WAMMP Water and Sediment Quality Monitoring Program:
Monitoring the condition of sediments in Walpole and Nornalup Inlets Marine Park – Comparing 1996 sediment nutrient data and investigation of pesticides

Marine Science Program Metadata Report
MDR_WQ&SedQ_WNIMP_201305

KP Bancroft

May 2013

Marine Science Program
Science Division
Department of Environment and Conservation

Department of
Environment and Conservation
Our environment, our future

This report may be cited as:

Bancroft KP (2013) *WAMMP Water and Sediment Quality Monitoring Program: Monitoring the condition of sediments in Walpole and Nornalup Inlets Marine Park – Comparing 1996 sediment nutrient data and investigation of pesticides*. Marine Science Program, Department of Environment and Conservation, Perth, Western Australia, Marine Science Program Metadata Report **MDR_WQ&SedQ_WNIMP_201305**. 15 p.

Report

Who is submitting this report?	Kevin Bancroft
Date report submitted?	26 April 2013
Who has reviewed this report?	Kim Friedman

What

What is the title of the study/project?	WAMMP Sediment Quality Monitoring
SPP number if relevant (refers to internal MSP projects)	SPP 2012-008
What kind of data was collected (e.g. species richness, species inventory, abundance or density, % coral cover, etc)	Sediment Quality data: • Total Kjeldahl Nitrogen (TKN) • Total Phosphorus (TP) • Organochlorins (OC) • Organophosphates (OP) • Carbomates (Carb)
What would be some key words for searching for these data?	Sediment quality, monitoring, nutrients, pesticides, herbicides, fungicides, Walpole and Nornalup Inlets Marine Park

Who

Who did the research/monitoring? Please list names, duties and their affiliations.	Kevin Bancroft	MSP	Trip Leader, Researcher
	Shaun Ossinger	Frankland District	Marine Park Coordinator, Skipper
	Jason Fletcher	Frankland District	Field Assistance
MSP	Kevin Bancroft Marine Science Program Science Division DEC 17 Dick Perry Ave Kensington WA 6151		
Who else should be acknowledged and what contribution did they make (field, technical, GIS support, post-processing)?			

Why

Why was the research done? Provide an abstract that summarises the aim and objectives of the research and where it might be used. This may be taken directly from SPP for internal MSP projects.	<u>WAMMP Water and Sediment Quality Monitoring</u> The monitoring of sediment quality within WA's marine park network falls within WAMMP's overall objectives of monitoring the states marine assets. Within Walpole and Nornalup Inlets Marine Park (WNIMP), water quality and sediment quality are listed as KPIs, increasing its priority as a primary focus for management and the need for CPR information from WAMMP. In a recent review, potential indicators and techniques and applicability of various approaches for monitoring water nutrients and toxicants (pesticides/hydrocarbons) were identified as priorities. As pesticides are more persistent in sediments than in the water column, pesticides in sediment will be investigated. . <u>WAMMP Water and Sediment Quality Monitoring</u> 1. Determine sediment nutrient (Total Keidjhal Nitrogen – TKN and Total Phosphorus - TP) and pesticides (Organochlorine/ Organophosphates/ Synthetic Pyrethroids/ Carbamates/ Fungicides) characteristics at five locations in Walpole and Nornalup Inlets Marine Park to develop a TP and TKN time series from Deeley 1995/6 results of estuarine sediment quality and establish a baseline for pesticides. <u>General</u> 1. Write a draft SOP for WAMMP sampling of sediments to assist operators and ensure standardised collection of sediments in the future. 2. Continue to communicate MSP aims, process, and preliminary results to DEC regional staff and local residents 3. Continue to build effective working arrangements with Walpole Regional Services staff..

How

How was the research done? (e.g. instrumentation, brief description of procedure)?	After laboratory analysis of samples from WNIMP by the National Measurement Institute (NATA accredited), sediment Total Keidjhal Nitrogen (TKN), Total Phosphates (TP) and pesticides concentrations will be obtained for5 sites inWNIMP. .

Please give a brief overview of the sampling design (spatial and temporal), including the spatial array of sample collection, how often measurements were taken and the specific unit of time or space that was used to aggregate samples (e.g. 20 sites, 10 inside sanctuary zones and 10 outside. 5 fixed transects at each site, each transect, surveyed twice a year, once in the summer and once in the winter, etc)?	Deeley established five sites in the WNIMP in 1995/6 for sediment characterisation. These sites were resampled in this survey for direct comparison to the historical data. <u>Method for TP and TKN:</u> • At each site, three replicate samples were collected by snorkeler at sites <2m or diver at sites >2m; • Each replicate was comprised of three 54mm dia x 100mm long sediment cores; • Using a push rod, each core was extruded to place the top 2 cm into a stainless steel mixing bowl and then the next 8 cm were placed into another stainless steel mixing bowl; • Each bowl was homogeneously mixed using a stainless steel ladle; • Sediment from the bowl containing the top 2 cm of sediment was placed into a 200mm sample jar clearly labelled with the site number, rep number, sample depth and analysis (e.g. WNI-01 Rep 1 0-2cm TP/TKN); • Procedure repeated for the collection of the 2-10cm sediment sample ensuring that little or no air was incorporated; and • The data was recorded in the field notes. <u>Method for Pesticides:</u> • At each site, three replicate samples were collected by snorkeler at sites <2m or diver at sites >2m; • Each replicate was comprised of one 54 mm dia x 100 mm long sediment core; • Using a push rod, each core was extruded into a stainless steel mixing bowl and then homogeneously mixed using a stainless steel ladle; • Sediment from the bowl was placed into a 200mm sample jar ensuring that little or no air was incorporated • Each jar was clearly labelled with the site number, rep number, sample depth and analysis (e.g. WNI-01 OP/OC/SP/Carb/Fung); • A second sample jar was also collected as a spare; and • The data was recorded in the field notes.
How are the data currently stored, that is what format is the data? (e.g. GIS shapefiles, Access database or geodatabase, compressed AVI etc.) Please provide as much information as possible.	Sample sites as GIS Shapefile Site data and analyses results as MS Excel spreadsheets

When

When was the research carried out? When were the start and end dates?	06-10 May 2013

Where

Where was the research done? As a minimum Please indicate the 'bounding box' in latitude/longitude (decimal degrees) (e.g. North bound latitude -22.00; West bound longitude 113.00; East bound longitude 114.00; South bound latitude -23.00)	Walpole and Nornalup Inlets Marine Park North: -34.974^{o} South: -35.032^{o} East: 116.756^{o} West: 116.698^{o}

Site names and GPS co-ordinates (in latitude/longitude (decimal degrees)	WAMMP Water ad Sediment Quality Monitoring Table 1. Location coordinates for the sediment quality monitoring sites in Walpole and Nornalup Inlets Marine Park on 06-10 May, 2013.

Esite_Code	Site_Name	Site_Desc	Depth	Longitude	Latitude
NI.1	Ocean entrance	Ocean entrance mid channel	1.5	116.73505	-35.02914
NI.2	Newdegate Is	Newdegate Is 100m sth off mid Is	3.5	116.70890	-35.01230
NI.3	Mid estuary	Mid estuary inline ocean channel & Sandy beach, Newdegate Is & Frankland R	4.0	116.72297	-35.00627
NI.4	Frankland R Mouth	Frankland R Mouth 200m N nav marker tyre	3.5	116.73663	-35.00591
NI.5	Walpole Est mouth	Walpole Est mouth off green nav marker	1.5	116.72299	-34.98829

Where in the vertical column of the ocean was the research undertaken? (e.g. minimum and maximum depth)	Between high water mark and 5 metres of depth

GIS/ Remote Sensing (to be filled in by the GIS officer responsible for the work)

Supporting Imagery

What satellite sensor/s or raster data type (ie Landsat , WV2 or bathymetry data)	aerial photogrammetry	
What was the date of imagery capture?	2007	
Imagery location: What regional mosaic or path/row was used?	K:\rs_imagery\Aerial_photography\Walpole\	
What is the imagery file name?	Deep_River_2228_Feb_2007_Mosaic.ecw	
What are the names of any derived raster products?		

Site Selection

Which datasets were used for site selection?	Deeley 1995/6		
Provide a brief description of the site selection method used	As per Deeley 1995/6 sites selected to look at indicators of estuarine health		

GPS format created for use in the field	Decimal degrees Datum GDA 94		
What are the names of any derived vector products?			

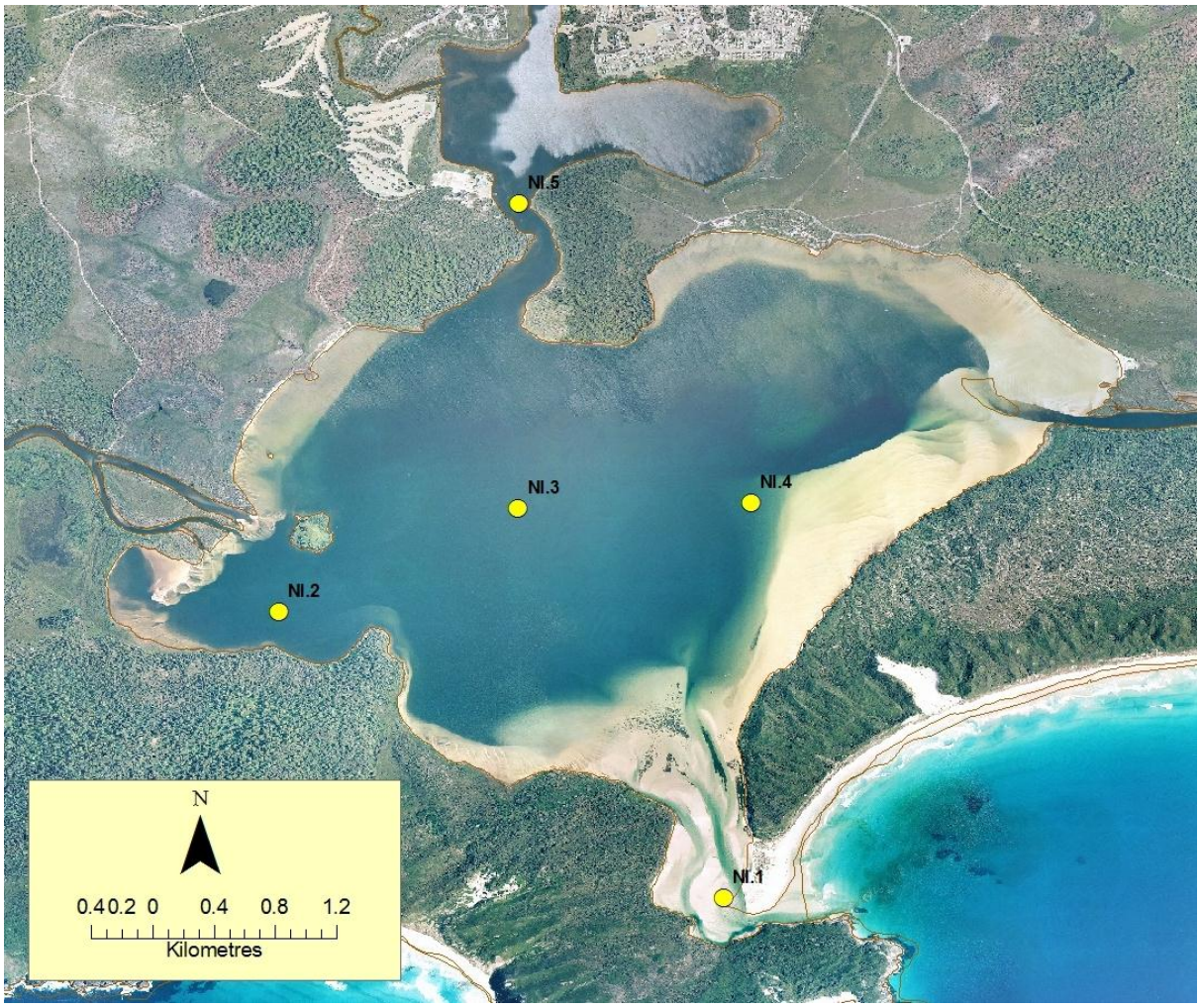
Data Creation date

Who is the custodian of the GIS products? Please list names, duties and their affiliations.	Kevin Bancroft, Marine Research Scientist, Marine Science Program
Where is the original source data stored? (database, computer directory and computer name)	• NAS drive: K:\KBA_GIS\WALPOLE\ • Backup Drive: G:\MSP_000_directory\GIS\WALPOLE\ • C Drive: C:\000_directory\GIS\WALPOLE\
Where are the derived data stored? (computer directory and computer name)	• NAS drive: K:\KBA_GIS\WALPOLE\ • Backup Drive: G:\MSP_000_directory\GIS\WALPOLE\ • C Drive: C:\000_directory\GIS\WALPOLE\

How to Access

Where are the raw data stored (include full file name and location, corporate file number etc)?	• Kevin Bancroft, Kensington Offices, computer: C:\000_directory\XXX_Working\2012_2013\WQ_SedQ\WNIMP_SedQ\SedQ_20130510 • Kevin Bancroft, Kensington Offices, Back up drive G:\MSP_000_directory\XXX_Working\2012_2013\WQ_SedQ\WNIMP_SedQ\SedQ_20130510 • NAS drive: K:\project_data\SedQ\WNIMP\SedQ_20130510
Where are derived data products and processed data stored (include full file name and location)?	• Kevin Bancroft, Kensington Offices, computer: C:\000_directory\XXX_Working\2012_2013\WQ_SedQ\WNIMP_SedQ\SedQ_20130510 • Kevin Bancroft, Kensington Offices, Back up drive G:\MSP_000_directory\XXX_Working\2012_2013\WQ_SedQ\WNIMP_SedQ\SedQ_20130510 • NAS drive: K:\project_data\SedQ\WNIMP\SedQ_20130510
Where are any other related publications/information about the research published - if any? (e.g. url)	- Field Operations Plan T:\REPORTS\POST 2009 REPORTS\FIELD OPERATIONS PLANS\FOP_SedQ\FOP_SedQ_Walpole_20130405.doc
What constraints/restrictions would you place on the data and access to it (e.g. legal, usage - purposes that shouldn't use the data)	None

Supplementary information -

Please attach any further information you think would be useful for future researchers	 Figure 1. Walpole sediment sampling sites as per Deeley 1995, in Walpole and Nornalup Inlets Marine Park.

Image

If you have one handy please also attach a picture (JPEG preferable) that best describes your research. This will be used as the thumbnail image next to the metadata records in the MEST	In the field  

Results of the toxicant analyses

Sample	WNI-01	WNI-02	WNI-03	WNI-04	WNI-05
Date Sampled	7-May-13	7-May-13	7-May-13	7-May-13	7-May-13
Toxicant Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Herbicides					
Atrazine	<0.1	<0.1	<0.1	<0.1	<0.1
Diuron	<0.1	<0.1	<0.1	<0.1	<0.1
Hexazinone	<0.1	<0.1	<0.1	<0.1	<0.1
Linuron	<0.1	<0.1	<0.1	<0.1	<0.1
Metolachlor	<0.1	<0.1	<0.1	<0.1	<0.1
Molinate	<0.1	<0.1	<0.1	<0.1	<0.1
Oxyfluorfen	<0.1	<0.1	<0.1	<0.1	<0.1
Pendimethalin	<0.1	<0.1	<0.1	<0.1	<0.1
Simazine	<0.1	<0.1	<0.1	<0.1	<0.1
Trifluralin	<0.1	<0.1	<0.1	<0.1	<0.1
Prometryn	<0.1	<0.1	<0.1	<0.1	<0.1
Organochlorine (OC) Pesticides					
HCB	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor epoxide	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC(Lindane)	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	<0.1	<0.1	<0.1	<0.1	<0.1
trans-Chlordane	<0.1	<0.1	<0.1	<0.1	<0.1
cis-Chlordane	<0.1	<0.1	<0.1	<0.1	<0.1
Oxychlordane	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	<0.1	<0.1	<0.1	<0.1	<0.1
p,p-DDE	<0.1	<0.1	<0.1	<0.1	<0.1
p,p-DDD	<0.1	<0.1	<0.1	<0.1	<0.1
p,p-DDT	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin aldehyde	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Ketone	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-Endosulfan	<0.1	<0.1	<0.1	<0.1	<0.1
beta-Endosulfan	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan sulfate	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	<0.1	<0.1	<0.1	<0.1	<0.1
Dicofol	<0.1	<0.1	<0.1	<0.1	<0.1
Carbamates					
Carbaryl	<0.1	<0.1	<0.1	<0.1	<0.1
Fenoxycarb	<0.1	<0.1	<0.1	<0.1	<0.1
Pirimicarb	<0.1	<0.1	<0.1	<0.1	<0.1
Organophosphate (OP) Pesticides					
Demeton-S-methyl	<0.1	<0.1	<0.1	<0.1	<0.1
Dichlorvos	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyrifos	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyrifos methyl	<0.1	<0.1	<0.1	<0.1	<0.1
Diazinon	<0.1	<0.1	<0.1	<0.1	<0.1

Sample	WNI-01	WNI-02	WNI-03	WNI-04	WNI-05
Date Sampled	7-May-13	7-May-13	7-May-13	7-May-13	7-May-13
Toxicant Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Dimethoate	<0.1	<0.1	<0.1	<0.1	<0.1
Fenthion	<0.1	<0.1	<0.1	<0.1	<0.1
Malathion	<0.1	<0.1	<0.1	<0.1	<0.1
Ethion	<0.1	<0.1	<0.1	<0.1	<0.1
Fenitrothion	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorfenvinphos (E)	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorfenvinphos (Z)	<0.1	<0.1	<0.1	<0.1	<0.1
Parathion (ethyl)	<0.1	<0.1	<0.1	<0.1	<0.1
Parathion methyl	<0.1	<0.1	<0.1	<0.1	<0.1
Pirimiphos methyl	<0.1	<0.1	<0.1	<0.1	<0.1
Pirimiphos ethyl	<0.1	<0.1	<0.1	<0.1	<0.1
Azinphos methyl	<0.1	<0.1	<0.1	<0.1	<0.1
Azinphos ethyl	<0.1	<0.1	<0.1	<0.1	<0.1
Bromophos ethyl	<0.1	<0.1	<0.1	<0.1	<0.1
Carbophenothion	<0.1	<0.1	<0.1	<0.1	<0.1
Coumaphos	<0.1	<0.1	<0.1	<0.1	<0.1
Dioxathion	<0.1	<0.1	<0.1	<0.1	<0.1
Fenamiphos	<0.1	<0.1	<0.1	<0.1	<0.1
Fenchlorphos	<0.1	<0.1	<0.1	<0.1	<0.1
Formothion	<0.1	<0.1	<0.1	<0.1	<0.1
Methacrifos	<0.1	<0.1	<0.1	<0.1	<0.1
Methidathion	<0.1	<0.1	<0.1	<0.1	<0.1
Mevinphos	<0.1	<0.1	<0.1	<0.1	<0.1
Phorate	<0.1	<0.1	<0.1	<0.1	<0.1
Phosalone	<0.1	<0.1	<0.1	<0.1	<0.1
Profenophos	<0.1	<0.1	<0.1	<0.1	<0.1
Prothiofos	<0.1	<0.1	<0.1	<0.1	<0.1
Thiometon	<0.1	<0.1	<0.1	<0.1	<0.1
Triazophos	<0.1	<0.1	<0.1	<0.1	<0.1
Synthetic Pyrethroids					
Bifenthrin	<0.1	<0.1	<0.1	<0.1	<0.1
Bioresmethrin	<0.1	<0.1	<0.1	<0.1	<0.1
Cyfluthrin	<0.1	<0.1	<0.1	<0.1	<0.1
Cyhalothrin	<0.1	<0.1	<0.1	<0.1	<0.1
Cypermethrin	<0.1	<0.1	<0.1	<0.1	<0.1
Deltamethrin	<0.1	<0.1	<0.1	<0.1	<0.1
Fenvalerate	<0.1	<0.1	<0.1	<0.1	<0.1
Permethrin	<0.1	<0.1	<0.1	<0.1	<0.1
Phenothrin	<0.1	<0.1	<0.1	<0.1	<0.1
Fungicides					
Bupirimate	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorothalonil	<0.1	<0.1	<0.1	<0.1	<0.1
Cyprodinil	<0.1	<0.1	<0.1	<0.1	<0.1
Dichlofluanid	<0.1	<0.1	<0.1	<0.1	<0.1
Dicloran	<0.1	<0.1	<0.1	<0.1	<0.1
Difenoconazole	<0.1	<0.1	<0.1	<0.1	<0.1
Dimethomorph	<0.1	<0.1	<0.1	<0.1	<0.1
Diphenylamine	<0.1	<0.1	<0.1	<0.1	<0.1

Sample		WNI-01	WNI-02	WNI-03	WNI-04	WNI-05
Date Sampled		7-May-13	7-May-13	7-May-13	7-May-13	7-May-13
Toxicant	**Units**	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Fenarimol		<0.1	<0.1	<0.1	<0.1	<0.1
Flusilazole		<0.1	<0.1	<0.1	<0.1	<0.1
Hexaconazole		<0.1	<0.1	<0.1	<0.1	<0.1
Imazalil		<0.1	<0.1	<0.1	<0.1	<0.1
Iprodione		<0.1	<0.1	<0.1	<0.1	<0.1
Metalaxyl		<0.1	<0.1	<0.1	<0.1	<0.1
Penconazole		<0.1	<0.1	<0.1	<0.1	<0.1
Prochloraz		<0.1	<0.1	<0.1	<0.1	<0.1
Procymidone		<0.1	<0.1	<0.1	<0.1	<0.1
Propiconazole I		<0.1	<0.1	<0.1	<0.1	<0.1
Propiconazole II		<0.1	<0.1	<0.1	<0.1	<0.1
Pyrimethanil		<0.1	<0.1	<0.1	<0.1	<0.1
Tebuconazole		<0.1	<0.1	<0.1	<0.1	<0.1
Vinclozolin		<0.1	<0.1	<0.1	<0.1	<0.1
o-Phenylphenol		<0.1	0.1	0.1	<0.1	0.21

Results of the Nutrient Analyses

				Moisture	TKN	TP
			Units	%	mg/kg	mg/kg
Sample	Date	Depth	Limit of Reporting	<0.1	<50	<5
Top 0-2 cm						
WNI-01-REP1	7-May-13	0-2 cm		24	53	110
WNI-01-REP2	7-May-13	0-2 cm		22	60	130
WNI-01-REP3	7-May-13	0-2 cm		25	58	150
			WN-01 Mean	**23.67**	**57.00**	**130.00**
			WN-01 SE	**0.88**	**2.08**	**11.55**
WNI-02-REP1	7-May-13	0-2 cm		77	530	180
WNI-02-REP2	7-May-13	0-2 cm		79	560	170
WNI-02-REP3	7-May-13	0-2 cm		79	520	240
			WN-02 Mean	**78.33**	**536.67**	**196.67**
			WN-02 SE	**0.67**	**12.02**	**21.86**
WNI-03-REP1	7-May-13	0-2 cm		79	410	140
WNI-03-REP2	7-May-13	0-2 cm		78	2000	110
WNI-03-REP3	7-May-13	0-2 cm		79	480	100
			WN-03 Mean	**78.67**	**963.33**	**116.67**
			WN-03 SE	**0.33**	**518.73**	**12.02**
WNI-04-REP1	7-May-13	0-2 cm		28	170	67
WNI-04-REP2	7-May-13	0-2 cm		29	270	63
WNI-04-REP3	7-May-13	0-2 cm		28	230	52
			WN-04 Mean	**28.33**	**223.33**	**60.67**
			WN-04 SE	**0.33**	**29.06**	**4.48**
WNI-05-REP1	7-May-13	0-2 cm		77	520	93
WNI-05-REP2	7-May-13	0-2 cm		77	590	67
WNI-05-REP3	7-May-13	0-2 cm		74	6100	93
			WN-05 Mean	**76.00**	**2403.33**	**84.33**
			WN-05 SE	**1.00**	**1848.44**	**8.67**

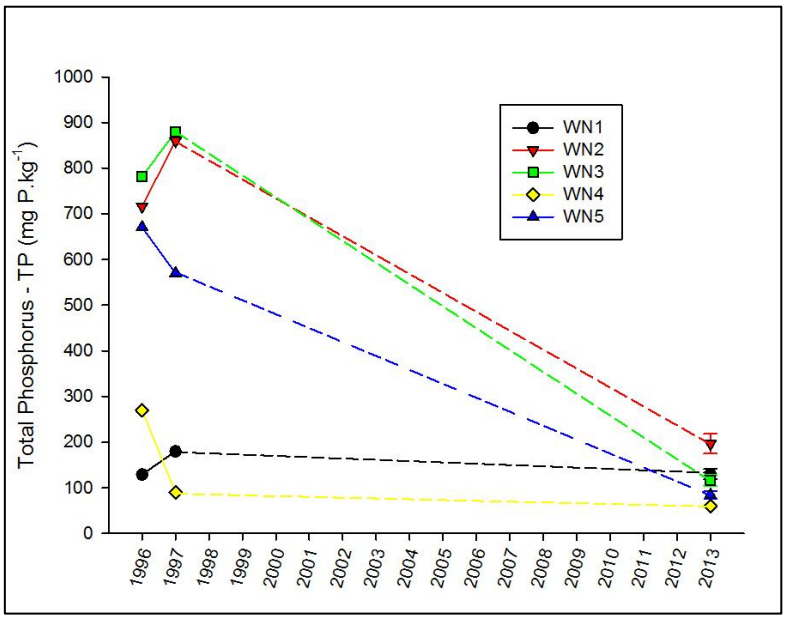
				Moisture	TKN	TP
			Units	%	mg/kg	mg/kg
Sample	Date	Depth	Limit of Reporting	<0.1	<50	<5
Bottom 2-10 cm						
WNI-01-REP1	7-May-13	2-10 cm		23	78	82
WNI-01-REP2	7-May-13	2-10 cm		23	<50	78
WNI-01-REP3	7-May-13	2-10 cm		24	<50	93
			WN-01 Mean	**23.33**	42.67	**84.33**
			WN-01 SE	**0.33**	17.67	**4.48**
WNI-02-REP1	7-May-13	2-10 cm		75	4800	220
WNI-02-REP2	7-May-13	2-10 cm		74	940	200
WNI-02-REP3	7-May-13	2-10 cm		74	5700	110
			WN-02 Mean	**74.33**	**3813.33**	**176.67**
			WN-02 SE	**0.33**	**1459.97**	**33.83**
WNI-03-REP1	7-May-13	2-10 cm		75	6100	130
WNI-03-REP2	7-May-13	2-10 cm		75	7600	130
WNI-03-REP3	7-May-13	2-10 cm		75	6500	180
			WN-03 Mean	**75.00**	**6733.33**	**146.67**
			WN-03 SE	**0.00**	**448.45**	**16.67**
WNI-04-REP1	7-May-13	2-10 cm		24	200	35
WNI-04-REP2	7-May-13	2-10 cm		24	110	32
WNI-04-REP3	7-May-13	2-10 cm		23	100	26
			WN-04 Mean	**23.67**	**136.67**	**31.00**
			WN-04 SE	**0.33**	**31.80**	**2.65**
WNI-05-REP1	7-May-13	2-10 cm		74	4200	220
WNI-05-REP2	7-May-13	2-10 cm		73	6500	130
WNI-05-REP3	7-May-13	2-10 cm		76	6300	130
			WN-05 Mean	**74.33**	**5666.67**	**160.00**
			WN-05 SE	**0.88**	**735.60**	**30.00**

Deeley 1995 data

				Moisture	TKN	TP
			Units	%	µg/g	µg/g
Site	Date	Depth	Limits of Reporting	<0.1	<100	<5
Top 0-2 cm						
NI.1	12-Jan-95	0-2 cm		23.8	329	129
NI.2	12-Jan-95	0-2 cm		79.6	6345	717
NI.3	12-Jan-95	0-2 cm		72.8	5961	782
NI.4	12-Jan-95	0-2 cm		58.6	2121	270
NI.5	12-Jan-95	0-2 cm		72.6	6537	671
Bottom 2-10 cm						
NI.1	12-Jan-95	2-10 cm		23.2	<100	140
NI.2	12-Jan-95	2-10 cm		75.9	6153	648
NI.3	12-Jan-95	2-10 cm		76.2	5705	720
NI.4	12-Jan-95	2-10 cm		43.7	1289	148
NI.5	12-Jan-95	2-10 cm		67.6	5321	530

Time series & ANOVAs

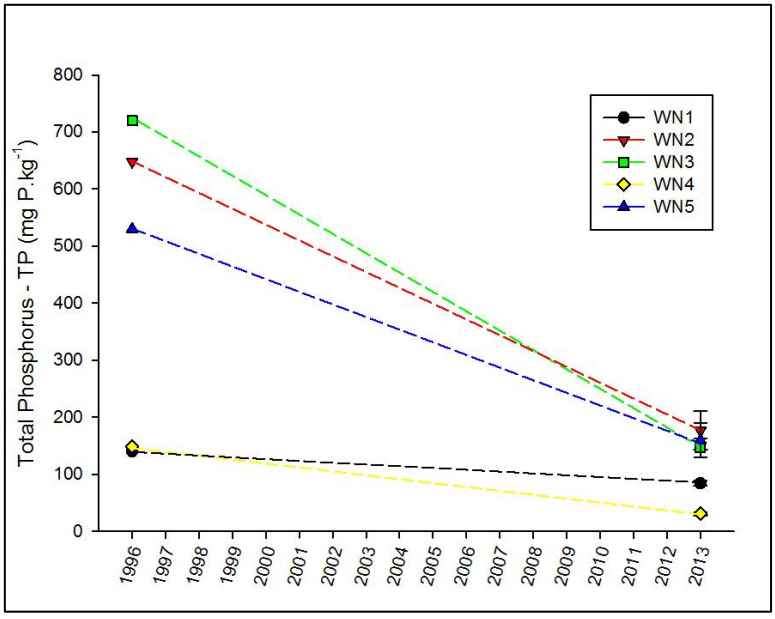
TP 0-2 cm



ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sites	197509.5	4	49377.38	1.249026	0.417295	6.388233
Year	391935.2	1	391935.2	9.9142	0.034558	7.708647
Error	158130.9	4	39532.71			

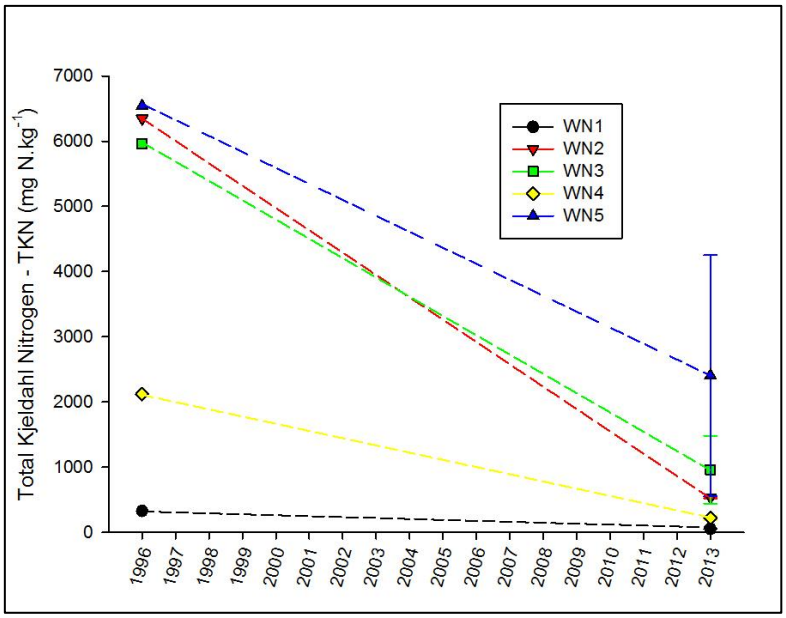
TP2-10 cm



ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sites	66528035	4	16632009	18.80558	0.007391	6.388233
Year	451362.8	1	451362.8	0.51035	0.514462	7.708647
Error	3537676	4	884419			

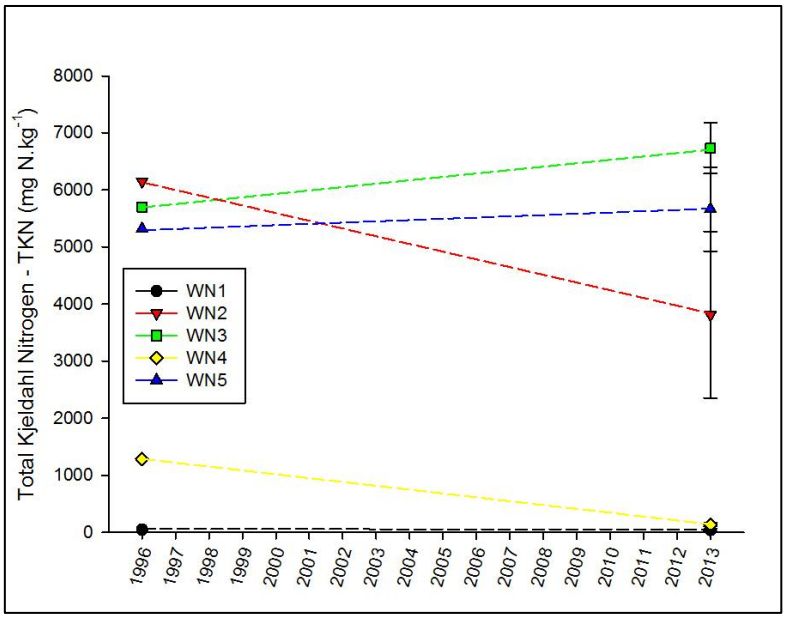
TKN 0-2 cm



ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sites	25533033	4	6383258	2.439866	0.204399	6.388233
Year	29269530	1	29269530	11.18766	0.028707	7.708647
Error	10464931	4	2616233			

TKN 2-10 cm



ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sites	66528035	4	16632009	18.80558	0.007391	6.388233
Year	451362.8	1	451362.8	0.51035	0.514462	7.708647
Error	3537676	4	884419			