BAHIA BLANCA 2040 MASTER PLAN, FLEXIBLE PLANNING FOR WATERWAYS

by

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ABSTRACT

Up-to-date development of the Bahia Blanca Estuary and region was tied to the improvement of the access channel to the main Ports located in the innermost section. Since the late 19th century the Ports constituted one of the main gates to distribute the agricultural produce of a vast region to the world markets. As the traffic and size of bulk carriers grew, it became apparent that the waterway needed to be adapted. In the early 90's, because of a change in policy, Bahia Blanca became the first Self-administered Port in Argentina. This provided the possibility to plan and invest directly on the port system the revenues generated by the Port itself. This circumstance leads to a considerable improvement of the facilities and services, which in time promoted the arrival of new terminals and industries to the region.

A great portion of the revenues have been applied to the maintenance of its waterways. Today dredging represents roughly some 60% of the total budget. It becomes paramount to make a comprehensive planning of the waterways to promote adequate depth and sizes for the current fleet, thus lowering dredging volumes.

Since 2017 the CGPBB has taken a big step in Port Planning. For the first time in its history it has undergone, with the help and supervision of Port Consultants of Rotterdam, a thorough process of devising a Plan looking at 2040. This means a change of paradigm, were the actual waterways will be defined by the needs of its users.

This change will lead to a more flexible channel design, where the actual size of the waterways will be that that is required at the time by its users. As a result, the dredging volumes will be limited to maintain the necessary depth, thus proving more sustainable both economically and environmentally.

1. LOCATION AND MAIN CHARACTERISTICS OF THE WATERWAYS OF BAHIA BLANCA

The Port of Bahía Blanca and its waterways are located in the estuary of the same name some 500 km south west of the city of Buenos Aires. The estuary has over 2400 square kilometres of wetlands and shallow waters and its coastline totals some 400 km on both margins. On the northern shore there are three main ports (Puerto Rosales, Belgrano Naval Base and the Port of Bahía Blanca) all located along a strip of some 25 km.

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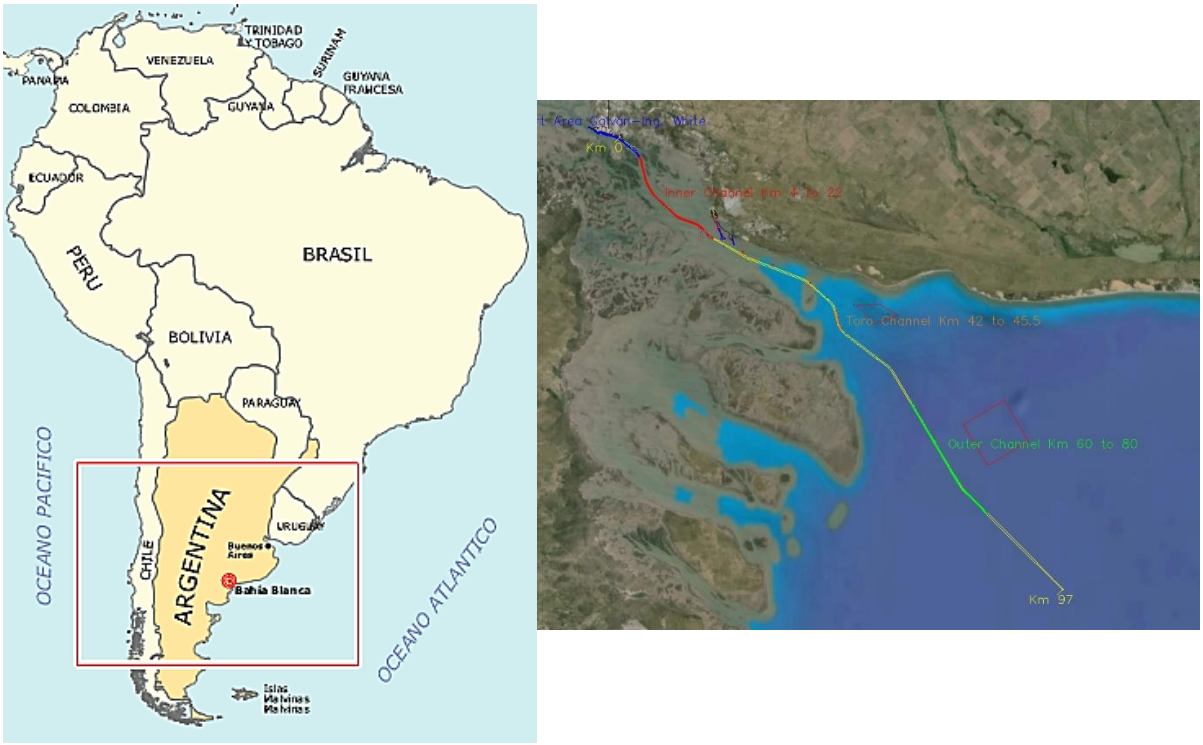

Figure 1: Location of Bahía Blanca Estuary

The extensive wetlands and tidal plains are connected by a series of side channels which flow to the Main Channel that runs on a NW-SE direction. The shape of the Estuary is roughly a triangle, with its base oriented to the SE.

One of the main characteristics is the tidal amplitude, which varies throughout the estuary, ranging from 2.5 m in the outer portion to up to 4.5 m in the inner port area. This great amplitude renders Bahía Blanca as one of the major deep-water ports of the region, since it allows with the use of high tide window the navigation of vessels with a draught of up to 45 feet.

Wave climate is dependent of wind conditions, especially in the outer estuary, where the open waters provide enough fetch, which added to the relatively shallow depth result in waves of up to 3 m when persistent high intensity winds from the southern quadrant blow. The wave heights drop dramatically further into the estuary, providing a sheltered natural port that was the main reason for the settlement of what today is Bahía Blanca Port.

The distribution of sediments along the estuary is a direct consequence of the surrounding availability of the sea bottom materials and of the hydrodynamics present locally.

When the sediments are mobilized, because of lateral erosion, the finer proportion (clay and silt) is kept in suspension in the entire water column causing high turbidity, a characteristic of the inner portion of the estuary. Coarser materials (sands) are mobilized by the currents near to the sea bottom and deposited in the channel area.

The dominant hydrodynamics results in the formation of sand bars on the outer portion of the estuary, and of highly movable bottom sand dunes, which sometimes cross the navigation channel, generally without affecting navigation.

The morphology of the estuary and its waterways has been modified throughout the decades, due to the shifting of the sand bars and bottom dunes, which alters the layout of the channel as they protrude into them. This calls for constant monitoring and survey of the area, besides maintenance dredging of some portions of the channels.

2. EVOLUTION OF BAHIA BLANCA AND ITS WATERWAYS

What today is known as Bahía Blanca Port can be traced back to the 1820's, when colonization of aboriginal land and the threat of war with the Brazilian Empire motivated expeditions to the Bahia Blanca Estuary, with the intention of establishing a small port and a fort to proclaim sovereignty. Favourable conditions for settlement (nearby fresh water) and a sheltered natural port resulted in the establishment of a minor outpost which served as the sole connection to the rest of the country for the incipient town of Bahia Blanca.

Along its history the port and its channel received sprouts of quick development followed by decades of apparent stagnation. It was not until the 1880's when the port and its channel as we know it today began to take shape.

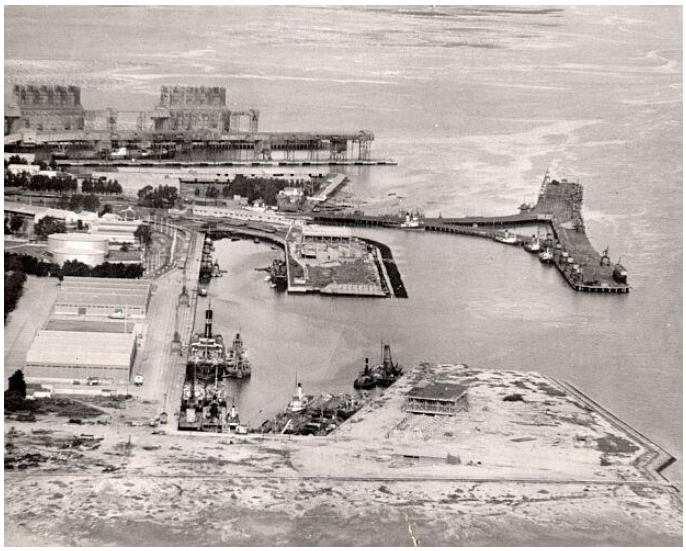

Figure 2: Ing. White Port ca. 1930s

The expansion of the railroads was the kick off to a spectacular development from mid-1880 till the 1920's. Alongside the development of the port infrastructure, the waterways of the time were the natural channels available within the estuary. Primitive and partial surveys, conducted by the hydrographic department of the Argentina navy, allowed the navigation with relative safety of ships of drafts of up to 25 feet. Later around the 1920's improved survey and primitive aids to navigation allowed the drafts to be augmented to 33 feet.

Political and economic swings and lack of well-defined policies and legislation prevented the Port to achieve a sustained development. It was not until the 1960's and 70's that new berths were constructed, but no intervention was carried out in the waterways which maintained its natural depth allowing the sailing of vessel with a draft of up to 33 feet.

By the late 60's ships growth called for deeper ports and waterways. Consequently, the National Government started to analyse possible alternatives. These included the building of a totally new port on the Atlantic shore of the Province of Buenos Aires, the deepening of existing waterways and ports up the Parana River (Argentina´s main waterway and where 80% of the agricultural produce is concentrated) among others. Finally, the decision was adopted by the Government at the time (beginning 1970's) to turn Bahía Blanca as the main deep-water port in Argentina. First step in this direction was the capital dredge conducted that gave the port facilities and the main Channel an operational depth of 40 feet.

Such policy has been maintained since, not only under national administration, but also when it became self-administered in 1993. Another major landmark was the deepening of the port and Main Channel to 45 feet (using the appropriate tide window), giving Bahia Blanca yet another competitive boost. This called for the dredging of fifty million cubic meters, with an investment of over two hundred million US Dollars (at the time). This capital dredge was carried out from 1989 to 1992.

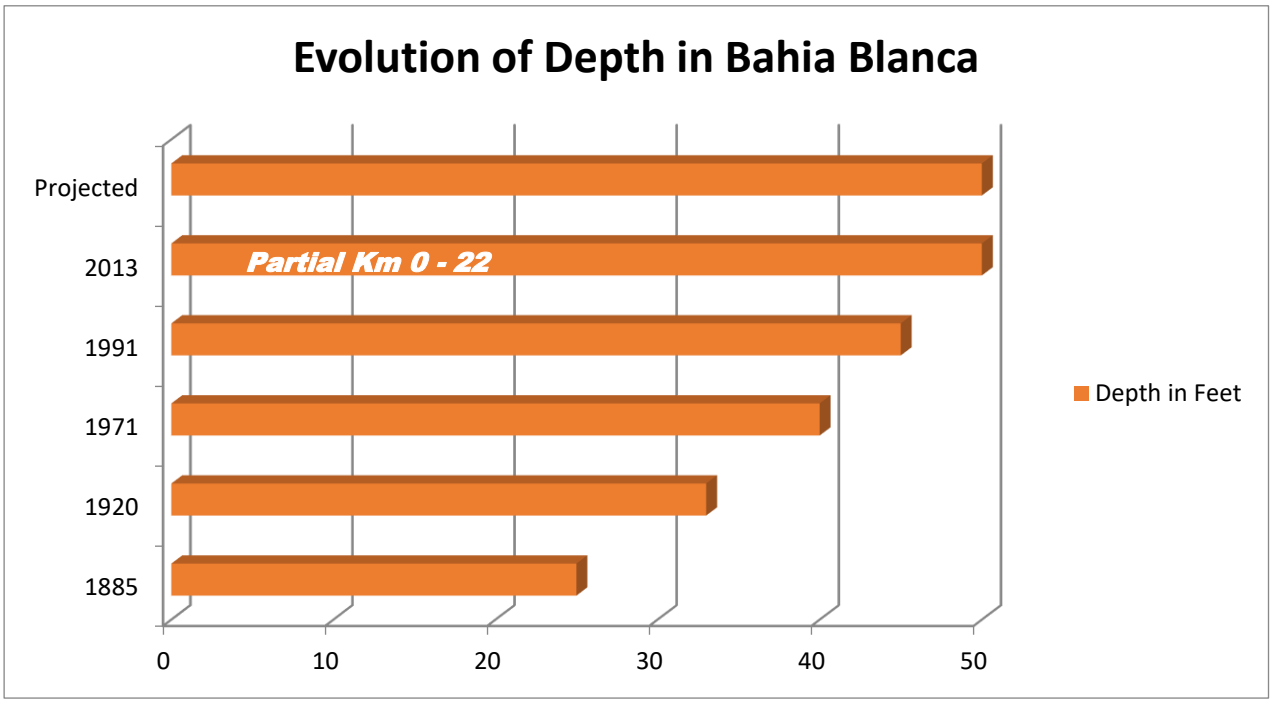

Figure 3: Depth evolution in Bahia Blanca

The current layout of the Channel is a consequence of the studies carried out in the 80's by NEDECO Consulting of the Netherlands which concluded that such was the best option, considering all the relevant factors (sedimentation, currents, navigation time, etc.).

Thanks to all the data gathered several layouts were considered and sediment models were proposed. After careful consideration, a layout was chosen evaluating different channel depths being the chosen design vessel a Panamax Bulk carrier, thought at the time to be the biggest ship to call upon the port at time.

Thus, we arrive at today's Main Access Channel to Bahía Blanca, which is located close to the northern shore of the estuary; its total length is 97 Km beginning in the Bahia Blanca Port Area.

Connected to Main Channel are two other side channels: the 4 kilometres long Access Channel to de Belgrano Naval Base located at Chainage Km 22 and Puerto Rosales Access Channel, 1.7 kilometres long, at Chainage Km 23.5.

Consequently, the actual design of the channel is the result of the above-mentioned study. The Main Channel has a width of 190 m throughout the whole extension, except between kilometres 14 to 22 where it has 205 m due to the presence of consecutive curves. The side slopes vary according to the stability of the banks ranging from 1 to 5 to as much as 1 to 15.

BAHIA BLANCA MAIN ACCESS CHANNEL DESIGN				
Chainage (Km. a Km.)	Nautical Depth (m.)	Bottom Width (m.)	Slopes	
			RED	GREEN
0,0 a 4,0	13,50 m. Width and slopes variable			
4,0 a 8,9	13,50 m.	190 m.	1:5	1:5
8,9 a 14,2	13,50 m.	190 m.	1:10	1:10
14,3 a 21,0	13,50 m.	205 m.	1:10	1:10
21,0 a 40,3	Natural Width and Depth			
40,3 a 45,3	12,80/13,20 m.	190 m.	1:10	1:10
45,3 a 52,0	Natural Width and Depth			
52,0 a 63,2	12,80 m.	190 m.	1:10	1:10
63,2 a 72,0	12,80 m.	190 m.	1:10	1:10
72,0 a 75,0	12,80 m.	190 m.	1:15	1:10
75,0 a 85,0	12,80/13,10 m.	190 m.	1:15	1:10
85,0 a 97,0	13,10 m.	190 m.	1:15	1:10

Figure 4: Bahia Blanca Channel Design (as of 2013)

The Main Channel is divided into three sections:

- Inner Channel (Km 4 to Km 22) One way, no crossing permitted except for vessels with a Beam under 25m.
- Toro Channel (Km 42 to Km 46) One-way same restrictions apply.
- Outer Channel (Km 60 onwards) One-way until Km 80, from there onwards no restrictions applied.

Between these sections the channel has naturally a great depth, not requiring any maintenance work and posing no restriction to navigation.

The *Inner Channel* runs along banks of great stability, presenting little to no sedimentation at all. The predominant material is coarse sand with migrating bottom sand dunes. These occasionally interfere with the channel requiring small dredging campaigns to restore design depth.

This portion of the Main Channel received capital dredge in 2013 (known as stage 1 of the deepening project), going from an initial depth of 12.20 m to 13.50 m (referred to local Datum) thus improving port operation and allowing navigation at maximum depth (45+ feet) regardless tide condition.

Between this section and the Toro Channel natural depth is over 15 m, reaching a maximum of up to 25 m. The channel widens to as much as 1000 m. This provides a safe zone for overtaking and crossing manoeuvres.

The *Toro Channel* runs along the Toro Bank, South and West Banks. These are advancing towards the channel. Consequently, the area presents high volumes of sedimentation. The sediments are medium sand with silt in different proportions. Along the years this section of the channel has suffered several changes (minor) to its layout, adapting to the dynamics of the mentioned banks.

Design depths in this section vary from 12.8 meters at Chainage Km 42 to 13.1 meters at progressive Km 45.5. From there until Km 60 natural depth is above 15 meters requiring no maintenance dredging at all.

The *Outer Channel* runs on a NW to SE orientation and generally is aligned with the current, thus sedimentation is moderate. Between Km 67 to 73 the presence of a curve and a slight change in current alignment causes sedimentation to rise. The bottom material in this area is fine sand, with different grades of silt.

The Outer Channel has a depth of 12.8 m from Chainage Km 60 to Km 75. From there onwards it varies reaching 13.1 m on Chainage Km 85, maintaining that value till the end. All the depths mentioned are referred to local chart Datum.

3 FACTORS INVOLVED IN WATERWAYS EVOLUTION

Change in legislation and port related policies permitted Bahia Blanca to become in 1993 the country's first self-administered Port with the creation of the ***Consorcio de Gestión del Puerto de Bahía Blanca (CGPBB)***. With it came also the responsibility to maintain the waterways financed through the fares and tariffs for the usage of the waterway and other services provided by the Port. Today maintenance dredging constitutes the main expense to be afforded by the CGPBB drawing roughly up to 60% of its annual budget with ever rising costs.

3.1 Evolution of Maintenance Dredging

Since 1999 all dredging conducted in the waterways was contracted and payed for by the CGPBB, with no further financing from the Government.

Since maintenance of navigation draft is paramount to keeping its comparative advantage against other ports in the region, from the beginning it was devised that the best bet was to pursue a Performance Based Contract (PBC), ensuring at all-times (and regardless the volume to be dredged) the design depths in the Main Channel.

Because the layout of the channel has been almost the same since it was originally plotted in the 80's, considerable data is available regarding the sedimentation along the channel and the hot spots where it peaks. Moreover 25 years of continual surveys allows to form a good picture in terms of the evolution of the waterways morphologically. This can be translated to a fairly good understanding of the sedimentation process and the expected volumes.

Statistics show that the annual sedimentation is close to three million cubic meters, of which some two million are contributed by the Outer Channel (Chainage Km 60 to 80), another 700.000 cubic meters to the Toro Channel (Chainage Km 42 to 45.5) and the rest correspond to the Inner Channel (Chainage Km 4 to 20) and the access channels to the Belgrano Naval Base and to Puerto Rosales. The rest of the waterways, as mentioned before, because of their natural depth or due to the local hydrodynamics and morphology, do not require any maintenance work.

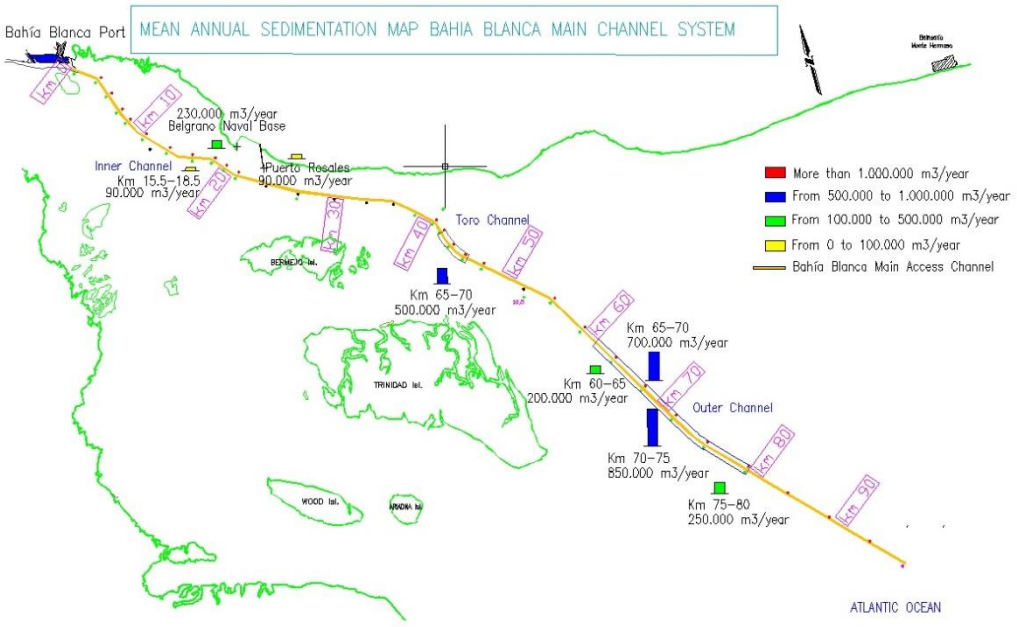

Figure 5: Mean Annual Sedimentation along the Main Channel

Due to the characteristic of the material deposited (sand and silt in various proportions), the work is carried out using Trailing Suction Hopper Dredges (THSD). Depth limitations outside the channel area and the volumes removed determine the size and capacity of the equipment used. In general, the dredgers employed are of medium to small dimensions, with a hopper capacity of around 3 to 4 thousand cubic meters.

3.2 The cost of Dredging

As mentioned above, volumes dredged annually have been constant throughout the last 20 odd years, with some variation related to climatological harsher years. Nevertheless, these differences have been within an interval of some 30%. But when we look at the evolution of the cost of dredging its obvious that the price per cubic meter has risen dramatically in subsequent contracts.

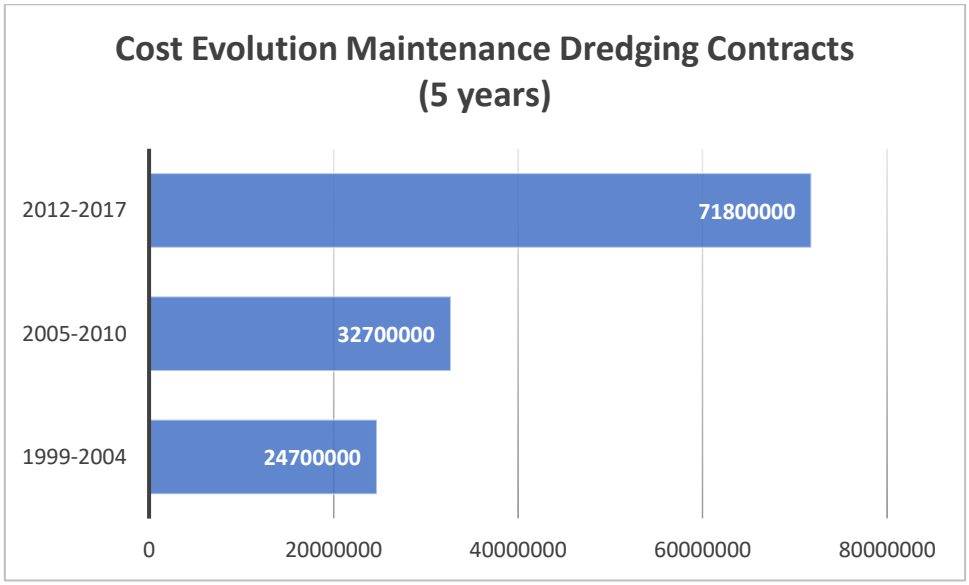

Figure 6: Maintenance Cost evolution in Bahia Blanca

Reasons for this steep rise are several, amongst others a big component is the uncertainty posed by the country's economy (with recurrent crisis and changes in policy), the price of oil, availability of equipment in the area etc.

What is clear enough is that the tendency that costs will most likely keep growing, and with it the resources that the CGPBB will have to allocate to maintenance. This could in the long run affect competitivity, since fares for usage of waterway might be affected to provide for the necessary funding to pay for the higher cost.

3.3 Traffic analysis

Looking at the evolution of traffic since the CGPBB was created, it becomes apparent that the total numbers haven't varied much (some 30%) compared to the volume handled which has more than doubled in the same period.

Reasons for this disparity can be found in the size of the ships calling on the port, also on the amount of cargo carried in each vessel (due to the increase in draft).

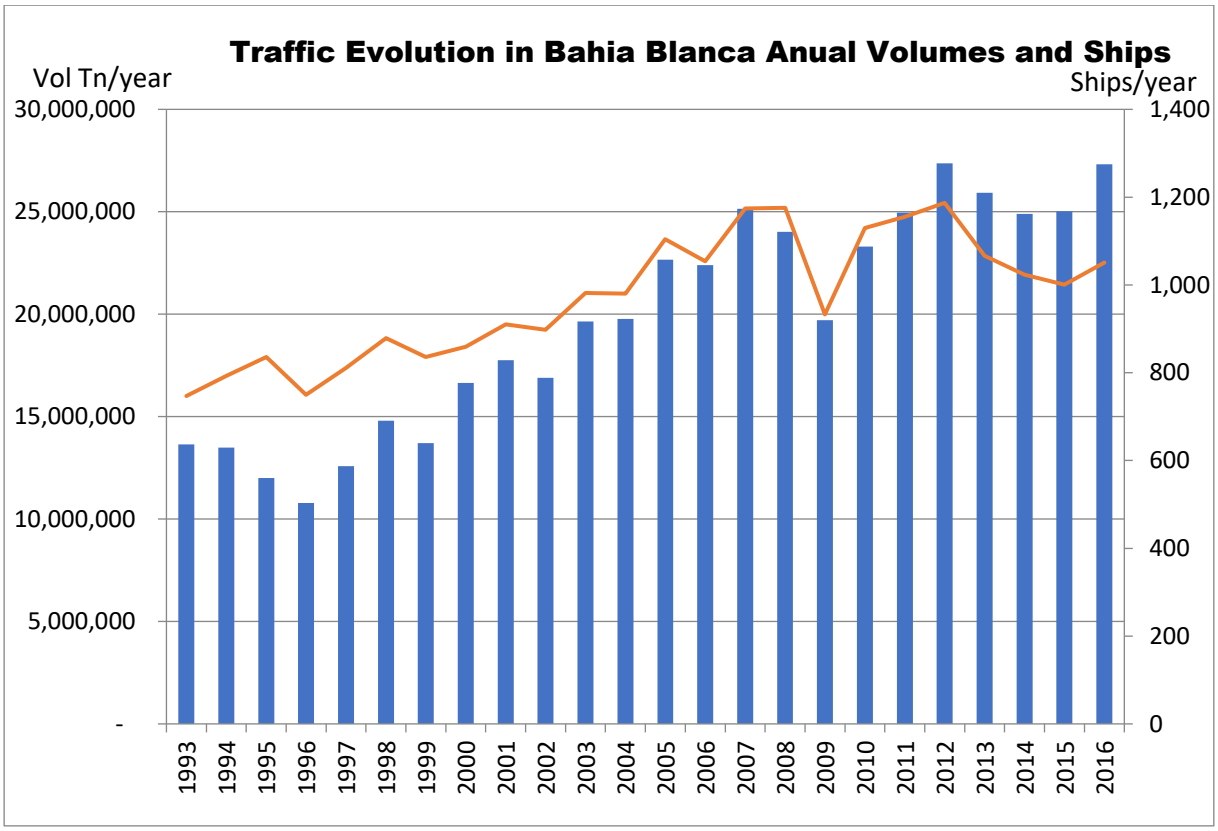

Figure 7: Traffic evolution in Tons and number of ships

One key factor to consider is that Bahía Blanca has positioned itself as one of the country's leading top off ports for solid bulk (mainly grains). Today the bulk of the more than 100 Mill tons of the grains produced in Argentina (close to 80%) is exported through the ports located up the Parana River in various terminals along several hundred kilometers. The main reason for this volume is the closeness of the main production zones, which in turn means less land transportation cost compared to the ports located in the Atlantic coast.

But drafts in up river ports is today limited to 34 feet and subject to the variations (which can be sudden) in the Parana river level. Hence the necessity to top off the Panamax and Post Panamax bulk carriers which constitute the gross of the fleet currently used.

Bahía Blanca results (along with Quequen some 250 km NE in the Atlantic coast) the main Argentinian top off port. Together they round off the 20 odd % of the exports, being today roughly Bahia Blanca volume 60% more than Quequen's (considering only grain exports).

When analyzed, in 2016 and 2015 all the Panamax Dry Bulk carriers that called upon Bahía Blanca came to top off, averaging some 20.000 tons per ship.

Another interesting fact is the number of ships with drafts above 44-45 feet that call on Bahía Blanca (Dry Bulk carriers leave port fully loaded), including incoming Panamax tankers that operate unloading crude oil to booth CALM buoys near Puerto Rosales which usually sail with draft of 45 feet (13.70m). They represent roughly 35% of the total traffic. The maximum draft ever operated was 47 feet using a particular tide window and favourable weather conditions.

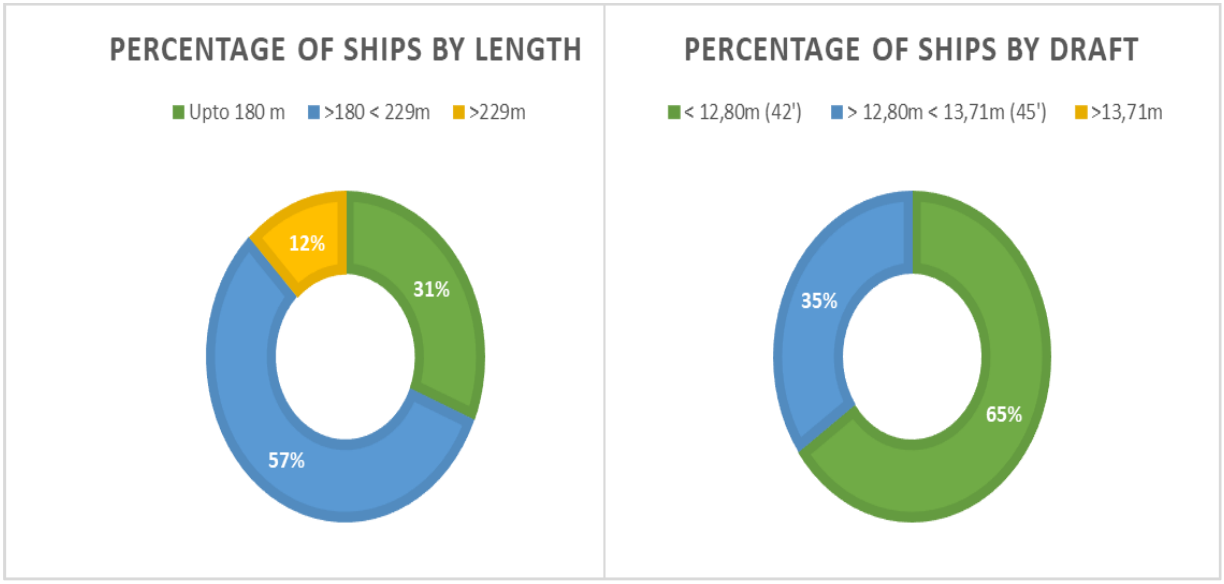

Figure 8: Traffic share by Dimensions in 2017

When considering extreme dimensions beside draft, since 2008 Bahia Blanca receives LNG ships with some 277 m in length, 43,5 m breath and a maximum draft of 12.1m. Although the channel was originally designed for a Panamax, simulations carried out and almost 10 years of continual operations have shown that with minimal restriction to the rest of the traffic these vessels can operate without inconvenience. Further simulation even allowed safely sailing of ships up to Q Flex size, though up to now no such vessel has called on the port.

When looking at the traffic it is also necessary to consider not only the port itself, but also the destination port and its facilities. The fully loaded dry bulk carriers have as destination ports in the east (mainly China) and Middle East. Those ports nowadays have capacity to operate with ships with drafts of up to 45 to 48 feet, thus the size of ships that call upon Bahia Blanca has maintained for the past 15 years.

4 WATERWAYS PLANNING

Since CGPBB came to be, all the responsibility for the operation and maintenance has befallen solely upon itself, including the planning of possible enhancement or modification to its layout.

4.1 Reasons for a deeper system

In 2007 owing to the increasing traffic in the port area and with the perspective of the establishment of future terminals, the Board of Directors required the Technical Areas within the CGPBB to begin feasibility studies to improve operations and availability of berths.

Early on it was decided to tackle the system in two stages, since the cost involved in doing the whole capital dredge was rendered too high considering that the entire works were going to be afforded by the CGPBB, with no financial help from the government.

At the time the priority was set on avoiding congestion in port operation caused by the cramming of all the operations (dockings and un-dockings) in just a few hours a day (using high water in case of the completed ships). This fact stressed to the limit the capacity of the services in the port (tugs and pilots) and led to increasing downtimes, a matter that would worsen quickly if the projected arrival of new terminals were to have happen.

Figure 9: Port Congestion

At the time it was deemed that continuous increase in grain production (specially soy bean) destined to the ever-demanding Chinese market could drive to the arrival of greater ships, requiring thus deeper drafts, enhancing the possibility of Bahia Blanca to attract not only top off operations but also complete loads of post Panamax or even cape size bulk carriers. All of this would benefit if the system was prepared to handle drafts of up to 50 feet (using the tide window). Already back in the 80's NEDECO had determined that 50 was the ultimate scenario to be analysed.

4.2 First Stage Port Area and Inner Channel, avoiding Congestion

The result of the work carried out by the specialists at the CGPBB was a project to carry out capital dredge in the port area from the former 12.20 to 13.50 meters; this would allow vessels to operate at 45 feet regardless of the tide condition.

Furthermore, it was also determined to dredge the Access Channel from Km 4 to 20 to a depth of 13.50 meters maintaining the overall width of 190 meters. This would allow the operation of vessels of up to 50 feet draught with the use of the appropriate tide condition or 45 feet at any time within the mentioned sector. This meant that ships could cast off at any time, sail the one-way channel up to one of the three available anchorage areas near the Toro Channel and await there the tide window to continue sailing outwards. Doing so would increase the number of operations per day, employing the services available in an orderly manner thus reducing downtimes significantly.

The project called for a total volume of 5.700.000 cubic metres to be dredged. Due to the characteristics of the material, (determined by seismic profiling and obtaining soil samples using coring), large trailing suction hopper dredgers (THSD) and cutter suction dredgers (CSD) were needed.

Financing was secured through a loan of the CAF (Corporación Andina de Fomento), for an amount of over sixty million dollars, to be repaid by the Consorcio during the following ten years.
An international tender was called in 2011, by which the joint venture between Boskalis International and Jan de Null was awarded the contract that amounted to a total of over 120 Million U$S Dollars, this included the capital dredge and the maintenance of the waterways for a period of five years (2012-2017). Deepening works were carried out throughout nine months in 2013, within the planned schedule.

As it was shown on the preceding section, traffic didn't experience the forecasted increase, mainly due to internal and external factors (2008 world economic crisis and, in 2009, a bitter taxing dispute between agricultural producers and the government). Nevertheless, the deepening of this portion of the main channel and the ports basin proved a success lowering downtimes to almost 0.

5 2040 MASTERPLAN AND FLEXIBLE WATERWAYS

5.1 Lessons learnt, needs to change

The biggest lesson learnt after the 2013 deepening was that forecast are dependant on factors that are out of reach of local port authorities. In an ever-increasing globalized world, one must expect the unexpected. This turns even more critical when decisions taken could severely affect the financial health of the port considering it does not have the backing of the State.

To date (in Bahia Blanca), waterways were built (dredged) in answer to what the government thought (or planned) without knowing first-hand the actual needs or perspectives of the prospected users, only acknowledging what central planners thought would be best for the country. Once it was operational then the port and its stakeholders made the best of what was available, with little or no possibility to have a saying at what are the needs in terms of channel design.

Changes began once self-administration was obtained. The CGPBB started to analyse the operations, traffic and tendencies in shipping to evaluate possible needs to be filled, and whether the waterway's design fulfilled the current necessities.

A major step forward was the realization of a Vision for the long term (2040). This Vision was not only from the perspective of the Port, but what was innovative compared to prior works, is that all the stakeholders were considered. With the supervision and help of Port Consultants Rotterdam (PCR), a thorough and comprehensive work was carried out during 2017. As a result of more than 500 interviews, workshops and data gathering and processing the Goals for 2040 were set. As part of these goals the definition of what waterways would be needed and when was obviously resolved.

5.2 Reasons to be flexible

As mentioned forecasts seldom become true, specially when we consider politics in a country prone to sudden shifts in economic horizons and ideologies and with no long-term planning. This makes planning ahead and investing a hard job. On the other hand, waterways need careful planning and study to design the best scenario, and this obviously takes time to carry out. So, the balance between thinking too further away (with high probabilities of not being feasible) and not having time to gather the required information and planning to take good decisions is being halfway. In other words, be flexible in the planning, have several scenarios and what is required to trigger the actions needed with enough time for carrying out all the necessary works will result in the best possible option at the desired time.

Other very important reason to be flexible is cost. Dredging is not cheap, and the prices have consistently gone up, with no sign of subduing. So, only dredging when is strictly necessary will save money, not only in the capital dredge, but specially afterwards in maintenance.

In waterways like Bahía Blanca every centimetre constitutes tens of thousands of cubic metres, thus just half a foot turns into millions of dollars. With this predicament, it is easy to see why one must consider all the alternatives possible before getting involved in deepening the existing waterways.

Another no less important factor to consider is the environment. Dredging has become an activity (even in developing countries) subject to ever increasing controls and regulations. This calls for careful planning of works to be carried out minimizing the impact (all anthropic activities have to a certain extent) on the Environment.

For instance, deepening the channel will not only result in higher volumes to extract and later to maintain, but also it will affect larger portions of the Channel. Every foot deepened turns into in several kilometres added to maintenance works and may lead to requiring new dump areas to cope with the extra volume extracted. This constitutes additional strain on the estuaries ecosystem and execution of a greater monitoring program.

Bottomline being flexible is not only cost-friendly but also environmentally reasonable.

5.3 Flexible contracts

Up to date (during the last 20 years), dredging contracts have been Performance Based owing to the need of securing the depth at all times. This was important due to past struggles and difficulties when the state was in charge.

Experience has shown that volumes tend to be circumscribed to a certain amount, with a variation of around some 30 %. Also, since the late 90's the equipment used in the maintenance has been a THSD (trailing suction hopper dredge) for the waterways, and a WID (Water Injection Dredge) for the berths and port basins.

This means that one could consider two contracts instead of just one for all the dredging works, drafting them according the type of equipment used. The advantage is that by doing so more offers could be received (specially from smaller or local companies), since there are few dredging companies with the capacity to carry out all the works that requires specific equipment. Also, time span for the contract can vary since maintenance of berths calls for frequent interventions as opposed to outer channel where one could even plan just a single campaign per year, provided sufficient over dredging allow to cope with the expected annual sedimentation.

Another way of making contracts smaller and thus open to more participants is to minimize the additional task to be performed by the contractor, for instance maintenance of tide gauge system, and all which is not directly concerned with dredging.

Being flexible also means that the CGPBB has begun to listen what the companies have to say regarding the tendering process. Among others, a revision of requested paperwork to minimize bureaucracy, providing constant feedback and consulting all the parties throughout the entire process. All this with the goal of obtaining the best contract that will satisfy all parties involved in terms of time span, reach and (of course) costs.

As a first approach to attain this goal and the change in the dredging contract paradigm, in 2018 the partial tender was placed reducing paperwork and performing a partition in the works carried out (considering the equipment used THSD or WID). Allowing an offer to be made for one or the other or both if possible. Direct contact and briefing was maintained all through the process, and special meetings were maintained with all the companies at the same time, giving all the contenders the required information that would lower the uncertainties, thus providing the grounds for an adjusted offer.

5.4 Being ready to be flexible

The Bahia Blanca 2040 Port Vision has provided the basis for the ongoing Master Plan, and amongst the various tasks to be performed, one of the highest priorities is the gathering and improving of all the basic data available, to be able to conduct the studies that will provide grounds for the development of future projects.

When it comes to waterways and its design, in the 80's a thorough study was carried out by a group of Dutch consulting companies, applying what was at the time state-of-the-art tools (including computational sedimentation models). Also, it included hundreds of field measurements of current, suspended sediments, bottom sediment, wave climate and tide at several sample points. Besides this, a comprehensive bathymetric survey was carried out along several potential layout areas.

But although the data is still used today, a lot has changed since. Not only in the equipment and methods used in the data collection and processing, but moreover in the estuary itself. More than 30 years have seen big morphological changes in the estuary. So, there is dire need to update and improve data to be able to have a better understanding of the estuary today, and the future development of its waterways.

Back in 2012, and because of the ever-increasing sedimentation in the Toro channel, a minor correction was carried out in the layout that meant shifting some 80 meters further south the curve near an advancing sand bank and adjusting the layout to maintain the curve radius and navigation conditions. This sole action meant cutting by half maintenance dredging at the zone. This proves the necessity of knowing what is happening not only in the waterways but also in its surroundings.

To improve such knowledge, and to have further control on the dredging works, the CGPBB has developed is of 2018 its own Survey Department with state of the art Multi Beam and Inertial GNSS equipment. This will ensure a better understanding through periodical soundings of the changes in morphology, also providing data to conduct accurate volume calculations.

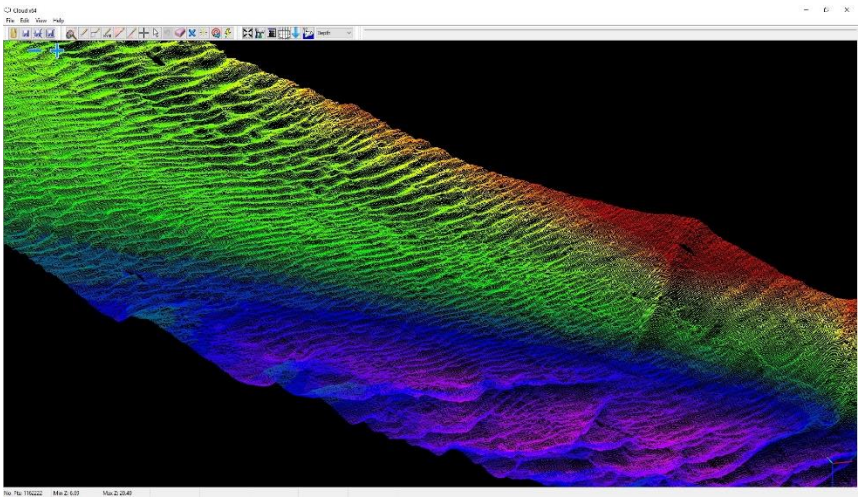

Figure 10: Multibeam Survey

Another action derived from the 2040 Vision is to initiate studies and data collection that will enable to set up, calibrate, validate and eventually run a Hydrodynamic mathematic model of the Estuary, including its waterways. It will provide enough detail to evaluate currents and water heights at every place and at all times. Having such a tool will generate useful information for setting up a Sedimentation model and Environmental one. All these tools will serve as the basis for layout and geometrical design of future waterway or the modification or deepening of the current ones. Enabling the analysis of multiple scenarios and, by comparison, the arrival of the best solution. Adding to these, a cooped manoeuvre simulator could provide information that could provide how vessels would react to modifications, or even be used to train pilots to sail new vessels that have not yet visited the system.

Being able to own and operate such a tool will give the CGPBB an unparalleled flexibility to analyse all possible requirements in a fast and trustworthy manner, provided the needed information to carry out the works (dredging, modifications in AtoN etc.) or eventually provide the basis to prepare tenders to achieve the desired goals.

Not only can mathematical modelling help with the analysis of future designs. Increasingly in other channels throughout the world the concept of Dynamic Under Keel Clearance (DUKC) is being used as a way of allowing safe sailing without over dredging. The waterways in the Bahia Blanca Estuary could profit immensely from its adoption.

Today every foot turns into almost a million cubic metres of annual sedimentation, which constitutes several million U$D. So, having a reliable tool to forecast high waters and wave climate and being able to have an improved management of the tide window and drafts could provide a deeper waterway without dredging, meeting the requirements of the users with a fraction of the cost as compared to deepening.

As a summary one could say that being ready is having the information and the possibility of developing the tools in a short amount of time. Also, not less important, is to have the staff prepared to handle and to analyse these data. Training the personal at the CGPBB to cope with the required new skills, then becomes a task to tackle immediately.

5.5 When to change

As with dredging contracts, the time has come to exercise a change in paradigm when it comes to waterway planning. And as mentioned before, hearing what others have to say is perhaps the most important factor. In line with what was promoted in the Port's 2040 Vision and Master Plan all the stakeholders have something to say and must be heard. Of course, some of them will request deeper or wider channels, or better signalling, or lower fares, it is then up to the CGPBB to correctly analyse all these requests and promote those actions that sees fit to improve the waterway accordingly. There won't be complete satisfaction, but from interaction there will surely be a better understanding between the parties.

But change won't come only from local or regional request, worldwide shipping must be considered. In the past changes in the world fleet were slow to be acknowledged, leading to loss of cargo, greater downtimes or hasty works to adequate to newcomers with greater dimensions. Today the access to information allows to keep track of tendencies regarding the types of ships likely to call upon port, considering new orders placed on the main shipyards, or the constitution of the actual fleet. This is done regularly to ensure that the system will be able to cope in the foreseeable future with the traffic expected.

Nevertheless, a Port must also be prepared, should the case arouse of a different type or cargo, which in term will require a different kind of ship. For this reason, definition in waterways is a subject to which all areas within the CGPBB should relate. It takes a couple of years to build (depending its size), approximately the same time required to make changes to the waterways.

So, the time to change will be promoted by the need to change, but to be able to do so one has to be willing and prepared.

6 CONCLUSIONS

Up to recently, planning of waterways was mainly done considering what others (the government) stablished as the goals to achieve. This partially was modified once the CGPBB began to operate (and maintain) the waterways. The requirements of potential operators were seldom considered or evaluated.

A first attempt came when in 2013, when partial capital dredge was carried out to improve congestion in the port area and the associated increasing downtimes. Assumptions and forecast made at the time concerning rise in traffic turned out to be too optimistic. Conditions in and out of the country prevented the envisioned development to happen.

A great landmark came in 2017 with the realization of the 2040 Port Vision as the stepping stone to making a Master Plan. This innovative tool provided much needed feedback of all the port's activities, in particular, what the stakeholders needs are and the requirements for the future in all aspects.

Another important issue is the ever-increasing maintenance dredging cost and how it affects the port competitivity, consuming an increasing share of the budget. This calls to address a change in paradigm when it comes to Dredging Contracts, modifying the way tenders are conducted and the interaction with offering companies, partitioning tasks, time span, avoiding unnecessary bureaucracy etc.

Providing due time for studying all the information and analyses of potential scenarios, to be ready to react to new needs is of the upmost importance. Also, having a constant oversight of the world's trend in fleets likely to call port and interacting fluidly with all the stakeholders on a regular basis.

Being flexible when it comes to waterways is to be prepared to adapt to the immediate needs, to be cost effective and, not less important, environmentally aware. Not preforming unnecessary capital dredging that will entail greater maintenance afterwards. In all, dredging should be the last resort, after improving aids to navigation and operational management tools.
The Port of Bahia Blanca began to implement measures that hopefully will set the bases for achieving flexible planning when it comes to its waterways, in a cost effective and greener way.

7 REFERENCES

ABITANTE O., LINARES J. and SCHNEGELBERGER M. (2007): Anteproyecto Conectividad Marítima del Sistema Interior

NEDECO Netherland Engineering Consultants and ARCONSULT Consultores Argentinos (1983): Estudio de Dragado del Canal de Acceso al Puerto de Bahía Blanca

OPERATIONS DEPARTMENT CGPBB (1993-2015): Anuario Portuario years 1993-2017 Traffic statistics