28.12	0.85

BH-2

Depth below existing ground level (m)	SPT Values Observed	SPT Values Corrected	Effective Density (gm/cc)
1.0	4.0	6.52	1.53
2.0	7.0	9.76	1.56
3.0	6.0	7.55	1.56
4.0	10.0	11.61	1.56
5.0	14.0	15.18	1.61
6.0	16.0	16.34	1.61
7.0	29.0	27.89	1.84
8.0	35.0	31.89	1.84
9.0	31.0	26.89	1.84
10.0	34.0	28.17	1.84
11.0	36.0	28.57	1.84
12.0	41.0	31.25	1.84
13.0	46.0	33.74	1.84
14.0	38.0	26.86	1.84
15.0	41.0	27.98	1.84
16.0	45.0	29.68	1.84
17.0	50.0	23.74	0.84
18.0	47.0	22.54	0.84
19.0	50.0	23.26	0.84
20.0	55.0	24.59	0.84

The values of allowable pressure intensities computed based on the above selected soil parameters are shown below:-

(BH-1 & BH-2) (Allowable pressure intensity (t/m^2))

Depth of foundation Below existing ground Surface/ depth Below (m)	Type of Foundation	Size / Width of foundation (m)	Allowable pressure intensity (t/m^2)	
			BH-1	BH-2
5.0	Strip footings	2.0	20.41	30.93
		3.0	21.13	29.41
		4.0	21.82	27.52
	Isolated footings	2.0 x 2.0	17.01	25.77
		3.0 x 3.0	17.61	24.51
		4.0 x 4.0	18.18	22.94
	Raft footings	≥6.0	28.30	31.12
15.0	Strip footings	2.0	30.61	29.13
		3.0	27.03	22.90
		4.0	25.21	22.06
	Isolated footings	2.0 x 2.0	25.51	24.27
		3.0 x 3.0	22.52	19.08
		4.0 x 4.0	21.01	18.38
	Raft footings	≥6.0	30.74	26.60

9.0 CONCLUSION WITH RECOMMENDATIONS:

On the basis of above Soil investigation the following recommendations are suggested:

9.1. The sub-soil strata met at this site consists of layers of Fine sand, Silty Sand and Medium Coarse Fine sand.

The subsoil strata are loose to medium dense.

9.2. On the basis of field & laboratory test results, the following values of the net safe bearing capacity for Strip, Isolated & Raft footings are to be considered .

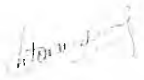
(BH-1 & BH-2) (NET SAFE BEARING CAPACITY/ ALLOWABLE PRESSURE INTENSITY T/M2))

Depth of foundation Below existing ground Surface/ depth Below (m)	Type of Foundation	Size / Width of foundation (m)	Net safe bearing capacity/ allowable pressure intensity t/m^2	
			BH-1	BH-2
5.0	Strip footings	2.0	18.67	18.91
		3.0	19.49	19.73
		4.0	20.30	20.56
	Isolated footings	2.0 x 2.0	17.01	22.03
		3.0 x 3.0	17.61	22.69
		4.0 x 4.0	18.18	22.94
	Raft footings	≥6.0	23.38	23.68
15.0	Strip footings	2.0	30.61	29.13
		3.0	27.03	22.90
		4.0	25.21	22.06
	Isolated footings	2.0 x 2.0	25.51	24.27
		3.0 x 3.0	22.52	19.08
		4.0 x 4.0	21.01	18.38
	Raft footings	≥6.0	30.74	26.6

10. CLOSURE

We appreciate the opportunity given to us to submit this report. This presented report is based on observations and tests on samples collected from the boreholes as decided by the client. In case any difference is noticed in the field subsoil strata and reported subsoil strata during excavation please contact us before proceeding with further construction.

For VISHWA BHUMI TECHNOLOGIES



(DINESH BHARDWAJ)

TABLE INDEX

FIGURE INDEX

VBT	VISHWA BHUMI TECHNOLOGIES	PROJECT :- GEOTECHNICAL SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT.													Sheet No- 17
		BH - 1 (RAMNA STP)			BORING DATE 12/11/2015 to 13/11/2015			TERMINAL DEPTH (m) 20.00							WATER TABLE 16.0m

N VALUES	DEPTH (M)	SAMPLE	DESCRIPTION OF SOIL	IS CLASSIF-ICATION	GRAIN SIZE ANALYSIS				LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	DRY/BULK DENSITY	MOISTURE CONTENT	SHEAR PARAMETER			SPECIFIC GRAVITY
					GRAVEL	SAND	SILT	CLAY						TEST TYPE	COHESION INTERCEPT (c)	ANGLE OF INTERNAL FRICTION (ϕ)	
					%	%	%	%	%	%	%	gm/cc	%		kg/cm^2	deg.	
	0.5	DS-1		Filledup													
7	1.0	SPT-1		SM	0	78	32	0									
	1.5	UDS-1	Silty Sand	SM	0	74	36	0	N	P		1.47/1.55	5.18	DST	0	27.0	2.63
5	2.0	SPT-2															
9	3.0	SPT-3		ML	0	39	55	6	22	19	3	1.45*/1.57*	6.53*	DST*	0*	27.5*	2.67*
11	4.0	SPT-4	Sandy Silt														
	4.5	UDS-2		SPSM	0	84	16	0	N	P		1.49/1.59	6.38	DST	0	28.0	2.65
14	5.0	SPT-5															
16	6.0	SPT-6															
18	7.0	SPT-7		SPSM	0	83	17	0									
23	8.0	SPT-8															
27	9.0	SPT-9															
31	10.0	SPT-10		SPSM	0	86	14	0									
31	11.0	SPT-11															
34	12.0	SPT-12	Fine Sand														
37	13.0	SPT-13		SPSM	0	90	10	0									
42	14.0	SPT-14															
42	15.0	SPT-15		SPSM	0	92	8	0	N	P		1.69*/1.85*	9.49*	DST*	0*	32.0*	2.66*
46	16.0	SPT-16															
49	17.0	SPT-17															
54	18.0	SPT-18		SPSM	0	91	9	0									
58	19.0	SPT-19															
63	20.0	SPT-20		SPSM	0	89	11	0									

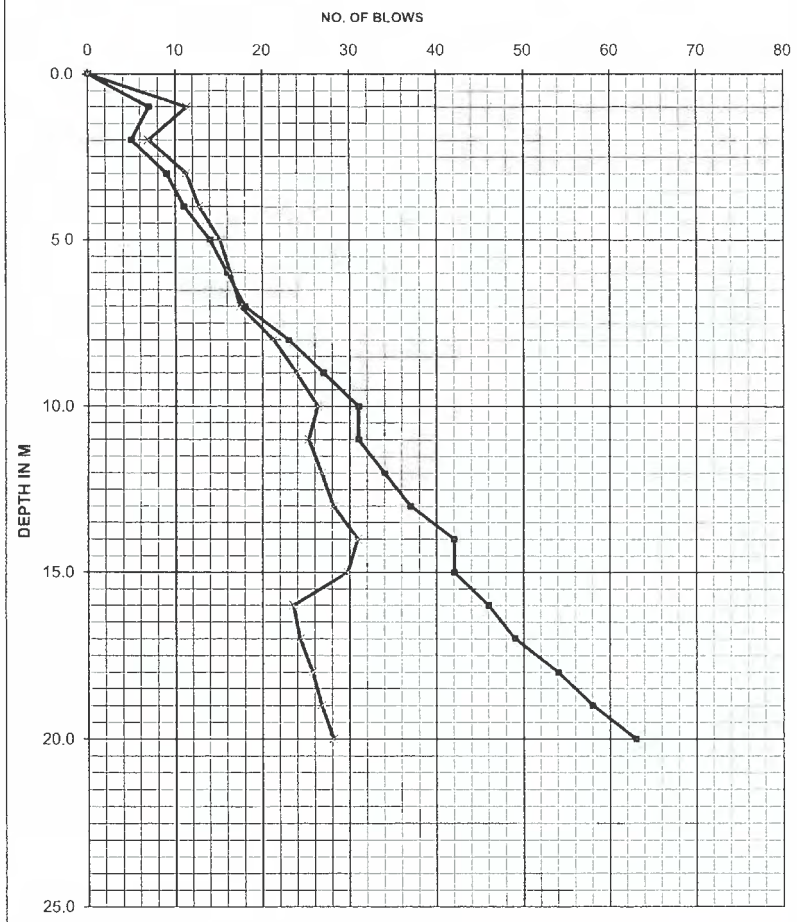
*Remoulded Sapmle

VBT	VISHWA BHUMI TECHNOLOGIES				PROJECT :- GEOTECHNICAL SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT.												Sheet No- 18
					BH - 2 (RAMNA STP)			BORING DATE 11/11/2015 to 11/11/2015			TERMINAL DEPTH (m) 20.00						WATER TABLE 16.50m
N VALUES	DEPTH (M)	SAMPLE	DESCRIPTION OF SOIL	IS CLASSIF - ICATION	GRAIN SIZE ANALYSIS				LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	DRY/BULK DENSITY	MOISTURE CONTENT	SHEAR PARAMETER			SPECIFIC GRAVITY
					GRAVEL	SAND	SILT	CLAY						TEST TYPE	COHESION INTERCEPT (c)	ANGLE OF INTERNAL FRICTION (ϕ)	
					%	%	%	%	%	%	%	gm/cc	%		kg/cm^2	deg.	
	0.5	DS-1		Filledup													
4	1.0	SPT-1	Silty Sand	SM	0	77	23	0	N	P		1.44*/1.53*	6.17*	DST*	0*	26.5*	2.65*
	1.5	UDS-1		ML	0	41	55	4	21	19	2	1.46/1.56	6.70	DST	0	27.0	2.66
7	2.0	SPT-2	Sandy Silt														
6	3.0	SPT-3		ML	0	44	51	5									
10	4.0	SPT-4															
	4.5	UDS-2		SPSM	2	83	15	0	N	P		1.50/1.61	7.09	DST	0	28.0	2.65
14	5.0	SPT-5	Fine Sand with Clay traces														
16	6.0	SPT-6		SPSM	0	84	16	0									
29	7.0	SPT-7		SPSM	0	87	13	0									
35	8.0	SPT-8															
31	9.0	SPT-9															
34	10.0	SPT-10		SPSM	0	88	12	0									
36	11.0	SPT-11															
41	12.0	SPT-12															

46	13.0	SPT-13	Fine Sand	SPSM	0	93	7	0									
38	14.0	SPT-14															
41	15.0	SPT-15		SPSM	0	90	10	0	N	P		1.67*/1.84*	10.17*	DST*	0*	32.5*	2.64*
45	16.0	SPT-16															
50	17.0	SPT-17															
47	18.0	SPT-18		SPSM	0	92	8	0									
50	19.0	SPT-19															
55	20.0	SPT-20		SPSM	0	91	9	0									

*Remoulded Sapmle

VISHWA BHUMI TECHNOLOGIES	SHEET NO. 19



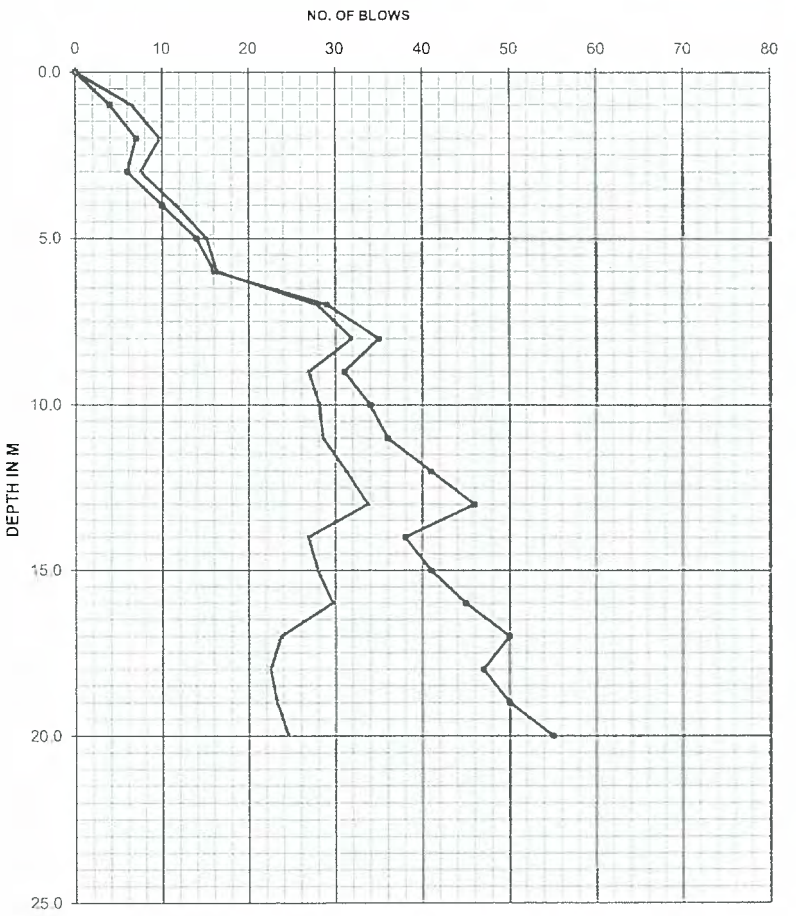
SPT CURVE

LEGEND	
Symbol	Notation
■	No
⊠	Nc

PROJECT - GEOTECHNICAL SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT.

BH - 1

VISHWA BHUMI TECHNOLOGIES	SHEET NO. 20



SPT CURVE

LEGEND	
Symbol	Notation
■	No
⊠	Nc

PROJECT - GEOTECHNICAL SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT.

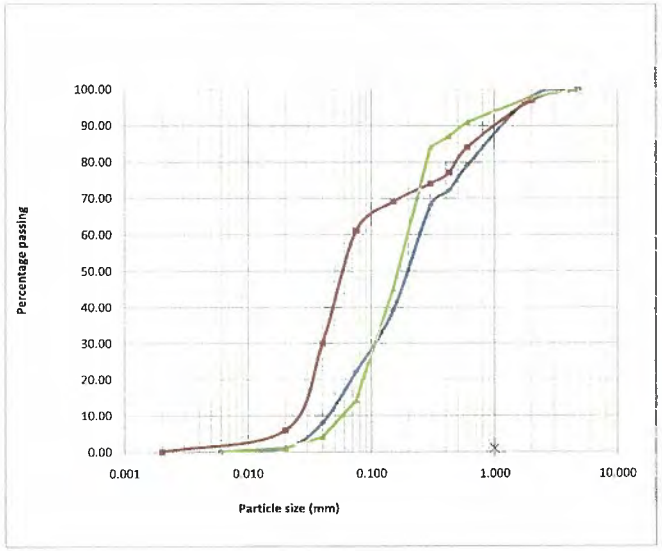
BH - 2

VISHWA BHUMI TECHNOLOGIES	Sheet no. 21

GRAIN SIZE ANALYSIS

PROJECT :- GEOTECHNICAL SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT.

BH - 1



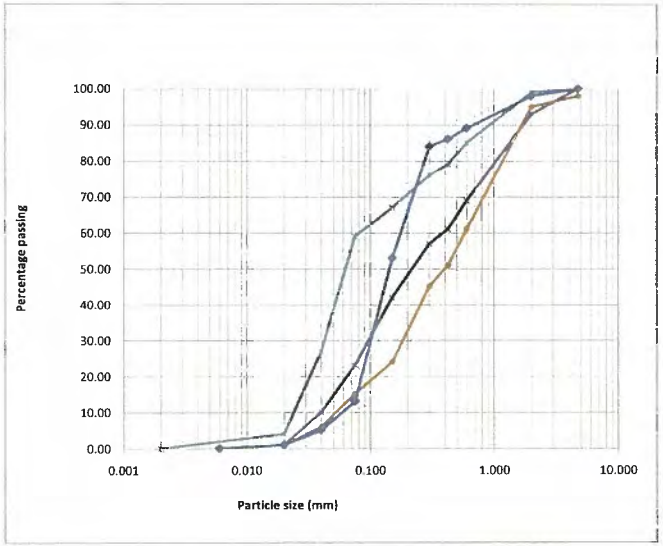
Symbol	Description of soil	Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
	Silty Sand(SM)	1.00	0	78	22	0
	Sandy Silt(ML)	3.00	0	39	55	6
	Fine Sand (SP-SM)	4.50	0	86	14	0

VISHWA BHUMI TECHNOLOGIES	Sheet no. 22

GRAIN SIZE ANALYSIS

PROJECT :- GEOTECHNICAL SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT.

BH - 2

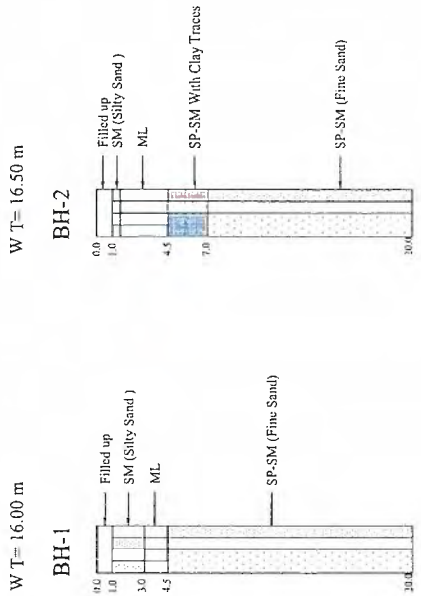


Symbol	Description of soil	Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
	Silty Sand (SM)	1.00	0	77	23	0
	Silty Sand (ML)	1.50	0	41	55	4
	Fine Sand with Clay traces (SP-SM	4.50	2	83	15	0
	Fine Sand (SP-SM)	7.00	0	87	13	0

VISHWA BHUMI TECHNOLOGIES

SHEET NO. 23

LOCATION- RAMNA STP



SUB SOIL PROFILE

GEOTECHNICAL SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENTION PROJECT

VISHWA BHUMI TECHNOLOGIES.

(BH-1) LOCATION:- RAMNA STP

SAMPLE CALCULATION

Type of Foundation – Raft footing
Depth of Foundation –5.0m below EGL
Size of Foundation– 6.0mx6.0m (B=6.0 m)
Allowable Settlement S = 75 mm

1.0 SHEAR FAILURE CRITERIA (REF. IS: 6403)

Average soil data
Cohesion, c = 0kg/cm^2
Angle of Shear Resistance, ϕ = 28.0°
Effective Density
γ = 1.59 gm/cc for 4.50 to 15.00m depth below EGL
Water correction factor w' = 0.50
Overburden pressure q = 500x0.00159 = 0.795 kg/cm^2
$d_c = d_q = d_\gamma = 1.00$
$i_c = i_q = i_\gamma = 1$
$S_c = 1.2\ S_q = 1.2\ 1+0.2xB/L = 1.2$. $S_\gamma = 1-0.4xB/L = 0.6$ ..... for raft footing
Factor of Safety = 2.5

For Local Shear

N_c = 14.45, Nq = 6.36, Nγ = 5.12

$Q_{ns} = [2/3\ cN_c.S_c.d_c.i_c + q(N_q - 1).s_q.d_q.i_q + 0.5\ \gamma_{eff}.B.N\gamma.S_\gamma.d_\gamma.i_\gamma.w']/2.5$

$= [2/3x0x14.45x1.2x1.0+0.795x(6.36-1)x1.2x1.0x1.0+0.5x0.00159x600x5.12x0.6x1.0x1.0x0.50]/2.5$

$= [0+5.11344+0.732672]/2.5$

$= 2.33844$ Kg/cm^2 = 23.38 T/m^2

2.0 SETTLEMENT CRITERIA (IS: 8009,Pt.I)

Average weighted N value at 5.0 m depth (below EGL) = 24.51, w'= 0.50
Influence Zone is considered 2B below foundation level.
From Chart N vs settlement given on page 17 of IS: 8009 (Part 1-1978)
Corrected Settlement at a load of 1.0 Kg/cm2 = 26.5 mm
Hence for 75mm permissible settlement, net API = 75 / 26.5 = 2.830186 Kg/cm^2
= 28.30 T/ m^2

RECOMMENDATION:

LEAST FROM ABOVE VALUES OF NET SBC OBTAINED FROM SHEAR FAILURE CRITERIA AND SETTLEMENT FAILURE CRITERIA i.e. **23.38 T/m^2** FOR 75 MM SETTLEMENT MAY BE ADOPTED FOR DESIGN PURPOSES.

(BH-2) LOCATION:- RAMNA STP

SAMPLE CALCULATION

Type of Foundation – Raft footing
Depth of Foundation –5.0m below EGL
Size of Foundation– 6.0mx6.0m (B=6.0 m)
Allowable Settlement S = 75 mm

1.0 SHEAR FAILURE CRITERIA (REF. IS: 6403)

Average soil data
Cohesion, c = 0kg/cm^2
Angle of Shear Resistance, ϕ = 28.0°
Effective Density
γ = 1.61 gm/cc for 4.50 to 7.00m depth below EGL
Water correction factor w' = 0.50
Overburden pressure q = 500 x 0.00161 = 0.805 kg/cm^2
d_c=, $d_q = d\gamma$ =1.00
i_c=i_q=$i\gamma$ = 1
S_c =1.2 S_q =1.2 1+0.2xB/L = 1.2, $S\gamma$ = 1-0.4xB/L = 0.6 ..... For raft footing
Factor of Safety = 2.5

For Local Shear

N_c= 14.45, Nq = 6.36, Nγ = 5 12

$$Q_{ns} = [2/3\ cN_c.S_c.d_c.i_c + q(N_q - 1).s_q.d_q.i_q + 0.5\ \gamma_{eff}.B.N\gamma.S_\gamma.d_\gamma.i_\gamma.w']/\ 2.5$$

= [2/3x0x14.45x1 2x1.0+0.805x (6 36-1)x1.2x1.0x1.0+0.5x0.00161x600x5 12x0.6x1.0x1.0x0.50]/2.5

= [0+5.17776+0.741888]/2.5

= 2.36785 Kg/cm^2 = 23.68 T/m^2

2.0 SETTLEMENT CRITERIA (IS: 8009,Pt.I)

Average weighted N value at 5.0 m depth (below EGL) = 27.75, w'= 0.50
Influence Zone is considered 2B below foundation level.
From Chart N vs settlement given on page 17 of IS: 8009 (Part 1-1978)
Corrected Settlement at a load of 1.0 Kg/cm2 = 24.1 mm
Hence for 75mm permissible settlement, net API = 75 / 24.10 = 3.112033 Kg/cm^2
= 31.12 T/ m^2

RECOMMENDATION:
LEAST FROM ABOVE VALUES OF NET SBC OBTAINED FROM SHEAR FAILURE CRITERIA AND SETTLEMENT FAILURE CRITERIA i.e. **23.68 T/m^2** FOR 75 MM SETTLEMENT MAY BE ADOPTED FOR DESIGN PURPOSES.

PHOTOGRAPHS

BH- 1 RAMNA STP

BH- 2 RAMNA STP

BOREHOLE DESIGNATION	ACTUAL TEST LOCATION COORDINATES	
	LATITUDE	LONGITUDE
BH-2	25° 14'.529"N	82° 59'.993"E

2. Ghazipur STP

VISHWA BHUMI TECHNOLOGIES

PROJECT NO. 93

REPORT ON

GEOTECHNICAL SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT

SUBMITTED TO

NJS CONSULTANTS CO. LTD

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CONTENTS

1.0 INTRODUCTION

M/s NJS CONSULTANTS CO. LTD has planned Geotechnical Survey for preparatory survey on Ganga rejuvenation project in Varanasi, India.

M/s VISHWA BHUMI TECHNOLOGIES has carried out the geotechnical survey.

2.0 BRIEF DESCRIPTION OF GEOLOGY AND TYPE OF STRUCTURE

Ghazipur (Previously spelled Ghazeepore, Gauspur, and Ghazipour), is a city and municipal corporation in the state of Uttar Pradesh, India. Ghazipur city is the administrative headquarters of the Ghazipur district, one of the four districts that form the Varanasi division of Uttar Pradesh. The city of Ghazipur also constitutes one of the five distinct tehsils, or subdivisions, of the Ghazipur district.

It lies close to the Uttar Pradesh-Bihar border, about 80 kilometres (50 mi) east of Varanasi and 50 kilometres (31 mi) from Buxar, the entry point to Bihar state.

It is located at 25.58°N 83.57°E. It has an average elevation of 62 metres (203 feet).

3.0 SCOPE OF WORK

3.1 The scope of the geotechnical Investigation work consisted of the following activities.

Carrying out the soil investigation by drilling two no. of 150 mm diameter boreholes of 20.0m depth below existing ground level or up to Refusal ('N' value > 100) whichever occurs earlier in all types of soil strata.

a) At every 1.0m intervals standard penetration test shall be carried out in order to determine at load bearing capacity of different strata. If the N-value of 50 is encountered continues 5m, boring test can be stopped.

b) Depth of each boring shall be 20 m or refusal. Refusal is defined as SPT value exceeding 100 blows for 30 cm penetration or 25 blows for 2.5 cm or less penetration.

c) Collected samples are to be logged descriptively indicating the soil types and stratigraphic characteristics to evaluate the suitability for construction of the structure

d) The depth of water table shall be measured from the surface of the boreholes. The level of the water shall be measured and recorded daily

4.0 EXECUTION OF FIELD WORK

4.1 Location of boreholes: The client gave the location of two boreholes. These were marked on the ground and all the field tests were conducted in the presence of site engineer of the client.

4.2 Methodology:

a) **Making of Boreholes**: The bore holes of 150mm diameter were made by shell & auger method up to 20 m depth respectively. All the borings were carried out as per IS: 1892 - 1979. The boreholes were terminated on meeting the specified depth. Following field tests / samplings were carried out during the progress of the bore holes.

b) **Standard Penetration Test (SPT):** SPT are conducted as per IS 2131. For this a standard split spoon sampler is driven at the bottom of the hole. The penetration resistance in terms of blows for 150mm penetration of the split spoon sampler is measured. The blows are impacted by a standard weight of 63.5kg falling through a height of 750 mm. The resistance is measured for 150 mm, 300 mm and 450 mm. The resistance of first 150 mm is ignored and the resistance of next 300 mm is recorded as standard penetration value 'N'

c) **Undisturbed Soil Samples (UDS):** The Undisturbed soil samples are collected at regular interval of 3.0m depth. The work was carried out according to IS 2132. For this an open drive tube sampler is pushed / driven into the soil strata at the bottom of the bore hole in progress. The diameter of the sampler is 100 mm. The sampler with the undisturbed soil sample inside is gently withdrawn. The sampler is cleaned externally, properly sealed with wax at both ends, labeled and transported to the laboratory for conducting tests.

d) **Disturbed Soil Sample (DS):** Disturbed soil samples are collected generally from the split spoon samples of SPT test. The samples is extracted from the sampler, packed, labeled and transported to the laboratory for testing

e) **Summary of Boreholes**

Borehole No	Depth of overburden soil (m)	Final depth (m)	Water table depth Below EGL. (m)
(BH-1)	20.0	20.0	7.0
(BH-2)	20.0	20.0	4.5

Layer wise Properties of encountered subsoil strata

BH-1

Depth (m)		Properties
From	To	
0.0	1.0	Filledup
1.0	1.5	γ_{eff} = 1.61gm/cc ,C = 0.0kg/cm^2, Φ = 28.5°
1.5	3.0	γ_{eff} = 1.62 gm/cc ,C = 0.0kg/cm^2, Φ = 30.0°
3.0	4.0	γ_{eff} = 1.69gm/cc ,C = 0.300kg/cm^2, Φ = 12.0°
4.0	4.5	γ_{eff} = 1.71gm/cc ,C = 0.0kg/cm^2, Φ = 30.5°
4.5	7.0	γ_{eff} = 1.77 gm/cc ,C = 0.0kg/cm^2, Φ = 31.0°
7.0	10.0	γ_{eff} = 0.77gm/cc ,C = 0kg/cm^2, Φ = 31.0°
10.0	20.0	γ_{eff} = 0.95gm/cc ,C = 0.800kg/cm^2, Φ = 8.0°

BH-2

Depth (m)		Properties
From	To	
0.0	1.0	Filledup
1.0	3.0	γ_{eff} = 1.62gm/cc ,C = 0.0kg/cm^2, Φ = 28.5°
3.0	4.0	γ_{eff} = 1.73gm/cc ,C = 0.300kg/cm^2, Φ = 13.0°
4.0	4.5	γ_{eff} =1.80gm/cc ,C = 0.0kg/cm^2, Φ = 30.0°
4.5	7.0	γ_{eff} = 0.80gm/cc ,C = 0.0kg/cm^2, Φ = 30.0°
7.0	14.0	γ_{eff} = 0.86gm/cc ,C = 0.810kg/cm^2, Φ = 6.0°
14.0	17.0	γ_{eff} = 0.94gm/cc ,C = 0.600kg/cm^2, Φ = 10.0°
17.0	20.0	γ_{eff} =0.98gm/cc ,C = 0.960kg/cm^2, Φ = 7.0°

5.0 LABORATORY TESTING

The relevant laboratory tests were conducted on representative subsoil samples in our well equipped laboratory as per relevant IS codes mentioned above.

a) Dry density/Bulk Density	as per IS: 2720, pt-IX, 1992
b) Particle size analysis	as per IS: 2720, pt-IV, 1985
c) Atterberg's limits	as per IS: 2720, pt-V, 1985
d) Classification of soil	as per IS: 1498, 1987
e) Specific gravity of soil	as per IS: 2720, pt-III, 1997
f) Moisture content	as per IS: 2720, pt-II, 1973

6.0 FINDINGS OF THE GEOTECHNICAL INVESTIGATION

Site Stratification

(BH-1)

The subsoil stratum from 0.0 to 1.0 m depth consists of Filled up, from 1.0 to 1.5 m depth consists of Sandy Silt classified as ML, from 1.5 to 3.0 m depth consists of Poorly graded Gravel classified as GP, from 3.0 to 4.0 m depth consists of Sandy Silt with Clay classified as ML-CL, from 4.0 to 4.5 m depth consists of Silty Sand classified as SM, from 4.5 to 10.0 m depth consists of Sandy Silt classified as ML and from 10.0 to 20.0 m depth consists of Clay with medium Plasticity classified as CI.

(BH-2)

The subsoil stratum from 0.0 to 1.0 m depth consists of Filled up, from 1.0 to 3.0 m depth consists of Silty Sand classified as SM, from 3.0 to 4.0 m depth consists of Sandy Silt with Clay classified as ML-CL, from 4.0 to 7.0m depth consists of Sandy Silt classified as ML, from 7.0 to 14.0 m depth consists of Clay with medium Plasticity classified as CI, from 14.0 to 17.0 m depth consists of Clay with low Plasticity classified as CL and from 17.0 to 20.0 m depth consists of Clay with medium Plasticity classified as CI.

6.1 Ground Water: The ground water table was encountered at 7.0 m in BH-1 and 4.5 m in BH-2 up to the depth of exploration in the bore holes below existing ground level during boring activities at site

7.0 PROPOSED FOUNDATIONS AND THEIR DEPTHS

Depending on the field and laboratory observations of subsoil strata, test results and the type of structures proposed at site, the types of foundations, depths and net safe bearing capacities recommended for design purposes are given in the following table. The net SBC/API in the following table are the lower of the values obtained from shear failure criterion as per IS: 6403 and settlement failure criterion as per IS 8009, Part-I. The permissible settlements are as below:-

(a) Strip footings of width 2.0, 3.0 & 4.0m cast at 5.0 & 15.0m depth below existing ground surface.

(b) Isolated footings of size 2.0, 3.0 & 4.0m cast at 5.0 & 15.0m depths below existing ground surface.

(c) Raft footings of width 6.0m and above cast at 5.0 m, & 15.0 m depth below existing ground surface

8.0 COMPUTATION OF SAFE /ALLOWABLE BEARING CAPACITY:

Shear and settlement failure criteria as per IS: 6403- 1981 , IS : 8009 (part-1) -1976 and IS: 1904-1986 have been considered to compute the safe allowable bearing capacity of underlying soil strata for isolated footings, Strip footings & Raft footings. The safe/allowable bearing capacity from both criteria is given as follows:

The net safe bearing capacity of sub-soil strata has been computed by considering Interpolated shear failure using the following equation for calculating the net ultimate bearing capacity ;

$Q_{ns} = 2/3\ c.N_c\ s_c.d_c.i_c + q(N_q'-1).s_q.d_q.i_q + 1/2\ B.\gamma.N\gamma'.s\gamma.d\gamma.i\gamma.W'$

.....for local shear

$Q_{ns} = c.N_c.s_c.d_c.i_c + q(N_q-1).s_q.d_q.i_q + 1/2\ B.\gamma.N\gamma.s\gamma.d\gamma.i\gamma.W'$

.....for general shear

$Qns = \text{Local SBC} + \frac{(\text{General SBC} - \text{Local SBC})}{0.75 - 0.55} \times (0.75 - e0)$

.....for interpolated SBC

The Factor of safety has been considered as 2.5

Shape factors have been taken as follows:-

$s_c = s_q = s_\gamma = 1.0$ -for Strip footing

$s_c = 1.3, s_q = 1.2, s_\gamma = 0.8$ -for Isolated footing

$s_c = s_q = 1+0.2B/L = 1.2,\ s_\gamma = 1-0.4\ B/L = 0.6$ -for Raft footing

Depth factors:

$d_c = d_q = d_\gamma = 1.0$ for shallow foundations

Using the above equation and parameters, the following values of net safe bearing capacity have been computed:

(BH-1 & BH-2)Net Safe Bearing capacity (t/m^2))

Depth of foundation Below existing ground Surface/ depth Below (m)	Type of Foundation	Size / Width of foundation (m)	Net Safe Bearing capacity (t/m^2)	
			BH-1	BH-2
5.0	Strip footings	2.0	54.55	48.63
		3.0	57.64	49.98
		4.0	60.73	51.33
	Isolated footings	2.0 x 2.0	62.99	57.28
		3.0 x 3.0	65.46	58.36
		4.0 x 4.0	67.93	59.44
	Raft footings	≥6.0	69.16	58.95
15.0	Strip footings	2.0	30.41	25.49
		3.0	30.49	25.61
		4.0	30.58	25.72
	Isolated footings	2.0 x 2.0	38.80	32.46
		3.0 x 3.0	38.87	32.55
		4.0 x 4.0	38.94	32.64
	Raft footings	≥6.0	36.58	30.73

8.1 SETTLEMENT FAILURE CRITERION:

The settlement of sandy layers below the foundation level and up to the zone of Influence are computed by using the chart of settlement V/s SPT 'N' given on page 17 of IS 8009.

For Isolated footings, Strip footings & Raft footing the zone of influence below the foundation depth is considered as 2.0B, where B is the width of foundation

The total permissible settlement for Strip footing = 60mm

The total permissible settlement for isolated footing = 50mm

The total permissible settlement for raft footing = 75mm:

The layer wise properties of the sub soil strata are as follows:

The depth wise SPT values of the subsoil strata (observed/corrected) are as below: -

VISHWA BHUMI TECHNOLOGIES

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BH-1

Depth below existing ground level (m)	SPT Values Observed	SPT Values Corrected	Effective Density (gm/cc)
1.0	11.0	17.74	1.61
2.0	13.0	17.94	1.62
3.0	16.0	19.82	1.69
4.0	19.0	21.65	1.71
5.0	23.0	24.38	1.77
6.0	28.0	27.89	1.77
7.0	29.0	21.59	0.77
8.0	32.0	22.68	0.77
9.0	40.0	26.05	0.77
10.0	44.0	27.37	0.95
11.0	50.0	29.51	0.95
12.0	42.0	25.54	0.95
13.0	46.0	26.79	0.95
14.0	54.0	29.64	0.95
15.0	60.0	31.56	0.95
16.0	64.0	32.62	0.95
17.0	34.0	20.57	0.95
18.0	49.0	25.95	0.95
19.0	55.0	27.81	0.95
20.0	61.0	29.59	0.95

BH-2

Depth below existing ground level (m)	SPT Values Observed	SPT Values Corrected	Effective Density (gm/cc)
1.0	13.0	20.94	1.62
2.0	17.0	23.44	1.62
3.0	22.0	27.18	1.73
4.0	26.0	29.44	1.80
5.0	26.0	21.73	0.80
6.0	22.0	19.17	0.80
7.0	29.0	22.41	0.86
8.0	34.0	24.48	0.86
9.0	36.0	24.99	0.86
10.0	44.0	28.32	0.86
11.0	41.0	26.41	0.86
12.0	47.0	28.67	0.86
13.0	51.0	29.94	0.86
14.0	60.0	33.27	0.94
15.0	60.0	32.67	0.94
16.0	63.0	33.34	0.94
17.0	67.0	34.36	0.98
18.0	73.0	36.12	0.98
19.0	64.0	32.06	0.98
20.0	63.0	31.18	0.98

The values of allowable pressure intensities computed based on the above selected soil parameters are shown below :-

(BH-1 & BH-2) (Allowable pressure intensity (t/m^2))

Depth of foundation Below existing ground Surface/ depth Below (m)	Type of Foundation	Size / Width of foundation (m)	Allowable pressure intensity (t/m^2)	
			BH-1	BH-2
5.0	Strip footings	2.0	27.78	30.00
		3.0	26.67	26.09
		4.0	25.32	21.43
	Isolated footings	2.0 x 2.0	23.15	25.00
		3.0 x 3.0	22.22	21.74
		4.0 x 4.0	21.10	17.86
	Raft footings	≥6.0	30.86	32.61
15.0	Strip footings	2.0	32.61	37.50
		3.0	30.00	32.97
		4.0	28.85	31.58
	Isolated footings	2.0 x 2.0	27.17	31.25
		3.0 x 3.0	25.00	27.47
		4.0 x 4.0	24.04	26.32
	Raft footings	≥6.0	31.25	37.88

9.0 CONCLUSION WITH RECOMMENDATIONS:

On the basis of above Soil investigation the following recommendations are suggested:

9.1. The sub-soil strata met at this site consists of layers of Fine sand, Silty Sand and Medium Coarse Fine sand.

The subsoil strata are loose to medium dense.

9.2. On the basis of field & laboratory test results, the following values of the net safe bearing capacity for Strip, Isolated & Raft footings are to be considered .

(BH-1 & BH-2) (NET SAFE BEARING CAPACITY/ ALLOWABLE PRESSURE INTENSITY T/M2))

Depth of foundation Below existing ground Surface/ depth Below (m)	Type of Foundation	Size / Width of foundation (m)	Net safe bearing capacity/ allowable pressure intensity t/m^2	
			BH-1	BH-2
5.0	Strip footings	2.0	27.78	30.00
		3.0	26.67	26.09
		4.0	25.32	21.43
	Isolated footings	2.0 x 2.0	23.15	25.00
		3.0 x 3.0	22.22	21.74
		4.0 x 4.0	21.10	17.86
	Raft footings	≥6.0	30.86	32.61
15.0	Strip footings	2.0	30.41	25.49
		3.0	30.00	25.61
		4.0	28.85	25.72
	Isolated footings	2.0 x 2.0	27.17	31.25
		3.0 x 3.0	25.00	27.47
		4.0 x 4.0	24.04	26.32
	Raft footings	≥6.0	31.25	30.73

10. CLOSURE

We appreciate the opportunity given to us to submit this report. This presented report is based on observations and tests on samples collected from the boreholes as decided by the client. In case any difference is noticed in the field subsoil strata and reported subsoil strata during excavation please contact us before proceeding with further construction.

For VISHWA BHUMI TECHNOLOGIES

(DINESH BHARDWAJ)

TABLE INDEX

FIGURE INDEX

VBT	VISHWA BHUMI TECHNOLOGIES	PROJECT :- GEOTECHNICAL SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT.													Sheet No- 17	
		BH - 1 (GHAZIPUR CITY)			BORING DATE 20/11/2015 to 21/11/2015			TERMINAL DEPTH (m) 20.00							WATER TABLE 7.0m	
N VALUES	DEPTH (M)	SAMPLE	DESCRIPTION OF SOIL	IS CLASSIFICATION	GRAIN SIZE ANALYSIS				LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	DRY/BULK DENSITY	MOISTURE CONTENT	SHEAR PARAMETER		ANGLE OF INTERNAL FRICTION (ϕ)	SPECIFIC GRAVITY
					GRAVEL	SAND	SILT	CLAY						TEST TYPE	COHESION INTERCEPT (c)		
					%	%	%	%	%	%	%	gm/cc	%		kg/cm^2	deg	
	0.5	DS-1		Filledup													
11	1.0	SPT-1	Sandy Silt	ML	2	40	56	2	21	19	2	1.51*/6.75*	1.61*	DST*	0*	28.5*	2.64*
	1.5	UDS-1	Poorly graded Gravel	GP	36	23	41	0	N	P		1.52/6.35	1.62	DST	0	30.0	2.62
13	2.0	SPT-2															
16	3.0	SPT-3	Sandy Silt with Clay	ML-CL	1	33	55	11	28	23	5	1.56*/8.18*	1.69*	UUT*	0.300*	12.0*	2.66*
19	4.0	SPT-4	Silty Sand	SM	2	60	38	0	N	P		1.59*/7.85*	1.71*	DST*	0*	30.5*	2.63*
	4.5	UDS-2	Sandy Silt	ML	0	42	53	5	24	20	4	1.61/9.70	1.77	DST	0	31.0	2.65
23	5.0	SPT-5															
28	6.0	SPT-6		ML	0	44	50	6									
29	7.0	SPT-7															
32	8.0	SPT-8															
40	9.0	SPT-9		ML	1	40	54	5									
44	10.0	SPT-10		CI	2	24	58	16									
50	11.0	SPT-11															
42	12.0	SPT-12		CI	0	22	59	19									

46	13.0	SPT-13	Clay with medium Plasticity														
54	14.0	SPT-14															
60	15.0	SPT-15		CI	3	19	55	21	33	21	12	1.72*/13.14*	1.95*	UUT*	0.800*	8.0*	2.68*
64	16.0	SPT-16															
34	17.0	SPT-17		CI	2	18	57	23									
49	18.0	SPT-18															
55	19.0	SPT-19															
61	20.0	SPT 20		CI	7	18	53	22									

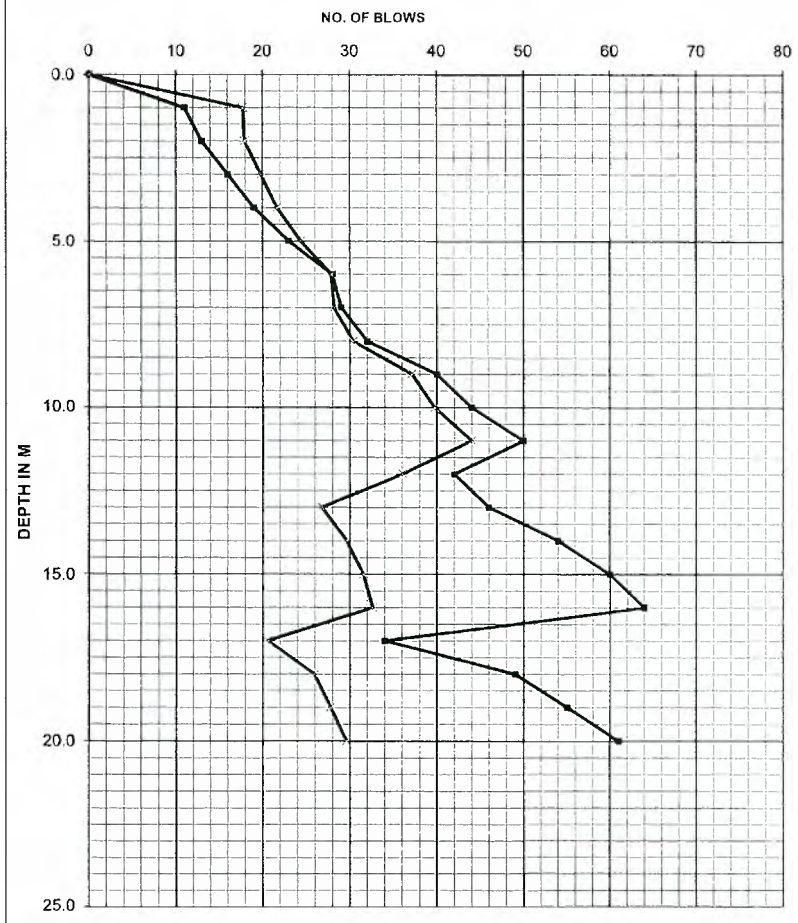
*Remoulded Sapmle

VISHWA BHUMI TECHNOLOGIES	PROJECT :- GEOTECHNICAL SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT.															Sheet No- 18	
	BH - 2 (GHAZIPUR CITY)			BORING DATE 22/11/2015 to 23/11/2015				TERMINAL DEPTH (m) 20.00								WATER TABLE 4.50m	
N VALUES	DEPTH (M)	SAMPLE	DESCRIPTION OF SOIL	IS CLASSIF-ICATION	GRAIN SIZE ANALYSIS				LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	DRY/BULK DENSITY	MOISTURE CONTENT	SHEAR PARAMETER			SPECIFIC GRAVITY
					GRAVEL	SAND	SILT	CLAY						TEST TYPE	COHESION INTERCEPT (c)	ANGLE OF INTERNAL FRICTION (ϕ)	
					%	%	%	%	%	%	%	gm/cc	%		kg/cm^2	deg.	
	0.5	DS-1		Filledup													
13	1.0	SPT-1	Silty Sand	SM	2	57	41	0	N	P		1.53*/1.62*	6.18*	DST*	0*	28.5*	2.62*
	1.5	UDS-1		SM	6	55	39	0									
17	2.0	SPT-2															
22	3.0	SPT-3	Sandy Silt with Clay	ML-CL	3	36	51	10	26	19	7	1.61*/1.73*	7.51*	UUT*	0.300*	13.0*	2.65*
26	4.0	SPT-4	Sandy Silt	ML	0	41	54	5									
	4.5	UDS-2		ML	1	43	52	4	22	19	2	1.63/1.80	10.20	DST	0	30.0	2.64
26	5.0	SPT-5															
22	6.0	SPT-6		ML	0	39	55	6									
29	7.0	SPT-7	Clay with medium Plasticity	CI	3	20	58	19									
	7.5	UDS-3		CI	0	22	57	21	34	19	15	1.65*/1.86*	12.68*	UUT*	0.810*	6.0*	2.67*
34	8.0	SPT-8															
36	9.0	SPT-9		CI	0	24	59	17									
44	10.0	SPT-10															
41	11.0	SPT-11		CI	2	21	61	16									

47	12.0	SPT-12	Clay with low Plasticity														
51	13.0	SPT-13		CI	0	18	60	22									
51	14.0	SPT-14		CL	6	28	53	13									
60	15.0	SPT-15		CL	0	29	57	14	30	21	9	1.72*/1.94*	13.05*	UUT*	0.600*	10.0*	2.68*
63	16.0	SPT-16															
67	17.0	SPT-17	Clay with medium Plasticity	CI	0	17	61	22	35	18	17	1.73*/1.98*	14.64*	UUT*	0.960*	7.0*	2.69*
73	18.0	SPT-18															
64	19.0	SPT-19															
63	20.0	SPT-20		CI	1	22	57	20									

*Remoulded Sapmle

VISHWA BHUMI TECHNOLOGIES	SHEET NO. 19



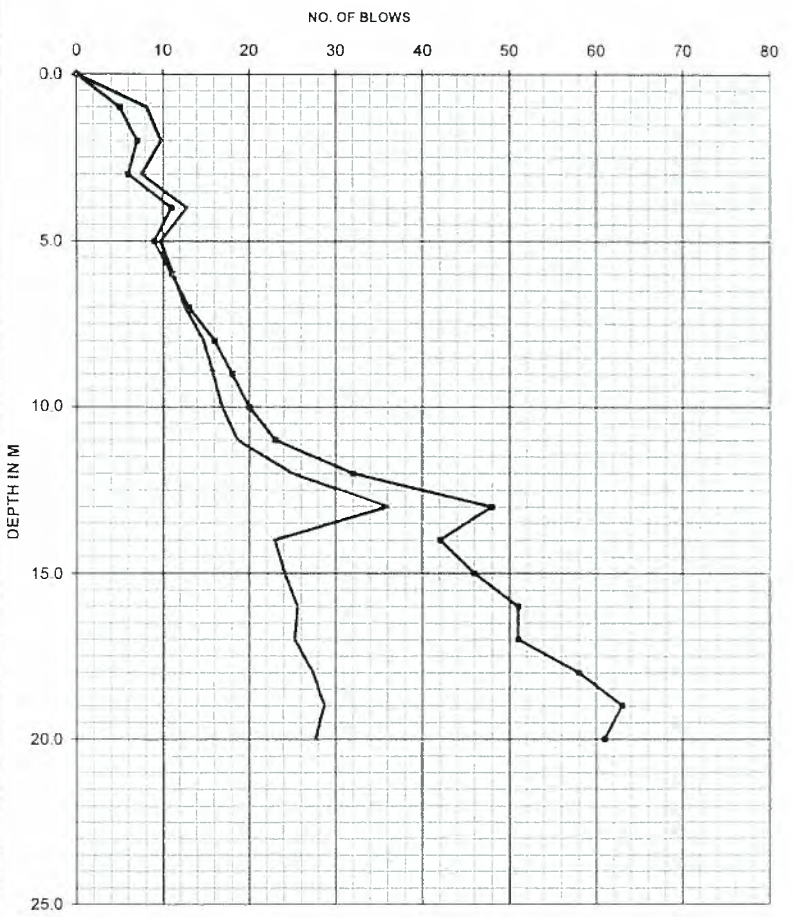
SPT CURVE

LEGEND	
Symbol	Notation
■	No
⊠	Nc

PROJECT - GEOTECHNICAL SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT.

BH - 1

VISHWA BHUMI TECHNOLOGIES	SHEET NO. 20



SPT CURVE

LEGEND	
Symbol	Notation
■	No
⊠	Nc

PROJECT - GEOTECHNICAL SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT.

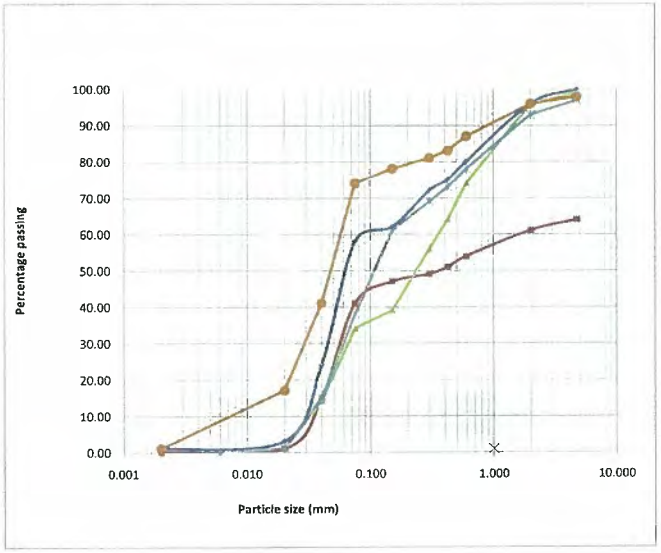
BH - 2

VISHWA BHUMI TECHNOLOGIES | Sheet no. 21

GRAIN SIZE ANALYSIS

PROJECT :- GEOTECHNICAL SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT.

BH - 1



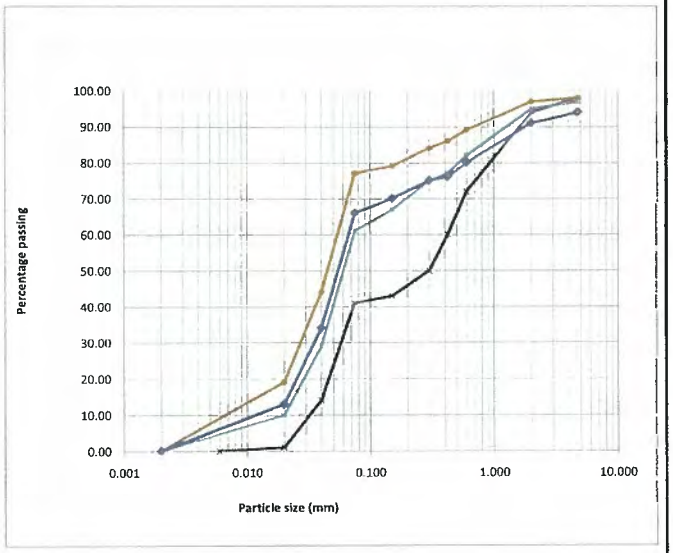
Symbol	Description of soil	Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
	Sandy Silt(ML)	1.00	2	40	56	2
	Poorly graded Gravel (GP)	1.50	36	23	41	0
	Sandy Silt with Clay (ML-CL)	3.00	1	33	55	11
	Silty Sand (SM)	4.00	2	68	30	0
	Clay with medium Plasticity (CI)	10.00	2	24	58	16

VISHWA BHUMI TECHNOLOGIES | Sheet no. 22

GRAIN SIZE ANALYSIS

PROJECT :- GEOTECHNICAL SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT.

BH - 2

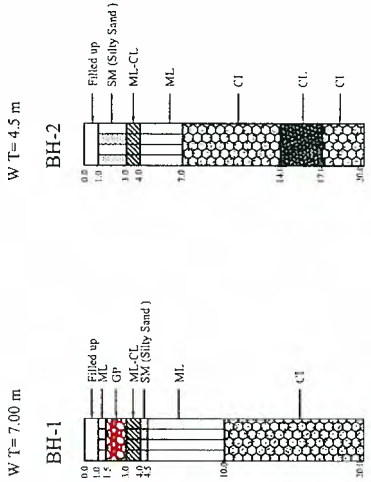


Symbol	Description of soil	Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
	Silty Sand (SM)	1.00	2	57	41	0
	Silty Sand with Clay (ML-CL)	3.00	3	36	51	10
	Clay with medium Plasticity (CI)	7.00	3	20	58	19
	Clay with low Plasticity (CL)	14.00	6	28	53	13

VISHWA BHUMI TECHNOLOGIES

SHEET NO. 23

LOCATION- GHAZIPUR CITY



SUB SOIL PROFILE

GEOTECHNICAL SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENTION PROJECT

VISHWA BHUMI TECHNOLOGIES.

(BH-1) LOCATION:-GHAZIPUR CITY

SAMPLE CALCULATION

Type of Foundation – Raft footing
Depth of Foundation –5.0m below EGL
Size of Foundation– 6.0mx6.0m (B=6.0 m)
Allowable Settlement S = 75 mm

1.0 SHEAR FAILURE CRITERIA (REF. IS: 6403)

Average soil data
Cohesion, $c = 0 kg/cm^2$
Angle of Shear Resistance, $\phi = 31.0°$
Effective Density
$\gamma = 1.77$ gm/cc for 4.50 to 10.00m depth below EGL
Water correction factor $w' = 0.820$
Overburden pressure $q = 500x0.00177 = 0.885 kg/cm^2$
$d_c = d_q = d_\gamma = 1.00$
$i_c = i_q = i_\gamma = 1$
$S_c = 1.2$ $S_q = 1.2$ $1+0.2xB/L = 1.2$, $S_\gamma = 1-0.4xB/L = 0.6$ ..... for raft footing
Factor of Safety = 2.5

For Local Shear

$N_c = 16.93$, $Nq = 7.95$, $N\gamma = 7.36$

$Q_{ns} = [2/3\ cN_c.S_c.d_c.i_c + q(N_q - 1).s_q.d_q.i_q + 0.5\ \gamma_{eff}.B.N\gamma.S_\gamma.d_\gamma.i_\gamma.w']/\ 2.5$

$= [2/3x0x16.93x1.2x1.0+0.885x\ (7.95-1)x1.2x1.0x1.0+0.5x0.00177x600x7.36x0.6x1.0x1.0x0.50]/2.5$

$= [0+7.3809+1.172448]/2.5$

$= 3.4213392\ Kg/cm^2 = 34.21\ T/m^2$

For General Shear

$N_c = 33.34$, $Nq = 21.38$, $N\gamma = 27.53$

$Q_{ns} = [cN_c.S_c.d_c.i_c + q(N_q - 1).s_q.d_q.i_q + 0.5\ \gamma_{eff}.B.N\gamma.S_\gamma.d_\gamma.i_\gamma.w']/\ 2.5$

$= [0x33.24x1.2x1.0+0.885x\ (21.38-1)x1.2x1.0x1.0+0.5x0.00177x600x27.53x0.6x1.0x1.0x0.50]/2.5$

$= [0+21.64356+4.385529]/2.5$

$= 10.41163.56\ Kg/cm^2 = 104.12\ T/m^2$

Interpolated SBC = Local SBS + (General SBC – Local SBC) X (0.75- eo) / (0.75-0.55)

= 34.21 + (104.12 – 34.21) X (0.10) / 0.2

= 34.21 + (69.91) X (0.10) / 0.2

= 69.16 T/m^2

2.0 SETTLEMENT CRITERIA (IS: 8009,Pt.I)

Average weighted N value at 5.0 m depth (below EGL) = 26.82, w'= 0.50
Influence Zone is considered 2B below foundation level.
From Chart N vs settlement given on page 17 of IS: 8009 (Part 1-1978)
Corrected Settlement at a load of 1.0 Kg/cm2 = 24.30 mm
Hence for 75mm permissible settlement, net API = 75 / 24.30 = 3.08641 Kg/cm^2
= 30.86 T/ m^2

RECOMMENDATION:
LEAST FROM ABOVE VALUES OF NET SBC OBTAINED FROM SHEAR FAILURE CRITERIA AND SETTLEMENT FAILURE CRITERIA i.e. **30.86 T/m^2** FOR 75 MM SETTLEMENT MAY BE ADOPTED FOR DESIGN PURPOSES.

(BH-2) **LOCATION:- GHAZIPUR CITY**

SAMPLE CALCULATION

Type of Foundation – Raft footing
Depth of Foundation –5.0m below EGL
Size of Foundation– 6.0mx6.0m (B=6.0 m)
Allowable Settlement S = 75 mm

1.0 SHEAR FAILURE CRITERIA (REF. IS: 6403)

Average soil data
Cohesion, c = 0kg/cm^2
Angle of Shear Resistance, ϕ = 30.0°
Effective Density
γ = 0.80 gm/cc for 4.50 to 7.00m depth below EGL
Water correction factor w' = 0.50
Overburden pressure q = 0.850 kg/cm^2
d_c=, d_q = dγ =1.00
i_c=i_q=iγ = 1
S_c =1.2 S_q =1.2 1+0.2xB/L = 1.2, Sγ = 1-0.4xB/L = 0.6 ..... For raft footing
Factor of Safety = 2.5

For Local Shear

N_c= 15.16, Nq = 6.63, Nγ = 5.66

$Q_{ns} = [2/3\ cN_c.S_c.d_c.i_c + q(N_q - 1).s_q.d_q.i_q + 0.5\ \gamma_{eff}.B.N\gamma.S_\gamma.d_\gamma.i_\gamma.w']/\ 2.5$

= [2/3x0x15.16x1.2x1.0+0.850x (6.63-1)x1.2x1.0x1.0+0.5x0.00080x600x5.66x0.6x1.0x1.0x0.50]/2.5

= [0+5.7426+0.40752]/2.5

= 2.460048 Kg/cm^2 = 24.60 T/m^2

For General Shear

N_c= 30.14, Nq = 18.40, Nγ = 22.40

$Q_{ns} = [cN_c.S_c.d_c.i_c + q(N_q - 1).s_q.d_q.i_q + 0.5\ \gamma_{eff}.B.N\gamma.S_\gamma.d_\gamma.i_\gamma.w']/\ 2.5$

= [0x30.24x1.2x1.0+0.850x (18.40-1)x1.2x1.0x1.0+0.5x0.00080x600x22.40x0.6x1.0x1.0x0.50]/2.5

= [0+17.748+1.6128]/2.5

= 7.74432 Kg/cm^2 = 77.44 T/m^2

Interpolated SBC = Local SBS + (General SBC – Local SBC) X (0.75- eo)
(0.75-0.55)

= 24.60 + (77.44 – 24.60) X (0.13)
0.2

= 24.60 + (52.84) X (0.13)
0.2

= 98.95 T/m^2

2.0 SETTLEMENT CRITERIA (IS: 8009,Pt.I)

Average weighted N value at 5.0 m depth (below EGL) = 28.17, w'= 0.50
Influence Zone is considered 2B below foundation level.
From Chart N vs settlement given on page 17 of IS: 8009 (Part 1-1978)
Corrected Settlement at a load of 1.0 Kg/cm2 = 23.0 mm
Hence for 75mm permissible settlement, net API = 75 / 23.0 = 3.26086 Kg/cm^2
= 32.61 T/ m^2

RECOMMENDATION:
LEAST FROM ABOVE VALUES OF NET SBC OBTAINED FROM SHEAR FAILURE CRITERIA AND SETTLEMENT FAILURE CRITERIA i.e. **32.61 T/m^2** FOR 75 MM SETTLEMENT MAY BE ADOPTED FOR DESIGN PURPOSES.

PHOTOGRAPHS

BH- 1 GHAZIPUR CITY

BH- 2 GHAZIPUR CITY

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BOREHOLE DESIGNATION	ACTUAL TEST LOCATION COORDINATES	
	LATITUDE	LONGITUDE
BH-2	25°34'30.2"N	83°33'21.5"E

3. Ramnagar STP

VISHWA BHUMI TECHNOLOGIES

PROJECT NO. 93

REPORT ON

GEOTECHNICAL SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT

SUBMITTED TO

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CONTENTS

1.0 INTRODUCTION

M/s NJS CONSULTANTS CO. LTD has planned Geotechnical Survey for preparatory survey on Ganga rejuvenation project in Varanasi, India.

M/s VISHWA BHUMI TECHNOLOGIES has carried out the geotechnical survey.

2.0 BRIEF DESCRIPTION OF GEOLOGY AND TYPE OF STRUCTURE

Ramnagar is a city and a municipal board in Varanasi district in the Indian state of Uttar Pradesh having Coordinates 25.28°N 83.03°E. Ramnagar has a fort known as Ramnagar Fort which is still the residence of King of Varanasi (Banaras).

Recently Ramnagar has emerged as a favorite spot for shooting movies because of the scenic location of the Ramnagar Fort near the Ganges. Chokher Bali is one of the popular movies shot here.

Soils found in the region are sandy and clayey in texture and consists of gravels or kankars.

3.0 SCOPE OF WORK

3.1 The scope of the geotechnical investigation work consisted of the following activities.

Carrying out the soil investigation by drilling two no. of 150 mm diameter boreholes of 20.0m depth below existing ground level or up to Refusal ('N' value > 100) whichever occurs earlier in all types of soil strata.

a) At every 1.0m intervals standard penetration test shall be carried out in order to determine at load bearing capacity of different strata. If the N-value of 50 is encountered continues 5m. boring test can be stopped.

b) Depth of each boring shall be 20 m or refusal. Refusal is defined as SPT value exceeding 100 blows for 30 cm penetration or 25 blows for 2.5 cm or less penetration.

c) Collected samples are to be logged descriptively indicating the soil types and stratigraphic characteristics to evaluate the suitability for construction of the structure

d) The depth of water table shall be measured from the surface of the boreholes. The level of the water shall be measured and recorded daily

4.0 EXECUTION OF FIELD WORK

4.1 Location of boreholes: The client gave the location of two boreholes. These were marked on the ground and all the field tests were conducted in the presence of site engineer of the client.

4.2 Methodology:

a) **Making of Boreholes**: The bore holes of 150mm diameter were made by shell & auger method up to 20 m depth respectively. All the borings were carried out as per IS: 1892 - 1979. The boreholes were terminated on meeting the specified depth. Following field tests / samplings were carried out during the progress of the bore holes.

b) **Standard Penetration Test (SPT):** SPT are conducted as per IS 2131. For this a standard split spoon sampler is driven at the bottom of the hole. The penetration resistance in terms of blows for 150mm penetration of the split spoon sampler is measured. The blows are impacted by a standard weight of 63.5kg falling through a height of 750 mm. The resistance is measured for 150 mm, 300 mm and 450 mm. The resistance of first 150 mm is ignored and the resistance of next 300 mm is recorded as standard penetration value 'N'

c) **Undisturbed Soil Samples (UDS):** The Undisturbed soil samples are collected at regular interval of 3.0m depth. The work was carried out according to IS 2132. For this an open drive tube sampler is pushed / driven into the soil strata at the bottom of the bore hole in progress. The diameter of the sampler is 100 mm. The sampler with the undisturbed soil sample inside is gently withdrawn. The sampler is cleaned externally, properly sealed with wax at both ends, labeled and transported to the laboratory for conducting tests.

d) **Disturbed Soil Sample (DS):** Disturbed soil samples are collected generally from the split spoon samples of SPT test. The samples is extracted from the sampler, packed, labeled and transported to the laboratory for testing.

e) **Summary of Boreholes**

Borehole No	Depth of overburden soil (m)	Final depth (m)	Water table depth Below EGL. (m)
(BH-1)	20.0	20.0	16.50
(BH-2)	20.0	20.0	15.00

Layer wise Properties of encountered subsoil strata

BH-1

Depth (m)		Properties
From	To	
0.0	2.0	Filledup
2.0	7.0	γ_{eff} = 1.58gm/cc, C = 0.0kg/cm^2, Φ = 27.0°
7.0	7.5	γ_{eff} = 1.69 gm/cc, C = 0.0kg/cm^2, Φ = 27.5°
7.5	10.0	γ_{eff} = 1.70gm/cc, C = 0.0kg/cm^2, Φ = 28.5°
10.0	11.0	γ_{eff} = 1.76gm/cc, C = 0.4kg/cm^2, Φ = 13.0°
11.0	16.5	γ_{eff} = 1.86gm/cc, C = 0.0kg/cm^2, Φ = 33.0°
16.5	20.0	γ_{eff} = 0.86gm/cc, C = 0.0kg/cm^2, Φ = 33.0°

BH-2

Depth (m)		Properties
From	To	
0.0	1.0	Filledup
1.0	3.0	γ_{eff} = 1.52gm/cc, C = 0.0kg/cm^2, Φ = 27.0°
3.0	6.0	γ_{eff} = 1.66gm/cc, C = 0.0kg/cm^2, Φ = 28.0°
6.0	15.0	γ_{eff} =1.84gm/cc, C = 0.0kg/cm^2, Φ = 32.0°
15.0	20.0	γ_{eff} = 0.84gm/cc, C = 0.0kg/cm^2, Φ = 32.0°

5.0 LABORATORY TESTING

The relevant laboratory tests were conducted on representative subsoil samples in our well equipped laboratory as per relevant IS codes mentioned above.

a) Dry density/Bulk Density	as per IS: 2720, pt-IX, 1992
b) Particle size analysis	as per IS: 2720, pt-IV, 1985
c) Atterberg's limits	as per IS: 2720, pt-V, 1985
d) Classification of soil	as per IS: 1498, 1987
e) Specific gravity of soil	as per IS: 2720, pt-III, 1997
f) Moisture content	as per IS: 2720, pt-II, 1973

6.0 FINDINGS OF THE GEOTECHNICAL INVESTIGATION

Site Stratification

(BH-1)

The subsoil stratum from 0.0 to 2.0m depth consists of Filledup, from 2.0 to 7.0m depth consists of Silty Sand classified as SM, from 7.0 to 7.5.0m depth consists of Sandy Silt classified as ML, from 7.5 to 10.0m depth consists of Fine Sand classified as SP-SM, from 10.0 to 11.0m depth consists of Sandy Silt with Clay classified as ML-CL and from 11.0 to 20.0m depth consists of Fine Sand classified as SP-SM.

(BH-2)

The subsoil stratum from 0.0 to 1.0m depth consists of Filledup, from 1.0 to 3.0m depth consists of Silty Sand classified as SM, from 3.0 to 6.0m depth consists of Sandy Silt classified as ML and from 6.0 to 20.0m depth consists of Fine Sand classified as SP-SM.

6.1 Ground Water: The ground water table was encountered at 16.5m in BH-1 and 15.0m in BH-2 upto the depth of exploration in the bore holes below existing ground level during boring activities at site.

7.0 PROPOSED FOUNDATIONS AND THEIR DEPTHS

Depending on the field and laboratory observations of subsoil strata, test results and the type of structures proposed at site, the types of foundations, depths and net safe bearing capacities recommended for design purposes are given in the following table. The net SBC/API in the following table are the lower of the values obtained from shear failure criterion as per IS: 6403 and settlement failure criterion as per IS 8009, Part-I. The permissible settlements are as below:-

(a) Strip footings of width 2.0, 3.0 & 4.0m cast at 5.0 & 15.0m depth below existing ground surface.

(b) Isolated footings of size 2.0, 3.0 & 4.0m cast at 5.0 & 15.0m depths below existing ground surface.

(c) Raft footings of width 6.0m and above cast at 5.0 m, & 15.0 m depth below existing ground surface.

8.0 COMPUTATION OF SAFE /ALLOWABLE BEARING CAPACITY:

Shear and settlement failure criteria as per IS: 6403- 1981 , IS : 8009 (part-1) -1976 and IS: 1904-1986 have been considered to compute the safe allowable bearing capacity of underlying soil strata for isolated footings, Strip footings & Raft footings. The safe/allowable bearing capacity from both criteria is given as follows:

The net safe bearing capacity of sub-soil strata has been computed by considering Interpolated shear failure using the following equation for calculating the net ultimate bearing capacity:

$Q_{nu} = 2/3\ c.N_c.s_c.d_c.i_c + q(N_q'-i).s_q.d_q.i_q + 1/2\ B.\gamma.N\gamma'.s\gamma.d\gamma.i\gamma.W'$

.....for local shear

$Q_{nu} = c.N_c.s_c.d_c.i_c + q(N_q-1).s_q.d_q.i_q + 1/2\ B.\gamma.N\gamma.s\gamma.d\gamma.i\gamma.W'$

.....for general shear

$$Qns = \text{Local SBC} + \frac{(\text{General SBC} - \text{Local SBC})}{0.75 - 0.55} \times (0.75 - e0)$$

.....for interpolated SBC

The Factor of safety has been considered as 2.5

Shape factors have been taken as follows:-

$s_c = s_q = s_\gamma = 1.0$ -for Strip footing

$s_c = 1.3,\ s_q = 1.2,\ s_\gamma = 0.8$ -for Isolated footing

$s_c = s_q = 1 + 0.2B/L = 1.2,\ s_\gamma = 1 - 0.4\ B/L = 0.6$ -for Raft footing

Depth factors:

$d_c = d_q = d_\gamma = 1.0$ for shallow foundations

Using the above equation and parameters, the following values of net safe bearing capacity have been computed:

(BH-1 & BH-2)Net Safe Bearing capacity (t/m^2))

Depth of foundation Below existing ground Surface/ depth Below (m)	Type of Foundation	Size / Width of foundation (m)	Net Safe Bearing capacity (t/m^2)	
			BH-1	BH-2
5.0	Strip footings	2.0	16.62	21.49
		3.0	17.37	22.54
		4.0	18.11	23.58
	Isolated footings	2.0 x 2.0	19.35	24.96
		3.0 x 3.0	19.95	25.79
		4.0 x 4.0	20.55	26.63
	Raft footings	≥6.0	20.84	27.05
15.0	Strip footings	2.0	276.21	242.51
		3.0	282.44	247.85
		4.0	288.67	253.18
	Isolated footings	2.0 x 2.0	326.47	286.75
		3.0 x 3.0	331.45	291.02
		4.0 x 4.0	336.43	295.28
	Raft footings	≥6.0	184.34	172.41

8.1 SETTLEMENT FAILURE CRITERION:

The settlement of sandy layers below the foundation level and up to the zone of Influence are computed by using the chart of settlement V/s SPT 'N' given on page 17 of IS 8009.

For Isolated footings, Strip footings & Raft footing the zone of influence below the foundation depth is considered as 2.0B, where B is the width of foundation

The total permissible settlement for Strip footing = 60mm

The total permissible settlement for isolated footing = 50mm

The total permissible settlement for raft footing = 75mm:

The layer wise properties of the sub soil strata are as follows:

The depth wise SPT values of the subsoil strata (observed/corrected) are as below: -

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BH-1

Depth below existing ground level (m)	SPT Values Observed	SPT Values Corrected	Effective Density (gm/cc)
1.0	5	8.09	1.58
2.0	7	9.71	1.58
3.0	9	11.26	1.58
4.0	11	12.71	1.58
5.0	13	14.05	1.58
6.0	18	18.35	1.58
7.0	19	18.33	1.69
8.0	23	21.10	1.70
9.0	27	23.65	1.70
10.0	31	25.97	1.76
11.0	36	28.86	1.86
12.0	36	27.69	1.86
13.0	40	29.58	1.86
14.0	44	31.34	1.86
15.0	50	34.35	1.86
16.0	55	36.50	1.86
17.0	50	23.83	0.86
18.0	52	24.23	0.86
19.0	56	25.24	0.86
20.0	60	26.23	0.86

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BH-2

Depth below existing ground level (m)	SPT Values Observed	SPT Values Corrected	Effective Density (gm/cc)
1.0	4.0	6.53	1.52
2.0	7.0	9.80	1.52
3.0	11.0	13.80	1.66
4.0	15.0	17.30	1.66
5.0	16.0	17.21	1.66
6.0	14.0	14.09	1.84
7.0	16.0	15.19	1.84
8.0	18.0	16.21	1.84
9.0	16.0	13.73	1.84
10.0	19.0	15.58	1.84
11.0	22.0	17.29	1.84
12.0	28.0	21.15	1.84
13.0	33.0	23.99	1.84
14.0	37.0	25.94	1.84
15.0	44.0	22.68	0.84
16.0	45.0	22.78	0.84
17.0	48.0	23.54	0.84
18.0	52.0	24.61	0.84
19.0	55.0	25.33	0.84
20.0	59.0	26.34	0.84

The values of allowable pressure intensities computed based on the above selected soil parameters are shown below :-

(BH-1 & BH-2) (Allowable pressure intensity (t/m^2))

Depth of foundation Below existing ground Surface/ depth Below (m)	Type of Foundation	Size / Width of foundation (m)	Allowable pressure intensity (t/m^2)	
			BH-1	BH-2
5.0	Strip footings	2.0	20.98	16.30
		3.0	21.43	15.71
		4.0	22.90	17.54
	Isolated footings	2.0 x 2.0	17.48	13.59
		3.0 x 3.0	17.85	13.09
		4.0 x 4.0	19.08	14.62
	Raft footings	≥6.0	25.34	23.29
15.0	Strip footings	2.0	31.57	24.79
		3.0	29.7	25.21
		4.0	28.85	25.42
	Isolated footings	2.0 x 2.0	26.32	20.33
		3.0 x 3.0	24.75	21.01
		4.0 x 4.0	24.04	21.19
	Raft footings	≥6.0	33.63	31.65

9.0 CONCLUSION WITH RECOMMENDATIONS:

On the basis of above Soil investigation the following recommendations are suggested:

9.1. The sub-soil strata met at this site consists of layers of Fine sand, Silty Sand and Medium Coarse Fine sand.

The subsoil strata are loose to medium dense.

9.2. On the basis of field & laboratory test results, the following values of the net safe bearing capacity for Strip, Isolated & Raft footings are to be considered .

(BH-1 & BH-2) (NET SAFE BEARING CAPACITY/ ALLOWABLE PRESSURE INTENSITY T/M2))

Depth of foundation Below existing ground Surface/ depth Below (m)	Type of Foundation	Size / Width of foundation (m)	Net safe bearing capacity/ allowable pressure intensity t/m^2	
			BH-1	BH-2
5.0	Strip footings	2.0	16.62	16.30
		3.0	17.37	15.71
		4.0	18.11	17.54
	Isolated footings	2.0 x 2.0	17.48	13.59
		3.0 x 3.0	17.85	13.09
		4.0 x 4.0	19.08	14.62
	Raft footings	≥6.0	20.84	23.29
15.0	Strip footings	2.0	31.57	24.79
		3.0	29.70	25.21
		4.0	28.85	25.42
	Isolated footings	2.0 x 2.0	26.32	20.33
		3.0 x 3.0	24.75	21.01
		4.0 x 4.0	24.04	21.19
	Raft footings	≥6.0	33.63	31.65

10. CLOSURE

We appreciate the opportunity given to us to submit this report. This presented report is based on observations and tests on samples collected from the boreholes as decided by the client. In case any difference is noticed in the field subsoil strata and reported subsoil strata during excavation please contact us before proceeding with further construction.

For VISHWA BHUMI TECHNOLOGIES

(DINESH BHARDWAJ)

VISHWA BHUMI TECHNOLOGIES

Project No. 93

TABLE INDEX

FIGURE INDEX

GEOTECHNICAL SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT

VISHWA BHUMI TECHNOLOGIES

PROJECT :- GEOTECHNICAL SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT.

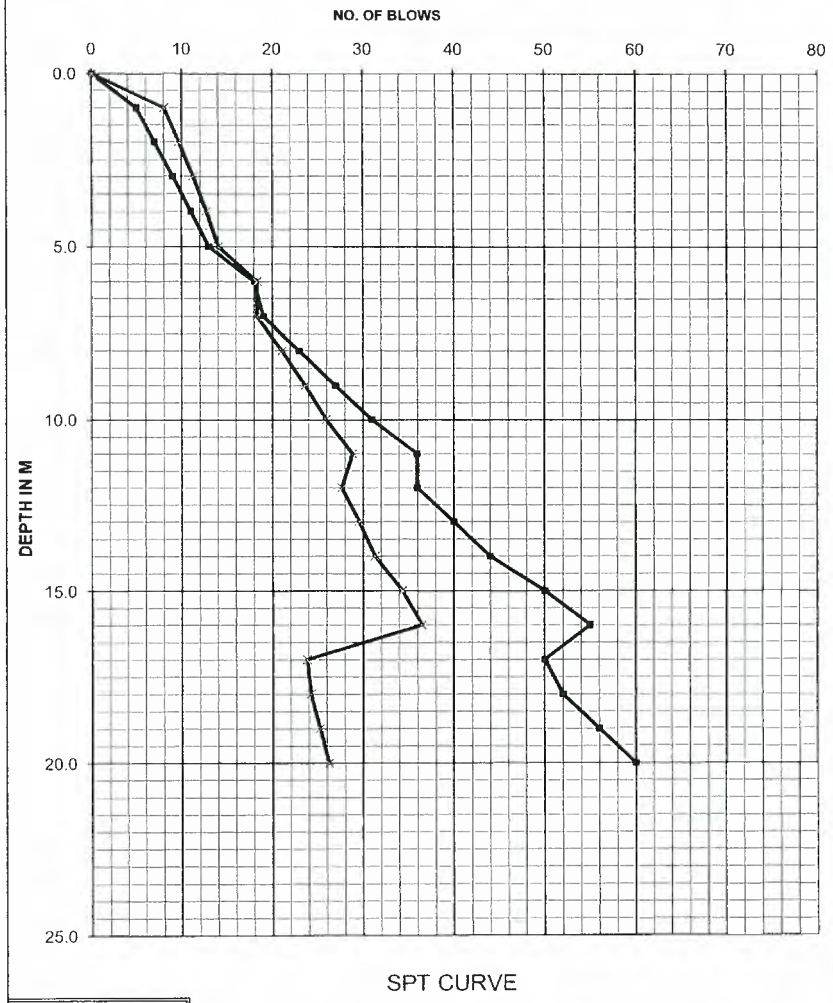
BH - 1 | BORING DATE 14/11/2015 | TERMINAL DEPTH (m) 20.00 | WATER TABLE 14.50m | Sheet No- 16

N VALUES	DEPTH (M)	SAMPLE	DESCRIPTION OF SOIL	IS CLASSIF-ICATION	GRAIN SIZE ANALYSIS				LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	DRY/BULK DENSITY	MOISTURE CONTENT	SHEAR PARAMETER			SPECIFIC GRAVITY
					GRAVEL	SAND	SILT	CLAY						TEST TYPE	COHESION INTERCEPT (c)	ANGLE OF INTERNAL FRICTION (ϕ)	
					%	%	%	%	%	%	%	gm/cc	%		kg/cm²	deg.	
	0.5	DS-1	Filledup														
5	1.0	SPT-1															
7	2.0	SPT-2	Silty Sand	SM	0	63	37	0									
9	3.0	SPT-3															
11	4.0	SPT-4		SM	0	60	40	0									
	4.5	UDS-2		SM	0	67	33	0	N	P		1.51/1.58	4.63	DST	0	27.0	2.64
13	5.0	SPT-5															
18	6.0	SPT-6		SM	0	63	37	0									
19	7.0	SPT-7	Sandy Silt	ML	0	55	40	5	19	16	3	1.59*/1.69*	6.19*	DST*	0*	27.5*	2.63*
	7.5	UDS-3		SPSM	0	86	14	0	N	P		1.61/1.70	5.72	DST	0	28.5	2.65
23	8.0	SPT-8	Fine Sand														
27	9.0	SPT-9		SPSM	0	89	11	0									
31	10.0	SPT-10	Sandy Silt with Clay	ML-CL	0	38	54	8	24	19	5	1.65*/1.76*	7.31*	UUT*	0.4*	13*	2.67*
	10.5	UDS-4															
36	11.0	SPT-11		SPSM	0	89	11	0									

36	12.0	SPT-12	Fine Sand														
40	13.0	SPT-13		SPSM	0	88	12	0									
44	14.0	SPT-14															
50	15.0	SPT-15		SPSM	0	90	10	0	N	P		1.70*/1.86*	9.47*	DST*	0*	33.0*	2.68*
55	16.0	SPT-16															
	16.5	UDS-6		SPSM	0	87	13	0									
50	17.0	SPT-17															
52	18.0	SPT-18															
56	19.0	SPT-19															
60	20.0	SPT-20		SPSM	0	91	9	0									
*	Remoulded Sample																

VBT	VISHWA BHUMI TECHNOLOGIES			PROJECT :- GEOTECHNICAL SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT.													Sheet No- 17
				BH - 2			BORING DATE 15/11/2015		TERMINAL DEPTH (m) 20.00								WATER TABLE 15.00m
N VALUES	DEPTH (M)	SAMPLE	DESCRIPTION OF SOIL	IS CLASSIFICATION	GRAIN SIZE ANALYSIS					PLASTIC LIMIT	PLASTICITY INDEX	DRY BULK DENSITY	MOISTURE CONTENT	SHEAR PARAMETER		ANGLE OF INTERNAL FRICTION (ϕ)	SPECIFIC GRAVITY
					GRAVEL	SAND	SILT	CLAY	LIQUID LIMIT					TEST TYPE	COHESION INTERCEPT (c)		
					%	%	%	%	%	%	%	gm/cc	%		kg/cm²	deg	
	0.5	DS-1		Filledup													
4	1.0	SPT-1	Silty Sand	SM	0	71	29	0									
	1.5	UDS-1		SM	0	73	27	0	N	P		1.44/1.52	5.28	DST	0	27.0	2.63
7	2.0	SPT-2															
11	3.0	SPT-3	Sandy Silt	ML	0	43	55	2									
15	4.0	SPT-4															
	4.5	UDS-2		ML	0	47	50	3	20	18	2	1.55/1.66	7.39	DST	0	28.0	2.62
16	5.0	SPT-5		ML	0	48	50	2									
14	6.0	SPT-6		SPSM	0	92	8	0									
16	7.0	SPT-7															
18	8.0	SPT-8		SPSM	0	86	14	0									
16	9.0	SPT-9															
19	10.0	SPT-10		SPSM	0	93	7	0									
22	11.0	SPT-11															
28	12.0	SPT-12		SPSM	0	91	9	0									

			2.66*							
			32.0*							
			0*							
			DST*							
			9.29*							
			1.68*/1.84*							
			P							
			N							
		0	0				0			0
		10	13				11			10
		90	87				89			88
		0	0				0			2
		SPSM	SPSM				SPSM			SPSM
Fine Sand										
33	SPT-13	13.0	37	SPT-14	14.0	44	SPT-15	15.0	45	SPT-16	16.0	48	SPT-17	17.0	52	SPT-18	18.0	55	SPT-19	19.0	59	SPT-20	20.0
	UDS-5	13.5																					



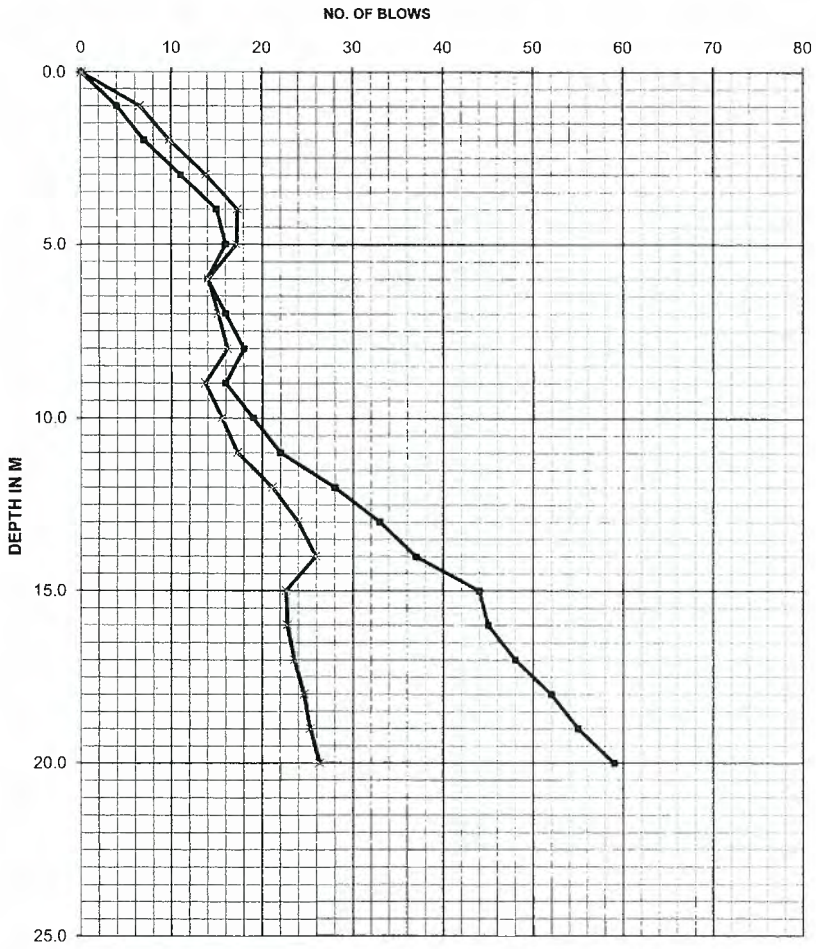
SPT CURVE

LEGEND	
Symbol	Notation
■	No
⊠	Nc

PROJECT - GEOTECHNICAL SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT.

BH - 1

VISHWA BHUMI TECHNOLOGIES	SHEET NO. 19



SPT CURVE

LEGEND	
Symbol	Notation
■	No
⊠	Nc

PROJECT - GEOTECHNICAL SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT.

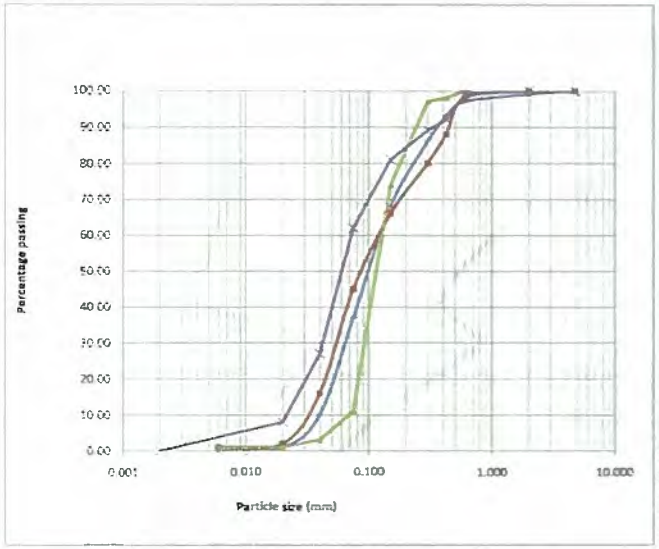
BH - 2

VBT	VISHWA BHUMI TECHNOLOGIES	Sheet no. 20

GRAIN SIZE ANALYSIS

PROJECT :- GEOTECHNICAL SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT.

BH - 1



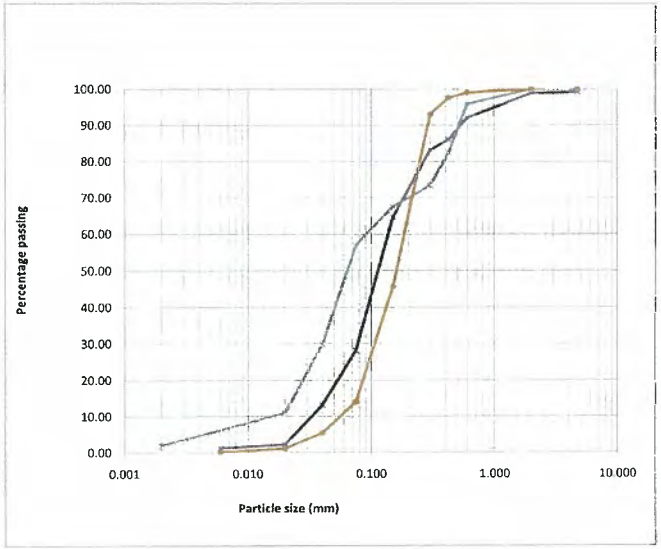
Symbol	Description of soil	Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
	Silty Sand (SM)	2.00	0	63	37	0
	Sandy Silt (ML)	7.00	0	55	40	5
	Fine Sand (SP - SM)	7.00	0	89	11	0
	Sandy Silt with Clay (ML-CL)	10.00	0	11	34	5

VBT	VISHWA BHUMI TECHNOLOGIES	Sheet no. 21

GRAIN SIZE ANALYSIS

PROJECT :- GEOTECHNICAL SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT.

BH - 2

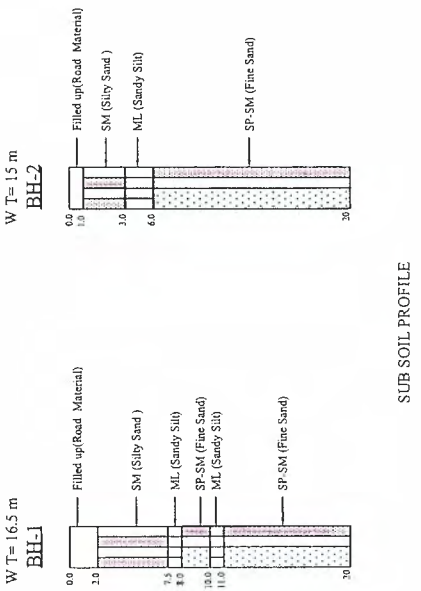


Symbol	Description of soil	Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
	Silty Sand (SM)	1.00	0	71	29	0
	Silty Sand with Clay (ML)	4.00	0	43	55	2
	Fine Sand (SPSM)	8.00	0	86	14	0

VISHWA BHUMI TECHNOLOGIES

SHEET NO. 22

Location - Rammagar



SUB SOIL PROFILE

Geotechnical Investigation Work for Proposed Ganga Rejuvenation Project.

(BH-1) LOCATION:-RAMNAGAR

SAMPLE CALCULATION

Type of Foundation – Raft footing
Depth of Foundation –5.0m below EGL
Size of Foundation– 6.0mx6.0m (B=6.0 m)
Allowable Settlement S = 75 mm

1.0 SHEAR FAILURE CRITERIA (REF. IS: 6403)

Average soil data
Cohesion, c = 0kg/cm^2
Angle of Shear Resistance, ϕ = 27.0°
Effective Density
γ = 1.58 gm/cc for 2.00 to 7.00m depth below EGL
Water correction factor w' = 0.50
Overburden pressure q = 500x0.00158 = 0.790 kg/cm^2
d_c=, d_q = $d\gamma$ =1.00
i_c=i_q=$i\gamma$ = 1
S_c =1.2 S_q=1.2 1+0.2xB/L = 1.2, $S\gamma$ = 1-0.4xB/L = 0.6 ..... for raft footing
Factor of Safety = 2.5

For Local Shear

N_c= 13.88, Nq = 5.79, Nγ = 4.71

$Q_{ns} = [2/3\ cN_c.S_c.d_c.i_c + q(N_q - 1).s_q.d_q.i_q + 0.5\ \gamma_{eff}.B.N\gamma.S_\gamma.d_\gamma.i_\gamma.w']/\ 2.5$

= [2/3x0x13.88x1.2x1.0+0.790x (5.79-1)x1.2x1.0x1.0+0.5x0.00158x600x4.71x0.6x1.0x1.0x0.50]/2.5

= [0+4.54+0.669762]/2.5

= 2.08390 Kg/cm^2 = 20.84 T/m^2

2.0 SETTLEMENT CRITERIA (IS: 8009,Pt.I)

Average weighted N value at 3.0 m depth (below EGL) = 26.63, w'= 0.50
Influence Zone is considered 2B below foundation level.
From Chart N vs settlement given on page 17 of IS: 8009 (Part 1-1978)
Corrected Settlement at a load of 1.0 Kg/cm2 = 24.40 mm
Hence for 75mm permissible settlement, net API = 75 / 24.40 = 3.07377 Kg/cm^2
= 30.74 T/ m^2

RECOMMENDATION:

LEAST FROM ABOVE V ALUES O F NE T S BC OB TAINED FROM S HEAR FAILURE CRITERIA A ND SETTLEMENT FAILURE C RITERIA i .e. **20.84 T/m^2** FOR 75 M M SETTLEMENT MAY BE ADOPTED FOR DESIGN PURPOSES.

(BH-2) LOCATION:-RAMNAGAR

SAMPLE CALCULATION

Type of Foundation – Raft footing
Depth of Foundation –5.0m below EGL
Size of Foundation– 6.0mx6.0m (B=6.0 m)
Allowable Settlement S = 75 mm

1.0 SHEAR FAILURE CRITERIA (REF. IS: 6403)

Average soil data
Cohesion, c = 0kg/cm^2
Angle of Shear Resistance, ϕ = 27.0°
Effective Density
γ = 1.58 gm/cc for 3.00 to 6.00m depth below EGL
Water correction factor w' = 0.50
Overburden pressure q = 500x0.00152 = 0.760 kg/cm^2
d_c=, d_q = $d\gamma$ =1.00
i_c=i_q=$i\gamma$ = 1
S_c =1.2 S_q=1.2 1+0.2xB/L = 1.2, $S\gamma$ = 1-0.4xB/L = 0.6 ..... for raft footing
Factor of Safety = 2.5

For Local Shear

N_c= 13.88, Nq = 5.79, Nγ = 4.71

$Q_{ns} = [2/3\ cN_c.S_c.d_c.i_c + q(N_q - 1).s_q.d_q.i_q + 0.5\ \gamma_{eff}.B.N\gamma.S_\gamma.d_\gamma.i_\gamma.w']/\ 2.5$

= [2/3x0x13.88x1.2x1.0+0.760x (5.79-1)x1.2x1.0x1.0+0.5x0.00152x600x4.71x0.6x1.0x1.0x0.50]/2.5

= [0+4.37+0.644]/2.5

= 2.0050 Kg/cm^2 = 20.05 T/m^2

For General Shear

N_c= 24.09, Nq = 13.76, Nγ = 15.49

$Q_{ns} = [cN_c.S_c.d_c.i_c + q(N_q - 1).s_q.d_q.i_q + 0.5\ \gamma_{eff}.B.N\gamma.S_\gamma.d_\gamma.i_\gamma.w']/\ 2.5$

= [0x24.09x1.2x1.0+0.760x (13.76-1)x1.2x1.0x1.0+0.5x0.00152x600x15.49x0.6x1.0x1.0x0.50]/2.5

= [0+11.6371+2.1190]/2.5

= 5.50244 Kg/cm^2 = 55.02 T/m^2

Interpolated SBC = Local SBS + (General SBC – Local SBC) X (0.75- eo)
(0.75-0.55)

= 20.05 + (55.02 – 20.05) X (0.04)
0.2

= 20.05 + (55.02 – 20.05) X (0.04)
0.2
= 27.05 T/m^2

2.0 SETTLEMENT CRITERIA (IS: 8009,Pt.I)

Average weighted N value at 3.0 m depth (below EGL) = 19.35, w'= 0.50
Influence Zone is considered 2B below foundation level.
From Chart N vs settlement given on page 17 of IS: 8009 (Part 1-1978)
Corrected Settlement at a load of 1.0 Kg/cm2 = 32.2 mm
Hence for 75mm permissible settlement, net API = 75 / 32.2 = 2.329192 Kg/cm^2
= 23.29 T/ m^2

RECOMMENDATION:
LEAST FROM ABOVE V ALUES O F NE T S BC OB TAINED F ROM SHEAR F AILURE CRITERIA A ND SETTLEMENT FAILURE C RITERIA i .e. **23.29 T/m^2** FOR 75 M M SETTLEMENT MAY BE ADOPTED FOR DESIGN PURPOSES.

SITE PHOTOGRAPHS

BH- 1 RAMNAGAR

BH- 2 RAMNAGAR

27


BH-2
N
BOREHOLE DESIGNATION
ACTUAL TEST LOCATION COORDINATES
LATITUDE
LONGITUDE
BH-2
25° 17.292' N
83° 1.211' E
015 Google
015 CNES / Astrium
2015 DigitalGlobe
3° 1.183' E elev 73 m
Google ea
Eye alt 475

4. Chunar STP

VISHWA BHUMI TECHNOLOGIES

PROJECT NO. 93

REPORT ON

GEOTECHNICAL SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT

SUBMITTED TO

NJS CONSULTANTS CO. LTD

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CONTENTS

1.0 INTRODUCTION

M/s NJS CONSULTANTS CO. LTD has planned **Geotechnical Survey for preparatory survey on Ganga rejuvenation project** in Varanasi, India.

M/s VISHWA BHUMI TECHNOLOGIES has carried out the geotechnical survey

2.0 BRIEF DESCRIPTION OF GEOLOGY AND TYPE OF STRUCTURE

Chunar, located in Mirzapur District of Uttar Pradesh state, India, is an ancient town. The town of Chunar is situated on the south side of the Ganges about 17 miles in a straight direction south – west from Banaras having Co - ordinates 25.13°N 82.9°E

It is connected to Varanasi, the ancient and pilgrimage city also well known as Kashi or Benaras, by roads and rails. Chunar is well known for its pottery work, especially clay toys.

3.0 SCOPE OF WORK

3.1 The scope of the geotechnical investigation work consisted of the following activities.

Carrying out the soil investigation by drilling two no. of 150 mm diameter boreholes of 20.0m depth below existing ground level or up to Refusal ('N' value > 100) whichever occurs earlier in all types of soil strata.

a) At every 1.0m intervals standard penetration test shall be carried out in order to determine at load bearing capacity of different strata. If the N-value of 50 is encountered continues 5m, boring test can be stopped.

b) Depth of each boring shall be 20 m or refusal. Refusal is defined as SPT value exceeding 100 blows for 30 cm penetration or 25 blows for 2.5 cm or less penetration.

c) Collected samples are to be logged descriptively indicating the soil types and stratigraphic characteristics to evaluate the suitability for construction of the structure

d) The depth of water table shall be measured from the surface of the boreholes. The level of the water shall be measured and recorded daily

4.0 EXECUTION OF FIELD WORK

4.1 Location of boreholes: The client gave the location of two boreholes. These were marked on the ground and all the field tests were conducted in the presence of site engineer of the client.

4.2 Methodology:

a) **Making of Boreholes**: The bore holes of 150mm diameter were made by shell & auger method up to 20 m depth respectively. All the borings were carried out as per IS: 1892 - 1979. The boreholes were terminated on meeting the specified depth. Following field tests / samplings were carried out during the progress of the bore holes.

b) **Standard Penetration Test (SPT):** SPT are conducted as per IS 2131. For this a standard split spoon sampler is driven at the bottom of the hole. The penetration resistance in terms of blows for 150mm penetration of the split spoon sampler is measured. The blows are impacted by a standard weight of 63.5kg falling through a height of 750 mm. The resistance is measured for 150 mm, 300 mm and 450 mm. The resistance of first 150 mm is ignored and the resistance of next 300 mm is recorded as standard penetration value 'N'

c) **Undisturbed Soil Samples (UDS):** The Undisturbed soil samples are collected at regular interval of 3.0m depth. The work was carried out according to IS 2132. For this an open drive tube sampler is pushed / driven into the soil strata at the bottom of the bore hole in progress. The diameter of the sampler is 100 mm. The sampler with the undisturbed soil sample inside is gently withdrawn. The sampler is cleaned externally, properly sealed with wax at both ends, labeled and transported to the laboratory for conducting tests.

d) **Disturbed Soil Sample (DS):** Disturbed soil samples are collected generally from the split spoon samples of SPT test. The samples is extracted from the sampler, packed, labeled and transported to the laboratory for testing

e) **Summary of Boreholes**

Borehole No	Depth of overburden soil (m)	Final depth (m)	Water table depth Below EGL. (m)
(BH-1)	20.0	20.0	13.80
(BH-2)	20.0	20.0	14.00

Layer wise Properties of encountered subsoil strata

BH-1

Depth (m)		Properties
From	To	
0.0	1.0	Filledup
1.0	4.5	γ_{eff} = 1.53gm/cc ,C = 0.0kg/cm^2, Φ = 26.5°
4.5	13	γ_{eff} = 1.64 gm/cc ,C = 0.0kg/cm^2, Φ = 28.0°
13	13.8	γ_{eff} = 1.90gm/cc ,C = 0.0kg/cm^2, Φ = 34.0°
13.8	20	γ_{eff} = 0.90gm/cc ,C = 0.0kg/cm^2, Φ = 34.0°

BH-2

Depth (m)		Properties
From	To	
0.0	1.0	Filledup
1.0	5.0	γ_{eff} = 1.55gm/cc ,C = 0.0kg/cm^2, Φ = 27.5°
5.0	13.0	γ_{eff} = 1.64gm/cc ,C = 0.0kg/cm^2, Φ = 29.0°
13.0	14.0	γ_{eff} =1.92gm/cc ,C = 0.0kg/cm^2, Φ = 32.5°
14.0	20.0	γ_{eff} =0.92gm/cc ,C = 0.0kg/cm^2, Φ = 32.5o

5.0 LABORATORY TESTING

The relevant laboratory tests were conducted on representative subsoil samples in our well equipped laboratory as per relevant IS codes mentioned above.

a) Dry density/Bulk Density	as per IS: 2720, pt-IX, 1992
b) Particle size analysis	as per IS: 2720, pt-IV, 1985
c) Atterberg's limits	as per IS: 2720, pt-V, 1985
d) Classification of soil	as per IS: 1498, 1987
e) Specific gravity of soil	as per IS: 2720, pt-III, 1997
f) Moisture content	as per IS: 2720, pt-II, 1973

6.0 FINDINGS OF THE GEOTECHNICAL INVESTIGATION

Site Stratification

(BH-1)

The subsoil stratum from 0.0 to 1.0 m depth consists of Filled up, from 1.0 to 4.5 m depth consists of Silty Sand classified as SM, from 4.5 to 13.0 m depth consists of Sandy Silt classified as ML, from 13.0 to 20.0m depth consists of Fine Sand classified as SP-SM.

(BH-2)

The subsoil stratum from 0.0 to 1.0m depth consists of Filled up, from 1.0 to 5.0m depth consists of Silty Sand classified as SM, from 5.0 to 13.0m depth consists of Sandy Silt classified as ML and from 13.0 to 20.0m depth consists of Fine Sand classified as SP-SM.

6.1 Ground Water: The ground water table was encountered at 13.8m in BH-1 and 14.0m in BH-2 upto the depth of exploration in the bore holes below existing ground level during boring activities at site.

7.0 PROPOSED FOUNDATIONS AND THEIR DEPTHS

Depending on the field and laboratory observations of subsoil strata, test results and the type of structures proposed at site, the types of foundations, depths and net safe bearing capacities recommended for design purposes are given in the following table. The net SBC/API in the following table are the lower of the values obtained from shear failure criterion as per IS: 6403 and settlement failure criterion as per IS 8009, Part-I. The permissible settlements are as below:-

(a) Strip footings of width 2.0, 3.0 & 4.0m cast at 5.0 & 15.0m depth below existing ground surface.

(b) Isolated footings of size 2.0, 3.0 & 4.0m cast at 5.0 & 15.0m depths below existing ground surface.

(c) Raft footings of width 6.0m and above cast at 5.0 m, & 15.0 m depth below existing ground surface.

8.0 COMPUTATION OF SAFE /ALLOWABLE BEARING CAPACITY:

Shear and settlement failure criteria as per IS: 6403- 1981 , IS : 8009 (part-1) -1976 and IS: 1904-1986 have been considered to compute the safe allowable bearing capacity of underlying soil strata for isolated footings, Strip footings & Raft footings. The safe/allowable bearing capacity from both criteria is given as follows:

The net safe bearing capacity of sub-soil strata has been computed by considering Interpolated shear failure using the following equation for calculating the net ultimate bearing capacity :

$Q_n = 2/3\ c.N_c\ s_c\ d_c\ i_c + q(N_q'-1).s_q.d_q.i_q + 1/2\ B\ .\gamma\ .N\gamma'.s\gamma.d\gamma.i\gamma.W'$

.....for local shear

$Q_n = c.N_c\ s_c\ d_c\ i_c + q(N_q-1).s_q.d_q.i_q + 1/2\ B\ .\gamma\ .N\gamma.s\gamma.d\gamma.i\gamma.W'$

.....for general shear

$Qns = \text{Local SBC} + \frac{(\text{General SBC} - \text{Local SBC})}{0.75 - 0.55} \times (0.75 - e0)$

.....for interpolated SBC

The Factor of safety has been considered as 2.5

Shape factors have been taken as follows:-

$s_c = s_q = s_\gamma = 1.0$ -for Strip footing

$s_c = 1.3,\ s_q = 1.2,\ s_\gamma = 0.8$ -for Isolated footing

$s_c = s_q = 1+0.2B/L = 1.2,\ s_\gamma = 1-0.4\ B/L = 0.6$ -for Raft footing

Depth factors:

$d_c = d_q = d_\gamma = 1.0$ for shallow foundations

Using the above equation and parameters, the following values of net safe bearing capacity have been computed:

(BH-1 & BH-2)Net Safe Bearing capacity (t/m²))

Depth of foundation Below existing ground Surface/ depth Below (m)	Type of Foundation	Size / Width of foundation (m)	Net Safe Bearing capacity (t/m²)	
			BH-1	BH-2
5.0	Strip footings	2.0	19.26	20.32
		3.0	20.10	21.25
		4.0	20.94	22.18
	Isolated footings	2.0 x 2.0	22.44	23.64
		3.0 x 3.0	23.11	24.39
		4.0 x 4.0	23.78	25.13
	Raft footings	≥6.0	24.12	25.50
15.0	Strip footings	2.0	314.93	272.81
		3.0	318.49	275.80
		4.0	322.06	278.80
	Isolated footings	2.0 x 2.0	375.06	324.97
		3.0 x 3.0	377.91	327.37
		4.0 x 4.0	380.77	329.77
	Raft footings	≥6.0	377.28	330.96

8.1 SETTLEMENT FAILURE CRITERION:

The settlement of sandy layers below the foundation level and up to the zone of Influence are computed by using the chart of settlement V/s SPT 'N' given on page 17 of IS 8009.

For Isolated footings, Strip footings & Raft footing the zone of influence below the foundation depth is considered as 2.0B, where B is the width of foundation

The total permissible settlement for Strip footing = 60mm

The total permissible settlement for isolated footing = 50mm

The total permissible settlement for raft footing = 75mm:

The layer wise properties of the sub soil strata are as follows:

The depth wise SPT values of the subsoil strata (observed/corrected) are as below: -

BH-1

Depth below existing ground level (m)	SPT Values Observed	SPT Values Corrected	Effective Density (gm/cc)
1.0	5.0	8.15	1.53
2.0	7.0	9.78	1.53
3.0	9.0	11.36	1.53
4.0	11.0	12.83	1.53
5.0	10.0	10.87	1.64
6.0	9.0	9.20	1.64
7.0	12.0	11.62	1.64
8.0	13.0	11.99	1.64
9.0	15.0	13.23	1.64
10.0	19.0	16.06	1.64
11.0	28.0	22.76	1.64
12.0	36.0	28.19	1.64
13.0	45.0	24.77	0.90
14.0	49.0	25.95	0.90
15.0	52.0	26.72	0.90
16.0	48.0	24.91	0.90
17.0	52.0	26.03	0.90
18.0	57.0	27.46	0.90
19.0	61.0	28.49	0.90
20.0	64.0	29.15	0.90

VISHWA BHUMI TECHNOLOGIES

BH-2

Depth below existing ground level (m)	SPT Values Observed	SPT Values Corrected	Effective Density (gm/cc)
1.0	5.0	8.13	1.55
2.0	7.0	9.75	1.55
3.0	6.0	7.55	1.55
4.0	11.0	12.78	1.55
5.0	9.0	9.75	1.64
6.0	11.0	11.22	1.64
7.0	13.0	12.56	1.64
8.0	16.0	14.72	1.64
9.0	18.0	15.84	1.64
10.0	20.0	16.88	1.64
11.0	23.0	18.66	1.64
12.0	32.0	25.01	1.64
13.0	48.0	35.99	1.92
14.0	42.0	22.95	0.92
15.0	46.0	24.11	0.92
16.0	51.0	25.58	0.92
17.0	51.0	25.26	0.92
18.0	58.0	27.35	0.92
19.0	63.0	28.69	0.92
20.0	61.0	27.67	0.92

The values of allowable pressure intensities computed based on the above selected soil parameters are shown below :-

(BH-1 & BH-2) (Allowable pressure intensity (t/m^2))

Depth of foundation Below existing ground Surface/ depth Below (m)	Type of Foundation	Size / Width of foundation (m)	Allowable pressure intensity (t/m^2)	
			BH-1	BH-2
5.0	Strip footings	2.0	14.63	14.02
		3.0	15.00	14.78
		4.0	15.78	17.39
	Isolated footings	2.0 x 2.0	12.20	11.68
		3.0 x 3.0	12.50	12.32
		4.0 x 4.0	13.16	14.49
	Raft footings	≥6.0	22.72	23.73
15.0	Strip footings	2.0	31.57	30.93
		3.0	30.61	29.70
		4.0	28.57	29.27
	Isolated footings	2.0 x 2.0	26.32	25.77
		3.0 x 3.0	25.51	24.75
		4.0 x 4.0	23.81	24.39
	Raft footings	≥6.0	30.00	30.99

9.0 CONCLUSION WITH RECOMMENDATIONS:

On the basis of above Soil investigation the following recommendations are suggested:

9.1. The sub-soil strata met at this site consists of layers of Fine sand, Silty Sand and Medium Coarse Fine sand.

The subsoil strata are loose to medium dense.

9.2. On the basis of field & laboratory test results, the following values of the net safe bearing capacity for Strip, Isolated & Raft footings are to be considered .

(BH-1 & BH-2) (NET SAFE BEARING CAPACITY/ ALLOWABLE PRESSURE INTENSITY T/M2))

Depth of foundation Below existing ground Surface/ depth Below (m)	Type of Foundation	Size / Width of foundation (m)	Net safe bearing capacity/ allowable pressure intensity t/m^2	
			BH-1	BH-2
5.0	Strip footings	2.0	14.63	14.02
		3.0	15.00	14.78
		4.0	15.78	17.39
	Isolated footings	2.0 x 2.0	12.20	11.68
		3.0 x 3.0	12.50	12.32
		4.0 x 4.0	13.16	14.49
	Raft footings	≥6.0	22.72	23.73
15.0	Strip footings	2.0	31.57	30.93
		3.0	30.61	29.70
		4.0	28.57	29.27
	Isolated footings	2.0 x 2.0	26.32	25.77
		3.0 x 3.0	25.51	24.75
		4.0 x 4.0	23.81	24.39
	Raft footings	≥6.0	30.00	30.99

10. CLOSURE

We appreciate the opportunity given to us to submit this report. This presented report is based on observations and tests on samples collected from the boreholes as decided by the client. In case any difference is noticed in the field subsoil strata and reported subsoil strata during excavation please contact us before proceeding with further construction.

For VISHWA BHUMI TECHNOLOGIES

(DINESH BHARDWAJ)

VISHWA BHUMI TECHNOLOGIES

Project No. 93

TABLE INDEX

FIGURE INDEX

GEOTECHNICAL SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT

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PROJECT :- GEOTECHNICAL SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT.

Sheet No- 16

VISHWA BHUMI TECHNOLOGIES

BH - 1 (CHUNAR) | BORING DATE 16/11/2015 to 17/11/2015 | TERMINAL DEPTH (m) 20.00 | WATER TABLE 13.50m

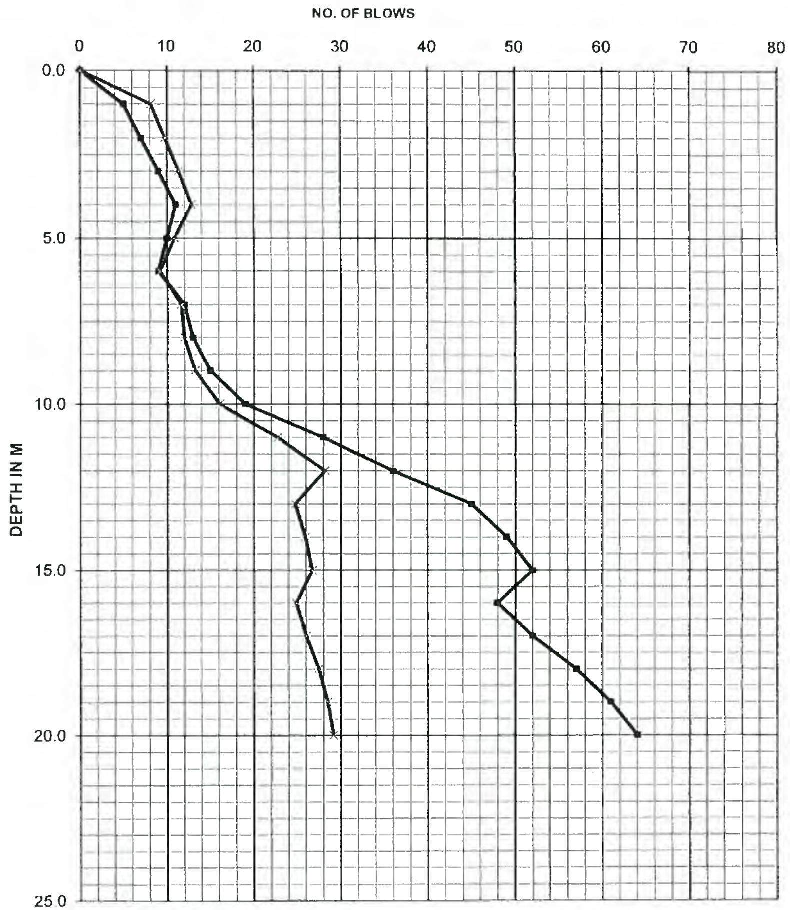
N VALUES	DEPTH (M)	SAMPLE	DESCRIPTION OF SOIL	IS CLASSIF-ICATION	GRAIN SIZE ANALYSIS				LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	DRY/BULK DENSITY	MOISTURE CONTENT	SHEAR PARAMETER			
					GRAVEL	SAND	SILT	CLAY						TEST TYPE	COHESION INTERCEPT (c)	ANGLE OF INTERNAL FUCTION (ϕ)	SPECIFIC GRAVITY
					%	%	%	%	%	%	%	gm/cc	%		kg/cm^2	deg.	
	0.5	DS-1	Filledup														
5	1.0	SPT-1	Silty Sand	SM	0	79	21	0									
	1.5	UDS-1		SM	0	72	28	0	N	P		1.45/1.53	5.30	DST	0	26.5	2.63
7	2.0	SPT-2															
9	3.0	SPT-3		SM	0	75	25	0									
11	4.0	SPT-4															
	4.5	UDS-2	Sandy Silt	ML	0	46	52	2	22	19	3	1.50/1.64	9.11	DST	0	28.0	2.67
10	5.0	SPT-5															
9	6.0	SPT-6															
12	7.0	SPT-7		ML	0	39	56	5									
13	8.0	SPT-8															
15	9.0	SPT-9															
19	10.0	SPT-10		ML	0	42	55	3									
28	11.0	SPT-11															
36	12.0	SPT-12		ML	0	40	56	4									

45	13.0	SPT-13	Fine Sand	SPSM	0	85	15	0									
49	14.0	SPT-14															
52	15.0	SPT-15		SPSM	0	91	9	0	N	P		1.70*/1.90*	11.94*	DST*	0*	34.0*	2.66*
48	16.0	SPT-16															
52	17.0	SPT-17		SPSM	0	90	10	0									
57	18.0	SPT-18															
61	19.0	SPT-19															
64	20.0	SPT-20		SPSM	0	92	8	0									
*Remoulded Sapmle																	

VISHWA BHUMI TECHNOLOGIES					PROJECT :- GEOTECHNICAL SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT.												Sheet No- 47
					BH- 2 (CHUNAR)			BORING DATE 17/11/2015 to 18/11/2015			TERMINAL DEPTH (m) 20.00						WATER TABLE 14.00m
					GRAIN SIZE ANALYSIS									SHEAR PARAMETER			
N VALUES	DEPTH (M)	SAMPLE	DESCRIPTION OF SOIL	IS CLASSIFICATION	GRAVEL	SAND	SILT	CLAY	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	DRY/BULK DENSITY	MOISTURE CONTENT	TEST TYPE	COHESION INTERCEPT (c)	ANGLE OF INTERNAL FRICTION (ϕ)	SPECIFIC GRAVITY
					%	%	%	%	%	%	%	gm/cc	%		kg/cm^2	deg	
	0.5	DS-1		Filledup													
5	1.0	SPT-1	Silty Sand	SM	0	81	19	0									
	1.5	UDS-1		SM	3	79	18	0	N	P		1.46/1.55	6.08	DST	0	27.5	2.64
7	2.0	SPT-2															
6	3.0	SPT-3		SM	2	76	22	0									
11	4.0	SPT-4															
9	5.0	SPT-5	Sandy Silt	ML	1	13	83	2	21	19	2	1.49*/1.64*	9.77*	DST*	0*	29*	2.66*
11	6.0	SPT-6															
13	7.0	SPT-7		ML	3	11	52	1									
16	8.0	SPT-8															
18	9.0	SPT-9		ML	0	13	84	3									
20	10.0	SPT-10															
23	11.0	SPT-11															
32	12.0	SPT-12		ML	0	46	49	5									
18	13.0	SPT-13		SPSM	0	88	12	0									

42	14.0	SPT-14	Fine Sand														
46	15.0	SPT-15		SPSM	0	91	9	0	N	P		1.69*/1.92*	13.48*	DST*	0*	32.5*	2.65*
51	16.0	SPT-16															
51	17.0	SPT-17		SPSM	0	89	11	0									
58	18.0	SPT-18															
63	19.0	SPT-19															
61	20.0	SPT-20		SPSM	0	92	8	0									

*Remoulded Sapmle



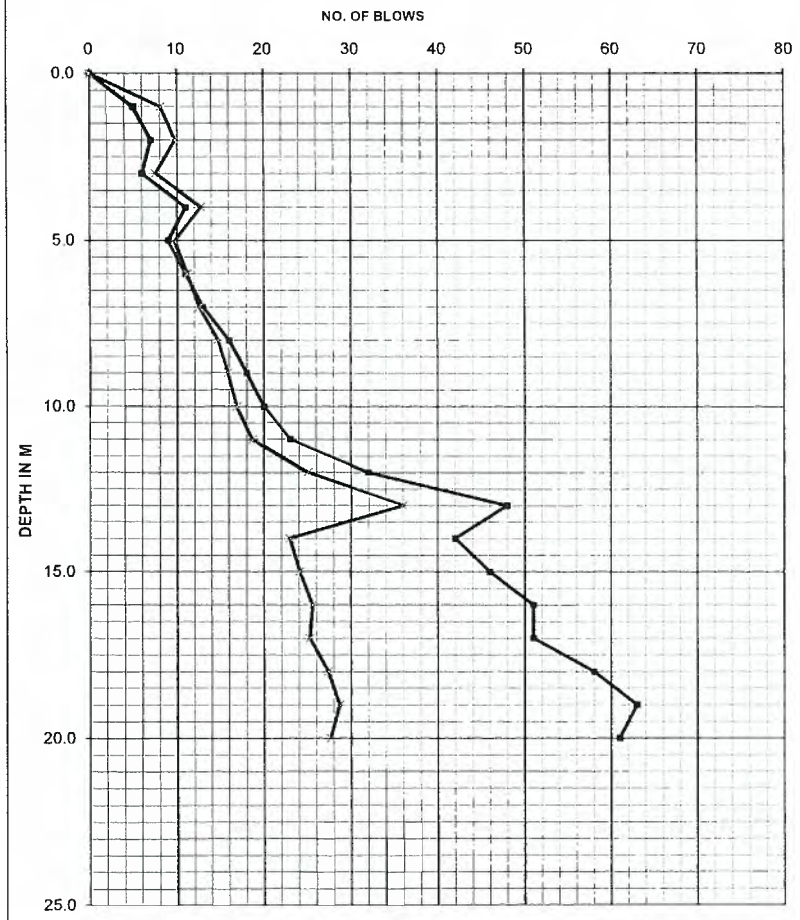
SPT CURVE

LEGEND	
Symbol	Notation
■	No
✖	Nc

PROJECT - GEOTECHNICAL SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT.

BH - 1

VISHWA BHUMI TECHNOLOGIES	SHEET NO. 19



SPT CURVE

LEGEND	
Symbol	Notation
■	No
⊠	Nc

PROJECT - GEOTECHNICAL SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT.

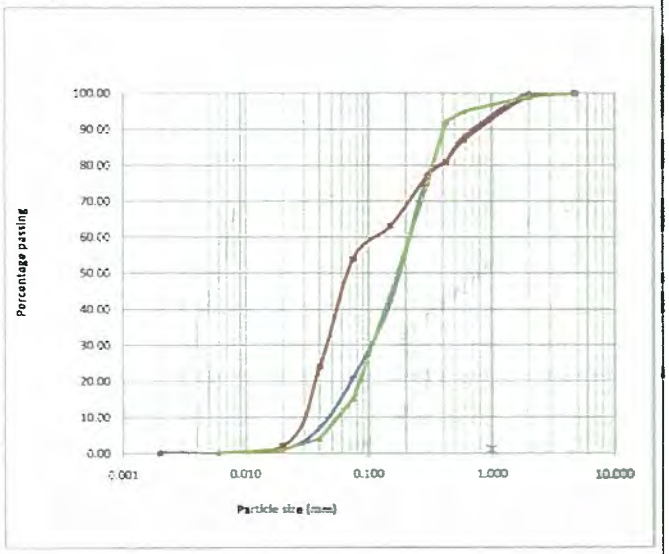
BH - 2

VISHWA BHUMI TECHNOLOGIES	Sheet no. 20

GRAIN SIZE ANALYSIS

PROJECT :- GEOTECHNICAL SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT.

BH - 1



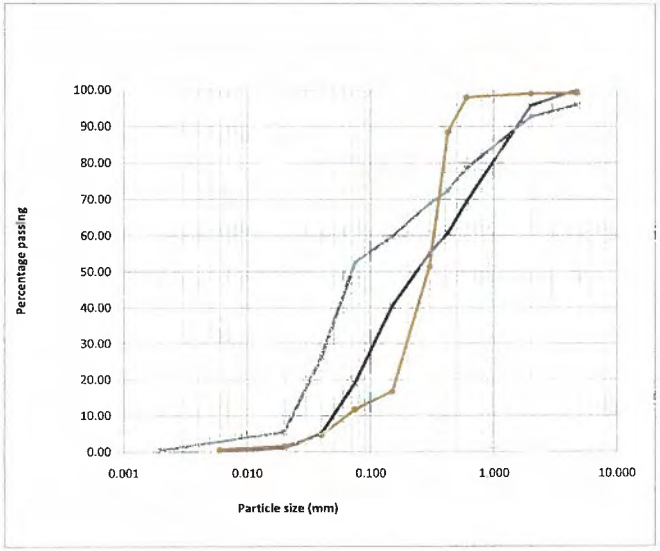
Symbol	Description of soil	Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
	Silty Sand (SM)	1.00	0	79	21	0
	Sandy Silt (ML)	4.50	0	46	52	2
	Fine Sand (SP - SM)	13.00	0	85	15	0

VBT	VISHWA BHUMI TECHNOLOGIES	Sheet no. 21

GRAIN SIZE ANALYSIS

PROJECT :- GEOTECHNICAL SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT.

BH - 2

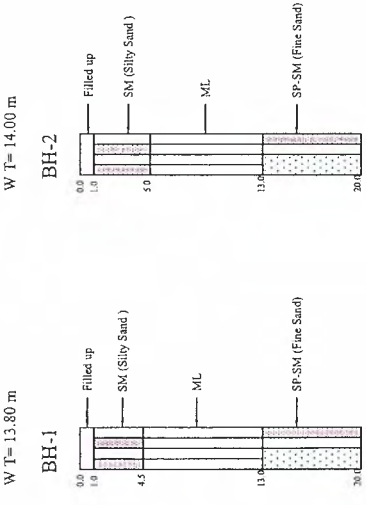


Symbol	Description of soil	Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
	Silty Sand (SM)	1.00	0	81	19	0
	Silty Sand with Clay (ML)	5.00	4	43	51	2
	Fine Sand (SPSM)	13.00	0	88	12	0

VISHWA BHUMI TECHNOLOGIES

SHEET NO. 22

LOCATION- CHUNAR



SUB SOIL PROFILE

GEOTECHNICAL SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENTION PROJECT

(BH-1) LOCATION:-CHUNAR

SAMPLE CALCULATION

Type of Foundation – Raft footing
Depth of Foundation –5.0m below EGL
Size of Foundation– 6.0mx6.0m (B=6.0 m)
Allowable Settlement S = 75 mm

1.0 SHEAR FAILURE CRITERIA (REF. IS: 6403)

Average soil data
Cohesion, c = 0kg/cm^2
Angle of Shear Resistance, ϕ = 28.0°
Effective Density
γ = 1.58 gm/cc for 4.50 to 13.00m depth below EGL
Water correction factor w' = 0.50
Overburden pressure q = 500x0.00164 = 0.790 kg/cm^2
d_c=, d_q = dγ =1.00
i_c=i_q=iγ = 1
S_c =1.2 S_q =1.2 1+0.2xB/L = 1.2, Sγ = 1-0.4xB/L = 0.6 ..... for raft footing
Factor of Safety = 2.5

For Local Shear

N_c= 14.45, Nq = 6.36, Nγ = 5.12

$Q_{ns} = [2/3\ cN_c.S_c.d_c.i_c + q(N_q - 1).s_q.d_q.i_q + 0.5\ \gamma_{eff}.B.N\gamma.S_\gamma.d_\gamma.i_\gamma.w']/\ 2.5$

= [2/3x0x14.45x1.2x1.0+0.820x (6.36-1)x1.2x1.0x1.0+0.5x0.00164x600x5.12x0.6x1.0x1.0x0.50]/2.5

= [0+5.27424+0.755712]/2.5

= 2.41198 Kg/cm^2 = 24.12 T/m^2

2.0 SETTLEMENT CRITERIA (IS: 8009,Pt.I)

Average weighted N value at 5.0 m depth (below EGL) = 20.12, w'= 0.50
Influence Zone is considered 2B below foundation level.
From Chart N vs settlement given on page 17 of IS: 8009 (Part 1-1978)
Corrected Settlement at a load of 1.0 Kg/cm2 = 33.0 mm
Hence for 75mm permissible settlement, net API = 75 / 33.0 = 2.272 Kg/cm^2
= 22.72 T/ m^2

RECOMMENDATION:

LEAST F ROM A BOVE VA LUES OF NE T S BC OB TAINED F ROM S HEAR F AILURE CRITERIA A ND S ETTLEMENT F AILURE CRITERIA i .e. **22.72 T/m^2** FOR 75 M M SETTLEMENT MAY BE ADOPTED FOR DESIGN PURPOSES.

(BH-2) LOCATION:-CHUNAR

SAMPLE CALCULATION

Type of Foundation – Raft footing
Depth of Foundation –5.0m below EGL
Size of Foundation– 6.0mx6.0m (B=6.0 m)
Allowable Settlement S = 75 mm

1.0 SHEAR FAILURE CRITERIA (REF. IS: 6403)

Average soil data
Cohesion, c = 0kg/cm^2
Angle of Shear Resistance, ϕ = 29.0°
Effective Density
γ = 1.64 gm/cc for 5.00 to 13.00m depth below EGL
Water correction factor w' = 0.50
Overburden pressure q = 500x0.00164 = 0.820 kg/cm^2
d_c=, d_q = dγ =1.00
i_c=i_q=iγ = 1
S_c =1.2 S_q =1.2 1+0.2xB/L = 1.2, Sγ = 1-0.4xB/L = 0.6 ..... For raft footing
Factor of Safety = 2.5

For Local Shear

N_c= 15.16, Nq = 6.63, Nγ = 5.66

$Q_{ns} = [2/3\ cN_c.S_c.d_c.i_c + q(N_q - 1).s_q.d_q.i_q + 0.5\ \gamma_{eff}.B.N\gamma.S_\gamma.d_\gamma.i_\gamma.w']/\ 2.5$

= [2/3x0x15.16x1.2x1.0+0.820x (6.63-1)x1.2x1.0x1.0+0.5x0.00164x600x5.66x0.6x1.0x1.0x0.50]/2.5

= [0+5.5399+0.835416]/2.5

= 2.55013 Kg/cm^2 = 25.50 T/m^2

2.0 SETTLEMENT CRITERIA (IS: 8009,Pt.I)

Average weighted N value at 5.0 m depth (below EGL) = 20.73, w'= 0.50
Influence Zone is considered 2B below foundation level.
From Chart N vs settlement given on page 17 of IS: 8009 (Part 1-1978)
Corrected Settlement at a load of 1.0 Kg/cm2 = 31.6 mm
Hence for 75mm permissible settlement, net API = 75 / 31.6 = 2.3734 Kg/cm^2
= 23.73 T/ m^2

RECOMMENDATION:

LEAST F ROM A BOVE VA LUES OF NE T S BC OB TAINED F ROM S HEAR F AILURE CRITERIA A ND S ETTLEMENT F AILURE CRITERIA i .e. **23.73 T/m^2** FOR 75 M M SETTLEMENT MAY BE ADOPTED FOR DESIGN PURPOSES.

PHOTOGRAPHS

BH- 1 CHUNAR

BH- 2 CHUNAR

BOREHOLE DESIGNATION	ACTUAL TEST LOCATION COORDINATES	
	LATITUDE	LONGITUDE
BH-1	25° 8.183' N	82° 53.377' E

BOREHOLE DESIGNATION	ACTUAL TEST LOCATION COORDINATES	
	LATITUDE	LONGITUDE
BH-2	[illegible]	[illegible]

4. Topography / route survey report

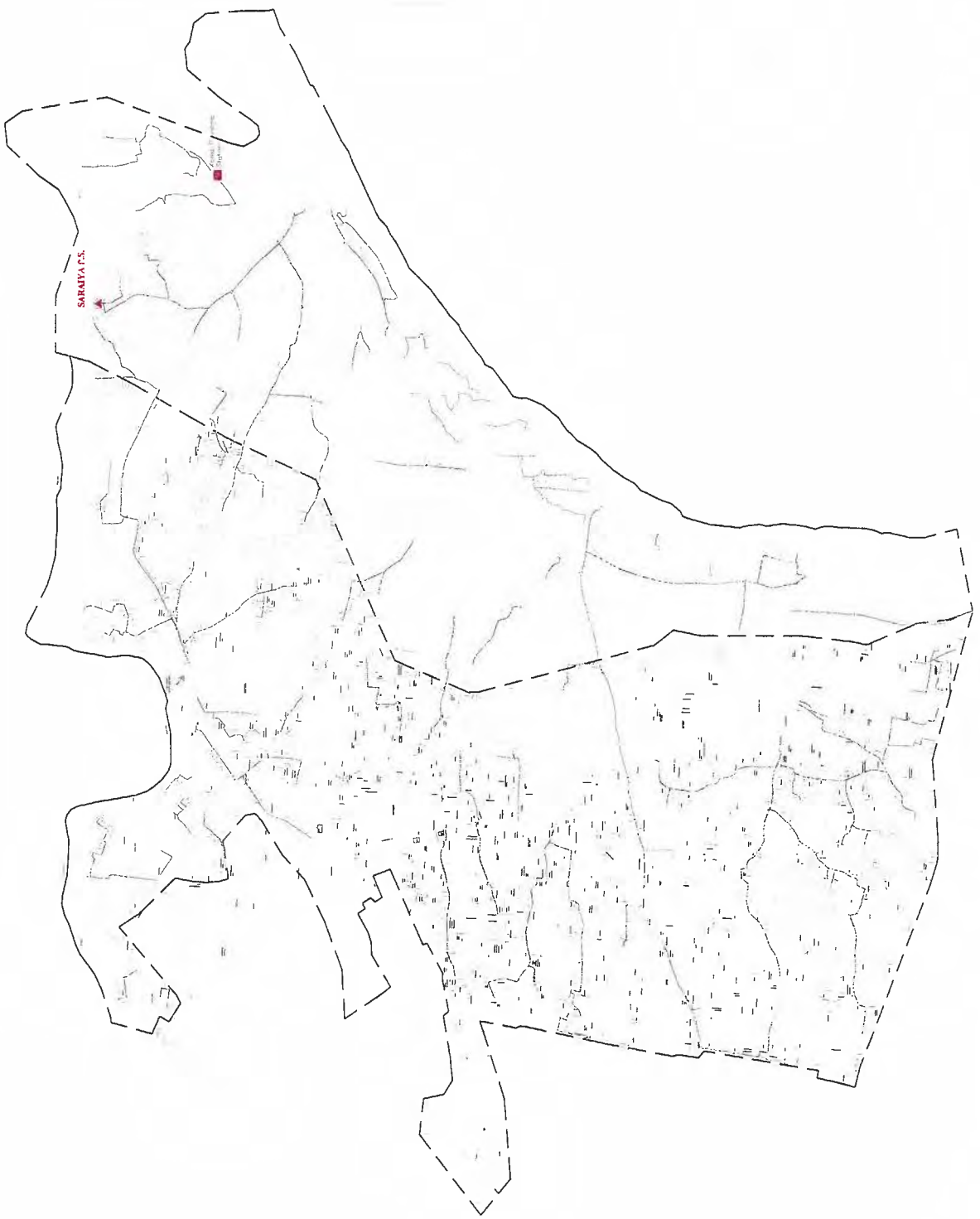
TABLE OF CONTENTS

1. District I & II (Varanasi)

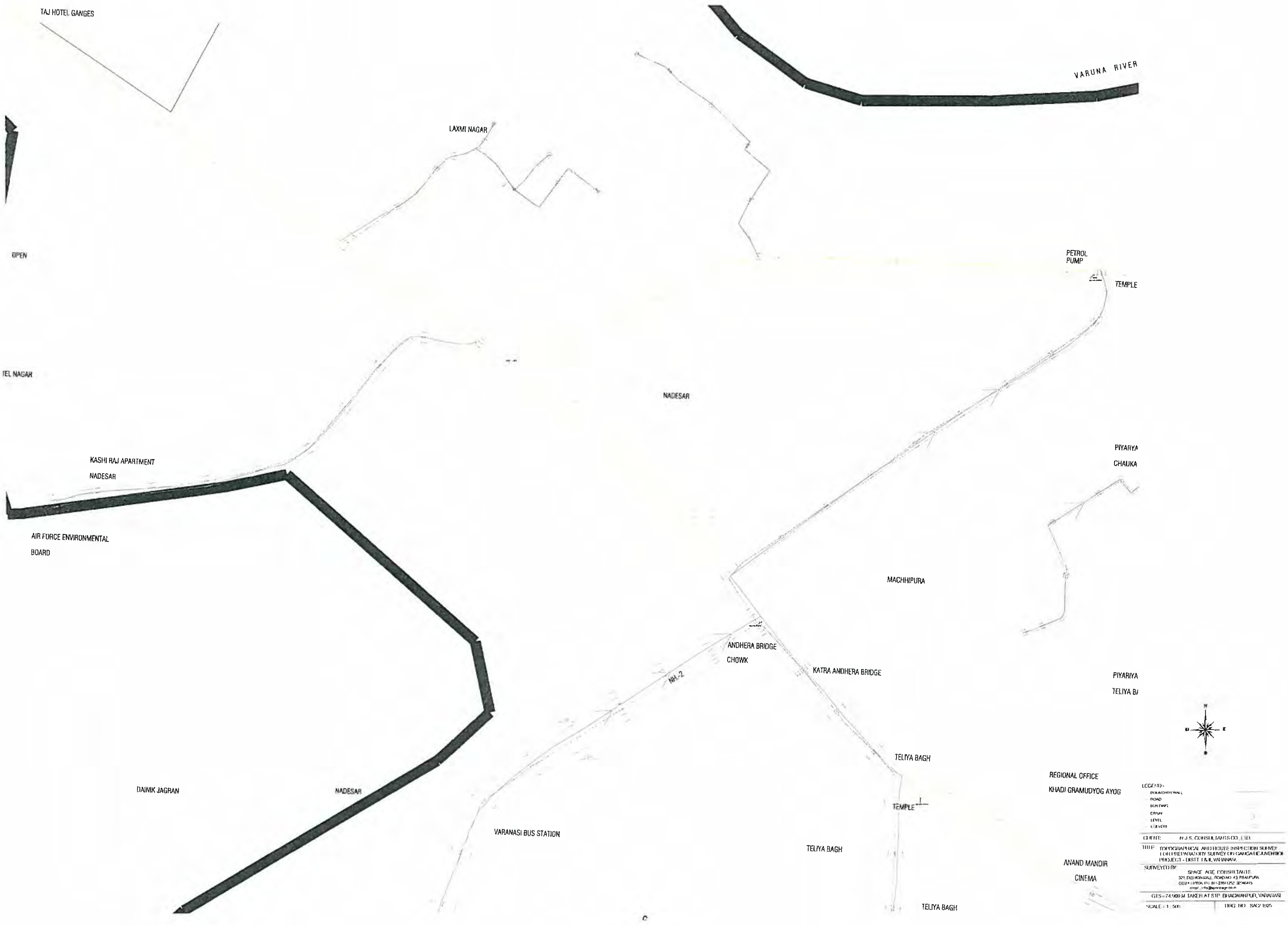
LIST OF BANCH MARKS ESTABLISHED AT SITE

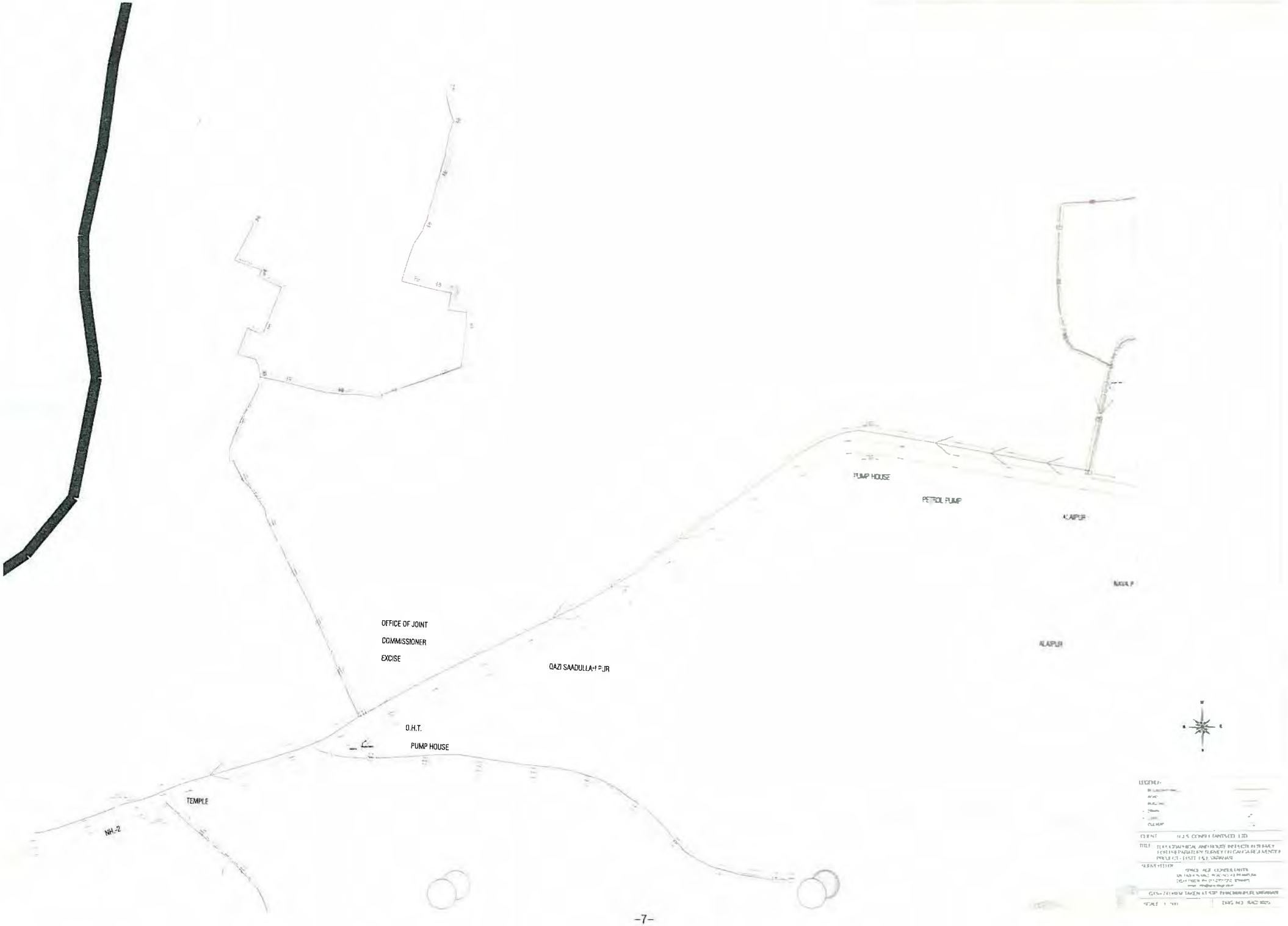
VARANASI DISTT-I & II:-
TBM FOR ROUTE SURVEY = TBM 74.743 M TRANSFERED FROM STP BHAGWANPUR, VARANASI (74.969 M).

SL. NO	BM	EASTING	NORTHING	LEVEL	LOCATION
1	TBM (12)	700279.04	2799480.6	80.255	PLINTH OF TEMPLE SUDAMAPUR COLONY
2	TBM (13)	699969.616	2799588.32	81.130	PLINTH OF PUMP HOUSE SUDAMAPUR COLONY
3	TBM (14)	700272.405	2800822.62	80.410	TOP OF CIRCLE SIGRA CHAURAHA
4	TBM (15)	700223.345	2801452.54	80.110	TOP OF CENTRAL VERGE SAJAN CHAURAHA
5	TBM (16)	700477.662	2802342.86	79.300	TOP OF CIRCLE MALDAHIYA CHAURAHA.
6	TBM (17)	700655.485	2802884.98	75.860	FOUNDATION OF JUNCTION BOX TELIYA BAGHA TIRAHA.
7	TBM (18)	700815.119	2803368.49	76.885	PLINTH OF TEMPLE CHOKA GHAT
8	TBM (19)	700509.545	2803047.82	75.485	FOUNDATION OF FLYOVER PIEAR CHOKA GHAT
9	TBM (20)	700884.799	2802767.43	75.160	PLINTH OF TEMPLE TELIYA BAGH CHAURAHA.
10	TBM (21)	701580.95	2803497.15	76.090	PLINTH OF PUMP HOUSE O.H.T. CHOKA GHAT
11	TBM (22)	702267.459	2803820.61	76.850	PLINTH OF GUARD ROOM CITY CROSSING.
12	TBM (23)	703118.445	2803603.43	75.195	PLINTH OF BUILDING STEP SHELPUTTRI CHOMUHANI.
13	TBM (24)	703619.879	2804030.51	75.295	PLINTH OF TEMPLE NEAR POLICE STATION SARAIYA.
14	TBM (25)	703785.047	2803122.35	78.870	TOP OF TEMPLE WAL KAZZAKPURA CHOWK
15	TBM (26)	704130.001	2802802.75	76.860	TOP OF CULVERT BHADAU CHUNGI.
16	TBM (27)	704308.714	2802692.52	77.525	PLINTH OF POLICE BOOTH RAJGHAT ROAD.
17	TBM (28)	701284.314	2800633.54	76.460	PLINTH OF BOUNDARY WALL GATE LAKSHA T-POINT.
18	TBM (29)	701892.079	2800741.12	76.105	TOP OF CIRCLE CHURCH CHAURAHA.
19	TBM (30)	702027.027	2800709	76.000	TOP OF CIRCLE GODOLIA CHAURAHA.
20	TBM (31)	701807.47	2799286.75	76.975	FOUNDATION OF SIGNAGE BOARD.
21	TBM (32)	701595.863	2798898.64	76.195	TOP OF CIRCLE RAVINDRAPURI CHAURAHA
22	TBM (33)	701641.269	2798046.08	78.548	TOP OF CULVERT ASSI NALAH
23	TBM (36)	704124.415	2802348.92	84.330	PLINTH OF TEMPLE TELIYA BAGH CHAURAHA.
24	TBM (37)	703349.217	2801942.57	75.710	PLINTH OF GATE MACHHODARI PARK.
25	TBM (39)	702388.222	2801006.74	86.995	FOUNDATION OF SIGNAGE BOARD MANIKA GHAT.
26	TBM (40)	702616.407	2801788.91	76.365	PLINTH OF STATUTE MEDAGINI CHAURAHA.
27	TBM (41)	700277.105	2803287.66	77.92	TOP OF CIRCLE NADESHAR.
28	TBM (42)	699783.3	2803628.04	79.115	PLINTH OF TEMPLE NEAR HOTEL GATEWAY.
29	TBM (43)	699836.652	2804094.66	77.045	PLINTH OF DHARAMSHALA JADID BAZAR VARUNA.
30	BM-6	700499.505	2800436.37	78.775	TOP OF CIRCLE RATH YATRA CHAURAHA.
31	TBM (44)	698648.221	2799929.94	80.845	TOP OF WELL MAHMOOR GANJ CHAURAHA.


SARAIYA P.S.


VARUNA RIVER
VARUNA BRIDGE
NADESAR
TAJ HOTEL GANGES


TAJ HOTEL GANGES
VARUNA RIVER
LAXMI NAGAR
OPEN
PETROL PUMP
TEMPLE
TEL NAGAR
NADESAR
KASHI RAJ APARTMENT
NADESAR
PIYARIYA
CHAUKA
AIR FORCE ENVIRONMENTAL
BOARD
MACHHIPURA
ANDHERA BRIDGE
CHOWK
NH-2
KATRA ANDHERA BRIDGE
PIYARIYA
TELIYA BA
TELIYA BAGH
REGIONAL OFFICE
KHADI GRAMUDYOG AYOG
DAINIK JAGRAN
NADESAR
TEMPLE
VARANASI BUS STATION
TELIYA BAGH
ANAND MANDIR
CINEMA
TELIYA BAGH
LEGEND:-
ROAD
LEVEL
CLIENT:
N.J.S. CONSULTANTS CO., LTD.
TITLE:
PROJECT - DISTT. [illegible], VARANASI.
SURVEYED BY:
SPACE AGE CONSULTANTS
GTS=74.909 M TAKEN AT STP, BHAGWANPUR, VARANASI
DRG. NO. SAC/ 1925


PUMP HOUSE
PETROL PUMP
ALAIPUR
OFFICE OF JOINT
COMMISSIONER
EXCISE
QAZI SAADULLAH PUR
O.H.T.
PUMP HOUSE
TEMPLE
NH-2

LEGEND :-

- BOUNDARY WALL
- ROAD
- BUILDING
- DRAIN
- LEVEL
- CULVERT

CLIENT: N.J.S. CONSULTANTS CO., LTD

TITLE: TOPOGRAPHICAL AND ROUTE INSPECTION SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT - DISTT. VARANASI

SURVEYED BY:

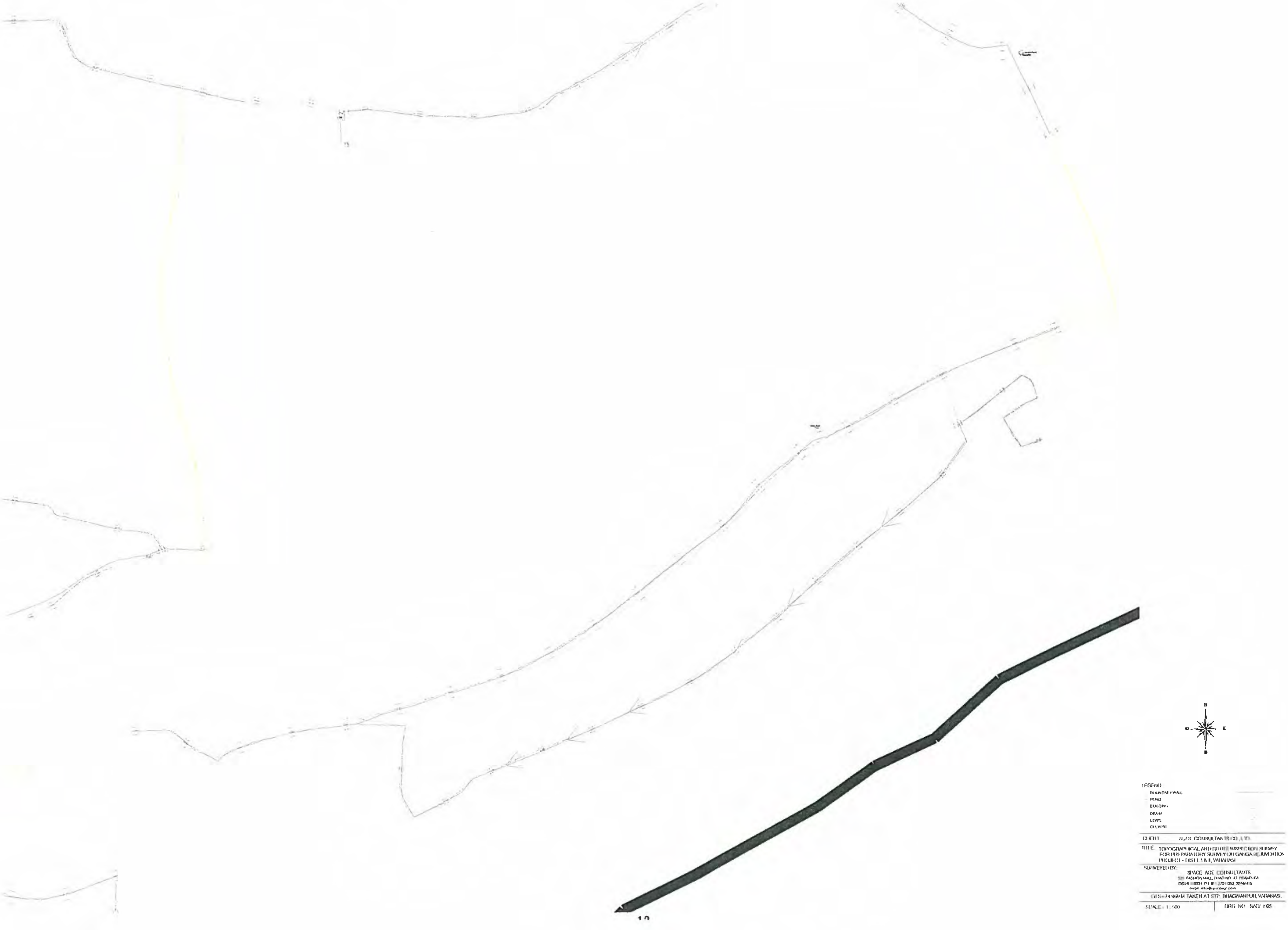
SPACE AGE CONSULTANTS

GTS=74.960 M TAKEN AT STP, BHAGWANPUR, VARANASI

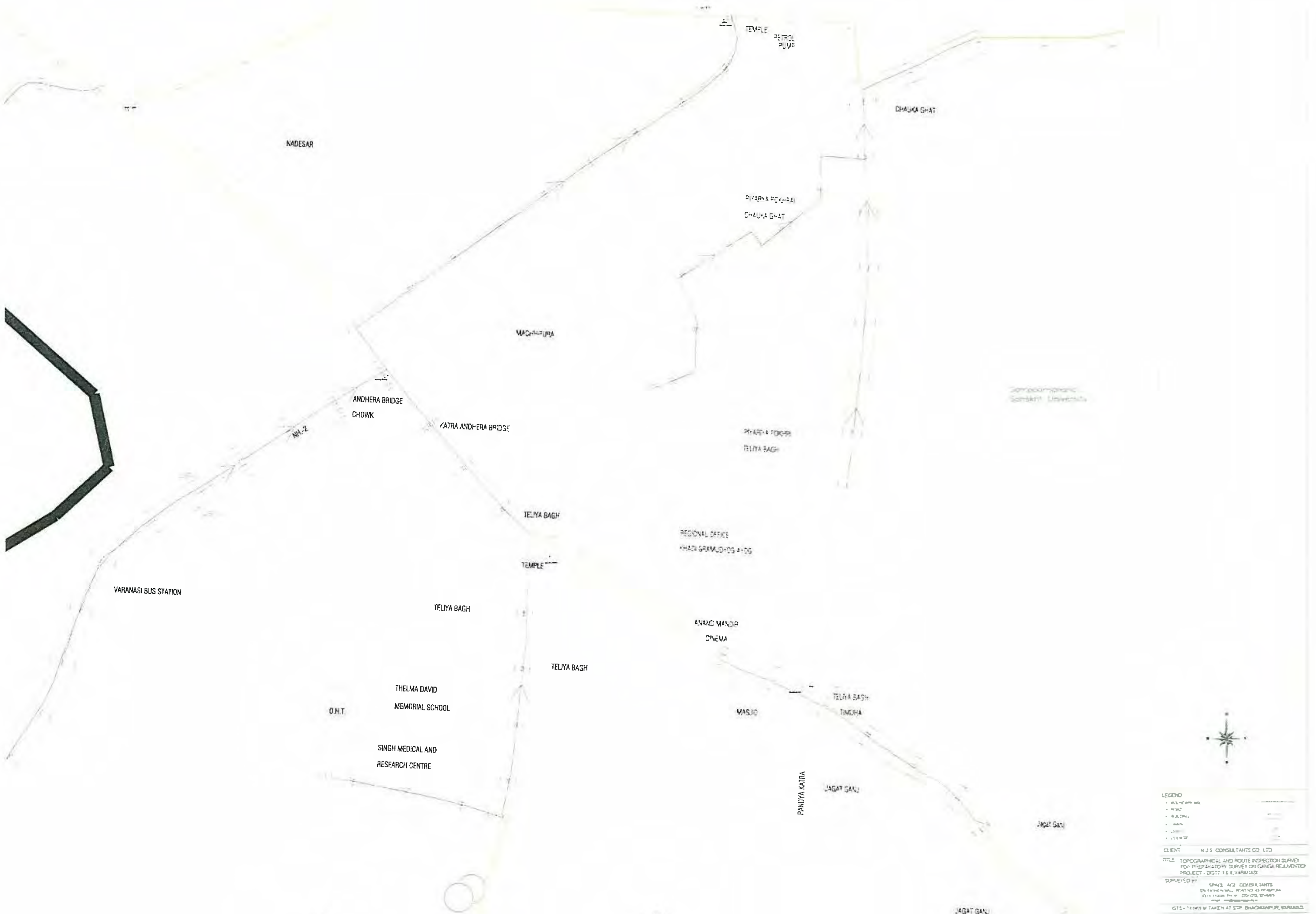
SCALE - 1 : 500 | DRG. NO. : SAC/ 1925

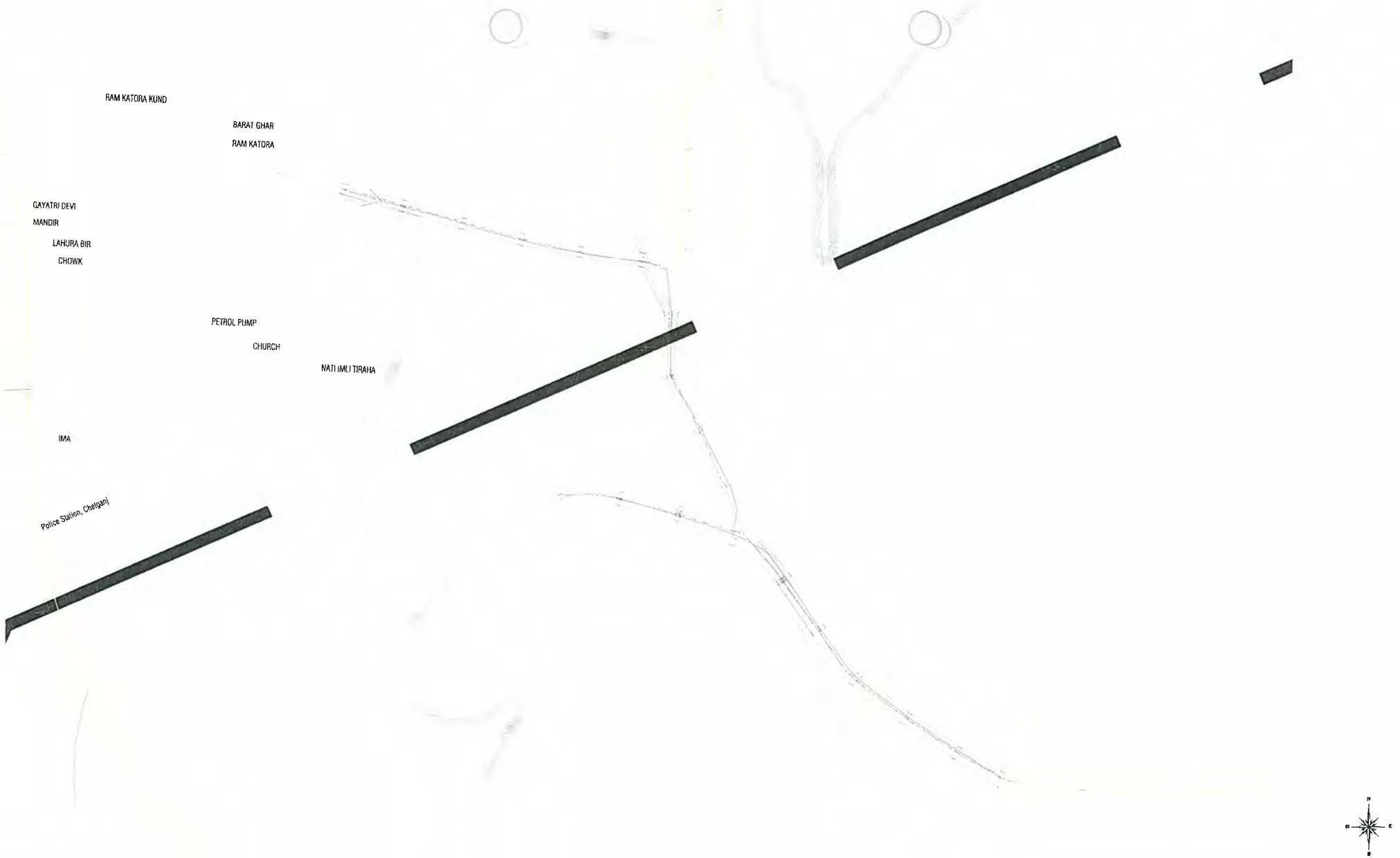
SARAIYA P.S.

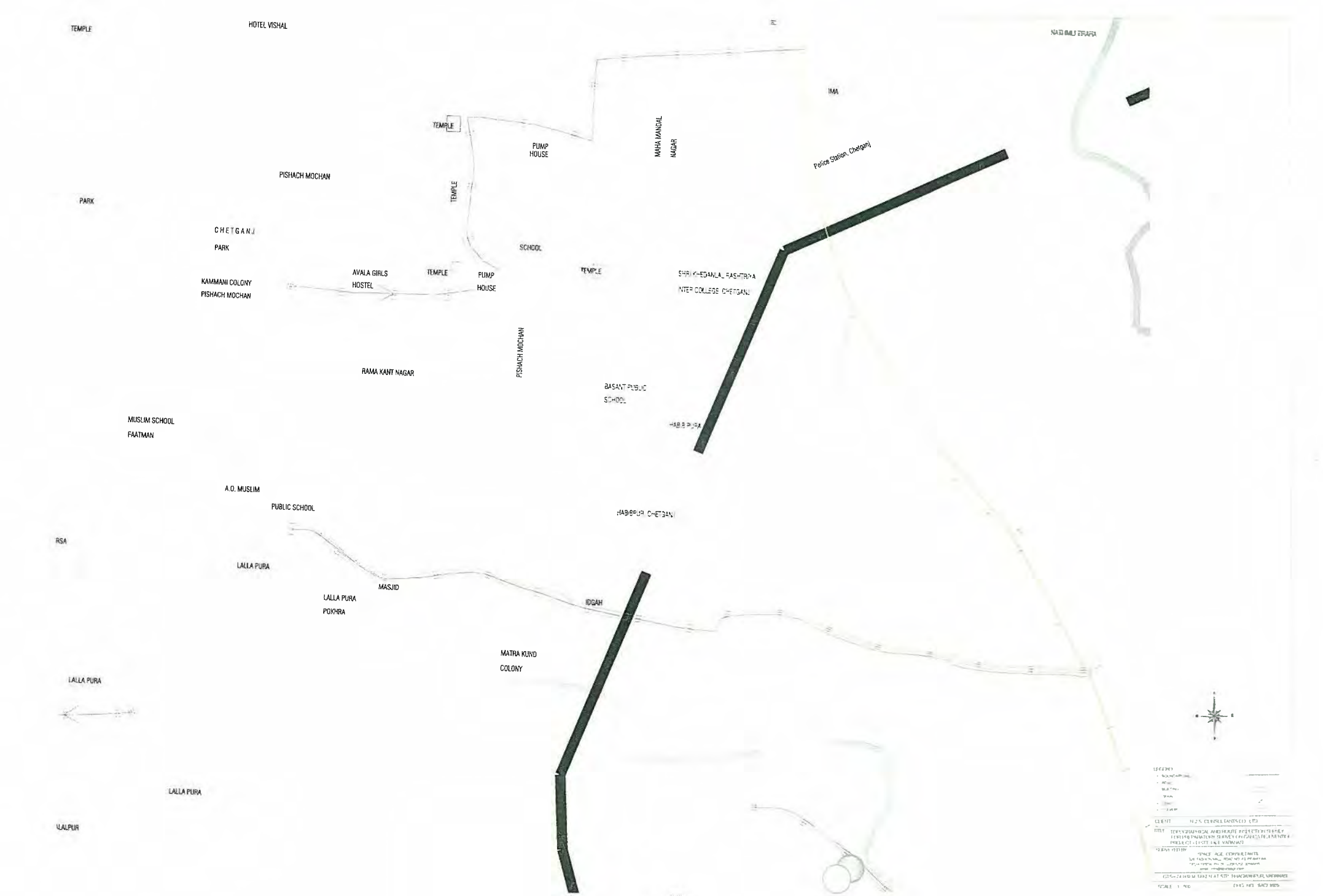

N
E
LEGEND -
BOUNDARY WALL
ROAD
DRAIN
LEVEL
CLIENT: N.J.S. CONSULTANTS CO., LTD.
TITLE: TOPOGRAPHICAL AND ROUTE INSPECTION SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT - DISTT. I & II, VARANASI
SURVEYED BY
SPACE AGE CONSULTANTS
GTS=74.960 M TAKEN AT STP, BHAGWANPUR, VARANASI
SCALE - 1 : 500
DRG. NO. :SAC/ 1105


LEGEND
BOUNDARY WALL
ROAD
BUILDING
DRAIN
LEVEL
CULVERT
CLIENT N.J.S. CONSULTANTS CO., LTD.
TITLE TOPOGRAPHICAL AND ROUTE INSPECTION SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT - DISTT. & U, VARANASI
SURVEYED BY:
SPACE AGE CONSULTANTS
GTS=74.969 M TAKEN AT STP, BHAGWANPUR, VARANASI
SCALE : 1 : 500
DRG. NO. SAC/ 1125


NH-2
TEMPLE
JAIT PURA
WOMEN'S ITI, CHAUKA GHAT
REGIONAL SEVAYOGAN
OFFICE
CHAUKA GHAT
HEALTH OFFICE
DHUP CHANDI
LABOUR COLONY
CHOWK
LABOUR COLONY
OFFICE OF
COMMISSIONER
CHANDRA
TOWER
NATI IMLI
CHAURAHA
TEMPLE
LEGEND -
ROAD
DRAIN
CLIENT:
N.J.S. CONSULTANTS CO., LTD.
SURVEYED BY
SPACE AGE CONSULTANTS


TEMPLE
PETROL PUMP
CHAUKA GHAT
NADESAR
PIYARIYA POKHRA
CHAUKA GHAT
MACHHPURA
ANDHERA BRIDGE
CHOWK
NH-2
KATRA ANDHERA BRIDGE
PIYARIYA POKHRA
TELIYA BAGH
TELIYA BAGH
REGIONAL OFFICE
TEMPLE
VARANASI BUS STATION
TELIYA BAGH
ANAND MANDIR
CINEMA
TELIYA BAGH
THELMA DAVID
MEMORIAL SCHOOL
O.H.T.
MASJID
TELIYA BAGH
TIMUHA
SINGH MEDICAL AND
RESEARCH CENTRE
PANDYA KATRA
JAGAT GANJ
Jagat Ganj
JAGAT GANJ
LEGEND
CLIENT N.J.S. CONSULTANTS CO. LTD.
TITLE TOPOGRAPHICAL AND ROUTE INSPECTION SURVEY
SURVEYED BY


RAM KATORA KUND
BARAT GHAR
RAM KATORA
GAYATRI DEVI
MANDIR
LAHURA BIR
CHOWK
PETROL PUMP
CHURCH
NATI IMLI TIRAHA
IMA
Police Station, Chetganj


TEMPLE
HOTEL VISHAL
IMA
TEMPLE
PUMP HOUSE
MAHA MANGAL NAGAR
Police Station, Chetganj
PISHACH MOCHAN
PARK
TEMPLE
CHETGANJ
PARK
SCHOOL
KAMMANI COLONY
PISHACH MOCHAN
AVALA GIRLS HOSTEL
TEMPLE
PUMP HOUSE
TEMPLE
SHRI KHEDAMLAL RASHTRIYA INTER COLLEGE CHETGANJ
PISHACH MOCHAN
RAMA KANT NAGAR
BASANT PUBLIC SCHOOL
HABIB PURA
MUSLIM SCHOOL
FAATMAN
A.O. MUSLIM
PUBLIC SCHOOL
HABIBPUR CHETGANJ
RSA
LALLA PURA
MASJID
LALLA PURA
POKHRA
IDGAH
MATRA KUND
COLONY
LALLA PURA
LALLA PURA
UALPUR


N
E
S
LEGEND:-
BOUNDARY WALL
ROAD
BUILDING
DRAIN
LEVEL
CULVERT
CLIENT N.J.S. CONSULTANTS CO. LTD.
TITLE: TOPOGRAPHICAL AND ROUTE INSPECTION SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT - DISTT. U.P. VARANASI.
SURVEYED BY:
SPACE AGE CONSULTANTS
GTS=74.960 M TAKEN AT STP, BHAGWANPUR, VARANASI
SCALE - 1:500
DRG. NO.: SAC/1025

AGAR
ROTARY
CHOWK
Temple
IMP
N
E
LEGEND :
ROAD
BUILDING
LEVEL
CLIENT : N.J.S. CONSULTANTS CO., LTD.
TITLE : TOPOGRAPHICAL AND ROUTE INSPECTION SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT - DISTT. 1 & II, VARANASI.
SURVEYED BY : SPACE AGE CONSULTANTS


GURU DHAM
CHOWK
DURGAKUND ROAD
GURU DHAM COL
NAWABGANJ
DAYAL TOWER
DURGA KUND
DURGA MANDIR
COME FORTH TO LEARN
GO FORTH TO SERVE
PARK
UPENDRA NAGAR COLONY
TULSI MANAS MANDIR COLONY
MANAS
MANDIR

LEGEND -
BOUNDARY WALL
ROAD
DRAIN
LEVEL

CLIENT: N.J.S. CONSULTANTS CO. LTD.

TITLE: TOPOGRAPHICAL AND ROUTE INSPECTION SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT - VARANASI

SURVEYED BY: SPACE AGE CONSULTANTS

GTS=74.900 M TAKEN AT STP, BHAGWANPUR, VARANASI

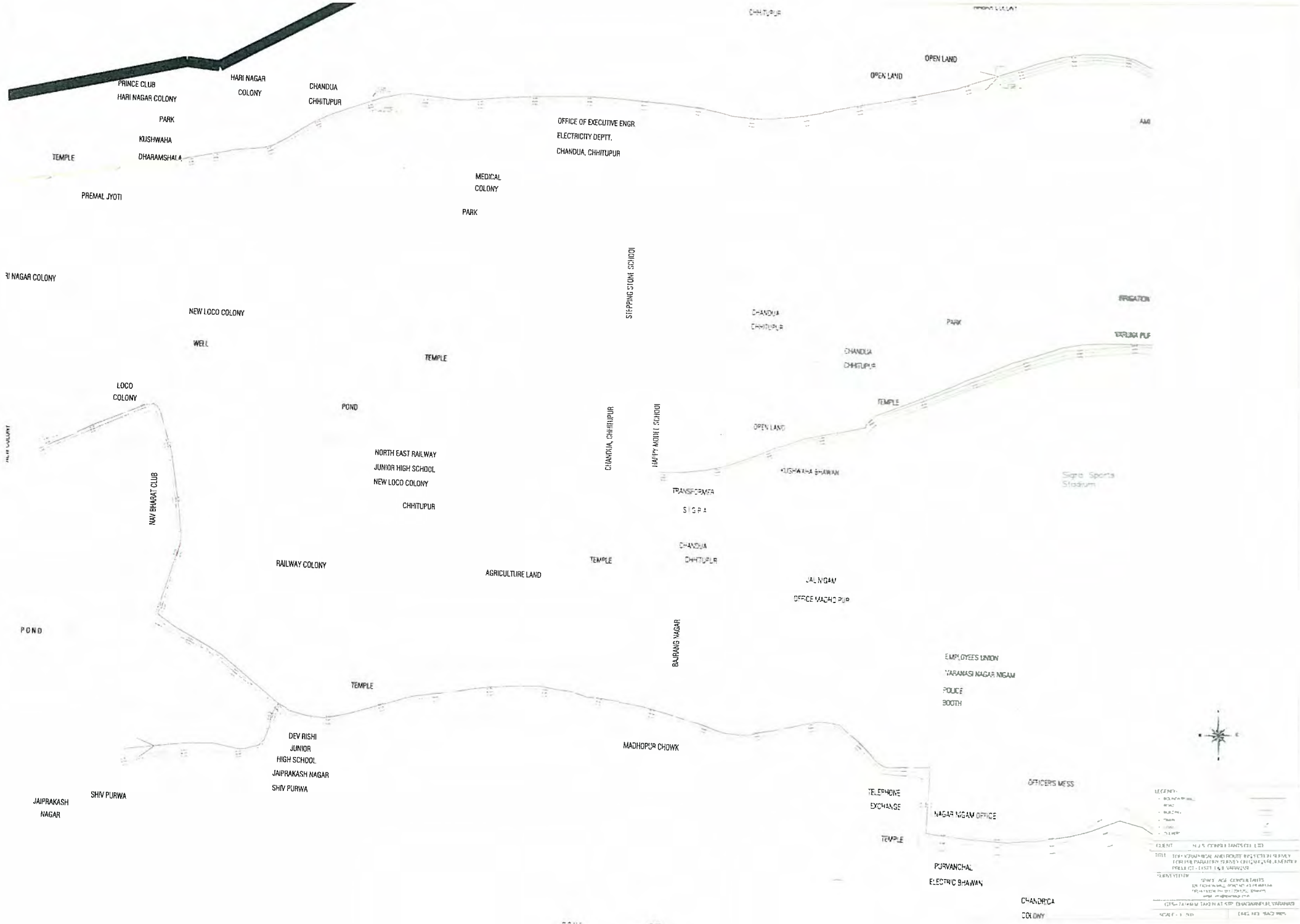
SCALE - 1 : 500 | DRG. NO. SAC/ 1025


JAKKHA POKHRA
HANUMAN MANDIR
CEMETARY
POND
POND
OPEN LAND
TEMPLE
POLICE STATION
BAJARDIHA


RAILWAY RESER
TRANSFORMER
PANIN GIRLS COLLEGE
TULSIPUR
RANIPUR
OHT
MOHINI DEVI RUNGTA
SHISHU MANDIR
TEMPLE
SHEEL NAGAR ENCLAVE
RANIPUR
RAILWAY QUARTERS
POND
RANIPUR
SHIVRAJ NAGAR
TEMPLE
RANIPUR
JAKKHA POKHRA
SHIVRAJ NAGAR
JAKKHA
HANUMAN MANDIR
CEMETARY
TEMPLE
SHIV RATAN PUR
SHRIRAM NAGAR COLONY
POND
SHIV RATAN PUR
OPEN LAND
COLONY
POLICE POST, BAJARDIHA
THANA BHELUPUR
TEMPLE
DEV POKHRA
LEGEND:-
BOUNDARY WALL
ROAD
DRAIN
LEVEL
CLIENT
TITLE
TOPOGRAPHICAL AND ROUTE INSPECTION SURVEY
FOR PREPARATORY SURVEY ON GANGA REJUVENTION
PROJECT - DISTT. VARANASI.
SURVEYED BY:
SPACE AGE CONSULTANTS
GTS=74.909 M TAKEN AT STP BHAGWANPUR, VARANASI
SCALE - 1 : 500
DRG. NO. SAC/1925


ALL INDIA RADIO
VARANASI
PETROL
PUMP
ANAND NAGAR
MAHMUR GANJ
Utkarsh Nursing Home
MARUTI SERVICE
CENTRE
RELIANCE
PETROL
PUMP
MAHMOOR GANJ
ROYAL PAVILION
BINDAL COMPLEX
TULSI UDYAN
ABHINANDAN UDYAN
MOHINI KUNJ
PUMP HOUSE
TEMPLE
MAHMOOR GANJ
POLICE CHAUKI
NAVODIT NAGAR
POND
OPEN
GOKUL NAGAR
ADARSH PRIMARY
SCHOOL, MAHMUR PURA
TULSIPUR
TEMPLE
PUMP HOUSE
TULSI PUR
MANGLA BHARTI SCHOOL
O.H.T.
MOTI JHEEL
MAHMUR GANJ
MOTI JHEEL
POND
SURYA ENCLAVE
RAILWAY RESERVATION
MANDUADIH STATION
TRANSFORMER
TULSIPUR
PANIN GIRLS COLLEGE
BARI GANJ
RANIPUR
O.H.T.
RANIPUR
TEMPLE
MOHINI DEVI RUNGTA
SHISHU MANDIR
AILWAY QUARTERS


SHIV PURWA
DEV RISHI
JUNIOR
HIGH SCHOOL
JAIPRAKASH NAGAR
SHIV PURWA
MADHOPUR CHOWK
JAIPRAKASH
NAGAR
SHIV PURWA
POND
SHIV PURWA
NIRALA NAGAR
SHIV PURAM COLONY
MADHO PUR
OPEN LAND
AC. PUBLICK
SCHOOL
NIRALA NAGAR
O.H.T.
MANAV DHARAM
RAJESHWARI NAGAR
GANESH NAGAR
NIRALA NAGAR
YOG NAGAR
KALYAN VATIKA
TRANSFORMER
NIRALA NAGAR
BANK CO
MAHMUR GANJ
SUNDER PUR
SHIV PURWA
SHIVAJI NAGAR
TEMPLE
SHIV PURWA
AADARSH NAGAR
PARK
NARSINGH APARTMENTS
MAHMUR GANJ
N
E
LEGEND:-
BOUNDARY WALL
ROAD
BUILDING
DRAIN
LEVEL
CULVERT
CLIENT: N.J.S. CONSULTANTS CO., LTD
TITLE: TOPOGRAPHICAL AND ROUTE INSPECTION SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT - DISTT. (U.P.), VARANASI
SURVEYED BY:
SPACE AGE CONSULTANTS
GTS=74.970 M TAKEN AT STP, BHAGWANPUR, VARANASI
SCALE - 1 : 500
DRG. NO. - SAC/ 1125


PRINCE CLUB
HARI NAGAR COLONY
PARK
KUSHWAHA
TEMPLE
DHARAMSHALA
HARI NAGAR
COLONY
CHANDUA
CHHITUPUR
OPEN LAND
OPEN LAND
OFFICE OF EXECUTIVE ENGR.
ELECTRICITY DEPTT.
CHANDUA, CHHITUPUR
MEDICAL
COLONY
PARK
PREMAL JYOTI
STEPPING STONE SCHOOL
NEW LOCO COLONY
WELL
TEMPLE
CHANDUA
CHHITUPUR
PARK
IRRIGATION
TEMPLE
CHANDUA
CHHITUPUR
LOCO
COLONY
POND
NORTH EAST RAILWAY
JUNIOR HIGH SCHOOL
NEW LOCO COLONY
CHHITUPUR
CHANDUA, CHHITUPUR
HAPPY MONTE SCHOOL
OPEN LAND
TEMPLE
KUSHWAHA BHAWAN
Sigra Sports
Stadium
NAV BHARAT CLUB
TRANSFORMER
SIGRA
CHANDUA
CHHITUPUR
TEMPLE
RAILWAY COLONY
AGRICULTURE LAND
JAL NIGAM
OFFICE MADHO PUR
POND
BAJRANG NAGAR
EMPLOYEES UNION
VARANASI NAGAR NIGAM
POLICE
BOOTH
TEMPLE
DEV RISHI
JUNIOR
HIGH SCHOOL
JAIPRAKASH NAGAR
SHIV PURWA
MADHOPUR CHOWK
JAIPRAKASH
NAGAR
SHIV PURWA
OFFICERS MESS
TELEPHONE
EXCHANGE
NAGAR NIGAM OFFICE
TEMPLE
PURVANCHAL
ELECTRIC BHAWAN
CHANDRIKA
COLONY

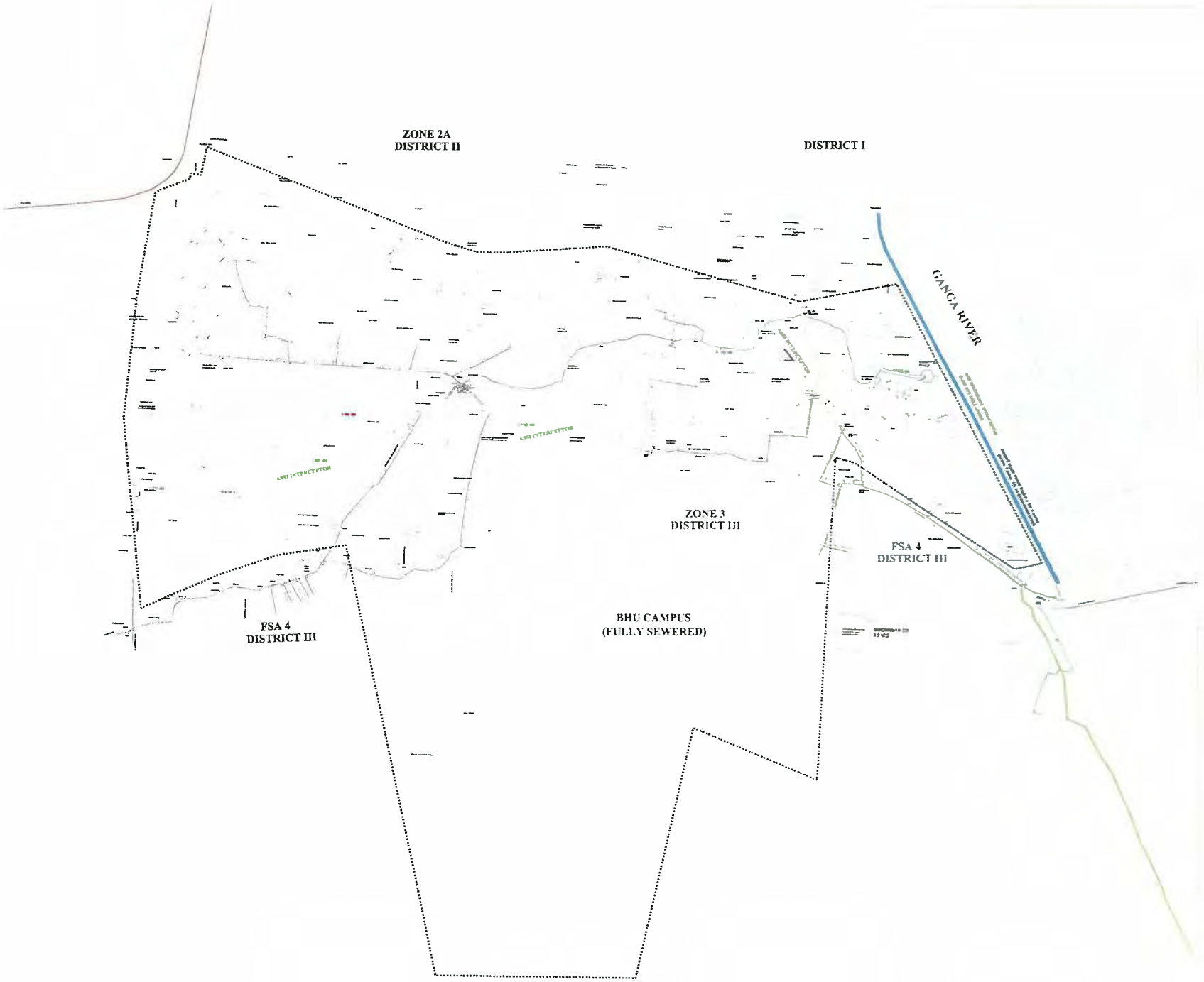

NAGAR COLONY
VIRAT SUB CENTRE SIGRA
FAATMAN
MADARSA
CEMETARY
LALLA PURA
OPEN LAND
I LAND
PETROL PUMP
FACTORY
TEMPLE
POLICE STATION SIGRA
PARK
PUMP HOUSE
KAMLA NAGAR
INTERMEDIATE COLLEGE
AMBALIKA PURI COLONY
SUBZI MANDI
BHARAT MATA MANDIR
LALLA PURA
CEMETARY
I.P. TOWER
SHASTRI NAGAR
PT. DEEN DAYAL UPADHAYAY COMMUNITY DEV. CENTRE
IRRIGATION COLONY
LALIT KALA DEPT.
CEMETARY
LALLA PURA
PARK
VARUNA PURAM
SAJAN CHOWK
JALALPUR
LIBERTY SHOWMAN
SAJAN CINEMA
ANCIENT SHIV TEMPLE
CHAKRA TAL
CEMETARY
DR SAMPOORNANAND STADIUM
Sigra Sports Stadium
HOTEL ASHOK
ASHOK NAGAR COLONY
AMAR NAGAR
BUDDHIST TEMPLE
AMAR SHAHEED SANT KANWAR RAM DHAM
ASHOK NAGAR
VACANT LAND
SONIA POKHRA
SONIA ROAD
BHARAT SEVA ASHRAM SANGH
EMPLOYEES UNION
VARANASI NAGAR NIGAM
POLICE BOOTH
OHT
GANDHI NAGAR
PUMP PARK HOUSE
KASTURBA NAGAR
Varanasi Nagar Nigam Park
SHAHEED UDYAN
OFFICER'S MESS
NAGAR NIGAM OFFICE
PURVANCHAL ELECTRIC BHAWAN
ARIHANT COMPLEX
PETROL PUMP
CHANDRIKA COLONY
N
W
E
S
LEGEND :-
BOUNDARY WALL
ROAD
BUILDING
DRAIN
LEVEL
CULVERT
CLIENT: R.J.S. CONSULTANTS CO., LTD
TITLE: TOPOGRAPHICAL AND ROUTE INSPECTION SURVEY FOR PREPARATION OF SURVEY ON GANGA HERITAGE PROJECT - DISTT. I.A.S. VARANASI
SURVEYED BY: SPACE AGE CONSULTANTS
GTS = 74.9891 M TAKEN AT STP DHAGWANPUR, VARANASI
SCALE - 1:500
DRG NO. SAC/ 1925

2. District III (Varanasi)

LIST OF BANCH MARKS ESTABLISHED AT SITE

VARANASI DISTT-III:-
TBM FOR ROUTE SURVEY = TBM 74.743 M TRANSFERED FROM STP BHAGWANPUR, VARANASI (74.969 M).

SL. NO.	BM	EASTING	NORTHING	LEVEL	LOCATION
1	TBM (1)	702792.982	2796625.97	74.743	PLINTH OF TEMPLE RAMNAGAR ROAD SAMNE GHAT TIRAHA
2	TBM (2)	701859.924	2797444.52	75.946	TOP OF HANDPUMP NAGWA CHAURAHA
3	TBM (3)	701757.819	2796831.06	76.437	TOP OF WELL BHAGWANPUR
4	TBM (4)	699811.556	2797716.56	77.46	PLINTH OF TEMPLE SUNDERPUR CHAURAHA.
5	TBM (6)	701700.809	2797630.58	76.365	TOP OF CIRCLE LANKA CHAURAHA
6	TBM (7)	700847.656	2797318.81	78.91	PLINTH OF PUMP HOUSE NARIYA TIRAHA
7	TBM (8)	698880.422	2797808.7	79.74	FOUNDANTION BOARD VISHWANATH PURI COLONY
8	TBM (9)	698582.19	2797811.09	79.9	PLINTH OF TEMPLE NAWADA COLONY
9	TBM (10)	698710.288	2798328.29	81.135	PLINTH OF JUNCTION BOX JANKINAGAR COLONY
10	TBM (11)	698097.04	2796374.43	80.595	TOP OF KM. STONE CHITAIPUR CHAURAHA.


ZONE 2A
DISTRICT II
DISTRICT I
GANGA RIVER
ZONE 3
DISTRICT III
FSA 4
DISTRICT III
FSA 4
DISTRICT III
BHU CAMPUS
(FULLY SEWERED)

LEGEND:-
- ROAD
- BUILDING
- DRAIN
- LEVEL
- CULVERT

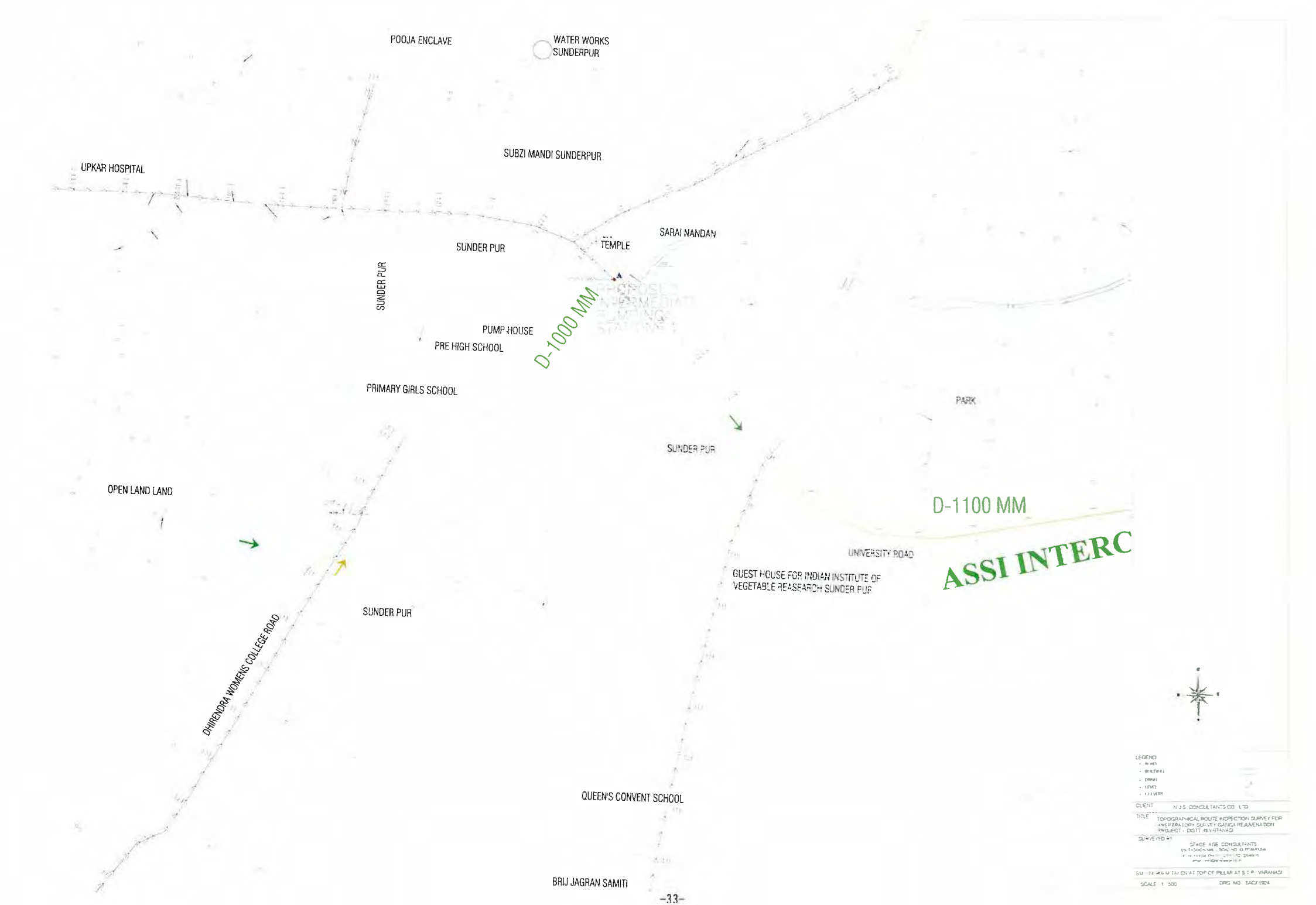
CLIENT: N.J.S. CONSULTANTS CO., LTD

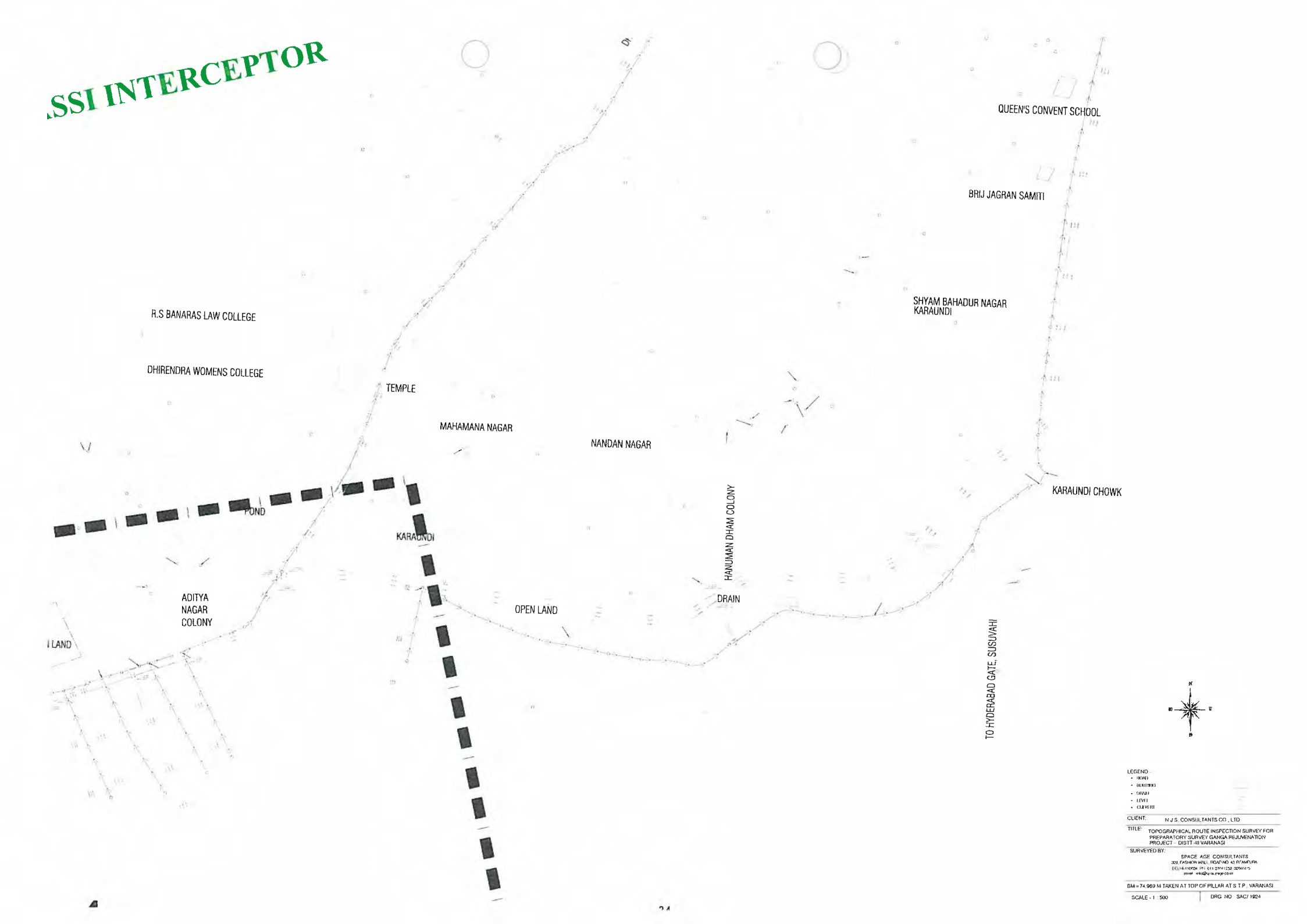
TITLE: TOPOGRAPHICAL ROUTE INSPECTION SURVEY FOR PREPARATORY SURVEY GANGA REJUVENATION PROJECT - DISTT -III VARANASI

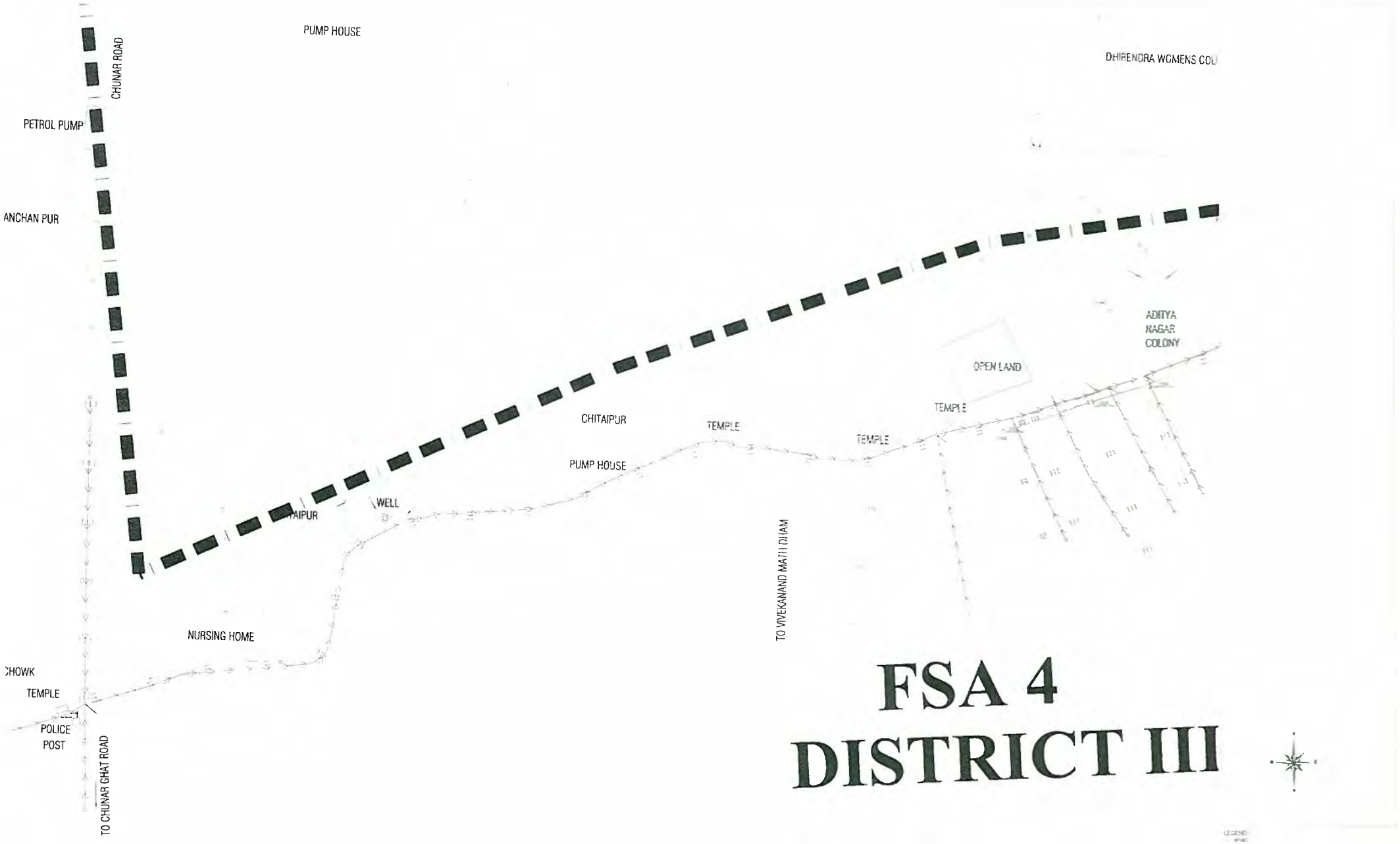
SURVEYED BY: SPACE AGE CONSULTANTS
[illegible]

BM= 74.969 M TAKEN AT TOP OF PILLAR AT S.T.P., VARANASI.

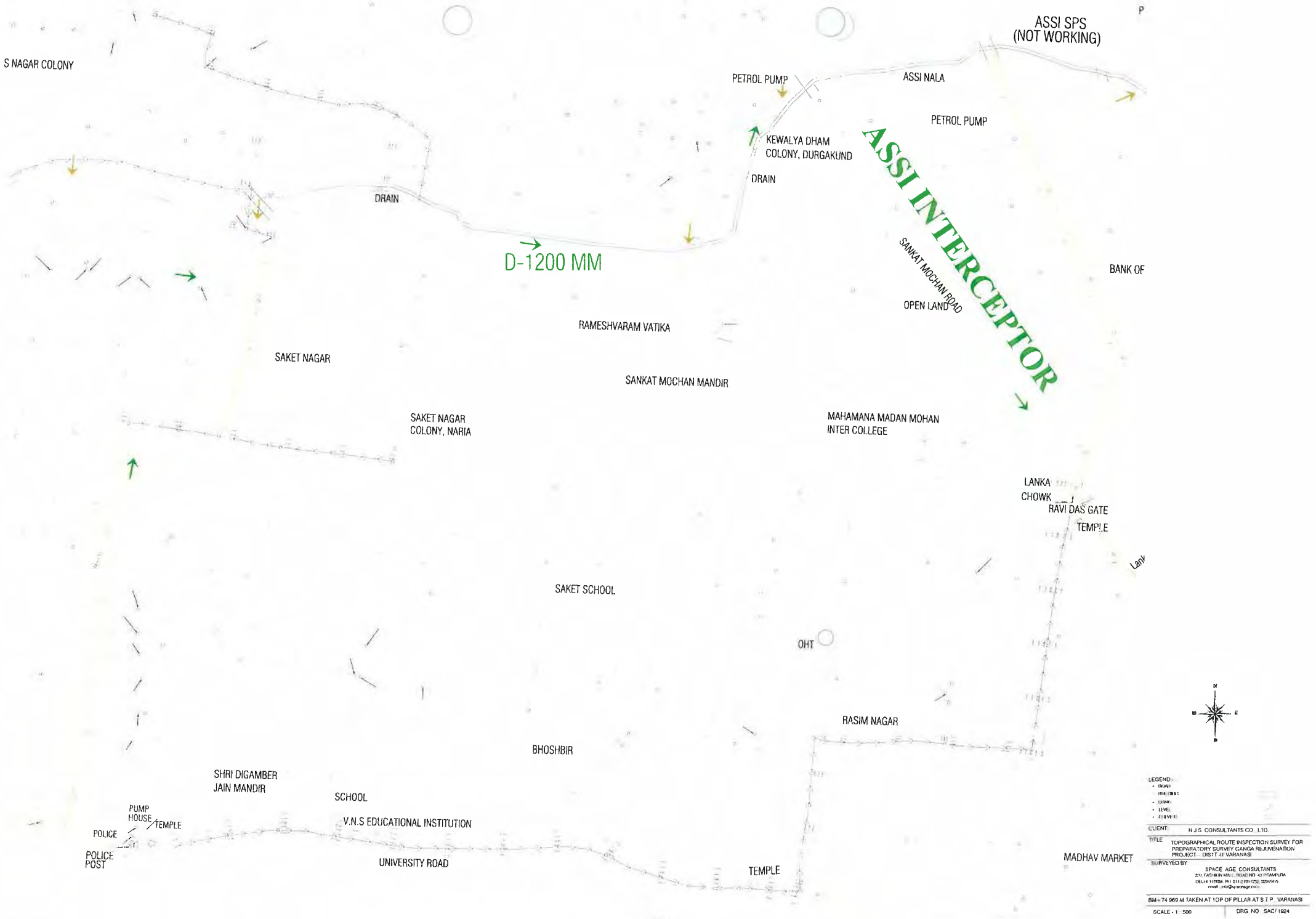
SCALE - 1 : 500 | DRG. NO. : SAC/ 1924

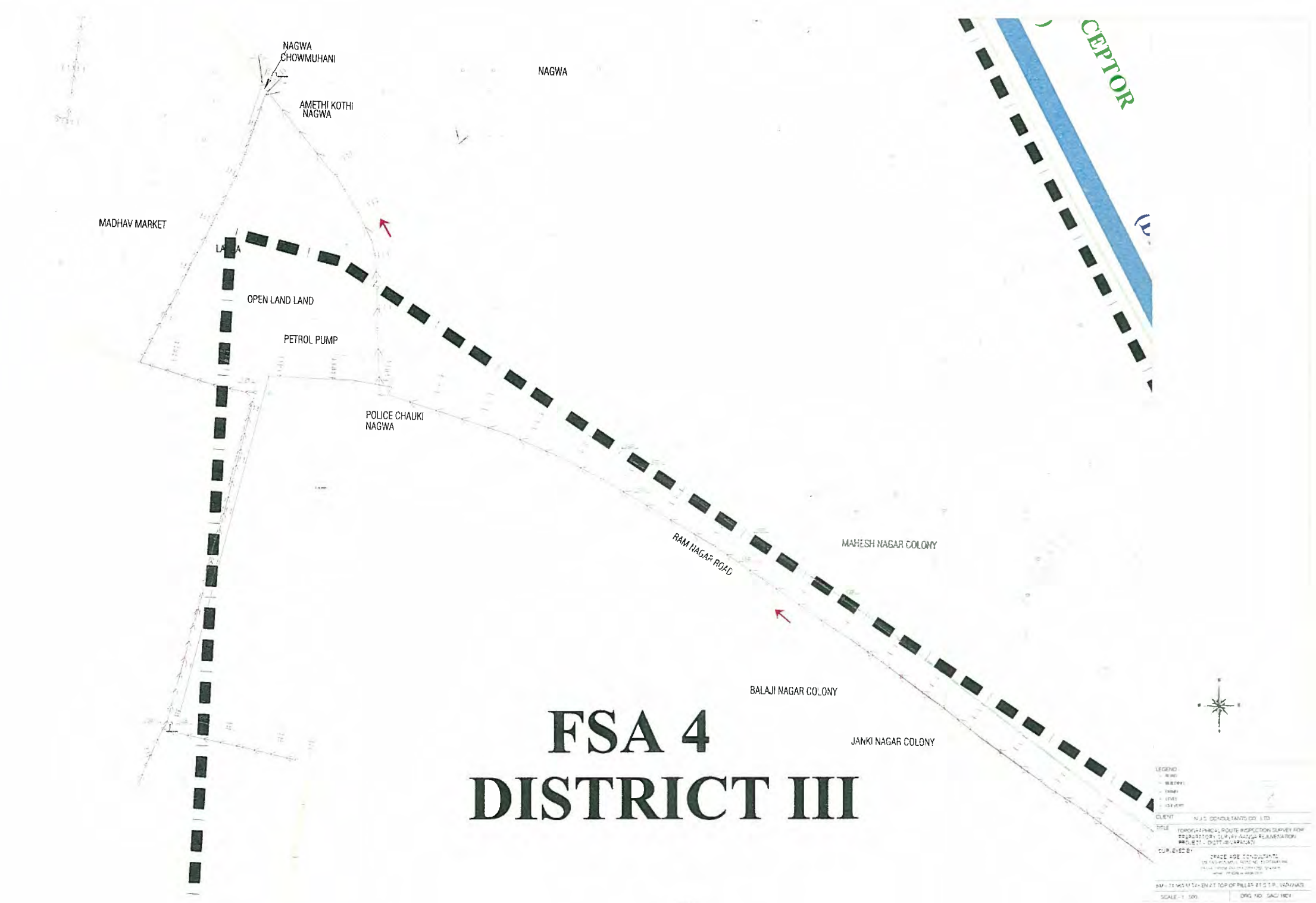

POOJA ENCLAVE
WATER WORKS SUNDERPUR
SUBZI MANDI SUNDERPUR
UPKAR HOSPITAL
SARAI NANDAN
TEMPLE
SUNDER PUR
SUNDER PUR
D-1000 MM
PUMP HOUSE
PRE HIGH SCHOOL
PRIMARY GIRLS SCHOOL
PARK
SUNDER PUR
OPEN LAND LAND
D-1100 MM
UNIVERSITY ROAD
GUEST HOUSE FOR INDIAN INSTITUTE OF VEGETABLE REASEARCH SUNDER PUR
ASSI INTERC
SUNDER PUR
DHIRENDRA WOMENS COLLEGE ROAD
QUEEN'S CONVENT SCHOOL
BRIJ JAGRAN SAMITI
LEGEND
CLIENT N J S CONSULTANTS CO LTD
TITLE TOPOGRAPHICAL ROUTE INSPECTION SURVEY FOR PREPARATORY SURVEY GANGA REJUVENATION PROJECT - DISTT. VARANASI
SURVEYED BY SPACE AGE CONSULTANTS
SCALE 1 500
DRG NO SAC/1804


SSI INTERCEPTOR
QUEEN'S CONVENT SCHOOL
BRIJ JAGRAN SAMITI
SHYAM BAHADUR NAGAR
KARAUNDI
R.S BANARAS LAW COLLEGE
DHIRENDRA WOMENS COLLEGE
TEMPLE
MAHAMANA NAGAR
NANDAN NAGAR
KARAUNDI CHOWK
POND
KARAUNDI
HANUMAN DHAM COLONY
ADITYA
NAGAR
COLONY
OPEN LAND
DRAIN
TO HYDERABAD GATE,, SUSUVAHI
LEGEND :
CLIENT: N.J.S. CONSULTANTS CO., LTD
TITLE: TOPOGRAPHICAL ROUTE INSPECTION SURVEY FOR PREPARATORY SURVEY GANGA REJUVENATION PROJECT - DISTT -III VARANASI
SURVEYED BY: SPACE AGE CONSULTANTS
BM = 74.969 M TAKEN AT TOP OF PILLAR AT S.T.P., VARANASI
SCALE - 1 : 500
DRG. NO : SAC/ 1924

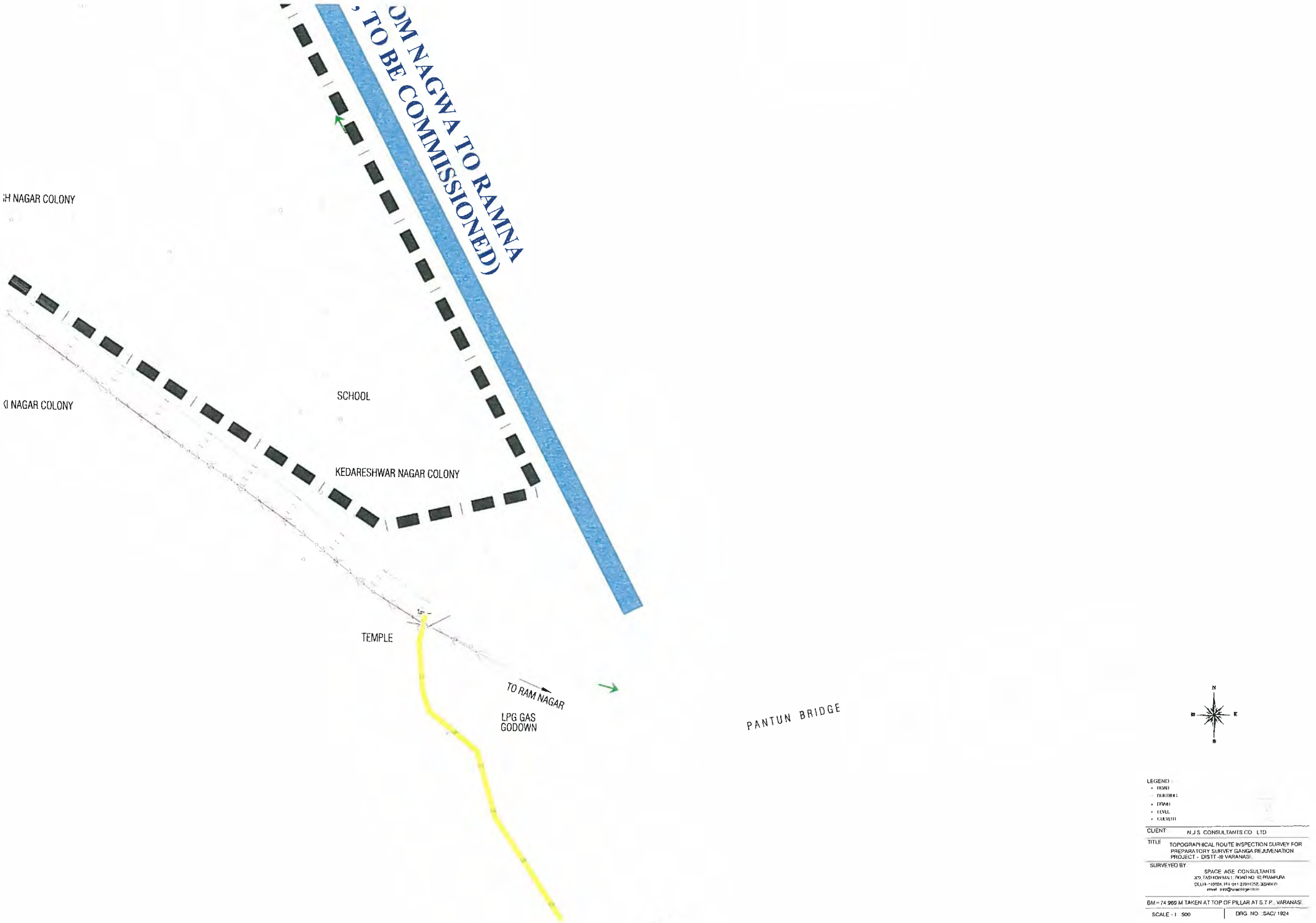


FSA 4
DISTRICT III


ASSI SPS
(NOT WORKING)
S NAGAR COLONY
PETROL PUMP
ASSI NALA
PETROL PUMP
KEWALYA DHAM
COLONY, DURGAKUND
DRAIN
DRAIN
ASSI INTERCEPTOR
D-1200 MM
SANKAT MOCHAN ROAD
OPEN LAND
BANK OF
RAMESHVARAM VATIKA
SAKET NAGAR
SANKAT MOCHAN MANDIR
SAKET NAGAR
COLONY, NARIA
MAHAMANA MADAN MOHAN
INTER COLLEGE
LANKA
CHOWK
RAVI DAS GATE
TEMPLE
SAKET SCHOOL
OHT
RASIM NAGAR
BHOSHBIR
SHRI DIGAMBER
JAIN MANDIR
SCHOOL
PUMP
HOUSE
TEMPLE
POLICE
POLICE
POST
V.N.S EDUCATIONAL INSTITUTION
UNIVERSITY ROAD
TEMPLE
MADHAV MARKET
LEGEND
CLIENT N.J.S. CONSULTANTS CO. LTD.
TITLE TOPOGRAPHICAL ROUTE INSPECTION SURVEY FOR PREPARATORY SURVEY GANGA REJUVENATION PROJECT – DIST.-III VARANASI
SURVEYED BY SPACE AGE CONSULTANTS
BM=74.969 M TAKEN AT TOP OF PILLAR AT S.T.P. VARANASI
SCALE - 1 : 500
DRG. NO. SAC/ 1924



FSA 4
DISTRICT III


OM NAGWA TO RAMNA
TO BE COMMISSIONED)
H NAGAR COLONY
I NAGAR COLONY
SCHOOL
KEDARESHWAR NAGAR COLONY
TEMPLE
TO RAM NAGAR
LPG GAS
GODOWN
PANTUN BRIDGE
N
W
E
S
LEGEND :
- ROAD
- BUILDINGS
- DRAIN
- LEVEL
- CURVETI
CLIENT N.J.S. CONSULTANTS CO. LTD
TITLE TOPOGRAPHICAL ROUTE INSPECTION SURVEY FOR PREPARATORY SURVEY GANGA REJUVENATION PROJECT - DISTT -III VARANASI.
SURVEYED BY SPACE AGE CONSULTANTS
BM = 74.969 M TAKEN AT TOP OF PILLAR AT S.T.P., VARANASI.
SCALE - 1 : 500
DRG. NO. :SAC/ 1924

3. Ramna STP (Varanasi)

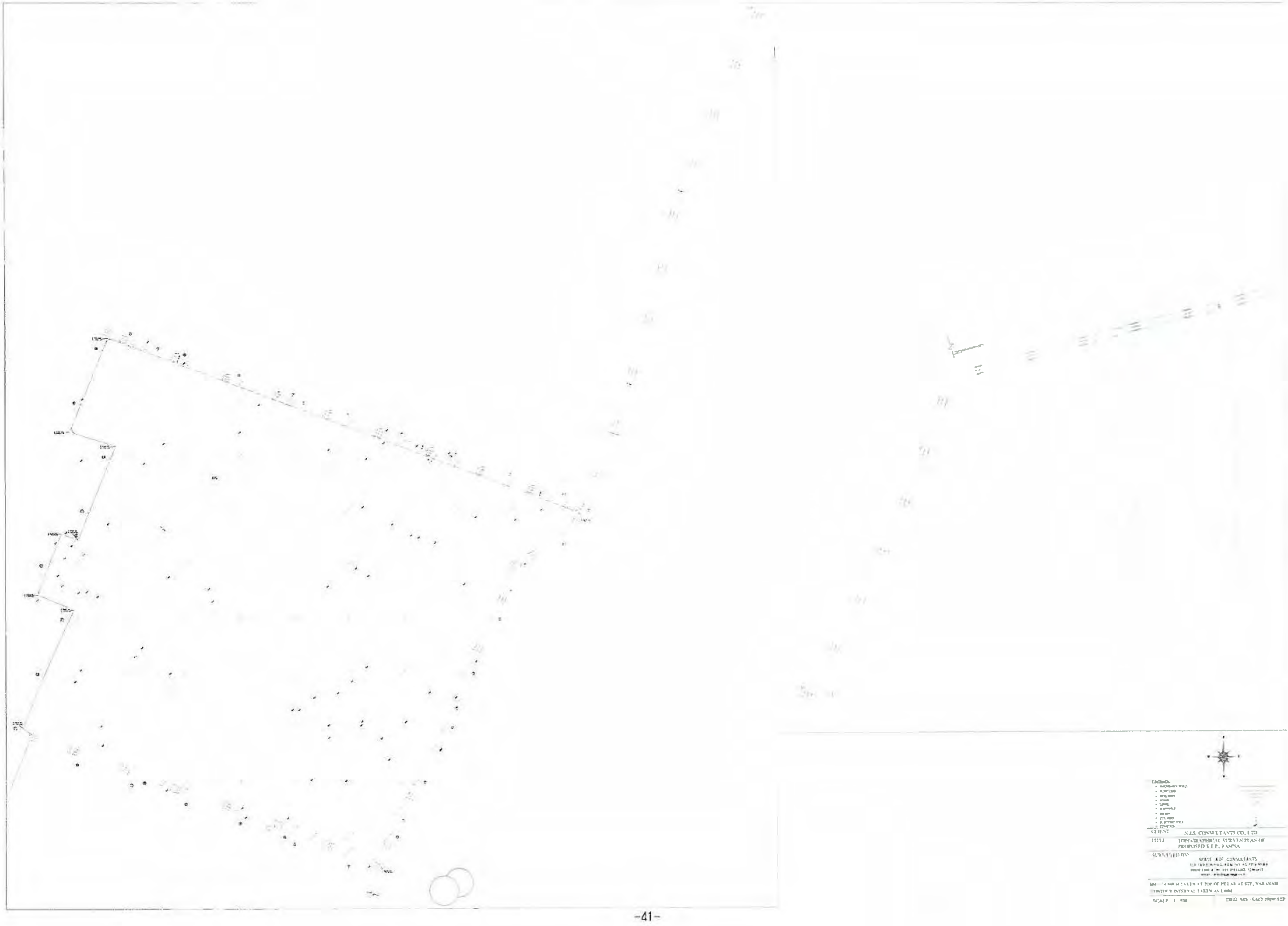
LIST OF BANCH MARKS ESTABLISHED AT SITE

RAMNA:-

TBM AT STP = TBM 73.879 M TRANSFERED FROM STP BHAGWANPUR, VARANASI (74.969 M).

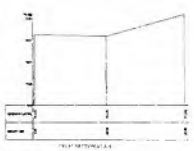
TBM FOR ROUTE SURVEY = TBM 73.879 M TRANSFERED FROM STP BHAGWANPUR, VARANASI (74.969 M).

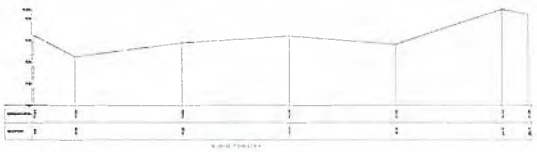
SL. NO.	BM	EASTING	NORTHING	LEVEL	LOCATION
1	TBM (1)	701560.227	2793497.41	73.879	PLINTH OF PUMP HOUSE RAMNA STP
2	TBM (A)	703600.48	2794631.96	75.334	PLINTH OF POLICE BOOTH GADHWA GHAT.

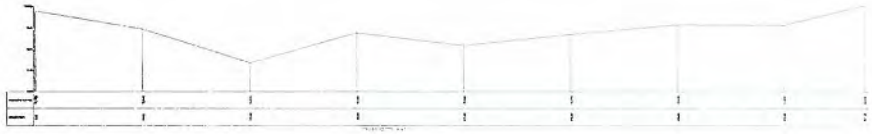

CLIENT
TITLE
SURVEYED BY
SCALE

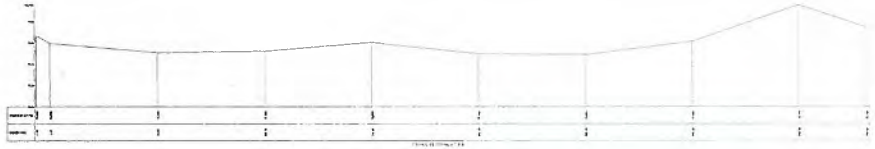
LEGEND
- BOUNDARY WALL
- PLOT LINE
- BUILDINGS
- ROAD
- LEVEL
- MANHOLE
- DRAIN
- CULVERT
- ELECTRIC POLE
- CONTOUR

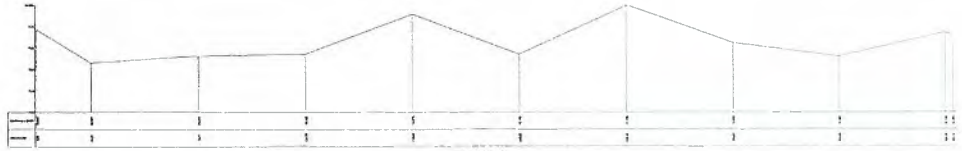
CLIENT:	N.J.S. CONSULTANTS CO., LTD.
TITLE:	TOPOGRAPHICAL SURVEY PLAN OF PROPOSED S.T.P., RAMNA
SURVEYED BY:	SPACE AGE CONSULTANTS 323, FASHION MALL, ROAD NO. 43, PITAMPURA DELHI-110034, PH. 011-27011252, 32944415 email : info@spaceage.co.in
BM = 74.964 M TAKEN AT TOP OF PILLAR AT STP, VARANASI CONTOUR INTERVAL TAKEN AS 1.00M	
SCALE - 1 : 500	DRG. NO. :SAC/ 1919/ STP

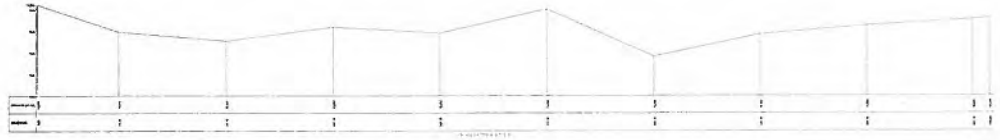


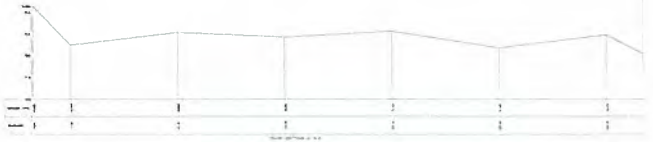


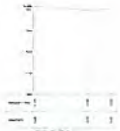


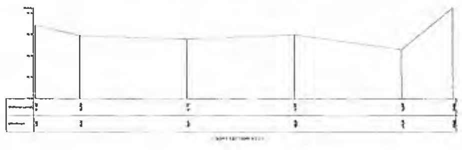


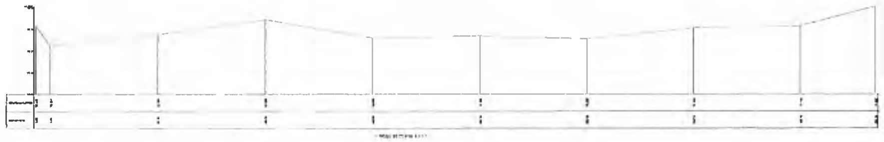


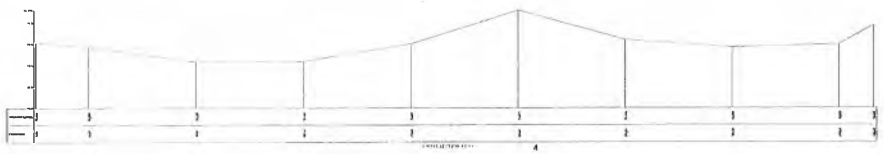


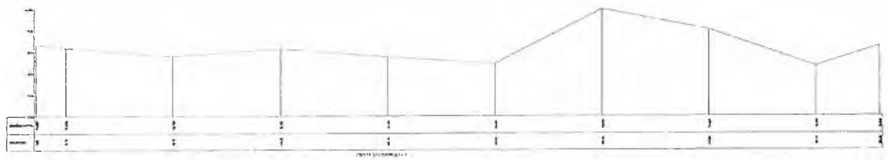


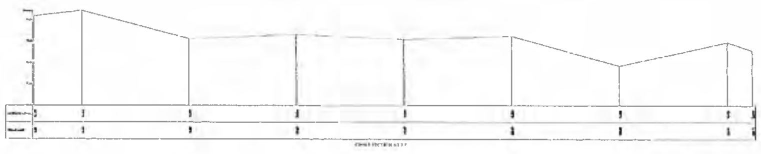


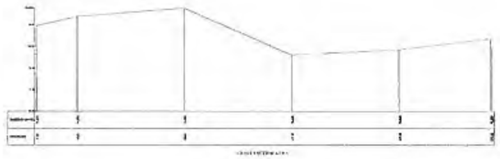


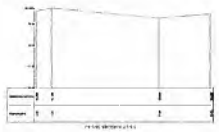


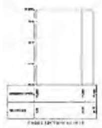












CLIENT: NJS CONSULTANTS CO. LTD

TITLE: TOPOGRAPHICAL SURVEY PLAN OF PROPOSED STP, RAMNA

SURVEYED BY: SPACE AGE CONSULTANTS

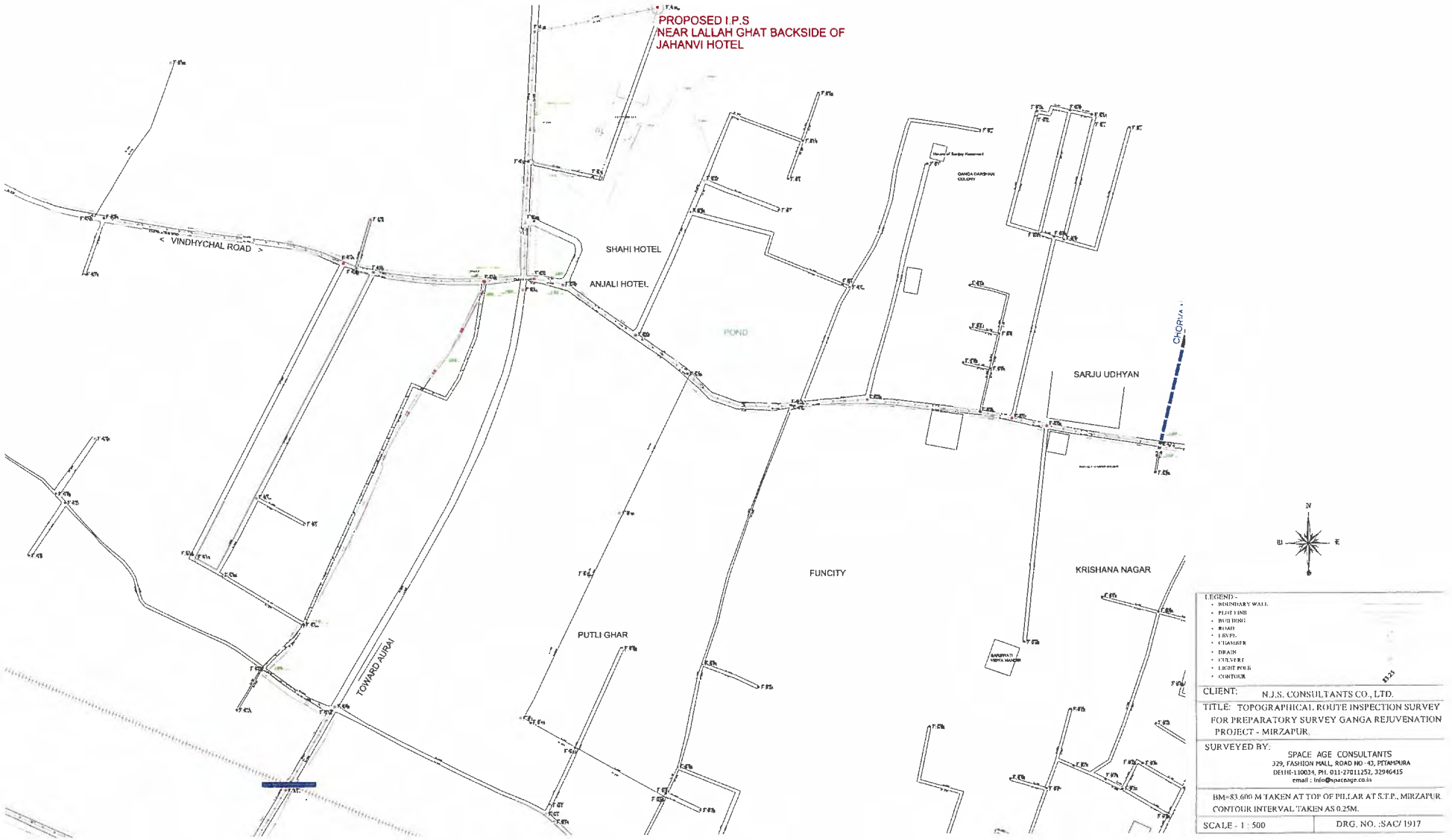
SCALE 1:100

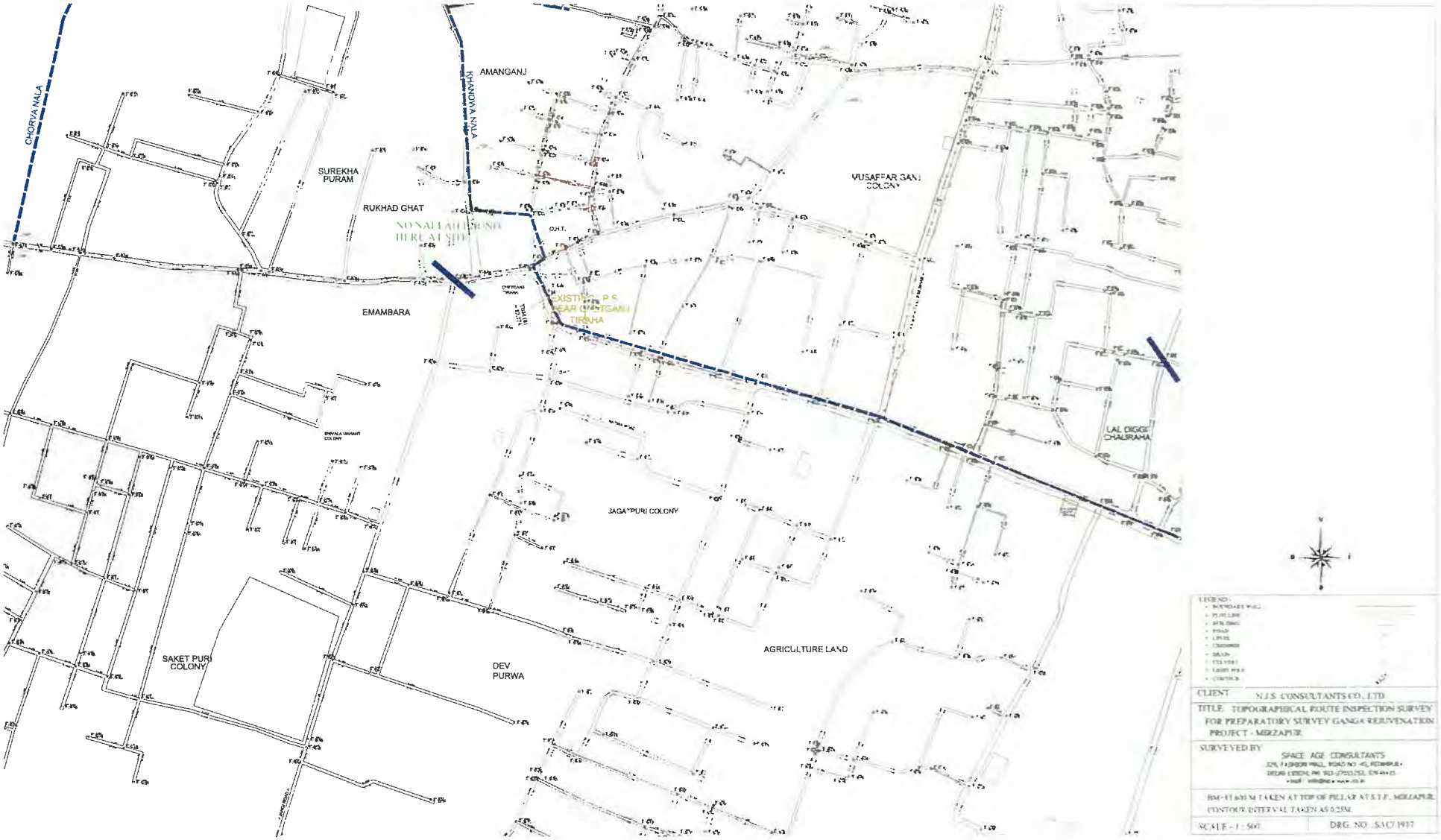
4. Mirzapur

LIST OF BANCH MARKS ESTABLISHED AT SITE

MIRZAPUR:-
TBM AT STP = 83.600 M
TBM FOR ROUTE SURVEY = 83.600 M

SL. NO.	BM	EASTING	NORTHING	LEVEL	LOCATION
1	TBM (1)	659893.445	2782596.38	83.557	TOP OF WEST WATER DRAIN CULVERT VESHNAMPURAM COLONY
2	TBM (2)	660017.668	2783034.35	83.620	TOP OF CULVERT GHURAHU GHURAHU PATTI CHAURAHA
3	TBM (3)	660439.826	2783102.2	82.940	TOP OF CULVERT JOGIYA WARI ROAD.
4	TBM (4)	659860.922	2783345.62	80.008	TOP OF WEST WATER DRAIN CULVERT NEAR NAGARPALIKA STORE.
5	TBM (5)	659821.294	2782009.98	83.147	PLINTH OF TEMPLE BRAHMPURI COLONY.
6	TBM (6)	659404.286	2782210.63	83.746	FOUNDATION OF TRANSFORMER PARRADE GROUND.
7	TBM (7)	659389.209	2781697.77	83.697	PLINTH OF TEMPLE TEHSEEL CHOWK.
8	TBM (8)	659637.806	2780723.69	84.723	TOP OF CIRCLE STATION ROAD.
9	TBM (9)	655676.17	2782585.08	86.295	TOP OF SHASTRI BRIDGE.
10	TBM (10)	655615.223	2782422.72	81.085	PLINTH OF TEMPLE VINDHYCHAL ROAD LALLA GHAT.
11	TBM (11)	660072.909	2783470.92	83.595	TOP OF CULVERT MORCHAGHAR COLONY.
12	TBM (12)	660660.826	2784167.19	84.500	TOP OF WATER LINE CHAMBER NEAR BAN SAGAR COLONY
13	TBM (13)	661156.114	2785079	83.575	TOP OF KM. STONE NEAR SAI BABA LANE
14	TBM (14)	661534.121	2785970.24	83.025	PLINTH OF BOUNDARY WALL GATE NURSERY FORM
15	TBM (15)	658231.045	2781219.96	84.395	TOP OF WELL PURANI DASHMI COLONY.
16	TBM (16)	658613.43	2780836.84	84.535	PLINTH OF POLICE BOOTH ROADWASE TIRAHA.
17	TBM (17)	659306.22	2781412.05	84.115	PLINTH OF TEMPLE SHUKLAHA KACHEHRI ROAD.
18	TBM (A)	655369.886	2781796.26	81.496	PLINTH OF TEMPLE NATBA TIRAHA.
19	TBM (B)	657251.218	2781300.77	84.375	PLINTH OF TEMPLE SABRI CHUNGI CHAURAHA.
20	TBM (C)	654999.163	2781952.2	80.013	TOP OF CULVERT NEAR BADI BASAI COLONY.
21	TBM (D)	656539.325	2781585.84	85.33	FOUNDATION OF LIGHT POLE NATBIR CHAURAHA.


PROPOSED I.P.S
NEAR LALLAH GHAT BACKSIDE OF
JAHANVI HOTEL
< VINDHYCHAL ROAD >
SHAHI HOTEL
ANJALI HOTEL
POND
SARJU UDHYAN
CHORIA
FUNCITY
KRISHANA NAGAR
PUTLI GHAR
TOWARD AURAI
N
W
E
S
LEGEND -
BOUNDARY WALL
PLOT LINE
BUILDING
ROAD
LEVEL
CHAMBER
DRAIN
CULVERT
LIGHT POLE
CONTOUR
CLIENT: N.J.S. CONSULTANTS CO., LTD.
TITLE: TOPOGRAPHICAL ROUTE INSPECTION SURVEY FOR PREPARATORY SURVEY GANGA REJUVENATION PROJECT - MIRZAPUR.
SURVEYED BY:
SPACE AGE CONSULTANTS
329, FASHION MALL, ROAD NO -43, PITAMPURA
DELHI-110034, PH. 011-27011252, 32946415
email : info@spaceage.co.in
BM=83.600 M TAKEN AT TOP OF PILLAR AT S.T.P., MIRZAPUR
CONTOUR INTERVAL TAKEN AS 0.25M.
SCALE - 1 : 500
DRG. NO. :SAC/ 1917


CHORVA NALA
KHANOVA NALA
AMANGANJ
SUREKHA PURAM
RUKHAD GHAT
NO NALLAH BUND HERE AT SITE
O.H.T.
EXISTING P.S. NEAR AMANGANJ TIRAHA
MUSAFFAR GANJ COLONY
EMAMBARA
LAL DIGGI CHAURAHA
JAGATPURI COLONY
AGRICULTURE LAND
SAKET PURI COLONY
DEV PURWA
N
W
E
S
CLIENT : N.J.S. CONSULTANTS CO., LTD.
TITLE : TOPOGRAPHICAL ROUTE INSPECTION SURVEY FOR PREPARATORY SURVEY GANGA REJUVENATION PROJECT - MIRZAPUR.
SURVEYED BY : SPACE AGE CONSULTANTS
BM=81.600 M TAKEN AT TOP OF PILLAR AT S.T.P., MIRZAPUR.
CONTOUR INTERVAL TAKEN AS 0.25M.
SCALE - 1 : 500
DRG. NO. : S.A.C/1937

LEGEND:-
- BOUNDARY WALL
- PLOT LINE
- BUILDING
- ROAD
- LEVEL
- CHAMBER
- DRAIN
- CULVERT
- LIGHT POLE
- CONTOUR

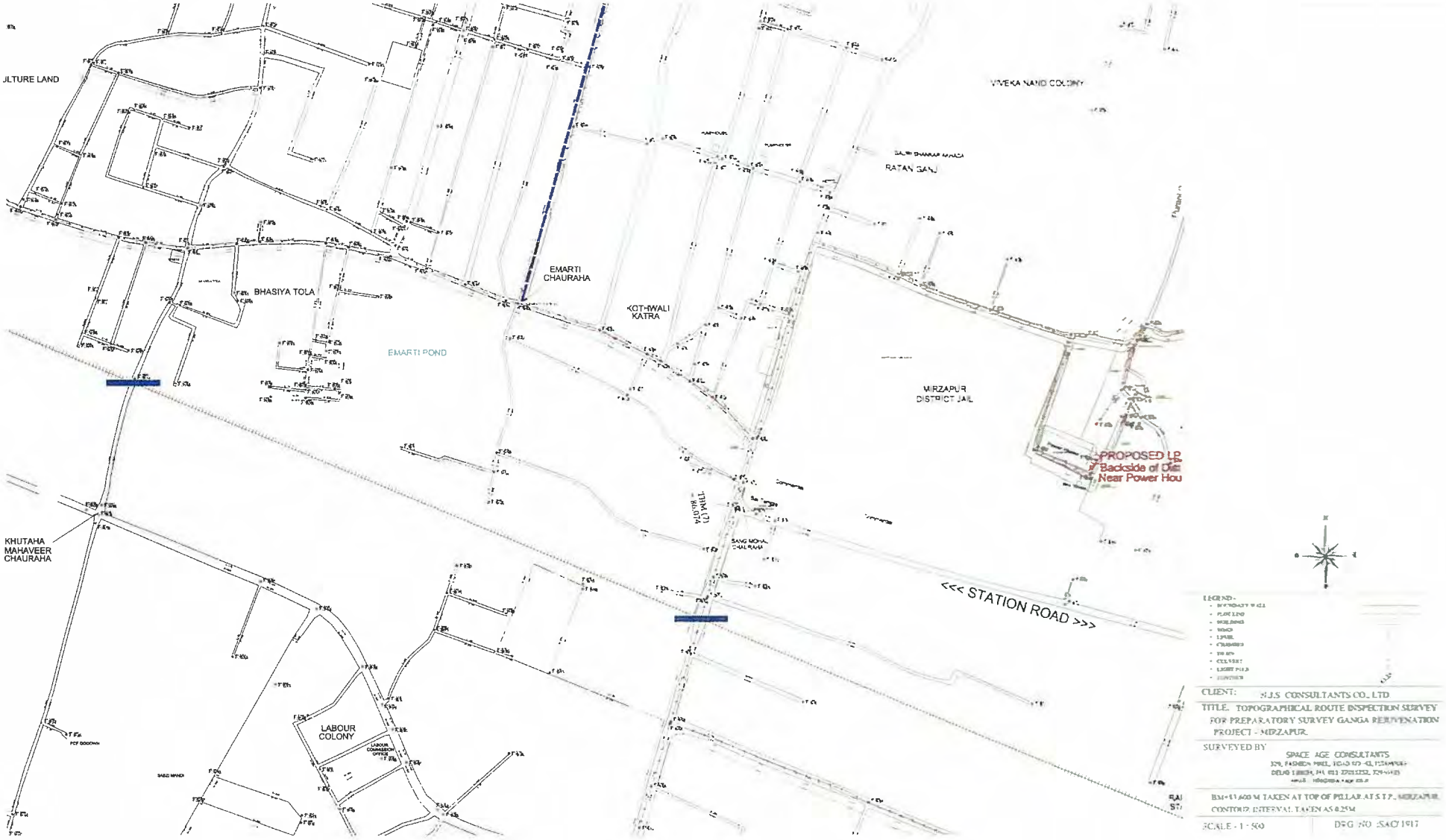
CLIENT: N.J.S. CONSULTANTS CO., LTD.

TITLE: TOPOGRAPHICAL ROUTE INSPECTION SURVEY FOR PREPARATORY SURVEY GANGA REJUVENATION PROJECT - MIRZAPUR.

SURVEYED BY:
SPACE AGE CONSULTANTS
329, FASHION MALL, ROAD NO -43, PITAMPURA
DELHI-110034, PH. 011-27011252, 32946415
email : info@spaceage.co.in

BM=83.600 M TAKEN AT TOP OF PILLAR AT S.T.P., MIRZAPUR.
CONTOUR INTERVAL TAKEN AS 0.25M.

SCALE - 1 : 500 | DRG. NO. :SAC/ 1917


JLTURE LAND
VIVEKA NAND COLONY
RATAN GANJ
EMARTI CHAURAHA
BHASIYA TOLA
KOTHWALI KATRA
EMARTI POND
MIRZAPUR DISTRICT JAIL
PROPOSED LP
Backside of DM
Near Power Hou
KHUTAHA MAHAVEER CHAURAHA
<<< STATION ROAD >>>
LABOUR COLONY
LEGEND -
CLIENT: N.J.S. CONSULTANTS CO., LTD.
TITLE: TOPOGRAPHICAL ROUTE INSPECTION SURVEY FOR PREPARATORY SURVEY GANGA REJUVENATION PROJECT - MIRZAPUR.
SURVEYED BY
SPACE AGE CONSULTANTS
BM=81.600 M TAKEN AT TOP OF PILLAR AT S.T.P., MIRZAPUR.
CONTOUR INTERVAL TAKEN AS 0.25M
SCALE - 1 : 500
DEG NO :SAC/1917

LEGEND:-

- BOUNDARY WALL
- PLOT LINE
- BUILDING
- ROAD
- LEVEL
- CHAMBER
- DRAIN
- CULVERT
- LIGHT POLE
- CONTOUR

CLIENT: N.J.S. CONSULTANTS CO., LTD

TITLE: TOPOGRAPHICAL ROUTE INSPECTION SURVEY FOR PREPARATORY SURVEY GANGA REJUVENATION PROJECT - MIRZAPUR.

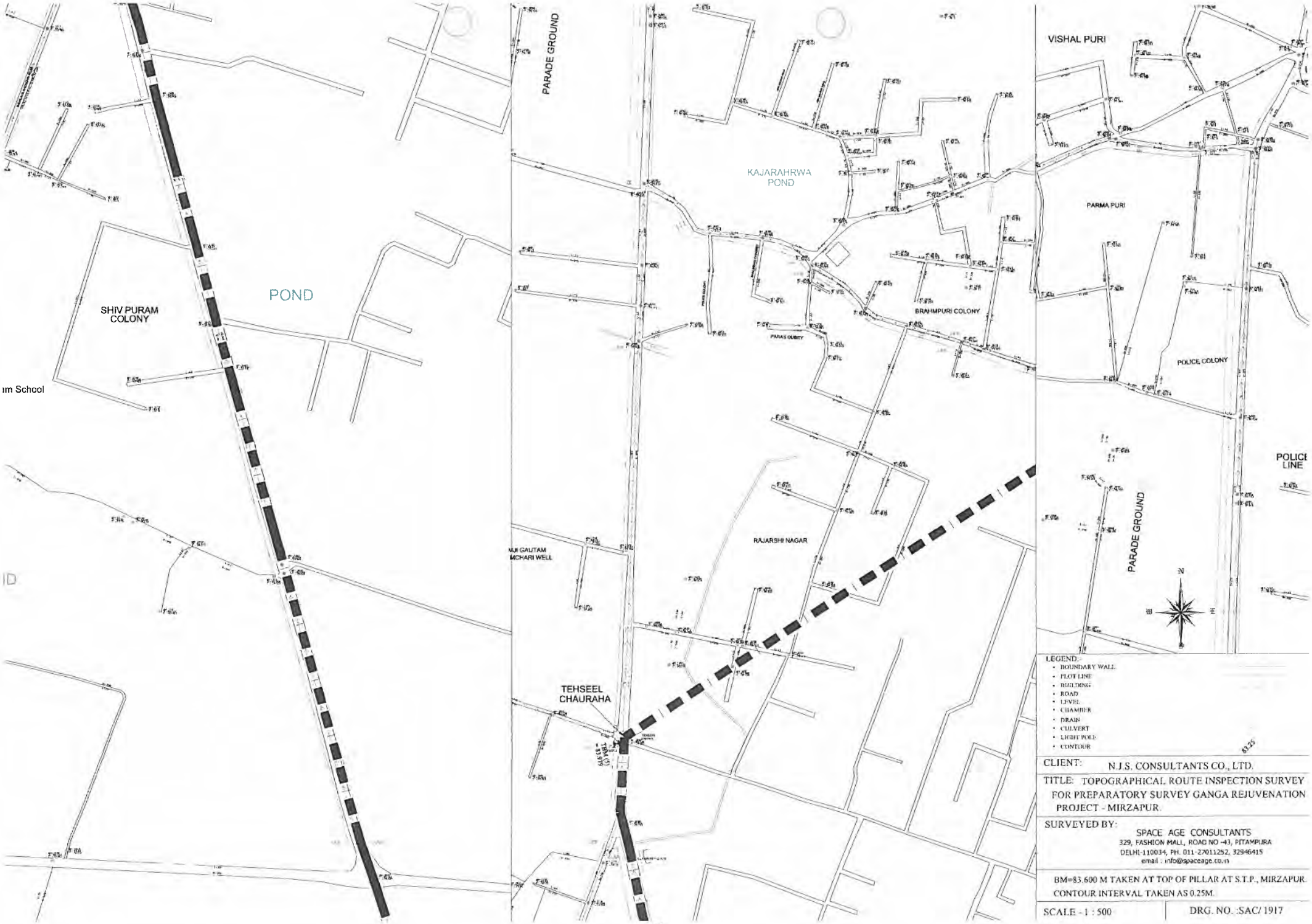
SURVEYED BY:

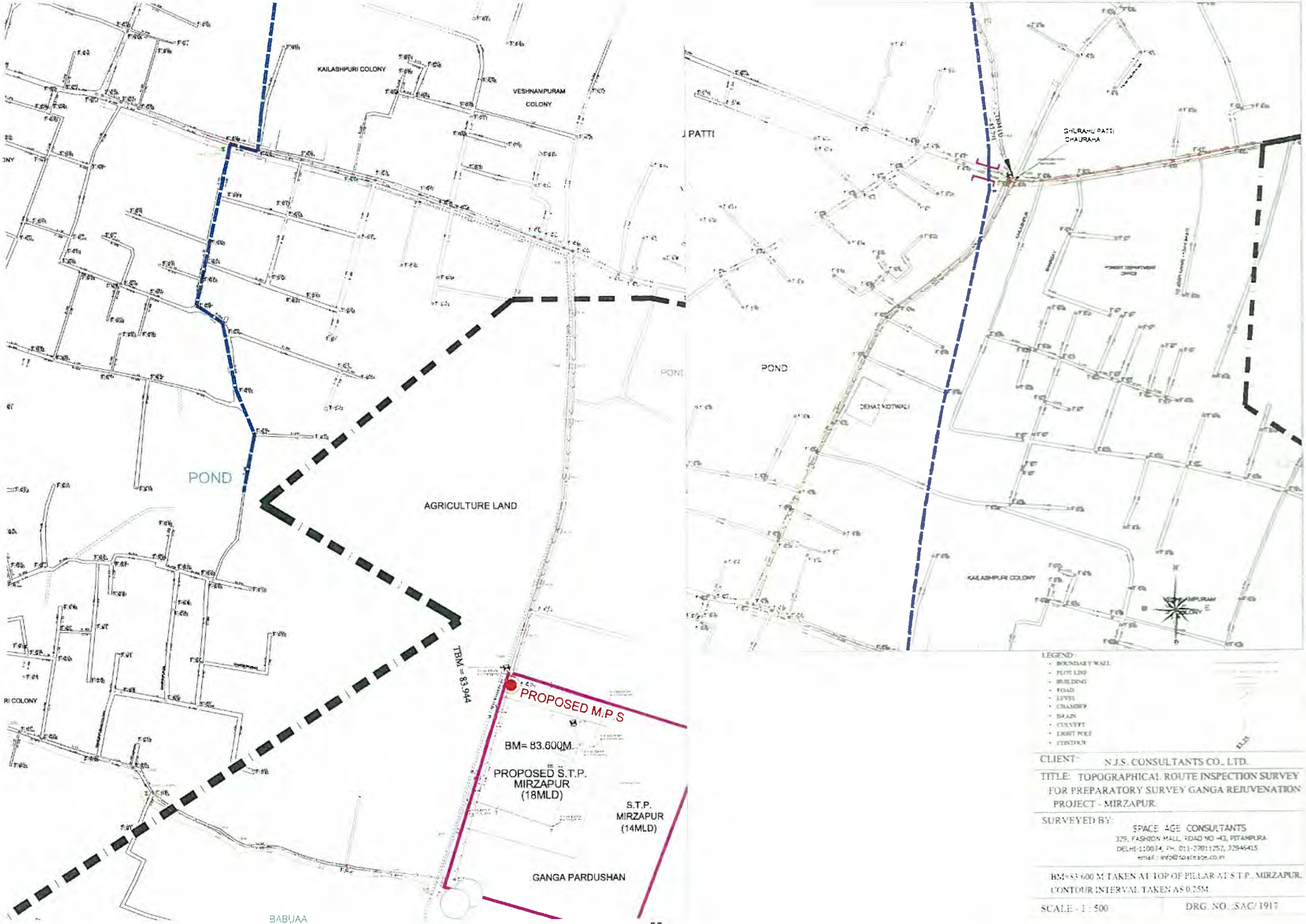
SPACE AGE CONSULTANTS
329, FASHION MALL, ROAD NO -43, PITAMPURA
DELHI 110034, PH. 011-27011252, 3296415
email : info@spaceage.co.in

BM=83.600 M TAKEN AT TOP OF PILLAR AT S.T.P., MIRZAPUR.
CONTOUR INTERVAL TAKEN AS 0.25M.

SCALE - 1 : 500 | DRG. NO. :SAC/ 1917


AGRICULTURE
LAND
SEVA YOJAN OFFICE
VISHNUPURAM COLONY
Purani Dashmi Road
PANCHO DEVI GALI
PATEL COLONY
J.P. PURAM COLONY
J.P. PURAM COLONY
PURANI
DASHMI COLONY
House of Rambak
Purani Dashmi Road
Pandit Gopi Ram School
POND
POND
POSED L.P.S
cside of District Jail
Power House
Shivpuri Colony
CHUNAR BUS STAND
CLIENT N.J.S. CONSULTANTS CO., LTD
TITLE: TOPOGRAPHICAL ROUTE INSPECTION SURVEY
FOR PREPARATORY SURVEY GANGA REJUVENATION
PROJECT - MIRZAPUR.
SURVEYED BY.
SPACE AGE CONSULTANTS
SCALE - 1 : 500
DRG NO SAC/1917


PARADE GROUND
VISHAL PURI
KAJARAHRWA
POND
PARMA PURI
SHIV PURAM
COLONY
POND
BRAHMPURI COLONY
POLICE COLONY
POLICE
LINE
RAJARSHI NAGAR
PARADE GROUND
TEHSEEL
CHAURAHA
N
LEGEND:-
BOUNDARY WALL
PLOT LINE
BUILDING
ROAD
LEVEL
CHAMBER
DRAIN
CULVERT
LIGHT POLE
CONTOUR
CLIENT: N.J.S. CONSULTANTS CO., LTD.
TITLE: TOPOGRAPHICAL ROUTE INSPECTION SURVEY FOR PREPARATORY SURVEY GANGA REJUVENATION PROJECT - MIRZAPUR.
SURVEYED BY:
SPACE AGE CONSULTANTS
329, FASHION MALL, ROAD NO -43, PITAMPURA
DELHI-110034, PH. 011-27011252, 32946415
email : info@spaceage.co.in
BM=83.600 M TAKEN AT TOP OF PILLAR AT S.T.P., MIRZAPUR.
CONTOUR INTERVAL TAKEN AS 0.25M.
SCALE - 1 : 500
DRG. NO. :SAC/ 1917



CLIENT: N.J.S. CONSULTANTS CO., LTD.

TITLE: TOPOGRAPHICAL ROUTE INSPECTION SURVEY FOR PREPARATORY SURVEY GANGA REJUVENATION PROJECT - MIRZAPUR.

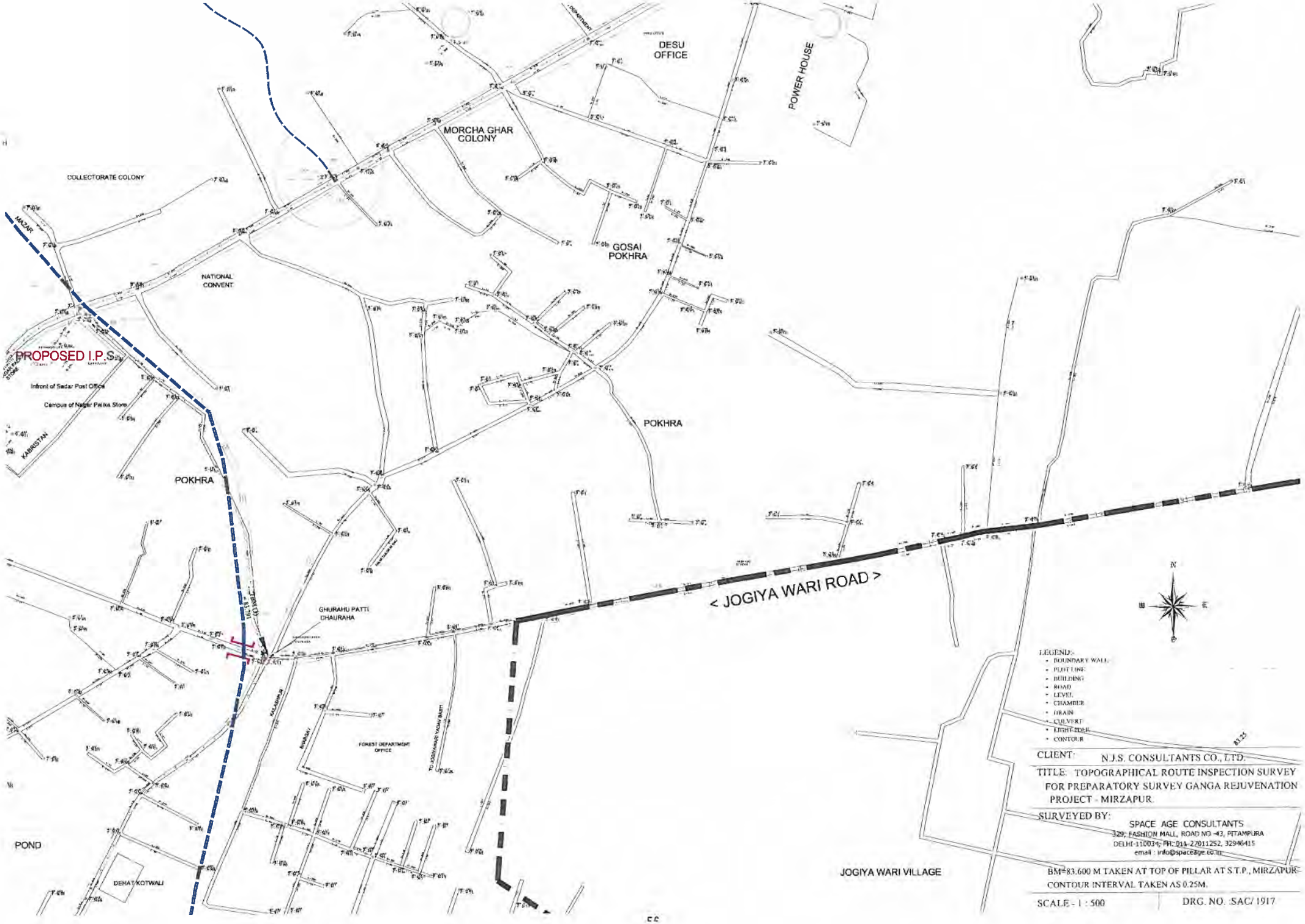
SURVEYED BY:

SPACE AGE CONSULTANTS
329, FASHION MALL, ROAD NO -43, PITAMPURA
DELHI-110034, PH. 011-27011252, 32546415
email : info@spaceage.co.in

BM=83.600 M TAKEN AT TOP OF PILLAR AT S.T.P., MIRZAPUR.
CONTOUR INTERVAL TAKEN AS 0.25M.

SCALE - 1 : 500

DRG. NO. :SAC/1917


DESU OFFICE
POWER HOUSE
MORCHA GHAR COLONY
COLLECTORATE COLONY
MAZAR
NATIONAL CONVENT
GOSAI POKHRA
POKHRA
PROPOSED I.P.S.
Infront of Sadar Post Office
Campus of Nagar Palika Store
KABRISTAN
POKHRA
< JOGIYA WARI ROAD >
GHURAHU PATTI CHAURAHA
FOREST DEPARTMENT OFFICE
TO JOGIYAWARI YOJNA BASTI
POND
DEHAT KOTWALI
JOGIYA WARI VILLAGE
N
W
E
S
LEGEND:-
• BOUNDARY WALL
• PLOT LINE
• BUILDING
• ROAD
• LEVEL
• CHAMBER
• DRAIN
• CULVERT
• LIGHT POLE
• CONTOUR
CLIENT: N.J.S. CONSULTANTS CO., LTD.
TITLE: TOPOGRAPHICAL ROUTE INSPECTION SURVEY FOR PREPARATORY SURVEY GANGA REJUVENATION PROJECT - MIRZAPUR.
SURVEYED BY:
SPACE AGE CONSULTANTS
329, FASHION MALL, ROAD NO -43, PITAMPURA
DELHI-110034, PH: 011-27011252, 32946415
email : info@spaceage.co.in
BM=83.600 M TAKEN AT TOP OF PILLAR AT S.T.P., MIRZAPUR.
CONTOUR INTERVAL TAKEN AS 0.25M.
SCALE - 1 : 500
DRG. NO. :SAC/ 1917

CLIENT: N.J.S. CONSULTANTS CO., LTD.

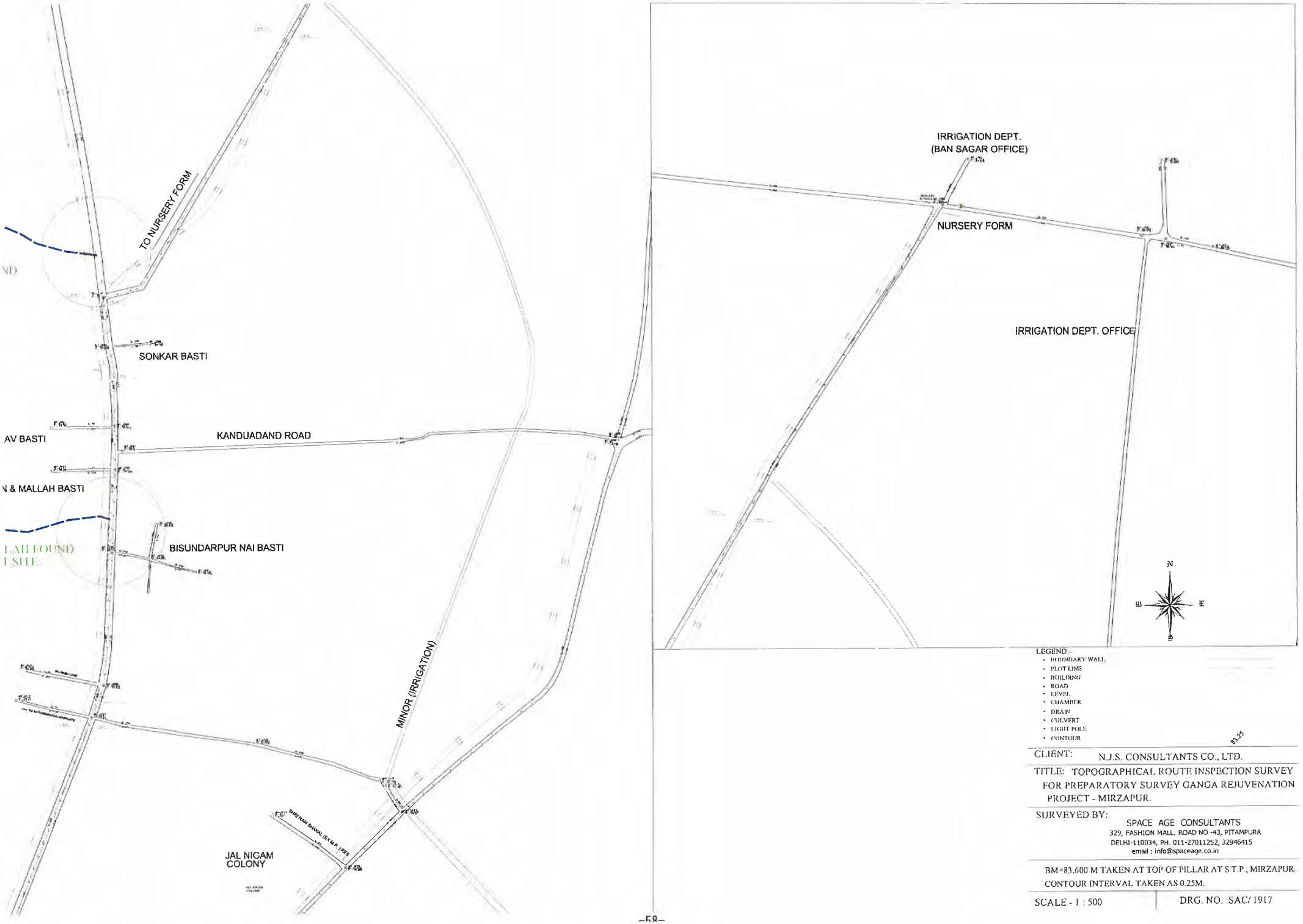
TITLE: TOPOGRAPHICAL ROUTE INSPECTION SURVEY FOR PREPARATORY SURVEY GANGA REJUVENATION PROJECT - MIRZAPUR.

SURVEYED BY:

SPACE AGE CONSULTANTS
329, FASHION MALL, ROAD NO. 45, PITAMPURA
DELHI-110034, PH. 011-27011352, 32966415
email : info@spaceage.co.in

BM=93.600 M. TAKEN AT TOP OF PILLAR AT S.T.P., MIRZAPUR.
CONTOUR INTERVAL TAKEN AS 0.25M.

SCALE - 1 : 500 DRG. NO. :SAC/1917



LEGEND :-

- BOUNDARY WALL
- PLOT LINE
- BUILDING
- ROAD
- LEVEL
- CHAMBER
- DRAIN
- CULVERT
- LIGHT POLE
- CONTOUR

CLIENT: N.J.S. CONSULTANTS CO., LTD.

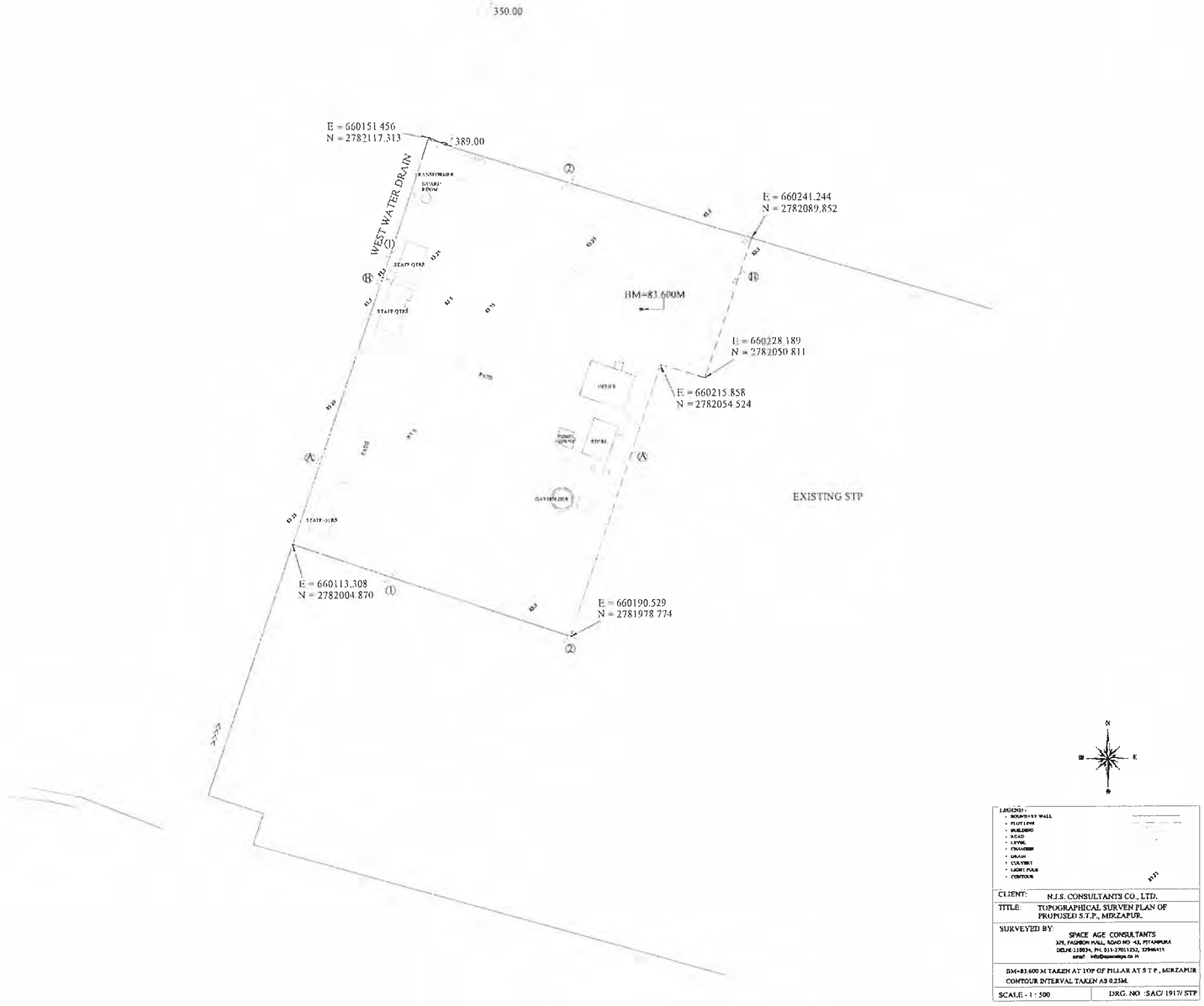
TITLE: TOPOGRAPHICAL ROUTE INSPECTION SURVEY FOR PREPARATORY SURVEY GANGA REJUVENATION PROJECT - MIRZAPUR.

SURVEYED BY:

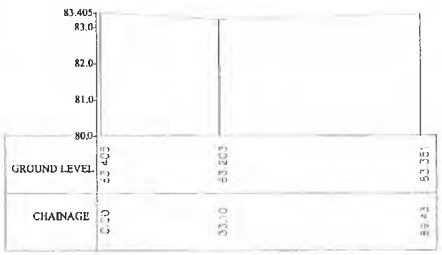
SPACE AGE CONSULTANTS
329, FASHION MALL, ROAD NO -43, PITAMPURA
DELHI-110034, PH. 011-27011252, 32946415
email : info@spaceage.co.in

BM=83.600 M TAKEN AT TOP OF PILLAR AT S.T.P., MIRZAPUR.
CONTOUR INTERVAL TAKEN AS 0.25M.

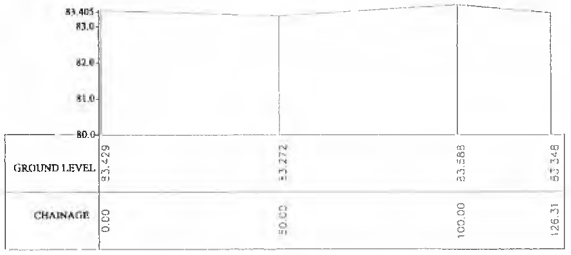
SCALE - 1 : 500 | DRG. NO. :SAC/ 1917


350.00
389.00
E = 660151.456
N = 2782117.313
E = 660241.244
N = 2782089.852
WEST WATER DRAIN
BM=83.600M
E = 660228.189
N = 2782050.811
E = 660215.858
N = 2782054.524
EXISTING STP
E = 660113.308
N = 2782004.870
E = 660190.529
N = 2781978.774
N
E
CLIENT: N.I.S. CONSULTANTS CO., LTD.
TITLE: TOPOGRAPHICAL SURVEN PLAN OF PROPOSED S.T.P., MIRZAPUR.
SURVEYED BY: SPACE AGE CONSULTANTS
BM=83.600 M TAKEN AT TOP OF PILLAR AT S T P , MIRZAPUR
CONTOUR INTERVAL TAKEN AS 0.25M.
SCALE - 1 : 500
DRG. NO :SAC/ 1917/ STP

WEST WATER DRAIN
350.00
300.00
250.00
200.00
150.00
100.00
50.00
E = 660241.244
N = 2782089.852
CLIENT:
TITLE:
SURVEYED BY:
SPACE AGE CONSULTANTS
SCALE - 1 : 500

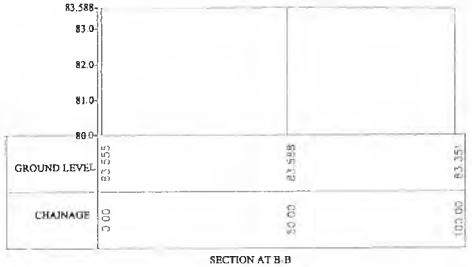


SECTION AT 1-1
SCALE : H=1:100, V=1:10



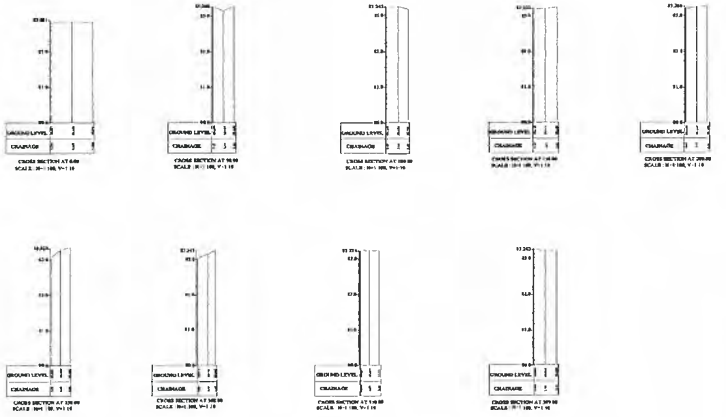
SECTION AT 2-2
SCALE : H=1:100, V=1:10

SECTION AT A-A
SCALE : H=1:100, V=1:10



SECTION AT B-B
SCALE : H=1:100, V=1:10

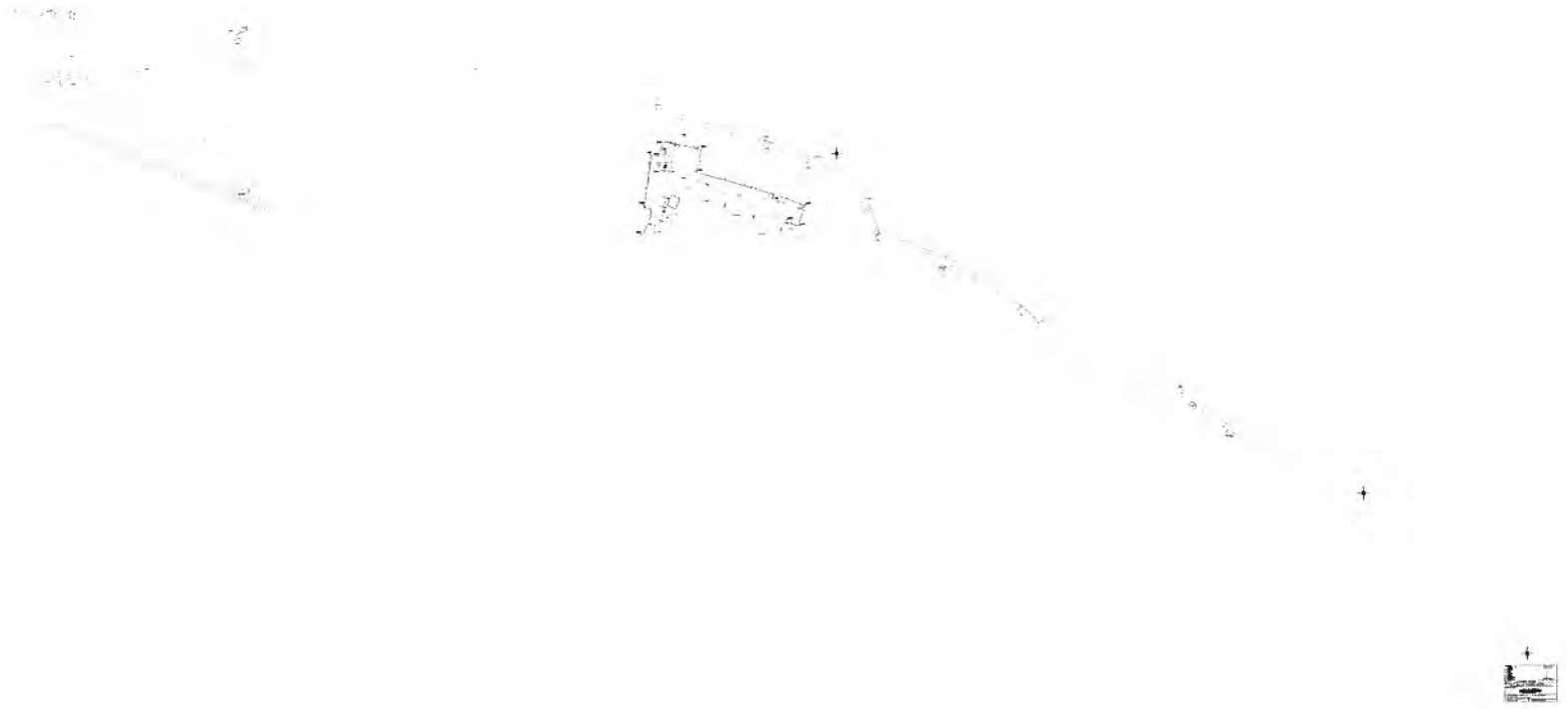
SECTION OF STP SITE

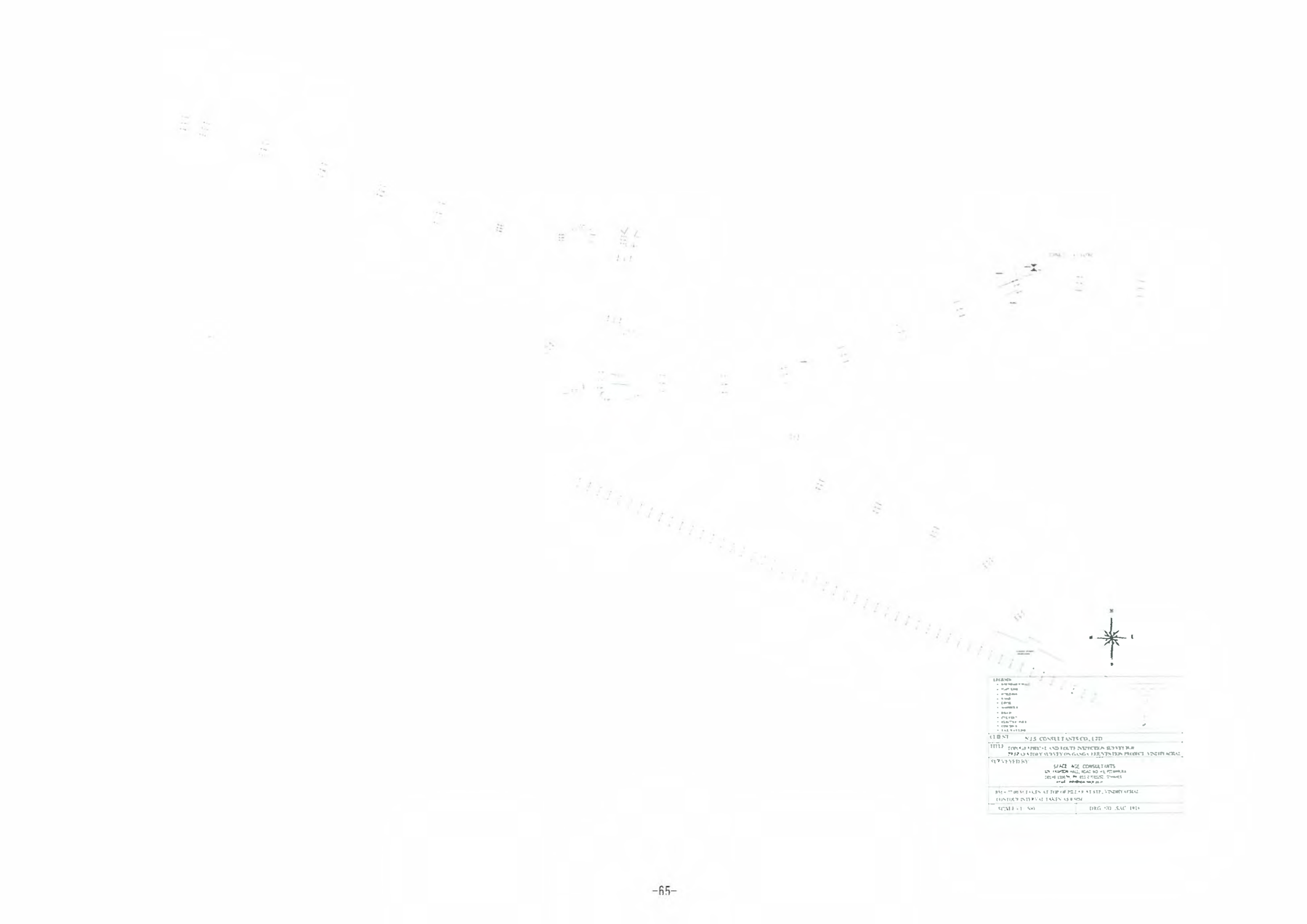


CROSS SECTION OF APPROACH ROAD TO S.T.P.

CLIENT:	N.J.S. CONSULTANTS CO., LTD.
TITLE:	TOPOGRAPHICAL SURVEN PLAN OF PROPOSED S.T.P., MIRZAPUR.
SURVEYED BY:	SPACE AGE CONSULTANTS 329, FASHION MALL, ROAD NO -43, PITAMPURA DELHI-110034, PH. 011-27011252, 32946415 email : info@spaceage.co.in
BM=83.600 M TAKEN AT TOP OF PILLAR AT S.T.P., MIRZAPUR. CONTOUR INTERVAL TAKEN AS 0.25M.	
SCALE - 1 : 100	DRG. NO. :SAC/ 1917/ STP

5. Vindhyachal (Mirzapur)





LEGEND:-
- BOUNDARY WALL
- PLOT LINE
- BUILDING
- ROAD
- LEVEL
- HANDHOLE
- DRAIN
- CULVERT
- ELECTRIC POLE
- CONTOUR
- RAILWAY LINE

CLIENT: N.J.S. CONSULTANTS CO., LTD.

TITLE: TOPOGRAPHICAL AND ROUTE INSPECTION SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENTION PROJECT -VINDHYACHAL

SURVEYED BY:

SPACE AGE CONSULTANTS
329, FASHION HALL, ROAD NO -43, PITAMPURA
DELHI-110034, PH. 011-27011252, 32946415
email : info@spaceage.co.in

BM = 77.00 M TAKEN AT TOP OF PILLAR AT STP., VINDHYACHAL
CONTOUR INTERVAL TAKEN AS 0.50M

SCALE - 1 : 500	DRG. NO. SAC/ 1918


POND
POND
POND
POND

LEGEND:
- BOUNDARY WALL
- ELECTRIC POLE
- BUILDING
- ROAD
- CANAL
- STAIRCASE
- DRAIN
- CULVERT
- ELECTRIC POLE
- CONTOUR
- RAILWAY LINE

CLIENT: N.T.S. CONSULTANTS CO., LTD.

TITLE: TOPOGRAPHICAL AND ROUTE INSPECTION SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENTION PROJECT VINDHYACHAL

SURVEYED BY:

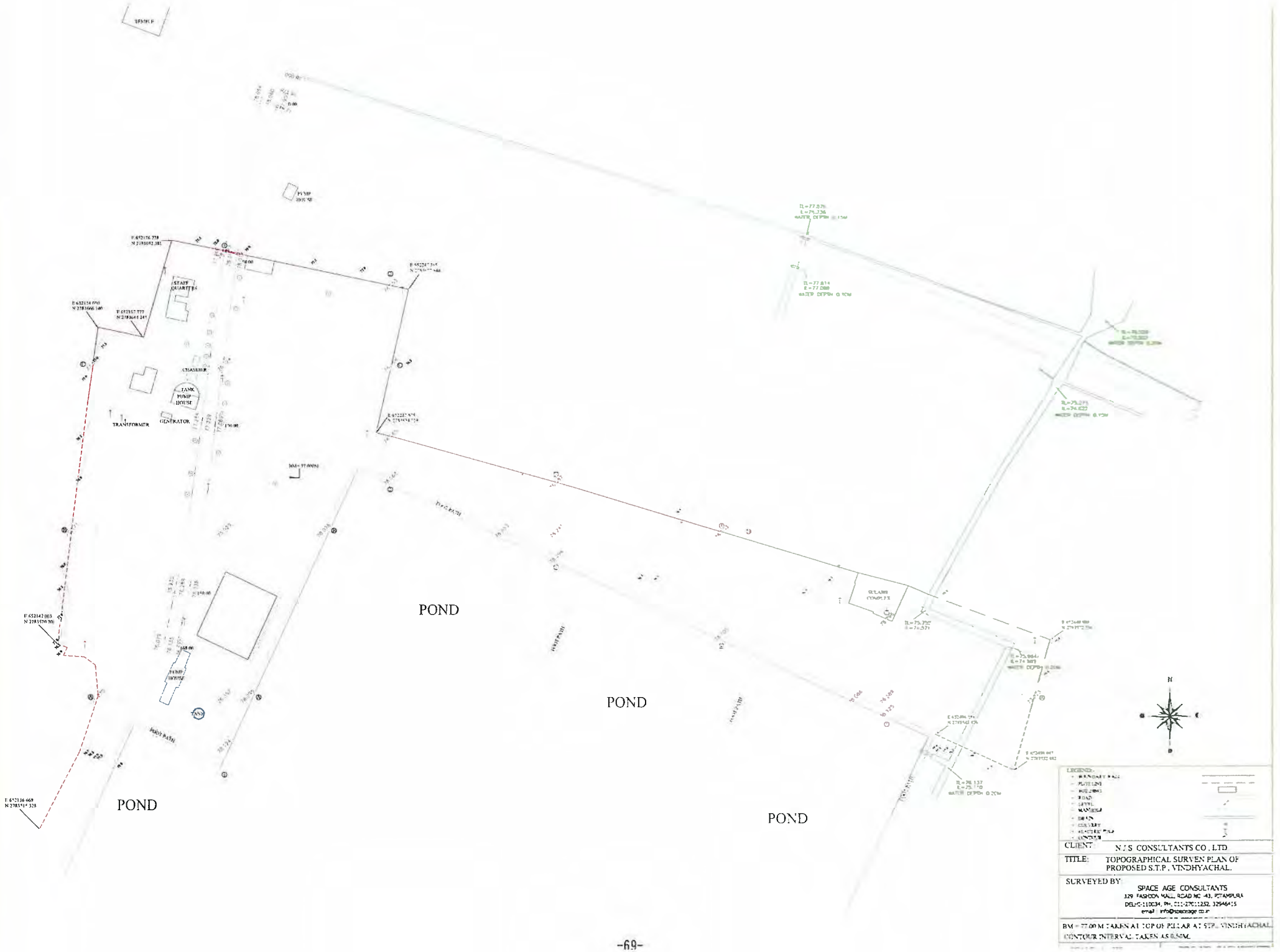
SPACE AGE CONSULTANTS
329, FASHION MALL, ROAD NO -43, PITAMPURA
DELHI-110034, PH. 011-27011252, 32986415
email : info@spaceage.co.in

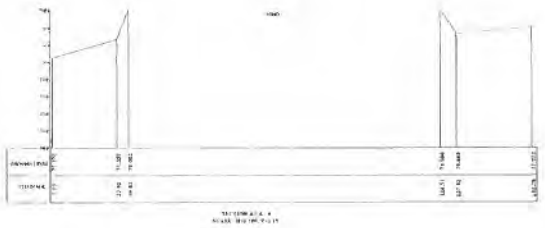
BM = 77.00 M TAKEN AT TOP OF PILLAR AT S.P., VINDHYACHAL.

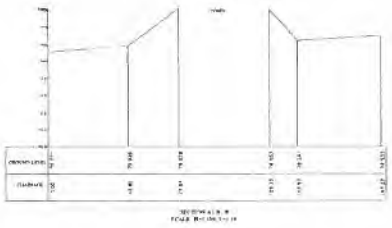
CONTOUR INTERVAL TAKEN AS 0.50M

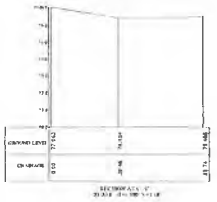
SCALE - 1 : 500

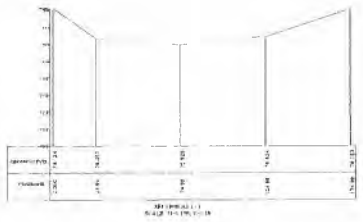
DRG. NO. :SAC/ 1918

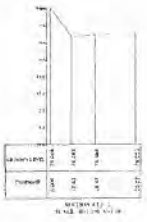

STAFF QUARTERS
CHAMBER
TANK
PUMP HOUSE
TRANSFORMER
GENERATOR
PUMP HOUSE
FOOT PATH
POND
POND
POND
POND
N
CLIENT: N.I.S CONSULTANTS CO., LTD
TITLE: TOPOGRAPHICAL SURVEN PLAN OF PROPOSED S.T.P., VINDHYACHAL.
SURVEYED BY: SPACE AGE CONSULTANTS
329, FASHION MALL ROAD NO -43, PITAMPURA
DELHI-110034, PH.: 011-27011252, 32946415
email : info@spaceage.co.in
BM = 77.00 M TAKEN AT TOP OF PILLAR AT STP, VINDHYACHAL
CONTOUR INTERVAL TAKEN AS 0.50M.



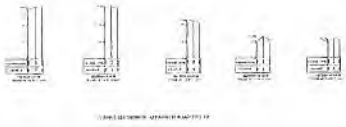








SECTION OF STP SITE



CLIENT:	N.J.S. CONSULTANTS CO., LTD.
TITLE:	TOPOGRAPHICAL SURVEN PLAN OF PROPOSED S.T.P., VINDHYACHAL.
SURVEYED BY:	SPACE AGE CONSULTANTS 329, FASHION MALL, ROAD NO 43, PITAMPURA DELHI-110034, PH. 011-27011252, 32946415 email : info@spaceage.co.in
BM = 77.00 M TAKEN AT TOP OF PILLAR AT STP., VINDHYACHAL.	
SCALE - 1 : 100	DRG. NO : SAC/ 1918

6. Ghazipur

LIST OF BANCH MARKS ESTABLISHED AT SITE

GHAZIPUR:-

TBM AT STP = TBM 71.141 M TRANSFERED FROM RAILWAY STATION GHAZIPUR (74.000 M).

TBM FOR ROUTE SURVEY = TBM 71.141 M TRANSFERED FROM RAILWAY STATION GHAZIPUR (74.000 M).

SL. NO.	BM	EASTING	NORTHING	LEVEL	LOCATION
1	TBM (1)	756539.14	2830844.82	71.141	TOP OF PLATFORM SARAI CROSSING.
2	TBM (27)	759478.4	2832057.41	73.890	PLINTH OF TEMPLE KAPUR CHUNGI
3	TBM (D)	756910.014	2830369.75	72.445	PLINTH OF TEMPLE ITI CHAURAHA.
4	TBM (E)	756189.536	2829490.26	73.110	TOP OF CIRCLE P.G. COLLEGE CHAURAHA.
5	TBM (F)	755075.329	2828965.23	72.902	PLINTH OF TEMPLE CHOCHAKPUR ROAD.
6	TBM (10)	760205.458	2831872.63	68.380	PLINTH OF PUMP HOUSE NEAR TOWN HALL.
7	TBM (11)	760790.444	760790.444	70.290	TOP OF CHAMBER NEAR PRIMARY SCHOOL MARTIN GANJ.
8	TBM (16)	758371.61	2831748.82	72.990	PLINTH OF TEMPLE DURGA CHAURAHA.
9	TBM (20)	757439.883	2830234.29	71.490	PLINTH OF EXISTING O.H.T. RAJENDRA NAGAR T -POINT


KEY PLAN
LEGEND
SPACE AGE CONSULTANTS
SCALE : 1 : 500


LEGEND:
BOUNDARY WALL
PLOT LINE
ROAD
BUILDING
DRAIN
LEVEL
CONTOUR
TREE
CLIENT: N.J.S. CONSULTANTS CO., LTD.
TITLE: TOPOGRAPHICAL AND ROUTE INSPECTION SURVEY FOR PREPARATORY SURVEY ON GANGA RIVERFRONT PROJECT -GHAZIPUR
SURVEYED BY
SPACE AGE CONSULTANTS
GTS = 74.000 M TAKEN AT RAILWAY STATION GHAZIPUR
SCALE - 1 : 500
DRG. NO. - SAC/ 1971
KEY PLAN


N
W
E
S
KEY PLAN
LEGEND:
CLIENT:
TITLE:
SURVEYED BY:

LEGEND :-

- BOUNDARY WALL
- FOOT LINE
- ROAD
- BUILDING
- DRAIN
- LEVEL
- CULVERT
- CONTOUR
- TREE

CLIENT:- TJ.S CONSULTANTS CO., LTD.

TITLE: TOPOGRAPHICAL AND ROUTE INSPECTION SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT -GHAZIPUR

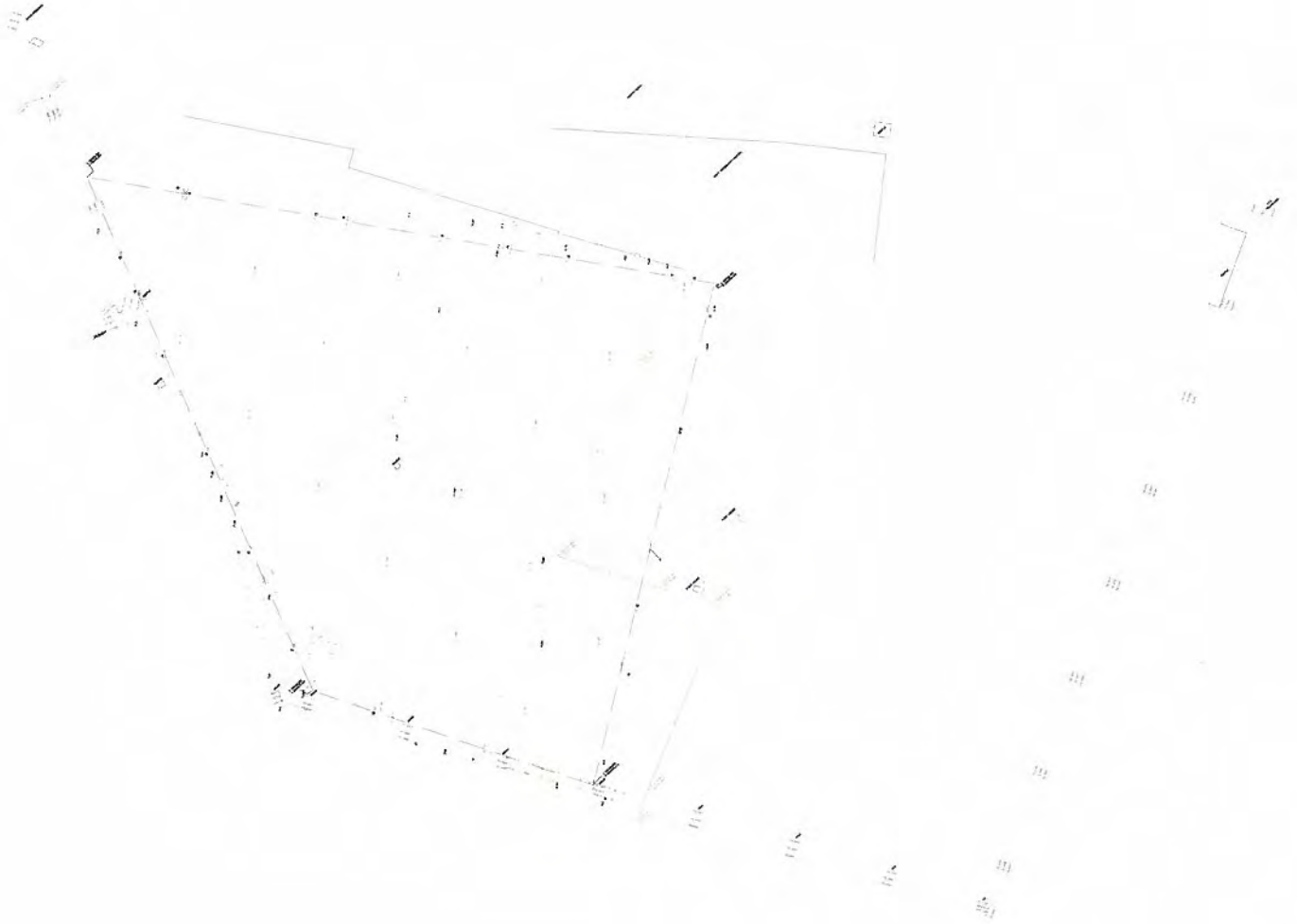
SURVEYED BY:

SPACE AGE CONSULTANTS

GTS=74.000 M TAKE AT RAILWAY STATION GHAZIPUR

SCALE - 1 : 500 | DRG. NO. :SAC/ P121

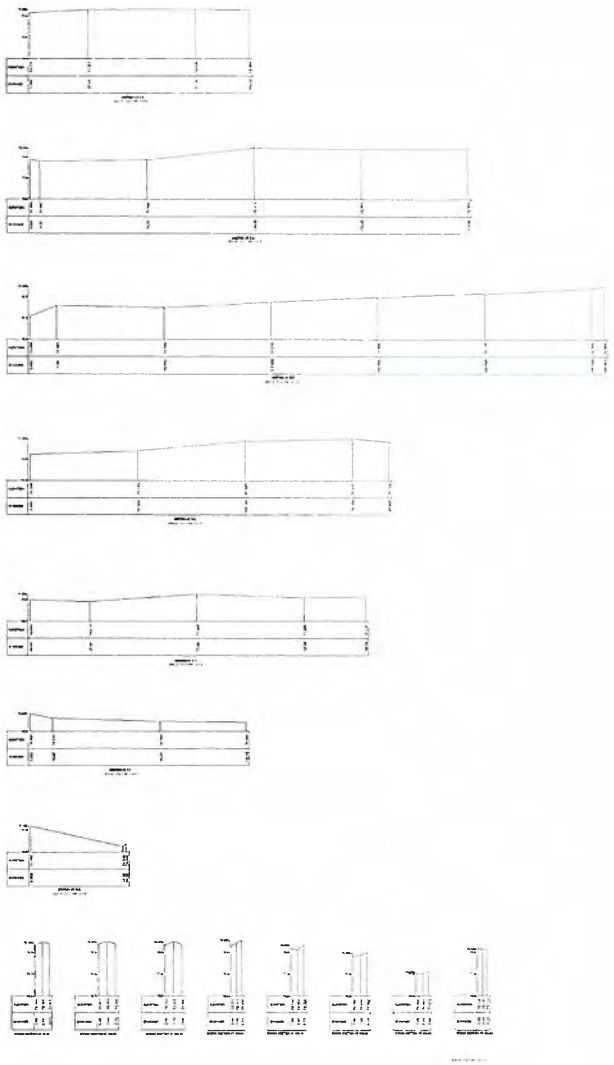

KEY PLAN
LEGEND:-
ROAD
LEVEL
SPACE AGE CONSULTANTS
SCALE : 1 : 500

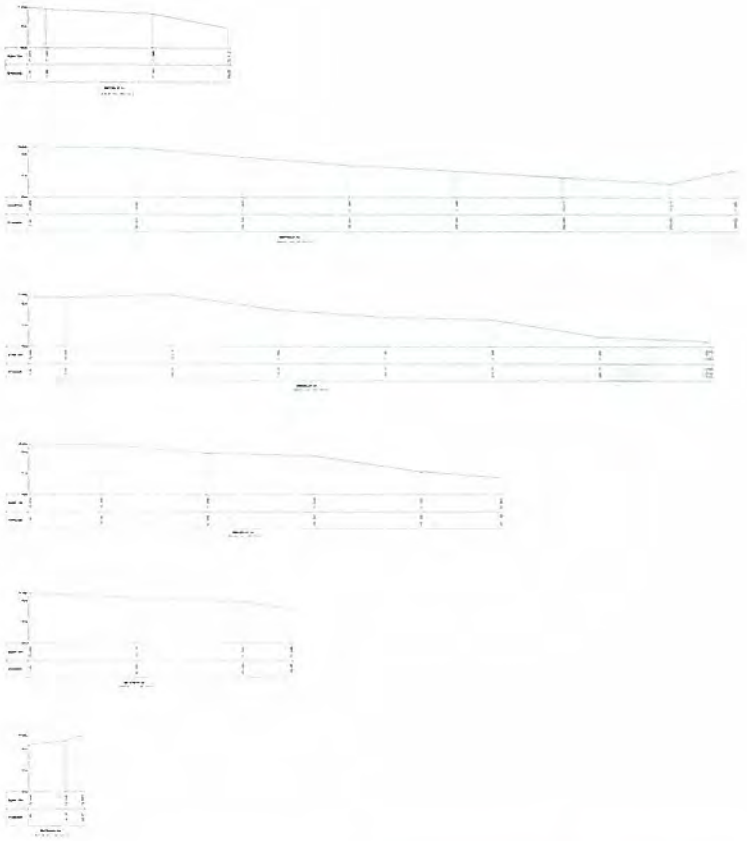


LEGEND:-

- BOUNDARY WALL
- PLOT LINE
- ROAD
- BUILDING
- DRAIN
- LEVEL
- CULVERT
- CONTOUR
- TREE

CLIENT:	N.J.S. CONSULTANTS CO., LTD.
TITLE:	TOPOGRAPHICAL SURVEN PLAN OF PROPOSED S.T.P., GAZIPUR
SURVEYED BY:	SPACE AGE CONSULTANTS 329, FASHION MALL, ROAD NO -43, PITAMPURA DELHI-110034, PH. 011-27011252, 32940415 email : info@spaceage.co.in
GTS=74.000 M TAKEN AT RAILWAY STATION GAZIPUR. CONTOUR INTERVAL TAKEN AS 0.25M	
SCALE - 1 : 500	DRG. NO. :SAC/ 1921





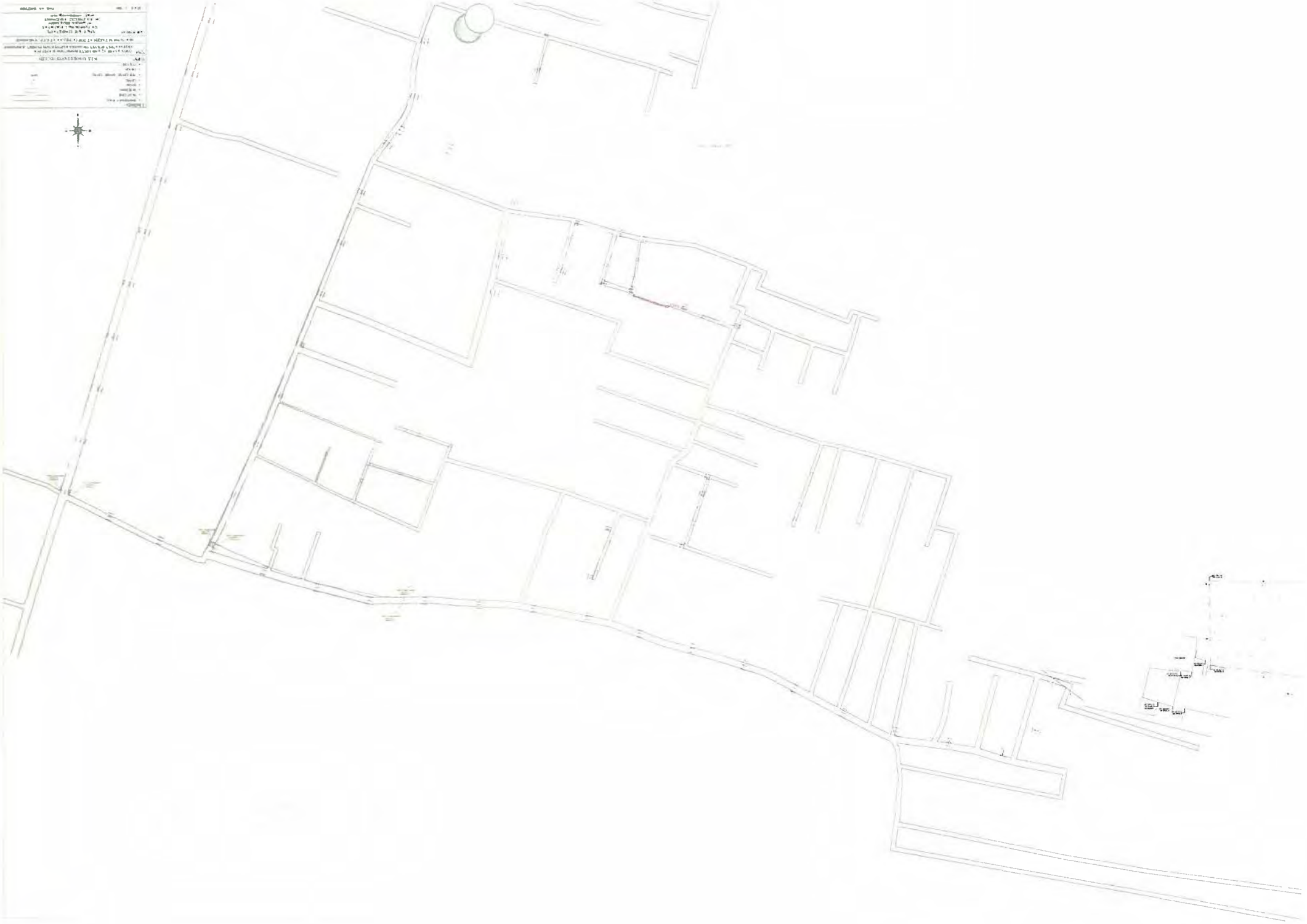
CLIENT:	N.J.S. CONSULTANTS CO., LTD.
TITLE:	TOPOGRAPHICAL SURVEN PLAN OF PROPOSED S.T.P., GAZIPUR.
SURVEYED BY:	SPACE AGE CONSULTANTS 329, FASHION MALL, ROAD NO -43, PITAMPURA DELHI-110034, PH. 011-27011252, 32946415 email : info@spaceage.co.in
	GTS=74.000 M TAKEN AT RAILWAY STATION GAZIPUR. CONTOUR INTERVAL TAKEN AS 0.25M.
SCALE - 1 : 100	DRG. NO. :SAC/ 1921

7. Ramnagar

LIST OF BANCH MARKS ESTABLISHED AT SITE

RAMNAGAR:-
TBM AT STP = TBM 73.523 M TRANSFERED FROM STP BHAGWANPUR, VARANASI (74.969 M).
TBM FOR ROUTE SURVEY = TBM 73.523 M TRANSFERED FROM STP BHAGWANPUR, VARANASI (74.969 M).

SL. NO.	BM	EASTING	NORTHING	LEVEL	LOCATION
1	TBM (1)	703370.741	2798384.73	73.523	TOP OF PILLAR STP, RAMNAGAR
2	TBM (2)	704668.798	2798196.27	77.157	TOP OF CULVERT BYEPASS ROAD
3	TBM (3)	704535.874	2797543.55	77.050	FOUNDATION OF LIGHT POLE SHAHEED SMARAK PARK JANAKPUR
4	TBM (4)	704507.594	2796870.16	78.535	TOP OF CULVERT NEAR JAN KALYAN SAMITI.
5	TBM (5)	704465.01	2796391.64	79.500	PLINTH OF POLICE BOOTH RAMNAGAR CHAURAHA
6	TBM (6)	703972.8	2796507.05	76.080	CIRCLE OF LA LBAHADUR SHASHTRI CHAURAHA
7	TBM (7)	703825.732	2796818.55	76.555	TOP OF CULVERT SHAKTI GHAT NALA

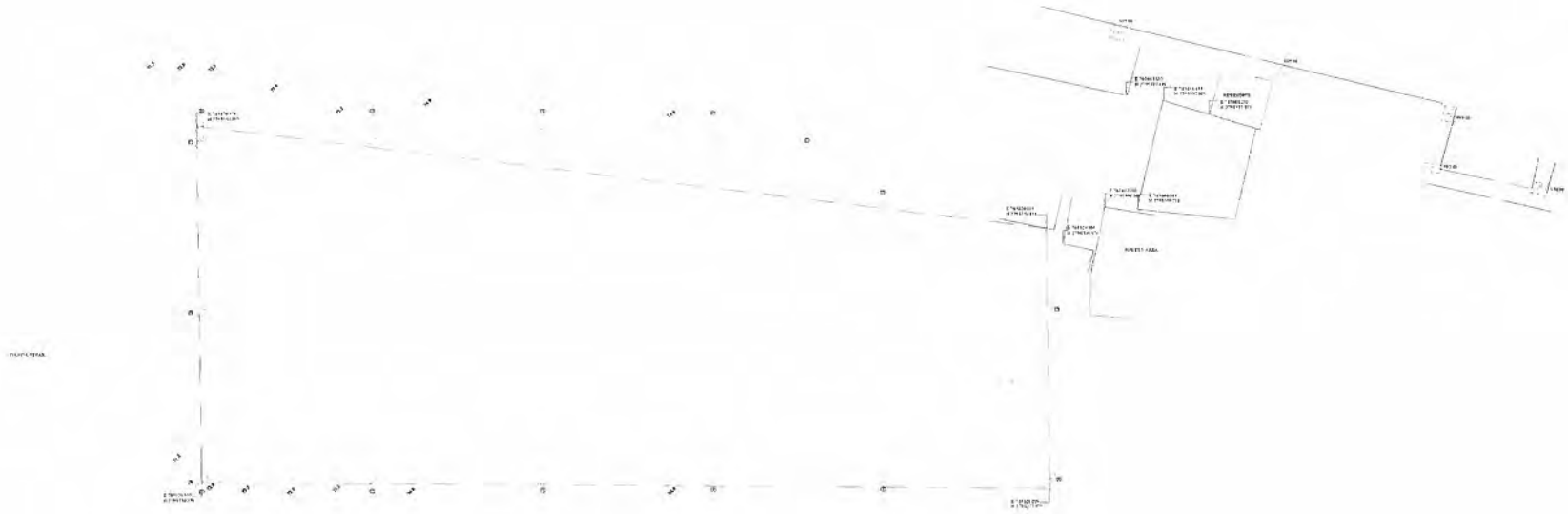



D. A. V. PUBLIC SCHOOL
PAC CAMP
LAL BAHADUR SHASTRI HOSPITAL
PRIMARY SCHOOL
PUMP HOUSE
LEGEND:-
BOUNDARY WALL
PLOT LINE
BUILDING
ROAD
LEVEL
DRAIN
CULVERT
CLIENT:
TITLE:
SURVEYED BY:
SPACE AGE CONSULTANTS
SCALE - 1 : 500


Ram Bagh Nala
IPS
RAM BAGH
NALA
Shakti Ghat Nala
Salotri Nala
lua Ghat Nala


LEGEND:
BOUNDARY WALL
PLOT LINE
BUILDING
ROAD
LEVEL
DRAIN
CULVERT
CLIENT
TITLE
TOPOGRAPHICAL AND ROUTE INSPECTION SURVEY FOR
TAKEN AT TOP OF PILLAR AT STP, VARANASI
SURVEYED BY:
SPACE AGE CONSULTANTS
FASHION MALL, ROAD NO 43,
PITAMPURA,
SCALE - 1 : 500
DRG. NO. : SAC/ 1920


LEGEND:
BOUNDARY WALL
ROAD
DRAIN
CLIENT:
TITLE:
TOPOGRAPHICAL AND ROUTE INSPECTION SURVEY FOR
PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT
SURVEYED BY
SPACE AGE CONSULTANTS
SCALE



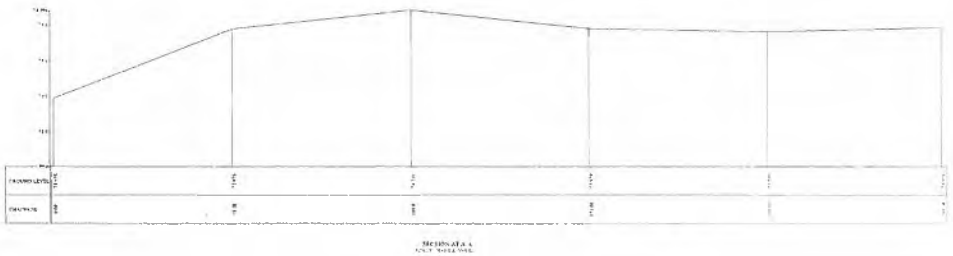
N
W
E
S

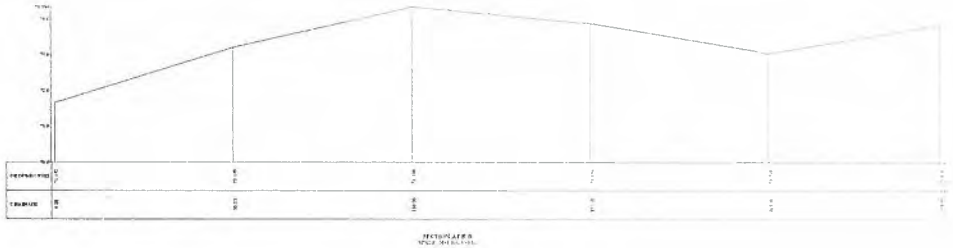
LEGEND :-
- BOUNDARY WALL
- PLOT LINE
- BUILDING
- ROAD
- LEVEL
- CONTOUR

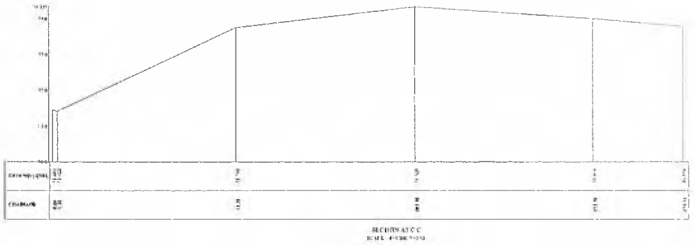
CLIENT:	N.J.S. CONSULTANTS CO., LTD.
TITLE:	TOPOGRAPHICAL SURVEY PLAN OF PROPOSED S.T.P., RAM NAGAR.
SURVEYED BY:	SPACE AGE CONSULTANTS 329, FASHION MALL, ROAD NO -43, PITAMPURA DELHI-110034, PH. 011-27011252, 32946415 email : info@spaceage.co.in

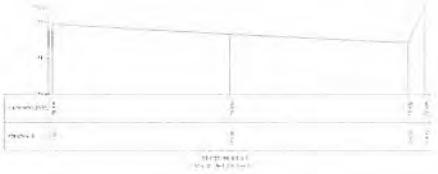
BM=74.969 M TAKEN AT TOP OF PILLAR AT S.T.P., VARANASI
CONTOUR INTERVAL TAKEN AS 0.50M

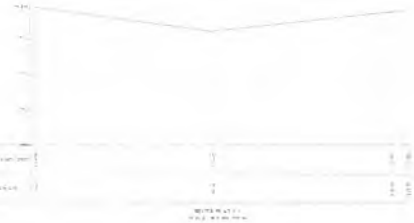
SCALE – 1 : 500	DRG. NO. :SAC/ 1920/ STP

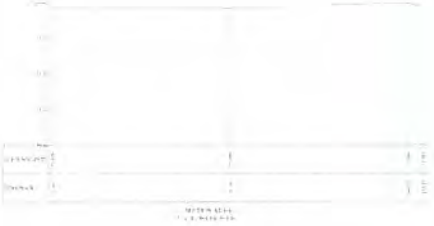


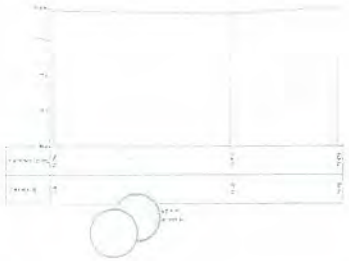












CLIENT: N.J.S. CONSULTANTS CO., LTD

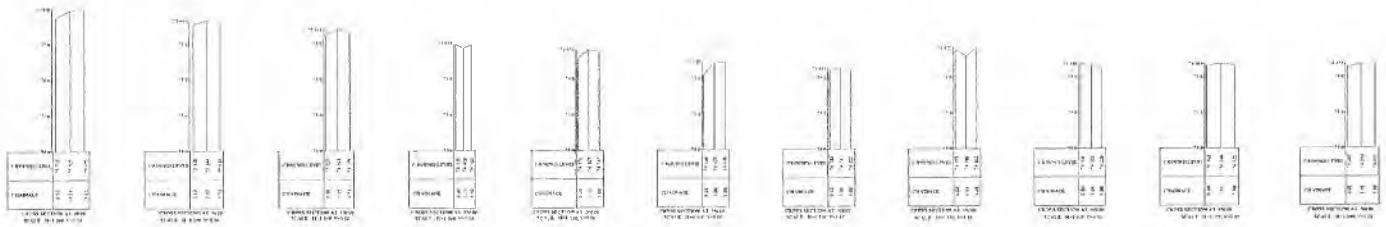
TITLE: TOPOGRAPHICAL SURVEY PLAN OF PROPOSED S.T.P., RAM NAGAR

SURVEYED BY:

SPACE AGE CONSULTANTS
329, FASHION MALL, ROAD NO -43, PITAMPURA
DELHI-110034, PH. 011-27011252, 32946415
email : info@spaceage.co.in

BM=74.969 M TAKEN AT TOP OF PILLAR AT S.T.P., VARANASI
CONTOUR INTERVAL TAKEN AS 0.50M.

SCALE - 1 : 100 DRG. NO. :SAC/ 1920/ STP



CLIENT: N.J.S. CONSULTANTS CO., LTD.

TITLE: TOPOGRAPHICAL SURVEY PLAN OF PROPOSED S.T.P., RAM NAGAR

SURVEYED BY:

SPACE AGE CONSULTANTS
329, FASHION MALL, ROAD NO -43, PITAMPURA
DELHI-110034, PH: 011-27011252, 32946415
email : info@spaceage.co.in

BM=74.969 M TAKEN AT TOP OF PILLAR AT S.T.P., VARANASI

CONTOUR INTERVAL TAKEN AS 0.50M.

SCALE – 1 : 100

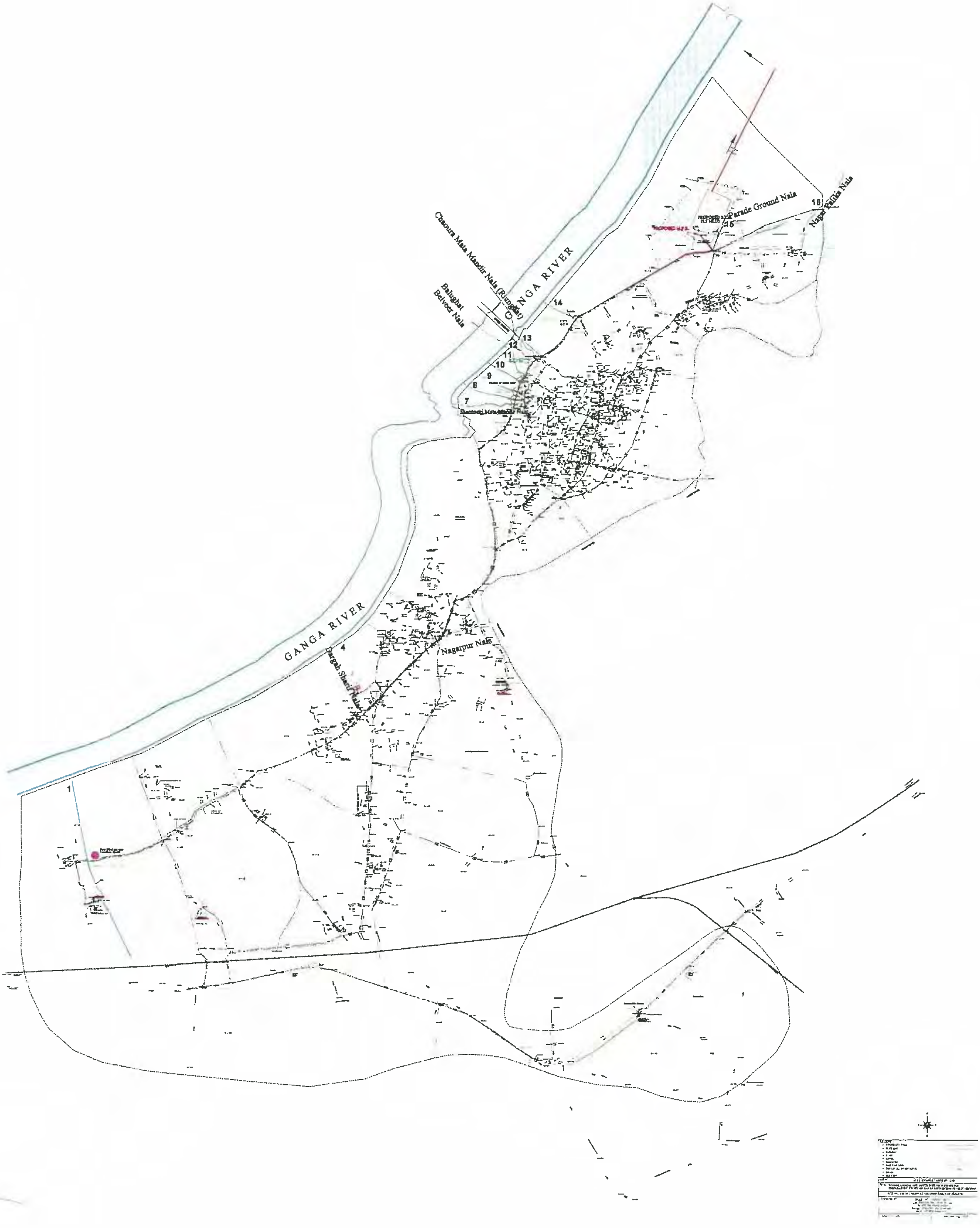
DRG. NO. :SAC/ 1920/ STP

8. Chunar

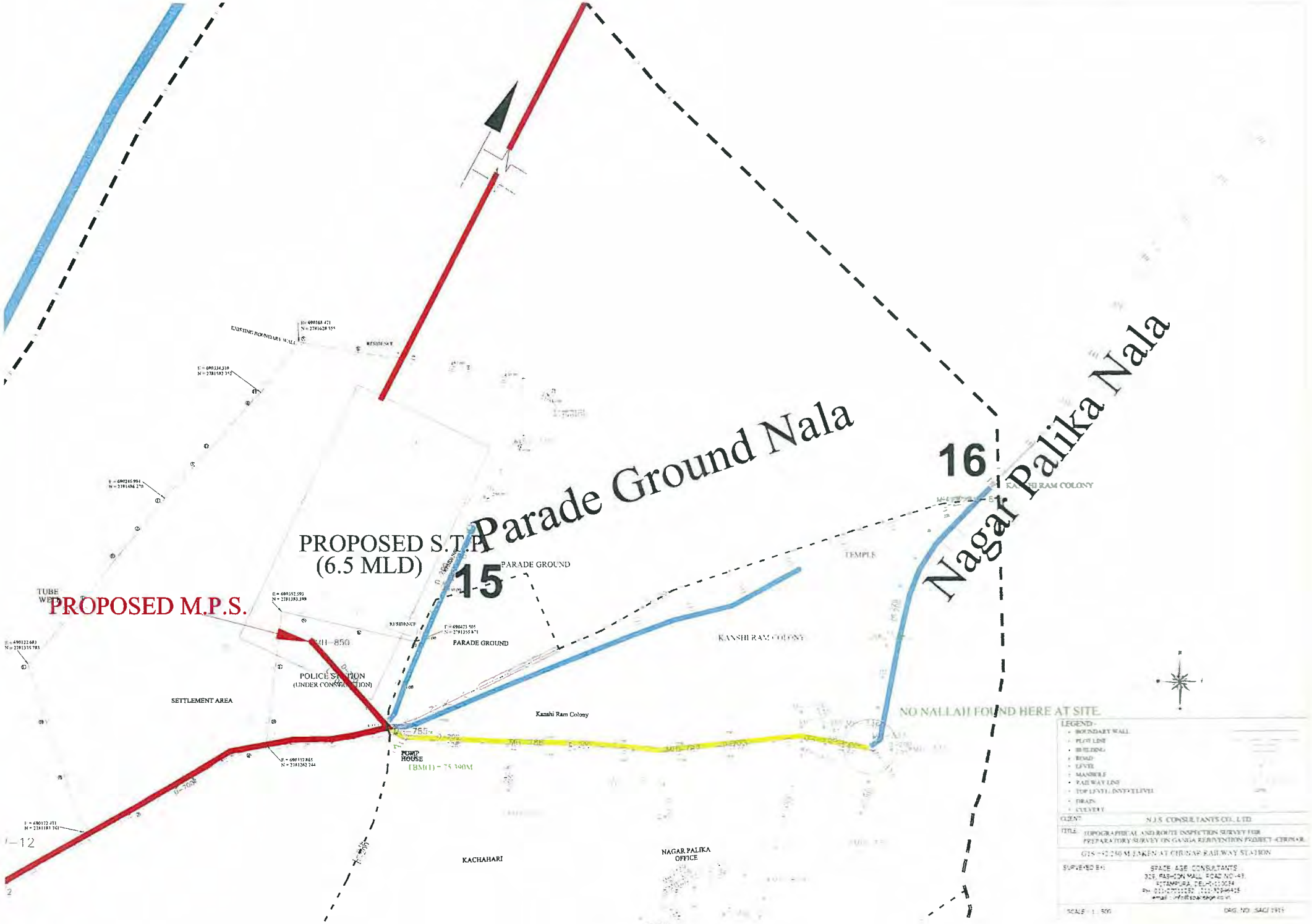
LIST OF BANCH MARKS ESTABLISHED AT SITE

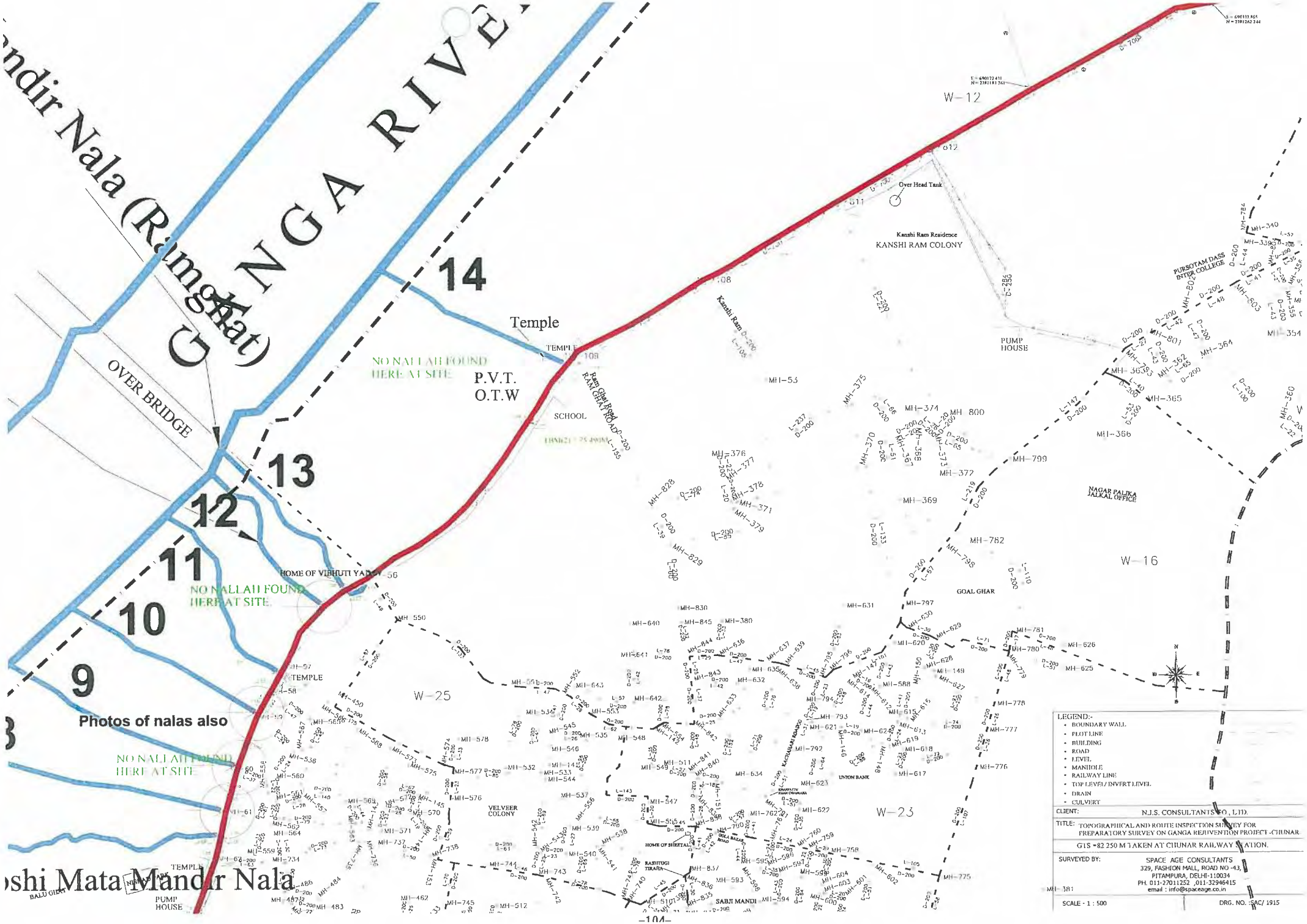
CHUNAR:-
TBM AT STP = 75.390 M TRANSFERED FROM RAILWAY STATION CHUNAR (82.250 M).
TBM FOR ROUTE SURVEY = 75.390 M TRANSFERED FROM RAILWAY STATION CHUNAR (82.250 M).

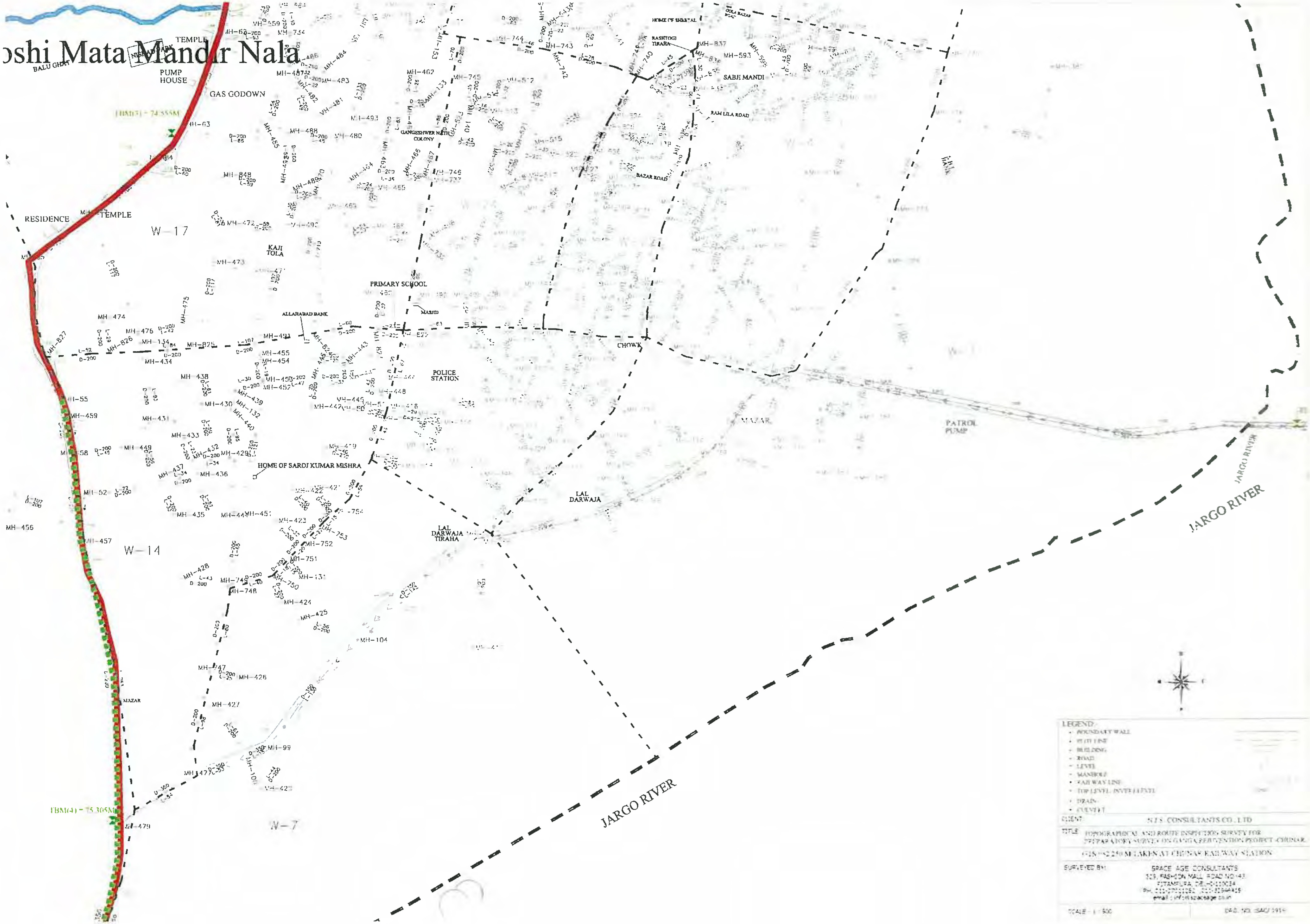
SL. NO.	BM	EASTING	NORTHING	LEVEL	LOCATION
1	TBM (2)	689716.627	2780878.079	75.490	TOP OF CULVERT JALALPUR MAFI ROAD BALUGAT
2	TBM (3)	689383.250	2780385.577	74.555	PLINTH OF REST ROOM JALALPUR MAFI ROAD BALUGAT
3	TBM (4)	689328.476	2779761.888	75.305	FLOOR LEVEL OF JUNCTION BOX FORT ROAD
4	TBM (5)	690404.908	2780122.185	73.299	TOP OF CULVERT JARGO RIVER
5	TBM (6)	689388.384	2779074.504	73.240	FOUNDATION OF ELECTRIC POLE NEAR GLOBAL ACADEMY
6	TBM (7)	687302.590	2777924.224	78.731	PLINTH OF PRIMARY SCHOOL TAMMAL GANJ
7	TBM (8)	687957.555	2777547.166	78.874	TOP OF CULVERT MIRZAPUR ROAD NEAR RAILWAY CROSSING
8	TBM (9)	688426.170	2777644.17	85.386	PLINTH OF POLICE POST MIRZAPUR ROAD
9	TBM (10)	689472.985	2777215.936	85.323	FOUNDATION OF SIGNAGE BOARD NEAR CHACHERI CROSSING.
10	TBM (11)	690057.888	2777413.646	82.461	TOP OF K.M. STONE PIRALLIPUR TIRAHA.
11	TBM (12)	690513.947	2777841.88	77.268	TOP OF CULVERT MIRZAPUR ROAD NEAR PISHLIPUR VILLAGE



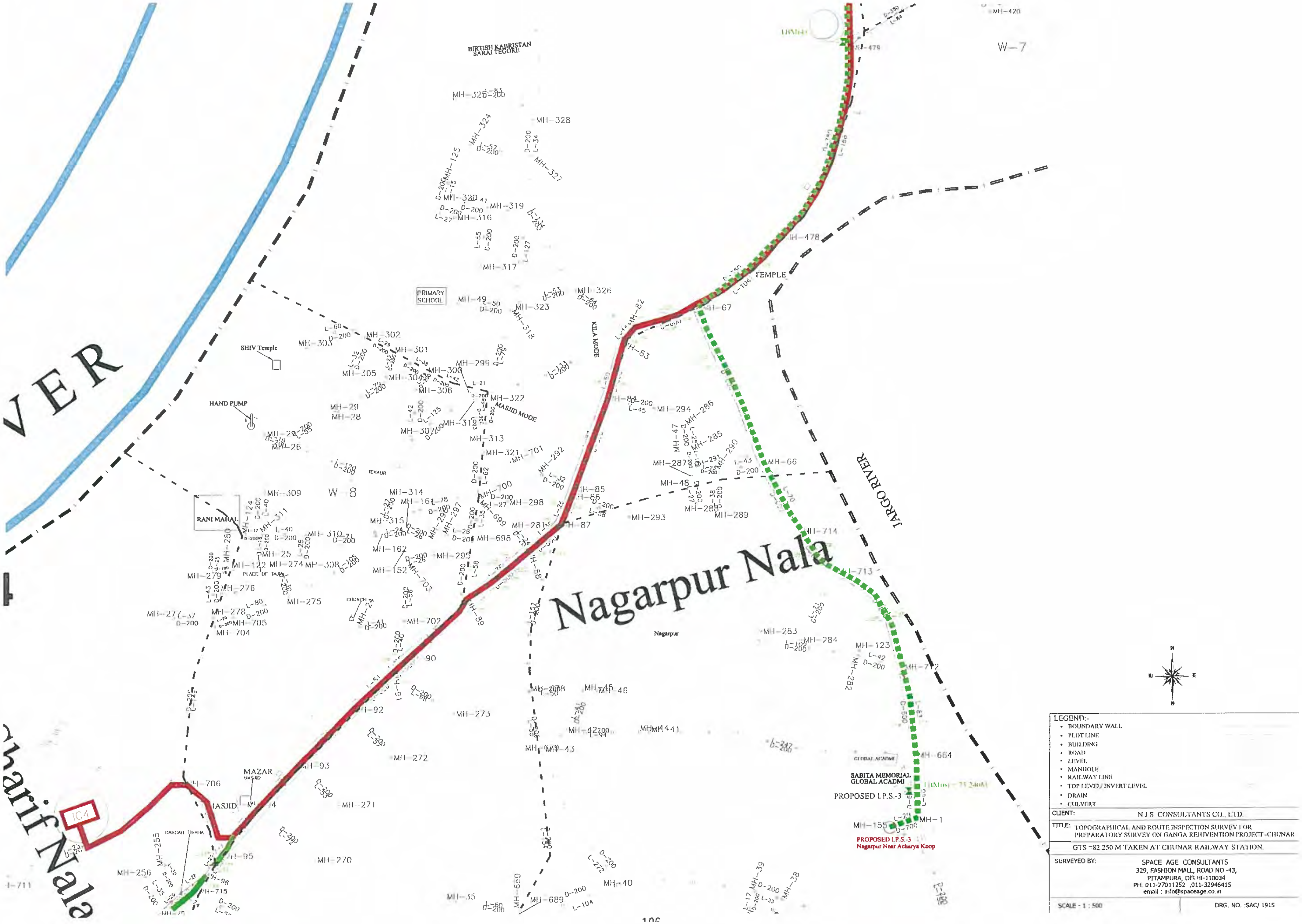
GANGA RIVER
GANGA RIVER
Chaoura Mata Mandir Nala (Rumghat)
Balughat
Belvoer Nala
Parade Ground Nala
Nagar Palika Nala
Nagarpur Nala
Dargah Sharif Nala
Santoshi Mata Mandir Nala
1
4
7
8
9
10
11
12
13
14
15
16


Parade Ground Nala
Nagar Palika Nala
16
15
PROPOSED S.T.P.
(6.5 MLD)
PROPOSED M.P.S.
PARADE GROUND
KANSHI RAM COLONY
TEMPLE
SETTLEMENT AREA
POLICE STATION
(UNDER CONSTRUCTION)
Kanshi Ram Colony
NO NALLAH FOUND HERE AT SITE
PUMP HOUSE
KACHAHARI
NAGAR PALIKA OFFICE
LEGEND :-
CLIENT
N.J.S. CONSULTANTS CO., LTD.
SURVEYED BY:
SPACE AGE CONSULTANTS

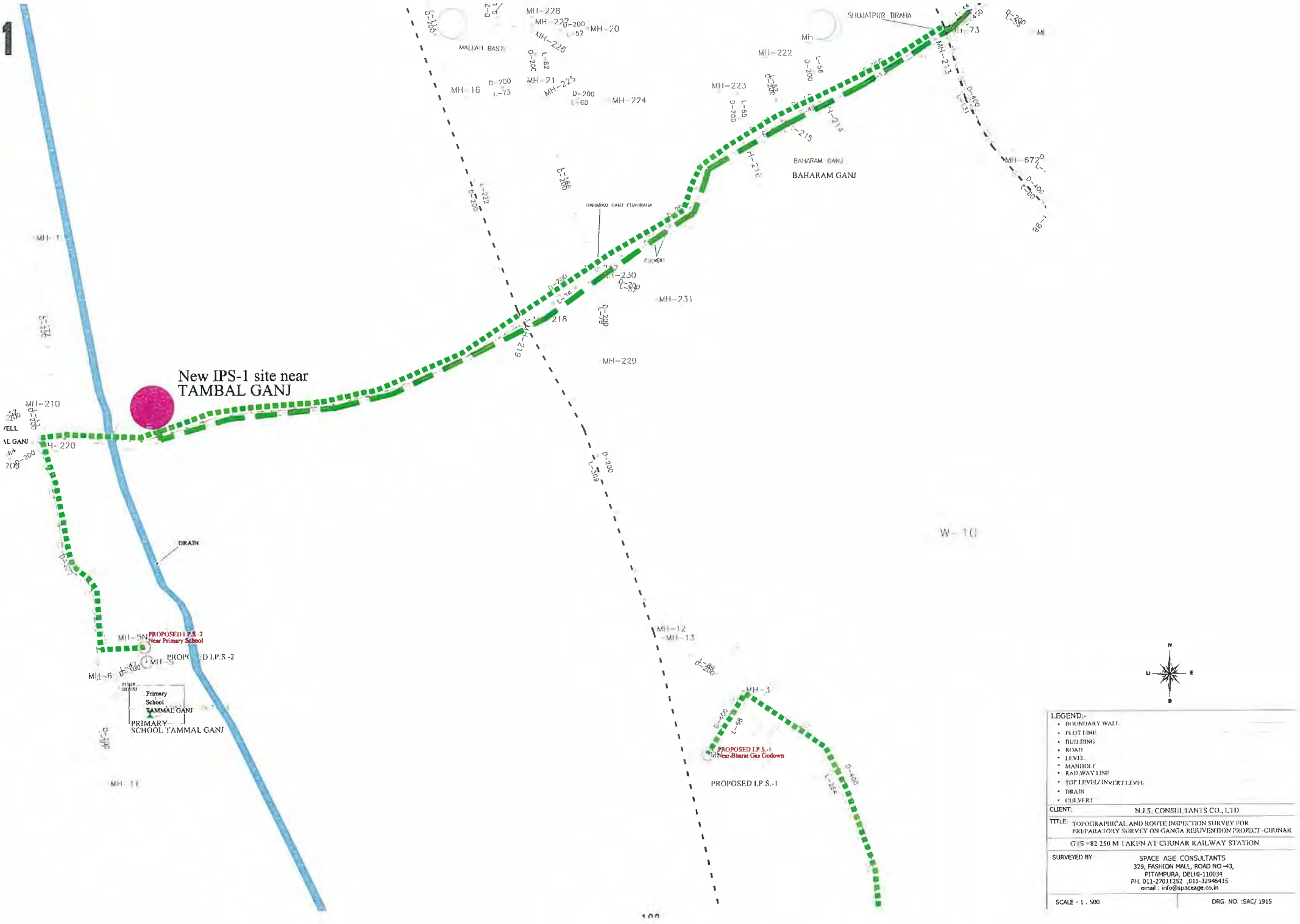

ndir Nala (Ramghat)
GANGA RIVER
14
13
12
11
10
9
OVER BRIDGE
Temple
TEMPLE
NO NALLAH FOUND HERE AT SITE
P.V.T.
O.T.W
SCHOOL
Ram Ghat Road
RAM GHAT ROAD
Over Head Tank
Kanshi Ram Residence
KANSHI RAM COLONY
PUMP HOUSE
PURSOTAM DASS INTER COLLEGE
NAGAR PALIKA JALKAL OFFICE
GOAL GHAR
HOME OF VIBHUTI YADAV
NO NALLAH FOUND HERE AT SITE
Photos of nalas also
NO NALLAH FOUND HERE AT SITE
VELVEER COLONY
HOME OF SHEETAL
RAJSTUGI TIRAHA
SABJI MANDI
UNION BANK
KACHAHARI ROAD
W-12
W-16
W-23
W-25
oshi Mata Mandir Nala
LEGEND:-
BOUNDARY WALL
PLOT LINE
BUILDING
ROAD
LEVEL
MANHOLE
RAILWAY LINE
TOP LEVEL/ INVERT LEVEL
DRAIN
CULVERT
CLIENT: N.J.S. CONSULTANTS CO., LTD.
TITLE: TOPOGRAPHICAL AND ROUTE INSPECTION SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENTION PROJECT -CHUNAR
G1S =82 250 M TAKEN AT CHUNAR RAILWAY STATION.
SURVEYED BY: SPACE AGE CONSULTANTS
329, FASHION MALL, ROAD NO -43,
PITAMPURA, DELHI-110034
PH. 011-27011252 ,011-32946415
email : info@spaceage.co.in
SCALE - 1 : 500
DRG. NO. :SAC/ 1915



Joshi Mata Mandir Nala
TEMPLE
PUMP HOUSE
GAS GODOWN
RESIDENCE
TEMPLE
W-17
KAJI TOLA
PRIMARY SCHOOL
ALLAHABAD BANK
POLICE STATION
HOME OF SAROJ KUMAR MISHRA
W-14
W-7
LAL DARWAJA TIRAHA
LAL DARWAJA
CHOWK
MAZAR
PATROL PUMP
SABJI MANDI
RAM LILA ROAD
BAZAR ROAD
GANGESHWER NATH COLONY
JARGO RIVER
JARGO RIVER
MAZAR
LEGEND
CLIENT
N.T.S. CONSULTANTS CO., LTD
TITLE
SURVEYED BY
SPACE AGE CONSULTANTS


BIRTISH KABRISTAN SARAI TEGORE
W-7
W-8
VER
SHIV Temple
HAND PUMP
RANI MAHAL
PRIMARY SCHOOL
MASJID MODE
KILA MODE
TEMPLE
TEKAUR
CHURCH
PLACE OF TAZIA
MAZAR
MASJID
DARGAH
Nagarpur Nala
Nagarpur
JARGO RIVER
Charif Nala
IC4
GLOBAL ACADMI
SABITA MEMORIAL GLOBAL ACADMI
PROPOSED I.P.S.-3
PROPOSED I.P.S.-3
Nagarpur Near Acharya Koop
LEGEND:-
BOUNDARY WALL
PLOT LINE
BUILDING
ROAD
LEVEL
MANHOLE
RAILWAY LINE
TOP LEVEL/ INVERT LEVEL
DRAIN
CULVERT
CLIENT: N J S CONSULTANTS CO., LTD.
TITLE: TOPOGRAPHICAL AND ROUTE INSPECTION SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENTION PROJECT-CHUNAR
GTS -82 250 M TAKEN AT CHUNAR RAILWAY STATION.
SURVEYED BY: SPACE AGE CONSULTANTS
329, FASHION MALL, ROAD NO -43,
PITAMPURA, DELHI-110034
PH. 011-27011252 ,011-32946415
email : info@spaceage.co.in
SCALE - 1 : 500
DRG. NO. :SAC/ 1915


DARGAH
QABRISTAN
QABRISTAN
SHUJATPUR TIRAHA
MH-221
MH-245
MH-213
MH-214
MH-672
MH-208
HARAM GANJ
LEGEND :-
BOUNDARY WALL
PLOT LINE
BUILDING
ROAD
LEVEL
MANHOLE
RAILWAY LINE
TOP LEVEL/ INVERT LEVEL
DRAIN
CULVERT
CLIENT:
N.J.S CONSULTANTS CO. LTD
TITLE:
TOPOGRAPHICAL AND ROUTE INSPECTION SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENTION PROJECT -CHUNAR.
G.T.S. =52.250 M TAKEN AT CHUNAR RAILWAY STATION
SURVEYED BY:
SPACE AGE CONSULTANTS
329, FASHION MALL, ROAD NO -43,
PITAMPURA, DELHI-110034
PH. 011-27011252, 011-32944435
SCALE - 1 : 500
DRG. NO. :SAC/ 1935



LEGEND:-

- BOUNDARY WALL
- PLOT LINE
- BUILDING
- ROAD
- LEVEL
- MANHOLE
- RAILWAY LINE
- TOP LEVEL/ INVERT LEVEL
- DRAIN
- CULVERT

CLIENT: N.J.S. CONSULTANTS CO., LTD.

TITLE: TOPOGRAPHICAL AND ROUTE INSPECTION SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENTION PROJECT -CHUNAR

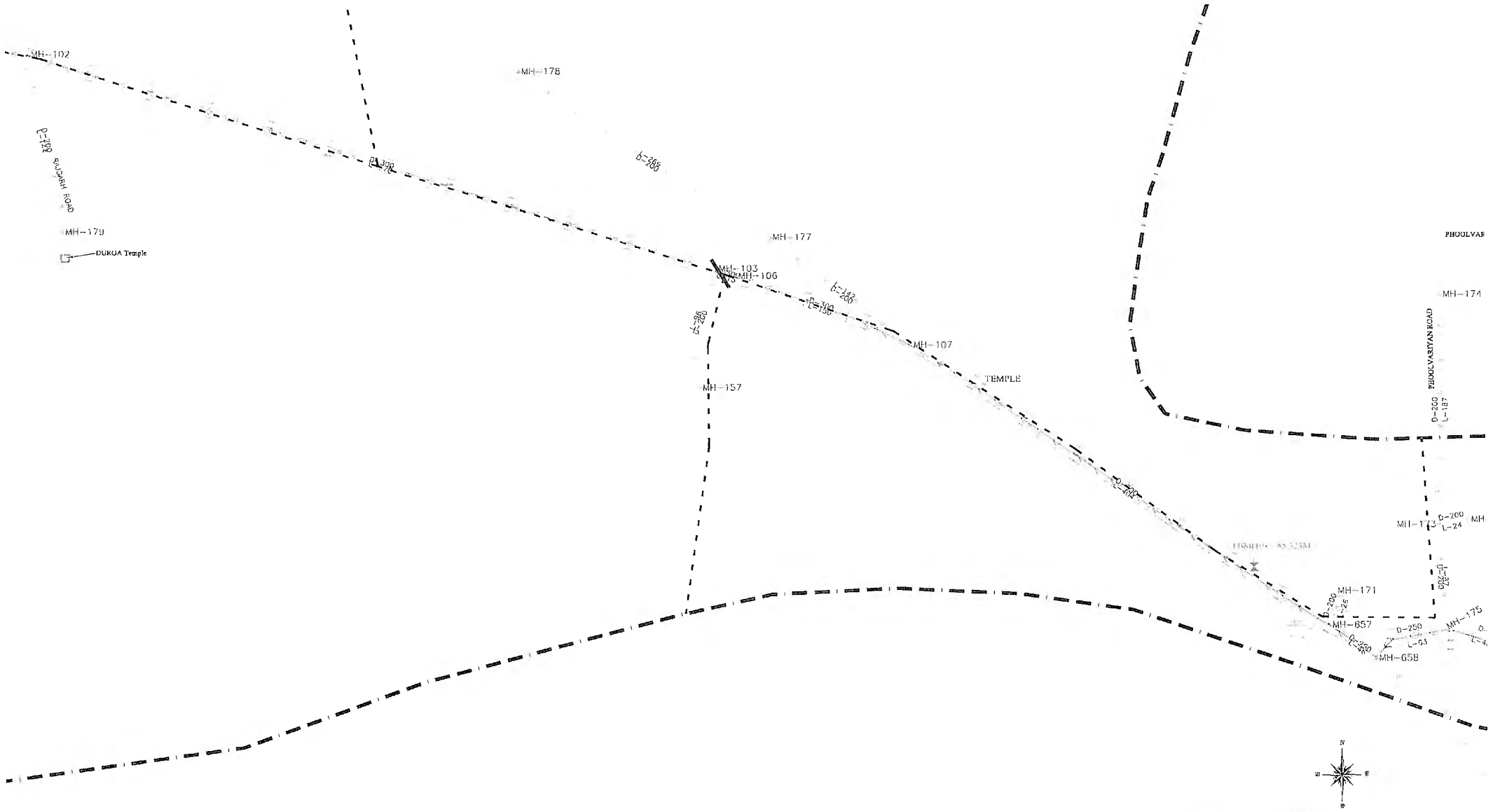
GTS =82 250 M TAKEN AT CHUNAR RAILWAY STATION.

SURVEYED BY: SPACE AGE CONSULTANTS
329, FASHION MALL, ROAD NO -43,
PITAMPURA, DELHI-110034
PH. 011-27011252 ,011-32946415
email : info@spaceage.co.in

SCALE - 1 . 500

DRG. NO. :SAC/ 1915

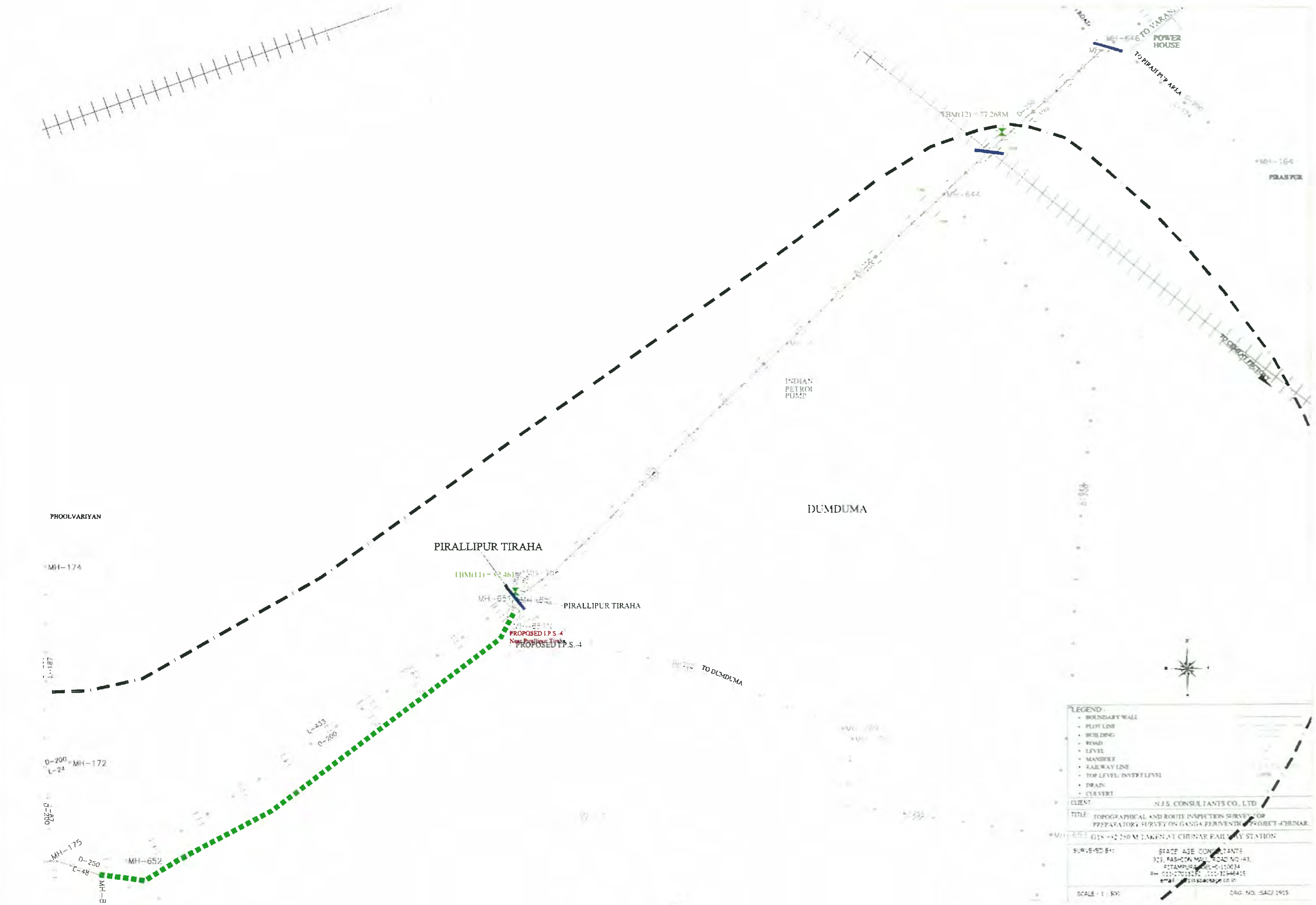
CULVERT
MH-230
MH-231
MH-218
MH-229
MH-12
MH-13
PROPOSED I.P.S.-1
Near Bharat Gas Godown
PROPOSED I.P.S.-1
MH-662
DRAIN
RAILWAY LAND
TO MUGHALSARAI
TO MIRZAPUR
TEMPLE
BHARAT PETROL PUMP
TBM(9) = 85.356M
POLICE BOOTH
MH-183
TO MIRZAPUR
TBM(8) = 78.874M
LEGEND:-
BOUNDARY WALL
PLOT LINE
BUILDING
ROAD
LEVEL
MANHOLE
RAILWAY LINE
TOP LEVEL/INVERT LEVEL
DRAIN
CULVERT
CLIENT
N.J.S. CONSULTANTS CO., LTD
TITLE
TOPOGRAPHICAL AND ROUTE INSPECTION SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENTION PROJECT -CHUNAR
SURVEYED BY
SPACE AGE CONSULTANTS
SCALE - 1 : 500



LEGEND:-

- BOUNDARY WALL
- PLOT LINE
- BUILDING
- ROAD
- LEVEL
- MANHOLE
- RAILWAY LINE
- TOP LEVEL/INVERT LEVEL
- DRAIN
- CULVERT

CLIENT:	N.J.S. CONSULTANTS CO., LTD.
TITLE:	TOPOGRAPHICAL AND ROUTE INSPECTION SURVEY FOR PREPARATORY SURVEY ON GANGA REJUVENTION PROJECT-CHUNAR.
	GTS =82.350 M TAKEN AT CHUNAR RAILWAY STATION.
SURVEYED BY:	SPACE AGE CONSULTANTS 329, FASHION MALL, ROAD NO -43, PITAMPURA, DELHI-110034 PH. 011-27011252 ,011-32946415 email : info@spaceage.co.in
SCALE - 1 : 500	DRG. NO. :SAC/ 1915


POWER HOUSE
PIRALLIPUR TIRAHA
PIRALLIPUR TIRAHA
DUMDUMA
PHOOLVARIYAN
INDIAN PETROL PUMP
PROPOSED I.P.S.-4
TO DUMDUMA
MH-174
MH-172
MH-175
MH-652
LEGEND
N.J.S. CONSULTANTS CO., LTD.

9. Saidpur

LIST OF BANCH MARKS ESTABLISHED AT SITE

SAIDPUR:-
TBM FOR ROUTE SURVEY = 72.863 M TRANSFERED FROM JOHAR GANJ CANAL (76.500 M-HFL)

SL. NO	BM	EASTING	NORTHING	LEVEL	LOCATION
1	TBM (1)	721803.693	2826516.24	72.863	FOUNDATION OF SIGNAGE BOARD NEAR POLICE STATION.
2	TBM (2)	723215.968	2825955.5	72.345	FOUNDATION OF SIGNAGE BOARD PAKKA GHAT.
3	TBM (3)	723627.233	2825839.19	69.855	FOUNDATION OF SIGNAGE BOARD

LEGEND:-

- ROAD
- BUILDING
- DRAIN
- LEVEL
- CULVERT

CLIENT: N.J.S. CONSULTANTS CO., LTD.

TITLE: TOPOGRAPHICAL ROUTE INSPECTION SURVEY FOR PREPARATORY SURVEY GANGA REJUVENATION PROJECT - SAIDPUR.

SURVEYED BY:

SPACE AGE CONSULTANTS
329, FASHION MALL, ROAD NO -43, PITAMPURA
DELHI-110034, PH. 011-27011252, 32946415
email:..info@spaceage.co.in

HFL=76.500 M TAKEN AT JOHARGANJ CANAL, SAIDPUR.

SCALE - 1 : 500 | DRG. NO. SAC/ 1922