Report on

Topographic and Bathymetric Survey of Reservoirs

for Water Resources Department, Govt. of Gujarat

at Saurashtra and Northern Gujarat Region, Gujarat

Khodiyar Reservoir

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0	18.09.2021	Draft	Sandeep Sugur	Farokh Patel
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Amendments in Revision 1

No.	Section, Page	Description
1.	At various places in the entire survey report	Original survey report year i.e., “1962” added
2.	8.7, 35	Year of original survey report added and the corresponding calculations (namely: Siltation rate, Siltation index, Annual loss of capacity and remarks) depending on the year of original survey report added in the table.
3.	8.14, 46	Column- “Area as per original report (1962)” added in Table 11
4.	8.14, 47	Column- “Area 1975” added in Table 12
5.	8.14, 50	Column- “Area 1987” added in Table 14
6.	Ann 3, 104	Capacity table showing heading “Junagadh Irrigation Division, Junagadh” changed to “Amreli Irrigation Division, Amreli”.
7.	8.6.1, 34	Rate of siltation and annual siltation calculations added. Text updated- “Siltation in 59 years”
8.	8.6.2, 34	Annual percentage loss of gross storage added.
9.	8.6.3, 35	Annual percentage loss of dead storage added.
10.	8.6.3, 35	Annual percentage loss of live storage added
11.	Executive summary, 9	Text updated mentioning rate of siltation and annual percentage loss of gross storage, live storage and dead storage capacity that has occurred in the reservoir over the past 59 years (from 1962 to 2021)
12.	9, 55	Text updated in conclusions mentioning rate of siltation and annual percentage loss of gross storage, live storage and dead storage capacity that has occurred in the reservoir over the past 59 years (from 1962 to 2021)

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ABBREVIATIONS

AutoCAD	Computer aided design and drafting software application
AM	Ante meridiem
BM	Benchmark
CAD	Computer Aided Design
COG	Centre of Gravity
Cm	Centimetre
C.M.	Central Meridian
CMG	Course Made Good
cu.m	Cubic metre
DF	Dual Frequency
DGPS	Differential Global Positioning System
dd-mm-yy	Date-Month-Year
DSL	Dead Storage Level
DTM	Digital Terrain Model
E	Easting
e.g.	Example
FRL	Full Reservoir Level
Ft.	Feet
Govt.	Government
GPS	Global Positioning System
Ha.m	Hectare metre
Horz	Horizontal
HFL	Highest Flood Level
HSE	Health, Safety & Environment
ID	Identification name/number
IHO	International Hydrographic Organization
kHz	Kilohertz
km	Kilometre
km^2	Square kilometre
KP	Kilometre Post
Lat	Latitude
LBM	Local Benchmark
Long	Longitude
Ltd.	Limited
m	Metre
M.cu.m	Million Cubic Metre
Mm	Millimetre

MDDL	Minimum Drawdown Level
MRU	Motion Reference Unit
MSL	Mean Sea Level
M sq.m	Million Square Metre
MWL	Maximum Water Level
NA	Not Applicable
N	Northing
NU	North Up
NWRWS	Narmada Water Resources Water Supply
OSaS	Ocean Science & Surveying Pvt. Ltd
PM	Post meridiem
Pvt.	Private
RF	Radio Frequency
R.L.	Reduced Level
RTK	Real-time Kinematic positioning
SBES	Single Beam Echo Sounder
SMB	Survey motor boat
sq. km	Square kilometre
SVP	Sound Velocity Profile
TBM	Temporary Benchmark
TIN	Triangulated Irregular Network
Th.cu.m	Thousand cubic metre
UTM	Universal Transverse Mercator projection
USB	Universal Serial Bus
VDU	Video Display Unit
Vert	Vertical
Vs	Versus
w.d.	Water depth
WGS84	World Geodetic System 1984
WRD	Water Resources Department

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, Khodiyar, Und-1, Machhu-1, Machhu-2, Brahmani, 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 Khodiyar reservoir, Saurashtra region, Gujarat.

The mobilisation of equipment on board survey boat SMB Ocean started on 01st August 2021 and was completed on the same day. Initial system preparation and equipment checks were completed on 01st August.

A DGPS consistency check was carried out on 28th July by establishing two reference stations (TBMs) using RTK systems. The details of the DGPS and RTK calibrations and established TBMs details are provided in **Annexure 2-Mob and Cal Report.**

The topographic and bathymetric survey commenced on 29th July and 03rd August 2021 respectively at Khodiyar reservoir. Topographic survey was completed on 05th August and bathymetric survey was completed on 10th August. The survey boat was demobilised on 10th August.

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 completion of 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 FRL.

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

The construction works for the Khodiyar dam commenced in the year 1958 and were completed in the year 1967. The khodiyar reservoir has a catchment area of 383.00 sq.km. The gross storage at FRL (202.68m above MSL) and dead storage at OSL (179.82m above MSL) as per the design storage of the reservoir was 29.94 M.cu.m and 0.000 M.cu.m respectively.

As per previous survey data provided by the client, it is understood that silt survey was conducted in the year 1975, 1986 and 1987. Also, the details of area-capacity data as per the original project report (1962) were obtained from the document provided by the client. All of this previous data as provided by the client are presented in **Annexure 3-Previous Data**.

The gross storage at FRL as per the original project report (1962) was 40.359 M.cu.m and the dead storage at OSL was 0.000 M.cu.m.

The gross storage at FRL as per the silt survey carried out in the years 1975, 1986 and 1987 were 32.219 M.cu.m, 29.943 M.cu.m, and 29.944 M.cu.m respectively. The dead storage at OSL as per the silt survey carried out in the years 1975, 1986 and 1987 was 0.000 M.cu.m.

As per the current survey (2021) results, a gross storage of 30.813 M.cu.m at FRL and a dead storage of 0.000 M.cu.m at OSL was obtained.

Bathymetric and topographic survey was restricted at some places in the survey area due to the presence of existing ravines (nallas), bushes and rocky areas.

In the current bathymetric and topographic survey, a minimum elevation of 187.9m and a maximum elevation of 201.3m was observed in the northern (in proximity to the dam wall) and western portions of the surveyed area respectively within the bathymetric section. A minimum and maximum elevation of 196.7m and 210.6m were both observed in the southwestern portion of the surveyed area within the topographic section.

For a major part of the reservoir a general range of elevation change between 190.0m to 200.0m.is observed within the bathymetric section, where steep to very steep slopes (up to 38°) are generally

observed in the northern portion of the surveyed area, mainly along the topographic and bathymetric survey boundary (near the dam wall), with the slopes becoming gentler moving away from the surveyed area boundary towards the central portion of the reservoir. Moderate to very steep slopes are also observed along the eastern, south-eastern and southwestern topographic and bathymetric survey boundaries.

The processed topographic data indicates that the land is sloping with very gentle to gentle gradients from all the sides of the topographic surveyed area towards the reservoir area. Steep to very steep slopes (up to 42°) are observed in the northern portion of the surveyed area, mainly along the topographic and bathymetric survey boundary (near the dam wall). Scattered areas with moderate to very steep gradients are also observed along the reservoir banks where the topographic survey ends, mainly in the north-western, southwestern and south-eastern portions of the topographic surveyed area.

The current survey data (2021) was compared with the original project report capacity data (1962) and previous silt surveys carried out in 1975, 1986 and 1987.

The comparison between the original project report-1962 and 2021 (59 years) data results indicates that siltation has occurred in the reservoir over the past 59 years and the rate of siltation is calculated to be 4.22 Ha.m/100sq.km./year. Annual percentage loss of gross storage capacity, live storage capacity and dead storage capacity are 0.40%, 0.40% and 0.00% respectively.

During the years 1962 to 2021 (59 years), the increase of sediment deposit and the corresponding reduction in reservoir 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 (179.82m) is 0.000 M.cu.m. The amount of sediment deposited during this period up to FRL (202.68m) is 9.546 M.cu.m.

The comparison between 1975 and 2021 (46 years) data results indicates that siltation has occurred in the reservoir over the past 46 years and the rate of siltation is calculated to be 0.80 Ha.m/100sq.km./year. Annual percentage loss of gross storage capacity, live storage capacity and dead storage capacity are 0.09%, 0.09% and 0.00% respectively.

During the years 1975 to 2021 (46 years), the increase of sediment deposit and the corresponding reduction in reservoir 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 (179.82m) is 0.000 M.cu.m. The amount of sediment deposited during this period up to FRL (202.68m) is 1.406 M.cu.m.

The comparison between 1986 and 2021 (35 years) data results indicates that erosion has occurred in the reservoir over the past 35 years and the rate of erosion is calculated to be 0.65 Ha.m/100sq.km./year. Annual percentage increase of gross storage capacity, live storage capacity and dead storage capacity are 0.08%, 0.08% and 0.00% respectively.

During the years 1986 to 2021 (35 years), the increase of sediment erosion and the corresponding increase in capacity is possibly due to the widening of river channels or removal of sediments due to outflow. Another possibility is the erosion of the reservoir bank at these levels or conversion of more irregular water spread areas around the FRL into levelled cultivation fields. Possible sediment removal using dedicated equipment also leads to the widening and deepening of river channels which ultimately results in an increase in capacity. The amount of sediment eroded during this period up to OSL (179.82m) is 0.000 M.cu.m. The amount of sediment eroded during this period up to FRL (202.68m) is 0.870 M.cu.m.

The comparison between 1987 and 2021 (34 years) data results indicates that erosion has occurred in the reservoir over the past 34 years and the rate of erosion is calculated to be 0.67 Ha.m/100sq.km./year. Annual percentage increase of gross storage capacity, live storage capacity and dead storage capacity are 0.09%, 0.09% and 0.00% respectively.

During the years 1987 to 2021 (34 years), the increase of sediment erosion and the corresponding increase in capacity is possibly due to the widening of river channels or removal of sediments due to outflow. Another possibility is the erosion of the reservoir bank at these levels or conversion of more irregular water spread areas around the FRL into levelled cultivation fields. Possible sediment removal using dedicated equipment

also leads to the widening and deepening of river channels which ultimately results in an increase in capacity. The amount of sediment eroded during this period up to OSL (179.82m) is 0.000 M.cu.m. The amount of sediment eroded during this period up to FRL (202.68m) is 0.869 M.cu.m.

The elevation-area-capacity curves showing a comparison of capacity survey results (original project report (1962), 1975, 1986, 1987 vs 2021) are generated using the data provided in **Table 6** and is presented in

Figure 7: Elevation-Area-Capacity Curves (Original report (1962), 1975, 1986, 1987 and 2021)

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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, Khodiyar, Und-1, Machhu-1, Machhu-2, Brahmani, 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 Khodiyar reservoir in Saurashtra, Gujarat.

1.1 Background of survey area

The Khodiyar Dam is a dam built on Shetrunji River in Amreli district, in the state of Gujarat in western India. The primary purpose of the dam is to provide water for irrigation. The Shetrunji is one of the major rivers of Saurashtra. It rises at Chachai hills in Gir Forest of Junagadh district of Gujarat at an elevation of 380 m above mean sea level. It flows eastwards and empties into the Gulf of Khambat. The total length of this east flowing river from its origin to the outfall is 182 km. Its length is 227 km. and has a catchment area of 5636 sq.km. Shel, Khari, Talaji are right bank tributaries and Satali, Thebi, Gagario, Rajaval, and Kharo are left bank tributaries of Shetrunji river. Khodiyar dam & Shetrunji dam are located on Shetrunji River at 55 km. and 160 km. distance from its origin respectively, with catchment areas of 384 sq.km and 4317 sq.km respectively.

The average rainfall in the Shetrunji basin is 604 mm. In winter, the minimum temperature varies from 60^0C to 180^0C

The construction works for the Khodiyar dam commenced in the year 1958 and were completed in the year 1967. It is an earthen and masonry type dam. The gross storage at FRL (202.68m above MSL) and dead storage at OSL (179.82m above MSL) as per the design storage of the reservoir was 29.94 M.cu.m and 0.000 M.cu.m respectively.

1.2 General Location

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

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

The surveyed area boundaries (both topographic and bathymetric) for Khodiyar reservoir have been overlaid on the Google earth image shown in **Figure 2**.

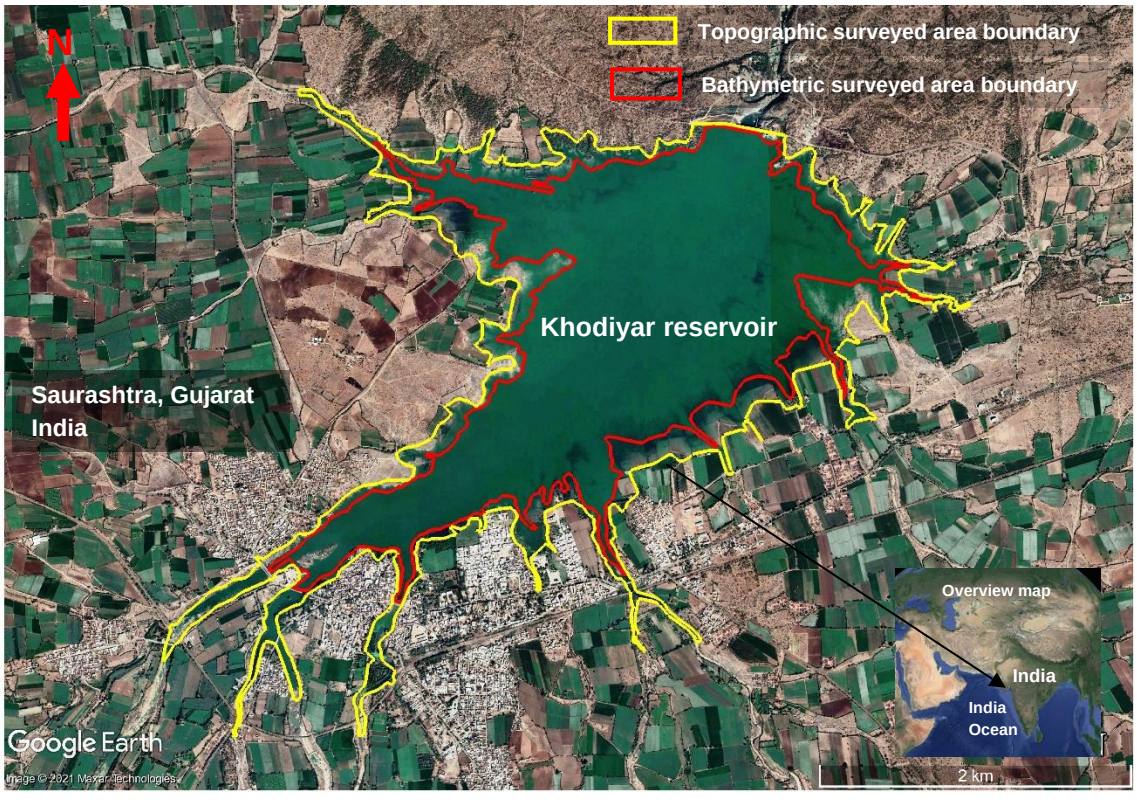


Figure 2: Surveyed area (Bathymetric and Topographic) – Reservoir Khodiyar

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 survey boat 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 Khodiyar reservoir is situated across the Shetrunji River in the Saurashtra peninsula, in the Western Indian state of Gujarat. The construction works for the Khodiyar dam commenced in the year 1958 and were completed in the year 1967. It is an earthen and masonry type dam (Source: https://en.wikipedia.org/wiki/Khodiyar_Dam).

The following salient features of Khodiyar reservoir are extracted from the following four documents (Document 1 to 4) provided by the client and two documents (Documents 5 and 6) obtained from the NWRWS website:

Document 1: Khodiyar Irrigation Scheme, area and capacity table as per original project report.

Document 2: Khodiyar Irrigation Scheme, area capacity table as per silt survey during 1975-76.

Document 3: Khodiyar Irrigation Scheme, capacity table as per silt survey-1986.

Document 4: Khodiyar Irrigation Scheme, area capacity chart: 87.

Document 5: https://wrd.guj.nic.in/dam/pdf.php.

Document 6: https://guj-nwrws.gujarat.gov.in/showpage.aspx?contentid=2093&lang=English

a. Location
   Latitude : 21^0 21’ 25’’ N
   Longitude : 71^0 02’ 45’’ E
b. Catchment Area : 383 sq.km
c. Full Reservoir Level (FRL) : 202.68 m
d. High Flood Level (HFL) : 202.68 m
e. Minimum Draw Down Level (MDDL/OSL) : 179.82 m

Capacity as per project design:

a. Gross Storage : 29.94 M.cu.m
b. Dead Storage : 0.000 M.cu.m
c. Live Storage : 29.94 M.cu.m
d. Area at FRL : 6.16 sq.km

Capacity as per original project report (1962)

a. Gross Storage : 40.359 M.cu.m
b. Dead Storage : 0.000 M.cu.m
c. Live Storage : 40.359 M.cu.m
d. Area at FRL : 6.163 M sq.m

Capacity as per 1975-76 silt survey

a. Gross Storage : 32.219 M.cu.m
b. Dead Storage : 0.000 M.cu.m
c. Live Storage : 32.219 M.cu.m
d. Area at FRL : 5.473 M sq.m

Capacity as per 1986 silt survey

a. Gross Storage : 29.943 M.cu.m
b. Dead Storage : 0.000 M.cu.m
c. Live Storage : 29.943 M.cu.m

Capacity as per 1987 silt survey

a. Gross Storage : 29.944 M.cu.m
b. Dead Storage : 0.000 M.cu.m
c. Live Storage : 29.944 M.cu.m
d. Area at FRL : 5.473 M sq.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 HFL of the reservoir, which is 202.68m (665.00ft.) 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 Khodiyar reservoir are provided in **Table 1** below.

Name of Reservoir	Bathymetric area surveyed (sq.km.)	Topographic area surveyed (sq.km.)
Khodiyar	4.701	1.112

Table 1: Surveyed areas for Khodiyar 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

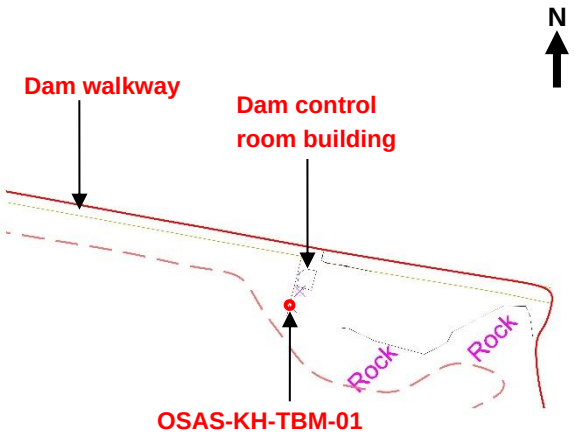
Two reference stations were established as temporary control points/temporary benchmarks (TBMs). RTK system was used to establish the local benchmark (TBMs) by transfer and to level the TBM with respect to the known level of benchmark (located near the side railing wall of dam spillway in front of dam gates) at 189.03m above MSL, as provided by the client.

The base stations of the RTK were set up at these positions (TBMs locations) 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.

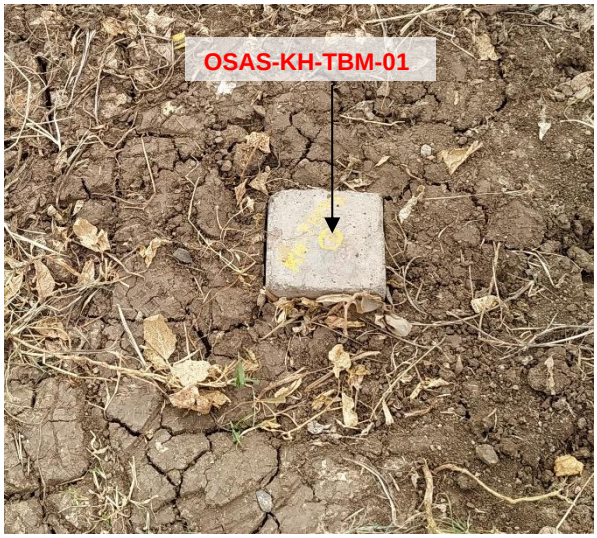
The details of the reference stations OSAS-KH-TBM-01 and OSAS-KH-TBM-02 are provided in **Figure 3** and **Figure 4** respectively.

Station Number:	OSAS-KH-TBM-01	**Latitude:**	21° 21.391' N
Locality:	Khodiyar Dam, Gujarat	**Longitude:**	71° 02.802' E
Geodetic Datum:	WGS84	**Northing:**	2362985.122 m N
Projection:	Universal Transverse Mercator (Zone: 42 North)	**Easting:**	712234.993 m E
Date:	28th July 2021	**Elevation:**	207.492m above MSL
Station Description:	A circle with a dot drawn inside it is painted in yellow colour on a concrete block embedded in the soil ground.		
Access:	From the rear entrance steps of the dam control room building at Khodiyar dam, head south-southwest for about 12m to reach the TBM-01 location.		

Sketch:



Map:



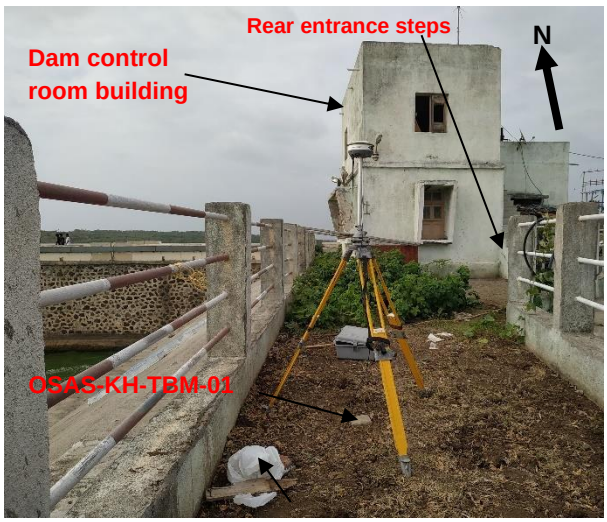
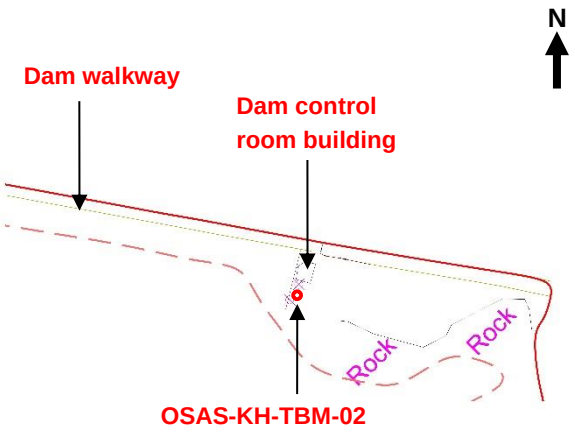


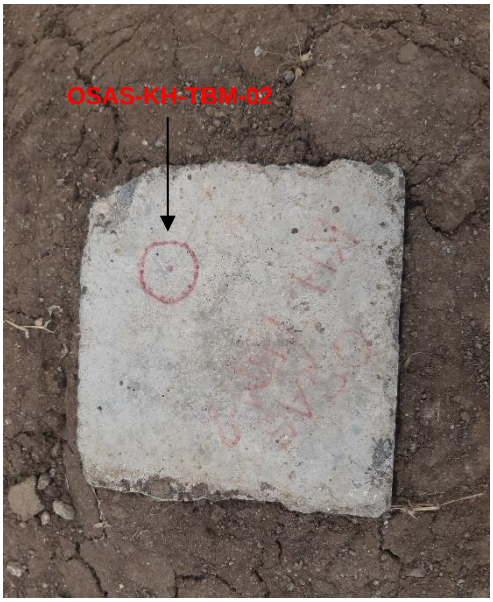
Figure 3: Details of OSAS-KH-TBM-01

Station Number:	OSAS-KH-TBM-02	**Latitude:**	21° 21.395' N
Locality:	Khodiyar Dam, Gujarat	**Longitude:**	71° 02.805' E
Geodetic Datum:	WGS84	**Northing:**	2362993.729 m N
Projection:	Universal Transverse Mercator (Zone: 42 North)	**Easting:**	712240.010 m E
Date:	28th July 2021	**Elevation:**	207.508m above MSL
Station Description:	A circle with a dot drawn inside it is painted in red colour on a concrete block embedded in the soil ground.		
Access:	From the rear entrance steps of the dam control room building at Khodiyar dam, head south-southwest for about 2m to reach the TBM-02 location.		

Sketch:



Map:



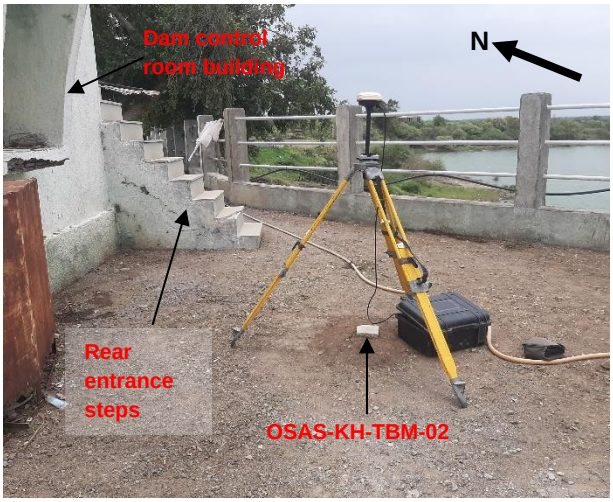


Figure 4: Details of OSAS-KH-TBM-02

3.2.2 *Bathymetric survey*

The same two reference stations, established as temporary control points/temporary benchmarks (TBMs) for the topographic survey were also used as the base stations for RTK positioning during the bathymetric survey. The rover fixed in the survey boat received 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 provided in **Figure 3** and **Figure 4**.

The water level of the reservoir with respect to the known value of FRL (202.68m 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 MSL. The observed water levels are given in **Table 3.**

Date (dd-mm-yy)	Water level				
	Start		End		Average level in metres (Above MSL, m)
	Time (AM)	Level (Above MSL, m)	Time (PM)	Level (Above MSL, m)	
03-08-21	10:00	201.73	06:00	201.74	201.735
05-08-21	10:00	201.75	06:00	201.75	201.75
06-08-21	10:00	201.75	06:00	201.75	201.75
07-08-21	10:00	201.76	06:00	201.76	201.76
08-08-21	10:00	201.75	06:00	201.75	201.75
09-08-21	10:00	201.75	06:00	201.75	201.75
10-08-21	10:00	201.75	06:00	201.75	201.75

Table 3: Observed Water Levels

3.3 Survey boat

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

Figure 5: Survey boat – SMB Ocean

4 PERSONNEL

The following survey personnel were involved in the survey at Khodiyar.

Name	Designation	Duration
Mansuri M. I.	Party Chief/ Land Surveyor	26th July – 01st August 2021
Salman	Party Chief / Land Surveyor	01st August – 11th August 2021
Pankaj Rabari	Survey Engineer	01st August – 11th August 2021
Gaurav Sharma	Surveyor	01st August – 11th August 2021
Nikhil Rane	Land Surveyor	26th July – 06th August 2021
Manoj More	Land Surveyor	01st August – 06th August 2021
Arsh Mansuri	Land Surveyor	26th July – 06th August 2021
Vipul Dangar	Local helper	26th July – 01st August 2021
Junas .I. Kher	Local boat operator	01st August – 10th August 2021

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

Adequate spares and back-ups for critical items will be carried on board the survey boat 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.

Survey boat 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. Survey boat track and offset positions were recorded digitally in the navigation software. DGPS positioning accuracy of the moving survey boat was better than $\pm$1m.

The survey boat'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 survey boat position to assist the helmsman in maintaining the selected track guidance line. The VDU displays the selected survey line, the survey boat position in relation to that line and numerical data to assist the helmsman such as the along-line and off-line distances, survey boat 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 boat were accurately measured during mobilisation and are included in **Annexure 2-Mob and Cal 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 survey 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

A 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 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 FRL at the TBM and rover used to fix the positions. This is a positioning system which can measure and calculate the XYZ 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.

The RTK system was used to establish the local benchmark (TBM) by transfer and to level the TBM with respect to the known benchmark (located near the side railing wall of the dam spillway in front of the dam sluice gates) at 189.03m above MSL, as provided by the client.

5.6 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 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 data were processed to form an edited survey boat track file. The final navigation data was reviewed in AutoCAD to confirm the validity of the survey boat'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 water level of the reservoir with respect to the known value of FRL (202.68m 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 MSL.

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 S320 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 XYZ 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 seven 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
- One chart showing topography and bathymetry of the surveyed area
- One longitudinal profile along the lowest elevation line within the surveyed area
- Three 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 on page no 5.

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 topographic survey boundary and 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 Khodiyar reservoir for the corresponding survey day. The topographic elevations are with respect to the known level at FRL, above MSL (202.68m). 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. One chart was 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 survey boat.

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

Khodiyar reservoir is constructed across Shetrunji river, which is the primary source of water in the reservoir.

Some areas within the topographic and bathymetric surveyed area were inaccessible due to the presence of rocky areas, ravines (nallas), bushes, trees and shallow areas.

A minimum elevation of 187.9m and a maximum elevation of 201.3m was observed in the northern (in proximity to the dam wall) and western portions of the surveyed area respectively within the bathymetric section.

For a major part of the reservoir a general range of elevation change between 190.0m to 200.0m.is observed within the bathymetric section, where steep to very steep slopes (up to 38°) are generally observed in the northern portion of the surveyed area, mainly along the topographic and bathymetric survey boundaries (near the dam wall), with the slopes becoming gentler moving away from the surveyed area boundary towards the central portion of the reservoir. Moderate to very steep slopes are also observed along the eastern, southeastern and southwestern topographic and bathymetric survey boundaries. Some scattered areas of moderate to very steep slopes are observed in the northeastern, southwestern, southeastern and central portions of the surveyed bathymetric section, mainly along the river channel and its tributaries.

Minimum and maximum elevations of 196.7m and 210.6m were both observed in the southwestern portion of the surveyed area within the topographic section.

For a major part of the topographic surveyed area a general range of elevations between 200.0m and 206.0m.is observed.

The processed topographic data indicates that the land is sloping with very gentle to gentle gradients from all the sides of the topographic surveyed area towards the reservoir area. Steep to very steep slopes (up to 42°) are observed in the northern portion of the surveyed area, mainly along the topographic and bathymetric survey boundary (near the dam wall). Scattered areas with moderate to very steep gradients are also observed along the reservoir banks where the topographic survey ends, mainly in the northwestern, southwestern and southeastern portions of the topographic surveyed area.

Features like a temple, islands, bund, bushes, trees, ravines (nallas), roads, bridges, culverts, check

dams, fences, gates, steps, compound walls and dam wall were observed within the topographic survey area.

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

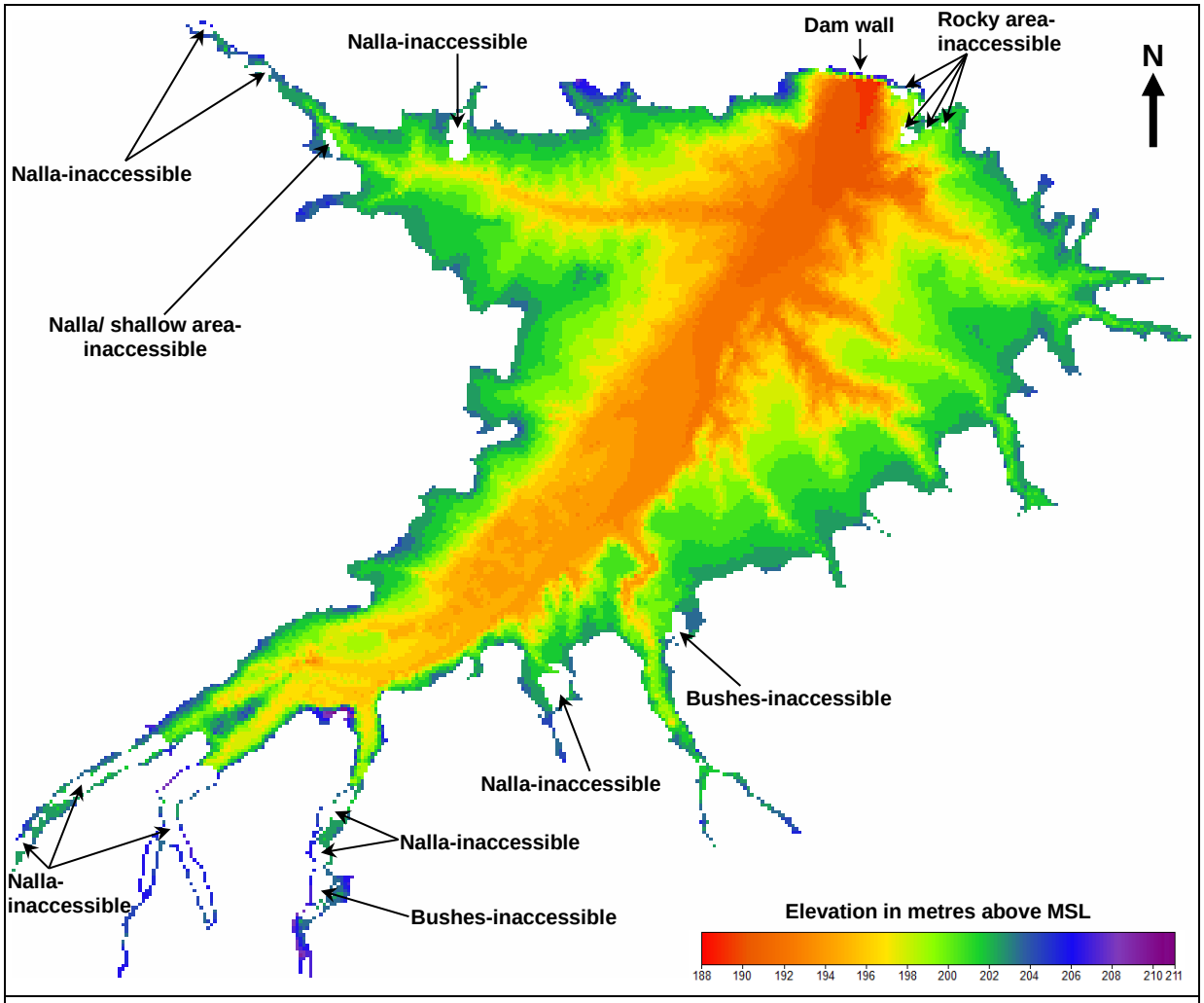


Figure 6: 2D image of the Khodiyar reservoir surveyed area

7.3 Longitudinal Profile

A longitudinal profile of the reservoir was prepared from a 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 drive, 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 Surveys

The details of previous data (as provided by the client) are provided in **Annexure 3-Previous Data.**

8.3.1 Capacity as per original project report (1962)

The construction works of Khodiyar reservoir commenced in 1958 and were completed in 1967.

The details of area-capacity data as per the original project report (1962) were obtained from the following document provided by the client.

Document: Khodiyar Irrigation Scheme, area and capacity table as per original project report.

8.3.2 Capacity survey of 1975

The information of a capacity survey conducted in the year 1975 has been made available in the following document provided by the client.

Document: Khodiyar Irrigation Scheme, area capacity table as per silt survey during 1975-76.

8.3.3 Capacity survey of 1986

The information of a capacity survey conducted in the year 1986 has been available in the following document provided by the client.

Document: Khodiyar Irrigation Scheme, capacity table *as per silt survey-1986.*

The Elevation-capacity data available in the above document are from 186.22m to 202.68m (FRL) above MSL. The data from 186.22m to 187.29m above MSL and from 187.32m to 202.68m above MSL are available at intervals of 0.01m and 0.03m respectively.

8.3.4 Capacity survey of 1987

The information of a capacity survey conducted in the year 1987 has been available in the following document provided by the client.

Document: Khodiyar Irrigation Scheme, area capacity chart: 87.

8.4 Capacity survey of 2021

The water spread area and its corresponding capacity has been calculated from the acquired bathymetric and topographic data. Hypack software's TIN (Triangulated Irregular Network) MODEL package was used to calculate the Area and Capacity of the Khodiyar 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 existing ravines (nallas), bushes and rocky 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 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-Elev Area Cap.** For

ease of further calculations and preparation of Elevation-Area-capacity curve, the data has been selected at required intervals to compare present survey results with that of previous survey data results at the same elevations.

8.5 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 previous elevation-area-capacity data is available in the documents provided by the client mentioned in section 8.3 and is presented in **Annexure 3-Previous data**.

The current survey was conducted in 2021 and the data is provided at intervals of 0.01m in **Annexure 1-Elev Area Cap.**

For ease of further calculations, comparison and preparation of elevation-area-capacity curves, the capacity and area data from the present (2021) survey were extracted at the same elevations as those available in the previous survey data.

Table 6 shows the comparative statement of data between original project report (1962), previous silt surveys carried out in 1975, 1986, 1987 and present survey data (2021).

Elevation (Above MSL, m)	As per original project report data (1962)		As per 1975 survey		As per 1986 survey		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)	Area (M.sq.m or sq.km)	Gross Capacity (M.cu.m)	Area (M.sq.m or sq.km)	Gross Capacity (M.cu.m)	Area (M.sq.m or sq.km)	Gross Capacity (M.cu.m)	Area (M.sq.m or sq.km)	
179.82	0.000	0.000	0.000	0.000	-	-	-	-	-	-	**MDDL/OSL**
185.93	1.445	0.511	-	-	-	-	-	-	-	-	
186.00	-	-	-	-	-	-	0.000	0.027	-	-	
186.22	-	-	-	-	0.013	-	-	-	-	-	
186.50	-	-	-	-	0.029	-	-	-	-	-	
187.00	-	-	-	-	0.062	-	0.056	0.091	-	-	
187.06	-	-	0.634	0.176	-	-	0.060	0.100	-	-	
187.50	-	-	-	-	0.141	-	-	-	-	-	
187.99	-	-	-	-	0.213	-	-	-	-	-	
188.00	-	-	-	-	-	-	0.208	0.231	-	-	
188.48	-	-	-	-	0.329	-	-	-	-	-	
188.98	-	-	1.131	0.341	-	-	0.450	0.320	0.003	0.013	
189.00	-	-	-	-	0.467	-	0.508	0.340	0.003	0.014	
189.48	-	-	-	-	0.703	-	-	-	0.021	0.064	
190.00	-	-	-	-	0.914	-	0.899	0.482	0.070	0.128	
190.49	-	-	-	-	1.150	-	-	-	0.146	0.179	
190.50	4.901	1.037	1.880	0.643	-	-	1.150	0.540	0.147	0.180	
190.98	-	-	-	-	1.471	-	-	-	0.253	0.268	
191.00	-	-	-	-	-	-	1.474	0.630	0.258	0.272	
191.50	-	-	-	-	1.827	-	-	-	0.426	0.392	
191.98	-	-	-	-	2.177	-	-	-	0.635	0.485	

Elevation (Above MSL, m)	As per original project report data (1962)		As per 1975 survey		As per 1986 survey		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)	Area (M.sq.m or sq.km)	Gross Capacity (M.cu.m)	Area (M.sq.m or sq.km)	Gross Capacity (M.cu.m)	Area (M.sq.m or sq.km)	Gross Capacity (M.cu.m)	Area (M.sq.m or sq.km)	
192.00	-	-	-	-	-	-	2.167	0.800	0.645	0.489	
192.02	-	-	3.086	0.940	-	-	2.200	0.804	0.655	0.493	
192.50	-	-	-	-	2.644	-	-	-	0.926	0.649	
192.99	-	-	-	-	3.093	-	-	-	1.283	0.809	
193.00	-	-	-	-	-	-	3.085	1.000	1.292	0.813	
193.48	-	-	-	-	3.587	-	-	-	1.721	0.987	
193.55	8.785	1.511	4.771	1.272	-	-	3.650	1.100	1.792	1.017	
194.00	-	-	-	-	4.192	-	4.172	1.210	2.300	1.246	
194.48	-	-	-	-	4.811	-	-	-	2.950	1.449	
195.00	-	-	-	-	5.433	-	5.466	1.300	3.753	1.641	
195.07	-	-	7.084	1.763	-	-	5.500	1.510	3.869	1.668	
195.49	-	-	-	-	6.144	-	-	-	4.602	1.829	
195.98	-	-	-	-	6.881	-	-	-	5.546	2.025	
196.00	-	-	-	-	-	-	6.899	1.770	5.587	2.034	
196.49	-	-	-	-	7.874	-	-	-	6.634	2.248	
196.60	14.904	2.505	10.124	2.241	-	-	8.050	2.020	6.884	2.298	
196.98	-	-	-	-	8.979	-	-	-	7.790	2.469	
197.00	-	-	-	-	-	-	8.994	2.200	7.839	2.478	
197.50	-	-	-	-	10.175	-	-	-	9.134	2.702	

Elevation (Above MSL, m)	As per original project report data (1962)		As per 1975 survey		As per 1986 survey		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)	Area (M.sq.m or sq.km)	Gross Capacity (M.cu.m)	Area (M.sq.m or sq.km)	Gross Capacity (M.cu.m)	Area (M.sq.m or sq.km)	Gross Capacity (M.cu.m)	Area (M.sq.m or sq.km)	
197.99	-	-	-	-	11.300	-	-	-	10.516	2.943	
198.00	-	-	-	-	-	-	11.300	2.630	10.546	2.948	
198.12	-	-	13.986	2.812	-	-	11.600	2.680	10.903	3.010	
198.48	-	-	-	-	12.732	-	-	-	12.021	3.203	
198.99	-	-	-	-	14.303	-	-	-	13.722	3.465	
199.00	-	-	-	-	-	-	14.285	3.151	13.756	3.471	
199.48	-	-	-	-	15.824	-	-	-	15.487	3.743	
199.64	24.857	4.017	18.746	3.434	-	-	16.299	3.260	16.093	3.832	
200.00	-	-	-	-	17.657	-	17.619	3.720	17.505	4.014	
200.49	-	-	-	-	19.683	-	-	-	19.537	4.290	
200.98	-	-	-	-	21.697	-	-	-	21.732	4.671	
201.00	-	-	-	-	-	-	21.749	4.360	21.825	4.684	
201.17	-	-	24.706	4.388	-	-	22.299	4.460	22.631	4.792	
201.49	-	-	-	-	23.931	-	-	-	24.197	5.001	
201.98	-	-	-	-	26.305	-	-	-	26.780	5.538	
202.00	-	-	-	-	-	-	26.386	4.990	26.891	5.553	
202.50	-	-	-	-	28.993	-	-	-	29.748	5.864	
202.68	40.359	6.163	32.219	5.473	29.943	-	29.944	5.473	30.813	5.969	**FRL**

Table 6: Comparative statement of Khodiyar reservoir (original project report (1962), 1975, 1986 and 1987)

The above data in **Table 6** was used for the preparation of Elevation-Area-Capacity curves presented in **Figure 7,** which shows the Elevation-Area-Capacity curves of 2021, 1987, 1986 and 1975 superimposed on the original project report (1962) Elevation-Area-Capacity curves.

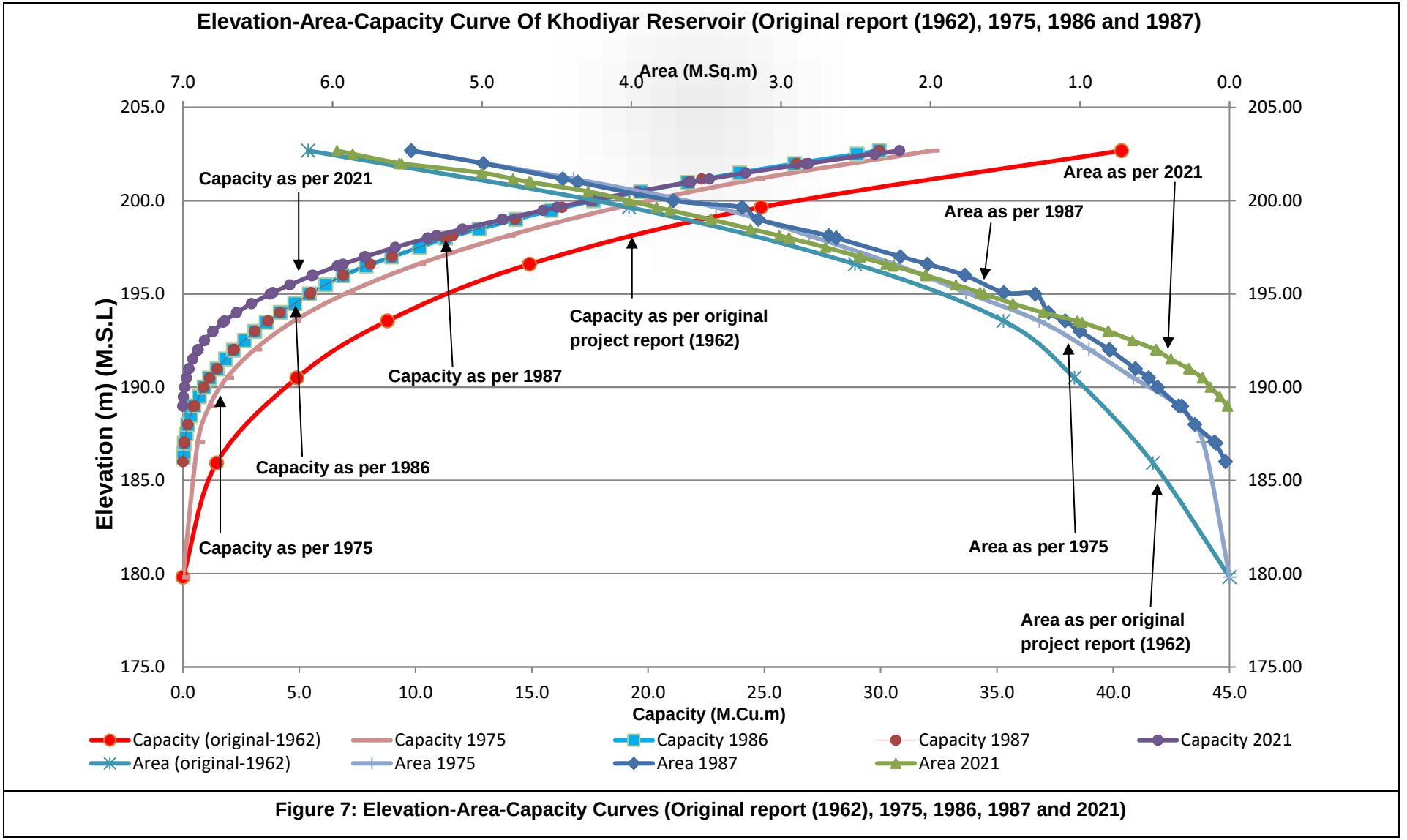


Figure 7: Elevation-Area-Capacity Curves (Original report (1962), 1975, 1986, 1987 and 2021)

8.6 Data Comparison between Original project report (1962) 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.

8.6.1 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 383.00 sq.km.

ii) The Full Reservoir Level (FRL) of the reservoir is given as 202.68m above MSL.

iii) The Outlet Sill Level (OSL) of the reservoir is at 179.82m above MSL.

The results obtained after comparing the original project report survey data (1962) with that of 2021 are provided below:

Capacity at FRL (202.68m) as per the original project report (1962)	= 40.359 M.cu.m
Capacity at FRL (202.68m) as per 2021 survey	= 30.813 M.cu.m
Siltation in 59 years (1962-2021)	= 40.359 – 30.813
	= 9.546 M.cu.m
Annual siltation	= 9.546/59= 0.162 M.cu.m/yr
Rate of siltation (Siltation index)	= (0.162/383.00) x 1000
	= 0.42 Th.cu.m/sq.km/year
	= **4.22** Ha.m/100sq.km/year

8.6.2 Loss of gross storage capacity at FRL

Capacity at FRL (202.68m) as per original project report survey data (1962) = 40.359 M.cu.m

Capacity at FRL (202.68) as per 2021 survey	= 30.813 M.cu.m
Loss of storage capacity in 59 years (1962-2021)	= 40.359 – 30.813
	= 9.546 M.cu.m
Percentage loss of Gross storage capacity up to FRL in 59 years	= (9.546/40.359) x 100
	= 23.65%
Annual percentage loss	= 23.65/59
	= **0.40%**

8.6.3 Loss of dead storage capacity

Capacity at MDDL/OSL (179.82m) as per original project report (1962)	= 0.000 M.cu.m
Capacity at MDDL/OSL as per 2021 survey	= 0.000 M.cu.m
Loss of storage capacity in 59 years (1962-2021)	= 0.000 – 0.000
	= 0.000 M.cu.m
Percentage loss of dead storage capacity up to OSL in 59 years	= 0.00%
Annual percentage loss	= 0.00/59
	= **0.00%**

8.6.4 Loss of live storage capacity

Live storage capacity as per the original project report survey data (1962)	= 40.359 – 0.000
	= 40.359 M.cu.m
Live storage capacity as per 2021 survey	= 30.813 – 0.000
	= 30.813 M.cu.m
Loss of Live storage capacity in 59 years (1962-2021)	= 40.359 – 30.813
	= 9.546 M.cu.m
Percentage loss of live storage capacity in 59 years	= (9.546/40.359) x 100
	= 23.65%
Annual percentage loss	= 23.65/59
	= **0.40%**

8.7 Summary of Capacity Surveys (Original survey report data (1962) and 2021)

Reservoir data as per original survey report (1962):

Catchment Area : 383.00 sq.km

Spread area at FRL (202.68m) : 6.163 sq.km

Gross storage at FRL (202.68m) : 40.359 M.cu.m

Dead storage at O.S.L (179.82m) : 0.000 M.cu.m

Live storage at FRL (202.68m) : 40.359 M.cu.m

Rate of siltation (at FRL 202.68m) with respect to the original project report survey data (1962)													
Sr. No	Year of Survey	Capacity in M.cu.m			Siltation in M.cu.m	Period in years	Siltation Rate in M.cu.m/Year	Loss in Capacity in M.cu.m and percentage			Siltation index Ham/100 sq.km/Yr	Annual % loss of capacity	Remarks
		Dead	Live	Gross				Dead	Live	Gross			
1	1962	0.000	40.359	40.359	-	-	-	-	-	-	-	-	-
2	2021	0.000	30.813	30.813	9.546	59	0.162	0.000 0.00%	9.546 23.65%	9.546 23.65%	4.22	0.40	Significant

Table 7: Rate of siltation (Original project report (1962) vs 2021) at FRL (202.68m)

According to IS-12182 (1987)

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

Rate of Erosion – Increase in Gross Capacity/No of Years

Erosion Index – (Erosion rate/Catchment area) x 10000

Annual % Increase – Increase in % of Gross Capacity/No. of years

8.8 Data Comparison between 1975 and 2021

8.8.1 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 383.00 sq.km.

v) The Full Reservoir Level (FRL) of the reservoir is given as 202.68m above MSL.

vi) The Outlet Sill Level (OSL) of the reservoir is at 179.82m above MSL.

The results obtained after comparing the survey data of the year 1975 with that of 2021 are provided below:

Capacity at FRL (202.68m) as per 1975 survey	= 32.219 M.cu.m
Capacity at FRL (202.68m) as per 2021 survey	= 30.813 M.cu.m
Siltation in 46 years (1975-2021)	= 32.219 – 30.813
	= 1.406 M.cu.m
Annual siltation	= 1.406/46= 0.031 M.cu.m/yr
Rate of siltation (Siltation index)	= (0.031/383.00) x 1000
	= 0.08 Th.cu.m/sq.km/year
	= **0.80** Ha.m/100sq.km/year

8.8.2 Loss of gross storage capacity at FRL

Capacity at FRL (202.68m) as per 1975 survey	= 32.219 M.cu.m
Capacity at FRL (202.68) as per 2021 survey	= 30.813 M.cu.m
Loss of storage capacity in 46 years (1975-2021)	= 32.219 – 30.813
	= 1.406 M.cu.m
Percentage loss of Gross storage capacity up to FRL in 46 years	= (1.406/32.219) x 100
	= 4.36%
Annual percentage loss	= 4.36/46
	= **0.09%**

8.8.3 Loss of dead storage capacity

Capacity at MDDL/OSL (179.82m) as per 1975 survey	= 0.000 M.cu.m
Capacity at MDDL/OSL as per 2021 survey	= 0.000 M.cu.m
Loss of storage capacity in 46 years (1975-2021)	= 0.000 – 0.000
	= 0.000 M.cu.m
Percentage loss of dead storage capacity up to OSL in 46 years	= 0.00%
Annual percentage loss	= 0.00/46
	= **0.00%**

8.8.4 Loss of live storage capacity

Live storage capacity as per 1975 survey	= 32.219 – 0.000
	= 32.219 M.cu.m

Live storage capacity as per 2021 survey	= 30.813 – 0.000 = 30.813 M.cu.m
Loss of Live storage capacity in 46 years (1975-2021)	= 32.219 – 30.813 = 1.406 M.cu.m
Percentage loss of live storage capacity in 46 years	= (1.406/32.219) x 100 = 4.36%
Annual percentage loss	= 4.36/46 = **0.09%**

8.9 Summary of Capacity Surveys (1975 and 2021)

Reservoir data as per 1975 silt survey:

Year of silt survey : 1975
Catchment Area : 383.00 sq.km
Spread area at FRL (202.68m) : 5.473 sq.km
Gross storage at FRL (202.68m) : 32.219 M.cu.m
Dead storage at O.S.L (179.82m) : 0.000 M.cu.m
Live storage at FRL (202.68m) : 32.219 M.cu.m

Rate of siltation (at FRL 202.68m) with respect to the silt survey data in the year 1975													
Sr. No	Year of Survey	Capacity in M.cu.m			Siltation in M.cu.m	Period in years	Siltation Rate in M.cu.m/Year	Loss in Capacity in M.cu.m and percentage			Siltation index Ham/100 sq.km/Yr	Annual % loss of capacity	Remarks
		Dead	Live	Gross				Dead	Live	Gross			
1	1975	0.000	32.219	32.219	-	-	-	-	-	-	-	-	-
2	2021	0.000	30.813	30.813	1.406	46	0.08	0.000 0.00%	1.406 4.36%	1.406 4.36%	0.80	0.09	Insignificant category

Table 8: Rate of siltation (1975 vs 2021) at FRL (202.68m)

According to IS-12182 (1987)

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

Rate of Erosion – Increase in Gross Capacity/No of Years
Erosion Index – (Erosion rate/Catchment area) x 10000
Annual % Increase – Increase in % of Gross Capacity/No. of years

8.10 Data Comparison between 1986 and 2021

8.10.1 Rate of erosion

The increase of storage and rate of erosion calculations are based on the following basic data.

i) The catchment area of the reservoir is 383.00 sq.km.

ii) The FRL of the reservoir is given as 202.68m.

iii) The Outlet Sill Level (OSL) of the reservoir is at 179.82m above MSL.

The results obtained after comparing the survey data of the year 1986 with that of 2021 are provided below:

Capacity at FRL (202.68m) as per the 1986 survey	= 29.943 M.cu.m
Capacity at FRL (202.68m) as per 2021 survey	= 30.813 M.cu.m
Erosion in 35 years (1986-2021)	= 30.813 – 29.943
	= 0.870 M.cu.m
Annual Erosion	= 0.870/35= 0.025 M.cu.m/yr
Rate of Erosion	= (0.025/383.00) x 1000
	= 0.06 Th.cu.m/sq.km/year
	= **0.65** Ha.m/100sq.km./year

8.10.2 Increase of gross storage capacity at FRL

Capacity at FRL (202.68m) as per the 1986 survey	= 29.943 M.cu.m
Capacity at FRL (202.68m) as per 2021 survey	= 30.813 M.cu.m
Increase of storage capacity in 35 years (1986-2021)	= 30.813 – 29.943
	= 0.870 M.cu.m
Percentage increase of gross storage capacity up to FRL in 35 years	= (0.870/29.943) x 100
	= 2.91%
Annual percentage increase	= 2.91/35
	= **0.08%**

8.10.3 Increase of dead storage capacity

Capacity at DSL/OSL (179.82m) as per the 1986 survey	= 0.000 M.cu.m
Capacity at DSL/ OSL as per 2021 survey	= 0.000 M.cu.m
Loss of storage capacity in 35 years (1986-2021)	= 0.000 – 0.000
	= 0.000 M.cu.m
Percentage increase of dead storage capacity up to OSL in 35 years	= 0.00%
Annual percentage increase	= 0.00/35
	= **0.00%**

8.10.4 Increase of live storage capacity

Live storage capacity as per the 1986 survey	= 29.943 – 0.000
	= 29.943 M.cu.m
Live storage capacity as per 2021 survey	= 30.813 – 0.000

	= 30.813 M.cu.m
Increase of Live storage capacity in 35 years (1986-2021)	= 30.813 – 29.943
	= 0.87 M.cu.m
Percentage increase of live storage capacity in 35 years	= (0.87/29.943) x 100
	= 2.91%
Annual percentage increase	= 2.91/35
	= **0.08%**

8.11 Summary of Capacity Surveys (1986 and 2021)

Reservoir data as per 1986 silt survey:

Year of silt survey : 1986
Catchment Area : 383.00 sq.km
Gross storage at FRL (202.68m) : 29.943 M.cu.m
Dead storage at O.S.L (179.82m) : 0.000 M.cu.m
Live storage at FRL (202.68m) : 29.943 M.cu.m

Rate of erosion (at FRL 202.68m) with respect to the silt survey data in the year 1986													
Sr. No	Year of Survey	Capacity in M.cu.m			Erosion in M.cu.m	Period in years	Erosion Rate in M.cu.m/Year	Increase in Capacity in M.cu.m and percentage			Erosion index Ham/100 sq.km/yr.	Annual % increase of capacity	Remarks
		Dead	Live	Gross				Dead	Live	Gross			
1	1986	0.000	29.943	29.943	-	-	-	-	-	-	-	-	-
2	2021	0.000	30.813	30.813	0.870	35	0.025	0.000 0.00%	0.870 2.91%	0.870 2.91%	0.65	0.08	-

Table 9: Rate of Erosion (1986 vs 2021) at FRL (202.68m)

According to IS-12182 (1987)

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

Rate of Erosion – Increase in Gross Capacity/No of Years
Erosion Index – (Erosion rate/Catchment area) x 10000
Annual % Increase – Increase in % of Gross Capacity/No. of years

8.12 Data Comparison between 1987 and 2021

8.12.1 Rate of erosion

The increase of storage and rate of erosion calculations are based on the following basic data.

i) The catchment area of the reservoir is 383.00 sq.km

ii) The FRL of the reservoir is given as 202.68m.

iii) The dead storage level of the reservoir is at 179.82m.

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

Capacity at FRL (202.68m) as per the 1987 survey	= 29.944 M.cu.m
Capacity at FRL (202.68m) as per 2021 survey	= 30.813 M.cu.m
Erosion in 34 years (1987-2021)	= 30.813 – 29.944
	= 0.869 M.cu.m
Annual Erosion	= 0.869/34= 0.026 M.cu.m/yr
Rate of Erosion	= (0.026/383.00) x 1000
	= 0.07 Th.cu.m/sq.km/year
	= **0.67** Ha.m/100sq.km./year

8.12.2 Increase of gross storage capacity at FRL

Capacity at FRL (202.68m) as per the 1987 survey	= 29.944 M.cu.m
Capacity at FRL (202.68m) as per 2021 survey	= 30.813 M.cu.m
Increase of storage capacity in 34 years (1987-2021)	= 30.813 – 29.944
	= 0.869 M.cu.m
Percentage increase of gross storage capacity up to FRL in 34 years	= (0.869/29.944) x 100
	= 2.90%
Annual percentage increase	= 2.90/34
	= **0.09%**

8.12.3 Increase of dead storage capacity

Capacity at DSL/OSL (179.82m) as per the 1987 survey	= 0.000 M.cu.m
Capacity at DSL/OSL as per 2021 survey	= 0.000 M.cu.m
Increase of storage capacity in 34 years (1987-2021)	= 0.000 – 0.000
	= 0.000 M.cu.m
Percentage increase of dead storage capacity up to OSL in 34 years	= 0.00%
Annual percentage increase	= 0.00/34
	= **0.00%**

8.12.4 Increase of live storage capacity

Live storage capacity as per the 1987 survey	= 29.944 – 0.000
	= 29.944 M.cu.m
Live storage capacity as per 2021 survey	= 30.813 – 0.000

	= 30.813 M.cu.m
Increase of Live storage capacity in 34 years (1987-2021)	= 30.813 – 29.944
	= 0.869 M.cu.m
Percentage increase of live storage capacity in 34 years	= (0.869/29.944) x 100
	= 2.90%
Annual percentage increase	= 2.90/34
	= **0.09%**

8.13 Summary of Capacity Surveys (1987 and 2021)

Reservoir data as per 1987 silt survey:

Year of silt survey : 1987
Catchment Area : 383.00 sq.km
Spread area at FRL (202.68m) : 5.473 sq.km
Gross storage at FRL (202.68m) : 29.944 M.cu.m
Dead storage at O.S.L (179.82m) : 0.000 M.cu.m
Live storage at FRL (202.68m) : 29.944 M.cu.m

Rate of erosion (at FRL 202.68m) with respect to the silt survey data in the year 1987													
Sr. No	Year of Survey	Capacity in M.cu.m			Erosion in M.cu.m	Period in years	Erosion Rate in M.cu.m/Year	Increase in Capacity in M.cu.m and percentage			Erosion index Ham/100 sq.km/Yr	Annual % increase of capacity	Remarks
		Dead	Live	Gross				Dead	Live	Gross			
1	1987	0.000	29.944	29.944	-	-	-	-	-	-	-	-	-
2	2021	0.000	30.813	30.813	0.869	34	0.026	0.000 0.00%	0.869 2.90%	0.869 2.90%	0.67	0.09	-

Table 10: Rate of Erosion (1987 vs 2021) at FRL (202.68m)

According to IS-12182 (1987)

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

Rate of Erosion – Increase in Gross Capacity/No of Years
Erosion Index – (Erosion rate/Catchment area) x 10000
Annual % Increase – Increase in % of Gross Capacity/No. of years

8.14 Loss/Increase of Storage due to Sediment Deposit/Erosion

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.

On the other hand, the storage capacity of a reservoir may increase due to various reasons. One of the major reasons behind the increase of storage capacity is due to the conversion of more irregular land area around the river bank in to levelled cultivation lands. This will increase the water spread area around the FRL and the corresponding volume of capacity will be increased. The capacity could also increase by the widening of the river channel at various levels within the reservoir. The increases in capacity due to sediment removal can occur in any level from the dead storage level to gross storage level.

For ease of reporting, the current survey data in 2021 has been compared separately with the original project report data (1962) and with the previous silt survey data of 1975, 1986 and 1987.

For Khodiyar reservoir, the detailed comparison of current capacity data (2021) at different levels to the original project report survey data (1962) indicates a decrease in capacity due to sediment deposition in the live storage area. It is observed that a minimum elevation of 185.93m was observed as per the original project report data (1962) (**Table 11**). Further, in the recent survey conducted in 2021, a minimum elevation of 188.55m was observed (**Annexure1-Elev Area Cap**). Hence, it can be said that the minimum elevation observed in the reservoir over the years (from 1962-2021) has increased, which indicates that sedimentation has occurred over the years. Thus, it can be understood that the reservoir is filled with silt alone between elevations 185.93m and 188.55m from 1962 to 2021. Hence the cumulative capacity calculated in 2021 at elevation 185.93m is zero as indicated in **Table 11**.

There is no change in the capacity at OSL (179.82m) from 1962 to 2021 and remains at 0.000 M.cu.m.

The increase of sediment deposit from elevation 185.93m above MSL 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 FRL (202.68m) decreased from 40.359 M.cu.m to 30.813 M.cu.m between 1962 and 2021 with a decrease in capacity of about 23.65%. The amount of sediment deposited during this period up to FRL is 9.546 M.cu.m.

The following **Table 11** shows the amount of deposition of sediment at different levels of the reservoir and corresponding percentage loss in storage capacity.

Elevation (Above MSL, m)	Area as per original report (1962) (M.sq.m or sq.km)	Capacity as per original report (1962) (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
179.82 (OSL)	0.000	0.000	0.000	0.000	0.000	0.00	No change
185.93	0.511	1.445	0.000	0.000	1.445	100.00	Sediment deposit, loss of capacity
190.50	1.037	4.901	0.180	0.147	4.754	97.00	Sediment deposit, loss of capacity
193.55	1.511	8.785	1.017	1.792	6.993	79.60	Sediment deposit, loss of capacity

Elevation (Above MSL, m)	Area as per original report (1962) (M.sq.m or sq.km)	Capacity as per original report (1962) (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
196.60	2.505	14.904	2.298	6.884	8.020	53.81	Sediment deposit, loss of capacity
199.64	4.017	24.857	3.832	16.093	8.764	35.26	Sediment deposit, loss of capacity
202.68 (FRL)	6.163	40.359	5.969	30.813	9.546	23.65	Sediment deposit, loss of capacity

Table 11: Loss of storage capacity between original project report data (1962) and current survey data (2021)

For Khodiyar reservoir, the detailed comparison of current capacity data (2021) at different levels to the previous capacity data of 1975 survey indicates a decrease in capacity due to sediment deposition in the live storage area. It is observed that a minimum elevation of 187.06m was observed as per the 1975 silt survey results (**Table 12**). Further, in the recent survey conducted in 2021, a minimum elevation of 188.55m was observed (**Annexure1-Elev Area Cap**). Hence, it can be said that the minimum elevation observed in the reservoir over the years (from 1975 to 2021) has increased, which indicates that sedimentation has occurred over the years. Thus, it can be understood that the reservoir is filled with silt alone between elevations 187.06m and 188.55m from the year 1975 to 2021. Hence the cumulative capacity calculated in 2021 at elevations 179.82m and 187.06m is zero as indicated in **Table 12**.

There is no change in the capacity at OSL (179.82m) from 1975 to 2021 and remains at 0.000 M.cu.m.

The increase of sediment deposit from 187.06m above MSL 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 FRL (202.68m) decreased from 32.219 M.cu.m to 30.813 M.cu.m between the years 1975 and 2021 with a decrease in capacity of about 4.36%. The amount of sediment deposited during this period up to FRL is 1.406 M.cu.m.

The following **Table 12** shows the amount of deposition of sediment at different levels of reservoir and corresponding percentage loss in storage capacity.

Elevation (Above MSL, m)	Area 1975 (M.sq.m or sq.km)	Capacity 1975 (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
179.82 (OSL)	0.000	0.000	0.000	0.000	0.000	0.00	No change
187.06	0.176	0.634	0.000	0.000	0.634	100.00	Sediment deposit, loss of capacity
188.98	0.341	1.131	0.013	0.003	1.128	99.73	Sediment deposit, loss of capacity
190.50	0.643	1.880	0.180	0.147	1.733	92.18	Sediment deposit, loss of capacity
192.02	0.940	3.086	0.493	0.655	2.431	78.78	Sediment deposit, loss of capacity
193.55	1.272	4.771	1.017	1.792	2.979	62.44	Sediment deposit, loss of capacity
195.07	1.763	7.084	1.668	3.869	3.215	45.38	Sediment deposit, loss of capacity
196.60	2.241	10.124	2.298	6.884	3.240	32.00	No change
198.12	2.812	13.986	3.010	10.903	3.083	22.05	Sediment deposit, loss of capacity

199.64	3.434	18.746	3.832	16.093	2.653	14.15	Sediment deposit, loss of capacity
201.17	4.388	24.706	4.792	22.631	2.075	8.40	Sediment deposit, loss of capacity
202.68 (FRL)	5.473	32.219	5.969	30.813	1.406	4.36	Sediment deposit, loss of capacity

Table 12: Loss of storage capacity between 1975 and 2021

For Khodiyar reservoir, the detailed comparison of current capacity data (2021) at different levels to the previous capacity data of 1986 survey indicates a decrease in capacity due to sediment deposition from elevations 186.22m to 200.49m, while an increase in capacity due to possible sediment erosion is observed from elevations 200.49m to 202.68m (**Table 13**). The increase of sediment erosion and the corresponding increase in capacity is possibly due to the widening of river channels or removal of sediments due to outflow. Another possibility is the erosion of the reservoir bank at these levels or conversion of more irregular water spread areas around the FRL into levelled cultivation fields. Possible sediment removal using dedicated equipment also leads to the widening and deepening of river channels which ultimately results in an increase in capacity.

It is observed that a minimum elevation of 186.22m was observed as per the 1986 silt survey results (**Table 13**). Further, in the recent survey conducted in 2021, a minimum elevation of 188.55m was observed (**Annexure1-Elev Area Cap**). Hence, it can be said that the minimum elevation observed in the reservoir over the years (from 1986 to 2021) has increased, which indicates that sedimentation has occurred over the years from elevations 186.22m to 188.55m. Thus, it can be understood that the reservoir is filled with silt alone between elevations 186.22m and 200.49m from the year 1986 to 2021. Hence the cumulative capacity calculated in 2021 at elevations from 186.22m to 188.48m is zero as indicated in **Table 13**.

The capacity at FRL (202.68m) increased from 29.943 M.cu.m to 30.813 M.cu.m between the years 1986 and 2021 (35 years) with an increase in capacity of about 2.91%. The amount of sediment eroded during this period from elevation 200.49m up to 202.68 (FRL) is 0.870 M.cu.m.

The following **Table 13** shows the amount of deposition of sediments at different levels of reservoir and corresponding percentage loss in capacity from elevations 186.22m to 200.49m and also the amount of erosion of sediments at different levels of reservoir and corresponding percentage increase in capacity from elevations 200.49m to 202.68m (FRL).

Elevation (Above MSL, m)	Capacity 1986 (M.cu.m)	Area 2021 (M.sq.m or sq.km)	Capacity 2021 (M.cu.m)	Erosion/ Deposition of Sediments (M.cu.m)	% Increase/ Loss of Capacity	Remarks
186.22	0.013	0.000	0.000	0.013	100.00	Sediment deposition, loss of capacity
186.50	0.029	0.000	0.000	0.029	100.00	Sediment deposition, loss of capacity
187.00	0.062	0.000	0.000	0.062	100.00	Sediment deposition, loss of capacity
187.50	0.141	0.000	0.000	0.141	100.00	Sediment deposition, loss of capacity
187.99	0.213	0.000	0.000	0.213	100.00	Sediment deposition, loss of capacity
188.48	0.329	0.001	0.000	0.329	100.00	Sediment deposition, loss of capacity
189.00	0.467	0.014	0.003	0.464	99.36	Sediment deposition, loss of capacity
189.48	0.703	0.064	0.021	0.682	97.01	Sediment deposition, loss of capacity

Elevation (Above MSL, m)	Capacity 1986 (M.cu.m)	Area 2021 (M.sq.m or sq.km)	Capacity 2021 (M.cu.m)	Erosion/ Deposition of Sediments (M.cu.m)	% Increase/ Loss of Capacity	Remarks
190.00	0.914	0.128	0.070	0.844	92.34	Sediment deposition, loss of capacity
190.49	1.150	0.179	0.146	1.004	87.30	Sediment deposition, loss of capacity
190.98	1.471	0.268	0.253	1.218	82.80	Sediment deposition, loss of capacity
191.50	1.827	0.392	0.426	1.401	76.68	Sediment deposition, loss of capacity
191.98	2.177	0.485	0.635	1.542	70.83	Sediment deposition, loss of capacity
192.50	2.644	0.649	0.926	1.718	64.98	Sediment deposition, loss of capacity
192.99	3.093	0.809	1.283	1.810	58.52	Sediment deposition, loss of capacity
193.48	3.587	0.987	1.721	1.866	52.02	Sediment deposition, loss of capacity
194.00	4.192	1.246	2.300	1.892	45.13	Sediment deposition, loss of capacity
194.48	4.811	1.449	2.950	1.861	38.68	Sediment deposition, loss of capacity
195.00	5.433	1.641	3.753	1.680	30.92	Sediment deposition, loss of capacity
195.49	6.144	1.829	4.602	1.542	25.10	Sediment deposition, loss of capacity
195.98	6.881	2.025	5.546	1.335	19.40	Sediment deposition, loss of capacity
196.49	7.874	2.248	6.634	1.240	15.75	Sediment deposition, loss of capacity
196.98	8.979	2.469	7.790	1.189	13.24	Sediment deposition, loss of capacity
197.50	10.175	2.702	9.134	1.041	10.23	Sediment deposition, loss of capacity
197.99	11.300	2.943	10.516	0.784	6.94	Sediment deposition, loss of capacity
198.48	12.732	3.203	12.021	0.711	5.58	Sediment deposition, loss of capacity
198.99	14.303	3.465	13.722	0.581	4.06	Sediment deposition, loss of capacity
199.48	15.824	3.743	15.487	0.337	2.13	Sediment deposition, loss of capacity
200.00	17.657	4.014	17.505	0.152	0.86	Sediment deposition, loss of capacity
200.49	19.683	4.290	19.537	0.146	0.74	Sediment deposition, loss of capacity
200.98	21.697	4.671	21.732	0.035*	0.16**	Sediment erosion, increase of capacity
201.49	23.931	5.001	24.197	0.266*	1.11**	Sediment erosion, increase of capacity
201.98	26.305	5.538	26.780	0.475*	1.81**	Sediment erosion, increase of capacity
202.50	28.993	5.864	29.748	0.755*	2.60**	Sediment erosion, increase of capacity
202.68	29.943	5.969	30.813	0.870*	2.91**	Sediment erosion, increase of capacity

Table 13: Loss/ Increase of storage capacity between 1986 and 2021

Note:

- *Values highlighted with single asterisks (*) represents the volume of sediments eroded.*
- *Values highlighted with double asterisks (**) represents the percentage (%) increase of storage capacity.*

For Khodiyar reservoir, the detailed comparison of current capacity data at different levels to the previous capacity data of 1987 survey shows a decrease in capacity due to sediment deposition from elevations 186.00m to 200.00m, while an increase in capacity due to possible sediment erosion is observed from elevations 200.00m to 202.68m. The increase of sediment erosion and the corresponding increase in capacity is possibly due to the widening of river channels or removal of sediments due to outflow. Another possibility is the erosion of the reservoir bank at these levels or conversion of more irregular water spread areas around the FRL into levelled cultivation fields. Possible sediment removal using dedicated equipment also leads to the widening and deepening of river channels which ultimately results in an increase in capacity.

It is observed that a minimum elevation of 186.00m was observed as per the 1987 silt survey results (**Table 14**). Further, in the recent survey conducted in 2021, a minimum elevation of 188.55m was observed (Annexure1-Elev Area Cap). Hence, it can be said that the minimum elevation observed in the reservoir over the years (from 1987 to 2021) has increased, which indicates that sedimentation has occurred over the years from elevations 186.00m to 188.55m. Thus, it can be understood that the reservoir is filled with silt alone between elevations 186.00m and 188.55m from the year 1987 to 2021. Hence the cumulative capacity calculated in 2021 at elevations from 186.00m to 188.00m is zero as indicated in **Table 14**.

The capacity at FRL (202.68m) increased from 29.944 M.cu.m to 30.813 M.cu.m between the years 1987 and 2021 with an increase in capacity of about 2.90%. The amount of sediment eroded during this period from elevation 200.00m up to 202.68 (FRL) is 0.869 M.cu.m.

The following **Table 14** shows the amount of deposition of sediments at different levels of reservoir and corresponding percentage loss in capacity from elevations 186.00m to 200.00m and also the amount of erosion of sediments at different levels of reservoir and corresponding percentage increase in capacity from elevations 200.00m to 202.68m (FRL).

Elevation (Above MSL, m)	Area 1987 (M.sq.m or sq.km)	Capacity 1987 (M.cu.m)	Area 2021 (M.sq.m or sq.km)	Capacity 2021 (M.cu.m)	Erosion/ Deposition of Sediments (M.cu.m)	% Increase/ Loss of Capacity	Remarks
186.00	0.027	0.000	0.000	0.000	0.000	0.00	Sediment deposition, loss of capacity
187.00	0.091	0.056	0.000	0.000	0.056	100.00	Sediment deposition, loss of capacity
187.06	0.100	0.060	0.000	0.000	0.060	100.00	Sediment deposition, loss of capacity
188.00	0.231	0.208	0.000	0.000	0.208	100.00	Sediment deposition, loss of capacity
188.98	0.320	0.450	0.013	0.003	0.447	99.33	Sediment deposition, loss of capacity
189.00	0.340	0.508	0.014	0.003	0.505	99.41	Sediment deposition, loss of capacity

Elevation (Above MSL, m)	Area 1987 (M.sq.m or sq.km)	Capacity 1987 (M.cu.m)	Area 2021 (M.sq.m or sq.km)	Capacity 2021 (M.cu.m)	Erosion/ Deposition of Sediments (M.cu.m)	% Increase/ Loss of Capacity	Remarks
190.00	0.482	0.899	0.128	0.070	0.829	92.22	Sediment deposition, loss of capacity
190.50	0.540	1.150	0.180	0.147	1.003	87.22	Sediment deposition, loss of capacity
191.00	0.630	1.474	0.272	0.258	1.216	82.50	Sediment deposition, loss of capacity
192.00	0.800	2.167	0.489	0.645	1.522	70.24	Sediment deposition, loss of capacity
192.02	0.804	2.200	0.493	0.655	1.545	70.23	Sediment deposition, loss of capacity
193.00	1.000	3.085	0.813	1.292	1.793	58.12	Sediment deposition, loss of capacity
193.55	1.100	3.650	1.017	1.792	1.858	50.90	Sediment deposition, loss of capacity
194.00	1.210	4.172	1.246	2.300	1.872	44.86	Sediment deposition, loss of capacity
195.00	1.300	5.466	1.641	3.753	1.713	31.34	Sediment deposition, loss of capacity
195.07	1.510	5.500	1.668	3.869	1.631	29.65	Sediment deposition, loss of capacity
196.00	1.770	6.899	2.034	5.587	1.312	19.02	Sediment deposition, loss of capacity
196.60	2.020	8.050	2.298	6.884	1.166	14.48	Sediment deposition, loss of capacity
197.00	2.200	8.994	2.478	7.839	1.155	12.84	Sediment deposition, loss of capacity
198.00	2.630	11.300	2.948	10.546	0.754	6.67	Sediment deposition, loss of capacity
198.12	2.680	11.600	3.010	10.903	0.697	6.01	Sediment deposition, loss of capacity
199.00	3.151	14.285	3.471	13.756	0.529	3.70	Sediment deposition, loss of capacity
199.64	3.260	16.299	3.832	16.093	0.206	1.27	Sediment deposition, loss of capacity
200.00	3.720	17.619	4.014	17.505	0.114	0.65	Sediment deposition, loss of capacity
201.00	4.360	21.749	4.684	21.825	0.076*	0.35**	Sediment erosion, increase of capacity
201.17	4.460	22.299	4.792	22.631	0.332*	1.49**	Sediment erosion, increase of capacity
202.00	4.990	26.386	5.553	26.891	0.505*	1.91**	Sediment erosion, increase of capacity
202.68	5.473	29.944	5.969	30.813	0.869*	2.90**	Sediment erosion, increase of capacity

Table 14: Loss/ Increase of storage capacity between 1987 and 2021

Note:

- *Values highlighted with single asterisks (*) represents the volume of sediments eroded.*

- *Values highlighted with double asterisks (**) represents the percentage (%) increase of storage capacity.*

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.

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

8.15 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

8.15.1 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

8.15.2 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 ppreventive 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 ccontour 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.

8.15.3 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 deposition 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.

8.15.4 Regular removal of depositioned 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 depositions may be accomplished by a variety of mechanical and hydraulic methods, such as excavation, dredging, draining & flushing, sluicing aided by measures like 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 deposition 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 depositions.

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 depositions. 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 depositions 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 depositions, or sloughing them off, into a stream flowing through the reservoir basin should be considered.

9 CONCLUSIONS

- The construction works for the Khodiyar dam commenced in the year 1958 and was completed in the year 1967.
- FRL of the Khodiyar reservoir is at 202.68m above MSL. Khodiyar reservoir has a catchment area of 383.00 km^2.
- From the documents (previous data) provided by the client, the gross storage at FRL (202.68m) and dead storage at DSL: (179.82m) as per the original project report (1962) were found to be 40.359 M.cu.m and 0.000 M.cu.m respectively. The gross storage at FRL and dead storage at DSL as per the silt survey carried out in 1975 were found to be 32.219 M.cu.m and 0.000 M.cu.m respectively. The gross storage at FRL and dead storage at DSL as per the silt survey carried out in 1986 were found to be 29.943 M.cu.m and 0.000 M.cu.m respectively. The gross storage at FRL and dead storage at DSL as per the silt survey carried out in 1987 were found to be 29.944 M.cu.m and 0.000 M.cu.m respectively.
- The gross storage at FRL and dead storage at DSL as per the present survey (2021) were found to be 30.813 M.cu.m and 0.000 M.cu.m respectively.
- As per the current bathymetric and topographic survey, a minimum elevation of 187.9m and a maximum elevation of 201.3m was observed in the northern (in proximity to the dam wall) and western portions of the surveyed area respectively within the bathymetric section. A minimum and maximum elevations of 196.7m and 210.6m were both observed in the south-western portion of the surveyed area within the topographic section.
- For a major part of the reservoir a general range of elevation change between 190.0m to 200.0m.is observed within the bathymetric section, where steep to very steep slopes (up to 38°) are generally observed in the northern portion of the surveyed area, mainly along the topographic and bathymetric survey boundary (near the dam wall), with the slopes becoming gentler moving away from the surveyed area boundary towards the central portion of the reservoir. Moderate to very steep slopes are also observed along the eastern, south-eastern and south-western topographic and bathymetric survey boundary.
- The processed topographic data indicates that the land is sloping with very gentle to gentle gradients from all the sides of the topographic surveyed area towards the reservoir area. Steep to very steep slopes (up to 42°) are observed in the northern portion of the surveyed area, mainly along the topographic and bathymetric survey boundary (near the dam wall). Scattered areas with moderate to very steep gradients are also observed along the reservoir banks where the topographic survey ends, mainly in the north-western, south-western and south-eastern portions of the topographic surveyed area.
- The topographic survey was extended till the elevation of 202.68m (HFL) above MSL as instructed by the client.
- Bathymetric and topographic survey was restricted at some places in the survey area due to the presence of existing ravines (Nalla), bushes and rocky areas.
- Based on the previous data received from the client, the capacity/volume data as per the original project report (1962), silt surveys carried out in 1975, 1986, 1987 and 2021 (present survey by OSaS) have been compared to draw conclusions on loss/increase of reservoir capacity and rate of siltation/erosion that has occurred over the years.
- The comparison between the original project report capacity data (1962) and 2021 indicates that siltation has occurred in the reservoir over the past 59 years and the rate of siltation is calculated to be 4.22 Ha.m/100sq.km./year. Annual percentage loss of gross storage capacity, live storage capacity and dead storage capacity are 0.40%, 0.00% and 0.40% respectively.

- During the years 1962 to 2021 (59 years), the increase of sediment deposit and the corresponding reduction in reservoir 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 (179.82m) is 0.000 M.cu.m. The amount of sediment deposited during this period up to FRL (202.68m) is 9.546 M.cu.m.
- The comparison between 1975 and 2021 (46 years) data results indicates that siltation has occurred in the reservoir over the past 46 years and the rate of siltation is calculated to be 0.80 Ha.m/100sq.km./year. Annual percentage loss of gross storage capacity, live storage capacity and dead storage capacity are 0.09%, 0.09% and 0.00% respectively.
- During the years 1975 to 2021 (46 years), the increase of sediment deposit and the corresponding reduction in reservoir 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 (179.82m) is 0.000 M.cu.m. The amount of sediment deposited during this period up to FRL (202.68m) is 1.406 M.cu.m.
- The comparison between 1986 and 2021 (35 years) data results indicates that erosion has occurred in the reservoir over the past 35 years and the rate of erosion is calculated to be 0.65 Ha.m/100sq.km./year. Annual percentage increase of gross storage capacity, live storage capacity and dead storage capacity are 0.08%, 0.08% and 0.00% respectively.
- During the years 1986 to 2021 (35 years), the increase of sediment erosion and the corresponding increase in capacity possibly due to the widening of river channels or removal of sediments due to outflow. Another possibility is that the erosion of the reservoir bank at these levels or conversion of more irregular water spread areas around the FRL into levelled cultivation fields. Possible sediment removal using dedicated equipment also leads to the widening and deepening of river channels which ultimately results an increase in capacity. The amount of sediment eroded during this period up to OSL (179.82m) is 0.000 M.cu.m. The amount of sediment eroded during this period up to FRL (202.68m) is 0.870 M.cu.m.
- The comparison between 1987 and 2021 (34 years) data results indicates that erosion has occurred in the reservoir over the past 34 years and the rate of erosion is calculated to be 0.67 Ha.m/100sq.km./year. Annual percentage increase of gross storage capacity, live storage capacity and dead storage capacity are 0.09%, 0.09% and 0.00% respectively.
- During the years 1987 to 2021 (34 years), the increase of sediment erosion and the corresponding increase in capacity possibly due to the widening of river channels or removal of sediments due to outflow. Another possibility is that the erosion of the reservoir bank at these levels or conversion of more irregular water spread areas around the FRL into levelled cultivation fields. Possible sediment removal using dedicated equipment also leads to the widening and deepening of river channels which ultimately results an increase in capacity. The amount of sediment eroded during this period up to OSL (179.82m) is 0.000 M.cu.m. The amount of sediment eroded during this period up to FRL (202.68m) is 0.869 M.cu.m.
- The elevation-area-capacity curves showing a comparison of capacity survey results (original project report (1962), 1975, 1986, 1987 vs 2021) are generated using the data provided in **Table 6** and is presented in **Figure 7.**

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Annexure - 1

Elevation-Area-Capacity (2021)

Khodiyar Reservoir

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
				Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
618.60	188.55	0.022	0.002	0.035	0.001	0.035	0.001
618.64	188.56	0.022	0.002	0.035	0.001	0.035	0.001
618.67	188.57	0.022	0.002	0.035	0.001	0.035	0.001
618.70	188.58	0.022	0.002	0.035	0.001	0.035	0.001
618.73	188.59	0.022	0.002	0.035	0.001	0.035	0.001
618.77	188.60	0.022	0.002	0.035	0.001	0.035	0.001
618.80	188.61	0.022	0.002	0.035	0.001	0.035	0.001
618.83	188.62	0.032	0.003	0.035	0.001	0.035	0.001
618.86	188.63	0.032	0.003	0.035	0.001	0.035	0.001
618.90	188.64	0.032	0.003	0.035	0.001	0.035	0.001
618.93	188.65	0.032	0.003	0.035	0.001	0.035	0.001
618.96	188.66	0.032	0.003	0.035	0.001	0.035	0.001
619.00	188.67	0.032	0.003	0.035	0.001	0.035	0.001
619.03	188.68	0.032	0.003	0.035	0.001	0.035	0.001
619.06	188.69	0.043	0.004	0.035	0.001	0.035	0.001
619.09	188.70	0.043	0.004	0.035	0.001	0.035	0.001
619.13	188.71	0.043	0.004	0.035	0.001	0.035	0.001
619.16	188.72	0.043	0.004	0.035	0.001	0.035	0.001
619.19	188.73	0.043	0.004	0.035	0.001	0.035	0.001
619.23	188.74	0.043	0.004	0.035	0.001	0.035	0.001
619.26	188.75	0.054	0.005	0.035	0.001	0.035	0.001
619.29	188.76	0.054	0.005	0.035	0.001	0.035	0.001
619.32	188.77	0.054	0.005	0.035	0.001	0.035	0.001
619.36	188.78	0.054	0.005	0.035	0.001	0.035	0.001
619.39	188.79	0.054	0.005	0.035	0.001	0.035	0.001
619.42	188.80	0.065	0.006	0.035	0.001	0.035	0.001
619.46	188.81	0.065	0.006	0.035	0.001	0.035	0.001
619.49	188.82	0.065	0.006	0.035	0.001	0.035	0.001
619.52	188.83	0.065	0.006	0.071	0.002	0.071	0.002
619.55	188.84	0.075	0.007	0.071	0.002	0.071	0.002
619.59	188.85	0.075	0.007	0.071	0.002	0.071	0.002
619.62	188.86	0.075	0.007	0.071	0.002	0.071	0.002
619.65	188.87	0.086	0.008	0.071	0.002	0.071	0.002
619.69	188.88	0.086	0.008	0.071	0.002	0.071	0.002
619.72	188.89	0.086	0.008	0.071	0.002	0.071	0.002
619.75	188.90	0.097	0.009	0.071	0.002	0.071	0.002
619.78	188.91	0.097	0.009	0.071	0.002	0.071	0.002
619.82	188.92	0.108	0.010	0.071	0.002	0.071	0.002
619.85	188.93	0.108	0.010	0.071	0.002	0.071	0.002
619.88	188.94	0.118	0.011	0.071	0.002	0.071	0.002
619.91	188.95	0.118	0.011	0.106	0.003	0.106	0.003
619.95	188.96	0.129	0.012	0.106	0.003	0.106	0.003

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
				Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
619.98	188.97	0.129	0.012	0.106	0.003	0.106	0.003
620.01	188.98	0.140	0.013	0.106	0.003	0.106	0.003
620.05	188.99	0.151	0.014	0.106	0.003	0.106	0.003
620.08	189.00	0.151	0.014	0.106	0.003	0.106	0.003
620.11	189.01	0.161	0.015	0.106	0.003	0.106	0.003
620.14	189.02	0.161	0.015	0.106	0.003	0.106	0.003
620.18	189.03	0.172	0.016	0.141	0.004	0.141	0.004
620.21	189.04	0.183	0.017	0.141	0.004	0.141	0.004
620.24	189.05	0.183	0.017	0.141	0.004	0.141	0.004
620.28	189.06	0.194	0.018	0.141	0.004	0.141	0.004
620.31	189.07	0.205	0.019	0.141	0.004	0.141	0.004
620.34	189.08	0.215	0.020	0.177	0.005	0.177	0.005
620.37	189.09	0.215	0.020	0.177	0.005	0.177	0.005
620.41	189.10	0.226	0.021	0.177	0.005	0.177	0.005
620.44	189.11	0.237	0.022	0.177	0.005	0.177	0.005
620.47	189.12	0.237	0.022	0.177	0.005	0.177	0.005
620.51	189.13	0.248	0.023	0.212	0.006	0.212	0.006
620.54	189.14	0.258	0.024	0.212	0.006	0.212	0.006
620.57	189.15	0.269	0.025	0.212	0.006	0.212	0.006
620.60	189.16	0.280	0.026	0.212	0.006	0.212	0.006
620.64	189.17	0.291	0.027	0.247	0.007	0.247	0.007
620.67	189.18	0.301	0.028	0.247	0.007	0.247	0.007
620.70	189.19	0.312	0.029	0.247	0.007	0.247	0.007
620.73	189.20	0.323	0.030	0.247	0.007	0.247	0.007
620.77	189.21	0.334	0.031	0.283	0.008	0.283	0.008
620.80	189.22	0.344	0.032	0.283	0.008	0.283	0.008
620.83	189.23	0.355	0.033	0.283	0.008	0.283	0.008
620.87	189.24	0.366	0.034	0.318	0.009	0.318	0.009
620.90	189.25	0.388	0.036	0.318	0.009	0.318	0.009
620.93	189.26	0.398	0.037	0.318	0.009	0.318	0.009
620.96	189.27	0.409	0.038	0.353	0.010	0.353	0.010
621.00	189.28	0.420	0.039	0.353	0.010	0.353	0.010
621.03	189.29	0.441	0.041	0.388	0.011	0.388	0.011
621.06	189.30	0.452	0.042	0.388	0.011	0.388	0.011
621.10	189.31	0.463	0.043	0.388	0.011	0.388	0.011
621.13	189.32	0.484	0.045	0.424	0.012	0.424	0.012
621.16	189.33	0.495	0.046	0.424	0.012	0.424	0.012
621.19	189.34	0.517	0.048	0.459	0.013	0.459	0.013
621.23	189.35	0.527	0.049	0.459	0.013	0.459	0.013
621.26	189.36	0.538	0.050	0.494	0.014	0.494	0.014
621.29	189.37	0.560	0.052	0.494	0.014	0.494	0.014
621.33	189.38	0.570	0.053	0.530	0.015	0.530	0.015

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
				Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
621.36	189.39	0.581	0.054	0.530	0.015	0.530	0.015
621.39	189.40	0.592	0.055	0.565	0.016	0.565	0.016
621.42	189.41	0.603	0.056	0.565	0.016	0.565	0.016
621.46	189.42	0.624	0.058	0.600	0.017	0.600	0.017
621.49	189.43	0.635	0.059	0.636	0.018	0.636	0.018
621.52	189.44	0.646	0.060	0.636	0.018	0.636	0.018
621.56	189.45	0.657	0.061	0.671	0.019	0.671	0.019
621.59	189.46	0.667	0.062	0.671	0.019	0.671	0.019
621.62	189.47	0.678	0.063	0.706	0.020	0.706	0.020
621.65	189.48	0.689	0.064	0.742	0.021	0.742	0.021
621.69	189.49	0.700	0.065	0.742	0.021	0.742	0.021
621.72	189.50	0.710	0.066	0.777	0.022	0.777	0.022
621.75	189.51	0.721	0.067	0.812	0.023	0.812	0.023
621.78	189.52	0.743	0.069	0.812	0.023	0.812	0.023
621.82	189.53	0.753	0.070	0.848	0.024	0.848	0.024
621.85	189.54	0.764	0.071	0.883	0.025	0.883	0.025
621.88	189.55	0.786	0.073	0.883	0.025	0.883	0.025
621.92	189.56	0.797	0.074	0.918	0.026	0.918	0.026
621.95	189.57	0.807	0.075	0.953	0.027	0.953	0.027
621.98	189.58	0.818	0.076	0.989	0.028	0.989	0.028
622.01	189.59	0.829	0.077	0.989	0.028	0.989	0.028
622.05	189.60	0.840	0.078	1.024	0.029	1.024	0.029
622.08	189.61	0.861	0.080	1.059	0.030	1.059	0.030
622.11	189.62	0.872	0.081	1.095	0.031	1.095	0.031
622.15	189.63	0.883	0.082	1.130	0.032	1.130	0.032
622.18	189.64	0.893	0.083	1.130	0.032	1.130	0.032
622.21	189.65	0.904	0.084	1.165	0.033	1.165	0.033
622.24	189.66	0.915	0.085	1.201	0.034	1.201	0.034
622.28	189.67	0.936	0.087	1.236	0.035	1.236	0.035
622.31	189.68	0.947	0.088	1.271	0.036	1.271	0.036
622.34	189.69	0.958	0.089	1.307	0.037	1.307	0.037
622.38	189.70	0.969	0.090	1.342	0.038	1.342	0.038
622.41	189.71	0.990	0.092	1.377	0.039	1.377	0.039
622.44	189.72	1.001	0.093	1.413	0.040	1.413	0.040
622.47	189.73	1.012	0.094	1.413	0.040	1.413	0.040
622.51	189.74	1.023	0.095	1.448	0.041	1.448	0.041
622.54	189.75	1.033	0.096	1.483	0.042	1.483	0.042
622.57	189.76	1.044	0.097	1.519	0.043	1.519	0.043
622.61	189.77	1.055	0.098	1.554	0.044	1.554	0.044
622.64	189.78	1.066	0.099	1.589	0.045	1.589	0.045
622.67	189.79	1.087	0.101	1.624	0.046	1.624	0.046
622.70	189.80	1.098	0.102	1.660	0.047	1.660	0.047

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
				Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
622.74	189.81	1.109	0.103	1.695	0.048	1.695	0.048
622.77	189.82	1.119	0.104	1.730	0.049	1.730	0.049
622.80	189.83	1.141	0.106	1.766	0.050	1.766	0.050
622.83	189.84	1.152	0.107	1.801	0.051	1.801	0.051
622.87	189.85	1.163	0.108	1.872	0.053	1.872	0.053
622.90	189.86	1.173	0.109	1.907	0.054	1.907	0.054
622.93	189.87	1.195	0.111	1.942	0.055	1.942	0.055
622.97	189.88	1.206	0.112	1.978	0.056	1.978	0.056
623.00	189.89	1.216	0.113	2.013	0.057	2.013	0.057
623.03	189.90	1.238	0.115	2.048	0.058	2.048	0.058
623.06	189.91	1.249	0.116	2.084	0.059	2.084	0.059
623.10	189.92	1.270	0.118	2.119	0.060	2.119	0.060
623.13	189.93	1.281	0.119	2.190	0.062	2.190	0.062
623.16	189.94	1.292	0.120	2.225	0.063	2.225	0.063
623.20	189.95	1.302	0.121	2.260	0.064	2.260	0.064
623.23	189.96	1.324	0.123	2.295	0.065	2.295	0.065
623.26	189.97	1.335	0.124	2.331	0.066	2.331	0.066
623.29	189.98	1.345	0.125	2.401	0.068	2.401	0.068
623.33	189.99	1.367	0.127	2.437	0.069	2.437	0.069
623.36	190.00	1.378	0.128	2.472	0.070	2.472	0.070
623.39	190.01	1.389	0.129	2.543	0.072	2.543	0.072
623.43	190.02	1.399	0.130	2.578	0.073	2.578	0.073
623.46	190.03	1.410	0.131	2.613	0.074	2.613	0.074
623.49	190.04	1.421	0.132	2.649	0.075	2.649	0.075
623.52	190.05	1.442	0.134	2.719	0.077	2.719	0.077
623.56	190.06	1.453	0.135	2.755	0.078	2.755	0.078
623.59	190.07	1.464	0.136	2.790	0.079	2.790	0.079
623.62	190.08	1.475	0.137	2.860	0.081	2.860	0.081
623.65	190.09	1.485	0.138	2.896	0.082	2.896	0.082
623.69	190.10	1.496	0.139	2.966	0.084	2.966	0.084
623.72	190.11	1.507	0.140	3.002	0.085	3.002	0.085
623.75	190.12	1.518	0.141	3.037	0.086	3.037	0.086
623.79	190.13	1.528	0.142	3.108	0.088	3.108	0.088
623.82	190.14	1.539	0.143	3.143	0.089	3.143	0.089
623.85	190.15	1.539	0.143	3.214	0.091	3.214	0.091
623.88	190.16	1.550	0.144	3.249	0.092	3.249	0.092
623.92	190.17	1.572	0.146	3.320	0.094	3.320	0.094
623.95	190.18	1.582	0.147	3.355	0.095	3.355	0.095
623.98	190.19	1.593	0.148	3.390	0.096	3.390	0.096
624.02	190.20	1.604	0.149	3.461	0.098	3.461	0.098
624.05	190.21	1.615	0.150	3.496	0.099	3.496	0.099
624.08	190.22	1.625	0.151	3.567	0.101	3.567	0.101

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
				Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
624.11	190.23	1.636	0.152	3.602	0.102	3.602	0.102
624.15	190.24	1.658	0.154	3.673	0.104	3.673	0.104
624.18	190.25	1.668	0.155	3.743	0.106	3.743	0.106
624.21	190.26	1.679	0.156	3.779	0.107	3.779	0.107
624.25	190.27	1.690	0.157	3.849	0.109	3.849	0.109
624.28	190.28	1.701	0.158	3.885	0.110	3.885	0.110
624.31	190.29	1.711	0.159	3.955	0.112	3.955	0.112
624.34	190.30	1.722	0.160	3.991	0.113	3.991	0.113
624.38	190.31	1.733	0.161	4.061	0.115	4.061	0.115
624.41	190.32	1.744	0.162	4.132	0.117	4.132	0.117
624.44	190.33	1.755	0.163	4.167	0.118	4.167	0.118
624.48	190.34	1.765	0.164	4.238	0.120	4.238	0.120
624.51	190.35	1.776	0.165	4.308	0.122	4.308	0.122
624.54	190.36	1.787	0.166	4.344	0.123	4.344	0.123
624.57	190.37	1.798	0.167	4.414	0.125	4.414	0.125
624.61	190.38	1.808	0.168	4.485	0.127	4.485	0.127
624.64	190.39	1.819	0.169	4.520	0.128	4.520	0.128
624.67	190.40	1.830	0.170	4.591	0.130	4.591	0.130
624.70	190.41	1.841	0.171	4.662	0.132	4.662	0.132
624.74	190.42	1.851	0.172	4.697	0.133	4.697	0.133
624.77	190.43	1.862	0.173	4.767	0.135	4.767	0.135
624.80	190.44	1.873	0.174	4.838	0.137	4.838	0.137
624.84	190.45	1.884	0.175	4.909	0.139	4.909	0.139
624.87	190.46	1.894	0.176	4.944	0.140	4.944	0.140
624.90	190.47	1.905	0.177	5.015	0.142	5.015	0.142
624.93	190.48	1.916	0.178	5.085	0.144	5.085	0.144
624.97	190.49	1.927	0.179	5.156	0.146	5.156	0.146
625.00	190.50	1.938	0.180	5.191	0.147	5.191	0.147
625.03	190.51	1.948	0.181	5.262	0.149	5.262	0.149
625.07	190.52	1.959	0.182	5.333	0.151	5.333	0.151
625.10	190.53	1.970	0.183	5.403	0.153	5.403	0.153
625.13	190.54	1.991	0.185	5.474	0.155	5.474	0.155
625.16	190.55	2.002	0.186	5.544	0.157	5.544	0.157
625.20	190.56	2.013	0.187	5.580	0.158	5.580	0.158
625.23	190.57	2.024	0.188	5.650	0.160	5.650	0.160
625.26	190.58	2.034	0.189	5.721	0.162	5.721	0.162
625.30	190.59	2.056	0.191	5.792	0.164	5.792	0.164
625.33	190.60	2.067	0.192	5.862	0.166	5.862	0.166
625.36	190.61	2.077	0.193	5.933	0.168	5.933	0.168
625.39	190.62	2.099	0.195	6.003	0.170	6.003	0.170
625.43	190.63	2.110	0.196	6.074	0.172	6.074	0.172
625.46	190.64	2.120	0.197	6.145	0.174	6.145	0.174

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
				Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
625.49	190.65	2.142	0.199	6.215	0.176	6.215	0.176
625.52	190.66	2.153	0.200	6.286	0.178	6.286	0.178
625.56	190.67	2.174	0.202	6.357	0.180	6.357	0.180
625.59	190.68	2.196	0.204	6.427	0.182	6.427	0.182
625.62	190.69	2.217	0.206	6.498	0.184	6.498	0.184
625.66	190.70	2.239	0.208	6.569	0.186	6.569	0.186
625.69	190.71	2.260	0.210	6.639	0.188	6.639	0.188
625.72	190.72	2.282	0.212	6.710	0.190	6.710	0.190
625.75	190.73	2.303	0.214	6.780	0.192	6.780	0.192
625.79	190.74	2.336	0.217	6.851	0.194	6.851	0.194
625.82	190.75	2.357	0.219	6.957	0.197	6.957	0.197
625.85	190.76	2.390	0.222	7.028	0.199	7.028	0.199
625.89	190.77	2.411	0.224	7.098	0.201	7.098	0.201
625.92	190.78	2.443	0.227	7.169	0.203	7.169	0.203
625.95	190.79	2.476	0.230	7.275	0.206	7.275	0.206
625.98	190.80	2.497	0.232	7.345	0.208	7.345	0.208
626.02	190.81	2.530	0.235	7.416	0.210	7.416	0.210
626.05	190.82	2.551	0.237	7.522	0.213	7.522	0.213
626.08	190.83	2.573	0.239	7.593	0.215	7.593	0.215
626.12	190.84	2.605	0.242	7.663	0.217	7.663	0.217
626.15	190.85	2.626	0.244	7.769	0.220	7.769	0.220
626.18	190.86	2.648	0.246	7.840	0.222	7.840	0.222
626.21	190.87	2.669	0.248	7.946	0.225	7.946	0.225
626.25	190.88	2.691	0.250	8.016	0.227	8.016	0.227
626.28	190.89	2.713	0.252	8.122	0.230	8.122	0.230
626.31	190.90	2.734	0.254	8.193	0.232	8.193	0.232
626.35	190.91	2.745	0.255	8.299	0.235	8.299	0.235
626.38	190.92	2.766	0.257	8.370	0.237	8.370	0.237
626.41	190.93	2.788	0.259	8.476	0.240	8.476	0.240
626.44	190.94	2.809	0.261	8.546	0.242	8.546	0.242
626.48	190.95	2.820	0.262	8.652	0.245	8.652	0.245
626.51	190.96	2.842	0.264	8.758	0.248	8.758	0.248
626.54	190.97	2.863	0.266	8.829	0.250	8.829	0.250
626.57	190.98	2.885	0.268	8.935	0.253	8.935	0.253
626.61	190.99	2.906	0.270	9.041	0.256	9.041	0.256
626.64	191.00	2.928	0.272	9.111	0.258	9.111	0.258
626.67	191.01	2.939	0.273	9.217	0.261	9.217	0.261
626.71	191.02	2.960	0.275	9.323	0.264	9.323	0.264
626.74	191.03	2.982	0.277	9.429	0.267	9.429	0.267
626.77	191.04	3.014	0.280	9.500	0.269	9.500	0.269
626.80	191.05	3.035	0.282	9.606	0.272	9.606	0.272
626.84	191.06	3.068	0.285	9.712	0.275	9.712	0.275

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
				Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
626.87	191.07	3.100	0.288	9.817	0.278	9.817	0.278
626.90	191.08	3.122	0.290	9.923	0.281	9.923	0.281
626.94	191.09	3.154	0.293	10.029	0.284	10.029	0.284
626.97	191.10	3.186	0.296	10.135	0.287	10.135	0.287
627.00	191.11	3.218	0.299	10.241	0.290	10.241	0.290
627.03	191.12	3.251	0.302	10.347	0.293	10.347	0.293
627.07	191.13	3.283	0.305	10.453	0.296	10.453	0.296
627.10	191.14	3.315	0.308	10.559	0.299	10.559	0.299
627.13	191.15	3.337	0.310	10.665	0.302	10.665	0.302
627.17	191.16	3.369	0.313	10.771	0.305	10.771	0.305
627.20	191.17	3.401	0.316	10.877	0.308	10.877	0.308
627.23	191.18	3.434	0.319	10.983	0.311	10.983	0.311
627.26	191.19	3.466	0.322	11.124	0.315	11.124	0.315
627.30	191.20	3.498	0.325	11.230	0.318	11.230	0.318
627.33	191.21	3.520	0.327	11.336	0.321	11.336	0.321
627.36	191.22	3.552	0.330	11.442	0.324	11.442	0.324
627.40	191.23	3.584	0.333	11.583	0.328	11.583	0.328
627.43	191.24	3.617	0.336	11.689	0.331	11.689	0.331
627.46	191.25	3.638	0.338	11.795	0.334	11.795	0.334
627.49	191.26	3.670	0.341	11.936	0.338	11.936	0.338
627.53	191.27	3.692	0.343	12.042	0.341	12.042	0.341
627.56	191.28	3.714	0.345	12.184	0.345	12.184	0.345
627.59	191.29	3.735	0.347	12.290	0.348	12.290	0.348
627.62	191.30	3.767	0.350	12.431	0.352	12.431	0.352
627.66	191.31	3.789	0.352	12.537	0.355	12.537	0.355
627.69	191.32	3.810	0.354	12.678	0.359	12.678	0.359
627.72	191.33	3.832	0.356	12.784	0.362	12.784	0.362
627.76	191.34	3.853	0.358	12.925	0.366	12.925	0.366
627.79	191.35	3.875	0.360	13.031	0.369	13.031	0.369
627.82	191.36	3.897	0.362	13.172	0.373	13.172	0.373
627.85	191.37	3.918	0.364	13.314	0.377	13.314	0.377
627.89	191.38	3.950	0.367	13.420	0.380	13.420	0.380
627.92	191.39	3.972	0.369	13.561	0.384	13.561	0.384
627.95	191.40	3.993	0.371	13.702	0.388	13.702	0.388
627.99	191.41	4.026	0.374	13.808	0.391	13.808	0.391
628.02	191.42	4.047	0.376	13.949	0.395	13.949	0.395
628.05	191.43	4.069	0.378	14.091	0.399	14.091	0.399
628.08	191.44	4.090	0.380	14.232	0.403	14.232	0.403
628.12	191.45	4.112	0.382	14.338	0.406	14.338	0.406
628.15	191.46	4.133	0.384	14.479	0.410	14.479	0.410
628.18	191.47	4.155	0.386	14.620	0.414	14.620	0.414
628.22	191.48	4.176	0.388	14.762	0.418	14.762	0.418

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
				Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
628.25	191.49	4.198	0.390	14.903	0.422	14.903	0.422
628.28	191.50	4.219	0.392	15.044	0.426	15.044	0.426
628.31	191.51	4.230	0.393	15.185	0.430	15.185	0.430
628.35	191.52	4.252	0.395	15.327	0.434	15.327	0.434
628.38	191.53	4.273	0.397	15.468	0.438	15.468	0.438
628.41	191.54	4.284	0.398	15.609	0.442	15.609	0.442
628.44	191.55	4.306	0.400	15.750	0.446	15.750	0.446
628.48	191.56	4.327	0.402	15.892	0.450	15.892	0.450
628.51	191.57	4.338	0.403	16.033	0.454	16.033	0.454
628.54	191.58	4.359	0.405	16.174	0.458	16.174	0.458
628.58	191.59	4.381	0.407	16.315	0.462	16.315	0.462
628.61	191.60	4.402	0.409	16.457	0.466	16.457	0.466
628.64	191.61	4.424	0.411	16.598	0.470	16.598	0.470
628.67	191.62	4.445	0.413	16.739	0.474	16.739	0.474
628.71	191.63	4.467	0.415	16.880	0.478	16.880	0.478
628.74	191.64	4.489	0.417	17.022	0.482	17.022	0.482
628.77	191.65	4.510	0.419	17.163	0.486	17.163	0.486
628.81	191.66	4.532	0.421	17.340	0.491	17.340	0.491
628.84	191.67	4.553	0.423	17.481	0.495	17.481	0.495
628.87	191.68	4.575	0.425	17.622	0.499	17.622	0.499
628.90	191.69	4.596	0.427	17.763	0.503	17.763	0.503
628.94	191.70	4.618	0.429	17.940	0.508	17.940	0.508
628.97	191.71	4.639	0.431	18.081	0.512	18.081	0.512
629.00	191.72	4.661	0.433	18.222	0.516	18.222	0.516
629.04	191.73	4.672	0.434	18.399	0.521	18.399	0.521
629.07	191.74	4.693	0.436	18.540	0.525	18.540	0.525
629.10	191.75	4.715	0.438	18.681	0.529	18.681	0.529
629.13	191.76	4.736	0.440	18.858	0.534	18.858	0.534
629.17	191.77	4.758	0.442	18.999	0.538	18.999	0.538
629.20	191.78	4.768	0.443	19.176	0.543	19.176	0.543
629.23	191.79	4.790	0.445	19.317	0.547	19.317	0.547
629.27	191.80	4.811	0.447	19.494	0.552	19.494	0.552
629.30	191.81	4.833	0.449	19.635	0.556	19.635	0.556
629.33	191.82	4.855	0.451	19.776	0.560	19.776	0.560
629.36	191.83	4.876	0.453	19.953	0.565	19.953	0.565
629.40	191.84	4.898	0.455	20.129	0.570	20.129	0.570
629.43	191.85	4.919	0.457	20.271	0.574	20.271	0.574
629.46	191.86	4.951	0.460	20.447	0.579	20.447	0.579
629.49	191.87	4.962	0.461	20.588	0.583	20.588	0.583
629.53	191.88	4.984	0.463	20.765	0.588	20.765	0.588
629.56	191.89	5.005	0.465	20.942	0.593	20.942	0.593
629.59	191.90	5.027	0.467	21.083	0.597	21.083	0.597

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
				Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
629.63	191.91	5.059	0.470	21.259	0.602	21.259	0.602
629.66	191.92	5.081	0.472	21.436	0.607	21.436	0.607
629.69	191.93	5.102	0.474	21.577	0.611	21.577	0.611
629.72	191.94	5.124	0.476	21.754	0.616	21.754	0.616
629.76	191.95	5.145	0.478	21.930	0.621	21.930	0.621
629.79	191.96	5.167	0.480	22.107	0.626	22.107	0.626
629.82	191.97	5.188	0.482	22.248	0.630	22.248	0.630
629.86	191.98	5.220	0.485	22.425	0.635	22.425	0.635
629.89	191.99	5.242	0.487	22.601	0.640	22.601	0.640
629.92	192.00	5.264	0.489	22.778	0.645	22.778	0.645
629.95	192.01	5.285	0.491	22.955	0.650	22.955	0.650
629.99	192.02	5.307	0.493	23.131	0.655	23.131	0.655
630.02	192.03	5.339	0.496	23.308	0.660	23.308	0.660
630.05	192.04	5.360	0.498	23.484	0.665	23.484	0.665
630.09	192.05	5.393	0.501	23.661	0.670	23.661	0.670
630.12	192.06	5.414	0.503	23.837	0.675	23.837	0.675
630.15	192.07	5.447	0.506	24.014	0.680	24.014	0.680
630.18	192.08	5.468	0.508	24.191	0.685	24.191	0.685
630.22	192.09	5.500	0.511	24.367	0.690	24.367	0.690
630.25	192.10	5.522	0.513	24.544	0.695	24.544	0.695
630.28	192.11	5.554	0.516	24.720	0.700	24.720	0.700
630.31	192.12	5.586	0.519	24.897	0.705	24.897	0.705
630.35	192.13	5.608	0.521	25.109	0.711	25.109	0.711
630.38	192.14	5.640	0.524	25.285	0.716	25.285	0.716
630.41	192.15	5.673	0.527	25.462	0.721	25.462	0.721
630.45	192.16	5.705	0.530	25.638	0.726	25.638	0.726
630.48	192.17	5.726	0.532	25.850	0.732	25.850	0.732
630.51	192.18	5.759	0.535	26.027	0.737	26.027	0.737
630.54	192.19	5.791	0.538	26.204	0.742	26.204	0.742
630.58	192.20	5.813	0.540	26.415	0.748	26.415	0.748
630.61	192.21	5.845	0.543	26.592	0.753	26.592	0.753
630.64	192.22	5.877	0.546	26.804	0.759	26.804	0.759
630.68	192.23	5.909	0.549	26.980	0.764	26.980	0.764
630.71	192.24	5.942	0.552	27.192	0.770	27.192	0.770
630.74	192.25	5.974	0.555	27.369	0.775	27.369	0.775
630.77	192.26	6.017	0.559	27.581	0.781	27.581	0.781
630.81	192.27	6.049	0.562	27.757	0.786	27.757	0.786
630.84	192.28	6.092	0.566	27.969	0.792	27.969	0.792
630.87	192.29	6.135	0.570	28.181	0.798	28.181	0.798
630.91	192.30	6.178	0.574	28.358	0.803	28.358	0.803
630.94	192.31	6.211	0.577	28.570	0.809	28.570	0.809
630.97	192.32	6.254	0.581	28.781	0.815	28.781	0.815

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
				Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
631.00	192.33	6.286	0.584	28.993	0.821	28.993	0.821
631.04	192.34	6.329	0.588	29.205	0.827	29.205	0.827
631.07	192.35	6.361	0.591	29.417	0.833	29.417	0.833
631.10	192.36	6.405	0.595	29.594	0.838	29.594	0.838
631.14	192.37	6.448	0.599	29.806	0.844	29.806	0.844
631.17	192.38	6.480	0.602	30.017	0.850	30.017	0.850
631.20	192.39	6.523	0.606	30.229	0.856	30.229	0.856
631.23	192.40	6.577	0.611	30.477	0.863	30.477	0.863
631.27	192.41	6.620	0.615	30.688	0.869	30.688	0.869
631.30	192.42	6.663	0.619	30.900	0.875	30.900	0.875
631.33	192.43	6.706	0.623	31.112	0.881	31.112	0.881
631.36	192.44	6.749	0.627	31.324	0.887	31.324	0.887
631.40	192.45	6.792	0.631	31.571	0.894	31.571	0.894
631.43	192.46	6.835	0.635	31.783	0.900	31.783	0.900
631.46	192.47	6.867	0.638	31.995	0.906	31.995	0.906
631.50	192.48	6.910	0.642	32.242	0.913	32.242	0.913
631.53	192.49	6.953	0.646	32.454	0.919	32.454	0.919
631.56	192.50	6.986	0.649	32.701	0.926	32.701	0.926
631.59	192.51	7.029	0.653	32.913	0.932	32.913	0.932
631.63	192.52	7.061	0.656	33.161	0.939	33.161	0.939
631.66	192.53	7.104	0.660	33.372	0.945	33.372	0.945
631.69	192.54	7.136	0.663	33.620	0.952	33.620	0.952
631.73	192.55	7.180	0.667	33.867	0.959	33.867	0.959
631.76	192.56	7.212	0.670	34.079	0.965	34.079	0.965
631.79	192.57	7.244	0.673	34.326	0.972	34.326	0.972
631.82	192.58	7.287	0.677	34.573	0.979	34.573	0.979
631.86	192.59	7.319	0.680	34.785	0.985	34.785	0.985
631.89	192.60	7.363	0.684	35.032	0.992	35.032	0.992
631.92	192.61	7.406	0.688	35.279	0.999	35.279	0.999
631.96	192.62	7.438	0.691	35.527	1.006	35.527	1.006
631.99	192.63	7.481	0.695	35.774	1.013	35.774	1.013
632.02	192.64	7.513	0.698	36.021	1.020	36.021	1.020
632.05	192.65	7.545	0.701	36.268	1.027	36.268	1.027
632.09	192.66	7.578	0.704	36.515	1.034	36.515	1.034
632.12	192.67	7.610	0.707	36.763	1.041	36.763	1.041
632.15	192.68	7.642	0.710	37.010	1.048	37.010	1.048
632.19	192.69	7.675	0.713	37.257	1.055	37.257	1.055
632.22	192.70	7.707	0.716	37.504	1.062	37.504	1.062
632.25	192.71	7.739	0.719	37.787	1.070	37.787	1.070
632.28	192.72	7.772	0.722	38.034	1.077	38.034	1.077
632.32	192.73	7.815	0.726	38.281	1.084	38.281	1.084
632.35	192.74	7.847	0.729	38.528	1.091	38.528	1.091

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
				Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
632.38	192.75	7.879	0.732	38.811	1.099	38.811	1.099
632.41	192.76	7.911	0.735	39.058	1.106	39.058	1.106
632.45	192.77	7.944	0.738	39.305	1.113	39.305	1.113
632.48	192.78	7.987	0.742	39.588	1.121	39.588	1.121
632.51	192.79	8.019	0.745	39.835	1.128	39.835	1.128
632.55	192.80	8.051	0.748	40.117	1.136	40.117	1.136
632.58	192.81	8.094	0.752	40.365	1.143	40.365	1.143
632.61	192.82	8.127	0.755	40.647	1.151	40.647	1.151
632.64	192.83	8.159	0.758	40.894	1.158	40.894	1.158
632.68	192.84	8.191	0.761	41.177	1.166	41.177	1.166
632.71	192.85	8.224	0.764	41.424	1.173	41.424	1.173
632.74	192.86	8.267	0.768	41.707	1.181	41.707	1.181
632.78	192.87	8.299	0.771	41.989	1.189	41.989	1.189
632.81	192.88	8.331	0.774	42.236	1.196	42.236	1.196
632.84	192.89	8.364	0.777	42.519	1.204	42.519	1.204
632.87	192.90	8.396	0.780	42.801	1.212	42.801	1.212
632.91	192.91	8.428	0.783	43.084	1.220	43.084	1.220
632.94	192.92	8.460	0.786	43.366	1.228	43.366	1.228
632.97	192.93	8.503	0.790	43.649	1.236	43.649	1.236
633.01	192.94	8.536	0.793	43.896	1.243	43.896	1.243
633.04	192.95	8.568	0.796	44.179	1.251	44.179	1.251
633.07	192.96	8.600	0.799	44.461	1.259	44.461	1.259
633.10	192.97	8.643	0.803	44.744	1.267	44.744	1.267
633.14	192.98	8.676	0.806	45.026	1.275	45.026	1.275
633.17	192.99	8.708	0.809	45.309	1.283	45.309	1.283
633.20	193.00	8.751	0.813	45.627	1.292	45.627	1.292
633.23	193.01	8.783	0.816	45.909	1.300	45.909	1.300
633.27	193.02	8.816	0.819	46.192	1.308	46.192	1.308
633.30	193.03	8.859	0.823	46.474	1.316	46.474	1.316
633.33	193.04	8.891	0.826	46.757	1.324	46.757	1.324
633.37	193.05	8.923	0.829	47.074	1.333	47.074	1.333
633.40	193.06	8.966	0.833	47.357	1.341	47.357	1.341
633.43	193.07	8.999	0.836	47.640	1.349	47.640	1.349
633.46	193.08	9.031	0.839	47.957	1.358	47.957	1.358
633.50	193.09	9.074	0.843	48.240	1.366	48.240	1.366
633.53	193.10	9.106	0.846	48.558	1.375	48.558	1.375
633.56	193.11	9.139	0.849	48.840	1.383	48.840	1.383
633.60	193.12	9.171	0.852	49.158	1.392	49.158	1.392
633.63	193.13	9.214	0.856	49.441	1.400	49.441	1.400
633.66	193.14	9.246	0.859	49.758	1.409	49.758	1.409
633.69	193.15	9.278	0.862	50.041	1.417	50.041	1.417
633.73	193.16	9.322	0.866	50.359	1.426	50.359	1.426

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)		
				Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)	
633.76	193.17	9.354	0.869	50.677	1.435	50.677	1.435	
633.79	193.18	9.386	0.872	50.959	1.443	50.959	1.443	
633.83	193.19	9.429	0.876	51.277	1.452	51.277	1.452	
633.86	193.20	9.461	0.879	51.595	1.461	51.595	1.461	
633.89	193.21	9.494	0.882	51.913	1.470	51.913	1.470	
633.92	193.22	9.537	0.886	52.195	1.478	52.195	1.478	
633.96	193.23	9.569	0.889	52.513	1.487	52.513	1.487	
633.99	193.24	9.612	0.893	52.831	1.496	52.831	1.496	
634.02	193.25	9.644	0.896	53.149	1.505	53.149	1.505	
634.06	193.26	9.688	0.900	53.466	1.514	53.466	1.514	
634.09	193.27	9.720	0.903	53.784	1.523	53.784	1.523	
634.12	193.28	9.763	0.907	54.102	1.532	54.102	1.532	
634.15	193.29	9.806	0.911	54.420	1.541	54.420	1.541	
634.19	193.30	9.838	0.914	54.738	1.550	54.738	1.550	
634.22	193.31	9.881	0.918	55.091	1.560	55.091	1.560	
634.25	193.32	9.924	0.922	55.409	1.569	55.409	1.569	
634.28	193.33	9.957	0.925	55.727	1.578	55.727	1.578	
634.32	193.34	10.000	0.929	56.044	1.587	56.044	1.587	
634.35	193.35	10.043	0.933	56.398	1.597	56.398	1.597	
634.38	193.36	10.086	0.937	56.715	1.606	56.715	1.606	
634.42	193.37	10.140	0.942	57.033	1.615	57.033	1.615	
634.45	193.38	10.183	0.946	57.386	1.625	57.386	1.625	
634.48	193.39	10.226	0.950	57.704	1.634	57.704	1.634	
634.51	193.40	10.269	0.954	58.057	1.644	58.057	1.644	
634.55	193.41	10.312	0.958	58.375	1.653	58.375	1.653	
634.58	193.42	10.355	0.962	58.728	1.663	58.728	1.663	
634.61	193.43	10.398	0.966	59.081	1.673	59.081	1.673	
634.65	193.44	10.452	0.971	59.399	1.682	59.399	1.682	
634.68	193.45	10.495	0.975	59.752	1.692	59.752	1.692	
634.71	193.46	10.538	0.979	60.106	1.702	60.106	1.702	
634.74	193.47	10.581	0.983	60.459	1.712	60.459	1.712	
634.78	193.48	10.624	0.987	60.777	1.721	60.777	1.721	
634.81	193.49	10.678	0.992	61.130	1.731	61.130	1.731	**OSL**
634.84	193.50	10.721	0.996	61.483	1.741	61.483	1.741	
634.88	193.51	10.764	1.000	61.836	1.751	61.836	1.751	
634.91	193.52	10.807	1.004	62.189	1.761	62.189	1.761	
634.94	193.53	10.861	1.009	62.542	1.771	62.542	1.771	
634.97	193.54	10.904	1.013	62.895	1.781	62.895	1.781	
635.01	193.55	10.947	1.017	63.284	1.792	63.284	1.792	
635.04	193.56	11.001	1.022	63.637	1.802	63.637	1.802	
635.07	193.57	11.055	1.027	63.990	1.812	63.990	1.812	
635.11	193.58	11.098	1.031	64.343	1.822	64.343	1.822	

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
				Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
635.14	193.59	11.151	1.036	64.732	1.833	64.732	1.833
635.17	193.60	11.194	1.040	65.085	1.843	65.085	1.843
635.20	193.61	11.248	1.045	65.438	1.853	65.438	1.853
635.24	193.62	11.302	1.050	65.827	1.864	65.827	1.864
635.27	193.63	11.356	1.055	66.180	1.874	66.180	1.874
635.30	193.64	11.399	1.059	66.568	1.885	66.568	1.885
635.33	193.65	11.453	1.064	66.957	1.896	66.957	1.896
635.37	193.66	11.507	1.069	67.310	1.906	67.310	1.906
635.40	193.67	11.560	1.074	67.698	1.917	67.698	1.917
635.43	193.68	11.614	1.079	68.087	1.928	68.087	1.928
635.47	193.69	11.668	1.084	68.475	1.939	68.475	1.939
635.50	193.70	11.722	1.089	68.828	1.949	68.828	1.949
635.53	193.71	11.776	1.094	69.217	1.960	69.217	1.960
635.56	193.72	11.830	1.099	69.605	1.971	69.605	1.971
635.60	193.73	11.894	1.105	69.994	1.982	69.994	1.982
635.63	193.74	11.948	1.110	70.382	1.993	70.382	1.993
635.66	193.75	12.002	1.115	70.806	2.005	70.806	2.005
635.70	193.76	12.056	1.120	71.194	2.016	71.194	2.016
635.73	193.77	12.109	1.125	71.583	2.027	71.583	2.027
635.76	193.78	12.163	1.130	71.971	2.038	71.971	2.038
635.79	193.79	12.217	1.135	72.395	2.050	72.395	2.050
635.83	193.80	12.282	1.141	72.784	2.061	72.784	2.061
635.86	193.81	12.335	1.146	73.172	2.072	73.172	2.072
635.89	193.82	12.389	1.151	73.596	2.084	73.596	2.084
635.93	193.83	12.443	1.156	73.984	2.095	73.984	2.095
635.96	193.84	12.508	1.162	74.408	2.107	74.408	2.107
635.99	193.85	12.561	1.167	74.832	2.119	74.832	2.119
636.02	193.86	12.626	1.173	75.220	2.130	75.220	2.130
636.06	193.87	12.680	1.178	75.644	2.142	75.644	2.142
636.09	193.88	12.734	1.183	76.068	2.154	76.068	2.154
636.12	193.89	12.788	1.188	76.492	2.166	76.492	2.166
636.15	193.90	12.852	1.194	76.915	2.178	76.915	2.178
636.19	193.91	12.906	1.199	77.339	2.190	77.339	2.190
636.22	193.92	12.960	1.204	77.763	2.202	77.763	2.202
636.25	193.93	13.014	1.209	78.187	2.214	78.187	2.214
636.29	193.94	13.078	1.215	78.611	2.226	78.611	2.226
636.32	193.95	13.132	1.220	79.034	2.238	79.034	2.238
636.35	193.96	13.186	1.225	79.458	2.250	79.458	2.250
636.38	193.97	13.240	1.230	79.917	2.263	79.917	2.263
636.42	193.98	13.293	1.235	80.341	2.275	80.341	2.275
636.45	193.99	13.347	1.240	80.765	2.287	80.765	2.287
636.48	194.00	13.412	1.246	81.224	2.300	81.224	2.300

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
				Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
636.52	194.01	13.466	1.251	81.648	2.312	81.648	2.312
636.55	194.02	13.519	1.256	82.107	2.325	82.107	2.325
636.58	194.03	13.573	1.261	82.530	2.337	82.530	2.337
636.61	194.04	13.627	1.266	82.990	2.350	82.990	2.350
636.65	194.05	13.692	1.272	83.449	2.363	83.449	2.363
636.68	194.06	13.746	1.277	83.872	2.375	83.872	2.375
636.71	194.07	13.789	1.281	84.332	2.388	84.332	2.388
636.75	194.08	13.842	1.286	84.791	2.401	84.791	2.401
636.78	194.09	13.896	1.291	85.250	2.414	85.250	2.414
636.81	194.10	13.950	1.296	85.709	2.427	85.709	2.427
636.84	194.11	14.004	1.301	86.168	2.440	86.168	2.440
636.88	194.12	14.058	1.306	86.627	2.453	86.627	2.453
636.91	194.13	14.101	1.310	87.086	2.466	87.086	2.466
636.94	194.14	14.155	1.315	87.545	2.479	87.545	2.479
636.98	194.15	14.208	1.320	88.004	2.492	88.004	2.492
637.01	194.16	14.251	1.324	88.463	2.505	88.463	2.505
637.04	194.17	14.305	1.329	88.958	2.519	88.958	2.519
637.07	194.18	14.348	1.333	89.417	2.532	89.417	2.532
637.11	194.19	14.391	1.337	89.876	2.545	89.876	2.545
637.14	194.20	14.445	1.342	90.370	2.559	90.370	2.559
637.17	194.21	14.488	1.346	90.829	2.572	90.829	2.572
637.20	194.22	14.531	1.350	91.324	2.586	91.324	2.586
637.24	194.23	14.585	1.355	91.783	2.599	91.783	2.599
637.27	194.24	14.628	1.359	92.277	2.613	92.277	2.613
637.30	194.25	14.660	1.362	92.736	2.626	92.736	2.626
637.34	194.26	14.703	1.366	93.231	2.640	93.231	2.640
637.37	194.27	14.747	1.370	93.725	2.654	93.725	2.654
637.40	194.28	14.790	1.374	94.184	2.667	94.184	2.667
637.43	194.29	14.833	1.378	94.679	2.681	94.679	2.681
637.47	194.30	14.876	1.382	95.173	2.695	95.173	2.695
637.50	194.31	14.919	1.386	95.668	2.709	95.668	2.709
637.53	194.32	14.962	1.390	96.162	2.723	96.162	2.723
637.57	194.33	15.005	1.394	96.656	2.737	96.656	2.737
637.60	194.34	15.048	1.398	97.151	2.751	97.151	2.751
637.63	194.35	15.080	1.401	97.645	2.765	97.645	2.765
637.66	194.36	15.123	1.405	98.140	2.779	98.140	2.779
637.70	194.37	15.166	1.409	98.634	2.793	98.634	2.793
637.73	194.38	15.209	1.413	99.128	2.807	99.128	2.807
637.76	194.39	15.242	1.416	99.623	2.821	99.623	2.821
637.80	194.40	15.285	1.420	100.117	2.835	100.117	2.835
637.83	194.41	15.328	1.424	100.612	2.849	100.612	2.849
637.86	194.42	15.371	1.428	101.141	2.864	101.141	2.864

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
				Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
637.89	194.43	15.403	1.431	101.636	2.878	101.636	2.878
637.93	194.44	15.446	1.435	102.130	2.892	102.130	2.892
637.96	194.45	15.478	1.438	102.660	2.907	102.660	2.907
637.99	194.46	15.522	1.442	103.154	2.921	103.154	2.921
638.02	194.47	15.565	1.446	103.649	2.935	103.649	2.935
638.06	194.48	15.597	1.449	104.178	2.950	104.178	2.950
638.09	194.49	15.640	1.453	104.673	2.964	104.673	2.964
638.12	194.50	15.683	1.457	105.202	2.979	105.202	2.979
638.16	194.51	15.715	1.460	105.732	2.994	105.732	2.994
638.19	194.52	15.758	1.464	106.227	3.008	106.227	3.008
638.22	194.53	15.801	1.468	106.756	3.023	106.756	3.023
638.25	194.54	15.834	1.471	107.251	3.037	107.251	3.037
638.29	194.55	15.877	1.475	107.780	3.052	107.780	3.052
638.32	194.56	15.909	1.478	108.310	3.067	108.310	3.067
638.35	194.57	15.952	1.482	108.840	3.082	108.840	3.082
638.39	194.58	15.995	1.486	109.370	3.097	109.370	3.097
638.42	194.59	16.027	1.489	109.864	3.111	109.864	3.111
638.45	194.60	16.071	1.493	110.394	3.126	110.394	3.126
638.48	194.61	16.103	1.496	110.923	3.141	110.923	3.141
638.52	194.62	16.146	1.500	111.453	3.156	111.453	3.156
638.55	194.63	16.189	1.504	111.983	3.171	111.983	3.171
638.58	194.64	16.221	1.507	112.513	3.186	112.513	3.186
638.62	194.65	16.264	1.511	113.042	3.201	113.042	3.201
638.65	194.66	16.297	1.514	113.607	3.217	113.607	3.217
638.68	194.67	16.340	1.518	114.137	3.232	114.137	3.232
638.71	194.68	16.383	1.522	114.667	3.247	114.667	3.247
638.75	194.69	16.415	1.525	115.197	3.262	115.197	3.262
638.78	194.70	16.458	1.529	115.726	3.277	115.726	3.277
638.81	194.71	16.490	1.532	116.291	3.293	116.291	3.293
638.85	194.72	16.533	1.536	116.821	3.308	116.821	3.308
638.88	194.73	16.576	1.540	117.386	3.324	117.386	3.324
638.91	194.74	16.619	1.544	117.916	3.339	117.916	3.339
638.94	194.75	16.652	1.547	118.446	3.354	118.446	3.354
638.98	194.76	16.695	1.551	119.011	3.370	119.011	3.370
639.01	194.77	16.738	1.555	119.540	3.385	119.540	3.385
639.04	194.78	16.770	1.558	120.105	3.401	120.105	3.401
639.07	194.79	16.813	1.562	120.670	3.417	120.670	3.417
639.11	194.80	16.856	1.566	121.200	3.432	121.200	3.432
639.14	194.81	16.899	1.570	121.765	3.448	121.765	3.448
639.17	194.82	16.932	1.573	122.330	3.464	122.330	3.464
639.21	194.83	16.975	1.577	122.860	3.479	122.860	3.479
639.24	194.84	17.018	1.581	123.425	3.495	123.425	3.495

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
				Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
639.27	194.85	17.050	1.584	123.990	3.511	123.990	3.511
639.30	194.86	17.093	1.588	124.555	3.527	124.555	3.527
639.34	194.87	17.136	1.592	125.120	3.543	125.120	3.543
639.37	194.88	17.168	1.595	125.685	3.559	125.685	3.559
639.40	194.89	17.211	1.599	126.250	3.575	126.250	3.575
639.44	194.90	17.255	1.603	126.815	3.591	126.815	3.591
639.47	194.91	17.287	1.606	127.380	3.607	127.380	3.607
639.50	194.92	17.330	1.610	127.945	3.623	127.945	3.623
639.53	194.93	17.373	1.614	128.510	3.639	128.510	3.639
639.57	194.94	17.405	1.617	129.075	3.655	129.075	3.655
639.60	194.95	17.448	1.621	129.640	3.671	129.640	3.671
639.63	194.96	17.491	1.625	130.205	3.687	130.205	3.687
639.67	194.97	17.534	1.629	130.806	3.704	130.806	3.704
639.70	194.98	17.577	1.633	131.371	3.720	131.371	3.720
639.73	194.99	17.621	1.637	131.936	3.736	131.936	3.736
639.76	195.00	17.664	1.641	132.536	3.753	132.536	3.753
639.80	195.01	17.707	1.645	133.101	3.769	133.101	3.769
639.83	195.02	17.739	1.648	133.701	3.786	133.701	3.786
639.86	195.03	17.782	1.652	134.266	3.802	134.266	3.802
639.90	195.04	17.825	1.656	134.867	3.819	134.867	3.819
639.93	195.05	17.868	1.660	135.432	3.835	135.432	3.835
639.96	195.06	17.911	1.664	136.032	3.852	136.032	3.852
639.99	195.07	17.954	1.668	136.633	3.869	136.633	3.869
640.03	195.08	17.986	1.671	137.198	3.885	137.198	3.885
640.06	195.09	18.030	1.675	137.798	3.902	137.798	3.902
640.09	195.10	18.073	1.679	138.398	3.919	138.398	3.919
640.12	195.11	18.116	1.683	138.999	3.936	138.999	3.936
640.16	195.12	18.148	1.686	139.564	3.952	139.564	3.952
640.19	195.13	18.191	1.690	140.164	3.969	140.164	3.969
640.22	195.14	18.234	1.694	140.764	3.986	140.764	3.986
640.26	195.15	18.266	1.697	141.365	4.003	141.365	4.003
640.29	195.16	18.309	1.701	141.965	4.020	141.965	4.020
640.32	195.17	18.352	1.705	142.565	4.037	142.565	4.037
640.35	195.18	18.385	1.708	143.166	4.054	143.166	4.054
640.39	195.19	18.428	1.712	143.766	4.071	143.766	4.071
640.42	195.20	18.471	1.716	144.366	4.088	144.366	4.088
640.45	195.21	18.503	1.719	145.002	4.106	145.002	4.106
640.49	195.22	18.546	1.723	145.603	4.123	145.603	4.123
640.52	195.23	18.589	1.727	146.203	4.140	146.203	4.140
640.55	195.24	18.632	1.731	146.803	4.157	146.803	4.157
640.58	195.25	18.675	1.735	147.439	4.175	147.439	4.175
640.62	195.26	18.708	1.738	148.039	4.192	148.039	4.192

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
				Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
640.65	195.27	18.751	1.742	148.675	4.210	148.675	4.210
640.68	195.28	18.794	1.746	149.275	4.227	149.275	4.227
640.72	195.29	18.837	1.750	149.876	4.244	149.876	4.244
640.75	195.30	18.880	1.754	150.511	4.262	150.511	4.262
640.78	195.31	18.923	1.758	151.147	4.280	151.147	4.280
640.81	195.32	18.966	1.762	151.747	4.297	151.747	4.297
640.85	195.33	19.009	1.766	152.383	4.315	152.383	4.315
640.88	195.34	19.052	1.770	152.983	4.332	152.983	4.332
640.91	195.35	19.095	1.774	153.619	4.350	153.619	4.350
640.94	195.36	19.138	1.778	154.255	4.368	154.255	4.368
640.98	195.37	19.171	1.781	154.890	4.386	154.890	4.386
641.01	195.38	19.214	1.785	155.526	4.404	155.526	4.404
641.04	195.39	19.257	1.789	156.126	4.421	156.126	4.421
641.08	195.40	19.300	1.793	156.762	4.439	156.762	4.439
641.11	195.41	19.343	1.797	157.398	4.457	157.398	4.457
641.14	195.42	19.386	1.801	158.033	4.475	158.033	4.475
641.17	195.43	19.429	1.805	158.669	4.493	158.669	4.493
641.21	195.44	19.472	1.809	159.305	4.511	159.305	4.511
641.24	195.45	19.515	1.813	159.940	4.529	159.940	4.529
641.27	195.46	19.558	1.817	160.611	4.548	160.611	4.548
641.31	195.47	19.601	1.821	161.247	4.566	161.247	4.566
641.34	195.48	19.644	1.825	161.883	4.584	161.883	4.584
641.37	195.49	19.687	1.829	162.518	4.602	162.518	4.602
641.40	195.50	19.730	1.833	163.189	4.621	163.189	4.621
641.44	195.51	19.773	1.837	163.825	4.639	163.825	4.639
641.47	195.52	19.816	1.841	164.461	4.657	164.461	4.657
641.50	195.53	19.859	1.845	165.132	4.676	165.132	4.676
641.54	195.54	19.902	1.849	165.767	4.694	165.767	4.694
641.57	195.55	19.946	1.853	166.438	4.713	166.438	4.713
641.60	195.56	19.989	1.857	167.074	4.731	167.074	4.731
641.63	195.57	20.032	1.861	167.745	4.750	167.745	4.750
641.67	195.58	20.064	1.864	168.416	4.769	168.416	4.769
641.70	195.59	20.107	1.868	169.051	4.787	169.051	4.787
641.73	195.60	20.150	1.872	169.722	4.806	169.722	4.806
641.77	195.61	20.193	1.876	170.393	4.825	170.393	4.825
641.80	195.62	20.236	1.880	171.029	4.843	171.029	4.843
641.83	195.63	20.279	1.884	171.700	4.862	171.700	4.862
641.86	195.64	20.322	1.888	172.371	4.881	172.371	4.881
641.90	195.65	20.365	1.892	173.042	4.900	173.042	4.900
641.93	195.66	20.408	1.896	173.713	4.919	173.713	4.919
641.96	195.67	20.451	1.900	174.384	4.938	174.384	4.938
641.99	195.68	20.494	1.904	175.055	4.957	175.055	4.957

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
				Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
642.03	195.69	20.538	1.908	175.726	4.976	175.726	4.976
642.06	195.70	20.581	1.912	176.397	4.995	176.397	4.995
642.09	195.71	20.624	1.916	177.068	5.014	177.068	5.014
642.13	195.72	20.667	1.920	177.739	5.033	177.739	5.033
642.16	195.73	20.710	1.924	178.445	5.053	178.445	5.053
642.19	195.74	20.753	1.928	179.116	5.072	179.116	5.072
642.22	195.75	20.796	1.932	179.787	5.091	179.787	5.091
642.26	195.76	20.839	1.936	180.493	5.111	180.493	5.111
642.29	195.77	20.882	1.940	181.164	5.130	181.164	5.130
642.32	195.78	20.925	1.944	181.835	5.149	181.835	5.149
642.36	195.79	20.968	1.948	182.542	5.169	182.542	5.169
642.39	195.80	21.011	1.952	183.213	5.188	183.213	5.188
642.42	195.81	21.054	1.956	183.919	5.208	183.919	5.208
642.45	195.82	21.097	1.960	184.590	5.227	184.590	5.227
642.49	195.83	21.140	1.964	185.296	5.247	185.296	5.247
642.52	195.84	21.183	1.968	186.003	5.267	186.003	5.267
642.55	195.85	21.226	1.972	186.674	5.286	186.674	5.286
642.59	195.86	21.269	1.976	187.380	5.306	187.380	5.306
642.62	195.87	21.313	1.980	188.086	5.326	188.086	5.326
642.65	195.88	21.356	1.984	188.792	5.346	188.792	5.346
642.68	195.89	21.399	1.988	189.499	5.366	189.499	5.366
642.72	195.90	21.442	1.992	190.205	5.386	190.205	5.386
642.75	195.91	21.485	1.996	190.876	5.405	190.876	5.405
642.78	195.92	21.528	2.000	191.582	5.425	191.582	5.425
642.81	195.93	21.571	2.004	192.324	5.446	192.324	5.446
642.85	195.94	21.625	2.009	193.030	5.466	193.030	5.466
642.88	195.95	21.668	2.013	193.736	5.486	193.736	5.486
642.91	195.96	21.711	2.017	194.443	5.506	194.443	5.506
642.95	195.97	21.754	2.021	195.149	5.526	195.149	5.526
642.98	195.98	21.797	2.025	195.855	5.546	195.855	5.546
643.01	195.99	21.851	2.030	196.597	5.567	196.597	5.567
643.04	196.00	21.894	2.034	197.303	5.587	197.303	5.587
643.08	196.01	21.937	2.038	198.010	5.607	198.010	5.607
643.11	196.02	21.980	2.042	198.751	5.628	198.751	5.628
643.14	196.03	22.023	2.046	199.457	5.648	199.457	5.648
643.18	196.04	22.066	2.050	200.199	5.669	200.199	5.669
643.21	196.05	22.120	2.055	200.905	5.689	200.905	5.689
643.24	196.06	22.163	2.059	201.647	5.710	201.647	5.710
643.27	196.07	22.206	2.063	202.353	5.730	202.353	5.730
643.31	196.08	22.249	2.067	203.095	5.751	203.095	5.751
643.34	196.09	22.292	2.071	203.836	5.772	203.836	5.772
643.37	196.10	22.335	2.075	204.543	5.792	204.543	5.792

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
				Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
643.41	196.11	22.378	2.079	205.284	5.813	205.284	5.813
643.44	196.12	22.432	2.084	206.026	5.834	206.026	5.834
643.47	196.13	22.475	2.088	206.768	5.855	206.768	5.855
643.50	196.14	22.518	2.092	207.509	5.876	207.509	5.876
643.54	196.15	22.561	2.096	208.251	5.897	208.251	5.897
643.57	196.16	22.604	2.100	208.992	5.918	208.992	5.918
643.60	196.17	22.658	2.105	209.734	5.939	209.734	5.939
643.64	196.18	22.701	2.109	210.476	5.960	210.476	5.960
643.67	196.19	22.744	2.113	211.217	5.981	211.217	5.981
643.70	196.20	22.787	2.117	211.959	6.002	211.959	6.002
643.73	196.21	22.830	2.121	212.700	6.023	212.700	6.023
643.77	196.22	22.884	2.126	213.442	6.044	213.442	6.044
643.80	196.23	22.927	2.130	214.219	6.066	214.219	6.066
643.83	196.24	22.970	2.134	214.961	6.087	214.961	6.087
643.86	196.25	23.013	2.138	215.702	6.108	215.702	6.108
643.90	196.26	23.067	2.143	216.479	6.130	216.479	6.130
643.93	196.27	23.110	2.147	217.221	6.151	217.221	6.151
643.96	196.28	23.153	2.151	217.998	6.173	217.998	6.173
644.00	196.29	23.196	2.155	218.739	6.194	218.739	6.194
644.03	196.30	23.250	2.160	219.516	6.216	219.516	6.216
644.06	196.31	23.293	2.164	220.258	6.237	220.258	6.237
644.09	196.32	23.347	2.169	221.035	6.259	221.035	6.259
644.13	196.33	23.390	2.173	221.812	6.281	221.812	6.281
644.16	196.34	23.444	2.178	222.553	6.302	222.553	6.302
644.19	196.35	23.487	2.182	223.330	6.324	223.330	6.324
644.23	196.36	23.541	2.187	224.107	6.346	224.107	6.346
644.26	196.37	23.594	2.192	224.884	6.368	224.884	6.368
644.29	196.38	23.638	2.196	225.661	6.390	225.661	6.390
644.32	196.39	23.691	2.201	226.438	6.412	226.438	6.412
644.36	196.40	23.745	2.206	227.215	6.434	227.215	6.434
644.39	196.41	23.799	2.211	227.992	6.456	227.992	6.456
644.42	196.42	23.842	2.215	228.769	6.478	228.769	6.478
644.46	196.43	23.896	2.220	229.546	6.500	229.546	6.500
644.49	196.44	23.950	2.225	230.358	6.523	230.358	6.523
644.52	196.45	23.993	2.229	231.135	6.545	231.135	6.545
644.55	196.46	24.047	2.234	231.912	6.567	231.912	6.567
644.59	196.47	24.100	2.239	232.724	6.590	232.724	6.590
644.62	196.48	24.143	2.243	233.501	6.612	233.501	6.612
644.65	196.49	24.197	2.248	234.278	6.634	234.278	6.634
644.69	196.50	24.251	2.253	235.090	6.657	235.090	6.657
644.72	196.51	24.294	2.257	235.867	6.679	235.867	6.679
644.75	196.52	24.348	2.262	236.679	6.702	236.679	6.702

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
				Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
644.78	196.53	24.402	2.267	237.491	6.725	237.491	6.725
644.82	196.54	24.445	2.271	238.268	6.747	238.268	6.747
644.85	196.55	24.499	2.276	239.081	6.770	239.081	6.770
644.88	196.56	24.542	2.280	239.893	6.793	239.893	6.793
644.91	196.57	24.585	2.284	240.705	6.816	240.705	6.816
644.95	196.58	24.639	2.289	241.517	6.839	241.517	6.839
644.98	196.59	24.682	2.293	242.329	6.862	242.329	6.862
645.01	196.60	24.735	2.298	243.106	6.884	243.106	6.884
645.05	196.61	24.778	2.302	243.919	6.907	243.919	6.907
645.08	196.62	24.832	2.307	244.766	6.931	244.766	6.931
645.11	196.63	24.875	2.311	245.578	6.954	245.578	6.954
645.14	196.64	24.918	2.315	246.391	6.977	246.391	6.977
645.18	196.65	24.972	2.320	247.203	7.000	247.203	7.000
645.21	196.66	25.015	2.324	248.015	7.023	248.015	7.023
645.24	196.67	25.069	2.329	248.827	7.046	248.827	7.046
645.28	196.68	25.112	2.333	249.675	7.070	249.675	7.070
645.31	196.69	25.166	2.338	250.487	7.093	250.487	7.093
645.34	196.70	25.209	2.342	251.299	7.116	251.299	7.116
645.37	196.71	25.263	2.347	252.147	7.140	252.147	7.140
645.41	196.72	25.317	2.352	252.959	7.163	252.959	7.163
645.44	196.73	25.360	2.356	253.807	7.187	253.807	7.187
645.47	196.74	25.414	2.361	254.654	7.211	254.654	7.211
645.51	196.75	25.457	2.365	255.467	7.234	255.467	7.234
645.54	196.76	25.510	2.370	256.314	7.258	256.314	7.258
645.57	196.77	25.553	2.374	257.162	7.282	257.162	7.282
645.60	196.78	25.597	2.378	257.974	7.305	257.974	7.305
645.64	196.79	25.650	2.383	258.821	7.329	258.821	7.329
645.67	196.80	25.693	2.387	259.669	7.353	259.669	7.353
645.70	196.81	25.747	2.392	260.517	7.377	260.517	7.377
645.73	196.82	25.790	2.396	261.364	7.401	261.364	7.401
645.77	196.83	25.844	2.401	262.212	7.425	262.212	7.425
645.80	196.84	25.887	2.405	263.059	7.449	263.059	7.449
645.83	196.85	25.941	2.410	263.907	7.473	263.907	7.473
645.87	196.86	25.984	2.414	264.754	7.497	264.754	7.497
645.90	196.87	26.038	2.419	265.602	7.521	265.602	7.521
645.93	196.88	26.081	2.423	266.449	7.545	266.449	7.545
645.96	196.89	26.135	2.428	267.332	7.570	267.332	7.570
646.00	196.90	26.178	2.432	268.180	7.594	268.180	7.594
646.03	196.91	26.232	2.437	269.027	7.618	269.027	7.618
646.06	196.92	26.275	2.441	269.910	7.643	269.910	7.643
646.10	196.93	26.328	2.446	270.758	7.667	270.758	7.667
646.13	196.94	26.382	2.451	271.641	7.692	271.641	7.692

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
				Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
646.16	196.95	26.425	2.455	272.488	7.716	272.488	7.716
646.19	196.96	26.479	2.460	273.371	7.741	273.371	7.741
646.23	196.97	26.533	2.465	274.219	7.765	274.219	7.765
646.26	196.98	26.576	2.469	275.102	7.790	275.102	7.790
646.29	196.99	26.630	2.474	275.984	7.815	275.984	7.815
646.33	197.00	26.673	2.478	276.832	7.839	276.832	7.839
646.36	197.01	26.727	2.483	277.715	7.864	277.715	7.864
646.39	197.02	26.781	2.488	278.598	7.889	278.598	7.889
646.42	197.03	26.824	2.492	279.481	7.914	279.481	7.914
646.46	197.04	26.877	2.497	280.363	7.939	280.363	7.939
646.49	197.05	26.921	2.501	281.246	7.964	281.246	7.964
646.52	197.06	26.974	2.506	282.129	7.989	282.129	7.989
646.56	197.07	27.017	2.510	283.012	8.014	283.012	8.014
646.59	197.08	27.071	2.515	283.895	8.039	283.895	8.039
646.62	197.09	27.114	2.519	284.778	8.064	284.778	8.064
646.65	197.10	27.168	2.524	285.696	8.090	285.696	8.090
646.69	197.11	27.211	2.528	286.579	8.115	286.579	8.115
646.72	197.12	27.254	2.532	287.462	8.140	287.462	8.140
646.75	197.13	27.308	2.537	288.345	8.165	288.345	8.165
646.78	197.14	27.351	2.541	289.263	8.191	289.263	8.191
646.82	197.15	27.405	2.546	290.146	8.216	290.146	8.216
646.85	197.16	27.448	2.550	291.064	8.242	291.064	8.242
646.88	197.17	27.491	2.554	291.947	8.267	291.947	8.267
646.92	197.18	27.545	2.559	292.865	8.293	292.865	8.293
646.95	197.19	27.588	2.563	293.748	8.318	293.748	8.318
646.98	197.20	27.631	2.567	294.666	8.344	294.666	8.344
647.01	197.21	27.674	2.571	295.584	8.370	295.584	8.370
647.05	197.22	27.728	2.576	296.502	8.396	296.502	8.396
647.08	197.23	27.771	2.580	297.385	8.421	297.385	8.421
647.11	197.24	27.814	2.584	298.303	8.447	298.303	8.447
647.15	197.25	27.868	2.589	299.221	8.473	299.221	8.473
647.18	197.26	27.911	2.593	300.140	8.499	300.140	8.499
647.21	197.27	27.965	2.598	301.058	8.525	301.058	8.525
647.24	197.28	28.008	2.602	301.976	8.551	301.976	8.551
647.28	197.29	28.051	2.606	302.894	8.577	302.894	8.577
647.31	197.30	28.105	2.611	303.812	8.603	303.812	8.603
647.34	197.31	28.148	2.615	304.731	8.629	304.731	8.629
647.38	197.32	28.201	2.620	305.649	8.655	305.649	8.655
647.41	197.33	28.244	2.624	306.602	8.682	306.602	8.682
647.44	197.34	28.298	2.629	307.520	8.708	307.520	8.708
647.47	197.35	28.341	2.633	308.439	8.734	308.439	8.734
647.51	197.36	28.395	2.638	309.357	8.760	309.357	8.760

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
				Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
647.54	197.37	28.438	2.642	310.310	8.787	310.310	8.787
647.57	197.38	28.492	2.647	311.228	8.813	311.228	8.813
647.61	197.39	28.546	2.652	312.182	8.840	312.182	8.840
647.64	197.40	28.589	2.656	313.100	8.866	313.100	8.866
647.67	197.41	28.643	2.661	314.054	8.893	314.054	8.893
647.70	197.42	28.686	2.665	315.007	8.920	315.007	8.920
647.74	197.43	28.740	2.670	315.925	8.946	315.925	8.946
647.77	197.44	28.783	2.674	316.879	8.973	316.879	8.973
647.80	197.45	28.836	2.679	317.832	9.000	317.832	9.000
647.83	197.46	28.890	2.684	318.786	9.027	318.786	9.027
647.87	197.47	28.933	2.688	319.704	9.053	319.704	9.053
647.90	197.48	28.987	2.693	320.657	9.080	320.657	9.080
647.93	197.49	29.030	2.697	321.611	9.107	321.611	9.107
647.97	197.50	29.084	2.702	322.564	9.134	322.564	9.134
648.00	197.51	29.127	2.706	323.518	9.161	323.518	9.161
648.03	197.52	29.181	2.711	324.471	9.188	324.471	9.188
648.06	197.53	29.235	2.716	325.460	9.216	325.460	9.216
648.10	197.54	29.278	2.720	326.414	9.243	326.414	9.243
648.13	197.55	29.332	2.725	327.367	9.270	327.367	9.270
648.16	197.56	29.375	2.729	328.321	9.297	328.321	9.297
648.20	197.57	29.429	2.734	329.310	9.325	329.310	9.325
648.23	197.58	29.482	2.739	330.263	9.352	330.263	9.352
648.26	197.59	29.525	2.743	331.217	9.379	331.217	9.379
648.29	197.60	29.579	2.748	332.205	9.407	332.205	9.407
648.33	197.61	29.633	2.753	333.159	9.434	333.159	9.434
648.36	197.62	29.687	2.758	334.148	9.462	334.148	9.462
648.39	197.63	29.741	2.763	335.101	9.489	335.101	9.489
648.43	197.64	29.784	2.767	336.090	9.517	336.090	9.517
648.46	197.65	29.838	2.772	337.079	9.545	337.079	9.545
648.49	197.66	29.891	2.777	338.032	9.572	338.032	9.572
648.52	197.67	29.945	2.782	339.021	9.600	339.021	9.600
648.56	197.68	29.999	2.787	340.010	9.628	340.010	9.628
648.59	197.69	30.053	2.792	340.999	9.656	340.999	9.656
648.62	197.70	30.107	2.797	341.988	9.684	341.988	9.684
648.65	197.71	30.160	2.802	342.976	9.712	342.976	9.712
648.69	197.72	30.214	2.807	343.965	9.740	343.965	9.740
648.72	197.73	30.268	2.812	344.954	9.768	344.954	9.768
648.75	197.74	30.322	2.817	345.943	9.796	345.943	9.796
648.79	197.75	30.376	2.822	346.932	9.824	346.932	9.824
648.82	197.76	30.430	2.827	347.956	9.853	347.956	9.853
648.85	197.77	30.483	2.832	348.945	9.881	348.945	9.881
648.88	197.78	30.537	2.837	349.933	9.909	349.933	9.909

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
				Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
648.92	197.79	30.591	2.842	350.957	9.938	350.957	9.938
648.95	197.80	30.645	2.847	351.946	9.966	351.946	9.966
648.98	197.81	30.699	2.852	352.970	9.995	352.970	9.995
649.02	197.82	30.752	2.857	353.959	10.023	353.959	10.023
649.05	197.83	30.806	2.862	354.983	10.052	354.983	10.052
649.08	197.84	30.860	2.867	355.972	10.080	355.972	10.080
649.11	197.85	30.903	2.871	356.996	10.109	356.996	10.109
649.15	197.86	30.957	2.876	358.020	10.138	358.020	10.138
649.18	197.87	31.011	2.881	359.045	10.167	359.045	10.167
649.21	197.88	31.075	2.887	360.069	10.196	360.069	10.196
649.25	197.89	31.129	2.892	361.057	10.224	361.057	10.224
649.28	197.90	31.183	2.897	362.082	10.253	362.082	10.253
649.31	197.91	31.237	2.902	363.106	10.282	363.106	10.282
649.34	197.92	31.291	2.907	364.130	10.311	364.130	10.311
649.38	197.93	31.344	2.912	365.154	10.340	365.154	10.340
649.41	197.94	31.398	2.917	366.213	10.370	366.213	10.370
649.44	197.95	31.452	2.922	367.238	10.399	367.238	10.399
649.48	197.96	31.517	2.928	368.262	10.428	368.262	10.428
649.51	197.97	31.571	2.933	369.286	10.457	369.286	10.457
649.54	197.98	31.624	2.938	370.345	10.487	370.345	10.487
649.57	197.99	31.678	2.943	371.369	10.516	371.369	10.516
649.61	198.00	31.732	2.948	372.429	10.546	372.429	10.546
649.64	198.01	31.786	2.953	373.453	10.575	373.453	10.575
649.67	198.02	31.840	2.958	374.512	10.605	374.512	10.605
649.70	198.03	31.893	2.963	375.537	10.634	375.537	10.634
649.74	198.04	31.947	2.968	376.596	10.664	376.596	10.664
649.77	198.05	32.012	2.974	377.655	10.694	377.655	10.694
649.80	198.06	32.066	2.979	378.680	10.723	378.680	10.723
649.84	198.07	32.119	2.984	379.739	10.753	379.739	10.753
649.87	198.08	32.173	2.989	380.798	10.783	380.798	10.783
649.90	198.09	32.227	2.994	381.858	10.813	381.858	10.813
649.93	198.10	32.281	2.999	382.917	10.843	382.917	10.843
649.97	198.11	32.335	3.004	383.977	10.873	383.977	10.873
650.00	198.12	32.399	3.010	385.036	10.903	385.036	10.903
650.03	198.13	32.453	3.015	386.096	10.933	386.096	10.933
650.07	198.14	32.507	3.020	387.155	10.963	387.155	10.963
650.10	198.15	32.561	3.025	388.250	10.994	388.250	10.994
650.13	198.16	32.615	3.030	389.309	11.024	389.309	11.024
650.16	198.17	32.679	3.036	390.369	11.054	390.369	11.054
650.20	198.18	32.733	3.041	391.463	11.085	391.463	11.085
650.23	198.19	32.798	3.047	392.523	11.115	392.523	11.115
650.26	198.20	32.851	3.052	393.582	11.145	393.582	11.145

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
				Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
650.30	198.21	32.916	3.058	394.677	11.176	394.677	11.176
650.33	198.22	32.970	3.063	395.772	11.207	395.772	11.207
650.36	198.23	33.034	3.069	396.831	11.237	396.831	11.237
650.39	198.24	33.088	3.074	397.926	11.268	397.926	11.268
650.43	198.25	33.153	3.080	399.021	11.299	399.021	11.299
650.46	198.26	33.207	3.085	400.116	11.330	400.116	11.330
650.49	198.27	33.260	3.090	401.175	11.360	401.175	11.360
650.52	198.28	33.325	3.096	402.270	11.391	402.270	11.391
650.56	198.29	33.379	3.101	403.365	11.422	403.365	11.422
650.59	198.30	33.443	3.107	404.459	11.453	404.459	11.453
650.62	198.31	33.497	3.112	405.554	11.484	405.554	11.484
650.66	198.32	33.562	3.118	406.684	11.516	406.684	11.516
650.69	198.33	33.616	3.123	407.779	11.547	407.779	11.547
650.72	198.34	33.669	3.128	408.874	11.578	408.874	11.578
650.75	198.35	33.734	3.134	409.968	11.609	409.968	11.609
650.79	198.36	33.788	3.139	411.098	11.641	411.098	11.641
650.82	198.37	33.842	3.144	412.193	11.672	412.193	11.672
650.85	198.38	33.906	3.150	413.323	11.704	413.323	11.704
650.89	198.39	33.960	3.155	414.418	11.735	414.418	11.735
650.92	198.40	34.014	3.160	415.548	11.767	415.548	11.767
650.95	198.41	34.068	3.165	416.643	11.798	416.643	11.798
650.98	198.42	34.132	3.171	417.773	11.830	417.773	11.830
651.02	198.43	34.186	3.176	418.903	11.862	418.903	11.862
651.05	198.44	34.240	3.181	420.033	11.894	420.033	11.894
651.08	198.45	34.305	3.187	421.128	11.925	421.128	11.925
651.12	198.46	34.369	3.193	422.258	11.957	422.258	11.957
651.15	198.47	34.423	3.198	423.388	11.989	423.388	11.989
651.18	198.48	34.477	3.203	424.518	12.021	424.518	12.021
651.21	198.49	34.531	3.208	425.648	12.053	425.648	12.053
651.25	198.50	34.595	3.214	426.778	12.085	426.778	12.085
651.28	198.51	34.649	3.219	427.944	12.118	427.944	12.118
651.31	198.52	34.703	3.224	429.074	12.150	429.074	12.150
651.35	198.53	34.767	3.230	430.204	12.182	430.204	12.182
651.38	198.54	34.821	3.235	431.334	12.214	431.334	12.214
651.41	198.55	34.875	3.240	432.499	12.247	432.499	12.247
651.44	198.56	34.940	3.246	433.629	12.279	433.629	12.279
651.48	198.57	34.993	3.251	434.795	12.312	434.795	12.312
651.51	198.58	35.047	3.256	435.925	12.344	435.925	12.344
651.54	198.59	35.101	3.261	437.090	12.377	437.090	12.377
651.57	198.60	35.155	3.266	438.220	12.409	438.220	12.409
651.61	198.61	35.209	3.271	439.385	12.442	439.385	12.442
651.64	198.62	35.273	3.277	440.551	12.475	440.551	12.475

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
				Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
651.67	198.63	35.327	3.282	441.716	12.508	441.716	12.508
651.71	198.64	35.381	3.287	442.882	12.541	442.882	12.541
651.74	198.65	35.435	3.292	444.012	12.573	444.012	12.573
651.77	198.66	35.489	3.297	445.177	12.606	445.177	12.606
651.80	198.67	35.542	3.302	446.342	12.639	446.342	12.639
651.84	198.68	35.596	3.307	447.508	12.672	447.508	12.672
651.87	198.69	35.650	3.312	448.673	12.705	448.673	12.705
651.90	198.70	35.704	3.317	449.874	12.739	449.874	12.739
651.94	198.71	35.758	3.322	451.039	12.772	451.039	12.772
651.97	198.72	35.811	3.327	452.205	12.805	452.205	12.805
652.00	198.73	35.865	3.332	453.370	12.838	453.370	12.838
652.03	198.74	35.919	3.337	454.571	12.872	454.571	12.872
652.07	198.75	35.973	3.342	455.736	12.905	455.736	12.905
652.10	198.76	36.027	3.347	456.937	12.939	456.937	12.939
652.13	198.77	36.081	3.352	458.102	12.972	458.102	12.972
652.17	198.78	36.134	3.357	459.303	13.006	459.303	13.006
652.20	198.79	36.188	3.362	460.468	13.039	460.468	13.039
652.23	198.80	36.242	3.367	461.669	13.073	461.669	13.073
652.26	198.81	36.296	3.372	462.870	13.107	462.870	13.107
652.30	198.82	36.350	3.377	464.035	13.140	464.035	13.140
652.33	198.83	36.404	3.382	465.236	13.174	465.236	13.174
652.36	198.84	36.457	3.387	466.437	13.208	466.437	13.208
652.40	198.85	36.511	3.392	467.637	13.242	467.637	13.242
652.43	198.86	36.565	3.397	468.838	13.276	468.838	13.276
652.46	198.87	36.619	3.402	470.039	13.310	470.039	13.310
652.49	198.88	36.673	3.407	471.239	13.344	471.239	13.344
652.53	198.89	36.737	3.413	472.440	13.378	472.440	13.378
652.56	198.90	36.791	3.418	473.641	13.412	473.641	13.412
652.59	198.91	36.845	3.423	474.841	13.446	474.841	13.446
652.62	198.92	36.899	3.428	476.077	13.481	476.077	13.481
652.66	198.93	36.952	3.433	477.278	13.515	477.278	13.515
652.69	198.94	37.006	3.438	478.479	13.549	478.479	13.549
652.72	198.95	37.071	3.444	479.715	13.584	479.715	13.584
652.76	198.96	37.125	3.449	480.916	13.618	480.916	13.618
652.79	198.97	37.179	3.454	482.152	13.653	482.152	13.653
652.82	198.98	37.243	3.460	483.352	13.687	483.352	13.687
652.85	198.99	37.297	3.465	484.588	13.722	484.588	13.722
652.89	199.00	37.361	3.471	485.789	13.756	485.789	13.756
652.92	199.01	37.415	3.476	487.025	13.791	487.025	13.791
652.95	199.02	37.480	3.482	488.261	13.826	488.261	13.826
652.99	199.03	37.534	3.487	489.497	13.861	489.497	13.861
653.02	199.04	37.598	3.493	490.733	13.896	490.733	13.896

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
				Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
653.05	199.05	37.663	3.499	491.969	13.931	491.969	13.931
653.08	199.06	37.717	3.504	493.205	13.966	493.205	13.966
653.12	199.07	37.781	3.510	494.441	14.001	494.441	14.001
653.15	199.08	37.846	3.516	495.677	14.036	495.677	14.036
653.18	199.09	37.900	3.521	496.913	14.071	496.913	14.071
653.22	199.10	37.964	3.527	498.149	14.106	498.149	14.106
653.25	199.11	38.018	3.532	499.420	14.142	499.420	14.142
653.28	199.12	38.083	3.538	500.657	14.177	500.657	14.177
653.31	199.13	38.136	3.543	501.893	14.212	501.893	14.212
653.35	199.14	38.201	3.549	503.164	14.248	503.164	14.248
653.38	199.15	38.255	3.554	504.400	14.283	504.400	14.283
653.41	199.16	38.319	3.560	505.671	14.319	505.671	14.319
653.44	199.17	38.384	3.566	506.943	14.355	506.943	14.355
653.48	199.18	38.438	3.571	508.179	14.390	508.179	14.390
653.51	199.19	38.502	3.577	509.450	14.426	509.450	14.426
653.54	199.20	38.567	3.583	510.721	14.462	510.721	14.462
653.58	199.21	38.632	3.589	511.993	14.498	511.993	14.498
653.61	199.22	38.685	3.594	513.264	14.534	513.264	14.534
653.64	199.23	38.750	3.600	514.535	14.570	514.535	14.570
653.67	199.24	38.815	3.606	515.807	14.606	515.807	14.606
653.71	199.25	38.879	3.612	517.078	14.642	517.078	14.642
653.74	199.26	38.933	3.617	518.349	14.678	518.349	14.678
653.77	199.27	38.998	3.623	519.620	14.714	519.620	14.714
653.81	199.28	39.062	3.629	520.892	14.750	520.892	14.750
653.84	199.29	39.127	3.635	522.198	14.787	522.198	14.787
653.87	199.30	39.181	3.640	523.470	14.823	523.470	14.823
653.90	199.31	39.245	3.646	524.741	14.859	524.741	14.859
653.94	199.32	39.310	3.652	526.048	14.896	526.048	14.896
653.97	199.33	39.364	3.657	527.319	14.932	527.319	14.932
654.00	199.34	39.428	3.663	528.626	14.969	528.626	14.969
654.04	199.35	39.482	3.668	529.932	15.006	529.932	15.006
654.07	199.36	39.547	3.674	531.204	15.042	531.204	15.042
654.10	199.37	39.611	3.680	532.510	15.079	532.510	15.079
654.13	199.38	39.665	3.685	533.817	15.116	533.817	15.116
654.17	199.39	39.730	3.691	535.124	15.153	535.124	15.153
654.20	199.40	39.794	3.697	536.430	15.190	536.430	15.190
654.23	199.41	39.848	3.702	537.737	15.227	537.737	15.227
654.27	199.42	39.913	3.708	539.044	15.264	539.044	15.264
654.30	199.43	39.977	3.714	540.350	15.301	540.350	15.301
654.33	199.44	40.031	3.719	541.657	15.338	541.657	15.338
654.36	199.45	40.096	3.725	542.964	15.375	542.964	15.375
654.40	199.46	40.160	3.731	544.305	15.413	544.305	15.413

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
				Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
654.43	199.47	40.225	3.737	545.612	15.450	545.612	15.450
654.46	199.48	40.289	3.743	546.919	15.487	546.919	15.487
654.49	199.49	40.343	3.748	548.261	15.525	548.261	15.525
654.53	199.50	40.408	3.754	549.567	15.562	549.567	15.562
654.56	199.51	40.472	3.760	550.909	15.600	550.909	15.600
654.59	199.52	40.526	3.765	552.251	15.638	552.251	15.638
654.63	199.53	40.591	3.771	553.558	15.675	553.558	15.675
654.66	199.54	40.655	3.777	554.900	15.713	554.900	15.713
654.69	199.55	40.709	3.782	556.242	15.751	556.242	15.751
654.72	199.56	40.774	3.788	557.584	15.789	557.584	15.789
654.76	199.57	40.838	3.794	558.926	15.827	558.926	15.827
654.79	199.58	40.892	3.799	560.232	15.864	560.232	15.864
654.82	199.59	40.957	3.805	561.610	15.903	561.610	15.903
654.86	199.60	41.010	3.810	562.952	15.941	562.952	15.941
654.89	199.61	41.075	3.816	564.294	15.979	564.294	15.979
654.92	199.62	41.129	3.821	565.636	16.017	565.636	16.017
654.95	199.63	41.193	3.827	566.978	16.055	566.978	16.055
654.99	199.64	41.247	3.832	568.319	16.093	568.319	16.093
655.02	199.65	41.301	3.837	569.697	16.132	569.697	16.132
655.05	199.66	41.366	3.843	571.039	16.170	571.039	16.170
655.09	199.67	41.419	3.848	572.416	16.209	572.416	16.209
655.12	199.68	41.473	3.853	573.758	16.247	573.758	16.247
655.15	199.69	41.527	3.858	575.135	16.286	575.135	16.286
655.18	199.70	41.581	3.863	576.477	16.324	576.477	16.324
655.22	199.71	41.635	3.868	577.854	16.363	577.854	16.363
655.25	199.72	41.678	3.872	579.232	16.402	579.232	16.402
655.28	199.73	41.732	3.877	580.574	16.440	580.574	16.440
655.31	199.74	41.785	3.882	581.951	16.479	581.951	16.479
655.35	199.75	41.839	3.887	583.328	16.518	583.328	16.518
655.38	199.76	41.893	3.892	584.705	16.557	584.705	16.557
655.41	199.77	41.947	3.897	586.083	16.596	586.083	16.596
655.45	199.78	42.001	3.902	587.460	16.635	587.460	16.635
655.48	199.79	42.055	3.907	588.837	16.674	588.837	16.674
655.51	199.80	42.108	3.912	590.215	16.713	590.215	16.713
655.54	199.81	42.162	3.917	591.592	16.752	591.592	16.752
655.58	199.82	42.205	3.921	592.969	16.791	592.969	16.791
655.61	199.83	42.259	3.926	594.382	16.831	594.382	16.831
655.64	199.84	42.313	3.931	595.759	16.870	595.759	16.870
655.68	199.85	42.367	3.936	597.136	16.909	597.136	16.909
655.71	199.86	42.421	3.941	598.549	16.949	598.549	16.949
655.74	199.87	42.485	3.947	599.926	16.988	599.926	16.988
655.77	199.88	42.539	3.952	601.339	17.028	601.339	17.028

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
				Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
655.81	199.89	42.593	3.957	602.716	17.067	602.716	17.067
655.84	199.90	42.647	3.962	604.129	17.107	604.129	17.107
655.87	199.91	42.711	3.968	605.506	17.146	605.506	17.146
655.91	199.92	42.765	3.973	606.918	17.186	606.918	17.186
655.94	199.93	42.819	3.978	608.331	17.226	608.331	17.226
655.97	199.94	42.873	3.983	609.744	17.266	609.744	17.266
656.00	199.95	42.926	3.988	611.121	17.305	611.121	17.305
656.04	199.96	42.980	3.993	612.533	17.345	612.533	17.345
656.07	199.97	43.045	3.999	613.946	17.385	613.946	17.385
656.10	199.98	43.099	4.004	615.359	17.425	615.359	17.425
656.14	199.99	43.152	4.009	616.771	17.465	616.771	17.465
656.17	200.00	43.206	4.014	618.184	17.505	618.184	17.505
656.20	200.01	43.260	4.019	619.632	17.546	619.632	17.546
656.23	200.02	43.314	4.024	621.044	17.586	621.044	17.586
656.27	200.03	43.368	4.029	622.457	17.626	622.457	17.626
656.30	200.04	43.432	4.035	623.869	17.666	623.869	17.666
656.33	200.05	43.486	4.040	625.317	17.707	625.317	17.707
656.36	200.06	43.540	4.045	626.730	17.747	626.730	17.747
656.40	200.07	43.594	4.050	628.178	17.788	628.178	17.788
656.43	200.08	43.648	4.055	629.590	17.828	629.590	17.828
656.46	200.09	43.701	4.060	631.038	17.869	631.038	17.869
656.50	200.10	43.755	4.065	632.451	17.909	632.451	17.909
656.53	200.11	43.809	4.070	633.899	17.950	633.899	17.950
656.56	200.12	43.874	4.076	635.347	17.991	635.347	17.991
656.59	200.13	43.927	4.081	636.795	18.032	636.795	18.032
656.63	200.14	43.981	4.086	638.207	18.072	638.207	18.072
656.66	200.15	44.035	4.091	639.655	18.113	639.655	18.113
656.69	200.16	44.100	4.097	641.103	18.154	641.103	18.154
656.73	200.17	44.154	4.102	642.551	18.195	642.551	18.195
656.76	200.18	44.207	4.107	643.999	18.236	643.999	18.236
656.79	200.19	44.272	4.113	645.447	18.277	645.447	18.277
656.82	200.20	44.326	4.118	646.930	18.319	646.930	18.319
656.86	200.21	44.390	4.124	648.378	18.360	648.378	18.360
656.89	200.22	44.444	4.129	649.826	18.401	649.826	18.401
656.92	200.23	44.509	4.135	651.274	18.442	651.274	18.442
656.96	200.24	44.563	4.140	652.757	18.484	652.757	18.484
656.99	200.25	44.627	4.146	654.205	18.525	654.205	18.525
657.02	200.26	44.692	4.152	655.688	18.567	655.688	18.567
657.05	200.27	44.746	4.157	657.136	18.608	657.136	18.608
657.09	200.28	44.810	4.163	658.619	18.650	658.619	18.650
657.12	200.29	44.875	4.169	660.067	18.691	660.067	18.691
657.15	200.30	44.939	4.175	661.550	18.733	661.550	18.733

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
				Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
657.19	200.31	45.004	4.181	663.033	18.775	663.033	18.775
657.22	200.32	45.068	4.187	664.517	18.817	664.517	18.817
657.25	200.33	45.133	4.193	666.000	18.859	666.000	18.859
657.28	200.34	45.198	4.199	667.483	18.901	667.483	18.901
657.32	200.35	45.262	4.205	668.966	18.943	668.966	18.943
657.35	200.36	45.327	4.211	670.450	18.985	670.450	18.985
657.38	200.37	45.391	4.217	671.933	19.027	671.933	19.027
657.41	200.38	45.456	4.223	673.416	19.069	673.416	19.069
657.45	200.39	45.521	4.229	674.899	19.111	674.899	19.111
657.48	200.40	45.585	4.235	676.418	19.154	676.418	19.154
657.51	200.41	45.639	4.240	677.901	19.196	677.901	19.196
657.55	200.42	45.704	4.246	679.420	19.239	679.420	19.239
657.58	200.43	45.768	4.252	680.903	19.281	680.903	19.281
657.61	200.44	45.833	4.258	682.421	19.324	682.421	19.324
657.64	200.45	45.908	4.265	683.904	19.366	683.904	19.366
657.68	200.46	45.973	4.271	685.423	19.409	685.423	19.409
657.71	200.47	46.037	4.277	686.942	19.452	686.942	19.452
657.74	200.48	46.102	4.283	688.425	19.494	688.425	19.494
657.78	200.49	46.177	4.290	689.943	19.537	689.943	19.537
657.81	200.50	46.242	4.296	691.462	19.580	691.462	19.580
657.84	200.51	46.317	4.303	692.980	19.623	692.980	19.623
657.87	200.52	46.382	4.309	694.499	19.666	694.499	19.666
657.91	200.53	46.457	4.316	696.017	19.709	696.017	19.709
657.94	200.54	46.532	4.323	697.571	19.753	697.571	19.753
657.97	200.55	46.597	4.329	699.090	19.796	699.090	19.796
658.01	200.56	46.672	4.336	700.608	19.839	700.608	19.839
658.04	200.57	46.748	4.343	702.162	19.883	702.162	19.883
658.07	200.58	46.834	4.351	703.681	19.926	703.681	19.926
658.10	200.59	46.909	4.358	705.235	19.970	705.235	19.970
658.14	200.60	46.995	4.366	706.753	20.013	706.753	20.013
658.17	200.61	47.081	4.374	708.307	20.057	708.307	20.057
658.20	200.62	47.167	4.382	709.861	20.101	709.861	20.101
658.23	200.63	47.254	4.390	711.415	20.145	711.415	20.145
658.27	200.64	47.340	4.398	712.933	20.188	712.933	20.188
658.30	200.65	47.426	4.406	714.487	20.232	714.487	20.232
658.33	200.66	47.523	4.415	716.076	20.277	716.076	20.277
658.37	200.67	47.619	4.424	717.630	20.321	717.630	20.321
658.40	200.68	47.706	4.432	719.184	20.365	719.184	20.365
658.43	200.69	47.802	4.441	720.738	20.409	720.738	20.409
658.46	200.70	47.889	4.449	722.327	20.454	722.327	20.454
658.50	200.71	47.975	4.457	723.881	20.498	723.881	20.498
658.53	200.72	48.072	4.466	725.470	20.543	725.470	20.543

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
				Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
658.56	200.73	48.158	4.474	727.059	20.588	727.059	20.588
658.60	200.74	48.244	4.482	728.648	20.633	728.648	20.633
658.63	200.75	48.341	4.491	730.202	20.677	730.202	20.677
658.66	200.76	48.427	4.499	731.791	20.722	731.791	20.722
658.69	200.77	48.513	4.507	733.380	20.767	733.380	20.767
658.73	200.78	48.610	4.516	734.970	20.812	734.970	20.812
658.76	200.79	48.696	4.524	736.594	20.858	736.594	20.858
658.79	200.80	48.782	4.532	738.183	20.903	738.183	20.903
658.83	200.81	48.879	4.541	739.772	20.948	739.772	20.948
658.86	200.82	48.965	4.549	741.397	20.994	741.397	20.994
658.89	200.83	49.051	4.557	742.986	21.039	742.986	21.039
658.92	200.84	49.137	4.565	744.610	21.085	744.610	21.085
658.96	200.85	49.223	4.573	746.235	21.131	746.235	21.131
658.99	200.86	49.309	4.581	747.824	21.176	747.824	21.176
659.02	200.87	49.396	4.589	749.449	21.222	749.449	21.222
659.06	200.88	49.482	4.597	751.073	21.268	751.073	21.268
659.09	200.89	49.568	4.605	752.698	21.314	752.698	21.314
659.12	200.90	49.654	4.613	754.322	21.360	754.322	21.360
659.15	200.91	49.740	4.621	755.946	21.406	755.946	21.406
659.19	200.92	49.815	4.628	757.606	21.453	757.606	21.453
659.22	200.93	49.891	4.635	759.231	21.499	759.231	21.499
659.25	200.94	49.977	4.643	760.855	21.545	760.855	21.545
659.28	200.95	50.052	4.650	762.515	21.592	762.515	21.592
659.32	200.96	50.127	4.657	764.139	21.638	764.139	21.638
659.35	200.97	50.203	4.664	765.799	21.685	765.799	21.685
659.38	200.98	50.278	4.671	767.459	21.732	767.459	21.732
659.42	200.99	50.354	4.678	769.084	21.778	769.084	21.778
659.45	201.00	50.418	4.684	770.743	21.825	770.743	21.825
659.48	201.01	50.493	4.691	772.403	21.872	772.403	21.872
659.51	201.02	50.558	4.697	774.063	21.919	774.063	21.919
659.55	201.03	50.633	4.704	775.723	21.966	775.723	21.966
659.58	201.04	50.698	4.710	777.382	22.013	777.382	22.013
659.61	201.05	50.763	4.716	779.042	22.060	779.042	22.060
659.65	201.06	50.838	4.723	780.702	22.107	780.702	22.107
659.68	201.07	50.902	4.729	782.397	22.155	782.397	22.155
659.71	201.08	50.967	4.735	784.057	22.202	784.057	22.202
659.74	201.09	51.042	4.742	785.717	22.249	785.717	22.249
659.78	201.10	51.107	4.748	787.412	22.297	787.412	22.297
659.81	201.11	51.172	4.754	789.072	22.344	789.072	22.344
659.84	201.12	51.247	4.761	790.767	22.392	790.767	22.392
659.88	201.13	51.312	4.767	792.462	22.440	792.462	22.440
659.91	201.14	51.376	4.773	794.122	22.487	794.122	22.487

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
				Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
659.94	201.15	51.441	4.779	795.817	22.535	795.817	22.535
659.97	201.16	51.516	4.786	797.512	22.583	797.512	22.583
660.01	201.17	51.581	4.792	799.207	22.631	799.207	22.631
660.04	201.18	51.645	4.798	800.902	22.679	800.902	22.679
660.07	201.19	51.710	4.804	802.597	22.727	802.597	22.727
660.11	201.20	51.785	4.811	804.292	22.775	804.292	22.775
660.14	201.21	51.850	4.817	805.987	22.823	805.987	22.823
660.17	201.22	51.914	4.823	807.683	22.871	807.683	22.871
660.20	201.23	51.990	4.830	809.378	22.919	809.378	22.919
660.24	201.24	52.054	4.836	811.108	22.968	811.108	22.968
660.27	201.25	52.119	4.842	812.803	23.016	812.803	23.016
660.30	201.26	52.194	4.849	814.534	23.065	814.534	23.065
660.33	201.27	52.259	4.855	816.229	23.113	816.229	23.113
660.37	201.28	52.323	4.861	817.959	23.162	817.959	23.162
660.40	201.29	52.388	4.867	819.654	23.210	819.654	23.210
660.43	201.30	52.463	4.874	821.385	23.259	821.385	23.259
660.47	201.31	52.528	4.880	823.115	23.308	823.115	23.308
660.50	201.32	52.592	4.886	824.845	23.357	824.845	23.357
660.53	201.33	52.668	4.893	826.541	23.405	826.541	23.405
660.56	201.34	52.732	4.899	828.271	23.454	828.271	23.454
660.60	201.35	52.797	4.905	830.001	23.503	830.001	23.503
660.63	201.36	52.872	4.912	831.767	23.553	831.767	23.553
660.66	201.37	52.937	4.918	833.498	23.602	833.498	23.602
660.70	201.38	53.001	4.924	835.228	23.651	835.228	23.651
660.73	201.39	53.077	4.931	836.958	23.700	836.958	23.700
660.76	201.40	53.141	4.937	838.724	23.750	838.724	23.750
660.79	201.41	53.217	4.944	840.455	23.799	840.455	23.799
660.83	201.42	53.292	4.951	842.185	23.848	842.185	23.848
660.86	201.43	53.357	4.957	843.951	23.898	843.951	23.898
660.89	201.44	53.432	4.964	845.716	23.948	845.716	23.948
660.93	201.45	53.507	4.971	847.447	23.997	847.447	23.997
660.96	201.46	53.583	4.978	849.213	24.047	849.213	24.047
660.99	201.47	53.669	4.986	850.978	24.097	850.978	24.097
661.02	201.48	53.755	4.994	852.744	24.147	852.744	24.147
661.06	201.49	53.830	5.001	854.510	24.197	854.510	24.197
661.09	201.50	53.916	5.009	856.276	24.247	856.276	24.247
661.12	201.51	53.992	5.016	858.041	24.297	858.041	24.297
661.15	201.52	54.078	5.024	859.807	24.347	859.807	24.347
661.19	201.53	54.153	5.031	861.573	24.397	861.573	24.397
661.22	201.54	54.250	5.040	863.374	24.448	863.374	24.448
661.25	201.55	54.358	5.050	865.140	24.498	865.140	24.498
661.29	201.56	54.508	5.064	866.941	24.549	866.941	24.549

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
				Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
661.32	201.57	54.670	5.079	868.706	24.599	868.706	24.599
661.35	201.58	54.842	5.095	870.507	24.650	870.507	24.650
661.38	201.59	54.960	5.106	872.308	24.701	872.308	24.701
661.42	201.60	55.068	5.116	874.109	24.752	874.109	24.752
661.45	201.61	55.197	5.128	875.946	24.804	875.946	24.804
661.48	201.62	55.305	5.138	877.747	24.855	877.747	24.855
661.52	201.63	55.413	5.148	879.548	24.906	879.548	24.906
661.55	201.64	55.520	5.158	881.384	24.958	881.384	24.958
661.58	201.65	55.617	5.167	883.221	25.010	883.221	25.010
661.61	201.66	55.714	5.176	885.022	25.061	885.022	25.061
661.65	201.67	55.822	5.186	886.858	25.113	886.858	25.113
661.68	201.68	55.918	5.195	888.694	25.165	888.694	25.165
661.71	201.69	56.015	5.204	890.531	25.217	890.531	25.217
661.75	201.70	56.112	5.213	892.367	25.269	892.367	25.269
661.78	201.71	56.220	5.223	894.204	25.321	894.204	25.321
661.81	201.72	56.338	5.234	896.075	25.374	896.075	25.374
661.84	201.73	56.478	5.247	897.912	25.426	897.912	25.426
661.88	201.74	56.618	5.260	899.748	25.478	899.748	25.478
661.91	201.75	56.758	5.273	901.620	25.531	901.620	25.531
661.94	201.76	56.920	5.288	903.491	25.584	903.491	25.584
661.98	201.77	57.102	5.305	905.363	25.637	905.363	25.637
662.01	201.78	57.296	5.323	907.235	25.690	907.235	25.690
662.04	201.79	57.512	5.343	909.106	25.743	909.106	25.743
662.07	201.80	57.727	5.363	911.013	25.797	911.013	25.797
662.11	201.81	57.910	5.380	912.920	25.851	912.920	25.851
662.14	201.82	58.060	5.394	914.827	25.905	914.827	25.905
662.17	201.83	58.222	5.409	916.734	25.959	916.734	25.959
662.20	201.84	58.330	5.419	918.641	26.013	918.641	26.013
662.24	201.85	58.437	5.429	920.548	26.067	920.548	26.067
662.27	201.86	58.545	5.439	922.455	26.121	922.455	26.121
662.30	201.87	58.642	5.448	924.398	26.176	924.398	26.176
662.34	201.88	58.739	5.457	926.305	26.230	926.305	26.230
662.37	201.89	58.835	5.466	928.247	26.285	928.247	26.285
662.40	201.90	58.932	5.475	930.189	26.340	930.189	26.340
662.43	201.91	59.018	5.483	932.096	26.394	932.096	26.394
662.47	201.92	59.105	5.491	934.039	26.449	934.039	26.449
662.50	201.93	59.191	5.499	935.981	26.504	935.981	26.504
662.53	201.94	59.277	5.507	937.923	26.559	937.923	26.559
662.57	201.95	59.363	5.515	939.865	26.614	939.865	26.614
662.60	201.96	59.438	5.522	941.808	26.669	941.808	26.669
662.63	201.97	59.514	5.529	943.785	26.725	943.785	26.725
662.66	201.98	59.610	5.538	945.728	26.780	945.728	26.780

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
				Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
662.70	201.99	59.697	5.546	947.670	26.835	947.670	26.835
662.73	202.00	59.772	5.553	949.648	26.891	949.648	26.891
662.76	202.01	59.847	5.560	951.625	26.947	951.625	26.947
662.80	202.02	59.923	5.567	953.568	27.002	953.568	27.002
662.83	202.03	59.998	5.574	955.545	27.058	955.545	27.058
662.86	202.04	60.073	5.581	957.523	27.114	957.523	27.114
662.89	202.05	60.149	5.588	959.500	27.170	959.500	27.170
662.93	202.06	60.224	5.595	961.443	27.225	961.443	27.225
662.96	202.07	60.289	5.601	963.420	27.281	963.420	27.281
662.99	202.08	60.364	5.608	965.398	27.337	965.398	27.337
663.02	202.09	60.439	5.615	967.411	27.394	967.411	27.394
663.06	202.10	60.504	5.621	969.389	27.450	969.389	27.450
663.09	202.11	60.579	5.628	971.366	27.506	971.366	27.506
663.12	202.12	60.644	5.634	973.344	27.562	973.344	27.562
663.16	202.13	60.719	5.641	975.357	27.619	975.357	27.619
663.19	202.14	60.784	5.647	977.334	27.675	977.334	27.675
663.22	202.15	60.848	5.653	979.347	27.732	979.347	27.732
663.25	202.16	60.913	5.659	981.325	27.788	981.325	27.788
663.29	202.17	60.988	5.666	983.338	27.845	983.338	27.845
663.32	202.18	61.053	5.672	985.351	27.902	985.351	27.902
663.35	202.19	61.117	5.678	987.328	27.958	987.328	27.958
663.39	202.20	61.182	5.684	989.341	28.015	989.341	28.015
663.42	202.21	61.257	5.691	991.354	28.072	991.354	28.072
663.45	202.22	61.322	5.697	993.367	28.129	993.367	28.129
663.48	202.23	61.387	5.703	995.380	28.186	995.380	28.186
663.52	202.24	61.462	5.710	997.393	28.243	997.393	28.243
663.55	202.25	61.526	5.716	999.406	28.300	999.406	28.300
663.58	202.26	61.591	5.722	1001.419	28.357	1001.419	28.357
663.62	202.27	61.656	5.728	1003.467	28.415	1003.467	28.415
663.65	202.28	61.720	5.734	1005.480	28.472	1005.480	28.472
663.68	202.29	61.785	5.740	1007.493	28.529	1007.493	28.529
663.71	202.30	61.849	5.746	1009.541	28.587	1009.541	28.587
663.75	202.31	61.914	5.752	1011.554	28.644	1011.554	28.644
663.78	202.32	61.979	5.758	1013.603	28.702	1013.603	28.702
663.81	202.33	62.043	5.764	1015.615	28.759	1015.615	28.759
663.85	202.34	62.108	5.770	1017.664	28.817	1017.664	28.817
663.88	202.35	62.172	5.776	1019.712	28.875	1019.712	28.875
663.91	202.36	62.237	5.782	1021.725	28.932	1021.725	28.932
663.94	202.37	62.301	5.788	1023.773	28.990	1023.773	28.990
663.98	202.38	62.366	5.794	1025.821	29.048	1025.821	29.048
664.01	202.39	62.420	5.799	1027.870	29.106	1027.870	29.106
664.04	202.40	62.484	5.805	1029.918	29.164	1029.918	29.164

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)		
				Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)	
664.07	202.41	62.549	5.811	1031.966	29.222	1031.966	29.222	
664.11	202.42	62.614	5.817	1034.014	29.280	1034.014	29.280	
664.14	202.43	62.678	5.823	1036.098	29.339	1036.098	29.339	
664.17	202.44	62.743	5.829	1038.146	29.397	1038.146	29.397	
664.21	202.45	62.807	5.835	1040.194	29.455	1040.194	29.455	
664.24	202.46	62.872	5.841	1042.278	29.514	1042.278	29.514	
664.27	202.47	62.937	5.847	1044.326	29.572	1044.326	29.572	
664.30	202.48	62.990	5.852	1046.410	29.631	1046.410	29.631	
664.34	202.49	63.055	5.858	1048.458	29.689	1048.458	29.689	
664.37	202.50	63.120	5.864	1050.542	29.748	1050.542	29.748	
664.40	202.51	63.184	5.870	1052.590	29.806	1052.590	29.806	
664.44	202.52	63.249	5.876	1054.674	29.865	1054.674	29.865	
664.47	202.53	63.324	5.883	1056.757	29.924	1056.757	29.924	
664.50	202.54	63.389	5.889	1058.841	29.983	1058.841	29.983	
664.53	202.55	63.442	5.894	1060.924	30.042	1060.924	30.042	
664.57	202.56	63.507	5.900	1063.008	30.101	1063.008	30.101	
664.60	202.57	63.572	5.906	1065.091	30.160	1065.091	30.160	
664.63	202.58	63.636	5.912	1067.175	30.219	1067.175	30.219	
664.67	202.59	63.701	5.918	1069.258	30.278	1069.258	30.278	
664.70	202.60	63.755	5.923	1071.342	30.337	1071.342	30.337	
664.73	202.61	63.819	5.929	1073.426	30.396	1073.426	30.396	
664.76	202.62	63.884	5.935	1075.545	30.456	1075.545	30.456	
664.80	202.63	63.948	5.941	1077.628	30.515	1077.628	30.515	
664.83	202.64	64.002	5.946	1079.747	30.575	1079.747	30.575	
664.86	202.65	64.067	5.952	1081.831	30.634	1081.831	30.634	
664.90	202.66	64.131	5.958	1083.949	30.694	1083.949	30.694	
664.93	202.67	64.185	5.963	1086.033	30.753	1086.033	30.753	
664.96	202.68	64.250	5.969	1088.152	30.813	1088.152	30.813	**FRL**

Annexure - 2

Mobilisation and Calibration Report

Khodiyar Reservoir

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 surveys of thirteen reservoirs in the Saurashtra and Northern Gujarat region; namely Bhadar-1, Bhadar-2, Khodiyar, Und-1, Machhu-1, Machhu-2, Brahmani, Aji-1, Nara, Tappar, Rudramata, Mitti and Fatehgadh.

This report documents the mobilisation and calibrations carried out by OSaS on board SMB Ocean for bathymetric and topographic survey of Khodiyar reservoir in Saurashtra region, Gujarat.

The survey team arrived at survey site on 27th July 2021 and the land survey was started on 28th July. The survey boat arrived at Khodiyar dam site on 31st July and the mobilisation of equipment on board survey boat SMB Ocean started on 01st August and was completed on the same day.

To establish TBMs, two points TBM-1 and TBM-2 were marked/painted on two separate concrete blocks embedded in soil ground in an area to the southsouthwest of the rear entrance steps of the dam control room building. These two points were spaced 10.0m apart. DGPS observations were carried out at each of these points for about 2 hours on 28th July. The elevation (above MSL) at the client-provided benchmark located near the wall of the dam spillway was transferred using the RTK system to obtain the elevations at TBM-01 and TBM-02 locations.

Initial system preparation and equipment checks for bathy survey were completed on 01st August. A bar check was carried out every day before commencing the bathymetric survey.

The topographic and bathymetric survey commenced on 29th July and 03rd August respectively at Khodiyar reservoir. Topographic survey was completed on 05th August and bathymetric survey was completed on 10th August. The survey boat was demobilised on 10th August.

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, hard hats 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 *Power Systems*

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

1.3.4 *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 **Figure 1** below:

XYZ Offsets in metres			
Offset Name	X	Y	Z
COG	0.00	0.00	0.00
DGPS	-0.95	0.40	1.80
SBES	-0.95	0.00	-0.33
Heave Sensor	0.00	0.50	0.70

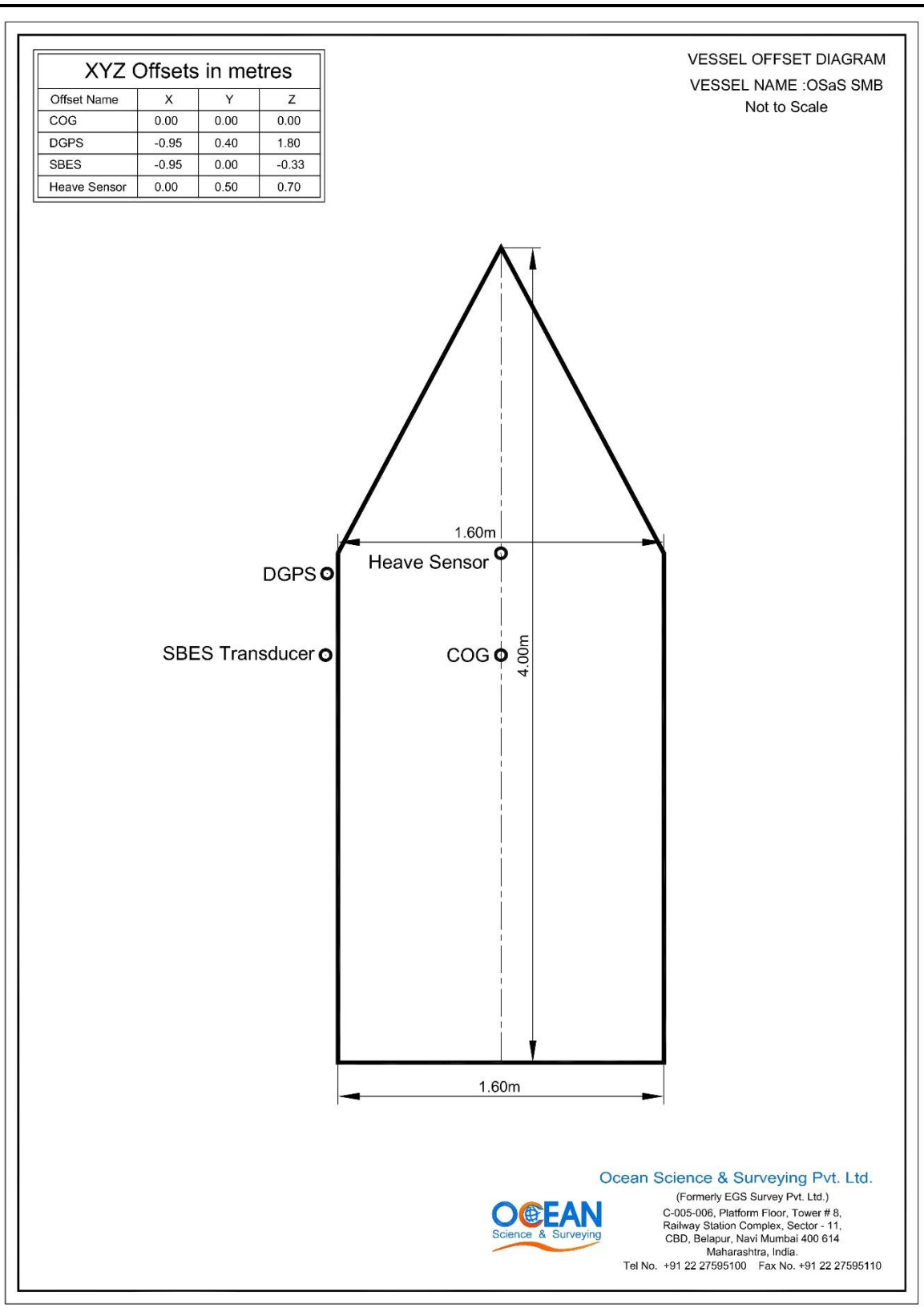


Figure 1: Vessel Offset Diagram

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.

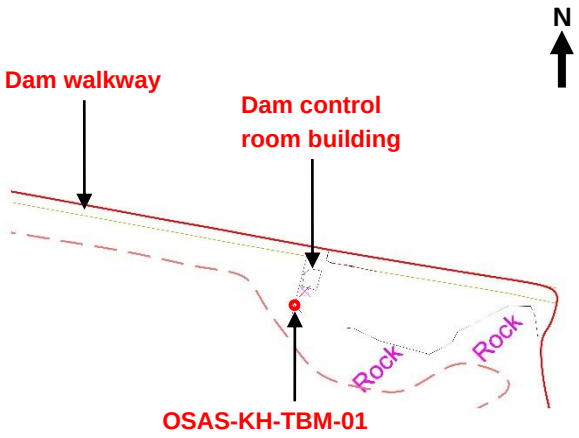
Two points were manually marked/painted on two separate concrete blocks embedded in soil ground in an area to the southsouthwest of the rear entrance steps of the dam control room building. These two points were spaced 10.0m apart. About 2 hours of DGPS observations were carried out at each of the two points. After observations, the two points were established as temporary control points/ temporary benchmark (TBM). The base stations of the Hemisphere Atlas Link RTK were set up at these positions and two-hour continuous observations using Hemisphere RTK positioning system were conducted to fix the consistency of the position for horizontal control. The system provides real time correction signals, providing centimetre level accuracy.

The elevation (above MSL) at client provided benchmark located near the wall of dam spillway was transferred using RTK system to obtain the elevations at TBM-01 and TBM-02 locations.

The details of reference stations OSaS-KH-TBM-01 and OSaS-KH-TBM-02 are provided in **Table 1** and **Table 2** respectively.

Station Number:	OSAS-KH-TBM-01	**Latitude:**	21° 21.391' N
Locality:	Khodiyar Dam, Gujarat	**Longitude:**	71° 02.802' E
Geodetic Datum:	WGS84	**Northing:**	2362985.122 m N
Projection:	Universal Transverse Mercator (Zone: 42 North)	**Easting:**	712234.993 m E
Date:	28th July 2021	**Elevation:**	207.492m above MSL
Station Description:	A circle with a dot drawn inside it is painted in yellow colour on a concrete block embedded in the soil ground.		
Access:	From the rear entrance steps of the dam control room building at Khodiyar dam, head south-southwest for about 12m to reach the TBM-01 location.		

Sketch:

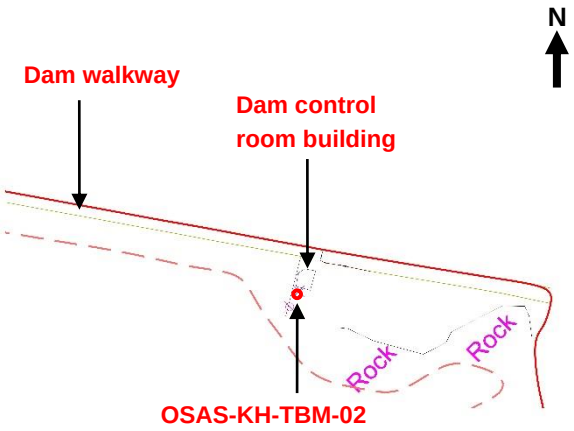


Map:

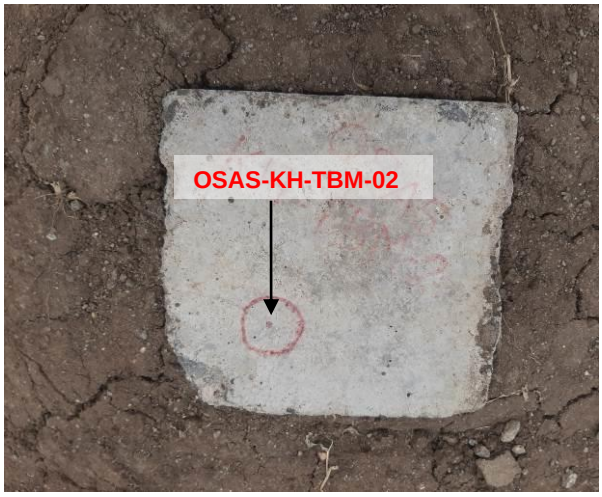
Table 1: Details of OSAS-KH-TBM-01

Station Number:	OSAS-KH-TBM-02	**Latitude:**	21° 21.395' N
Locality:	Khodiyar Dam, Gujarat	**Longitude:**	71° 02.805' E
Geodetic Datum:	WGS84	**Northing:**	2362993.729 m N
Projection:	Universal Transverse Mercator (Zone: 42 North)	**Easting:**	712240.010 m E
Date:	28th July 2021	**Elevation:**	207.508m above MSL
Station Description:	A circle with a dot drawn inside it is painted in red colour on a concrete block embedded in the soil ground.		
Access:	From the rear entrance steps of the dam control room building at Khodiyar dam, head south-southwest for about 2m to reach the TBM-02 location.		

Sketch:



Map:



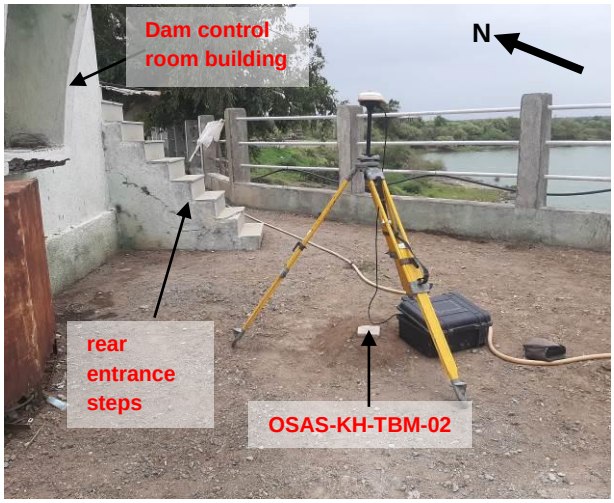


Table 2: Details of OSAS-KH-TBM-02

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.

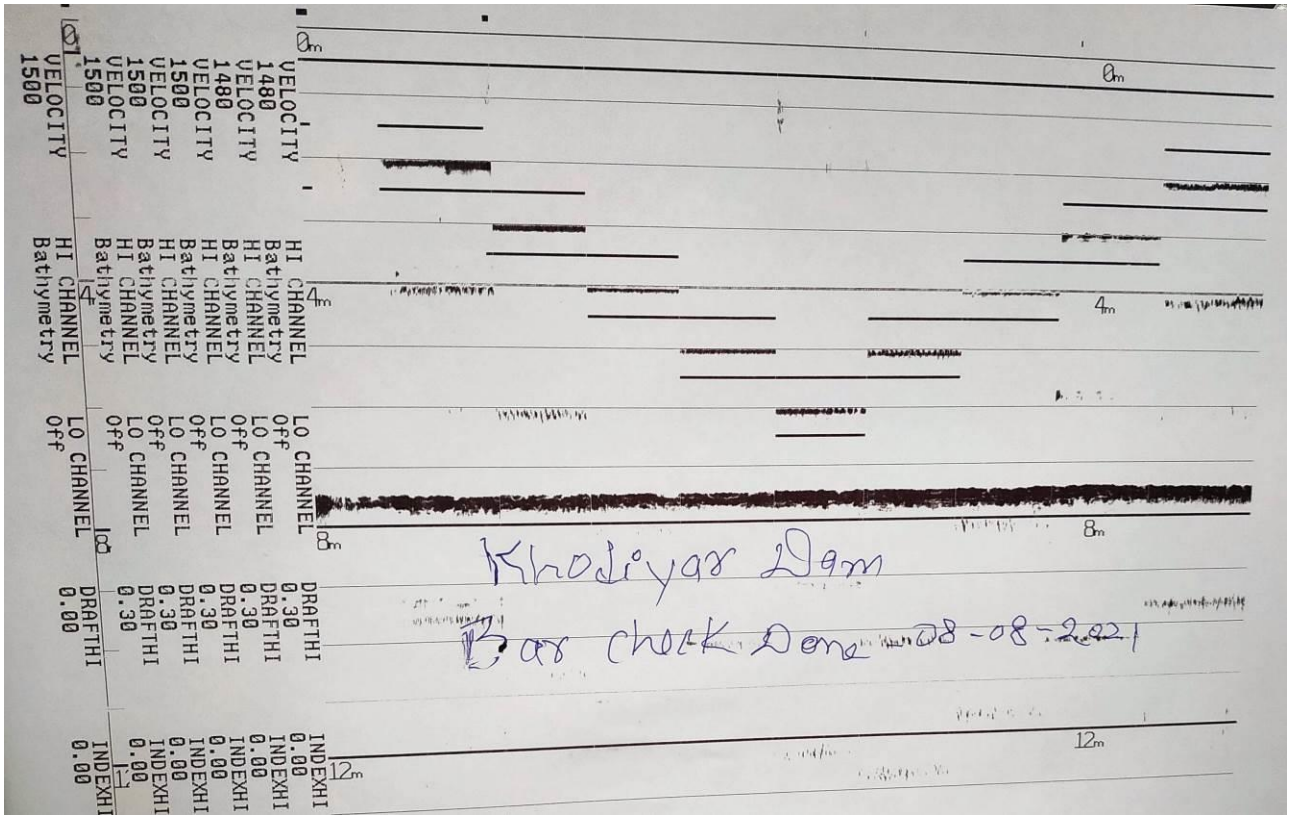


Figure 2: Bar check calibration on board OSaS SMB

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 specifications throughout the length of the survey.

Annexure - 3

Previous Data – Original project report (1962), 1975, 1986 and 1987

Khodiyar Reservoir

Figure 1 shows the snapshot of Khodiyar irrigation scheme area and capacity table and curves as per the original project report-1962 (as provided by the client).

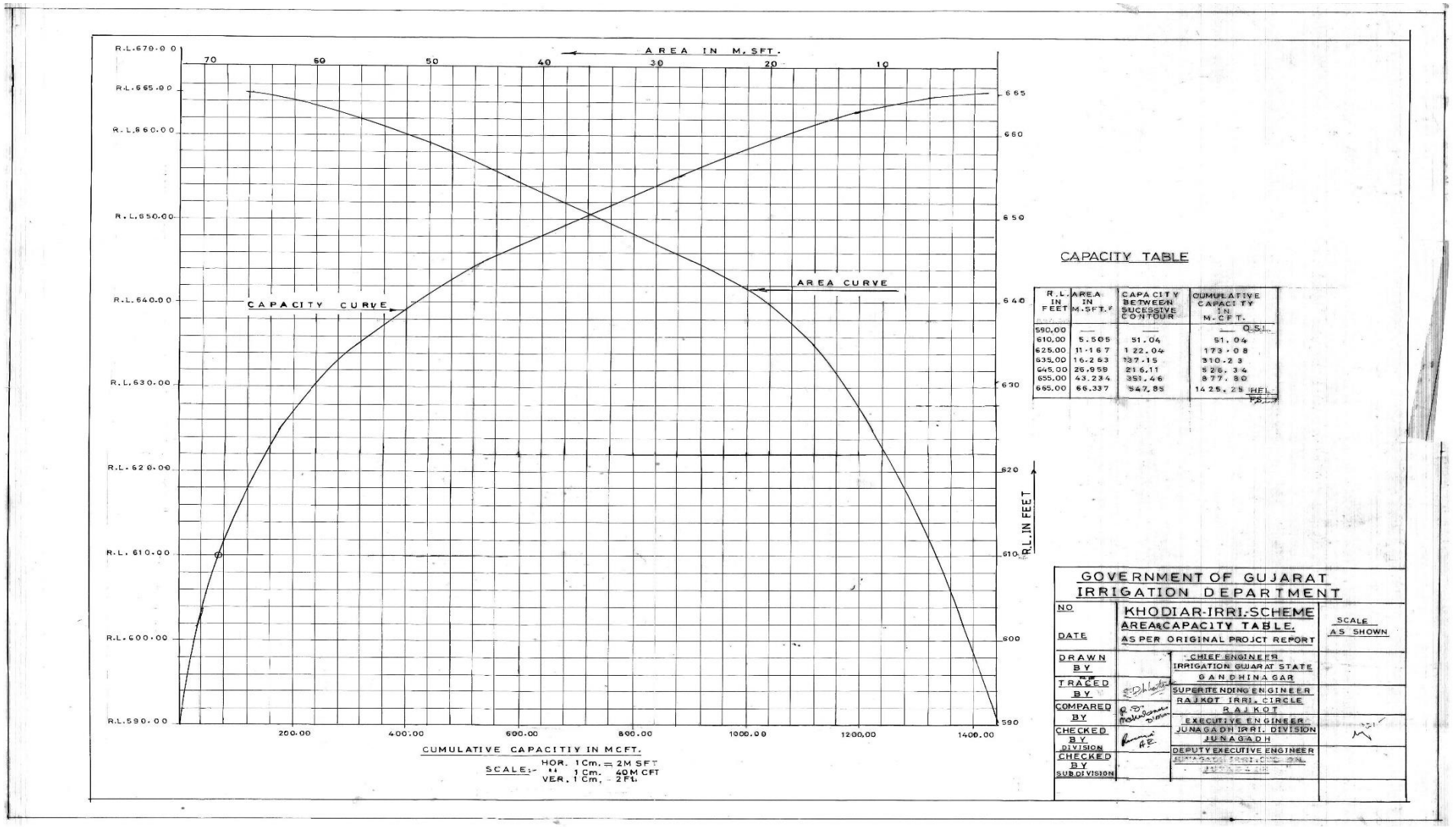


Figure 1: Khodiyar irrigation scheme, area and capacity table and curves as per original project report

Figure 2 shows the snapshot of Khodiyar irrigation scheme area and capacity table and curves as per silt survey during 1975-76 (as provided by the client).

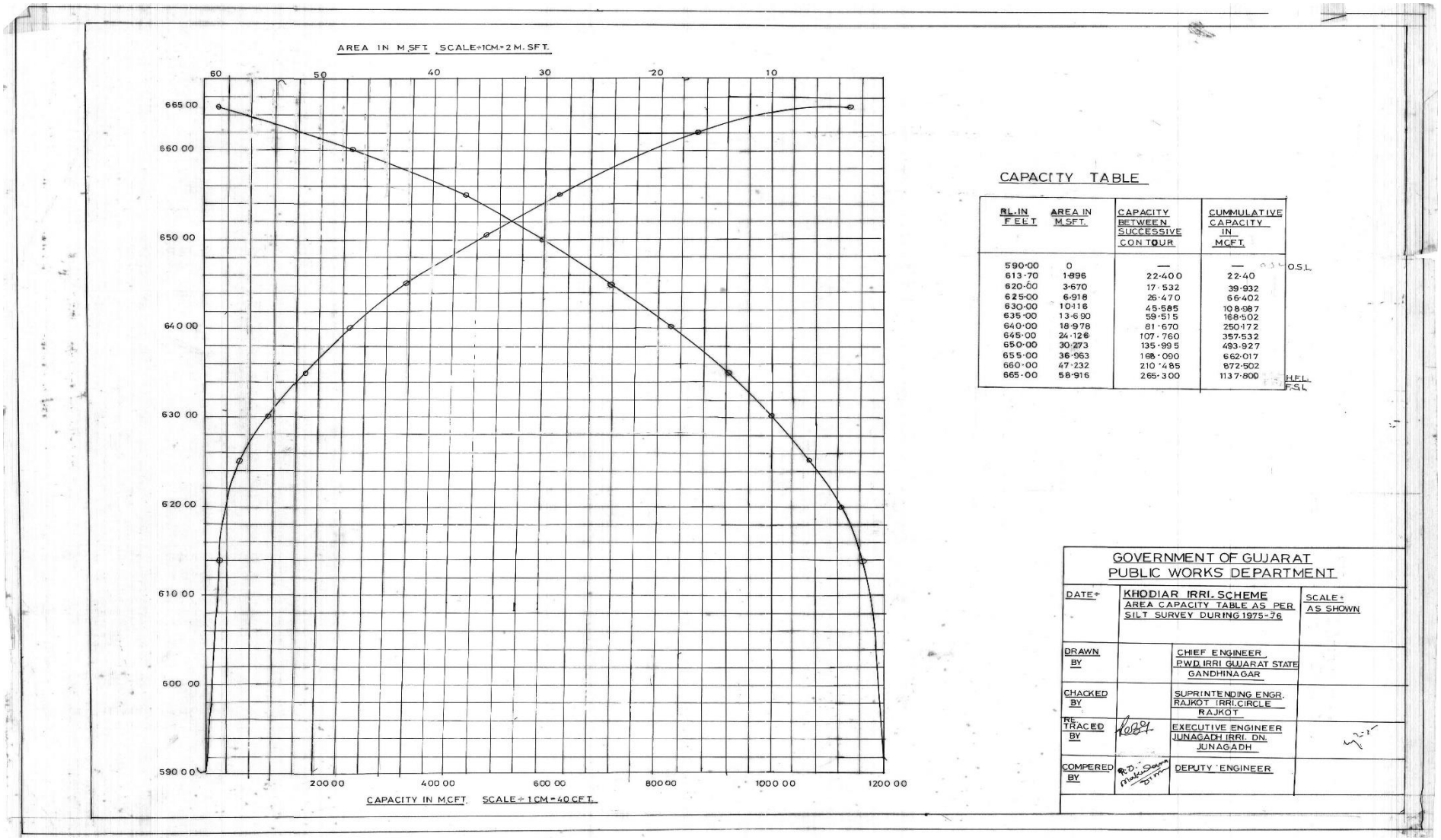


Figure 2: Khodiyar irrigation scheme, area and capacity table and curves as per silt survey during 1975-76

Table 1 to **Table 21** provide the previous survey data (Capacity table as per silt survey–1986), extracted from the client-provided excel document (Capacity survey results_1986.xlsx).

AMRELI IRRIGATION DIVISION, AMRELI

Name of Scheme:- KHODIYAR IRRIGATION SCHEME.

Sub:- Capacity Table (As per Silt Survey -1986)

OSL = 179.82 Mt.		FRL = 202.68 Mt./ 665.00 Ft.		HFL = 202.68 Mt. / 665.00 Ft.	
Dead Storage = 0.00 MCM		Live Storage = 29.943 MCM		Gross Sto. = 29.943 MCM	
R.L. In Feet	Depth in Feet	Capacity in M.C.Ft.	R.L. In Meter	Depth in Meter	Capacity in M.CuM.
1	2	3	4	5	6
611.00	21.00	0.464	186.22	6.40	0.013
611.01	21.01	0.470	186.23	6.41	0.013
611.02	21.02	0.476	186.23	6.41	0.013
611.03	21.03	0.482	186.23	6.41	0.014
611.04	21.04	0.488	186.24	6.42	0.014
611.05	21.05	0.494	186.24	6.42	0.014
611.06	21.06	0.500	186.24	6.42	0.014
611.07	21.07	0.506	186.25	6.43	0.014
611.08	21.08	0.512	186.25	6.43	0.014
611.09	21.09	0.518	186.25	6.43	0.015
611.10	21.10	0.524	186.25	6.43	0.015
611.11	21.11	0.530	186.26	6.44	0.015
611.12	21.12	0.536	186.26	6.44	0.015
611.13	21.13	0.542	186.26	6.44	0.015
611.14	21.14	0.548	186.27	6.45	0.016
611.15	21.15	0.554	186.27	6.45	0.016
611.16	21.16	0.560	186.27	6.45	0.016
611.17	21.17	0.566	186.28	6.46	0.016
611.18	21.18	0.572	186.28	6.46	0.016
611.19	21.19	0.578	186.28	6.46	0.016
611.20	21.20	0.584	186.28	6.46	0.017
611.21	21.21	0.590	186.29	6.47	0.017
611.22	21.22	0.596	186.29	6.47	0.017
611.23	21.23	0.602	186.29	6.47	0.017
611.24	21.24	0.608	186.30	6.48	0.017
611.25	21.25	0.614	186.30	6.48	0.017
611.26	21.26	0.620	186.30	6.48	0.018
611.27	21.27	0.626	186.31	6.49	0.018
611.28	21.28	0.632	186.31	6.49	0.018
611.29	21.29	0.638	186.31	6.49	0.018
611.30	21.30	0.644	186.32	6.50	0.018

Table 1: Capacity table as per silt survey–1986 (Page 1 of 21)

611.31	21.31	0.650	186.32	6.50	0.018
611.32	21.32	0.656	186.32	6.50	0.019
611.33	21.33	0.662	186.32	6.50	0.019
611.34	21.34	0.668	186.33	6.51	0.019
611.35	21.35	0.675	186.33	6.51	0.019
611.36	21.36	0.681	186.33	6.51	0.019
611.37	21.37	0.687	186.34	6.52	0.019
611.38	21.38	0.693	186.34	6.52	0.020
611.39	21.39	0.699	186.34	6.52	0.020
611.40	21.40	0.705	186.35	6.53	0.020
611.41	21.41	0.711	186.35	6.53	0.020
611.42	21.42	0.717	186.35	6.53	0.020
611.43	21.43	0.723	186.35	6.53	0.020
611.44	21.44	0.729	186.36	6.54	0.021
611.45	21.45	0.735	186.36	6.54	0.021
611.46	21.46	0.741	186.36	6.54	0.021
611.47	21.47	0.747	186.37	6.55	0.021
611.48	21.48	0.753	186.37	6.55	0.021
611.49	21.49	0.759	186.37	6.55	0.021
611.50	21.50	0.765	186.38	6.56	0.022
611.51	21.51	0.771	186.38	6.56	0.022
611.52	21.52	0.777	186.38	6.56	0.022
611.53	21.53	0.783	186.39	6.57	0.022
611.54	21.54	0.789	186.39	6.57	0.022
611.55	21.55	0.795	186.39	6.57	0.022
611.56	21.56	0.800	186.39	6.57	0.023
611.57	21.57	0.806	186.40	6.58	0.023
611.58	21.58	0.812	186.40	6.58	0.023
611.59	21.59	0.818	186.40	6.58	0.023
611.60	21.60	0.824	186.41	6.59	0.023
611.61	21.61	0.830	186.41	6.59	0.024
611.62	21.62	0.836	186.41	6.59	0.024
611.63	21.63	0.843	186.42	6.60	0.024
611.64	21.64	0.849	186.42	6.60	0.024
611.65	21.65	0.855	186.42	6.60	0.024
611.66	21.66	0.861	186.42	6.60	0.024
611.67	21.67	0.867	186.43	6.61	0.025
611.68	21.68	0.874	186.43	6.61	0.025
611.69	21.69	0.880	186.43	6.61	0.025
611.70	21.70	0.886	186.44	6.62	0.025
611.71	21.71	0.892	186.44	6.62	0.025
611.72	21.72	0.898	186.44	6.62	0.025

Table 2: Capacity table as per silt survey–1986 (Page 2 of 21)

611.73	21.73	0.904	186.45	6.63	0.026
611.74	21.74	0.910	186.45	6.63	0.026
611.75	21.75	0.916	186.45	6.63	0.026
611.76	21.76	0.922	186.46	6.64	0.026
611.77	21.77	0.928	186.46	6.64	0.026
611.78	21.78	0.934	186.46	6.64	0.026
611.79	21.79	0.940	186.46	6.64	0.027
611.80	21.80	0.946	186.47	6.65	0.027
611.81	21.81	0.952	186.47	6.65	0.027
611.82	21.82	0.958	186.47	6.65	0.027
611.83	21.83	0.964	186.48	6.66	0.027
611.84	21.84	0.970	186.48	6.66	0.027
611.85	21.85	0.976	186.48	6.66	0.028
611.86	21.86	0.982	186.49	6.67	0.028
611.87	21.87	0.988	186.49	6.67	0.028
611.88	21.88	0.994	186.49	6.67	0.028
611.89	21.89	1.000	186.49	6.67	0.028
611.90	21.90	1.006	186.50	6.68	0.028
611.91	21.91	1.012	186.50	6.68	0.029
611.92	21.92	1.018	186.50	6.68	0.029
611.93	21.93	1.024	186.51	6.69	0.029
611.94	21.94	1.030	186.51	6.69	0.029
611.95	21.95	1.037	186.51	6.69	0.029
611.96	21.96	1.043	186.52	6.70	0.030
611.97	21.97	1.049	186.52	6.70	0.030
611.98	21.98	1.055	186.52	6.70	0.030
611.99	21.99	1.061	186.53	6.71	0.030
612.00	22.00	1.067	186.53	6.71	0.030
612.01	22.01	1.073	186.53	6.71	0.030
612.02	22.02	1.079	186.53	6.71	0.031
612.03	22.03	1.085	186.54	6.72	0.031
612.04	22.04	1.091	186.54	6.72	0.031
612.05	22.05	1.097	186.54	6.72	0.031
612.06	22.06	1.103	186.55	6.73	0.031
612.07	22.07	1.109	186.55	6.73	0.031
612.08	22.08	1.115	186.55	6.73	0.032
612.09	22.09	1.121	186.56	6.74	0.032
612.10	22.10	1.127	186.56	6.74	0.032
612.11	22.11	1.133	186.56	6.74	0.032
612.12	22.12	1.139	186.57	6.75	0.032
612.13	22.13	1.145	186.57	6.75	0.032
612.14	22.14	1.151	186.57	6.75	0.033

Table 3: Capacity table as per silt survey–1986 (Page 3 of 21)

612.15	22.15	1.157	186.57	6.75	0.033
612.16	22.16	1.163	186.58	6.76	0.033
612.17	22.17	1.169	186.58	6.76	0.033
612.18	22.18	1.175	186.58	6.76	0.033
612.19	22.19	1.181	186.59	6.77	0.033
612.20	22.20	1.187	186.59	6.77	0.034
612.21	22.21	1.193	186.59	6.77	0.034
612.22	22.22	1.199	186.60	6.78	0.034
612.23	22.23	1.205	186.60	6.78	0.034
612.24	22.24	1.211	186.60	6.78	0.034
612.25	22.25	1.217	186.60	6.78	0.034
612.26	22.26	1.223	186.61	6.79	0.035
612.27	22.27	1.229	186.61	6.79	0.035
612.28	22.28	1.235	186.61	6.79	0.035
612.29	22.29	1.241	186.62	6.80	0.035
612.30	22.30	1.247	186.62	6.80	0.035
612.31	22.31	1.253	186.62	6.80	0.035
612.32	22.32	1.259	186.63	6.81	0.036
612.33	22.33	1.265	186.63	6.81	0.036
612.34	22.34	1.271	186.63	6.81	0.036
612.35	22.35	1.277	186.64	6.82	0.036
612.36	22.36	1.282	186.64	6.82	0.036
612.37	22.37	1.288	186.64	6.82	0.036
612.38	22.38	1.294	186.64	6.82	0.037
612.39	22.39	1.300	186.65	6.83	0.037
612.40	22.40	1.308	186.65	6.83	0.037
612.41	22.41	1.315	186.65	6.83	0.037
612.42	22.42	1.322	186.66	6.84	0.037
612.43	22.43	1.329	186.66	6.84	0.038
612.44	22.44	1.336	186.66	6.84	0.038
612.45	22.45	1.343	186.67	6.85	0.038
612.46	22.46	1.350	186.67	6.85	0.038
612.47	22.47	1.357	186.67	6.85	0.038
612.48	22.48	1.364	186.67	6.85	0.039
612.49	22.49	1.371	186.68	6.86	0.039
612.50	22.50	1.378	186.68	6.86	0.039
612.51	22.51	1.383	186.68	6.86	0.039
612.52	22.52	1.388	186.69	6.87	0.039
612.53	22.53	1.393	186.69	6.87	0.039
612.54	22.54	1.398	186.69	6.87	0.040
612.55	22.55	1.403	186.70	6.88	0.040
612.56	22.56	1.408	186.70	6.88	0.040

Table 4: Capacity table as per silt survey–1986 (Page 4 of 21)

612.57	22.57	1.413	186.70	6.88	0.040
612.58	22.58	1.418	186.71	6.89	0.040
612.59	22.59	1.423	186.71	6.89	0.040
612.60	22.60	1.428	186.71	6.89	0.040
612.61	22.61	1.434	186.71	6.89	0.041
612.62	22.62	1.440	186.72	6.90	0.041
612.63	22.63	1.446	186.72	6.90	0.041
612.64	22.64	1.452	186.72	6.90	0.041
612.65	22.65	1.459	186.73	6.91	0.041
612.66	22.66	1.465	186.73	6.91	0.041
612.67	22.67	1.471	186.73	6.91	0.042
612.68	22.68	1.477	186.74	6.92	0.042
612.69	22.69	1.483	186.74	6.92	0.042
612.70	22.70	1.489	186.74	6.92	0.042
612.71	22.71	1.495	186.74	6.92	0.042
612.72	22.72	1.501	186.75	6.93	0.043
612.73	22.73	1.507	186.75	6.93	0.043
612.74	22.74	1.513	186.75	6.93	0.043
612.75	22.75	1.519	186.76	6.94	0.043
612.76	22.76	1.525	186.76	6.94	0.043
612.77	22.77	1.531	186.76	6.94	0.043
612.78	22.78	1.537	186.77	6.95	0.044
612.79	22.79	1.543	186.77	6.95	0.044
612.80	22.80	1.549	186.77	6.95	0.044
612.81	22.81	1.555	186.78	6.96	0.044
612.82	22.82	1.561	186.78	6.96	0.044
612.83	22.83	1.567	186.78	6.96	0.044
612.84	22.84	1.573	186.78	6.96	0.045
612.85	22.85	1.579	186.79	6.97	0.045
612.86	22.86	1.585	186.79	6.97	0.045
612.87	22.87	1.591	186.79	6.97	0.045
612.88	22.88	1.597	186.80	6.98	0.045
612.89	22.89	1.603	186.80	6.98	0.045
612.90	22.90	1.609	186.80	6.98	0.046
612.91	22.91	1.615	186.81	6.99	0.046
612.92	22.92	1.621	186.81	6.99	0.046
612.93	22.93	1.627	186.81	6.99	0.046
612.94	22.94	1.633	186.81	6.99	0.046
612.95	22.95	1.640	186.82	7.00	0.046
612.96	22.96	1.646	186.82	7.00	0.047
612.97	22.97	1.652	186.82	7.00	0.047
612.98	22.98	1.658	186.83	7.01	0.047

Table 5: Capacity table as per silt survey–1986 (Page 5 of 21)

612.99	22.99	1.664	186.83	7.01	0.047
613.00	23.00	1.670	186.83	7.01	0.047
613.01	23.01	1.680	186.84	7.02	0.048
613.02	23.02	1.689	186.84	7.02	0.048
613.03	23.03	1.699	186.84	7.02	0.048
613.04	23.04	1.708	186.85	7.03	0.048
613.05	23.05	1.718	186.85	7.03	0.049
613.06	23.06	1.727	186.85	7.03	0.049
613.07	23.07	1.737	186.85	7.03	0.049
613.08	23.08	1.746	186.86	7.04	0.049
613.09	23.09	1.756	186.86	7.04	0.050
613.10	23.10	1.765	186.86	7.04	0.050
613.11	23.11	1.775	186.87	7.05	0.050
613.12	23.12	1.784	186.87	7.05	0.051
613.13	23.13	1.794	186.87	7.05	0.051
613.14	23.14	1.803	186.88	7.06	0.051
613.15	23.15	1.813	186.88	7.06	0.051
613.16	23.16	1.823	186.88	7.06	0.052
613.17	23.17	1.832	186.89	7.07	0.052
613.18	23.18	1.842	186.89	7.07	0.052
613.19	23.19	1.851	186.89	7.07	0.050
613.20	23.20	1.861	186.89	7.07	0.053
613.21	23.21	1.871	186.90	7.08	0.053
613.22	23.22	1.880	186.90	7.08	0.053
613.23	23.23	1.890	186.90	7.08	0.054
613.24	23.24	1.899	186.91	7.09	0.054
613.25	23.25	1.909	186.91	7.09	0.054
613.26	23.26	1.918	186.91	7.09	0.054
613.27	23.27	1.928	186.92	7.10	0.055
613.28	23.28	1.937	186.92	7.10	0.055
613.29	23.29	1.947	186.92	7.10	0.055
613.30	23.30	1.956	186.92	7.10	0.055
613.31	23.31	1.966	186.93	7.11	0.056
613.32	23.32	1.975	186.93	7.11	0.056
613.33	23.33	1.985	186.93	7.11	0.056
613.34	23.34	1.994	186.94	7.12	0.056
613.35	23.35	2.004	186.94	7.12	0.057
613.36	23.36	2.014	186.94	7.12	0.057
613.37	23.37	2.023	186.95	7.13	0.057
613.38	23.38	2.033	186.95	7.13	0.058
613.39	23.39	2.042	186.95	7.13	0.058
613.40	23.40	2.052	186.96	7.14	0.058

Table 6: Capacity table as per silt survey–1986 (Page 6 of 21)

613.41	23.41	2.062	186.96	7.14	0.058
613.42	23.42	2.071	186.96	7.14	0.059
613.43	23.43	2.081	186.96	7.14	0.059
613.44	23.44	2.090	186.97	7.15	0.059
613.45	23.45	2.100	186.97	7.15	0.059
613.46	23.46	2.110	186.97	7.15	0.060
613.47	23.47	2.119	186.98	7.16	0.060
613.48	23.48	2.129	186.98	7.16	0.060
613.49	23.49	2.138	186.98	7.16	0.061
613.50	23.50	2.148	186.99	7.17	0.061
613.51	23.51	2.158	186.99	7.17	0.061
613.52	23.52	2.167	186.99	7.17	0.061
613.53	23.53	2.177	186.99	7.17	0.062
613.54	23.54	2.186	187.00	7.18	0.062
613.55	23.55	2.196	187.00	7.18	0.062
613.56	23.56	2.205	187.00	7.18	0.062
613.57	23.57	2.215	187.01	7.19	0.063
613.58	23.58	2.224	187.01	7.19	0.063
613.59	23.59	2.234	187.01	7.19	0.063
613.60	23.60	2.243	187.02	7.20	0.064
613.61	23.61	2.253	187.02	7.20	0.064
613.62	23.62	2.262	187.02	7.21	0.064
613.63	23.63	2.272	187.03	7.21	0.064
613.64	23.64	2.281	187.03	7.21	0.065
613.65	23.65	2.291	187.03	7.21	0.065
613.66	23.66	2.300	187.03	7.22	0.065
613.67	23.67	2.310	187.04	7.22	0.065
613.68	23.68	2.319	187.04	7.22	0.066
613.69	23.69	2.329	187.04	7.23	0.066
613.70	23.70	2.338	187.05	7.23	0.066
613.71	23.71	2.348	187.05	7.23	0.066
613.72	23.72	2.357	187.05	7.23	0.067
613.73	23.73	2.367	187.06	7.24	0.067
613.74	23.74	2.376	187.06	7.24	0.067
613.75	23.75	2.386	187.06	7.24	0.068
613.76	23.76	2.396	187.06	7.24	0.068
613.77	23.77	2.405	187.07	7.25	0.068
613.78	23.78	2.415	187.07	7.25	0.068
613.79	23.79	2.424	187.07	7.25	0.069
613.80	23.80	2.434	187.08	7.26	0.069
613.81	23.81	2.444	187.08	7.26	0.069
613.82	23.82	2.453	187.08	7.26	0.069

Table 7: Capacity table as per silt survey–1986 (Page 7 of 21)

613.83	23.83	2.463	187.09	7.27	0.070
613.84	23.84	2.472	187.09	7.27	0.070
613.85	23.85	2.482	187.09	7.27	0.070
613.86	23.86	2.491	187.10	7.28	0.071
613.87	23.87	2.501	187.10	7.28	0.071
613.88	23.88	2.510	187.10	7.28	0.071
613.89	23.89	2.520	187.10	7.28	0.071
613.90	23.90	2.529	187.11	7.29	0.072
613.91	23.91	2.539	187.11	7.29	0.072
613.92	23.92	2.548	187.11	7.29	0.072
613.93	23.93	2.558	187.12	7.30	0.072
613.94	23.94	2.567	187.12	7.30	0.073
613.95	23.95	2.577	187.12	7.30	0.073
613.96	23.96	2.587	187.13	7.31	0.073
613.97	23.97	2.596	187.13	7.31	0.074
613.98	23.98	2.606	187.13	7.31	0.074
613.99	23.99	2.615	187.14	7.32	0.074
614.00	24.00	2.625	187.14	7.32	0.074
614.01	24.01	2.646	187.14	7.32	0.075
614.02	24.02	2.667	187.14	7.32	0.076
614.03	24.03	2.688	187.15	7.33	0.076
614.04	24.04	2.709	187.15	7.33	0.077
614.05	24.05	2.730	187.15	7.33	0.077
614.06	24.06	2.750	187.16	7.34	0.078
614.07	24.07	2.771	187.16	7.34	0.078
614.08	24.08	2.792	187.16	7.34	0.079
614.09	24.09	2.813	187.17	7.35	0.080
614.10	24.10	2.834	187.17	7.35	0.080
614.11	24.11	2.855	187.17	7.35	0.081
614.12	24.12	2.876	187.17	7.35	0.081
614.13	24.13	2.897	187.18	7.36	0.082
614.14	24.14	2.918	187.18	7.36	0.083
614.15	24.15	2.939	187.18	7.36	0.083
614.16	24.16	2.959	187.19	7.37	0.084
614.17	24.17	2.980	187.19	7.37	0.084
614.18	24.18	3.001	187.19	7.37	0.085
614.19	24.19	3.022	187.20	7.38	0.086
614.20	24.20	3.043	187.20	7.38	0.086
614.21	24.21	3.064	187.20	7.38	0.087
614.22	24.22	3.085	187.21	7.39	0.087
614.23	24.23	3.106	187.21	7.39	0.088
614.24	24.24	3.127	187.21	7.39	0.089

Table 8: Capacity table as per silt survey–1986 (Page 8 of 21)

614.25	24.25	3.148	187.21	7.39	0.089
614.26	24.26	3.168	187.22	7.40	0.090
614.27	24.27	3.189	187.22	7.40	0.090
614.28	24.28	3.210	187.22	7.40	0.091
614.29	24.29	3.231	187.23	7.41	0.091
614.30	24.30	3.252	187.23	7.41	0.092
614.31	24.31	3.273	187.23	7.41	0.093
614.32	24.32	3.294	187.24	7.42	0.093
614.33	24.33	3.315	187.24	7.42	0.094
614.34	24.34	3.336	187.24	7.42	0.094
614.35	24.35	3.357	187.24	7.42	0.095
614.36	24.36	3.377	187.25	7.43	0.096
614.37	24.37	3.398	187.25	7.43	0.096
614.38	24.38	3.419	187.25	7.43	0.097
614.39	24.39	3.440	187.26	7.44	0.097
614.40	24.40	3.461	187.26	7.44	0.098
614.41	24.41	3.482	187.26	7.44	0.099
614.42	24.42	3.503	187.27	7.45	0.099
614.43	24.43	3.524	187.27	7.45	0.100
614.44	24.44	3.545	187.27	7.45	0.100
614.45	24.45	3.566	187.28	7.46	0.101
614.46	24.46	3.586	187.28	7.46	0.102
614.47	24.47	3.607	187.28	7.46	0.102
614.48	24.48	3.628	187.28	7.46	0.103
614.49	24.49	3.649	187.29	7.47	0.103
614.50	24.50	3.670	187.29	7.47	0.104
614.60	24.60	3.879	187.32	7.50	0.110
614.70	24.70	4.008	187.35	7.53	0.113
614.80	24.80	4.297	187.38	7.56	0.122
614.90	24.90	4.506	187.41	7.59	0.128
615.00	25.00	4.715	187.44	7.62	0.134
615.10	25.10	4.843	187.47	7.65	0.137
615.20	25.20	4.972	187.50	7.68	0.141
615.30	25.30	5.200	187.53	7.71	0.147
615.40	25.40	5.229	187.56	7.74	0.148
615.50	25.50	5.357	187.60	7.78	0.152
615.60	25.60	5.486	187.63	7.81	0.155
615.70	25.70	5.614	187.66	7.84	0.159
615.80	25.80	5.743	187.69	7.87	0.163
615.90	25.90	5.871	187.72	7.90	0.166
616.00	26.00	6.000	187.75	7.93	0.170
616.10	26.10	6.189	187.78	7.96	0.175

Table 9: Capacity table as per silt survey–1986 (Page 9 of 21)

616.20	26.20	6.379	187.81	7.99	0.181
616.30	26.30	6.569	187.84	8.02	0.186
616.40	26.40	6.758	187.87	8.05	0.191
616.50	26.50	6.948	187.90	8.08	0.197
616.60	26.60	7.138	187.93	8.11	0.202
616.70	26.70	7.327	187.96	8.14	0.207
616.80	26.80	7.517	187.99	8.17	0.213
616.90	26.90	7.707	188.02	8.20	0.218
617.00	27.00	7.897	188.05	8.23	0.224
617.10	27.10	8.163	188.08	8.26	0.231
617.20	27.20	8.430	188.11	8.29	0.239
617.30	27.30	8.696	188.14	8.32	0.246
617.40	27.40	8.963	188.17	8.35	0.254
617.50	27.50	9.229	188.20	8.38	0.261
617.60	27.60	9.496	188.24	8.42	0.269
617.70	27.70	9.762	188.27	8.45	0.276
617.80	27.80	10.029	188.30	8.48	0.284
617.90	27.90	10.295	188.33	8.51	0.292
618.00	28.00	10.562	188.36	8.54	0.299
618.10	28.10	10.828	188.39	8.57	0.307
618.20	28.20	11.095	188.42	8.60	0.314
618.30	28.30	11.361	188.45	8.63	0.322
618.40	28.40	11.628	188.48	8.66	0.329
618.50	28.50	11.894	188.51	8.69	0.337
618.60	28.60	12.161	188.54	8.72	0.344
618.70	28.70	12.427	188.57	8.75	0.352
618.80	28.80	12.694	188.60	8.78	0.359
618.90	28.90	12.960	188.63	8.81	0.367
619.00	29.00	13.227	188.66	8.84	0.375
619.10	29.10	13.493	188.69	8.87	0.382
619.20	29.20	13.759	188.72	8.90	0.390
619.30	29.30	14.026	188.75	8.93	0.397
619.40	29.40	14.292	188.78	8.96	0.405
619.50	29.50	14.559	188.81	8.99	0.412
619.60	29.60	14.825	188.84	9.02	0.420
619.70	29.70	15.091	188.88	9.06	0.427
619.80	29.80	15.358	188.91	9.09	0.435
619.90	29.90	15.624	188.94	9.12	0.442
620.00	30.00	15.891	188.97	9.15	0.450
620.10	30.10	16.488	189.00	9.18	0.467
620.20	30.20	17.860	189.03	9.21	0.506
620.30	30.30	17.683	189.06	9.24	0.501

Table 10: Capacity table as per silt survey–1986 (Page 10 of 21)

620.40	30.40	18.281	189.09	9.27	0.518
620.50	30.50	18.879	189.12	9.30	0.535
620.60	30.60	19.476	189.15	9.33	0.551
620.70	30.70	20.079	189.18	9.36	0.569
620.80	30.80	20.671	189.21	9.39	0.585
620.90	30.90	21.269	189.24	9.42	0.602
621.00	31.00	21.867	189.27	9.45	0.619
621.10	31.10	22.287	189.30	9.48	0.631
621.20	31.20	22.708	189.33	9.51	0.643
621.30	31.30	23.129	189.36	9.54	0.655
621.40	31.40	23.550	189.39	9.57	0.667
621.50	31.50	23.972	189.42	9.60	0.679
621.60	31.60	24.392	189.45	9.63	0.691
621.70	31.70	24.813	189.48	9.66	0.703
621.80	31.80	25.234	189.52	9.70	0.715
621.90	31.90	25.655	189.55	9.73	0.726
622.00	32.00	26.076	189.58	9.76	0.738
622.10	32.10	26.496	189.61	9.79	0.750
622.20	32.20	26.917	189.64	9.82	0.762
622.30	32.30	27.338	189.67	9.85	0.774
622.40	32.40	27.759	189.70	9.88	0.786
622.50	32.50	28.180	189.73	9.91	0.798
622.60	32.60	28.601	189.76	9.94	0.810
622.70	32.70	29.022	189.79	9.97	0.822
622.80	32.80	29.443	189.82	10.00	0.834
622.90	32.90	29.864	189.85	10.03	0.846
623.00	33.00	30.285	189.88	10.06	0.858
623.10	33.10	30.781	189.91	10.09	0.872
623.20	33.20	31.277	189.94	10.12	0.886
623.30	33.30	31.773	189.97	10.15	0.900
623.40	33.40	32.269	190.00	10.18	0.914
623.50	33.50	32.765	190.03	10.21	0.928
623.60	33.60	33.261	190.06	10.24	0.942
623.70	33.70	33.757	190.09	10.27	0.956
623.80	33.80	34.253	190.12	10.30	0.970
623.90	33.90	34.749	190.16	10.34	0.984
624.00	34.00	35.246	190.19	10.37	0.998
624.10	34.10	35.782	190.22	10.40	1.013
624.20	34.20	36.318	190.25	10.43	1.028
624.30	34.30	36.855	190.28	10.46	1.044
624.40	34.40	37.391	190.31	10.49	1.059
624.50	34.50	37.928	190.34	10.52	1.074

Table 11: Capacity table as per silt survey–1986 (Page 11 of 21)

624.60	34.60	38.464	190.37	10.55	1.089
624.70	34.70	39.000	190.40	10.58	1.104
624.80	34.80	39.537	190.43	10.61	1.120
624.90	34.90	40.073	190.46	10.64	1.135
625.00	35.00	40.610	190.49	10.67	1.150
625.10	35.10	41.312	190.52	10.70	1.170
625.20	35.20	42.014	190.55	10.73	1.190
625.30	35.30	42.716	190.58	10.76	1.210
625.40	35.40	43.418	190.61	10.79	1.229
625.50	35.50	44.120	190.64	10.82	1.249
625.60	35.60	44.822	190.67	10.85	1.269
625.70	35.70	45.524	190.70	10.88	1.289
625.80	35.80	46.226	190.73	10.91	1.309
625.90	35.90	46.928	190.77	10.95	1.329
626.00	36.00	47.631	190.80	10.98	1.349
626.10	36.10	48.349	190.83	11.01	1.369
626.20	36.20	49.067	190.86	11.04	1.389
626.30	36.30	49.766	190.89	11.07	1.409
626.40	36.40	50.505	190.92	11.10	1.430
626.50	36.50	51.223	190.95	11.13	1.450
626.60	36.60	51.942	190.98	11.16	1.471
626.70	36.70	52.660	191.01	11.19	1.491
626.80	36.80	53.379	191.04	11.22	1.512
626.90	36.90	54.097	191.07	11.25	1.532
627.00	37.00	54.816	191.10	11.28	1.552
627.10	37.10	55.561	191.13	11.31	1.573
627.20	37.20	56.306	191.16	11.34	1.594
627.30	37.30	57.051	191.19	11.37	1.615
627.40	37.40	57.796	191.22	11.40	1.637
627.50	37.50	58.542	191.25	11.43	1.658
627.60	37.60	59.287	191.28	11.46	1.679
627.70	37.70	60.032	191.31	11.49	1.700
627.80	37.80	60.777	191.34	11.52	1.721
627.90	37.90	61.522	191.37	11.55	1.742
628.00	38.00	62.268	191.41	11.59	1.763
628.10	38.10	63.015	191.44	11.62	1.784
628.20	38.20	63.762	191.47	11.65	1.806
628.30	38.30	64.509	191.50	11.68	1.827
628.40	38.40	65.257	191.53	11.71	1.848
628.50	38.50	66.004	191.56	11.74	1.869
628.60	38.60	66.791	191.59	11.77	1.891
628.70	38.70	67.499	191.62	11.80	1.911

Table 12: Capacity table as per silt survey–1986 (Page 12 of 21)

628.80	38.80	68.246	191.65	11.83	1.932
628.90	38.90	68.993	191.68	11.86	1.954
629.00	39.00	69.741	191.71	11.89	1.975
629.10	39.10	70.535	191.74	11.92	1.997
629.20	39.20	71.330	191.77	11.95	2.020
629.30	39.30	72.125	191.80	11.98	2.042
629.40	39.40	72.920	191.83	12.01	2.065
629.50	39.50	73.715	191.86	12.04	2.087
629.60	39.60	74.509	191.89	12.07	2.110
629.70	39.70	75.304	191.92	12.10	2.132
629.80	39.80	76.099	191.95	12.13	2.155
629.90	39.90	76.894	191.98	12.16	2.177
630.00	40.00	77.689	192.01	12.19	2.200
630.10	40.10	78.668	192.05	12.23	2.228
630.20	40.20	79.648	192.08	12.26	2.255
630.30	40.30	80.628	192.11	12.29	2.283
630.40	40.40	81.608	192.14	12.32	2.311
630.50	40.50	82.588	192.17	12.35	2.339
630.60	40.60	83.567	192.20	12.38	2.366
630.70	40.70	84.547	192.23	12.41	2.394
630.80	40.80	85.527	192.26	12.44	2.422
630.90	40.90	86.507	192.29	12.47	2.450
631.00	41.00	87.847	192.32	12.50	2.488
631.10	41.10	88.466	192.35	12.53	2.505
631.20	41.20	89.446	192.38	12.56	2.533
631.30	41.30	90.426	192.41	12.59	2.561
631.40	41.40	91.406	192.44	12.62	2.588
631.50	41.50	92.386	192.47	12.65	2.616
631.60	41.60	93.365	192.50	12.68	2.644
631.70	41.70	94.345	192.53	12.71	2.672
631.80	41.80	95.325	192.56	12.74	2.699
631.90	41.90	96.305	192.59	12.77	2.727
632.00	42.00	97.285	192.62	12.80	2.755
632.10	42.10	98.264	192.65	12.83	2.783
632.20	42.20	99.244	192.69	12.87	2.810
632.30	42.30	100.224	192.72	12.90	2.838
632.40	42.40	101.204	192.75	12.93	2.866
632.50	42.50	102.184	192.78	12.96	2.894
632.60	42.60	103.163	192.81	12.99	2.921
632.70	42.70	104.143	192.84	13.02	2.949
632.80	42.80	105.123	192.87	13.05	2.977
632.90	42.90	106.103	192.90	13.08	3.004

Table 13: Capacity table as per silt survey–1986 (Page 13 of 21)

633.00	43.00	107.083	192.93	13.11	3.032
633.10	43.10	108.161	192.96	13.14	3.063
633.20	43.20	109.240	192.99	13.17	3.093
633.30	43.30	110.319	193.02	13.20	3.124
633.40	43.40	111.398	193.05	13.23	3.154
633.50	43.50	112.477	193.08	13.26	3.185
633.60	43.60	113.556	193.11	13.29	3.216
633.70	43.70	114.635	193.14	13.32	3.246
633.80	43.80	115.714	193.17	13.35	3.277
633.90	43.90	116.793	193.20	13.38	3.307
634.00	44.00	117.872	193.23	13.41	3.338
634.10	44.10	117.974	193.26	13.44	3.341
634.20	44.20	120.076	193.29	13.47	3.400
634.30	44.30	121.178	193.33	13.51	3.431
634.40	44.40	122.280	193.36	13.54	3.463
634.50	44.50	123.383	193.39	13.57	3.494
634.60	44.60	124.485	193.42	13.60	3.525
634.70	44.70	125.587	193.45	13.63	3.556
634.80	44.80	126.689	193.48	13.66	3.587
634.90	44.90	127.791	193.51	13.69	3.619
635.00	45.00	128.894	193.54	13.72	3.650
635.10	45.10	130.142	193.57	13.75	3.685
635.20	45.20	131.391	193.60	13.78	3.721
635.30	45.30	132.640	193.63	13.81	3.756
635.40	45.40	133.889	193.66	13.84	3.791
635.50	45.50	135.138	193.69	13.87	3.827
635.60	45.60	136.666	193.72	13.90	3.870
635.70	45.70	137.635	193.75	13.93	3.897
635.80	45.80	138.884	193.78	13.96	3.933
635.90	45.90	140.133	193.81	13.99	3.968
636.00	46.00	141.382	193.84	14.02	4.003
636.10	46.10	142.714	193.87	14.05	4.041
636.20	46.20	144.047	193.90	14.08	4.079
636.30	46.30	145.380	193.93	14.11	4.117
636.40	46.40	146.712	193.97	14.15	4.154
636.50	46.50	148.045	194.00	14.18	4.192
636.60	46.60	149.378	194.03	14.21	4.230
636.70	46.70	150.710	194.06	14.24	4.268
636.80	46.80	152.043	194.09	14.27	4.305
636.90	46.90	153.376	194.12	14.30	4.343
637.00	47.00	154.709	194.15	14.33	4.381
637.10	47.10	156.089	194.18	14.36	4.420

Table 14: Capacity table as per silt survey–1986 (Page 14 of 21)

637.20	47.20	157.470	194.21	14.39	4.459
637.30	47.30	158.851	194.24	14.42	4.498
637.40	47.40	160.232	194.27	14.45	4.537
637.50	47.50	161.613	194.30	14.48	4.576
637.60	47.60	162.993	194.33	14.51	4.615
637.70	47.70	164.374	194.36	14.54	4.655
637.80	47.80	165.755	194.39	14.57	4.694
637.90	47.90	167.136	194.42	14.60	4.733
638.00	48.00	168.517	194.45	14.63	4.772
638.10	48.10	169.907	194.48	14.66	4.811
638.20	48.20	171.298	194.51	14.69	4.851
638.30	48.30	172.689	194.54	14.72	4.890
638.40	48.40	174.080	194.57	14.75	4.929
638.50	48.50	175.471	194.61	14.79	4.969
638.60	48.60	176.861	194.64	14.82	5.008
638.70	48.70	178.252	194.67	14.85	5.047
638.80	48.80	179.643	194.70	14.88	5.087
638.90	48.90	181.034	194.73	14.91	5.126
639.00	49.00	182.425	194.76	14.94	5.166
639.10	49.10	183.605	194.79	14.97	5.199
639.20	49.20	184.786	194.82	15.00	5.233
639.30	49.30	185.960	194.85	15.03	5.266
639.40	49.40	187.147	194.88	15.06	5.299
639.50	49.50	188.327	194.91	15.09	5.333
639.60	49.60	189.508	194.94	15.12	5.366
639.70	49.70	190.688	194.97	15.15	5.400
639.80	49.80	191.869	195.00	15.18	5.433
639.90	49.90	193.049	195.03	15.21	5.466
640.00	50.00	194.230	195.06	15.24	5.500
640.10	50.10	195.854	195.09	15.27	5.546
640.20	50.20	197.479	195.12	15.30	5.592
640.30	50.30	199.103	195.15	15.33	5.638
640.40	50.40	200.728	195.18	15.36	5.684
640.50	50.50	202.353	195.21	15.39	5.730
640.60	50.60	203.977	195.25	15.43	5.776
640.70	50.70	205.602	195.28	15.46	5.822
640.80	50.80	207.226	195.31	15.49	5.868
640.90	50.90	208.851	195.34	15.52	5.914
641.00	51.00	210.496	195.37	15.55	5.961
641.10	51.10	212.102	195.40	15.58	6.006
641.20	51.20	213.727	195.43	15.61	6.052
641.30	51.30	215.353	195.46	15.64	6.098

Table 15: Capacity table as per silt survey–1986 (Page 15 of 21)

641.40	51.40	216.968	195.49	15.67	6.144
641.50	51.50	218.604	195.52	15.70	6.190
641.60	51.60	220.230	195.55	15.73	6.236
641.70	51.70	221.856	195.58	15.76	6.282
641.80	51.80	223.481	195.61	15.79	6.328
641.90	51.90	225.106	195.64	15.82	6.374
642.00	52.00	226.733	195.67	15.85	6.420
642.10	52.10	228.358	195.70	15.88	6.466
642.20	52.20	229.684	195.73	15.91	6.504
642.30	52.30	231.610	195.76	15.94	6.558
642.40	52.40	233.235	195.79	15.97	6.604
642.50	52.50	234.861	195.82	16.00	6.650
642.60	52.60	236.487	195.85	16.03	6.697
642.70	52.70	238.112	195.89	16.07	6.743
642.80	52.80	239.738	195.92	16.10	6.789
642.90	52.90	241.364	195.95	16.13	6.835
643.00	53.00	242.990	195.98	16.16	6.881
643.10	53.10	244.110	196.01	16.19	6.912
643.20	53.20	246.643	196.04	16.22	6.984
643.30	53.30	249.031	196.07	16.25	7.052
643.40	53.40	251.104	196.10	16.28	7.110
643.50	53.50	253.166	196.13	16.31	7.169
643.60	53.60	255.250	196.16	16.34	7.228
643.70	53.70	257.323	196.19	16.37	7.287
643.80	53.80	259.393	196.22	16.40	7.345
643.90	53.90	261.469	196.25	16.43	7.404
644.00	54.00	263.543	196.28	16.46	7.463
644.10	54.10	265.615	196.31	16.49	7.521
644.20	54.20	266.688	196.34	16.52	7.552
644.30	54.30	269.761	196.37	16.55	7.639
644.40	54.40	271.834	196.40	16.58	7.697
644.50	54.50	273.907	196.43	16.61	7.756
644.60	54.60	275.980	196.46	16.64	7.815
644.70	54.70	278.053	196.49	16.67	7.874
644.80	54.80	280.127	196.53	16.71	7.932
644.90	54.90	282.199	196.56	16.74	7.991
645.00	55.00	284.273	196.59	16.77	8.050
645.10	55.10	286.797	196.62	16.80	8.121
645.20	55.20	289.322	196.65	16.83	8.193
645.30	55.30	291.847	196.68	16.86	8.264
645.40	55.40	294.372	196.71	16.89	8.336
645.50	55.50	296.896	196.74	16.92	8.407

Table 16: Capacity table as per silt survey–1986 (Page 16 of 21)

645.60	55.60	299.481	196.77	16.95	8.480
645.70	55.70	301.946	196.80	16.98	8.550
645.80	55.80	304.471	196.83	17.01	8.622
645.90	55.90	306.995	196.86	17.04	8.693
646.00	56.00	309.524	196.89	17.07	8.765
646.10	56.10	312.045	196.92	17.10	8.836
646.20	56.20	314.570	196.95	17.13	8.908
646.30	56.30	317.095	196.98	17.16	8.979
646.40	56.40	319.586	197.01	17.19	9.050
646.50	56.50	322.000	197.04	17.22	9.118
646.60	56.60	324.553	197.07	17.25	9.190
646.70	56.70	327.037	197.10	17.28	9.261
646.80	56.80	329.521	197.14	17.32	9.331
646.90	56.90	332.004	197.17	17.35	9.401
647.00	57.00	334.488	197.20	17.38	9.472
647.10	57.10	336.971	197.23	17.41	9.542
647.20	57.20	339.455	197.26	17.44	9.612
647.30	57.30	341.938	197.29	17.47	9.683
647.40	57.40	344.422	197.32	17.50	9.753
647.50	57.50	346.905	197.35	17.53	9.823
647.60	57.60	349.389	197.38	17.56	9.894
647.70	57.70	351.862	197.41	17.59	9.964
647.80	57.80	354.356	197.44	17.62	10.034
647.90	57.90	356.839	197.47	17.65	10.104
648.00	58.00	359.329	197.50	17.68	10.175
648.10	58.10	361.807	197.53	17.71	10.245
648.20	58.20	364.290	197.56	17.74	10.315
648.30	58.30	366.773	197.59	17.77	10.386
648.40	58.40	369.256	197.62	17.80	10.456
648.50	58.50	371.741	197.65	17.83	10.526
648.60	58.60	374.224	197.68	17.86	10.597
648.70	58.70	376.708	197.71	17.89	10.667
648.80	58.80	379.195	197.74	17.92	10.738
648.90	58.90	381.675	197.78	17.96	10.808
649.00	59.00	384.158	197.81	17.99	10.878
649.10	59.10	386.642	197.84	18.02	10.948
649.20	59.20	389.125	197.87	18.05	11.019
649.30	59.30	391.609	197.90	18.08	11.089
649.40	59.40	394.092	197.93	18.11	11.159
649.50	59.50	396.566	197.96	18.14	11.229
649.60	59.60	399.060	197.99	18.17	11.300
649.70	59.70	401.703	198.02	18.20	11.375

Table 17: Capacity table as per silt survey–1986 (Page 17 of 21)

649.80	59.80	404.347	198.05	18.23	11.450
649.90	59.90	406.991	198.08	18.26	11.525
650.00	60.00	409.635	198.11	18.29	11.599
650.10	60.10	412.927	198.14	18.32	11.693
650.20	60.20	416.219	198.17	18.35	11.786
650.30	60.30	419.511	198.20	18.38	11.879
650.40	60.40	422.804	198.23	18.41	11.972
650.50	60.50	426.096	198.26	18.44	12.066
650.60	60.60	429.388	198.29	18.47	12.159
650.70	60.70	432.680	198.32	18.50	12.252
650.80	60.80	435.975	198.35	18.53	12.345
650.90	60.90	439.275	198.38	18.56	12.439
651.00	61.00	442.055	198.42	18.60	12.517
651.10	61.10	445.539	198.45	18.63	12.616
651.20	61.20	449.642	198.48	18.66	12.732
651.30	61.30	452.434	198.51	18.69	12.811
651.40	61.40	455.726	198.54	18.72	12.905
651.50	61.50	459.018	198.57	18.75	12.998
651.60	61.60	462.311	198.60	18.78	13.091
651.70	61.70	465.603	198.63	18.81	13.184
651.80	61.80	468.825	198.66	18.84	13.276
651.90	61.90	472.187	198.69	18.87	13.371
652.00	62.00	475.480	198.72	18.90	13.464
652.10	62.10	479.772	198.75	18.93	13.586
652.20	62.20	481.064	198.78	18.96	13.622
652.30	62.30	485.756	198.81	18.99	13.755
652.40	62.40	489.049	198.84	19.02	13.848
652.50	62.50	492.341	198.87	19.05	13.941
652.60	62.60	495.633	198.90	19.08	14.035
652.70	62.70	499.025	198.93	19.11	14.131
652.80	62.80	502.218	198.96	19.14	14.221
652.90	62.90	505.123	198.99	19.17	14.303
653.00	63.00	508.479	199.02	19.20	14.398
653.10	63.10	511.008	199.06	19.24	14.470
653.20	63.20	515.193	199.09	19.27	14.589
653.30	63.30	518.542	199.12	19.30	14.683
653.40	63.40	521.905	199.15	19.33	14.779
653.50	63.50	525.262	199.18	19.36	14.874
653.60	63.60	528.611	199.21	19.39	14.968
653.70	63.70	531.974	199.24	19.42	15.064
653.80	63.80	535.331	199.27	19.45	15.159
653.90	63.90	538.687	199.30	19.48	15.254

Table 18: Capacity table as per silt survey–1986 (Page 18 of 21)

654.00	64.00	542.044	199.33	19.51	15.349
654.10	64.10	545.400	199.36	19.54	15.444
654.20	64.20	548.756	199.39	19.57	15.539
654.30	64.30	552.113	199.42	19.60	15.634
654.40	64.40	555.469	199.45	19.63	15.729
654.50	64.50	558.825	199.48	19.66	15.824
654.60	64.60	562.182	199.51	19.69	15.919
654.70	64.70	565.538	199.54	19.72	16.014
654.80	64.80	568.895	199.57	19.75	16.109
654.90	64.90	572.251	199.60	19.78	16.204
655.00	65.00	575.608	199.63	19.81	16.299
655.10	65.10	579.612	199.66	19.84	16.413
655.20	65.20	583.676	199.70	19.88	16.528
655.30	65.30	587.651	199.73	19.91	16.640
655.40	65.40	591.665	199.76	19.94	16.754
655.50	65.50	595.680	199.79	19.97	16.868
655.60	65.60	599.695	199.82	20.00	16.981
655.70	65.70	603.009	199.85	20.03	17.075
655.80	65.80	607.723	199.88	20.06	17.209
655.90	65.90	611.738	199.91	20.09	17.322
656.00	66.00	615.752	199.94	20.12	17.436
656.10	66.10	619.767	199.97	20.15	17.550
656.20	66.20	623.554	200.00	20.18	17.657
656.30	66.30	628.400	200.03	20.21	17.794
656.40	66.40	632.847	200.06	20.24	17.920
656.50	66.50	637.292	200.09	20.27	18.046
656.60	66.60	641.738	200.12	20.30	18.172
656.70	66.70	646.184	200.15	20.33	18.298
656.80	66.80	650.630	200.18	20.36	18.424
656.90	66.90	655.036	200.21	20.39	18.548
657.00	67.00	659.522	200.24	20.42	18.675
657.10	67.10	663.968	200.27	20.45	18.801
657.20	67.20	669.419	200.30	20.48	18.956
657.30	67.30	672.860	200.34	20.52	19.053
657.40	67.40	677.306	200.37	20.55	19.179
657.50	67.50	681.752	200.40	20.58	19.305
657.60	67.60	686.198	200.43	20.61	19.431
657.70	67.70	690.644	200.46	20.64	19.557
657.80	67.80	695.090	200.49	20.67	19.683
657.90	67.90	699.536	200.52	20.70	19.808
658.00	68.00	703.982	200.55	20.73	19.934
658.10	68.10	708.428	200.58	20.76	20.060

Table 19: Capacity table as per silt survey–1986 (Page 19 of 21)

658.20	68.20	712.874	200.61	20.79	20.186
658.30	68.30	717.320	200.64	20.82	20.312
658.40	68.40	721.767	200.67	20.85	20.438
658.50	68.50	726.212	200.70	20.88	20.564
658.60	68.60	730.658	200.73	20.91	20.690
658.70	68.70	735.104	200.76	20.94	20.816
658.80	68.80	739.550	200.79	20.97	20.942
658.90	68.90	743.996	200.82	21.00	21.067
659.00	69.00	748.442	200.85	21.03	21.193
659.10	69.10	752.888	200.88	21.06	21.319
659.20	69.20	757.880	200.91	21.09	21.461
659.30	69.30	761.780	200.94	21.12	21.571
659.40	69.40	766.226	200.98	21.16	21.697
659.50	69.50	770.124	201.01	21.19	21.807
659.60	69.60	773.593	201.04	21.22	21.906
659.70	69.70	777.070	201.07	21.25	22.004
659.80	69.80	780.543	201.10	21.28	22.102
659.90	69.90	784.016	201.13	21.31	22.201
660.00	70.00	787.490	201.16	21.34	22.299
660.10	70.10	792.729	201.19	21.37	22.447
660.20	70.20	797.968	201.22	21.40	22.596
660.30	70.30	803.207	201.25	21.43	22.744
660.40	70.40	808.446	201.28	21.46	22.892
660.50	70.50	813.685	201.31	21.49	23.041
660.60	70.60	818.925	201.34	21.52	23.189
660.70	70.70	824.164	201.37	21.55	23.338
660.80	70.80	829.403	201.40	21.58	23.486
660.90	70.90	834.642	201.43	21.61	23.634
661.00	71.00	839.881	201.46	21.64	23.783
661.10	71.10	845.121	201.49	21.67	23.931
661.20	71.20	850.360	201.52	21.70	24.079
661.30	71.30	855.599	201.55	21.73	24.228
661.40	71.40	860.838	201.58	21.76	24.376
661.50	71.50	866.070	201.62	21.80	24.524
661.60	71.60	871.317	201.65	21.83	24.673
661.70	71.70	876.556	201.68	21.86	24.821
661.80	71.80	881.795	201.71	21.89	24.969
661.90	71.90	887.034	201.74	21.92	25.118
662.00	72.00	892.273	201.77	21.95	25.266
662.10	72.10	897.512	201.80	21.98	25.414
662.20	72.20	902.752	201.83	22.01	25.563
662.30	72.30	907.991	201.86	22.04	25.711

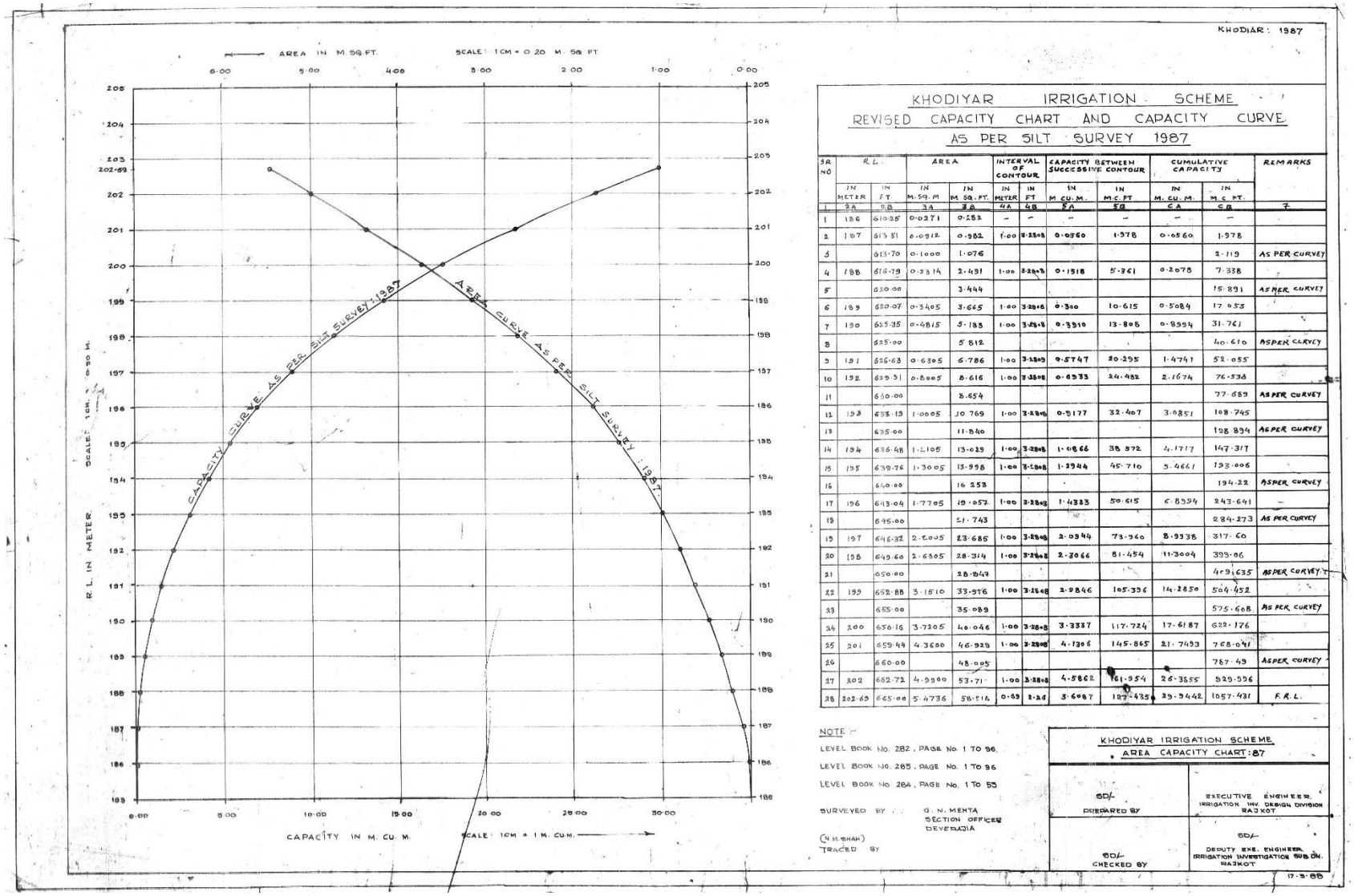
Table 20: Capacity table as per silt survey–1986 (Page 20 of 21)

662.40	72.40	913.230	201.89	22.07	25.860
662.50	72.50	918.469	201.92	22.10	26.008
662.60	72.60	923.708	201.95	22.13	26.156
662.70	72.70	928.948	201.98	22.16	26.305
662.80	72.80	934.467	202.01	22.19	26.461
662.90	72.90	940.057	202.04	22.22	26.619
663.00	73.00	945.645	202.07	22.25	26.777
663.10	73.10	951.235	202.10	22.28	26.936
663.20	73.20	956.824	202.13	22.31	27.094
663.30	73.30	962.413	202.16	22.34	27.252
663.40	73.40	968.002	202.19	22.37	27.411
663.50	73.50	973.592	202.22	22.40	27.569
663.60	73.60	979.181	202.26	22.44	27.727
663.70	73.70	984.370	202.29	22.47	27.874
663.80	73.80	990.359	202.32	22.50	28.044
663.90	73.90	995.949	202.35	22.53	28.202
664.00	74.00	1002.538	202.38	22.56	28.388
664.10	74.10	1007.127	202.41	22.59	28.518
664.20	74.20	1012.716	202.44	22.62	28.677
664.30	74.30	1018.706	202.47	22.65	28.846
664.40	74.40	1023.895	202.50	22.68	28.993
664.50	74.50	1029.484	202.53	22.71	29.151
664.60	74.60	1035.073	202.56	22.74	29.310
664.70	74.70	1040.662	202.59	22.77	29.468
664.80	74.80	1046.252	202.62	22.80	29.626
664.90	74.90	1051.841	202.65	22.83	29.785
665.00	75.00	1057.431	202.68	22.86	29.94

Executive Engineer
Amreli Irrigation Divisioin
Amreli

Table 21: Capacity table as per silt survey–1986 (Page 21 of 21)

Figure 3 shows the snapshot of Khodiyar irrigation scheme, revised capacity chart and capacity curve as per silt survey 1987 (as provided by the client).



KHODIYAR IRRIGATION SCHEME
REVISED CAPACITY CHART AND CAPACITY CURVE
AS PER SILT SURVEY 1987

SR NO	R.L. IN METER	R.L. IN FT	AREA IN M.SQ.M	AREA IN M SQ.FT.	INTERVAL OF CONTOUR IN METER	INTERVAL OF CONTOUR IN FT	CAPACITY BETWEEN SUCCESSIVE CONTOUR IN M CU.M.	CAPACITY BETWEEN SUCCESSIVE CONTOUR IN M.C.FT	CUMULATIVE CAPACITY IN M. CU.M.	CUMULATIVE CAPACITY IN M.C.FT.	REMARKS
1	186	610.25	0.0271	0.283	–	–	–	–	–	–	
2	187	613.51	0.0912	0.982	1.00	3.2808	0.0360	1.278	0.0360	1.278	
3		613.70	0.1000	1.076						2.119	AS PER CURVE
4	188	616.79	0.2314	2.491	1.00	3.2808	0.1518	5.361	0.2078	7.338	
5		620.00		3.444						15.891	AS PER CURVE
6	189	620.07	0.3405	3.665	1.00	3.2808	0.300	10.615	0.5084	17 953	
7	190	623.35	0.4815	5.183	1.00	3.2808	0.3910	13.808	0.8994	31.761	
8		625.00		5 812						40.610	AS PER CURVE
9	191	626.63	0.6305	6.786	1.00	3.2808	0.5747	20.295	1.4741	52.055	
10	192	629.91	0.8005	8.616	1.00	3.2808	0.6333	24.482	2.1674	76.538	
11		630.00		8.654						77.689	AS PER CURVE
12	193	633.13	1.0005	10 769	1.00	3.2808	0.9177	32.407	3.0851	108.745	
13		635.00		11.840						128.894	AS PER CURVE
14	194	636.48	1.2105	13.029	1.00	3.2808	1.0866	38.372	4.1717	147.317	
15	195	639.76	1.3005	13.998	1.00	3.2808	1.2944	45.710	5.4661	193.006	
16		640.00		16 253						194.22	AS PER CURVE
17	196	643.04	1.7705	19.057	1.00	3.2808	1.4333	50.615	6.8994	243.641	
18		645.00		21.743						284.273	AS PER CURVE
19	197	646.32	2.2005	23.685	1.00	3.2808	2.0944	73.960	8.9938	317.60	
20	198	649.60	2.6505	28.314	1.00	3.2808	2.3066	81.454	11.3004	399.06	
21		650.00		28.847						409.635	AS PER CURVE
22	199	652.88	3.1510	33.916	1.00	3.2808	2.9846	105.336	14.2850	504.452	
23		655.00		35.089						575.608	AS PER CURVE
24	200	656.16	3.7205	40.046	1.00	3.2808	3.3337	117.724	17.6187	622.176	
25	201	659.44	4.3600	46.929	1.00	3.2808	4.1306	145.865	21.7493	768.041	
26		660.00		48.005						787.49	AS PER CURVE
27	202	662.72	4.9900	53.71	1.00	3.2808	4.5862	161.954	26.3355	929.596	
28	202.65	665.00	5.4736	58.918	0.65	2.26	3.6987	127.435	29.9442	1057.431	F.R.L.

NOTE :-
LEVEL BOOK No. 282, PAGE No. 1 TO 96.
LEVEL BOOK No. 285, PAGE No. 1 TO 96
LEVEL BOOK No. 284, PAGE No. 1 TO 55

SURVEYED BY : G. N. MEHTA, SECTION OFFICER, DEVERADIA
TRACED BY : (N.M.SHAH)

KHODIYAR IRRIGATION SCHEME
AREA CAPACITY CHART : 87

SD/- PREPARED BY — EXECUTIVE ENGINEER, IRRIGATION INV. DESIGN DIVISION RAJKOT
SD/- CHECKED BY — SD/- DEPUTY EXE. ENGINEER, IRRIGATION INVESTIGATION SUB DN. RAJKOT

17-3-88

Figure 3: Khodiyar irrigation scheme, revised capacity chart and capacity curve as per silt survey 1987

Annexure - 4
Daily Progress Reports

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

Khodiyar Dam DPR No. 001

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSAS SMB	Date:	26-07-2021
Location:	Khodiyar Dam	Sheet No:	1 of 1
Party Chief: Mansuri M. I.		Client Rep.	

Survey Personnel:

1. Nikhil Rane	2. Arsh Mansuri	3.Vipul Dangar (Local)
4.	5.	6.
7.	8.	9.
10.		

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

Time (hrs)		Activities
1445		Transit from Kunariya to Khodiyar Dam, Dhari.
	2200	Night halt at Rajkot en route to Khodiyar Dam.

		Today's coverage		Cumulative coverage	
		Bathymetry: **0.000sq.km**	Line km: **0.000**	Bathymetry: **0.000sq.km**	Line km: **0.000**
		Topo: **0.000sq.km**	Line km: 8.760	Topo: **0.000km**	Line km: **0.000**
		Weather downtime today: 0 hours		Cumulative weather downtime: 0 hours	

Plan for next 24 hours : Continue with shifting equipment and team to Khodiyar dam .

Remarks :

Party Chief	**Client Representative**

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

Khodiyar Dam DPR No. 002

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSAS SMB	Date:	27-07-2021
Location:	Khodiyar Dam	Sheet No:	1 of 1
Party Chief: Mansuri M. I.		Client Rep.	

Survey Personnel:

1. Nikhil Rane	2. Arsh Mansuri	3.Vipul Dangar (Local)
4.	5.	6.
7.	8.	9.
10.		

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

Time (hrs)		**Activities**
0700		Team continues to Khodiyar dam from Rajkot
	1100	Reached Khodiyar dam.
1300		Equipment unloaded at Khodiyar dam restroom.
1730	2000	Observation starts by DGPS for reference station of TBM-1.

		Today's coverage		Cumulative coverage	
		Bathymetry: **0.000sq.km**	Line km**: 0.000**	Bathymetry: **0.000sq.km**	Line km**: 0.000**
		Topo: **0.000sq.km**	Line km: 0.000	Topo: **0.000km**	Line km: **0.000**
		Weather downtime today: 0 hours		Cumulative weather downtime: 0 hours	

Plan for next 24 hours : Continue with RTK topo survey.

Remarks :

Party Chief	**Client Representative**

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

Khodiyar Dam DPR No. 003

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSAS SMB	Date:	28-07-2021
Location:	Khodiyar Dam	Sheet No:	1 of 1
Party Chief: Mansuri M. I.		Client Rep.	

Survey Personnel:

1. Nikhil Rane	2. Arsh Mansuri	3.Vipul Dangar (Local)
4.	5.	6.
7.	8.	9.
10.		

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

Time (hrs)		Activities
0630	0700	Transit dam guest house to Khodiyarmata dam site.
0700	0715	Land survey start.
0715		Observation starts by DGPS for reference station of TBM-2.
	0920	Observation completed for TBM-2.
0920	1430	Waiting for weather (raining).
1430		Observation starts by DGPS for reference station of TBM-1.
	1710	Observation completed for TBM-1.
1710	1720	Land survey terminated and reference station secured.
1720	1800	Land survey team returned to dam guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry: **0.000sq.km**	Line km: **0.000**	Bathymetry: **0.000sq.km**	Line km: **0.000**
		Topo: **0.000sq.km**	Line km: 0.000	Topo: **0.000km**	Line km: **0.000**
		Weather downtime today: 5 hours		Cumulative weather downtime: 5 hours	

Plan for next 24 hours : Continue with RTK topo survey.

Remarks :

Party Chief	**Client Representative**

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

Khodiyar Dam DPR No. 004

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSAS SMB	Date:	29-07-2021
Location:	Khodiyar Dam	Sheet No:	1 of 1
Party Chief: Mansuri M. I.		Client Rep.	

Survey Personnel:

1. Nikhil Rane	2. Arsh Mansuri	3.Vipul Dangar (Local)
4.	5.	6.
7.	8.	9.
10.		

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

Time (hrs)		**Activities**
0645	0710	Transit dam guest house to Khodiyarmata dam site.
0710		Land survey start.
	1245	Land survey terminated due to rain.
1445		Land survey resumed.
		Meeting with S.O. Mr. Hiren Vaja, Dep. Engineer Mr. Shailesh Katariya and Pulkeet Kaul
	1630	Cross checked elevation of their known point with our DGPS system. They are satisfied and allowed to proceed for further survey.
1630	1645	Land survey terminated and reference station secured.
1645	1715	Land survey team returned to dam guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry: **0.000sq.km**	Line km: **0.000**	Bathymetry: **0.000sq.km**	Line km: **0.000**
		Topo: **0.006sq.km**	Line km: 0.240	Topo: **0.006km**	Line km: **0.240**
		Weather downtime today: 2 hours		Cumulative weather downtime: 7 hours	

Plan for next 24 hours : Continue with RTK topo survey.

Remarks :

Party Chief	**Client Representative**

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

Khodiyar Dam DPR No. 005

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSAS SMB	Date:	30-07-2021
Location:	Khodiyar Dam	Sheet No:	1 of 1
Party Chief: Mansuri M. I.		Client Rep.	

Survey Personnel:

1. Nikhil Rane	2. Arsh Mansuri	3.Vipul Dangar (Local)
4.	5.	6.
7.	8.	9.
10.		

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

Time (hrs)		**Activities**
0645	0710	Transit dam guest house to Khodiyarmata dam site.
0710		Land survey start.
	1415	Land survey terminated and reference station secured.
1415	1500	Land survey team returned to dam guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry: **0.000sq.km**	Line km**: 0.000**	Bathymetry: **0.000sq.km**	Line km**: 0.000**
		Topo: **0.104sq.km**	Line km: 4.160	Topo: **0.110km**	Line km: **4.400**
		Weather downtime today: 2 hours		Cumulative weather downtime: 7 hours	

Plan for next 24 hours : Continue with RTK topo survey.

Remarks :

Party Chief	**Client Representative**

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

Khodiyar Dam DPR No. 006

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSAS SMB	Date:	31-07-2021
Location:	Khodiyar Dam	Sheet No:	1 of 1
Party Chief: Mansuri M. I.		Client Rep.	

Survey Personnel:

1. Nikhil Rane	2. Arsh Mansuri	3.Vipul Dangar (Local)
4.	5.	6.
7.	8.	9.
10.		

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

Time (hrs)		**Activities**
0645	0710	Transit dam guest house to Khodiyarmata dam site.
0710		Land survey started.
	1345	Land survey suspended due to rain.
1345	1430	Land survey terminated and reference station secured.
1430	1500	Land survey team returned to dam guest house.
1800		Tappar dam team arrived (Salman, Pankaj, Gaurav, Manoj and boat operator.
		Equipment unloaded at Khodiyar dam guest house and boat unloaded at Khodiyar dam side.
		Tappar team returned to Dhari guest house.
	2100	Land survey team returned to dam guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry: **0.000sq.km**	Line km**: 0.000**	Bathymetry: **0.000sq.km**	Line km**: 0.000**
		Topo: **0.181sq.km**	Line km: 7.240	Topo: **0.291km**	Line km: **11.640**
		Weather downtime today: 2 hours		Cumulative weather downtime: 7 hours	

Plan for next 24 hours : Continue with RTK topo survey.

Remarks :

Party Chief	**Client Representative**

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

Khodiyar Dam DPR No. 007

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSAS SMB	Date:	01-08-2021
Location:	Khodiyar Dam	Sheet No:	1 of 1
Party Chief: Mansuri M. I.		Client Rep.	

Survey Personnel:

1. Nikhil Rane	2. Arsh Mansuri	3.Vipul Dangar (Local)
4. Salman	5. Pankaj Rabari	6.Gaurav Sharma
7.Manoj More	8. Junas I. Kher(Local boat opretor)	9.
10.		

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

Time (hrs)		Activities
0645	0710	Transit dam guest house to Khodiyarmata dam site.
0710		Land survey start.
	1345	Land survey suspended due to rain.
1345	1430	Land survey terminated and reference station secured.
1430	1500	Land survey team returned to dam guest house.
0700	0730	Transit guest house Dhari to dam guest house.
0730		Vertical datum established by observation by DGPS for reference station of OS-TBM from dam right side railing wall on top shown by client representative, S.O. Mr. Hiren Vaja Dy. Engineer Mr. Shailesh Katariya and Pulkeet Kaul (Khodiyarmata dam) to the newly established reference Station (temporary benchmark).
		Boat mobilisation completed.
	1700	Land survey team returned to dam guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry: **0.000sq.km**	Line km**: 0.000**	Bathymetry: **0.000sq.km**	Line km**: 0.000**
		Topo: **0.041sq.km**	Line km: 1.640	Topo: **0.332km**	Line km: **13.280**
		Weather downtime today: 2 hours		Cumulative weather downtime: 7 hours	

Plan for next 24 hours : Continue with RTK topo survey.

Remarks :

Party Chief	**Client Representative**

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Khodiyar Dam DPR No. 008

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSAS SMB	Date:	02-08-2021
Location:	Khodiyar Dam	Sheet No:	1 of 1
Party Chief: Salman		Client Rep.	

Survey Personnel:

1. Gaurav Sharma	2. Pankaj Rabari	3. Manoj More
4. Nikhil Rane	5. Arsh Mansuri	6. Junas I. Kher (Local boat operator)
7.	8.	9.

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

Time (hrs)		**Activities**
0740	0820	Team reached dam site.
0820	0850	set up RTK base station.
0850	1740	Survey carried out.
1740	1800	Secured base and team returned to guest house.

	Today's coverage		Cumulative coverage	
	Bathymetry: **0.000sq.km**	Line km: **0.000**	Bathymetry: **0.000sq.km**	Line km: **0.000**
	Topo: **0.218sq.km**	Line km: **8.72**	Topo: **0.550km**	Line km: **22**
	Weather downtime today: 1 hours		Cumulative weather downtime: 8 hours	

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

Remarks :

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

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

Khodiyar Dam DPR No. 009

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSAS SMB	Date:	03-08-2021
Location:	Khodiyar Dam	Sheet No:	1 of 1
Party Chief: Salman		Client Rep.	

Survey Personnel:

1. Gaurav Sharma	2. Pankaj Rabari	3. Manoj More
4. Nikhil Rane	5. Arsh Mansuri	6. Junas I. Kher (Local boat operator)
7.	8.	9.

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

Time (hrs)		**Activities**
0730	0800	Team reached dam site.
0820	0850	Set up RTK base station.
0850	1050	Bathymetry survey carried out.
0850	1740	Topo survey carried out.
1050	1300	Due to high wind speed bathy survey suspended, waiting for weather.
1300	1330	Secured base and bathy team returned to guest house.
1740	1800	Secured base and topo team returned to guest house.
Note:		**Due to high wind speed bathy survey could not continue, waiting on weather.**

	Today's coverage		Cumulative coverage	
	Bathymetry: **0.092sq.km**	Line km: **3.68**	Bathymetry: **0.092sq.km**	Line km: **3.68**
	Topo: **0.11sq.km**	Line km: **4.4**	Topo: **0.66km**	Line km: **26.4**
	Weather downtime today: 4 hours		Cumulative weather downtime: 12 hours	

Plan for next 24 hours : Continue bathy, 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

Khodiyar Dam DPR No. 010

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSAS SMB	Date:	04-08-2021
Location:	Khodiyar Dam	Sheet No:	1 of 1
Party Chief: Salman		Client Rep.	

Survey Personnel:

1. Gaurav Sharma	2. Pankaj Rabari	3. Manoj More
4. Nikhil Rane	5. Arsh Mansuri	6. Junas I. Kher (Local boat opretor)
7.	8.	9.

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

Time (hrs)		Activities
0730	0800	Team reached dam site.
0800	0830	Set up RTK base station.
0830	1810	Topo survey carried out.
1810	1850	Secured base and topo team returned to guest house.
Note:		**Due to rough weather no bathy survey carried out. Both the teams did topo survey.**

		Today's coverage		Cumulative coverage	
		Bathymetry: **0.000sq.km**	Line km: **0.000**	Bathymetry: **0.092sq.km**	Line km: **3.68**
		Topo: **0.365sq.km**	Line km: **14.6**	Topo: **1.025km**	Line km: **41**
		Weather downtime today: 0 hours		Cumulative weather downtime: 12 hours	

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

Remarks :

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

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

Khodiyar Dam DPR No. 011

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSAS SMB	Date:	05-08-2021
Location:	Khodiyar Dam	Sheet No:	1 of 1
Party Chief: Salman		Client Rep.	

Survey Personnel:

1. Gaurav Sharma	2. Pankaj Rabari	3. Manoj More
4. Nikhil Rane	5. Arsh Mansuri	6. Junas I. Kher (Local boat opretor)
7.	8.	9.

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

Time (hrs)		**Activities**
0730	0800	Team reached dam site.
0820	0850	Set up RTK base station.
0850	1820	Bathymetry survey carried out.
0850	1700	Topo survey carried out.
1700	1720	Secured base and topo team returned to guest house.
1820	1900	Secured base and bathy team returned to guest house.
Note:		**Topo survey completed.**

		Today's coverage		Cumulative coverage	
		Bathymetry: **1.032sq.km**	Line km: **41.3**	Bathymetry: **1.125 sq.km**	Line km: **44.98**
		Topo: **0.087sq.km**	Line km: **3.48**	Topo: **1.112km**	Line km: **44.48**
		Weather downtime today: 0 hours		Cumulative weather downtime: 12 hours	

Plan for next 24 hours : Continue bathy 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

Khodiyar Dam DPR No. 012

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSAS SMB	Date:	06-08-2021
Location:	Khodiyar Dam	Sheet No:	1 of 1
Party Chief: Salman		Client Rep.	

Survey Personnel:

1. Gaurav Sharma	2. Pankaj Rabari	3. Manoj More
4. Nikhil Rane	5. Arsh Mansuri	6. Junas I. Kher (Local boat operator)
7.	8.	9.

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

Time (hrs)		Activities
0710	0730	Team reached dam site.
0730	0750	Set up RTK base station.
0750	1640	Bathymetry survey carried out.
1640	1700	Secured base and team returned to guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry: **1.075sq.km**	Line km**: 43**	Bathymetry: **2.200 sq.km**	Line km**: 87.98**
		Topo: 0.000sq.km	Line km**:** 0.000	Topo: **1.112km**	Line km: **44.48**
		Weather downtime today: 0 hours		Cumulative weather downtime: 12 hours	

Plan for next 24 hours : Continue bathy survey.

Remarks : Manoj more, Nikhil rane and Arsh mansuri left site at 1700hrs.

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

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

Khodiyar Dam DPR No. 013

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

Survey Personnel:

1. Gaurav Sharma	2. Pankaj Rabari	3. Junas I. Kher (Local boat operator)
4.	5.	6.
7.	8.	9.

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

Time (hrs)		**Activities**
0730	0750	Team reached dam site.
0750	0820	Set up RTK base station.
0820	1800	Bathymetry survey carried out.
1800	1830	Secured base and team returned to guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry: **0.79sq.km**	Line km: **31.6**	Bathymetry: **2.990sq.km**	Line km: **119.58**
		Topo: 0.000sq.km	Line km: 0.000	Topo: **1.112km**	Line km: **44.48**
		Weather downtime today: 0 hours		Cumulative weather downtime: 12 hours	

Plan for next 24 hours : Continue bathy 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

Khodiyar Dam DPR No. 014

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

Survey Personnel:

1. Gaurav Sharma	2. Pankaj Rabari	3. Junas I. Kher (Local boat operator)
4.	5.	6.
7.	8.	9.

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

Time (hrs)		**Activities**
0730	0750	Team reached dam site.
0750	0820	Set up RTK base station.
0820	1800	Bathymetry survey carried out.
1800	1830	Secured base and team returned to guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry: **0.743sq.km**	Line km: **29.7**	Bathymetry: **3.733sq.km**	Line km: **149.28**
		Topo: 0.000sq.km	Line km: 0.000	Topo: **1.112km**	Line km: **44.48**
		Weather downtime today: 0 hours		Cumulative weather downtime: 12 hours	

Plan for next 24 hours : Continue bathy 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

Khodiyar Dam DPR No. 015

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSAS SMB	Date:	09-08-2021
Location:	Khodiyar Dam	Sheet No:	1 of 1
Party Chief: Salman		Client Rep.	

Survey Personnel:

1. Gaurav Sharma	2. Pankaj Rabari	3. Junas I. Kher (Local boat opretor)
4.	5.	6.
7.	8.	9.

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

Time (hrs)		Activities
0745	0810	Team reached dam site.
0810	0830	Set up RTK base station.
0830	1830	Bathymetry survey carried out.
1830	1900	Secured base and team returned to guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry: **0.663 sq.km**	Line km: **26.5**	Bathymetry: **4.396 sq.km**	Line km: **175.78**
		Topo: 0.000sq.km	Line km: 0.000	Topo: **1.112km**	Line km: **44.48**
		Weather downtime today: 0 hours		Cumulative weather downtime: 12 hours	

Plan for next 24 hours : Continue bathy survey.

Remarks :

Party Chief **Client Representative**

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

Khodiyar Dam DPR No. 016

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSAS SMB	Date:	10-08-2021
Location:	Khodiyar Dam	Sheet No:	1 of 1
Party Chief: Salman		Client Rep.	

Survey Personnel:

1. Gaurav Sharma	2. Pankaj Rabari	3. Junas I. Kher (Local boat opretor)
4.	5.	6.
7.	8.	9.

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

Time (hrs)		**Activities**
0630	0710	Team reached dam site.
0710	0730	Set up RTK base station.
0730	1330	Bathymetry survey carried out.
1330	1430	Client rep visited site.
1430	1500	Secured base and team returned to guest house.
Note:		**Site completed. Boat being demobilised.**

		Today's coverage		Cumulative coverage	
		Bathymetry: **0.305 sq.km**	Line km: **12.2**	Bathymetry: **4.701 sq.km**	Line km: **187.98**
		Topo: 0.000sq.km	Line km: 0.000	Topo: **1.112km**	Line km: **44.48**
		Weather downtime today: 0 hours		Cumulative weather downtime: 12 hours	

Plan for next 24 hours :

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

Khodiyar Dam DPR No. 017

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSAS SMB	Date:	11-08-2021
Location:	Khodiyar Dam	Sheet No:	1 of 1
Party Chief: Salman		Client Rep.	

Survey Personnel:

1. Gaurav Sharma	2. Pankaj Rabari	3.
4.	5.	6.
7.	8.	9.

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

Time (hrs)		Activities
1200	2030	Started journey from Khodiyar dam and reached UND-1 dam.
2030	2130	Boat loaded in the truck from UND-1 dam.
2130	0230	Started journey from UND-1 dam and reached Khodiyar dam.
Note:		**Both boat tracker handed over to Mr Fateh Singh Jadeja at Rajkot irrigation department office.**

		Today's coverage		Cumulative coverage	
		Bathymetry: **0.000sq.km**	Line km: **0.000**	Bathymetry: **4.701 sq.km**	Line km: **187.98**
		Topo: 0.000sq.km	Line km: 0.000	Topo: **1.112km**	Line km: **44.48**
		Weather downtime today: 0 hours		Cumulative weather downtime: 12 hours	

Plan for next 24 hours :

Remarks : Boat operator left site 0730hrs.

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