

# Environmental Impact of Hovercraft

**Report By:**



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Hovercraft or Air Cushion Vehicles have been in use now for some 30 years and over that time they have worked in some very difficult and sensitive areas.

During that time all the evidence shows that the Air Cushion Vehicle is the idea vehicle for accessing sensitive areas.

## Theory

Low pressure high volume air is pushed via fans driven by diesel engines into a plenum chamber and because of the rubber skirt around the outside the air is forced under the craft. The pressure exerted on the ground is 1 psi (0.0703 kilo/cm sq).

Therefore  $P = L/A$  i.e. Pressure = Load over Area.

So keeping the Pressure at 1 psi and with a known load, an approximate size can be calculated:

$A = \text{Load (Lbs)} / \text{Area Ft sq} = \text{area in Feet Square.}$

Or

$A = \text{Load (Kilo)} / \text{Area m sq} = \text{area in Metre Square.}$

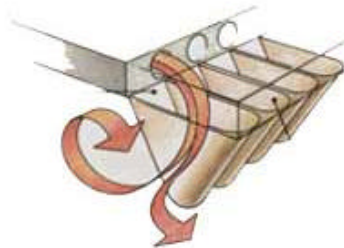
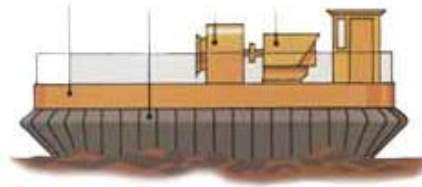
**ACV Ground pressure 1-2psi**  
**Man walking ground pressure 5-10psi**

Each skirt segment is designed to form a flexible seal with fingers and these take the profile of the ground being passed over. In addition, if one fails, the finger each side will fill the gap reducing air loss.

Once the platform is on air there is little or no vibration as it is now sat on a large air chamber. Even if the fans stop or a large section of skirt is lost the platform will take a few minutes to settle down for what will be a very gentle landing.

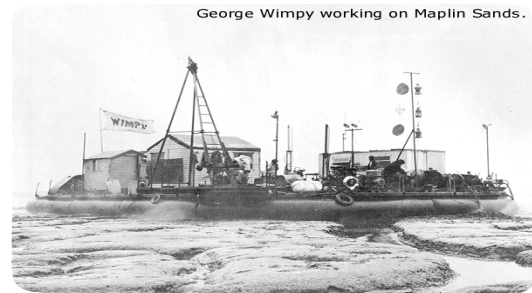
The skirt system will also give a small righting moment but for simplicity it should be treated as if floating on water. Therefore if a load is placed on one corner the platform will be offset and need a counter balance. However, design and shape of the skirt system is critical for an efficient lift.

Unlike high speed hovercraft, there is little movement and even the effect of a sea running is dampened by the cushion.





Wave Test Trials



George Wimpy working on Maplin Sands.  
50 Tons Working in Mud Flats

Work done in Kazakhstan in 1998 with tracked vehicles shows some of the damage caused.

## Kazakhstan

A few years ago we were asked to look at a problem of supplying a rig in the Caspian Sea.

The contractor was using tractors which ran from dry land through shallow water over an Island and through water again to reach the rig over a distances of some 40 kms. These trips were causing serious damage to the ground which consisted of small sea shells and the cost of repair to the tractors was becoming unacceptable and slowing the project.

There were a number of vehicles being used to transport equipment from the shore base to the rig. Two Canadian Huskies and a Russian vehicle (VJ).



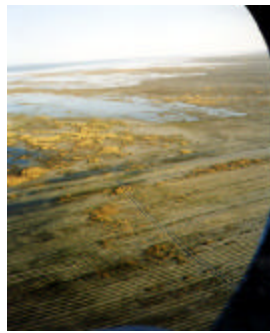
The Huskies have a 'D' shaped track, which gave good traction but at the same time crushing the shells into talcum powder. Mixed with the water it produced a deep creamy type mixture that was causing the operators great problems. The Huskies exert some 4.8 psi on the ground. The Russian VJ had a lower ground bearing pressure (2.9 psi) and operated more efficiently causing less damage but had a lack of spares.

Due to this rutting of the ground in the water, the tractor operators were moving continually to new routes so that now there was an area probably some five kilometres wide that would need repairing at the end of the contract.

#### Photos of environmental damage



Tractor Damage



Tractor Damage

#### Cowdenbeath Scotland

This is a sensitive area of peat bog that required core samples for analysis. A modular hover barge with a 50 ton payload was used to access the site. The ground bearing pressure of the barge when sat on the surface and coring was less than 2 psi and when hover less than 1 psi.

Plastic sheeting was laid on the ground so that men could walk to the barge without sinking into the peat bog.



## Dead Sea

Further work using a hover barge towed by a Rolligon Low Ground Pressure tyre tractor working over difficult soils was carried out in the mid 70's. The surface consisted of shallow water, hot liquid sands and salt out crops. During the 3 months project the ACV moved up to 50 Km per day without every getting stuck in the dangerous quick sands.

Again the Hover barge exerted less than 1 psi when on hover and 2 psi when sat on the surface. The tractor tyres exerted 2.5 psi.



Other work carried out on mud flats in Portsmouth harbour and on the ice over the river Yukon showed that generally keeping below 3 psi had little to no effect on the ground conditions.

## Abstracts from other work & papers (complete reports follow)

“The Final Ecological Monitoring Summary, was released on March 20, 2000. The winter underwater noise monitoring and visual observations showed that the hovercraft had little impact on blackfish subsistence gathering by the local Eskimos. It also showed that, after careful observation and repeated testing performed by Volpe staff over the past three years, the hovercraft has had little impact on waterfowl and only a few dead, injured, or stranded fish have been found.” Ecological Impact of Hovercraft Transportation in Alaska (Paul Valihura — Volpe National Transportation Systems Center Stephen Petron — CH2MHILL)

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“The hovercraft does not pierce the surface over which it is travelling the advantage is two-fold, a) less friction = less fuel burnt to move, b) less friction or interruption to the surface = less disturbance of the environment.”

“Damage to the shore environment, such as beaches, mud flats and vegetation is virtually nil because of the hovercraft’s low pressure "footprint". For example, the average human being when standing on a beach exerts a pressure of some 3lbs per square inch underfoot, rising locally to 25lbs per square inch when walking. The average hovercraft by comparison, exerts a pressure of only 0.33lb per square inch on the surface regardless of speed. This "footprint" pressure is less than that of a seagull standing on one leg! “

“It therefore becomes obvious that fish and other marine life are in no way affected. This has been confirmed by independent scientific tests. “

“There is no exhaust discharge into the water as with most conventional water craft, thus eliminating the pollution of the marine environment by oil and fuel particles, particularly prevalent with two stroke outboard motor usage.”

“The wake created by the passage of a hovercraft is minimal, ensuring that river bank erosion and damage to foreshore by the waves created is virtually nil. “

“Last not least - Hovercraft need minimal base requirements. Hovercraft do not require, docks, piers or dredged channels and can operate off many beach sites. Road access to the maintenance base is desirable but not essential. Hovercraft can work in areas and leave without the need for environmentally damaging construction projects to support the operation.”  
Environmental impact of Hovercraft by 4wings hovercraft

“Studies of the impact of hovercraft on wetland soils and vegetation are limited but generally seem to indicate that effects are minimal and temporary”

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INNOVATIVE ALTERNATIVE FOR WETLANDS RESTORATION: TRANSPORT AND DISTRIBUTION OF DREDGED MATERIAL BY LARGE HOVERCRAFT Trudy J. Olin, Michael R. Palermo, Anthony C. Gibson Environmental Laboratory US Army Engineer Waterways Experiment Station Vicksburg, MS 39180

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“An indication of the relatively low impact of the ACV may be seen from the fact that bird eggs in nests survived one or two passes without damage. Also, lemmings (small tundra rodents) which in a few cases were inadvertently run over by the ACV did not show any visible injury nor were their burrows or trails effected by several passes. A 5-day old red phalarope chick (sandpiper-like shorebird) survived being run over by the ACV without any injury”

“Generally these effects could be considered as slight, particularly when compared to the level of damage to Louisiana marshes caused by access canals, spoil banks, and caterpillar tracked marsh buggies.” Sikora: Air Cushion Vehicles

## **Ecological Impact of Hovercraft Transportation in Alaska**

**Paul Valihura** — Volpe National Transportation Systems Center  
**Stephen Petron** — CH2MHILL

The United States Postal Service (USPS) has completed a 3-year demonstration program to transport bypass mail and non-priority mail by hovercraft on a year-round basis in the Yukon Delta of Alaska. The hovercraft would replace the current method of using fixed-wing airplanes for the transport of bypass and non-priority mail. The program involved Bethel and seven remote Alaskan villages along the Kuskokwim and Johnson Rivers. The USPS agreed to conduct waterfowl, fish, and subsistence monitoring to obtain data on actual impacts of the hovercraft project. The Alaska Hovercraft Ecological Monitoring Program evaluated the nature and extent of impacts, if any, from the use of the hovercraft to fish, waterfowl, and subsistence efforts. The intent was not to quantify the exact number of fish or birds that might be affected by the hovercraft. The EA/FONSI did not claim that no impact to these resources would occur, but instead concluded that negative impacts would not be significant. The monitoring was designed to provide information to support or refute the conclusion that there is no significant adverse impact to fish and bird resources and thus to subsistence efforts focused on those resources.

Little is known on the ecological impact of the hovercraft and less on the potential impact in the arctic environment. The paper is intended to show the methodology and results of the ecological monitoring conducted by the Volpe National Transportation Systems Center on this unique mode of marine transportation. Aerial monitoring during transect flights resulted in observing approximately 4,800 waterfowl. In boat reconnaissance and flushing response work, approximately 4,200 birds were observed. During observations for floating fish after the hovercraft passed, approximately 260 miles were observed directly behind the hovercraft and approximately 3,700 miles were observed along the hovercraft route. During the observation of potential impact to juvenile fish in shallow water, approximately 9,000 fish were counted during 87 seining. In the studies for identifying stranded fish when the hovercraft passed approximately 20,000 yards of beach were observed. In the studies for impact to subsistence, gill netting (110 sets) was performed. Blackfish (very little is known of these subsistence species) fishing success was observed in the winter. The importance of this information is to present scientific research to refute claims that the hovercraft could result in significant adverse impact to the natural environment as operated in the Yukon Delta National Wild Refuge. The result of the research provided the necessary information to allow the hovercraft to serve as an environmentally acceptable alternative mode of marine transportation in Alaska.

### **Volpe Acoustics Experts Study the Environmental Effects of Hovercraft on Fish and Wildlife in Alaska (USPA)**

Could mail delivery in remote parts of Alaska be hurting fish and wildlife? The Volpe Center is supporting the U.S. Postal Service (USPS) by providing environmental services for a three-year demonstration program in which hovercraft are used to transport mail to remote villages in the vicinity of Bethel, Alaska. A comprehensive noise study of the British Hovercraft Corporation Model AP1-88 air cushion vehicle, the craft used for mail delivery, is part of a project being conducted by Dr. Paul Valihura of the Environmental Engineering Division to study the underwater effects of hovercraft operation on fish and wildlife.

From January 23 to 28, 2000, Mr. Christopher Roof of the Safety and Environmental Technology Division along with Mr. David Read of W. T. Chen and Mr. John Burgess, a biologist with CH2M Hill (both Volpe Center contractors), visited Bethel, Alaska, in order to perform noise measurements of the hovercraft and to study blackfish behaviour near the small village of Kasigluk. Blackfish are a primary food source for the local population. The measurements were conducted while the Johnson River was covered with ice in order to evaluate the effects of ice on

the underwater noise. In addition to conventional acoustic instrumentation, the team used hydrophones to measure underwater noise levels and specialized video equipment to monitor blackfish behaviour. The team also monitored other environmental conditions, and interviewed local fishermen to obtain their day-to-day accounts.

Mr. Roof and his team accomplished their tasks despite numerous obstacles. Unexpected and unusual above-freezing temperatures caused the ice on the Johnson River to start melting. The state road, which is near the river and on which the team planned to travel by truck, had not been ploughed. In addition, the team planned to stay in Kasigluk near where the testing would take place, but an electrical outage forced them to stay in Bethel and make the 30-mile trip each way every day to Kasigluk via snowmobiles.

Sleds were used to transport more than 500 pounds of support equipment, including acoustic instrumentation for measurement in water and air, as well as meteorological and video instruments. One of Mr. Roof's biggest challenges was making certain that all of the electronic equipment worked despite low temperatures, wind, and vibrations from riding on the snowmobiles. Fortunately, extra backup equipment was brought along, as it was needed.

The final summary of the three-year ecological and noise monitoring project, The Final Ecological Monitoring Summary, was released on March 20, 2000. The winter underwater noise monitoring and visual observations showed that the hovercraft had little impact on blackfish subsistence gathering by the local Eskimos. It also showed that, after careful observation and repeated testing performed by Volpe staff over the past three years, the hovercraft has had little impact on waterfowl and only a few dead, injured, or stranded fish have been found.

### **Environmental impact of Hovercraft by 4wings hovercraft**

For the majority of people hovercraft are a new experience. Our knowledge of them is usually gleaned from newspapers, television, magazines and the like, and consequently misconceptions are ripe.

For any vehicle to operate economically the drag, or resistance to motion, must be kept to a minimum. The majority of drag arises from the motion of the vessels hull through the water, therefore we can reduce drag and consequentially propulsive power by minimizing hull contact. The hovercraft achieves this by using low-pressure air to form an air cushion beneath it, thus actually lifting the hull clear of the water. In addition, by using air propulsion to generate forward movement, the hovercraft becomes amphibious, and able to traverse land, soft terrain or water. The main point here is that because the hovercraft does not pierce the surface over which it is travelling the advantage is two-fold, a) less friction = less fuel burnt to move, b) less friction or interruption to the surface = less disturbance of the environment. Therefore Hovercraft can be used to best advantage in shallow water and drying areas, these areas often being remote and environmentally sensitive. Most of these areas are wetlands, swamps, and river delta. They are not only the feeding ground for a lot of different species of birds but as well very often used from marine life for hiding from predators. In these sensitive areas are nearly no transportation means available. Hovercraft are able to operate in these areas in an environmentally friendly way.

Being amphibious the hovercraft can use direct routes across sand banks, marshes and flats, with no loss of speed or comfort. Channel dredging becomes unnecessary, whilst rivers and tidal estuaries present no problem for the passage of the vessel. Previously inaccessible areas may be accessed economically with little or no impact on their environment. If this area is a future wetland where nobody could prove that it is a wetland or not -since it was not accessible by traditional transportation means, or a very shallow bay where you need to download your data from your instrument platform. With the Hovercraft you can reach destinations which were before not accessible for research and studies.

Damage to the shore environment, such as beaches, mud flats and vegetation is virtually nil because of the hovercraft's low pressure "footprint". For example, the average human being when standing on a beach exerts a pressure of some 3lbs per square inch underfoot, rising locally to 25lbs per square inch when walking. The average hovercraft by comparison, exerts a pressure of only 0.33lb per square inch on the surface regardless of speed. This "footprint" pressure is less than that of a seagull standing on one leg!

All advanced Hovercraft are fully amphibious and create virtually no under water noise, just atmospheric noise levels which would be typical of a truck or bus. The fact that there are no underwater protrusions eliminates the usual thrashing noise signature associated with conventional propeller driven craft, as well as negating any possible sea bed erosion when operating in shallow waters. It therefore becomes obvious that fish and other marine life are in no way affected. This has been confirmed by independent scientific tests. The major noise factor with any hovercraft is the air-propeller noise, which in any case is largely directional in characteristic and more apparent to above surface creatures like humans. To minimize this effect advanced hovercraft propulsion propellers have been designed with low tip speed to minimize atmospheric noise. It is not possible to move air for the purpose of creating thrust without making some noise. What must be attempted is to keep the noise within tolerable limits and we believe that we have gone a long way towards this.

Another important factor is that, by necessity, the hovercraft hull is a 'sealed unit'. Any accidental discharges and leaks are fully contained within the hull structure, remaining there to be pumped out at an appropriate shore facility. There is no exhaust discharge into the water as with most conventional water craft, thus eliminating the pollution of the marine environment by oil and fuel particles, particularly prevalent with two stroke outboard motor usage. These engines operate at a mixing range of 1 : 50 = 1 part oil : 50 parts gasoline where the unburned oil and fuel particles get discharged over the lower unit of the engine - basically oil injecting the environment you navigate in. Atmospheric pollution is also considerably less because of the inherent fuel efficiency of the modern four stroke machinery utilized, as opposed to the very large percentage of marine propulsion units which still utilize the two stroke principle. In addition, the hovercraft is in itself a fuel efficient mode of transport, thus lessening the pollution of the atmosphere even more. For example a fully loaded six-person hovercraft burns less fuel per hour than a typical Jet Ski, it does not pollute the water and does not disturb the bottom in shallow areas which many fish rely upon for food and breeding. The lower hull of a Hovercraft is not in water contact under way and very seldom at stand. This eliminates an anti fouling coating like on all common boat hulls. These anti fouling paints have just one purpose - slowly come off your hull with whatever marine life adheres to it. On an average 30' boat hull you have to apply all two years a new bottom coat - besides the expenses of haul out - you will apply between 1 gal - 1 1/2 gal of bottom paint to your hull. Bottom paint which tries to have a very high copper content to work effectively ( 30% to 75% ). Copper is just not the best stuff for our marine environment - but we do our best to supply on a continuous basis till we find a better solution ... when? If the last fish is dead?

The wake created by the passage of a hovercraft is minimal, ensuring that river bank erosion and damage to foreshore by the waves created is virtually nil. A recent study in the United Kingdom concluded that the passage of hovercraft over inter tidal areas caused no damage to sea grasses or invertebrates. It was also noted that bird life rapidly adjusted to the presence of hovercraft. This has been confirmed on the Gold Coast (Australia) where a commercial operator passed over the same area of beach many times a day for more than three years without any affect to the Yabby population (a Yabbies live just below the surface of the wet sand) on the actual operating launch ramp. The air pressure exerted by the hovercraft is considerably less than the normal pressure variations due to natural tidal movements. Commercial operators in other areas around Australia have had similar experiences.

Last not least - Hovercraft need minimal base requirements.

Hovercraft do not require, docks, piers or dredged channels and can operate off many beach sites. Road access to the maintenance base is desirable but not essential. Hovercraft can work in areas and leave without the need for environmentally damaging construction projects to support the operation.

## **INNOVATIVE ALTERNATIVE FOR WETLANDS RESTORATION: TRANSPORT AND DISTRIBUTION OF DREDGED MATERIAL BY LARGE HOVERCRAFT**

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### **Abstract**

Thin layer placement of dredged material in wetlands areas has been proposed as a viable disposal alternative that could address the need for sediment and nutrient resources for deteriorating wetlands. The focus of this study addresses the technical and economic feasibility of a conceptual "hoverbarge" as a transport mechanism for dredged material nourishment of wetlands.

Transport and distribution of dredged material in coastal wetlands is motivated by the need to address severe and ongoing losses due to subsidence and impacts of anthropogenic activities. Hovercraft have been proposed as an environmentally sensitive transport alternative. The scope of the study was constrained by limited available data pertaining to environmental effects of hovercraft traffic on wetlands and lack of actual performance and cost data.

### **Environmental Effects**

Studies of the impact of hovercraft on wetland soils and vegetation are limited but generally seem to indicate that effects are minimal and temporary, except under certain circumstances (Planning Systems Inc. 1984). However, the effects of continuous operation over a restricted area has not been evaluated.

### **Technical and Economic Feasibility**

Technical Feasibility. At the time of this study, a hoverbarge prototype had not been developed. The technical feasibility of hovercraft transport of dredged material into wetlands was evaluated based on identifiable technical issues, status of the current technology, necessary physical and operational modifications, and potential interfaces with dredging operations. The principal technical issues include: load capacity, stability, loading/offloading operations, performance, and environmental considerations.

The load capacity of hovercraft is limited; currently 75 tons maximum domestically. The maximum feasible payload size is projected to be 300 tons, according to industry experts. A 300 ton payload corresponds to a volume of approximately 247 cuyd, depending upon the material and solids concentration, as compared to the 1500 to 4000 cuyd capacities of conventional barges. Interim storage of sediments would be required because typical dredged material production far exceeds foreseeable utilization rates. The stability of hovercraft in transporting bulk cargo is unknown. Trim and balance problems have been reported under certain conditions. Modifications of the craft to address this concern, as well as to facilitate loading, offloading and distribution of materials, would be required. Operating performance in a low speed, high capacity application has not been demonstrated.

Economic Feasibility. The economic analysis of the hoverbarge concept was based on actual capital and operating costs of military hovercraft, the LCAC and the LACV30, and industry estimates. Because significant differences exist between the proposed hoverbarge prototype existing hovercraft, the cost analysis cannot be considered to be definitive. However, an estimated cost range was established which was compared to pipeline transport, the most economical conventional transport alternative for the volumes and distances projected (Souder, Paul S., Tobias, Leo, Imperial, J.F., Mushal, Frances C. 1978).

### Conclusions

From a technical perspective, the hoverbarge concept appears to be viable but the load capacity of hovercraft is limited and the volume of sediments that can be transported is small relative to conventional means of transport. Estimates indicate that due to high capital and operating costs, the use of hovercraft to transport and distribute slurried sediments will be significantly more expensive than other methods available. Environmental justification as a compensating factor has not been adequately demonstrated at this time.

### Literature Cited

Planning Systems Incorporated 1984. "Environmental Assessment (EA) for Landing Craft Air Cushion (LCAC) Program at NCSC, Panama City, Florida", PSI Job No. 1293, NCSC Contract No. N61331-84-M- 0127, Naval Coastal Systems Center, Panama City, Florida.

Souder, Paul S., Tobias, Leo, Imperial, J.F., Mushal, Frances C. 1978. "Dredged Material Transport Systems for Inland Disposal and/or Productive Use Concepts", Technical Report D-78-28, General Research Corporation, McLean, Virginia.

### Sikora: Air Cushion Vehicles

After completion of the manuscript, four published papers which I had inadvertently overlooked were kindly brought to my attention by Mr. James Yates of the Environmental Law Center at Tulane University, to whom I am indebted. Two of the papers, Abele and Brown (1977). and Ramsden (1984), contain significant information which I have summarized in this addendum. **The remaining two papers, Crawford (1979) and Petroleum Engineer (1977), contained general information on Mackace hovercraft applications which has been covered in other sections of this report.** Arctic Ecological Impact of ACV Traffic Abele and Brown (1977) conducted a detailed study in the summer of 1971, near Barrow, Alaska, of the effects of a mid-sized ACV on wet and dry tundra, one of the most fragile of terrestrial biomes. The ACV used in the tests was a Bell SK-5, an earlier design (a re-engined version of the British Hovercraft SR.N5), length 38 ft 10 inches, beam 23 ft 9 inches, crew of 3. with a gross weight between 7.7 and 8.8 tons, resulting in a cushion pressure of 0.014 kg per cm<sup>2</sup> (0.2 psi). Specifications of this machine are given in Jane's (1972-73). Three test variables were investigated; the number of traffic passes (1,5.25 and 50), vehicle speed (15 and 60 km per hr [9.3 and 37.3 mph]), and length of hovering time (15 sec to 10 min).

The wet tundra was relatively level, characterized by a uniform and homogeneous water-saturated active layer. The dry tundra was a well-drained, low-centered polygon area (example pictured in Odum. 1971, pg.382 Fig. 14-10). characterized by wide, uplifted, flat polygonal areas resembling flattened mounds. Generally, traffic signatures were more visible on the wet tundra than on the dry polygonal tundra however, raised centers of the polygonal areas sticking above the surrounding ground did suffer vegetation removal. It was found that the number of traffic passes and the speed of the vehicle had greater effects than the length of hovering time, which had virtually no effect. The cushion pressure of 0.014 kg per cm<sup>2</sup> had no detectable consequence. Disturbance from the air flow of 20-30 m per sec (66 to 118 ft'per sec) consisted of

displacement of loose, dead vegetation but no apparent damage to live vegetation such as detachment of sedge or grass blades, moss, leaves, or blossoms. In actual practice, however, there was a slight combined effect of the air flow and skirt contact action in that the mechanical loosening or detachment of vegetation and soil by skirt contact increased the amount of material removed by the air flow.

Most of the effects from the ACV, as might be expected, were caused by skirt contact. The SK-5 had a 0.9 inch or less skirt clearance in the front, and virtually none in the rear. For this reason the rear skirts were equipped with wearing strips (strakes). several of which were broken and partly detached on the test machine. This condition left small grooves on any soft terrain surface and was responsible for most of the effects. Mosses were less resistant to skirt abrasion than sedges or grasses. The effect caused by the number of passes levelled off at 5 passes, i.e., 50 passes did not cause significantly more damage than 5 passes, indicating any damage to susceptible vegetation occurred in the first few passes and was not additive.

An indication of the relatively low impact of the ACV may be seen from the fact that bird eggs in nests survived one or two passes without damage. Also, lemmings (small tundra rodents) which in a few cases were inadvertently run over by the ACV did not show any visible injury nor were their burrows or trails effected by several passes. A 5-day old red phalarope chick (sandpiper-like shorebird) survived being run over by the ACV without any injury, although newly hatched 1-day old chicks did not survive.

Overall, the ecological effects on the tundra by the SK-5 air cushion vehicle were summarized as follows: "detached vegetation with weak root systems. such as mosses and lichens; removal of some loose organic soil; breaking of stems of vascular plants with effects increasing with number of passes and vehicle speed; little effect in level areas with subsequent growth of some vascular species stimulated by surface disturbance." Generally these effects could be considered as slight, particularly when compared to the level of damage to Louisiana marshes caused by access canals, spoil banks, and caterpillar tracked marsh buggies. Of particular interest are the results that air cushion pressure, air flow, and length of hovering time had no observable effects. Extrapolating to a situation in the Louisiana marshes where ACV's would typically move slowly and hover for extended periods, no increased damage can be expected to occur from this type of operation. Most of the observed impacts were caused by skirt contact, particularly the rear skirt which in this design always contacted the ground surface in the rear of the craft. The design of the skid strakes or wearing strips, which were damaged in the test vehicle\* caused most of the observable damage. It should be noted that these tests were conducted in 1971, and there has been improvement in both skirt design as well as overall craft balance and stability. This study constitutes the most detailed observation of ACV effects on a most biologically fragile terrain from which it could be deduced that air cushion vehicles should have only a slight effect on Louisiana coastal marsh.

#### ACT-100 Arctic Drilling Rig Move

Ramsden (1984) reports on the moving of an arctic drilling rig, the Alaska United Drilling Rig 2, from Mukluk Island to Prudhoe Bay. The move was carried out in temperatures that ranged from -20°F to -57°F, and winds ranging from calm to 30 knots. The ACT-100 was towed by two tractors. The overall project required 200 truck loads to transport the rig modules. It should be noted that drilling rigs in the harsh arctic environment are usually stand-alone entities complete with living quarters, mess facilities, shops, enough supplies for extended periods of operation without outside contact, various work shelters for personnel, plus heating systems. Arctic rigs would be contained in many more modules than an inshore drilling rig in Louisiana would require. The heaviest single load was a 300,000 lb (150 tons) crane. The module-laden trucks were driven onto the ACT-100 by means of a snow ramp. The operation took 13 days and 30 trips with loading times taking from 30 minutes to one hour. These short loading times were possible because of the drive-on capability which could be useful in Louisiana for moving rig modules. The ACT-100 did not experience any shutdowns because of mechanical failure, and the operation was halted only once, intentionally for 36 hours, because of temperatures below -57°F.

Once again, the ACT-100 has been proven to be exceptionally reliable under the harshest of conditions and extremely heavy loads. ACV reliability of this sort is an important factor that augers well for rugged yet simple construction of the ACT-100, and for the adoption of ACV's as rig carriers in the oil fields of coastal Louisiana. Literature Citeri Abele.G., and J. Brown. 1977. Arctic transportation: operational and environmental evaluation of an air cushion vehicle in northern Alaska.

Journal Pressure Vessel Technol. Trans. ASME Ser. J 99(1):176-182.

Crawford.D. 1979. Hover vehicles offer uplifting services. Offshore, Feb. 1979,39(2): 111-112.

Jane's 1972-73. Jane's Surface Skimmers hovercraft and Hydrofoils. 6th edition, R. McLeavy (ed.). Jane's Yearbooks, McGraw-Hill Book Co., New York N.Y. 330. pp.

Odum,E.P. 1971. Fundamentals of Ecology. 3rd edition. W. B. Saunders Co. Phila. Pa. 574 pp.

Petroleum Engineer. 1977. Offshore hovercraft for drilling, shipping, (staff report).

Petroleum Engineer. Dec. 1977,49(13): 14. Ramsden.H.D. 1984. Hoverbarge transports Mukluk drilling rig. Petroleum Engineer International, Sept. 1984 56(11):10,12.

### **Why not a Ferry for both Cargo and People Connecting Bay Airports?**

**By F. Weston Starratt, P.E.**

[http://www.baycrossings.com/Archives/2001/06\\_July/why\\_not\\_an\\_oakland\\_airport\\_ferry.htm](http://www.baycrossings.com/Archives/2001/06_July/why_not_an_oakland_airport_ferry.htm)

### **They Worked for the Canadian Coast Guard**

The *Canadian Coast Guard* (CCG) has, for years, operated amphibious hovercraft at Vancouver International Airport; so, both the Port of Oakland and the Airport Commission of the City and County of San Francisco sent Anthony Bruzzoni of Pacific Transit Management Corporation to investigate the operation.

He reported that the CCG was so impressed with its British-built hovercraft after a decade of service that it introduced two additional larger craft to be used not only for search-and-rescue operations, but also for dealing with oil spills, ice breaking and recovering navigational buoys. CCG's Dash 400 hovercraft, measuring 40 by 100 ft, has a cruising speed of 45 knots and a maximum speed of 60 knots, with a carrying capacity of almost 30 tons. After a demonstration by the CCG, Bruzzoni concluded that the craft is "a proven reliable vessel which has substantial flexibility due to its amphibious qualities. The vessel would be appropriate for use either in cargo operations or in passenger service." However, in an interview with Bruzzoni, it was noted that noise was not a problem for the CCG, which had even removed mufflers and noise suppressors on these craft had so that they could be readily heard in search and rescue operations. Those craft were also operating in deeper waters than are to be found at the south end of San Francisco Bay.