

## CHAPTER 5

### CONCLUSION AND RECOMMENDATIONS

#### 5.1 Conclusion

Niche of *MpN2000* may originate from man-made-containers. It consists of algae (producer), mosquito larvae (consumer), Micronectidae (consumer) and bacteria (decomposer). The niche of *MpN2000* in man-made containers must be exposed to solar radiation. The direct sun light supports the algae growth in the stagnant water. *MpN2000* consumed both algae and mosquito larvae as a food source. *MpN2000* food consumption is an omnivorous type. Algae density in the habitat can be up to 93860 mg/L.

*MpN2000* is an efficient predator with a rapid growth population. The growth population of *MpN2000* indicated that this predator can double up their numbers or can reach to an optimum number within 25 days. The maximum population that *MpN2000* can reach was 35 Micronectidae per litre of water depending on the environmental condition and inter-specific competition behavior if food source is limiting. The averages growth rate,  $r$  for population of *MpN2000* based on exponential growth model equation was 0.08 per day per *MpN2000*.

*MpN2000* can survive in water with dissolved oxygen as low as 2 mg/l. However, *MpN2000* will not survive under high BOD level of 723.75 mg/L and temperature more than 40 °C. The predatory pattern of *MpN2000* showed that they can consume both larvae and pupae. The average daily rate of consumption was 0.35 mosquito larvae per *MpN2000* per day respectively.

pdfMachine

A pdf writer that produces quality PDF files with ease!

Produce quality PDF files in seconds and preserve the integrity of your original documents. Compatible across nearly all Windows platforms, if you can print from a windows application you can use pdfMachine.

Get yours now!

Under tropical climate, mosquito lifecycle requires stagnant water particularly that is not exposed directly to solar radiation (Akram and Lee, 2004). On the other hand, *MpN2000* habitat is generally receiving direct sunlight. Although *MpN2000* can be an efficient bio-control for mosquito, the environment of the water is likely to be a limiting factor. Thus, in order to use *MpN2000* as biological control for mosquito, it is necessary that the stagnant water to be exposed to sunlight. The water must be clean, clear and free from pollution.

The niche of *MpN2000* was in pristine environment. The quality of water from *MpN2000* niche is comparable to Class IIA/IIB of National Water Quality Standards that represents water body of excellent quality. The water bodies in this category meet the requirements for most aquatic life protection. In urban areas, this type of quality is for natural water sources that are free from pollution and also favors the *Aedes* mosquito to breed (Wu *et al.*, 1993).

*MpN2000* in stagnant water can be used to control infestation of mosquito breeding. Ecosystems that were established with *MpN2000* were free from mosquito. However, the ecosystems were very susceptible towards chemicals particularly fogging. Areas that are frequently fogged were unable to establish an ecosystem for *MpN2000*.

The analyses on Infested Container Index and Micronecta Index show that the infested container index for MEs was zero in every month. However for stagnant water in areas provided with *MpN2000*, the Container Index can be as low as 3.12.

Stagnant clear water under tropical environment in small to medium container that is commonly found in landscape or engineering structures can become a balance ecosystem in urban areas. Such ecosystem will support the life of mosquito predators like *MpN2000*. Thus act as a control for mosquito population. The findings of this study suggest that mosquito in urban areas can be control by keeping a healthy environment with clean water that promotes the coexistence of mosquito and its predators.

pdfMachine

**A pdf writer that produces quality PDF files with ease!**

Produce quality PDF files in seconds and preserve the integrity of your original documents. Compatible across nearly all Windows platforms, if you can print from a windows application you can use pdfMachine.

Get yours now!

## 5.2 Recommendations

Four recommendations are listed below:

1. Ecological control can be used for mosquito control.
2. Due to sensitive nature of this organism, the water quality and the environment must be clean.
3. Wastewater should be treated in water treatment plant and not flow into the drain. Otherwise this ecological approach is not going to work.
4. To study on a bigger scale of application such as covering the whole township on state.

**pdfMachine**

**A pdf writer that produces quality PDF files with ease!**

Produce quality PDF files in seconds and preserve the integrity of your original documents. Compatible across nearly all Windows platforms, if you can print from a windows application you can use pdfMachine.

Get yours now!

## REFERENCES

- Abd Manan, T. S., and Sapari, N. 2008. The Application of Micronectidae and *Poecilia reticulata* for Mosquito Breeding Control in Engineering Structures. *Proceedings of EnCon2008: 2<sup>nd</sup> Engineering Conference on Sustainable Engineering Infrastructures Development & Management. December 18-19, 2008, Kuching, Sarawak, Malaysia.* 2:11-14.
- Abdul Rahman, H. 2008. Ministry of Health Report: Situasi Semasa Demam Denggi di Malaysia. Kenyataan Akhbar Pengarah Kawalan Penyakit, Kementerian Kesihatan Malaysia. Disease Control Division, Ministry of Health Malaysia, Pusat Pentadbiran Kerajaan Persekutuan, 62590 Putrajaya, Malaysia.
- Abdul Rahman, H. 2009. Ministry of Health Report: Situasi Semasa Demam Denggi di Malaysia. Kenyataan Akhbar Pengarah Kawalan Penyakit, Kementerian Kesihatan Malaysia. Disease Control Division, Ministry of Health Malaysia, Pusat pentadbiran Kerajaan Persekutuan, 62590 Putrajaya, Malaysia.
- Abu Hassan, A., Che Salmah, M. R., Ngumbang, J., Ahmad Ramli, S., and El-Badri, A. M. 2005. Mosquitoes of Urban Areas of Penang: Abundance and Control. *Proceedings of the Fifth International Conference on Urban Pests.* 34:257-263.
- Aburas, H. M. 2007. ABURAS Index: A Statistically Developed Index for Dengue-Transmitting Vector Population Prediction. *Proceedings of World Academy of Science, Engineering and Technology Volume 23 August 2007 ISSN 1307-6884.* 23:151-155.
- Adli Muhmed, M. I. 2005. Water Retention in Urban Environment and Mosquito Breeding Problem. Department of Civil Engineering, Universiti Teknologi Petronas, Bandar Sri Iskandar, 31750 Tronoh, Perak, Malaysia.
- Akram, W., and Lee, J. J. 2004. Effect of Habitat Characteristic on the Distribution and Behavior of *Aedes albopictus*. *Journal of Vector Ecology.* 41:379-382.
- APHA (American Public Health Association). 1997. Standard Methods for the Examination of Water and Wastewater. Published by American Public Health Association. ISBN: 9780875530475.
- Anderson, R. R., and Harrington, L. C. 2009. Medical Entomology Extension: An extension program of the Department of Entomology, College of Agriculture & life Sciences at Cornell University. [Online] <http://www.entomology.cornell.edu/MedEnt/MosquitoFS/MosquitoFS.html>. [Accessed date: 10<sup>th</sup> December 2008].

- Baerg, D. C., and Boreham, M. M. 1974. *Anopheles Neivai* Howard, Dyar & Knab: Laboratory Observation on the life Cycle and Description of the Egg Stage. *Journal of Medical Entomology*. 5:629-630.
- Barrero, P. R., and Mistchenko, A. S. 2008. Genetic Analysis of Dengue Virus Type 3 Isolated in Buenos Aires, Argentina. *ELSEVIER Virus Research*. 135:83-88.
- Breene, R. G., Sweet, M. H., and Olson, J. K. 1987. Spider Predators of Mosquito Larvae. *The Journal of Arachnology*. 16:275-277.
- CALS (College of Agricultural and Life Sciences, Cornell University). 2009. Water Wonders. [Online] <http://www.cals.ncsu.edu/course/ent525/water/aquatic/index.htm> [Assessed on 27th May 2009].
- Arora, P. N., Arora, S. and Arora, S. 2006. First Edition 2007: Comprehensive Statistical Methods. S.Chand & Company LTD. ISBN: 81-219-2776-5.
- Chandra, G., Bhattacharjee, I., Chatterjee, S. N., and Ghosh, A. 2008. Mosquito Control by Larvivorous Fish. *Indian Journal Medical Research*. 127:13-27.
- Chen, C. D., Benjamin, S., Saranam, M. M., Chiang, Y. F., Lee, H. L., Ahmad, N. W., and Azirun, M. S. 2005. Dengue Vector Surveillance in Urban Residential and Settlement Areas in Selangor, Malaysia. *Tropical Biomedicine*. 22:39-43.
- Cheng, L., Chang, M. Y., Li, D., and Liu, H. 2006. Aquatic Heteroptera (Insecta: Gerromorpha and nepomorpha) From Xishuangbanna, Yunnan, China. *The raffles bulletin of Zoology* 2006. 54(2):203-214.
- Cheong, H. T., Vythilingam, I., Matusop, A., Chan, S. T., and Singh, B. 2008. Bionomics of *Anopheles latens* in Kapit, Sarawak, Malaysian Borneo in Relation to the Transmission of Zoonotic Simian Malaria Parasite *Plasmodium knowlesi*. *Malaria Journal*. 7(52):1-8.
- Chua, K. B., Chua, I. L., Chua, I. E., and Chua, K. H. 2005. Effect of Chemical Fogging on Immature Aedes Mosquitoes in Natural Field Condition. *Singapore medical Journal*. 46(11):639-645.
- Chua, K. B., Bellini, W. J., Rota, P. A., Harcourt, B. H., Tamin. A., Lam, S. K., Ksiazek, T. G., Rollin, P. E., Zaki, S. R., Sgieh, W. J., Goldsmith, C. S., Gubler, D. J., Roehrig, J. T., Eaton, B., Gould, A. R., Olson, J., Field, H., Daniels, P., Ling, A. E., Peters, C. J., Anderson, L. J., and Mahy, B. W. J. 2000. Nipah Virus: A Recently Emergent Deadly Paramyxovirus. *SCIENCE*. 288:1432-1435.

- Daly, Doyen and Purcell. 1998. Second Edition: Introduction to Insect Biology and Diversity. Oxford University Press Inc. ISBN 0-19-510033-6.
- DOE (Department of Environment, Ministry of Natural Resources and Environment). 2005. National Water Quality Standards for Malaysia. [Online] [http://www.doe.gov.my/index.php?option=com\\_content&task=view&id=244&Itemid=615&lang=en](http://www.doe.gov.my/index.php?option=com_content&task=view&id=244&Itemid=615&lang=en) [Accessed on 10<sup>th</sup> March 2008].
- Duffus H. J. 1980. Environmental Toxicology-(Resource and Environmental Series). Department of Brewing and Biological Sciences, Heriot-Watt University, Edinburgh. First Edition.
- Eisenberg, J. N. S., Cevallos, W., Ponce, K., Levy, K., Bates, S. J., Scott, J. C., Hubbard, A., Vieira, N., Endara, P., Espinel, M., Trueba, G., Riley, L. W., and Trostle, J. 2006. Environmental Change and Infectious Disease: How New Roads Affect the Transmission of Diarrheal Pathogens in Rural Ecuador. PNAS. 103(51):19460-19465.
- Environmental Quality Act 1974 (Act 1972) & Subsidiary Legislations as at 31<sup>st</sup> August 1997. Compiled by Legal Research Board. Printed by Direct Art Company, Kuala Lumpur. Sole Distributor: Golden Book Centre Sdn Bhd. ISBN: 967-89-0764-X.
- Garcia, R. 1983. Mosquito Management: Ecological Approaches. Environmental Management. 7:73-78.
- Garcia, R. 1972. The Control of Malaria. Environment. 14:2-9.
- Gautam, A., Anirban, A., and Goutam, K. S. 2006. Predatory Activity of *Rhantus sikkimensis* and Larvae of *Toxorhynchites splendens* on Mosquito larvae in Darjeeling, India. Journal of Vector Borne Disease. 43:66-72.
- Google. 2009. Google Earth Official Websites for 3D World Map [Online] <http://earth.google.com/> [Accessed on 21<sup>st</sup> Mac 2009].
- Ira, S and Bhushan, K. 2004. Clinical and Laboratory Abnormalities due to Dengue in Hospitalized Children in Mumbai in 2004. Dengue Bulletin. 29:90-96.
- Joseph, F. H. 2002. Statistics: A Tool For Social Research. Wadsworth/Thomson Learning Academic Resource Centre, USA. ISBN: 0-534-55785-6.
- Kay, B., and Nam, V. S. 2005. Net Strategy Against *Aedes aegypti* in Vietnam. Lancet 2005. 365:613-617.

- Kosiyachinda, P., Bhumiratana, A., and Kittayapong, P. 2003. Enhancement of The Efficacy of a Combination of *Mesocyclops aspericornis* and *Bacillus thuringiensis* Var. *Israelensis* by Community-based Products in Controlling *Aedes aegypti* Larvae in Thailand. *The American Journal of Tropical Medicine and Hygiene*. 69(2):206-212.
- Kolsky, P. 1999. Engineers and Urban Malaria: Part of the Solution, or Part of the Problem? *Environment and Urbanization*. 11(1):159-165.
- Larry, J. K. 2003. *Basic Statistics and Data Analysis*. Thomson Learning Academic Resource Centre, USA. ISBN: 0-534-38465-X.
- Leong, C. Y. 1966. A Taxonomic Study of the Malayan Corixidae (Hemiptera-Heteroptera) with the Description of *Micronecta malayana* sp. *Bulletin of the National Museum Singapore*. Department of Zoology, University of Singapore. 33(12):83-90.
- Mackay, A. J. 2007. Detection of West Nile Virus Activity in male and Female Mosquitoes, and Evaluation of host-Utilization Patterns of Mosquitoes, In East Baton Rouge Parish, Louisiana. The Department of Entomology, Graduate Faculty of the Louisiana State University and Agricultural and mechanical College. 1-173.
- Mariappan, T. 2000. urban Mosquito Control: A Case Study. *The Indian Council of Medical Research (ICMR) Bulletin*, VOLUME 30, ISSN 0377-4910. 30(3):1-9.
- Merritt, R. W. and Cummins, K. W. 1995. *An Introduction to the Aquatic Insects of North America*. Kendall / Hunt Publishing Company. 41-73.
- Metzger, M. E. 2004. *Managing Mosquitoes in Stormwater Treatment Devices*. Publication 8125. Vector-Borne Disease Section, California Department of Health Services, University of California, Division of Agriculture and Natural Resources.
- Ministry of Health, Malaysia, 2009. *Background of Vector Borne Disease Control in Malaysia*. [Online] file:///C:/Documents%20and%20Settings/User/Desktop/background.htm [Assessed on 16th April 2009].
- Molles, M. 2005. *Ecology: Concepts and Applications*. McGraw-Hill Publishers [Online] <http://ebooks.primsonline.com/eBookstore/index.jsp> [Assessed on 21st Mac 2009].
- MMD, 2009. *Official Website of Malaysian Meteorological Department (MMD)*. [Online] [www.met.gov.my/home\\_e.html](http://www.met.gov.my/home_e.html) [Assessed on 15th April 2009].

- Nam, V. S., Yen, N. T., Holynska, M., Reid, J. W. and Kay, B. H. 2000. National Progress in Dengue Vector Control in Vietnam: Survey For Mesocyclops (Copepoda), Micronecta (Corixidae) and Fish as Biological Control Agents. *The American Society of Tropical Medicine and Hygiene*. 62(1):5-10.
- Nieser, N., Chen, P., and Chang, M. Y. 2005. A New Subgenus and Six New Species of *Nepomorpha* (Insecta:Heteroptera) From Yunnan, China. *The Raffles Bulletin of Zoology* 2005. 53(2):189-209.
- Nieser, N. 2000. Three New Species of *Micronecta* from Thailand with a Key to SE Asian Species. (Heteroptera: Corixidae). *Journal of the New York Entomological Society*. 107:277-288.
- Nieser, N. 2002.a. Guide to Aquatic Heteroptera of Singapore and peninsular Malaysia. IV. Corixoidea. *The Raffles bulletin of Zoology* 2002. 50(1):263-274.
- Nieser, N. 2002.b. Four New Species of *Micronecta* (Insecta: Heteroptera: Micronectidae) From The malay Peninsula. *The Raffles Bulletin of Zoology* 2002. National University of Singapore, Singapore. 50(1):9-16.
- Ooi, E. E., Goh, K. T., and Guebler, D. J. 2006. Dengue Prevention and 35 Years of Vector Control in Singapore. *Emerging Infectious Diseases*. 12:887-893.
- Otero, M., Solari, H. G., and Schweigmann, N. 2005. A Stochastic Population Dynamics for *Aedes aegypti*: Formulation and Application to a City with Temperate Climate. *Bulletin of Mathematical Biology*. 70:1297-1325.
- Pandian, T. J., Mathavan, S., and Jeyagopal, C. P. 1979. Influence of Temperature and Body Weight on Mosquito Predation by the Dragonfly Nymph *Mesogomphus Lineatus*. *Hydrobiologia*. 62(2):99-104.
- Petersen, L. R., and Guebler, D.J. 2006. Viral Zoonoses. *ACP Medicine*. 13:1-14.
- Pitts, C. W., Holbrook, G. L, Gripp, S. I., and Hock, W. K. 2000. *Mosquito Biology and Control*. Publication Distribution Centre, The Pennsylvania State University, 112 Agricultural Administration Building, University Park, PA 16802.
- Poopathi, S., and Tyagi, B. K. 2006. The Challenge of mosquito Control Strategies: From Primordial to Molecular Approach. *Academic Journals: Biotechnology and Molecular Biology Review (BMBR)*. 1(2):51-65.



- Sapari, N., Maulut, M. S., Veeramohan, S. 2006. Prevention of Mosquito Infestation in Septic Tanks and Other Water Retaining Structures By Larviciding and Biological Control. Paper presented at *International Federation of Environmental Health Asia and Pacific Regional Conference on Environmental Health, UTP Tronoh, Malaysia*. 1:1-6.
- Sapari, N. and Abd Manan, T. S. 2008. Predation Potential of Micronectidae in Controlling Mosquito. *Proceedings of International Conference in Advancement of Science and Technology*. 4:245-247.
- Service, M. W. 2008. Mosquito Ecology: Field Sampling Methods. Chapman & Hall. ISBN 978-1-4020-6665-8.
- Shope, R. E., Andrade, A. H. P. D., Bensabath, G., Causey, O. R., and Humphrey, P. S. 1966. The Epidemiology of EEE, WEE, SLE and Turlock Viruses, with Special Reference to Birds in a Tropical Rain Forest near Belem, Brazil. *American Journal of Epidemiology*. 84(3):467-472.
- Subodh Mahanti. 2008. Climate Change and Health. Vigyan Prasar, Dream 2047. 10(9):19-35.
- Suphaphom, K., Sathantriphop, S., and Paeporn, P. 2002. The Distribution of Micronecta sp. (Hemiptera: Corixidae) as the Enemy of Aedes aegypti Larvae in Different Regions of Thailand. *Proceedings Third International Conference on Biopesticides, Kuala Lumpur, Malaysia*.
- Suprakash, K., and Aditya, A. K. 2003. Biological Control of Mosquitoes by Aquatic Planaria. *TISCIA*. 34:15-18.
- Surendran, S. N., Kajatheepan, A., Sanjeevkumar, K. F. A., and Jude, P. J. 2007. Seasonality and Insecticide Susceptibility of Dengue Vectors: An Ovitrap based Survey in a Residential Area of northern Sri Lanka. 13(2):12-15.
- Tansley, A. G. 1923. Practical Plant Ecology: A Guide for beginners in Field Study of Plant Communities. Printed in London: George Allen & Unwin LTD. Ruskin House, 40 Musuem street, W.C. April 1923. 12:15-20.
- Teng, A. K., and Singh, S. 2001. Epidemiology and New Initiatives in the Prevention and Control of Dengue in Malaysia. *Dengue Bulletin* Volume 25, 2001. 25:7-14.
- Vasudevan, P., Pathak, N., and Mittal, P. K. 2000. DRWH and Insect Vectors: A Literature Review. Central for Rural Development & Technology, Indian Institute of Technology, Delhi, India and Malaria Research Centre, New Delhi, India. Published by European Commission. 32:71-74.

- Washington State Department of Health. 2008. Guidance for Surveillance, Prevention, and Control of Mosquito-Borne Disease (Prevention Trough Partnership). Washington State Department of Health, Zoonotic Disease Program, Division of Environmental Health, Office of Environmental Health and Safety. DOH Publication: 10:149-333.
- Wearing, H. J., and Rohani, P. 2006. Ecological and Immunological Determinants of Dengue Epidemics. PNAS. 13(31):11802-11807.
- Webb, A., Maughan, M., and Knott, M. 2007. Pest Fish Profiles: *Gambusia holbrooki*- *Gambusia*. [Online] <http://www.actfr.jcu.edu.au/Projects/Pestfish/PDFs/Gambusia.pdf> [Assessed on 3rd November 2007].
- West P., Brown A. and Hall K. 1995. Queensland Government Report: Review of Alien Fish Monitoring, indicators and Protocols; Implications for National Monitoring of Australia's Inland River Systems. Report to the National Land and Water Resources Audit. NSW Department of Primary Industries.
- WHO. 1972. A System of World-wide Surveillance for Vectors. WHO Weekly Epidemiological Record 1972. 47:73-84.
- WHO. 2001. WHO Official Website: Yellow Fever. [Online] <http://www.who.int/mediacentre/factsheets/fs100/en/> [Accessed on 21<sup>st</sup> October 2008].
- WHO. 2002. Report on dengue prevention and control : WHO, 55th World Health Assembly, 4 March 2002, document A55/19.
- Wong, K. L., and Phua, K. L. 2006. Statistics Made Simple for Healthcare and Social Science Professionals and Students. Universiti Putra Malaysia Press. ISBN: 983-3455-03-4.
- Wroblewski, A. 1968. Note on Oriental Micronectinae (Heteroptera, Corixidae). Bulletin Entomologique. 38:753-779.
- Wu, N., Wang, S., Han, G., Xu, R., Tang, G., and Qian, C. 1987. Control of *Aedes aegypti* Larvae in Household Water Containers by Chinese Catfish. Bulletin of the World Health Organization. 65(4):503-506.
- Yoshito, W. 1994. Japanese Encephalitis Vector. Tropical Medicine. 36(4):235-242.

## APPENDICES

### Appendix 1

#### 1.1 National Water Quality Standards for Malaysia

PARAMETER	UNIT	CLASS					
		I	IIA	IIB	III	IV	V
Ammoniacal Nitrogen	mg/l	<b>0.1</b>	<b>0.3</b>	0.3	0.9	2.7	> 2.7
Biochemical Oxygen Demand	mg/l	1	3	3	6	<b>12</b>	> 12
Chemical Oxygen Demand	mg/l	10	<b>25</b>	<b>25</b>	50	100	> 100
Dissolved Oxygen	mg/l	7	<b>5 - 7</b>	5 - 7	3 - 5	< 3	< 1
pH	-	<b>6.5 - 8.5</b>	6 - 9	6 - 9	5 - 9	5 - 9	-
Colour	TCU	15	150	150	-	-	-
Electrical Conductivity*	μS/cm	1000	1000	-	-	6000	-
Floatables	-	N	N	N	-	-	-
Odour	-	N	N	N	-	-	-
Salinity	%	0.5	1	-	-	2	-
Taste	-	N	N	N	-	-	-
Total Dissolved Solid	mg/l	500	1000	-	-	4000	-
Total Suspended Solid	mg/l	25	50	50	150	300	300
Temperature	°C	-	Normal + 2 °C	-	Normal + 2 °C	-	-
Turbidity	NTU	5	50	50	-	-	-
Faecal Coliform**	count/100 ml	10	100	400	5000 (20000)a	5000 (20000)a	-
Total Coliform	count/100 ml	100	5000	5000	50000	50000	> 50000

**Notes**

\* = At hardness 50 mg/l CaCO<sub>3</sub>

**pdfMachine**

**A pdf writer that produces quality PDF files with ease!**

Produce quality PDF files in seconds and preserve the integrity of your original documents. Compatible across nearly all Windows platforms, if you can print from a windows application you can use pdfMachine.

Get yours now!

# = Maximum (unbracketed) and 24-hour average (bracketed) concentrations

N = Free from visible film sheen, discolouration and deposits

## 1.2 DOE Water Quality Index Classification

PARAMETER	UNIT	CLASS				
		I	II	III	IV	V
Ammoniacal Nitrogen	mg/l	< 0.1	0.1 - 0.3	0.3 - 0.9	0.9 - 2.7	> 2.7
Biochemical Oxygen Demand	mg/l	< 1	1 - 3	3 - 6	6 - 12	> 12
Chemical Oxygen Demand	mg/l	< 10	10 - 25	25 - 50	50 - 100	> 100
Dissolved Oxygen	mg/l	> 7	5 - 7	3 - 5	1 - 3	< 1
pH	-	> 7	6 - 7	5 - 6	< 5	> 5
Total Suspended Solid	mg/l	< 25	25 - 50	50 - 150	150 - 300	> 300
Water Quality Index (WQI)	-	< 92.7	76.5 - 92.7	51.9 - 76.5	31.0 - 51.9	> 31.0

## 1.3 Water Classes And Uses

CLASS	USES
Class I	Conservation of natural environment. Water Supply I - Practically no treatment necessary. Fishery I - Very sensitive aquatic species.
Class IIA	Water Supply II - Conventional treatment. Fishery II - Sensitive aquatic species.
Class IIB	Recreational use body contact.
Class III	Water Supply III - Extensive treatment required. Fishery III - Common, of economic value and tolerant species; livestock drinking.
Class IV	Irrigation
Class V	None of the above.

## Appendix 2

pdfMachine

**A pdf writer that produces quality PDF files with ease!**

Produce quality PDF files in seconds and preserve the integrity of your original documents. Compatible across nearly all Windows platforms, if you can print from a windows application you can use pdfMachine.

Get yours now!

## 2.1 Results of MI and ICI in Housing Area: Bandar Universiti

Bandar Universiti (BU)	Containers with Micronectidae (ME)			Containers with No Micronectidae (Control)					
	Date	Nos. of container inspected	Nos. of container with larvae	ICI	Nos. of container inspected	Nos. of container with Micronecta	MI	Nos. of containers with larvae	ICI
8-Dec-08	30	0	0	30	0	0	0	0	0.00
12-Dec-08	30	0	0	30	2	6.67	0	0	0.00
16-Dec-08	30	0	0	30	7	23.33	0	0	0.00
20-Dec-08	30	0	0	30	17	56.67	1	3.33	
24-Dec-08	30	0	0	30	11	36.67	0	0	0.00
28-Dec-08	30	0	0	30	11	36.67	0	0	0.00
01-Jan-09	30	0	0	30	10	33.33	5	16.67	
05-Jan-09	21	0	0	21	10	47.62	6	28.57	
09-Jan-09	21	0	0	21	17	80.95	0	0	0.00
13-Jan-09	21	0	0	21	12	57.14	0	0	0.00
17-Jan-09	21	0	0	21	12	57.14	1	4.76	
21-Jan-09	20	0	0	20	12	60.00	3	15.00	
25-Jan-09	19	0	0	19	13	68.42	1	5.26	
29-Jan-09	11	0	0	11	9	81.82	1	9.09	
02-Feb-09	11	0	0	11	9	81.82	2	18.18	
06-Feb-09	11	0	0	11	9	81.82	2	18.18	
10-Feb-09	11	0	0	11	9	81.82	0	0.00	
14-Feb-09	11	0	0	11	9	81.82	0	0.00	
18-Feb-09	11	0	0	11	9	81.82	0	0.00	
22-Feb-09	11	0	0	11	9	81.82	2	18.18	
26-Feb-09	11	0	0	11	9	81.82	0	0.00	
Total	421	0	0	421	206	58.06	24	6.53	

## 2.2 Results of MI and ICI in Housing Area: Taman Tasek Putra

Taman Tasek Putra (TTP)	Containers with Micronectidae (ME)			Containers with No Micronectidae (Control)				
Date	Nos. of container inspected	Nos. of container with larvae	ICI	Nos. of container inspected	Nos. of containers with Micronecta	MI	Nos. of container with larvae	ICI
08-Dec-08	30	0	0	30	0	0	0	0
12-Dec-08	30	0	0	30	17	56.67	0	0
16-Dec-08	29	0	0	29	16	55.17	0	0
20-Dec-08	29	0	0	29	19	65.52	1	3.45
24-Dec-08	28	0	0	28	11	39.29	5	17.86
28-Dec-08	28	0	0	28	11	39.29	0	0
01-Jan-09	28	0	0	28	16	57.14	0	0
05-Jan-09	20	0	0	20	16	80.00	3	15
09-Jan-09	20	0	0	20	16	80.00	2	10
13-Jan-09	20	0	0	20	16	80.00	0	0
17-Jan-09	20	0	0	20	16	80.00	3	15
21-Jan-09	20	0	0	20	18	90.00	1	5
25-Jan-09	18	0	0	18	16	88.89	0	0
29-Jan-09	17	0	0	17	14	82.35	0	0
02-Feb-09	17	0	0	17	15	88.24	1	5.88
06-Feb-09	17	0	0	17	15	88.24	0	0
10-Feb-09	17	0	0	17	16	94.12	0	0
14-Feb-09	17	0	0	17	15	88.24	0	0
18-Feb-09	17	0	0	17	14	82.35	0	0
22-Feb-09	17	0	0	17	14	82.35	2	11.76
26-Feb-09	17	0	0	17	14	82.35	0	0
Total	426	0	0	426	305	71.60	18	3.12

**pdfMachine**

**A pdf writer that produces quality PDF files with ease!**

Produce quality PDF files in seconds and preserve the integrity of your original documents. Compatible across nearly all Windows platforms, if you can print from a windows application you can use pdfMachine.

Get yours now!

## REFERENCES

- Abd Manan, T. S., and Sapari, N. 2008. The Application of Micronectidae and *Poecilia reticulata* for Mosquito Breeding Control in Engineering Structures. *Proceedings of EnCon2008: 2<sup>nd</sup> Engineering Conference on Sustainable Engineering Infrastructures Development & Management. December 18-19, 2008, Kuching, Sarawak, Malaysia.* 2:11-14.
- Abdul Rahman, H. 2008. Ministry of Health Report: Situasi Semasa Demam Denggi di Malaysia. Kenyataan Akhbar Pengarah Kawalan Penyakit, Kementerian Kesihatan Malaysia. Disease Control Division, Ministry of Health Malaysia, Pusat Pentadbiran Kerajaan Persekutuan, 62590 Putrajaya, Malaysia.
- Abdul Rahman, H. 2009. Ministry of Health Report: Situasi Semasa Demam Denggi di Malaysia. Kenyataan Akhbar Pengarah Kawalan Penyakit, Kementerian Kesihatan Malaysia. Disease Control Division, Ministry of Health Malaysia, Pusat pentadbiran Kerajaan Persekutuan, 62590 Putrajaya, Malaysia.
- Abu Hassan, A., Che Salmah, M. R., Ngumbang, J., Ahmad Ramli, S., and El-Badri, A. M. 2005. Mosquitoes of Urban Areas of Penang: Abundance and Control. *Proceedings of the Fifth International Conference on Urban Pests.* 34:257-263.
- Aburas, H. M. 2007. ABURAS Index: A Statistically Developed Index for Dengue-Transmitting Vector Population Prediction. *Proceedings of World Academy of Science, Engineering and Technology Volume 23 August 2007 ISSN 1307-6884.* 23:151-155.
- Adli Muhmed, M. I. 2005. Water Retention in Urban Environment and Mosquito Breeding Problem. Department of Civil Engineering, Universiti Teknologi Petronas, Bandar Sri Iskandar, 31750 Tronoh, Perak, Malaysia.
- Akram, W., and Lee, J. J. 2004. Effect of Habitat Characteristic on the Distribution and Behavior of *Aedes albopictus*. *Journal of Vector Ecology.* 41:379-382.
- APHA (American Public Health Association). 1997. Standard Methods for the Examination of Water and Wastewater. Published by American Public Health Association. ISBN: 9780875530475.
- Anderson, R. R., and Harrington, L. C. 2009. Medical Entomology Extension: An extension program of the Department of Entomology, College of Agriculture & life Sciences at Cornell University. [Online] <http://www.entomology.cornell.edu/MedEnt/MosquitoFS/MosquitoFS.html>. [Accessed date: 10<sup>th</sup> December 2008].

- Baerg, D. C., and Boreham, M. M. 1974. *Anopheles Neivai* Howard, Dyar & Knab: Laboratory Observation on the life Cycle and Description of the Egg Stage. *Journal of Medical Entomology*. 5:629-630.
- Barrero, P. R., and Mistchenko, A. S. 2008. Genetic Analysis of Dengue Virus Type 3 Isolated in Buenos Aires, Argentina. *ELSEVIER Virus Research*. 135:83-88.
- Breene, R. G., Sweet, M. H., and Olson, J. K. 1987. Spider Predators of Mosquito Larvae. *The Journal of Arachnology*. 16:275-277.
- CALS (College of Agricultural and Life Sciences, Cornell University). 2009. Water Wonders. [Online] <http://www.cals.ncsu.edu/course/ent525/water/aquatic/index.htm> [Assessed on 27th May 2009].
- Arora, P. N., Arora, S. and Arora, S. 2006. First Edition 2007: Comprehensive Statistical Methods. S.Chand & Company LTD. ISBN: 81-219-2776-5.
- Chandra, G., Bhattacharjee, I., Chatterjee, S. N., and Ghosh, A. 2008. Mosquito Control by Larvivorous Fish. *Indian Journal Medical Research*. 127:13-27.
- Chen, C. D., Benjamin, S., Saranam, M. M., Chiang, Y. F., Lee, H. L., Ahmad, N. W., and Azirun, M. S. 2005. Dengue Vector Surveillance in Urban Residential and Settlement Areas in Selangor, Malaysia. *Tropical Biomedicine*. 22:39-43.
- Cheng, L., Chang, M. Y., Li, D., and Liu, H. 2006. Aquatic Heteroptera (Insecta: Gerromorpha and nepomorpha) From Xishuangbanna, Yunnan, China. *The raffles bulletin of Zoology* 2006. 54(2):203-214.
- Cheong, H. T., Vythilingam, I., Matusop, A., Chan, S. T., and Singh, B. 2008. Bionomics of *Anopheles latens* in Kapit, Sarawak, Malaysian Borneo in Relation to the Transmission of Zoonotic Simian Malaria Parasite *Plasmodium knowlesi*. *Malaria Journal*. 7(52):1-8.
- Chua, K. B., Chua, I. L., Chua, I. E., and Chua, K. H. 2005. Effect of Chemical Fogging on Immature Aedes Mosquitoes in Natural Field Condition. *Singapore medical Journal*. 46(11):639-645.
- Chua, K. B., Bellini, W. J., Rota, P. A., Harcourt, B. H., Tamin. A., Lam, S. K., Ksiazek, T. G., Rollin, P. E., Zaki, S. R., Sgieh, W. J., Goldsmith, C. S., Gubler, D. J., Roehrig, J. T., Eaton, B., Gould, A. R., Olson, J., Field, H., Daniels, P., Ling, A. E., Peters, C. J., Anderson, L. J., and Mahy, B. W. J. 2000. Nipah Virus: A Recently Emergent Deadly Paramyxovirus. *SCIENCE*. 288:1432-1435.



- Daly, Doyen and Purcell. 1998. Second Edition: Introduction to Insect Biology and Diversity. Oxford University Press Inc. ISBN 0-19-510033-6.
- DOE (Department of Environment, Ministry of Natural Resources and Environment). 2005. National Water Quality Standards for Malaysia. [Online] [http://www.doe.gov.my/index.php?option=com\\_content&task=view&id=244&Itemid=615&lang=en](http://www.doe.gov.my/index.php?option=com_content&task=view&id=244&Itemid=615&lang=en) [Accessed on 10<sup>th</sup> March 2008].
- Duffus H. J. 1980. Environmental Toxicology-(Resource and Environmental Series). Department of Brewing and Biological Sciences, Heriot-Watt University, Edinburgh. First Edition.
- Eisenberg, J. N. S., Cevallos, W., Ponce, K., Levy, K., Bates, S. J., Scott, J. C., Hubbard, A., Vieira, N., Endara, P., Espinel, M., Trueba, G., Riley, L. W., and Trostle, J. 2006. Environmental Change and Infectious Disease: How New Roads Affect the Transmission of Diarrheal Pathogens in Rural Ecuador. PNAS. 103(51):19460-19465.
- Environmental Quality Act 1974 (Act 1972) & Subsidiary Legislations as at 31<sup>st</sup> August 1997. Compiled by Legal Research Board. Printed by Direct Art Company, Kuala Lumpur. Sole Distributor: Golden Book Centre Sdn Bhd. ISBN: 967-89-0764-X.
- Garcia, R. 1983. Mosquito Management: Ecological Approaches. Environmental Management. 7:73-78.
- Garcia, R. 1972. The Control of Malaria. Environment. 14:2-9.
- Gautam, A., Anirban, A., and Goutam, K. S. 2006. Predatory Activity of *Rhantus sikkimensis* and Larvae of *Toxorhynchites splendens* on Mosquito larvae in Darjeeling, India. Journal of Vector Borne Disease. 43:66-72.
- Google. 2009. Google Earth Official Websites for 3D World Map [Online] <http://earth.google.com/> [Accessed on 21<sup>st</sup> Mac 2009].
- Ira, S and Bhushan, K. 2004. Clinical and Laboratory Abnormalities due to Dengue in Hospitalized Children in Mumbai in 2004. Dengue Bulletin. 29:90-96.
- Joseph, F. H. 2002. Statistics: A Tool For Social Research. Wadsworth/Thomson Learning Academic Resource Centre, USA. ISBN: 0-534-55785-6.
- Kay, B., and Nam, V. S. 2005. Net Strategy Against *Aedes aegypti* in Vietnam. Lancet 2005. 365:613-617.

- Kosiyachinda, P., Bhumiratana, A., and Kittayapong, P. 2003. Enhancement of The Efficacy of a Combination of *Mesocyclops aspericornis* and *Bacillus thuringiensis* Var. *Israelensis* by Community-based Products in Controlling *Aedes aegypti* Larvae in Thailand. *The American Journal of Tropical Medicine and Hygiene*. 69(2):206-212.
- Kolsky, P. 1999. Engineers and Urban Malaria: Part of the Solution, or Part of the Problem? *Environment and Urbanization*. 11(1):159-165.
- Larry, J. K. 2003. *Basic Statistics and Data Analysis*. Thomson Learning Academic Resource Centre, USA. ISBN: 0-534-38465-X.
- Leong, C. Y. 1966. A Taxonomic Study of the Malayan Corixidae (Hemiptera-Heteroptera) with the Description of *Micronecta malayana* sp. *Bulletin of the National Museum Singapore*. Department of Zoology, University of Singapore. 33(12):83-90.
- Mackay, A. J. 2007. Detection of West Nile Virus Activity in male and Female Mosquitoes, and Evaluation of host-Utilization Patterns of Mosquitoes, In East Baton Rouge Parish, Louisiana. The Department of Entomology, Graduate Faculty of the Louisiana State University and Agricultural and mechanical College. 1-173.
- Mariappan, T. 2000. urban Mosquito Control: A Case Study. *The Indian Council of Medical Research (ICMR) Bulletin*, VOLUME 30, ISSN 0377-4910. 30(3):1-9.
- Merritt, R. W. and Cummins, K. W. 1995. *An Introduction to the Aquatic Insects of North America*. Kendall / Hunt Publishing Company. 41-73.
- Metzger, M. E. 2004. *Managing Mosquitoes in Stormwater Treatment Devices*. Publication 8125. Vector-Borne Disease Section, California Department of Health Services, University of California, Division of Agriculture and Natural Resources.
- Ministry of Health, Malaysia, 2009. *Background of Vector Borne Disease Control in Malaysia*. [Online] file:///C:/Documents%20and%20Settings/User/Desktop/background.htm [Assessed on 16th April 2009].
- Molles, M. 2005. *Ecology: Concepts and Applications*. McGraw-Hill Publishers [Online] <http://ebooks.primsonline.com/eBookstore/index.jsp> [Assessed on 21st Mac 2009].
- MMD, 2009. *Official Website of Malaysian Meteorological Department (MMD)*. [Online] [www.met.gov.my/home\\_e.html](http://www.met.gov.my/home_e.html) [Assessed on 15th April 2009].

- Nam, V. S., Yen, N. T., Holynska, M., Reid, J. W. and Kay, B. H. 2000. National Progress in Dengue Vector Control in Vietnam: Survey For Mesocyclops (Copepoda), Micronecta (Corixidae) and Fish as Biological Control Agents. *The American Society of Tropical Medicine and Hygiene*. 62(1):5-10.
- Nieser, N., Chen, P., and Chang, M. Y. 2005. A New Subgenus and Six New Species of *Nepomorpha* (Insecta:Heteroptera) From Yunnan, China. *The Raffles Bulletin of Zoology* 2005. 53(2):189-209.
- Nieser, N. 2000. Three New Species of *Micronecta* from Thailand with a Key to SE Asian Species. (Heteroptera: Corixidae). *Journal of the New York Entomological Society*. 107:277-288.
- Nieser, N. 2002.a. Guide to Aquatic Heteroptera of Singapore and peninsular Malaysia. IV. Corixoidea. *The Raffles bulletin of Zoology* 2002. 50(1):263-274.
- Nieser, N. 2002.b. Four New Species of *Micronecta* (Insecta: Heteroptera: Micronectidae) From The malay Peninsula. *The Raffles Bulletin of Zoology* 2002. National University of Singapore, Singapore. 50(1):9-16.
- Ooi, E. E., Goh, K. T., and Guebler, D. J. 2006. Dengue Prevention and 35 Years of Vector Control in Singapore. *Emerging Infectious Diseases*. 12:887-893.
- Otero, M., Solari, H. G., and Schweigmann, N. 2005. A Stochastic Population Dynamics for *Aedes aegypti*: Formulation and Application to a City with Temperate Climate. *Bulletin of Mathematical Biology*. 70:1297-1325.
- Pandian, T. J., Mathavan, S., and Jeyagopal, C. P. 1979. Influence of Temperature and Body Weight on Mosquito Predation by the Dragonfly Nymph *Mesogomphus Lineatus*. *Hydrobiologia*. 62(2):99-104.
- Petersen, L. R., and Guebler, D.J. 2006. Viral Zoonoses. *ACP Medicine*. 13:1-14.
- Pitts, C. W., Holbrook, G. L, Gripp, S. I., and Hock, W. K. 2000. Mosquito Biology and Control. Publication Distribution Centre, The Pennsylvania State University, 112 Agricultural Administration Building, University Park, PA 16802.
- Poopathi, S., and Tyagi, B. K. 2006. The Challenge of mosquito Control Strategies: From Primordial to Molecular Approach. *Academic Journals: Biotechnology and Molecular Biology Review (BMBR)*. 1(2):51-65.

- Sapari, N., Maulut, M. S., Veeramohan, S. 2006. Prevention of Mosquito Infestation in Septic Tanks and Other Water Retaining Structures By Larviciding and Biological Control. Paper presented at *International Federation of Environmental Health Asia and Pacific Regional Conference on Environmental Health, UTP Tronoh, Malaysia*. 1:1-6.
- Sapari, N. and Abd Manan, T. S. 2008. Predation Potential of Micronectidae in Controlling Mosquito. *Proceedings of International Conference in Advancement of Science and Technology*. 4:245-247.
- Service, M. W. 2008. Mosquito Ecology: Field Sampling Methods. Chapman & Hall. ISBN 978-1-4020-6665-8.
- Shope, R. E., Andrade, A. H. P. D., Bensabath, G., Causey, O. R., and Humphrey, P. S. 1966. The Epidemiology of EEE, WEE, SLE and Turlock Viruses, with Special Reference to Birds in a Tropical Rain Forest near Belem, Brazil. *American Journal of Epidemiology*. 84(3):467-472.
- Subodh Mahanti. 2008. Climate Change and Health. Vigyan Prasar, Dream 2047. 10(9):19-35.
- Suphaphom, K., Sathantriphop, S., and Paeporn, P. 2002. The Distribution of Micronecta sp. (Hemiptera: Corixidae) as the Enemy of Aedes aegypti Larvae in Different Regions of Thailand. *Proceedings Third International Conference on Biopesticides, Kuala Lumpur, Malaysia*.
- Suprakash, K., and Aditya, A. K. 2003. Biological Control of Mosquitoes by Aquatic Planaria. *TISCIA*. 34:15-18.
- Surendran, S. N., Kajatheepan, A., Sanjeevkumar, K. F. A., and Jude, P. J. 2007. Seasonality and Insecticide Susceptibility of Dengue Vectors: An Ovitrap based Survey in a Residential Area of northern Sri Lanka. 13(2):12-15.
- Tansley, A. G. 1923. Practical Plant Ecology: A Guide for beginners in Field Study of Plant Communities. Printed in London: George Allen & Unwin LTD. Ruskin House, 40 Musuem street, W.C. April 1923. 12:15-20.
- Teng, A. K., and Singh, S. 2001. Epidemiology and New Initiatives in the Prevention and Control of Dengue in Malaysia. *Dengue Bulletin* Volume 25, 2001. 25:7-14.
- Vasudevan, P., Pathak, N., and Mittal, P. K. 2000. DRWH and Insect Vectors: A Literature Review. Central for Rural Development & Technology, Indian Institute of Technology, Delhi, India and Malaria Research Centre, New Delhi, India. Published by European Commission. 32:71-74.

- Washington State Department of Health. 2008. Guidance for Surveillance, Prevention, and Control of Mosquito-Borne Disease (Prevention Trough Partnership). Washington State Department of Health, Zoonotic Disease Program, Division of Environmental Health, Office of Environmental Health and Safety. DOH Publication: 10:149-333.
- Wearing, H. J., and Rohani, P. 2006. Ecological and Immunological Determinants of Dengue Epidemics. PNAS. 13(31):11802-11807.
- Webb, A., Maughan, M., and Knott, M. 2007. Pest Fish Profiles: *Gambusia holbrooki*- *Gambusia*. [Online] <http://www.actfr.jcu.edu.au/Projects/Pestfish/PDFs/Gambusia.pdf> [Assessed on 3rd November 2007].
- West P., Brown A. and Hall K. 1995. Queensland Government Report: Review of Alien Fish Monitoring, indicators and Protocols; Implications for National Monitoring of Australia's Inland River Systems. Report to the National Land and Water Resources Audit. NSW Department of Primary Industries.
- WHO. 1972. A System of World-wide Surveillance for Vectors. WHO Weekly Epidemiological Record 1972. 47:73-84.
- WHO. 2001. WHO Official Website: Yellow Fever. [Online] <http://www.who.int/mediacentre/factsheets/fs100/en/> [Accessed on 21<sup>st</sup> October 2008].
- WHO. 2002. Report on dengue prevention and control : WHO, 55th World Health Assembly, 4 March 2002, document A55/19.
- Wong, K. L., and Phua, K. L. 2006. Statistics Made Simple for Healthcare and Social Science Professionals and Students. Universiti Putra Malaysia Press. ISBN: 983-3455-03-4.
- Wroblewski, A. 1968. Note on Oriental Micronectinae (Heteroptera, Corixidae). Bulletin Entomologique. 38:753-779.
- Wu, N., Wang, S., Han, G., Xu, R., Tang, G., and Qian, C. 1987. Control of *Aedes aegypti* Larvae in Household Water Containers by Chinese Catfish. Bulletin of the World Health Organization. 65(4):503-506.
- Yoshito, W. 1994. Japanese Encephalitis Vector. Tropical Medicine. 36(4):235-242.

## APPENDICES

### Appendix 1

#### 1.1 National Water Quality Standards for Malaysia

PARAMETER	UNIT	CLASS					
		I	IIA	IIB	III	IV	V
Ammoniacal Nitrogen	mg/l	<b>0.1</b>	<b>0.3</b>	0.3	0.9	2.7	> 2.7
Biochemical Oxygen Demand	mg/l	1	3	3	6	<b>12</b>	> 12
Chemical Oxygen Demand	mg/l	10	<b>25</b>	<b>25</b>	50	100	> 100
Dissolved Oxygen	mg/l	7	<b>5 - 7</b>	5 - 7	3 - 5	< 3	< 1
pH	-	<b>6.5 - 8.5</b>	6 - 9	6 - 9	5 - 9	5 - 9	-
Colour	TCU	15	150	150	-	-	-
Electrical Conductivity*	µS/cm	1000	1000	-	-	6000	-
Floatables	-	N	N	N	-	-	-
Odour	-	N	N	N	-	-	-
Salinity	%	0.5	1	-	-	2	-
Taste	-	N	N	N	-	-	-
Total Dissolved Solid	mg/l	500	1000	-	-	4000	-
Total Suspended Solid	mg/l	25	50	50	150	300	300
Temperature	°C	-	Normal + 2 °C	-	Normal + 2 °C	-	-
Turbidity	NTU	5	50	50	-	-	-
Faecal Coliform**	count/100 ml	10	100	400	5000 (20000)a	5000 (20000)a	-
Total Coliform	count/100 ml	100	5000	5000	50000	50000	> 50000

**Notes**

\* = At hardness 50 mg/l CaCO<sub>3</sub>

**pdfMachine**

**A pdf writer that produces quality PDF files with ease!**

Produce quality PDF files in seconds and preserve the integrity of your original documents. Compatible across nearly all Windows platforms, if you can print from a windows application you can use pdfMachine.

Get yours now!

# = Maximum (unbracketed) and 24-hour average (bracketed) concentrations

N = Free from visible film sheen, discolouration and deposits

## 1.2 DOE Water Quality Index Classification

PARAMETER	UNIT	CLASS				
		I	II	III	IV	V
Ammoniacal Nitrogen	mg/l	< 0.1	0.1 - 0.3	0.3 - 0.9	0.9 - 2.7	> 2.7
Biochemical Oxygen Demand	mg/l	< 1	1 - 3	3 - 6	6 - 12	> 12
Chemical Oxygen Demand	mg/l	< 10	10 - 25	25 - 50	50 - 100	> 100
Dissolved Oxygen	mg/l	> 7	5 - 7	3 - 5	1 - 3	< 1
pH	-	> 7	6 - 7	5 - 6	< 5	> 5
Total Suspended Solid	mg/l	< 25	25 - 50	50 - 150	150 - 300	> 300
Water Quality Index (WQI)	-	< 92.7	76.5 - 92.7	51.9 - 76.5	31.0 - 51.9	> 31.0

## 1.3 Water Classes And Uses

CLASS	USES
Class I	Conservation of natural environment. Water Supply I - Practically no treatment necessary. Fishery I - Very sensitive aquatic species.
Class IIA	Water Supply II - Conventional treatment. Fishery II - Sensitive aquatic species.
Class IIB	Recreational use body contact.
Class III	Water Supply III - Extensive treatment required. Fishery III - Common, of economic value and tolerant species; livestock drinking.
Class IV	Irrigation
Class V	None of the above.

## Appendix 2

pdfMachine

**A pdf writer that produces quality PDF files with ease!**

Produce quality PDF files in seconds and preserve the integrity of your original documents. Compatible across nearly all Windows platforms, if you can print from a windows application you can use pdfMachine.

Get yours now!

## 2.1 Results of MI and ICI in Housing Area: Bandar Universiti

Bandar Universiti (BU)	Containers with Micronectidae (ME)			Containers with No Micronectidae (Control)					
	Date	Nos. of container inspected	Nos. of container with larvae	ICI	Nos. of container inspected	Nos. of container with Micronecta	MI	Nos. of containers with larvae	ICI
8-Dec-08	30	0	0	30	0	0	0	0	0.00
12-Dec-08	30	0	0	30	2	6.67	0	0	0.00
16-Dec-08	30	0	0	30	7	23.33	0	0	0.00
20-Dec-08	30	0	0	30	17	56.67	1	3.33	
24-Dec-08	30	0	0	30	11	36.67	0	0	0.00
28-Dec-08	30	0	0	30	11	36.67	0	0	0.00
01-Jan-09	30	0	0	30	10	33.33	5	16.67	
05-Jan-09	21	0	0	21	10	47.62	6	28.57	
09-Jan-09	21	0	0	21	17	80.95	0	0	0.00
13-Jan-09	21	0	0	21	12	57.14	0	0	0.00
17-Jan-09	21	0	0	21	12	57.14	1	4.76	
21-Jan-09	20	0	0	20	12	60.00	3	15.00	
25-Jan-09	19	0	0	19	13	68.42	1	5.26	
29-Jan-09	11	0	0	11	9	81.82	1	9.09	
02-Feb-09	11	0	0	11	9	81.82	2	18.18	
06-Feb-09	11	0	0	11	9	81.82	2	18.18	
10-Feb-09	11	0	0	11	9	81.82	0	0.00	
14-Feb-09	11	0	0	11	9	81.82	0	0.00	
18-Feb-09	11	0	0	11	9	81.82	0	0.00	
22-Feb-09	11	0	0	11	9	81.82	2	18.18	
26-Feb-09	11	0	0	11	9	81.82	0	0.00	
Total	421	0	0	421	206	58.06	24	6.53	

## 2.2 Results of MI and ICI in Housing Area: Taman Tasek Putra



Taman Tasek Putra (TTP)	Containers with Micronectidae (ME)			Containers with No Micronectidae (Control)				
Date	Nos. of container inspected	Nos. of container with larvae	ICI	Nos. of container inspected	Nos. of containers with Micronecta	MI	Nos. of container with larvae	ICI
08-Dec-08	30	0	0	30	0	0	0	0
12-Dec-08	30	0	0	30	17	56.67	0	0
16-Dec-08	29	0	0	29	16	55.17	0	0
20-Dec-08	29	0	0	29	19	65.52	1	3.45
24-Dec-08	28	0	0	28	11	39.29	5	17.86
28-Dec-08	28	0	0	28	11	39.29	0	0
01-Jan-09	28	0	0	28	16	57.14	0	0
05-Jan-09	20	0	0	20	16	80.00	3	15
09-Jan-09	20	0	0	20	16	80.00	2	10
13-Jan-09	20	0	0	20	16	80.00	0	0
17-Jan-09	20	0	0	20	16	80.00	3	15
21-Jan-09	20	0	0	20	18	90.00	1	5
25-Jan-09	18	0	0	18	16	88.89	0	0
29-Jan-09	17	0	0	17	14	82.35	0	0
02-Feb-09	17	0	0	17	15	88.24	1	5.88
06-Feb-09	17	0	0	17	15	88.24	0	0
10-Feb-09	17	0	0	17	16	94.12	0	0
14-Feb-09	17	0	0	17	15	88.24	0	0
18-Feb-09	17	0	0	17	14	82.35	0	0
22-Feb-09	17	0	0	17	14	82.35	2	11.76
26-Feb-09	17	0	0	17	14	82.35	0	0
Total	426	0	0	426	305	71.60	18	3.12

**pdfMachine**

**A pdf writer that produces quality PDF files with ease!**

Produce quality PDF files in seconds and preserve the integrity of your original documents. Compatible across nearly all Windows platforms, if you can print from a windows application you can use pdfMachine.

Get yours now!