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EDM Height Traversing Levelling Survey Report

Pohnpei, Federated States of Micronesia, August 2012

S. J. K. Yates, A. Lal

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GEOSCIENCE AUSTRALIA
RECORD 2014/21

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Australian Government
Geoscience Australia

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1 Introduction

This report outlines the levelling survey completed during the visit to Pohnpei, Federated States of Micronesia (FSM) from 2nd to 9th August 2012.

Personnel involved in the survey were Steve Yates, Project Officer, Geoscience Australia and Andrick Lal, Surveyor, Secretariat of the Pacific Community (SPC).

This is the fifth Electronic Distance Measuring (EDM) height traversing levelling survey of the deep bench mark array in Pohnpei, FSM which runs approximately 3.5 km from the tide gauge sensor bench mark Sea Level Fine Resolution Acoustic Measuring Equipment (SEAFRAME) at the wharf to the continuous GNSS (Global Navigation Satellite System) Station located in the Pohnpei Weather Office Compound. The previous levelling surveys using this technique were performed in 2006, 2008, 2009 and 2011.

Precise Differential Levelling surveys were performed in 2001 and 2003 by the National Tidal Centre Australia (NTCA) and the survey in May – June 2006 included a comparison between the precise differential levelling and EDM height traversing technique. This report contains a comparison between the 2011 and 2012 EDM height traversing results as well as a combined comparison since the first levelling survey.

2 The Survey

The EDM Height Traversing levelling survey was carried out between the five deep driven bench marks; from the CGNSS Station to the SEAFRAME Station.

POHNB	– CGNSS Benchmark
FSM55	– SEAFRAME sensor benchmark
FSM1	– Deep Driven Benchmark
FSM2	– Deep Driven Benchmark
FSM3	– Deep Driven Benchmark
FSM4	– Deep Driven Benchmark
FSM5	– Deep Driven Benchmark

Included in the survey was FSM17, a stainless steel bolt located adjacent to the tide gauge hut.

Also included in the survey were temporary holding marks – FSM8, FSM10, FSM11, FSM12, FSM14, FSM16, FSM25, FSM27, FSM29, FSM31, FSM34, FSM100, FSM44, FSM47, FSM51 and the three CGNSS reference marks - RM1, RM2 and RM3. Temporary holding marks, FSM101, FSM102, FSM103 and FSM104 were placed during this survey, consisting of a stainless steel bolt drilled in concrete and then glued in place with quality epoxy resin. The following temporary holding marks, FSM36, FSM38, FSM43 and FSM49 were destroyed and not found.

All the deep bench marks were located and found in good order.

The EDM height traversing levelling technique was performed to the Class L2A specifications (ICSM, 2002). After reduction an internal precision of $1\text{mm} \sqrt{K}$ or better was achieved, where K is distance in kilometres. This is well within the project specification of $2\text{mm} \sqrt{K}$. A table of results and comparisons and the 2012 reduced levels are detailed later in this report.

2.1 Bench Mark Locality Diagram



2.2 The FSM Datum

Reduction of the data has been calculated holding FSM1 fixed at 2.4382 metres.

This value was determined by the NTCA by:

- 2001 Adopting the height of PNIA; RL = 2.00000 metres (Arbitrary Datum)
- 2003 Adopting the height of FSM1 as derived in the 2001 survey

2.3 Equipment

- Leica total station model TM30 (Serial No: 361441)
- Leica precision prisms GPH1P (2).
- Leica rigid tripod.
- Stainless steel target poles supported by Leica telescopic bi-poles (2).
- Shortened stainless steel target pole for the SEAFRAME sensor BM connection.
- Leica cast iron change plates (2).
- Kestral 4000 pocket weather tracker

2.4 Method

The “Leap-Frog” EDM height traversing technique was employed for the Pohnpei tide gauge levelling survey. This technique involves setting up a total station (TCA1800L) midway between two target/reflectors (on reflector rods with struts). The targets remain at a particular change point for the back-sight and fore-sight observations. The instrument measures slope distances ($\pm 1\text{mm}$) and vertical angle ($1''$) to derive height differences (between the instrument’s trunnion axis and the reflectors). In support of the slope distance observations, the ambient temperature, pressure and humidity are recorded (Kestral 4000 pocket weather tracker) and input into the instrument to apply the first velocity correction to the observed distances (Rüeger & Brunner, 1982). Four rounds of observations are taken to the back-sight and fore-sight targets from each instrument setup. All levelling runs started and finished with the same reflector and reflector rod, i.e. an even number of setups when the two reflector rod configuration was used. This eliminates any reflector rod zero error. This technique can also be performed using a single set-up / single rod configuration which is particularly useful when levelling between bench marks which are close together e.g. between the CGNSS RMs.

Reduction of the digital data was computed by the Geoscience Australia levelling program “leveling1.exe”. This program computes the height difference between the two reflectors.

2.5 Pohnpei 2012 Reduced Levels

Table 2.1 Pohnpei, FSM – Reduced levels from the 2013 survey

Date: 4th to 8th August 2012

Datum: Arbitrary

Point ID	Reduced Level 2012	Type
FSM1	2.4382	Stainless Steel Rod in Ground
FSM17	3.0719	Stainless Steel Pin in Concrete
FSM55	4.0319	Stainless Steel Sensor Pin
FSM2	2.3421	Stainless Steel Rod in Ground
FSM8	2.3679	Stainless Steel Pin in Concrete
FSM10	2.0059	Stainless Steel Pin in Concrete
FSM3	2.0677	Stainless Steel Rod in Ground
FSM11	2.8590	Stainless Steel Pin in Concrete
FSM12	2.7860	Stainless Steel Pin in Concrete
FSM14	2.6041	Stainless Steel Pin in Concrete
FSM16	2.4184	Stainless Steel Pin in Concrete
FSM4	1.7543	Stainless Steel Rod in Ground
FSM25	2.3944	Stainless Steel Pin in Concrete
FSM27	2.5435	Stainless Steel Pin in Concrete
FSM29	1.9428	Metal Pin in ground
FSM31	3.0779	Metal Pin in ground
FSM34	6.4778	Stainless Steel Pin in Concrete

Point ID	Reduced Level 2012	Type
FSM101	14.7279	Stainless Steel Pin in Concrete
FSM102	20.4777	Stainless Steel Pin in Concrete
FSM5	20.5927	Stainless Steel Rod in Ground
FSM100	21.8480	Stainless Steel Pin in Concrete
FSM103	21.6609	Stainless Steel Pin in Concrete
FSM44	22.6846	Stainless Steel Pin in Concrete
FSM47	25.6969	Masonry Nail in Concrete
FSM104	29.1914	Stainless Steel Pin in Concrete
FSM51	37.5510	Masonry Nail in Concrete
POHNB	38.0080	Stainless Steel Pillar Pin
RM1	37.4375	Stainless Steel Rod in Ground
RM2	36.7847	Stainless Steel Rod in Ground
RM	37.1586	Stainless Steel Rod in Ground
NWSBM	37.5037	Top of Weather Sensor

**The RL of the Reference Point POHN (ARP) is derived from adding the static height difference of 0.9520 m (POHNB to POHN) to the levelled RL of POHNB.*

2.6 Survey Support

The survey team very much appreciated the assistance from staff of the Pohnpei State Weather Office and SPC North Regional Office namely:

Personnel consulted during the visit were:

- Mr. Eden Skilling – OIC, Pohnpei State Weather Office
- Mr. Toshio Akinaga – Weather Officer, Pohnpei State Weather Office
- Mr. Amena Yauvoli – SPC North Regional Office, Pohnpei
- Ms Miyuki Norman – SPC North Regional Office, Pohnpei

All personnel consulted had a keen interest in the project and were always supportive with any project associated matters.

2.7 Issues

Due to a recent change in field procedures, a labourer, Nixon David of Nett Village was hired to carry the Leica Total Station during the survey. This was arranged through the kind assistance of Jun Tamps, General Manager, Pacific Foods and Services Ltd – Phone (691) 320 8895.

To have access to the Pohnpei tide gauge, prior arrangement should be made with Fisheries.

2.8 Description of Marks – Pohnpei, FSM

FSM1	- Deep Driven bench mark (BM) located adjacent to the Caroline Fisheries Bldg
FSM17	- Stainless Steel bolt in concrete below the SEAFRAME sensor bench mark
FSM55	- SEAFRAME Sensor Bench Mark
FSM2	- Deep Driven BM located next to the Continental Air Cargo depot.
FSM8	- Stainless Steel Pin near the Pohnpei airport entrance gate.
FSM10	- Stainless Steel Pin at the Fisheries Corporation compound entrance.
FSM3	- Deep driven BM located within the Fisheries Corporation compound.
FSM11	- Stainless Steel Pin located along the Deketik Causeway Road
FSM12	- Stainless Steel Pin located along the Deketik Causeway Road.
FSM14	- Stainless Steel Pin located along the Deketik Causeway Road.
FSM16	- Stainless Steel Pin located along the Deketik Causeway Road.
FSM4	- Deep Driven BM located along the Deketik Causeway Road.
FSM25	- Stainless Steel Pin located along the Deketik Causeway Road.
FSM27	- Stainless Steel Pin located along the Deketik Causeway Road.
FSM29	- Metal Pin located along the Deketik Causeway Road.
FSM31	- Metal Pin located along the Deketik Causeway Road
FSM34	- Stainless Steel Pin located corner Deketik Causeway Road and Kaselehlie Street.
FSM101	- Stainless Steel Pin located on a sewer manhole along Kaselehlie Street.
FSM102	- Stainless Steel Pin located on top of a concrete culvert along Kaselehlie Street.
FSM5	- Deep Driven BM located in the grassed area next to the Spanish Wall.
FSM100	- New stainless steel bolt located along Kaselehlie Street.
FSM103	- Stainless Steel Pin located on top of a concrete culvert along Kaselehlie Street.
FSM44	- Stainless Steel Pin located in front of A-one Fashion shop along Kaselehlie Street.
FSM47	- Masonry nail located at the end of guard rail along Kaselehlie Street.
FSM104	- Stainless Steel Pin near the Namiki Restaurant along Kaselehlie Street.
FSM51	- Pin near the north east corner to the weather office along Kaselehlie Street.
POHNBM	- CGNSS Benchmark
POHN	- CGNSS Reference Point
RM1, 2 & 4	- CGNSS Reference Mark

3 Comparisons

3.1 Comparisons between 2112 and 2011 EDM Surveys

Table 3.1 Pohnpei, FSM EDM Height Traversing Levelling Comparison 2012 - 2011. FSM1 - adopted fixed height of 2.43822m.

From	To	Levelled Ht. Diff.	RL 2012	Misclose (mm)	Dist. (km)	1mm/k	RL 2011	Difference (mm) 2011 - 2012
FSM1			2.4382					
FSM17	FSM17	0.63366	3.0719	0.3833	0.1096	0.331	3.0713	0.58
	FSM55	0.95997	4.0319	-0.0233	0.0213	0.146	4.0313	0.55
FSM1			2.4382					
FSM2	FSM2	-0.09614	2.3421	0.0875	0.2501	0.500	2.3420	0.08
FSM8	FSM8	0.02584	2.3679	-0.3125	0.1206	0.347	2.3682	-0.28
FSM10	FSM10	-0.36198	2.0059	0.3125	0.2324	0.482	2.0092	-3.26
	FSM3	0.06175	2.0677	0.2250	0.0809	0.285	2.0683	-0.62
FSM10			2.0059					
FSM11	FSM11	0.85303	2.8590	0.2875	0.1744	0.418	2.8590	-0.04
FSM12	FSM12	-0.07297	2.7860	-0.0542	0.0929	0.305	2.7869	-0.90
FSM14	FSM14	-0.18191	2.6041	0.2625	0.1813	0.426	2.6079	-3.81
FSM16	FSM16	-0.18569	2.4184	-0.1625	0.1839	0.429	2.4245	-6.10
FSM4	FSM4	-0.66415	1.7543	-0.1050	0.0993	0.315	1.7546	-0.35
FSM25	FSM25	0.64010	2.3944	0.1075	0.0942	0.307	2.3963	-1.95
FSM27	FSM27	0.14914	2.5435	0.3792	0.1818	0.426	2.5442	-0.71
FSM29	FSM29	-0.60068	1.9428	0.3375	0.1838	0.429	1.9445	-1.69
FSM31	FSM31	1.13508	3.0779	-0.1875	0.1827	0.427	3.0784	-0.51
FSM34	FSM34	3.39989	6.4778	0.3875	0.1558	0.395	6.4756	2.19
FSM101	FSM101	8.25008	14.7279	0.1625	0.0847	0.291	New Mark	New Mark
FSM102	FSM102	5.74987	20.4777	-0.0125	0.0656	0.256	New Mark	New Mark
FSM5	FSM5	0.11496	20.5927	0.3025	0.0982	0.313	20.5923	0.40
FSM100	FSM100	1.25532	21.8480	-0.3875	0.1791	0.423	21.8471	0.92
FSM103	FSM103	-0.18717	21.6609	-0.0125	0.0651	0.255	New Mark	New Mark
FSM44	FSM44	1.02377	22.6846	0.2075	0.1011	0.318	22.6839	0.72
FSM47	FSM47	3.01233	25.6969	-0.0458	0.1968	0.444	25.6974	-0.45
FSM104	FSM104	3.49444	29.1914	-0.1000	0.0827	0.288	New Mark	New Mark
FSM51	FSM51	8.35962	37.5510	0.0625	0.1075	0.328	37.5502	0.80

From	To	Levelled Ht. Diff.	RL 2012	Misclose (mm)	Dist. (km)	1mm/k	RL 2011	Difference (mm) 2011 - 2012
POHNB	POHNB	0.45702	38.0080	-0.3250	0.1415	0.376	38.0076	0.43
	NWSBM	-0.50432	37.5037	0.0125	0.0207	0.144	New Mark	New Mark
			Misclose for all bays levelled =	1.789	3.488	1.868		
POHNB			38.0080					
	RM1	-0.57050	37.4375	0.1083	0.0303	0.174	37.4377	-0.14
POHNB								
	RM2	-1.22334	36.7847	-0.0200	0.0214	0.146	36.7843	0.35
POHNB								
	RM4	-0.84939	37.1586	0.0125	0.0216	0.147	New Mark	New Mark

All levelling was performed within the project specifications of 2 √k

3.2 Combined Comparisons 2001 to 2012

Examination of the level survey results indicate that deep driven bench mark FSM3 is sinking at a rate of 2.3mm per year, relative to FSM1.

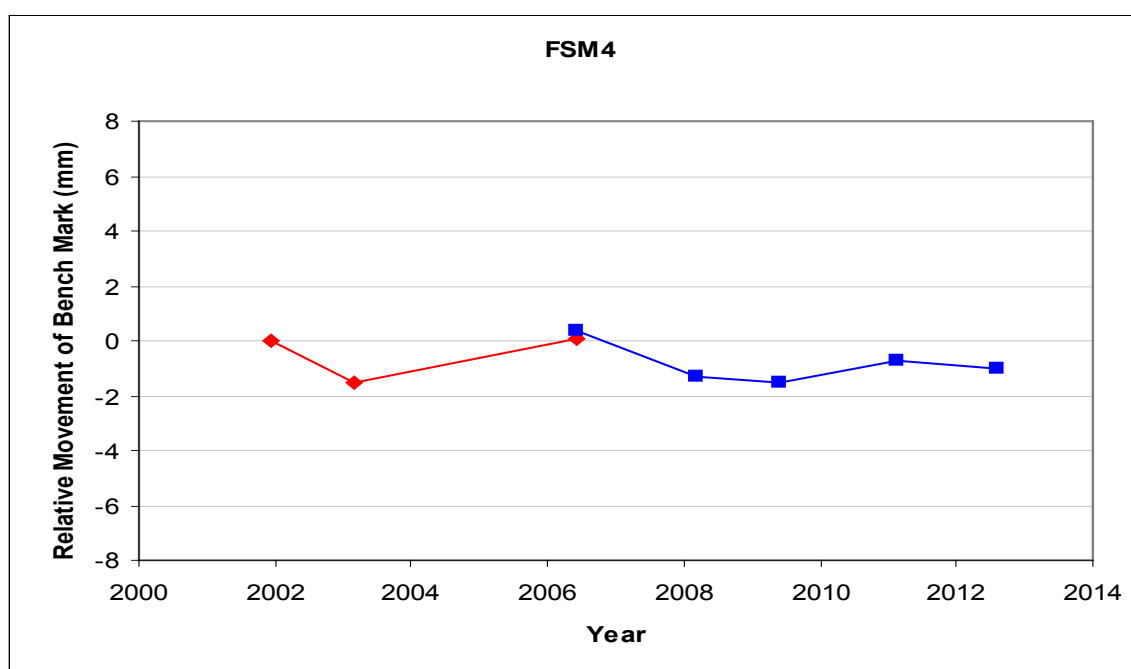
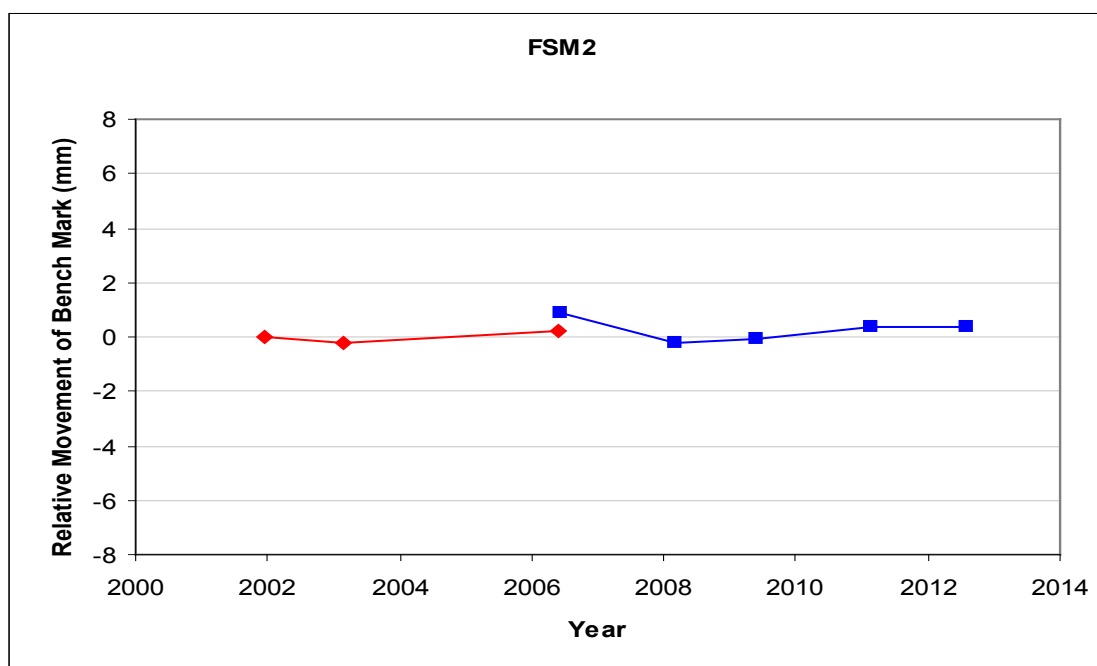
Table 3.2 Pohnpei, FSM - Comparison of the RL's for Precise Differential Levelling (2001 - 2006) and EDM Height Traversing (2006 - 2012).

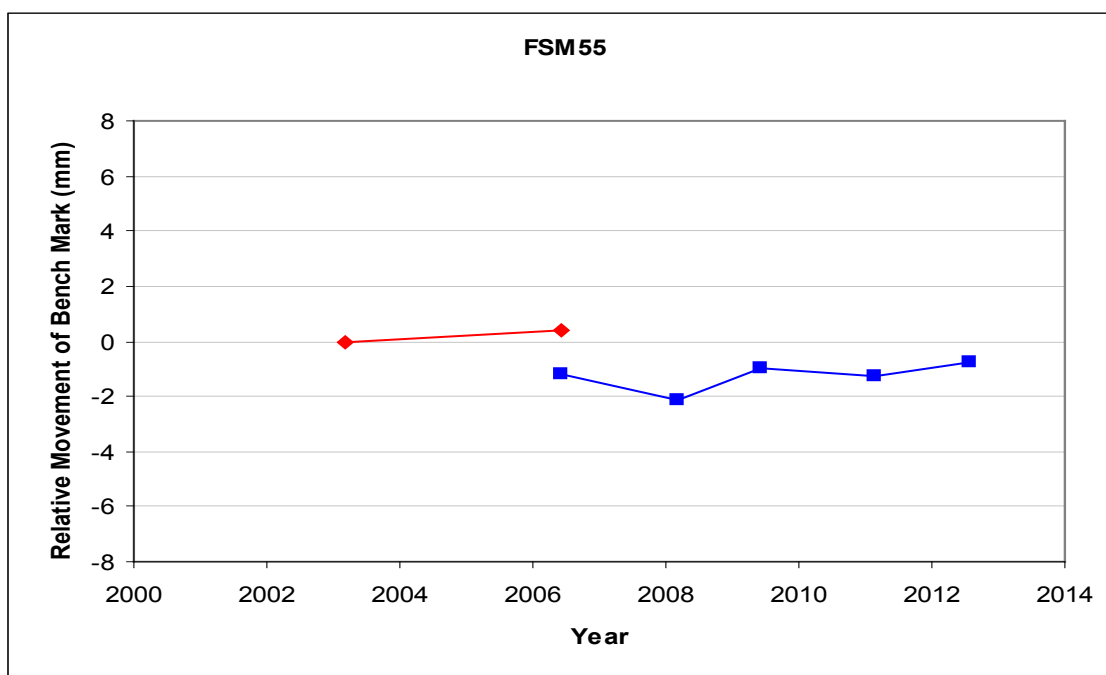
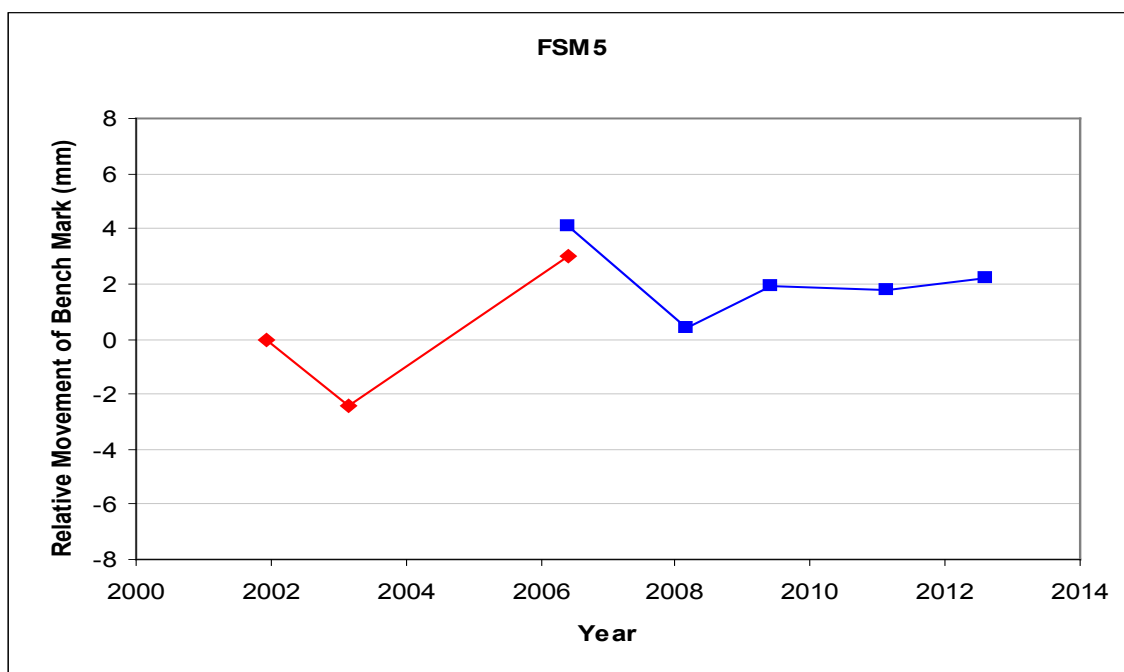
Year	FSM1	FSM2	FSM3	FSM4	FSM5	FSM55	FSM17	POHNB	*POHN
2001.95	2.4382	2.3417	2.0875	1.7553	20.5905		3.0757		
2003.16	2.4382	2.3415	2.0816	1.7538	20.5881	4.0326	3.0750	38.0022	
2006.41	2.4382	2.3419	2.0746	1.7554	20.5935	4.0330	3.0740	38.0100	

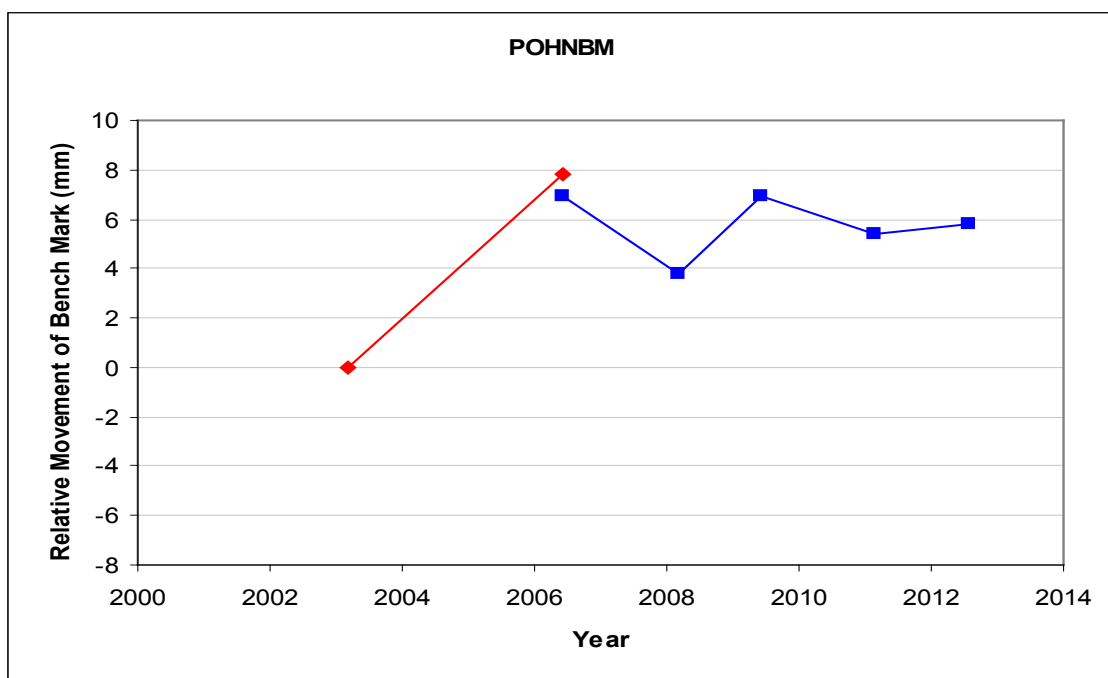
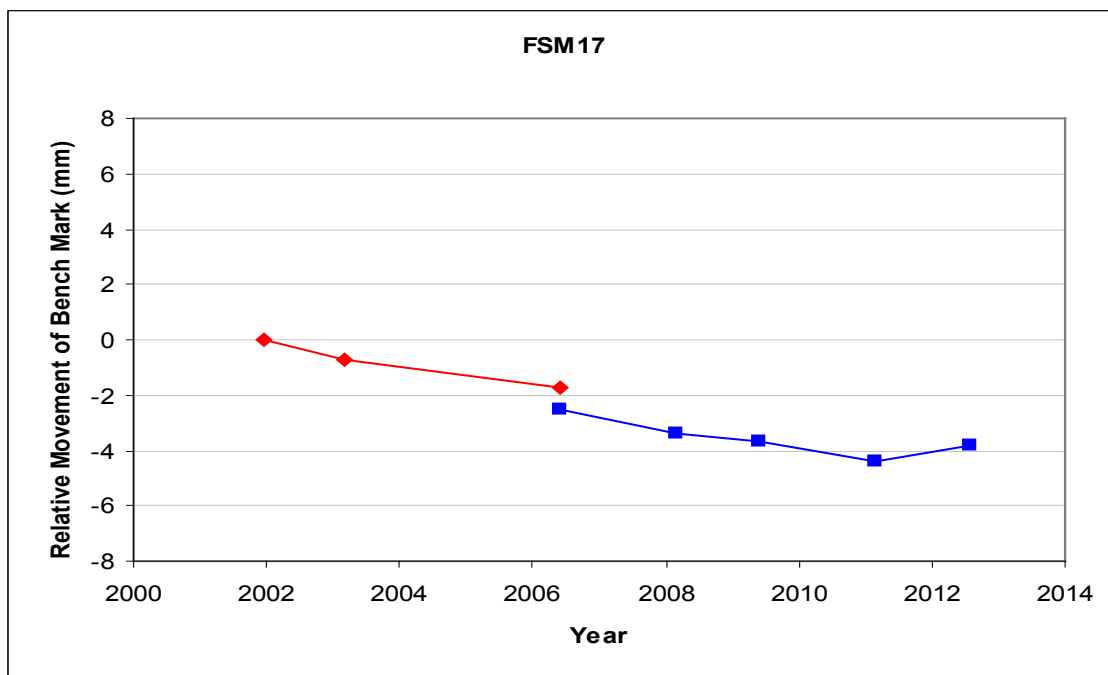
Year	FSM1	FSM2	FSM3	FSM4	FSM5	FSM55	FSM17	POHNB	*POHN
2006.42	2.4382	2.3426	2.0760	1.7557	20.5946	4.0314	3.0732	38.0091	38.9609
2008.17	2.4382	2.3415	2.0720	1.7540	20.5909	4.0305	3.0723	38.0060	38.9580
2009.41	2.4382	2.3416	2.0695	1.7538	20.5924	4.0316	3.0720	38.0091	38.9612
2011.14	2.4382	2.3420	2.0683	1.7546	20.5923	4.0313	3.0713	38.0076	38.9597
2012.59	2.4382	2.3421	2.0677	1.7543	20.5927	4.0319	3.0719	38.0080	38.9600

3.3 Time Series of Bench Mark Movement relative to Fixed Deep Bench Mark FSM1

Precise Differential Levelling: 2001 - 2006 ◆ — ◆
EDM Height Traversing: 2006 onwards ◆ — ◆







4 Deep Bench Mark Locality Diagrams



SOUTH PACIFIC SEA LEVEL & CLIMATE MONITORING PROJECT



Survey Bench Mark Record

Bench Mark Number: FSM1

Original Bench Mark Established by: National Tidal Centre Australia, Oceanographic Services, Bureau of Meteorology, 25 College Rd, Kent Town, SA.		Date: 12-12-01
Existing Bench Mark Established by:		Date:
Notes / References: Deep Survey Benchmark This survey mark is not in a good locality for GPS occupation.		
Country: Federated States of Micronesia Island: Pohnpei		City: Kolonia
<u>Marking and locality sketch</u> Bench Mark: 5.1m of 19mm diameter stainless steel capped rod driven to refusal. Rod sheathed with 50mm diameter PVC pipe, filled with bentonite, for 0.5m. Top of mark 0.1m below ground level. Locality sketch: Mark approximately 125m from the tide gauge station. office of the Caroline Fisheries Corporation Inc. (2-storey white painted cement building) to SEAFRAME Gauge 0.70 0.90 drain Security Office chainwire fence entrance to Caroline Fisheries		
Not to scale	Distances in Metres	Magnetic bearings
Approved by: Geoscience Australia / SOPAC		Date: February 2008
c:\users\andrick\spslcmpl\localitydiagrams\fsm		



**SOUTH PACIFIC SEA LEVEL
&
CLIMATE MONITORING PROJECT**



Survey Bench Mark Record

Bench Mark Number: FSM2

<i>Original Bench Mark Established by:</i> National Tidal Centre Australia, Oceanographic Services, Bureau of Meteorology, 25 College Rd, Kent Town, SA.	<i>Date:</i> 12-12-01
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<i>Existing Bench Mark Established by:</i>	<i>Date:</i>
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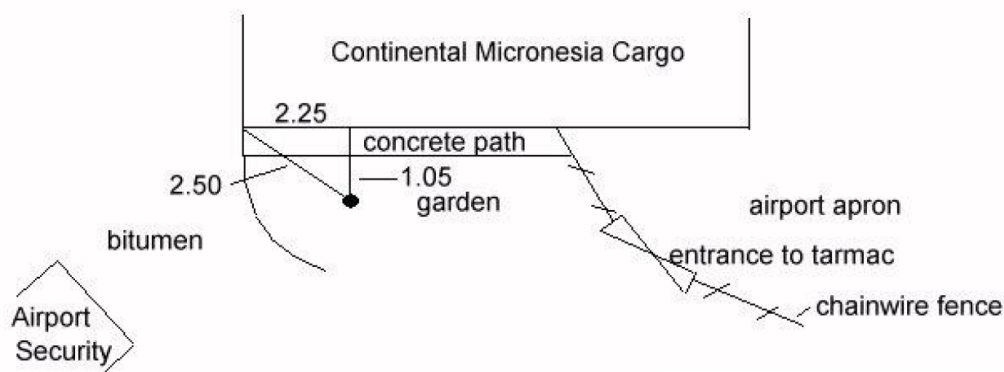
<i>Notes / References:</i> Deep Survey Benchmark This survey mark is not in a good locality for GPS occupation.
--

<i>Country:</i> Federated States of Micronesia <i>Island:</i> Pohnpei	<i>City:</i> Kolonia
--	----------------------

Marking and locality sketch

Bench Mark: 9.1m of 19mm diameter stainless steel capped rod driven to refusal.
 Rod sheathed with 50mm diameter PVC pipe, filled with bentonite, for 0.5m. Top of mark 0.1m below ground level.

Locality sketch: Mark approximately 425m from the tide gauge station.



Not to scale	Distances in Metres	Magnetic bearings
--------------	---------------------	-------------------

Approved by: Geoscience Australia / SOPAC	Date: February 2008 c:\users\landrick\spslcmp\localitydiagrams\fsm
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**SOUTH PACIFIC SEA LEVEL
&
CLIMATE MONITORING PROJECT**



Survey Bench Mark Record

Bench Mark Number: FSM3

<i>Original Bench Mark Established by:</i> National Tidal Centre Australia, Oceanographic Services, Bureau of Meteorology, 25 College Rd, Kent Town, SA.	<i>Date:</i> 11-12-01
<i>Existing Bench Mark Established by:</i>	<i>Date:</i>
<i>Notes / References:</i> Deep Survey Benchmark This survey mark is not in a good locality for GPS occupation.	
<i>Country:</i> Federated States of Micronesia <i>Island:</i> Pohnpei	<i>City:</i> Kolonia
<u>Marking and locality sketch</u> Bench Mark: 5.4m of 19mm diameter stainless steel capped rod driven to refusal. Rod sheathed with 50mm diameter PVC pipe, filled with bentonite, for 0.5m. Top of mark 0.1m below ground level. Locality sketch: Mark approximately 750m from the tide gauge station. The diagram shows a cross-section of the ground. At the bottom is a horizontal line labeled 'bitumen road'. Above the road is a 'grassed area'. To the left of the grassed area is a 'concrete pad' with two 'flag poles' indicated by small squares. A point on the grassed area is marked with a dot and labeled '3.10'. To the right of the grassed area is a 'metal landing' with 'stairs up' leading to a '3-storey building' labeled 'Pohnpei Fisheries Corporation'. A point on the metal landing is marked with a dot and labeled '3.39'. A distance of '2.55' is indicated between the '3.10' point and the '3.39' point. The ground surface is labeled 'concrete'.	
Not to scale Distances in Metres Magnetic bearings	
Approved by: Geoscience Australia / SOPAC	
Date: February 2008 c:\users\landrick\spslcmp\localitydiagrams\fsm	



**SOUTH PACIFIC SEA LEVEL
&
CLIMATE MONITORING PROJECT**



Survey Bench Mark Record

Bench Mark Number: FSM4

<i>Original Bench Mark Established by:</i> National Tidal Centre Australia, Oceanographic Services, Bureau of Meteorology, 25 College Rd, Kent Town, SA.	<i>Date:</i> 12-12-01
<i>Existing Bench Mark Established by:</i>	<i>Date:</i>
<i>Notes / References:</i> Deep Survey Benchmark This survey mark is in a good locality for GPS occupation.	
<i>Country:</i> Federated States of Micronesia <i>Island:</i> Pohnpei	<i>City:</i> Kolonia
<u>Marking and locality sketch</u> Bench Mark: 7.0m of 19mm diameter stainless steel capped rod driven to refusal. Rod sheathed with 50mm diameter PVC pipe, filled with bentonite, for 0.5m. Top of mark 0.1m below ground level. Locality sketch: Mark approximately 1625m from the tide gauge station.	
Not to scale	Distances in Metres
Magnetic bearings	
Approved by: Geoscience Australia / SOPAC	
Date: February 2008 c:\users\andrick\spslcmptlocalitydiagrams\fsm	



**SOUTH PACIFIC SEA LEVEL
&
CLIMATE MONITORING PROJECT**

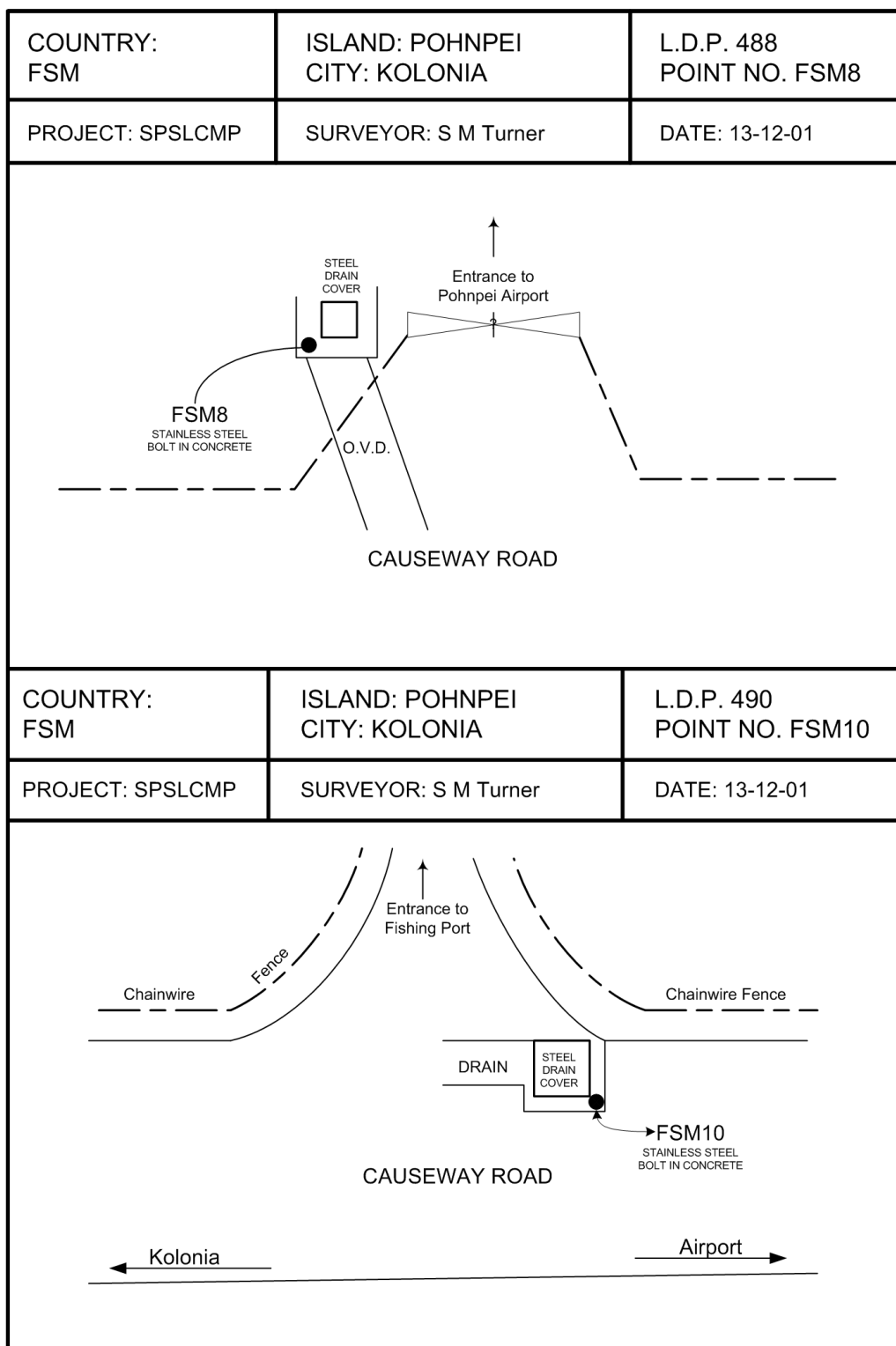


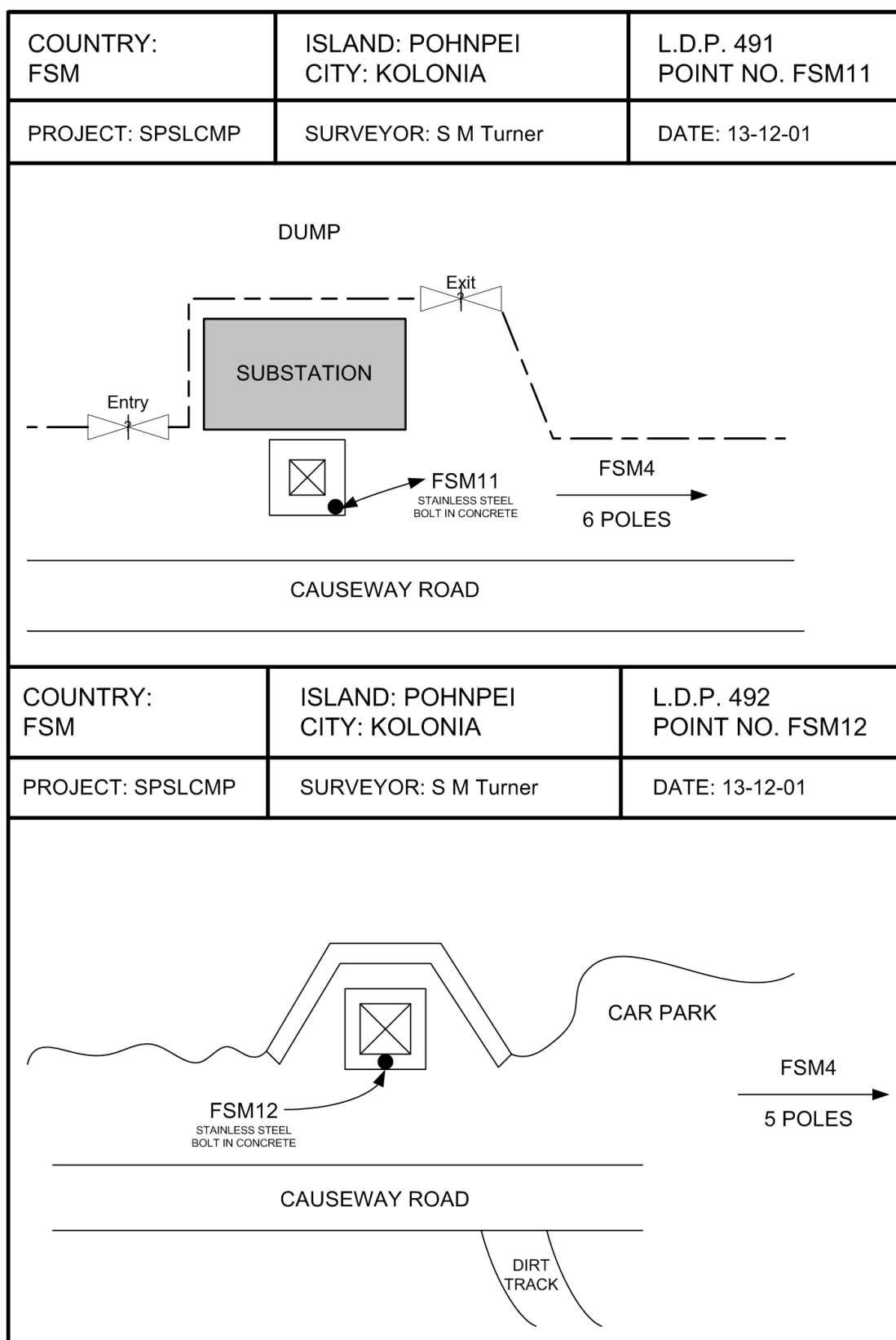
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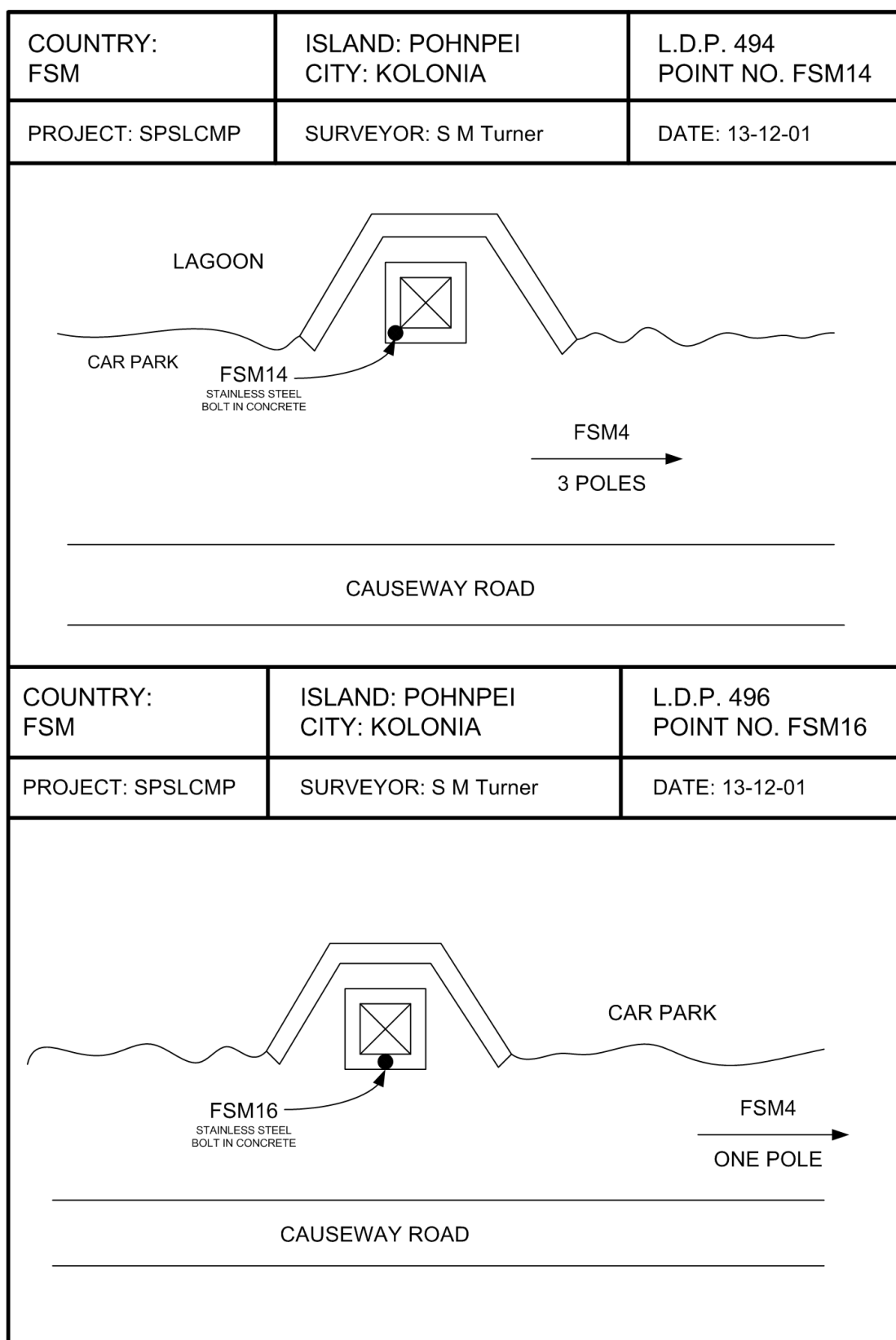
Bench Mark Number: FSM5

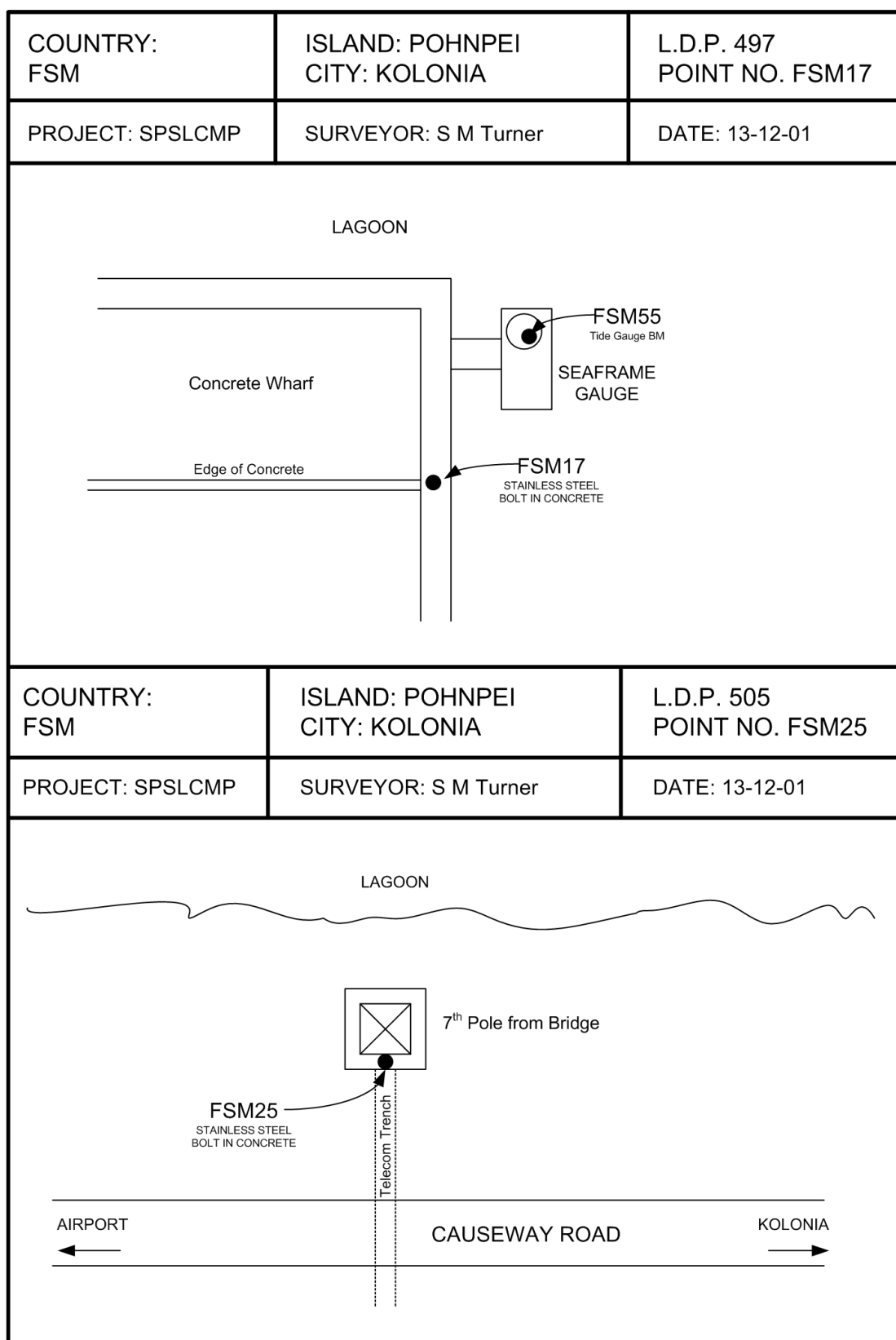
<i>Original Bench Mark Established by:</i> National Tidal Centre Australia, Oceanographic Services, Bureau of Meteorology, 25 College Rd, Kent Town, SA.	<i>Date:</i> 17-12-01
<i>Existing Bench Mark Established by:</i>	<i>Date:</i>
<i>Notes / References:</i> Deep Survey Benchmark This survey mark is in a good locality for GPS occupation.	
<i>Country:</i> Federated States of Micronesia <i>Island:</i> Pohnpei	<i>City:</i> Kolonia
<u>Marking and locality sketch</u> Bench Mark: 3.4m of 19mm diameter stainless steel capped rod driven to refusal. Rod sheathed with 50mm diameter PVC pipe, filled with bentonite, for 0.5m. Top of mark 0.1m below ground level. Locality sketch: Mark approximately 2700m from the tide gauge station. Not to scale Distances in Metres Magnetic bearings	
Approved by: Geoscience Australia / SOPAC	
Date: February 2008 c:\users\landrick\spslcmp\localitydiagrams\fsm	

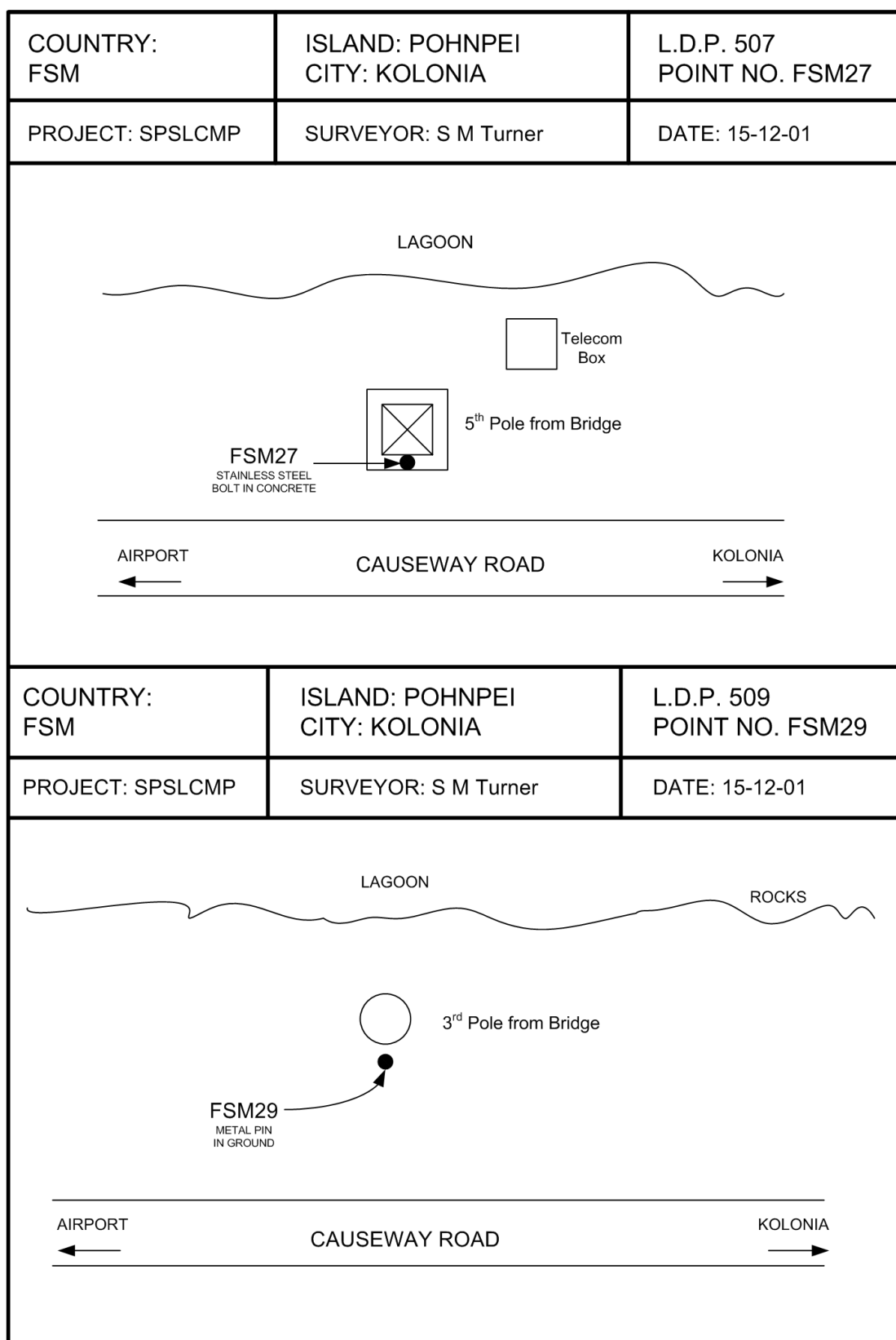
5 Temporary Bench Mark Locality Diagrams

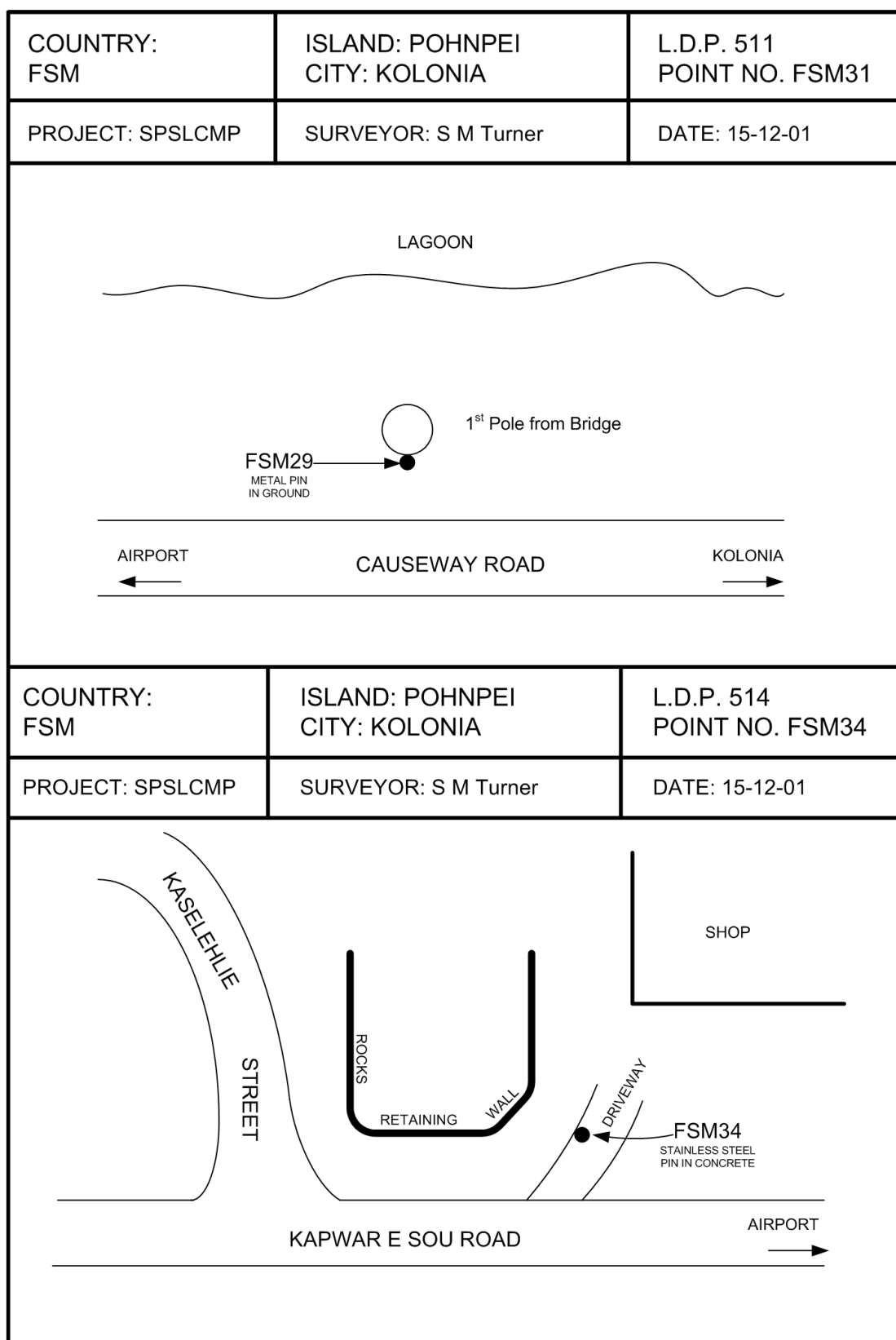


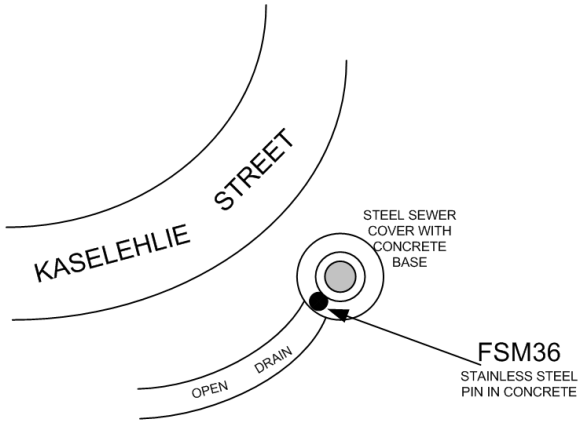
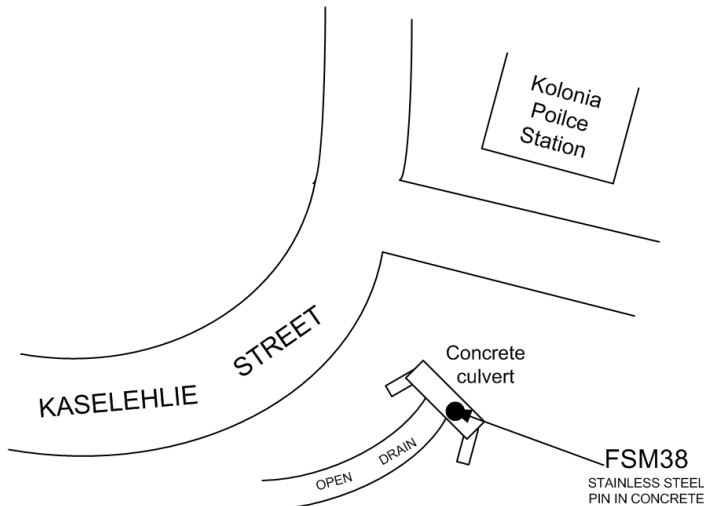










COUNTRY: FSM	ISLAND: POHNPEI CITY: KOLONIA	L.D.P. 516 POINT NO. FSM36
PROJECT: SPSLCMP	SURVEYOR: S M Turner	DATE: 17-12-01
 The diagram for point FSM36 shows a curved line representing 'KASELEHLIE STREET'. Below the street, there is a line labeled 'OPEN DRAIN'. A circular feature represents a 'STEEL SEWER COVER WITH CONCRETE BASE'. A line points from the label 'FSM36 STAINLESS STEEL PIN IN CONCRETE' to a small black dot on the concrete base.		
COUNTRY: FSM	ISLAND: POHNPEI CITY: KOLONIA	L.D.P. 518 POINT NO. FSM38
PROJECT: SPSLCMP	SURVEYOR: S M Turner	DATE: 17-12-01
 The diagram for point FSM38 shows a curved line representing 'KASELEHLIE STREET'. To the right of the street is a rectangular area labeled 'Kolonia Police Station'. Below the street, there is a line labeled 'OPEN DRAIN'. A trapezoidal feature represents a 'Concrete culvert'. A line points from the label 'FSM38 STAINLESS STEEL PIN IN CONCRETE' to a small black dot on the concrete culvert.		

COUNTRY: FSM	ISLAND: POHNPEI CITY: KOLONIA	L.D.P. 699 POINT NO. FSM43
PROJECT: SPSLCMP	SURVEYOR: S M Turner	DATE: 01-03-03

KOLONIA ROAD

FSM43
STAINLESS STEEL
BOLT IN CONCRETE

GREEN, RED &
YELLOW
PAINTED SHOP

DRAIN

OPEN CONCRETE

COUNTRY: FSM	ISLAND: POHNPEI CITY: KOLONIA	L.D.P. 700 POINT NO. FSM44
PROJECT: SPSLCMP	SURVEYOR: S M Turner	DATE: 01-03-03

KOLONIA ROAD

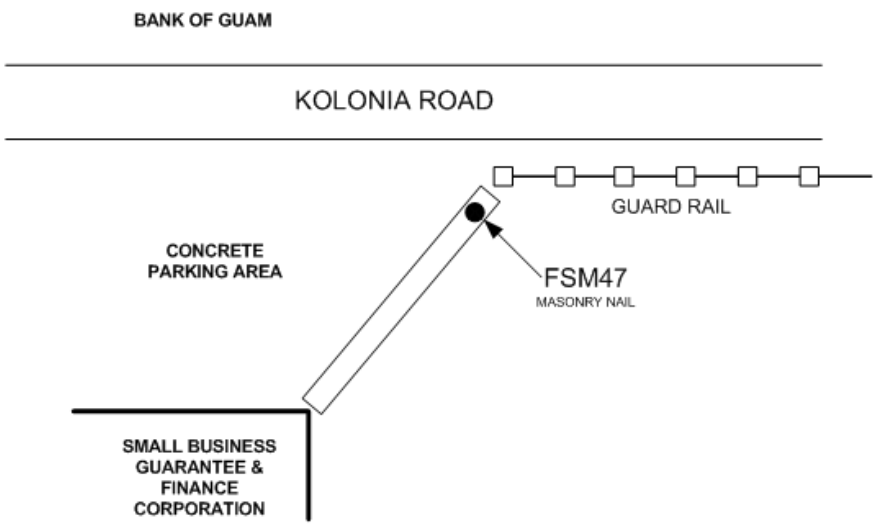
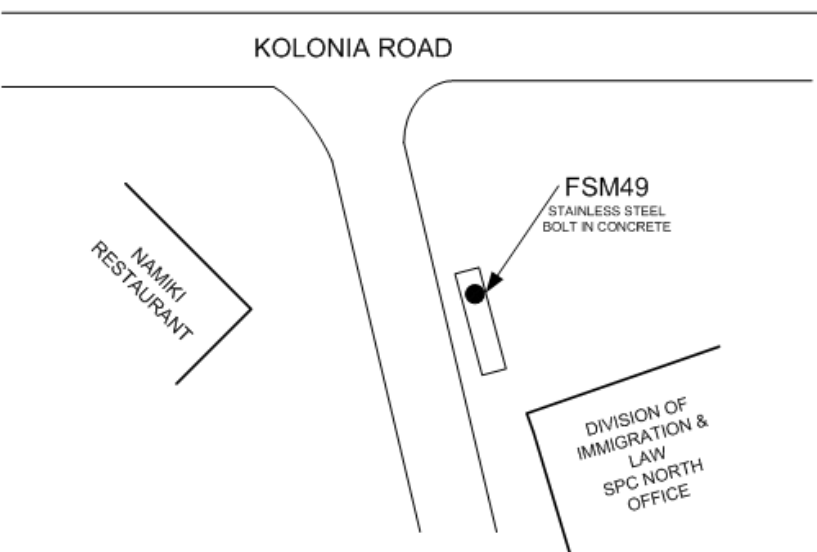
FSM44
STAINLESS STEEL
BOLT IN CONCRETE

A-ONE
FASHION

DRAIN

OPEN CONCRETE

FSM
TELECOMMUNICATIONS
CORPORATION

COUNTRY: FSM	ISLAND: POHNPEI CITY: KOLONIA	L.D.P. 703 POINT NO. FSM47
PROJECT: SPSLCMP	SURVEYOR: S M Turner	DATE: 01-03-03
 The diagram shows the location of Point FSM47. At the top, a horizontal line is labeled 'BANK OF GUAM'. Below it, another horizontal line is labeled 'KOLONIA ROAD'. To the left of the road is a 'CONCRETE PARKING AREA'. Further left is a building labeled 'SMALL BUSINESS GUARANTEE & FINANCE CORPORATION'. A diagonal line representing a driveway or path leads from the parking area towards the road. At the intersection of this path and the road, a black dot is labeled 'FSM47 MASONRY NAIL'. To the right of this point, a horizontal line with several small squares is labeled 'GUARD RAIL'.		
COUNTRY: FSM	ISLAND: POHNPEI CITY: KOLONIA	L.D.P. 705 POINT NO. FSM49
PROJECT: SPSLCMP	SURVEYOR: S M Turner	DATE: 01-03-03
 The diagram shows the location of Point FSM49. At the top, a horizontal line is labeled 'KOLONIA ROAD'. Below the road, a diagonal line leads to a building labeled 'NAMIKI RESTAURANT'. To the right of the road, a black dot is labeled 'FSM49 STAINLESS STEEL BOLT IN CONCRETE'. Below this point is a building labeled 'DIVISION OF IMMIGRATION & LAW SPC NORTH OFFICE'.		

COUNTRY: FSM	ISLAND: POHNPEI CITY: KOLONIA	L.D.P. 707 POINT NO. FSM51
PROJECT: SPSLCMP	SURVEYOR: S M Turner	DATE: 01-03-03

T-SHIRT SHOP

ADVERTISING SIGN

FSM51
MASONRY NAIL

Kolonia Road

COUNTRY: FSM	ISLAND: POHNPEI CITY: KOLONIA	L.D.P. 850 POINT NO. FSM100
PROJECT: SPSLCMP	SURVEYOR: A Lal & M Deo	DATE: 14-08-09

JICA Office
3-storey
Bldg

Vacant
Bldg

Store

UN Offices
3-storey
Bldg

◊ P/P

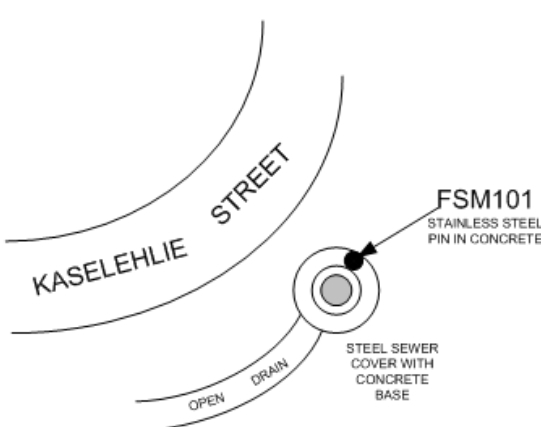
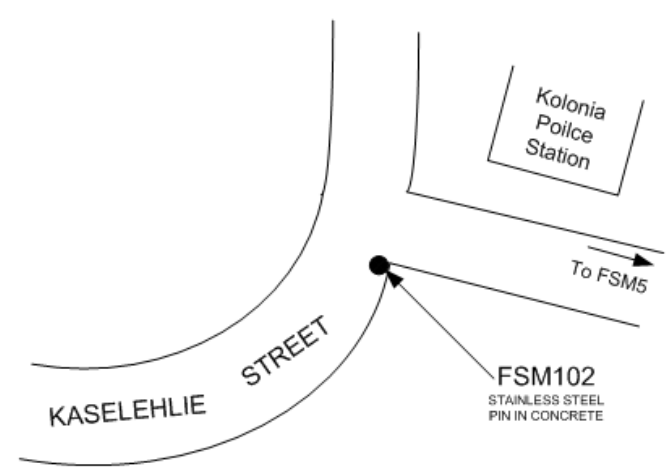
FSM100
STAINLESS STEEL
BOLT IN CONCRETE

← FROM
OHMINE ST

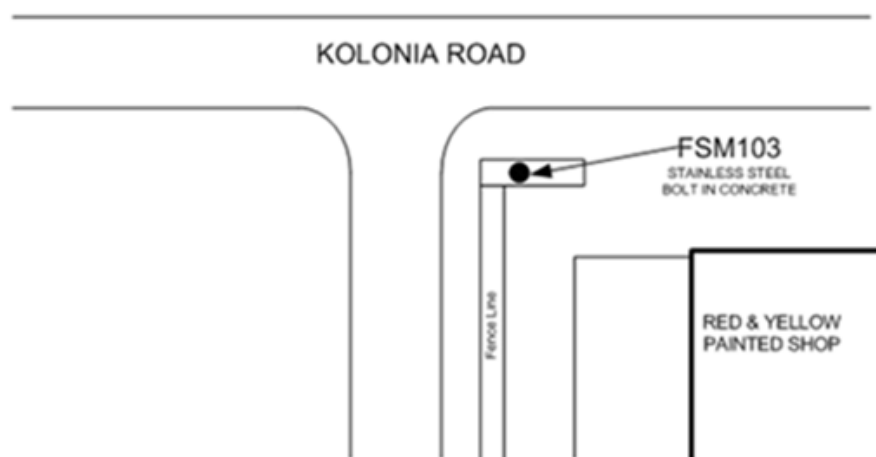
KOLONIA STREET

TO SOFTBALL
PITCH →

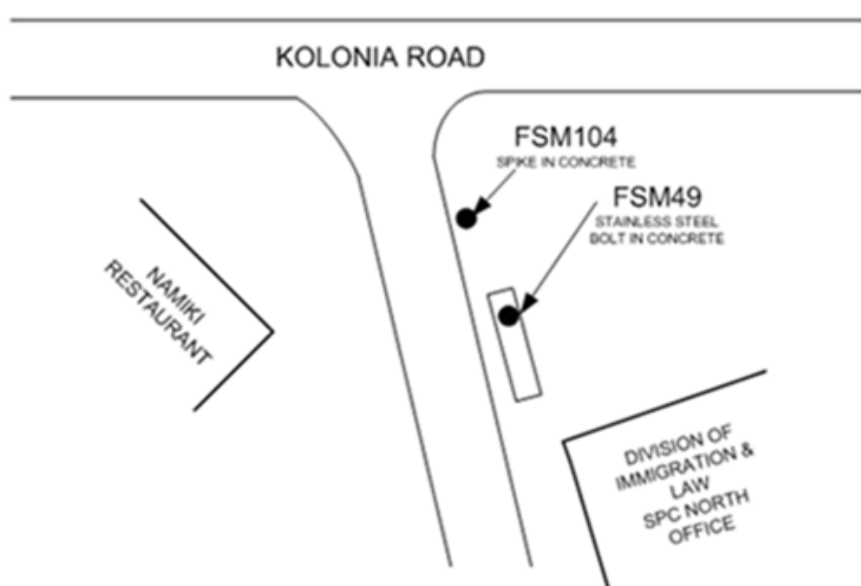
WALL MART STORE

COUNTRY: FSM	ISLAND: POHNPEI CITY: KOLONIA	L.D.P. 516 POINT NO. FSM101
PROJECT: SPSLCMP	SURVEYOR: YATES/LAL	DATE: 03-08-12
		
COUNTRY: FSM	ISLAND: POHNPEI CITY: KOLONIA	L.D.P. 518 POINT NO. FSM102
PROJECT: SPSLCMP	SURVEYOR: YATES/LAL	DATE: 03-08-12
		

COUNTRY: FSM	ISLAND: POHNPEI CITY: KOLONIA	L.D.P. 699 POINT NO. FSM103
PROJECT: SPSLCMP	SURVEYOR: YATES/LAL	DATE: 03-08-12



COUNTRY: FSM	ISLAND: POHNPEI CITY: KOLONIA	L.D.P. 705 POINT NO. FSM104
PROJECT: SPSLCMP	SURVEYOR: YATES/LAL	DATE: 04-08-12

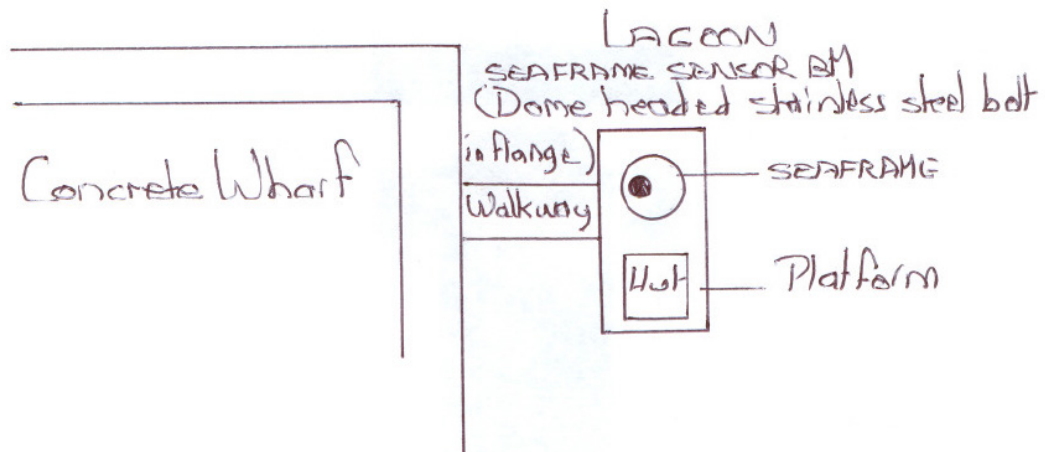


SOUTH PACIFIC SEA LEVEL AND CLIMATE MONITORING PROJECT

COUNTRY FSM	ISLAND / ATOLL	POHNPEI	L.D.P. 711
CITY / ATOLL KOLONIA	SURVEYOR S M TURNER	DATE 01-03-03	POINT NO. FSM 55

27-Aug-03

c:\word docs\general\pacific ldp.doc

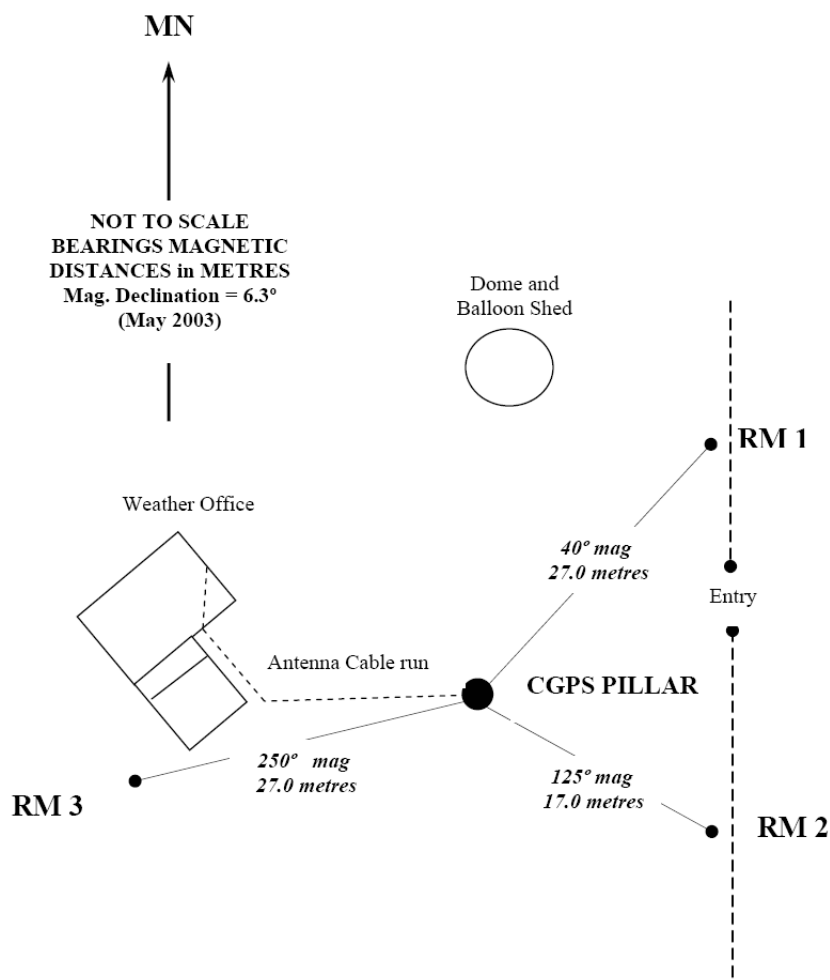


6 POHNBM and POHN Reference Mark Locality Diagrams

FSM CGPS Station, Pohnpei. – Reference Marks

REFERENCE MARKS

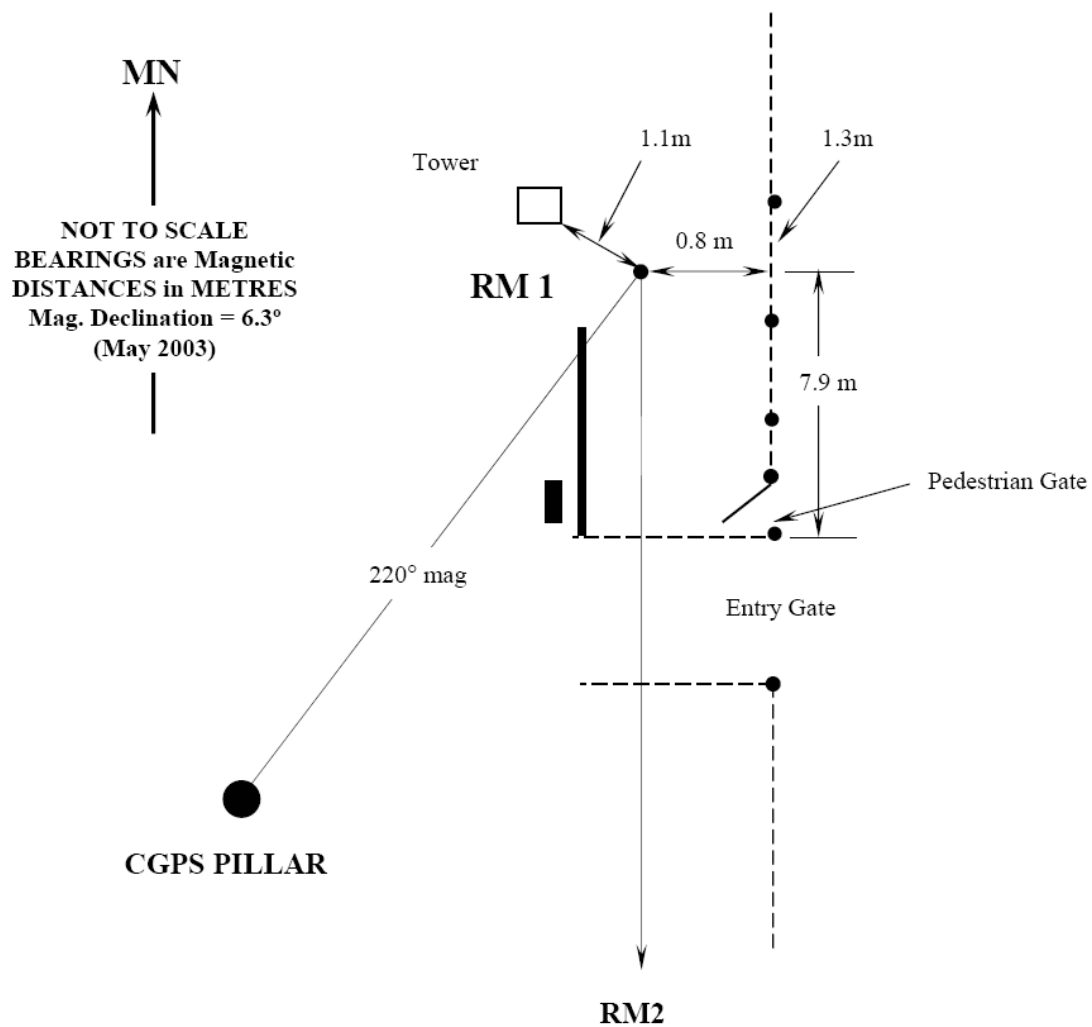
All RM's are capped 20 mm stainless steel rods driven to refusal and protected by 150 mm PVC pipe within circular poly carbonate valve boxes. The valve box lids are approximately 50mm below ground level.



FSM CGPS Station, Pohnpei. – RM 1

REFERENCE MARKS

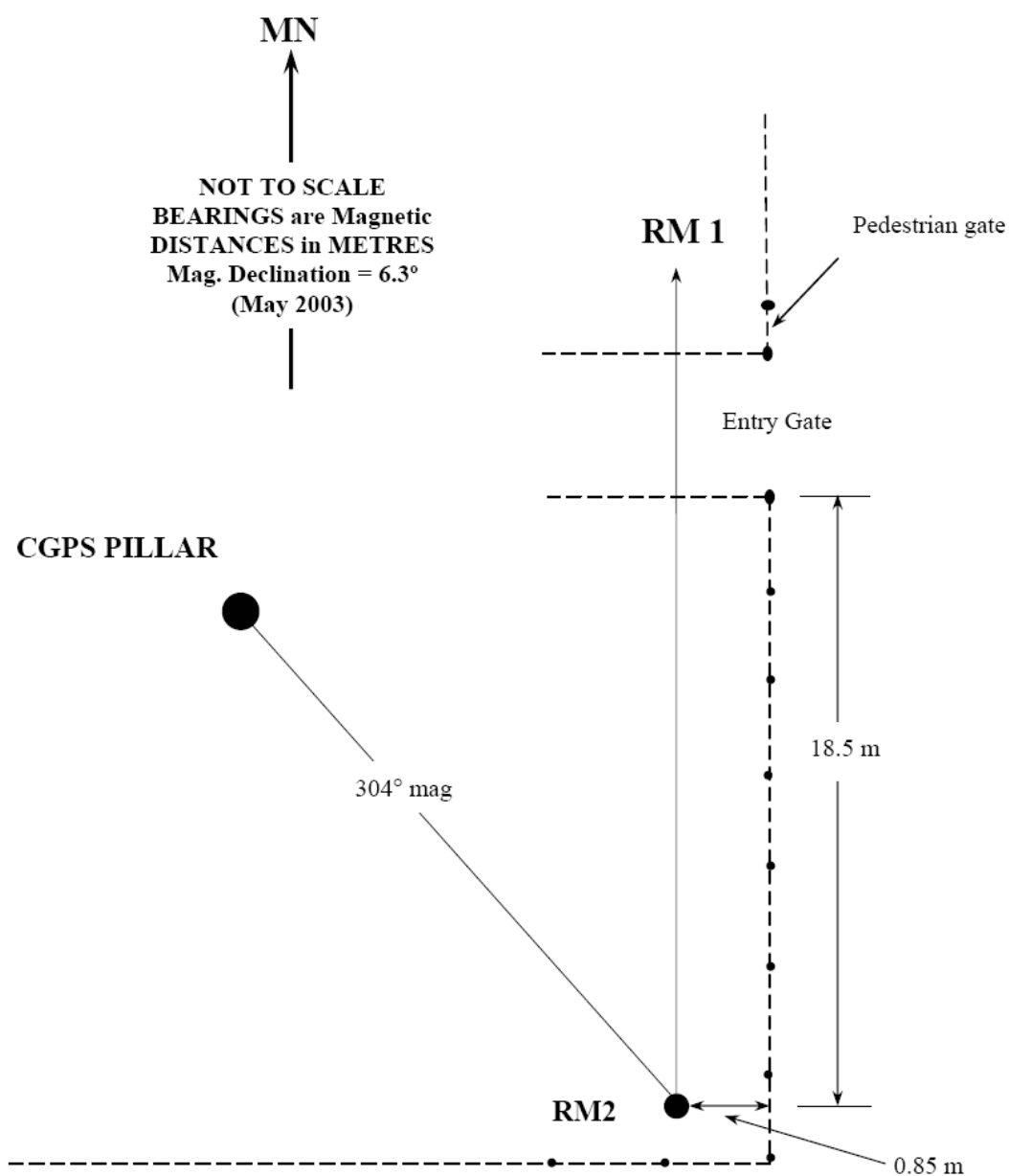
All RM's are capped 20 mm stainless steel rods driven to refusal and protected by 150 mm PVC pipe within circular poly carbonate valve boxes. The valve box lids are approximately 50mm below ground level.



FSM CGPS Station, Pohnpei. – RM 2

REFERENCE MARKS

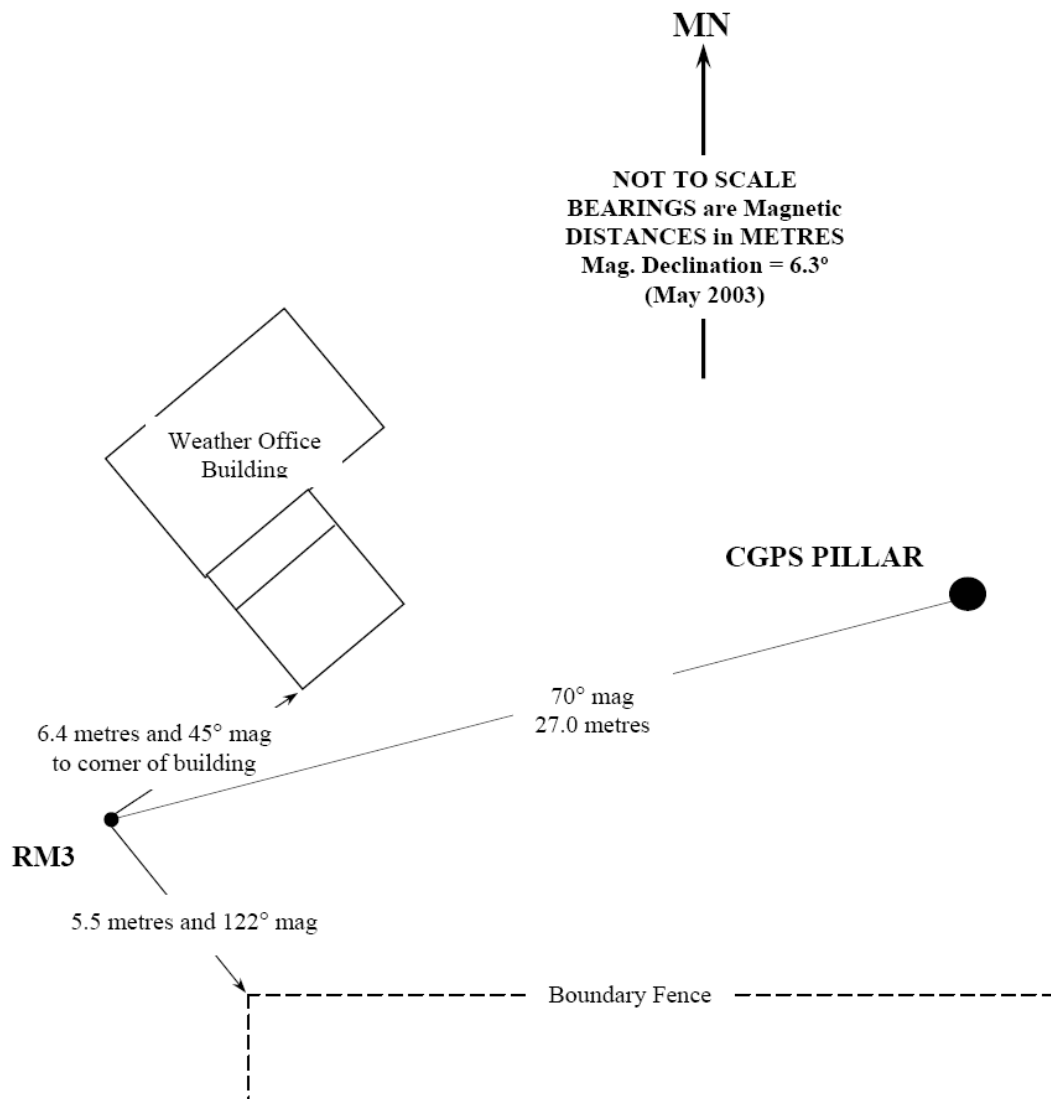
All RM's are capped 20 mm stainless steel rods driven to refusal and protected by 150 mm PVC pipe within circular poly carbonate valve boxes. The valve box lids are approximately 50mm below ground level.



FSM CGPS Station, Pohnpei. – RM 3

REFERENCE MARKS

All RM's are capped 20 mm stainless steel rods driven to refusal and protected by 150 mm PVC pipe within circular poly carbonate valve boxes. The valve box lids are approximately 50mm below ground level.



7 References

- Rüeger, J.M. & Brunner, F.K. 1982, 'EDM Height Traversing versus Geodetic Levelling', The Canadian Surveyor, vol. 36, no. 1, pp. 69-87.
- Inter-Government Committee on Surveying and Mapping (ICSM) 2002, Standards and Practices for Control Surveys, SP1, Ver. 1.5, May 2002.