

An Analysis of the Zoning of Petroleum Exploration & Development Blocks Proposal Developed by the Geology and Petroleum Department



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1. INTRODUCTION:

The Government of Belize (GOB) through the Geology and Petroleum Department (GPD) has drafted a zonation of petroleum exploration and development blocks. The Belize Coalition to Save Our Natural Heritage is desirable to provide input to this zonation plan. Following up on this, the Association of Protected Area Management Organizations (APAMO) has engaged the services of the Consultant in the context of a consultancy by: promulgation of a report of the complete analysis of Government's proposed zonation for petroleum exploration and development blocks, with particular emphasis on the zoning for marine/coastal areas and terrestrial protected areas.

2. METHODOLOGY:

The first step undertaken was an analysis of the existing presentation by the Geology and Petroleum Department (dated November 15, 2011). The zonation is effectively a GIS (Geographic Information Systems) exercise, and therefore the appropriate geographical baseline layers need to be identified.

On three separate occasions, it was attempted to engage the Geology and Petroleum Department in a discussion in order to establish the rationale behind the choice of some of the base layers and particularly the weighting system used, but such meetings were denied. Even though the analysis thus had to be carried out without the benefit of feedback from the GDP, there were no serious issues identifying the base layers used.

A web search was carried out to identify any other Petroleum zoning schemes developed elsewhere in the world and the methodologies used therein.

Additional baseline layers for potential incorporation into the zoning system were identified based on existing resources and grey literature in the field of Protected Area Management and overall GIS applications.

Principal considerations during the analysis were:

- Objectivity, use only recognized, publically available data and do not manipulate these in such a way as to guarantee a desired outcome
- Create theme-based layers and use one set of data only once in order to prevent "double dipping"
- Be aware of existing (official or de-facto) policies which may have an impact on whether certain layers are acceptable or not.

Meetings with APAMO and the Coalition were held on February 23, 2012; March 16, 2012 and April 4, 2012. This presentation reflects these consultations.

3. ANALASYS OF THE 2011 GDP ZONING PROPOSAL:

The analysis here follows the outline of the PowerPoint Presentation prepared by the GPD.

a. Protected Areas

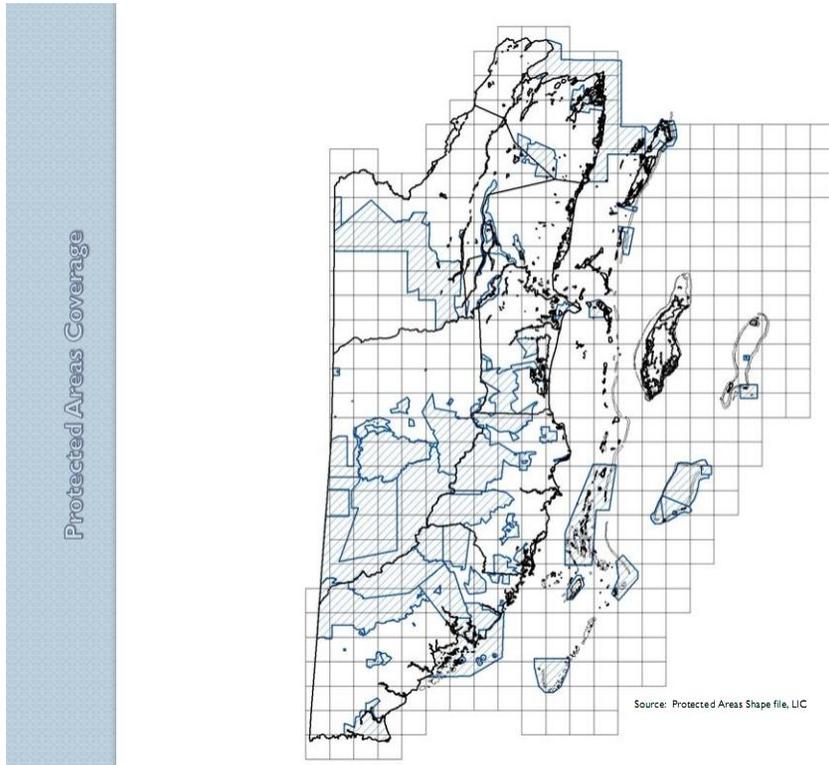


Figure 1. Protected Areas

Values assigned:

Protected Area: 3

This is the principal layer included in the analysis. For obvious reasons this is a base layer that is essential to include. However, giving them a standard rating of "3" is too coarse. Some protected areas are more critical than others. Some should even be virtually "inviolable":

b. Ecosystems under Stress

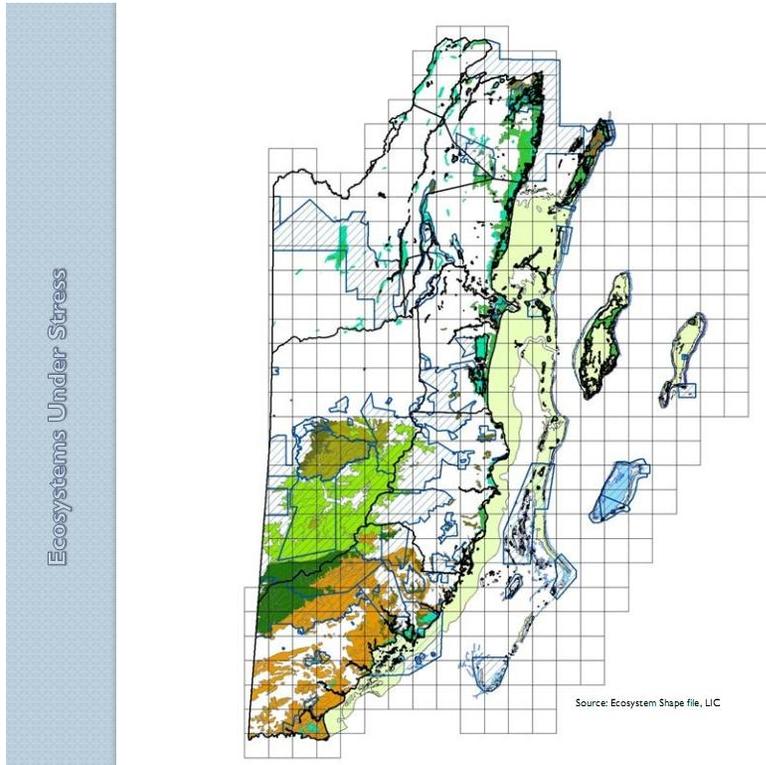


Figure 2. Ecosystems under stress

Values assigned:

| | |
|-----------------------------------|---|
| Mangrove & Littoral Forest | 3 |
| Coral Reef | 3 |
| Seagrass | 1 |
| Submontane Broadleaf Wet Forest | 3 |
| Submontane Broadleaf Moist Forest | 2 |
| Submontane Pine Forest | 2 |
| Lowland Broadleaf Dry Forests | 3 |
| Lowland Pine Forest | 2 |
| Lowland Broadleaf Wet Forest | 1 |
| Marshes, Lakes, Lagoons, Swamps | 2 |

Ecosystems are another essential base layer in the zoning plan. However, the rationale for the ranking of the ecosystems is unclear. The heading "Ecosystems under stress" implies an existing threat to these specific ecosystems, but this is not supported by the

ranking.

Replacing "Ecosystems under stress" with "Ecosystem Services" would improve the level of analysis.

c. Miscellaneous

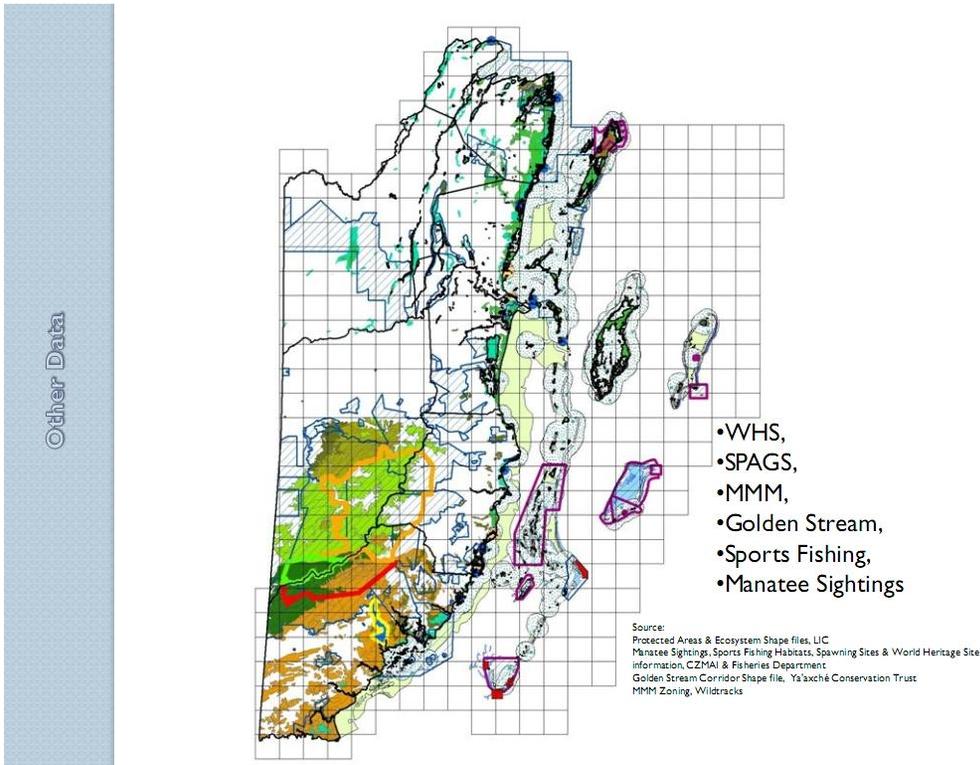


Figure 3. Other Considerations

| | |
|---------------------------------|---|
| Values assigned: | |
| World Heritage Site | 2 |
| Marine Fisheries Spawning Sites | 3 |
| Manatee sightings | 1 |
| Sport Fishing Habitat | 1 |
| Golden Stream Corridor | 1 |
| MMM Zoning | |
| Core preservation zone Ia(i) | 3 |
| Core preservation zone Ia(ii) | 2 |
| Core preservation zone Ia(iii) | 1 |

The inclusion of these miscellaneous layers is correct but needs to be supported by a rationale. Reviewing the layers separately:

World Heritage Sites

Given the international importance, this layer

is essential to include. However, they are essentially a component of the protected areas layer and would be better integrated there.

Marine Fisheries Spawning Sites

Given the critical importance of these sites for fish resources, the layer is essential to include. However, they are already a component of the Protected Areas Layer and their importance should not be restricted to just the small area enclosed within the PA. It would be better to create buffers around these SPAGS

Sport Fishing Habitat

Uncertain why this is included. The justification in the presentation states "User based data that relies of specific ecosystems". Obviously, it attempts to recognize an important source of tourism revenue. Possibly, it should be incorporated as a broader "Tourism" Layer.

Manatee sightings

This is a good dataset to include. However, the dataset used appears to contain only a few records and should be updated. Also, it would be good to buffer the individual sightings in order to come to areas of particular importance to manatees.

Golden Stream Corridor

The justification for including this layer in the analysis was "included as integral to wildlife movement". The Golden Stream Corridor Reserve has already been incorporated in the PA layer. Moreover, singling out the Golden Stream Corridor overlooks the importance of the Belize Biological Corridor as a whole. The entire Biological corridor needs to be incorporated.

MMM Zoning

Incorporating existing or proposed PA zoning is a recommendable approach. However, since this zoning is an attribute of the Protected Areas layer, it should be incorporated in that, and not added as an extra layer. Also, the GPD proposal only considers the MMM zonation, and overlooks that this has been modified later in the Chiquibul Management Plan.

Also other Protected areas have zoning implemented as identified in the 2010 Forest Policy Recommendations from Protected Area Managers, Meanwhile, zoning in Marine Protected Areas is standard practice.

d. The use of the block system

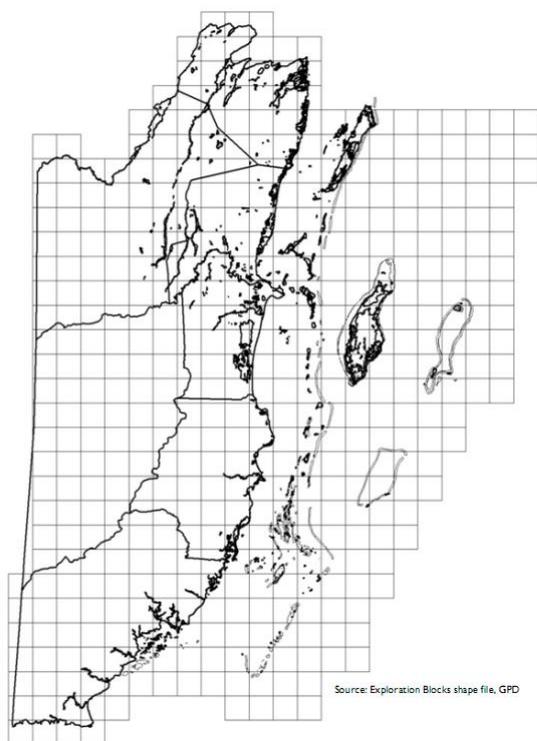
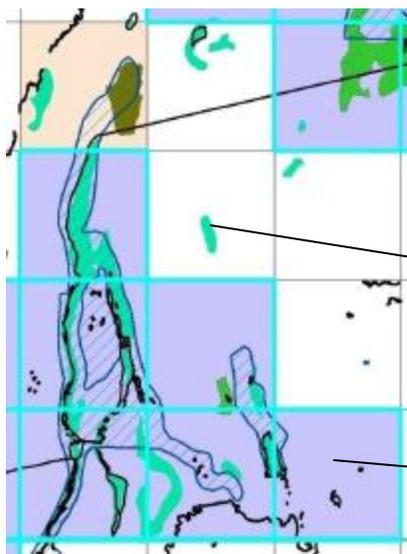


Figure 4. 10 x 10 km block system

The zoning plan as proposed by the GPD uses a 10 x 10 km grid system. These are the "Petroleum Blocks" used in the department for the management of the various Petroleum Concessions.

However, petroleum concessions are not necessarily assigned according to these block boundaries. They do follow strict coordinates but a single block can easily be divided under 2 or 3 different concessionaires. Consequently, the 10 x 10 km grid should not be seen as an imperative for a zonation scheme.

The principal weaknesses of a zoning scheme following a 10 x 10 km block system is that it is rather coarse for a small country such as Belize.



It can be argued that restricting zoning to 10 x 10 km blocks could result the loss of areas open for exploration/exploitation or could lead to damage to small but critical features that did not trigger the selection of its containing block as a special zone.

This block is empty and thus ranked as zone 4. But what happens to this small feature here. Is it important? fragile?

This block is contains a small fraction of the Crooked Tree Wildlife Sanctuary. Should the entire 10 x 10 km block therefore be part of a special zone?

Figure 5. Block system limitations

Zonation does not have to be restricted to these blocks (even though they would simplify administration), with the increasing levels of GIS functionality and capacity within various departments, there is no need to do so. Features can be assessed individually and or in conjunction with others. Making a zonation plan more detailed will also allow it to be used in a tool within the EIA process.

4. RECOMMENDATIONS FOR IMPROVEMENT OF THE ZONING SYSTEM

While the proposed zonation scheme would be functional, it should be considered too coarse for the benefit of both the environment and the petroleum industry. For this reason, suggestions are being made here to improve and fine-tune such a zonation scheme. It has to be stressed that these are suggestions only.

Firstly, it is suggested to have a separate zoning for terrestrial and marine projects. The differences between terrestrial and marine areas become initially clear during the exploration phase. Exploration activities typically require extensive seismic work. While the impacts of seismic work on are largely restricted to access issues, in the marine area the sonic blasts that are used travel wide and far. Sonic blasts are still very detectable at a distance of 10 km or 6.7 miles (Day 2002, Hooker et al. 1999, Royal Soc. of Canada 2004, Salm et al. 2000). While the effects of sonic blasts are being debated, there is a consensus that they are harmful to marine mammals.

More important are the associated risks that come with drilling and extraction, in which case the risks between terrestrial and marine areas are fundamentally different.

In the case of an incident on land, a rapid containment is likely. In the marine environment, without any effective barriers and an average current of 1-2 knots¹. Spills can travel quickly.

In the case of a marine spill, it can take 24-30 hours after calling out the incident for a Marine Oil Spill Company to arrive on the scene². By that time, a spill can have traveled between 44 and 110 km (30-75 mile) from the source based on current alone. Given the fact that a spill is unlikely to lead to mobilization at the same instant it occurs, a call out time of 24 hours is not unrealistic. In the case of the Deepwater Horizon Incident, the call out time was 48 hours. In the case of Belize, the spill can travel anywhere up to 220 km (150 mile).

Once on site it could possibly take 48 hours or more to get an oil spill under "control" by means of booms and or the deployment of dispersants, meanwhile, a spill could travel even further. To put these figures in perspective, the Belize Barrier Reef has a length of approximately 250 km (170 mile). In other words, a spill could traverse the length of the barrier reef in less than 3 days.

¹ The knot is a unit of speed equal to one nautical mile (1.852 km) per hour,

² Skip Przelomski, VP and Senior Technical Advisor, Clean Caribbean telecon 4/4/2012

5. TERRESTRIAL ZONATION

a. Protected Areas

Protected Areas are essential to include in this analysis. However, giving them a standard rating of "3" is too coarse. It is recommended to incorporate some ranking that recognizes that some protected areas are more critical than other PA's. Some PA's should even be virtually "inviolable":

There have been a number of attempts to rank protected areas:

- a. Meerman, J.C. 2005: National Protected Areas Systems Plan: Analysis. Which includes an attempt to classify protected areas on their biophysical characteristics (ecology + species)
- b. Wildtracks 2009. State of Protected Areas Analysis. APAMO. This provides a similar rating system for a number of Marine Protected Areas based on biodiversity.

Combining the above two classifications into one new scale and modifying it to **a scale from 1-100** is reflected in figure 6.

But within these protected areas are PA's or parts thereof that should be virtually off-limits. Protected Areas receiving this in this class include:

- 1) National Monuments
- 2) Spawning Aggregations
- 3) Bird Sanctuaries
- 4) World Heritage Sites

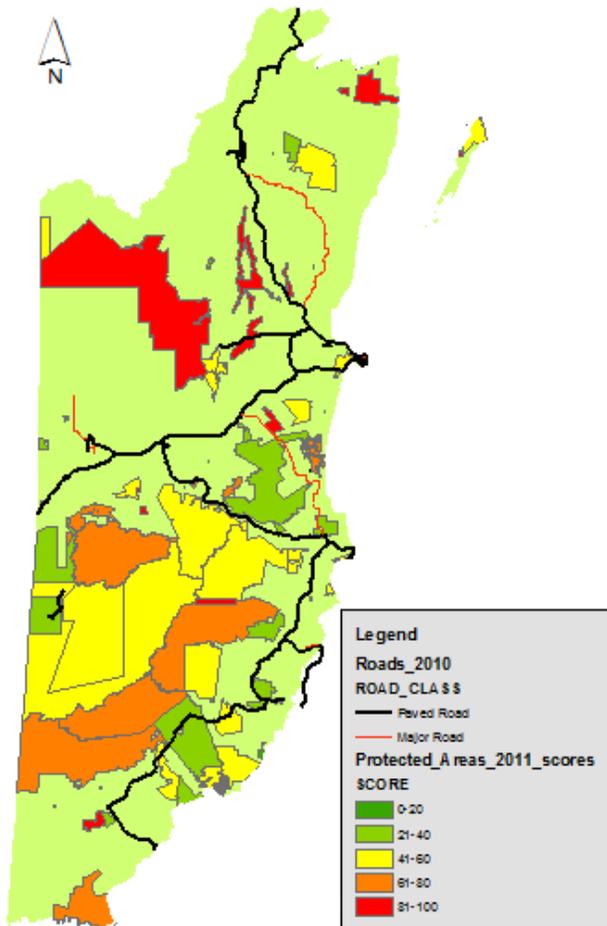


Figure 6. Protected Areas ranking



Figure 7. Special Zonation Considerations (100 points)

In addition to this, many protected areas have zonation schemes proposed or prescribed. These are best developed in Marine Protected Areas, but increasingly applied to terrestrial protected areas. There is little agreement of the terminology and various categories of Zonation (Meerman & Cayetano 2010). But based on their study the following zones should be considered of the highest level (figure 7):

- Core-zones as in the Chiquibul Maya Mountains and Aguacaliente NP.
- Tourism Zones as in the Chiquibul

This list of zones is by no means exhaustive and subject to constant modifications as is the protected area dataset itself.

This Protected Areas ranking does not consider Private Protected Areas or areas with other forms of conservation management in place. Such areas include Private Protected Areas seeking recognition as a Protected Area through the Belize Association of Private Protected Areas (BAPPA), nor does it consider other forms of conservation management such as proposed for the Turneffe Atoll (Figure 9) in the marine realm. At the same

time, such un-conventional conservation activities have been known to be highly effective and a case could be made for their inclusion in the zonation scheme. But since these areas still lack official recognition, they have been left out for the time being.

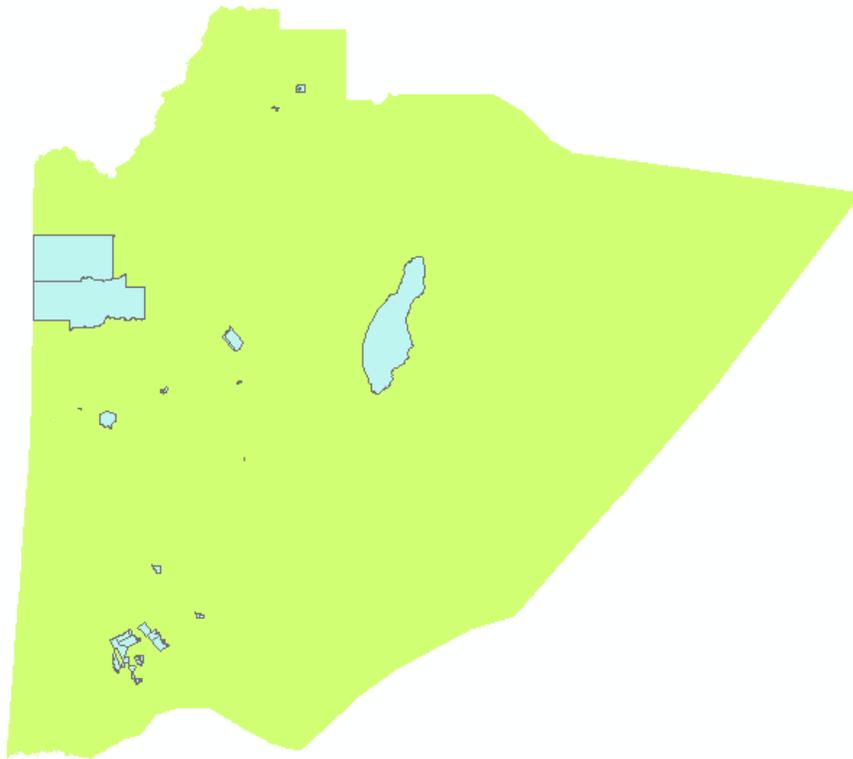


Figure 8. Other Conservation Management Areas

b. Ecosystem Services

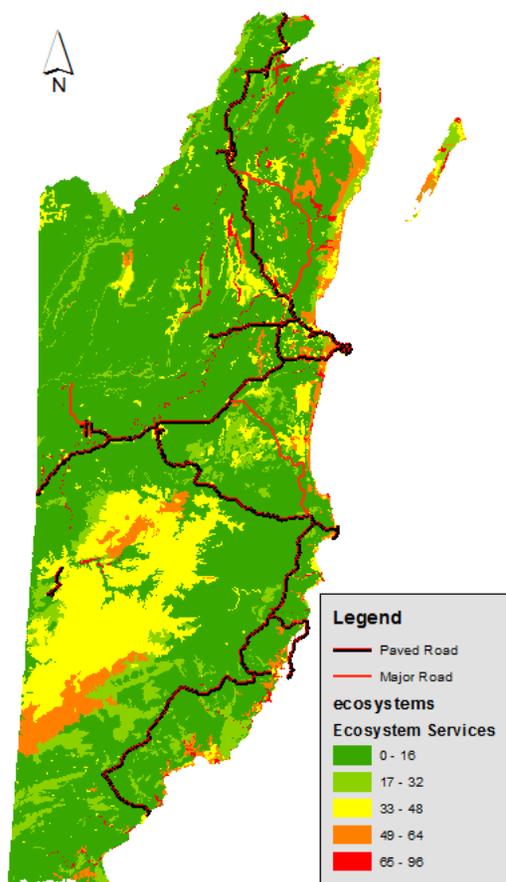


Figure 9. Ecosystem services ranking

The Ecosystems Map utilized in the draft-zoning plan was the 2004 Ecosystems Map prepared by Meerman for the NPAPSP. Meanwhile an updated version has been prepared for use in the the National Land Use Policy and this should be applied here.

Instead of "Ecosystems under Stress", it is suggested to focus more on Ecosystem Services. This approach can be taken irrespective of any protected status of the ecosystem.

A first attempt to such a ranking based on services was carried out in Meerman, J.C. 2005: National Protected Areas Systems Plan: Analysis. Building on the experiences gained during the development of that specific ranking system, a new ranking system is being proposed based on Ecosystem Services. These include:

- **Rarity:** Not a true ecosystem service, but recognizes those ecosystems that are exceptionally rare or small in extent.
- **Hydrology:** Which effectively relates to the importance of watersheds and water catchments. All Submontane and Lower Montane as well as all steep terrain have been included in this.
- **Wetland:** Recognizing their general fragility, their overall biodiversity value and their value for local hydrology and flood buffering.
- **Tourism:** Those ecosystems deemed to be crucial to the tourism

industry in Belize. These include scenic hilltops, but particularly coastal areas, reef and littoral forests.

- **Coastal Protection:** Barrier Reef and Coastal Mangroves.

In order to give this layer the same weight as the Protected Areas Layer, a system was devised where each ecosystem could be ranked from 0 to 100. However, the highest score using this system was 96 (Riverine Mangrove).

c. Biological Corridors

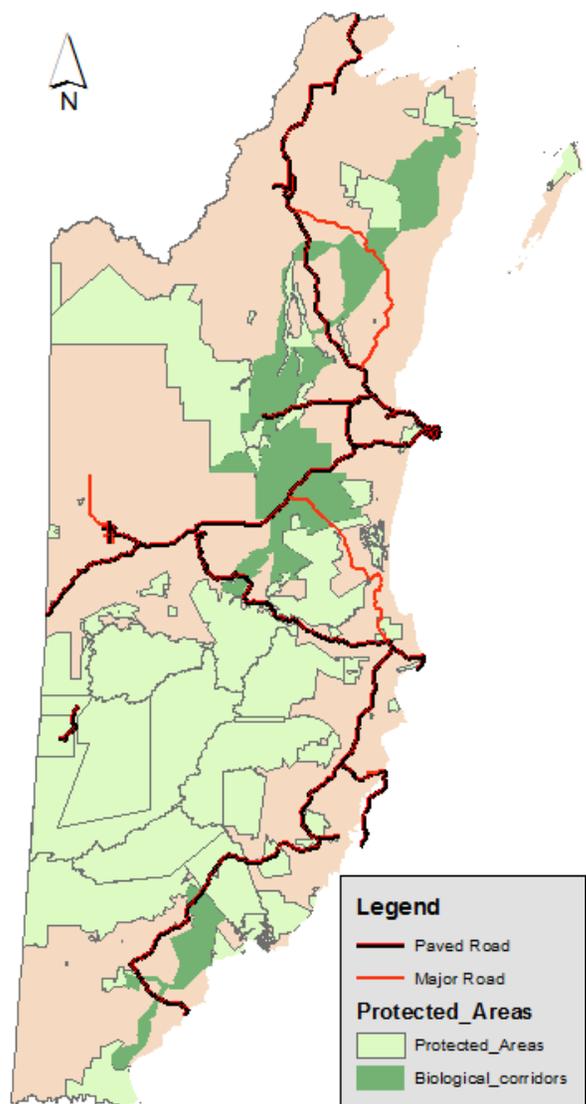


Figure 10. Proposed Biological Corridor linking Protected Areas

There is merit in incorporating a layer depicting the entire Belize Biological Corridor that is based on a study in 2000 as part of the Northern Belize Biological Corridor Feasibility Study, The corridor then included Northern Belize up to a link with the Hummingbird Highway in Central Belize. In 2002, this was extended with information for Southern Belize. In 2011, the University of Belize started work in the Central Belize Biological Corridor and conducted a study to validate the design of the corridor. In 2011 the three sources were combined into one single file. Simultaneously, the viability of the suggested corridor route was validated using 2010 Landsat TM images.

Principal change in the 2011 version is that the corridor is represented by actual terrain and not by weighted arrows as in the 2000 and 2002 versions. Private Protected Areas are recognized as forming part of the Biological Corridor if they are en route between statutory protected areas.

As Petroleum Exploration and Exploitation would not necessarily have a great impact on wildlife movement, this combined layer was weighed at 10% of the Protected Area Layer and Ecosystem Services Layer and thus received a maximum of 10 points.

d.

Key Biodiversity Areas;

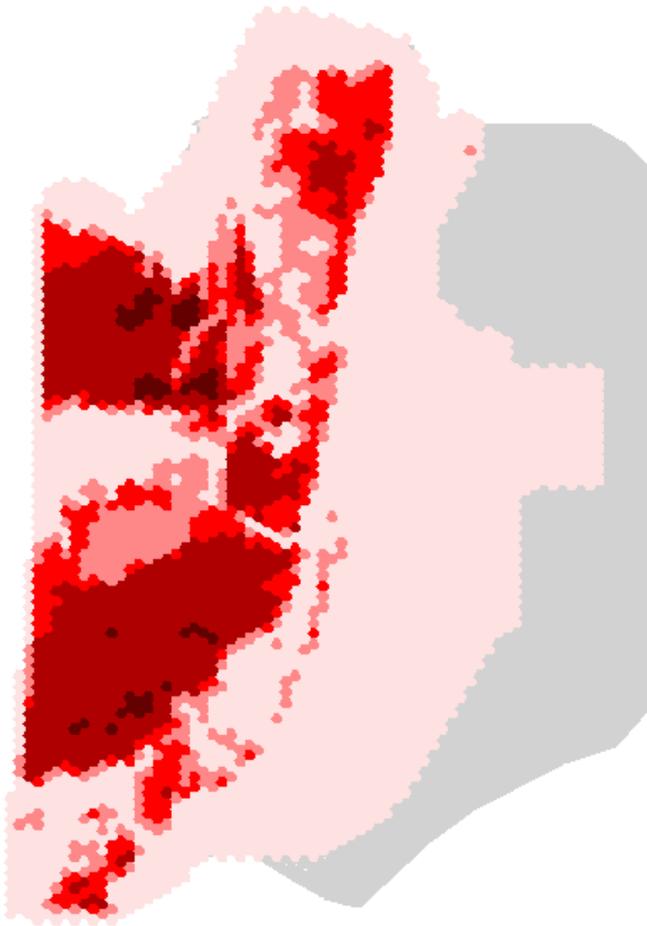


Figure 11 Terrestrial Key Biodiversity Areas

In 2007, Conservation International conducted a Key Biodiversity Analysis for terrestrial Belize (Meerman 2007). This analysis ranks areas of Belize on the basis of the presence or absence of IUCN Redlisted species for Belize. Using this approach, a spatial analysis was achieved that ranked terrestrial areas on their importance for threatened species. It is proposed that this layer be included in the Petroleum Zonation Analysis.

As Petroleum Exploration and Exploitation would not automatically have a great impact on wildlife movement, this combined layer was weighed at 10% of the Protected Area Layer and Ecosystem Services Layer and thus received a maximum of 10 points.

6. CONCLUSION TERRESTRIAL ZONING

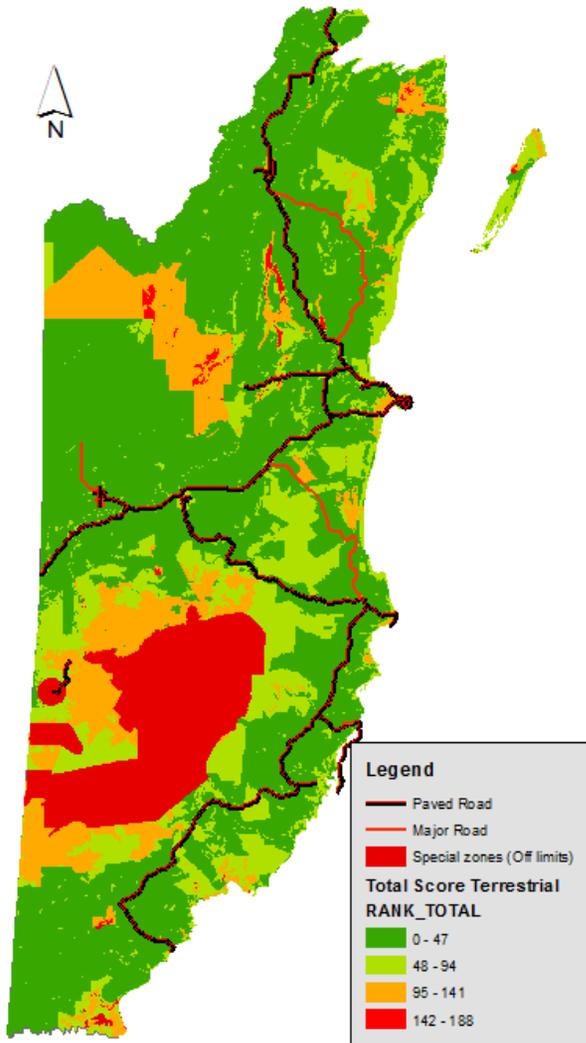


Figure 12. Possible Outcome of a ranking system when recommendations are followed

Following the recommendations outlined above, a new zonation ranking scheme surfaces (left image) that is much more detailed than the one proposed by the GPD (right image). Some elements are still recognizable but overall there are considerable refinements and changes.

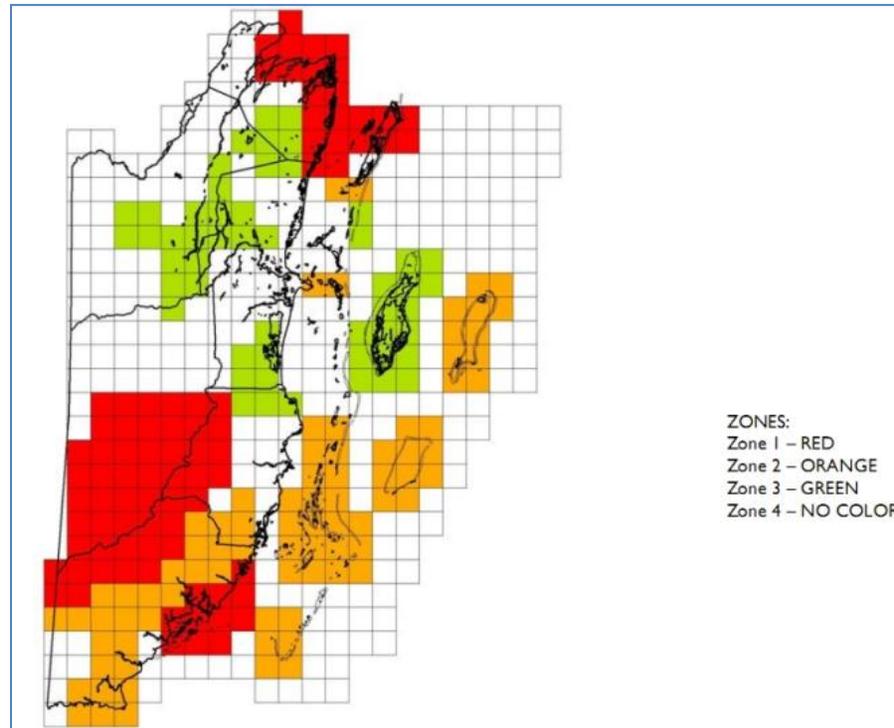


Figure 13. Original GPD zonation scheme

It is possible to translate the ranking system into the same four as suggested by the GPD:

Based on this 4-tier ranking system a Zonation description is suggested that describes the zone requirements. This zonation description follows the example set by the GPD but has been fine-tuned as to incorporate better the Environmental Impact Assessment regulations and methodologies used in Belize. These descriptions again are here only for demonstration purposes.

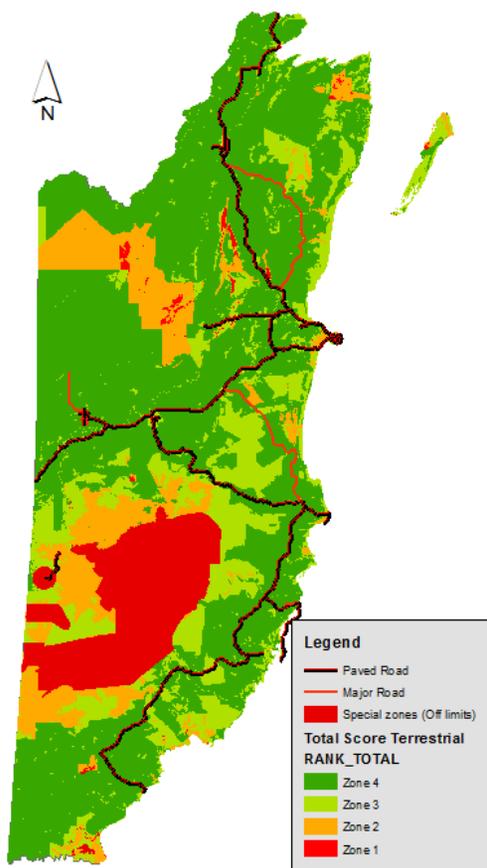
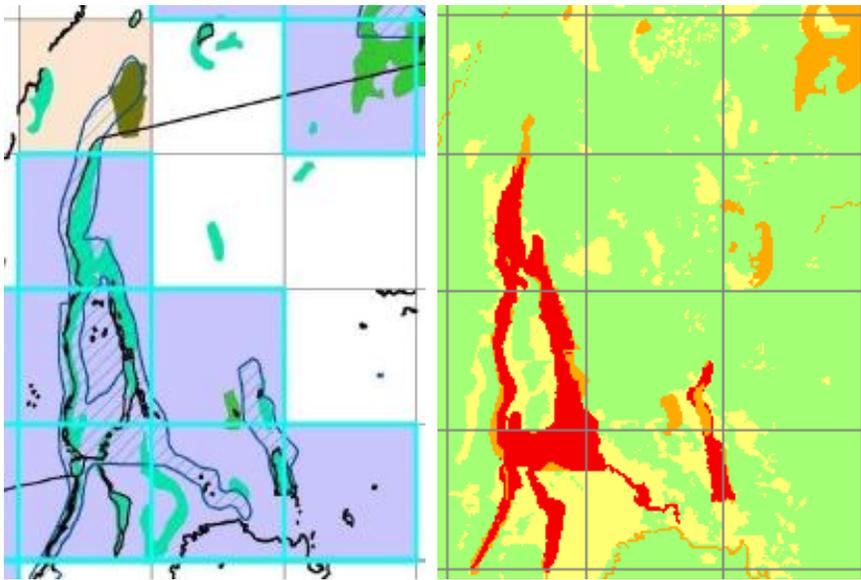


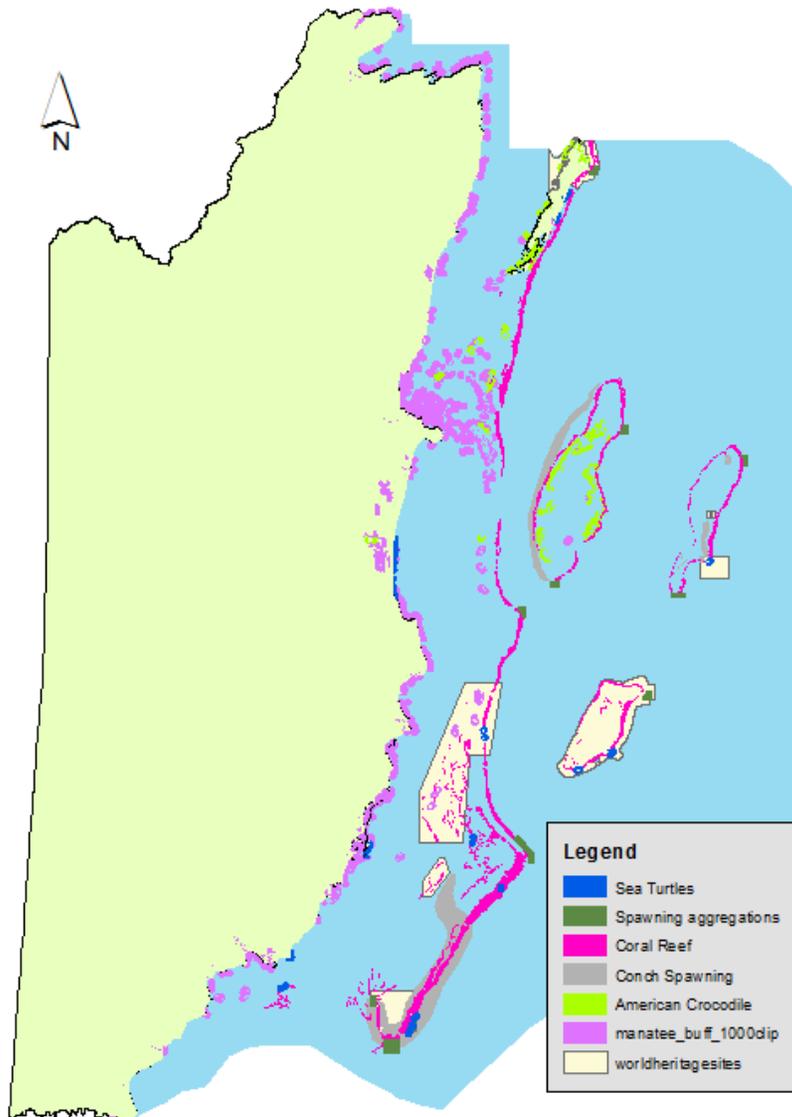
Figure 14. Four possible planning zones

| Zonation | Description | Tally |
|----------|--|---------|
| Zone 1 | Area is off limits, "no exploration/exploitation activities" | 121-240 |
| Zone 2 | Area is subject to strict regulations. Any activities will require consent from relevant authorities and those responsible for the management of any protected areas. Both exploration and exploitation are subject to a full EIA, which include consultation with co-managers of protected areas and major users of the area such as the agricultural and tourism industries. Depending on the activity, wide buffer zones <u>should be expected to be implemented</u> around sensitive features. | 61-120 |
| Zone 3 | Area is subject to strict regulations. Any activities will require consent from relevant authorities and those responsible for the management of any protected areas. Both exploration and exploitation are subject to a full EIA, which include consultation with co-managers of protected areas and major users of the area such as the agricultural and tourism industries. Although some specific features may be off limits, no large buffer zones will be required | 31-60 |
| Zone 4 | Area is free for exploration and development activities that are processed through the usual methods by the relevant authorities | 0-30 |

Re-considering the issue of a zonation tied to the 10 x 10 km grid compared with a more GIS based zonation system, the previous Crooked Tree example is compared here with the proposed methodology.



7. MARINE ZONATION



As in the terrestrial zonation example, various layers could be used in a ranking system for Marine Petroleum Zone planning.

World Heritage Sites

This layer needs to be added for obvious reasons and needs to be classified as off limits for all petroleum exploration and exploitation.

Marine Fisheries Spawning Aggregation Sites

Similarly this layer needs to be added and needs to be classified as off limits for all petroleum exploration and exploitation.

Conch Spawning Areas.

Existing data need to be used similarly ("buffered" to 1 km to indicate environmental distribution) to indicate areas where this commercially important species reproduces.

Manatee sightings

It is proposed use a CZMAI layer containing 2004 and 2005 count records or more up to date if available. Here, each record from that period has been "buffered" (in order to better approximate environmental distribution) to a radius of 1 km around the sighting(s). Subsequently only those buffers containing more than a single record are to be

included in the base layer for this species. The latter will put the focus on the key areas for Manatee distribution.

Turtle Nesting Sites

As in Manatee sightings "buffered" to 1 km to indicate environmental distribution.

American Crocodile Core Areas

As in Manatee sightings "buffered" to 1 km to indicate environmental distribution.

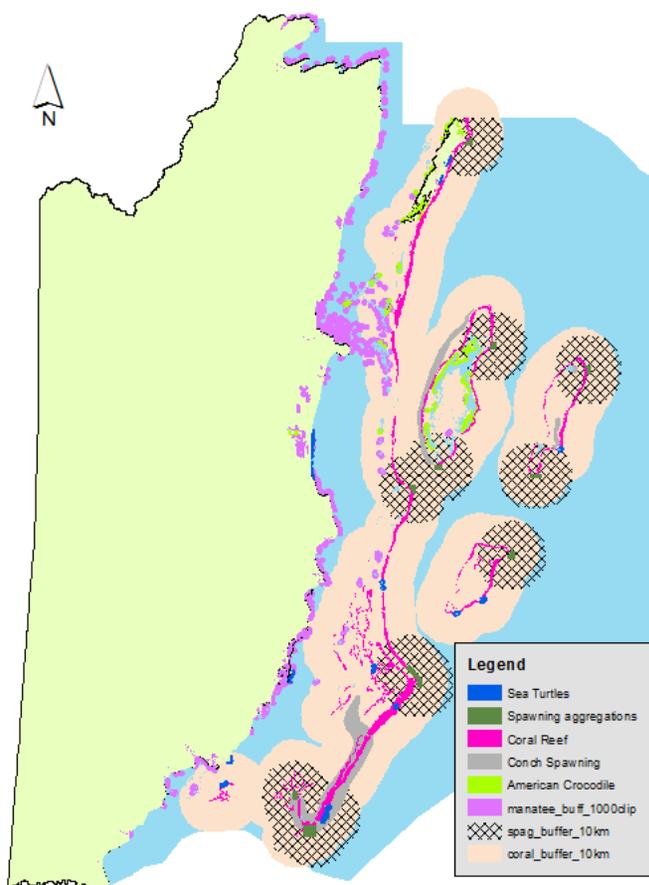


Figure 16. 10 Km safety buffers around reef and SPAGs

With the above marine features it is clear that somehow giving extra protection to a species based on the observation of a limited number of individuals is not sufficient. For this reason "buffers" have been added in some cases as a strictly spatial technique in order to better represent environmental distribution of the species.

In the case of features such as Coral Reef and Spawning aggregation sites, a similar spatial "buffer" can be applied, but in this case more specifically to create a "safe zone" around these features. The width of such safety buffers is open to debate. In this case an example is presented whereby the following safety buffers were applied

- Coral reefs with a safety buffer of 10 km
- Spawning Aggregations with a safety buffer of 10 km

These proposed buffers essentially attempt to mitigate the risk of the potential rapid spread of hydrocarbons in the marine environment as the result of a calamity.

The 10 km buffer for coral reef and SPAGS is based on a literature

search (Day 2002, Hooker et al. 1999, Royal Soc. of Canada 2004, Salm et al. 2000) and refers specifically to a buffer zone set specifically to protect Cetaceans from the effect of acoustic tests (seismic research). The literature also shows that this or any safety buffer width remains highly arbitrary.

When considering the observations made earlier, whereby it was noted that a marine spill can potentially travel anywhere from 88 to 220 Km (30-150 mile) before there is any realistic chance of containment, the creation of a 10 km safety buffer around certain features appears to be a futile effort. Based on this observation, a safety buffer would need to be anywhere from 88 to 220 km wide. But even a "compromise" safety buffer of 50 km (around Reef, Spags and WHS) would effectively cover the Belizean waters (figure 17).

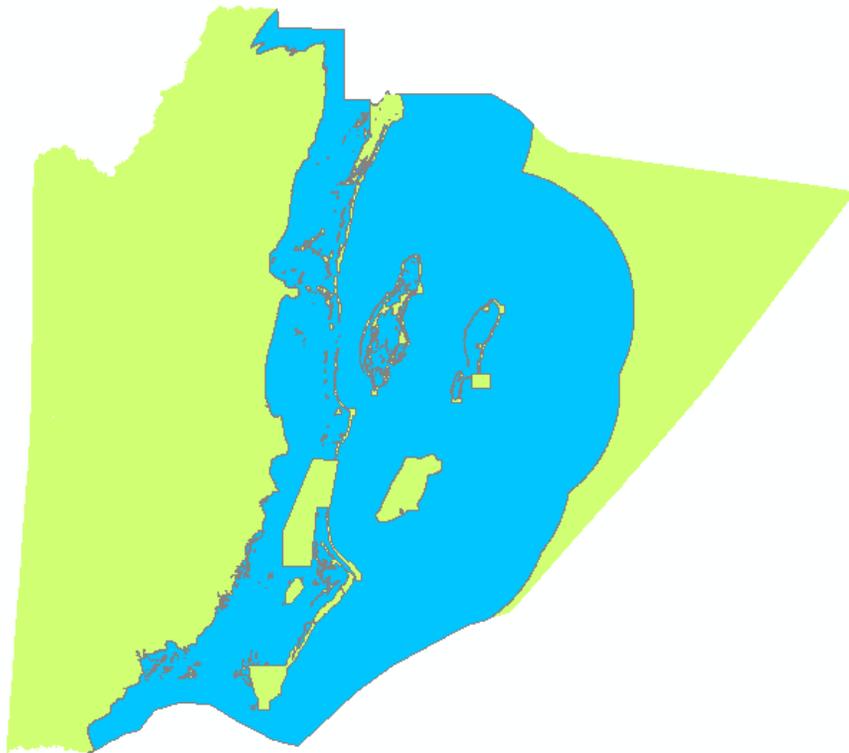


Figure 17. 50 Km buffer around reef, Spags and WHS.

With a need for such wide safety buffers, zonation considerations as applied for the terrestrial part of Belize effectively disappears.

Another consideration for marine drilling is the financial capacity of the companies exploring in Belize. With all the large companies having effectively abandoned Belize, the onus is now on small entrepreneurs with limited financial capacity. Drilling in deep water requires specialized equipment (figure 18) with associated higher

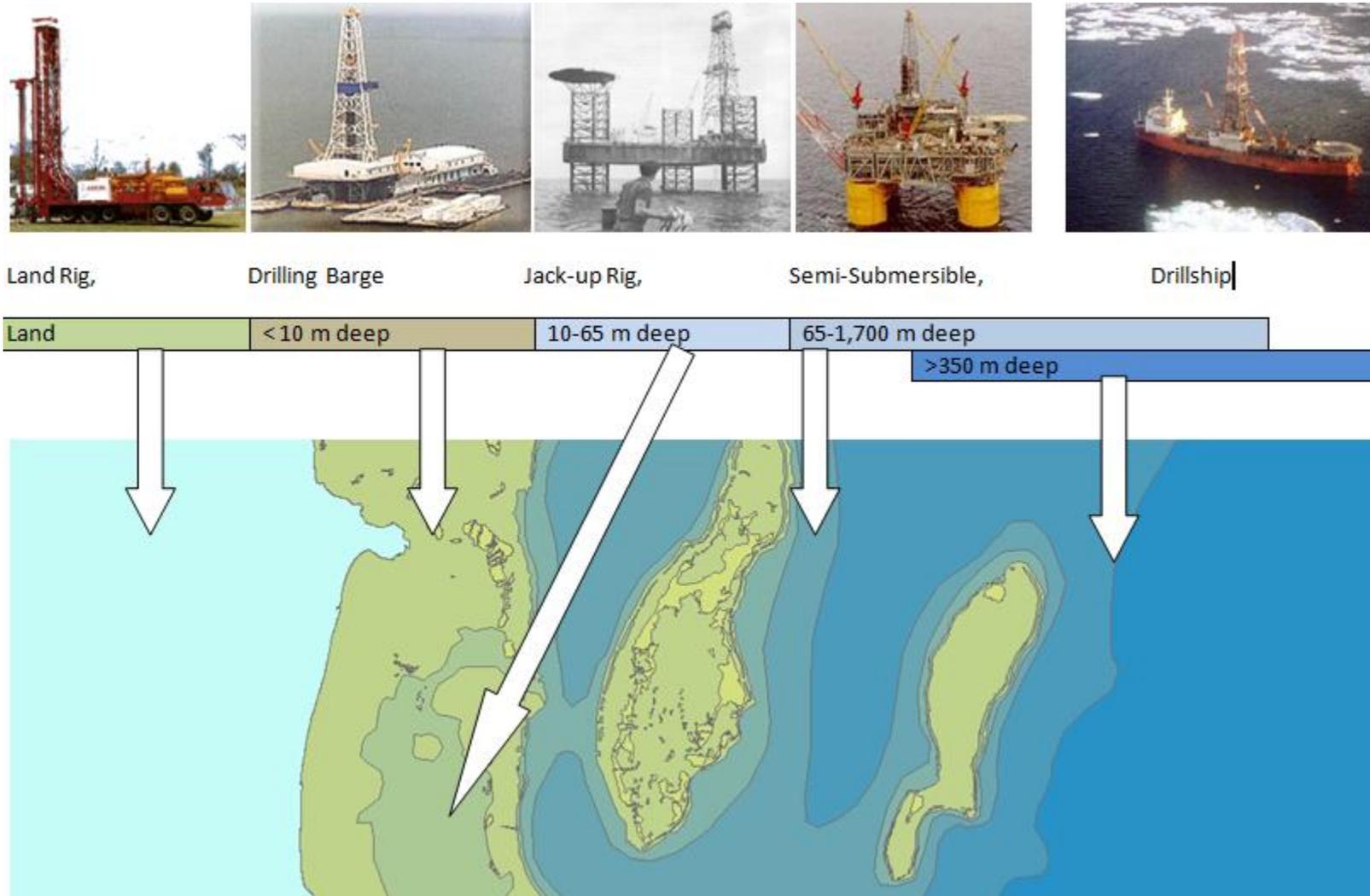


Figure 18 Various Drill Rig Types and their potential use in Belize

investments and higher risks (both financial and environmental). Given the fact that the expected oil and gas reserves in Belize are not likely to warrant the investment of semi-submersible rigs or drill-ships, drilling in water deeper than 65 meters should be considered unrealistic for Belize.

8. CONCLUSION FOR MARINE PETROLEUM EXPLORATION ZONATION

Given the need for wide safety buffers around Belize's principal marine assets, a zoning as has been attempted here for terrestrial Belize is not realistic for the marine sector of Belize. Also given the financial and technical challenges for drilling deeper water, petroleum exploration is essentially only practical within the inner lagoon and near the offshore atolls. At the same time, the risks of a rapid spread of any oil spill puts the whole reef system, the world heritage sites and all its intrinsic and economic assets at risk.

9. LITERATURE

- Conservation International, 2008. CI Policy Paper: Mainstreaming Biodiversity Conservation into Oil and Gas Development. Prepared for "Biodiversity Opportunities in Latin American and the Caribbean: The Role of the IDB". A workshop at the Inter-American Development Bank July 28, 2006
- Day, J. 2002. Zoning : lessons from the Great Barrier Reef. Marine park. Ocean & Coastal Zone Management. (In press, 2002). Staff Paper 2002-20
- Doncaster, C. P., Figueroa, O., Foster, R., Guitierrez, S., Harmsen, B., Kay, E., Pertracca, L., Quigley, H., Zeller, K.. 2011. Central Belize Corridor. A collaborative initiative between: UB's Environmental Research Institute, Belize Forest Department, Panthera, University of Southampton & UK Darwin Initiative. Presentation to National Protected Area Secretariat.
- Herrera, A., J. Meerman, J. McGill & F. Griffith, 2002. Phase II of the characterization study: Belize National Report of the Participation Planning Process. Report to the Mesoamerican Biological Corridor Office.
- Hooker, S.K., H. Whitehead & S. Gowans. 1999. Marine Protected Area Design and the Spatial and Temporal Distribution of Cetaceaens in a Submarine Canyon. Conservation Biology 13(3): 592-602. Recommend 10km buffer around core zone.
- Meerman & Cayetano, 2010 Recommendations from Protected Areas Management Organizations to the Forest Department for the National Forest Policy. Report to APAMO. 79 pp.
- Meerman, J. C. & A. Moore. 2010. Chiquibul Cave System Management Plan 2010-2015. Report to FCD. 79 pp.
- Meerman, J. C. & J. R. Wilson (Eds). 2005. The Belize National Protected Areas System Plan. Taskforce on Belize's National Protected Areas System Plan. 71 pp.
- Meerman, J. C. 2005. National Protected Areas System Analysis: Various reports to the Taskforce on Belize's National Protected Areas System Plan. Various deliverables <http://biological-diversity.info/NPAPSP.htm>
- Meerman, J. C. 2007. Establishing a Baseline to Monitor Species and Key Biodiversity Areas in Belize. Funded by a CEPF grant - Critical Ecosystem Partnership Fund. 15 pp.
- Meerman, J. C., M. Vasquez, E. McRae, N. Arnold, T. Boomsma, R. Wilson. 2000. Feasibility Study of the Proposed Northern Belize Biological Corridor Project (NBBCP). Report to Programme for Belize. 2 vols. 77 pp + app.
- Pomeroy, R.S. and T. Goetze. 2003. Belize case study: Marine protected areas co-managed by Friends of Nature. Caribbean Coastal Co-management Guidelines Project. Caribbean Conservation Association, Barbados. 69p.
- R.V. Salm, John Clark, and Erkki Siirila (2000). Marine and Coastal Protected Areas: A guide for planners and managers. IUCN.

Washington DC. xxi + 371pp. Mentions buffers for oil exploration but no figures.

Salas, O. & J. Meerman. 2008. Chiquibul National Park Management Plan 2008-2013. Report to FCD. 192 pp.

The Royal Society of Canada. 2004. Report of the Expert Panel on Science Issues Related to Oil and Gas Activities, Offshore British Columbia. Suggests an overall width of 20 km.

Weilgart, L.S. 2006. Managing Noise through Marine Protected Areas around Global Hot Spots. International Whaling Commission Committee Scientific Document SC/58/E25

Wildtracks, 2009. State of Protected Areas Analysis. APAMO.

Wildtracks, 2008. Summary Report Technical Assessment of the Maya Mountains Massif