REPUBLIC OF LEBANON
Ministry of Public Works & Transport
Directorate General of
Land & Maritime Transport

الجمهورية اللبنانية
وزارة الأشغال العامة والنقل
المديرية العامة للنقل البري والبحري

٦/٧٦٥١
١٧ تشرين الأول ٢٠١٩

الموضوع: ايداع دراسة حماية وتغذية شاطئ صيدا الرملي.

بالإشارة إلى الموضوع المبين أعلاه،

وحيث ان مديرية الصرفيات في وزارة المالية قد اعادت المعاملة المتعلقة بتصفية النفقة العائدة لعقد اتفاق رضائي لدراسة اشغال حماية وتغذية شاطئ صيدا الرملي لإرفاق مستند استلام الدراسة من قبل وزارتكم،

لذلك، نرفق لجانبكم ربطاً نسخة عن دراسة حماية وتغذية شاطئ صيدا الرملي، تنفيذاً لتعاميم رئاسة مجلس الوزراء بشأن الدراسات التي تجريها الوزارات والادارات العامة،

يرجى التفضل بالاطلاع والافادة عن وجود دراسات مماثلة للدراسة المذكورة اعلاه او عدمه.

المدير العام للنقل البري والبحري

المهندس عبد الحفيظ القيسي

للإحالة الى: السيد ابتسام هبر

بيروت في: ٢٠١٩/١٠/١٧

شارع جورج بيكو - بناية ستاركو، ط٣ - بيروت - لبنان - هاتف: ٦/٥/٣٧١٦٤٤ ٩٦١ ١ + فاكس: ٦٤٧ ٣٧١ ٩٦١ ١ +
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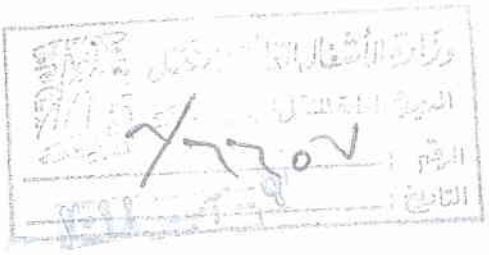

وزارة الأشغال العامة و النقل

جانب المديرية العامة للنقل البري و البحري
حضرة المدير العام الأستاذ المهندس عبد الحفيظ القيسي المحترم

المرجع : مشروع اشغال حماية و تغذية شاطىء صيدا الرملي
الموضوع : عرض الأسعار لإنجاز الدراسة

عطفًا على المرجع و الموضوع أعلاه، يسرنا أن نرفع لحضرتكم ربطًا عرضنا المفصل أدناه لإنجاز دراسة مشروع "أشغال حماية و تغذية شاطىء صيدا الرملي".

يتضمن عرضنا شرحا تفصيليا لمختلف مراحل الدراسة الخمس و التي أتت على الشكل التالي :

- المرحلة الأولى : المسح الطوبوغرافي و البحري و الكشف تحت الماء
- المرحلة الثانية : المخطط الأولي لحماية و تغذية شاطىء صيدا
- المرحلة الثالثة : المشبهات الرقمية
- المرحلة الرابعة : الدراسة التمهيدية
- المرحلة الخامسة : الدراسة التفصيلية

إضافة لثلاث ملاحق :

- ملحق رقم ١ : البرنامج الزمني لتنفيذ الدراسة
- ملحق رقم ٢ : معدات المسح الطوبوغرافي و البحري
- ملحق رقم ٣ : البرامج المستخدمة في الدراسة

و عرضا مفصلا للأسعار بحسب مختلف المراحل أعلاه.

بإنتظار قراركم في هذا الخصوص و مع إستعدادنا لتقديم أيّ مستند أو توضيح إضافي، نتقدم منكم سعادة المدير، بقبول فائق الإحترام.

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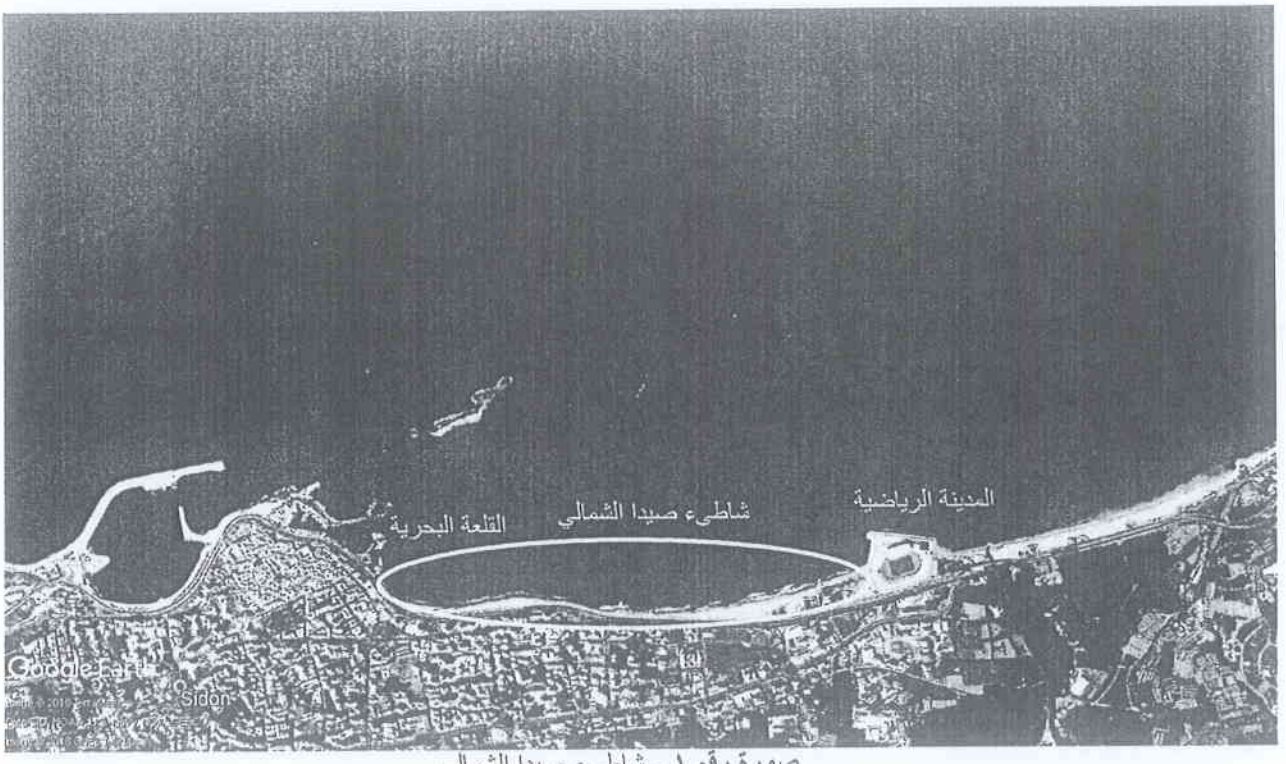
دراسة مشروع اشغال حماية و تغذية شاطىء صيدا الرملي

١- مقدمة :

لما كانت المنطقة الساحلية لمدخل مدينة صيدا من الجهة الشمالية عبارة شاطىء رملي، يمتد على طول ٢٢٠٠م، يحده شمالا المدينة الرياضية و جنوبا قلعة صيدا البحرية (حسب الصورة رقم ١) أدناه،



صورة رقم ١ - شاطىء صيدا الشمالي

و لما كان الشاطىء المذكور عرضة للعوامل التالية :

- تيارات ساحلية Longshore currents قوية أدت مؤخرا إلى حوادث غرق بعض السابحين خلال السنوات المنصرمة
- إنحسار لكمية الرمول في بعض المناطق من الشاطىء المذكور، خاصة في المنطقة الوسطية ما أدى إلى تقلص عرضه و مساحته الإجمالية ليبلغ في حدة الأدنى عشرة أمتار، و بالتالي قدرة إستيعابه

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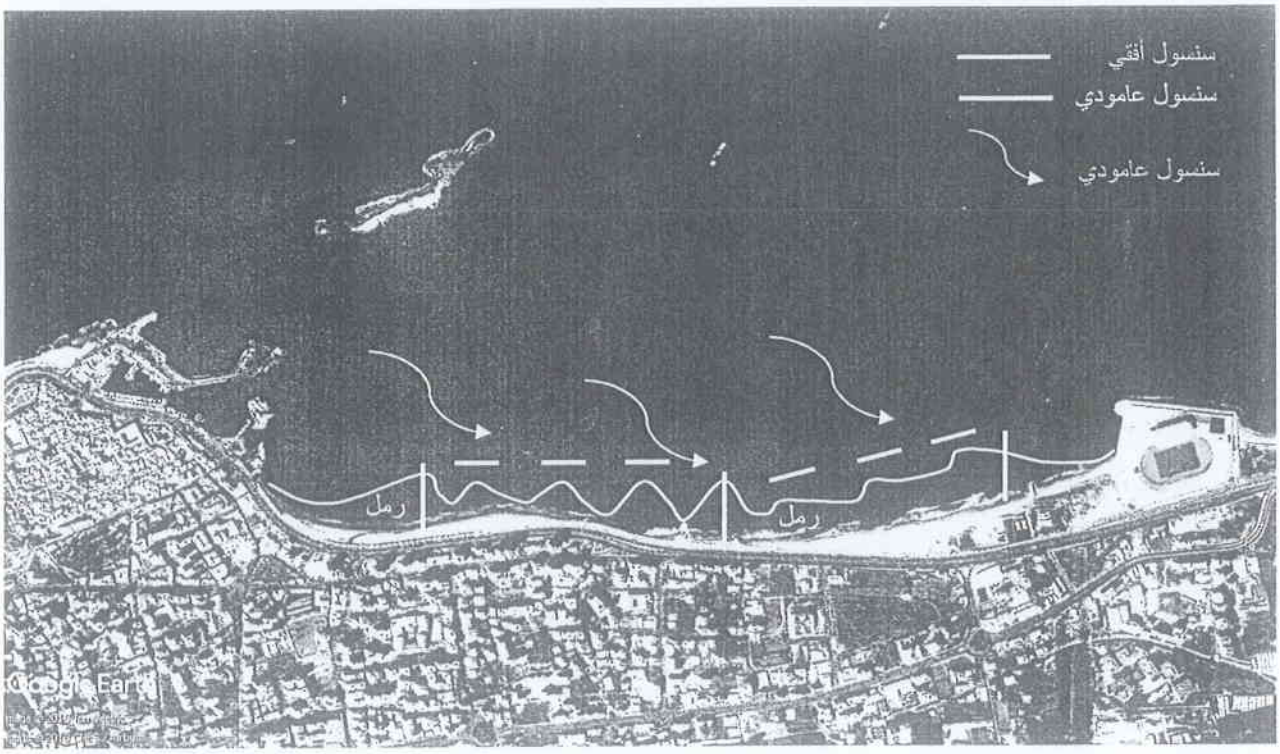
برزت الحاجة إلى إجراء دراسة تفصيلية مبنية على أساس تقييم حركة الرمول وفق سيناريوهات متعددة، بغية إيجاد الحلول لتأمين :

- تقليل سرعة التيارات أعلاه و بالتالي الحدّ من الحوادث التي قد تطال السابحين و تحسين شروط إرتياد و السباحة على الشاطىء
- حماية الشاطىء من خسارته على مرّ السنوات للرمول، و ذلك عن طريق إعتماد إنشاءات بحرية خاصة
- تغذية الشاطىء بالرمول، بطريقة طبيعية و/أو إصطناعية و إعتماد الإنشاءات البحرية الخاصة لزيادة كمية الرمول تلك و تجنب خسارتها بفعل العواصف.

يمكن الوصول إلى الأهداف أعلاه عن طريق إعتماد سناسيل عامودية خاصة Groyne و/أو أفقية غير متصلة بالشاطىء Tombolos نسبة لإتجاه الشاطىء، يتمّ إحتساب تباعدها بناء على دراسة و تقييم دقيقين لحركة الرمول تنجز بواسطة سلسلة مشبهات رقمية متخصصة Numercial modeling و وفق سيناريوهات متعدّدة من العواصف البحرية و من الإنشاءات المقامة.

تتضمن **الصورة رقم ٢** مخططا تشبيهيا للسناسيل أعلاه، مع الإشارة إلى ضرورة إحترام معايير عديدة في إعتماد الإنشاءات البحرية، منها :

- الحفاظ على جمالية و طبيعية الموقع
- تأمين زيادة كمية الرمول و حمايتها



صورة رقم ٢ - مخطط تشبيهي للسناسيل

على المخطط العام للإنشاءات البحرية الواجب إعتمادها أن لا يتعارض و سلامة الملاحة البحرية وإضافة إلى الأسس الهندسية في تصميم الإنشاءات تلك، مع الإشارة إلى أن السناسيل المنوه عنها يمكن أن تكون صخرية مائلة Rubble mound sloped structures، مرتفعة، منخفضة الإرتفاع Low crested أو تحة الماء Submerged.

٢- مراحل الدراسة :

يمكن تجزئة الدراسة إلى مراحل عدّة، تأتي على الشكل التالي :

(٢-١) المرحلة الأولى : المسح الطوبوغرافي و البحري و الكشف تحت الماء

(٢-١-١) المسح الطوبوغرافي (topographic survey)

سوف يغطي المسح الطوبوغرافي منطقة الشاطىء المحاذية لخط الماء و على طول ٢٢٠٠م من الكورنيش البحري الموجود بين المدينة الرياضية و قلعة صيدا البحرية مع تحديد مختلف الشقلات (levels) و ربطها بالمعدل الوسطي لمستوى إرتفاع المياه (Mean Sea Level) و بالشبكة الطوبوغرافية المعتمدة في لبنان (X,Y) أو (E,N).

سيستعمل فريق عملنا لهذه الغاية المعدات الطوبوغرافية التالية :

- Hi-target V30 Dual frequency GNSS RTK instrument
- Leika Total station

حيث تقدّر المساحة المكالة على البر بحوالي ١٤٠,٠٠٠م٢. (راجع **الملحق رقم ٢** لمواصفات معدات القياس).

سوف تظهر خريطة المسح الطوبوغرافي المسطح العام لمنطقة الدراسة مع التفاصيل التالية، على سبيل المثال لا الحصر:

- الشاطىء الرملي الموجود
- الكورنيش البحري
- الحدود العقارية لكافة العقارات الخاصة المحاذية
- الطريق العام
- قنوات تصريف المياه و الريكارات
- كافة الشقلات

تبين **الصورة رقم ٣** أدناه المنطقة التقريبية للمسح الطوبوغرافي.

على المخطط العام للإنشاءات البحرية الواجب إعتمادها أن لا يتعارض و سلامة الملاحة البحرية وإضافة إلى الأسس الهندسية في تصميم الإنشاءات تلك، مع الإشارة إلى أن السناسيل المنوه عنها يمكن أن تكون صخرية مائلة Rubble mound sloped structures، مرتفعة، منخفضة الإرتفاع Low crested أو تحة الماء Submerged.

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- Hi-target V30 Dual frequency GNSS RTK instrument
- Leika Total station

حيث تقدّر المساحة المكالة على البر بحوالي ١٤٠,٠٠٠م٢. (راجع **الملحق رقم ٢** لمواصفات معدات القياس).

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- الشاطىء الرملي الموجود
- الكورنيش البحري
- الحدود العقارية لكافة العقارات الخاصة المحاذية
- الطريق العام
- قنوات تصريف المياه و الريكارات
- كافة الشقلات

تبين **الصورة رقم ٣** أدناه المنطقة التقريبية للمسح الطوبوغرافي.

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الصورة رقم ٣ - المنطقة التقريبية للمسح الطوبوغرافي

(٢-١-٢) المسح البحري (Bathymetric survey)

سوف يغطي المسح البحري للأعماق (Bathymetric survey) مساحة بحرية تصل بمعدلها إلى مسافة ١٥٠٠م بعيدا عن خط الشاطىء بواسطة فريق متخصص من قبلنا، حيث تقدّر المساحة المكالة بحوالي ٣،٣٠٠،٠٠٠ م^{٢}.

ينجز الكيل البحري على طول مقاطع كتعامدة مع الشاطىء لا تبعد عن بعضها أكثر من ٥٠م. تظهر الصورة رقم ٤ المنطقة التقريبية للمسح البحري.

إضافة الى المنطقة المنوه عنها أعلاه، سوف يتم إنجاز مسحا بحريا على طول ثلاثة مقاطع يبلغ طول كل واحد منها ٢٥٠٠م (باللون الأخضر) بحسب **الصورة رقم ٥**.

سوف تربط كل الأعماق المكالة بالمعدل الوسطي لمستوى إرتفاع المياه (Mean Sea Level) و بالشبكة الطوبوغرافية المعتمدة في لبنان (X,Y) أو(E,N).

يعتمد فريق عملنا في قياس الأعماق البحرية على جهاز خاص :

- Hi-target HD370 Echo-sounder موصول بجهاز تحديد للمواقع (بحسب **الملحق رقم ٢**).

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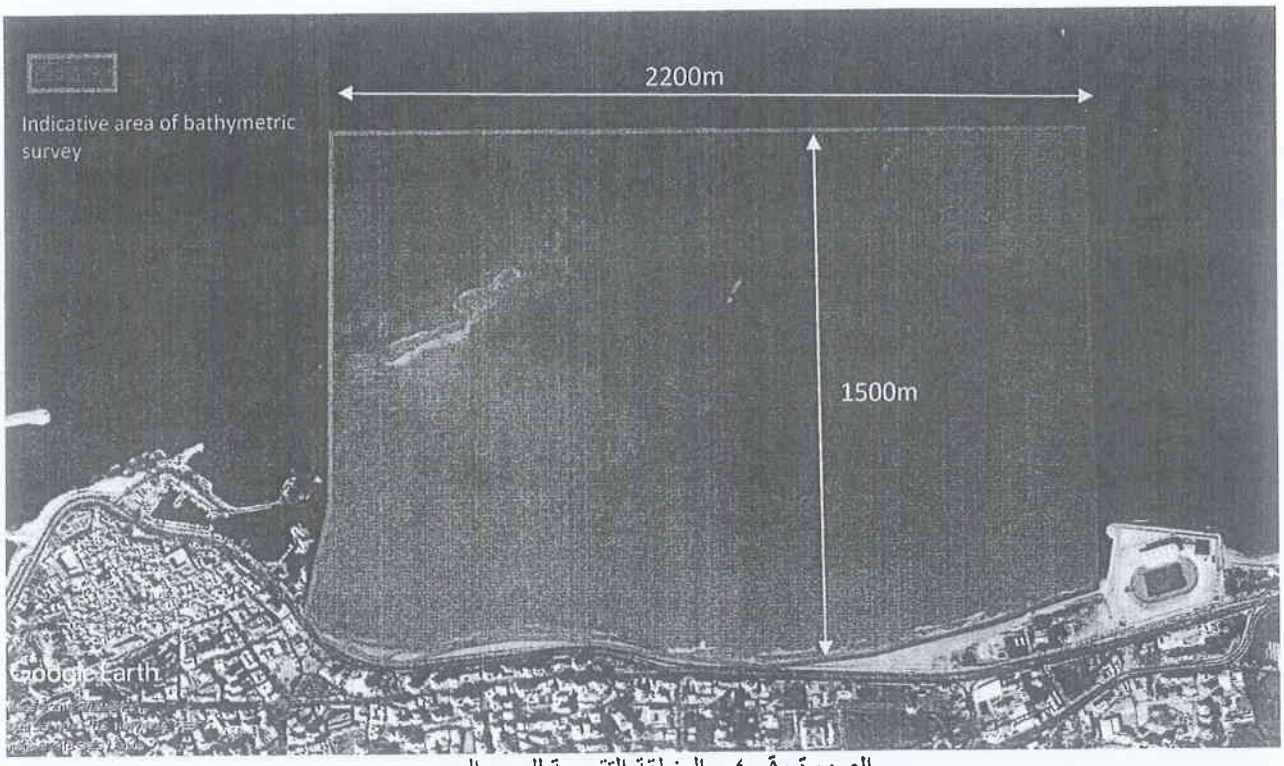
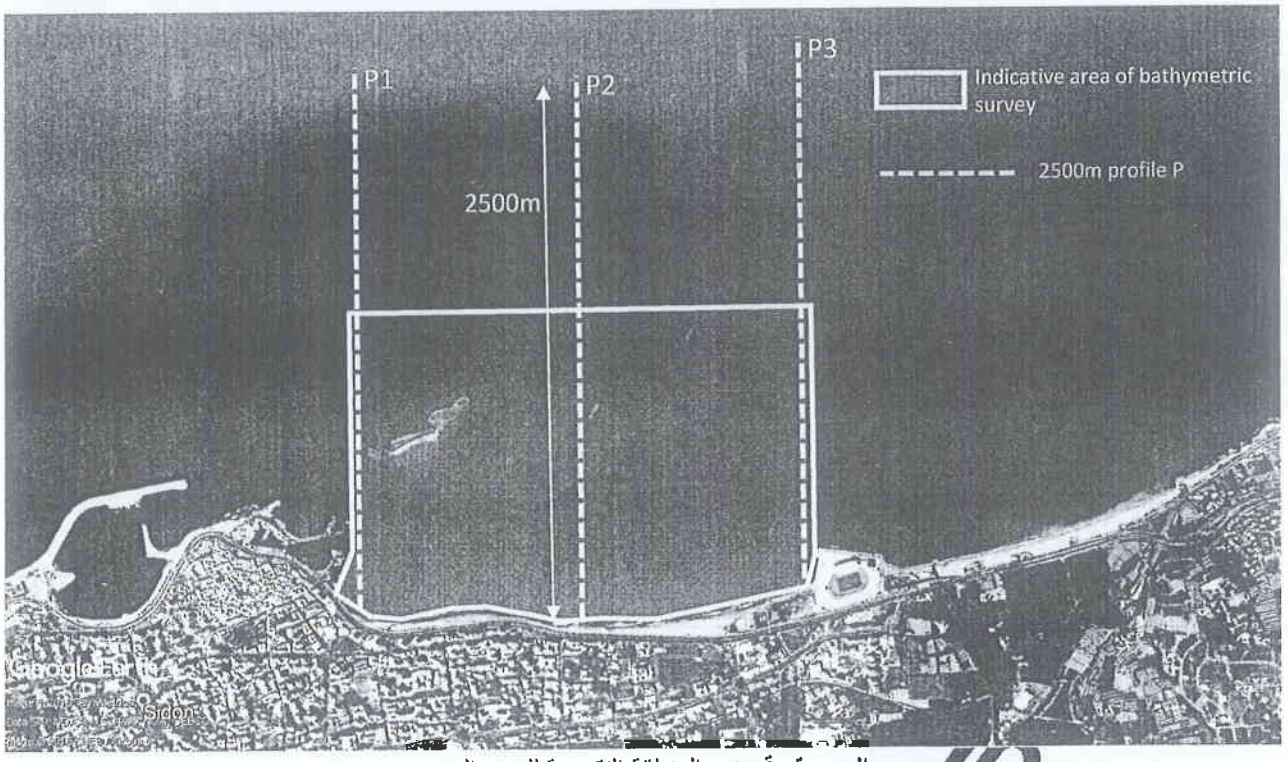


الصورة رقم ٤ - المنطقة التقريبية للمسح البحري



الصورة رقم ٥ - المنطقة التقريبية للمسح البحري

تنظمّ خريطة إجمالية (overall mass plan) تظهر الشاطىء الرملي، كافة الإنشاءات الموجودة، الشقلات البرية و الأعماق البحرية الحالية.

سوف ينجز المسح في ظروف بحرية مثالية (مسطح مائي هادىء) مع الأخذ بعين الإعتبار التالي :

- إستعمال قارب صغير لتركيب أجهزة المسح البحري
- تثبيت نقاط مقارنة على الشاطىء موصولة بالشبكة االعتمة
- مراقبة إرتفاع المّد و الجزر
- دقة المسح ٠،١٠م عامودي و ٣م أفقي
- تباعد نقاط المسح لا يتعدى العشرة أمتار عن بعضها البعض
- مراقبة عيارات جهاز المسح يوميا بعد إنتهاء العمل

(٣-١-٢) الكشف تحت الماء

لا يتضمن عرضنا أية إختبارات جيوتقنية من أيّ نوع كانت أو إختبارات للتربة بواسطة معدات بحرية، حيث يقتصر الكشف تحت الماء على إستخراج عينات من الرمل بواسطة الغطاسين و تحديد حجم حبيبات الرمل إضافة لإمتداد خط الرمل حتى الأعماق و تظهيره على خريطة الكيول. إن الكشف تحت الماء يعطي صورة عامة عن طبيعة الأرض.

المستندات و الخرائط الواجب تقديمها ضمن هذه المرحلة :

عند إنتهاء كافة الكيول الطوبوغرافية، المسح البحري و الكشف تحت الماء، تقدمّ إلى الإدارة المستندات و الخرائط التالية :

- تقرير أولي يتضمن وصفا لأشغال الكيول و المسح
- الخرائط التالية:

● للمسح البحري :

١- مسطح عام مع :
- شبكة أعماق (١٠ X١٠)م
- خطوط أعماق كل متر

٢- خريطة الكيول البحرية مقياس ١/١٠٠٠

● للمسح الطوبوغرافي :

- خريطة الشاطىء مع شقلات مقياس ١/١٠٠٠

تجدر الإشارة إلى أن كيول الأعماق البحرية سوف تحدّد شكل، طبيعة، حجم و كلفة أيّ منشأة بحرية والتي سوف نقترحها على إدارتكم الكريمة، و ذلك لتأمين حماية شاطىء الرملي دون إغفال أهمية معرفة تطور الشاطىء في ظل وجود المنشاءات البحرية تلك.

(٢-٢) المرحلة الثانية : المخطط الأولي لحماية و تغذية شاطىء صيدا

على أساس خرائط المسح الطوبوغرافي و كيول الأعماق البحرية، المعطيات المناخية كإرتفاع حركة الأمواج، سرعات و إتجاه الهواء أثناء العواصف، حركات المدّ و الجزر القصوى... سوف نقوم بتحضير مخطط أولي لحماية و تغذية شاطىءصيدا (Conceptual Mass Plan for Saida beach protection and nourishment) آخذين بالإعتبار المعطيات كافة، خاصة الجمالية و البيئية منها، إضافة لأسس هندسة المنشاءات البحرية و بالطبع كافة متطلبات ربّ العمل.

سوف يقدم المخطط الأولي إلى ربّ العمل قبل المباشرة بالمرحالة الثالثة و التي تتلخص بإجاز المشبهات الرقمية لحركة الأمواج و بالتالي حركة الرمول.

في هذه المرحلة يحتسب إرتفاع مستوى الأمواج و إتجاهها مع الأخذ بعين الإعتبار إتجاه الهواء (Dominant wind)، ذلك أن الأمواج تتأثر أثناء تحركها بإتجاه الشاطئ بعدّة عوامل أهمها الأعماق البحرية، بحيث يتغير إرتفاعها و حتى إتجاهها (waves refraction and shoaling) وصولا إلى إنكسارها على الشاطئ (Waves Breaking). إن إحتساب إرتفاع و إتجاه الأمواج هو الذي سيحدّد شكل، إتجاه، إرتفاع و نوعية الحماية العائدة لمختلف المنشاءات البحرية والتي ستتلخص مهمتها الأولى بتأمين حماية حماية الشاطىء و منع الرمول من الإنحسار إضافة إلى تقليل خطر التيارات البحرية.

يمكن إعتبار المخطط المذكور أعلاه نظريا لحين تأكيده بواسطة المشبهات الرقمية و التي تعتبر ضرورية لتظهير حقيقة تحرك الشاطىء الرملي و تفاعله في مختلف الظروف خاصة بوجوج المنشاءات تلك.

(٢-٣) المرحلة الثالثة : المشبهات الرقمية

تتضمن المرحلة الثالثة إنجاز المشبهات الرقمية.

يمكن تلخيص المرحلة أعلاه بالتالي :

(٢-٣-١) : تجميع المعطيات

يتوجب تجميع المعطيات (إذا ما وجدت) التي تتمحور حول خصائص تربة القاع و تربة الشاطىء، خرائط المسح البحرية القديمة و الجديدة، دفق النهر، أعمال منفذة سابقا كالتعميق، معلومات عن حوادث الغرق، أية دراسات سابقة عن التيارات.

2-3-1 Data collect

- Sediment characteristics:
  seabed: constitution of the seabed (sand, gray, ...), thickness of sand, grain size (D50),
  beach: characteristics of the beach material (D50, pictures, ...),
- Current and previous (if available) bathymetric and topographic surveys (from the beach top level to the -10 m isobathic line), in Autocad or ASCII (*.xyz file) format, with the altimetry attached to a clearly identified reference level (CD, NGL...);
- River discharge data (flow rate and sediment transport rate);
- Information regarding all the anthropogenic events on the coast during the last 20 years (beach replenishment operation, dredging, date of construction of the coastal structures located in the vicinity of the project, ...);
- Information on the drownings (locations, dates);
- Any study that can be used for the current analysis.

(٢-٣-٢) : تشبيه رقمي للأمواج في المياه العميقة

يتضمن التشبيه الرقمي للأمواج في المياه العميقة إجراء دراسات تفصيلية مبنية على أسس الحسابات الإحتمالية، مفصلة كالتالي :

2-3-2: Offshore waves study

2-3-2-1: Principles

A hindcast wave study will be performed in order to get the wind and wave time series over 25 years.

The numerical modelling will be carried out in two distinct stages:

- Offshore wave modelling: generation of sea states over the Eastern Mediterranean Sea and propagation to the coast of South Lebanon;
- Nearshore wave modelling: propagation of sea states to the site.

Winds and sea states will be analyzed in order to provide at a set of output locations:
- Frequent conditions: wind and wave climate to provide input conditions for the hydrosedimentary studies;
- Extreme conditions: extreme wind speeds and wave heights to provide input conditions for the design of the beach protection structures.

The advantages of this methodology include in particular:

- a long duration (25 years) allowing for a sound estimation of extreme conditions;
- the use of satellite data for calibrating and validating the sea states;
- the inclusion of 2014 with the storm that caused damage on the Lebanese coast;
- An hourly time step that accurately accounts for the temporal variability of wind fields in the Levantine Basin.

2-3-2-2: Modeling

A. Wind fields

Wind fields will be issued from the reanalyzes of the atmospheric model on the wave generation area (Mediterranean Sea). The model has a spatial resolution of 0.3° x 0.3°. Original time step of the analyses is 6 hours, but hourly forecasts are made available for the analyses.
Satellite measurements of wind speeds will be used for validating the global wind fields over the wave generation area.

B. Waves

Sea states will be modelled through the use of Mike 21 SW DHI software, with refined grids as the model size decreases.
First, the modelling will be implemented over two computation grids: a grid covering the Eastern Mediterranean Sea with a spatial resolution of 0.2° x 0.2°, nested to a regional grid with a spatial resolution around 0.5° x 0.5° (**Figure N6**).

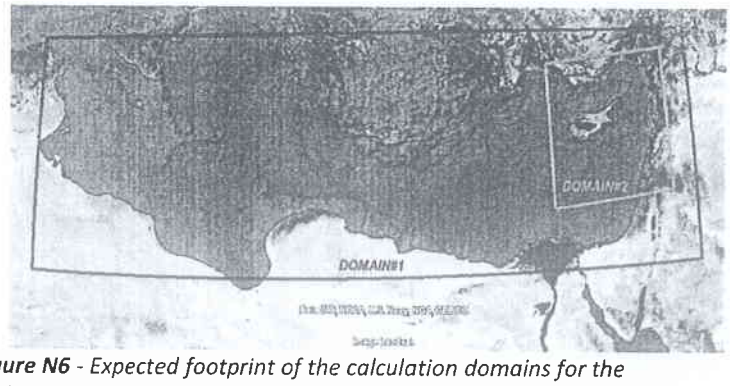


***Figure N6** - Expected footprint of the calculation domains for the offshore wave simulations*

Second, the regional grid will be nested to an additional finer domain of the project location, run by the nearshore wave propagation model. The spatial resolution will reach ~ 400m in the final grid. This code will account for all the phenomena of nearshore wave transformation such as refraction, shoaling, diffraction round capes, bottom friction and bottom-induced wave breaking.

Satellite measurements of wave heights will be used for validating the sea states output over the wave generation area.

An output location will be defined off the project location:

- **wind:**
  wind velocity W_S at 10 m, averaged over 10 min (m/s),
  wind direction W_d (°N),
- **sea states:**
  spectral significant wave height H_{m0}(m),
  peak period T_P(s),
  peak and mean direction θ_p and θ_m (°N),
  directional spreading σ (°),
  peak enhancement factor Y based on the assumption of a JONSWAP-type spectrum.

Furthermore, a spectral partitioning of the global sea state shall be carried out in order to define the above wave parameters for distinct wave systems (wind waves, primary swell, secondary swell...).

2-3-2-3: Analysis

A. Wind and wave climate

The local wind and wave climates will be established in order to identify the different wind and wave populations. The following plots will be provided:

- directional wind and wave roses;
- scatter diagrams W_S/W_d, H_{m0}/T_p, and T_p/θ_p
- histogram of the frequency curves for W_S, H_{m0} and T_p
- exceedance frequency curves for W_S, H_{m0} and T_p

Examples of such plots are provided in **Figure N7** below.

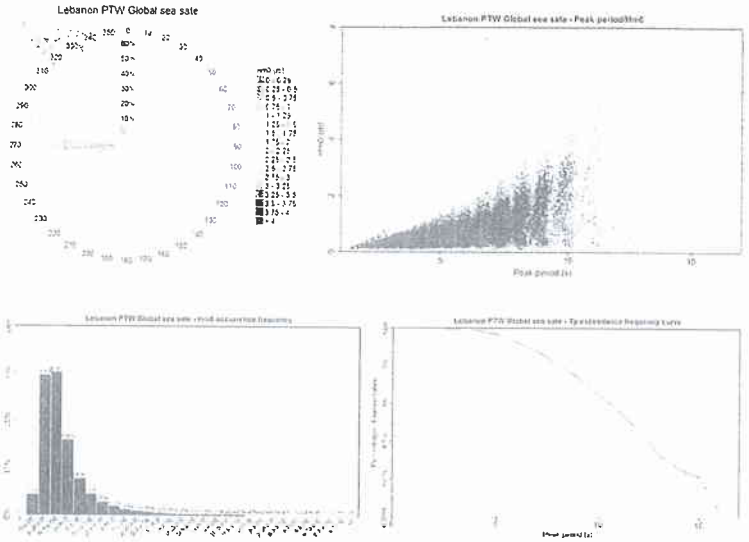


***Figure N7** – Example of plots form wave climate*

Different wave populations, based on distinct directional sectors, will be identified and characterized.

B. Extreme winds and waves

Extreme wind speeds and wave heights will be estimated for the different directional sectors (wind and wave populations) identified through the assessment of the wind and wave climates.

This estimation is performed through a statistical extrapolation. Its methodology is as follows:

- determination of homogeneous (identically distributed) wave populations, based on directional criteria or others (e.g. wave steepness);
- declustering of the time series (over a K-year duration) using the Peaks-Over-Threshold (POT) approach:
  - Identification and extraction from the time series of storm events exceeding a "physical threshold" u_p set so as to get λ_p = 5-10 storm events per year in average;
  - Selection of the wave height peaks of the storm events for setting up a sample of independent and identically distributed (i.i.d.) data ($\lambda_p = N_p/k$);
- statistical extreme value analysis applied to the i.d.d. sample:
  - determination of a "statistical threshold" u_s: the N peaks exceeding this threshold are considered as extreme values (λ = N/k peaks per year in average);
  - fitting of statistical distributions (GPD, Weibull, Gamma, Exponential) to these extreme peaks;
  - Determination of the best-fitting distribution using a statistical test (such as X^2 or Kolmogorov-Smirnov);
  - Computation of quantiles (return values) for a set of return periods (e.g. 10:1, 1, 5, 10, 50, 100 years);
  - Computation of 90% confidence intervals using the parametric bootstrap method.

This state-of-the-art methodology is presented in several presentations in international congresses (both coastal engineering- and statistics-oriented) and in several papers published in international peer-reviewed journals.

Figure N8 below illustrates such an extrapolation of extreme wave heights.

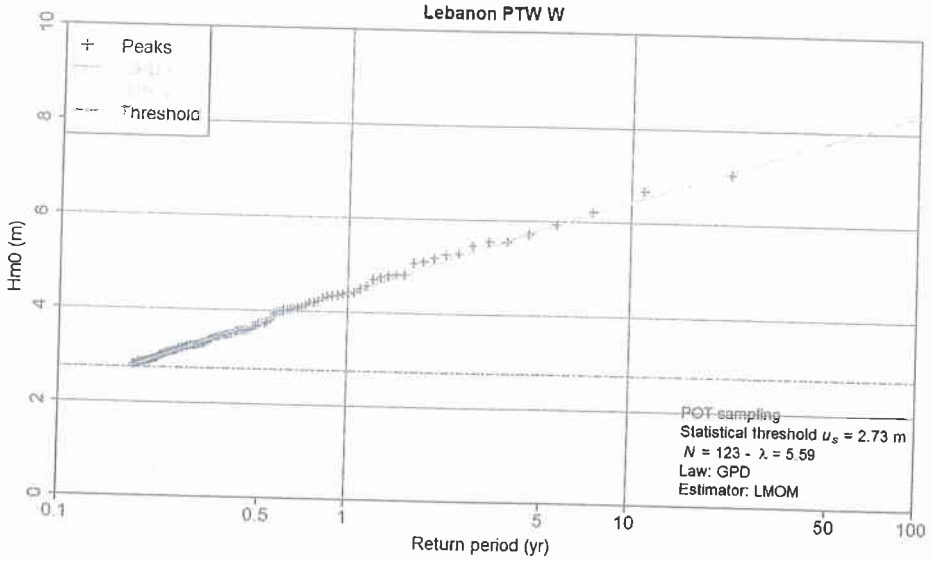


***Figure N8** - Example of statistical extrapolation of extreme wave heights*

(٣-٣-٢) : تشبيه رقمي للأمواج في المياه الضحلة و دراسة التيارات

يتضمن التشبيه الرقمي للأمواج في المياه الضحلة إجراء دراسات تفصيلية مبنية على أسس الحسابات الإحتمالية، مفصلة كالتالي :

2-3-3: Nearshore wave and current study

2-3-3-1: Nearshore wave propagation

Sea states will be propagated from the offshore to the site using the dedicated computation code that accounts for the phenomena of wave transformation in the nearshore area. **Figure N9** below illustrates the propagation of sea states from the offshore output point to the shore in the area of the bay of Jounieh.

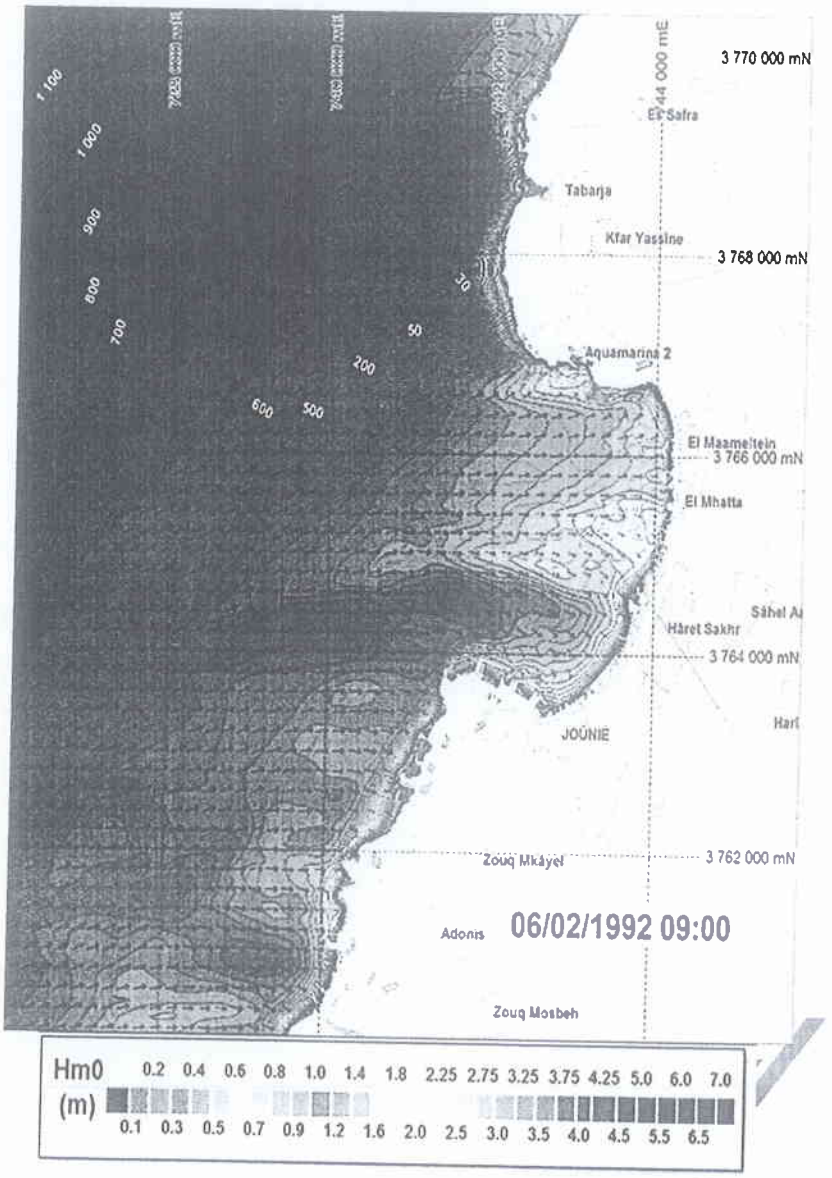


***Figure N9** - Example of statistical extrapolation of wave propagation map [illegible] of Jounieh*

The nearshore bathymetry will come from local marine charts and surveys provided by the Client. Several output points will be located in front of the beach. At each point, the model will output the 25-year time series of sea states. Wave climate will be established at the nearshore output points (see section A) and extreme wave heights will be extrapolated (see section B).

2-3-3-2: Wave-induced currents

Along the Lebanese coastline, the currents associated to the astronomical tide or atmospheric phenomena (wind and pressure) are weak. In the surf zone, the currents associated to wave breaking are thus predominant.

It is proposed to estimate the currents associated to the breaking of five specific conditions, representative of bathing conditions (potentially storm events if bodyboard is practiced during winter storms...).

Wave-induced currents will be estimated using the specialized module in Mike 21.

It will takes into account refraction, diffraction, dissipation phenomena caused by friction on the sea bed and by breaking waves (water depth and limit steepness), and calculates costal currents and sedimentary flows.

The calculations are performed on a regular grid, with the following values being provided at each computation point on this grid:

- significant wave height and mean wave direction (vectors or iso-value lines);
- velocity and direction of wave-induced currents;
- sedimentary transport.

Figure N10 and **Figure N11** below give examples of the results provided by the module.

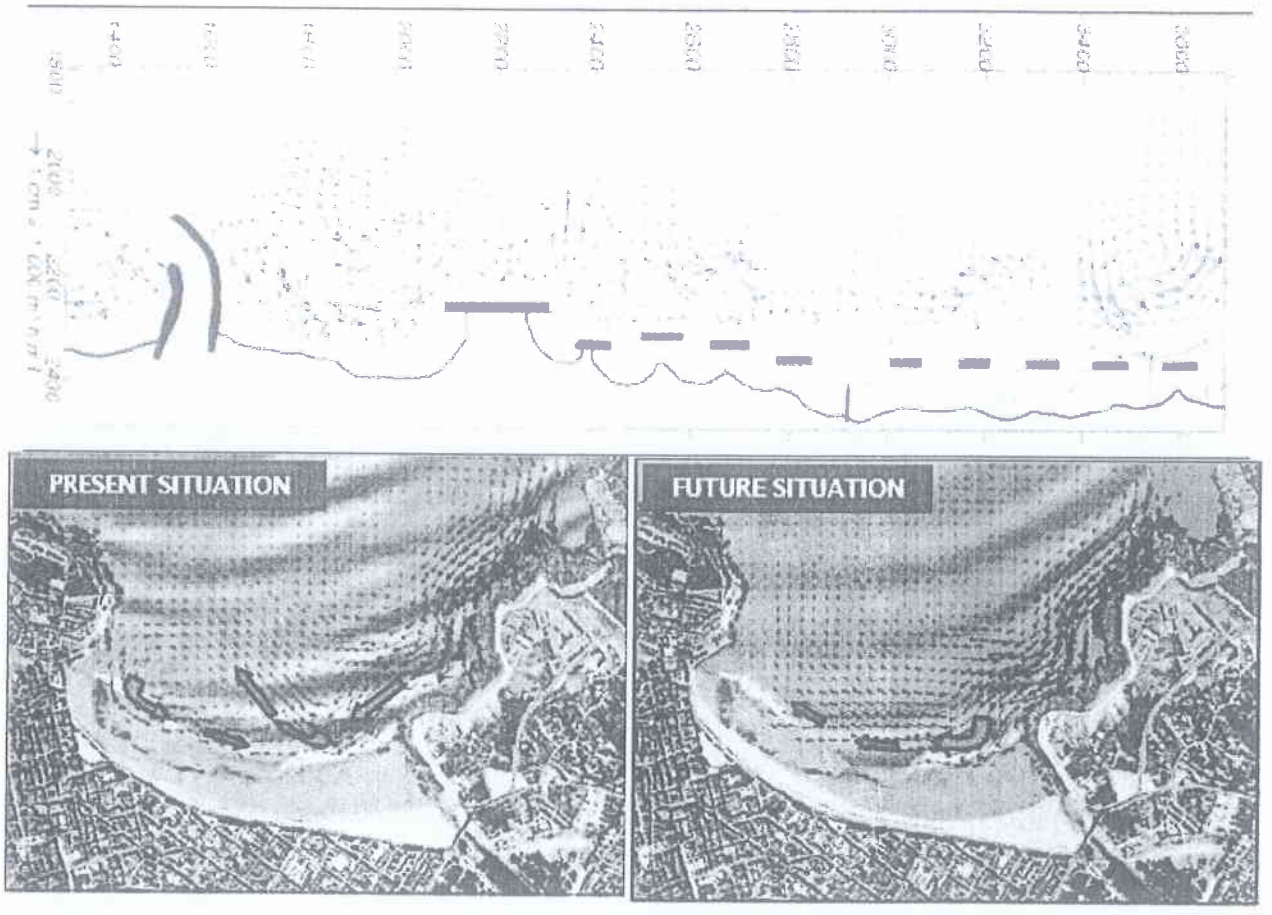


Figure N10 – *Illustrations of coastal currents*

The simulations will be run on four configurations: the initial configuration and three proposed beach layouts. Comparative figures will be issued in order to assess the effect of the proposed developments on the coastal currents.

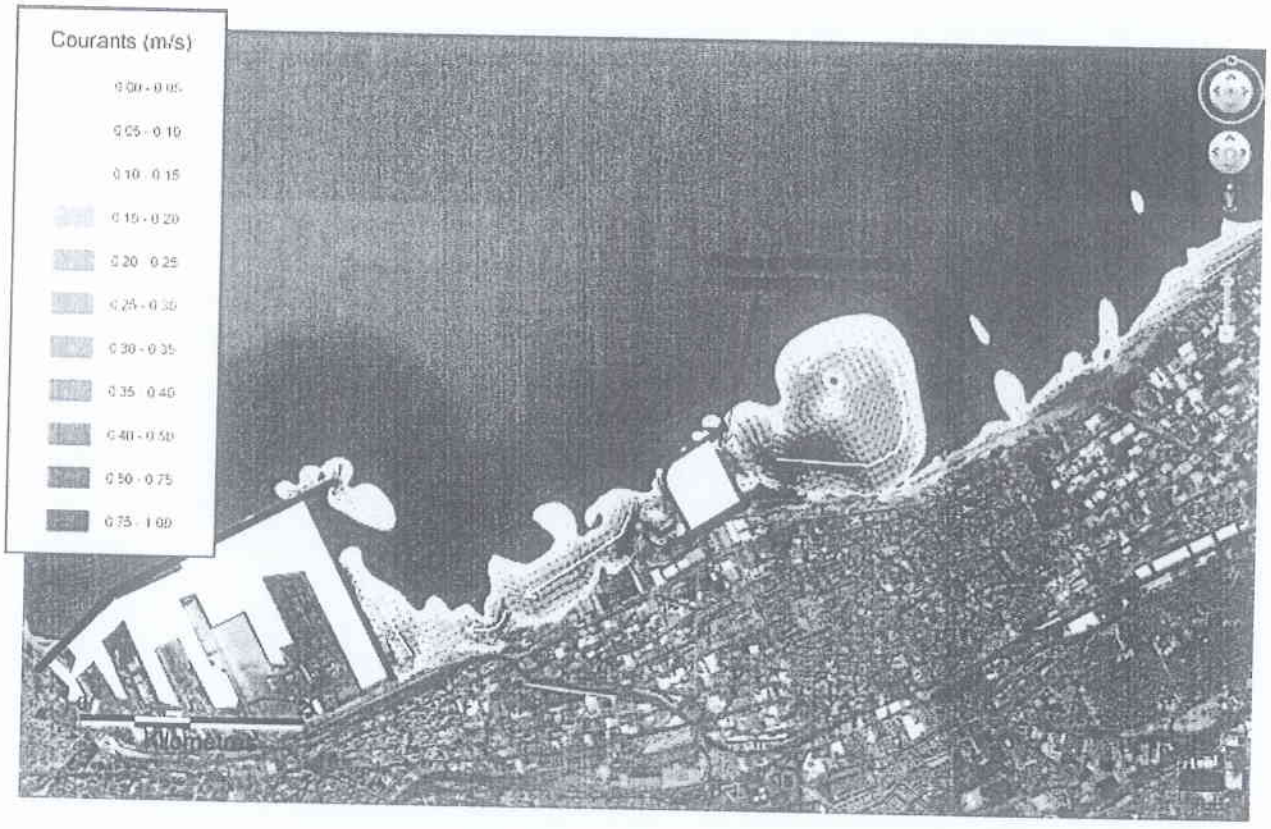


Figure N11 *– Illustrations of coastal currents*

(٤-٣-٢) : توصيات فيما خصّ المخططات الشاطئية المنتقاة

2-3-4: Appraisal of the proposed beach layouts

An appraisal will be provided on up to three layouts of beach protection proposed for the Client. This assessment will account for the proposed structures, the local sedimentologic context, the nearshore wave climate, etc., and will aim at refining the proposed layouts before carrying out the models presented below.

In case of need for sand replenishment, recommendations will be issued as regards the requirements for grain size, beach cross-shore profiles (according to Dean's method as illustrated in **Figure N12**), sand volume...

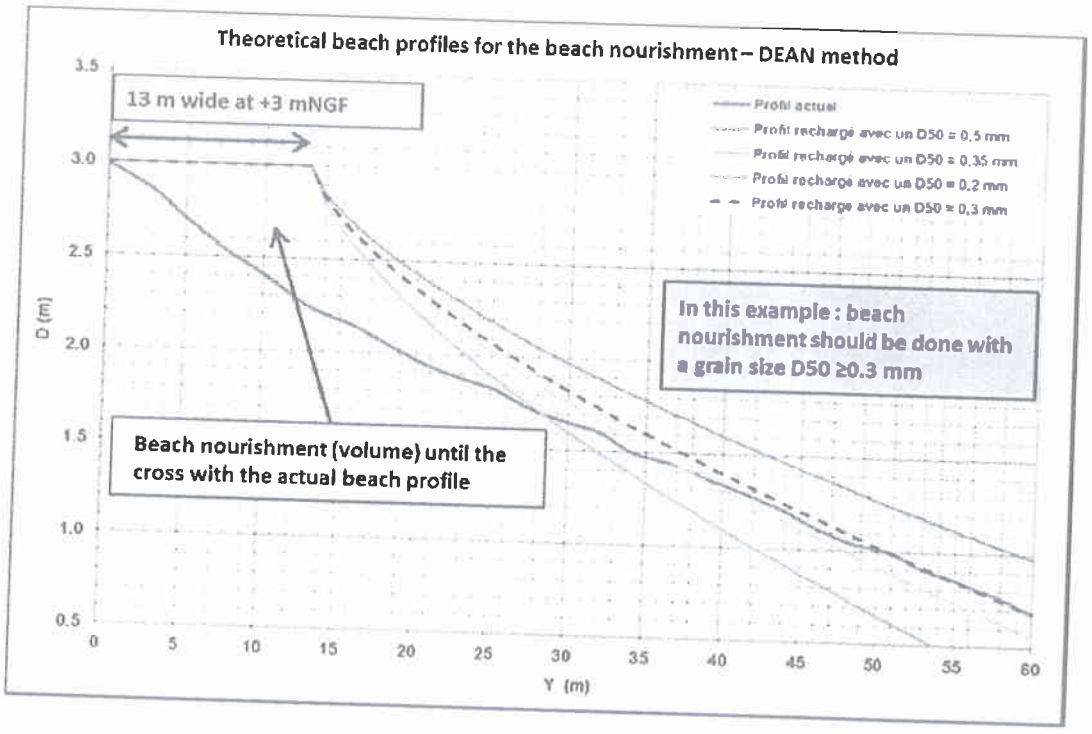


Figure N12 *– Theoretical beach profiles according to Dean's method*

(٥-٣-٢) : تحليل ثبات الشاط

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2-3-5 Beach stability analysis

2-3-5-1: Assessment of the current sedimentological context

A- Beach evolution

It is assumed that no previous topo-bathymetric survey of the studied area is available. Thus, it is not possible to assess the seabed evolution.

A comparison of the beach width between the last few 15 to 20 years using satellite imagery will be made (if available) to determine the evolution of the sandy shoreline in the study zone.

B- Sediment transport by waves

Movements of sediments are caused by the combined action of winds, waves (mainly), tidal currents and river discharges. These processes will be qualified and quantified for the project coastal zone.

Waves transport sediments along the shore in the active beach profile which extends from the beach top level to a closure depth[5] (beyond which wave action is negligible). The wave-driven longshore sediment transport will be estimated. (see example in **Figure N13**).

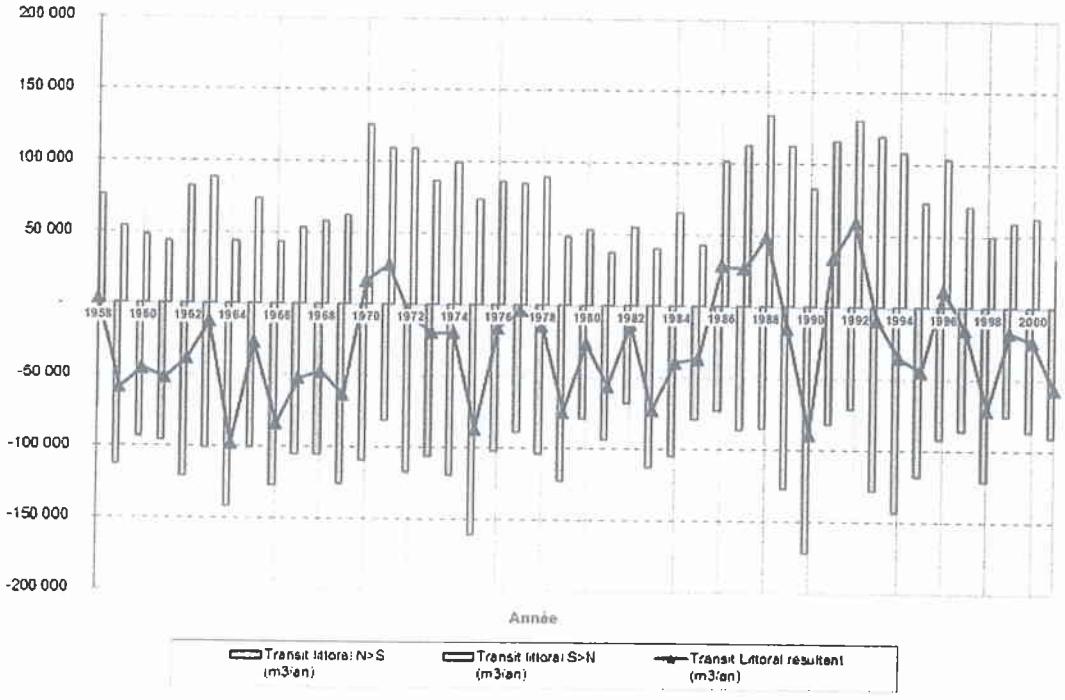

***Figure N13** – Evolution of littoral drift*

2-3-5-2: Evolution of the shoreline for the proposed layouts

The changes in shoreline equilibrium induced by the proposed developments will be assessed for up to three beach layouts.

This will be achieved by consideration of the following issues:

- impacts of the coastal structures on the wave-induced currents;
- Plane equilibrium beach profiles in response to the coastal defenses.

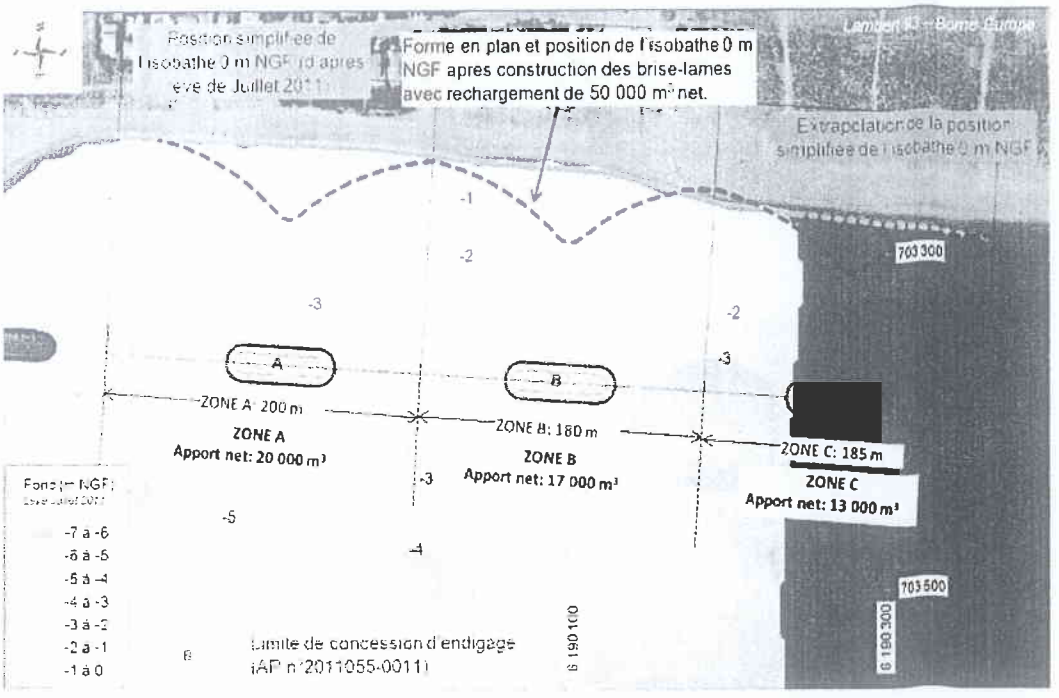

Figure N14 *– Plane equilibrium beach profiles with detached breakwaters*

2-3-5-3: Profile beach evolution under storms conditions

In order to study the beach profile stability under storm conditions, a mathematical model (S-BEACH will be applied.

The input data for determining the beach profile stability under storm conditions are:

- Storm conditions (HS, TP, wave direction, water level, storm duration) in front of the beach;
- Beach profile
- Sediment size

The evolution of the beach will be calculated as presented in **Figure N15** below.

REF. : ST-1820-SL003
Date : 07-08-2018

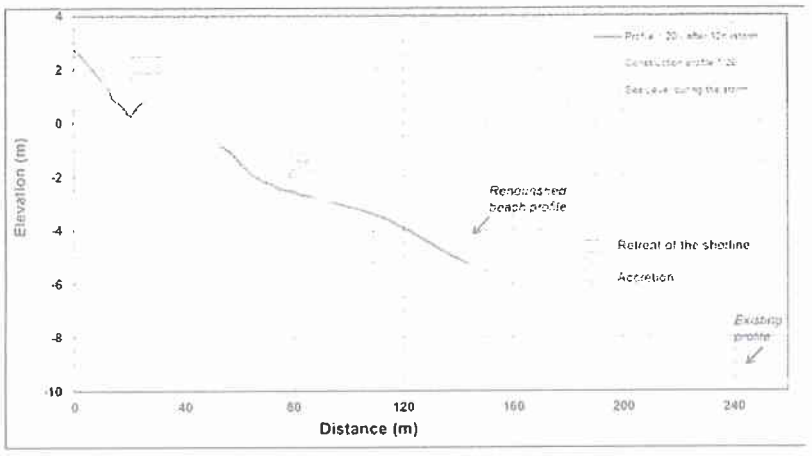

Figure N15 *– Profile beach evolution under storm conditions*

(٦-٣-٢) : خلاصة

2-3-6: Conclusion

The input data for determining the beach profile stability under storm conditions are:
For each proposed beach layout, a synthesis of sedimentary dynamics will be done. Recommendations will be issued to determine the optimal layout.

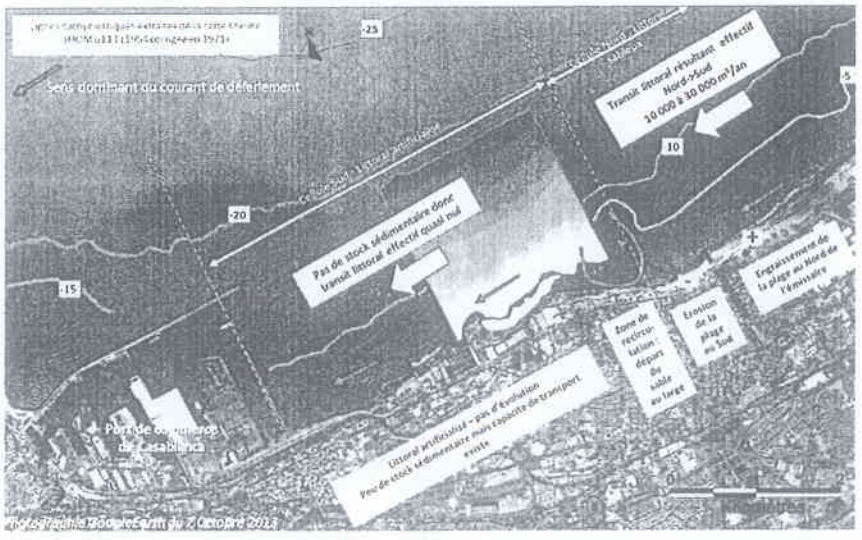

Figure N16 *– Synthesis of sedimentary dynamics*

(٢-٤) المرحلة الرابعة : الدراسة التمهيدية

تتلخص المرحلة الرابعة بإنجاز الدراسة التمهيدية للمشروع على أساس النتيجة النهائية للمشبهات الرقمية الموضحة في المرحلة الثالثة.

تتضمن هذه المرحلة تقديم خريطة المسطح التمهيدية و التي تظهر على سبيل المثال لا الحصر:

- خرائط المسح الطوبوغرافي و المسح البحري
- مسطح عام لموقع الإنشاءات البحرية المعتمدة
- مقاطع عامة على الإنشاءات أعلاه تظهر الشقلات و القياسات
- طرق الدخول و الخروج إلى الشاطىء

(٢-٥) المرحلة النهائية : الدراسة التفصيلية

تتضمن الدراسة التفصيلية :

الخرائط التفصيلية و التي تبين :

- خرائط المسح الطوبوغرافي و المسح البحري
- مسطح تفصيلي لموقع الإنشاءات البحرية المعتمدة يظهر كاقة الشقلات، القياسات، المقاطع...
- مقاطع تفصيلية على الإنشاءات أعلاه تظهر الشقلات و القياسات
- حدود مناطق السباحة
- مختلف الإنشاءات الخرسانية كالأدراج، المسطحات، حيطان الدعم (إذا ما وجدت)

دفتر الشروط و الذي يتضمن :

- الشروط العامة
- المواصفات الفنية
- جدول الأسعار
- الكشف التخميني

تتلخص هذه المرحلة بتنظيم و جمع كافة الخرائط الخاصة بالمشروع في ملف واحد و تحضير دفتر الشروط إداري و فني مع كميات تخمينية لكامل المشروع حيث تشكل الخرائط التفصيلية المشار إليها مع دفتر الشروط ملف التلزيم الذي سيقوم ربّ العمل على أساسه بإجراء المناقصة لإختيار أحد المتعهدين لتنفيذ الأشغال.

REF. : ST-1820-SL003
Date : 07-08-2018

٣- عرض الأسعار :

إن عرضنا لإنجاز ما ذكر أعلاه مفصّل كالتالي :

رقم المرحلة	تجزئة الدفعات	قيمة الدفعة المطلوبة بالليرة اللبنانية (ل.ل.)	المدة القصوى المطلوبة للتنفيذ (أسابيع)
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٢-٢	المخطط الأولي لحماية و تغذية شاطىء صيدا	١٥,٠٠٠,٠٠٠	٢
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٢-٣-٣	تشبيه رقمي للأمواج في المياه الضحلة و دراسة التيارات	١٢,٠٠٠,٠٠٠	٢
٢-٣-٤	توصيات فيما خص المخططات الشاطئية المنتقاة	١,٥٠٠,٠٠٠	٢
٢-٣-٥	تحليل ثبات الشاطىء	٩,٠٠٠,٠٠٠	٤
٢-٤	الدراسة التمهيدية	١٢,٠٠٠,٠٠٠	٤
٢-٥	الدراسة التفصيلية	١١,٠٠٠,٠٠٠	٢
	المجموع بالليرة اللبنانية	١٣٩,٠٠٠,٠٠٠	١٩
	الضريبة على القيمة المضافة (TVA) ١١٪	١٥,٢٩٠,٠٠٠	
	الإجمالي	١٥٤,٢٩٠,٠٠٠	

يكون المبلغ الإجمالي المطلوب : مائة و أربعة و خمسون مليون و مائتان و تسعون ألف ليرة لبنانية فقط لا غير

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الملحق رقم ١

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			أسبوع																		
			١	٢	٣	٤	٥	٦	٧	٨	٩	١٠	١١	١٢	١٣	١٤	١٥	١٦	١٧	١٨	١٩	المجموع
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٢.٢	المخطط الاولي لحماية و تغذية شاطىء صيدا																					٢
٢.٣	المشبهات الرقمية																					١١
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	٢-٣-٢	تشبيه رقمي للأمواج في المياه العميقة																				٤
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٢.٥	الدراسة التفصيلية																					٢
		الخرائط التفصيلية																				٢
		دفتر الشروط																				٢
																					المجموع	١٩

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الملحق رقم ٢

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الملحق رقم :

البرامج المستخدمة في الدراسة

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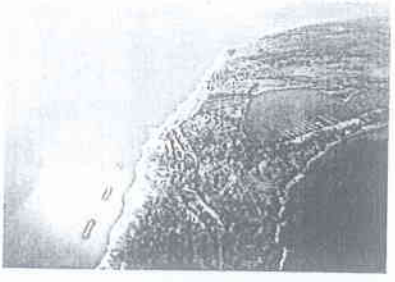
S BEACH



For engineers and scientists in the fields of: coastal, ocean, and hydraulic engineering; oceanography; and geology

A comprehensive collection of coastal engineering design and analysis software developed by or for the Waterways Experiment Station

Contents range from the simplified techniques of the ACES, to more sophisticated models for multi-dimensional hydrodynamics, wave propagation, nearshore hydrodynamics and beach processes, and inlet technology

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Easy to use Windows interface and graphics within a visual development environment

Integrated Windows, tools, menus, toolbars, and directories

Buy the full system or only the models /modules you need

Companion manuals and reports also available on CD-ROM

Exceptional technical support

8 Functional Areas

ACES is an interactive computer-based design and analysis system in the field of coastal engineering containing eight functional areas.

The original ACES information contained only six functional areas and 24 codes (shown in red).

Veritech developed all codes shown in blue as a by-product of CEDAS-PC.

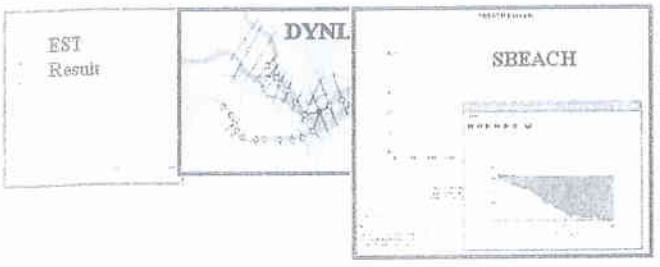
- Wave Prediction
- Wave Theory
- Wave Transformation
- Structural Design
- Wave Runup
- Littoral Processes
- Inlet Processes
- Harbor Design

34 CODES

Windspeed Adjustment and Wave Growth
Sea-Kaleigh Distribution
Extremal Significant Wave Height Analysis
Constituent Tide Analysis
Near-surface wind speeds
Holland Hurricane Model
Linear Wave Theory
Cnoidal Wave Theory
Fourier Series Wave Theory - Fenton
Wave Parameters
Solitary Wave Theory
Linear Wave Theory with Shelf's Law
Irregular Wave Transformation - Goda's Method
Combined Diffraction / Reflection of a Vertical Wedge
Breakwater Design Using Hudson Equation
Toe Protection Design
Nonbreaking Wave Forces on Vertical Wall
Rubble-Mound Revetment Design
Irregular Wave Runup on Beaches
Wave Runup / Overtopping on Impermeable Structures
Wave Transmission on Impermeable Structures
Wave Transmission through Permeable Structure
Wave Setup Across Surf Zone
Longshore Sediment Transport - Deepwater Condition
Longshore Sediment Transport - Breaking Wave Conditions
Longshore Transport using CEDRS / WIS Statistical Data
Beach Nourishment Overfill Ratio
Calculation of Composite Grain-Size Distribution
Simplified Inlet Hydraulics
Wave-current Interaction
Properties of Rectangular Basins
Vessel Generated Waves
Surging of a Moored Vessel

CEDAS includes the following modules:

General Engineering Module
ACES – system of 34 routines
EST – life-cycle risk analysis
RELIABLE – reliability-based structure design
Inlet Processes Module
DYNLET – powerful 1D hydrodynamic model
NMLong-CW – simulates long-shore current & transport rate
Beach Processes Module
NEMOS – simulates nearshore beach evolution
SBEACH – simulates cross-shore beach / dune erosion
BMAP – beach morphology analysis tools



SHOPPING CART

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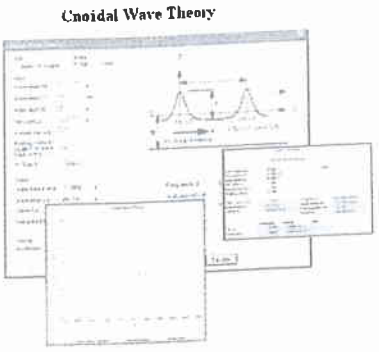
NAVIGATION

CEDAS – Coastal Engineering Design and Analysis System

General Engineering Module includes:

ACES (Automated Coastal Engineering System) is itself an integrated collection of coastal engineering design and analysis software. ACES provides a comprehensive environment for applying a broad spectrum of coastal engineering technologies. It uses the CEDAS window-oriented intuitive interface to access the underlying collection of coastal engineering design and analysis technologies, prepare various and often-large input data sets, and visualize results.

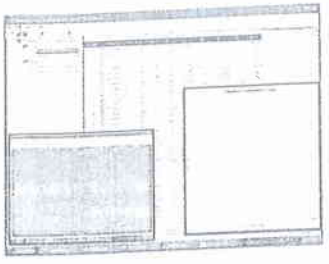


Functional areas covered by the ACES system include:

wave prediction
wave theory
wave transformation
structural design
wave runup, transmission, and overtopping
littoral processes
inlet processes
harbor design

Click here to see a listing of ACES models.

EST (Empirical Simulation Technique) is a life-cycle approach to risk analysis based on bootstrap resampling-with-replacement, interpolation, and smoothing of observed and/or computed information about site-specific historical events.



Disposal sites

Dune / beach recession

Storm surge stage and wave runup frequency

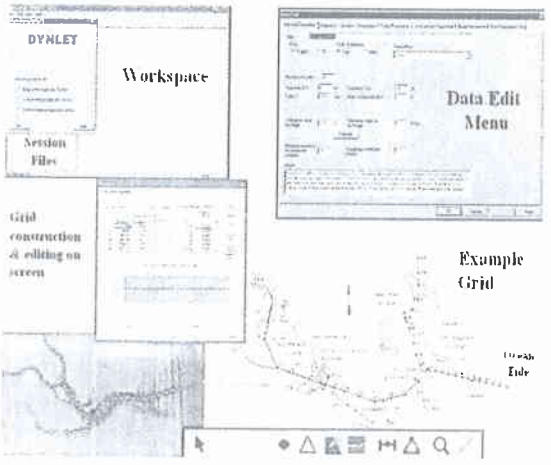
Storm event impacts in estuaries

The Empirical Simulation Technique (EST) is a bootstrap-based statistical procedure for simulating multiple time sequences of non-deterministic multi-parameter systems such as storm events and their corresponding environmental impacts. Results of the multiple repetitions are

Close ×

enhancements to NMLONG-CWprovide calculations of cross-shore distribution of the longshore sediment transport rate on a barred profile under either monochromatic or random waves. A more accurate wave blocking routine is used in the face of strong currents. Finally, a wave roller model is included to permit simulation of momentum flux introduced by wave breaking before energy dissipation actually occurs.The major assumptions in NMLONG-CW are longshore homogeneity (straight and parallel bottom contours) and linear wave theory. Potential applications of NMLONG-CWinclude estimating the distribution and magnitude of sediment or pollutant transport, estimating wave overtopping and wave forces, and preliminary structure design, such as length and placement of groins and breakwaters.

DYNLET (DYNamic behavior of tidal flow at inLETs) is a powerful 1-D hydrodynamic model for riverine, estuarine, or coastal problems. DYNLET predicts tide-dominated velocities and water level fluctuations at an inlet and interior back bay system. It can also serve as a generalized model for one-dimensional channel flow in river or estuarine systems. The model solves the full one-dimensional shallow water equations employing an implicit finite difference technique. It provides detailed velocity information across channels and is able to describe multi-channel inlets or river systems. The model can be used for design-level studies simulating 1-D fluid flow from the ocean through a tidal inlet, into back-bay regions, and up tributaries.



Key Features in DYNLET include:

Variable bottom elevations and friction coefficients at user-specified stations across channel cross sections.
Use of channel conveyance for describing friction loss.
Computation of the velocity field at stations that can be spaced arbitrarily across each cross section (at each node).
Optimization of the computational procedure by employing a banded matrix solver for channel networks.
Generalization of external and internal boundary conditions so that channel networks and multiple entrances can be described.
Capability to include culvert influence in the network.
Automated grid generation.
Beach Processes Module includes:

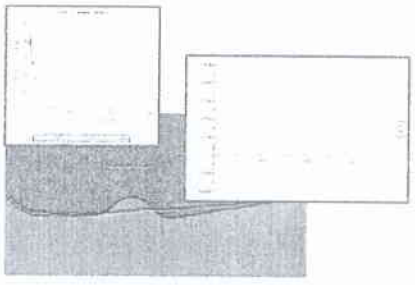
NEMOS (Nearshore Evolution MOdeling System) is a set of codes that operates as a system to simulate the long-term planform evolution of

the beach in response to imposed wave conditions, coastal structures, and other engineering activity (e.g., beach nourishment).

The system consists of the following key codes:

GENESIS (GENEralized Model for SImulating Shoreline Change) is a model for calculating shoreline change caused primarily by wave action and can be applied to a diverse variety of situations involving almost arbitrary numbers, locations, and combinations of groins, jetties, detached breakwaters, seawalls, and beach fills. The system is based on one-line theory, whereby it is assumed the beach profile remains unchanged permitting beach change to be described uniquely in terms of the shoreline position. The program can be applied to a diverse variety of situations involving almost arbitrary numbers, locations, and combinations of groins, jetties, detached breakwaters, seawalls, and beach fills. Other features included in the system are wave shoaling, refraction, and diffraction; sand passing through and around groins, and sources and sinks of sand.The GENESIS package is structured to enable complete design-level shoreline evolution investigations to be performed by engineers regardless of their computer-programming capabilities.GENESIS now contains two solution schemes – implicit (for general use) and explicit (to simulate tombolo formation). The explicit scheme is referred to as GENESIS-T. New features also include capability to use tidal currents, variable transmission through detached breakwaters, and a regional contour trend to help model crenulated beaches more accurately.

RCPWAVE (Regional Coastal Processes WAVE propagation model) is a 2-D, steady state,



monochromatic short wave model for simulating wave propagation over arbitrary bathymetry. The governing equations solved in the model are the "mild slope" equation for linear, monochromatic waves, and the equation specifying irrotationality of the wave phase function gradient. Finite-difference approximations of these equations are solved to predict wave propagation outside the surf zone. These equations account for shoaling, refraction and bottom-induced diffraction within a study area. Included in the model is an algorithm for treating wave breaking. Results include wave height, wave angle, and wave number at each grid location.

STWAVE (STeady WAVE) is a 2-D finite-difference representation of a simplified form of the spectral balance equation to simulate near-coast, time-independent spectral wave energy propagation.

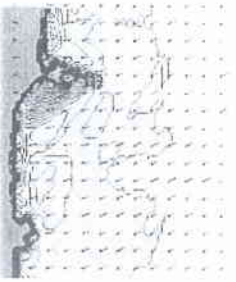
The model assumes:

only wave energy directed into the computational grid is significant, i.e., wave energy not directed into the grid is neglected, and
wave conditions vary slowly enough that the variation of waves at a given point over time may be neglected relative to the time required for waves to pass across the computational grid.

STWAVE is based on a simplified form of the spectral balance equation. The model now has capability of using tidal currents, nested grids, and a variable ocean boundary condition.

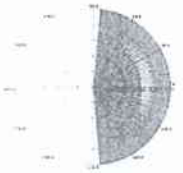
The wave models and GENESIS can be used independently. There are also several auxiliary codes

in NEMOS allowing for constructing grids, developing input data sets, and visualizing results.

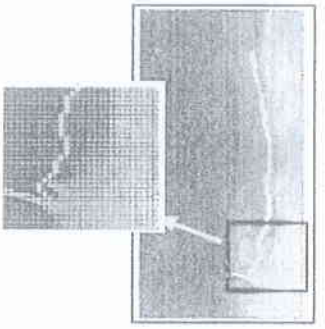


These auxiliary codes include:

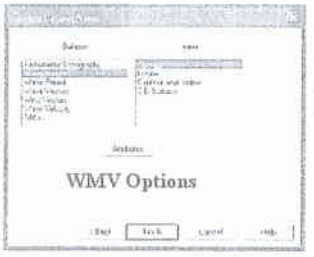
SPECGEN is a helper application used to import, create, or visualize directional spectra for use inSTWAVE. It can be run as a standalone application, or invoked from within CEDAS when working on data for STWAVE.



GRIDGEN is a code to create uniform grids at arbitrary orientations from random bathymetry/topography data. This code now permits construction of both the wave model and GENESISgrids.



WSAV (Wave Station Analysis and Visualization) is used to perform statistical analysis of series of wave events, graphically displaying the results of these analyses, and producing a representative group of wave events for use in simulations.



WMV(WaveModelVisualization) is an application for performing graphical analysis from the various uniform rectilinear grid models within CEDAS. It displays data produced by wave model simulations solved on uniform rectilinear grids. The various plan views of scalar and vector data is overlaid for simultaneous viewing. In 3-D views, several planes of plan views can be stacked above one 3-D surface.

WWWL (Waves, Winds, Water Levels) Editor is used for specifying and editing a variety of record-oriented data types. Common data sources include WWWL databases, analyzed gage data, statistically-derived datasets, theoretical cases, and data derived from other model simulations.

WISPH3 (WISPHase 3 Wave Transformation) is a simplified point-to-point steady-state spectral transformation of WIS 2-component wave descriptions from deeper water to an arbitrary shallower water depth. From basic parametric wave descriptions (H, T, theta) for each of 2 components, it generates theoretical directional spectra, performs shoaling and refraction, and considers shore-induced sheltering at a nearshore location.

SBEACH (Storm-induced BEAch CHange) simulates cross-shore beach, berm, and dune erosion produced by storm waves and water levels. The latest version allows simulation of dune erosion in the presence of hard bottom and has improved graphics and file standards. The model is applied in beach fill project design and evaluation and in other studies of

MIKE 21

2D modelling
of coast and sea

MIKE 21 is by far **the most versatile tool for coastal modelling**. If you need to **simulate physical, chemical or biological processes** in coastal or marine areas, MIKE 21 has the tools you need.

APPLICATIONS

The following is a small subset of the almost endless list of possible MIKE 21 applications.

TYPICAL APPLICATIONS

MIKE 21 is the ideal software for:

- Design of data assessment for coastal and offshore structures
- Optimisation of port layouts and coastal protection measures
- Cooling water, desalination and recirculation analysis
- Optimisation of coastal outfalls
- Environmental impact assessment of marine infrastructures
- Ecological modelling including optimisation of aquaculture systems
- Optimisation of renewable energy systems
- Water forecast for safe marine operations and navigation
- Coastal flooding and storm surge warnings
- Inland flooding and overland flow modelling

ENGINES

MIKE 21 comprises the following simulation engines:

- **Single Grid**, which is a classic rectilinear model that is easy to set up and with easy I/O exchange
- **Multiple Grids**, which is a dynamically nested rectilinear model with the ability to focus the grid resolution
- **Flexible Mesh**, which allows maximum flexibility for adapting grid resolution of the model domain

PARALLEL PROCESSING

All Flexible Mesh and Single Grid engines support parallel processing. The Flexible Mesh (FM) engines show excellent performance when parallel processing is undertaken - also on a large number of computational cores. On multicore Windows computers, parallelisation is menu-driven and straight forward. The FM engines are also available for Linux, which gives the possibility to employ high performance computation.

GRAPHICS PROCESSING UNITS

For the FM engines, the use of graphics processing units (GPU) is also supported and gives easy access to spectacular increase in simulation speed.

MODULES

MIKE 21 is modular. You buy what you need and nothing more. It includes a wide range of modules, allowing you to create your own tailored modelling framework for your coastal and marine studies.

PP - PREPROCESSING AND POSTPROCESSING

This module offers an integrated work environment which provides convenient and compatible routines to ease the tasks of data input, analysis and presentation of simulation results.

HD - HYDRODYNAMICS

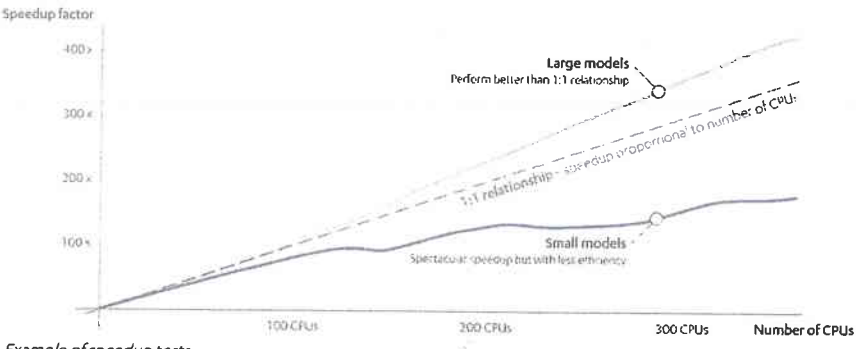
This module simulates water level variations and flows in response to a variety of forcing functions.

AD - ADVECTION-DISPERSION

This simulates the transport, dispersion and decay of dissolved or suspended substances. It is typically used in cooling water and wastewater discharge studies.

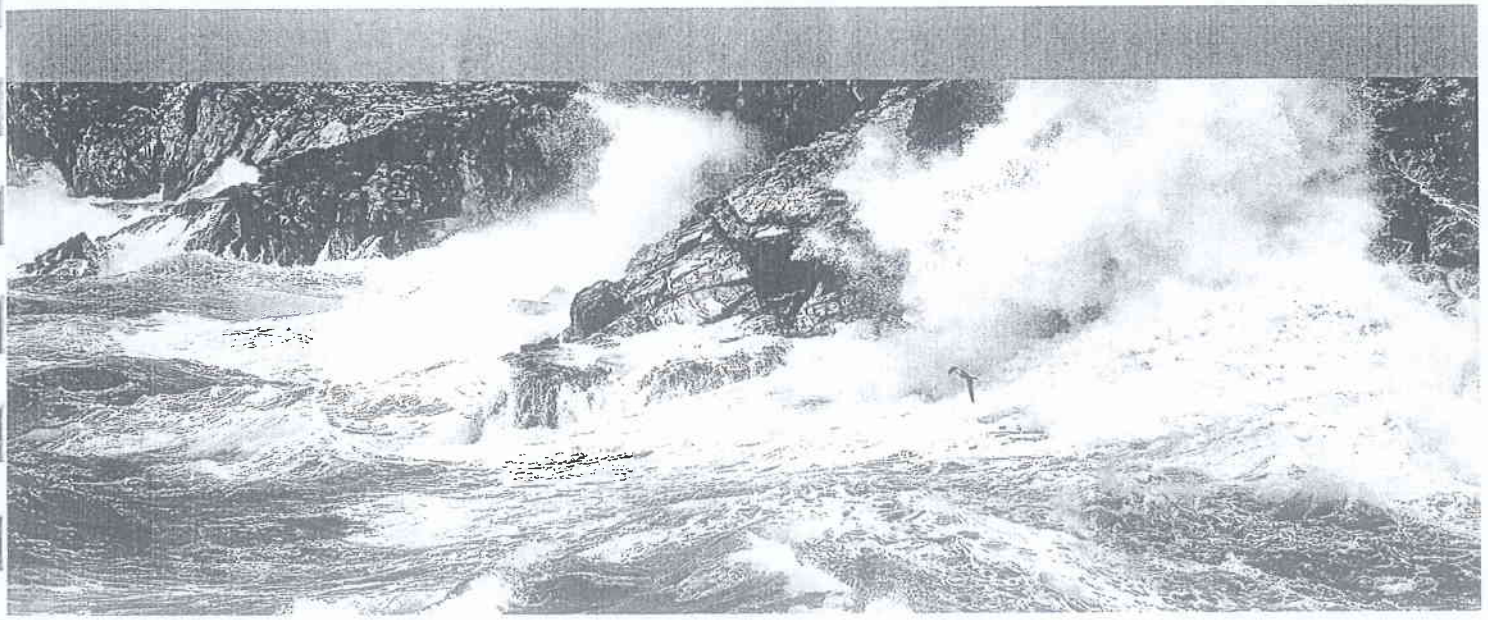
COUPLED MODELLING

The FM series include a powerful, integrated system which, in a surprisingly easy manner, combines wave, flow and sediment transport models into a fully dynamic morphological model.



Example of speedup tests.

MIKE
Powered by DHI



MODULES

MIKE 21 includes the following modules specifically for sediment transport and water quality modelling.

ST - SAND TRANSPORT

This is an advanced sand transport model with several formulations for current as well as current-wave generated transport, including 3D description of sediment transport rates. It is, for example, used for morphological optimisation of port layouts, impact of shore protection schemes and stability of tidal inlets.

MT - MUD TRANSPORT

This is a combined multi-fraction and multi-layered model that describes erosion, transport and deposition of mud (cohesive sediment) or mixtures of sand and mud.

PT - PARTICLE TRACKING

This module simulates transport and fate of dissolved and suspended substances, including sediments.

SM - SHORELINE MORPHOLOGY

This module combines detailed 2D modelling of currents and waves with a constrained morphological model, making it possible to undertake stable and robust modelling of shoreline evolution in 2D environments.

OS - OIL SPILL

This module simulates the spreading and weathering of hydrocarbons and is used for oil spill modelling.

ECO LAB - ECOLOGICAL MODELLING

This is a complete numerical laboratory for water quality and ecological modelling. See page 18.

MODULES

MIKE 21 includes the following modules specifically for wave modelling.

SW - SPECTRAL WAVES

This is a spectral wind-wave model that simulates the growth, decay and transformation of wind-generated waves and swell.

PMS - PARABOLIC MILD SLOPE WAVES

This is a linear refraction-diffraction model for studying wave disturbance in open coastal areas.

EMS - ELLIPTIC MILD SLOPE WAVES

This is an efficient model for studying wave dynamics in coastal areas and, for instance, harbour resonance in response to linear and monochromatic wave forcing.

BW - BOUSSINESQ WAVES

The state-of-the-art tool for studies and analyses of wave disturbance in ports, harbours and coastal areas. It includes full surf and swash zone dynamics.

MA – MOORING ANALYSIS

This module simulates the motions of a moored vessel subject to winds, waves and currents. It also calculates the forces in fenders and mooring lines and can directly use results from MIKE 21 BW and MIKE 21 HD as input.

SELECTED TOOLS IN MIKE 21

In addition to its variety of modules, MIKE 21 also includes a number of tools to optimise your work. Here is a subset of tools:

- Global tide data and tools for tidal analysis and prediction
- MIKE's Climate Change Editor
- Cyclone wind generation and wind generation from pressure maps
- Advanced mesh and grid generators and editors
- Advanced tools for generation of graphical output
- An interface (API) for reading and modifying files in MIKE 21's internal, binary format

BENEFITS

MIKE 21 is proven technology. No other modelling package has been used for as many coastal and marine engineering projects around the world as MIKE 21.

The recipe for the unique success of MIKE 21 is simple. It gives you maximum flexibility, higher productivity and full confidence in the results.

Also, MIKE 21 is much more than just the right tool for your project. It also gives access to other benefits of MIKE software products, including unparalleled technical support, training courses and access to DHI's expertise and know-how regardless of where you are in the world.

MIKE 21 also comes with a wealth of first class tools that enhance and ease modelling possibilities.

Contact: mike@dhigroup.com

For more information, visit:
www.mikepoweredbydhi.com

CEDAS

(Coastal Engineering Design and Analysis System)

- For engineers and scientists in the fields of: coastal, ocean, and hydraulic engineering; marine science; oceanography; and geology
- A comprehensive collection of coastal engineering design and analysis software developed by or for the Waterways Experiment Station
- Contents range from the simplified techniques of the ACES package, to more sophisticated models for hydrodynamics, wave propagation, nearshore hydrodynamics, beach processes, and inlet technology
- Pre-and post-processing routines, graphical tools for visualization and animation, grid generation
- Easy to use Windows interface and graphics within a visual development environment
- Buy the full system or only the models you need
- Manuals and reports available on CD-ROM
- Exceptional HELP files & technical support

GENERAL ENGINEERING MODULE

- ACES (Automated Coastal Engineering System - includes 34 codes)
- EST (Empirical Simulation Technique) is a life-cycle approach to risk analysis based on use of historical data used for site-specific studies involving storm and wave impacts.
- RELIABLE computes a Level II analysis of the reliability of a structure design—the process of determining risk of damage or probability of failure.

INLET PROCESSES MODULE

- NMLong-CW (Numeric Model for simulating Longshore current - Current Wave Interaction)
- DYNLET (DYNamic behavior of tidal flow at inLETs)

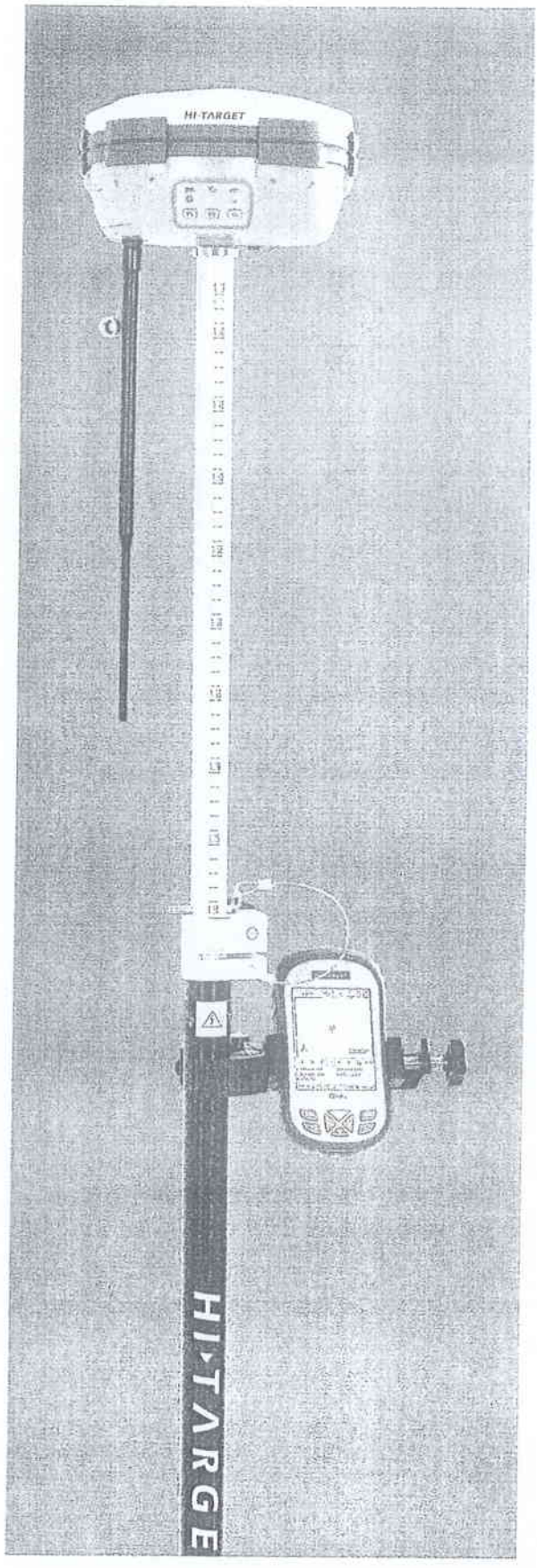
BEACH PROCESSES MODULE

- SBEACH (Storm-induced BEAch CHange)
- BMAP (Beach Morphology Analysis Package)
- NEMOS (Nearshore Evolution Modeling System), includes the following key programs:
  - GENESIS (calculates shoreline change primarily due to wave action)
  - GENESIS_T (permits tombolo formation in shoreline evolution)
  - RCPWAVE (2-D steady-state, monochromatic wave propagation)
  - STWAVE (2-D finite-difference representation for simulating near-coast, time-independent spectral wave energy propagation)
  - SPECGEN (Used to import, create, or visualize directional spectra in STWAVE)
  - GRIDGEN (Creates uniform grids at arbitrary orientations from random bathymetry-topographic data)
  - WSAV (Wave Station Analysis & Visualization)
  - WMV (Wave Model Visualization)
  - WWWL (Waves, Winds, Water Levels editor)
  - WISPH3 (WIS Phase 3 Wave Transformation)

HI-TARGET

V30

Dual-Frequency GNSS RTK System



V30 GNSS RTK SYSTEM

220 Channels

GPS+GLONASS+BDS(Optional)

Built-in NGS Approved Antenna

The V30 is designed to meet high quality standard at fair price. It is outstanding of its kind with rugged design and user-friendly functions.

The V30's housing is made of General Electric Xenoy 5220U polymer resin to handle severe and harsh filed conditions. With its unique internal design, it can perfectly avoid or lessen obstruction and multipath effect to ensure superior positioning capability.

Special modular design enables any user to simply equip or exchange the internal UHF radio. This is for quick and easy maintenance. What's more, the user can get the other UHF radio module when it is necessary, to have it equipped for particular use, such as having the V30 work with other brand's receiver is required.

KEY FEATURES

Fully Automated Operation

The V30 is equipped with a smart speaker, which guides the user during operation. All its functionalities are designed to make survey jobs to be done conveniently, such as auto base setup by one button, the rover can get fix solution once it is turned on. No need to spend time setting the parameters for every single operation.

Multi Constellation Tracking

220 channels. The V30 is fully compatible with GNSS constellations to track GLONASS, GALILEO, BDS, SBAS as well as GPS.

High Power Transceiver UHF Radio

The transceiver UHF radio enables the V30's working mode to be switchable between base and rover in the same receiver. In the V30 package, 2 watts HI-TARGET internal UHF radio and 1 watt Pacific Crest TrimTalk© internal UHF radio are optional for flexible use. 2 watts transceiver UHF radio is an excellent choice for UHF RTK operation. On the other hand, 1 watt transceiver UHF radio is to be used to have the V30 work with other brand's receiver having TrimTalk© compatible radios.

Seamlessly Operation in CORS System

With internal GPRS or 3G modem, the V30 works perfectly with corrections from CORS networks in any version of CMR, RTCM without needing to interpret the message but reading seamlessly.

Long-life Battery

Powered by 4400mAh Li-Ion battery.
Static working time 13 - 15 hours
RTK Rover(UHF/GPRS/3G) working time 10 - 12 hours
RTK Base working time 8 - 10 hours

Rugged Design, IP67

The special latching technology on flexible flat cables

ensures trouble-free operation under impact or vibration. The V30 withstands 3 meters natural fall onto concrete.

Field Controller and Software

There are optional field controllers and software in the V30 package. The controllers with OS Microsoft Windows Mobile 6.5 are fully compatible with the third party software such as Carlson SurvCE, MicroSurvey FieldGenius, Digiterra Explorer, Esri ArcPad etc. besides standard field&GIS software made by HI-TARGET. HI-TARGET controller with WiFi, Bluetooth, and GPRS/3G is completely wireless to connect to any device, collect data and connect to server simultaneously and seamlessly.

Post-processing Software

HI-TARGET Geomatics Office (HGO) software provides total GNSS solution with a complete suite of programs to support HI-TARGET GNSS receivers. Standard Rinex data and HI-TARGET raw data can be processed flexibly and easily.

PERFORMANCE SPECIFICATIONS

MEASUREMENTS

- 220 Channels
- Advanced Pacific Crest Maxwell 6 Custom Survey GNSS Technology
- High precision multiple correlator for GNSS pseudo range measurements
- Unfiltered, unsmoothed pseudo range measurements data for low noise, low multipath error, low time domain correlation and high dynamic response
- Very low noise GNSS carrier phase measurements with <1 mm precision in a 1 Hz bandwidth
- Signal-to-Noise ratios reported in dB-Hz
- Proven Pacific Crest low elevation tracking technology

Satellite signals tracked simultaneously

GPS ..... Simultaneous L1C/A, L2C, L2E, L5
GLONASS ..... Simultaneous L1C/A, L1P, L2C/A (GLONASS M only), L2P
SBAS ..... Simultaneous L1 C/A, L5
Galileo ..... Simultaneous L1 BOC, E5A, E5B, E5AltBOC[1]
BDS/Compass(optional) ..... B1, B2[2]
QZSS ..... L1 C/A, L1 SAIF, L2C, L5

POSITIONING PERFORMANCE[3]

Static and Fast Static GNSS surveying

Horizontal ..... 2.5mm+0.5ppm RMS
Vertical ..... 5mm+0.5ppm RMS

Post Processing Kinematic (PPK / Stop & Go) GNSS surveying

Horizontal ..... 1cm+1ppm RMS
Vertical ..... 2.5cm+1ppm RMS
Initialization time ..... typically 10 minutes for base while 5 minutes for rover
Initialization reliability ..... typically > 99.9%

Realtime Kinematic(RTK) surveying

Horizontal ..... 8mm+1ppm RMS
Vertical ..... 15mm+1ppm RMS
Initialization time ..... typically < 8 seconds
Initialization reliability ..... typically > 99.9%

Code Differential GNSS positioning

Horizontal ..... 25cm+1ppm RMS
Vertical ..... 50cm+1ppm RMS
SBAS[4] ..... 0.50m Horizontal, 0.85m Vertical

HARDWARE

Physical

Dimensions (W x H) ..... 19.50cm x 10.40cm (7.68 in x 4.09 in)
Weight ..... 1.3kg (2.86lb) with internal battery, internal radio, standard UHF antenna
Operating temperature ..... -45°C to +65°C (-49°F to +149°F)
Storage temperature ..... -55°C to +85°C (-67°F to +185°F)
Humidity ..... 100%, considering
Water/dustproof ..... IP67 dustproof, protected from temporary immersion to depth of 1m (3.28ft).
Shock and Vibration ..... Designed to survive a 3m(9.84ft) nature fall onto concrete.

Electrical

Power 6V to 28V DC external power input
Power consumption 2.5W
Automatic Switching between internal power and external power
Rechargeable, removable 7.4V, 4400mAh Lithium-Ion battery in internal battery compartment

Internal battery life

Static 13 - 15 hours
RTK Rover (UHF/GPRS/3G) 10 - 12 hours
RTK Base 8 - 10 hours

I/O interface

1 x Bluetooth
1 x standard USB2.0 port
2 x RS232 serial port
2 x DC power input (8-pin & 5-pin)

COMMUNICATION AND DATA STORAGE

GPRS/GSM or 3G

Fully integrated, fully sealed internal GPRS/GSM or 3G
Network RTK (via CORS) range 20-50km

HI-TARGET internal UHF radio (standard)

Frequency ..... 460 MHz with 116 channels
Transmitting power ..... 0.1W, 1W, 2W adjustable
Transmitting Speed ..... Up to 19.2Kbps
Working range ..... 3~5Km typical, 8~10km optimal

Pacific Crest ADL Foundation internal UHF radio

Frequency ..... 390~430 MHz or 430~470 MHz
Transmitting Power ..... 0.1W, 0.5W, 1W adjustable
Transmitting Speed ..... Up to 19.2Kbps
Support most of radio communication protocol
Working range ..... 3~5km typical, 8~10 optimal

HI-TARGET External UHF radio (standard)

Frequency ..... 460 MHz with 116 channels
Transmitting power ..... 5W, 10W, 20W, 30W adjustable
Transmitting Speed ..... Up to 19.2Kbps
Working Range ..... 8~10Km typical, 15~20km optimal

Pacific Crest ADL Vantage Pro External UHF radio

Frequency ..... 390~430 MHz or 430~470 MHz
Transmitting Power ..... 4W to 35W adjustable
Transmitting Speed ..... Up to 19.2Kbps
Support most of radio communication protocol
Working Range ..... 8~10Km typical, 15~20km optimal

Support other external communication device

For example, external GSM modem.

Data storage

64MB internal memory

Data formats

(1Hz positioning output, up to 50 Hz - depends on installed option)
CMR: sCMRx,CMR,CMR+input and output
RTCM: RTCM 2.1, 2.2, 2.3, 3.0, 3.1 input and output
Navigation outputs ASCII: NMEA-0183 GSV, AVR, RMC, HDT, VGK, VHD, ROT, GGK, GGA, GSA, ZDA, VTG, GST, PJT, PJK, BPQ, GLL, GRS, GBS
Navigation outputs Binary: GSOF
1 Pulse Per Second Output

[1]Developed under a License of the European Union and the European Space Agency.
[2]At the time of this publication, no public Compass ICD was available. The current capability in the receivers is based on publicly available information. As such, HI-TARGET can not guarantee that these receivers will be fully [2]compatible with a future generation of Compass satellites or signals.
[3]Precision and reliability may be subject to anomalies due to multipath, obstructions, satellite geometry, and atmospheric conditions. The specifications stated recommend the use of stable mounts in an open sky view, EMI and multipath clean environment, optimal GNSS constellation configurations, along with the use of survey practices that are generally accepted for performing the highest-order surveys for the applicable application including occupation times appropriate for baseline length. Baselines longer than 30 km require precise ephemeris and occupations up to 24 hours may be required to achieve the high precision static specification.
[4]GPS only and depends on SBAS system performance. FAA WAAS accuracy specifications are <5 m 3DRMS.

Descriptions and specifications are subject to change without notice

HI TARGET

Hi-Target Surveying Instrument Co. Ltd

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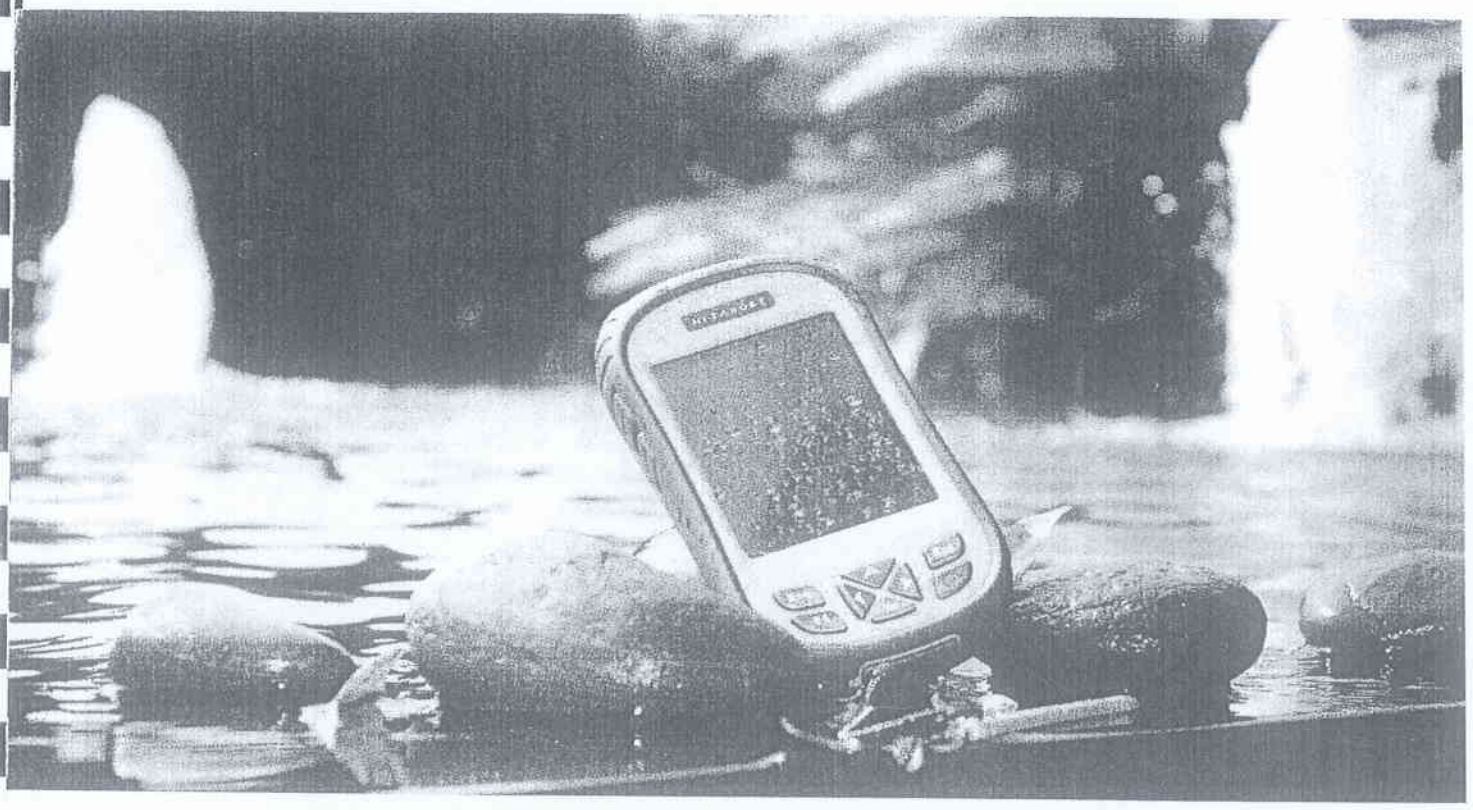
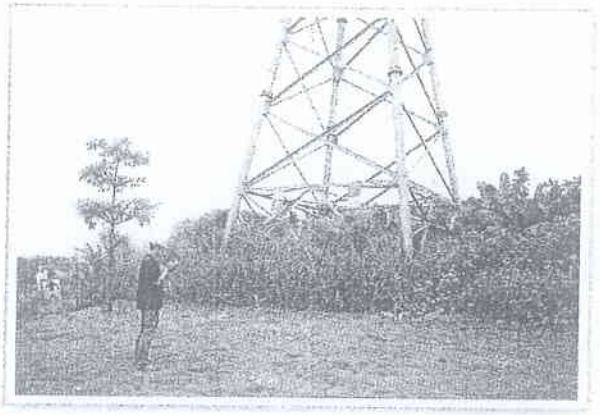
FC CE IP67

HI-TARGET

GIS Handheld Qmini M Series



GIS Handheld Qmini M Series

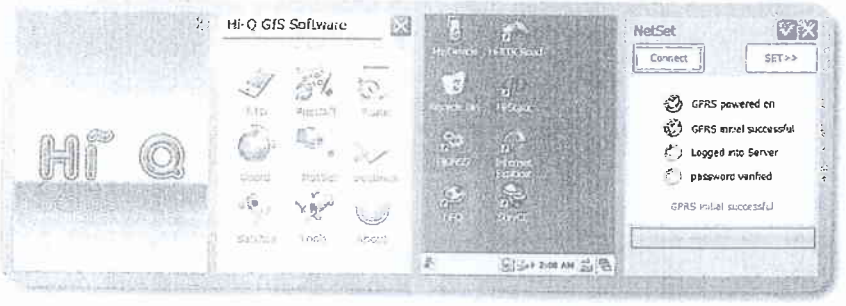


Rugged design
Microsoft Windows Mobile 6.5
806 MHz high-speed CPU
Embedded high sensitivity GPS+GLONASS receiver
3.7 inch QVGA TFT, sunlight - readable color touch screen
5 Megapixel auto-focus camera with LED
Field swappable long life Li-Ion battery

The Hi-Target Qmini M is a rugged GIS handheld built to meet users' requirement in working under hard environmental conditions and most extreme weather conditions. The Qmini M has embedded high sensitivity GPS/GPS+GLONASS receiver to ensure high accuracy and stable performance in positioning. With 806Mhz high-speed CPU, 256M RAM, 8G flash memory, the user will enjoy large storage capacity while Qmini M working fast and smoothly.

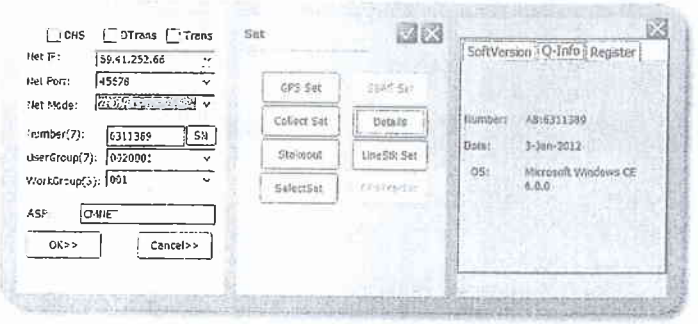
3.7 inch QVGA TFT color touch screen with high display resolution 640 x 480 makes it perfectly readable even it is under sunlight.

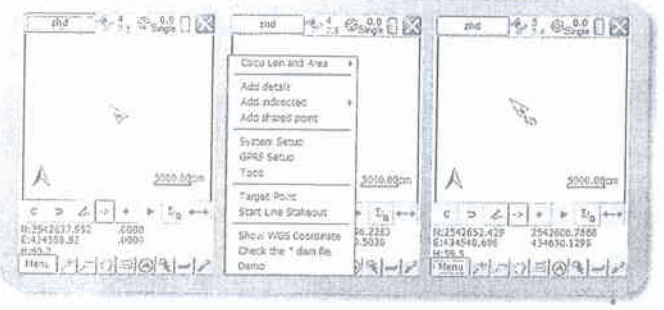
Software



Tune Qmini M Series to your applications

With Windows Mobile 6.5 you may upload necessary utilities or software on your Qmini M, to suit your next job. You can collect GIS/GPS points and maps via the GIS application of your choice, either a third-party software such as ESRI, ArcPad or the proprietary Hi-Target application.





Qmini M Series	Qmini M1	Qmini M3	Qmini MT
SYSTEM CONFIGURATION			
	√	√	√
	√	√	√
	√	√	√
	√	√	√
	√	√	√
GNSS FEATURES			
	√		
		√	√
	√	√	√
	√	√	√
	√		
		√	√
	√	√	√
TRANSMISSION FEATURES			
	√	√	√
	√	√	√
APPLICATION FUNCTIONS			
	√	√	√
	√	√	√
	√	√	√
		√	√
COMMUNICATION INTERFACE			
	√	√	√
	√	√	√
	√	√	√
	√	√	√
	√	√	√
		optional	
			√
BASIC CONFIGURATION			
	√	√	√
PHYSICAL PROPERTIES			
	√	√	√
	√	√	√
	√	√	√
	√	√	√
	√	√	√
	√	√	√

Specification subject to change without notice. Battery performance will vary based on software applications, wireless settings, power management settings, LCD brightness, customized modules and environmental conditions. As with all batteries, maximum capacity decreases with time and use and may eventually need to be replaced by a Hi-Target service provider. Battery life and charge cycles vary by use and settings. Battery life may be reduced in subzero applications.

Hi-Target Surveying Instrument Co., Ltd

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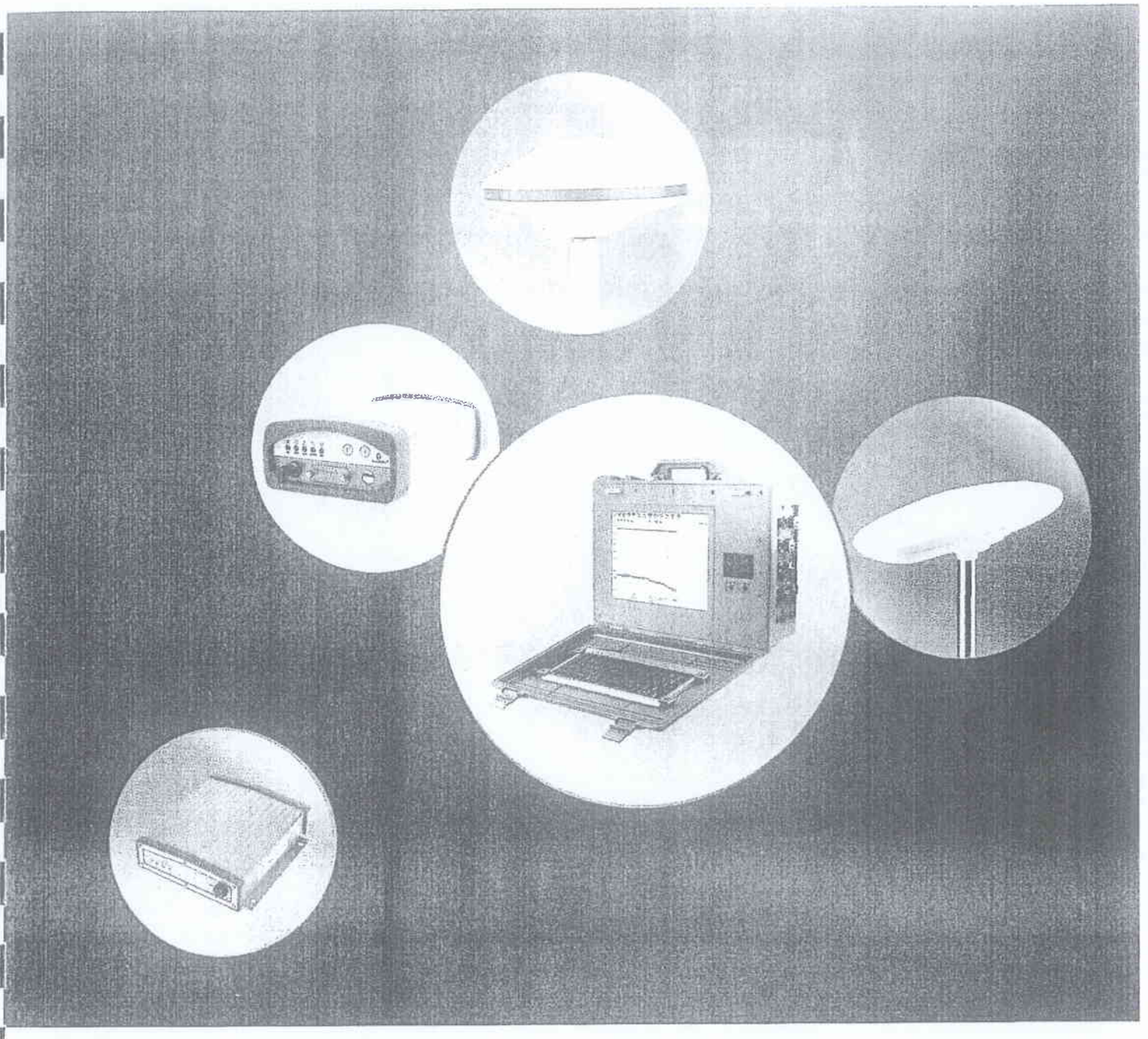
Hi-Target

Marine Surveying Product Categories



Hi-Target surveying Instrument Co., Ltd, established in 1999, engaging in marine echosounder technology for more than 10 years. it launched the first echsounder in China in 1999, has profound hydrographic suvery technology experience which always made the surpassed hi-accuracy, reliable, stable echosounder.

CE

HI TARGET

Key Benefits

- Easy to compatibilities with different brands of GPS which is NMEA output data format(Topcon, Leica,Trimble), compass, surge compensator
- Easy to upgrade of frequency adjustable version HD370A,and easy to compatibilities with different brand trasducers
- Field work and post processing software already in the whole package, adapt latest marine technology
- Paperless recording, high resolution for permanent data storage
- Windows XP Operation
- High-resolution screen with touch mouse area
- High quality ABS+ Synthetic PC material Mainfame,not easy to be corroded, strong serial ports
- User friendly trackball Mouse, you can move the cursor to any place by moving the ball when the boat is shaking
- Lighter weight
- Shock resistance, waterproof, dustproof, portable

HD370/370A/380/390 Performance Advantages

A Accuracy

- Advanced VF Frequency adjustable technology lower the buzzer noise caused by the transducer, eases interference echo.
- Latest designed TVG curve provides perfect Gain Control for Sonar transmission attenuation.
- Advanced bottom digitizing capabilities and pulse width selection technology assure the accuracy of underwater survey.

B Efficiency

- 30 Hz water dapth collection rate, improve sounder efficiency and provide echogram more detailed and precise.
- Adjustable frequency for various transducer, expand the scope of application.

C Stable Performance

- Embedded windows XP operation system, stable operation.
- Adopt unique "Fast Mapping Failback" technology for protection from virus
- Dual storage disk, dual operation system, one key ghost.
- High strength ABS+PC material cover, waterproof, shock resistance.

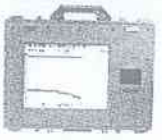
D Convenience

- Range is automatically and manually.
- Digital image resolution technology, display like falls and record, easy to reply and print.
- Portable design, easy to carry.
- 1024X768 dpi high-resolution, high-brightness LCD display, high definition in the sun.

E Compatibility

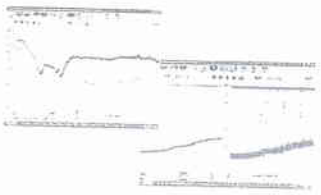
- Easy to configure with various transducer.
- Internal two-in-one software process marine GPS and echo-sounder data, able to work with any GPS, attitude indicator and surge detector and so on.
- Able to connect to external VGA display, support multi display terminal.
- Able to connect USB keyboard and mouse.

Hi-Target the 3rd Generation Digital Echosounder Series

Digital Echosounder	HD370 Single Frequency	HD370A Single Frequency (Adjustable)	HD380 Dual Frequency	HD390 Multi-Channel
Image				
Working Frequency	200 KHZ	100-750KHZ (Adjustable)	High frequency 100-750KHZ (Adjustable) Low frequency 10-50KHZ (Adjustable)	150~750KHZ (Adjustable)
Transmission Power	500W (200KHZ transducer)	500W (200KHZ transducer)	500W (200KHZ High frequency Channel) 1000W (20KHZ Low frequency Channel)	500W (200KHZ transducer)
Bathymetric Range	0.3m-600m		0.3m-600m (High frequency) 0.3m-2000m (Low frequency)	0.3~600m (Under Transducer)
Bathymetric Accuracy	±10mm+0.1%h, definition: 1cm		±10mm+0.1%h definition: 1cm	±10mm+0.1%h
Draft Range	0.0m-15m			
Adjustment Range of Sound Velocity	1370-1700m/s, definition 1m/s			
CPU	Industrial embedded high speed low power CPU,fequency :1.6GHZ			
Memory	1G			
Max. Depth Collection Rate	30 times/second	30 times/second	30 times/second	25 times/second
Internal Storage Device	4G CF card storage (can be customized)	4G CF card storage (can be customized)	4G CF card storage (can be customized)	4G CF card storage (can be customized)
LCD Display	12 inches, definition 1024X768, 1000cd/ m2	12 inches, definition 1024X768, 1000cd/ m2	12 inches, definition 1024X768, 1000cd/ m2	12 Inches, definition 1024X768, 1000cd/ m2
Peripheral Interface	Two RS-232 ports, three USB ports, one DC power port, two TX ports (for transducer)	Two RS-232 ports, three USB ports, one DC power port, two TX ports (for transducer)	Two RS-232 ports, three USB ports, one DC power port, two TX ports (for transducer)	Two RS-232 ports, three USB ports, one DC power port, two TX ports (for transducer)
Power Supply	DC 10~14V / AC 220V	DC 10~14V / AC 220V	DC 10~14V / AC 220V	DC 10~14V / AC 220V
Power Consumption	20W	20W	20W	20W
Working Temperature	-30°C~60°C	-30°C~60°C	-30°C~60°C	-30°C~60°C
Dimension	440mmL X 341mmW X 164mmH	440mmL X 341mmW X 164mmH	440mmL X 341mmW X 164mmH	440mmL X 341mmW X 164mmH
Weight	9kg	9kg	9kg	9kg
Transducer				

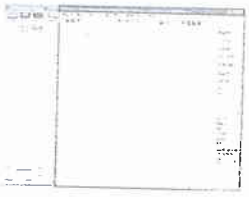
Software

Hi-Target developed the third generation of echosounder is installed the latest Hi-Target depth sounding software and marine positioning software, powerful function and simple operation, would be your best partner in survey project.



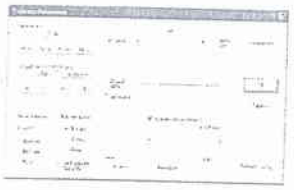
Hi-Target Depth Sounding Software

Hi-Target Depth Sounding Software adopts entirely automatic design, setting parameter in advance, only boot-strap can start surveying. Sounder data is intuitively displayed by figure. Echogram is saved in digital encrypted files, data saving in long time storage, replay, inquiry and print.



Hi-Target Navigation Sounding Software

Combining of position and Depth Sounding function, In virtue of this software, only require GPS receiver and power supply system, can Hi-Target the third generation of echosounder implement; high precised positioning, echo sound surveying, increasing efficiency, and reducing cost of system configuration.



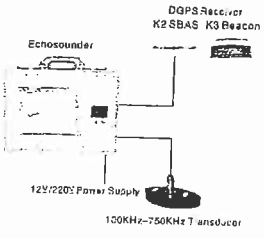
Software Parameter & Environment Setting

Hi-Target Sounding and Positioning software is simple for setting. One interface for you to set sea gauge, sound velocity, transmission power, gain and frequency adjustment parameter, simple and intuitive.

Application Mode

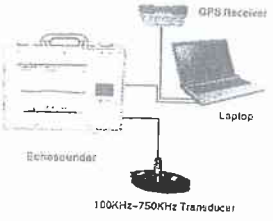
Ideal for reservior,river,lake and ocean surveying, and marine construction engineering surveying

Working Station Echoing Mode



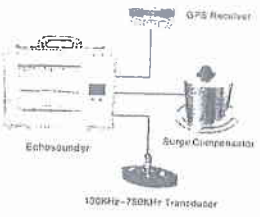
Hi-Target third generation of the echosounder is integrated with high stable industrial controlling computer, echosounder, depth measuring software and marine surveying software. Only need to connect to DGPS receiver and 12V DC battery can launch survey work, greatly simply water depth survey work.

Combined Echoing Mode



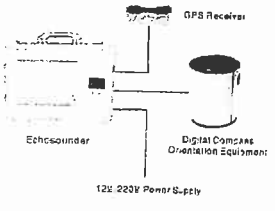
Hi-Target third generation of the echosounder also carries out working mode with echosounder + laptop + GPS + battery, satisfying customer's traditional surveying requirement.

Precise Echoing Mode



Hi-Target third generation of the echosounder can connect to surge compensator, for correcting error which evocable from surge in water depth surveying, to increase surveying precision.

Construction Positioning Surveying Mode



Hi-Target third generation of the echosounder is not only a set of digital echosounder, but also a set of stable Industrial Controlling Computer. To effectively solve unstable AC power supply on board, it"s available for direct power supplying in 12V DC, connecting GPS receiver and processing construction.