GECO PREQUALIFICATION

Geotechnical & Environmental Co. Ltd





+966 11 233 2805
+966 553501395
info@geco.com.sa

INTRODUCTION

Due to the progress and rapid development which can be seen at the Kingdom of Saudi Arabia in various fields, therefore, it requires the need to adjust and monitor the quality control in all areas in order to achieve the required balance access to the highest degree of urbanization without prejudice to the safety and security of the Saudi citizen and the environment around him. In order to achieve this noble goal, we have sought to establish the Geotechnical and Environmental Company, with the availability of the scientific expertise, specialists, modern technology and equipment to carry out quality control in those areas and the associated studies and research on soil, concrete, block, steel, asphalt and testing environment for air, water and soil. With the aid of after God competencies qualified human resources and the latest and best machines, equipment, and scientific instruments that qualified us for innovation and excellence.

GENERAL MANAGER



Geotechnical & Environmental Co. Ltd (GECO) was established to provide services in several disciplines, including geotechnical engineering, construction materials testing and engineering, environmental consulting and measurements, hydrological studies and geophysical survey.

Our main goal is to benefit our customers in both the public and private sectors through technical and consulting engagements with high professional standards and technical competence. This has been achieved by joining a group of scientific experts and specialists in the field of services that we offer joined by a crew technical coaches at the highest level in addition to laboratory specifications and global standards and a set of high-quality measuring tools and the latest findings of the science of devices field tests and sampling.

VISION رؤيـــة 2030
المملكة العربية السعودية
KINGDOM OF SAUDI ARABIA

Geco جيكو



GECO SERVICES

+966 11 269 5847
+966 553501395
info@geco.com.sa

- providing efficient cost effective public utility services to the citizens of KSA with a commitment to continuous improvement through teamwork.
- To continue to innovative development of our services with high-quality technique

MISSION

- A partner of choice by our clients.
- Delivering services based on real needs.
- Technologically advanced in our fields of expertise while remaining practical and business oriented.
- Adding value to clients' projects
- Being worthy of clients' confidence by remaining accountable for our actions.

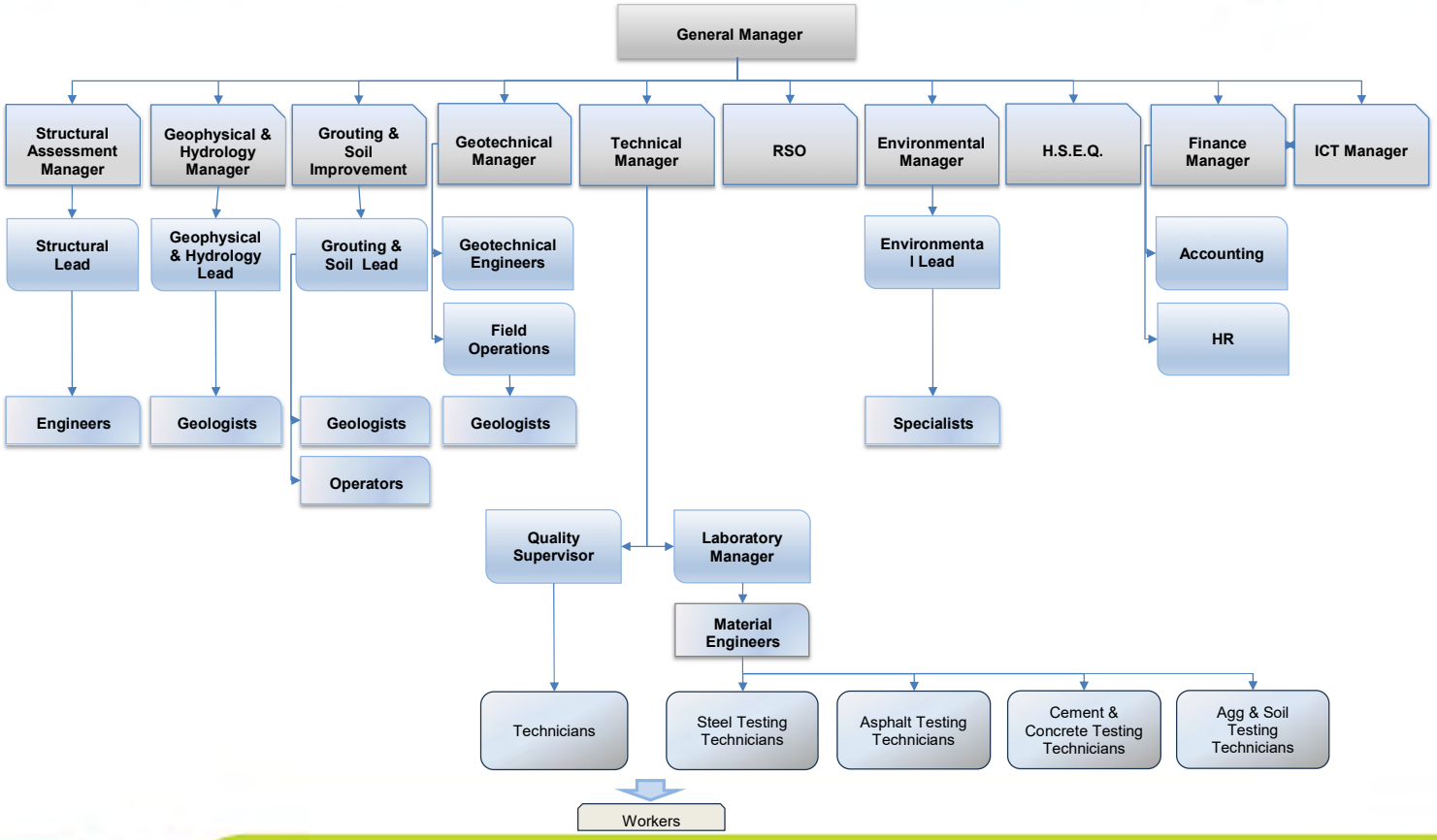
VISION

OBJECTIVES

- Maintaining broadly based employee ownership
- Providing an environment for a satisfying and challenging career
- Providing an umbrella for ambitious individuals to grow their client base and their reputations in directions somewhat of their own choosing
- Maintaining an environment which is conducive to innovative thinking and solutions
- Recognizing and rewarding excellence and achievement
- Fostering a unified corporate culture

ORGANIZATION CHART

GECO Organizational Chart



LEGAL DOCUMENTS

وزارة التجـارة
Ministry of Commerce

شهادة السجل التجاري

البيانات الأساسية للسجل التجاري

7037400103

شركة الجيوتقنية والبيئية المحدودة

- الرقم الوطني الموحد: 7037400103
- تاريخ الإصدار: 03/12/2023
- نوع الكيان: شركة ذات مسؤولية محدودة
- صفات الشركة : (شخص واحد)
- حالة السجل: نشط

100241096398827

TIN	3119385147	الرقم المميز
Certificate No.	100241096398827	رقم الشهادة
Certificate date	03/12/2023	تاريخ الشهادة

هيئة الزكاة والضريبة والجمارك
Zakat, Tax and Customs Authority

المملكة العربية السعودية
Kingdom of Saudi Arabia

شهادة تسجيل في ضريبة القيمة المضافة

VAT Registration Certificate

تشهد هيئة الزكاة والضريبة والجمارك بأن المكلف أدناه مسجل في ضريبة القيمة المضافة بتاريخ ٢٠٢٣/١٢/٠٣ م

The Zakat, Tax and Customs Authority certifies that taxpayer below is VAT registered on 03/12/2023 AD

Taxpayer Name	شركة الجيوتقنية والبيئية المحدودة	اسم المكلف
VAT Registration Number	311938514700003	رقم التسجيل الضريبي
Effective Registration Date	2024/01/01	تاريخ نفاذ التسجيل
Taxpayer Address	الرياض،الرياض،14263،XXXX	عنوان المكلف
CR / License Contact / ID No	1010957842	رقم السجل التجاري / الرخصة / العقد / الهوية
Tax Period	ربع سنوي-Quarterly	الفترة الضريبية
First Filing due date	2024/04/30	تاريخ استحقاق أول إقرار ضريبي

ملاحظة: كمكلفين مسجلين في ضريبة القيمة المضافة, لا يجوز لكم تحصيل ضريبة القيمة المضافة من عملائكم قبل تاريخ نفاذ التسجيل في الضريبة. و في حال تبين غير ذلك ستقوم هيئة الزكاة والضريبة و الجمارك بتنفيذ الغرامات المستحقة

Note: As a VAT registered taxpayer, you are not allowed to collect VAT from your customers prior to the effective date of the tax registration. If otherwise approved, The ZAKAT,Tax and Customs Authority will impose the applicable penalties

ضريبة القيمة المضافة VAT

هذه الوثيقة مستخرجة من النظام الآلي ولا تحتاج إلى توقيع
و لا يعتد بهذه الشهادة إلا بعد التحقق من موقع الهيئة
www.zatca.gov.sa

1027257785

TIN	3119385147	الرقم المميز
Certificate No.	1027257785	رقم الشهادة
Certificate date	1447/11/12هـ	تاريخ الشهادة

هيئة الزكاة والضريبة والجمارك
Zakat, Tax and Customs Authority

المملكة العربية السعودية
Kingdom of Saudi Arabia

شهادة
Certificate

The Zakat,Tax and Customs Authority certifies that the Taxpayer	شركة الجيوتقنية والبيئية المحدودة	تشهد هيئة الزكاة و الضريبة و الجمارك أن المكلف /
Entity Unified No./ID No.	7037400103	الرقم الموحد للمنشأة /رقم الهوية
CR National Number / License / Contract No.	1010957842	الرقم الموحد للسجل التجاري / رخصة /عقد رقم

Has submitted his tax return for the period ending on 31/12/2025 AD, and he was granted the certificate to complete all his transactions including the payment of the final amount due on the contract.

قدم إقراره عن الفترة المنتهية في 1447/07/11 هـ ، وقد منح هذه الشهادة لإنهاء جميع معاملاته بما في ذلك صرف مستحقاته النهائية عن العقود.

This certificate is valid until 23/11/1448 AH corresponding to 30/04/2027 AD

يسري مفعول هذه الشهادة حتى تاريخ 1448/11/23 هـ الموافق 2027/04/30 م

The Twenty third of Dhu al-Qi'dah one thousand four hundred forty-eight Hijri

الثالث و العشرون من ذو القعدة ألف و أربعمائة و ثمانية و أربعون هجري

لايعتد بهذه الشهادة إلا بعد التحقق من موقع الهيئة الالكتروني www.zatca.gov.sa

This certificate is not valid until verified by the Authority's Website www.zatca.gov.sa

هذه الوثيقة مستخرجة من النظام الآلي ولا تحتاج إلى توقيع
و لا يعتد بهذه الشهادة إلا بعد التحقق من موقع الهيئة
www.zatca.gov.sa

CLICK TO VALIDATE

شهادة آيبان

IBAN Letter

مصرف الراجحي
alrajhi bank

Ref. No	29187995	الرقم التسلسلي
Date	20/01/2025 - 1446/07/20	التاريخ
Time	02:12 PM	الوقت

Certificate Details

To	من يهمه الأمر	إلى
Mr./Mrs.	شركة الجيوتقنية والبيئية المحدودة	المكرمالمكرمة
ID No. Unified National	7037400103	رقم الهوية الوطنية
Account Number	296000010006084598547	رقم الحساب
IBAN Number	SA5080000296608014598547	رقم الحساب الدولي - الآيبان

We would like to inform you that you can use your IBAN number in the following services:
- In receiving remittances, dividends, or salaries in your account locally or internationally.
- In uploading IBAN number of your beneficiaries in local or international bank through E-channel of Al Rajhi Bank

This statement was issued to customer upon his/her request without any liability

نود أن نلفت نظركم بأن رقم الحساب الدولي الآيبان يتم استخدامه في العمليات المصرفية التالية:
- في حالة استلامكم حوالة ، أو أرباح أسهم ، أو إيداع الراتب من خلال بنوك محلية ودولية يتم تزويد الجهة المنفذة
- في حال أردتم حفظ بعض أرقام حسابات المستفيدين لدى البنوك المحلية أو الدولية عن طريق القنوات الإلكترونية.

أعطى العميلة هذه الإفادة بناء على طلبها دون أدنى مسؤولية مترتبة على مصرف الراجحي

Note:

This document is confidential and under the responsability of the holder

ملاحظة:

هذه الوثيقة سرية ويتحمل حاملها كامل مسؤولية المحافظة عليها.

business
alrajhi bank business

App Store Google play

المصرفية الرقمية
digital banking

Alrajhibank.com.sa
920 003 344

غرفة الرياض
Riyadh Chamber

شهـادة اشتراك
Membership Certificate

Membership No. :	879023	879023	رقم العضوية الموحد :
Date of Issue:	30/11/2023	2023/11/30	تاريخ الاصدار:
Membership Class :	Second	الثانية	درجة العضوية :

Riyadh Chamber Certifies

تشهد الغرفة التجارية الصناعية بالرياض بأن

.aljiotqniya walbaiya Company Ltd

شركة الجيوتقنية والبيئية المحدودة

Commercial Registration No.	1010957842	1010957842	مقيدة بالسجل التجاري / الترخيص رقم :
National Number	7037400103	7037400103	الرقم الموحد :
Certificate Expires on	10/11/2027	2027/11/10	ينتهي سريان هذه الشهادة في

- يلزم التحقق من الوثيقة عبر الرابط التالي https://mybusiness.chamber.sa/ او تطبيق (بوابة أعمالي) للهواتف الذكية دون أدنى مسؤولية على الغرفة التجارية عن محتوى الوثيقة.
- تعتبر هذه الوثيقة مصدقة من غرفة الرياض ولا تحتاج الى توقيع او ختم.
- عند التعديل على الوثيقة او محاولة العبث بها تعتبر لاغية وتعرض صاحبها للمسألة القانونية.

الخدمات الإلكترونية
E-SERVICES
الخدمات الإلكترونية لغرفة الرياض - بوابة أعمالي © E-Services Riyadh Chamber
920004565

RIYADH EXPO 2030

أمانة منطقة الرياض
RIYADH REGION MUNICIPALITY

خدمات بلدي
balady services

رخصة نشاط تجاري
Commercial Activity Licence
شركة الجيوتقنية والبيئية المحدودة

License Expiry Date	تاريخ نهاية الترخيص	License Number	رقم الرخصة الموحد
1449/04/14		460216616458	

Owner's Name	اسم المالك
شركة الجيوتقنية والبيئية المحدودة	

Owner's ID	رقم هوية المالك
7037400103	

ISIC Classification	التصنيف الصناعي القياسي الدولي (نشاط ايزك)
مختبرات التشييد ومواد البناء	

Detailed Activity	النشاط التفصيلي
مختبرات التشييد ومواد البناء	

Sub-Municipality	البلدية	Municipality	الأمانة
قطاع جنوب مدينة الرياض		أمانة منطقة الرياض	

Street	الشارع	District	الحي
هارون الرشيد		السلي	

Sign's Area	مساحة اللوحة	Sign's Type	نوع اللوحة
2		إرشادية	

موقع المحل

Shop's Total Area	مساحة المحل الإجمالية
350 متر مربع	

للاطلاع على الأنشطة الإضافية وتفاصيل الرخصة يرجي مسح رمز الاستجابة السريع Code QR

Permit Expiry Date	تاريخ انتهاء التصريح	Permit Number	رقم التصريح	Permits	التصاريح

هذا الترخيص لا يخول البدء بالانتاج الا بعد الحصول على تراخيص الجهات ذات العلاقة

هيئة المحتوى المحلي
والمشتريات الحكومية
Local Content & Government
Procurement Authority

التاريخ: 2026/02/16م
رقم الشهادة : M 225542

شهادة المحتوى المحلي
Local content certification

تشهد هيئة المحتوى المحلي والمشتريات الحكومية أن نسبة المحتوى المحلي لـ [شركة الجيوتقنية والبيئية المحدودة] الرقم الوطني الموحد [7037400103]، للسنة المالية المنتهية بتاريخ 2024/12/31م، تبلغ 48.26%.

تنتهي صلاحية هذه الشهادة في **2026/07/31م**.

تنويه:
تم إصدار هذه الشهادة بحسب الإجراءات المتبعة لدى الهيئة بناء على الإفصاح المقدم من المنشأة و التقرير الصادر من مكتب المراجعة المعتمد، دون أدنى مسؤولية على الهيئة.

هذه الوثيقة مرسلة عبر البريد الإلكتروني/ النظام الآلي ولا تحتاج إلى توقيع.

يمكنك التحقق من صحة البيانات الواردة في الشهادة أعلاه من خلال الرابط التالي URL أو من خلال مسح الرمز الرقمي أعلاه

The Local Content & Government Procurement Authority certifies that the Local Content Score for [aljiotqniya walbaiya Company Ltd] Unified National Number [7037400103] for the year ended in 31/12/2024, is 48.26%.

This certificate expires on **31/07/2026**.

Note:
This certificate was issued according to the procedures followed by the Authority and based on the disclosure submitted by the entity and the report issued by the approved audit firm, without holding LCGPA minimally responsible.
This certificate is sent via electronic mail / automated system and it does not require a signature.

You can validate the information in this certificate via the following link URL or by scanning the above QR code

ترخيص مختبر خاص

Private Laboratory License

Laboratory Name:	شركة الجيوتقنية والبيئية المحدودة geotechnical and environmental Limited Company	اسم المختبر:
Laboratory Address:	5 8041-14263 الرياض 3543	العنوان:
Responsible Person:	علي عمر حمدان Ali Omar Hamdan	الشخص المسؤول:
Contact Information:	Email: finance@geco.com.sa TEL: +966112695847	علاوين للتواصل:

تم ترخيص المنشأة المذكورة أعلاه كمختبر خاص مرخص لدى الهيئة السعودية للمواصفات والمقاييس والجودة بناء على الطلب المقدم من قبلهم بتاريخ 2025/03/25 م ووفقاً لنظام المختبرات الخاصة الصادر بموجب المرسوم الملكي الكريم رقم (م/3) وتاريخ 1423/02/08 هـ والمعدل بموجب المرسوم الملكي الكريم رقم (م/31) وتاريخ 1443/04/06 هـ ولائحته التنفيذية.

وذلك لممارسة نشاط:

(الفحص والاختبار للمواد والمنتجات والعمليات والأجهزة والمعدات)

للقطاعات المحددة في الوثيقة المرفقة.

يحدد الملحق : القطاعات الفنية ضمن مجال الترخيص

Saudi Standards, Metrology and Quality Organization has licensed the above facility as a private laboratory based on their application submitted on 25/03/2025 and in accordance with the private laboratories system, issued by the Royal Decree No. (M/3) dated 02/08/1423 AH, and amended by the Royal Decree No. (M/31) dated 06/04/1443 AH, and its implementing regulation.

To conduct the activity of:

(Testing an examination of Materials, Products, Processes, Devices and Equipment)

For the sectors specified in the attached document.

Annex specifies: The Technical Sectors within the scope of licensing

License No:	PLL 0021	رقم الترخيص:

Date of Issue: 09/04/2025 — **تاريخ الإصدار : 2025/04/09 م**

License Validity : Five years from the date of issue — **صلاحية الترخيص: خمس سنوات من تاريخ الإصدار**

نائب المحافظ للمطابقة والعمليات

Vice Governor for Conformity and Operations

المهندس / سعود بن راشد العسكر

Eng. Saud R. AlAsker

الإدارة العامة لسلامة المنتجات
SASO
إدارة قبول جهات تقويم المطابقة
الهيئة السعودية للمواصفات والمقاييس والجودة
Saudi Standards, Metrology and Quality org.

يخضع هذا الترخيص خلال مدة سريانه للأنظمة واللوائح ذات العلاقة في المملكة العربية السعودية وأي تعليمات أو تعديلات تصدرها الهيئة

(مجال ترخيص مختبر خاص) رقم الترخيص: PLL 0021 - 09/04/2025

(Private Laboratory License Scope) License No.: PLL 0021 - 09/04/2025

رقم الترخيص License No.	عنوان المختبر Laboratory Address	اسم المختبر Laboratory Name	مجال ترخيص مختبر Laboratory License Scope

قطاع التشييد ومواد البناء
Construction and Building Materials Sector

S.No.	المجالات الفنية Technical Scopes	المواصفات القياسية Standards
1	اللائحة الفنية لقطاعات المعادن وسبائكها للإنشاءات والمباني Technical Regulation for Sectors of Metals and their Alloys for Buildings and Constructions	ASTM A370----SASO-ASTM-A370
3	اللائحة الفنية للروابط الهيدروليكية والمنتجات ذات العلاقة Technical Regulation for Hydraulic Links and Related Produets	ASTM C136-----NO EQUIVALENT IN SASO, ASTM C535----NO EQUIVALENT IN SASO, ASTM C131/C131M----SASO-ASTM-C131, ASTM C127-----NO EQUIVALENT IN SASO, ASTM D2419 ----- NO EQUIVALENT IN SASO, ASTM C29/C29M---SASO-ASTM-C29, ASTM C143/C143M----SASO-ASTM-C143M, ASTM C138/C138M----SASO-ASTM-C138M, ASTM C39/C39M---SASO-ASTM-C39M
8	اختبارات التربة Soil Testing	ASTM D422, ASTM D2435, ASTM D3080, ASTM D1194, ASTM D4318, ASTM D6913/D6913M, ASTM D2216, ASTM D1883, ASTM D1557, ASTM D1556/D1556M, ASTM D1140

PLL 0021	3543 الرياض 14263- / 5 8041 3543 14263-8041 5 Riyadh	شركة الجيوتقنية والبيئية المحدودة / geotechnical and environmental Limited Company	

الإدارة العامة لسلامة المنتجات
إدارة قبول جهات تقويم المطابقة
الهيئة السعودية للمواصفات والمقاييس والجودة
Saudi Standards, Metrology and Quality org.

PSD-CAB-F59 V01

(مجال ترخيص مختبر خاص) رقم الترخيص: PLL 0021 - 09/04/2025

(Private Laboratory License Scope) License No.: PLL 0021 - 09/04/2025

9	أخرى Other	ASTM D2041, ASTM D5731, ASTM D6927, ASTM D2172/D2172M

الإدارة العامة لسلامة المنتجات
SASO
إدارة قبول جهات تقويم المطابقة
الهيئة السعودية للمواصفات والمقاييس والجودة
Saudi Standards, Metrology and Quality org.

المملكة العربية السعودية
Kingdom of Saudi Arabia
ص.ب. 3437 الرياض 11471
P.O.Box 3437 Riyadh 11471
T 920009085
F +966114520086
www.saso.gov.sa
info@saso.gov.sa

المركز السعودي للاعتماد
Saudi Accreditation Center

ilac-MRA

شهادة اعتماد

ACCREDITATION CERTIFICATE

Saudi Accreditation (SAAC) certifies that :

geotechnical and environmental Limited Company

Address: 6181 Haroun Arrasheed street Al Sulay Dist. 14322 Riyadh

Scope : Construction

Has met the requirements of Saudi Accreditation Center and has been accredited in compliance with the following standard :

يشهد الاعتماد السعودي بأن :

شركة الجيوتقنية والبيئية المحدودة

العنوان : 6181 طريق هارون الرشيد حي السلي 14322 الرياض

المجال : التشييد والبناء

قد حقق متطلبات المركز السعودي للاعتماد وتم اعتماده وفقاً لمتطلبات المواصفات القياسية التالية :

ISO/IEC 17025:2017

General Requirements for the competence of testing and calibration laboratories

المتطلبات العامة لكفاءة مختبرات الفحص والمعايرة

N-T-00717

Issue Date : 07/06/2025

Expire Date : 07/05/2028

الختم

تاريخ الإصدار : 07/06/2025

تاريخ الانتهاء : 07/05/2028

#	اسم الاختبار	المنتج / المادة	طريقة العمل / المواصفة	التقنية / الجهاز المستخدم	الحالة
1	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens	Concrete	ASTM C39/C39M	Compression Testing Machine , Digital Balance ,Caliper , Currying Tank	مفعل
2	Standard Test Method for Slump of Hydraulic Cement Concrete	Concrete	ASTM C143/C143M	Slump Cone Test Sets	مفعل
3	Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate	Aggregate	ASTM C29/C29M	Digital Balance , Bulk Density Measure	مفعل
4	Standard Test Methods for Determining the Amount of Material Finer than 75-m (No.200) Sieve in Soils by Washing	Soil	ASTM D1140	Sieves , Digital Balance	مفعل
5	Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method	Soil	ASTM D1556/D1556M	Sand Cone Apparatus , Digital Balance	مفعل
6	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN- m/m3))	Soil	ASTM D1557	Digital Balance , Drying Oven , Riffle Sampler , Automatic Proctor Compactor	مفعل
7	Standard Test Method for California Bearing Ratio (CBR) of Laboratory- Compacted Soils	Soil	ASTM D1883- 16	Automatic CBR	مفعل
8	Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass	Soil	ASTM D2216	Digital Balance and Drying Oven	مفعل
9	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate	Aggregate	ASTM D2419	Drying Oven , Sieves and Sand Equivalent Device	مفعل

#	اسم الاختبار	المنتج / المادة	طريقة العمل / المواصفة	التقنية / الجهاز المستخدم	الحالة
10	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils	Soil	ASTM D4318	Drying Oven , Casagrande Liquid Limit Apparatus and Analytical Balance	مفعل
11	Standard Test Method for Relative Density (Specific Gravity) and Absorption of Course Aggregate	Aggregate	ASTM C127	Specific Gravity Frame	مفعل
12	Standard Test Method for Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine	Aggregate	ASTM C131/C131M	Drying Oven , Riffle Sampler , Sieves and Digital Balance	مفعل
13	Standard Test Methods for Quantitative Extraction of Asphalt Binder from Asphalt Mixtures	Asphalt	ASTM D2172/D2172M	Asphalt Centrifuge Extractor ,Sieves , Drying Oven and Digital Balance	مفعل
14	Standard test method for Marshall stability and flow for asphalt mixtures	Asphalt	ASTM D6927	Automatic Marshall Stability Tester	مفعل
15	Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures	Asphalt	ASTM D2041	Vacuum Pycnometer , Digital Balance , Drying Oven	مفعل
16	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates	Aggregate	ASTM C136	Sieves	مفعل
17	Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine	Aggregate	ASTM C535	Los Angeles Machine	مفعل

License Number:	**31293RY-01**	**رقم الرخصة:**
Version:	1	الإصدار:
Effective Date:	16/02/2026	تاريخ الإصدار:
Expiration Date	15/02/2031	تاريخ الإنتهاء:

هيئة الرقابة النووية والإشعاعية
Nuclear and Radiological Regulatory Commission

License Operation
For Use of radiation sources in gauges and exploration

رخصة تشغيل
لممارسة استخدام المصادر الإشعاعية للقياس والاستكشاف

Facility Details — تفاصيل المنشأة

Organization Name:	Geotecnical and Environmental Company Limited شركة الجيوتقنية والبيئية المحدودة	**إسم الجهة:**
Facility Name:	Geotecnical and Environmental Company Limited شركة الجيوتقنية والبيئية المحدودة	**إسم المنشأة:**
Facility Code:	31293RY	**رقم المنشأة:**
Province:	الرياض/Riyadh	**المنطقة:**
City:	الرياض	**المدينة / المحافظة:**
Location:	-	**الموقع:**

This is a license to perform the following radiation practices: — تتيح هذه الرخصة للمنشأة القيام بالممارسات الإشعاعية التالية:

Use of nuclear moisture / density gauges — **استخدام المصادر الإشعاعية النووية لقياس الكثافة أو الرطوبة**

License Allowed Use Limits: — حدود الاستخدام المسموح بها

Sealed Sources — مصادر مشعة مختومة

Radionuclide	Maximum Radioactivity of each source - radionuclide	Number of Sources
Am-241	40.00 ملي كيوري (mCi)	5
Cs-137	10.00 ملي كيوري (mCi)	5

Operational Limits and Conditions: — حدود وشروط التشغيل:

.1 List of vehicles plate number:

1. 8043 TGB
2. 6687 BGB
3. 6689 BGB
4. 6690 BGB
5. 8042 TGB

License Number:	**31293RY-01**	**رقم الرخصة:**
Version:	1	الإصدار:
Effective Date:	16/02/2026	تاريخ الإصدار:
Expiration Date	15/02/2031	تاريخ الإنتهاء:

هيئة الرقابة النووية والإشعاعية
Nuclear and Radiological Regulatory Commission

To check authenticity of the license by visiting the link below on the website of NRRC

https://aman.nrrc.gov.sa/LicenseVerification

or

By using the following identifier code:



للتحقق من صحة وصلاحية الرخصة عبر زيارة الرابط أدناه في الموقع الإلكتروني لهيئة الرقابة النووية والإشعاعية

https://aman.nrrc.gov.sa/LicenseVerification

أو

عن طريق استخدام الرمز المعرف التالي:

ترخيص بيئي

البيانات الاساسية

اسم المنشأة	شركة الجيوتقنية والبيئية المحدودة		
رقم السجل التجاري	1010957842	الهاتف	597720882
العنوان	الرياض – 7056 الدائري الشرقي الفرعي- مخرج 14 – 4682 حي الربوة 12824		
الخدمات البيئية	خدمات الدراسات والاستشارات البيئية		
رقم الترخيص	ELESL-2025-000320	الفئة	Type A
تاريخ اصدار الترخيص	27/10/2025	تاريخ إنتهاء الترخيص	27/09/2028

نطاق العمل

إعداد وتقديم دراسات تقييم الأثر البيئي للفئة الثانية والثالثة
إعداد دراسات التدقيق البيئي للفئة الثانية والثالثة
إعداد خطط الإدارة البيئية
إعداد خطط إعادة التأهيل المواقع المتدهورة ومعالجة التربة الملوثة
إعداد التقارير البيئية الدورية أو الذاتية
تقديم الاستشارات البيئية

اشتراطات الترخيص البيئي الخاصة

الالتزام بإجراء التحاليل والقياسات من أحد المختبرات والمنشآت أو مراكز الأبحاث الحكومية المرخصة من قبل المركز
الالتزام بجميع الارشادات الخاصة بعمل الدراسات البيئية حسب ما ورد في اللائحة التنفيذية للتصاريح البيئية لإنشاء وتشغيل الأنشطة لنظام البيئة

ترخيص بيئي

اسم المنشأة	شركة الجيوتقنية والبيئية المحدودة
الخدمات البيئية	خدمات الدراسات والاستشارات البيئية
رقم السجل التجاري	1010957842

اشتراطات الترخيص البيئي العامة

الإفصاح عن أي تضارب مصالح، والقيام بكل ما هو ضروري ولازم لعدم حدوث ذلك.
الالتزام بإضافة النشاط في السجل التجاري.
الالتزام بالأنظمة واللوائح ذات العلاقة في توظيف الكادر الفني مع الالتزام بتقديم الخدمات بجودة عالية وصورة متقنة وفقاً لأفضل الطرق . والأساليب العلمية الصحيحة والحديثة
الالتزام بالتقدم لتجديد شهادة الترخيص البيئي قبل انتهائه.
الالتزام بالتقيد بضوابط واشتراطات الترخيص البيئي والصادرة بقرار إداري.
الالتزام بالنظام البيئة ولوائحه التنفيذية والقرارات والاشتراطات والمتطلبات والمعايير البيئية والتوجيهات الصادرة من المركز الوطني للرقابة . على الالتزام البيئي
الالتزام بتزويد المركز بتقارير سنوية عن نشاط المنشأة مع إرفاق تقرير شامل عند طلب تجديد شهادة الترخيص.
الالتزام بتنفيذ جميع الاشتراطات المذكورة وفي حال الإخلال بها سيعرض المنشأة لإيقاع العقوبة عليها حسب النظام البيئي ولوائحه التنفيذية.
الالتزام بتوظيف الكادر الفني المعتمد بالمنشأة وإرسال ما يثبت ذلك إلى المركز خلال 3 شهر من تاريخ اصدار الترخيص.
الالتزام بمشاركة مندوب من المنشأة اثناء الزيارة الميدانية للموقع من قبل مختصي المركز.
تلتزم كافة الجهات المرخصة إخطار المركز عن أي تغييرات أو مستجدات تطرأ على أوضاعها أو كوادرها الفنية أو تغيير ملكية السجل التجاري . أو على البيانات والمعلومات المسجلة لدى المركز وذلك خلال شهر من تاريخ هذا التغيير كحد أقص
لا يجوز التنازل عن الترخيص البيئي إلا بعد موافقة المركز وتحقيق جميع المتطلبات والشروط الخاصة بالنشاط.
يجب على الجهات المرخصة التي تنفذ أعمال بيئية بواسطة جهات أخرى التأكد من حصول هذه الجهات على الترخيص البيئي في مجال العمل.

ترخيص بيئي

اسم المنشأة	شركة الجيوتقنية والبيئية المحدودة
الخدمات البيئية	خدمات الدراسات والاستشارات البيئية
رقم السجل التجاري	1010957842

الكادر الفني

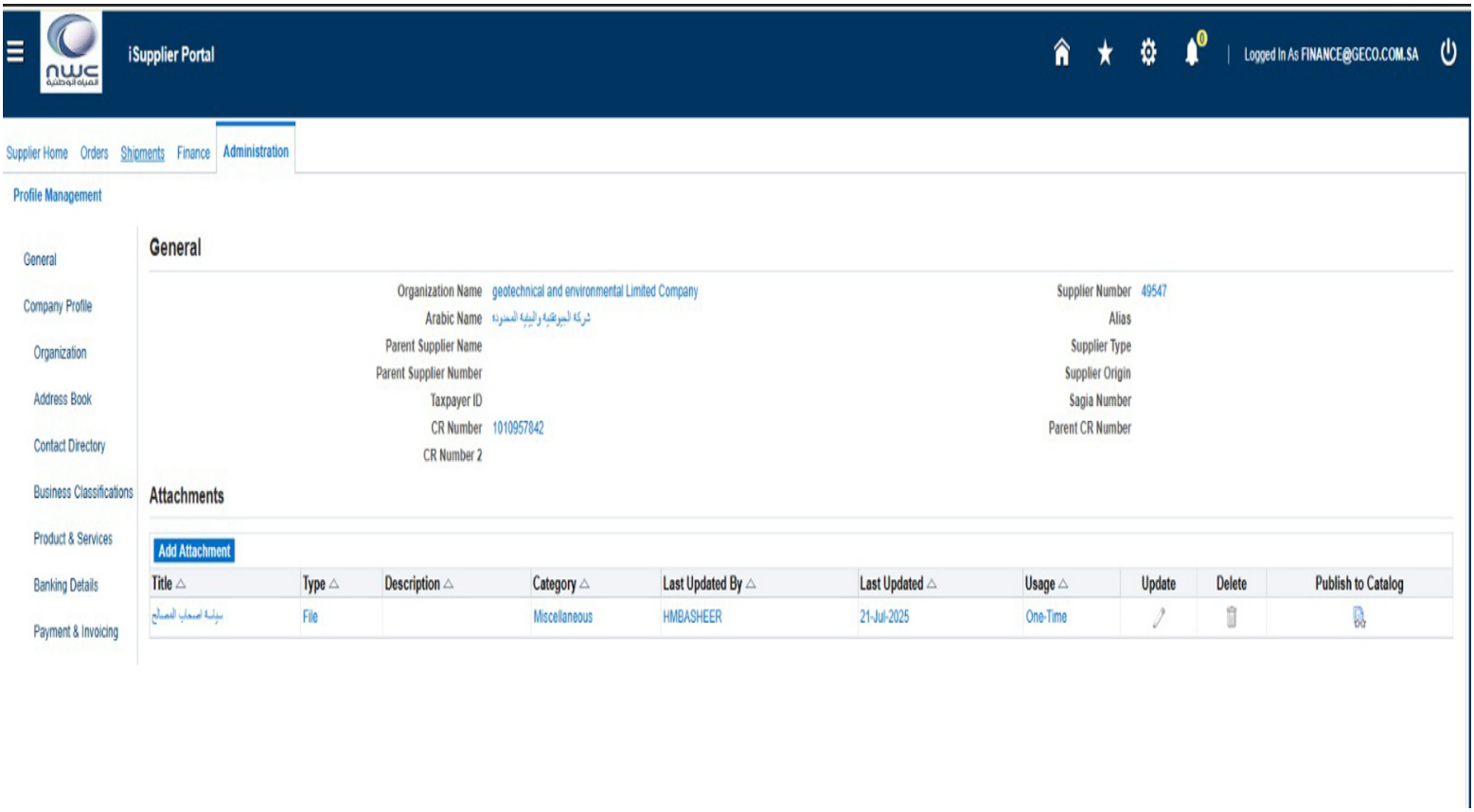
الاسم	رقم الهوية	التخصص
ALI HAMDAN	2268171473	علوم الأرض والبيئة
ALANOUD LAGHABI	1112006075	الكيمياء
MASHAEL ROTHAN	1082582113	الكيمياء
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HIND ALBALAWI	1048371783	التنوع الأحيائي
GEHAN ELSAKKA	2513813622	علوم البحار
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مدحت رمضان عطيه	2114953637	بكالوريس العلوم شعبة جيولوجيا وكيمياء

ترخيص بيئي

اسم المنشأة	شركة الجيوتقنية والبيئية المحدودة
الخدمات البيئية	خدمات الدراسات والاستشارات البيئية
رقم السجل التجاري	1010957842

الأجهزة البيئية

الشركة المصنعه	بلد المنشأ	الرقم التسلسلي


iSupplier Portal
Logged In As FINANCE@GECO.COM.SA
Supplier Home
Orders
Shipments
Finance
Administration
Profile Management
General
Company Profile
Organization
Address Book
Contact Directory
Business Classifications
Product & Services
Banking Details
Payment & Invoicing
General
Organization Name geotechnical and environmental Limited Company
Arabic Name شركة الجيوتقنية والبيئية المحدودة
Parent Supplier Name
Parent Supplier Number
Taxpayer ID
CR Number 1010957842
CR Number 2
Supplier Number 49547
Alias
Supplier Type
Supplier Origin
Sagia Number
Parent CR Number
Attachments
Add Attachment
Title
Type
Description
Category
Last Updated By
Last Updated
Usage
Update
Delete
Publish to Catalog
بيانية اصحاب المصالح
File
Miscellaneous
HMBASHEER
21-Jul-2025
One-Time

CERTIFICATE

This is to certify that the Environmental Management System of

Geotechnical and Environmental Company Ltd.

3543, Al Sulay Dist., Riyadh 14326, 8144, Kingdom of Saudi Arabia

has been assessed and found to conform to the requirements of

ISO 14001:2015

This Certificate is valid for the following scope

Provide Comprehensive solutions for in-site Investigation, Materials Testing, Environmental and Geophysical Studies, Topography and Mass Land Surveying, Ensuring Accurate Data and Reliable Results for Projects.

Certificate No.	:AMER24955
Original Issue Date	:25/02/2025
Issue Date	:14/04/2026 R0
Surveillance /Expiry Date	:24/02/2027
Recertification Date	:24/02/2028

Director

AMERICO QUALITY STANDARDS REGISTECH PVT. LTD

USA Office: 1603 Capitol Ave, Suite #402E, Majestic Building, Cheyenne, WY 82001

India Office: Office no 407, Commerce Center, Pimple Saudagar, Pune, 411027

CM-MS-7836

For verification and updated information concerning the present certificate, please visit www.americocert.com The Certificate is valid for period of 3 years subject to satisfactory annual surveillance audit. This Certificate is the property of AMERICO Quality Standards Registech Pvt. Ltd. & shall be returned immediately when demanded.

CERTIFICATE

This is to certify that the Occupational Health and Safety Management System of

Geotechnical and Environmental Company Ltd.

3543, Al Sulay Dist., Riyadh 14326, 8144, Kingdom of Saudi Arabia

has been assessed and found to conform to the requirements of

ISO 45001:2018

This Certificate is valid for the following scope

Provide Comprehensive solutions for in-site Investigation, Materials Testing, Environmental and Geophysical Studies, Topography and Mass Land Surveying, Ensuring Accurate Data and Reliable Results for Projects.

Certificate No.	:AMER24956
Original Issue Date	:25/02/2025
Issue Date	:14/04/2026 R0
Surveillance /Expiry Date	:24/02/2027
Recertification Date	:24/02/2028

Director

AMERICO QUALITY STANDARDS REGISTECH PVT. LTD

USA Office: 1603 Capitol Ave, Suite #402E, Majestic Building, Cheyenne, WY 82001

India Office: Office no 407, Commerce Center, Pimple Saudagar, Pune, 411027

CM-MS-7832

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CERTIFICATE

This is to certify that the Quality Management System of

Geotechnical and Environmental Company Ltd.

3543, Al Sulay Dist., Riyadh 14326, 8144, Kingdom of Saudi Arabia

has been assessed and found to conform to the requirements of

ISO 9001:2015

This Certificate is valid for the following scope

Provide Comprehensive solutions for in-site Investigation, Materials Testing, Environmental and Geophysical Studies, Topography and Mass Land Surveying, Ensuring Accurate Data and Reliable Results for Projects.

Certificate No.	:AMER24954
Original Issue Date	:25/02/2025
Issue Date	:14/04/2026 R0
Surveillance /Expiry Date	:24/02/2027
Recertification Date	:24/02/2028

Director

AMERICO QUALITY STANDARDS REGISTECH PVT. LTD

USA Office: 1603 Capitol Ave, Suite #402E, Majestic Building, Cheyenne, WY 82001

India Office: Office no 407, Commerce Center, Pimple Saudagar, Pune, 411027

CM-MS-7842

For verification and updated information concerning the present certificate, please visit www.americocert.com The Certificate is valid for period of 3 years subject to satisfactory annual surveillance audit. This Certificate is the property of AMERICO Quality Standards Registech Pvt. Ltd. & shall be returned immediately when demanded.

METHOD OF STATEMENT

Geotechnical & Environmental Co.

Method Of Statement For
Geotechnical Investigation



- Introduction.
- Site Reconnaissance.
- Drilling and Sampling Process.
- Field Tests.
- Lab. Tests.
- Logging.
- Geotechnical Report.
- Important Projects.

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Method of Statement for

GEOTECHNICAL INVESTIGATIONS

1. INTRODUCTION

The purpose of the geotechnical investigation shall be to obtain information concerning the nature, thickness and characteristics of the soil and rock strata underlying the project site and to determine the engineering properties of the various strata for use in the design of the project. The investigation shall include interpretation of data obtained with recommendations for suitable building foundation system.

The geotechnical investigation shall comprise drilling of boreholes, obtaining soil and rock samples for the laboratory analysis and carrying out in-situ and laboratory tests in accordance with the appropriate requirements of applicable British (BS) or American Standards (ASTM)

The geotechnical investigation works shall consist of:

- Site reconnaissance study consisting of a thorough review of available, aerial photos, literature, and a visual reconnaissance of the works
- Subsurface investigation program (Drilling & Sampling Procedures).
- Field testing of the strata.
- Laboratory testing of the samples recovered.
- Documentation, evaluation and reporting of the data obtained.

In this process of site reconnaissance, field investigations and testing, the nature, or characteristics of the material (surface and subsurface) will be evaluated.

2. SITE RECONNAISSANCE

Description of site area and the location of structure in addition to the surface soils.

3. SUBSURFACE INVESTIGATIONS (DRILLING & SAMPLING PROCEDURES)

The rotary drilling machine will make the boreholes.

Undisturbed sample will be taken in the soft and medium clay at 1.0, 1.5, 2.0 and 3.0 m depths and at 1.5 m intervals thereafter using a thin-walled sampler with dimensions conforming to standard sampling tubes specification (ASTM D 1587).

Disturbed samples for very stiff clay to hard clay layer will be collected during Standard Penetration Testing at 1.5 m intervals. (ASTM D 1586)

3.1 Rotary Drilling (ASTM D5783)

Rotary drilling consists of advancing a borehole by rotation and pressure on the drilling bits attached to the bottom of the drilling rods which cut and grind the material at the bottom of the boreholes into small particles. These particles are removed by circulating water or drilling fluid in a manner similar to that in wash borings. To obtain a sample, the drilling bit is replaced by a sampler. Collapse of the hole is normally prevented by drilling fluid, which consists of slurry of clay and water to which bentonite is often added. Most firm to hard foundation materials can be successfully sampled and explored for soil and rock classification using rotary drilling. The method works well at almost any site, and most types of sampling can be performed in a rotary drilling program.



3.2 Sampling

Samples are necessary for the identification and classification of soil and rock and for laboratory testing.

3.2.1 Soil Sampling:

Types of soil samples can be obtained during ground investigation: disturbed and undisturbed samples.

3.2.1.1 Undisturbed Samples:

Obtain in all cohesive soils or mixed soil having sufficient cohesion at depth intervals of 1m. The 200 mm of soil immediately above the level of soil to be sampled should be removed without the casing being lowered. Carefully clean boreholes before sampling;

Take samples in seamless sampling tubes not less than 100 mm internal diameter and 450 mm long designed so that samples can be sent to the laboratory without removal. Area ratio of sampling tube is to be less than 15%;

Oil the sampling tool inside and out. Force tool into the soil by jacking or, where this is not possible, by carefully hammer driving. Check distance tool is driven to prevent soil becoming compressed in sampler;

Immediately after taking samples from the boreholes remove a 25-mm thick layer from each end and seal ends with a thick coating of paraffin wax or other wax approved by the Engineer. Store the 25 mm thick layers in an airtight container for classification testing. Place a close-fitting lid or screwed cap over each sample tube end and make tube airtight. Send samples to the laboratory, suitably packed to prevent damage or disturbance. The number and label each tube so that sample can be identified giving borehole, soil stratum, depth at which it was taken and date.

3.2.1.2 Disturbed Samples:

Perform standard penetration test as specified to recover a disturbed sample of soil at intervals of not more than l m in the top 5 m and at intervals of 1.5 m or at the change of each strata thereafter, unless otherwise instructed by the Engineer;

Where undisturbed soil samples and standard penetration test samples are not obtained, recover disturbed samples of soils from boring tools. Obtain disturbed samples at such spacing to ensure that samples from borehole either in the form of undisturbed samples, standard penetration test samples or disturbed samples are obtained for every 1 m depth bored. Minimum weight of disturbed samples is to be as specified in ASTM D 420.

Where soil samples are required for compaction tests, the minimum weight of sample is to be 50 kg, unless otherwise instructed by the Engineer.

3.2.2 Rock Sampling:

3.2.2.1 Rotary Coring Methods:

Where boreholes are bored using rotary coring methods, extract rock cores of not less than 76 mm diameter, unless otherwise directed by the Engineer. After being brought to the surface remove core from core barrel by methods designed to cause least possible further disturbance;

Where split inner core barrels are not in use extract core by steadily applied pressure. Extraction by means of hammering the barrel or explosive extrusion under high air pressure or water pressures will not be permitted. After extrusion place core in a purpose made core box;

Adequately preserve cores and log. Photograph weak rock cores and those subject to disintegration on recovery.

3.2.2.2 Core Boxes:

To be of sound, robust construction able to withstand weight of core and any full boxes which may subsequently be placed on them and sufficiently watertight to protect core from rain. They are to be specially made to hold size of core being obtained tightly in place in rows separated by wooden slats. Boxes are to have strong metal hinged lid fitted with padlock, hasp, and staple for closing and end ropes for handling. Top and bottom of boxes are to be reinforced by cross straps to aid stacking and retrieval. Boxes are to be constructed of wood, marine plywood or other material approved by the Engineer.

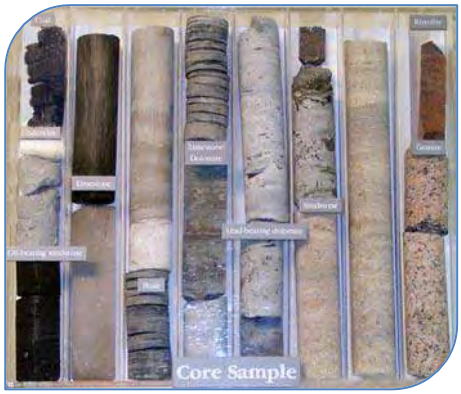
3.2.2.3 Placing Cores in Boxes:

As cores are extruded lay them in core box with shallowest core to left and deepest to right. Place highest row of core nearest lid hinge. Box is to be identified inside and outside by the site name, borehole number, core box number, depth of top and bottom of core included the Contractor's name and the date. Information is to be either painted on box or stamped on metal labels waxed and nailed to box;

Paint the depth of the top and bottom of the total core and separate core runs on blocks of wood or other material approved by the Engineer made to fit between dividing slots;

In order that zones of core loss can be readily identified insert wooden dowels cut to appropriate lengths and suitably identified either in sections where loss occurred or at base of particular core runs;

First seal with aluminum foil and subsequently cover with wax, sections of core which are weak and friable, formed of rocks or soils which are likely to dry out or otherwise alter in nature with time, before placing in core box.



3.2.2.4 Photographs:

All core boxes will be photographed as soon as possible after extraction. Photographs shall be free from distortion and shall include a scale and color chart. All boxes shall be clearly labeled and show the depth to the top and bottom of each core run.

3.2.3 Groundwater Sampling:

Take a sample of groundwater as soon as sufficient water has entered borehole after boring has reached groundwater level;

If water has been added to bore-hole before reaching groundwater level bale out all water in borehole and allows uncontaminated groundwater to seep back into borehole before sample is taken;

Where groundwater is sealed off by borehole casing and a lower aquifer is encountered take a sample of water from this and any succeeding aquifers;

Sample of groundwater is to be at least 500 ml in volume and placed in clean jars or bottles already rinsed with the water to be sampled and labeled and stored as described in BS 5930.

3.2.4 Sampling Techniques:

The main sampling operations include:

- Single tube core barrel sampling;
- Double tube core barrel sampling;

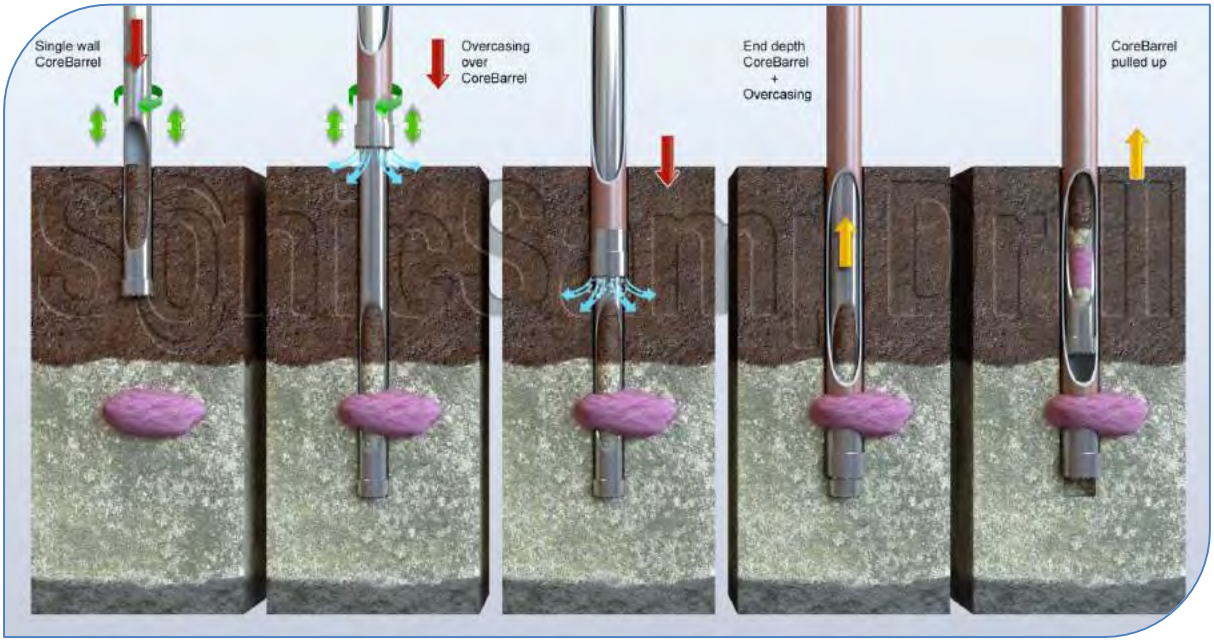
The following are general remarks on sampling methods and equipment

3.2.4.1 Single Tube Core Barrel Sampling:

Intact samples of rock can be obtained by means of core barrel with attached coring bit which cuts an annular ring in the rock and leaves a control core that enters in the core barrel. The cutting elements of the coring bit may consist of diamonds, tungsten carbide inserts or other types of cutter appropriate to the hardness of the material being cored. Samples taken in a single tube core barrel generally experience considerable disturbance due to torsion and swelling and due to contamination with the drilling fluid which result general in poor core recovery.

3.2.4.2 Double Tube Core Barrel Sampling:

The double tube core barrel, as the name signifies, consists of two barrel: inner and outer. It is designed to protect the core against the action of circulating fluid which results in higher recovery ratios than can be obtained with single tube core barrel.



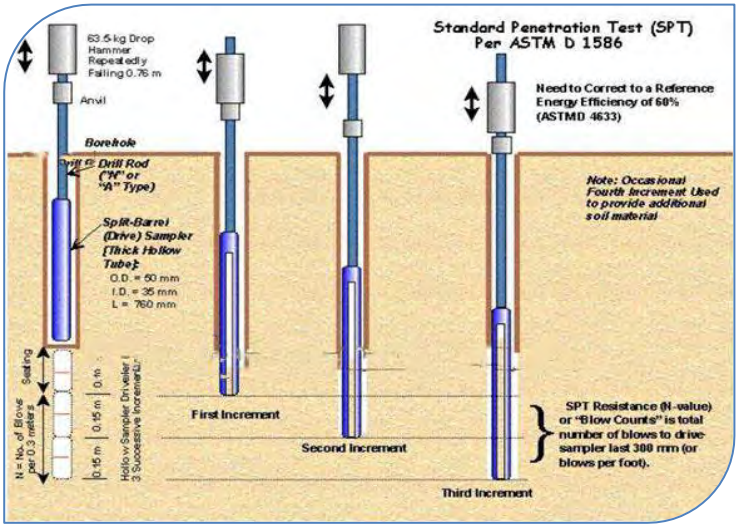
4. FIELD TEST

Field testing can include a wide variety of methods depending on the type of material to be tested and the use for which the test results are required. Full descriptions of many of the test methods can be found in the ASTM&AASHTOO.

In-situ penetration tests have been widely used in geotechnical and foundation engineering for site investigation in support of analysis and design. The standard penetration test (SPT) and the cone penetration test (CPT) are two typical in-situ penetration tests.

4.1 Standard Penetration Test - S.P.T (ASTM D 1586)

Standard Penetration Test (SPT) is the most widely used of the dynamic field tests. It is used to determine the relative density of granular soils and to estimate consistency of cohesive soils. The test uses a drop hammer of standard weight falling through a standard distance to drive a split-barrel sampler. The number of blows required to drive the sampler 0.3 m is called the Standard Penetration Test Blow Count and is usually designated by the letter N. Blow counts (N values) are used to determine the density of granular soils and the consistency of cohesive soils. However, it should be noted that the use of N values to describe the consistency of cohesive soils is less reliable than for the density of granular soils.



When the test is carried out in granular soils below groundwater level, the soil may become loosened by the action of the boring tools and pressure differences between the groundwater and water in the boring. It is essential that the loosening effect be minimized by careful operation of the boring tools and by keeping the boring topped up with water.

4.2 Groundwater Measurement

Groundwater is one element that affects in the stability and foundation analyses. The groundwater level was measured 24 hours after completion of the borehole.

However, the low permeability of the soil will mean that the water level in the borehole is controlled more by drilling fluid rather than by the ground water itself. Significant fluctuations in the location of ground water table should be anticipated throughout the year, depending upon the amount of precipitation, evaporation, and surface runoff.

4.3 In Situ Permeability Test

Three in situ deferent permeability tests can be conducted in the field to measure the soil and rock permeability. These three methods are:

- In Situ Permeability Test by Constant Head Test (ASTM D 2434)
- In Situ Permeability Test – Packer Test (ASTM D 1586)
- In Situ Permeability Test – Falling Head Test (ASTM D 5093)

4.3.1 Constant Head Test (ASTM D 2434)

After reaching the level of a pervious stratum in which a test is to be made continue boring until penetration into stratum is not less than five times internal diameter of casing being used. Clean out borehole just to bottom of casing. If casing is below level of groundwater keep it full of water during cleaning and withdrawal of tools so that soil does not squeeze into it.

In gravity tests adjust rate of flow of water supplied to borehole so that water level remains constant against a mark inside borehole casing near top. If it is impossible to maintain water level a constant rate of flow producing a fluctuation of no more than 75 mm above and below the mark during a period of five minutes will be accepted. When steady state has been reached, the quantity of water entering borehole over a fixed interval of not less than five minutes will be recorded. Repeat until consistent results are obtained.

4.3.2 In Situ Permeability Test – Packer Test (ASTM D1586)

Tests may be carried out using a single or double Packer. Use only clean water with a temperature not less than of groundwater. Carry out tests at three pressure increments and two decrements equivalent to P/3, 2P/3 and P, where P is the vertical overburden pressure at level of test. Normally the flow rate at each pressure will be recorded at ten minute intervals to a maximum of three periods or less if similar results are obtained in two consecutive periods. Pressure difference between each increment/decrement should not normally be less than 35 KN/m2 and pressure in Packer units should be at least 300 KN/m2 greater than test water pressure loss at varying flow rates before use.

4.3.3 In Situ Permeability Test – Falling Head Test (ASTM 2004a D5093)

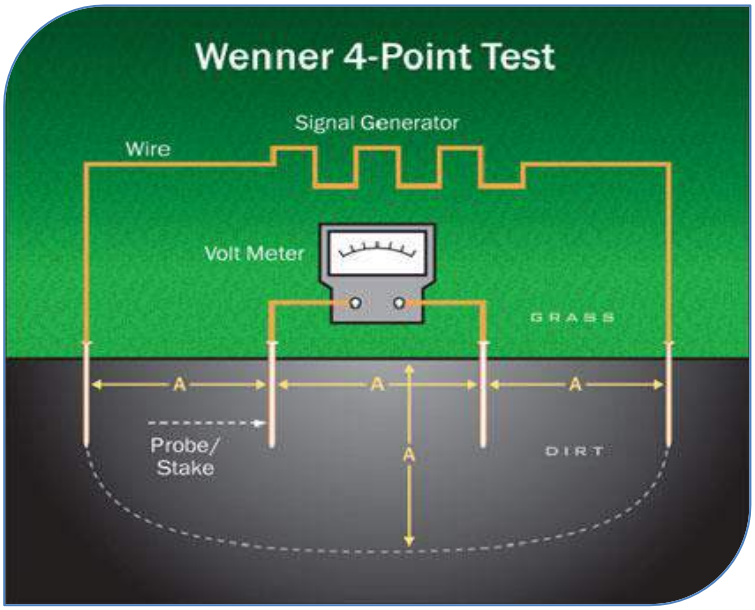
Where conditions in borehole indicate that a permeable stratum has been reached bale or pump out borehole to lower level of the water. Record water level until it returns to equilibrium. If it is impossible to lower water level in borehole either because soil is too permeable or because it flows into casing carry out a pouring in test instead. In this test pour water into borehole until casing is full. Record water level at intervals until equilibrium position is reached.

Normally record the water level in the borehole at five minute intervals for the first hour, fifteen minute intervals for the second hour and a final reading after a suitable time to be decided by the Engineer but not less than four hours. Measure water level with a battery operated indicator or similar approved instrument. Take reasonable precautions to prevent ingress of water into hole during test period.

4.4 Soil Resistivity Test:

The purpose of this test is to investigate for the need of cathode protection and to have data necessary for the design of an adequate grounding system.

The soil Resistivity measurement shall be carried out in accordance with IEEE 81 standard. Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System. The measurement shall be done using Wenner Four Points Method with equal test rods spacing.



The area to be measured shall be the power block area of power plant, terminal substation, and switchyard. Before carrying out the measurement, the rectangular grid shall be drawn for the testing areas with mesh spacing at approximately 5-10 m. The measurement shall be made at every intersection point of grid lines. The measurement at any point shall be done for two directions, one from the measured point along the direction from east to west and another shall be from the measured

point along the direction from north to south. The measurement at any point shall consist of the measured data at the varying space between test rods for the following distance; 0.5, 1.0, 2.0, 3.0, 4.0, 5.0 m. For each area of measurement, the results of measurement shall be shown in the table for each point of measurement for each direction and every designated space of measurement. The measured resistivity data shall be averaged for each of the same spacing of measured data. The overall averaged resistivity of each area shall also be reported.

4.5 Test Pit:

This method is also known as open excavation method. It is one of the most satisfactory methods of soil inspection by visual observation and it also provides both disturbed and undisturbed sampling. It can be done manually by hand, using labor, or by using some equipment like backhoe, trencher or the dozer etc. test pits are used for exploring sites where greater sampling is required such as highways and airfields.



Bulk sample taken from the test pits of not less than 50 kg each shall be sent to test at laboratory for compaction and CBR test.

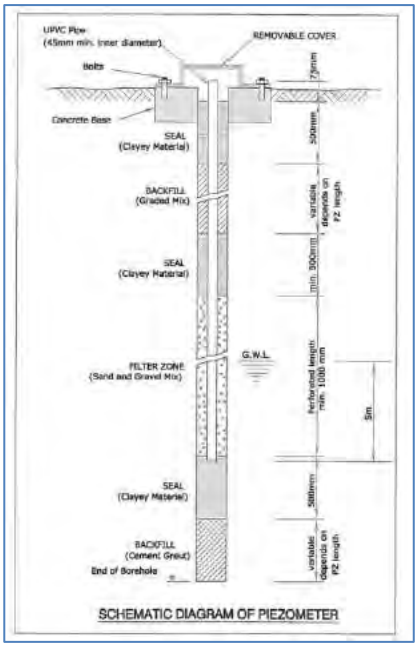
4.6 Piezometer:

A **piezometer** is either a device used to measure liquid pressure in a system by measuring the height to which a column of the liquid rises against gravity, or a device which measures the pressure (more precisely, the piezometric head) of groundwater at a specific point. A piezometer is designed to measure static pressures, and thus differs from a pitot tube by not being pointed into the fluid flow.

Observation wells give some information on the water level in a formation, but must be read manually.

The piezometers in geotechnical engineering are either open wells or PVC standpipes (sometimes called Casagrande piezometers) installed into the borehole. A Casagrande piezometer will typically have a solid casing down to the depth of interest, and a slotted or screened casing within the zone where water pressure is

being measured. The casing is sealed into the borehole with clay, bentonite or concrete to prevent surface water from contaminating the groundwater supply. In an unconfined aquifer, the water level in the piezometer would not be exactly coincident with the water table especially when vertical component of flow velocity is significant. In a confined aquifer under artesian conditions, the water level in the piezometer indicates the pressure in the aquifer, but not necessarily the water table. A 5-cm diameter standpipe is common.



Piezometers in durable casings can be buried or pushed into the ground to measure the groundwater pressure at the point of installation.

4.7 Plate Load Test

Plate Load Test is a field test for determining the ultimate bearing capacity of soil and the likely settlement under a given load. The Plate Load Test basically consists of loading a steel plate placed at the foundation level and recording the settlements corresponding to each load increment. The test load is gradually increased till the plate starts to sink at a rapid rate. The total value of load on the plate in such a stage divided by the area of the steel plate gives the value of the ultimate bearing capacity of soil.

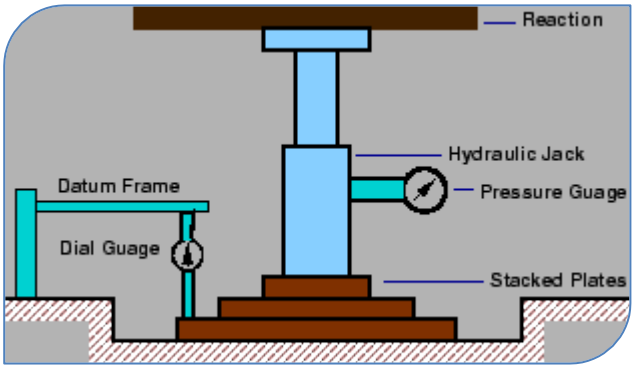


Plate load test is most suited for sands and clay's. In sand, they are usually carried out when the project is big and large numbers of footings are available. In clay, where unconfined compression tests are not feasible due to presence of fissures and cracks, plate load tests are used to determine the ultimate bearing capacity.

Plate load test is helpful for the selection and design the foundation. To calculate safe bearing capacity suitable factor of safety is applied.

5. LABORATORY TESTING

Geotechnical laboratory tests will be performed on the soil samples to classify soil and to determine their engineering characteristics. All laboratory tests will be conducted in accordance with ASTM Standards.

The program of laboratory testing shall be oriented toward obtaining data pertinent to the design of the foundation system. The laboratory tests include the following tests:

5.1 Physical & Mechanical Tests:

5.1.1 For soil material:

- Moisture content (ASTM D 2216).
- Specific gravity (ASTM D-854).
- Atterberg limits (ASTM D-423 & D 424).
- Sieve analysis, and hydrometer analysis (ASTM D-422).
- Direct shear test (AASHTO T-236).
- Compressive test if needed (ASTM D-2166).
- Tri-axial compression test if needed (optional). (ASTM D-2850)
- Swelling potential for cohesive soils if needed.

5.1.2 For rock cores, if needed (optional).

- Unconfined compression test (ASTM D-2939 - 71a).
- Bulk density (MRDTM 304).

5.2 Chemical Tests:

The following chemical tests shall be performed on ground water samples and soil samples near foundation level.

- PH index (ASTM D-4972)
- Sulphate content (ASTM D-516).
- Chloride content (ASTM D-512).

The number and frequency of tests shall be determined by the Contractor's geotechnical engineer in order to get reliable and representative characteristics of the sub-soil and ground water.

6. LOGGING:

All results obtained in the field investigation, laboratory tests and ground conditions discovered for each borehole will be summarized in the form of a borehole log (to be approved by the Engineer). The borehole log shall contain the following information or data: method of investigation, details of equipment used, the location, ground level, diameter of the hole, drilling data, subsurface formation (soil & rock), water level, names of the client and the project, etc.

All sampling and coring operations: the sample and number; the inside diameter, outside diameter, and length of the sample tube; the depth at the start and at the completion of the sampling drive or push or coring "run"; core recovered to the length of sampling drive or push or coring run); and a complete visual description of each sample visual description of each sample or core including color, type of material, density or consistency of soil, hardness of rocks, stratification, rock structure, moisture conditions, etc. The description should be made immediately following the retrieval of the sample or core so that it represents the "as retrieved" classification. This is particularly important when sampled materials tend to break down on exposure.

- The depth at which each stratum begins.
- For drive samples: the weight and height of drop of the hammer, and the number of blows required for each 0.15 meters of penetration of the sampler.
- For rock coring: the percentage core recovery and Rock Quality Designation (RQD).
- Casing information including the size of the casing; the depth at which casing was added; the length of casing added; the final depth of the bottom of the casing. In our case the casing diameter is 4".
- Ground water information including the depth to water in the hole, at the start and close of work. These readings should be continued after completion of the hole until the water level in the hole has stabilized.
- The date and time of all operations.
- Miscellaneous are information which may aid in the interpretation of subsurface conditions. This could include the depth at which drilled water is lost or regained, the amount and color of the return water, and the depth at which a change in drilling action occurs.

7. FINAL GEOTECHNICAL REPORT

We will describe all the field investigations and results of laboratory tests, in a report that shall include:

- The complete borehole logs (core boring, wash boring);
- The results of in situ test;
- The results of geotechnical and mechanical laboratory test for each sample tested;

A plan view and longitudinal profile (supplied by the Engineer) showing the correct location of each borehole, strip log, stratigraphy and in situ tests.

Geotechnical reports shall also contain engineering recommendations for depth of foundations, bearing capacity of soil, expected settlement, and Engineering Recommendations.

As regards geotechnical reports for structures, they should basically cover the following:

- Introduction;
- Purpose and scope of work;
- Site description;
- Geology (Regional & site);
- Drilling & sampling procedures;
- Laboratory testing involved;
- Description criteria for soil and rock;
- Description of subsurface condition revealed;
- Groundwater condition;
- Geotechnical analysis;
- Recommendations.
- Recommendations with respect to structures should address the following topics:
- Type of foundation (spread, pile);
- Depth of spread foundation;
- Net allowable soil/rock bearing pressure;
- Maximum settlement of footing and differential settlement between adjacent footings.

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Method Of Statement For
Materials Testing and Quality Control



- Introduction.
- Filling & Backfilling Materials
- Concrete .
- Asphalt .
- Aggregates.
- Cement.
- Block & Tiles.
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10. Important Project

Method of Statement for

MATERIALS TESTING AND QUALITY CONTROL

Our quality control program is made to control all the materials before, during and after construction. Basically, we conduct suitability tests on all proposed construction materials such as fill/soil materials, concrete and its aggregates, asphalt/bituminous mixtures and its aggregates, trial mixes, blocks, and other related materials. Approval for use of the materials depends on testing results. Necessary tests during placement are also conducted. We quality assure in-situ materials for their specified in-situ properties.

The quality control work can be made for fill & backfill material, concrete, asphalt and other construction materials as follows:

1. FILLING & BACKFILLING MATERIALS TESTING AND QUALITY CONTROL:

The purpose of fill and backfill materials quality control is to get a good quality and good compaction for the fill and backfill works according to ASTM standards and specifications. This can be done by performing laboratory and field quality control test on the fill and backfill materials before, during and after construction as follows:

1.1 Soil/Fill/Backfill Materials Testing:

1)	Field Density test by sand cone method.	(ASTM D-1556)
2)	Field Density test by nuclear method.	(ASTM D -2922)
3)	Washed Sieve Analysis.	(ASTM C-136)
4)	Atterberg limit test.	(ASTM D-4318)
5)	Moisture density relationship of cohesive soil.	(ASTM D-1557)
6)	Max. / Min Index densities of non-cohesive soil. (Relative density).	(ASTM D 4253)
7)	Hydrometer analysis (including sieve analysis)	(ASTM D 422)
8)	C.B.R. Test	(ASTM D 1883)
9)	Sulphate and Chloride	(BS 1377)
10)	Plate bearing test (Load provided by costumer).	(ASTM D-1194)
11)	Lab. Permeability test (Constant Head).	(ASTM D-2434)
12)	Lab. Permeability test (Falling Head).	(ASTM E-2396)

13) Triaxial test. (ASTM D-2850)

14) Consolidation test. (ASTM D-2435)

15) Direct shear test. (ASTM D-3080)

16) Unconfined compression test for soil. (ASTM D-2166)

17) Unconfined compression test for rock. (ASTM D-2938)

1.2 Soil/Fill/Backfill Materials Quality Control:

1.2.1 On-site Soil/Fill/Backfill Materials Quality Control

These tests are made to check the percent compaction and the adequacy of the backfill materials to support the structure safely. The main field tests which will be done for soil backfill are as follows:

- Field Density Test by Sand Cone Method (ASTM D-1556)
- Field Density Test by Nuclear Method (ASTM D-2922)
- C.B.R. Test (ASTM D 1883)
- Plate Bearing Test (Load Provided by Costumer) (ASTM D-1194)

1.2.2 Field Supervision, Test Request & Reports

1.2.2.1 Visit Basis:

- Field supervision will be covered at site to supervise the soil mixing by water, type of material, layer thickness and method of compaction.
- A work program should be given to us through a test request form one (1) day before.
- Reports will be given on time at site (one {1} original copy).

1.2.2.2 Monthly Basis:

our scope of work includes the following:

1) Creation of a laboratory at the project site with equipment required for conducting the routines tests on the materials.
2) Send a qualified technician to supervise the backfilling works and conduct all field and laboratory testing required for the materials to determine the suitability of the materials to be used as a backfill.

3) The Materials Testing:

- Field Density by sand cone or by Nuclear Gauge (if needed).
- Washed Sieve Analysis & Atterberg limit test.
- Moisture density relationship of soil (Modified Proctor).
- Max. / Min. Index densities of natural sand

4) The Testing Equipment:

- Field Density sand cone or Nuclear Gauge.
- Oven, Electronic Balance 30kg.
- Others.

2. CONCRETE TESTING AND QUALITY CONTROL:

The purpose of concrete quality control testing is to get good quality of concrete according to ASTM standards and project specification. This can be done by performing laboratory and field quality control tests on the concrete mix material (cement, aggregate and water) and on the concrete batch as follows:

2.1 Concrete Testing:

There are so many tests available for testing different qualities of concrete. Different tests give results for their respective quality of concrete. Thus, it is not possible to conduct all the tests as it involves cost and time. Thus, it is very important to be sure about purpose of quality tests for concrete. The most important test for quality check of concrete is to detect the variation of concrete quality with the given specification and mix design during concrete mixing and placement. It will ensure that right quality of concrete is being placed at site and with checks for concrete placement in place, the quality of constructed concrete members will be as desired

2.1.1 Fresh Concrete Tests:

Concrete is tested to ensure that the material that was specified and bought is the same material delivered to the job site. There are different tests for freshly mixed concrete as follows:

- Temperature of Freshly Mixed Hydraulic-Cement Concrete (ASTM C1064 / C1064M).
- Sampling freshly mixed concrete (ASTM C-172).
- Slump of Hydraulic-Cement Concrete (ASTM C-143).
- Unit weight, yield and air content (ASTM C-138).
- Air content (ASTM C-173 or C-231).
- Making and Curing Concrete Test Specimens in the Field (ASTM C-31 or BS-1881: part 3).

2.1.2 Hardened Concrete Tests:

Various tests on Hardened Concrete is done to ensure the design strength of concrete and quality of concrete construction is achieved.

2.1.2.1 Non-Destructive Tests:

The main non-destructive tests for strength on hardened concrete are as follows:

- Schmidt hammer test (ASTM C-805).
- Ultrasonic test (ASTM C-597).
- Pull-out test (ASTM C-900)

  Corrosion analysis of steel in hardened concrete (Half-cell potential measurements) (ASTM C876)

2.1.2.2 Destructive Tests:

The main destructive tests on hardened concrete are as follows:

- Compressive strength (ASTM C-39)
- Splitting Tensile Strength of Cylindrical Concrete specimen (ASTM C-496)
- Flexural Strength of Concrete (ASTM C-78)
- Concrete core test (ASTM C42)

2.1.2.3 Other tests:

- Concrete mix design.
- Chemical analysis: Carbonation – Cement Content – Salts (Cl^- - SO_4^-).

2.2 Concrete Quality Control:

2.2.1 Batch Plant Quality Control

- Complete quality control test will be done for the concrete material (cement, aggregate and water) to determine the suitability of this material to be used in concrete mix design.
- Based on concrete project specification requirements, a concrete mix design (ACI 211.1) should be made by concrete supplier and verified by us or it can be done completely by us as per your request.
- Batch Plant scales calibration certificate should be valid or recalibrated by us.
- Chiller, transit mixers, material storage place should be checked by us. All the above will be done as per your request and in separate charge.

2.2.2 On-site Concrete Quality Control

The main field quality control tests that can be done for concrete are as follows:

- Slump test (ASTM C 143)
- Concrete temperature (ASTM C 143)
- Concrete sampling by using Cylinder or Cube (ASTM C 31)
- Compressive strength for Cylinder or Cube (ASTM C 39)
- Density for Cylinder or Cube.
- Air Content & Unit Weight

2.2.3 Field Supervision, Test Request & Reports

2.2.3.1 Visit Basis:

- Field supervision will be covered on site to supervise the concrete pouring and checking the concrete homogeneity, casting time and placing of concrete.
- A work program should be given to us through a request form one (1) day before.
- Reports will be given on time at site (one {1} day original copy) which consists of pouring observation report and compressive strength test report.

2.2.3.2 Monthly Basis:

our scope of work includes the following:

1) Creation of a laboratory at the project site with equipment required for conducting the routines tests on the concrete.
2) Send a qualified technician to supervise the concrete pouring and checking the concrete homogeneity, casting time, placing of concrete, and conduct all field and laboratory testing required for the concrete to determine the quality of the concrete to be used.
3) The Concrete Testing:
   - Site sampling fresh concrete, make & cure concrete Cylinder or cube, ASTM C172, C31 or BS 1881.
   - Temperature, Slump & Air content
     Compressive Strength of cylinders, BS 1881.
4) The Testing Equipment:
   - Slump Cone Set
   - Concrete Cylinder or Cube Molds.
     Calibrated Compressive Strength Machine.
   - Others.

3. ASPHALT TESTING:

1)	Bitumen penetration test.	(AASHTO T-49)
2)	Bit. Softening point test (Ring & Ball method)	(AASHTO T-53)
3)	Bit. Flush & fire point test.	(ASTM D-92)
4)	Bit. Viscosity test.	(ASTM D-88)
5)	Bitumen Ductility test.	(ASTM D-113)
6)	Asphalt extraction test.	(ASTM D-6847)
7)	Max. theoretical specific gravity (Gmm) of asphalt mix	(ASTM D-2041)
8)	Marshall & flow test.	(ASTM D-6927)
9)	Asphalt mix design	
10)	Asphalt coring at site.	(ASTM D-2950)

4. AGGREGATE TESTS:

1) Practice for sampling aggregates	(ASTM D-75)
2) Reducing field samples to testing size	(ASTM C-702)
3) Sieve Analysis of Aggregates	(ASTM C-136)
4) Materials finer than (No. 200) sieve by washing	(ASTM C-117)
5) Specific gravity and absorption of coarse aggregate	(ASTM C-127)
6) Specific gravity and absorption of fine aggregate	(ASTM C-128)
7) Organic Impurities in fine aggregate	(ASTM C-40)
8) Total moisture content of aggregate by drying	(ASTM C-566)
9) Unit weight and voids in aggregates	(ASTM C-29)
10) Resistance degradation of coarse aggregate	(ASTM C-131)
11) Clay lumps and friable particles	(ASTM C-142)
12) Soundness of aggregate	(ASTM C-88)
13) Potential reactivity of aggregate	(ASTM C-289)
14) Flat and elongated particles in coarse aggregate	(ASTM D-4791)
15) Flat and elongated particles in coarse aggregate	(BS 812)
16) Chloride in aggregate	(BS 812)
17) Sulfate in aggregate	(BS 812)
18) Crushing value of aggregate	(BS 812)
19) 10% fine value of aggregate	(BS 812)
20) Aggregate shape test (Angularity Number)	(BS 812)

5. CEMENT TESTS:

1) Specific gravity of cement.	(ASTM C-188)
2) Setting Time	(ASTM C-191)
3) Compressive Strength	(ASTM C-109)
4) Fineness of hydraulic cement	(ASTM C-204)
5) Loss of ignition of Portland cement.	(ASTM C-114)

6. ADMIXTURE:

1) Technical sheet

2) Trial mixes for evaluating the effect admixture on Slump, Slump loss, Setting Time, and Strength.

7. STEEL TEST:

1) Steel Yield & Ultimate Stress.	(ASTM A-370)
2) Steel Elongation at breakage.	(ASTM A-370)
3) Cold Steel Bend Test.	(ASTM A-370)

8. CALIBRATION SERVICE:

1- Concrete crushing machine.	(ASTM E-4-03)
2- CBR machine	(ASTM E-4-03)
3- Marshall machine	(ASTM E-4-03)
4- Lab. Balances	(ASTM E-898-93)
5- Concrete batching plant	(ASTM C-94)
6- Asphalt batching plant	(ASTM C-94)

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Method Of Statement For
Environmental Impact Assessment



- Introduction.
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  - Field Investigation.
  - EIA Report.
- Important Projects.

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Method of Statement for

ENVIRONMENTAL IMPACT ASSESSMENT

1. INTRODUCTION

Environmental Impact Assessment (EIA) is the process of assessing the likely environmental impacts of a proposal and identifying options to minimize environmental damage. The main purpose of EIA is to inform decision makers of the likely impacts of a proposal before a decision is made. EIA provides an opportunity to identify key issues and stakeholders early in the life of a proposal so that potentially adverse impacts can be addressed before final approval decisions are made.

2. ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

2.1 Collection and Review of Project Data:

The data will be collected as per the standard formats devised for the purpose and the available data shall be reviewed for characterization of baseline environmental set-up as follows:

- ✓ Meteorological Data (Rainfall, Seasons, Humidity, Temperature etc.) Information on Geo-Physical Aspects.
- ✓ Relevant information on soil characteristics. topography and drainage and geology.
- ✓ Soil characteristics will be studied in terms of its type, cohesion, and permeability.
- ✓ Topology and drainage study will focus on slope, terrain characteristics, and micro-drainage.
- ✓ Sensitive Location / Issues within Corridor of Influence: Forest Department Officials. NGOs and local people will be consulted for information on the sensitive locations such as National Parks, Reserved Forests, wild life

sanctuary and issues like occurrence of rare / endangered flora and fauna, wildlife migration route, breeding ground of any endangered species etc.

- ✓ Air & Water Quality and Noise Level: The data available on air. water and noise quality will be collected from PME.

- ✓ Identification of Data Gaps: The data collected will be collated and analyzed for identification of any gaps.

2.2 Field Investigation:

1. Collecting information on various environmental features such as ponds, soil type. water resources, wetlands, natural drainage channels, agricultural produces, plantations and species diversity, grasslands, natural vegetation, and forest land within the proposed ROW will be recorded during the field survey.

2. Collecting information on public facilities such as hand pump, tube wells, sections of School buildings, hospitals, and amusement parks.

3. Collecting information on Archaeological monuments and structures of cultural and religious importance such as mosques.

4. Conduction Air Quality Monitoring, air samples will be collected and analyzed to monitor air quality nearby the residential. commercial, sensitive, and industrial areas to establish the baseline status of the area for PM10, PM2.5, SO2, NOx, HC, CO, Pb, Ozone, Ammonia, etc. as PME specifications and compared with the standard permissible limits as PME standards.

5. Conduction Water Quality Monitoring, water samples of ground water (dug well, hand pump and deep bore pumps) and surface water (rivers, lakes, streams etc.) of selected locations / sites will be collected and analyzed to monitor the contaminates concentrations. The required tested parameters will be considered for the study will be as PME specifications and compared with the standard permissible limits as PME standards.

6. Noise level: Background noise levels will be monitored both at day and night at different residential, industrial, and sensitive areas. Noise level values will be computed and compared with the standard permissible limits as PME standards.

7. Land Quality: Detailed land use pattern and soil fertility data will be obtained and if possible soil characteristics in terms of physical, chemical, and biological parameters will be analyzed along the alignment of the road project for stretches of agricultural fields, dry lands, river banks etc.

8. A public consultation will be conducted using questionnaires to receive valued feedback from the project affected persons, local people, and different stakeholders. Steps involved in public consultation process will include appraising the respective persons about the project and the anticipated environmental, socioeconomic implications of the proposed project.

2.3 EIA Report:

An EIA report typically includes many or all of the following headings and items:

1. executive or non-technical summary (which may be used as a public communication document);

2. statement of the need for, and objectives of, the proposal;

3. reference to applicable legislative, regulatory and policy frameworks;

4. description of the proposal and how it will be implemented (construction, operation, and decommissioning);

5. comparison of the proposal and the alternatives to it (including the no action alternative);

6. description of the project setting, including the relationship to other proposals, current land-uses and relevant policies and plans for the area;
7. description of baseline conditions and trends (biophysical, socioeconomic etc.), identifying any changes anticipated prior to project implementation;

8. review of the public consultation process, the views and concerns expressed by stakeholders and the way these have been considered;

9. consideration of the main impacts (positive and adverse) that are identified as likely to result from the proposal, their predicted characteristics (e.g. magnitude, occurrence, timing, etc.) proposed mitigation measures, the residual effects and any uncertainties and limitations of data and analysis;

10. evaluation of the significance of the residual impacts, preferably for each alternative, with an identification of the best practicable environmental option;

11. an environmental management plan that identifies how proposed mitigation and monitoring measures will be translated into specific actions as part of impact management;

12. appendices containing supporting technical information, description of methods used to collect and analysis data, list of references, etc.

Geotechnical & Environmental Co.

Method Of Statement For

Environmental Monitoring



- Air quality Monitoring.
- Noise quality Monitoring.
- Water quality Monitoring.
- Soil quality Monitoring.

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2. TYPES OF ENVIRONMENTAL MONITORING:

- Air quality Monitoring.
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Method of Statement for

ENVIRONMENTAL MONITORING

INTRODUCTION:

Pollution has become a great problem nowadays on earth. It is necessary to know the quality of environment in which we live to take step to reduce pollution. That's when Environmental Monitoring and Assessment comes into picture. It's a process to measurement of pollutants available in Air, Water, Soil, and steps to be taken to reduce pollution after analysis of data received from Environmental Quality Monitoring. This is the primary process before preparing Environmental Impact Assessment for particular project.

In this Process Sample is collected from suitable or representative area. It is stored in Controlled temperature conditions. Once it is reached in analytical laboratory various tests are performed to Know Presence of particular Parameters. After that analysis is done to identify source of pollutants and alternate ways can be suggested to reduce quantity of pollutant. Environmental Monitoring generates complex and critical information to take decisions and predict the future of environment.

TYPES OF ENVIRONMENTAL MONITORING:

1) Air quality Monitoring:

There are two types of air quality monitoring i.e. Ambient and Indoor air quality. Ambient air Quality monitoring is carried out in industry or site premises. And Indoor air quality monitoring can be carried out in Home, office etc. In Air quality monitoring Direction, Velocity and Pollutants are measured. Parameters measured in Air Quality monitoring are SO2 (Sulphur Dioxide), NOx (Oxides of Nitrogen), Particulate Matter (PM 10 and PM2.5), Ozone, Lead, CO (Carbon Monoxide) etc.



2) Noise level Monitoring:



Noise level Monitoring is carried out with noise level meter. Noise Level can be observed for 24 hours to find out trends in noise level fluctuations. Also, Noise Impact Assessment is Part of Environmental Impact Assessment.

3) Water Quality Monitoring:



In Water quality monitoring samples are taken from water source (Eg. River, lake or tap water etc.) by grab sampling or by regular intervals, Passive Sampling, or remote sampling. then in laboratory Chemical, Biological, radiological, microbiological, and E-coli test to determine quality of water.

4) Soil Monitoring:



Initially soil samples are collected by grab sampling method or composite sampling method. It is further tested in analytical laboratory. It is tested for pH, Chlorine, Sulphate, Phosphate, LOD, LOI etc. Soil analysis can be helpful to find out Soil fertility and corrective action can be taken to improve yield.

Method of Statement for

AIR QUALITY MONITORING

INTRODUCTION:

Air Quality means state of air around us. Good Air quality denotes non-polluted and clean air. Air quality monitoring is process of sampling and testing of air. It helps to understand quality of air by pollutants and over the period of time. It also gives trends and patterns about air quality whether it is improving or degrading.

Importance of Air quality monitoring:

a. It can help us to measure types of pollutants and their concentrations which further can be analyzed and interpreted. This information can be used to take actions based on trends.
b. It can also help us to determine which areas in country are more pollutants, which type of pollutants are increasing relating to industrial pollution and traffic.
c. It can also answer questions like can we open new industrial plant near city and what will be its impact on air quality near city or in an industry.

Air quality monitoring Procedure:

Before starting air monitoring on site there is some background information required of the sources/emissions, health and demographic information, meteorological data, topographical information, and previous air quality monitoring information. It helps to decide whether to increase or decrease monitoring locations based on previous readings.

Air quality testing and monitoring is done in areas where pollution problem exists and it is expected e.g. Industrial area, traffic intersection.

It is good to conduct air monitoring program in order to get annual average sampling as pollutants behave in each season differently.

Also, instruments used in air quality monitoring must be well maintained and calibrated. Also, laboratory should be nearby from the air quality monitoring site to avoid loss due to incorrect handling in transportation.

Air Quality Monitoring Parameters

As per notification by pollution control board Sulphur Dioxides (SOx), Nitrogen Oxides NOx, Carbon monoxide (CO), Suspended Particulate Matters (PM2.5 / PM10), and Ozone (O3) are important pollutants to monitor.

Also, Monitoring of meteorological parameters like wind direction, speed, humidity, and temperature should be integrated part of air quality monitoring.

Types of Air Quality Monitoring:

It can be divided into three parts:

a. Ambient air quality monitoring.
b. Indoor air quality monitoring.

1. AMBIENT AIR QUALITY MONITORING:

Ambient Air Quality monitoring is a process of measurement of pollutants present in atmosphere. It measures healthiness and safety of our environment. Ambient Air Quality Monitoring is an important part of Environmental Monitoring.

1.1 Guidelines before Ambient Air Quality monitoring

Before commencing Ambient Air Quality monitoring there are certain guidelines which should to be considered. These guidelines minimize the risk of getting wrong data due to improper methods. The guidelines are summarized as following:

1.1.1 Sources and emissions:

It includes details about number of vehicles, type of fuel used, composition of fuel used, number of stacks present, height of stacks etc. this data will help in identifying which pollutant can be present and can be measured.

1.1.2 Meteorological data:

Temperature, humidity, wind speed and direction needs to be collected. Wind directions, humidity plays an important role in placement of Ambient Air Quality monitoring system.

1.1.3 Topographical information:

If there are any river valleys, mountains in monitoring area then variation in concentration of pollutants is large.

1.2 Selection of monitoring location

Ambient Air Quality monitoring should be done in areas where pollution problem exists and is expected e.g. Industrial areas, traffic intersections roads, high population density area etc. Selection of sampling point should be done carefully as incorrect location may result in high or low concentration of pollutants present in air and it will not meet objective of Ambient Air Quality monitoring.

1.3 Types of Ambient Air Quality Monitoring System

1.3.1 Continuous Ambient Air Quality Monitoring System:

Continuous emission monitors (CEM) are very high accuracy methods that provides continuous records of pollutants. These CEMs are self-operating systems which can go days, weeks with minimal intervention of operators. They also have remote communication facilities so that data can be downloaded remotely. They have extreme level of measurement accuracy, and wide range of detection limits. Also, some of the instruments have features like automatic calibration, flameproof sensors. Continuous emission monitors are the most expensive monitoring systems which requires high level of calibration, maintenance, operational and quality control procedures to get accurate data.

1.3.1.1 Ambient air quality monitoring stations

Ambient air quality monitoring stations measure real time and peak concentration levels of dangerous pollutants in air. Industrial and vehicular emissions along with other anthropogenic activities release air pollutants in the atmosphere across Indian cities. It is important to monitor them and keep them under control to prevent risk to human health and protect the survival of other living organisms.

The station can monitor meteorological conditions, and take continuous and non-continuous measurements for a variety of parameters, including particulate matter (PM), sulphur dioxide (SO_2), hydrogen sulphide (H_2S), carbon monoxide (CO), nitrogen oxides (NO_x) and ozone (O_3).

We have two stations was equipped with EPA approved gas analyzers and dust monitors



Our stations specifications, components, Analyzers model and technology are shown in the following table:

NO	Components	Model No.	Model	Origin
1	H_2S & SO_2 Gas analyzer UV Fluorescence	T101	TELEDYNE	USA
2	NO/NO2/NOx Gas analyzer Chemiluminescence NOx, NO, NO2	T 200	TELEDYNE	USA
3	CO Gas analyzer Gas Filter Correlation CO	T 301	TELEDYNE	USA
4	O_3 Gas analyzer UV Absorption O3	T 400	TELEDYNE	USA
5	Ozone and zero air system	T 701	TELEDYNE	USA
6	Dust monitor Beta PLUS Particle Measurement System	EDM180	GRIMM MONITORING	GERMANY
7	Calibration Equipment	T 700	TELEDYNE	USA
8	Weather Station	Lufft WS601- UMB	Lufft	GERMANY
9	Mast & Accessories (10 m)	CSQT10-17923	Clark Masts	UK
10	Data Acquisition system and instruments	My_ base_Server	WB Engineering	GERMANY
11	Cooling units	1.5 ton (capacity)	Daikin	JAPAN
12	Air inlet	00001	WB Engineering	GERMANY
13	Cabinet and accessories	My_ES_CS_A	WB Engineering	GERMANY
14	(Diesel Generator unit)	APD25A	ASKA	TURKEY
15	Security Thermal Switch	My_E_base_Server	WB Engineering	GERMANY

1.3.1.2 Meteorological Monitoring by Weather Station:

Meteorological data is uploaded in the same way as continuous air quality data, it is very important to monitor meteorological data at the air quality monitoring site as weather is important factor for the movement of pollutants, which can affect concentrations of pollutants, wind speed, wind direction, temperature, humidity etc.



A weather station is a facility, either on land or sea, with instruments and equipment for measuring atmospheric conditions to provide information for weather forecasts and to study the weather and climate. The measurements taken include temperature, barometric pressure, humidity, wind speed, wind direction, and precipitation amounts. Wind measurements are taken with as few as other obstructions as possible, while temperature and humidity measurements are kept free from direct solar radiation, or insolation. Manual observations are taken at least once daily, while automated measurements are taken at least once an hour. Weather conditions out at sea are taken by ships and buoys, which measure slightly different meteorological quantities such as sea surface temperature, wave height, and wave period. Drifting weather buoys outnumber their moored versions by a significant amount.

1.3.2 Non-Continuous Ambient Air Quality Monitoring System

non-continuous Monitoring is preferred in some cases because it is easier and less expensive than continuous, automatic sampling, while producing equally valuable results

We conducting the non-continuous measurements for a variety of parameters, including particulate matter (PM), sulphur dioxide (SO_2), hydrogen sulphide (H_2S), carbon monoxide (CO), nitrogen oxides (NO_x) and ozone (O_3) by a portable equipment approved by Presidency of Meteorology and Environment (PME).

Also in non-continuous Monitoring filters or canisters are placed in the field by technicians for a discrete period of time (such as 24 hours), and then sent to registered laboratories where they are weighed and analyzed to determine their content.

1.3.2.1 Portable Equipment:

We have a various portable equipment approved by PME to conduct the non-continuous ambient air quality monitoring for a variety of parameter such as PM2.5 & PM10, SOx, NOx, O3, H2S, HC, etc.



OZONE METER

Ozone Meter AQ-200 is a highly accurate instrument for measuring ozone concentrations in the air. The Ozone Meter can be equipped with four different heads that vary in their measurement range.



MULTIRAE

MultiRAE is the most advanced portable chemical detector on the market. With the flexibility of up to six gas sensors such as CO, CO2, SOx, Nox, H2S, HC, and NH4.



DUST TRAK

Dust Trak is a highly accurate instrument for measuring PM2.5 and PM10 concentrations.

1.3.2.2 High Volume Air Samplers

High Volume Air Sampler consist of filter holding assembly, High capacity blower, U-tube Manometer, Rotameter, impinges housed in detachable fiber case, inlet filters, voltage stabilizer & Timer.



High volume air samplers are used for the collection of airborne particulate matter in ambient air. They are available for the collection of Total Suspended particulates (TSP), particulate matter with an aerodynamic diameter of less than 10µm (PM10), particulate matter with an aerodynamic diameter of less than 2.5µm (PM2.5), and semi-volatile organic compounds and pesticides (PUF).

1.3.2.3 Canister air sampler



The canister is used for air sampling in the case of volatile organic compounds, an air sampling canister is a container for collecting a whole air sample. Canister may be spherical or cylindrical and is constructed of specially treated stainless steel. The canister is prepared for sampling by evacuation the contents to vacuum of approximately 29.9 inches of mercury (in Hg). Opening the stainless-steel bellows valve allows the air sample to enter the canister. Flow controllers can be utilized to restrict the flow and allow for collection at desired flow rate or over a desired range. When the sample has been collected, the valve is closed and the canister is returned to the laboratory.

1.3.3 Stack Emission Monitoring:

Stack monitoring is referred as Stack emission testing, stack emission monitoring or stack sampling. It is a process to measure emission of industrial waste or pollutants emitted into atmosphere. The pollutants emitted from stack can be solid, gaseous, liquid organic or inorganic.

1.3.3.1 The Purpose of Stack Emission Monitoring:

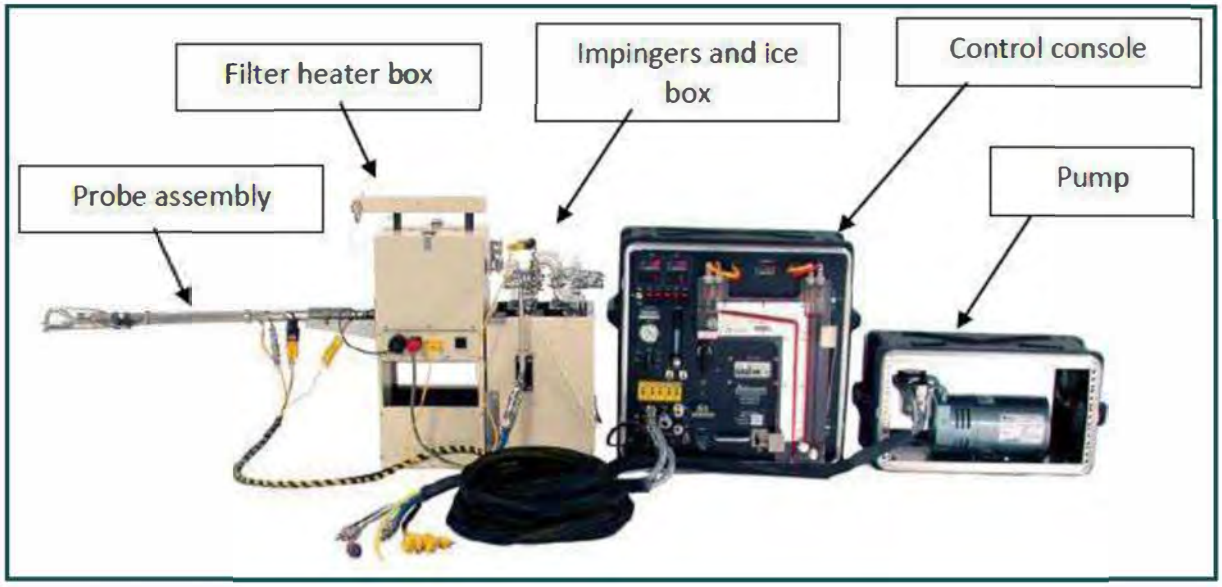
a. To determine the quality and quantity of air pollutants emitted by the source.
b. To measure effectiveness of pollutants controller equipment before and after installation.
c. To measure effectiveness of pollutants controller equipment for given condition.
d. To compare results with emission standards to take required action.
e. To compare changes in emission with the changes in processes or raw materials

1.3.3.2 Stack Emission Monitoring Procedure:

Stack Emission monitoring procedure includes tasks of Measurement, testing, sampling, and analysis. Onsite determination of physical parameters of flue gases such as temperature, flow and pressure also involved in Stack emission monitoring.

There are two options in stack emission measurements:

1) Measurement of particulate matter concentration in **COOLER STACK** for two line by using **Method 5.**



2) Measurement of GASES in **CLINKER STACK** by using Flue **Gases Analyzer:**

Monitoring stack emissions using techniques of continuous monitoring so that has been set concentration ratios of gases required on an ongoing basis (and that through the work of three batches for each batch of 60 minutes) and is set each gas separately by unit ultraviolet red, which confirms the accuracy of the measurements and the significance that it represents ratios gases on a regular basis and not on a temporary basis.

The methods used in measuring the emissions of flue gases:

#	Parameter	Unit	Method
01	Nitrogen Dioxide	mg/ m^3	US EPA Method 7E
02	Sulfur Dioxide	mg/ m^3	US EPA Method 6C
03	Carbon Monoxide	mg/ m^3	US EPA Method10
04	Carbon Dioxide	%	US EPA Method3A
05	Ratio of Oxygen	%	US EPA Method3A

1.3.4 Noise Level Monitoring

Noise or sound level monitoring or measurement is a process to measure magnitude of Noise in industries and residential area. Data collected from Noise level monitoring helps us to understand trends and action can be taken to reduce noise pollution. Noise pollution is Low or High frequency sound that can cause/harm the activity of human life. It can be caused by various industrial Machines, Motor Vehicles, and Craft etc. This process is a part of Environmental Monitoring as noise pollution is also increasing exponentially in recent years.



Noise pollution is measured by Sound/Noise level meter. It consists of several parts, mainly Microphone, Pre-amplifier, frequency weighting, Processor, Display System, communication System and Power Supply

2. INDOOR AIR QUALITY MONITORING:

Indoor Air Quality Monitoring is a essential process to determine level of contaminants present in indoor air which can affect productivity & well-being of occupants. Good and healthy Air Quality at workplace can increase worker's comfort, productivity, and well-being. Regular indoor air quality monitoring can help to identify issues with air quality.

Indoor Air quality can be affected by gases, particulate matters, bacteria, etc and Its quality can be improved by using filters, controlling source, proper ventilation.

2.1 Indoor Air Quality Monitoring Process:

Determination of Indoor Air Quality involves processes air sampling, testing and analysis of collected sample for various parameters. Major source of indoor air pollution is burning of wood, dung, charcoal for cooking purpose in households. Indoor Air quality denotes quality of air inside buildings as represented by humidity, temperature, air pollutants conditions which may affect comfort, health, and performance of occupiers.

Before proceeding to Indoor air quality monitoring below are the points need to keep in mind:

1. Building type (Residential, commercial, and sensitive building).
2. Selection of pollutants which needs to be monitor.
3. Diagnosing health related problems due to poor indoor air quality.
4. Building ventilation characteristic.
5. Number of people.
6. Activities in space (burning, smoking etc.).
7. Outdoor pollution.
8. Health records or disease history of people

2.2 Indoor Pollutants Management:

In a typical building, pollutants fall into two source categories those that enter the building from the outside and those generated within the building itself. Both include a wide variety of pollutant types and origins.

Outdoor sources can include building stack exhaust, vehicle emissions, industrial processes, and construction activity as well as many others.

Internal sources include maintenance or housekeeping activities, chemicals, cleaners, solvents, building renovations, new furnishings, new finishes, office equipment and various occupant activities.

Pollutant sources must be located and controlled to ensure good indoor air quality. Keep in mind that both sources and pathways are essential components that must be well understood for effective problem remediation. Pathways are created as pollutants travel by air movement or from relative positive to relative negative pressure areas through even the smallest of openings. Several methods for managing a pollutant source are available once the source is identified, including:

1. Removing the source.
2. Repairing the source so it no longer contributes pollutants.
3. Isolating the source with a physical barrier.
4. Isolating the source using air pressure differential.
5. Minimizing the time people are exposed.
6. Diluting pollutants and removing them from the building with increased ventilation.
7. Increasing filtration to clean the air and remove pollutants.

Method of Statement for

WATER QUALITY MONITORING

1. INTRODUCTION:

GECO Company water quality monitoring equipment help us to understand many of the pollutants and allow improvement of water quality. In GECO company, different high technology equipment were used for measuring most water pollutants in situ and in GECO lab for double check.

Water pollution is the contamination of water bodies (e.g. lakes, rivers, oceans, and ground water). Water pollution affects plants and organisms living in these bodies of water and in almost all cases the effect damaging not only to individual species populations, but also to the natural biological communities.

Water pollution occurs when pollutants are discharged directly or indirectly into water bodies without adequate treatment to remove harmful compounds. Source of water pollution include two sources, point source and non- point source.

1.1 Point sources

Point sources are direct discharges to a single point. Examples include waste water effluent, both municipal and industrial, runoff leachate from waste disposal sites, runoff mines, oil fields and industrial sites.

1.2 Non-point sources

Non-point sources are diffused across a broad area and their contamination cannot be traced to a single discharge point. Examples include runoff of excess fertilizers, herbicides, and insecticides from agricultural lands and residential areas; oil, grease, and toxic chemicals from urban runoff and energy production, and eroding stream banks.

Monitoring water quality is based on current water quality standards in the General Presidency of Meteorology and Environment Protection in Saudi Arabia, European and the International standards. GECO Company will measure the water quality parameters inside ground water wells, drinking water station, surface water, wastewater, and any water bodies requested from our customers.

2. IN-SITU TESTING

The field-measurement procedures implemented depend on:

a. The type of water body for which the chemical, physical, and biological characteristics are being determined.
b. Onsite characteristics and conditions at the time of measurement.
c. On the study objectives and data quality requirements of the project.

Onsite measurement is necessary to preserve sample integrity and ensure data accuracy for the following field measurements: water temperature, Dissolved-Oxygen (DO) concentration, Specific Electrical Conductance (SC),



pH, Oxidation Reduction Potential (ORP), Total Dissolved Solid, Salinity, Ammonia, Nitrate, Chloride, Chlorophyll-a, Blue Green Algae, and turbidity. All these parameters will be measured in situ by using multi-parameter sensors (TEST KIT, SOIL, AND IRRIGATION WATER, HACH SIW-1).

The water quality kits can simultaneously measure: pH, temperature, dissolved oxygen, conductivity, salinity, turbidity, total dissolved solids (TDS), water depth, oxidation reduction potential (ORP), seawater specific gravity and up to three specific ions. The water quality kit is flexible enough to use for checking the quality of a broad range of water samples, from factory effluent to urban drainage, river water, lake and marsh water, aquatic culture tanks, agricultural water supplies, and

seawater. The water quality instrumentation is water resistant, so it can be used safely even in the rain.

3. LABORATORY TESTS

Water samples or discrete samples that have been withdrawn from a sample-compositing device or point sampler can yield good data for conductivity, pH, turbidity, and alkalinity. In the site of investigation, field personal use appropriate methods and quality assurance measures to ensure that the field sites selected and the samples collected accurately represent the environment intended for study. In the lab, double check will be done for water quality parameters by using lab tool kits.



The laboratory tests conducted on the water samples are as follows:

3.1 Physical Analysis:

#	Test	Standard Method
1	Color.	SMWW-2120
2	PH.	SMWW-4500
3	Electrical Conductivity (EC).	SMWW-2510
4	Total Dissolved Salts (TDS).	SMWW-2540
5	Total Solids (TS).	SMWW-2540
6	Total Suspended Solids (TSS).	SMWW-2540
7	Temperature in field.	SMWW-2550
8	Turbidity.	SMWW-2130
9	Salinity.	SMWW-2520

3.2 Chemical Analysis:

#	Test	Standard Method
1	Anions	SMWW- 4500
2	Cations	SMWW- 3500

3	Total Hardness	SMWW- 2340
4	Calcium Hardness	SMWW- 2340
5	Magnesium Hardness	SMWW- 2340
6	Dissolved Oxygen	SMWW- 4500
7	Biological Oxygen demand (BOD)	SMWW- 5210
8	Chemical Oxygen demand (COD)	SMWW- 5220
9	Total Organic matter	SMWW- 5310
10	Grease & Oil	SMWW- 5520
11	Total Nitrogen	SMWW- 4500
12	Total Phosphate	SMWW- 4500
13	Total alkalinity	SMWW- 2320
14	Chlorine	SMWW-4500
15	Heavy Metals	SMWW- 3500

3.3 Microbiological Analysis:

#	Test	Standard Method
1	Microbiological Tests (Fecal Coliform, Total Coliform, Total Account, E-Coli, and other).	SMWW-9222

3.4 Organic Analysis:

#	Test	Standard Method
1	Total Chlorinated Hydrocarbons.	EPA- 8260
2	PCBs (Total)	USEPA – 3510 / 8270
3	PAHs (16 Parameters)	USEPA – 8270D
4	Total Petroleum Hydrocarbons (TPH)	APHA – 5520F
5	Volatile Organic Compounds (Benzene, Carbon tetrachloride, Chloroform, Toluene, Xylene, Vinyl Chloride, Methyl tert-butyl ether (MTBE)).	USEPA – 5030 / 8260

Method of Statement for

SOIL QUALITY MONITORING

1. INTRODUCTION:

Soil pollution, also commonly referred to as soil contamination, is defined as a phenomenon characterized by the loss of structural and biological properties by the soil layers as a result of manmade factors and natural factors, such as wind, soil erosion, acid rains and forest fires.



Manmade factors, such as deforestation, excessive and indiscriminate chemical usage, discharge of industrial waste products and more are often considered to be major causes leading to soil pollution. Soil pollution can lead to serious repercussions on both the plant and animal species and thus indirectly humans.

Some of the common effects on individuals include development of health disorders, such as cancer, skin disorders and development disorders, depending upon the chemicals present in the soil. From an Industrial perspective, soil pollution can lead to various effects, such as reduction in the soil fertility, significantly reducing the crop production, imbalance in the plant and animal species and deposition of silt in the underwater deposits. Testing soil pollution can be very complicated, and there is no way to detect all the possible pollutants. The most common pollutants are petroleum products, heavy metals, industrial solvents, pesticides, herbicides, salts and fertilizers or plant nutrients in such high concentrations that they become toxic for agricultural crops. Periodic use of agricultural soil testing as a diagnostic tool makes it possible to pinpoint deficiencies in time to remedy issues before significant revenue loss. Agricultural soil testing provides a measure of a soil's fertility, nutrient content, and the presence of potentially harmful organisms. Based on current soil quality standards in the General Presidency of Meteorology and Environment Protection in Saudi Arabia, European and the International standards. GECO Company will measure the soil contaminants, soluble salts, organic matter content, nutrient levels, and soil consolidation future which requested from our customers.

2. IN-SITU TESTING

The field-measurement procedures implemented depend on:

a. the type of soil for which the chemical and physical characteristics are being determined.
b. onsite characteristics and conditions at the time of measurement.
c. The study objectives and data quality requirements of the project.

Onsite measurement is necessary to preserve sample integrity and ensure data accuracy for the following field measurements.

Samples at field can be used to determine soil moisture content, Electric Conductivity, pH, some physical, chemical, and biological characteristics. Also, a complete soil profile will be done in the field.

All these parameters will be measured in situ by using multi-parameter sensors (TEST KIT, SOIL, AND IRRIGATION WATER, HACH SIW-1).



3. LABORATORY TESTS

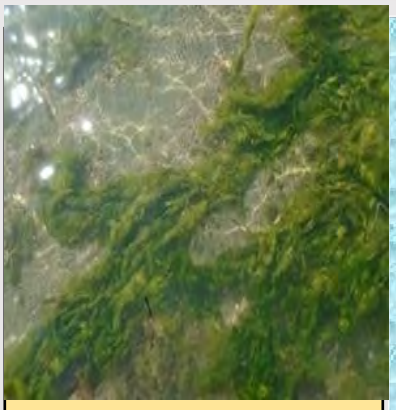
Soil samples collected from the site of investigation by a soil sampler will be send to lab for preservations. In Geco lab, soil pollutants, chemical, and physical characteristics will be measured by using lab tool kits. Also, Nitrogen, Phosphorus and Potassium and testing other pollutants such as petroleum products, heavy metals,

industrial solvents, pesticides, salts, and fertilizers will be measured by using Atomic Absorption.

The laboratory tests conducted on the water samples are as follows:

#	Test	Reference
1	PH Test.	ASTM D-4972 EPA- 9040D
2	Water Content.	ASTM D-2216
3	Lime Content.	ASTM D-3155
4	Carbonate Content.	ASTM D-4373
5	Total Organic Matter.	ASTM D-2976
6	Total Nitrogen	ASTM D-2973
7	Chlorides Content	ASTM D-1411
8	Determination of Lead	ASTM E-1614 EPA-SW-7420
9	Total, Fixed & Volatile Solids.	SMWW-2540
10	Volatile Organic Compounds in Soil.	EPA-SW-5021
11	Determination of Arsenic	EPA-SW-7060A EPA-SW-7061A
12	Determination of Antimony.	EPA-7062
13	Determination of Chromium.	EPA-SW-7197
14	Determination of Mercury.	EPA-SW-7471A
15	Determination of Selenium.	EPA-SW-7740 EPA-SW-7741A EPA-SW-7742
16	Determination of Cyanide.	EPA-SW-9010B
17	Caution Exchange Capacity.	EPA-SW-9080 EPA-SW-9081
18	Determination of Sulfate.	ASTM C-1580
19	Determination of Phosphorus.	ASTM D-6146
20	Nitrate & Nitrite.	ASTM D-3867

21	Grease & Oil.	ASTM D-3921
22	Phenol.	EPA-SW-3640A
23	Potassium.	EPA-SW-7610
24	Sulfides.	EPA-SW-9030B
25	Sulfide Total.	EPA-SW-9215
26	Titanium.	EPA-SW-6010B
27	Zinc.	EPA-SW-0600
28	Sodium.	EPA-SW-3005A
29	Electrical Conductivity.	SMWW-2510
30	Aluminum.	EPA-SW-3005A
31	Barium.	EPA-SW-0060
32	Boron.	EPA-SW-3051
33	Cadmium.	EPA-SW-0060
34	Calcium.	EPA-SW-3005A
35	Cobalt.	EPA-SW-0060
36	Copper.	EPA-SW-0060
37	Iron.	EPA-SW-3005A
38	Magnesium.	EPA-SW-3005A
39	Total Chlorinated Hydrocarbons.	EPA- 8260
40	PCBs (Total)	USEPA – 3510 / 8270
41	PAHs (16 Parameters)	USEPA – 8270D
42	Total Petroleum Hydrocarbons (TPH)	APHA – 5520F





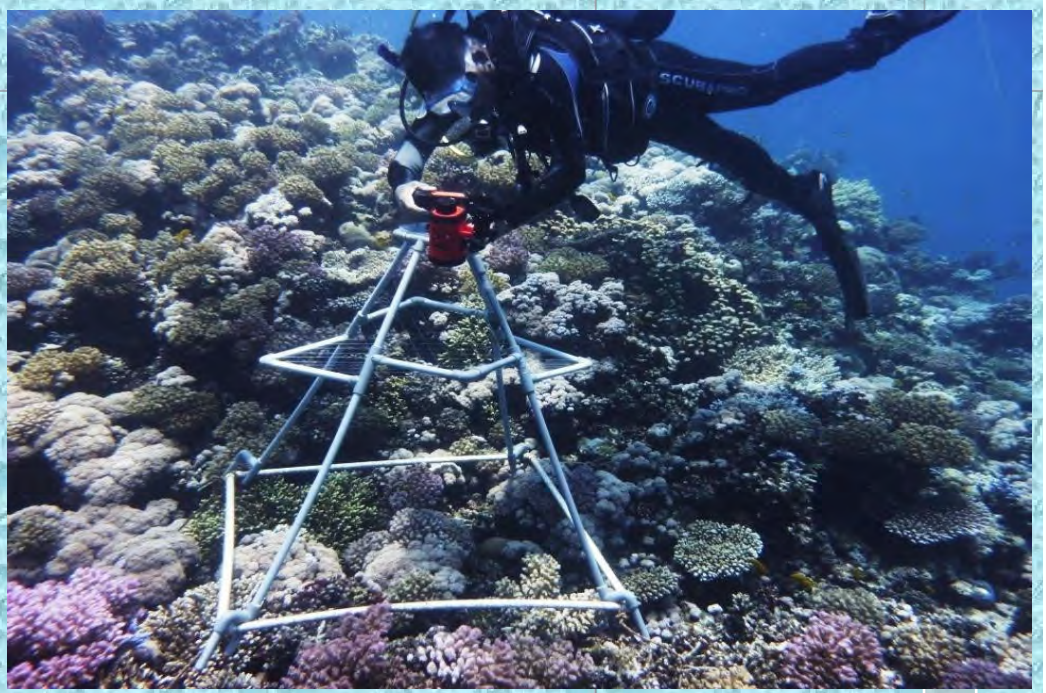






GECO OCEANOGRAPHIC AND COASTAL STUDIES
FACILITIES & SCOPE OF WORK





GECO Oceanographic and Coastal Studies

Vision :

Provide the best different Oceanographic and Coastal Studies of the different Coastal and Aquatic Ecosystems in the required and limited time with high quality and accuracy.

Mission:

The Oceanographic and Coastal Studies Department is a unique multidisciplinary in different Oceanographic Fields Ecological, Biological, Chemical, Geological and Physical, according to the National and International Standards which accredited by many Saudi Organizations and Authorities. As well as Study the different marine environments for face all the challenges and hazards which may exist from different Sources of Pollution and Climatic Changes. This is to serve the Coastal and Marine Communities related to Sustainable Development in the whole Coastal areas of Kingdom of Saudi Arabia, which develop the national economy according to Saudi Vision 2030.

Objectives:

1. Providing Oceanographic Environmental Assessment Consultations to Governmental and Private Institutions and Authorities.
2. Providing Studies and Monitoring of Ecological Oceanography and Coastal Processes.
3. Providing Digital and Numerical Simulation and Modeling of Coastal Processes and Ecological Oceanography.
4. Providing Coastal and Oceanographic Studies.
5. Providing Coastal and Oceanographic Base Line Ecology.
6. Providing Digital Numerical Hydrodynamic Simulation Models.
7. Providing Coastal Planning and Management.
8. Providing Assessment of the Likely Environmental Impacts of Coastal Development.
9. Providing Likely Oceanographic Environmental Impacts Assessment.
10. Training Courses for Oceanographic and Coastal Studies.

Coastal and Oceanographic Studies and Scope of Work

1. Bathymetric Surveys.
2. Sea Bottom Profilers.
3. Topographic Surveys.
4. Geomorphologic Surveys.
5. Water Quality (Physico-chemical Parameters) Surveys within the entire Depths of the Seawater Column.
6. Seawater Sampling.
7. Beach, Shoreline and Bottom Sediment Sampling.
8. Bottom Sediment Corer Sampling.
9. Videos and Photographs Imaging Surveys of Seabed and Coral Reef, using high quality and accurate Digital Marine Rack Mount Video Control System.
10. Videos and Photographs Imaging Surveys of Marine Organisms within the Seawater Column, using high quality and accurate Dropdown Digital Marine Rack Mount Video Control System.
11. Videos and Photographs Imaging Surveys of Benthic Marine Organisms, using high quality and accurate Dropdown Digital Marine Rack Mount Video Control System.
12. Videos and Photographs Imaging Surveys of Marine Habitats, using high quality and accurate Dropdown Digital Marine Rack Mount Video Control System.
13. Videos and Photographs Imaging Surveys of Intertidal Marine Organisms, using high quality and accurate Digital Marine Video Camera.
14. Videos and Photographs Imaging Surveys of Intertidal Marine Habitats, using high quality and accurate Digital Marine Video Camera.
15. Oceanographic Monitoring of Hydrocarbons Derivatives, Petroleum, Radiological, Sewage Pollutants.
16. Detailed Ecological (Substrate and Habitats) and Environmental Serves and Study of the Marine and Coastal Regions.
17. Detailed Biological Survey (Fauna and Flora) and Study of the Marine and Coastal Regions.

18. Detailed Chemical Survey (Seawater and Bottom Sediments) and Study of the Marine and Coastal Regions.
19. Detailed Physical (Wind, Waves, Currents, Tides) Survey and Study of the Marine and Coastal Regions.
20. Detailed Geological Survey (Geomorphology, Stratigraphy, Topography) and Study of the Marine and Coastal Regions.
21. Detailed Survey and Study of the Oceanography and Coastal Processes.
22. Detailed Studies of the Marine Environmental Base Line Ecology.
23. Marine Studies and consulting for Assessment of the Likely Impacts of Coastal Development.
24. Marine Studies and consulting Coastal Planning and Management.
25. Marine Studies and Consulting for Quantitative and Qualitative Change Detection of Bottom Sediments (Accretion / Erosion).
26. Marine Studies and Consulting for Quantitative and Qualitative Change Detection of Shoreline Changes (Accretion / Erosion).
27. Marine Studies and Consulting for Sea Bottom Topography Surveys.
28. Marine Studies and Consulting for Sea Bottom Bathymetric Surveys.
29. Marine Studies and Consulting for Measuring Slope of Sea Bottom and Shoreline.
30. Marine Studies and Consulting for Structural, Textile, Distributional and Geomorphological Properties of Sediment Types.
31. Marine Studies and Consulting for Marine Environmental Impact assessment, and Applications of World National Environmental Standards, Lows and Codes, and the Global Standards of the World Health Organization (WHO).
32. Develop the Future Forecasting and Prediction of an Environmental Sustainable Development in the Coastal area.
33. Develop the Future Forecasting and Prediction of an Environmental impacts of new Industrial and Strategic Institutions over the Long Term.

34. Oceanographic Studies and Consulting for Follow up and the study of the evolution of Natural Environmental Phenomena and update their data.
35. Support Decision-Making for the Site Selection and Evaluation Studies of the Best Appropriate Marine and Coastal Areas for Establishment of Strategic Installations, according to Safety, Economical and Environmental Standards.
36. Oceanographic Environmental Studies and Consulting for Coastal Processes and Morphodynamic Changes.
37. Oceanographic Environmental Studies and Consulting for the Hydrodynamic Transport of Marine Sediments.
38. Oceanographic Environmental Studies and Consultations to evaluate the Potential Impacts of Coastal Sustainable Development.
39. Oceanographic Environmental Studies and Consultancy for Planning and Management of Coastal Areas.
40. Prepare the Digital Numerical Ecological Oceanographic Simulation Models.
41. Prepare the Digital Numerical Hydrodynamic Simulation Models.
42. Prepare the Digital Numerical Bio-Geo-Hydro-Morphodynamical Oceanographic Simulation Models.
43. Prepare the Physical Oceanographic Simulation Models.
44. Detailed Study of Hydrodynamics of Bottom Sediment Transport.
45. Thermal Pollution and its dispersion in Oceanographic Environment.
46. Tracing and Dispersion of Wastewater Discharge.
47. Tracing and Dispersion of Sewage Discharge.
48. Photosynthetic Active Radiation (PAR) and Primary Productivity (PP).
49. Selecting the Proposed options of appropriate Intake and Discharge Canals of any coastal project.
50. Any Projects relative to the Oceanographic and Coastal Studies.

Methodological Approach of Coastal and Oceanographic Studies

Preparatory Survey Works and Exploratory Surveys:

a)-Mobilization :

Mobilizations will be started once the necessary approval is secured. Sampling Vessels, instruments, sampling bottles and other supplies will be mobilized to the site. All the sampling bottles will be selected as per the Manual of oceanographic observations and pollutant analyses methods (MOOPAM, 1989), by Regional Organization for the Protection of the Marine Environment (ROPME). The instruments will be calibrated as per the user's manuals of each instrument.

b)- Exploratory Surveys:

An Exploratory Surveys will be conducted to selecting the accurate and appropriate Transects and Stations for seawater quality surveys, Collection of Seawater and Bottom Sediment Samples and Biological Surveys (Substrates & Habitats) (Fauna & Flora) "Biodiversity", as well as Physical Oceanographic Data Collection.

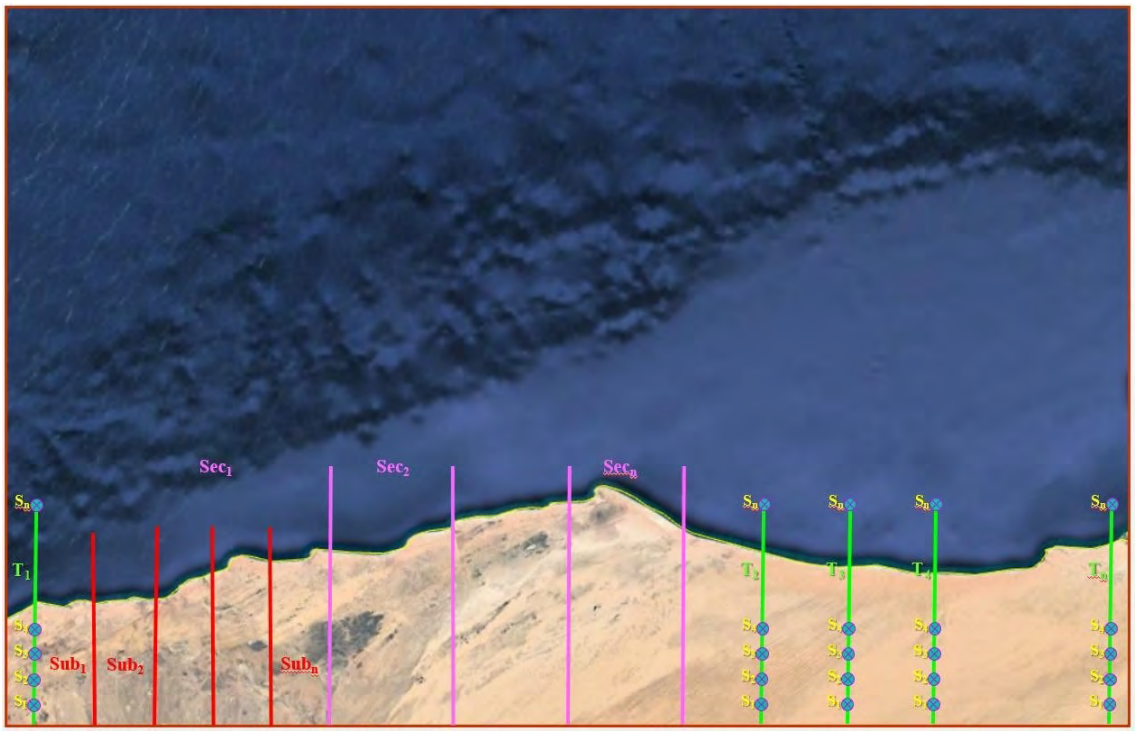
During this survey selected stations will be accessed and depth and other logistical problems will be assessed. The results will be discussed with the client for the final selection of the Transects and Stations (i.e. selected stations in the Initial Approval from the Client may be unsuitable for seawater and marine sediment collection due to the substrate type or depth). Finally, final approval is taken from the Client on the Transects and Stations which selected during this exploratory survey.

Two Exploratory Survey will be conducted :

i. The First one Beach, Shoreline and Near shore Surveys :

Will be done for Beach, Shoreline and Nearshore Surveys. Hand held GPS, Land Surveying Equipment, Digital Video Camera, high quality and accurate Digital Marine Video Camera and 4X4 Vehicle will be used for this survey. This survey is used as the guidance and assistance in the selecting the defined number of the best and high accurate of Beach, Shoreline and Nearshore Transects or Profiles (**T_1 – T_n**) roughly Perpendicular to the Shoreline Seaward (Offshoreward), and in the segmentation of the Beach, Shoreline and Nearshore into the defined number of Sections (**Sec_1 – Sec_n**) and Subsections (**Sub_1 – Sub_n**) depending on Topography, Geomorphology, Morphodynamics and Intertidal Zone for focusing the study of Beach, Shoreline and Nearshore

Surveys in more details. As well as used for the guidance and assistance in the selecting the defined number of the best and high accurate of Beach, Shoreline and Nearshore Stations ($S_1 - S_n$) for seawater quality surveys, Collection of Seawater and Sediment Samples and Biological Surveys (Substrates & Habitats) (Fauna & Flora) "Biodiversity" of Beach, Shoreline and Nearshore.

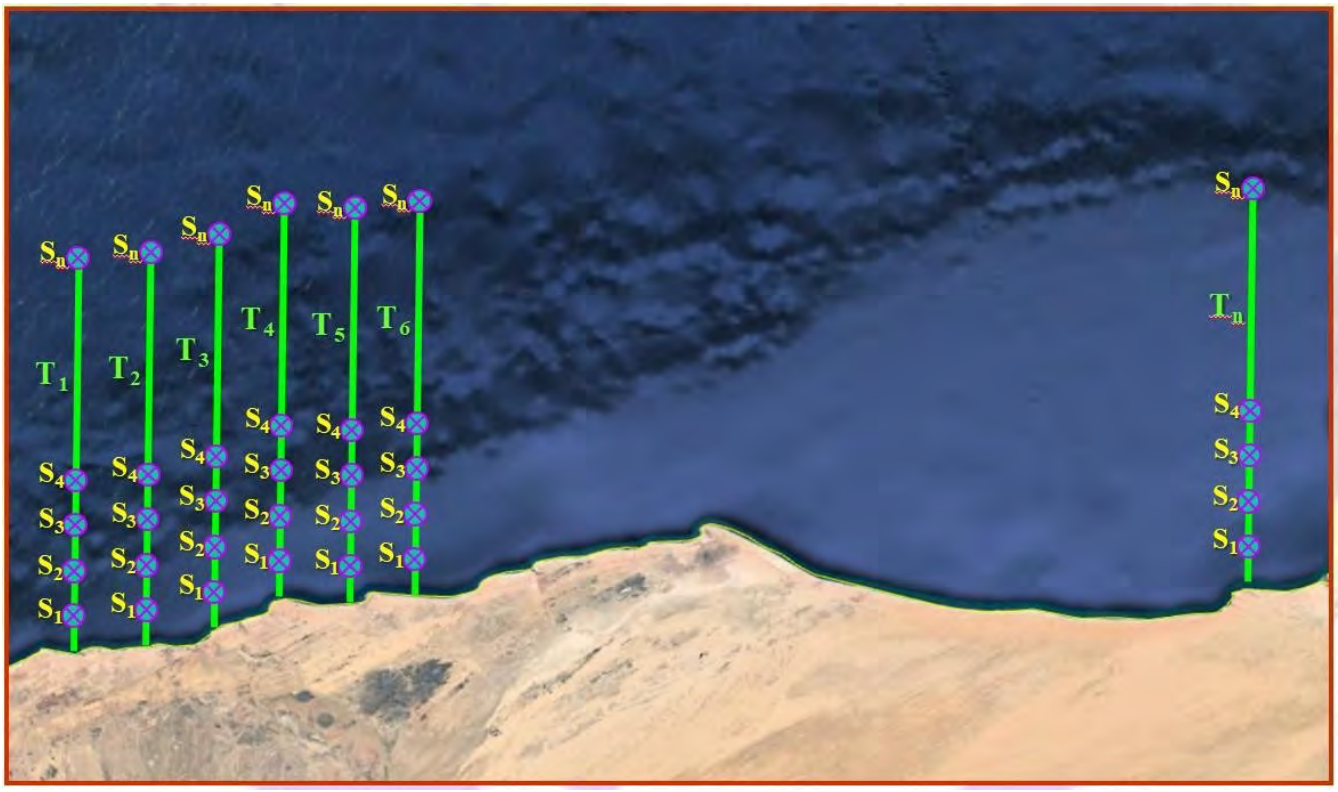


Beach, Shoreline and Nearshore Transects or Profiles ($T_1 - T_n$) Perpendicular to the Shoreline Seaward (Offshoreward), Sections ($Sec_1 - Sec_n$), Subsections ($Sub_1 - Sub_n$) and Stations ($S_1 - S_n$).

ii. The Second one Offshore Survey :

Will be done for Offshore Surveys. GPS, Bathymetric Echo Sounder and Sub Bottom Profiler, high quality and accurate Dropdown Digital Marine Rack Mount Video Control System and Boat will be used for this survey. This survey is used as the guidance and assistance in the selecting the defined number of the best and high accurate of Offshore Transects or Profiles ($T_1 - T_n$) roughly Perpendicular to the Shoreline extending Seaward (Offshoreward) from nearshore to offshore, depending on substrate type and depth. As well as used for the guidance and assistance in the selecting the defined number of the best and high accurate of Offshore Stations ($S_1 - S_n$) for seawater quality surveys, Collection of Seawater and Bottom Sediment Samples and Biological Surveys (Substrates & Habitats) (Fauna & Flora) "Biodiversity" of Offshore. Also used for the

guidance and assistance in the selecting the locations of appropriate sites for mooring and fixing the Instruments of Physical Oceanographic Data Collection.



Beach, Shoreline and Nearshore Transects or Profiles ($T_1 - T_n$) Perpendicular to the Shoreline Seaward (Offshoreward), and Stations ($S_1 - S_n$).





Beach, Shoreline and Nearshore Transects or Profiles ($T_1 - T_n$) Perpendicular to the Shoreline Seaward (Offshoreward), Sections ($Sec_1 - Sec_n$), Subsections ($Sub_1 - Sub_n$) and Stations ($S_1 - S_n$).

Beach, Nearshore and Shoreline Surveys :

Beach, Nearshore and Shoreline Surveys will be done using Hand held GPS, Land Surveying Equipment, Digital Video Camera, high quality and accurate Digital Marine Video Camera and 4X4 Vehicle. It is the visual survey, will monitor a section of the coast by walking or driving through the entire coastline and all the relevant information observed will be noted and at each Transects or Profiles (**$T_1 - T_n$**), Sections (**$Sec_1 - Sec_n$**) and Subsections (**$Sub_1 - Sub_n$**) intensive samplings will be conducted.

The scientific research team will be documented the site's location from the GPS and multiple pictures will be taken of each site. After the surveys, photographs and GPS data will be downloaded for analysis and interpretation using GIS and advanced sets of computer software. In

some cases using Satellite Images or Aerial Photographs as Digital Image Processing and Analysis by using Remote Sensing and GIS Techniques

The scientific research team will document the biota and habitats towards the seaward side up to 1m depth. The observations include the intertidal extent, slope, biological elements present like mangroves and shoreline vegetation and fauna and type of substrate and other geographical and geomorphological features. Land uses, water conditions, natural resources, human activities and potential pollution sources will be recorded. The data will be analyzed and will be presented as GIS maps.

Critical marine habitats like mangroves, coral heads, seaweeds and seagrass (if present) will be studied in detail; which includes density and cover by photo-quadrat method. Percentage cover will be calculated by visual estimation and the photographs will be analyzed with appropriate image analyzing software.

The vertical survey extended the beach, upper inter-tidal zone (Surf Zone) and extended up the sub-tidal zone. To characterize and classify the existing landforms, vegetation, and fauna, the scientific research team will be used two methods of sampling. The first method is an intensive, quantitative sampling method will be conducted in areas of patchy vegetation with variation in landforms, while the second method is a more subjective sampling method will be used in areas that have critical habitats and vegetation. A more subjective, qualitative method (preferential sampling) will be used in areas where vegetation and landforms are more uniform.

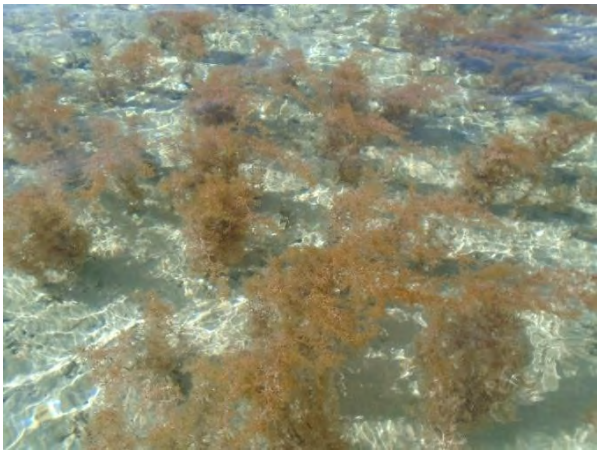
Systematic survey methods will be employed to provide the greatest coverage possible of the area and to get maximum coverage with sampling points spaced equidistant over the area. The survey approach and standards will be outlined to provide systematic data on terrestrial vegetation, fauna and landforms and their abundance and composition patterns. Representative areas of each habitat will be surveyed by direct observation. Photographs of habitats and ecological features of special importance will be noted with geographical coordinates.

The GECO team will be surveyed the beach and coastal shoreline according to the following criteria :

- Accessibility
- Coastal Uses
- Physical Characteristics of the Beach
- Physical Characteristics of the Near shore
- Physical Characteristics of the Shoreline

- Water Characteristics
- Wildlife Observations (Biological Biodiversity)
- Geographical coordinates
- Geological and Geomorphological Features
- General habitat
- Landward Habitat
- Intertidal Substratum
- Morph dynamics
- Inter-tidal extent
- Accretion and Erosion areas
- Land use pattern and Recreational Activities
- Litter and Debris Pollutions
- Terrestrial Flora and Fauna
- Marine Flora and Fauna
- General assessment of vegetation and faunal condition
- The range of major habitats in the study area
- Additional opportunistic data during ground trothing













Beach, Nearshore and Shoreline Surveys.







Mangrove Community of Beach, Nearshore and Shoreline Surveys.

Collection of Seawater Samples :

Seawater samples will be collected from each entire Stations ($S_1 - S_n$) which selected during Exploratory Survey, at three depths (Surface layer – Middle layer – Bottom layer). Horizontal Seawater Samplers (Van Dorn water samplers) or Vertical Seawater Samplers (Ruttner water samplers) will be used for water sample collection according to the nature of the project or the client's request. Seawater samples will be collected once or repeatedly several times during entire the study period, depending on the nature of the project or the client's request.

Surface water samples will be collected at about 0.50m below the surface of the water and bottom water samples will be collected at about 0.50m above the sea bottom, the depth was reading before by the Echo Sounder.







Seawater Samplers
a)- Vertical Seawater Samplers (Ruttner water samplers),
b)- Horizontal Seawater Samplers (Van Dorn water samplers).
c)- Bottles used to preserve Seawater Samples.

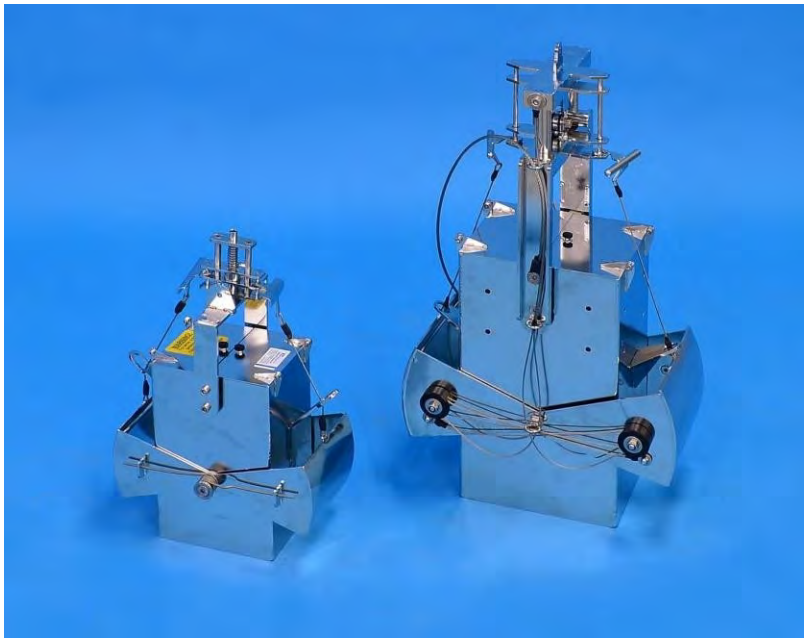
Collection of Surface Bottom Sediment Samples :

Surface Bottom Sediment Samples will be collected from each entire Stations ($S_1 - S_n$) which selected during Exploratory Survey. Ekman Bottom Corer will be used to collect surface bottom sediment samples. Lowering by Portable Winch (230 VAC – 2200 W / 3 HP, Load : 110 kg.) will be slowed to avoid disturbance to the superficial sediments and the Epibenthos when impact with the seabed will be near. Upon retrieval, samples will be judged as acceptable when there will be complete closure of the grab, samples possessed a disinclined surface or no observation of substantial spillage during retrieval will be realized.

Surface Bottom Sediment samples will be collected once or repeatedly several times during entire the study period, depending on the nature of the project or the client's request.

Five Samples will be collected from each station depending on the nature of the project or the client's request for the following parameters :

- One sample will be for Chemical analysis.
- One sample will be for Physical analysis.
- One sample will be for Mechanical analysis.
- One sample will be for Geological and Geochemical analysis.
- One sample will be for Biological analysis (Macrobenthos / Macrofauna).



Ekman Bottom Corer (5.00 L and 12.00 L).



Portable Winch – 230 VAC – 2200 W (3 HP), Load 110 kg.

Water Quality (Physico-chemical Parameters) :

Water Quality (Physico-chemical Parameters) study will be done by in-situ methods. Important water quality parameters of the water will be measured by pre-calibrated portable multi-parameter probes (YSI EXO2 Sonde).

Water Quality Profiling will be performed in each entire Stations (**S_1 – S_n**) which selected during Exploratory Survey, by collecting data at each 0.5 seconds and at entire depth of the water column. Preprogrammed mutliparameter probes will be lowered slowly to the bottom and the measurements will be performed in the continuous mode (profiling mode) at each 0.5 seconds during lowering. The stored data will be retrieved and downloaded for processing and analysis. The results will be tabulated in tables and represented graphically in figures, by using various sets of advanced computer software.

Water Quality (Physico-chemical Parameters) will be measured once or repeatedly several times during entire the study period, depending on the nature of the project or the client's request.

Parameters will be measured include :

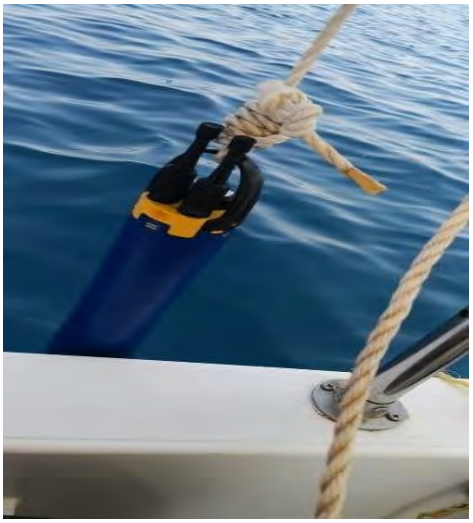
1. Depth.
2. pH/ ORP.
3. Turbidity.
4. Conductivity.
5. Specific conductivity.
6. Resistivity.
7. Salinity.
8. Temperature.
9. Total Dissolved Solids (TDS).
10. Total Suspended Solids (TSS).
11. Optical Dissolved Oxygen (Optical DO).
12. Total Algae (TAL), Chlorophyll and blue green algae.
13. Photosynthetic Active Radiation (PAR)/ Primary Productivity.
14. Chromophoric Dissolved Organic Matter or Colored Dissolved Organic Matter (CDOM/FDOM).
15. Organic Matter in water (OM).
16. Rhodamine : Monitoring the Movement of Water as well as Dispersion and Mixing Characteristics :
    - Time-of-travel (TOT) studies.
    - Hydraulic Characterization.
    - Mixing Zone Identification.
    - Pollution Plume Tracing.
    - Tracing and Dispersion of Wastewater Discharge.
    - Tracing and Dispersion of Sewage Discharge.
    - Spill Mapping.





Portable Mutliparameter Probes (Physico-chemical Parameters), YSI EXO2 Sonde

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Measuring of Water Quality (Physico-chemical Parameters), YSI EXO2 Sonde.

Physical Oceanographic Data Collection:

The required Physical oceanographic data will be acquired by mooring AANDERAA SEAGUARD II Doppler Current Profiler with Directional Wave Recorder, Tide and Water Quality sensors. It will be performed in the Station which selected during Exploratory Survey depending on the Nature of the project.

Physical oceanographic data will be measured one month or more during entire the study period, depending on the nature of the project or the client's request.

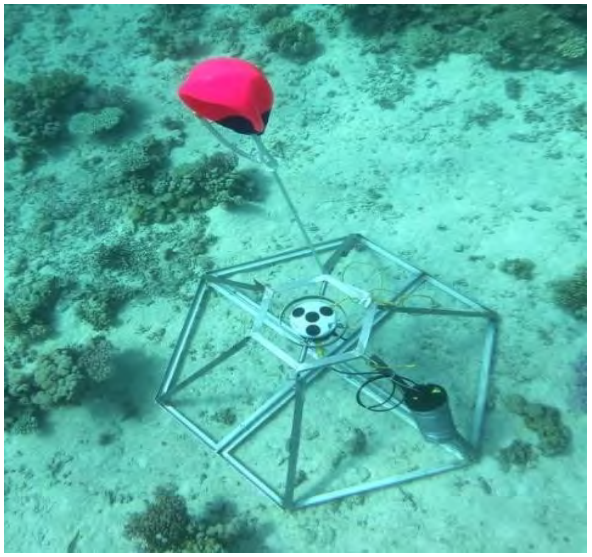
The stored raw data will be retrieved and downloaded for processing and analysis. Characteristics of the Manipulating, Extrapolating and Processing of Oceanographic Raw Data will be listed in tables. Also the Correlation Matrix and Statistical Parameters will be calculated and listed in tables. As well as Timeseries Results will be represented graphically, the Waveroses Results and Currentroses Results will be done by using various sets of advanced computer software, to show the general conditions.

Parameters will be measured include :

1. Tides and Sea Level Changes.
2. Current Speed.
3. Current Direction.
4. Wave Height.
5. Wave Period.
6. Wave Direction.
7. Turbidity.
8. Conductivity.
9. Salinity.
10. Temperature.
11. Hydrostatic Pressure.
12. Depth.

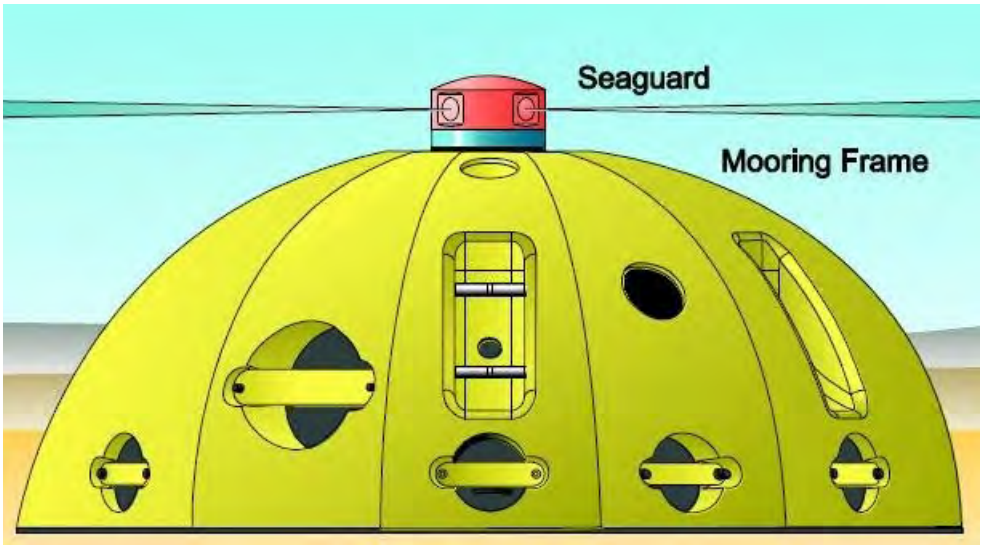




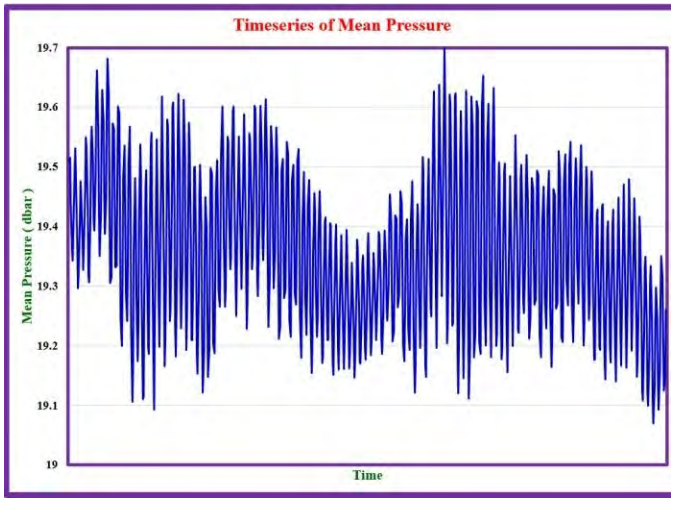



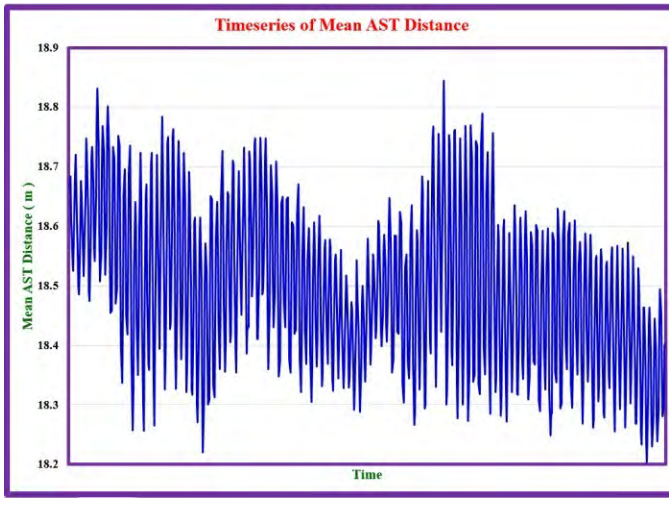
Installing the Oceanographic Instrument AANDERAA SEAGUARD II Doppler Current Profiler with Directional Wave Recorder, Tide and Water Quality sensors



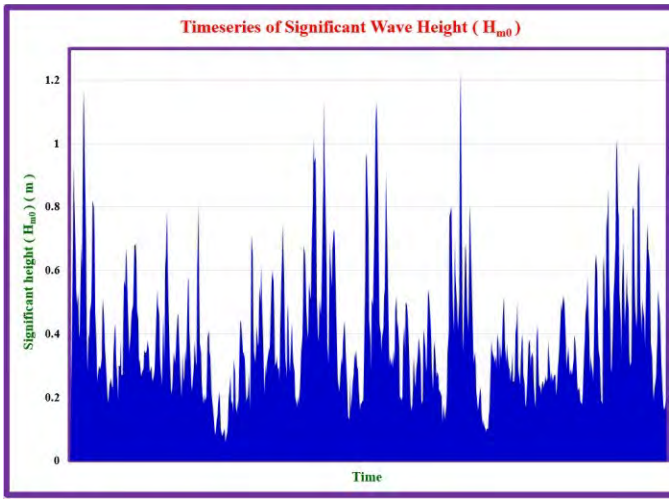


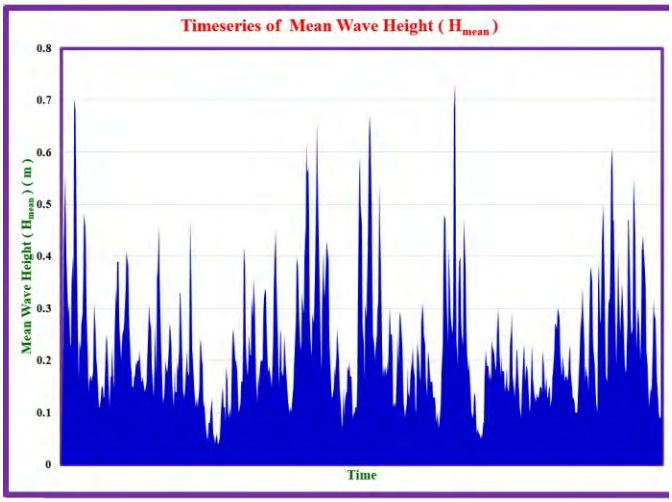
AANDERAA SEAGUARD II Doppler Current Profiler with Directional Wave Recorder, Tide and Water Quality sensors

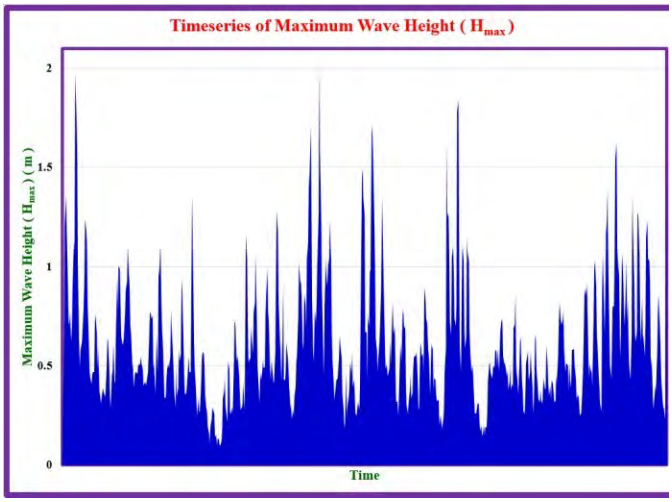


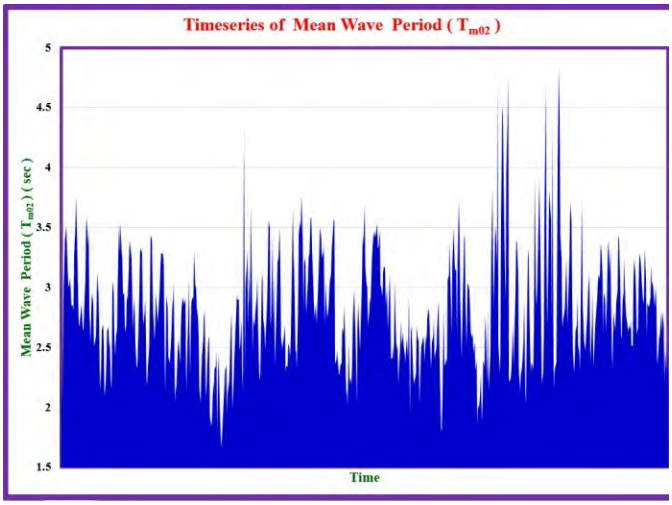


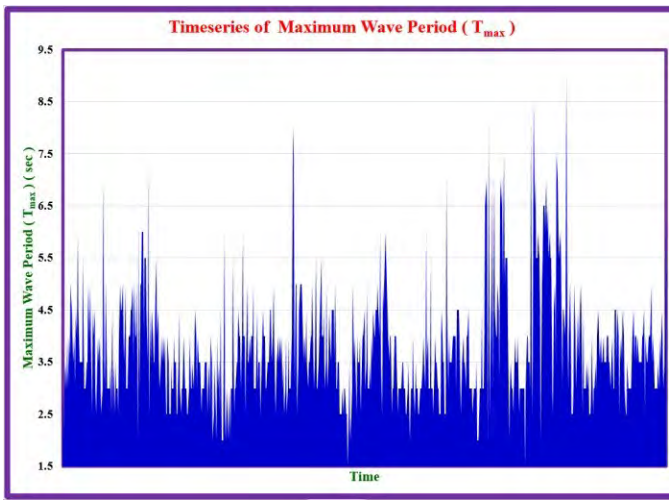
Timeseries Results of Physical Oceanographic Data.

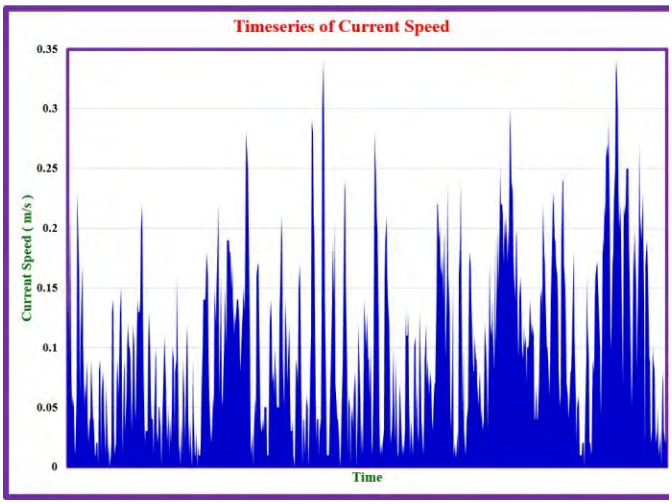




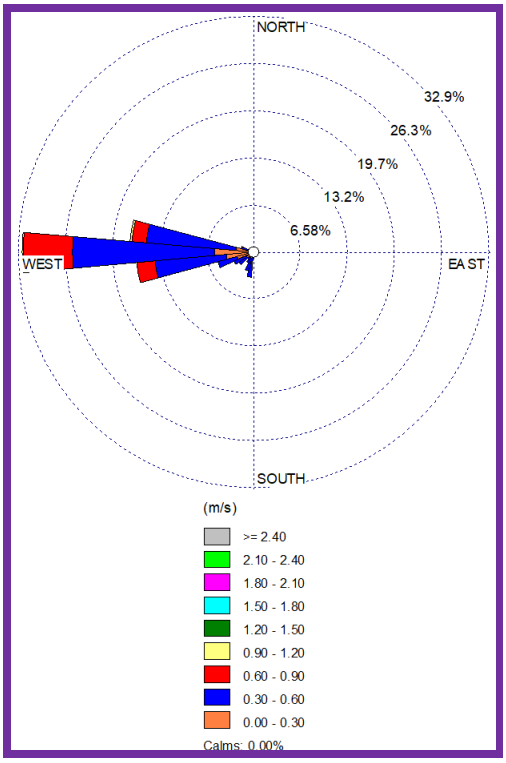




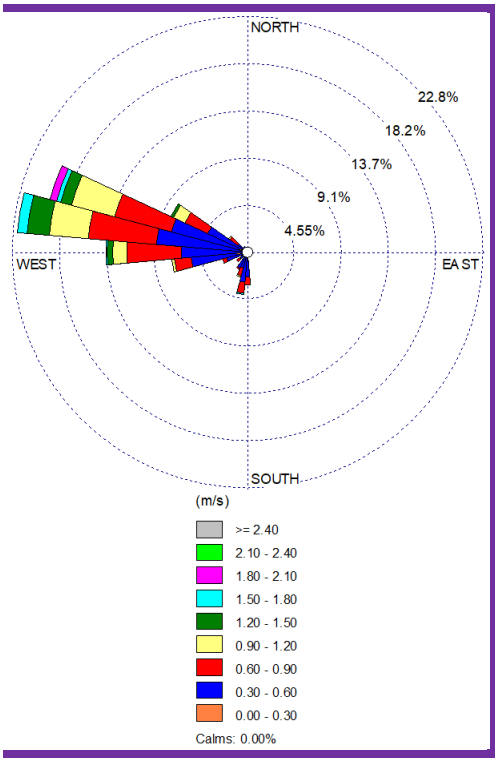




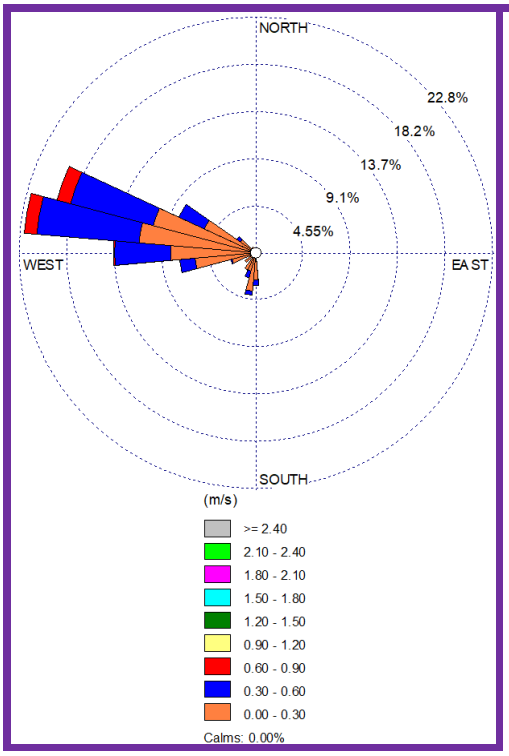
Timeseries Results of Physical Oceanographic Data.



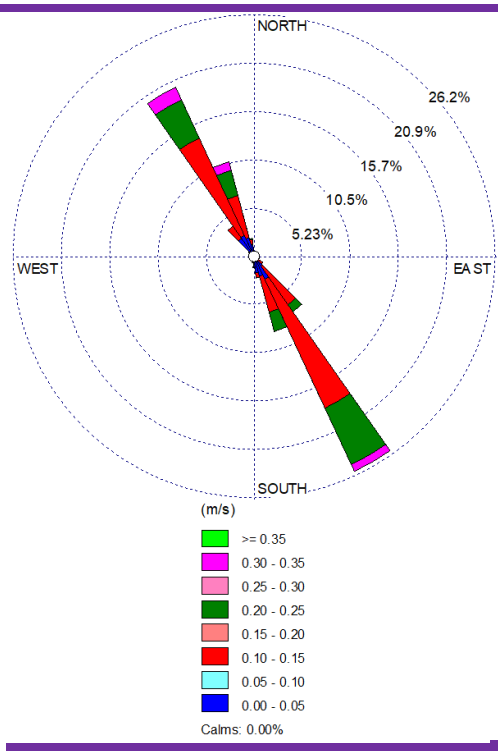
Waverose of Significant Wave Height



Waverose of Mean Wave Height



Waverose of Mean Wave Period



Currentrose

Waveroses and Currentrose Diagrams Results of Physical Oceanographic Data.

Bathymetric and Topographic Surveys and Sea Bottom Profilers

Bathymetric surveys allow us to measure the depth of a water body as well as map the underwater features of a water body. Multiple methods can be used for bathymetric surveys including multi-beam and single-beam surveys, sub-bottom profilers.

Parameters will be measured during Survey

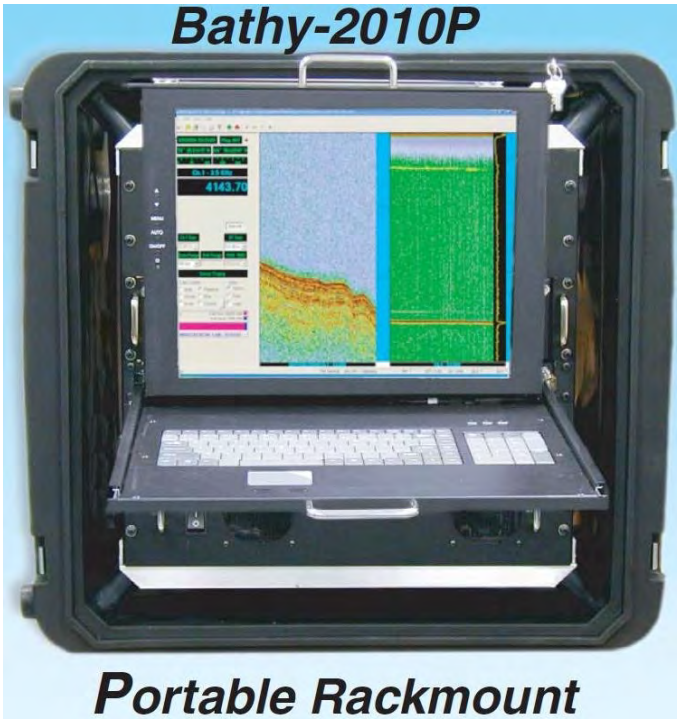
i. Bathymetry.
ii. Topography.
iii. Characteristics of Sea Bottom (Bed Rock, Sediments, Coral Reefs).
iv. Textural and Types of Bottom Sediments (Stones, Pebbles, Gravel, Sand, Silt, Clay and Mud).
v. Thickness of Bottom Sediments.

a)-Plotting Diagrams :

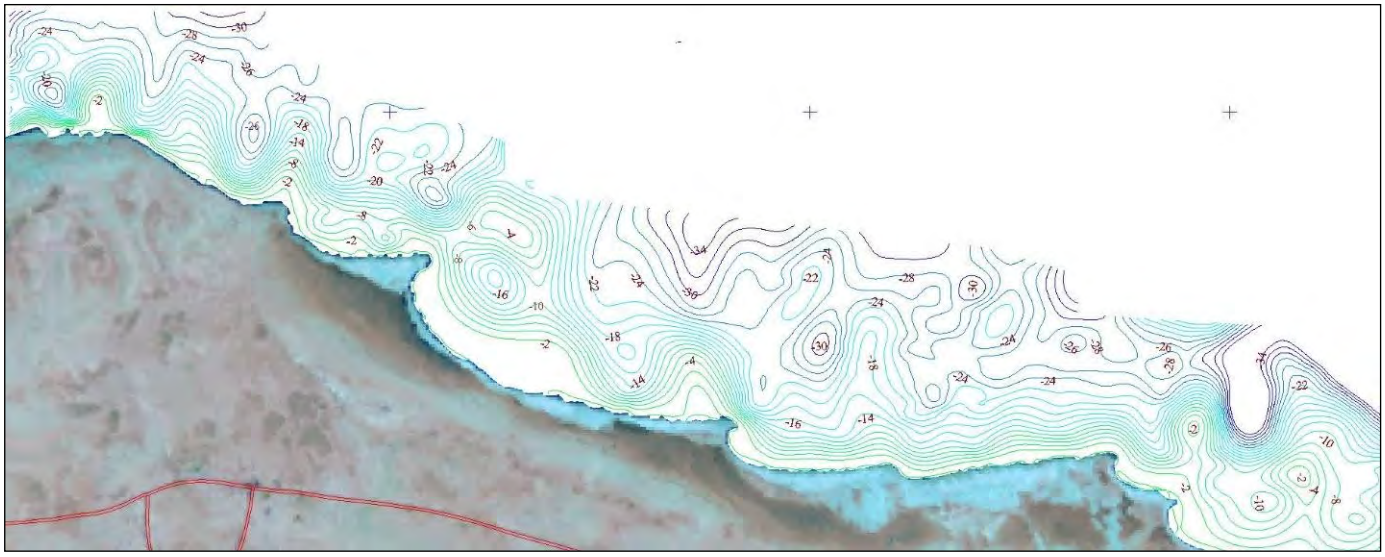
i. Plots Bathymetry Contour lines Diagrams.
ii. Plots Topography Diagrams.
iii. Plots Characteristics of Sea Bottom (Bed Rock, Sediments, Coral Reefs) Diagrams.
iv. Plots Textural and Types of Bottom Sediments (Stones, Pebbles, Gravel, Sand, Silt, Clay and Mud) Diagrams.
v. Plots Thickness of Bottom Sediments Diagrams.

Bathymetric and Topographic Surveys and Sub Bottom Profilers will be done entire the coastal area, using Bathy 2010P ™ CHIRP Sub Bottom Profiler and Bathymetric Echo Sounder. Bathymetric staring from shoreline seaward (offshoreward), reaching defined depth or distance from shoreline depending on the nature of the Project or the client's request.

This survey will be started by the defined number of the best and high accurate of Offshore Transects or Profiles ($T_1 - T_n$), which selected before during the Exploratory Survey, roughly Perpendicular to the Shoreline extending Seaward (Offshoreward) from nearshore to offshore, depending on substrate type and depth.



Bathy 2010P ™ CHIRP Sub Bottom Profiler and Bathymetric Echo Sounder.



Bathymetric Contour of the Coastal Zone.









Bathymetric and Topographic Surveys and Sub Bottom Profilers.

Biological Survey "Biodiversity":

b)- Plankton Study

Phytoplankton Study :

Phytoplankton is minute plant cells that contain chlorophyll pigment. Each cell contains pigment known as Chlorophyll “a”. It is a good indicator of the phytoplankton density found in the seawater. High concentrations of this phytoplankton may cause algal bloom.

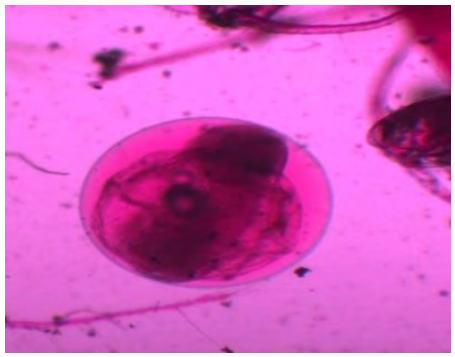
Phytoplankton concentration measurement is done by using YSI EXO2 multiparameter instrument equipped with Total Algae (TAL)/Chlorophyll and blue green algae sensor and Photosynthetic Active Radiation (PAR)/Primary Productivity sensor. The YSI instrument is lowered to a desired depth and the instrument is programmed to collect Chlorophyll and blue green algae data and Photosynthetic Active Radiation (PAR)/Primary Productivity data. The instrument is then brought to the lab to download data to the computer for analyses.

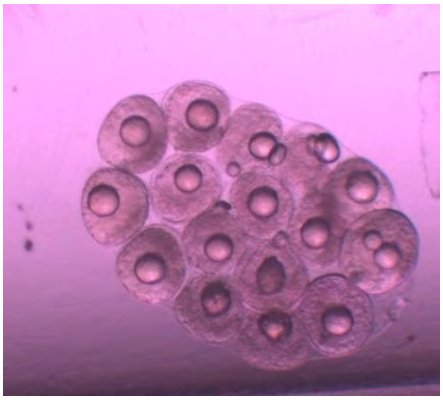
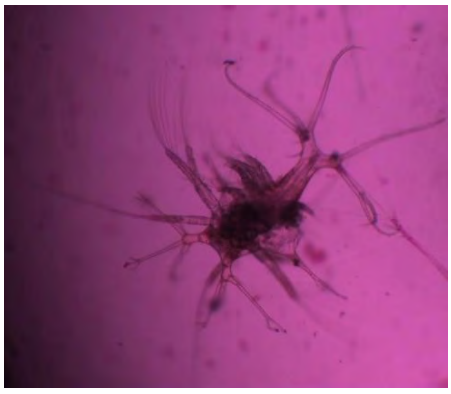
Zooplankton Study :

Zooplanktons are mostly compose of very small animals mostly found floating on the seawater. It includes minute’s foraminifers, radiolarians, crustaceans such as copepods and jellyfishes and its movement depends mostly on the water circulation. Most of the zooplanktons are planktonic in their life cycle while others are transient or temporary in its life cycle.

A zooplankton net will be towed horizontally for ten minutes in various sampling station to collect zooplankton samples. Collected samples are transferred to a one-liter bottle then brought to the laboratory for settling volume analysis. Some zooplankton samples will be also subjected to microscopy to determine its taxonomic composition.

Coliform Bacteria : Bacteria are commonly found in any aquatic environment and it can increase its population grammatically. Seawater samples will be collected and preserved from each entire Stations ($S_1 - S_n$) as we discussed before in section Collection of Seawater Samples.




Marine Fauna and Fish Visual Census

Marine Fauna and Fish Visual Census will be observed using high quality and accurate Dropdown Digital Marine Rack Mount Video Control System. This system including two Video Frames systems. The first one is Towed Frame will be used for Videos and Photographs Imaging Surveys of Marine Organisms within the Seawater Column. The second one is Bottom Quadruped Frame will be used for Videos and Photographs Imaging Surveys of Seabed Marine Organisms.

Marine Benthic Flora Studies

Monitoring the variations on the abundance and diversity of the Marine Benthic Flora communities such as Benthic Flora growth, mortality, any significant changes in ecosystem or any sign of Marine Benthic Flora recruitment using the photoquadrat technique.

Marine Benthic Flora studies will be doing using high quality and accurate Dropdown Digital Marine Rack Mount Video Control System with Bottom Quadruped Frame, is the same system used for Marine Fauna and Fish Visual Census at the sea bottom.

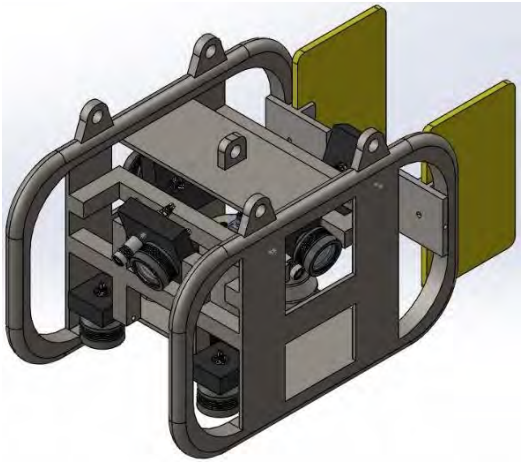
Coral Reef Studies

Monitoring the variations on the abundance and diversity of the coral reef communities such as coral growth, mortality, any significant changes in ecosystem or any sign of coral recruitment using the photoquadrat technique.

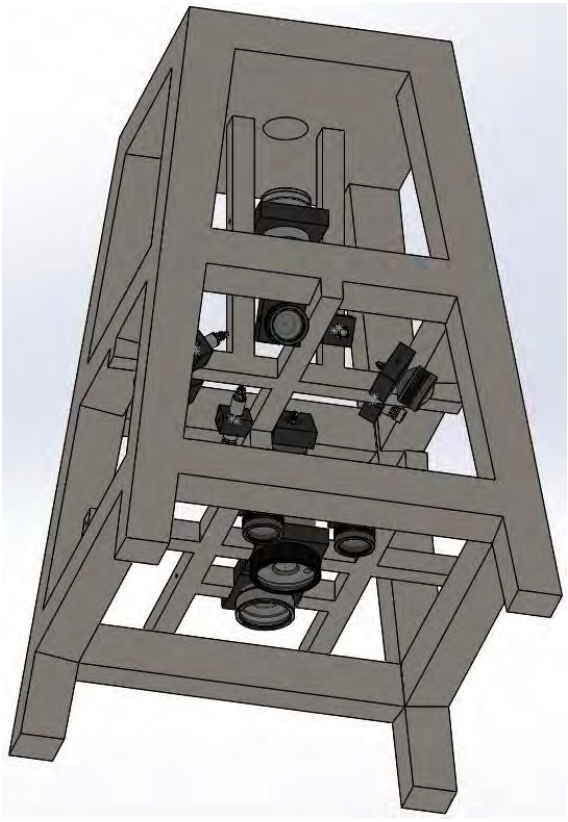
Coral Reef studies will be doing using high quality and accurate Dropdown Digital Marine Rack Mount Video Control System with Bottom Quadruped Frame, is the same system used for Marine Fauna and Fish Visual Census at the sea bottom.



C-Vision 24U Rack Mount Video Control System



Towed Frame



Bottom Quadruped Frame

High quality and accurate Dropdown Digital Marine Rack Mount Video Control System.

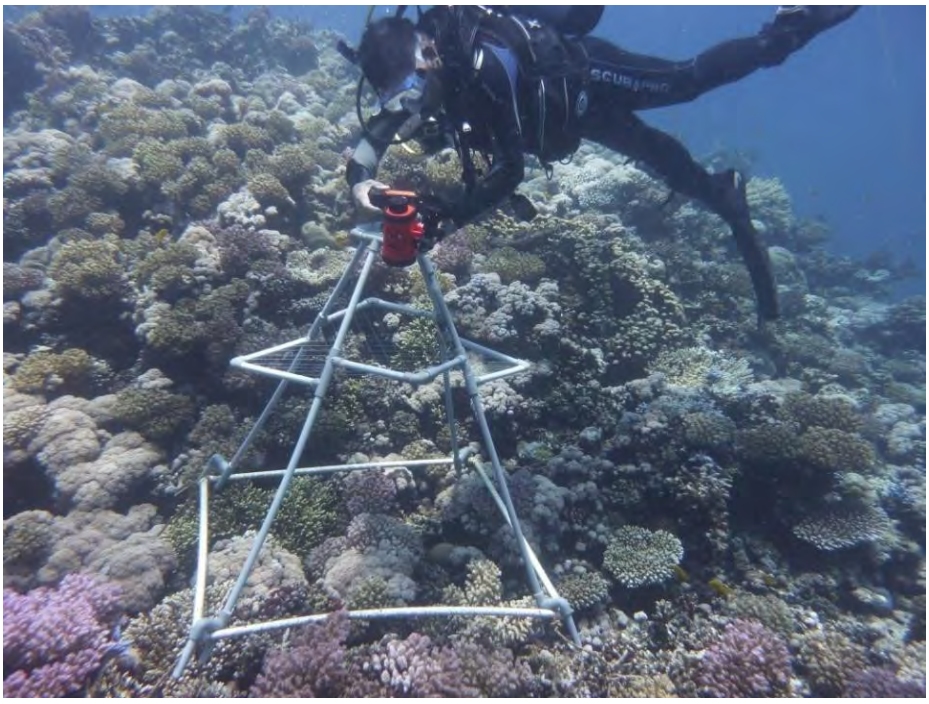


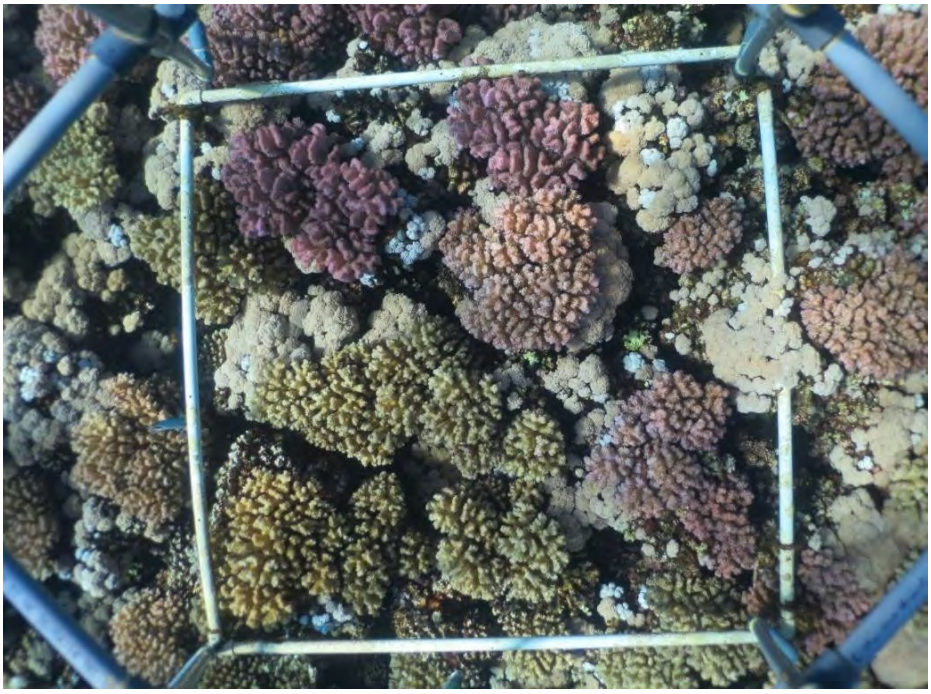






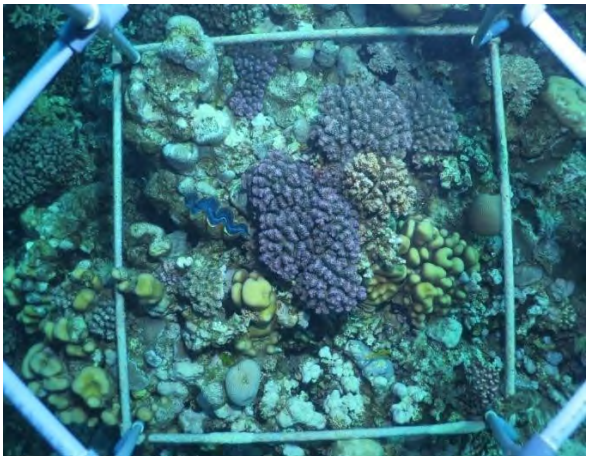
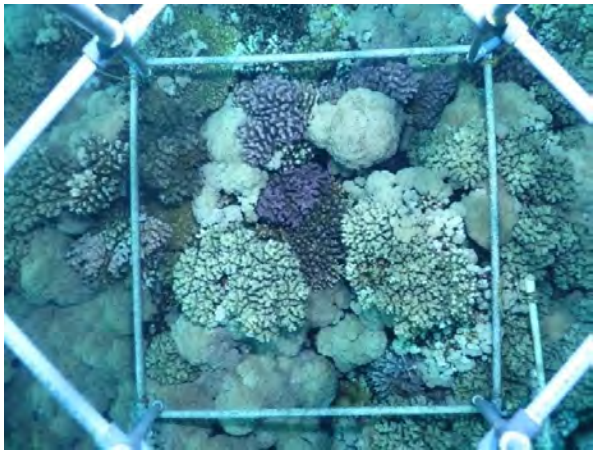
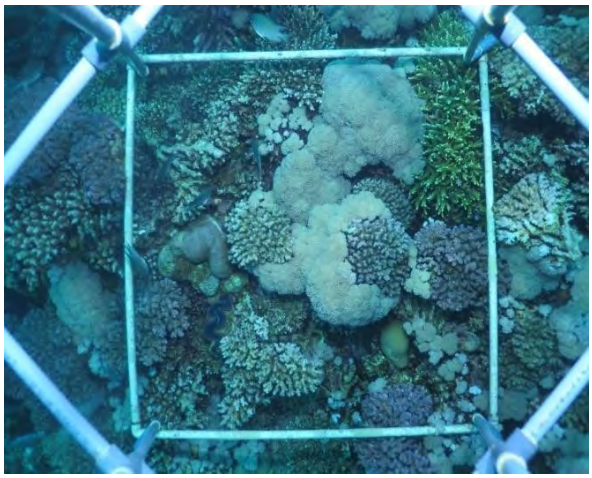
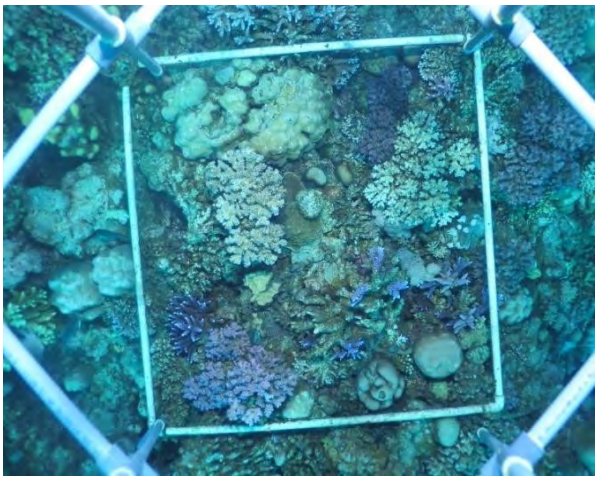

Fish Visual Census Samples.





Photoquadrat Study of Coral Reef using Bottom Quadruped Frame.



Monitoring the variations on the abundance and diversity of the Coral Reef Communities.

1)-Remote Sensing and Geographic Information System (GIS) :

a)-Application in Oceanographic and Coastal Studies :

Digital Satellite Images and Digital Aerial Photographs will be processed and analyzed using Remote Sensing techniques to identify :

- Terrestrial Enhancement Features of the Coastal Zone.
- Seawater Enhancement Features of the Coastal Zone.
- Geological Features of the Coastal Zone.
- Geomorphological Features of the Coastal Zone.
- Physiological Landuse & Landcover Features of the Coastal Zone.
- Bathymetry and Bottom Profilers.
- Bottom Topography.
- Soil Features of the Coastal Zone.
- Biological Features of the Coastal Zone.
- Chemical Features of the Coastal Zone.
- Characteristics of Seawater Color of the Coastal Zone : Chlorophyll content, Total Suspended Mater (TSM) and Colored Dissolved Organic Matter (CDOM).
- Optical Water Quality (OWQ).
- Monitoring Coral reef and Algae Bloom.
- Measuring Seawater Temperatures at different depths of the Coastal Zone.
- Seawater Salinity of the Coastal Zone.
- Characteristics of Sea Surface Winds in of the Coastal Zone.
- Waves Characteristics of the Coastal Zone.
- Currents Characteristics of the Coastal Zone.
- Tide Characteristics of the Coastal Zone.
- Sea Level of the Coastal Zone.
- Detections of Oil Spill / Seep and Spread.
- Wetland mapping and coastal hazards/vulnerability.
- Suspended Sediment Concentration.
- Potential Fishing Zone (PFZ).
- Monitor Coastal Resource.

b)- Change Detection Technique :

Change detection of multi-temporal data over the study area for detect the Bottom and Shoreline Changes. The change detection procedures used assume that, change in surface cover or surface material will produce corresponding change in the reflectance of the study area. Thus, new surface will consequently be picked out as area of increased (accretion) or decreased (erosion) reflectance between the two dates, because water has characteristically lower reflectance than soil (sediment).

Change Detection will be carried out using two methods :

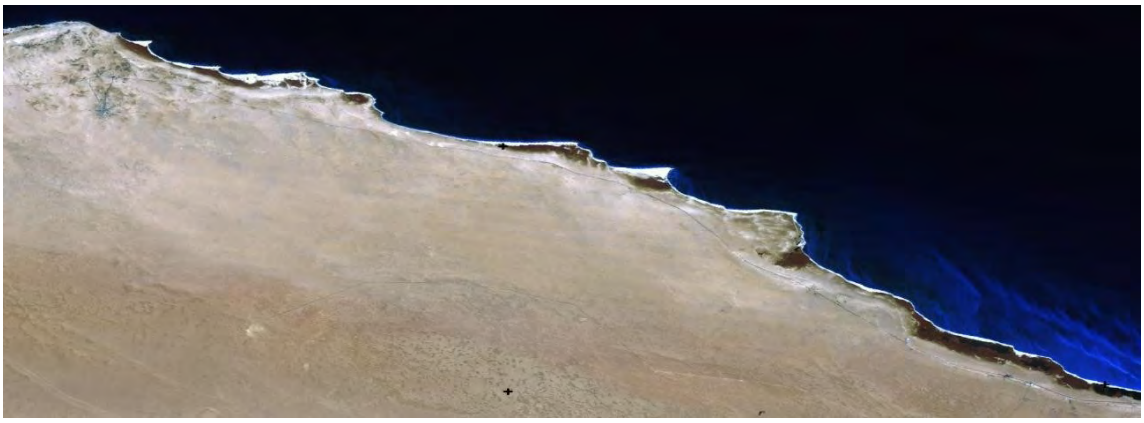
1)-Image-to-Image Technique "I - I" :

Change detection technique using multi-dates of digital data of Satellite Images, will be used to carry out the overall objectives of this technique. The recent date was geometrically corrected to the Universal Transverse Mercator projection, used as the master image in the process of registration. The destination images of old multi-dates will be registered to the master one.

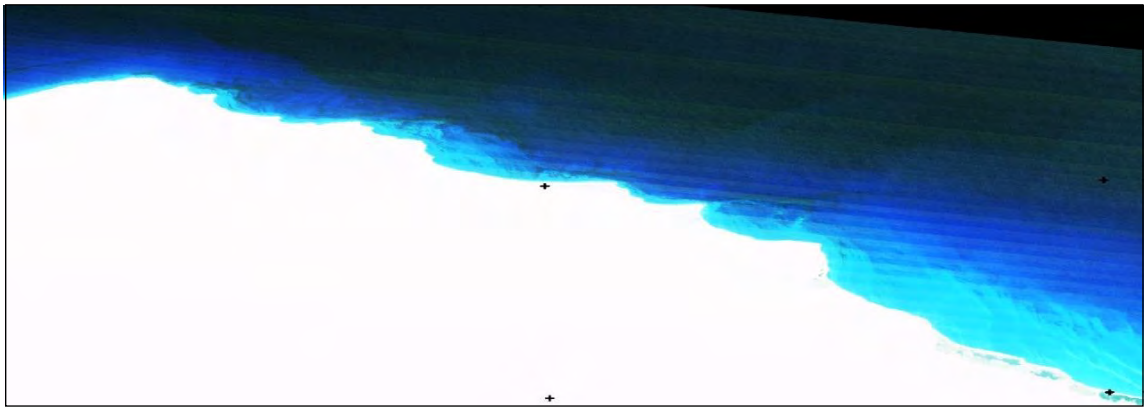
- **1-1)-** Image Differencing Analysis “IDA”.
- **1-2)-** Image Rationing Analysis “IRA”.
- **1-3)-** Principal Component Analysis “PCA”.
- **1-4)-** Change Vector Analysis “CVA” :
  - **1-4-1)-** Histogram.
  - **1-4-2)-** Change Distance Image.
  - **1-4-3)-** Creating the Difference Images.
  - **1-4-4)-** Cross-Tabulation.
  - **1-4-5)-** Combined Image.
  - **1-4-6)-** Change Direction Category Image.

2)-Map-to-Image Technique "M - I" :

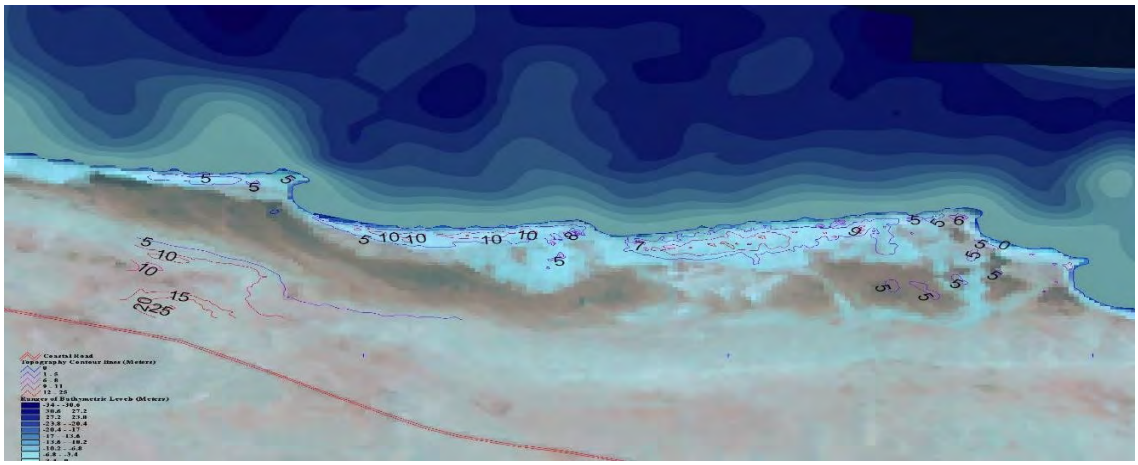
Change detection technique using multi-dates of digital Satellite Images data, Digital Aerial Photograph and/or Digital Bathymetric Survey Map.



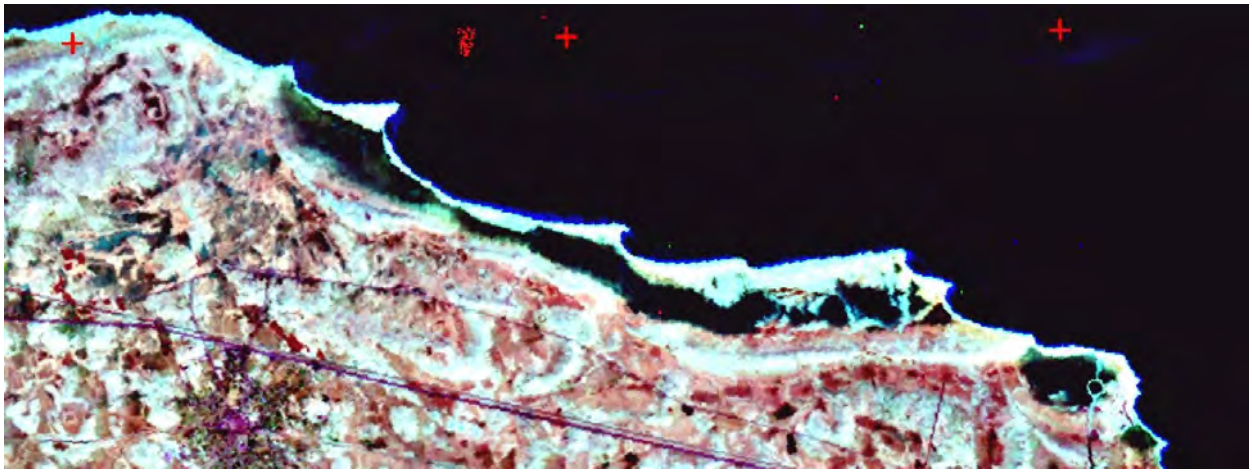
Terrestrial Enhancement Features of the Coastal Zone.



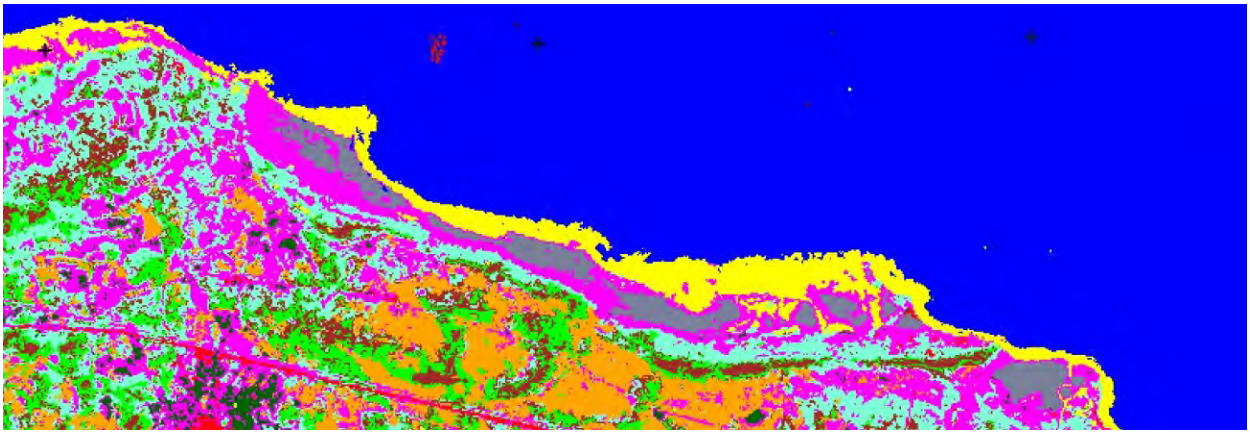
Seawater Enhancement Features of the Coastal Zone.



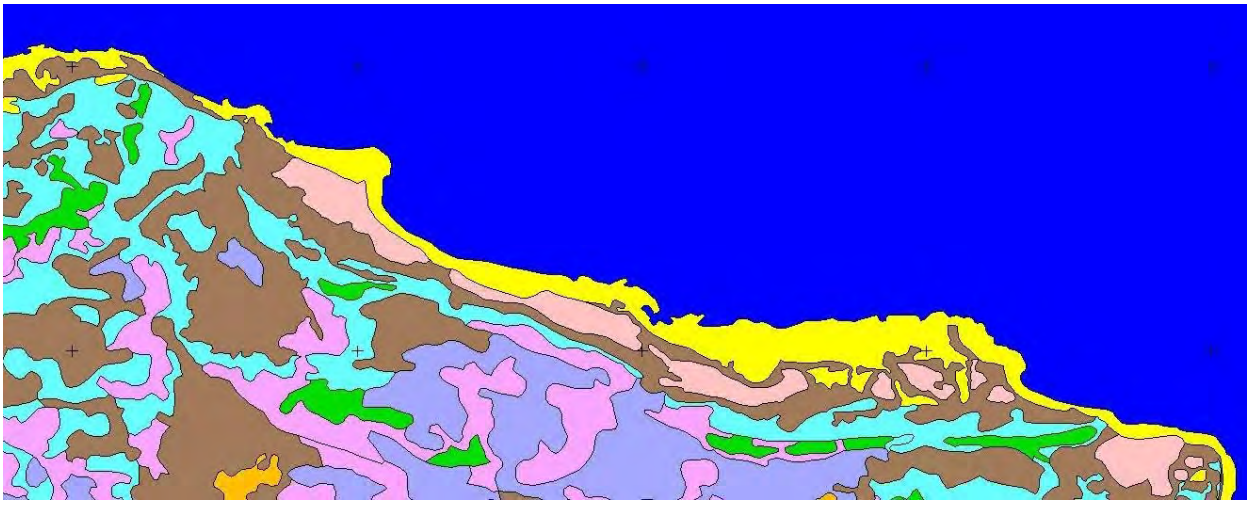
Topography of the Coastal Zone.



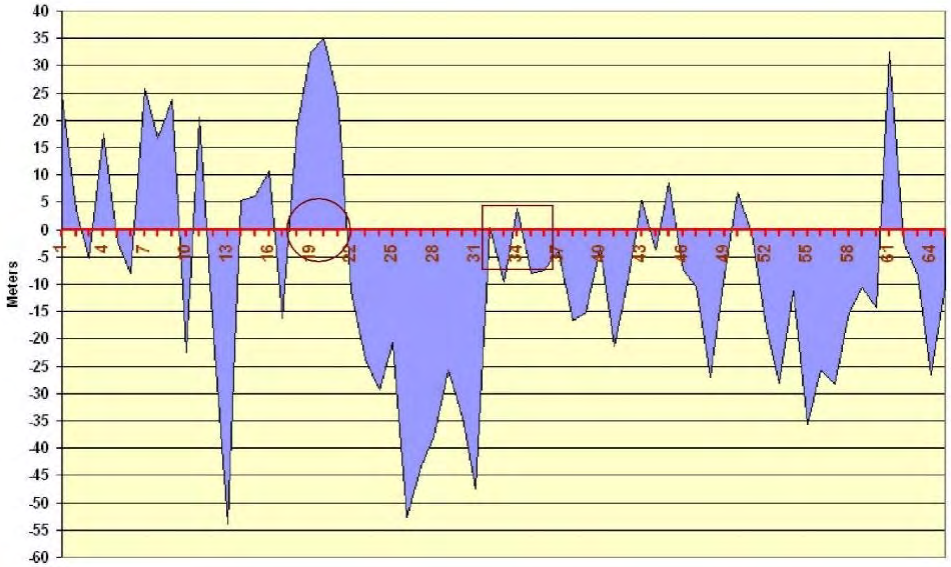
Geological and Geomorphological Features of the Coastal Zone.

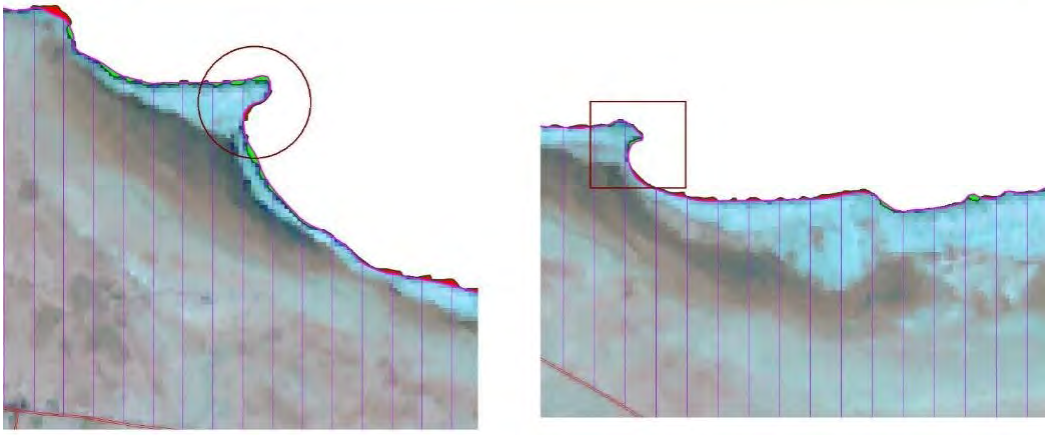


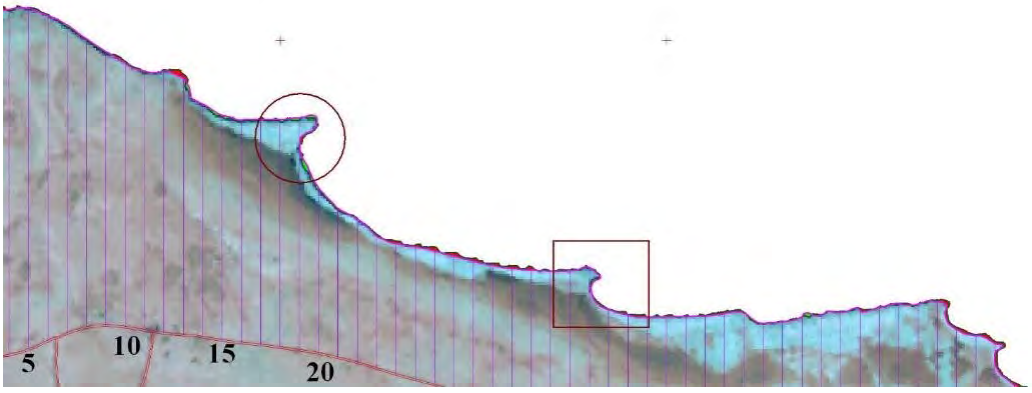
Physiological Land use & Landcover Features of the Coastal Zone.



Soil Features of the Coastal Zone.







Shoreline Change Detection of the Coastal Zone.

Oceanographic and Coastal Modeling :

a)-Digital Numerical Models :

Digital Numerical Models are specialized computer programs that solve governing (usually physics-based) equations using numerical simulation techniques. A model could be as simple as a spreadsheet solution or as complex as a multi-routine program containing thousands of lines of code that represent the many different physical processes being simulated. In many cases relevant to the topics covered in this manual, the related field of study is commonly referred to as computational fluid dynamics (CFD). The terminology CFD is also used to describe a subset of numerical models that are extremely complex and typically only applied to very specific scenarios, by definition, are CFD models. The purpose of a numerical model is to solve an equation, or system of equations, repetitively in time and/or space in a highly efficient manner.

Mathematical equations are solved using numerical simulation techniques. These techniques range from relatively simple to extremely complex.

The models that rely on the solution of three or four partial differential equations consisting of numerous terms, in multiple dimensions; spatial and temporal. There are a number of different techniques for solving these equations.

b)- Need for Modeling

Coastal hydrodynamic processes are rarely described by simple, mathematical equations. Waves, tidal currents, water levels, and sediment transport are complex, unsteady (i.e., changing in time) processes that vary substantially in space due to changes in bathymetry (terrain), roughness, shoreline geometry, and meteorology (e.g., wind, pressure, precipitation, etc.). These processes are also dependent on one another, these types of interactions can be recreated, through physical or numerical modeling.

c)-Typical Model Applications

Three general categories of Digital Numerical Hydrodynamic models, each category defined by the types of equations that are solved, numerically, to predict a certain process. The categories are defined as general circulation models, wave models, and sediment transport models.

General model types and their applications

1)-Circulation Model :

- Tidal Elevations.
- Tidal Currents.
- Storm Surge.
- Flooding.

2)-Wave Model

- Height, Period, Direction.
- Velocities.
- Breaking.
- Setup.

3)-Sediment Transport Model

- Scour.
- Erosion/Deposition.
- Shoreline Change.
- Dune Erosion.

d)- Types of Digital Numerical Hydrodynamic Models

1)-One-dimensional (1 D) hydrodynamic model.

2)-Two-dimensional (2 D) hydrodynamic model.

3)-Three-dimensional (3 D) hydrodynamic model.

Four basic dimensions could be resolved by a numerical model : one is time (t), the other three are spatial (x, y, z). The differences between one-dimensional (1D), two-dimensional (2D), and three-dimensional (3D) models in terms of the spatial dimension. The 1D and 2D models could involve any one or two of the three spatial dimensions, respectively, in addition to simulating the unsteady processes as a function of time.

The three spatial dimensions are commonly referred to as x, y, and z. These spatial coordinates are (in most cases) analogous to east-west (easting), north-south (northing), and up- down (vertical). The spatial dimensions, x and y, generally refer to the horizontal plane while z refers to the vertical plane.

The 1 D hydrodynamic models are mainly cross-shore (perpendicular to the shoreline) models that simulate beach profile change, dune erosion, wave shoaling and breaking, wave setup, and currents.

The 3D hydrodynamic model is one where the governing equations for momentum, specifically velocity, are solved in all three dimensions.

e)-Common types of numerical methods for solving mathematical equations :

1)-Finite Difference Method (FDM)

2)-Finite Element Method (FEM)

3)-Finite Volume Method (FVM)

4)-Spectral Element Method (SEM)

5)-Boundary Element Method (BEM)

f)- Input Data required for Oceanographic and Coastal Digital Simulation Models :

The stored raw data of the entire Oceanographic and Coastal Studies will be retrieved, downloaded and will be undergo for Manipulating, Extrapolating, Processing and Statistical Analysis by using various sets of advanced computer software. Finally entire results will be integrated to the model, or some of this Data according to the nature of the project or the client's request.

1)-Beach, Nearshore and Shoreline Surveys :

- Coastal Uses.
- Physical Characteristics of the Beach, Nearshore and Shoreline Surveys.
- Water Characteristics.
- Land Use.
- Wildlife Observations (Biological Biodiversity).
- Baseline data for future monitoring.

2)-Physical Oceanographic Data :

- Tides and Sea Level Changes.

- Current Speed.
- Current Direction.
- Wave Height.
- Wave Period.
- Wave Direction.
- Turbidity.
- Conductivity.
- Salinity.
- Temperature.
- Hydrostatic Pressure.

3)-Water Quality Data (Physico-chemical Parameters) :

- pH/ ORP.
- Turbidity.
- Conductivity.
- Specific conductivity.
- Resistivity.
- Salinity.
- Temperature.
- Total Dissolved Solids (TDS).
- Total Suspended Solids (TSS).
- Optical Dissolved Oxygen (Optical DO).
- Total Algae (TAL), Chlorophyll and blue green algae.
- Photosynthetic Active Radiation (PAR)/ Primary Productivity.
- Chromophoric Dissolved Organic Matter or Colored Dissolved Organic Matter (CDOM/FDOM).
- Organic Matter in water (OM).
- Rhodamine : Monitoring the Movement of Water as well as Dispersion and Mixing Characteristics: (Time-of-travel (TOT) studies, Hydraulic Characterization, Mixing Zone Identification, Pollution Plume Tracing, Tracing and Dispersion of Wastewater Discharge, Tracing and Dispersion of Sewage Discharge, Spill Mapping.
-

4)-Remote Sensing Data :

- Geological Features.
- Geomorphological Features.
- Physiological Landuse & Landcover Features.
- Bathymetry and Bottom Profilers.
- Bottom Topography.
- Biological Features.
- Chemical Features.

- Characteristics of Seawater Color.
- Optical Water Quality (OWQ).
- Coral reef and Algae Bloom.
- Seawater Temperatures at different depths.
- Seawater Salinity.
- Characteristics of Sea Surface Winds.
- Waves Characteristics.
- Currents Characteristics.
- Tide Characteristics.
- Sea Level of the.
- Detections of Oil Spill / Seep and Spread.
- Wetland and coastal hazards/vulnerability.
- Suspended Sediment Concentration.
- Potential Fishing Zone (PFZ).
- Coastal Resource.

5)-Results of Chemical Analysis of Seawater Samples:

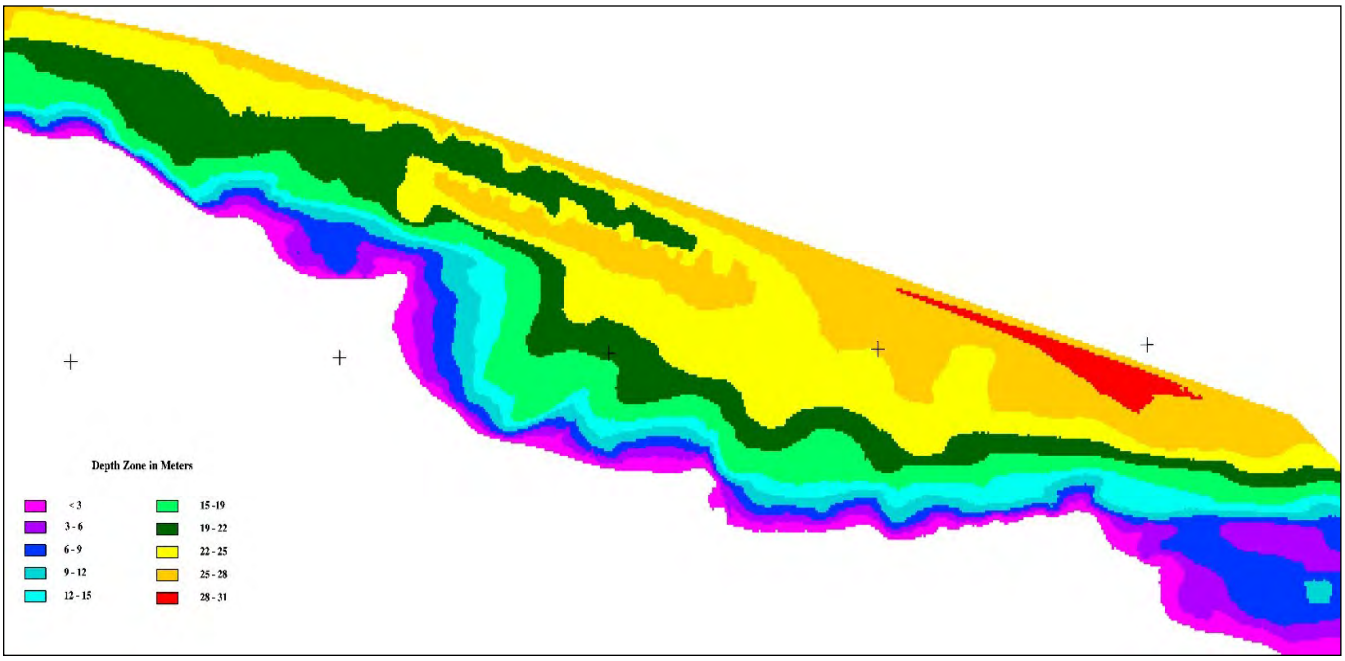
6)-Results of Analysis of Bottom Sediment Samples:

- Chemical analysis.
- Physical analysis.
- Mechanical analysis.
- Geological and Geochemical analysis.
- Biological analysis.

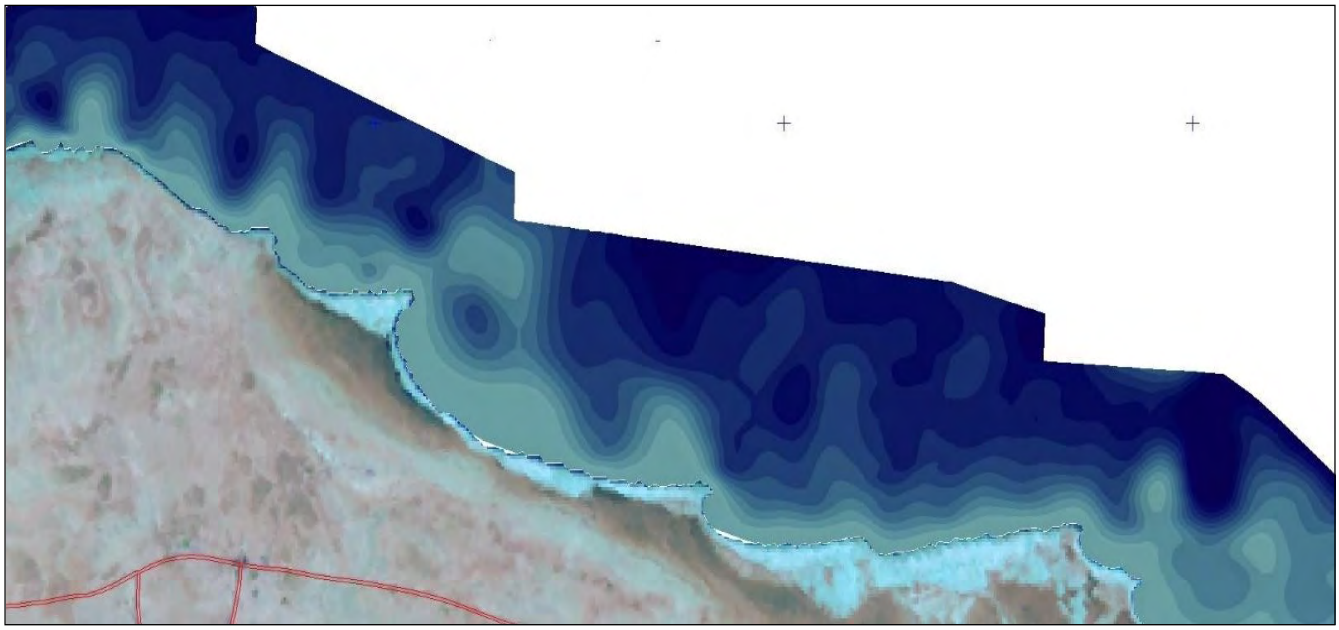
7)-Results of Biological Studies :

- Phytoplankton Study.
- Zooplankton Study.
- Coliform Bacteria.
- Marine Fauna and Fish Visual Census.
- Marine Benthic Flora Studies.
- Coral Reef Studies.

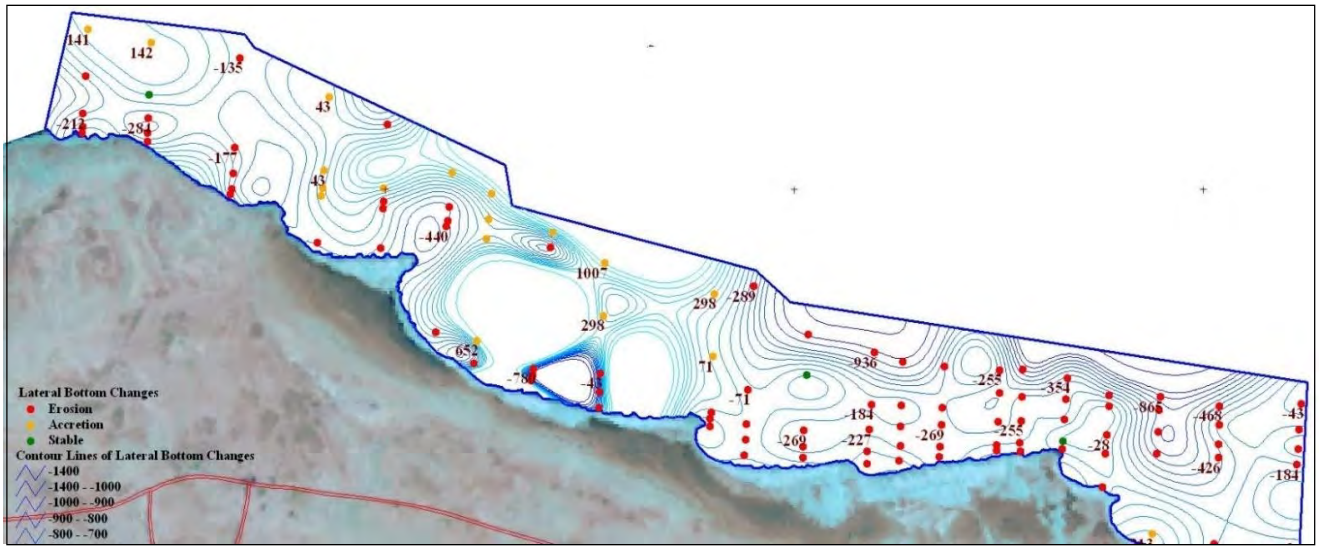
8)-Results of Bathymetric and Topographic Surveys and Bottom Profilers :



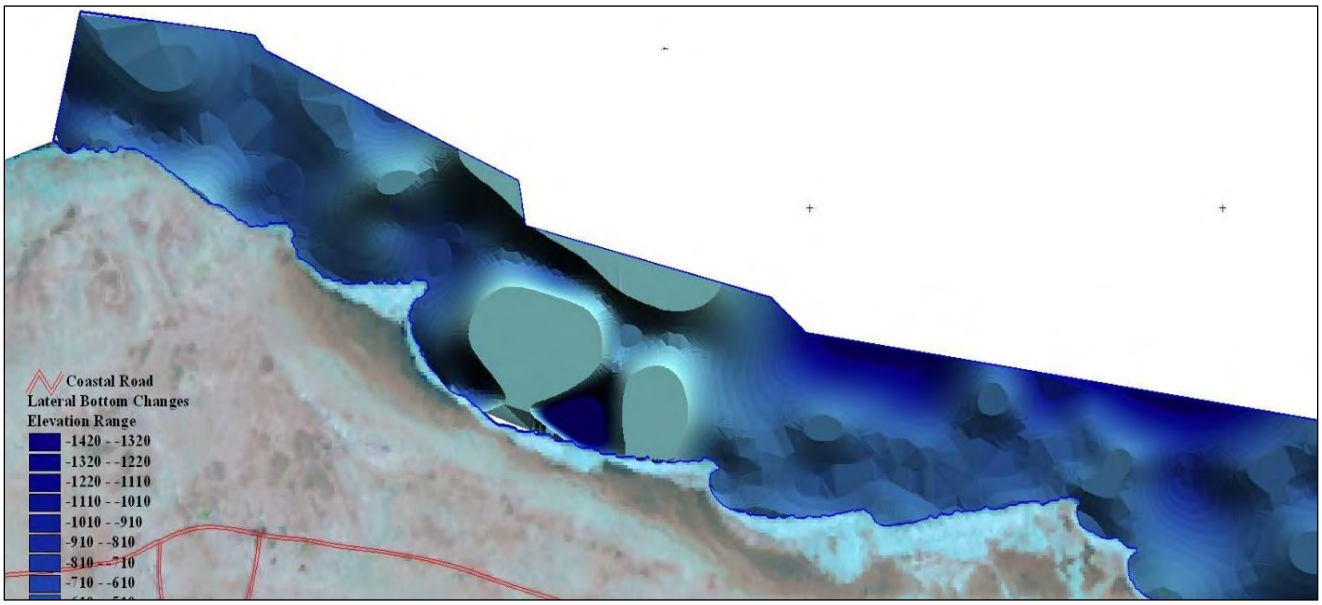
Bathymetric Zones Model of the Coastal Zone.



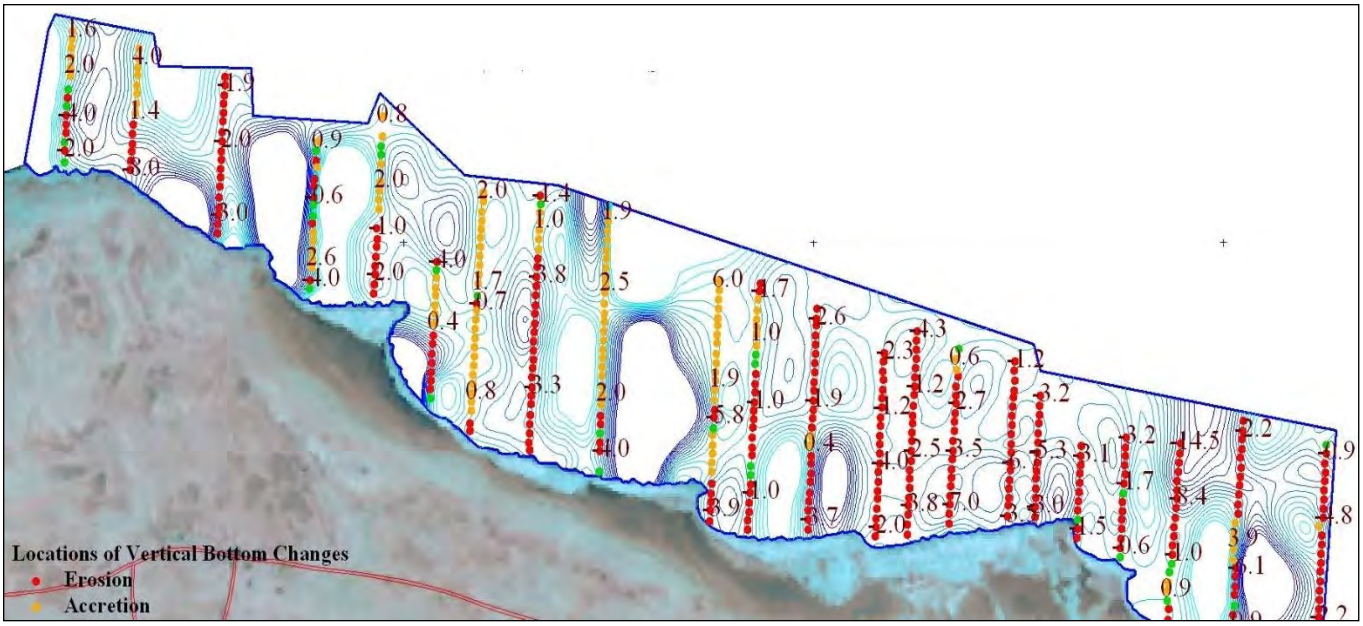
3 D Bathymetric Zones Model of the Coastal Zone.



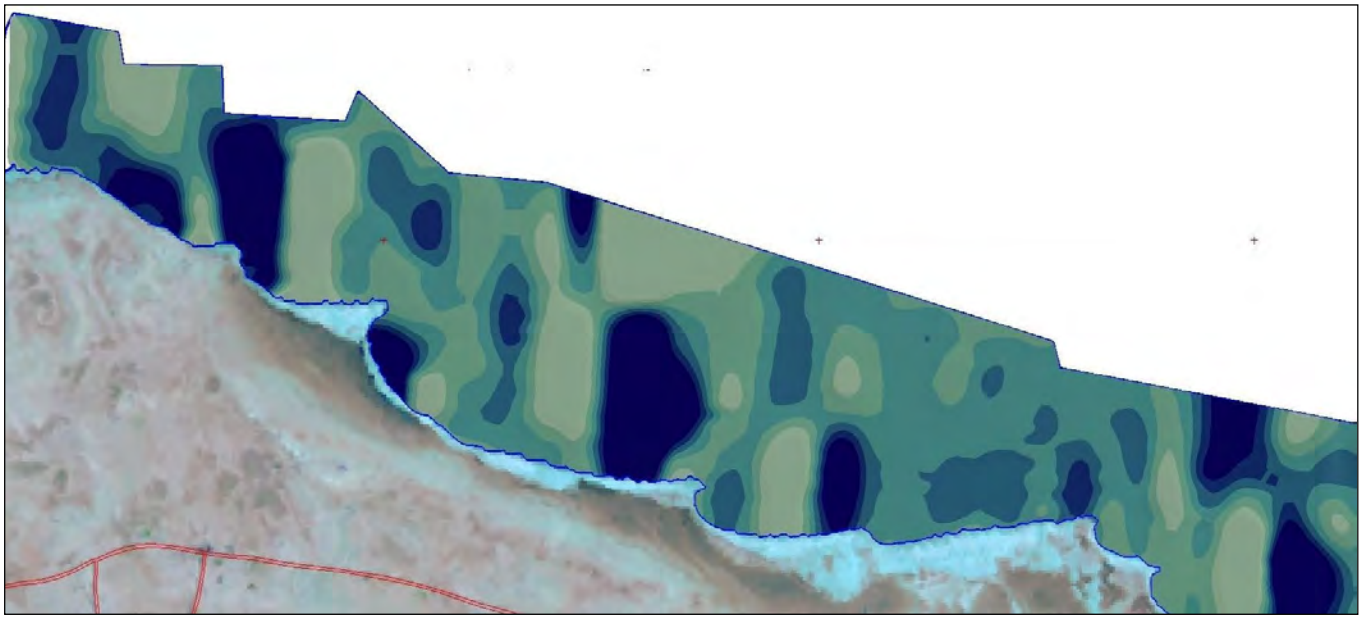
Contour Lines Lateral Bottom Changes Model of the Coastal Zone.



3D Lateral Bottom Changes Model of the Coastal Zone.



Contour Line Vertical Bottom Changes Model of the Coastal Zone.

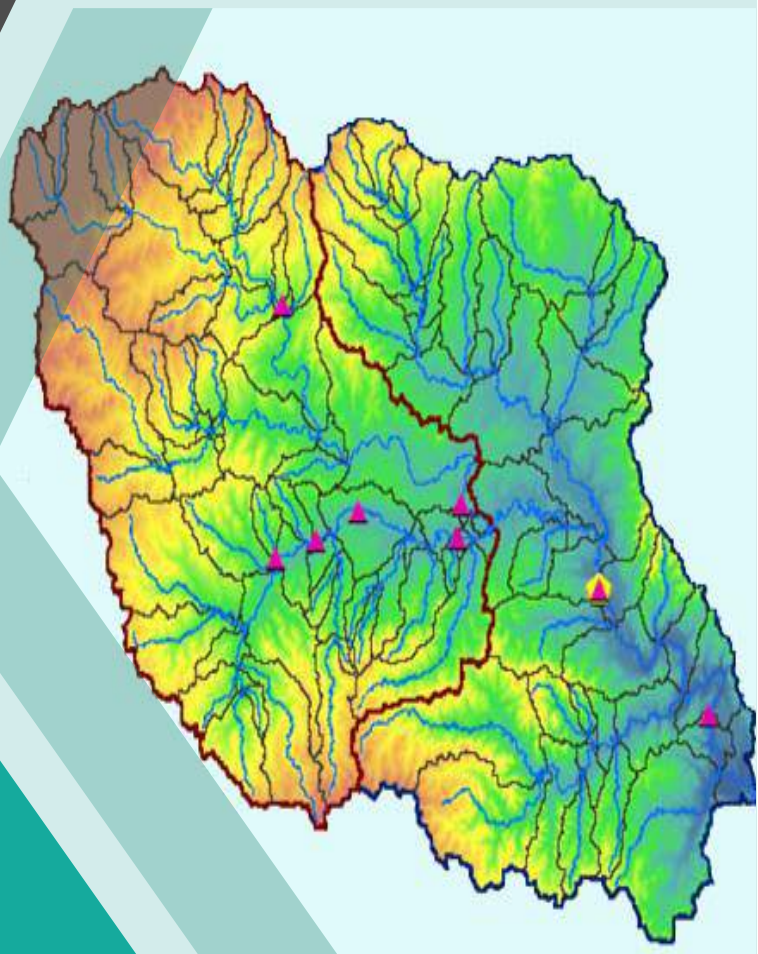


3D Vertical Bottom Model Changes of the Coastal Zone.

Geotechnical & Environmental Co.

Method Of Statement For

Hydrological Studies



- Scope of work.
- Procedures of Work .
- Software Programs Used.
- Codes and Reference .
- Important Projects.

TABLE OF CONTENT

1. Scope of work:

2. Procedures of Work:

2.1 Surface Hydrology Study:

2.1.1 Meteorological study

2.1.2 Identifying the Drainage Basin Characteristics

2.1.3 Estimating Peak discharge

2.2 Marine and wetland (lagoon) study

3. Software Programs Will Be Used in The Study:

4. Codes and Reference May Be Will Used In The Study

5. IMPORTANT PROJECT

Method of Statement for

HYDROLOGICAL STUDIES

1. SCOPE OF WORK:

Since the study area located parallel to the shoreline, the hydrological investigation should cover the effects from the following items:

1. Surface runoff from or flash flood (water flow) from the inland
2. The effects from marine environment
3. The wetlands (small lagoon) in the coast area.

The main goal of the present study is delineating the drainage networks (wadis and tributaries) which come from the mountain and high land area to predict surface water runoff, and consequently the flash flood hazards zones in the study area. Also, hazards of marine (such as erosion) on the study area.

To Providing solutions and recommendations to protect the project area from any hazards, caused by flash flood or surface runoff, it should first outline the high-and low-risk zones. Consequently, from the hydrological study, it can suggest the suitable location for future urban extension and development.

2. PROCEDURES OF WORK:

To achieve the objective of the hydrologic study, the methodology of work will be as follows:

2.1 Surface Hydrology Study:

The surface hydrology study includes the following item:

- Collection and analysis of all available data necessary for the study (Surveying data, climate, meteorology, hydrology, geology, etc.).

2.1.1 Meteorological study

- Meteorological study of rainfall data and climate (from the nearest meteorological weather stations to period not less than 30 year) in the region and analysis of these data by the specialized statistical software programs such as HYFRAN PLUS or SMADA.
- Identification the design Return Period of the project constructs.

- Determination of the rainfall intensity corresponding to return period such as 2, 5, 10, 25, 50 and100 year.
- Identification the Intensity – Duration – Frequency (IDF) Curve of the project sit.
- Geological study
- Conduct geological investigation of the soils to identification the Hydrological Soil Group and Curve Number (CN).

2.1.2 Identifying the Drainage Basin Characteristics

- Conduct topographic and geomorphology investigation from topographic maps (1: 50000), Digital Elevation Modeling (DEM) map and Satellites maps (Landsat ETM).
- Delineate wadies cross and affect the study area.
- Identifying the Drainage Basin and its characteristics from Topographic maps and Digital Elevation Modeling (DEM) map by Watershed Modeling System WMS software programs.
- Identify the engineering properties (properties morphometric) morphometric parameters of drainage basins (such as area, shape, length, slope, main channel length and slope etc..).

2.1.3 Estimating Peak discharge

- Estimate the volume and depth of surface runoff.
- Estimate peak discharge (Q_P).
- Determination the location which collecting rainfall water.
- Determination risk flood areas in the project.
- Propose the suitable solutions and methods (alternative methods) for protection of flash floods risk and rainfall (such as conversion valleys, Refine valleys, open channel, box culvert, Dams, storm water attenuation ponds, lakes, etc..

2.2 Marine and wetland (lagoon) study

The marine study includes investigation of the following effects:

- Investigate Current
- Wave direction
- Tidal water-level fluctuations
- Erosion in the shoreline

3. SOFTWARE PROGRAMS WILL BE USED IN THE STUDY:

- Watershed Modeling System (WMS 9.1).
- HYFRAN PLUS and SMADA software programs
- Storm CAD
- Global Mapper (Vr. 16)
- GIS Arc Map 9.3

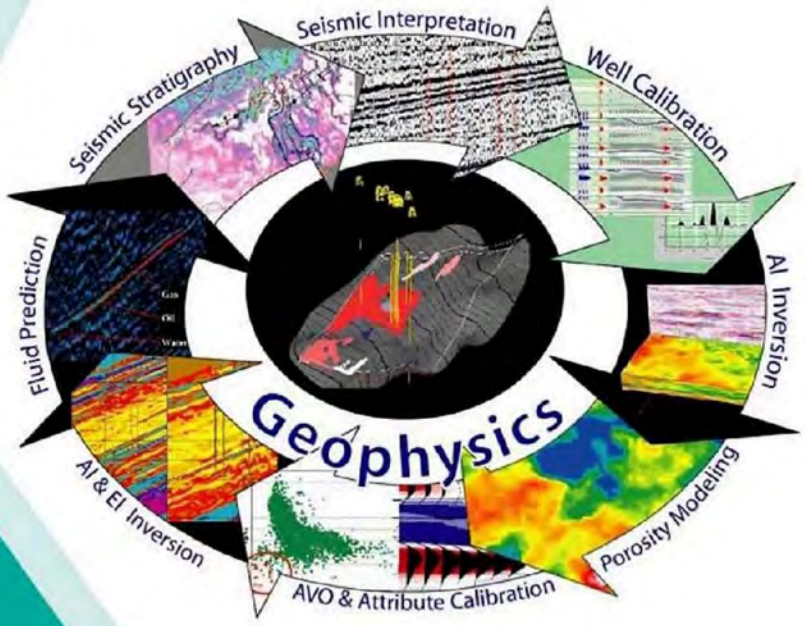
4. CODES AND REFERENCE MAY BE WILL USED IN THE STUDY

- **Riyadh Municipality**, Engineering Standards for Flood Mitigation Hazards, Flood Control Structures Manual **(1432H)**
- **Riyadh Municipality**, Engineering Standards for Flood Mitigation Hazards, Storm Drainage Networks Manual **(1432H)**
- MOT Standards, particularly the Highway Design Manual:
  Highway Design Manual. Vol. 1, Highway Development; 1425 H **(2004)**, Ministry of Communication, (at present, Ministry of Transport), KSA.
- Guidelines for Preparation of Hydrology Reports; 1407H **(1987)**, Ministry of Communication, (at present, Ministry of Transport), KSA.
- **McCuen, R. H., 2005.** Hydrologic Analysis and Design, Third Edition, Prentice Hall, Pearson Education, Inc., Upper Saddle River, NJ 07458.
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- **Bondelid, T., McCuen, R. H.,and Jackson, T. (1982).** " Sensitivity of SCS Models to Curve Number Variation" water Resources Bulletin 12: 337 – 349 P.
- **Soil Conservation Service SCS (1986).** "National Engineering Handbook" U.S. Department of Agriculture, Washington, DC.
- U.S. Army Corps of Engineers Hydrologic Engineering Center. HEC-1 Flood Hydrograph Package User's Manual.
- **U.S. Army Corps of Engineers, 2000.** "Hydrologic Modeling System HEC-HMS: Technical Reference Manual," Hydrological Engineering Center.
- **USDA Natural Resources Conservation Service.** National Engineering Handbook, Part 630, Hydrology.
- **Brown, L.N. 1965.** Small earth dams. University of California, USA.
- **AASHTO, 1991.** Model Drainage Manual. AASHTO, Washington, D.C.

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Method Of Statement For

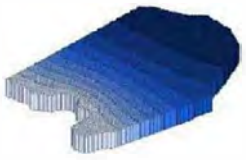
Geophysics Department

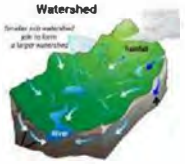


Scope of Services

Groundwater - Hydrology - Hydrodynamics - Coastal - Wet Utilities - BIM - Data Analytics - GIS

Detailed Portfolio of Tasks We Work On











Contents

1 Groundwater Modeling and Hydrogeologic Analyses

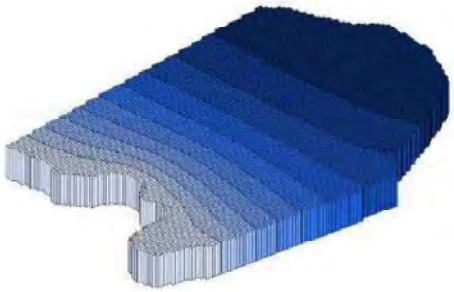
2 Hydrology and Flood Protection

3 Hydrodynamics and Coastal

4 GIS, Programming, and Data Analytics

5 Wet Utilities, Infrastructure, and BIM

Groundwater Modeling and Hydrogeologic Analyses

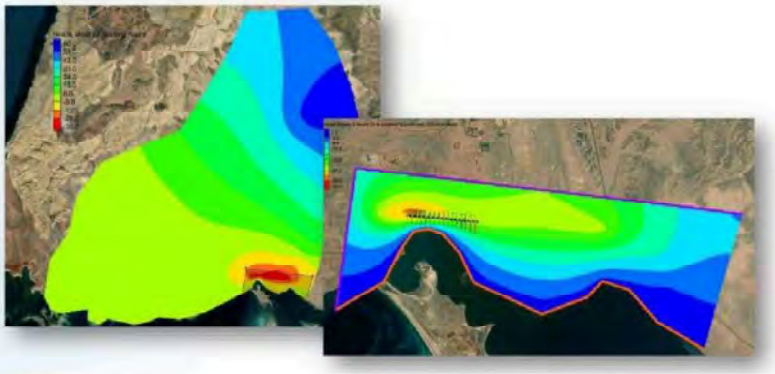


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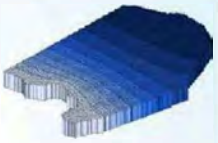


Tasks:

- Design and analysis of permanent and temporal dewatering wells systems
- Groundwater modeling of dewatering solutions (Transient and Steady-state)
- Detailed design, drawings, BOQ, and tender documents

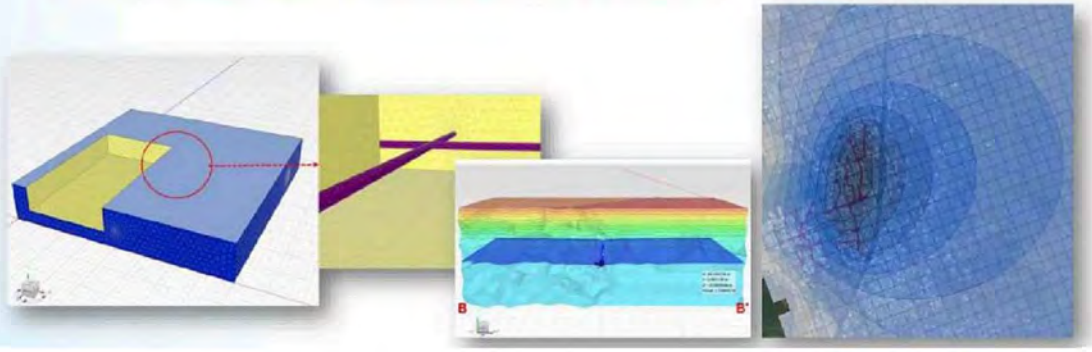


Subsurface Drainage Networks

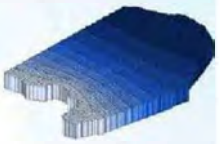


Tasks:

- Design and analysis of subsurface drainage networks
- Hydraulic design of perforated pipes network
- Groundwater modeling of subsurface drainage network (Transient and Steady-state)
- Detailed design, drawings, BOQ, and tender documents

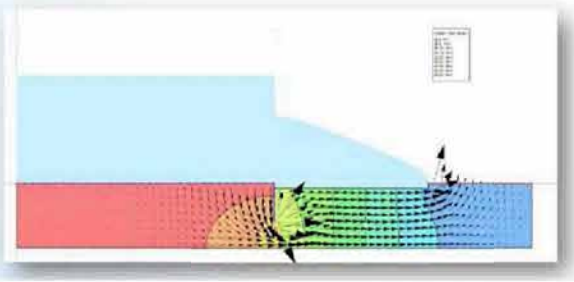


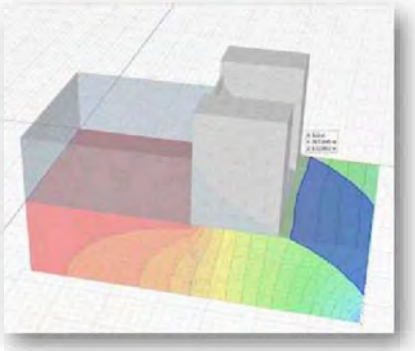
Seepage Analysis Works



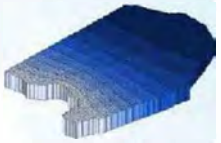
Tasks:

- 2D and 3D seepage modeling using HYDRUS, Seep 2D, and GeoStudio Seep/w – Seep3D
- Excavation protection works
- Dams' seepage analysis
- Infiltration basins and surface water-groundwater interactions modeling



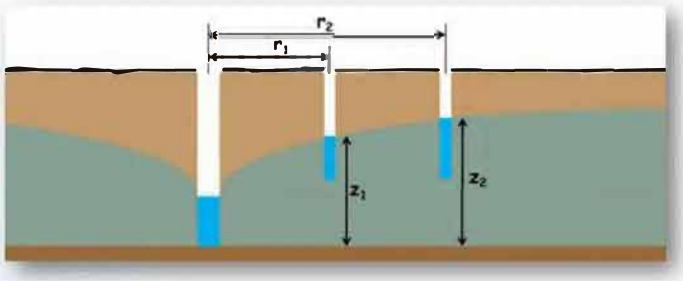


Pumping Test and Well Performance Analysis

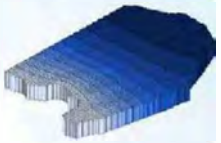


Tasks:

- Analysis using Theis, Cooper-Jacob, and Neuman methods using Aquifer Test tools
- Parameter estimation using modeling tools
- Long duration, step-drawdown, and recovery tests interpretations
- Analytical vs. numerical comparison for aquifer tests



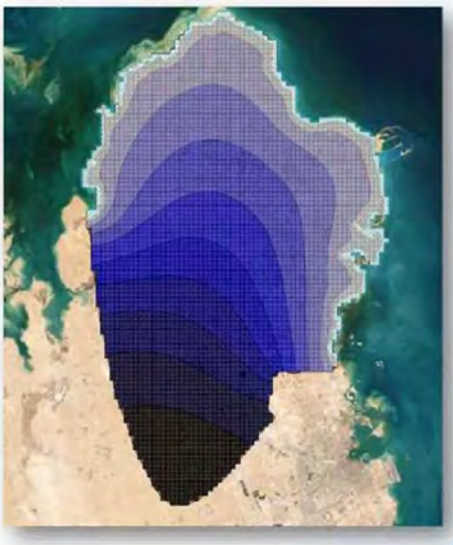
Groundwater Management



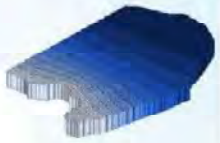
Tasks:

- Estimation of recharge from rainfall, rivers, and artificial sources
- Groundwater-surface water interactions
- Groundwater budgeting and sustainability assessments
- Assessment of current and future developments using groundwater modeling tools



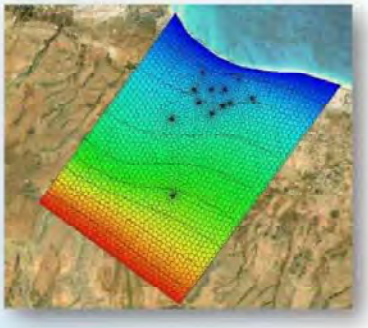


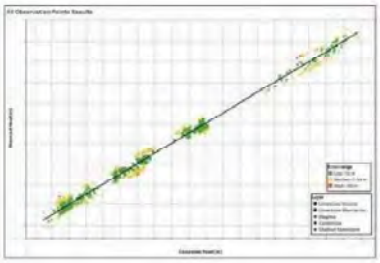
Groundwater Flow Modeling

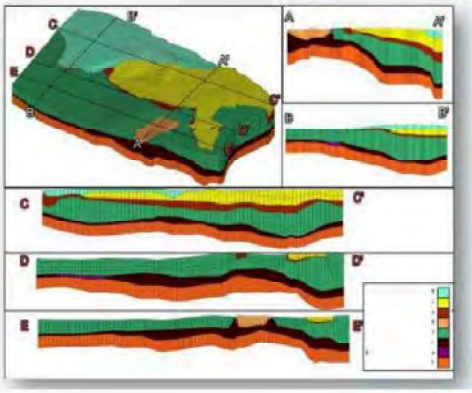


Tasks:

- 2D and 3D numerical modeling using MODFLOW
- Geological Models (Solids)
- Unstructured Grid (USG) modeling for complex hydrogeological settings
- Transient vs. steady-state flow simulations
- High level model calibration and sensitivity analysis





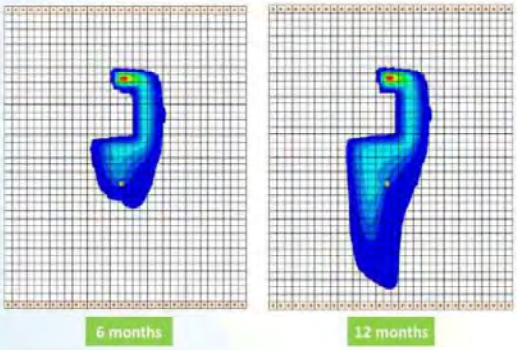


Contaminant Transport Modeling



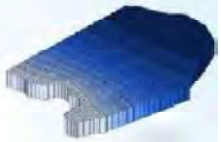
Tasks:

- MT3DMS, RT3D, SEAM3D and SEAWAT modeling for solute transport including sorption, decay, reactions, biodegradation, and density effects
- Simulation of chemical oxidation and remediation scenarios
- Source identification and contaminant migration pathways



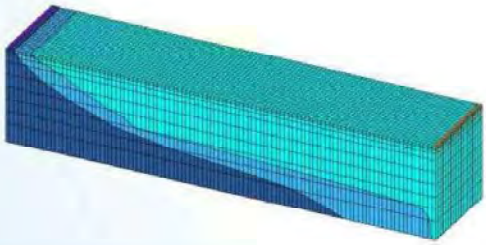


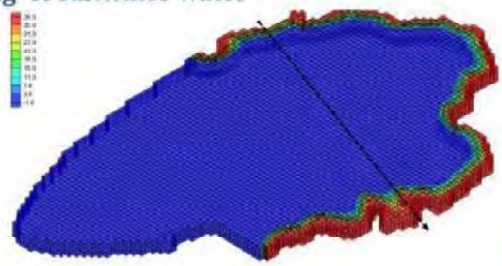
Saltwater Intrusion Modeling

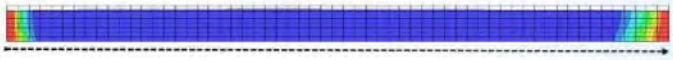


Tasks:

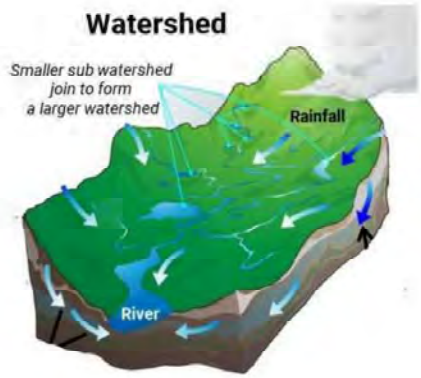
- SEAWAT Modeling for density driven flow at coastal aquifers
- Identification of saltwater-freshwater interface
- Modeling the impacts of current and future developments on saltwater intrusion
- Modeling of the interface movements and up-coning of saltwater water
- Modeling of mitigation measures and solutions







Hydrology and Flood Protection



Stormwater Management and Drainage Design



Tasks:

- Design of all different stormwater management systems
- Sizing of network elements, detention and retention basins
- Green infrastructure (bioswales, infiltration trenches)

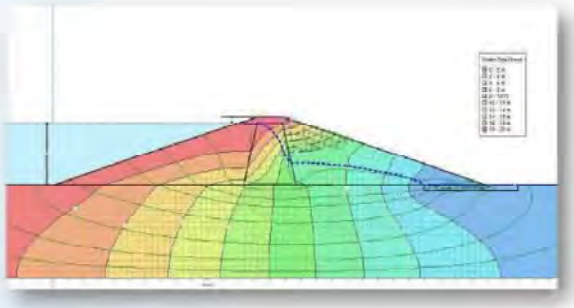


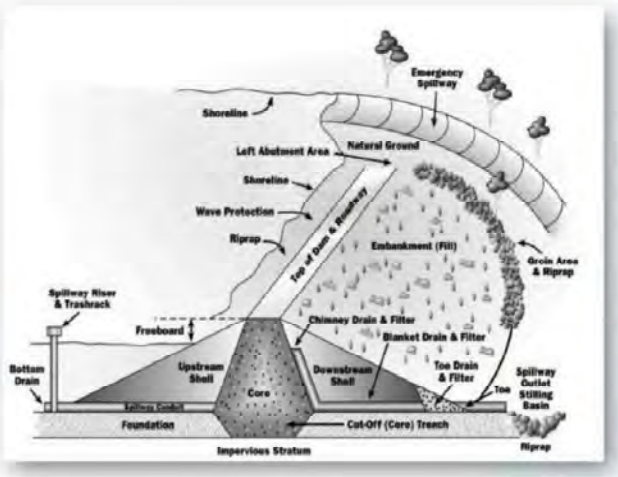
Dams Engineering



Tasks:

Comprehensive studies in Geological, Hydraulic, Hydrological, Geotechnical, Structural, and Mechanical fields for the design of various types of dams



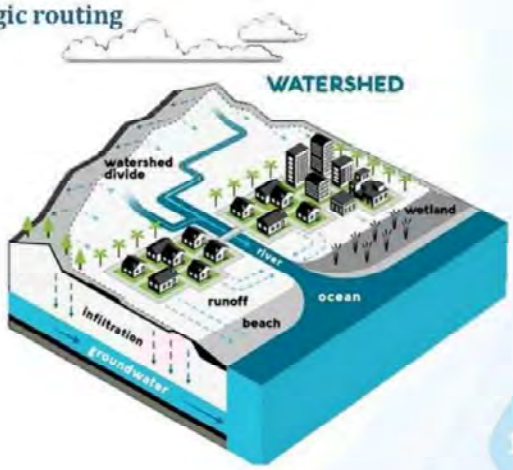


Watershed and Rainfall-Runoff Modeling



Tasks:

- HEC-HMS and SWMM modeling for urban and rural watersheds
- Design storm analysis and peak discharge estimation
- Time of concentration, hydrograph generation, and hydrologic routing
- Climate change impact assessment on storm events

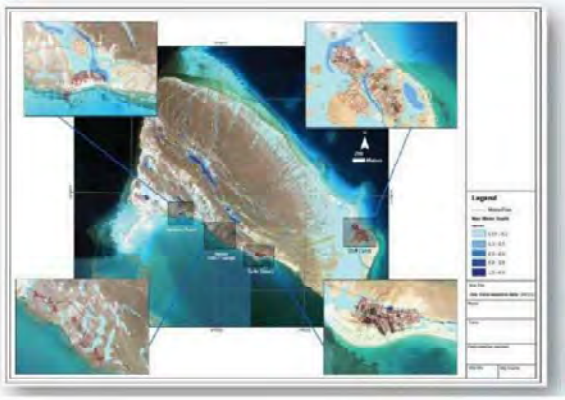


Flood Risk Assessment and Mitigation



Tasks:

- Floodplain mapping using HEC-RAS and 2D flood models
- Assessment of urban flooding and drainage system efficiency
- Climate change impact assessment on flood events
- Hydraulic design of different flood protection structures: Culverts, Bridges, Dikes, Bonds, Channels, etc..

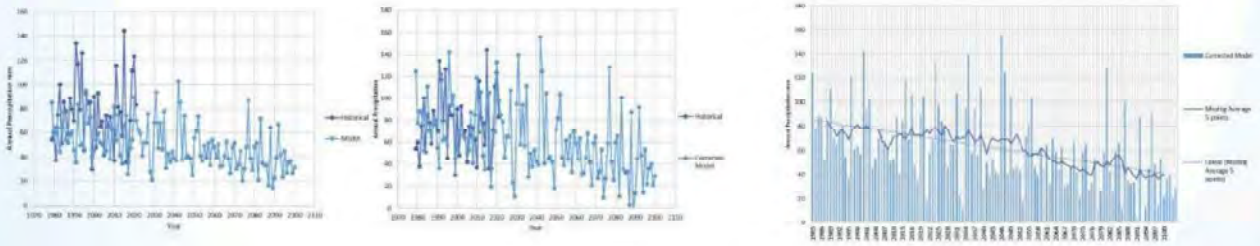


Climate Impact and Drought Analysis

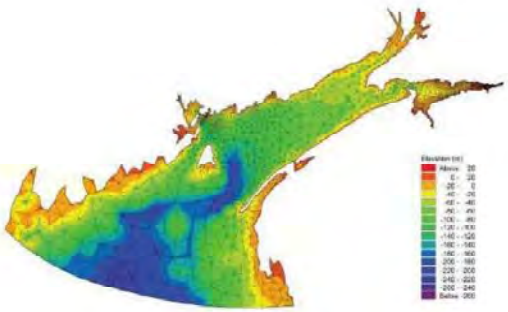


Tasks:

- Analysis of climate models data and bias correction
- Prediction of climate impact on extreme events
- Drought analysis on annual precipitation quantities due to climate change



Hydrodynamics and Coastal

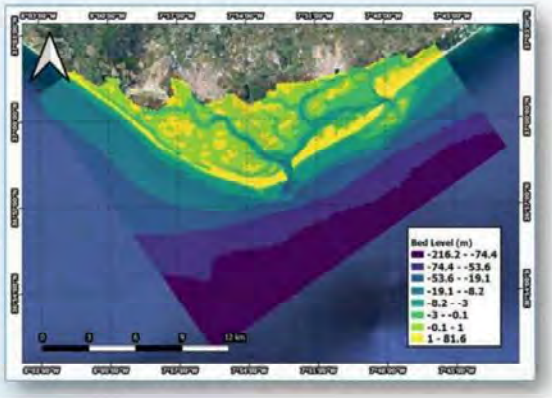


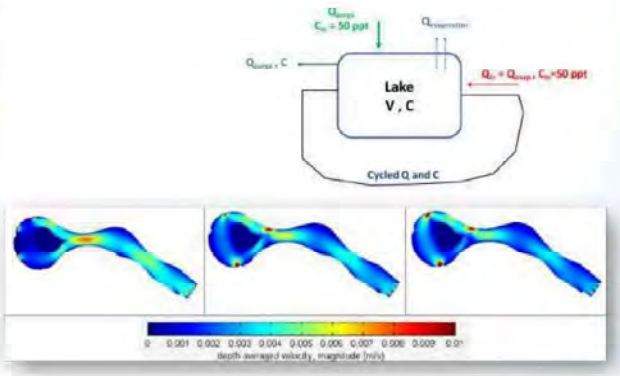
Hydrodynamic Modeling of Water Bodies



Tasks:

- Effectively applying hydrodynamic models like Delft3D in the modeling of lagoons, lakes, rivers, and estuaries
- Design of artificial lagoons circulation systems and purge calculations



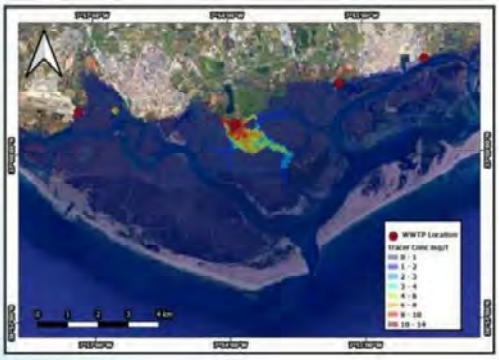


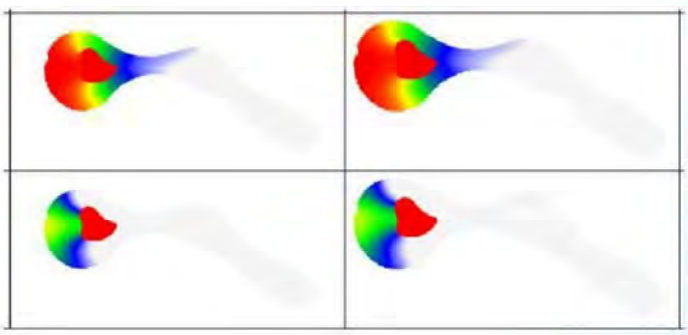
Surface Water Quality Modeling



Tasks:

- Flushing time and tracer runs applied to hydrodynamic model
- Incorporation of ecological and environmental cycles (Eutrophication, Nitrification, BOD cycle, etc..)





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Method Of Statement For
Ground Penetration Radar (GPR)



- Introduction.
- How GPR Work ?
- Purpose of GPR Investigation.
- Standard of Work.
- Instrument.
- GPR Survey Field Work.
- Data Processing.
- GPR Outputs Examples.
- Important Projects.

TABLE OF CONTENT

1. INTRODUCTION

2. How GPR works?

3. Purpose of Investigation

4. Standard of Work

5. Instrument

6. GPR Survey Fieldwork

7. Data Processing

8. GPR Output Examples

9. IMPORTANT PROJECTS

Method of Statement for

GROUND PENETRATING RADAR (GPR)

1. INTRODUCTION

Ground penetrating radar (GPR) is a nondestructive method that produces a continuous cross-sectional profile and record of subsurface features, without drilling, probing, or digging. It was first developed in the early 1970's for military applications such as locating underground tunnels in the DMZ between North and South Korea; later it was used to locate landmines, unexploded munitions and locating underground utilities (Bower 2001).

GPR is a reflection technique, which uses high frequency electromagnetic waves to acquire subsurface information and responds to changes in electrical properties (dielectric and conductivity), which are a function of soil and rock material and moisture content (Technos Inc 2001).

GPR techniques have been progressively developed and used for several types of engineering foundation problems like detecting underground utilities, karst limestone caves, open fractures (Comas et al., 2004; Jol et al., 2003; Neal, 2004; Robinson et al., 2013).

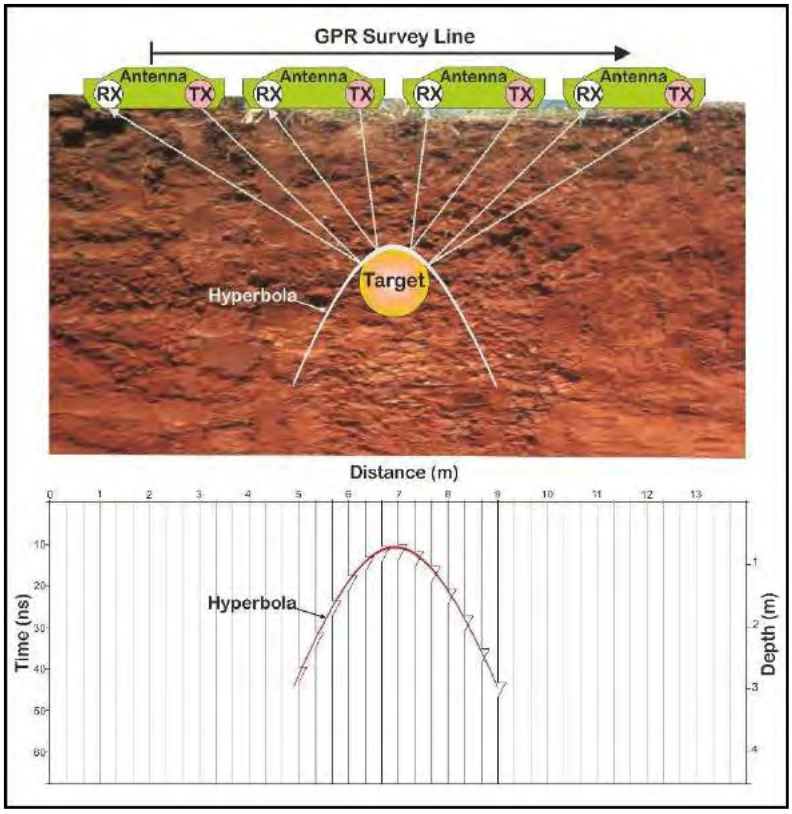
2. HOW GPR WORKS?

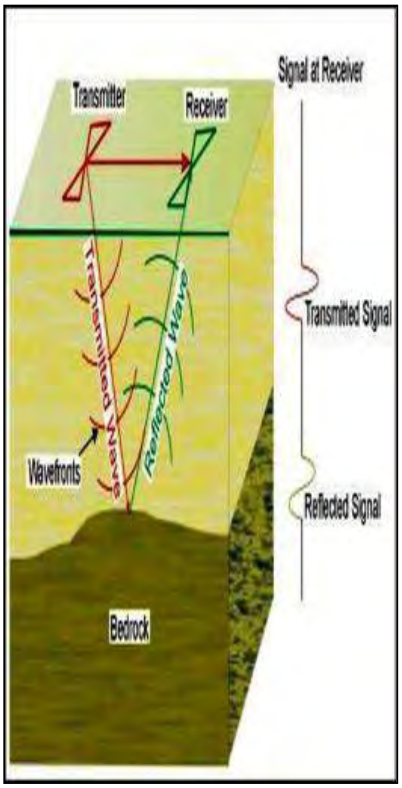
To generate an image of a buried object, a GPR profile must be obtained. A GPR profile is generated when the antenna is moved along the surface. The radar unit emits and receives reflected signals of ultra-high frequency radio waves millions of times per second; these signals contact objects or subsurface strata with different electrical conductivities and dielectric constants (Table 1); part of the GPR waves reflect off the object or the interface while the rest of the waves pass through the next interface. The reflected signals return to the antenna, pass through it and are received by the digital control unit, which register the reflections against two-way travelling time (TWTT) in nanoseconds and then amplifies the signals. The output signal voltage peaks plotted on the ground penetrating radar 2D profile as different color bands by digital control unit (Fig. 1). Thus, not only do the relative depths and strengths of the targets appear, but also the image or shape of the target is seen on the monitor.

Depth of GPR penetration depends on the material being surveyed and upon the antenna frequency being used. For instance, GPR will penetrate ice, rock, soil, and asphalt differently due to each material's unique electrical properties (dielectric). Lower frequency antennas will generally penetrate deeper, but there is a loss in resolution with the drop-in frequency GPR waves travel through different materials in the ground, in wide-angle bands. Both metallic and non-metallic utilities could be imaged by GPR at depths of 6 meters in low conductivity materials like dry sands or massive, dry concrete.

Table 1: Dielectric constants of common materials

	Material	Dielectric Constant
Dry Materials	Air	1
	Dry Clay	4
	Dry Sands	4
	Asphalt	5
	Dry Granite	5
	Dry Concrete	5.5
	Dry Limestone	5.5
	Dry Sand and Gravel	5.5
	Dry Salt	6
Wet Materials	Wet Sandstone	6
	Wet Granite	6.5
	Wet Limestone	8
	Wet Basalt	8.5
	Wet Concrete	12.5
	Wet Sands	15
	Wet Clay	27
	Sea Water	81





3. PURPOSE OF INVESTIGATION

The main purpose of the GPR scanning here is:

1) Investigate the subsurface cavities at the proposed sites of your project to detect Locations, Depths, and Sizes of the existed cavities.
2) Investigate the underground utilities.

4. STANDARD OF WORK

The procedure of GPR survey will be carried out according to the standard of ASTM D6432 "Standard guide for using the surface ground penetrating radar method for subsurface investigation".

5. INSTRUMENT

The field survey will be carried by using the Geophysical Survey System Inc. (GSSI) GPR system, with SIR-3000 control unit (Figs. 2). The SIR-3000 is a lightweight, portable, single channel GPR system. The radar parameters (like dielectric constant, scan, frequency, gain … etc.) will be setup in the field according to the ground surface conditions of soils/rocks using the SIR-3000 unit.

The depth and resolution of subsurface penetration depend on the frequency of the antenna used, Therefore, choice of Antenna is one of the most important factors in survey design as following:

Antenna Frequency (MHz)	Penetrating Depth (m)
80	0 – 30
200	0 – 10
270	0 – 6
400	0 – 3

6. GPR SURVEY FIELDWORK

The GPR survey will be carried out in a grid pattern across the project site (Fig. 3). The dimension of the grid pattern is based on the purpose of the investigation and the drawings approved by the consulting. The depth of survey is from the scanning level to 6 meters' depth (using 270 MHz antenna), the data will be collected using the survey wheel cart which enables distance- measuring mode of the GPR system.

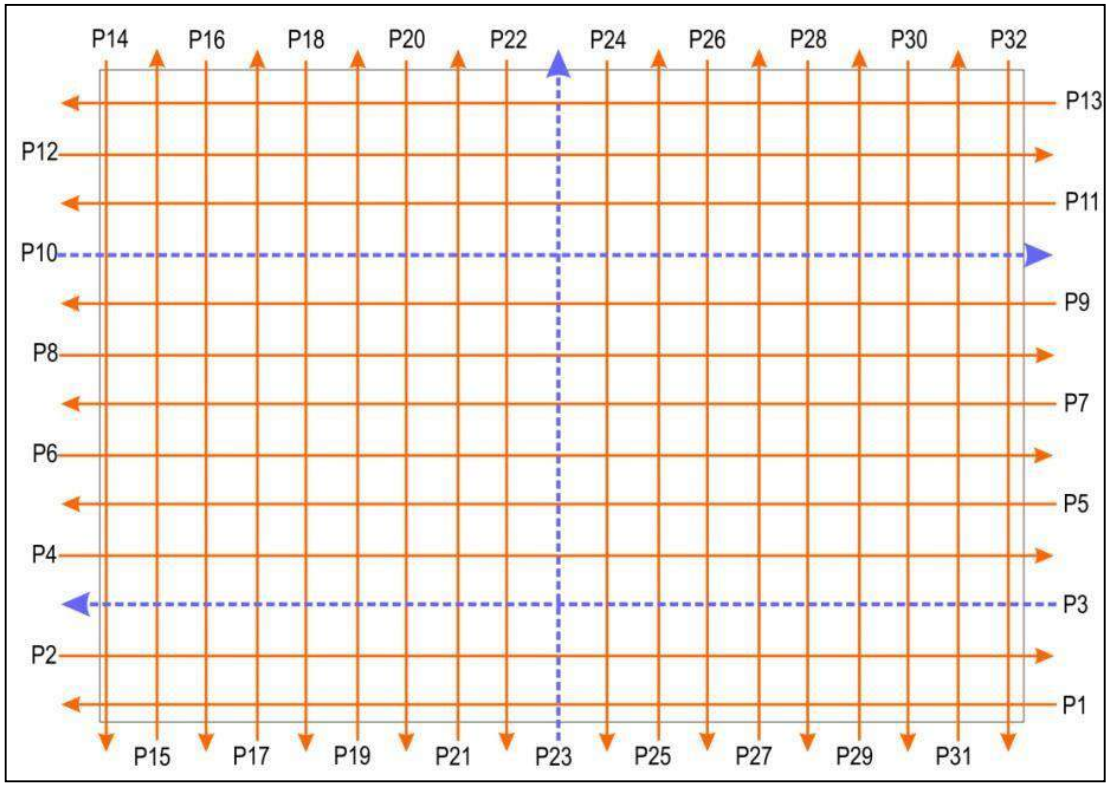




Fig. 3: A sample of GPR survey grid pattern.

7. DATA PROCESSING

Generally, the processing flow of GPR data is depicted in (Fig. 4).

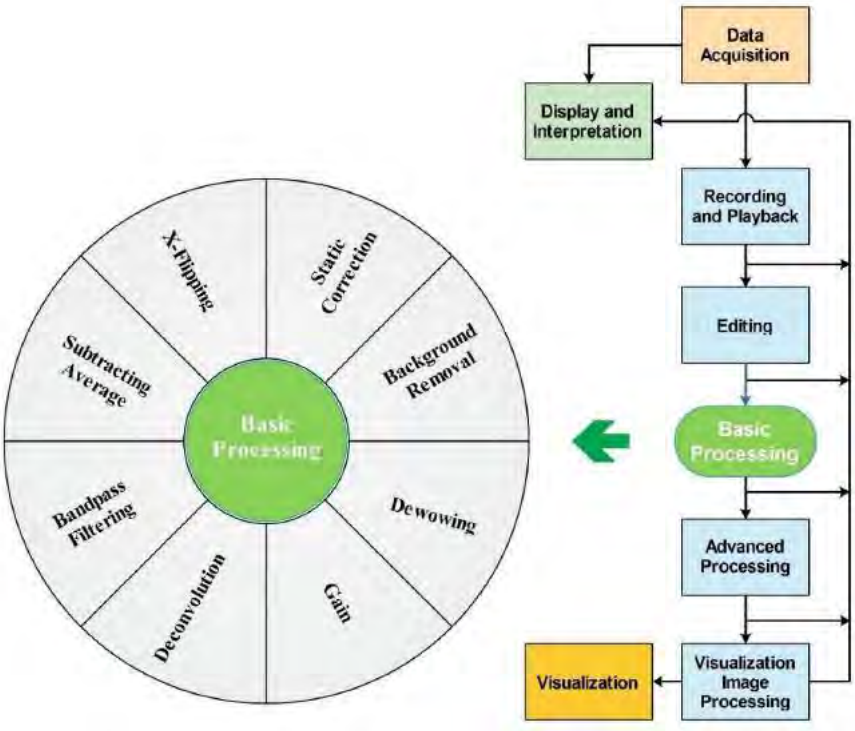


Fig. 4: A general overview of GPR data processing flow.

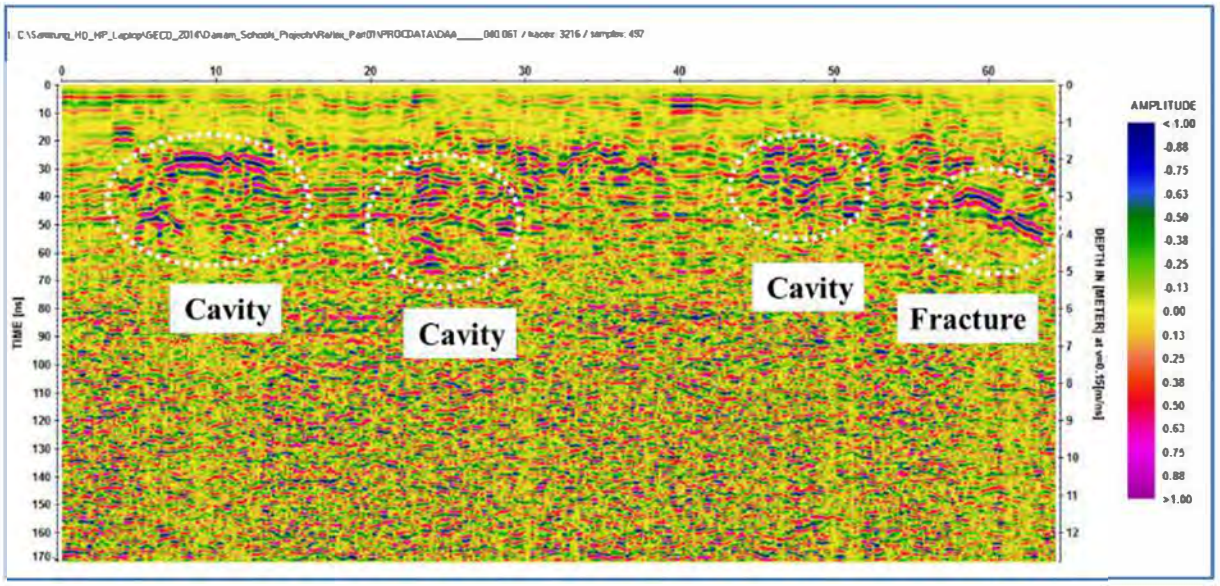
GPR processing routines vary per site and according to the type of equipment used, and may include the following (Table 2).

The collected data was processed using software Reflex 7.5 and RADAN 7 to produce 2D radargrams, time slices and 3D data cubes used for interpretation.

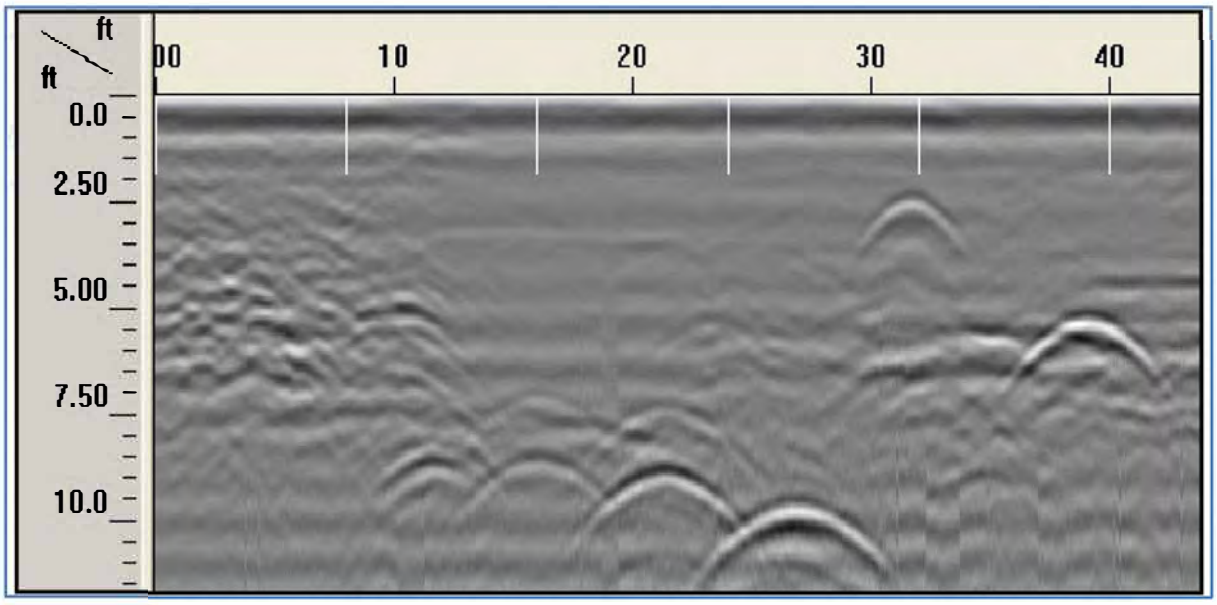
Table 4: Principal GPR data processing steps.

No.	Processing step	Objectives
1	Static Correction	Adjustment of time zero position.
2	Band-pass filtering	Removing unwanted high or low frequency noise or DC bias.
3	Dewowing filtering	Removing very low frequency components from the data.
4	Background removal	Subtracting of mean trace or moving average window to remove constant horizontal noise bands (e.g. ringing) from the data.
5	Deconvolution	Removing unwanted multiple echoes or signal 'ringing'.
6	Gain (Energy Decay)	Increasing signal amplitude.
7	Migration	Focusing the hyperbolic diffractions from buried objects back to their true positions.
8	Re-datuming	Removing distortion effect caused by layers with different velocities.
9	3D Interpretation	Constructing 3D data cube and time (depth) slices.

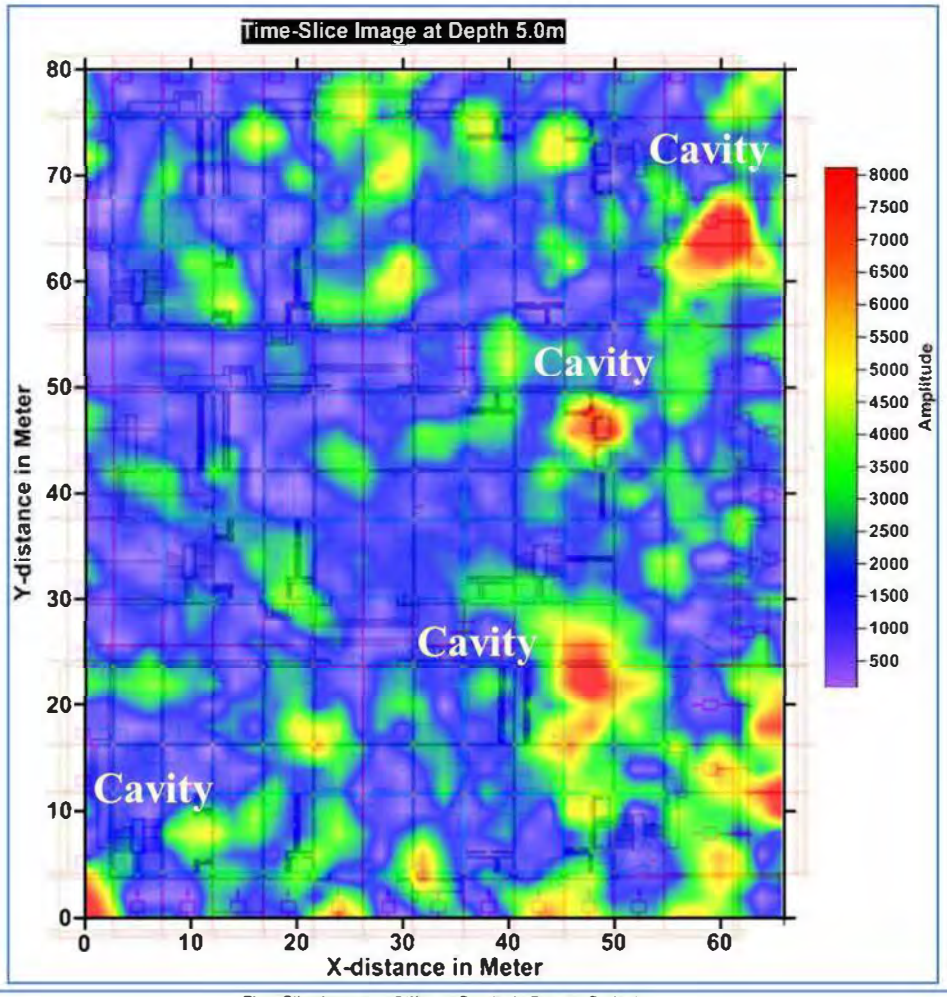
8. GPR OUTPUT EXAMPLES:

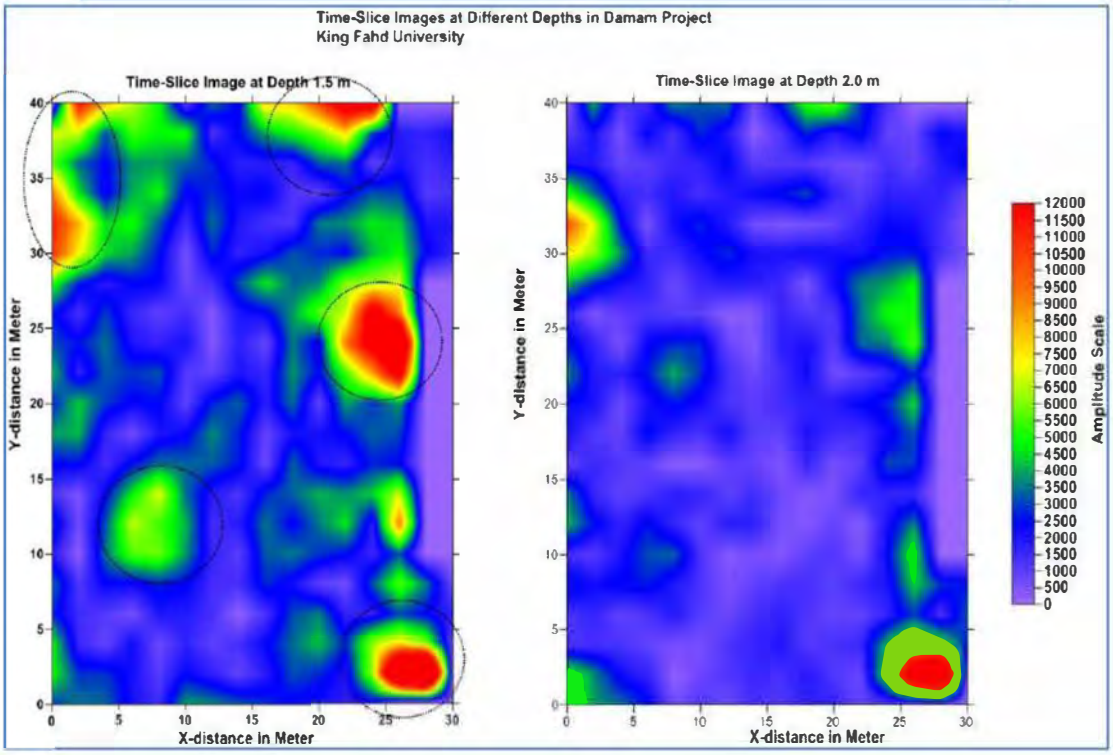


2D cross-section of the field survey

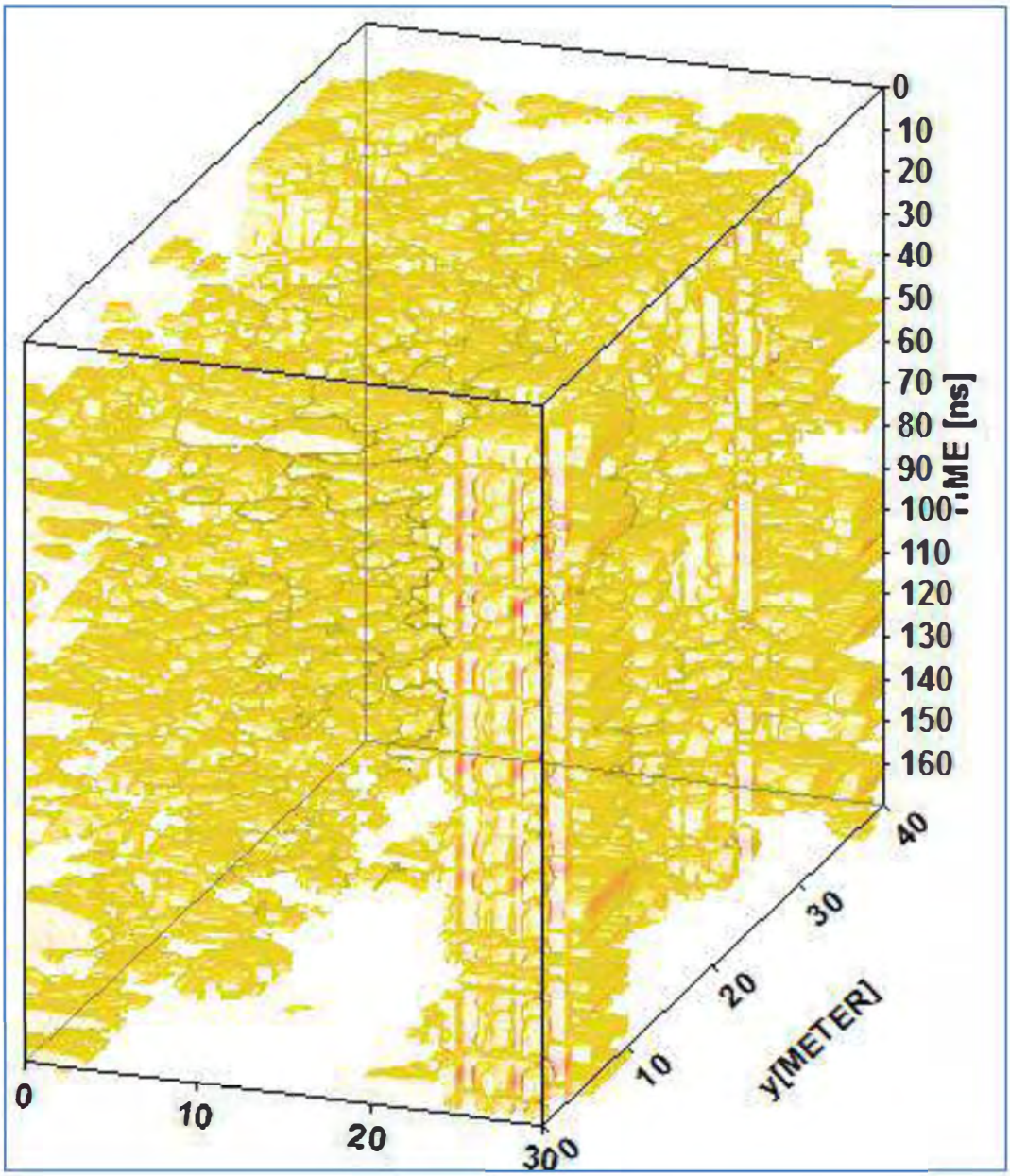


Six Miscellaneous Utilities at Multiple Depths with Backfill on Left Side

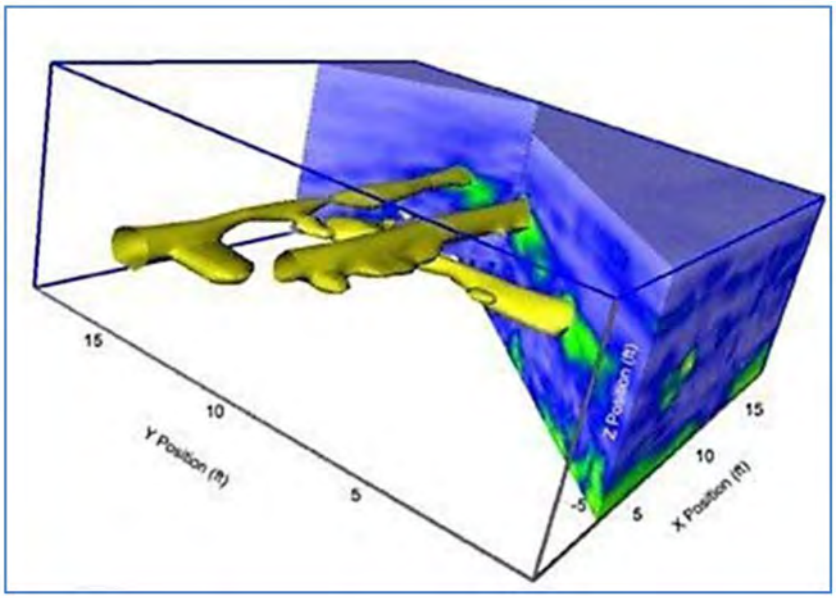




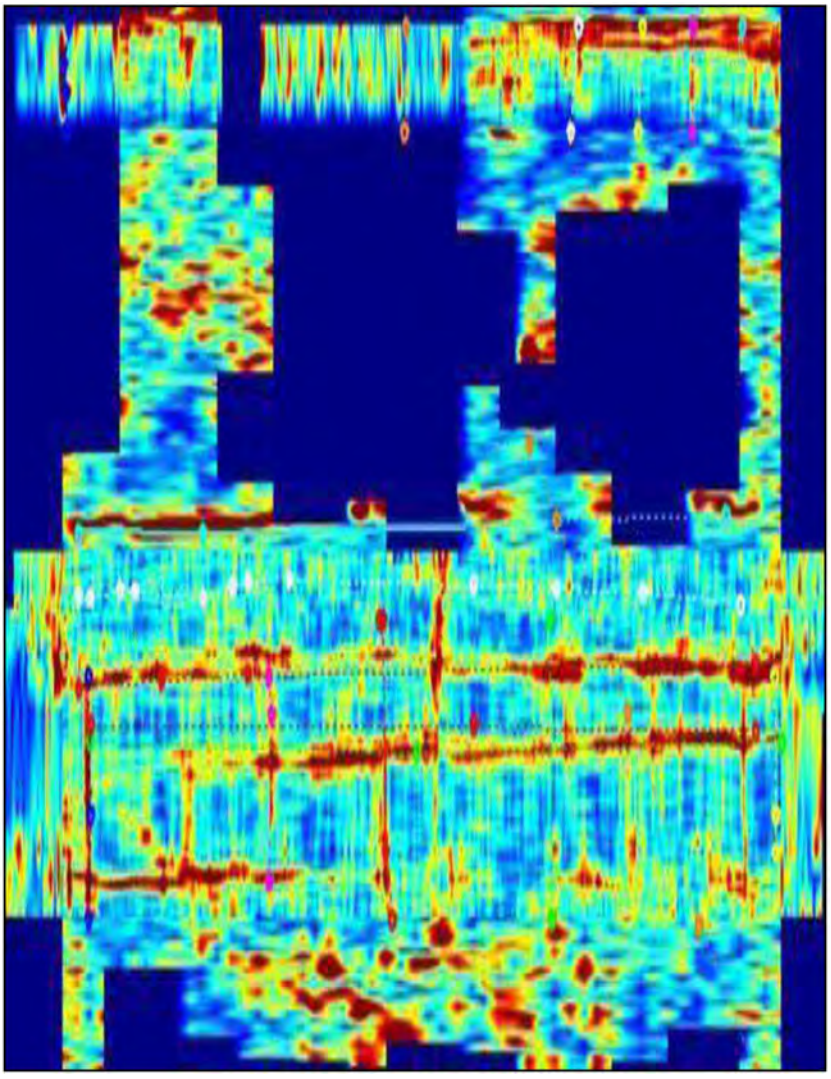
Time-Slice Images at Different Depths, Ar'Ar Airport



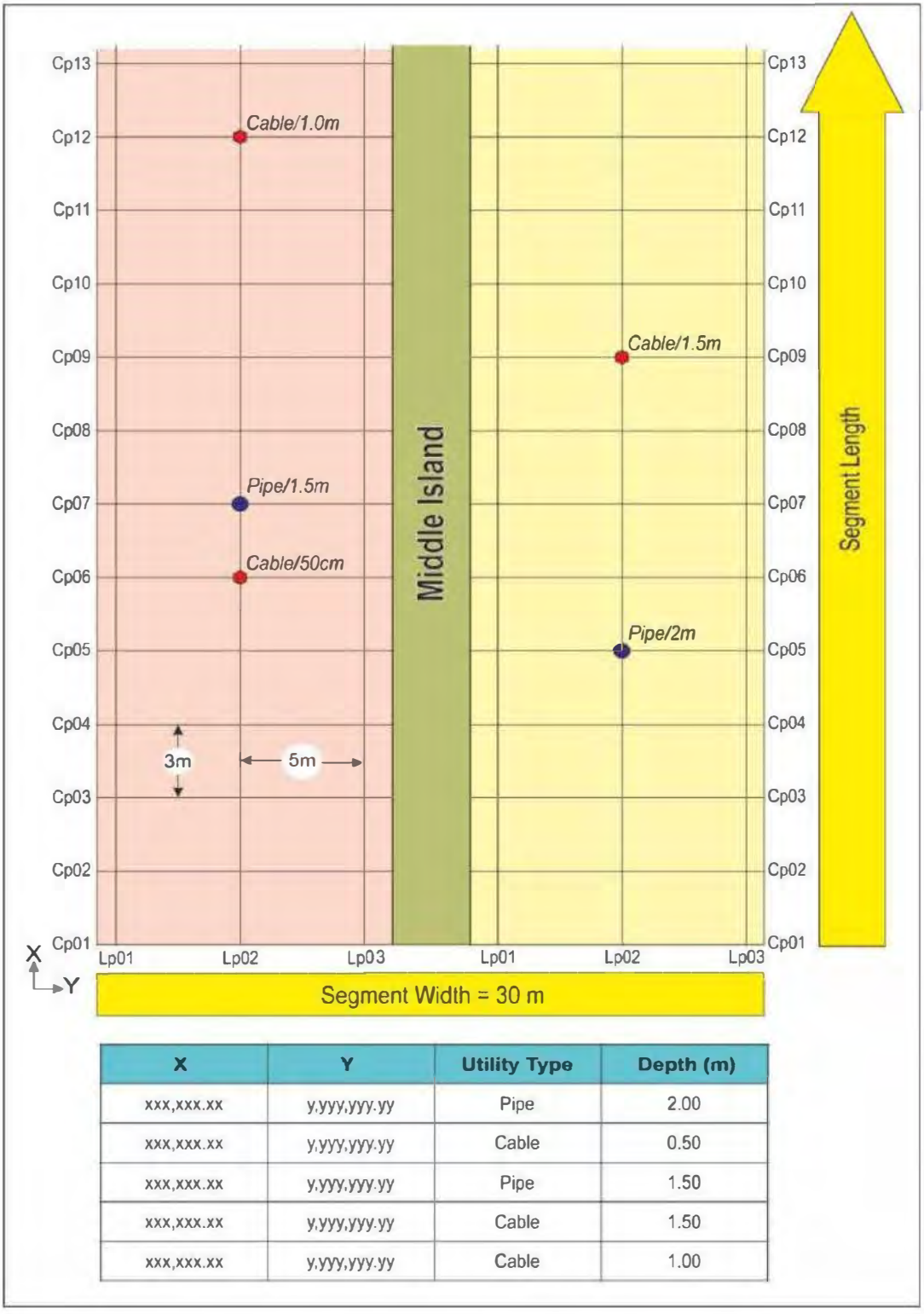
3D Iso-Surface Map for Water Network Supporting Facilities in Student Housing Area



3D GPR data cube with isosurface of subsurface utilities



Time (depth) slice derived from 2D GPR data shows subsurface utilities (cables)



X	Y	Utility Type	Depth (m)
xxx,xxx.xx	y,yyy,yyy.yy	Pipe	2.00
xxx,xxx.xx	y,yyy,yyy.yy	Cable	0.50
xxx,xxx.xx	y,yyy,yyy.yy	Pipe	1.50
xxx,xxx.xx	y,yyy,yyy.yy	Cable	1.50
xxx,xxx.xx	y,yyy,yyy.yy	Cable	1.00

An example of the output results of GPR utility scanning.

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Method Of Statement For

Cavity Probing & Grouting



- INTRODUCTION.
- PROBING.
- GROUTING.
- IMPORTANT PROJECTS.

TABLE OF CONTENT

1. INTRODUCTION

1.1 PROBING

1.2 GROUTING

2. Important Project

Method of Statement for

CAVITY PROBING & GROUTING

1. INTRODUCTION

When carrying out any development over areas underlined with limestone, it is highly probable to encounter cavities, whether void or infilled. The existence of cavities poses the uncertainties of whether the areas directly above the cavities are strong enough to withstand the load.

Pressure grouting involves the injection under pressure of a liquid or suspension (concrete grout) into the voids of a soil or rock mass or into voids between these materials and an existing structure. The injected grout must eventually form either a gel or a solid-within the treated voids, or the grouting process must result in the deposition of suspended solids in these voids. The primary purposes of pressure grouting a soil or rock mass are to improve the strength and durability of the mass and/or to reduce the permeability of the mass.

1.1 PROBING:

The treatment requires extensive drilling of boreholes that is used for grout injection. The probing works is made by utilizing a pneumatic percussion drill by air. The diameter of hole is range from 2.5 to 3 inch. PVC pipe with suitable length (0.5 - 1.5 m) put in the drilled hole to be the injection process from within and keeps the pressure of grouting. The depth of probing is a function of void size and its depth. From the recommendation of GPR survey the depth of probing is 6m.

1.1.1 Drilling Hole Equipment



1.2 GROUTING:

Grouting is a geotechnical process, which involves injection of cement or chemical grout for filling cracks or voids in the rock mass or soil to reduce the risk of sinkhole recurrence by minimizing the possibilities of collapse in the upper level cavities within the limestone bedrock.

1.2.1 Grouting equipment:

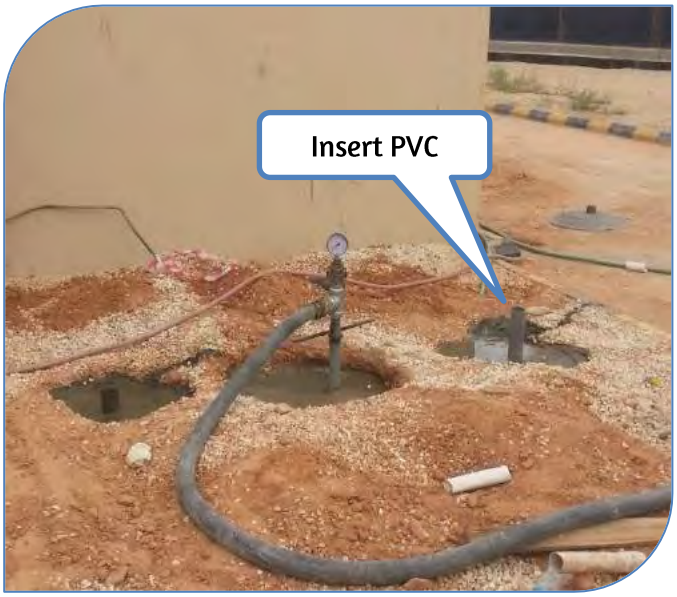
The basic form of grouting equipment consists of:

- mixer,
- pump,
- hoses,
- packers.



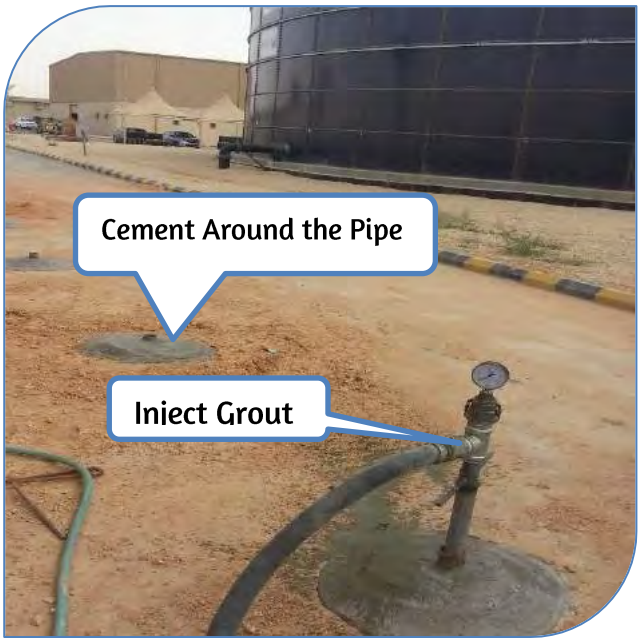
1.2.2 Grouting materials

The selection of a grout material is an essential part of grouting design. It is not realistic to expect that all the desirable qualities of a grout can be achieved, hence a prioritization is usually necessary.



The grout must penetrate the fractures and voids to seal them. It is therefore necessary that the grout can penetrate fractures small enough to meet the requirement on maximum inflow. These voids and fractures must also be filled to a certain penetration length, which is dependent on a combination of the grouting technique and the rheology of the grout.

Cement is the most common grout used in rock treatment. The most commonly used grout consists of cement and water with additives if required that reduce the cost or improve workability and applicability. The grout mix consists of water-cement ratio 1:1. The cement content is 300 kg/m3 grout.



When the voids are large, huge amounts of grouting mix are required and penetration is easy, fillers for bulking out are mixed with the grout. Sand is a cheap filler but requires care to avoid segregation. Sand percentage range from 10 to 20 % of the total volume of the grout mix.

1.2.3 Grouting pressure:

Grout is always satisfactorily pumped under pressure of 3: 5 bar.



1.2.4 Terminate Grouting

The pressure grouting shall be terminated if either of the followings criteria is encountered:

i. Achieving the injection pressure specified.
ii. The ground surface heave up.
iii. When grout overflows.
iv. Huge amounts of grouting mix are required

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Method Of Statement For
Building Assessment



- Introduction.
- Objectives of The Building Structure Assessment.
- Steps of The Building Structure Assessment.
- Examples of visible distress harmful to the safety of buildings.
- Main causes of such distress in buildings.
- Methodology of Condition Assessment.
- IMPORTANT PROJECTS.

TABLE OF CONTENT

1. Introduction:

2. Objectives of The Building Structure Assessment:

3. Steps of The Building Structure Assessment:

4. Examples of visible distress harmful to the safety of buildings:

5. Main causes of such distress in buildings:

6. Methodology of Condition Assessment:

6.1 Collection of information and details about the building:

6.2 Visual inspection:

6.3 Analyzing/Evaluating the safety of the building.

7. IMPORTANT PROJECTS

Method of Statement for

BUILDING STRUCTURE ASSESSMENT

1. INTRODUCTION:

Structural assessment can be initiated, when there has been a change in resistance. Such as structural deterioration due to time-depending processes (e.g. corrosion, fatigue) or structural damage by accidental actions. Also, when there will be a change in loading (e.g. increased traffic load) or an extension of the design working life.

In general, structural assessment is a process to determine, how reliable the existing structure is able to carry current and future loads and to fulfil its task for a given time period.

2. OBJECTIVES OF THE BUILDING STRUCTURE ASSESSMENT:

Main objective of condition assessment is to place the building into one of the following three categories:

a. The building has not shown any signs of distress and It satisfies all the safety and serviceability requirements according to relevant Codes of practice, hence no action is needed towards retrofitting.
b. The building is seen to be deficient (or distressed) but it can be repaired and strengthened to satisfy the Code safety requirements or performance criteria set by the user.
c. The building is badly damaged. It is to be demolished and a new building may be built, build back better.

3. STEPS OF THE BUILDING STRUCTURE ASSESSMENT:

Main steps of condition assessment will be as follows:

a. To record the damage if any, and find out the causes for distress.
b. To assess the extent of distress and to estimate the residual strengths of structural components and the system including the foundation.
c. To plan the rehabilitation and retrofitting/strengthening of the building.

4. EXAMPLES OF VISIBLE DISTRESS HARMFUL TO THE SAFETY OF BUILDINGS:

There is some visible distress harmful to the safety of buildings such as:

- Cracks in RC beams,
- Cracks in Columns,
- Cracks in slabs,
- Cracks in masonry walls (particularly if the walls are load bearing walls),
- Spalling of concrete,
- Sagging of beams or slabs,
- Tilting of columns or RC frames (out of plumb)

The major failure of structural members are the typical types of crucial damages that will require structural repairs to bring back the lost strength. Such actions will need to be done along with retrofitting if that is also decided for the building in question.

5. MAIN CAUSES OF SUCH DISTRESS IN BUILDINGS:

Either one or more of the factors listed below may cause distress in buildings:

- Deficiencies in design.
- Poor detailing of reinforcement in RC structural members and joints.
- Poor quality of construction.
- Corrosion of reinforcement due to aggressive environment.
- Inadequacies in the structural system to resist lateral forces due to natural hazards like cyclones and earthquakes.
- Settlement or differential settlement of foundation.
- Extreme and unforeseen loading.

6. METHODOLOGY OF CONDITION ASSESSMENT:

There are mainly four components and steps:

1. Collection of information and details about the building design, construction, utilization, and maintenance in the past.
2. Visual inspection of condition at site and recording details of distress.
3. Analyzing/Evaluating the safety of the building.

6.1 Collection of information and details about the building:

One needs a complete record of building design details and drawings, architectural details, construction details and drawings including the specifications of materials used, geotechnical details of the area and foundation particulars, details of any repair or retrofitting done from the

time of construction, details of usage of the building including the loads. Some nondestructive testing may be required to check the strength of concrete masonry etc.

If the above information is not available, detailed investigations have to be conducted.

6.2 Visual inspection:

The main purpose of visual investigation is to observe and note down all the items of distress or design deficiency and their locations, supported by sketches and drawings. The visual inspection includes:

a. Verification of the accuracy of the original drawings or determination of basic building information, if no drawings are available.
b. Identification of major alterations not shown on the original construction documents.
c. Identification of visible structural damage, such as concrete cracking or spalling, and observations on quality of construction.
d. Identification of potential non-structural falling hazards, including ceilings, partitions, curtain Walls, parapets, fixtures, and other non-structural building elements.
e. Observations on the condition of soil and the foundation.
f. Documentation of existing conditions with photographs at key locations.

Details about any deviations observed at the site from the original drawings have also to be recorded.

Based on the data collected about the details of the building, visual observation of damage/distress in different structural components and the system, structural engineer's experts can categorize the type and severity of damage and make judgments about further course of action.

6.3 Analyzing/Evaluating the safety of the building.

Measurements may have to be made on the existing building to note the dimensions of the structural elements. Properties of structural materials, namely, concrete, steel reinforcement and masonry, in the representative structural members, will be necessary by conducting Non-Destructive Testing (NDT) in the field and by carrying out laboratory investigations on samples collected from the field. Details of soil profile and its characterization must be obtained by collecting data or by conducting necessary geotechnical investigations.

These details are necessary for analyzing/evaluating the safety of the building and to recommend retrofitting/strengthening measures.

After identification of weak zones in a structure, detailed assessment of the in-situ quality of the material is to be done. Several tests have been developed and standardized for different properties of concrete. Suitable tests are to be selected based on the aims of testing. A list of various available tests is given below:

6.3.1 Schmidt Rebound Hammer Test

Surface hardness measured during the test give an idea about the soundness and quality of cover concrete. Locations having very low rebound numbers indicate weak surface concrete and may be affected by corrosion.



This is a non-destructive testing which can be easily done on a wide area of the structure without doing any damage on the structure.

A simple equipment known as Rebound Hammer or Schmidt Hammer is used for this purpose. The concrete hammer is a hand-held instrument used for testing the quality of hardened concrete in a structure.

6.3.2 Ultrasonic Pulse Velocity (UPV) technique?

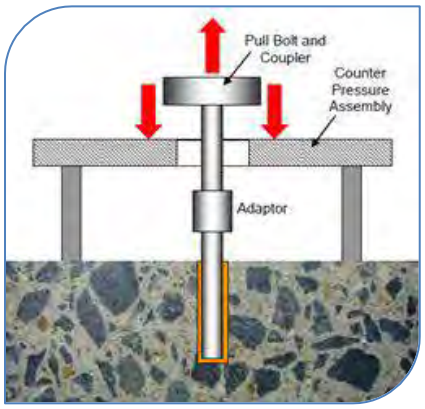
This test method is applicable to assess the uniformity and relative quality of concrete, to indicate the presence of voids and cracks, and to evaluate the effectiveness of crack repairs. It is also applicable to indicate changes in the properties of concrete, and in the survey of structures, to estimate the severity of deterioration or cracking. When used to monitor changes in condition over time, test locations are to be marked on the structure to ensure that tests are repeated at the same positions.



The dynamic modulus of elasticity of concrete is measured by measuring the velocity of ultrasonic pulse through concrete. The test equipment has provisions for generating ultrasonic pulse, transmitting it to concrete, receiving and amplifying the pulse and measuring and displaying the pulse travel time.

6.3.3 Pull-out Testing

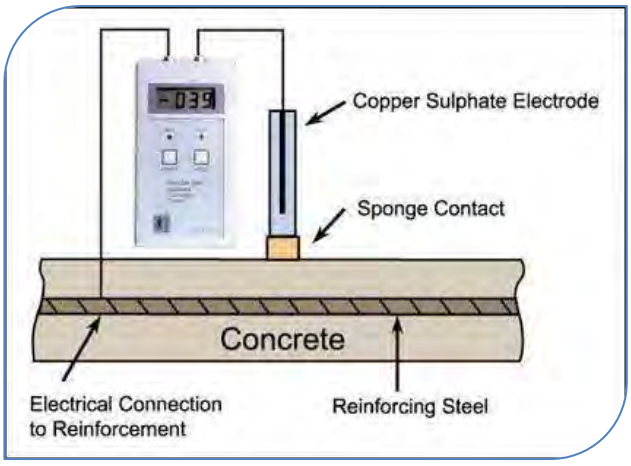
In pull-out testing, the force needed to pull a bolt or some similar device embedded into concrete is measured and correlated with the strength of concrete. This correlation has been shown to be unaffected by the mix characteristics and the curing history. The bolt may be inserted at the time of casting of the concrete or it may be epoxy grouted into a hole drilled into hardened concrete. The testing has high reliability and it is accepted by a number of public agencies in some countries as equivalent to cylinders for acceptance testing.



6.3.4 Half-Cell Electrical Potential:

This technique is most likely to be used for assessment of the durability of reinforced concrete members where reinforcement corrosion is suspected. Reported uses include the location of areas of high reinforcement corrosion risk in marine structures, bridge decks and abutments. Used in conjunction with other tests, it has been found helpful when investigating concrete contaminated by salts.

The method of half-cell potential measurements normally involves measuring the potential of an embedded reinforcing bar relative to a reference half-cell placed on the concrete surface. The half-cell is usually a copper/copper sulphate or silver/silver chloride cell but other combinations are used. The concrete functions as an electrolyte and the risk of corrosion of the reinforcement in the immediate region of the test location may be related empirically to the measured potential difference. In some circumstances, useful measurements can be obtained between two half-cells on the concrete surface. ASTM C876 - 91 gives a Standard Test Method for Half-Cell Potentials of Uncoated Reinforcing Steel in Concrete.



6.3.5 Core tests

The core test provides the visual inspection of the interior of the concrete and direct measurement of the compressive strength. Other physical properties, such as, density, water absorption, indirect tensile strength, and expansion due to alkali-aggregate reaction can also be measured. After strength testing, these can be used as samples for chemical analysis. The procedure has been standardized by BS, ASTM and ACI codes.



The core samples can be used for determination of unit weight, estimation of voids, and chemical analysis, a graphic analysis and analysis. Broken samples from the cores can be used to determine the pH value and the chloride content in the sample. These tests on cores and core samples will also provide information that can be used to assess the state of corrosion of reinforcing steel.

6.3.6 Carbonation Test

Carbonation incases the shrinkage of concrete on drying and thus tends to promote the development of cracks. It also reduces the alkalinity of concrete and thus reduces its effectiveness as a protecting medium. In good quality concrete, carbonation does not penetrate deeply. It is only in the porous or where the reinforcement is close to the surface that corrosion is likely a problem from this cause.



Immediately after extracting the concrete core sample, a phenolphthalein indicator will be dropped on the vertical side of the concrete core sample after which a pinkish color will appear on the surface, the depth of carbonation on will then be measured.

Geotechnical & Environmental Co.

Method Of Statement For
Topographical Survey



- THE STUDY PURPOSE.
- Field SURVEY.
- TOPOGRAPHIC SURVEY EQUIPMENT.
- IMPORTANT PROJECTS.

TABLE OF CONTENT

1. The study Purpose
2. Field Survey
3. Topographic Survey Equipment

Method of Statement for

TOPOGRAPHIC SURVEY

1. THE STUDY PURPOSE:

The purpose of a TOPOGRAPHIC SURVEY is to gather survey data about the natural and man-made features of the land, as well as its elevations. From this information, a three-dimensional map may be prepared. You may prepare the topographic map in the office after collecting the field data or prepare it right away in the field. The work usually consists of the following:

1. Establishing horizontal and vertical control that will serve as the framework of the survey by the theodolite and leveling instrument.
2. Determining enough horizontal location and elevation (usually called side shots) of ground points to provide enough data for plotting when the map is prepared
3. Locating natural and man-made features that may be required by the purpose of the survey
4. Computing distances, angles, and elevations
5. Drawing the topographic map Topographic surveys are commonly identified with horizontal and/or vertical control of third- and lower-order accuracies.

2. FIELD SURVEY

1. If Benchmarks from Municipality are not available in the vicinity, select a convenient location for survey control points.
2. Set the instrument and record the handheld GPS coordinates (UTM) of the control point (i.e. Northing = 2422351 m, Easting = 511599 m, and Elevation =(20.00 m). Take a back sight on another selected control point and record the coordinates to the nearest millimeter.
3. Start taking side shots on the ground by the use of the prism at a convenient grid interval and at the location where there is change in elevation or slope. This will depict the actual topography of the site. Record the coordinates. Record all the location of all structures and utilities that maybe required for the project. For some points that are not visible from the occupied instrument move the instrument by traversing to the next control point where it can be seen.

4. All control points will be established conforming to the specified accuracy and standard provided in the project specification, which might constitute of the following:
   a) Every order of geodetic control points shall be monument permanently using the monument types 1 & 2. Type 1 (PVC pipe filled with concrete) to be used in open areas and type 2 (concrete) to be used in built-up areas.
   b) All geodetic control points established shall conform to third-order or better standards Adjacent control points shall always be in sympathy with each other to a root mean square error of better than + 0.1 mm at map scale
5. Surveying works will be conducted according to international and project standards utilizing up-to-date surveying instruments like TOTAL STATIONS.
6. Data processing and mapping will utilize Soft Desk Civil-Survey software for surveying and AutoCAD software for mapping.
7. Submittal shall include all data regarding the reference and established geodetic control points, their description referenced to land marks, their coordinates and elevations based on the NGN datum.
8. All information shall be provided as digital files.

3. TOPOGRAPHIC SURVEY EQUIPMENT:



Sokkia Total Station CX 8

Geotechnical & Environmental Co.

Gecoجيكو

Some of Our Clients / Projects



Selected Previous Projects

Scope of Work	Project Name	Client
Geotechnical, Topographic, Geophysics, and Hydrology	Solar Plant Projects	IDOM Consulting Engineering Architecture
Geotechnical, Topographic, Geophysics, and Hydrology	Solar Plant Projects	Typsa Group
Geotechnical, Topographic, Geophysics, and Hydrology	Wind Farm Project	larsen & toubro
Geotechnical, Topographic, Geophysics, and Hydrology	several projects	Sela Company
Geotechnical Projects	Center For Social Development (7 Projects)	Contractors & Sub-Contractors
Geotechnical Projects	Kap1, Sites (72 Projects)	Zuhair Fayez Partnership
Geotechnical Projects	Housing Project (77 Projects)	Ministry Of Housing
Geotechnical Projects	Kap2, Second Stage (6 Projects)	Saudi Oger Co. Ltd.
Geotechnical Projects	Kap1, Sites (80 Projects)	Saudi Oger Co. Ltd.
Geotechnical Projects	Extension of Power Plant (14 Projects)	SCECO & Najm Al-Jazeerah Co.
Geotechnical Projects	Sewerage Lines Project (12 Projects)	National Water Co. & Sub Contractors
Geotechnical Projects	Schools & Medical Complex (16 Projects)	Ministry of Education & Sub Contractor
Geotechnical Projects	Zain, Mobily & STC Towers (41 Projects)	BATCO Ltd.
Geotechnical Projects	Residential Building (95 Projects)	Ministry of Housing & Sub-Contractors
Geotechnical Projects	Water Supply Enhancement Project (57 Projects)	National Water Co. & Sub Contractors
Geotechnical Projects	Electrical Equipment Warehouse (29 Projects)	SCECO & Sub-Contractors
Geotechnical Projects	Wadi Dam (98 Projects)	Water & Power Development Authority & Sub Contractors
Geotechnical Projects	Warehouse building for the Ministry of Finance	Arc View Engineering Consultancy
Geotechnical Projects	AL-RIMAL Project	Geotech Information Technology
Geotechnical Projects	Palace construction site	Al Omq Engineering Consultancy
Geotechnical Projects	Palaces buildings in Diriyah	Arc View Engineering Consultancy
Geotechnical Projects	Recycled Water System to Benefit from Water T	Alkhorayef Water & Power Techn
Geotechnical Projects	Construction of factories in Eastern, Central	Modern Technology Engineering
Geotechnical Projects	Hydrological studies for masterplans in North	Almenwal Engineering Consultancy
Geotechnical Projects	Wadi Malakan Project	ZUTARI
Geotechnical Projects	Shaybah Resort Project	Desert Resorts Development Com
Geotechnical Projects	Test Boreholes Project - National Water Company	Al Emad Al Arabi Environmental
Materials Testing Projects	Al-Roqai Power plant	Delta Company LTD
Materials Testing Projects	Wastewater lines in Riyadh	Salt Contracting EST.
Materials Testing Projects	Implementation of sewage networks in Dir'iya District	Al Areen Contracting EST.
Materials Testing Projects	The empty container yard	Al Mobty Contracting Co.
Materials Testing Projects	Thadig Tank	Energy Patterns Company
Materials Testing Projects	Hair Lakes	BADAN Agriculture Co.
Materials Testing Projects	Bridge between Omar bin al-Khattab and 'Amr ibn al-Aas	Advanced Company for Contracting
Materials Testing Projects	Housing Projects Of The Armed Forces	Shar Contracting Company
Materials Testing Projects	Housing Projects Of The Armed Forces	Tawaref Contracting company
Materials Testing Projects	Warehouses at Namar District	Crazy company for contracting
Materials Testing Projects	Riyadh Boulevard	United Measurements Contracting Co.
Materials Testing Projects	Sedra Mole	East Delta Saudi Company
Materials Testing Projects	CNG Project	Etwall Technology
Materials Testing Projects	Ministry of Civil Service building	Anwar Mouj Al Khalij Contracting Company
Materials Testing Projects	Munira Nasser Al Nasser Palace	Saleh Al Gebreen
Materials Testing Projects	ENA Project	Al Babteen
Environmental Impact Assessment	Southern Corniche Development	Ital Consult
Environmental Impact Assessment	Al Fanar Ceramic Factory	Al Fanar Company
Environmental Impact Assessment	Saudi Company for Roads Painting	Saudi Company for Roads Painting
Environmental Impact Assessment	Saleh Maameer Plant	Saleh Maameer Plant

Environmental Impact Assessment	Tag Al Tawass Factory	Tag Al Tawass Factory
Structural Evaluation	King Fahad Medical City	Dar Engineering
Structural Evaluation	Faculty of Computing and IT at Rafha	Babel Maintenance, Operation, and Trading Co.
Structural Evaluation	Social Security Office	Al Jazirah Engineers & Consultant
Structural Evaluation	Ministry of Housing Residential Apartments	AL Argan
Structural Evaluation	Kuwaiti Diplomatic Residence	Saudi Consulting Services
Structural Evaluation	Najran Hospital Housing	Dar Engineering
Structural Evaluation	Central Building Baif Arab University for Security Sciences	Al Rob'a Al Aly Company
Structural Evaluation	Structural assessment of the second basement	Shaghaf Engineering Consulting
Structural Evaluation	Structural study of the parking building at S	Al-Bakeen Arabic Contracting Co.
Structural Evaluation	Al Othaim Strip mall	Gulf Architects Contracting
Structural Evaluation	King Abdulaziz University housing complex (6) 106 buildings	ASAR Design for Engineering Consultants
Structural Evaluation	Dakhna Parking	Nassar Al-Aknan Engineering Consulting Company
Structural Evaluation	Al Khobar Public Library	Gulf Architects Contracting
Structural Evaluation	Zahran Mall	Ouj Real Estate Development and Investment Company
Structural Evaluation	Jazan Courts Complex	Ministry of Justice
Probing & Grouting	Rehabilitation, renovation & construction projects	Shamael Al Khaleej Contracting
Geophysics	Olaya Avenue Project	Jarir Real Estate Development
Hydrology Studies	Hydrological study for a mall building in Eastern Region	JAS Engineering Consulting

وزارة السياحة
Ministry of Tourism

وزارة الرياضة
Ministry of Sport

وزارة الإسكان
MINISTRY OF HOUSING

وزارة الزراعة
Ministry of Agriculture

وزارة البيئة والمياه والزراعة
Ministry of Environment Water & Agriculture

وزارة النقل
TRANSPORT MINISTRY

وزارة الداخلية
المملكة العربية السعودية

وزارة الدفاع
MINISTRY OF DEFENSE

وزارة الصحة
Ministry of Health

وزارة التعليم
Ministry of Education


نيوم NEOM


مدن MODON


صندوق الاستثمارات العامة 1391 1971
Public Investment Fund


وزارة الشؤون البلدية
والقروية والإسكان


وزارة الصناعة
والثروة المعدنية
Ministry of Industry and Mineral Resources


وزارة الثقافة
Ministry of Culture


الهيئة السعودية للمياه
Saudi Water Authority


شركة المياه الوطنية
National Water Company


NHC


البحر الأحمر
الدولية

fast
Riyadh Metro Alliance

stc

DAR AL-HANDASAH

DAR ENGINEERING

البواردي
للاستشارات الهندسية

سعودكونسلت
SAUDCONSULT

ALARGAN
الأرجان

البواني
AL BAWANI

المعماريون السعوديون
SAUDI ARCHITECTS

دار الرياض
DAR AL RIYADH


ALEMAD ALARABI
ENGINEERING CONSULTANCY


ALEMAD ALARABI
ENVIRONMENTAL CONSULTANCY


BEC


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