Report on
Topographic and Bathymetric Survey of Reservoirs
for Water Resources Department, Govt. of Gujarat
at Saurashtra and Northern Gujarat Region, Gujarat

Tappar Reservoir

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ABBREVIATIONS

WRD	Water Resources Department
BM	Benchmark
C.M.	Central Meridian
CD	Chart Datum
cm	Centimetre
ddmm.mmm	Degrees minutes. decimal minutes
DGPS	Differential Global Positioning System
DTM	Digital Terrain Model
DSL	Dead Storage Level
FRL	Full reservoir Level
GPS	Global Positioning System
HSE	Health, Safety & Environment
ID	Identification name/number
IHO	International Hydrographic Organization
kHz	Kilohertz
km	Kilometre
KP	Kilometre Post
Lat	Latitude
LBM	Local Benchmark
Long	Longitude
m	Metre
MCum	Million Cubic Metre
MDDL	Minimum Drawdown Level
MSL	Mean Sea Level
MSqm	Million Square Metre
MV	Motor Vessel
NA	Not Applicable
NU	North Up
OSL	Outlet Sill Level
SOW	Scope of Work
SVP	Sound Velocity Profile
UTM	Universal Transverse Mercator projection
w.d.	Water depth
WGS84	World Geodetic System 1984

EXECUTIVE SUMMARY

Ocean Science & Surveying Pvt. Ltd. (OSaS) was contracted by Narmada Water Resources, Water Supply & Kalpsar Department (WRD) to carry out topographic and bathymetric surveys of thirteen reservoirs in the Saurashtra and Northern Gujarat region; namely Bhadar-1, Bhadar-2, Und-1, Machhu-1, Machhu-2, Khodiyar, Aji-1, Nara, Tappar, Rudramata, Mitti and Fatehgadh.

This report describes the results of the topographic and bathymetric survey services provided by OSaS to the WRD for topographic and bathymetric mapping of the Tappar reservoir, Kutch (Northern Gujarat) region, Gujarat.

Another reservoir with the same name - Tappar also exists at 23° 02' 36.63" N, 69° 40' 6.35" E in Kutch (Northern Gujarat) region. However, the client representative in the field has confirmed that the reservoir described in this report was the correct location to be surveyed.

The mobilisation of the equipment was begun on 09th July 2021. A DGPS consistency check was done on 09th July 2021 by establishing two reference stations (TBMs) using RTK systems. The topographic survey commenced on the 10th July at Tappar reservoir and completed on 20th July 2021.

The mobilisation of the survey boat SMB Ocean for the bathymetric survey was carried out on 09th July 2021. Initial system preparation and equipment checks were completed on the same day. Bathymetric survey commenced on 10th July and was completed on 14th July 2021.

The survey data was processed on the site on a daily basis and reporting and charting was completed in the OSaS data processing centre in Navi-Mumbai after the survey.

All the co-ordinates in the report and charts are referenced to WGS 84 datum, UTM projection, CM 69° east, zone 42, northern hemisphere.

All bathymetric data has been reduced to MSL using the observed average water level of each day during the survey period. Topographic data has been reduced to MSL using the TBMs established in the field with respect to the known level of HFL

The survey was carried out in daylight hours keeping in mind the safety of personnel and survey equipment.

The waste weir construction works for Tappar dam commenced in the year 1965 and were completed in the year 1967. Later between 2001 and 2002, vertical lift gates were constructed for Tappar Dam. The year of first impounding was done in 1967 with a gross storage of 48.810 M.cu.m at FRL (40.85m above M.SL) over a net catchment area of 283.60 sq.km. The dead storage at OSL (29.87m above MSL) as per the impound survey was 0.215 M.cu.m.

A silt survey was conducted in 1987 on Tappar dam which indicates a gross storage of 49.031 M.cu.m at FRL (40.85m above M.SL) and dead storage of 0.245 M.cu.m at OSL (29.87m above MSL).

In the current survey (2021) the gross storage at FRL (40.855m above M.SL) is found to be 46.893 M.cu.m and the dead storage at OSL (29.87m above MSL) is 0.010 M.cu.m.

Bathymetric and topographic survey was restricted at some places due to the presence of bushes, forest with thick vegetation and small streams with unsafe and inaccessible marshy ground.

In the current bathymetric and topographic survey, a minimum elevation of 29.5m was observed in the southeastern portion of the survey area within the bathymetric section. A maximum topographic elevation value of 46.68m is observed in the in the northweastern portion of the survey area.

The average elevation change within the bathymetric survey area is between 29.5m and 37.3m and average elevation change within the topographic area is between 34.60m and 46.68m.

The outer boundaries of the survey area are mapped with elevation contours between 46m and 42m. Medium to steep slopes are observed near the northwestern and northeastern boundaries between the elevation contours 46m and 40m, associated with slightly irregular topography. Further towards the water-occupied

area, from the 40m elevation contour to the 37m elevation contour, the topography is found to be gently sloping.

Most of the water-occupied bathymetric survey area lies below the 37m elevation contour. The gently sloping reservoir bed from northwest to southeast between the 37m and 30m elevation contours shows scattered depressions and humps. An island is mapped in the southern portion of the survey area with a change in elevation between 37m and 39m. A minimum elevation contour of 30m is observed in the southeastern part of this area, near to the dam wall.

The current survey data (2021) was compared with the original capacity data in 1967 and previous silt survey capacity data in 1987 separately.

The comparison between 1967 and 2021 (54 years) data shows a rate of siltation of 1.25 Ha.m/100sq.km./year. Annual percentage loss of gross storage capacity, live storage capacity and dead storage capacity are 0.07%, 0.07% and 1.77% respectively.

The comparison between 1987 and 2021 (34 years) data shows a rate of siltation of 2.22 Ha.m/100sq.km./year. Annual percentage loss of gross storage capacity, live storage capacity and dead storage capacity are 0.13%, 0.11% and 2.82% respectively.

The comparison of current and previous silt survey capacity data of the 1987 survey shows a decrease in capacity due to sediment deposit at both the dead storage area and live storage area. The capacity at OSL (29.87m) reduced from 0.245 M.cu.m to 0.010 M.cu.m between the years 1987 and 2021 with a loss in capacity of about 95.92%. The capacity at FRL (40.85m) decreased from 49.031 M.cu.m to 46.893 M.cu.m between the years 1987 and 2021 with a decrease in capacity of about 4.36%.

During the years 1987 to 2021, the increase of sediment deposit from the reservoir bed level to FRL and the corresponding reduction in capacity could be due to the abundant sediment inflow into the reservoir due to floods or erosion of reservoir banks above these levels. The amount of sediment deposited during this period up to OSL (29.87m) is 0.235 M.cu.m. The amount of sediment deposited during this period up to FRL (40.85m) is 2.138 M.cu.m.

1 INTRODUCTION

The Water Resources Department, Govt. of Gujarat is engaged in developing water reservoirs within the state of Gujarat, under a World Bank funding programme towards National Hydrology Projects of Govt. of India. Towards this end, the Water Resources Department, Govt. of Gujarat requires services for conducting bathymetric survey of reservoirs of Saurashtra and northern Gujarat regions under its National Hydrology Project.

Ocean Science & Surveying Pvt. Ltd. (OSaS) was contracted by Narmada Water Resources, Water Supply & Kalpsar Department (WRD) to carry out topographic and bathymetric surveys of thirteen reservoirs in the Saurashtra and northern Gujarat regions; namely Bhadar-1, Bhadar-2, Brahmani-1, Und-1, Machhu-1, Machhu-2, Khodiyar, Aji-1, Nara, Tappar, Rudramata, Mitti and Fatehgadh.

This report describes the results of the topographic and bathymetric survey services provided by OSaS to WRD for topographic and bathymetric mapping of the Tappar reservoir in Kutch (Northern Gujarat) region, Gujarat.

1.1 Background of survey area

Tappar reservoir is located near Village Tappar in Anjar Taluka of Kutch (Northern Gujarat) District in the Western Indian state of Gujarat. The Tappar dam is located on River Sakara. The Sakara river brings a major part of the water to the reservoir area. River Sakara provides a total catchment area of 324.78 sq.km and a net catchment area of 283.60 sq.km for the Tappar reservoir.

The average rainfall in the Sakara basin is 360.0mm. In winter, the average temperature varies between 16^0C and 24^0C in different parts of the region. April-May are the hottest months, when the average temperature varies between 26^0C and 38^0C.

The waste weir construction works for Tappar dam commenced in the year 1965 and were completed in the year 1967. Later between 2001 and 2002, vertical lift gates were constructed for Tappar Dam. It is a rolled field zone type earthen type dam. This dam fulfills its operating purpose of water supply efficiently.

1.2 General Location

The reservoirs of Saurashtra and Northern Gujarat region, under study in this project, are shown on the Google Earth image in **Figure 1**.

Figure 1: Survey areas/reservoirs of Saurashtra and Northern Gujarat regions

This report specifically focuses on the results of topographic and bathymetric survey of the Tappar reservoir situated within the Kutch (Northern Gujarat) region, shown in the Google earth image below:

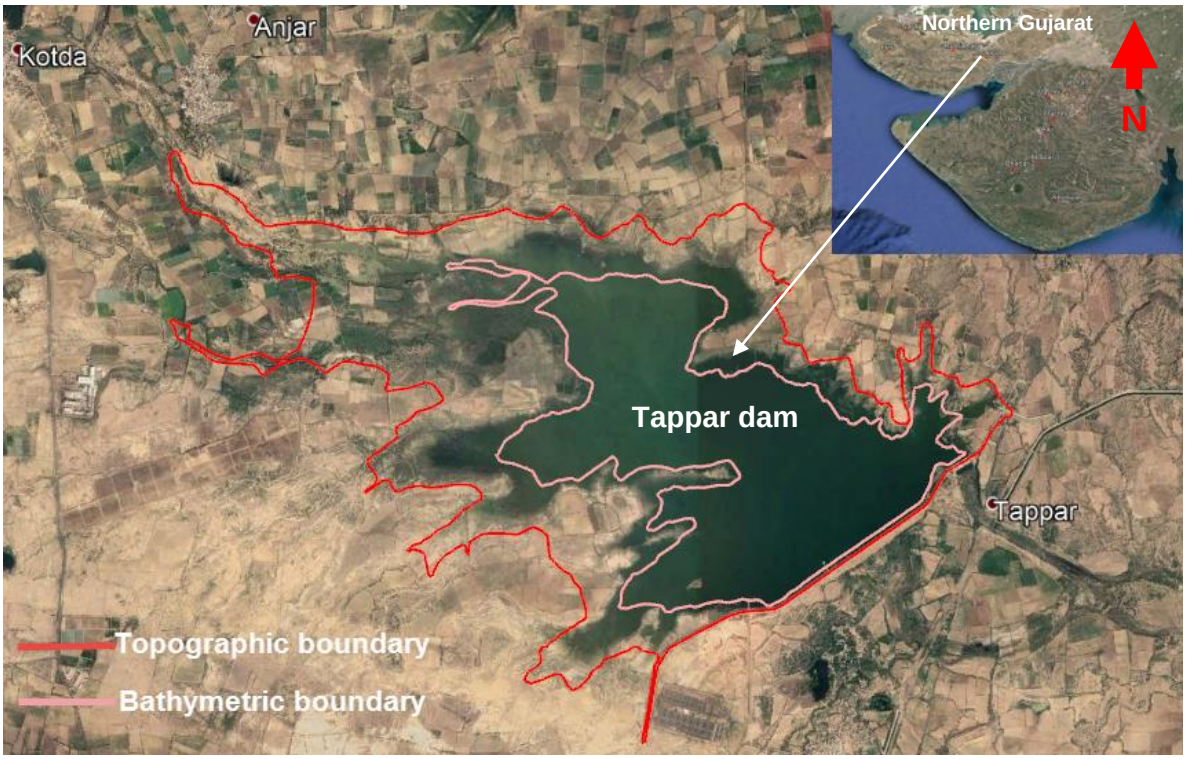


Figure 2: Survey area – Reservoir Tappar

2 SCOPE OF WORK

The scope of work for the survey was:

- To mobilize requisite topographic equipment and personnel at the sites specified by the client.
- To mobilize a suitable vessel along with requisite bathymetric equipment and personnel at the sites specified by the client.
- To carry out topographic and single beam echo sounder bathymetric survey in the specified areas.
- To estimate and study the sedimentation behaviour of the reservoirs in different zones including horizontal zones throughout the reservoirs as well as vertical zones namely (a) dead storage (b) live storage (c) flood storage, if any.
- The integrated bathymetric system will be used to collect data on depth and bottom topography of the reservoirs and rivers. Primary application is reservoir sedimentation surveying; products will be reservoir capacity figures as a function of depth, depth contours and bottom topography change over time.
- To upgrade elevation-area-capacity tables /curves of the reservoirs.
- To prepare contour plan, Longitudinal profile (L-section), Cross section profiles...etc.

2.1 Salient features of Survey Area

The Tappar dam is basically a water supply scheme located on River Sakara in the Kutch (Northern Gujarat) region, in the Western Indian state of Gujarat. The waste weir construction works for Tappar dam commenced in the year 1965 and were completed in the year 1967. Later between 2001 and 2002, vertical lift gates were constructed for Tappar Dam.

A reservoir with same name Tappar is exists at 23° 02’ 36.63” N, 69° 40’ 6.35” E in Kutch (Northern Gujarat) region. The reliability of to be surveyed reservoir had been confirmed with the client on field.

The following salient features of Tappar reservoir are extracted from the document provided by the client:

a. Location
   Latitude : 23˚ – 15’ – 00” N
   Longitude : 70° – 08’ – 00” E
b. Total Catchment Area : 324.78 sq.km
c. Net Catchment Area : 283.60 sq.km
d. Full Reservoir Level (FRL) : 40.85 m
e. High Flood Level (HFL) : 41.90 m
f. Minimum Draw Down Level (MDDL/OSL) : 29.87 m

Capacity as per impounding survey in 1967

a. Gross Storage : 48.810 M.cu.m
b. Dead Storage : 00.215 M.cu.m
c. Live Storage : 48.595 M.cu.m

Capacity as per silt survey in 1987

a. Gross Storage : 49.031 M.cu.m
b. Dead Storage : 00.245 M.cu.m
c. Live Storage : 48.786 M.cu.m

2.2 Survey Design

The topographic and bathymetric survey lines were planned and executed at intervals of 25m throughout the area of survey. Topographic survey was conducted using RTK base and rover system. The limit of

topographic survey was up to the H.F.L of the reservoir, which is 41.90m (137.47ft.) above MSL, as provided by the client. The bathymetric survey was conducted using RTK positioning system and single beam echo sounder. The topographic and bathymetric surveyed areas (in sq.km) for the Tappar reservoir are provided in **Table 1** below.

Name of Reservoir	Bathymetric area surveyed (sq. km.)	Topographic area surveyed (sq.km.)
Tappar	5.10	5.13

Table 1: Surveyed areas for Tappar reservoir

3 SURVEY CONTROL

3.1 Geodesy

The survey operations were conducted in WGS 84 Spheroid, Universal Transverse Mercator projection system, based on the geodetic parameters as presented below. All co-ordinates given within this document are with reference to it.

GEODETIC PARAMETERS	
Satellite Datum	
Datum, Spheroid	WGS-84
Semi-Major Axis	6378137.000 m
Semi Minor Axis	6356752.314 m
Inverse Flattening	298.2572
Projection Parameters	
Grid Projection	Universal Transverse Mercator
Latitude of Origin of Projection	0° (Equator)
Longitude of Origin of Projection	69° E, Zone 42 North
Hemisphere	North
False Easting (metres)	500000 E
False Northing (metres)	0
Scale Factor on CM	0.9996
Units	Metres

Table 2: Geodetic Parameters

3.2 Horizontal and vertical Control

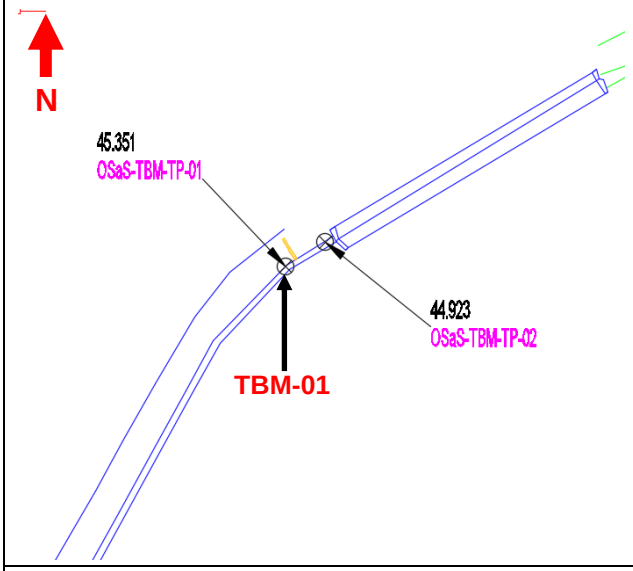
3.2.1 Topographic survey

Two reference stations were established as temporary control points/temporary benchmarks (TBM). The levelling of these TBMs was carried out using an auto level with respect to the known level of HFL which is given as 41.90m (137.47ft.) above MSL, as provided by the client. The base stations of the RTK were set up at these positions and two-hour long continuous observations were conducted using a Hemisphere RTK positioning system to fix the consistency of the position for horizontal control. The system provides real time correction signals, providing centimetre level accuracy. Topographic survey was conducted by keeping the rover in range with respect to the base station.

The details of the reference stations OSaS-TBM-TP-01 and OSaS-TBM-TP-02 are given in **Figure 3** and **Figure 4** respectively.

Station Number:	OSaS-TBM-TP-01	**Latitude:**	23° 15' 28.044" N
Locality:	Tappar, Gujarat	**Longitude:**	70° 08' 36.525" E
Geodetic Datum:	WGS84	**Northing:**	2572518.42 m N
Projection:	Universal Transverse Mercator	**Easting:**	616967.16 m E
Date:	09th July 2021	**Elevation:**	45.351 m above MSL
Station Description:	A circle with text OS-TBM-TP-1 is drawn with yellow paint on the top of the dam wall, at the eastern end of the reservoir.		
Access:	TBM-01 is accessible by the road from Tappar village towards the dam gates. The TBM-01 is situated on the top of the dam wall, at the eastern end of the reservoir.		

Sketch:



Map:

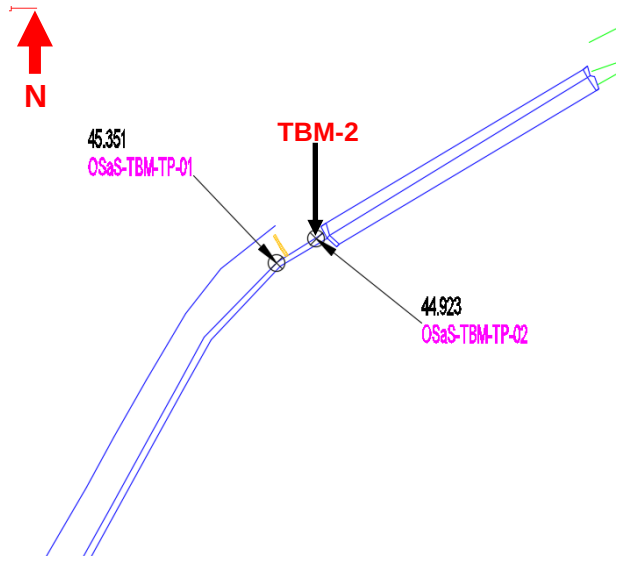
Photo:

Photo:

Figure 3: Details of OSaS-TBM-TP-01

Station Number:	OSaS-TBM-TP-02	**Latitude:**	23° 15' 28.466" N
Locality:	Tappar, Gujarat	**Longitude:**	70° 08' 37.278" E
Geodetic Datum:	WGS84	**Northing:**	2572531.57 m N
Projection:	Universal Transverse Mercator	**Easting:**	616988.45 m E
Date:	09th July 2021	**Elevation:**	44.923 m above MSL
Station Description:	A circle with text OS-TBM-TP-2 is drawn with yellow paint on the top of the dam wall, at the eastern end of the reservoir.		
Access:	TBM-02 is accessible by the road from Tappar village towards the dam gates. The TBM-02 is situated on the top of the dam wall, at the eastern end of the reservoir. TBM-02 is located approximately 21.5m NE of TBM-01.		

Sketch:



Map:

Photo:

Photo:

Figure 4: Details of OSaS-TBM-TP-02

3.2.2 *Bathymetric survey*

The same two reference stations, established as temporary control points/temporary benchmark (TBM) for topographic survey were also used as the base stations for RTK positioning during the bathymetric survey. The rover fixed in the survey boat can receive calculated X Y Z of its position at any point with centimetre level accuracy with respect to the known base positions. The details of these reference stations are given in **Figure 3** and **Figure 4**.

The water level of the reservoir with respect to the known level of HFL, which is given as 41.90m (137.47ft.) above MSL, was measured twice a day during the survey. The mean value of these two readings was taken as the datum for the day's work. The depths recorded by the echo sounder were deducted from these levels to obtain the bed levels with respect to M.S.L. The observed water levels are given in **Table 3.**

Date	Water level				
	Start		End		Average level in metres (MSL, m)
	Time (AM)	Level (MSL, m)	Time (PM)	Level (MSL, m)	
10-07-2021	10:00	37.91	4:00	37.90	37.905
11-07-2021	10:00	37.89	4:00	37.88	37.885
12-07-2021	10:00	37.87	4:00	37.86	37.865
13-07-2021	10:00	37.85	4:00	37.84	37.845
14-07-2021	10:00	37.83	4:00	37.82	37.825

Table 3: Observed Water Levels

3.3 Survey Vessel

A company owned boat, SMB Ocean, was utilised for conducting the survey operations.

Figure 5: Survey vessel – SMB Ocean

4 PERSONNEL

The following survey personnel were involved during the survey period.

Name	Designation	Duration
Santokh Chand	Project Manager	Project Duration (In Navi-Mumbai office)
Salman Khan	Party Chief / Surveyor	08th - 20th July 2021
Pankaj Rabary	Survey Engineer	08th - 20th July 2021
Gaurav Sharma	Survey Engineer	09th - 20th July 2021
Manoj More	Surveyor	09th - 20th July 2021
Mr. V. V. Damor	Client Representative	Project duration

Table 4: Survey Personnel

5 SURVEY EQUIPMENT DETAILS

5.1 General

The equipment used for the survey is described below.

Bathymetry:

- Hemisphere GPS S320 GNSS RTK Base and Rover system with accessories
- Odom MK III dual frequency single beam echo sounder system with accessories
- TSS HS50 heave sensor
- Hypack navigation system
- 2 x computers with associated accessories

Topography:

- Hemisphere GPS S320 GNSS RTK Base and Rover system with accessories
- Geomax Auto Level with accessories.

Adequate spares and back-ups for critical items will be carried on board the survey vessel to ensure that failure of any hardware unit does not adversely affect progress of field work.

5.2 RTK Positioning and Navigation

An RTK system was mobilised at the site to carry out the topographic and bathymetric survey. The system comprises the following:

- Hemisphere GPS R320 GNSS base station
- Hemisphere GPS R320 rover

The base station of the RTK was set up at the temporary benchmark. Real Time Kinematic (RTK) is a technique used to increase the accuracy of GPS signals by using a fixed base station which wirelessly sends out corrections to a moving receiver. By utilising these corrections, the GPS engine can fix the position of the antenna to within 1-2cm. GPS Real-Time Kinematic (RTK) operation provides centimetre-level accuracy by eliminating errors that are present in the GPS system. For obtaining corrected positions, a rover receiver and a source of corrections from a base station were used.

Vessel positioning was carried out by the RTK DGPS system and its heading determined by the course made good method (CMG). The positioning system was interfaced to the Hypack navigation software. Vessel track and offset positions were recorded digitally in the navigation software. DGPS positioning accuracy of the moving vessel was better than ±1m.

The vessel's computed position from the DGPS receiver was interfaced to the navigation computer system. Hypack navigation and data acquisition software was used to provide track guidance information for the survey crew and also output the vessel position to assist the helmsman in maintaining the selected track guidance line. The VDU displays the selected survey line, the vessel position in relation to that line and numerical data to assist the helmsman such as the along-line and off-line distances, vessel speed and course made good, gyro heading, distance and bearing to end of line and water depth. The position of each fix, together with other information such as fix numbers, depths, and down line distances were logged to the hard drive.

Sensor offsets on the survey vessel were accurately measured during mobilisation and are included in the mobilisation report.

5.3 Single Beam Echo Sounder System

Bathymetric data was acquired using a dual frequency 33/200 kHz Echotrac DF 3200 MK III single beam echo sounder. The SBES transducer assembly was side-mounted on a pole on the port side of the boat. A hard copy (paper) record was produced in real-time, annotated with line name, fix number, time and date. The digital output was logged by the navigation computer for post-processing.

Calibration

The echo sounder was calibrated at the survey location by conducting a bar-check. The bar-check is carried out by lowering a horizontal steel plate to known, fixed depths below the water surface directly below the echo sounder transducer. Acoustic reflections from the plate at different depths are then recorded and adjustments made to the settings for sound velocity and draft to get accurate results. A bar-check was carried out before commencing the survey and the average speed of sound obtained was entered into the unit.

5.4 Heave Sensor

An MRU-PD heave sensor was fixed on the deck of the boat about 0.5m ahead of the COG. Its output was given to the SBES unit.

5.5 Auto Level Geomax

A Geomax Auto Level was used to establish the local benchmark by transfer and to level the TBM with respect to the known level of HFL at 41.90m (137.47ft) above M.S.L, as provided by the client.

5.6 Real Time Kinematic (RTK) For Topographic Survey

A Hemisphere R320 GNSS RTK system with base station and rover was used to conduct the survey. Base stations were established with respect to HFL at the TBM and rover used to fix the positions. This is a positioning system which can measure and calculate the X Y Z of any given point with centimetre level accuracy with respect to the known base positions. An AutoCAD drawing can be generated with the help of the XYZ values obtained from this equipment.

5.7 HyPack Software

Navigation data was processed using the Hypack navigation software. Single beam data from the Echotrac DF 3200 MK III echo sounder was also processed using the Hypack software. Hypack provides all of the tools necessary to complete the hydrographic survey requirements. It provides a tool to design a survey, collect data, apply corrections to soundings, remove outliers, plot field sheets, export data to CAD, compute volume quantities, generate contours, create side scan mosaics and create/modify electronic charts.

6 DATA PROCESSING AND INTERPRETATION

This section explains the established terminology and standards for the project and how they were applied to the survey data.

6.1 Navigation Data

Raw DGPS and gyro data were processed and merged to form an edited vessel track file. The final navigation data was reviewed in AutoCAD to confirm the validity of the vessel's position and to aid in the correlation between navigation data and chart location.

The survey track plots were then used for data interpretation and generation of the survey charts.

6.2 Bathymetric Data

Single beam data from the Echotrac DF 3200 MK III echo sounder was processed using the Hypack navigation package. The vertical datum for all bathymetric measurements was the known MSL value of HFL. The depth soundings obtained from the single beam echo sounder were reduced to MSL with the help of the observed water level in the reservoir.

Recorded depth data was adjusted for transducer draft and changes in water mass acoustic velocity as measured during the bar-check.

Lakebed Gradient Classification

The following terms were used to describe the lakebed gradients.

CLASSIFICATION	GRADIENT (in terms of Degrees and Slope Interval)	
Very Gentle	<1°	< 1 in 57
Gentle	1° – 4.9°	1 in 57 to 1 in 11.7
Moderate	5° – 9.9°	1 in 11.7 to 1 in 5.7
Steep	10° – 14.9°	1 in 5.7 to 1 in 3.7
Very Steep	>15°	> 1 in 3.7

Table 5: Classification of gradients

Gradients documented in the report should be taken as an indication of general slopes for the area. The localised gradients, particularly near features such as depressions or trenches may occasionally be steeper.

Following the data processing and interpretation phase, the charts were prepared at the OSaS data processing centre, in Navi Mumbai. A team comprising a bathymetry data processor, CAD processor and geophysicist prepared the report and accompanying charts to WRD's specifications.

6.3 Topographic Data

A Hemisphere R320 GNSS RTK system with base station and rover was used to conduct the survey. This is a positioning system which can measure and calculate the X Y Z of any given point with centimetre level accuracy with respect to the known base positions. The data is downloaded from the controller system, processed in the OSaS Data Processing Centre in Navi Mumbai and formatted to a compatible ASCII format for plotting in AutoCAD.

6.4 Charting

The results of this survey are presented in ten charts. They consist of the following:

- One overview chart displaying a 2-dimensional image of bathymetry and topography
- One contour map displaying elevation contours at 1m intervals
- Two charts showing topography and bathymetry of the surveyed area
- One longitudinal profile along the lowest elevation line within the surveyed area
- Five charts showing cross section profiles at 100m intervals within the surveyed area.

Their details are listed after the List of Annexures at the beginning of this report.

7 SURVEY RESULTS

7.1 Overview and Contour Charts

One chart each has been prepared for an overview of the surveyed area as well as elevation contours at 1m intervals, as described in Section 6.4 **Charting**. These charts also show the boundary between the bathymetric and topographic surveys.

7.2 Bathymetry and Topography

The bathymetric elevations mentioned in this report and associated charts have been reduced to Mean Sea Level (MSL) using the observed average water level of the Tappar reservoir for the corresponding survey day. The topographic elevations are with respect to the known level at HFL, above MSL (41.90m). Hence, all the bathymetric and topographic values mentioned in this report are with respect to MSL

The MSL-reduced bathymetric and topographic data are plotted in 1:5000 scale in a 25m X 25m grid. A total of two charts were created for the purpose of plotting bathymetric and topographic data. For more details refer to Section 6.4 **Charting**.

The RTK positioning accuracy is metric, resulting in a similar positioning accuracy of single beam echo sounder data since the sensor was side-mounted on the vessel.

The following observations are obtained after the processing and interpretation of all the bathymetric and topographic data acquired during the entire period of survey.

Tappar dam is constructed across Sakara river, situated in the eastern part of the survey area. Sakara river exists in the northern part of the survey area, bringing a considerable amount of water to Tappar reservoir. In addition, a number of medium and small sized rivers and streams bring water to the dam area.

A minimum elevation of 29.5m was observed in the southeastern portion of the survey area within the bathymetric section. A maximum topographic elevation value of 46.68m is observed in the northwestern portion of the survey area.

Skara river generally flows from west to east. In the central and southeastern portions of the survey area, the reservoir occupies a large area of the reservoir bed to store its water. The average elevation change within the bathymetric survey area is between 29.5m and 37.3m.

The processed topographic data shows that the land is sloping from all the sides of the survey area towards the river channels and dam area. The average elevation change within the topographic area is between 34.60m and 46.68m. An elevated area is observed in the southern part of survey area associated with an island, within the water occupied area. Features like road, check dam, canal, bridge and bund are observed within the topographic survey area. The Tappar dam wall is located in the southeastern portion of the survey area.

The outer boundaries of the survey area are mapped with elevation contours between 46m and 42m. Slightly irregular topography is observed near the northwestern and northeastern boundaries of the survey area with a change in elevation between 46m and 40m, associated with scattered elevated lands. Medium to steep slopes are observed between elevation contours 46m and 40m. Further towards the water-occupied area, from the 40m elevation contour to the 37m elevation contour, the topography is seen to be gently sloping. In the extreme southeastern portion of the survey area, steep slopes are observed from the top of the dam to the water-occupied area with a change in elevation contours between 42m and 35m.

Most of the water-occupied bathymetric survey area lies below the 37m elevation contour. The reservoir bed is seen to be sloping gently from northwest to southeast between the 37m and 30m elevation contours. Scattered depressions and humps are observed on the reservoir bed. An island is mapped in the southern portion of the survey area with a change in elevation between 37m and 39m. A minimum

elevation contour of 30m is observed in the southeastern part of this area, near to the dam walls.

Bathymetric and topographic survey was restricted at some places due to the presence of small streams with unsafe and inaccessible marshy ground, bushes and forest with thick vegetation.

The following **Figure 6** shows a 2-dimensional image of the Tappar reservoir area using the gridded bathymetric and topographic data.

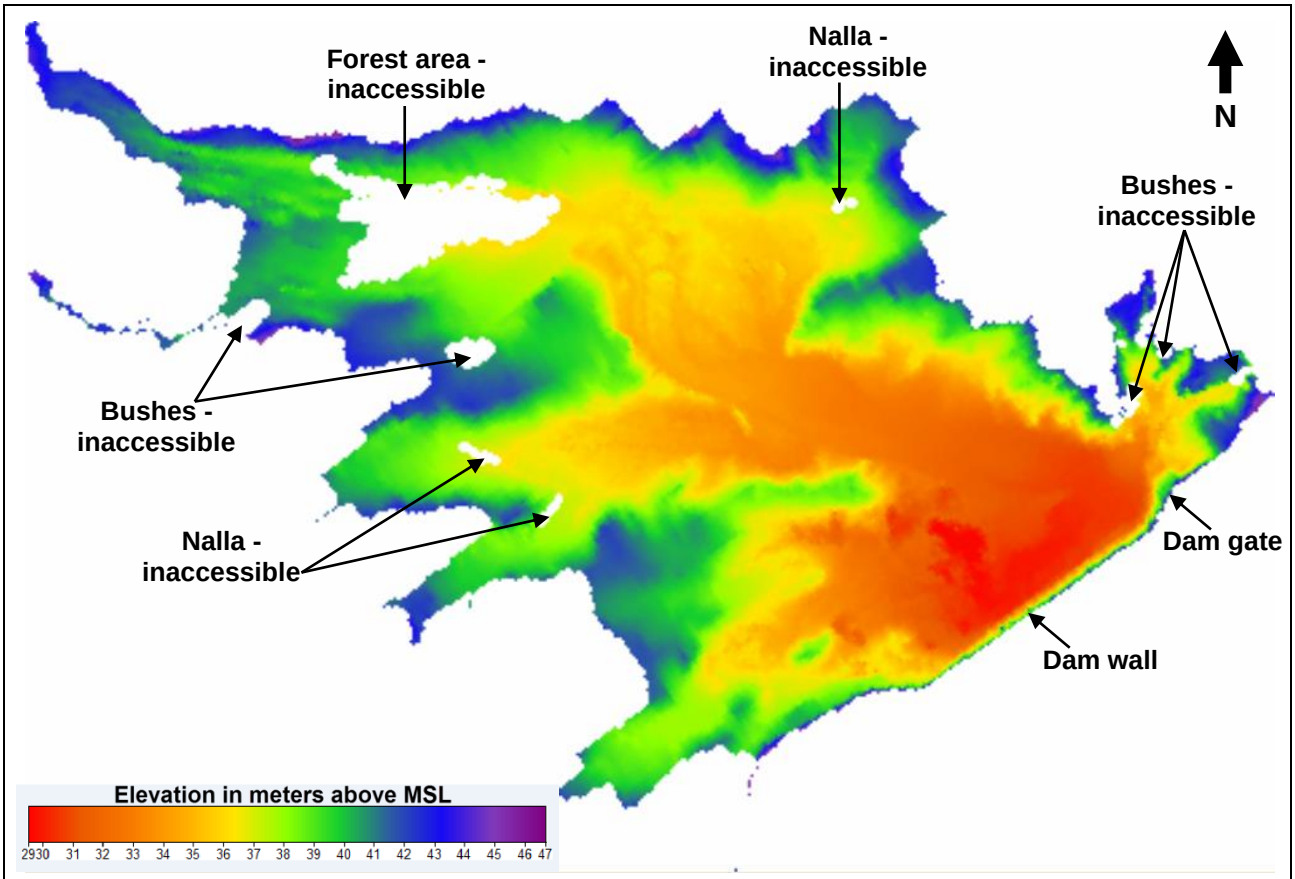


Figure 6: 2D image of the Tappar reservoir area

7.3 Longitudinal Profile

A longitudinal profile of the reservoir was prepared from the line created by connecting the lowest bed level for each survey line. For more details refer to the charts listed in the section on **Charting**.

7.4 Cross Section Profiles

Cross section profiles consist of the bed levels along the survey lines at 100m intervals. The cross-section profiles will also be provided in a Compact Disk/USB as per the instructions mentioned for deliverables. For more details refer to the charts listed in the section on **Charting**.

8 CAPACITY SURVEY RESULTS

8.1 General

It is natural for lakes and reservoirs to trap a major part of the sediment brought into them by the streams in the catchment. Sedimentation of reservoirs is therefore a natural process resulting from the geologic and geo-morphologic processes of water borne erosion.

Sedimentation of reservoirs leads to a gradual loss of their storage capacities available for regulation of supplies. Apart from this, it can cause operational problems created by the entry of large volumes of sediments in the canals or in the turbines, as also due to jamming of hydraulic gates. Reservoir sedimentation can also cause ecological problems due to turbidity, and due to gradual delta formation at the upstream end of the reservoirs. Therefore, sedimentation of reservoirs is a matter of vital concern in all water resources development projects.

The two dominant factors which influence the rate of silting in any storage reservoir are: (i) the relationship of capacity to inflow and (ii) the content of sediment in the inflow. The other factors that modify the long-term loss of storage capacities are (a) the trap efficiency of the reservoir, (b) the character of the sediment, and (c) the method of reservoir operation. Basically, these three factors mentioned are modifiers and do not usually have a major effect as compared to the capacity-inflow ratio and the sediment content in the inflow.

It is generally recommended to carry out capacity survey of reservoirs periodically so that the quantity of sedimentation taking place can be assessed and timely remedial measures taken. This also serves as a guide for proper sedimentation planning of future reservoirs to ensure that the reservoir sedimentation does not cause unexpected problems in the useful operation of the reservoir.

The capacity surveys in general, show that the observed rate of sedimentation is higher than the rate of sedimentation adopted in the original designs. However, it is observed that the rate of sedimentation decreases with the passage of time and the useful life of the reservoir may not get unduly reduced in most cases.

8.2 Effect of Sedimentation in Planning of Reservoirs

It is important to note that storage reservoirs built across rivers and streams lose their capacity on account of deposition of sediment. This deposition, which takes place progressively in time, reduces the active capacity of the reservoir to provide the outputs of water through the passage of time. Accumulation of sediment at or near the dam may interfere with the future functioning of water intakes and hence affects decisions regarding location and height of various outlets. It may also result in greater flow of water into canals / water conveyance systems drawing water from the reservoir. Problems of rise in flood levels in the head reaches and unsightly deposition of sediment from a recreation point of view may also crop up in the course of time.

In this regard, the Bureau of Indian Standards code IS: 12182 - 1987 “Guidelines for determination of effects of sedimentation in planning and performance of reservoir” is an important document which discusses some of the aspects of sedimentation that have to be considered while planning reservoirs. Some of the important points from the code are as follows:

While planning a reservoir, the degree of seriousness and the effect of sedimentation at the proposed location have to be judged from studies, which normally consist of a combination of:

1. Performance Assessment (Simulation) Studies with varying rate of sedimentation.
2. Likely effects of sedimentation at the dam face.

In special cases, where the effects of sedimentation on backwater levels are likely to be significant, backwater studies would be useful to understand the size of river water levels. The steps to be followed

for performance assessment studies with varying rates of sedimentation are as follows:

a. Estimation of annual sediment yields into the reservoir or the average annual sediment yield and of trap efficiency expected.

b. Distribution of sediment within the reservoir to obtain a sediment elevation and capacity curve at any appropriate time.

8.3 Earlier Capacity Survey

8.3.1 Capacity at the time of impounding (1967)

The waste weir construction works of Tappar dam commenced in 1965 and were completed in 1967. The first impounding was completed in 1967. The elevation-capacity data at the time of impounding are available in the document provided by the client. Capacity at OSL (29.87m above MSL) and FRL (40.85m above MSL) are 0.215 M.cu.m and 48.810 M.cu.m respectively.

The details of previous data are given in **Annexure 3**.

8.3.2 Capacity survey of 1987

The data provided by the client states that a capacity survey had been conducted on Tappar dam in 1987. The provided document contains the capacity details obtained after 1987 silt survey from 28.65m above MSL to 40.85m above MSL at intervals of 0.1m.

For ease of further calculations and preparation of elevation-capacity curves, the elevation-capacity data have been extracted from the provided document at intervals of approximately 0.5m, from 28.65m to 40.85m (FRL). **Table 6** shows the elevation-capacity at these intervals.

The details of this previous data are given in **Annexure 3**.

8.3.3 Capacity survey of 2021

The water spread area and its corresponding capacity has been calculated from the acquired bathymetry and topographic data. Hypack software's TIN (Triangulated Irregular Network) MODEL package was used to calculate the Area and Capacity of the Tappar reservoir at intervals of 0.01m with respect to the corresponding elevation above MSL. Within the survey area a few places were not accessible to the survey personnel due to the existing marshy streams, bushes and forest with thick vegetation areas. However, these areas with elevations below FRL were taken into account while calculating the water spread area by assigning interpolated values with respect to the acquired values around the restricted areas.

The depths recorded by the echo sounder were reduced to obtain the bed levels (bathymetry data) with respect to MSL for the entire surveyed area. The data obtained from the topographic survey was then merged with the bathymetric data to output a single xyz file for the entire surveyed area. Using the Hypack software a TIN (Triangulated irregular network) model was generated from this single xyz file. Further, using the 'TIN to level' option in Hypack software, the required range of levels (minimum and maximum water levels) and the desired interval (in this case 0.01m) at which the capacity/volume and area output is required were input in the software. Finally, a text file was generated by the software which contains all the information on the volume/capacity and area obtained at the specified elevation interval (0.01m) in the reservoir.

The detailed elevation-area-capacity data at 0.01m is available in **Annexure 1**. For ease of further calculations and preparation of elevation-area-capacity curve, the data has been selected at regular intervals of approximately 0.5m from 29.87m (OSL) to 40.85m (FRL).

Table 6 shows the elevation-area-capacity at these intervals.

8.4 Elevation-Area-Capacity Curves

One of the most important physical characteristics of dams and their reservoirs are elevation-area-capacity curves. These curves are important for defining the storage capacity of the reservoir and thereby can be used in reservoir operation, reservoir flood routing, determination of capacity and water spread corresponding to each elevation.

The required elevation-capacity data (1987) are available in the document provided by the client at intervals of 0.1m from 28.65m above MSL to 40.85m above MSL.

The current survey was conducted in 2021 and the data is provided at intervals of 0.01m.

For ease of further calculations and preparation of elevation-area-capacity curve, current survey data in 2021 and the silt survey data in 1987 have been selected at regular intervals of approximately 0.5m.

The following **Table 6** shows the comparative statement of previous silt survey data (1987) and current silt survey data (2021).

Elevation (Above MSL, m)	As per 1987 survey	As per 2021 survey		Remarks
	Gross Capacity (M.cu.m)	Area (M.sq.m or sq.km)	Gross Capacity (M.cu.m)	
28.65	0.005	0.0000	0.000	
29.00	0.014	0.0000	0.000	
29.50	0.147	0.0000	0.000	
29.87	**0.245**	**0.052**	**0.010**	**MDDL/OSL**
30.00	0.280	0.086	0.018	
30.50	0.641	0.287	0.112	
31.00	1.003	0.603	0.332	
31.50	1.451	0.928	0.716	
32.00	1.899	1.206	1.254	
32.50	2.957	1.417	1.907	
33.00	4.015	1.698	2.683	
33.50	5.316	2.017	3.612	
34.00	6.617	2.353	4.700	
34.50	8.231	2.688	5.959	
35.00	9.846	3.095	7.399	
35.50	11.773	3.589	9.065	
36.00	13.700	4.215	11.012	
36.50	16.102	5.004	13.310	
37.00	18.504	5.699	16.008	
37.50	21.623	6.149	18.969	
38.00	24.743	6.733	22.177	
38.50	28.194	7.299	25.679	
39.00	31.645	7.994	29.502	

Elevation (Above MSL, m)	As per 1987 survey	As per 2021 survey		Remarks
	Gross Capacity (M.cu.m)	Area (M.sq.m or sq.km)	Gross Capacity (M.cu.m)	
39.50	35.960	8.708	33.676	
40.00	40.275	9.527	38.232	
40.50	45.425	10.319	43.193	
40.85	**49.031**	**10.810**	**46.893**	**FRL**

Table 6: Comparative statement of Tappar reservoir

The above data was used for the preparation of elevation-area-capacity curves. The following **Figure 7** shows the elevation-area-capacity curves of 2021 superimposed on the elevation-capacity curves of 1987 silt survey.

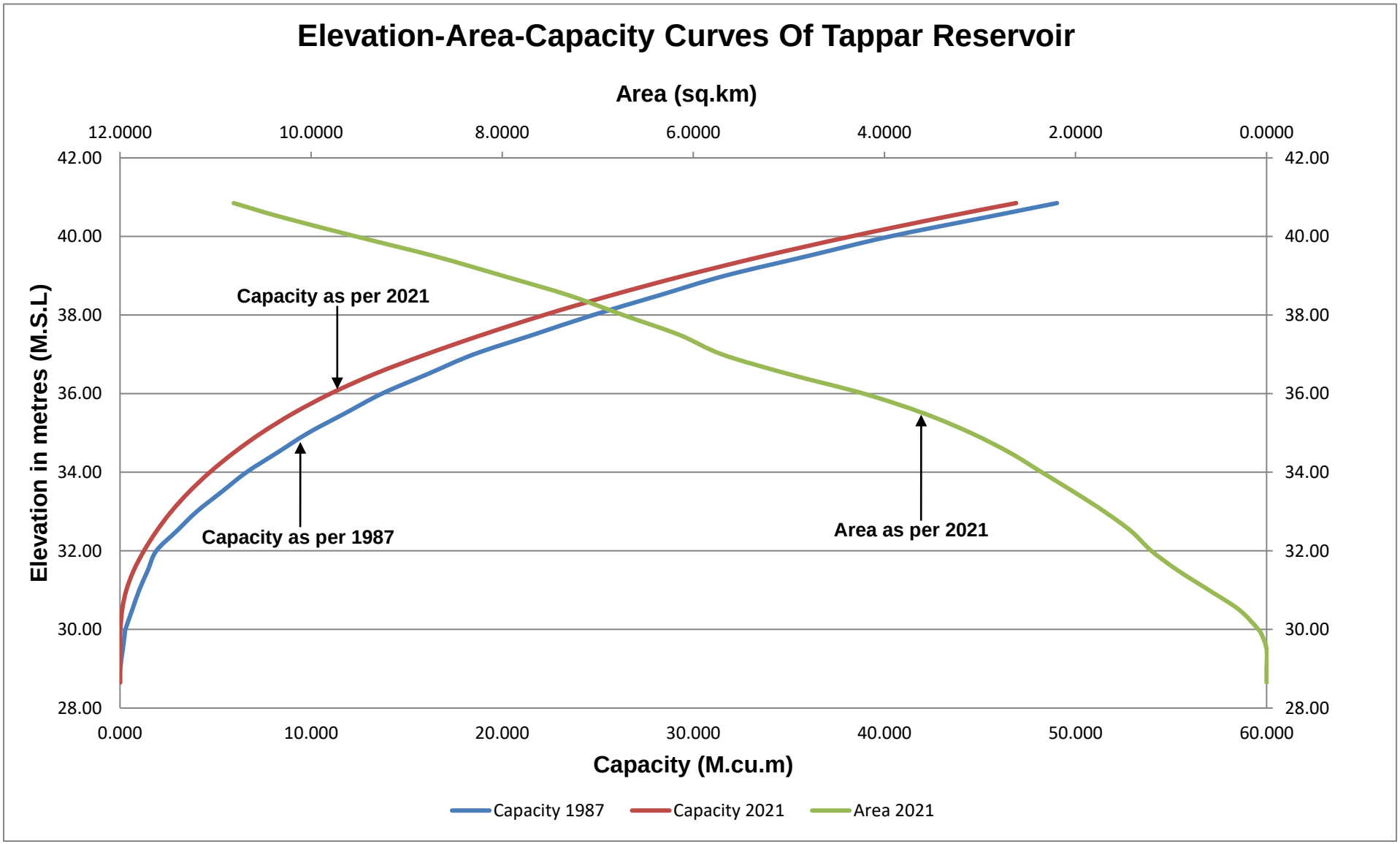


Figure 7: Elevation-Area-Capacity Curves

8.5 Data comparison between 1967 and 2021

Definitions

Full Reservoir Level: Denoted by FRL this level corresponds to the storage which includes both inactive and active storage and also the flood storage, it is the highest reservoir level that can be maintained without spillway discharge.

Minimum Drawdown Level (MDDL): This is the level below which the water from the reservoir will not be drawn down to maintain a minimum head required in power projects.

Maximum Water Level (MWL*)*: This is the water level that is likely to be attained during the passage of the design flood. This level is also called the highest reservoir level or the highest flood level**.**

Live storage: This is the volume of water actually available at any time between the Dead Storage Level and the Full Reservoir Level.

Outlet Sill Level (OSL) / Dead Storage Level (DSL): This is the level below which there is no outlets to drain the water in the reservoir by gravity.

Dead storage: This is the total storage below the invert level of the lowest discharge outlet from the reservoir. It may be available to contain sedimentation, provided the sediment does not adversely affect the lowest discharge.

8.5.1 Rate of siltation

The decrease of storage and rate of siltation calculations are based on the following basic data.

i) The catchment area of the reservoir is 283.60 sq.km.

ii) The FRL of the reservoir is given as 40.85m.

iii) The dead storage level/Outlet sill level of the reservoir is at 29.87m.

The results obtained after comparing the survey data of the year 1967 with that of 2021 are provided below:

Capacity at FRL (40.85m) as per the 1967 impounding survey	= 48.810 M.cu.m
Capacity at FRL (40.85m) as per 2021 survey	= 46.893 M.cu.m
Siltation in 54 years (1967-2021)	= 48.810 – 46.893
	= 1.917 M.cu.m
Annual siltation	= 1.917/54 = 0.036 M.cu.m/yr
Rate of siltation (Siltation index)	= (0.036/283.60) x 1000
	= 0.125 M.cu.m/sq.km/year
	= **1.25** Ha.m/100sq.km./year

8.5.2 Loss of gross storage capacity at FRL

Capacity at FRL (40.85m) as per the 1967 impounding survey	= 48.810 M.cu.m
Capacity at FRL (40.85m) as per 2021 survey	= 46.893 M.cu.m
Loss of storage capacity in 54 years (1967-2021)	= 48.810 – 46.893
	= 1.917 M.cu.m
Percentage loss of Gross storage capacity up to FRL in 54 years	= (1.917/48.810) x 100
	= 3.93%
Annual percentage loss	= 3.93/54
	= **0.07%**

8.5.3 Loss of dead storage capacity

Capacity at MDDL/OSL (29.87m) as the 1967 impounding survey	= 0.215 M.cu.m
Capacity at MDDL / OSL as per 2021 survey	= 0.010 M.cu.m
Loss of storage capacity in 54 years (1967-2021)	= 0.215 – 0.010 = 0.205 M.cu.m
Percentage loss of dead storage capacity up to OSL in 54 years	= (0.205/0.215) x 100 = 95.35%
Annual percentage loss	= 95.35/54 = **1.77%**

8.5.4 Loss of live storage capacity

Live storage capacity as the 1967 impounding survey	= 48.810 – 0.215 = 48.595 M.cu.m
Live storage capacity as per 2021 survey	= 46.893 – 0.010 = 46.883 M.cu.m
Loss of Live storage capacity in 54 years (1967-2021)	= 48.595 – 46.883 = 1.712 M.cu.m
Percentage loss of live storage capacity in 54 years	= (1.712/48.595) x 100 = 3.52%
Annual percentage loss	= 3.52/54 = **0.07%**

8.6 Summary Of Capacity Surveys (1967 and 2021)

Reservoir data as per impounding survey:

Year of impounding : 1967
Catchment Area : 283.60 sq.km
Gross storage at FRL (40.85m) : 48.810 M.cu.m
Dead storage at OSL (29.87m) : 0.215 M.cu.m
Live storage at FRL (40.85m) : 48.595 M.cu.m

Rate of siltation (at FRL 40.85m) with respect to the impounding survey data in the year 1967													
Sr. No	Year of Survey	Capacity in M.cu.m			Siltation in M.cu.m	Period in years	Erosion Rate in M.cu.m/Year	Loss in Capacity in M.cu.m and percentage			Siltation index ha.m/100 sq.km/Yr	Annual % loss of capacity	Remarks
		Dead	Live	Gross				Dead	Live	Gross			
1	1967	0.215	48.595	48.810	-	-	-	-	-	-	-	-	-
2	2021	0.010	46.883	46.893	1.917	54	0.036	0.205 95.35%	1.712 3.52%	1.917 3.93%	1.25	0.07	Insignificant category

Table 7: Rate of siltation at FRL (40.85m)

<u>According to IS-12182 (1987)</u>

Annual % loss	**-**	**Class of Reservoir**
Up to 0.1	-	Insignificant
0.1 to 0.5	-	Significant
Above 0.5	-	Serious

Rate of Siltation – Loss in Gross Capacity/No of Years
Silt Index – Silt rate/Catchment area) x 10000
Annual % Loss – Loss in % of Gross Capacity/No. of years

8.7 Data comparison between 1987 and 2021

8.7.1 Rate of siltation

The decrease of storage and rate of siltation calculations are based on the following basic data.

iv) The catchment area of the reservoir is 283.60 sq.km.

v) The FRL of the reservoir is given as 40.85m.

vi) The dead storage level/Outlet sill level of the reservoir is at 29.87m.

The results obtained after comparing the survey data of the year 1987 with that of 2021 are provided below:

Capacity at FRL (40.85m) as per the 1987 silt survey	= 49.031 M.cu.m
Capacity at FRL (40.85m) as per 2021 survey	= 46.893 M.cu.m
Siltation in 34 years (1987-2021)	= 49.031 – 46.893
	= 2.138 M.cu.m
Annual siltation	= 2.138/34 = 0.063 M.cu.m/yr
Rate of siltation (Siltation index)	= (0.063/283.60) x 1000
	= 0.222 M.cu.m/sq.km/year
	= **2.22** Ha.m/100sq.km./year

8.7.2 Loss of gross storage capacity at FRL

Capacity at FRL (40.85m) as per the 1987 silt survey	= 49.031 M.cu.m
Capacity at FRL (40.85m) as per 2021 survey	= 46.893 M.cu.m
Loss of storage capacity in 34 years (1987-2021)	= 49.031 – 46.893
	= 2.138 M.cu.m
Percentage loss of Gross storage capacity up to FRL in 34 years	= (2.138/49.031) x 100
	= 4.36%
Annual percentage loss	= 4.36/34
	= **0.13%**

8.7.3 Loss of dead storage capacity

Capacity at MDDL/OSL (29.87m) as the 1987 silt survey	= 0.245 M.cu.m
Capacity at MDDL / OSL as per 2021 survey	= 0.010 M.cu.m
Loss of storage capacity in 34 years (1987-2021)	= 0.245 – 0.010
	= 0.235 M.cu.m
Percentage loss of dead storage capacity up to OSL in 34 years	= (0.235/0.245) x 100
	= 95.92%
Annual percentage loss	= 95.92/34
	= **2.82%**

8.7.4 Loss of live storage capacity

Live storage capacity as the 1987 silt survey	= 49.031 – 0.245
	= 48.786 M.cu.m

Live storage capacity as per 2021 survey	= 46.893 – 0.010 = 46.883 M.cu.m
Loss of Live storage capacity in 34 years (1987-2021)	= 48.786 – 46.883 = 1.903 M.cu.m
Percentage loss of live storage capacity in 34 years	= (1.903/48.786) x 100 = 3.90%
Annual percentage loss	= 3.90/34 = **0.11%**

8.8 Summary Of Capacity Surveys (1987 and 2021)

Reservoir data as per silt survey:

Year of impounding : 1967
Year of silt survey : 1987
Catchment Area : 283.60 sq.km
Gross storage at FRL (40.85m) : 49.031 M.cu.m
Dead storage at OSL (29.87m) : 0.245 M.cu.m
Live storage at FRL (40.85m) : 48.786 M.cu.m

Rate of siltation (at FRL 40.85m) with respect to the silt survey data in the year 1987													
Sr. No	Year of Survey	Capacity in M.cu.m			Siltation in M.cu.m	Period in years	Erosion Rate in M.cu.m/Year	Loss in Capacity in M.cu.m and percentage			Siltation index ha.m/100 sq.km/Yr	Annual % loss of capacity	Remarks
		Dead	Live	Gross				Dead	Live	Gross			
1	1987	0.245	48.786	49.031	-	-	-	-	-	-	-	-	-
2	2021	0.010	46.883	46.893	2.138	34	0.063	0.235 95.92%	1.903 3.90%	2.138 4.36%	2.22	0.13	Significant category

Table 8: Rate of siltation at FRL (40.85m)

<u>According to IS-12182 (1987)</u>

Annual % loss - Class of Reservoir

Up to 0.1 - Insignificant
0.1 to 0.5 - Significant
Above 0.5 - Serious

Rate of Siltation – Loss in Gross Capacity/No of Years
Silt Index – Silt rate/Catchment area) x 10000
Annual % Loss – Loss in % of Gross Capacity/No. of years

8.9 Loss of Storage Due to Sediment Deposit

Reservoirs, created by dams on rivers, lose their storage capacity due to sedimentation. A large proportion of the transported silt eventually gets deposited at different levels of a reservoir and causes reduction not only in dead storage but also in live storage capacities. The consequence of loss in storage due to sediment accumulation may even cause operational problems. Periodic capacity survey of a reservoir is thus essential to ascertain the rate of sedimentation and reduction in storage capacity for efficient and productive management of water resources. Reservoir siltation affects the safety of an old reservoir since the sediment in the reservoirs increases the load on the wall of the dam.

The loss or increase in capacity within the reservoir is directly proportional to the amount of sediment deposited or eroded within the reservoir. This sediment deposition or removal can occur at any level of the reservoir throughout the live and dead storage area. This deposition or erosion of the sediment within the reservoir results in a corresponding loss or increase of capacity.

For Tappar reservoir, the detailed comparison of current capacity data (2021) at different levels to the capacity data of the 1987 silt survey shows a decrease in capacity due to sediment deposition at both, the dead storage area and the live storage area. The increase of sediment deposit from the lower elevation level to FRL and the corresponding reduction in capacity could be due to the abundant sediment inflow into the reservoir due to floods or erosion of reservoir banks above these levels. The capacity at OSL (29.87m) reduced from 0.245 M.cu.m to 0.010 M.cu.m between the years 1987 and 2021 with a loss in capacity of about 95.92%. The amount of sediment deposited during this period up to OSL is 0.235 M.cu.m. The capacity at FRL (40.85m) decreased from 49.031 M.cu.m to 46.893 M.cu.m between the years 1987 and 2021 with a decrease in capacity of about 4.36%. The amount of sediment deposited during this period up to FRL is 2.138 M.cu.m.

The following **Table 9** shows the amount of deposition of sediment at different levels of reservoir and corresponding percentage loss in storage capacity.

Elevation (Above MSL, m)	Capacity 1987 (M.cu.m)	Area 2021 (M.sq.m or sq.km)	Capacity 2021 (M.cu.m)	Deposition of Sediment (M.cu.m)	% Loss of Capacity	Remarks
28.65	0.005	0.000	0.000	0.005	100.00	Sediment deposit, loss of capacity
29.00	0.014	0.000	0.000	0.014	100.00	Sediment deposit, loss of capacity
29.50	0.147	0.000	0.000	0.147	100.00	Sediment deposit, loss of capacity
29.87 (**OSL**)	0.245	0.052	0.010	0.235	95.92	Sediment deposit, loss of capacity
30.00	0.280	0.086	0.018	0.262	93.57	Sediment deposit, loss of capacity
30.50	0.641	0.287	0.112	0.529	82.53	Sediment deposit, loss of capacity
31.00	1.003	0.603	0.332	0.671	66.90	Sediment deposit, loss of capacity
31.50	1.451	0.928	0.716	0.735	50.65	Sediment deposit, loss of capacity
32.00	1.899	1.206	1.254	0.645	33.97	Sediment deposit, loss of capacity
32.50	2.957	1.417	1.907	1.050	35.51	Sediment deposit, loss of capacity
33.00	4.015	1.698	2.683	1.332	33.18	Sediment deposit, loss of capacity

Elevation (Above MSL, m)	Capacity 1987 (M.cu.m)	Area 2021 (M.sq.m or sq.km)	Capacity 2021 (M.cu.m)	Deposition of Sediment (M.cu.m)	% Loss of Capacity	Remarks
33.50	5.316	2.017	3.612	1.704	32.05	Sediment deposit, loss of capacity
34.00	6.617	2.353	4.700	1.917	28.97	Sediment deposit, loss of capacity
34.50	8.231	2.688	5.959	2.272	27.60	Sediment deposit, loss of capacity
35.00	9.846	3.095	7.399	2.447	24.85	Sediment deposit, loss of capacity
35.50	11.773	3.589	9.065	2.708	23.00	Sediment deposit, loss of capacity
36.00	13.700	4.215	11.012	2.688	19.62	Sediment deposit, loss of capacity
36.50	16.102	5.004	13.310	2.792	17.34	Sediment deposit, loss of capacity
37.00	18.504	5.699	16.008	2.496	13.49	Sediment deposit, loss of capacity
37.50	21.623	6.149	18.969	2.654	12.27	Sediment deposit, loss of capacity
38.00	24.743	6.733	22.177	2.566	10.37	Sediment deposit, loss of capacity
38.50	28.194	7.299	25.679	2.515	8.92	Sediment deposit, loss of capacity
39.00	31.645	7.994	29.502	2.143	6.77	Sediment deposit, loss of capacity
39.50	35.960	8.708	33.676	2.284	6.35	Sediment deposit, loss of capacity
40.00	40.275	9.527	38.232	2.043	5.07	Sediment deposit, loss of capacity
40.50	45.425	10.319	43.193	2.232	4.91	Sediment deposit, loss of capacity
40.85 (**FRL**)	49.031	10.810	46.893	2.138	4.36	Sediment deposit, loss of capacity

Table 9: Loss of storage capacity between 1987 and 2021

The amount of silt present in any reservoir is attributed to the geological nature of the area surrounding the reservoir. If the area is rich in silt, definitely any reservoir located within the area will have a greater proportion of silt in any sediment transported into it. Since erosional sedimentation is a serious problem in different parts of the world today resulting in several reservoirs becoming completely silted over, designers should aim at the following mitigation measures of soil erosion and sediment transport processes:

- Prevention of further land degradation in any catchment to reduce siltation
- Prevention of soil erosion from catchment to reduce siltation of reservoir
- Ensuring adequate irrigation water to the demand area
- Improving land capability moisture regime in the watershed
- Improving land use to match capability
- Maintaining ecological balance in a catchment area
- Educating people in the management of a catchment

8.10 Control of Sedimentation in Reservoirs

Sedimentation in a reservoir is a natural process which affects the capacity of the reservoir. Excess deposition of sediment directly affects the useful capacity of the reservoir based on the project requirements like irrigation, hydroelectric power, flood control etc. The rate of deposition of sediment largely depends on the annual sediment load carried by the streams and up to what extent the sediment is retained in the reservoir. This, in turn, depends upon a number of factors such as the area and nature of the catchment, level use pattern (cultivation practices, grazing, logging, construction activities and conservation practices), rainfall pattern, storage capacity, period of storage in relation to the sediment load of the stream, particle size distribution in the suspended sediment, channel hydraulics, location and sizes of sluices, outlet works, configuration of the reservoir, and the method and purpose of releases through the dam. An appropriate approach to these factors mentioned above is essential for efficient control of sedimentation and therefore to extend the life of the reservoir.

There are numerous techniques developed to control the sedimentation in reservoirs, broadly classified as

I. Suitable design of reservoir
II. Restrict the sediment inflow
III. Limit the sediment deposition
IV. Regular removal of deposited sediment

8.10.1 Suitable design of reservoir

The volume of discharge directly affects the rate of sedimentation. The rate of sedimentation increases with the volume of discharge. The higher deposition of sediment within a reservoir increases the surface area of the water, thereby resulting in greater loss of water by evaporation. This will ultimately result in decrease of storage capacity which in turn lowers the trap efficiency of the reservoir.

The capacity of the reservoir and the size and characteristics of the reservoir and its drainage area are the most important factors governing the annual rate of accumulation of sediment. Periodic reservoir sediment surveys provide information about the rate of sediment deposited, and hence can enable us to make necessary steps to limit the same. The sedimentation may take place not only in the dead storage area of a reservoir; reservoir studies have revealed significant deposition of sediment in the live storage area of a reservoir as well.

The capacity of reservoirs largely depends on various factors. Hence the following points need to be considered for their optimum design.

- Topographical, geological and geomorphological factors which directly affect the sediment yield
- Sediment delivery characteristics of the channel system
- The efficiency of the reservoir as a sediment trap
- The ratio of capacity of the reservoir to the inflow
- Configuration of the reservoir
- Method of operation of the reservoir
- Provisions for silt exclusion

8.10.2 Restrict the sediment inflow

The sediment inflow to the reservoirs can be controlled by proper watershed management and soil conservation measures to check production and transport of sediment to the catchment area. Also adopt adequate preventive measures to check the inflow of sediment into the reservoir. Soil conservation involves the prevention of loss of the topmost layer of the soil from erosion or prevention of reduced fertility caused by over usage, acidification, salinization or other chemical soil contamination. The soil conservation measures are further sub-divided as

- Engineering
- Agronomy
- Forestry

Engineering methods

Check dams

One of the methods of soil conservation is the use of check dams. A check dam is a small dam which can be either temporary or permanent, built across a minor channel, swale, or drainage ditch. They are used to slow the velocity of concentrated water flows, a practice that helps reduce erosion.

Contour trenching and bunding

In the contour trenching method, the surrounding area of the reservoir is ploughed, like contour lines. These contour lines create a water break which reduces the formation of rills and gullies during times of heavy precipitation, allowing more time for the water to settle into the soil. Also, trenches can be artificially dug along the contour lines. Water flowing down the hill is retained by the trenches, and infiltrates the soil below. Manually dug trenches are smaller, machine dug trenches can be deeper. The dimensions and the format of the trenches should correspond to the local climate and soil conditions.

A similar practice is contour bunding where stones are placed around the contours of slopes. Contour bunding or contour bundling, and contour farming involves the placement of lines of stones along the natural rises of a landscape. These techniques help to capture and hold rainfall before it can become runoff. Contour bunds also help to control soil erosion.

Gully Plugging

A gully plug is a small, temporary or permanent dam constructed across a drainage ditch, swale, or channel to lower the speed of concentrated flows. These dams can be constructed using locally available materials. These small dams reduce the speed of water flow and minimise the erosive power of runoff. They also promote the deposition of eroded materials to further stabilise the gullies.

Agronomy methods

Agronomic conservation measures function by reducing the impact of raindrops through interception and thus reducing soil erosion and increasing infiltration rates, and also reducing surface runoff and soil erosion. The major agronomic soil and water conservation practices are strip cropping, mixed cropping, intercropping, fallowing, mulching, contour ploughing, crop rotation, conservation tillage, and agroforestry.

Forestry methods

Forestry measures include forest conservancy, control on grazing, lumbering operations and forest fires along with management and protection of forest plantations.

8.10.3 Limit sediment deposition

The amount of suspended sediment is comparatively large during and just after flood flow. The settlement of sediment in the reservoir can be controlled by adequate operation of outlets in such a manner as to permit selective withdrawals of water having a higher-than-average sediment content. Thus, more water wasted at peak time of inflow will result a low level of sediment to deposit in the reservoir. There are two methods:

Density Current

Water at various levels of a reservoir often contains radically different concentrations of suspended sediment, particularly during and after flood flows and if all waste-water could be withdrawn at those levels where the concentration is highest, a significant amount of sediment might be removed from the reservoir. The density differences between the sediment-laden inflow and the clear water in the reservoir leads to a turbidity current which plunges beneath the clear water and moves towards the dam as a

submerged current. The proper allocation of gates or sluices can remove a significant amount of sediment-saturated water and therefore can reduce the amount of sedimentation.

Waste-Water Release

This method is applicable only when a reservoir is of such a size that a small part of large flood flows will fill it. A series of outlets at various elevations can eject sediment-saturated water. This method, which can remove considerable amount of sediment from the reservoir through proper gate control, will differ greatly with different locations. The drawback of this method is that waste-water release is only possible when water can be or should be wasted.

8.10.4 Regular removal of deposited sediment

Removal of accumulated sediment is considered as the last resort as the operations are very expensive unless the excavated sediment is economically usable. The removal of sediment deposits may be accomplished by a variety of mechanical and hydraulic methods, such as excavation, dredging, draining and flushing, sluicing aided by such measures as hydraulic or mechanical agitation or blasting of the sediment.

Excavation

Excavation is the removal of the sediment by hand or power operated shovel, dragline scraper or other mechanical means after draining most of the water. The excavation of silt and clay which constitute most of the material in larger reservoirs is more difficult than the excavation of sand and gravel. Fine-textured sediment cannot be excavated easily from larger reservoirs unless it is relatively fluid or relatively compact.

Dredging

In this method, the deposit is removed from the bottom of the reservoir irrespective of the level of storage using mechanical or hydraulic equipment. The various types of dredging are mechanical dredging by bucket, suction dredging with floating pipeline and a pump on a barge and siphon dredging with a floating pipe extending over the dam or connected to an opening in the dam and with a pump on a barge.

Draining and flushing

This method, also called flood sluicing, involves a relatively slow release of all stored water in a reservoir through gates or valves located near the bottom of the dam and the maintenance thereafter of open outlets for a shorter or longer period during which normal stream flow cuts into or is directed against the sediment deposits.

Sluicing with Controlled Water

In this method the controlled water supply permits choosing the time of sluicing more advantageously and the water may be directed more effectively against the sediment deposits. While the flood sluicing depends either on the occurrence of flood or on being able to release rapidly all of a full or nearly full supply of water in the main reservoir. The advantage of this method is that generally more sediment can be removed per unit of water used than in flood scouring or draining and flushing.

Sluicing with Hydraulics and Mechanical Agitation

In this method, stirring up, breaking up or moving deposits of a sediment into a stream current moving through a drained reservoir basin or into a full reservoir will tend to make the removal of sediment from the reservoir more complete. Wherever draining, flushing or sluicing appear to be warranted, the additional use of hydraulic means for stirring up the sediment deposits, or sloughing them off, into a stream flowing through the reservoir basin should be considered.

9 CONCLUSIONS

- The waste weir construction works for Tappar dam commenced in the year 1965 and were completed in the year 1967. Later between 2001 and 2002, vertical lift gates were constructed for Tappar Dam. The year of first impounding was done in 1967 with a gross storage of 48.810 M.cu.m at FRL (40.85m above MSL) over a net catchment area of 283.60 sq.km. The dead storage at OSL (29.87m above MSL) as per impound survey was 0.215 M.cu.m.
- A silt survey was conducted in 1987 on Tappar dam which results in a gross storage of 49.031 M.cu.m at FRL (40.85m above MSL) and dead storage of 0.245 M.cu.m at OSL (29.87m above MSL).
- In the current survey (2021) the gross storage at FRL (40.855m above M.SL) is 46.893 M.cu.m and the dead storage at OSL (29.87m above MSL) is 0.010 M.cu.m.
- Bathymetric and topographic survey was restricted at some places due to the presence of bushes, forest with thick vegetation and small streams with unsafe and inaccessible marshy ground.
- In the current bathymetric and topographic survey, a minimum elevation of 29.5m was observed in the southeastern portion of the survey area within the bathymetric section. A maximum topographic elevation value of 46.68m is observed in the in the northweastern portion of the survey area.
- The average elevation change within the bathymetric survey area is between 29.5m and 37.3m and average elevation change within the topographic area is between 34.60m and 46.68m.
- The outer boundaries of the survey area occur between the elevation contours 46m and 42m. Medium to steep slopes are observed near the northwestern and northeastern boundaries between the elevation contours 46m and 40m, associated with slightly irregular topography. Further towards the water-occupied area, from the 40m elevation contour to the 37m elevation contour, the topography is found to be gently sloping.
- Most of the water-occupied bathymetric area lies below the 37m elevation contour. The gently sloping reservoir bed from northwest to southeast between the elevation contours 37m and 30m shows scattered depressions and humps. An island is mapped in the southern portion of the survey area with a change in elevation between 37m and 39m. A minimum elevation contour of 30m is observed in the southeastern part of this area, near to the dam walls.
- The current survey data (2021) was compared with the original capacity data in 1967 and previous silt survey capacity data in 1987 separately.
- The comparison between 1967 and 2021 (54 years) data results shows a rate of siltation of 1.25 Ha.m/100sq.km./year. Annual percentage loss of gross storage capacity, live storage capacity and dead storage capacity are 0.07%, 0.07% and 1.77% respectively.
- The comparison between 1987 and 2021 (34 years) data results shows a rate of siltation of 2.22 Ha.m/100sq.km./year. Annual percentage loss of gross storage capacity, live storage capacity and dead storage capacity are 0.13%, 0.11% and 2.82% respectively.
- The comparison of current and previous silt survey capacity data of the 1987 survey shows a decrease in capacity due to sediment deposit at both, the dead storage area and live storage area. The capacity at OSL (29.87m) reduced from 0.245 M.cu.m to 0.010 M.cu.m between the years 1987 and 2021 with a loss in capacity of about 95.92%. The capacity at FRL (40.85m) decreased from 49.031 M.cu.m to 46.893 M.cu.m between the years 1987 and 2021 with a decrease in capacity of about 4.36%.
- During the years 1987 to 2021, the increase of sediment deposit from the reservoir bed level to FRL and the corresponding reduction in capacity could be due to the abundant sediment inflow into the reservoir due to floods or erosion of reservoir banks above these levels. The amount of sediment deposited during this period up to OSL (29.87m) is 0.235 M.cu.m. The amount of sediment deposited during this period up to FRL (40.85m) is 2.138 M.cu.m.

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Annexure - 1

Elevation-Area-Capacity (2021)

Tappar Reservoir

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
97.05	29.58	0.00	0.00	0.140	0.013	0.000	0.000	0.000	0.000
97.08	29.59	0.00	0.00	0.172	0.016	0.000	0.000	0.035	0.001
97.11	29.60	0.00	0.00	0.183	0.017	0.000	0.000	0.035	0.001
97.15	29.61	0.00	0.00	0.205	0.019	0.000	0.000	0.035	0.001
97.18	29.62	0.00	0.00	0.215	0.020	0.000	0.000	0.035	0.001
97.21	29.63	0.00	0.00	0.226	0.021	0.000	0.000	0.035	0.001
97.24	29.64	0.00	0.00	0.248	0.023	0.000	0.000	0.071	0.002
97.28	29.65	0.00	0.00	0.258	0.024	0.000	0.000	0.071	0.002
97.31	29.66	0.00	0.00	0.269	0.025	0.000	0.000	0.071	0.002
97.34	29.67	0.00	0.00	0.280	0.026	0.000	0.000	0.071	0.002
97.38	29.68	0.00	0.00	0.291	0.027	0.000	0.000	0.106	0.003
97.41	29.69	0.00	0.00	0.301	0.028	0.000	0.000	0.106	0.003
97.44	29.70	0.00	0.00	0.312	0.029	0.000	0.000	0.106	0.003
97.47	29.71	0.00	0.00	0.323	0.030	0.000	0.000	0.106	0.003
97.51	29.72	0.00	0.00	0.334	0.031	0.000	0.000	0.141	0.004
97.54	29.73	0.00	0.00	0.344	0.032	0.000	0.000	0.141	0.004
97.57	29.74	0.00	0.00	0.355	0.033	0.000	0.000	0.141	0.004
97.60	29.75	0.00	0.00	0.366	0.034	0.000	0.000	0.177	0.005
97.64	29.76	0.00	0.00	0.377	0.035	0.000	0.000	0.177	0.005
97.67	29.77	0.00	0.00	0.388	0.036	0.000	0.000	0.177	0.005
97.70	29.78	0.00	0.00	0.409	0.038	0.000	0.000	0.212	0.006
97.74	29.79	0.00	0.00	0.420	0.039	0.000	0.000	0.212	0.006
97.77	29.80	0.00	0.00	0.441	0.041	0.000	0.000	0.247	0.007
97.80	29.81	0.00	0.00	0.452	0.042	0.000	0.000	0.247	0.007

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)		
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)	
97.83	29.82	0.00	0.00	0.474	0.044	0.000	0.000	0.247	0.007	
97.87	29.83	0.00	0.00	0.495	0.046	0.000	0.000	0.283	0.008	
97.90	29.84	0.00	0.00	0.506	0.047	0.000	0.000	0.283	0.008	
97.93	29.85	0.00	0.00	0.517	0.048	0.000	0.000	0.318	0.009	
97.97	29.86	0.00	0.00	0.538	0.050	0.000	0.000	0.318	0.009	
98.00	**29.87**	**0.00**	**0.00**	**0.560**	**0.052**	**0.000**	**0.000**	**0.353**	**0.010**	**OSL**
98.03	29.88	0.03	0.01	0.570	0.053	0.000	0.000	0.353	0.010	
98.06	29.89	0.07	0.02	0.592	0.055	0.035	0.001	0.388	0.011	
98.10	29.90	0.10	0.03	0.603	0.056	0.035	0.001	0.388	0.011	
98.13	29.91	0.13	0.04	0.624	0.058	0.071	0.002	0.424	0.012	
98.16	29.92	0.16	0.05	0.646	0.060	0.106	0.003	0.459	0.013	
98.20	29.93	0.20	0.06	0.667	0.062	0.106	0.003	0.459	0.013	
98.23	29.94	0.23	0.07	0.700	0.065	0.141	0.004	0.494	0.014	
98.26	29.95	0.26	0.08	0.732	0.068	0.141	0.004	0.494	0.014	
98.29	29.96	0.30	0.09	0.764	0.071	0.177	0.005	0.530	0.015	
98.33	29.97	0.33	0.10	0.797	0.074	0.212	0.006	0.565	0.016	
98.36	29.98	0.36	0.11	0.840	0.078	0.247	0.007	0.600	0.017	
98.39	29.99	0.39	0.12	0.883	0.082	0.247	0.007	0.600	0.017	
98.43	30.00	0.43	0.13	0.926	0.086	0.283	0.008	0.636	0.018	
98.46	30.01	0.46	0.14	0.969	0.090	0.318	0.009	0.671	0.019	
98.49	30.02	0.49	0.15	1.012	0.094	0.353	0.010	0.706	0.020	
98.52	30.03	0.52	0.16	1.066	0.099	0.388	0.011	0.742	0.021	
98.56	30.04	0.56	0.17	1.119	0.104	0.424	0.012	0.777	0.022	
98.59	30.05	0.59	0.18	1.173	0.109	0.459	0.013	0.812	0.023	

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
98.62	30.06	0.62	0.19	1.216	0.113	0.494	0.014	0.848	0.024
98.65	30.07	0.66	0.20	1.270	0.118	0.530	0.015	0.883	0.025
98.69	30.08	0.69	0.21	1.313	0.122	0.600	0.017	0.953	0.027
98.72	30.09	0.72	0.22	1.356	0.126	0.636	0.018	0.989	0.028
98.75	30.10	0.75	0.23	1.389	0.129	0.671	0.019	1.024	0.029
98.79	30.11	0.79	0.24	1.421	0.132	0.706	0.020	1.059	0.030
98.82	30.12	0.82	0.25	1.464	0.136	0.777	0.022	1.130	0.032
98.85	30.13	0.85	0.26	1.496	0.139	0.812	0.023	1.165	0.033
98.88	30.14	0.89	0.27	1.528	0.142	0.883	0.025	1.236	0.035
98.92	30.15	0.92	0.28	1.572	0.146	0.918	0.026	1.271	0.036
98.95	30.16	0.95	0.29	1.604	0.149	0.953	0.027	1.307	0.037
98.98	30.17	0.98	0.30	1.647	0.153	1.024	0.029	1.377	0.039
99.02	30.18	1.02	0.31	1.679	0.156	1.059	0.030	1.413	0.040
99.05	30.19	1.05	0.32	1.722	0.160	1.130	0.032	1.483	0.042
99.08	30.20	1.08	0.33	1.765	0.164	1.201	0.034	1.554	0.044
99.11	30.21	1.12	0.34	1.798	0.167	1.236	0.035	1.589	0.045
99.15	30.22	1.15	0.35	1.841	0.171	1.307	0.037	1.660	0.047
99.18	30.23	1.18	0.36	1.884	0.175	1.377	0.039	1.730	0.049
99.21	30.24	1.21	0.37	1.927	0.179	1.448	0.041	1.801	0.051
99.25	30.25	1.25	0.38	1.981	0.184	1.483	0.042	1.836	0.052
99.28	30.26	1.28	0.39	2.034	0.189	1.554	0.044	1.907	0.054
99.31	30.27	1.31	0.40	2.088	0.194	1.624	0.046	1.978	0.056
99.34	30.28	1.35	0.41	2.131	0.198	1.695	0.048	2.048	0.058
99.38	30.29	1.38	0.42	2.185	0.203	1.766	0.050	2.119	0.060

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
99.41	30.30	1.41	0.43	2.228	0.207	1.836	0.052	2.190	0.062
99.44	30.31	1.44	0.44	2.282	0.212	1.907	0.054	2.260	0.064
99.48	30.32	1.48	0.45	2.325	0.216	1.978	0.056	2.331	0.066
99.51	30.33	1.51	0.46	2.379	0.221	2.084	0.059	2.437	0.069
99.54	30.34	1.54	0.47	2.433	0.226	2.154	0.061	2.507	0.071
99.57	30.35	1.57	0.48	2.486	0.231	2.225	0.063	2.578	0.073
99.61	30.36	1.61	0.49	2.540	0.236	2.295	0.065	2.649	0.075
99.64	30.37	1.64	0.50	2.594	0.241	2.401	0.068	2.755	0.078
99.67	30.38	1.67	0.51	2.637	0.245	2.472	0.070	2.825	0.080
99.70	30.39	1.71	0.52	2.680	0.249	2.578	0.073	2.931	0.083
99.74	30.40	1.74	0.53	2.723	0.253	2.649	0.075	3.002	0.085
99.77	30.41	1.77	0.54	2.766	0.257	2.755	0.078	3.108	0.088
99.80	30.42	1.80	0.55	2.809	0.261	2.825	0.080	3.178	0.090
99.84	30.43	1.84	0.56	2.852	0.265	2.931	0.083	3.284	0.093
99.87	30.44	1.87	0.57	2.885	0.268	3.037	0.086	3.390	0.096
99.90	30.45	1.90	0.58	2.917	0.271	3.108	0.088	3.461	0.098
99.93	30.46	1.94	0.59	2.949	0.274	3.214	0.091	3.567	0.101
99.97	30.47	1.97	0.60	2.992	0.278	3.320	0.094	3.673	0.104
100.00	30.48	2.00	0.61	3.025	0.281	3.426	0.097	3.779	0.107
100.03	30.49	2.03	0.62	3.057	0.284	3.496	0.099	3.849	0.109
100.07	30.50	2.07	0.63	3.089	0.287	3.602	0.102	3.955	0.112
100.10	30.51	2.10	0.64	3.122	0.290	3.708	0.105	4.061	0.115
100.13	30.52	2.13	0.65	3.165	0.294	3.814	0.108	4.167	0.118
100.16	30.53	2.17	0.66	3.197	0.297	3.920	0.111	4.273	0.121

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
100.20	30.54	2.20	0.67	3.251	0.302	4.026	0.114	4.379	0.124
100.23	30.55	2.23	0.68	3.294	0.306	4.132	0.117	4.485	0.127
100.26	30.56	2.26	0.69	3.358	0.312	4.238	0.120	4.591	0.130
100.30	30.57	2.30	0.70	3.434	0.319	4.344	0.123	4.697	0.133
100.33	30.58	2.33	0.71	3.531	0.328	4.485	0.127	4.838	0.137
100.36	30.59	2.36	0.72	3.617	0.336	4.591	0.130	4.944	0.140
100.39	30.60	2.40	0.73	3.692	0.343	4.697	0.133	5.050	0.143
100.43	30.61	2.43	0.74	3.767	0.350	4.838	0.137	5.191	0.147
100.46	30.62	2.46	0.75	3.843	0.357	4.944	0.140	5.297	0.150
100.49	30.63	2.49	0.76	3.918	0.364	5.085	0.144	5.438	0.154
100.52	30.64	2.53	0.77	3.993	0.371	5.227	0.148	5.580	0.158
100.56	30.65	2.56	0.78	4.058	0.377	5.333	0.151	5.686	0.161
100.59	30.66	2.59	0.79	4.123	0.383	5.474	0.155	5.827	0.165
100.62	30.67	2.62	0.80	4.198	0.390	5.615	0.159	5.968	0.169
100.66	30.68	2.66	0.81	4.263	0.396	5.756	0.163	6.109	0.173
100.69	30.69	2.69	0.82	4.327	0.402	5.898	0.167	6.251	0.177
100.72	30.70	2.72	0.83	4.392	0.408	6.039	0.171	6.392	0.181
100.75	30.71	2.76	0.84	4.456	0.414	6.180	0.175	6.533	0.185
100.79	30.72	2.79	0.85	4.510	0.419	6.321	0.179	6.674	0.189
100.82	30.73	2.82	0.86	4.575	0.425	6.463	0.183	6.816	0.193
100.85	30.74	2.85	0.87	4.639	0.431	6.639	0.188	6.992	0.198
100.89	30.75	2.89	0.88	4.704	0.437	6.780	0.192	7.134	0.202
100.92	30.76	2.92	0.89	4.779	0.444	6.922	0.196	7.275	0.206
100.95	30.77	2.95	0.90	4.855	0.451	7.098	0.201	7.451	0.211

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
100.98	30.78	2.99	0.91	4.930	0.458	7.240	0.205	7.593	0.215
101.02	30.79	3.02	0.92	5.016	0.466	7.416	0.210	7.769	0.220
101.05	30.80	3.05	0.93	5.091	0.473	7.593	0.215	7.946	0.225
101.08	30.81	3.08	0.94	5.167	0.480	7.769	0.220	8.122	0.230
101.12	30.82	3.12	0.95	5.231	0.486	7.910	0.224	8.264	0.234
101.15	30.83	3.15	0.96	5.285	0.491	8.087	0.229	8.440	0.239
101.18	30.84	3.18	0.97	5.350	0.497	8.264	0.234	8.617	0.244
101.21	30.85	3.22	0.98	5.414	0.503	8.440	0.239	8.793	0.249
101.25	30.86	3.25	0.99	5.479	0.509	8.617	0.244	8.970	0.254
101.28	30.87	3.28	1.00	5.554	0.516	8.793	0.249	9.147	0.259
101.31	30.88	3.31	1.01	5.630	0.523	9.005	0.255	9.358	0.265
101.35	30.89	3.35	1.02	5.694	0.529	9.182	0.260	9.535	0.270
101.38	30.90	3.38	1.03	5.759	0.535	9.358	0.265	9.712	0.275
101.41	30.91	3.41	1.04	5.834	0.542	9.570	0.271	9.923	0.281
101.44	30.92	3.44	1.05	5.899	0.548	9.747	0.276	10.100	0.286
101.48	30.93	3.48	1.06	5.974	0.555	9.959	0.282	10.312	0.292
101.51	30.94	3.51	1.07	6.049	0.562	10.135	0.287	10.488	0.297
101.54	30.95	3.54	1.08	6.125	0.569	10.347	0.293	10.700	0.303
101.57	30.96	3.58	1.09	6.189	0.575	10.524	0.298	10.877	0.308
101.61	30.97	3.61	1.10	6.265	0.582	10.736	0.304	11.089	0.314
101.64	30.98	3.64	1.11	6.340	0.589	10.948	0.310	11.301	0.320
101.67	30.99	3.67	1.12	6.415	0.596	11.159	0.316	11.513	0.326
101.71	31.00	3.71	1.13	6.491	0.603	11.371	0.322	11.724	0.332
101.74	31.01	3.74	1.14	6.566	0.610	11.583	0.328	11.936	0.338

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
101.77	31.02	3.77	1.15	6.641	0.617	11.795	0.334	12.148	0.344
101.80	31.03	3.81	1.16	6.717	0.624	12.007	0.340	12.360	0.350
101.84	31.04	3.84	1.17	6.792	0.631	12.254	0.347	12.607	0.357
101.87	31.05	3.87	1.18	6.867	0.638	12.466	0.353	12.819	0.363
101.90	31.06	3.90	1.19	6.953	0.646	12.678	0.359	13.031	0.369
101.94	31.07	3.94	1.20	7.029	0.653	12.925	0.366	13.278	0.376
101.97	31.08	3.97	1.21	7.104	0.660	13.137	0.372	13.490	0.382
102.00	31.09	4.00	1.22	7.180	0.667	13.384	0.379	13.737	0.389
102.03	31.10	4.04	1.23	7.255	0.674	13.631	0.386	13.985	0.396
102.07	31.11	4.07	1.24	7.330	0.681	13.879	0.393	14.232	0.403
102.10	31.12	4.10	1.25	7.416	0.689	14.091	0.399	14.444	0.409
102.13	31.13	4.13	1.26	7.502	0.697	14.338	0.406	14.691	0.416
102.17	31.14	4.17	1.27	7.589	0.705	14.585	0.413	14.938	0.423
102.20	31.15	4.20	1.28	7.664	0.712	14.832	0.420	15.185	0.430
102.23	31.16	4.23	1.29	7.739	0.719	15.115	0.428	15.468	0.438
102.26	31.17	4.27	1.30	7.804	0.725	15.362	0.435	15.715	0.445
102.30	31.18	4.30	1.31	7.868	0.731	15.609	0.442	15.962	0.452
102.33	31.19	4.33	1.32	7.944	0.738	15.856	0.449	16.209	0.459
102.36	31.20	4.36	1.33	8.008	0.744	16.139	0.457	16.492	0.467
102.40	31.21	4.40	1.34	8.062	0.749	16.386	0.464	16.739	0.474
102.43	31.22	4.43	1.35	8.127	0.755	16.669	0.472	17.022	0.482
102.46	31.23	4.46	1.36	8.181	0.760	16.916	0.479	17.269	0.489
102.49	31.24	4.49	1.37	8.234	0.765	17.198	0.487	17.551	0.497
102.53	31.25	4.53	1.38	8.288	0.770	17.481	0.495	17.834	0.505

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
102.56	31.26	4.56	1.39	8.342	0.775	17.728	0.502	18.081	0.512
102.59	31.27	4.59	1.40	8.396	0.780	18.010	0.510	18.364	0.520
102.62	31.28	4.63	1.41	8.450	0.785	18.293	0.518	18.646	0.528
102.66	31.29	4.66	1.42	8.514	0.791	18.576	0.526	18.929	0.536
102.69	31.30	4.69	1.43	8.579	0.797	18.858	0.534	19.211	0.544
102.72	31.31	4.72	1.44	8.643	0.803	19.141	0.542	19.494	0.552
102.76	31.32	4.76	1.45	8.708	0.809	19.423	0.550	19.776	0.560
102.79	31.33	4.79	1.46	8.773	0.815	19.706	0.558	20.059	0.568
102.82	31.34	4.82	1.47	8.837	0.821	19.988	0.566	20.341	0.576
102.85	31.35	4.86	1.48	8.902	0.827	20.271	0.574	20.624	0.584
102.89	31.36	4.89	1.49	8.977	0.834	20.588	0.583	20.942	0.593
102.92	31.37	4.92	1.50	9.042	0.840	20.871	0.591	21.224	0.601
102.95	31.38	4.95	1.51	9.117	0.847	21.189	0.600	21.542	0.610
102.99	31.39	4.99	1.52	9.182	0.853	21.471	0.608	21.824	0.618
103.02	31.40	5.02	1.53	9.246	0.859	21.789	0.617	22.142	0.627
103.05	31.41	5.05	1.54	9.322	0.866	22.072	0.625	22.425	0.635
103.08	31.42	5.09	1.55	9.408	0.874	22.390	0.634	22.743	0.644
103.12	31.43	5.12	1.56	9.483	0.881	22.707	0.643	23.060	0.653
103.15	31.44	5.15	1.57	9.548	0.887	23.025	0.652	23.378	0.662
103.18	31.45	5.18	1.58	9.634	0.895	23.308	0.660	23.661	0.670
103.22	31.46	5.22	1.59	9.709	0.902	23.626	0.669	23.979	0.679
103.25	31.47	5.25	1.60	9.784	0.909	23.943	0.678	24.297	0.688
103.28	31.48	5.28	1.61	9.849	0.915	24.297	0.688	24.650	0.698
103.31	31.49	5.31	1.62	9.924	0.922	24.614	0.697	24.967	0.707

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
103.35	31.50	5.35	1.63	9.989	0.928	24.932	0.706	25.285	0.716
103.38	31.51	5.38	1.64	10.064	0.935	25.250	0.715	25.603	0.725
103.41	31.52	5.41	1.65	10.140	0.942	25.603	0.725	25.956	0.735
103.44	31.53	5.45	1.66	10.215	0.949	25.921	0.734	26.274	0.744
103.48	31.54	5.48	1.67	10.290	0.956	26.274	0.744	26.627	0.754
103.51	31.55	5.51	1.68	10.366	0.963	26.592	0.753	26.945	0.763
103.54	31.56	5.54	1.69	10.430	0.969	26.945	0.763	27.298	0.773
103.58	31.57	5.58	1.70	10.506	0.976	27.298	0.773	27.651	0.783
103.61	31.58	5.61	1.71	10.570	0.982	27.616	0.782	27.969	0.792
103.64	31.59	5.64	1.72	10.635	0.988	27.969	0.792	28.322	0.802
103.67	31.60	5.68	1.73	10.699	0.994	28.322	0.802	28.676	0.812
103.71	31.61	5.71	1.74	10.764	1.000	28.676	0.812	29.029	0.822
103.74	31.62	5.74	1.75	10.828	1.006	29.029	0.822	29.382	0.832
103.77	31.63	5.77	1.76	10.882	1.011	29.382	0.832	29.735	0.842
103.81	31.64	5.81	1.77	10.947	1.017	29.735	0.842	30.088	0.852
103.84	31.65	5.84	1.78	11.011	1.023	30.123	0.853	30.477	0.863
103.87	31.66	5.87	1.79	11.076	1.029	30.477	0.863	30.830	0.873
103.90	31.67	5.91	1.80	11.151	1.036	30.830	0.873	31.183	0.883
103.94	31.68	5.94	1.81	11.227	1.043	31.218	0.884	31.571	0.894
103.97	31.69	5.97	1.82	11.291	1.049	31.571	0.894	31.924	0.904
104.00	31.70	6.00	1.83	11.345	1.054	31.960	0.905	32.313	0.915
104.04	31.71	6.04	1.84	11.399	1.059	32.313	0.915	32.666	0.925
104.07	31.72	6.07	1.85	11.464	1.065	32.701	0.926	33.055	0.936
104.10	31.73	6.10	1.86	11.517	1.070	33.055	0.936	33.408	0.946

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
104.13	31.74	6.14	1.87	11.571	1.075	33.443	0.947	33.796	0.957
104.17	31.75	6.17	1.88	11.625	1.080	33.831	0.958	34.185	0.968
104.20	31.76	6.20	1.89	11.679	1.085	34.220	0.969	34.573	0.979
104.23	31.77	6.23	1.90	11.733	1.090	34.608	0.980	34.962	0.990
104.27	31.78	6.27	1.91	11.786	1.095	34.997	0.991	35.350	1.001
104.30	31.79	6.30	1.92	11.840	1.100	35.385	1.002	35.738	1.012
104.33	31.80	6.33	1.93	11.894	1.105	35.774	1.013	36.127	1.023
104.36	31.81	6.36	1.94	11.959	1.111	36.162	1.024	36.515	1.034
104.40	31.82	6.40	1.95	12.013	1.116	36.551	1.035	36.904	1.045
104.43	31.83	6.43	1.96	12.066	1.121	36.939	1.046	37.292	1.056
104.46	31.84	6.46	1.97	12.120	1.126	37.328	1.057	37.681	1.067
104.49	31.85	6.50	1.98	12.174	1.131	37.751	1.069	38.105	1.079
104.53	31.86	6.53	1.99	12.239	1.137	38.140	1.080	38.493	1.090
104.56	31.87	6.56	2.00	12.292	1.142	38.528	1.091	38.881	1.101
104.59	31.88	6.59	2.01	12.346	1.147	38.952	1.103	39.305	1.113
104.63	31.89	6.63	2.02	12.400	1.152	39.341	1.114	39.694	1.124
104.66	31.90	6.66	2.03	12.454	1.157	39.764	1.126	40.117	1.136
104.69	31.91	6.69	2.04	12.518	1.163	40.153	1.137	40.506	1.147
104.72	31.92	6.73	2.05	12.572	1.168	40.577	1.149	40.930	1.159
104.76	31.93	6.76	2.06	12.626	1.173	41.000	1.161	41.354	1.171
104.79	31.94	6.79	2.07	12.680	1.178	41.389	1.172	41.742	1.182
104.82	31.95	6.82	2.08	12.734	1.183	41.813	1.184	42.166	1.194
104.86	31.96	6.86	2.09	12.798	1.189	42.236	1.196	42.590	1.206
104.89	31.97	6.89	2.10	12.841	1.193	42.660	1.208	43.013	1.218

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
104.92	31.98	6.92	2.11	12.884	1.197	43.084	1.220	43.437	1.230
104.95	31.99	6.96	2.12	12.938	1.202	43.508	1.232	43.861	1.242
104.99	32.00	6.99	2.13	12.981	1.206	43.931	1.244	44.285	1.254
105.02	32.01	7.02	2.14	13.024	1.210	44.355	1.256	44.708	1.266
105.05	32.02	7.05	2.15	13.067	1.214	44.779	1.268	45.132	1.278
105.09	32.03	7.09	2.16	13.121	1.219	45.203	1.280	45.556	1.290
105.12	32.04	7.12	2.17	13.164	1.223	45.662	1.293	46.015	1.303
105.15	32.05	7.15	2.18	13.218	1.228	46.086	1.305	46.439	1.315
105.18	32.06	7.19	2.19	13.261	1.232	46.509	1.317	46.863	1.327
105.22	32.07	7.22	2.20	13.304	1.236	46.933	1.329	47.286	1.339
105.25	32.08	7.25	2.21	13.347	1.240	47.392	1.342	47.745	1.352
105.28	32.09	7.28	2.22	13.390	1.244	47.816	1.354	48.169	1.364
105.31	32.10	7.32	2.23	13.433	1.248	48.275	1.367	48.628	1.377
105.35	32.11	7.35	2.24	13.476	1.252	48.699	1.379	49.052	1.389
105.38	32.12	7.38	2.25	13.509	1.255	49.158	1.392	49.511	1.402
105.41	32.13	7.41	2.26	13.552	1.259	49.582	1.404	49.935	1.414
105.45	32.14	7.45	2.27	13.584	1.262	50.041	1.417	50.394	1.427
105.48	32.15	7.48	2.28	13.627	1.266	50.500	1.430	50.853	1.440
105.51	32.16	7.51	2.29	13.659	1.269	50.924	1.442	51.277	1.452
105.54	32.17	7.55	2.30	13.702	1.273	51.383	1.455	51.736	1.465
105.58	32.18	7.58	2.31	13.735	1.276	51.842	1.468	52.195	1.478
105.61	32.19	7.61	2.32	13.778	1.280	52.301	1.481	52.654	1.491
105.64	32.20	7.64	2.33	13.810	1.283	52.725	1.493	53.078	1.503
105.68	32.21	7.68	2.34	13.853	1.287	53.184	1.506	53.537	1.516

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
105.71	32.22	7.71	2.35	13.896	1.291	53.643	1.519	53.996	1.529
105.74	32.23	7.74	2.36	13.928	1.294	54.102	1.532	54.455	1.542
105.77	32.24	7.78	2.37	13.972	1.298	54.561	1.545	54.914	1.555
105.81	32.25	7.81	2.38	14.015	1.302	55.020	1.558	55.373	1.568
105.84	32.26	7.84	2.39	14.058	1.306	55.479	1.571	55.833	1.581
105.87	32.27	7.87	2.40	14.111	1.311	55.938	1.584	56.292	1.594
105.91	32.28	7.91	2.41	14.155	1.315	56.398	1.597	56.751	1.607
105.94	32.29	7.94	2.42	14.198	1.319	56.857	1.610	57.210	1.620
105.97	32.30	7.97	2.43	14.241	1.323	57.351	1.624	57.704	1.634
106.00	32.31	8.01	2.44	14.284	1.327	57.810	1.637	58.163	1.647
106.04	32.32	8.04	2.45	14.327	1.331	58.269	1.650	58.622	1.660
106.07	32.33	8.07	2.46	14.370	1.335	58.728	1.663	59.081	1.673
106.10	32.34	8.10	2.47	14.424	1.340	59.223	1.677	59.576	1.687
106.14	32.35	8.14	2.48	14.467	1.344	59.682	1.690	60.035	1.700
106.17	32.36	8.17	2.49	14.521	1.349	60.176	1.704	60.529	1.714
106.20	32.37	8.20	2.50	14.574	1.354	60.635	1.717	60.988	1.727
106.23	32.38	8.23	2.51	14.628	1.359	61.130	1.731	61.483	1.741
106.27	32.39	8.27	2.52	14.682	1.364	61.589	1.744	61.942	1.754
106.30	32.40	8.30	2.53	14.736	1.369	62.083	1.758	62.436	1.768
106.33	32.41	8.33	2.54	14.790	1.374	62.578	1.772	62.931	1.782
106.36	32.42	8.37	2.55	14.843	1.379	63.072	1.786	63.425	1.796
106.40	32.43	8.40	2.56	14.886	1.383	63.531	1.799	63.884	1.809
106.43	32.44	8.43	2.57	14.940	1.388	64.026	1.813	64.379	1.823
106.46	32.45	8.46	2.58	14.983	1.392	64.520	1.827	64.873	1.837

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
106.50	32.46	8.50	2.59	15.037	1.397	65.014	1.841	65.368	1.851
106.53	32.47	8.53	2.60	15.091	1.402	65.509	1.855	65.862	1.865
106.56	32.48	8.56	2.61	15.145	1.407	66.003	1.869	66.356	1.879
106.59	32.49	8.60	2.62	15.188	1.411	66.498	1.883	66.851	1.893
106.63	32.50	8.63	2.63	15.252	1.417	66.992	1.897	67.345	1.907
106.66	32.51	8.66	2.64	15.306	1.422	67.522	1.912	67.875	1.922
106.69	32.52	8.69	2.65	15.360	1.427	68.016	1.926	68.369	1.936
106.73	32.53	8.73	2.66	15.414	1.432	68.511	1.940	68.864	1.950
106.76	32.54	8.76	2.67	15.468	1.437	69.005	1.954	69.358	1.964
106.79	32.55	8.79	2.68	15.522	1.442	69.535	1.969	69.888	1.979
106.82	32.56	8.83	2.69	15.575	1.447	70.029	1.983	70.382	1.993
106.86	32.57	8.86	2.70	15.629	1.452	70.559	1.998	70.912	2.008
106.89	32.58	8.89	2.71	15.683	1.457	71.053	2.012	71.406	2.022
106.92	32.59	8.92	2.72	15.737	1.462	71.583	2.027	71.936	2.037
106.96	32.60	8.96	2.73	15.791	1.467	72.113	2.042	72.466	2.052
106.99	32.61	8.99	2.74	15.834	1.471	72.607	2.056	72.960	2.066
107.02	32.62	9.02	2.75	15.888	1.476	73.137	2.071	73.490	2.081
107.05	32.63	9.06	2.76	15.952	1.482	73.666	2.086	74.020	2.096
107.09	32.64	9.09	2.77	16.006	1.487	74.196	2.101	74.549	2.111
107.12	32.65	9.12	2.78	16.060	1.492	74.691	2.115	75.044	2.125
107.15	32.66	9.15	2.79	16.124	1.498	75.220	2.130	75.573	2.140
107.19	32.67	9.19	2.80	16.189	1.504	75.750	2.145	76.103	2.155
107.22	32.68	9.22	2.81	16.253	1.510	76.315	2.161	76.668	2.171
107.25	32.69	9.25	2.82	16.307	1.515	76.845	2.176	77.198	2.186

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
107.28	32.70	9.28	2.83	16.372	1.521	77.375	2.191	77.728	2.201
107.32	32.71	9.32	2.84	16.426	1.526	77.904	2.206	78.257	2.216
107.35	32.72	9.35	2.85	16.490	1.532	78.434	2.221	78.787	2.231
107.38	32.73	9.38	2.86	16.544	1.537	78.999	2.237	79.352	2.247
107.41	32.74	9.42	2.87	16.609	1.543	79.529	2.252	79.882	2.262
107.45	32.75	9.45	2.88	16.684	1.550	80.094	2.268	80.447	2.278
107.48	32.76	9.48	2.89	16.749	1.556	80.623	2.283	80.977	2.293
107.51	32.77	9.51	2.90	16.813	1.562	81.188	2.299	81.542	2.309
107.55	32.78	9.55	2.91	16.867	1.567	81.718	2.314	82.071	2.324
107.58	32.79	9.58	2.92	16.932	1.573	82.283	2.330	82.636	2.340
107.61	32.80	9.61	2.93	16.985	1.578	82.848	2.346	83.201	2.356
107.64	32.81	9.65	2.94	17.050	1.584	83.413	2.362	83.766	2.372
107.68	32.82	9.68	2.95	17.104	1.589	83.943	2.377	84.296	2.387
107.71	32.83	9.71	2.96	17.168	1.595	84.508	2.393	84.861	2.403
107.74	32.84	9.74	2.97	17.233	1.601	85.073	2.409	85.426	2.419
107.78	32.85	9.78	2.98	17.298	1.607	85.638	2.425	85.991	2.435
107.81	32.86	9.81	2.99	17.362	1.613	86.203	2.441	86.556	2.451
107.84	32.87	9.84	3.00	17.416	1.618	86.804	2.458	87.157	2.468
107.87	32.88	9.88	3.01	17.481	1.624	87.369	2.474	87.722	2.484
107.91	32.89	9.91	3.02	17.545	1.630	87.934	2.490	88.287	2.500
107.94	32.90	9.94	3.03	17.621	1.637	88.499	2.506	88.852	2.516
107.97	32.91	9.97	3.04	17.685	1.643	89.099	2.523	89.452	2.533
108.01	32.92	10.01	3.05	17.750	1.649	89.664	2.539	90.017	2.549
108.04	32.93	10.04	3.06	17.814	1.655	90.264	2.556	90.618	2.566

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
108.07	32.94	10.07	3.07	17.879	1.661	90.829	2.572	91.183	2.582
108.10	32.95	10.10	3.08	17.943	1.667	91.430	2.589	91.783	2.599
108.14	32.96	10.14	3.09	18.008	1.673	92.030	2.606	92.383	2.616
108.17	32.97	10.17	3.10	18.083	1.680	92.595	2.622	92.948	2.632
108.20	32.98	10.20	3.11	18.148	1.686	93.195	2.639	93.549	2.649
108.23	32.99	10.24	3.12	18.213	1.692	93.796	2.656	94.149	2.666
108.27	33.00	10.27	3.13	18.277	1.698	94.396	2.673	94.749	2.683
108.30	33.01	10.30	3.14	18.342	1.704	94.997	2.690	95.350	2.700
108.33	33.02	10.33	3.15	18.406	1.710	95.597	2.707	95.950	2.717
108.37	33.03	10.37	3.16	18.471	1.716	96.197	2.724	96.550	2.734
108.40	33.04	10.40	3.17	18.535	1.722	96.833	2.742	97.186	2.752
108.43	33.05	10.43	3.18	18.600	1.728	97.433	2.759	97.786	2.769
108.46	33.06	10.47	3.19	18.675	1.735	98.034	2.776	98.387	2.786
108.50	33.07	10.50	3.20	18.729	1.740	98.669	2.794	99.022	2.804
108.53	33.08	10.53	3.21	18.794	1.746	99.270	2.811	99.623	2.821
108.56	33.09	10.56	3.22	18.848	1.751	99.870	2.828	100.223	2.838
108.60	33.10	10.60	3.23	18.912	1.757	100.506	2.846	100.859	2.856
108.63	33.11	10.63	3.24	18.966	1.762	101.141	2.864	101.494	2.874
108.66	33.12	10.66	3.25	19.031	1.768	101.742	2.881	102.095	2.891
108.69	33.13	10.70	3.26	19.084	1.773	102.377	2.899	102.730	2.909
108.73	33.14	10.73	3.27	19.149	1.779	103.013	2.917	103.366	2.927
108.76	33.15	10.76	3.28	19.203	1.784	103.613	2.934	103.966	2.944
108.79	33.16	10.79	3.29	19.267	1.790	104.249	2.952	104.602	2.962
108.83	33.17	10.83	3.30	19.343	1.797	104.885	2.970	105.238	2.980

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
108.86	33.18	10.86	3.31	19.407	1.803	105.520	2.988	105.873	2.998
108.89	33.19	10.89	3.32	19.493	1.811	106.156	3.006	106.509	3.016
108.92	33.20	10.93	3.33	19.569	1.818	106.792	3.024	107.145	3.034
108.96	33.21	10.96	3.34	19.666	1.827	107.463	3.043	107.816	3.053
108.99	33.22	10.99	3.35	19.752	1.835	108.098	3.061	108.451	3.071
109.02	33.23	11.02	3.36	19.849	1.844	108.734	3.079	109.087	3.089
109.06	33.24	11.06	3.37	19.935	1.852	109.405	3.098	109.758	3.108
109.09	33.25	11.09	3.38	20.021	1.860	110.041	3.116	110.394	3.126
109.12	33.26	11.12	3.39	20.107	1.868	110.712	3.135	111.065	3.145
109.15	33.27	11.15	3.40	20.193	1.876	111.383	3.154	111.736	3.164
109.19	33.28	11.19	3.41	20.279	1.884	112.054	3.173	112.407	3.183
109.22	33.29	11.22	3.42	20.355	1.891	112.689	3.191	113.042	3.201
109.25	33.30	11.25	3.43	20.430	1.898	113.360	3.210	113.713	3.220
109.28	33.31	11.29	3.44	20.505	1.905	114.031	3.229	114.384	3.239
109.32	33.32	11.32	3.45	20.570	1.911	114.737	3.249	115.091	3.259
109.35	33.33	11.35	3.46	20.634	1.917	115.408	3.268	115.762	3.278
109.38	33.34	11.38	3.47	20.699	1.923	116.079	3.287	116.433	3.297
109.42	33.35	11.42	3.48	20.764	1.929	116.750	3.306	117.104	3.316
109.45	33.36	11.45	3.49	20.817	1.934	117.421	3.325	117.775	3.335
109.48	33.37	11.48	3.50	20.882	1.940	118.128	3.345	118.481	3.355
109.51	33.38	11.52	3.51	20.957	1.947	118.799	3.364	119.152	3.374
109.55	33.39	11.55	3.52	21.022	1.953	119.505	3.384	119.858	3.394
109.58	33.40	11.58	3.53	21.086	1.959	120.176	3.403	120.529	3.413
109.61	33.41	11.61	3.54	21.151	1.965	120.882	3.423	121.235	3.433

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
109.65	33.42	11.65	3.55	21.216	1.971	121.589	3.443	121.942	3.453
109.68	33.43	11.68	3.56	21.280	1.977	122.259	3.462	122.613	3.472
109.71	33.44	11.71	3.57	21.334	1.982	122.966	3.482	123.319	3.492
109.74	33.45	11.75	3.58	21.399	1.988	123.672	3.502	124.025	3.512
109.78	33.46	11.78	3.59	21.463	1.994	124.378	3.522	124.732	3.532
109.81	33.47	11.81	3.60	21.528	2.000	125.085	3.542	125.438	3.552
109.84	33.48	11.84	3.61	21.582	2.005	125.791	3.562	126.144	3.572
109.88	33.49	11.88	3.62	21.646	2.011	126.497	3.582	126.850	3.592
109.91	33.50	11.91	3.63	21.711	2.017	127.204	3.602	127.557	3.612
109.94	33.51	11.94	3.64	21.775	2.023	127.910	3.622	128.263	3.632
109.97	33.52	11.98	3.65	21.840	2.029	128.651	3.643	129.005	3.653
110.01	33.53	12.01	3.66	21.905	2.035	129.358	3.663	129.711	3.673
110.04	33.54	12.04	3.67	21.980	2.042	130.064	3.683	130.417	3.693
110.07	33.55	12.07	3.68	22.044	2.048	130.806	3.704	131.159	3.714
110.10	33.56	12.11	3.69	22.109	2.054	131.512	3.724	131.865	3.734
110.14	33.57	12.14	3.70	22.174	2.060	132.254	3.745	132.607	3.755
110.17	33.58	12.17	3.71	22.238	2.066	132.960	3.765	133.313	3.775
110.20	33.59	12.20	3.72	22.303	2.072	133.701	3.786	134.055	3.796
110.24	33.60	12.24	3.73	22.367	2.078	134.443	3.807	134.796	3.817
110.27	33.61	12.27	3.74	22.432	2.084	135.185	3.828	135.538	3.838
110.30	33.62	12.30	3.75	22.497	2.090	135.926	3.849	136.279	3.859
110.33	33.63	12.34	3.76	22.561	2.096	136.633	3.869	136.986	3.879
110.37	33.64	12.37	3.77	22.626	2.102	137.374	3.890	137.727	3.900
110.40	33.65	12.40	3.78	22.690	2.108	138.151	3.912	138.504	3.922

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
110.43	33.66	12.43	3.79	22.755	2.114	138.893	3.933	139.246	3.943
110.47	33.67	12.47	3.80	22.830	2.121	139.634	3.954	139.987	3.964
110.50	33.68	12.50	3.81	22.895	2.127	140.376	3.975	140.729	3.985
110.53	33.69	12.53	3.82	22.959	2.133	141.118	3.996	141.471	4.006
110.56	33.70	12.57	3.83	23.024	2.139	141.894	4.018	142.248	4.028
110.60	33.71	12.60	3.84	23.089	2.145	142.636	4.039	142.989	4.049
110.63	33.72	12.63	3.85	23.164	2.152	143.413	4.061	143.766	4.071
110.66	33.73	12.66	3.86	23.228	2.158	144.155	4.082	144.508	4.092
110.70	33.74	12.70	3.87	23.293	2.164	144.932	4.104	145.285	4.114
110.73	33.75	12.73	3.88	23.358	2.170	145.673	4.125	146.026	4.135
110.76	33.76	12.76	3.89	23.422	2.176	146.450	4.147	146.803	4.157
110.79	33.77	12.80	3.90	23.487	2.182	147.227	4.169	147.580	4.179
110.83	33.78	12.83	3.91	23.562	2.189	148.004	4.191	148.357	4.201
110.86	33.79	12.86	3.92	23.627	2.195	148.781	4.213	149.134	4.223
110.89	33.80	12.89	3.93	23.702	2.202	149.558	4.235	149.911	4.245
110.93	33.81	12.93	3.94	23.777	2.209	150.335	4.257	150.688	4.267
110.96	33.82	12.96	3.95	23.853	2.216	151.112	4.279	151.465	4.289
110.99	33.83	12.99	3.96	23.939	2.224	151.889	4.301	152.242	4.311
111.02	33.84	13.02	3.97	24.025	2.232	152.665	4.323	153.019	4.333
111.06	33.85	13.06	3.98	24.111	2.240	153.478	4.346	153.831	4.356
111.09	33.86	13.09	3.99	24.186	2.247	154.255	4.368	154.608	4.378
111.12	33.87	13.12	4.00	24.283	2.256	155.067	4.391	155.420	4.401
111.15	33.88	13.16	4.01	24.369	2.264	155.844	4.413	156.197	4.423
111.19	33.89	13.19	4.02	24.456	2.272	156.656	4.436	157.009	4.446

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
111.22	33.90	13.22	4.03	24.542	2.280	157.468	4.459	157.821	4.469
111.25	33.91	13.25	4.04	24.628	2.288	158.280	4.482	158.634	4.492
111.29	33.92	13.29	4.05	24.703	2.295	159.057	4.504	159.411	4.514
111.32	33.93	13.32	4.06	24.778	2.302	159.870	4.527	160.223	4.537
111.35	33.94	13.35	4.07	24.865	2.310	160.682	4.550	161.035	4.560
111.38	33.95	13.39	4.08	24.940	2.317	161.529	4.574	161.883	4.584
111.42	33.96	13.42	4.09	25.015	2.324	162.342	4.597	162.695	4.607
111.45	33.97	13.45	4.10	25.091	2.331	163.154	4.620	163.507	4.630
111.48	33.98	13.48	4.11	25.166	2.338	163.966	4.643	164.319	4.653
111.52	33.99	13.52	4.12	25.252	2.346	164.814	4.667	165.167	4.677
111.55	34.00	13.55	4.13	25.327	2.353	165.626	4.690	165.979	4.700
111.58	34.01	13.58	4.14	25.414	2.361	166.473	4.714	166.827	4.724
111.61	34.02	13.62	4.15	25.489	2.368	167.321	4.738	167.674	4.748
111.65	34.03	13.65	4.16	25.564	2.375	168.133	4.761	168.486	4.771
111.68	34.04	13.68	4.17	25.640	2.382	168.981	4.785	169.334	4.795
111.71	34.05	13.71	4.18	25.715	2.389	169.828	4.809	170.182	4.819
111.75	34.06	13.75	4.19	25.780	2.395	170.676	4.833	171.029	4.843
111.78	34.07	13.78	4.20	25.844	2.401	171.523	4.857	171.877	4.867
111.81	34.08	13.81	4.21	25.909	2.407	172.371	4.881	172.724	4.891
111.84	34.09	13.85	4.22	25.973	2.413	173.219	4.905	173.572	4.915
111.88	34.10	13.88	4.23	26.038	2.419	174.066	4.929	174.419	4.939
111.91	34.11	13.91	4.24	26.102	2.425	174.914	4.953	175.267	4.963
111.94	34.12	13.94	4.25	26.178	2.432	175.797	4.978	176.150	4.988
111.98	34.13	13.98	4.26	26.242	2.438	176.644	5.002	176.997	5.012

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
112.01	34.14	14.01	4.27	26.307	2.444	177.492	5.026	177.845	5.036
112.04	34.15	14.04	4.28	26.382	2.451	178.375	5.051	178.728	5.061
112.07	34.16	14.07	4.29	26.458	2.458	179.222	5.075	179.575	5.085
112.11	34.17	14.11	4.30	26.522	2.464	180.105	5.100	180.458	5.110
112.14	34.18	14.14	4.31	26.598	2.471	180.988	5.125	181.341	5.135
112.17	34.19	14.17	4.32	26.673	2.478	181.835	5.149	182.189	5.159
112.20	34.20	14.21	4.33	26.748	2.485	182.718	5.174	183.071	5.184
112.24	34.21	14.24	4.34	26.813	2.491	183.601	5.199	183.954	5.209
112.27	34.22	14.27	4.35	26.888	2.498	184.484	5.224	184.837	5.234
112.30	34.23	14.30	4.36	26.953	2.504	185.367	5.249	185.720	5.259
112.34	34.24	14.34	4.37	27.017	2.510	186.250	5.274	186.603	5.284
112.37	34.25	14.37	4.38	27.093	2.517	187.133	5.299	187.486	5.309
112.40	34.26	14.40	4.39	27.157	2.523	188.051	5.325	188.404	5.335
112.43	34.27	14.44	4.40	27.222	2.529	188.934	5.350	189.287	5.360
112.47	34.28	14.47	4.41	27.286	2.535	189.817	5.375	190.170	5.385
112.50	34.29	14.50	4.42	27.362	2.542	190.699	5.400	191.053	5.410
112.53	34.30	14.53	4.43	27.426	2.548	191.618	5.426	191.971	5.436
112.57	34.31	14.57	4.44	27.491	2.554	192.500	5.451	192.854	5.461
112.60	34.32	14.60	4.45	27.556	2.560	193.419	5.477	193.772	5.487
112.63	34.33	14.63	4.46	27.631	2.567	194.337	5.503	194.690	5.513
112.66	34.34	14.67	4.47	27.706	2.574	195.220	5.528	195.573	5.538
112.70	34.35	14.70	4.48	27.782	2.581	196.138	5.554	196.491	5.564
112.73	34.36	14.73	4.49	27.857	2.588	197.056	5.580	197.409	5.590
112.76	34.37	14.76	4.50	27.932	2.595	197.974	5.606	198.327	5.616

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
112.80	34.38	14.80	4.51	28.008	2.602	198.892	5.632	199.246	5.642
112.83	34.39	14.83	4.52	28.094	2.610	199.811	5.658	200.164	5.668
112.86	34.40	14.86	4.53	28.169	2.617	200.729	5.684	201.082	5.694
112.89	34.41	14.90	4.54	28.244	2.624	201.647	5.710	202.000	5.720
112.93	34.42	14.93	4.55	28.320	2.631	202.600	5.737	202.954	5.747
112.96	34.43	14.96	4.56	28.395	2.638	203.519	5.763	203.872	5.773
112.99	34.44	14.99	4.57	28.471	2.645	204.437	5.789	204.790	5.799
113.02	34.45	15.03	4.58	28.546	2.652	205.390	5.816	205.743	5.826
113.06	34.46	15.06	4.59	28.621	2.659	206.308	5.842	206.662	5.852
113.09	34.47	15.09	4.60	28.697	2.666	207.262	5.869	207.615	5.879
113.12	34.48	15.12	4.61	28.783	2.674	208.215	5.896	208.569	5.906
113.16	34.49	15.16	4.62	28.858	2.681	209.134	5.922	209.487	5.932
113.19	34.50	15.19	4.63	28.933	2.688	210.087	5.949	210.440	5.959
113.22	34.51	15.22	4.64	29.009	2.695	211.041	5.976	211.394	5.986
113.25	34.52	15.26	4.65	29.084	2.702	211.994	6.003	212.347	6.013
113.29	34.53	15.29	4.66	29.159	2.709	212.948	6.030	213.301	6.040
113.32	34.54	15.32	4.67	29.235	2.716	213.901	6.057	214.254	6.067
113.35	34.55	15.35	4.68	29.310	2.723	214.890	6.085	215.243	6.095
113.39	34.56	15.39	4.69	29.385	2.730	215.843	6.112	216.197	6.122
113.42	34.57	15.42	4.70	29.450	2.736	216.797	6.139	217.150	6.149
113.45	34.58	15.45	4.71	29.525	2.743	217.786	6.167	218.139	6.177
113.48	34.59	15.49	4.72	29.590	2.749	218.739	6.194	219.092	6.204
113.52	34.60	15.52	4.73	29.665	2.756	219.728	6.222	220.081	6.232
113.55	34.61	15.55	4.74	29.741	2.763	220.682	6.249	221.035	6.259

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
113.58	34.62	15.58	4.75	29.816	2.770	221.670	6.277	222.024	6.287
113.62	34.63	15.62	4.76	29.891	2.777	222.659	6.305	223.012	6.315
113.65	34.64	15.65	4.77	29.967	2.784	223.613	6.332	223.966	6.342
113.68	34.65	15.68	4.78	30.042	2.791	224.601	6.360	224.955	6.370
113.71	34.66	15.72	4.79	30.128	2.799	225.590	6.388	225.943	6.398
113.75	34.67	15.75	4.80	30.204	2.806	226.579	6.416	226.932	6.426
113.78	34.68	15.78	4.81	30.290	2.814	227.568	6.444	227.921	6.454
113.81	34.69	15.81	4.82	30.376	2.822	228.557	6.472	228.910	6.482
113.85	34.70	15.85	4.83	30.462	2.830	229.581	6.501	229.934	6.511
113.88	34.71	15.88	4.84	30.548	2.838	230.570	6.529	230.923	6.539
113.91	34.72	15.91	4.85	30.634	2.846	231.558	6.557	231.912	6.567
113.94	34.73	15.94	4.86	30.720	2.854	232.583	6.586	232.936	6.596
113.98	34.74	15.98	4.87	30.817	2.863	233.607	6.615	233.960	6.625
114.01	34.75	16.01	4.88	30.903	2.871	234.596	6.643	234.949	6.653
114.04	34.76	16.04	4.89	31.000	2.880	235.620	6.672	235.973	6.682
114.07	34.77	16.08	4.90	31.097	2.889	236.644	6.701	236.997	6.711
114.11	34.78	16.11	4.91	31.194	2.898	237.668	6.730	238.021	6.740
114.14	34.79	16.14	4.92	31.280	2.906	238.692	6.759	239.045	6.769
114.17	34.80	16.17	4.93	31.377	2.915	239.716	6.788	240.069	6.798
114.21	34.81	16.21	4.94	31.484	2.925	240.740	6.817	241.093	6.827
114.24	34.82	16.24	4.95	31.581	2.934	241.764	6.846	242.118	6.856
114.27	34.83	16.27	4.96	31.678	2.943	242.824	6.876	243.177	6.886
114.30	34.84	16.31	4.97	31.775	2.952	243.848	6.905	244.201	6.915
114.34	34.85	16.34	4.98	31.872	2.961	244.907	6.935	245.261	6.945

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
114.37	34.86	16.37	4.99	31.969	2.970	245.932	6.964	246.285	6.974
114.40	34.87	16.40	5.00	32.055	2.978	246.991	6.994	247.344	7.004
114.44	34.88	16.44	5.01	32.152	2.987	248.050	7.024	248.404	7.034
114.47	34.89	16.47	5.02	32.249	2.996	249.110	7.054	249.463	7.064
114.50	34.90	16.50	5.03	32.335	3.004	250.169	7.084	250.522	7.094
114.53	34.91	16.54	5.04	32.432	3.013	251.229	7.114	251.582	7.124
114.57	34.92	16.57	5.05	32.529	3.022	252.288	7.144	252.641	7.154
114.60	34.93	16.60	5.06	32.625	3.031	253.348	7.174	253.701	7.184
114.63	34.94	16.63	5.07	32.722	3.040	254.442	7.205	254.796	7.215
114.67	34.95	16.67	5.08	32.819	3.049	255.502	7.235	255.855	7.245
114.70	34.96	16.70	5.09	32.927	3.059	256.597	7.266	256.950	7.276
114.73	34.97	16.73	5.10	33.024	3.068	257.656	7.296	258.009	7.306
114.76	34.98	16.77	5.11	33.121	3.077	258.751	7.327	259.104	7.337
114.80	34.99	16.80	5.12	33.217	3.086	259.846	7.358	260.199	7.368
114.83	35.00	16.83	5.13	33.314	3.095	260.940	7.389	261.293	7.399
114.86	35.01	16.86	5.14	33.422	3.105	262.035	7.420	262.388	7.430
114.90	35.02	16.90	5.15	33.530	3.115	263.130	7.451	263.483	7.461
114.93	35.03	16.93	5.16	33.637	3.125	264.225	7.482	264.578	7.492
114.96	35.04	16.96	5.17	33.734	3.134	265.319	7.513	265.672	7.523
114.99	35.05	16.99	5.18	33.842	3.144	266.449	7.545	266.803	7.555
115.03	35.06	17.03	5.19	33.939	3.153	267.544	7.576	267.897	7.586
115.06	35.07	17.06	5.20	34.035	3.162	268.674	7.608	269.027	7.618
115.09	35.08	17.09	5.21	34.132	3.171	269.804	7.640	270.157	7.650
115.12	35.09	17.13	5.22	34.240	3.181	270.899	7.671	271.252	7.681

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
115.16	35.10	17.16	5.23	34.326	3.189	272.029	7.703	272.382	7.713
115.19	35.11	17.19	5.24	34.423	3.198	273.159	7.735	273.512	7.745
115.22	35.12	17.22	5.25	34.520	3.207	274.289	7.767	274.642	7.777
115.26	35.13	17.26	5.26	34.606	3.215	275.419	7.799	275.772	7.809
115.29	35.14	17.29	5.27	34.703	3.224	276.549	7.831	276.903	7.841
115.32	35.15	17.32	5.28	34.800	3.233	277.715	7.864	278.068	7.874
115.35	35.16	17.36	5.29	34.897	3.242	278.845	7.896	279.198	7.906
115.39	35.17	17.39	5.30	34.993	3.251	280.010	7.929	280.363	7.939
115.42	35.18	17.42	5.31	35.090	3.260	281.140	7.961	281.493	7.971
115.45	35.19	17.45	5.32	35.187	3.269	282.306	7.994	282.659	8.004
115.49	35.20	17.49	5.33	35.284	3.278	283.471	8.027	283.824	8.037
115.52	35.21	17.52	5.34	35.381	3.287	284.601	8.059	284.954	8.069
115.55	35.22	17.55	5.35	35.489	3.297	285.767	8.092	286.120	8.102
115.58	35.23	17.59	5.36	35.585	3.306	286.932	8.125	287.285	8.135
115.62	35.24	17.62	5.37	35.693	3.316	288.097	8.158	288.450	8.168
115.65	35.25	17.65	5.38	35.801	3.326	289.298	8.192	289.651	8.202
115.68	35.26	17.68	5.39	35.908	3.336	290.463	8.225	290.817	8.235
115.72	35.27	17.72	5.40	36.016	3.346	291.629	8.258	291.982	8.268
115.75	35.28	17.75	5.41	36.124	3.356	292.829	8.292	293.183	8.302
115.78	35.29	17.78	5.42	36.231	3.366	293.995	8.325	294.348	8.335
115.81	35.30	17.81	5.43	36.339	3.376	295.196	8.359	295.549	8.369
115.85	35.31	17.85	5.44	36.447	3.386	296.396	8.393	296.749	8.403
115.88	35.32	17.88	5.45	36.565	3.397	297.597	8.427	297.950	8.437
115.91	35.33	17.91	5.46	36.673	3.407	298.798	8.461	299.151	8.471

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
115.94	35.34	17.95	5.47	36.791	3.418	299.998	8.495	300.352	8.505
115.98	35.35	17.98	5.48	36.899	3.428	301.199	8.529	301.552	8.539
116.01	35.36	18.01	5.49	37.017	3.439	302.435	8.564	302.788	8.574
116.04	35.37	18.04	5.50	37.125	3.449	303.636	8.598	303.989	8.608
116.08	35.38	18.08	5.51	37.232	3.459	304.872	8.633	305.225	8.643
116.11	35.39	18.11	5.52	37.340	3.469	306.073	8.667	306.426	8.677
116.14	35.40	18.14	5.53	37.458	3.480	307.309	8.702	307.662	8.712
116.17	35.41	18.18	5.54	37.566	3.490	308.545	8.737	308.898	8.747
116.21	35.42	18.21	5.55	37.684	3.501	309.781	8.772	310.134	8.782
116.24	35.43	18.24	5.56	37.792	3.511	311.017	8.807	311.370	8.817
116.27	35.44	18.27	5.57	37.910	3.522	312.253	8.842	312.606	8.852
116.31	35.45	18.31	5.58	38.029	3.533	313.489	8.877	313.842	8.887
116.34	35.46	18.34	5.59	38.147	3.544	314.760	8.913	315.113	8.923
116.37	35.47	18.37	5.60	38.266	3.555	315.996	8.948	316.349	8.958
116.40	35.48	18.41	5.61	38.384	3.566	317.267	8.984	317.620	8.994
116.44	35.49	18.44	5.62	38.502	3.577	318.503	9.019	318.856	9.029
116.47	35.50	18.47	5.63	38.632	3.589	319.775	9.055	320.128	9.065
116.50	35.51	18.50	5.64	38.750	3.600	321.046	9.091	321.399	9.101
116.54	35.52	18.54	5.65	38.868	3.611	322.317	9.127	322.670	9.137
116.57	35.53	18.57	5.66	38.987	3.622	323.589	9.163	323.942	9.173
116.60	35.54	18.60	5.67	39.105	3.633	324.895	9.200	325.248	9.210
116.63	35.55	18.64	5.68	39.234	3.645	326.167	9.236	326.520	9.246
116.67	35.56	18.67	5.69	39.364	3.657	327.473	9.273	327.826	9.283
116.70	35.57	18.70	5.70	39.493	3.669	328.745	9.309	329.098	9.319

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
116.73	35.58	18.73	5.71	39.622	3.681	330.051	9.346	330.404	9.356
116.77	35.59	18.77	5.72	39.751	3.693	331.358	9.383	331.711	9.393
116.80	35.60	18.80	5.73	39.880	3.705	332.664	9.420	333.018	9.430
116.83	35.61	18.83	5.74	40.020	3.718	333.971	9.457	334.324	9.467
116.86	35.62	18.86	5.75	40.149	3.730	335.278	9.494	335.631	9.504
116.90	35.63	18.90	5.76	40.289	3.743	336.620	9.532	336.973	9.542
116.93	35.64	18.93	5.77	40.429	3.756	337.926	9.569	338.280	9.579
116.96	35.65	18.96	5.78	40.558	3.768	339.268	9.607	339.621	9.617
116.99	35.66	19.00	5.79	40.698	3.781	340.575	9.644	340.928	9.654
117.03	35.67	19.03	5.80	40.827	3.793	341.917	9.682	342.270	9.692
117.06	35.68	19.06	5.81	40.967	3.806	343.259	9.720	343.612	9.730
117.09	35.69	19.09	5.82	41.107	3.819	344.601	9.758	344.954	9.768
117.13	35.70	19.13	5.83	41.237	3.831	345.978	9.797	346.331	9.807
117.16	35.71	19.16	5.84	41.376	3.844	347.320	9.835	347.673	9.845
117.19	35.72	19.19	5.85	41.506	3.856	348.697	9.874	349.050	9.884
117.22	35.73	19.23	5.86	41.646	3.869	350.039	9.912	350.392	9.922
117.26	35.74	19.26	5.87	41.775	3.881	351.417	9.951	351.770	9.961
117.29	35.75	19.29	5.88	41.915	3.894	352.794	9.990	353.147	10.000
117.32	35.76	19.32	5.89	42.044	3.906	354.171	10.029	354.524	10.039
117.36	35.77	19.36	5.90	42.184	3.919	355.548	10.068	355.902	10.078
117.39	35.78	19.39	5.91	42.313	3.931	356.926	10.107	357.279	10.117
117.42	35.79	19.42	5.92	42.442	3.943	358.338	10.147	358.691	10.157
117.45	35.80	19.46	5.93	42.571	3.955	359.716	10.186	360.069	10.196
117.49	35.81	19.49	5.94	42.711	3.968	361.128	10.226	361.481	10.236

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
117.52	35.82	19.52	5.95	42.840	3.980	362.505	10.265	362.859	10.275
117.55	35.83	19.55	5.96	42.980	3.993	363.918	10.305	364.271	10.315
117.59	35.84	19.59	5.97	43.120	4.006	365.331	10.345	365.684	10.355
117.62	35.85	19.62	5.98	43.249	4.018	366.743	10.385	367.096	10.395
117.65	35.86	19.65	5.99	43.389	4.031	368.191	10.426	368.544	10.436
117.68	35.87	19.69	6.00	43.518	4.043	369.604	10.466	369.957	10.476
117.72	35.88	19.72	6.01	43.658	4.056	371.016	10.506	371.369	10.516
117.75	35.89	19.75	6.02	43.788	4.068	372.464	10.547	372.817	10.557
117.78	35.90	19.78	6.03	43.927	4.081	373.912	10.588	374.265	10.598
117.81	35.91	19.82	6.04	44.067	4.094	375.360	10.629	375.713	10.639
117.85	35.92	19.85	6.05	44.197	4.106	376.808	10.670	377.161	10.680
117.88	35.93	19.88	6.06	44.337	4.119	378.256	10.711	378.609	10.721
117.91	35.94	19.91	6.07	44.487	4.133	379.704	10.752	380.057	10.762
117.95	35.95	19.95	6.08	44.627	4.146	381.187	10.794	381.540	10.804
117.98	35.96	19.98	6.09	44.767	4.159	382.635	10.835	382.988	10.845
118.01	35.97	20.01	6.10	44.907	4.172	384.118	10.877	384.471	10.887
118.04	35.98	20.05	6.11	45.058	4.186	385.566	10.918	385.919	10.928
118.08	35.99	20.08	6.12	45.208	4.200	387.049	10.960	387.402	10.970
118.11	36.00	20.11	6.13	45.370	4.215	388.532	11.002	388.885	11.012
118.14	36.01	20.14	6.14	45.521	4.229	390.051	11.045	390.404	11.055
118.18	36.02	20.18	6.15	45.671	4.243	391.534	11.087	391.887	11.097
118.21	36.03	20.21	6.16	45.833	4.258	393.053	11.130	393.406	11.140
118.24	36.04	20.24	6.17	45.983	4.272	394.536	11.172	394.889	11.182
118.27	36.05	20.28	6.18	46.145	4.287	396.054	11.215	396.408	11.225

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
118.31	36.06	20.31	6.19	46.296	4.301	397.573	11.258	397.926	11.268
118.34	36.07	20.34	6.20	46.446	4.315	399.091	11.301	399.445	11.311
118.37	36.08	20.37	6.21	46.597	4.329	400.610	11.344	400.963	11.354
118.41	36.09	20.41	6.22	46.748	4.343	402.164	11.388	402.517	11.398
118.44	36.10	20.44	6.23	46.898	4.357	403.682	11.431	404.035	11.441
118.47	36.11	20.47	6.24	47.049	4.371	405.236	11.475	405.589	11.485
118.50	36.12	20.51	6.25	47.200	4.385	406.790	11.519	407.143	11.529
118.54	36.13	20.54	6.26	47.350	4.399	408.309	11.562	408.662	11.572
118.57	36.14	20.57	6.27	47.501	4.413	409.898	11.607	410.251	11.617
118.60	36.15	20.60	6.28	47.663	4.428	411.452	11.651	411.805	11.661
118.64	36.16	20.64	6.29	47.824	4.443	413.005	11.695	413.359	11.705
118.67	36.17	20.67	6.30	47.985	4.458	414.595	11.740	414.948	11.750
118.70	36.18	20.70	6.31	48.158	4.474	416.148	11.784	416.502	11.794
118.73	36.19	20.73	6.32	48.330	4.490	417.738	11.829	418.091	11.839
118.77	36.20	20.77	6.33	48.502	4.506	419.327	11.874	419.680	11.884
118.80	36.21	20.80	6.34	48.674	4.522	420.916	11.919	421.269	11.929
118.83	36.22	20.83	6.35	48.847	4.538	422.505	11.964	422.858	11.974
118.86	36.23	20.87	6.36	49.030	4.555	424.130	12.010	424.483	12.020
118.90	36.24	20.90	6.37	49.202	4.571	425.754	12.056	426.107	12.066
118.93	36.25	20.93	6.38	49.374	4.587	427.343	12.101	427.696	12.111
118.96	36.26	20.96	6.39	49.546	4.603	428.968	12.147	429.321	12.157
119.00	36.27	21.00	6.40	49.718	4.619	430.592	12.193	430.945	12.203
119.03	36.28	21.03	6.41	49.901	4.636	432.252	12.240	432.605	12.250
119.06	36.29	21.06	6.42	50.074	4.652	433.876	12.286	434.230	12.296

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
119.09	36.30	21.10	6.43	50.246	4.668	435.536	12.333	435.889	12.343
119.13	36.31	21.13	6.44	50.429	4.685	437.196	12.380	437.549	12.390
119.16	36.32	21.16	6.45	50.601	4.701	438.820	12.426	439.174	12.436
119.19	36.33	21.19	6.46	50.784	4.718	440.516	12.474	440.869	12.484
119.23	36.34	21.23	6.47	50.967	4.735	442.175	12.521	442.529	12.531
119.26	36.35	21.26	6.48	51.139	4.751	443.835	12.568	444.188	12.578
119.29	36.36	21.29	6.49	51.322	4.768	445.530	12.616	445.883	12.626
119.32	36.37	21.33	6.50	51.505	4.785	447.225	12.664	447.579	12.674
119.36	36.38	21.36	6.51	51.688	4.802	448.920	12.712	449.274	12.722
119.39	36.39	21.39	6.52	51.871	4.819	450.616	12.760	450.969	12.770
119.42	36.40	21.42	6.53	52.043	4.835	452.311	12.808	452.664	12.818
119.46	36.41	21.46	6.54	52.226	4.852	454.006	12.856	454.359	12.866
119.49	36.42	21.49	6.55	52.409	4.869	455.736	12.905	456.089	12.915
119.52	36.43	21.52	6.56	52.592	4.886	457.467	12.954	457.820	12.964
119.55	36.44	21.56	6.57	52.775	4.903	459.197	13.003	459.550	13.013
119.59	36.45	21.59	6.58	52.948	4.919	460.927	13.052	461.281	13.062
119.62	36.46	21.62	6.59	53.131	4.936	462.658	13.101	463.011	13.111
119.65	36.47	21.65	6.60	53.314	4.953	464.388	13.150	464.741	13.160
119.69	36.48	21.69	6.61	53.497	4.970	466.154	13.200	466.507	13.210
119.72	36.49	21.72	6.62	53.680	4.987	467.920	13.250	468.273	13.260
119.75	36.50	21.75	6.63	53.863	5.004	469.686	13.300	470.039	13.310
119.78	36.51	21.78	6.64	54.046	5.021	471.451	13.350	471.804	13.360
119.82	36.52	21.82	6.65	54.229	5.038	473.217	13.400	473.570	13.410
119.85	36.53	21.85	6.66	54.412	5.055	475.018	13.451	475.371	13.461

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
119.88	36.54	21.88	6.67	54.605	5.073	476.784	13.501	477.137	13.511
119.91	36.55	21.92	6.68	54.788	5.090	478.585	13.552	478.938	13.562
119.95	36.56	21.95	6.69	54.971	5.107	480.386	13.603	480.739	13.613
119.98	36.57	21.98	6.70	55.165	5.125	482.187	13.654	482.540	13.664
120.01	36.58	22.01	6.71	55.348	5.142	484.023	13.706	484.376	13.716
120.05	36.59	22.05	6.72	55.542	5.160	485.824	13.757	486.177	13.767
120.08	36.60	22.08	6.73	55.725	5.177	487.661	13.809	488.014	13.819
120.11	36.61	22.11	6.74	55.918	5.195	489.497	13.861	489.850	13.871
120.14	36.62	22.15	6.75	56.112	5.213	491.333	13.913	491.687	13.923
120.18	36.63	22.18	6.76	56.306	5.231	493.170	13.965	493.523	13.975
120.21	36.64	22.21	6.77	56.500	5.249	495.006	14.017	495.359	14.027
120.24	36.65	22.24	6.78	56.693	5.267	496.878	14.070	497.231	14.080
120.28	36.66	22.28	6.79	56.887	5.285	498.750	14.123	499.103	14.133
120.31	36.67	22.31	6.80	57.081	5.303	500.621	14.176	500.974	14.186
120.34	36.68	22.34	6.81	57.264	5.320	502.493	14.229	502.846	14.239
120.37	36.69	22.38	6.82	57.447	5.337	504.365	14.282	504.718	14.292
120.41	36.70	22.41	6.83	57.619	5.353	506.272	14.336	506.625	14.346
120.44	36.71	22.44	6.84	57.791	5.369	508.143	14.389	508.496	14.399
120.47	36.72	22.47	6.85	57.953	5.384	510.050	14.443	510.403	14.453
120.51	36.73	22.51	6.86	58.104	5.398	511.957	14.497	512.310	14.507
120.54	36.74	22.54	6.87	58.254	5.412	513.864	14.551	514.217	14.561
120.57	36.75	22.57	6.88	58.405	5.426	515.771	14.605	516.124	14.615
120.60	36.76	22.60	6.89	58.556	5.440	517.678	14.659	518.031	14.669
120.64	36.77	22.64	6.90	58.696	5.453	519.620	14.714	519.974	14.724

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
120.67	36.78	22.67	6.91	58.835	5.466	521.527	14.768	521.881	14.778
120.70	36.79	22.70	6.92	58.965	5.478	523.470	14.823	523.823	14.833
120.73	36.80	22.74	6.93	59.105	5.491	525.412	14.878	525.765	14.888
120.77	36.81	22.77	6.94	59.234	5.503	527.354	14.933	527.708	14.943
120.80	36.82	22.80	6.95	59.363	5.515	529.297	14.988	529.650	14.998
120.83	36.83	22.83	6.96	59.492	5.527	531.239	15.043	531.592	15.053
120.87	36.84	22.87	6.97	59.621	5.539	533.217	15.099	533.570	15.109
120.90	36.85	22.90	6.98	59.740	5.550	535.159	15.154	535.512	15.164
120.93	36.86	22.93	6.99	59.858	5.561	537.137	15.210	537.490	15.220
120.96	36.87	22.97	7.00	59.976	5.572	539.079	15.265	539.432	15.275
121.00	36.88	23.00	7.01	60.095	5.583	541.057	15.321	541.410	15.331
121.03	36.89	23.03	7.02	60.202	5.593	543.034	15.377	543.387	15.387
121.06	36.90	23.06	7.03	60.310	5.603	545.012	15.433	545.365	15.443
121.10	36.91	23.10	7.04	60.418	5.613	546.989	15.489	547.343	15.499
121.13	36.92	23.13	7.05	60.525	5.623	548.967	15.545	549.320	15.555
121.16	36.93	23.16	7.06	60.633	5.633	550.945	15.601	551.298	15.611
121.19	36.94	23.20	7.07	60.730	5.642	552.958	15.658	553.311	15.668
121.23	36.95	23.23	7.08	60.838	5.652	554.935	15.714	555.288	15.724
121.26	36.96	23.26	7.09	60.945	5.662	556.948	15.771	557.301	15.781
121.29	36.97	23.29	7.10	61.042	5.671	558.961	15.828	559.314	15.838
121.33	36.98	23.33	7.11	61.139	5.680	560.939	15.884	561.292	15.894
121.36	36.99	23.36	7.12	61.236	5.689	562.952	15.941	563.305	15.951
121.39	37.00	23.39	7.13	61.343	5.699	564.965	15.998	565.318	16.008
121.42	37.01	23.43	7.14	61.440	5.708	566.978	16.055	567.331	16.065

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
121.46	37.02	23.46	7.15	61.537	5.717	568.990	16.112	569.344	16.122
121.49	37.03	23.49	7.16	61.634	5.726	571.003	16.169	571.357	16.179
121.52	37.04	23.52	7.17	61.731	5.735	573.052	16.227	573.405	16.237
121.56	37.05	23.56	7.18	61.839	5.745	575.065	16.284	575.418	16.294
121.59	37.06	23.59	7.19	61.935	5.754	577.113	16.342	577.466	16.352
121.62	37.07	23.62	7.20	62.032	5.763	579.126	16.399	579.479	16.409
121.65	37.08	23.65	7.21	62.129	5.772	581.174	16.457	581.527	16.467
121.69	37.09	23.69	7.22	62.226	5.781	583.222	16.515	583.575	16.525
121.72	37.10	23.72	7.23	62.323	5.790	585.271	16.573	585.624	16.583
121.75	37.11	23.75	7.24	62.420	5.799	587.319	16.631	587.672	16.641
121.78	37.12	23.79	7.25	62.517	5.808	589.367	16.689	589.720	16.699
121.82	37.13	23.82	7.26	62.614	5.817	591.415	16.747	591.768	16.757
121.85	37.14	23.85	7.27	62.700	5.825	593.464	16.805	593.817	16.815
121.88	37.15	23.88	7.28	62.797	5.834	595.512	16.863	595.865	16.873
121.92	37.16	23.92	7.29	62.893	5.843	597.595	16.922	597.949	16.932
121.95	37.17	23.95	7.30	62.990	5.852	599.644	16.980	599.997	16.990
121.98	37.18	23.98	7.31	63.076	5.860	601.727	17.039	602.080	17.049
122.01	37.19	24.02	7.32	63.173	5.869	603.775	17.097	604.129	17.107
122.05	37.20	24.05	7.33	63.270	5.878	605.859	17.156	606.212	17.166
122.08	37.21	24.08	7.34	63.367	5.887	607.943	17.215	608.296	17.225
122.11	37.22	24.11	7.35	63.453	5.895	610.026	17.274	610.379	17.284
122.15	37.23	24.15	7.36	63.550	5.904	612.110	17.333	612.463	17.343
122.18	37.24	24.18	7.37	63.647	5.913	614.193	17.392	614.546	17.402
122.21	37.25	24.21	7.38	63.744	5.922	616.277	17.451	616.630	17.461

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
122.24	37.26	24.25	7.39	63.841	5.931	618.360	17.510	618.714	17.520
122.28	37.27	24.28	7.40	63.927	5.939	620.479	17.570	620.832	17.580
122.31	37.28	24.31	7.41	64.024	5.948	622.563	17.629	622.916	17.639
122.34	37.29	24.34	7.42	64.121	5.957	624.682	17.689	625.035	17.699
122.38	37.30	24.38	7.43	64.217	5.966	626.765	17.748	627.118	17.758
122.41	37.31	24.41	7.44	64.314	5.975	628.884	17.808	629.237	17.818
122.44	37.32	24.44	7.45	64.411	5.984	631.003	17.868	631.356	17.878
122.47	37.33	24.48	7.46	64.508	5.993	633.122	17.928	633.475	17.938
122.51	37.34	24.51	7.47	64.594	6.001	635.206	17.987	635.559	17.997
122.54	37.35	24.54	7.48	64.691	6.010	637.360	18.048	637.713	18.058
122.57	37.36	24.57	7.49	64.788	6.019	639.479	18.108	639.832	18.118
122.60	37.37	24.61	7.50	64.885	6.028	641.597	18.168	641.951	18.178
122.64	37.38	24.64	7.51	64.982	6.037	643.716	18.228	644.069	18.238
122.67	37.39	24.67	7.52	65.079	6.046	645.871	18.289	646.224	18.299
122.70	37.40	24.70	7.53	65.175	6.055	647.989	18.349	648.343	18.359
122.74	37.41	24.74	7.54	65.283	6.065	650.144	18.410	650.497	18.420
122.77	37.42	24.77	7.55	65.380	6.074	652.263	18.470	652.616	18.480
122.80	37.43	24.80	7.56	65.477	6.083	654.417	18.531	654.770	18.541
122.83	37.44	24.84	7.57	65.574	6.092	656.571	18.592	656.924	18.602
122.87	37.45	24.87	7.58	65.671	6.101	658.725	18.653	659.078	18.663
122.90	37.46	24.90	7.59	65.778	6.111	660.879	18.714	661.232	18.724
122.93	37.47	24.93	7.60	65.875	6.120	663.033	18.775	663.387	18.785
122.97	37.48	24.97	7.61	65.983	6.130	665.223	18.837	665.576	18.847
123.00	37.49	25.00	7.62	66.080	6.139	667.377	18.898	667.730	18.908

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
123.03	37.50	25.03	7.63	66.187	6.149	669.531	18.959	669.885	18.969
123.06	37.51	25.07	7.64	66.284	6.158	671.721	19.021	672.074	19.031
123.10	37.52	25.10	7.65	66.381	6.167	673.910	19.083	674.264	19.093
123.13	37.53	25.13	7.66	66.489	6.177	676.065	19.144	676.418	19.154
123.16	37.54	25.16	7.67	66.585	6.186	678.254	19.206	678.607	19.216
123.20	37.55	25.20	7.68	66.693	6.196	680.444	19.268	680.797	19.278
123.23	37.56	25.23	7.69	66.801	6.206	682.633	19.330	682.986	19.340
123.26	37.57	25.26	7.70	66.898	6.215	684.823	19.392	685.176	19.402
123.29	37.58	25.30	7.71	67.005	6.225	687.012	19.454	687.365	19.464
123.33	37.59	25.33	7.72	67.102	6.234	689.237	19.517	689.590	19.527
123.36	37.60	25.36	7.73	67.210	6.244	691.427	19.579	691.780	19.589
123.39	37.61	25.39	7.74	67.317	6.254	693.616	19.641	693.969	19.651
123.43	37.62	25.43	7.75	67.425	6.264	695.841	19.704	696.194	19.714
123.46	37.63	25.46	7.76	67.522	6.273	698.066	19.767	698.419	19.777
123.49	37.64	25.49	7.77	67.630	6.283	700.291	19.830	700.644	19.840
123.52	37.65	25.52	7.78	67.737	6.293	702.480	19.892	702.833	19.902
123.56	37.66	25.56	7.79	67.845	6.303	704.705	19.955	705.058	19.965
123.59	37.67	25.59	7.80	67.953	6.313	706.930	20.018	707.283	20.028
123.62	37.68	25.62	7.81	68.060	6.323	709.190	20.082	709.543	20.092
123.65	37.69	25.66	7.82	68.168	6.333	711.415	20.145	711.768	20.155
123.69	37.70	25.69	7.83	68.275	6.343	713.639	20.208	713.993	20.218
123.72	37.71	25.72	7.84	68.383	6.353	715.900	20.272	716.253	20.282
123.75	37.72	25.75	7.85	68.491	6.363	718.124	20.335	718.478	20.345
123.79	37.73	25.79	7.86	68.598	6.373	720.385	20.399	720.738	20.409

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
123.82	37.74	25.82	7.87	68.717	6.384	722.645	20.463	722.998	20.473
123.85	37.75	25.85	7.88	68.824	6.394	724.905	20.527	725.258	20.537
123.88	37.76	25.89	7.89	68.932	6.404	727.165	20.591	727.518	20.601
123.92	37.77	25.92	7.90	69.050	6.415	729.425	20.655	729.778	20.665
123.95	37.78	25.95	7.91	69.169	6.426	731.685	20.719	732.038	20.729
123.98	37.79	25.98	7.92	69.287	6.437	733.945	20.783	734.299	20.793
124.02	37.80	26.02	7.93	69.416	6.449	736.241	20.848	736.594	20.858
124.05	37.81	26.05	7.94	69.546	6.461	738.501	20.912	738.854	20.922
124.08	37.82	26.08	7.95	69.685	6.474	740.796	20.977	741.150	20.987
124.11	37.83	26.12	7.96	69.825	6.487	743.092	21.042	743.445	21.052
124.15	37.84	26.15	7.97	69.976	6.501	745.387	21.107	745.741	21.117
124.18	37.85	26.18	7.98	70.127	6.515	747.683	21.172	748.036	21.182
124.21	37.86	26.21	7.99	70.267	6.528	749.978	21.237	750.331	21.247
124.25	37.87	26.25	8.00	70.417	6.542	752.274	21.302	752.627	21.312
124.28	37.88	26.28	8.01	70.590	6.558	754.605	21.368	754.958	21.378
124.31	37.89	26.31	8.02	70.773	6.575	756.935	21.434	757.288	21.444
124.34	37.90	26.35	8.03	71.031	6.599	759.231	21.499	759.584	21.509
124.38	37.91	26.38	8.04	71.289	6.623	761.562	21.565	761.915	21.575
124.41	37.92	26.41	8.05	71.472	6.640	763.928	21.632	764.281	21.642
124.44	37.93	26.44	8.06	71.623	6.654	766.258	21.698	766.612	21.708
124.48	37.94	26.48	8.07	71.763	6.667	768.624	21.765	768.978	21.775
124.51	37.95	26.51	8.08	71.881	6.678	770.991	21.832	771.344	21.842
124.54	37.96	26.54	8.09	72.000	6.689	773.321	21.898	773.674	21.908
124.57	37.97	26.57	8.10	72.118	6.700	775.687	21.965	776.041	21.975

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
124.61	37.98	26.61	8.11	72.237	6.711	778.053	22.032	778.407	22.042
124.64	37.99	26.64	8.12	72.355	6.722	780.455	22.100	780.808	22.110
124.67	38.00	26.67	8.13	72.473	6.733	782.821	22.167	783.174	22.177
124.70	38.01	26.71	8.14	72.581	6.743	785.187	22.234	785.540	22.244
124.74	38.02	26.74	8.15	72.699	6.754	787.588	22.302	787.942	22.312
124.77	38.03	26.77	8.16	72.818	6.765	789.955	22.369	790.308	22.379
124.80	38.04	26.80	8.17	72.925	6.775	792.356	22.437	792.709	22.447
124.84	38.05	26.84	8.18	73.044	6.786	794.757	22.505	795.110	22.515
124.87	38.06	26.87	8.19	73.151	6.796	797.159	22.573	797.512	22.583
124.90	38.07	26.90	8.20	73.270	6.807	799.560	22.641	799.913	22.651
124.93	38.08	26.94	8.21	73.378	6.817	801.962	22.709	802.315	22.719
124.97	38.09	26.97	8.22	73.496	6.828	804.363	22.777	804.716	22.787
125.00	38.10	27.00	8.23	73.604	6.838	806.764	22.845	807.117	22.855
125.03	38.11	27.03	8.24	73.722	6.849	809.201	22.914	809.554	22.924
125.07	38.12	27.07	8.25	73.830	6.859	811.602	22.982	811.956	22.992
125.10	38.13	27.10	8.26	73.948	6.870	814.039	23.051	814.392	23.061
125.13	38.14	27.13	8.27	74.056	6.880	816.476	23.120	816.829	23.130
125.16	38.15	27.17	8.28	74.174	6.891	818.913	23.189	819.266	23.199
125.20	38.16	27.20	8.29	74.292	6.902	821.349	23.258	821.702	23.268
125.23	38.17	27.23	8.30	74.400	6.912	823.786	23.327	824.139	23.337
125.26	38.18	27.26	8.31	74.518	6.923	826.223	23.396	826.576	23.406
125.30	38.19	27.30	8.32	74.626	6.933	828.659	23.465	829.013	23.475
125.33	38.20	27.33	8.33	74.745	6.944	831.131	23.535	831.485	23.545
125.36	38.21	27.36	8.34	74.863	6.955	833.568	23.604	833.921	23.614

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
125.39	38.22	27.40	8.35	74.971	6.965	836.040	23.674	836.393	23.684
125.43	38.23	27.43	8.36	75.089	6.976	838.477	23.743	838.830	23.753
125.46	38.24	27.46	8.37	75.207	6.987	840.949	23.813	841.302	23.823
125.49	38.25	27.49	8.38	75.326	6.998	843.421	23.883	843.774	23.893
125.52	38.26	27.53	8.39	75.444	7.009	845.893	23.953	846.246	23.963
125.56	38.27	27.56	8.40	75.563	7.020	848.365	24.023	848.718	24.033
125.59	38.28	27.59	8.41	75.681	7.031	850.872	24.094	851.226	24.104
125.62	38.29	27.62	8.42	75.799	7.042	853.344	24.164	853.698	24.174
125.66	38.30	27.66	8.43	75.918	7.053	855.816	24.234	856.170	24.244
125.69	38.31	27.69	8.44	76.047	7.065	858.324	24.305	858.677	24.315
125.72	38.32	27.72	8.45	76.165	7.076	860.831	24.376	861.184	24.386
125.75	38.33	27.76	8.46	76.284	7.087	863.303	24.446	863.656	24.456
125.79	38.34	27.79	8.47	76.413	7.099	865.810	24.517	866.164	24.527
125.82	38.35	27.82	8.48	76.531	7.110	868.318	24.588	868.671	24.598
125.85	38.36	27.85	8.49	76.660	7.122	870.861	24.660	871.214	24.670
125.89	38.37	27.89	8.50	76.790	7.134	873.368	24.731	873.721	24.741
125.92	38.38	27.92	8.51	76.908	7.145	875.875	24.802	876.228	24.812
125.95	38.39	27.95	8.52	77.048	7.158	878.418	24.874	878.771	24.884
125.98	38.40	27.99	8.53	77.177	7.170	880.925	24.945	881.278	24.955
126.02	38.41	28.02	8.54	77.306	7.182	883.468	25.017	883.821	25.027
126.05	38.42	28.05	8.55	77.446	7.195	886.011	25.089	886.364	25.099
126.08	38.43	28.08	8.56	77.575	7.207	888.553	25.161	888.906	25.171
126.12	38.44	28.12	8.57	77.715	7.220	891.096	25.233	891.449	25.243
126.15	38.45	28.15	8.58	77.855	7.233	893.638	25.305	893.992	25.315

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
126.18	38.46	28.18	8.59	78.006	7.247	896.216	25.378	896.570	25.388
126.21	38.47	28.22	8.60	78.146	7.260	898.759	25.450	899.112	25.460
126.25	38.48	28.25	8.61	78.286	7.273	901.337	25.523	901.690	25.533
126.28	38.49	28.28	8.62	78.426	7.286	903.915	25.596	904.268	25.606
126.31	38.50	28.31	8.63	78.566	7.299	906.493	25.669	906.846	25.679
126.35	38.51	28.35	8.64	78.716	7.313	909.071	25.742	909.424	25.752
126.38	38.52	28.38	8.65	78.856	7.326	911.649	25.815	912.002	25.825
126.41	38.53	28.41	8.66	79.007	7.340	914.227	25.888	914.580	25.898
126.44	38.54	28.44	8.67	79.147	7.353	916.840	25.962	917.193	25.972
126.48	38.55	28.48	8.68	79.298	7.367	919.418	26.035	919.771	26.045
126.51	38.56	28.51	8.69	79.438	7.380	922.032	26.109	922.385	26.119
126.54	38.57	28.54	8.70	79.588	7.394	924.645	26.183	924.998	26.193
126.57	38.58	28.58	8.71	79.739	7.408	927.258	26.257	927.611	26.267
126.61	38.59	28.61	8.72	79.890	7.422	929.871	26.331	930.225	26.341
126.64	38.60	28.64	8.73	80.040	7.436	932.520	26.406	932.873	26.416
126.67	38.61	28.67	8.74	80.202	7.451	935.133	26.480	935.486	26.490
126.71	38.62	28.71	8.75	80.363	7.466	937.782	26.555	938.135	26.565
126.74	38.63	28.74	8.76	80.514	7.480	940.395	26.629	940.748	26.639
126.77	38.64	28.77	8.77	80.665	7.494	943.044	26.704	943.397	26.714
126.80	38.65	28.81	8.78	80.805	7.507	945.692	26.779	946.045	26.789
126.84	38.66	28.84	8.79	80.955	7.521	948.341	26.854	948.694	26.864
126.87	38.67	28.87	8.80	81.106	7.535	951.025	26.930	951.378	26.940
126.90	38.68	28.90	8.81	81.257	7.549	953.673	27.005	954.027	27.015
126.94	38.69	28.94	8.82	81.407	7.563	956.357	27.081	956.711	27.091

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
126.97	38.70	28.97	8.83	81.547	7.576	959.006	27.156	959.359	27.166
127.00	38.71	29.00	8.84	81.698	7.590	961.690	27.232	962.043	27.242
127.03	38.72	29.04	8.85	81.838	7.603	964.374	27.308	964.727	27.318
127.07	38.73	29.07	8.86	81.989	7.617	967.058	27.384	967.411	27.394
127.10	38.74	29.10	8.87	82.129	7.630	969.742	27.460	970.095	27.470
127.13	38.75	29.13	8.88	82.279	7.644	972.461	27.537	972.814	27.547
127.17	38.76	29.17	8.89	82.430	7.658	975.145	27.613	975.498	27.623
127.20	38.77	29.20	8.90	82.581	7.672	977.864	27.690	978.217	27.700
127.23	38.78	29.23	8.91	82.731	7.686	980.583	27.767	980.936	27.777
127.26	38.79	29.27	8.92	82.893	7.701	983.303	27.844	983.656	27.854
127.30	38.80	29.30	8.93	83.043	7.715	986.022	27.921	986.375	27.931
127.33	38.81	29.33	8.94	83.194	7.729	988.741	27.998	989.094	28.008
127.36	38.82	29.36	8.95	83.345	7.743	991.460	28.075	991.813	28.085
127.40	38.83	29.40	8.96	83.496	7.757	994.215	28.153	994.568	28.163
127.43	38.84	29.43	8.97	83.646	7.771	996.934	28.230	997.287	28.240
127.46	38.85	29.46	8.98	83.797	7.785	999.689	28.308	1000.042	28.318
127.49	38.86	29.49	8.99	83.958	7.800	1002.443	28.386	1002.796	28.396
127.53	38.87	29.53	9.00	84.109	7.814	1005.198	28.464	1005.551	28.474
127.56	38.88	29.56	9.01	84.271	7.829	1007.952	28.542	1008.305	28.552
127.59	38.89	29.59	9.02	84.421	7.843	1010.742	28.621	1011.095	28.631
127.62	38.90	29.63	9.03	84.572	7.857	1013.497	28.699	1013.850	28.709
127.66	38.91	29.66	9.04	84.712	7.870	1016.286	28.778	1016.640	28.788
127.69	38.92	29.69	9.05	84.863	7.884	1019.076	28.857	1019.429	28.867
127.72	38.93	29.72	9.06	85.003	7.897	1021.866	28.936	1022.219	28.946

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
127.76	38.94	29.76	9.07	85.153	7.911	1024.656	29.015	1025.009	29.025
127.79	38.95	29.79	9.08	85.293	7.924	1027.446	29.094	1027.799	29.104
127.82	38.96	29.82	9.09	85.444	7.938	1030.236	29.173	1030.589	29.183
127.85	38.97	29.86	9.10	85.595	7.952	1033.061	29.253	1033.414	29.263
127.89	38.98	29.89	9.11	85.745	7.966	1035.851	29.332	1036.204	29.342
127.92	38.99	29.92	9.12	85.896	7.980	1038.676	29.412	1039.029	29.422
127.95	39.00	29.95	9.13	86.047	7.994	1041.501	29.492	1041.854	29.502
127.99	39.01	29.99	9.14	86.197	8.008	1044.326	29.572	1044.679	29.582
128.02	39.02	30.02	9.15	86.348	8.022	1047.151	29.652	1047.505	29.662
128.05	39.03	30.05	9.16	86.488	8.035	1049.977	29.732	1050.330	29.742
128.08	39.04	30.09	9.17	86.639	8.049	1052.837	29.813	1053.190	29.823
128.12	39.05	30.12	9.18	86.789	8.063	1055.662	29.893	1056.015	29.903
128.15	39.06	30.15	9.19	86.940	8.077	1058.523	29.974	1058.876	29.984
128.18	39.07	30.18	9.20	87.080	8.090	1061.383	30.055	1061.736	30.065
128.22	39.08	30.22	9.21	87.231	8.104	1064.244	30.136	1064.597	30.146
128.25	39.09	30.25	9.22	87.381	8.118	1067.104	30.217	1067.457	30.227
128.28	39.10	30.28	9.23	87.521	8.131	1069.965	30.298	1070.318	30.308
128.31	39.11	30.31	9.24	87.672	8.145	1072.825	30.379	1073.178	30.389
128.35	39.12	30.35	9.25	87.823	8.159	1075.721	30.461	1076.074	30.471
128.38	39.13	30.38	9.26	87.984	8.174	1078.617	30.543	1078.970	30.553
128.41	39.14	30.41	9.27	88.135	8.188	1081.477	30.624	1081.831	30.634
128.44	39.15	30.45	9.28	88.286	8.202	1084.373	30.706	1084.726	30.716
128.48	39.16	30.48	9.29	88.436	8.216	1087.269	30.788	1087.622	30.798
128.51	39.17	30.51	9.30	88.587	8.230	1090.200	30.871	1090.553	30.881

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
128.54	39.18	30.54	9.31	88.738	8.244	1093.096	30.953	1093.449	30.963
128.58	39.19	30.58	9.32	88.888	8.258	1096.027	31.036	1096.380	31.046
128.61	39.20	30.61	9.33	89.050	8.273	1098.923	31.118	1099.276	31.128
128.64	39.21	30.64	9.34	89.200	8.287	1101.854	31.201	1102.207	31.211
128.67	39.22	30.68	9.35	89.362	8.302	1104.785	31.284	1105.138	31.294
128.71	39.23	30.71	9.36	89.513	8.316	1107.716	31.367	1108.069	31.377
128.74	39.24	30.74	9.37	89.663	8.330	1110.647	31.450	1111.000	31.460
128.77	39.25	30.77	9.38	89.825	8.345	1113.614	31.534	1113.967	31.544
128.81	39.26	30.81	9.39	89.975	8.359	1116.545	31.617	1116.898	31.627
128.84	39.27	30.84	9.40	90.148	8.375	1119.511	31.701	1119.864	31.711
128.87	39.28	30.87	9.41	90.309	8.390	1122.478	31.785	1122.831	31.795
128.90	39.29	30.91	9.42	90.471	8.405	1125.444	31.869	1125.797	31.879
128.94	39.30	30.94	9.43	90.632	8.420	1128.411	31.953	1128.764	31.963
128.97	39.31	30.97	9.44	90.804	8.436	1131.377	32.037	1131.730	32.047
129.00	39.32	31.00	9.45	90.966	8.451	1134.343	32.121	1134.697	32.131
129.04	39.33	31.04	9.46	91.127	8.466	1137.345	32.206	1137.698	32.216
129.07	39.34	31.07	9.47	91.289	8.481	1140.347	32.291	1140.700	32.301
129.10	39.35	31.10	9.48	91.439	8.495	1143.349	32.376	1143.702	32.386
129.13	39.36	31.14	9.49	91.590	8.509	1146.350	32.461	1146.704	32.471
129.17	39.37	31.17	9.50	91.730	8.522	1149.352	32.546	1149.705	32.556
129.20	39.38	31.20	9.51	91.881	8.536	1152.354	32.631	1152.707	32.641
129.23	39.39	31.23	9.52	92.021	8.549	1155.391	32.717	1155.744	32.727
129.27	39.40	31.27	9.53	92.171	8.563	1158.393	32.802	1158.746	32.812
129.30	39.41	31.30	9.54	92.322	8.577	1161.430	32.888	1161.783	32.898

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
129.33	39.42	31.33	9.55	92.473	8.591	1164.467	32.974	1164.820	32.984
129.36	39.43	31.36	9.56	92.634	8.606	1167.504	33.060	1167.857	33.070
129.40	39.44	31.40	9.57	92.785	8.620	1170.541	33.146	1170.894	33.156
129.43	39.45	31.43	9.58	92.946	8.635	1173.578	33.232	1173.931	33.242
129.46	39.46	31.46	9.59	93.108	8.650	1176.615	33.318	1176.968	33.328
129.49	39.47	31.50	9.60	93.258	8.664	1179.688	33.405	1180.041	33.415
129.53	39.48	31.53	9.61	93.420	8.679	1182.760	33.492	1183.113	33.502
129.56	39.49	31.56	9.62	93.571	8.693	1185.832	33.579	1186.185	33.589
129.59	39.50	31.59	9.63	93.732	8.708	1188.905	33.666	1189.258	33.676
129.63	39.51	31.63	9.64	93.893	8.723	1191.977	33.753	1192.330	33.763
129.66	39.52	31.66	9.65	94.055	8.738	1195.049	33.840	1195.403	33.850
129.69	39.53	31.69	9.66	94.216	8.753	1198.157	33.928	1198.510	33.938
129.72	39.54	31.73	9.67	94.378	8.768	1201.230	34.015	1201.583	34.025
129.76	39.55	31.76	9.68	94.550	8.784	1204.337	34.103	1204.690	34.113
129.79	39.56	31.79	9.69	94.712	8.799	1207.445	34.191	1207.798	34.201
129.82	39.57	31.82	9.70	94.884	8.815	1210.553	34.279	1210.906	34.289
129.86	39.58	31.86	9.71	95.056	8.831	1213.660	34.367	1214.013	34.377
129.89	39.59	31.89	9.72	95.228	8.847	1216.803	34.456	1217.156	34.466
129.92	39.60	31.92	9.73	95.411	8.864	1219.911	34.544	1220.264	34.554
129.95	39.61	31.96	9.74	95.583	8.880	1223.054	34.633	1223.407	34.643
129.99	39.62	31.99	9.75	95.745	8.895	1226.197	34.722	1226.550	34.732
130.02	39.63	32.02	9.76	95.917	8.911	1229.340	34.811	1229.693	34.821
130.05	39.64	32.05	9.77	96.089	8.927	1232.483	34.900	1232.836	34.910
130.09	39.65	32.09	9.78	96.262	8.943	1235.626	34.989	1235.979	34.999

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
130.12	39.66	32.12	9.79	96.445	8.960	1238.804	35.079	1239.158	35.089
130.15	39.67	32.15	9.80	96.617	8.976	1241.947	35.168	1242.301	35.178
130.18	39.68	32.19	9.81	96.789	8.992	1245.126	35.258	1245.479	35.268
130.22	39.69	32.22	9.82	96.961	9.008	1248.304	35.348	1248.657	35.358
130.25	39.70	32.25	9.83	97.144	9.025	1251.482	35.438	1251.835	35.448
130.28	39.71	32.28	9.84	97.316	9.041	1254.696	35.529	1255.049	35.539
130.31	39.72	32.32	9.85	97.489	9.057	1257.874	35.619	1258.227	35.629
130.35	39.73	32.35	9.86	97.661	9.073	1261.088	35.710	1261.441	35.720
130.38	39.74	32.38	9.87	97.844	9.090	1264.302	35.801	1264.655	35.811
130.41	39.75	32.41	9.88	98.016	9.106	1267.515	35.892	1267.868	35.902
130.45	39.76	32.45	9.89	98.210	9.124	1270.729	35.983	1271.082	35.993
130.48	39.77	32.48	9.90	98.404	9.142	1273.942	36.074	1274.296	36.084
130.51	39.78	32.51	9.91	98.587	9.159	1277.191	36.166	1277.545	36.176
130.54	39.79	32.55	9.92	98.780	9.177	1280.405	36.257	1280.758	36.267
130.58	39.80	32.58	9.93	98.963	9.194	1283.654	36.349	1284.007	36.359
130.61	39.81	32.61	9.94	99.157	9.212	1286.903	36.441	1287.256	36.451
130.64	39.82	32.64	9.95	99.340	9.229	1290.152	36.533	1290.505	36.543
130.68	39.83	32.68	9.96	99.523	9.246	1293.436	36.626	1293.789	36.636
130.71	39.84	32.71	9.97	99.717	9.264	1296.685	36.718	1297.038	36.728
130.74	39.85	32.74	9.98	99.900	9.281	1299.969	36.811	1300.323	36.821
130.77	39.86	32.78	9.99	100.083	9.298	1303.254	36.904	1303.607	36.914
130.81	39.87	32.81	10.00	100.266	9.315	1306.538	36.997	1306.891	37.007
130.84	39.88	32.84	10.01	100.449	9.332	1309.822	37.090	1310.175	37.100
130.87	39.89	32.87	10.02	100.632	9.349	1313.142	37.184	1313.495	37.194

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
130.91	39.90	32.91	10.03	100.804	9.365	1316.426	37.277	1316.779	37.287
130.94	39.91	32.94	10.04	100.987	9.382	1319.746	37.371	1320.099	37.381
130.97	39.92	32.97	10.05	101.159	9.398	1323.065	37.465	1323.418	37.475
131.00	39.93	33.01	10.06	101.331	9.414	1326.385	37.559	1326.738	37.569
131.04	39.94	33.04	10.07	101.504	9.430	1329.704	37.653	1330.058	37.663
131.07	39.95	33.07	10.08	101.676	9.446	1333.059	37.748	1333.412	37.758
131.10	39.96	33.10	10.09	101.848	9.462	1336.379	37.842	1336.732	37.852
131.14	39.97	33.14	10.10	102.031	9.479	1339.734	37.937	1340.087	37.947
131.17	39.98	33.17	10.11	102.203	9.495	1343.089	38.032	1343.442	38.042
131.20	39.99	33.20	10.12	102.375	9.511	1346.444	38.127	1346.797	38.137
131.23	40.00	33.23	10.13	102.548	9.527	1349.798	38.222	1350.152	38.232
131.27	40.01	33.27	10.14	102.709	9.542	1353.153	38.317	1353.507	38.327
131.30	40.02	33.30	10.15	102.881	9.558	1356.544	38.413	1356.897	38.423
131.33	40.03	33.33	10.16	103.054	9.574	1359.898	38.508	1360.252	38.518
131.36	40.04	33.37	10.17	103.226	9.590	1363.289	38.604	1363.642	38.614
131.40	40.05	33.40	10.18	103.409	9.607	1366.679	38.700	1367.032	38.710
131.43	40.06	33.43	10.19	103.581	9.623	1370.069	38.796	1370.422	38.806
131.46	40.07	33.46	10.20	103.753	9.639	1373.495	38.893	1373.848	38.903
131.50	40.08	33.50	10.21	103.915	9.654	1376.885	38.989	1377.238	38.999
131.53	40.09	33.53	10.22	104.087	9.670	1380.310	39.086	1380.664	39.096
131.56	40.10	33.56	10.23	104.259	9.686	1383.736	39.183	1384.089	39.193
131.59	40.11	33.60	10.24	104.431	9.702	1387.126	39.279	1387.479	39.289
131.63	40.12	33.63	10.25	104.593	9.717	1390.587	39.377	1390.940	39.387
131.66	40.13	33.66	10.26	104.754	9.732	1394.012	39.474	1394.366	39.484

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
131.69	40.14	33.69	10.27	104.916	9.747	1397.438	39.571	1397.791	39.581
131.73	40.15	33.73	10.28	105.077	9.762	1400.899	39.669	1401.252	39.679
131.76	40.16	33.76	10.29	105.239	9.777	1404.324	39.766	1404.678	39.776
131.79	40.17	33.79	10.30	105.400	9.792	1407.785	39.864	1408.138	39.874
131.82	40.18	33.83	10.31	105.562	9.807	1411.246	39.962	1411.599	39.972
131.86	40.19	33.86	10.32	105.734	9.823	1414.707	40.060	1415.060	40.070
131.89	40.20	33.89	10.33	105.906	9.839	1418.203	40.159	1418.556	40.169
131.92	40.21	33.92	10.34	106.078	9.855	1421.664	40.257	1422.017	40.267
131.96	40.22	33.96	10.35	106.250	9.871	1425.160	40.356	1425.513	40.366
131.99	40.23	33.99	10.36	106.412	9.886	1428.656	40.455	1429.009	40.465
132.02	40.24	34.02	10.37	106.573	9.901	1432.152	40.554	1432.505	40.564
132.05	40.25	34.06	10.38	106.735	9.916	1435.648	40.653	1436.002	40.663
132.09	40.26	34.09	10.39	106.907	9.932	1439.145	40.752	1439.498	40.762
132.12	40.27	34.12	10.40	107.069	9.947	1442.641	40.851	1442.994	40.861
132.15	40.28	34.15	10.41	107.241	9.963	1446.172	40.951	1446.525	40.961
132.19	40.29	34.19	10.42	107.413	9.979	1449.704	41.051	1450.057	41.061
132.22	40.30	34.22	10.43	107.585	9.995	1453.200	41.150	1453.553	41.160
132.25	40.31	34.25	10.44	107.757	10.011	1456.731	41.250	1457.085	41.260
132.28	40.32	34.28	10.45	107.930	10.027	1460.298	41.351	1460.651	41.361
132.32	40.33	34.32	10.46	108.134	10.046	1463.830	41.451	1464.183	41.461
132.35	40.34	34.35	10.47	108.328	10.064	1467.396	41.552	1467.750	41.562
132.38	40.35	34.38	10.48	108.532	10.083	1470.928	41.652	1471.281	41.662
132.41	40.36	34.42	10.49	108.715	10.100	1474.495	41.753	1474.848	41.763
132.45	40.37	34.45	10.50	108.888	10.116	1478.061	41.854	1478.415	41.864

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
132.48	40.38	34.48	10.51	109.071	10.133	1481.628	41.955	1481.981	41.965
132.51	40.39	34.51	10.52	109.243	10.149	1485.230	42.057	1485.583	42.067
132.55	40.40	34.55	10.53	109.404	10.164	1488.797	42.158	1489.150	42.168
132.58	40.41	34.58	10.54	109.577	10.180	1492.399	42.260	1492.752	42.270
132.61	40.42	34.61	10.55	109.749	10.196	1496.001	42.362	1496.354	42.372
132.64	40.43	34.65	10.56	109.910	10.211	1499.603	42.464	1499.957	42.474
132.68	40.44	34.68	10.57	110.072	10.226	1503.206	42.566	1503.559	42.576
132.71	40.45	34.71	10.58	110.244	10.242	1506.843	42.669	1507.196	42.679
132.74	40.46	34.74	10.59	110.405	10.257	1510.445	42.771	1510.798	42.781
132.78	40.47	34.78	10.60	110.578	10.273	1514.082	42.874	1514.436	42.884
132.81	40.48	34.81	10.61	110.739	10.288	1517.720	42.977	1518.073	42.987
132.84	40.49	34.84	10.62	110.911	10.304	1521.357	43.080	1521.710	43.090
132.87	40.50	34.88	10.63	111.073	10.319	1524.995	43.183	1525.348	43.193
132.91	40.51	34.91	10.64	111.234	10.334	1528.632	43.286	1528.985	43.296
132.94	40.52	34.94	10.65	111.406	10.350	1532.270	43.389	1532.623	43.399
132.97	40.53	34.97	10.66	111.568	10.365	1535.942	43.493	1536.295	43.503
133.01	40.54	35.01	10.67	111.719	10.379	1539.615	43.597	1539.968	43.607
133.04	40.55	35.04	10.68	111.880	10.394	1543.288	43.701	1543.641	43.711
133.07	40.56	35.07	10.69	112.041	10.409	1546.960	43.805	1547.314	43.815
133.10	40.57	35.10	10.70	112.203	10.424	1550.633	43.909	1550.986	43.919
133.14	40.58	35.14	10.71	112.375	10.440	1554.306	44.013	1554.659	44.023
133.17	40.59	35.17	10.72	112.537	10.455	1557.979	44.117	1558.332	44.127
133.20	40.60	35.20	10.73	112.698	10.470	1561.687	44.222	1562.040	44.232
133.23	40.61	35.24	10.74	112.849	10.484	1565.395	44.327	1565.748	44.337

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)		
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)	
133.27	40.62	35.27	10.75	112.999	10.498	1569.103	44.432	1569.456	44.442	
133.30	40.63	35.30	10.76	113.150	10.512	1572.811	44.537	1573.164	44.547	
133.33	40.64	35.33	10.77	113.301	10.526	1576.519	44.642	1576.872	44.652	
133.37	40.65	35.37	10.78	113.452	10.540	1580.227	44.747	1580.580	44.757	
133.40	40.66	35.40	10.79	113.602	10.554	1583.970	44.853	1584.323	44.863	
133.43	40.67	35.43	10.80	113.753	10.568	1587.678	44.958	1588.031	44.968	
133.46	40.68	35.47	10.81	113.904	10.582	1591.422	45.064	1591.775	45.074	
133.50	40.69	35.50	10.82	114.054	10.596	1595.165	45.170	1595.518	45.180	
133.53	40.70	35.53	10.83	114.205	10.610	1598.908	45.276	1599.262	45.286	
133.56	40.71	35.56	10.84	114.356	10.624	1602.652	45.382	1603.005	45.392	
133.60	40.72	35.60	10.85	114.506	10.638	1606.430	45.489	1606.784	45.499	
133.63	40.73	35.63	10.86	114.646	10.651	1610.174	45.595	1610.527	45.605	
133.66	40.74	35.66	10.87	114.797	10.665	1613.952	45.702	1614.306	45.712	
133.69	40.75	35.70	10.88	114.948	10.679	1617.696	45.808	1618.049	45.818	
133.73	40.76	35.73	10.89	115.098	10.693	1621.474	45.915	1621.828	45.925	
133.76	40.77	35.76	10.90	115.249	10.707	1625.253	46.022	1625.606	46.032	
133.79	40.78	35.79	10.91	115.389	10.720	1629.032	46.129	1629.385	46.139	
133.83	40.79	35.83	10.92	115.540	10.734	1632.846	46.237	1633.199	46.247	
133.86	40.80	35.86	10.93	115.680	10.747	1636.624	46.344	1636.978	46.354	
133.89	40.81	35.89	10.94	115.820	10.760	1640.403	46.451	1640.756	46.461	
133.92	40.82	35.93	10.95	115.949	10.772	1644.217	46.559	1644.570	46.569	
133.96	40.83	35.96	10.96	116.089	10.785	1648.031	46.667	1648.384	46.677	
133.99	40.84	35.99	10.97	116.218	10.797	1651.845	46.775	1652.198	46.785	
134.02	**40.85**	**36.02**	**10.98**	**116.358**	**10.810**	**1655.659**	**46.883**	**1656.012**	**46.893**	**FRL**

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
134.06	40.86	36.06	10.99	116.487	10.822	1659.473	46.991	1659.826	47.001
134.09	40.87	36.09	11.00	116.616	10.834	1663.287	47.099	1663.640	47.109
134.12	40.88	36.12	11.01	116.745	10.846	1667.136	47.208	1667.490	47.218
134.15	40.89	36.15	11.02	116.864	10.857	1670.950	47.316	1671.303	47.326
134.19	40.90	36.19	11.03	116.993	10.869	1674.800	47.425	1675.153	47.435
134.22	40.91	36.22	11.04	117.111	10.880	1678.649	47.534	1679.002	47.544
134.25	40.92	36.25	11.05	117.240	10.892	1682.463	47.642	1682.816	47.652
134.28	40.93	36.29	11.06	117.359	10.903	1686.312	47.751	1686.665	47.761
134.32	40.94	36.32	11.07	117.488	10.915	1690.197	47.861	1690.550	47.871
134.35	40.95	36.35	11.08	117.606	10.926	1694.046	47.970	1694.399	47.980
134.38	40.96	36.38	11.09	117.736	10.938	1697.895	48.079	1698.249	48.089
134.42	40.97	36.42	11.10	117.865	10.950	1701.745	48.188	1702.098	48.198
134.45	40.98	36.45	11.11	117.994	10.962	1705.629	48.298	1705.983	48.308
134.48	40.99	36.48	11.12	118.112	10.973	1709.514	48.408	1709.867	48.418
134.51	41.00	36.52	11.13	118.241	10.985	1713.399	48.518	1713.752	48.528

Annexure - 2

Mobilisation and Calibration Report

1 MOBILISATION

1.1 Introduction

Ocean Science & Surveying Pvt. Ltd. (OSaS) was contracted by Narmada Water Resources, Water Supply & Kalpsar Department (WRD) to carry out topographic and bathymetric survey of thirteen reservoirs in the Saurashtra & northern Gujarat region; namely Bhadar-1, Bhadar-2, Brahmani-1, Und-1, Machhu-1, Machhu-2, Khodiyar, Aji-1, Nara, Tappar, Rudramata, Mitti and Fatehgadh.

This report documents the mobilisation and calibrations carried out by OSaS for the topographic survey and on board SMB Ocean for the bathymetric survey of Tappar reservoir at Kutch (Northern Gujarat) region, Gujarat.

The survey team arrived at the survey site on 08th July 2021. TBM-1 and TBM-2 were established at the site on 09th July. DGPS observations were carried out at each of these points for about 2 hours. The levelling of these TBMs was carried out with respect to the known level of HFL (41.90m above MSL) provided by the client. The topographic survey commenced on 10th July at Tappar reservoir and was completed on 20th July 2021.

The mobilisation of the survey boat SMB Ocean was carried out on 09th July 2021 while the boat was near the dam gates of Tappar reservoir. Initial system preparation and equipment checks were completed on the same day. A bar check was carried out every day before commencing the bathymetric survey. Bathymetric survey commenced on 10th July and was completed on 14th July 2021.

1.2 HSE Checks

A safety induction was given by the Party Chief prior to survey, detailing personnel responsibilities in the event of emergency, life jacket locations, safety gear locations and procedures and signals for emergencies.

Back deck procedures were explained and enforced with no single man operations and all non-essential personnel keeping clear of operations. PPE included safety boots, hardhats and cover-all's for all personnel involved in back deck operations.

1.3 Survey Equipment list on SMB Ocean

1.3.1 *Navigation and Positioning*

Item	Quantity
Hemisphere DGPS system with cables	1
Navigation computer with Hypack software	1
Moxa 8-port cable	4
Hemisphere Atlas Link RTK system with all accessories	3

1.3.2 *Single beam Echo sounder*

Item	Quantity
Odom MK III single beam echo sounder	2
Dual frequency transducer and mounting pole	2
Bar check	1
MRU-PD	2

1.3.3 *Levelling equipment*

Item	Quantity
Geomax auto level complete with all accessories	1 set

1.3.4 *Power Systems*

Item	Quantity
2KVA stabilizer	2
1KVA generator	2
24V power supply	4
Exide battery 100Ah	1
Invertor	1
12V external battery	3
12V external battery charger	3

1.3.5 *Miscellaneous*

Item	Quantity
LCD monitors	8
Laptop	2
Helmets / life jackets	8
Tool box	1
Tripod and tribrach	4 & 3
Ranging rod	3
Antenna T-section	2 Sets
RF antenna	3
10m RF antenna cable	3
Echo rolls	52 nos
HP printer	1 nos
UPS	2 Sets
Switch board	8 Sets
Drill machine	1 Set

1.4 Vessel Offset Diagram

The equipment offsets in the survey motor boat (SMB) Ocean are shown in the figure below:

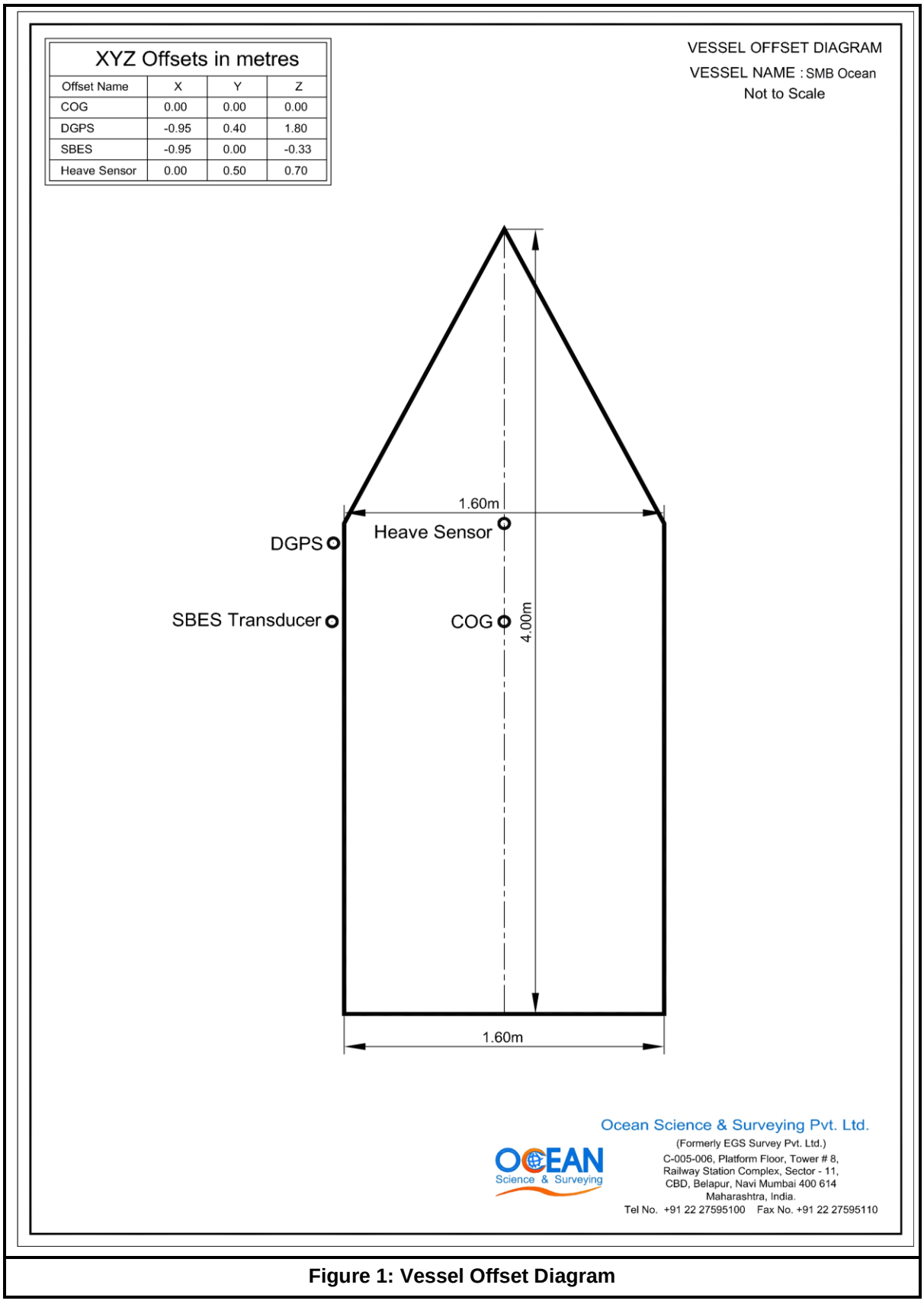


Figure 1: Vessel Offset Diagram

2 EQUIPMENT CALIBRATIONS

2.1 RTK system Calibrations

The details of the RTK system consistency checks are as follows:

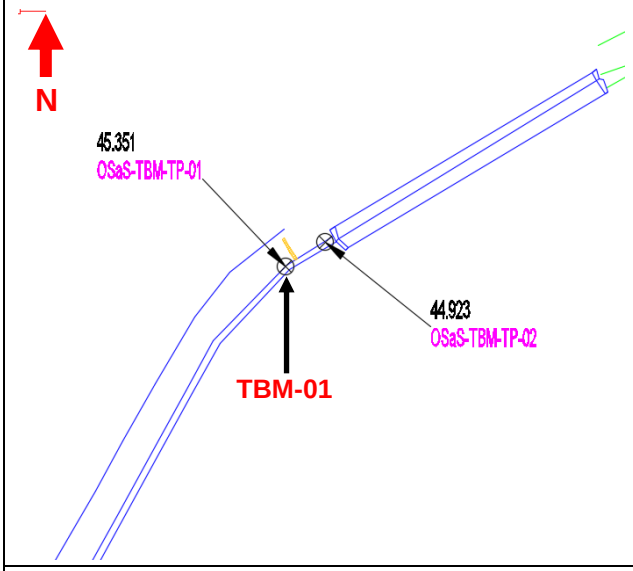
In order to determine the integrity and reliability of the positioning system, the system was checked for its consistency during mobilisation.

Two points were manually marked on the top of the dam wall, approximately 21.5m apart. About 2 hours of DGPS observations were carried out at each of the two points. After the observations, the two points were established as temporary control points/ temporary benchmark (TBM). The levelling of these TBMs were completed using Geomax auto level with respect to the known level of the HFL, which is given as 41.90m above MSL, provided by the client. The base stations of the Hemisphere Atlas Link RTK were set up at these positions and two-hour continuous observations were conducted using Hemisphere RTK positioning system to fix the consistency of the position for horizontal control. The system provides real time correction signals, providing centimetre level accuracy.

The details of reference stations OSaS-TBM-TP-01 and OSaS-TBM-TP-02 were provided in **Table 1** and **Table 2**.

Station Number:	OSaS-TBM-TP-01	**Latitude:**	23° 15' 28.044" N
Locality:	Tappar, Gujarat	**Longitude:**	70° 08' 36.525" E
Geodetic Datum:	WGS84	**Northing:**	2572518.42 m N
Projection:	Universal Transverse Mercator	**Easting:**	616967.16 m E
Date:	09th July 2021	**Elevation:**	45.351 m above MSL
Station Description:	A circle with text OS-TBM-TP-1 is drawn with yellow paint on the top of the dam wall, at the eastern end of the reservoir.		
Access:	TBM-01 is accessible by the road from Tappar village towards the dam gates. The TBM-01 is situated on the top of the dam wall, at the eastern end of the reservoir.		

Sketch:



Map:

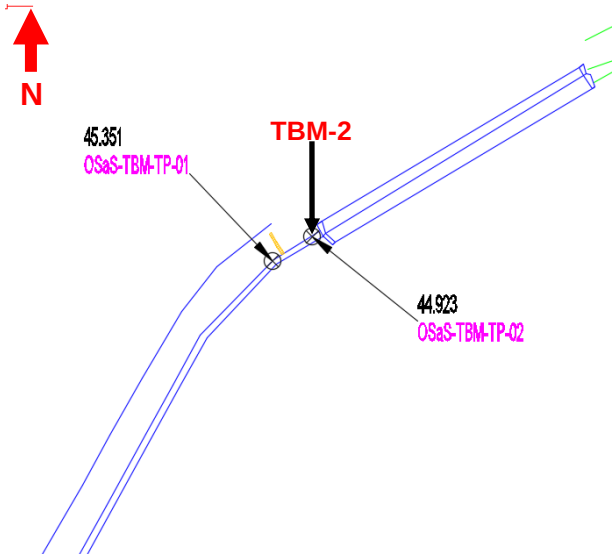
Photo:

Photo:

Table 1: Details of OSaS-TBM-TP-01

Station Number:	OSaS-TBM-TP-02	**Latitude:**	23° 15' 28.466" N
Locality:	Tappar, Gujarat	**Longitude:**	70° 08' 37.278" E
Geodetic Datum:	WGS84	**Northing:**	2572531.57 m N
Projection:	Universal Transverse Mercator	**Easting:**	616988.45 m E
Date:	09th July 2021	**Elevation:**	44.923 m above MSL
Station Description:	A circle with text OS-TBM-TP-2 is drawn with yellow paint on the top of the dam wall, at the eastern end of the reservoir.		
Access:	TBM-02 is accessible by the road from Tappar village towards the Dam gates. The TBM-02 is situated on the top of the dam wall, at the eastern end of the reservoir. TBM-02 is located approximately 21.5m NE of TBM-01.		

Sketch:



Map:

Photo:

Photo:

Table 2: Details of OSaS-TBM-TP-02

2.2 Single Beam Echo Sounder

The average speed of sound through the water column was input to the single beam echo sounder when a bar-check was performed before the start of survey operations. The following **Figure 2** shows a bar check extract of the Odom MK III echo sounder used in SMB Ocean.

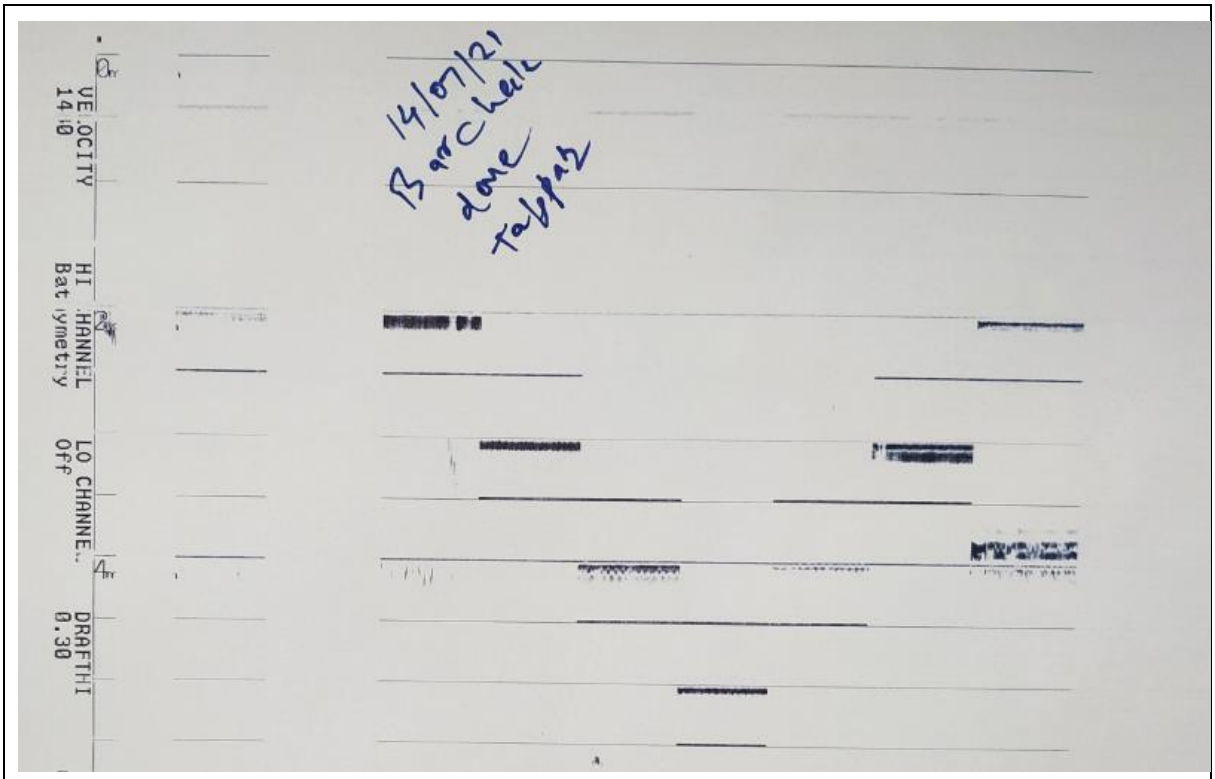


Figure 2: Bar check calibration on board SMB Ocean

3 CONCLUSIONS

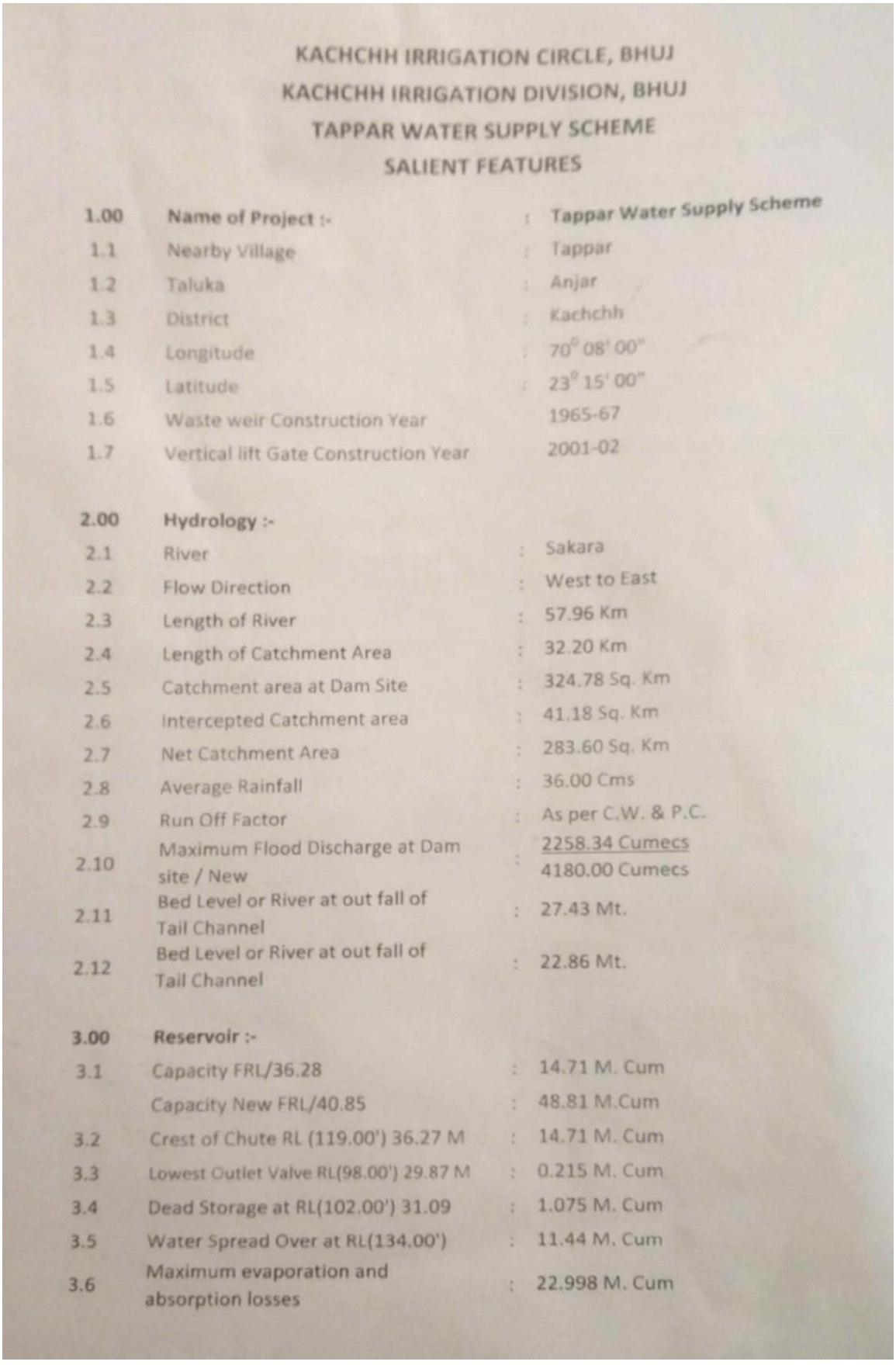
Mobilisation for this project, including calibration and verification were carried out on board SMB Ocean in a safe and acceptable manner. All systems performed to the specifications throughout the length of the survey.

Annexure - 3

Previous Data – 1967 and 1987

Tappar Reservoir

Tappar reservoir was constructed between 1965 and 1967 and first impounding was completed in 1967. The details of capacities at OSL (29.87m above MSL) and FRL (40.85m above MSL) have been extracted from the following document provides by the client.



KACHCHH IRRIGATION CIRCLE, BHUJ
KACHCHH IRRIGATION DIVISION, BHUJ
TAPPAR WATER SUPPLY SCHEME
SALIENT FEATURES

1.00	**Name of Project :-**	:	**Tappar Water Supply Scheme**
1.1	Nearby Village	:	Tappar
1.2	Taluka	:	Anjar
1.3	District	:	Kachchh
1.4	Longitude	:	70° 08' 00"
1.5	Latitude	:	23° 15' 00"
1.6	Waste weir Construction Year		1965-67
1.7	Vertical lift Gate Construction Year		2001-02
2.00	**Hydrology :-**		
2.1	River	:	Sakara
2.2	Flow Direction	:	West to East
2.3	Length of River	:	57.96 Km
2.4	Length of Catchment Area	:	32.20 Km
2.5	Catchment area at Dam Site	:	324.78 Sq. Km
2.6	Intercepted Catchment area	:	41.18 Sq. Km
2.7	Net Catchment Area	:	283.60 Sq. Km
2.8	Average Rainfall	:	36.00 Cms
2.9	Run Off Factor	:	As per C.W. & P.C.
2.10	Maximum Flood Discharge at Dam site / New	:	2258.34 Cumecs 4180.00 Cumecs
2.11	Bed Level or River at out fall of Tail Channel	:	27.43 Mt.
2.12	Bed Level or River at out fall of Tail Channel	:	22.86 Mt.
3.00	**Reservoir :-**		
3.1	Capacity FRL/36.28	:	14.71 M. Cum
	Capacity New FRL/40.85	:	48.81 M.Cum
3.2	Crest of Chute RL (119.00') 36.27 M	:	14.71 M. Cum
3.3	Lowest Outlet Valve RL(98.00') 29.87 M	:	0.215 M. Cum
3.4	Dead Storage at RL(102.00') 31.09	:	1.075 M. Cum
3.5	Water Spread Over at RL(134.00')	:	11.44 M. Cum
3.6	Maximum evaporation and absorption losses	:	22.998 M. Cum

The following document provided by the client shows the capacity values from 28.65m above MSL to 40.85m above MSL (FRL) as per the silt survey conducted in 1987. Capacity values have been extracted from this document at an interval of approximately 0.5m from 28.65m above MSL to 40.85m above MSL (FRL).

KACHCHH IRRIGATION DIVISION, BHUJ.

Tappar Water Supply Scheme

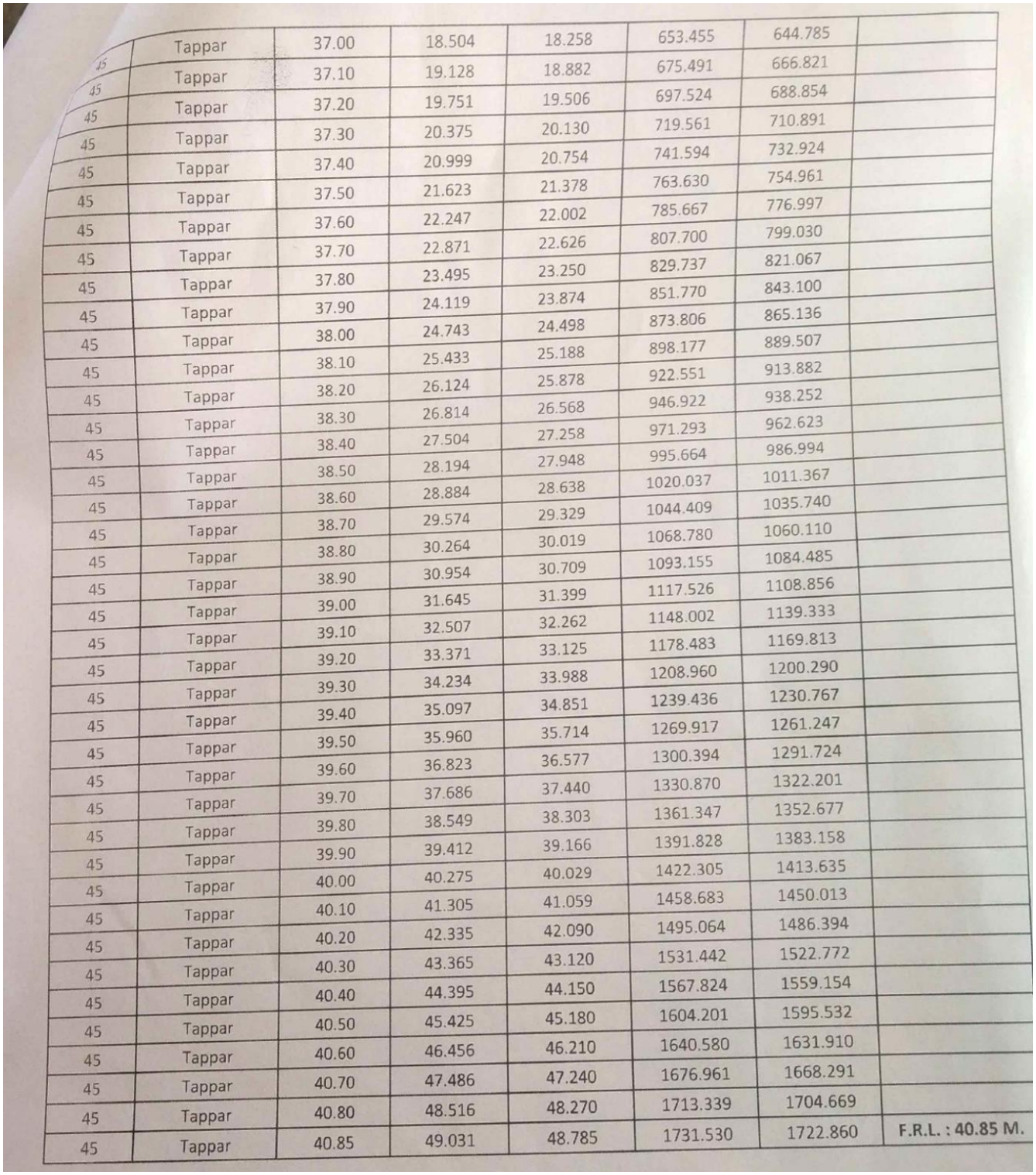
Area Capacity Table

O.S.L. : 29.87 M.
F.R.L. : 40.85 M.

Dead Storage : 0.24 Mcum.
Live Storage : 48.79 Mcum.
Gross Storage : 49.03 Mcum.

Scheme ID	Scheme Name	Water Level RL in Mt.	Gross Storage Capacity MCM	Live storage capacity in MCM	Gross Storage Capacity MCFT	Live storage capacity in MCFT	Remarks.
1	2	3	4	5	6	7	8
45	Tappar	28.65	0.005	-	0.191	-	
45	Tappar	28.70	0.007	-	0.237	-	
45	Tappar	28.80	0.009	-	0.328	-	
45	Tappar	28.90	0.012	-	0.420	-	
45	Tappar	29.00	0.014	-	0.512	-	
45	Tappar	29.10	0.041	-	1.451	-	
45	Tappar	29.20	0.068	-	2.387	-	
45	Tappar	29.30	0.094	-	3.327	-	
45	Tappar	29.40	0.121	-	4.263	-	
45	Tappar	29.50	0.147	-	5.202	-	
45	Tappar	29.60	0.174	-	6.138	-	
45	Tappar	29.70	0.200	-	7.077	-	
45	Tappar	29.80	0.227	-	8.013	-	
45	Tappar	29.87	0.245	0.000	8.670	0.000	O.S.L. : 29.87 M.
45	Tappar	29.90	0.254	0.008	8.952	0.283	
45	Tappar	30.00	0.280	0.035	9.888	1.218	
45	Tappar	30.10	0.352	0.107	12.441	3.772	
45	Tappar	30.20	0.424	0.179	14.991	6.321	
45	Tappar	30.30	0.497	0.251	17.544	8.875	
45	Tappar	30.40	0.569	0.324	20.094	11.424	
45	Tappar	30.50	0.641	0.396	22.648	13.978	
45	Tappar	30.60	0.714	0.468	25.201	16.531	
45	Tappar	30.70	0.786	0.540	27.751	19.081	
45	Tappar	30.80	0.858	0.613	30.304	21.634	
45	Tappar	30.90	0.930	0.685	32.854	24.184	
45	Tappar	31.00	1.003	0.757	35.407	26.737	
45	Tappar	31.10	1.092	0.847	38.571	29.901	
45	Tappar	31.20	1.182	0.936	41.735	33.065	
45	Tappar	31.30	1.271	1.026	44.899	36.230	
45	Tappar	31.40	1.361	1.115	48.064	39.394	
45	Tappar	31.50	1.451	1.205	51.228	42.558	
45	Tappar	31.60	1.540	1.295	54.392	45.722	
45	Tappar	31.70	1.630	1.384	57.556	48.887	
45	Tappar	31.80	1.719	1.474	60.721	52.051	
45	Tappar	31.90	1.809	1.564	63.885	55.215	
45	Tappar	32.00	1.899	1.653	67.049	58.379	

45	Tappar	32.10	2.110	1.865	74.522	65.852	
45	Tappar	32.20	2.322	2.076	81.994	73.325	
45	Tappar	32.30	2.533	2.288	89.467	80.797	
45	Tappar	32.40	2.745	2.499	96.940	88.270	
45	Tappar	32.50	2.957	2.711	104.416	95.746	
45	Tappar	32.60	3.168	2.923	111.889	103.219	
45	Tappar	32.70	3.380	3.134	119.361	110.691	
45	Tappar	32.80	3.592	3.346	126.834	118.164	
45	Tappar	32.90	3.803	3.558	134.306	125.637	
45	Tappar	33.00	4.015	3.769	141.779	133.109	
45	Tappar	33.10	4.275	4.029	150.968	142.298	
45	Tappar	33.20	4.535	4.290	160.157	151.487	
45	Tappar	33.30	4.795	4.550	169.346	160.676	
45	Tappar	33.40	5.056	4.810	178.535	169.865	
45	Tappar	33.50	5.316	5.070	187.724	179.054	
45	Tappar	33.60	5.576	5.330	196.913	188.243	
45	Tappar	33.70	5.836	5.591	206.102	197.432	
45	Tappar	33.80	6.096	5.851	215.291	206.621	
45	Tappar	33.90	6.357	6.111	224.480	215.810	
45	Tappar	34.00	6.617	6.371	233.669	224.999	
45	Tappar	34.10	6.940	6.694	245.076	236.406	
45	Tappar	34.20	7.263	7.017	256.479	247.809	
45	Tappar	34.30	7.586	7.340	267.885	259.216	
45	Tappar	34.40	7.909	7.663	279.292	270.622	
45	Tappar	34.50	8.231	7.986	290.695	282.026	
45	Tappar	34.60	8.554	8.309	302.102	293.432	
45	Tappar	34.70	8.877	8.632	313.509	304.839	
45	Tappar	34.80	9.200	8.955	324.916	316.246	
45	Tappar	34.90	9.523	9.278	336.319	327.649	
45	Tappar	35.00	9.846	9.601	347.726	339.056	
45	Tappar	35.10	10.232	9.986	361.332	352.663	
45	Tappar	35.20	10.617	10.372	374.943	366.273	
45	Tappar	35.30	11.002	10.757	388.550	379.880	
45	Tappar	35.40	11.388	11.142	402.157	393.487	
45	Tappar	35.50	11.773	11.528	415.767	407.097	
45	Tappar	35.60	12.158	11.913	429.374	420.704	
45	Tappar	35.70	12.544	12.298	442.981	434.311	
45	Tappar	35.80	12.929	12.683	456.588	447.918	
45	Tappar	35.90	13.314	13.069	470.198	461.528	
45	Tappar	36.00	13.700	13.454	483.805	475.135	
45	Tappar	36.10	14.180	13.935	500.770	492.100	
45	Tappar	36.20	14.660	14.415	517.736	509.066	
45	Tappar	36.30	15.141	14.895	534.701	526.031	
45	Tappar	36.40	15.621	15.376	551.666	542.996	
45	Tappar	36.50	16.102	15.856	568.632	559.962	
45	Tappar	36.60	16.582	16.337	585.593	576.924	
45	Tappar	36.70	17.062	16.817	602.559	593.889	
45	Tappar	36.80	17.543	17.297	619.524	610.854	
45	Tappar	36.90	18.023	17.778	636.489	627.819	



45	Tappar	37.00	18.504	18.258	653.455	644.785	
45	Tappar	37.10	19.128	18.882	675.491	666.821	
45	Tappar	37.20	19.751	19.506	697.524	688.854	
45	Tappar	37.30	20.375	20.130	719.561	710.891	
45	Tappar	37.40	20.999	20.754	741.594	732.924	
45	Tappar	37.50	21.623	21.378	763.630	754.961	
45	Tappar	37.60	22.247	22.002	785.667	776.997	
45	Tappar	37.70	22.871	22.626	807.700	799.030	
45	Tappar	37.80	23.495	23.250	829.737	821.067	
45	Tappar	37.90	24.119	23.874	851.770	843.100	
45	Tappar	38.00	24.743	24.498	873.806	865.136	
45	Tappar	38.10	25.433	25.188	898.177	889.507	
45	Tappar	38.20	26.124	25.878	922.551	913.882	
45	Tappar	38.30	26.814	26.568	946.922	938.252	
45	Tappar	38.40	27.504	27.258	971.293	962.623	
45	Tappar	38.50	28.194	27.948	995.664	986.994	
45	Tappar	38.60	28.884	28.638	1020.037	1011.367	
45	Tappar	38.70	29.574	29.329	1044.409	1035.740	
45	Tappar	38.80	30.264	30.019	1068.780	1060.110	
45	Tappar	38.90	30.954	30.709	1093.155	1084.485	
45	Tappar	39.00	31.645	31.399	1117.526	1108.856	
45	Tappar	39.10	32.507	32.262	1148.002	1139.333	
45	Tappar	39.20	33.371	33.125	1178.483	1169.813	
45	Tappar	39.30	34.234	33.988	1208.960	1200.290	
45	Tappar	39.40	35.097	34.851	1239.436	1230.767	
45	Tappar	39.50	35.960	35.714	1269.917	1261.247	
45	Tappar	39.60	36.823	36.577	1300.394	1291.724	
45	Tappar	39.70	37.686	37.440	1330.870	1322.201	
45	Tappar	39.80	38.549	38.303	1361.347	1352.677	
45	Tappar	39.90	39.412	39.166	1391.828	1383.158	
45	Tappar	40.00	40.275	40.029	1422.305	1413.635	
45	Tappar	40.10	41.305	41.059	1458.683	1450.013	
45	Tappar	40.20	42.335	42.090	1495.064	1486.394	
45	Tappar	40.30	43.365	43.120	1531.442	1522.772	
45	Tappar	40.40	44.395	44.150	1567.824	1559.154	
45	Tappar	40.50	45.425	45.180	1604.201	1595.532	
45	Tappar	40.60	46.456	46.210	1640.580	1631.910	
45	Tappar	40.70	47.486	47.240	1676.961	1668.291	
45	Tappar	40.80	48.516	48.270	1713.339	1704.669	
45	Tappar	40.85	49.031	48.785	1731.530	1722.860	F.R.L. : 40.85 M.

Annexure - 4

Daily Progress Reports

Tappar Reservoir

OCEAN Science & Surveying	DAILY PROGRESS REPORT	Form No.:	Sy01R
		Revision:	01
		Date:	11/07/2014
		Approved By	PKT

Location Tappar Reservoir **DPR No. 001**

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	08-07-2021
Location:	Tappar Reservoir	Sheet No:	1 of 1
Party Chief: Salman		Client Rep.	

Survey Personnel:

1. Pankaj Rabary	2.	3.
4.	5.	6.
7.	8.	9.
10.		

Equipment	RTK system	SBES system	Auto level	Heave sensor
	Hypack nav system	Bar check	Generator	
	Computer			

Time (hrs)		Activities
0800	1130	Boat and equipment loaded in truck and left for Tappar Reservoir
1400	1800	Team reached Tappar, boat landed to dam and equipment secured safe.
1800	1830	Team checked-in lodge.

		Today's coverage		Cumulative coverage	
		Bathymetry:**- sq.km**	Line km:	Bathymetry:**- sq.km**	Line km:
		Topo:**- sq.km**	Line km:	Topo:**- sq.km**	Line km:
		Weather downtime today:		Cumulative weather downtime: **0 hour**	

Plan for next 24 hours: Benchmark establishment, observation and levelling.

Remarks:

Party Chief	**Client Representative**

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		Approved By	PKT

Location Tappar Reservoir **DPR No. 002**

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	09-07-2021
Location:	Tappar Reservoir	Sheet No:	1 of 1
Party Chief: Salman		Client Rep.	

Survey Personnel:

1. Pankaj Rabary	2. Gaurav Sharma	3.Manoj More
4.	5.	6.
7.	8.	9.
10.		

Equipment	RTK system	SBES system	Auto level	Heave sensor
	Hypack nav system	Bar check	Generator	
	Computer			

Time (hrs)		Activities
0830	1830	Vertical datum established, TBM observation and boat mobilisation carried out.
		Vertical datum given by client is HFL, 41.90m above MSL

		Today's coverage		Cumulative coverage	
		Bathymetry:**- sq.km**	Line km:	Bathymetry:**- sq.km**	Line km:
		Topo:**- sq.km**	Line km:	Topo:**- sq.km**	Line km:
		Weather downtime today:		Cumulative weather downtime: **0 hour**	

Plan for next 24 hours: Start of bathy and topo survey.

Remarks: Gaurav Sharma and Manoj More reached site at 08:30 hrs

Party Chief	**Client Representative**

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		Approved By	PKT

Location Tappar Reservoir DPR No. 003

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	10-07-2021
Location:	Tappar Reservoir	Sheet No:	1 of 1
Party Chief: Salman		Client Rep.	

Survey Personnel:

1. Pankaj Rabary	2. Gaurav Sharma	3.Manoj More
4.	5.	6.
7.	8.	9.
10.		

Equipment	RTK system	SBES system	Auto level	Heave sensor
	Hypack nav system	Bar check	Generator	
	Computer			

Time (hrs)		Activities
0800	0830	Team arrived at dam site.
0830	0900	Set up RTK base station.
0900	1830	Survey carried out.
1830	1930	Secured base and team returned to guest house

		Today's coverage		Cumulative coverage	
		Bathymetry:**- 1.18sq.km**	Line km: **47.2**	Bathymetry:**- 1.18sq.km**	Line km: **47.2**
		Topo:**- 0.07sq.km**	Line km:**2.8**	Topo:**- 0.07 sq.km**	Line km: **2.8**
		Weather downtime today:		Cumulative weather downtime: **0 hour**	

Plan for next 24 hours: Continue bathy and topo survey.

Remarks:

Salman **Party Chief**	**Client Representative**

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		Date:	11/07/2014
		Approved By	PKT

Location Tappar Reservoir DPR No. 004

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	11-07-2021
Location:	Tappar Reservoir	Sheet No:	1 of 1
Party Chief: Salman		Client Rep.	

Survey Personnel:

1. Pankaj Rabary	2. Gaurav Sharma	3.Manoj More
4.	5.	6.
7.	8.	9.
10.		

Equipment	RTK system	SBES system	Auto level	Heave sensor
	Hypack nav system	Bar check	Generator	
	Computer			

Time (hrs)		Activities
0745	0800	Team arrived at dam site.
0800	0900	Set up RTK base station.
0900	1830	Survey carried out.
1830	1930	Secured base and team returned to guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry:**- 1.17sq.km**	Line km: **46.8**	Bathymetry:**- 2.35sq.km**	Line km: **94**
		Topo:**- 0.65sq.km**	Line km:**26**	Topo:**- 0.72sq.km**	Line km: **28.8**
		Weather downtime today:		Cumulative weather downtime: **0 hour**	

Plan for next 24 hours: Continue bathy and topo survey.

Remarks:

Party Chief | **Client Representative**

OCEAN Science & Surveying	DAILY PROGRESS REPORT	Form No.:	Sy01R
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		Date:	11/07/2014
		Approved By	PKT

Location Tappar Reservoir **DPR No. 005**

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	12-07-2021
Location:	Tappar Reservoir	Sheet No:	1 of 1
Party Chief: Salman		Client Rep.	

Survey Personnel:

1. Pankaj Rabary	2. Gaurav Sharma	3.Manoj More
4.	5.	6.
7.	8.	9.
10.		

Equipment	RTK system	SBES system	Auto level	Heave sensor
	Hypack nav system	Bar check	Generator	
	Computer			

Time (hrs)		Activities
0730	0800	Team arrived at dam site.
0800	0830	Set up RTK base station.
0830	1845	Survey carried out.
1845	1930	Secured base and team returned to guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry:**- 1.14sq.km**	Line km: **45.6**	Bathymetry:**- 3.49sq.km**	Line km: **139.6**
		Topo:**- 0.11sq.km**	Line km:**4.4**	Topo:**- 0.83sq.km**	Line km: **33.2**
		Weather downtime today:		Cumulative weather downtime: **0 hour**	

Plan for next 24 hours: Continue bathy and topo survey.

Remarks:

Party Chief	**Client Representative**

OCEAN Science & Surveying	DAILY PROGRESS REPORT	Form No.:	Sy01R
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		Date:	11/07/2014
		Approved By	PKT

Location Tappar Reservoir **DPR No. 006**

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	13-07-2021
Location:	Tappar Reservoir	Sheet No:	1 of 1
Party Chief: Salman		Client Rep.	

Survey Personnel:

1. Pankaj Rabary	2. Gaurav Sharma	3.Manoj More
4.	5.	6.
7.	8.	9.
10.		

Equipment	RTK system	SBES system	Auto level	Heave sensor
	Hypack nav system	Bar check	Generator	
	Computer			

Time (hrs)		Activities
0745	0815	Team arrived at dam site.
0815	0845	Set up RTK base station.
0845	1845	Survey carried out.
1845	1930	Secured base and team returned to guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry:**- 1.03sq.km**	Line km: **41.2**	Bathymetry:**- 4.52sq.km**	Line km: **180.8**
		Topo:**- 0.21sq.km**	Line km:**8.4**	Topo:**- 1.04sq.km**	Line km: **41.6**
		Weather downtime today:		Cumulative weather downtime: **0 hour**	

Plan for next 24 hours: Continue bathy and topo survey.

Remarks:

Party Chief	**Client Representative**

OCEAN Science & Surveying	DAILY PROGRESS REPORT	Form No.:	Sy01R
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		Date:	11/07/2014
		Approved By	PKT

Location Tappar Reservoir DPR No. 007

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	14-07-2021
Location:	Tappar Reservoir	Sheet No:	1 of 1
Party Chief: Salman		Client Rep.	

Survey Personnel:

1. Pankaj Rabary	2. Gaurav Sharma	3.Manoj More
4.	5.	6.
7.	8.	9.
10.		

Equipment	RTK system	SBES system	Auto level	Heave sensor
	Hypack nav system	Bar check	Generator	
	Computer			

Time (hrs)		Activities
0800	0830	Team arrived at dam site.
0830	0845	Set up RTK base station.
0845	1845	Survey carried out.
1900	1930	Secured base and team returned to guest house.
Note:		Bathy survey completed. Requesting boat demobilisation.

		Today's coverage		Cumulative coverage	
		Bathymetry:**- 0.58sq.km**	Line km: **23.2**	Bathymetry:**- 5.1sq.km**	Line km: **204**
		Topo:**- 0.42sq.km**	Line km:**16.8**	Topo:- **1.46sq.km**	Line km: **58.4**
		Weather downtime today:		Cumulative weather downtime: **0 hour**	

Plan for next 24 hours: Continue topo survey.

Remarks:

Salman **Party Chief**	**Client Representative**

OCEAN Science & Surveying	DAILY PROGRESS REPORT	Form No.:	Sy01R
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		Date:	11/07/2014
		Approved By	PKT

Location Tappar Reservoir DPR No. 008

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	15-07-2021
Location:	Tappar Reservoir	Sheet No:	1 of 1
Party Chief: Salman		Client Rep.	

Survey Personnel:

1. Pankaj Rabary	2. Gaurav Sharma	3.Manoj More
4.	5.	6.
7.	8.	9.
10.		

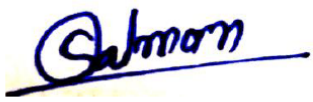
Equipment	RTK system	SBES system	Auto level	Heave sensor
	Hypack nav system	Bar check	Generator	
	Computer			

Time (hrs)		Activities
0730	0745	Team arrived at dam site.
0745	0820	Set up RTK base station.
0820	1730	Survey carried out.
1730	1830	Boat demobilised
1830	1900	Secured base and team returned to guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry:**- 0.00sq.km**	Line km: **0.00**	Bathymetry:**- 5.1sq.km**	Line km: **204**
		Topo:**- 0.55sq.km**	Line km:**22**	Topo:- **2.01sq.km**	Line km: **80.4**
		Weather downtime today:		Cumulative weather downtime: **0 hour**	

Plan for next 24 hours: Continue topo survey.

Remarks:



Party Chief **Client Representative**

OCEAN Science & Surveying	DAILY PROGRESS REPORT	Form No.:	Sy01R
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		Date:	11/07/2014
		Approved By	PKT

Location Tappar Reservoir DPR No. 009

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	16-07-2021
Location:	Tappar Reservoir	Sheet No:	1 of 1
Party Chief: Salman		Client Rep.	

Survey Personnel:

1. Pankaj Rabary	2. Gaurav Sharma	3.Manoj More
4.	5.	6.
7.	8.	9.
10.		

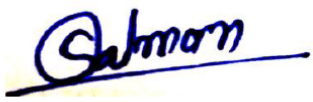
Equipment	RTK system	SBES system	Auto level	Heave sensor
	Hypack nav system	Bar check	Generator	
	Computer			

Time (hrs)		Activities
0730	0750	Team arrived at dam site.
0750	0830	Set up RTK base station.
0830	1845	Survey carried out.
1845	1915	Secured base and team returned to guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry:**- 0.00sq.km**	Line km: **0.00**	Bathymetry:**- 5.1sq.km**	Line km: **204**
		Topo:**- 0.65sq.km**	Line km:**26**	Topo:- **2.66sq.km**	Line km: **106.4**
		Weather downtime today:		Cumulative weather downtime: **0 hour**	

Plan for next 24 hours: Continue topo survey.

Remarks:



Party Chief **Client Representative**

OCEAN Science & Surveying	DAILY PROGRESS REPORT	Form No.:	Sy01R
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		Date:	11/07/2014
		Approved By	PKT

Location Tappar Reservoir **DPR No. 010**

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	17-07-2021
Location:	Tappar Reservoir	Sheet No:	1 of 1
Party Chief: Salman		Client Rep.	

Survey Personnel:

1. Pankaj Rabary	2. Gaurav Sharma	3.Manoj More
4.	5.	6.
7.	8.	9.
10.		

Equipment	RTK system	SBES system	Auto level	Heave sensor
	Hypack nav system	Bar check	Generator	
	Computer			

Time (hrs)		Activities
0720	0740	Team arrived at dam site.
0740	0820	Set up RTK base station.
0820	1915	Survey carried out.
1915	1930	Secured base and team returned to guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry:**- 0.00sq.km**	Line km: **0.00**	Bathymetry:**- 5.1sq.km**	Line km: **204**
		Topo:**- 0.86sq.km**	Line km:**34.4**	Topo:**- 3.52sq.km**	Line km: **140.8**
		Weather downtime today:		Cumulative weather downtime: **0 hour**	

Plan for next 24 hours: Continue topo survey.

Remarks:

Party Chief	**Client Representative**

OCEAN Science & Surveying	DAILY PROGRESS REPORT	Form No.:	Sy01R
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		Date:	11/07/2014
		Approved By	PKT

Location Tappar Reservoir **DPR No. 011**

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	18-07-2021
Location:	Tappar Reservoir	Sheet No:	1 of 1
Party Chief: Salman		Client Rep.	

Survey Personnel:

1. Pankaj Rabary	2. Gaurav Sharma	3.Manoj More
4.	5.	6.
7.	8.	9.
10.		

Equipment	RTK system	SBES system	Auto level	Heave sensor
	Hypack nav system	Bar check	Generator	
	Computer			

Time (hrs)		Activities
0730	0800	Team arrived at dam site.
0800	0830	Set up RTK base station.
0830	1915	Survey carried out.
1915	1945	Secured base and team returned to guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry:**- 0.00sq.km**	Line km: **0.00**	Bathymetry:**- 5.1sq.km**	Line km: **204**
		Topo:**- 0.76sq.km**	Line km:**30.4**	Topo:**- 4.28sq.km**	Line km: **171.2**
		Weather downtime today:		Cumulative weather downtime: **0 hour**	

Plan for next 24 hours: Continue topo survey.

Remarks:

Party Chief	**Client Representative**

OCEAN Science & Surveying	DAILY PROGRESS REPORT	Form No.:	Sy01R
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		Date:	11/07/2014
		Approved By	PKT

Location Tappar Reservoir DPR No. 012

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	19-07-2021
Location:	Tappar Reservoir	Sheet No:	1 of 1
Party Chief: Salman		Client Rep.	

Survey Personnel:

1. Pankaj Rabary	2. Gaurav Sharma	3.Manoj More
4.	5.	6.
7.	8.	9.
10.		

Equipment	RTK system	SBES system	Auto level	Heave sensor
	Hypack nav system	Bar check	Generator	
	Computer			

Time (hrs)		Activities
0745	0815	Team arrived at dam site.
0815	0845	Set up RTK base station.
0845	1900	Survey carried out.
1900	1930	Secured base and team returned to guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry:**- 0.00sq.km**	Line km: **0.00**	Bathymetry:**- 5.1sq.km**	Line km: **204**
		Topo:**- 0.42sq.km**	Line km:**16.8**	Topo:- **4.7sq.km**	Line km: **188**
		Weather downtime today:		Cumulative weather downtime: **0 hour**	

Plan for next 24 hours: Continue topo survey.

Remarks:

Party Chief **Client Representative**

OCEAN Science & Surveying	DAILY PROGRESS REPORT	Form No.:	Sy01R
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		Approved By	PKT

Location Tappar Reservoir DPR No. 013

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	20-07-2021
Location:	Tappar Reservoir	Sheet No:	1 of 1
Party Chief: Salman		Client Rep.	

Survey Personnel:

1. Pankaj Rabary	2. Gaurav Sharma	3.Manoj More
4.	5.	6.
7.	8.	9.
10.		

Equipment	RTK system	SBES system	Auto level	Heave sensor
	Hypack nav system	Bar check	Generator	
	Computer			

Time (hrs)		Activities
0720	0800	Team arrived at dam site.
0800	0845	Set up RTK base station.
0845	1900	Survey carried out.
1900	1930	Secured base and team returned to guest house.
Note-		**Survey completed for Tappar reservoir.**

		Today's coverage		Cumulative coverage	
		Bathymetry:**- 0.00sq.km**	Line km: **0.00**	Bathymetry:**- 5.1sq.km**	Line km: **204**
		Topo:**- 0.43sq.km**	Line km:**17.2**	Topo:- **5.13sq.km**	Line km: **205.2**
		Weather downtime today:		Cumulative weather downtime: **0 hour**	

Plan for next 24 hours: Going to visit Fatehghad Dam for recce survey.

Remarks:

Party Chief	**Client Representative**