New Zealand National Seismograph Network

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Introduction

The New Zealand National Seismograph Network (NZNSN) grew from 37 to 40 monitoring stations during the last two years. The new sites, which consist of broadband and strong motion recorders, were installed at Stewart Island, the Catlins, and Puysegur Point. During the coming years, the NZNSN will be expanding to 45 sites including two stations on the North Island, two stations on the South Island, and a station on the Chatham Islands. This year a station on the Chatham Islands and one mainland station are scheduled to be built, leaving a further three sites to complete the NZNSN.

Regional seismic networks have also grown in the last two years with the addition of 13 short period stations. Tintock, Holdsworth, Te Maipa, and Palliser contributes to the Wellington Regional Network; Waipukurau, Cape Kidnappers, and Kahuranaki contribute to the Hawke's Bay Network; Mahia, Paritu Road, and Carnagh Station contribute to the East Cape Network; Koharoa and Ohinepanea contribute to the Rotorua Regional Network; and Highcliff Hill is the first and to date only regional station in the South Island Regional Network. New Zealand GeoNet presently has 67 operational regional stations out of a total of 120, which are planned to be completed during the next three years. These regional stations will mostly provide extra coverage near volcanic centres and above the Hikurangi subduction zone. The new South Island station was built to fill in a gap in the national network array.

The NZNSN and regional seismic networks are operated by New Zealand GeoNet, a 10-year project to design, install and maintain an integrated geological hazard monitoring and data collection system for New Zealand. GeoNet consists of a national network of broadband and strong ground motion seismometers complimented by regional short period seismometers and continuous GPS stations, volcano-chemical analyses, and remote monitoring capabilities. New Zealand GeoNet is operated by GNS Science (a government owned research institute) and funded by the New Zealand Earthquake Commission (EQC).

The New Zealand National Seismograph Network

The NZNSN employs six-component (3D broadband and 3D strong motion) seismic recording stations throughout the country (see Figure 1). A station spacing of approximately 100 km provides earthquake data that is utilised in New Zealand and international tectonic research. The NZNSN is used in conjunction with regional seismic stations to provide rapid earthquake locations for public information and responding agencies. Location, equipment, and installation details of the NZNSN stations are contained within Table 1.

Almost all of the NZNSN stations are of a similar physical design and include an instrument vault, equipment hut, and VSAT antenna pole (Figure 2). The sensor vault is of solid concrete construction with additional insulation and a steel lid. The vault houses a Guralp CMG-3ESP or a Streckheisen STS2 broadband seismometer as well as a Kinemetrics Episensor (2g) strong motion accelerometer (Figure 3). The equipment hut is of the "portacom" design made of pre-assembled insulated aluminium panels on a concrete foundation. The VSAT dishes are 1.2 m to 2.4 m in diameter. Some of the smaller 1.2 m dishes are mounted on the equipment huts rather than on a separate pad. Several of the stations have either co-located continuous GPS, or act as the communications hub for nearby CGPS stations.

The equipment hut houses the digitiser, VSAT indoor unit and backup power supply (Figure 4). The digitiser used is usually a Quanterra Q4120, although some of the newer sites are now using the six-channel version of the Quanterra Q330 and Baler 14F data recording systems. The digitisers are operated at a sampling rate of 100 Hz, and this and a 1 Hz stream is sent in real time to the data centres. Data is also recorded on hard disks within either the Q4120 or the Baler 14F units and can be retrieved later if the data communications is lost.

Data Acquisition and Availability

Earthquake data is transported from the remote NZNSN stations to a GeoNet data centre via IP telecommunications networks based on a VSAT platform provided by Optus of Australia. The Optus VSAT system is connected to the GeoNet data centres via an earth station at Belrose, just outside Sydney, and trans-Tasman terrestrial data connections. GeoNet operates two data centres (at Avalon near Wellington and Wairakei near Taupo) to provide backup in the event of a large earthquake near Wellington or an eruption in the Taupo volcanic region. The NZNSN stations send continuous data to one of the two data centres with adjacent stations sending data to different data centres. As a backup against terrestrial network failures likely in a major earthquake, triggered strong motion data is sent to both Avalon and Wairakei via two VSAT hops to the VSAT terminals at the data centres.

Data from the NZNSN stations are acquired by computers at the two GeoNet data centres using a combination of COMSERV and SEEDLINK server software. Sites equipped with Quanterra Q4120 data loggers use the manufacturer supplied COMSERV routines to acquire the data which is then inserted into a SEEDLINK server while sites with Q330 data loggers have their data streams fed directly into the SEEDLINK server using locally written software. The SEEDLINK server allows the continuous data to be transferred between the data centres. The data handing and processing system is based around clients written for SEEDLINK making extensive use of the LIBSLINK software library. All of the continuous NZNSN data is kept on RAID hard disk arrays as well as backed up on DLT magnetic tape. New hard disk systems are purchased as required, with increases in disk sizes easily keeping up with the increase in data volume as more stations come on line.

The GeoNet policy is to make all data collected by the project freely available for research purposes. The GeoNet web site (www.geonet.org.nz) provides a portal for geological hazard data and information. This site administers general GeoNet information, listings of recent earthquake locations, and the current status of active New Zealand volcanoes. There are facilities to search the New Zealand Earthquake Catalogue and download NZNSN, CGPS, and strong ground motion data. NZNSN data is available using AutoDRM as described on the web site.

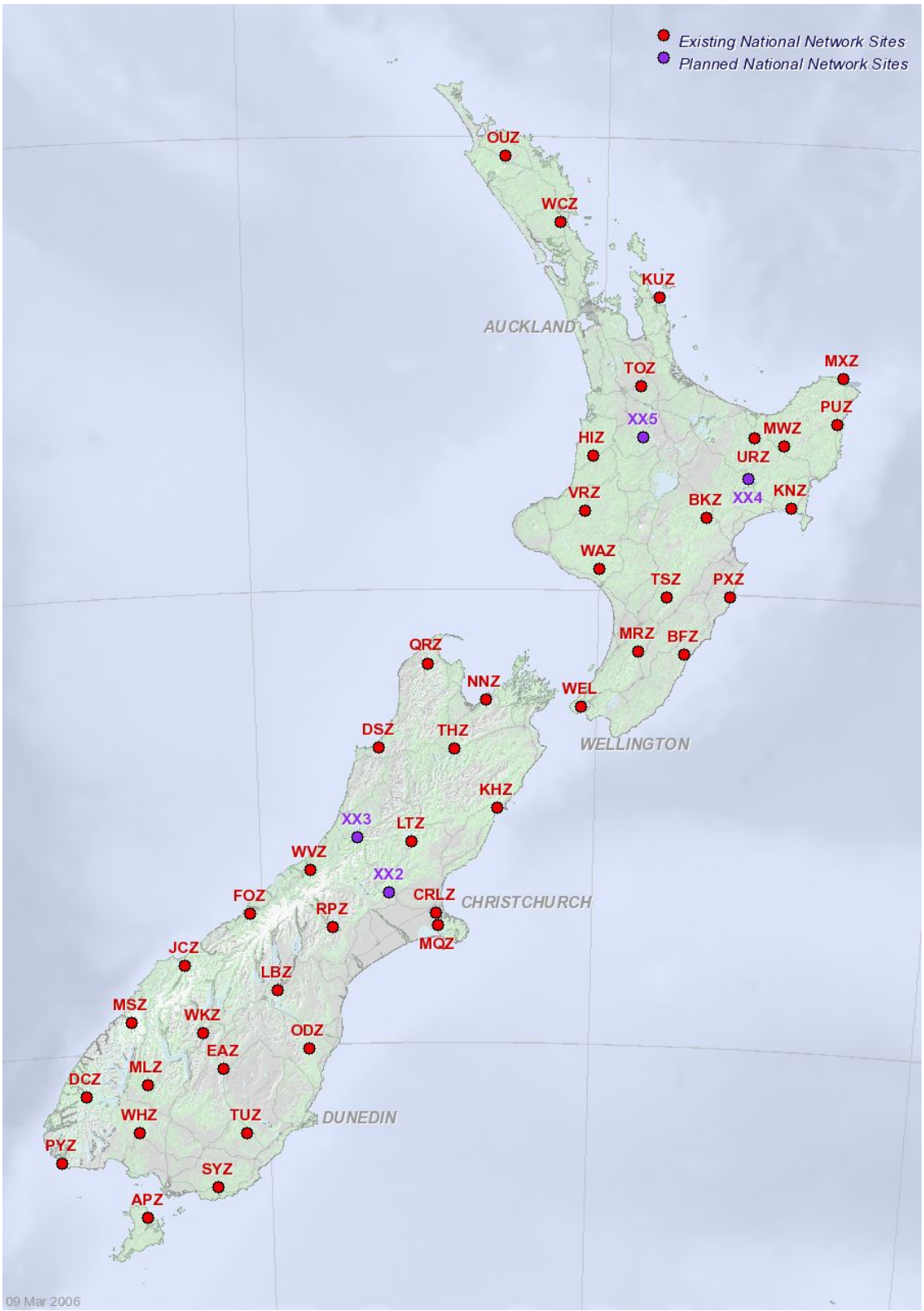

Figure 1. The New Zealand National Seismograph Network. Operational stations are red, while those that are still to be commissioned are purple. We expect to install a site on the Chatham Island and one other mainland site within the next year.

Figure 2. A photograph of the NZNSN station PUZ showing the VSAT dish and equipment hut on top of the rock outcrop. The sensor vault is located in the foreground on the left hand side of the photograph.

Figure 3. A view of the NZNSN vault at WHZ with a Guralp CMG-3ESP broadband seismometer and Kinemetrics Episensor installed.

Figure 4. A photograph of the inside of a NZNSN equipment hut showing the orange Quanterra Q4120 to the left and the VSAT indoor unit to the right on the bench. The digitiser and VSAT communications equipment have separate power supplies with backup batteries on the floor of the hut. This site also records the data from a CGPS station (using a Trimble NetRS) via a Freewave Ethernet Bridge radio to the left of the Quanterra.

Table 1. The details of the New Zealand National Seismograph Network stations. The digitisers are either Quanterra Q4120s or Quanterra Q330s. All sites have both broadband seismometers and accelerometers. The broadband sensors are made by Streckheisen (STS2), or Guralp (CMG-40T, CMG-3ESP, or CMG-3TB). The communications all use Internet protocols, over Ethernet radio bridges (Radio), Very Small Aperture Satellite Terminal (VSAT), and Frame Relay or DSL (FR). Stations marked with a "*" in the date installed column are still to be installed, and an approximate install date is given. The stations with XX* station codes do not yet have confirmed sites or station codes, and the locations given are approximate.

Station Name	Code	Latitude (deg.)	Longitude (deg.)	Altitude (m)	Digitiser	Sensors	Data Transfer	Date Installed
Omahuta	OUZ	-35.2214	173.5961	40	Q4120	STS2/Episensor	VSAT	26/08/2003
Waipu Caves	WCZ	-35.9411	174.3444	140	Q4120	3ESP/Episensor	VSAT	27/08/2003
Kuaotunu	KUZ	-36.7472	175.7200	40	Q330	3ESP/Episensor	VSAT	5/02/2004
Matakaoa Point	MXZ	-37.5640	178.3066	126	Q330	3ESP/Episensor	VSAT	19/02/2004
Tahuroa Road	TOZ	-37.7308	175.5019	109	Q4120	40T/Episensor	VSAT	16/10/1998
Puketiti	PUZ	-38.0733	178.2572	420	Q4120	3ESP/Episensor	VSAT	20/08/2003
Urewera	URZ	-38.2603	177.1103	100	Q4120	3TB/Episensor	VSAT	25/05/2001
Ngaroma	(XX5)	-38.30	175.56	-	Q330	3ESP/Episensor	-	2008*
Matawai	MWZ	-38.3359	177.5275	600	Q330	3ESP/Episensor	VSAT	18/02/2004
Hauiti	HIZ	-38.5147	174.8555	266	Q4120	STS2/Episensor	VSAT	3/02/2004
Hopuruahine Landing	(XX4)	-38.72	177.05	-	Q330	3ESP/Episensor	-	2007*
Kokohu	KNZ	-39.0214	177.6736	49	Q4120	40T/Episensor	VSAT	19/10/1998
Vera Road	VRZ	-39.1263	174.7584	182	Q4120	3ESP/Episensor	VSAT	26/11/2003
Black Stump Farm	BKZ	-39.1675	176.4923	729	Q4120	STS2/Episensor	VSAT	11/02/2004
Wanganui	WAZ	-39.7563	174.9852	401	Q4120	3ESP/Episensor	VSAT	27/11/2003
Pawanui	PXZ	-40.0314	176.8617	65	Q4120	3ESP/Episensor	VSAT	22/03/2001
Takapari Road	TSZ	-40.0603	175.9610	547	Q4120	3ESP/Episensor	VSAT	27/01/2004
Mangatainoka River	MRZ	-40.6625	175.5792	320	Q4120	3ESP/Episensor	VSAT	31/07/2003
Birch Farm	BFZ	-40.6817	176.2461	318	Q4120	STS2/Episensor	VSAT	30/07/2003
Quartz Range	QRZ	-40.8275	172.5289	260	Q4120	STS2/Episensor	VSAT	11/08/2003
Nelson	NNZ	-41.2166	173.3666	145	Q4120	3ESP/Episensor	VSAT	12/08/2003
Denniston	DSZ	-41.7469	171.8025	661	Q4120	40T/Episensor	VSAT	31/08/1998

Top House	THZ	-41.7639	172.9036	760	Q4120	3ESP/Episensor	VSAT	8/08/2003
Kahutara	KHZ	-42.4181	173.5403	70	Q4120	STS2/Episensor	VSAT	6/08/2003
Inchbonnie	(XX3)	-42.72	171.46	-	Q330	3ESP/Episensor	-	2008*
Lake Taylor	LTZ	-42.7833	172.2667	640	Q4120	3ESP/Episensor	VSAT	27/02/2004
Waitaha Valley	WVZ	-43.0764	170.7361	75	Q4120	3ESP/Episensor	VSAT	6/09/2003
Springfield	(XX2)	-43.33	171.92	-	Q330	3ESP/Episensor	-	2008*
Fox Glacier	FOZ	-43.5655	169.6886	10	Q330	3ESP/Episensor	Radio/VSAT	13/10/2004
McQueen's Valley	MQZ	-43.7078	172.6522	61	Q4120	40T/Episensor	VSAT	31/08/1998
Rata Peaks	RPZ	-43.7192	171.0539	412	Q4120	3TB/Episensor	VSAT	6/06/2001
Chatham Islands	(XX6)	-43.95	-176.45	-	Q330	3ESP/Episensor	-	2007*
Jackson Bay	JCZ	-44.0750	168.7853	1072	Q330	3ESP/Episensor	Radio/VSAT	2/06/2004
Lake Benmore	LBZ	-44.3872	170.1842	423	Q330	3ESP/Episensor	VSAT	5/06/2004
Milford Sound	MSZ	-44.6753	167.9275	90	Q330	3ESP/Episensor	VSAT	1/06/2005
Wanaka	WKZ	-44.8285	169.0176	564	Q4120	3ESP/Episensor	VSAT	3/06/2004
Otahua Downs	ODZ	-45.0453	170.6444	270	Q4120	STS2/Episensor	VSAT	12/09/2003
Earnscleugh	EAZ	-45.2327	169.3082	320	Q330	3ESP/Episensor	Radio/FR	5/11/2004
Mavora Lakes	MLZ	-45.3481	168.1728	640	Q4120	3ESP/Episensor	VSAT	9/09/2003
Deep Cove	DCZ	-45.4678	167.1542	50	Q330	3ESP/Episensor	VSAT	30/07/2005
Wether Hill Road	WHZ	-45.8939	167.9467	320	Q4120	40T/Episensor	VSAT	20/03/2001
Tuapeka	TUZ	-45.9561	169.6322	110	Q4120	3ESP/Episensor	VSAT	10/09/2003
Scrubby Hill (Catlins)	SYZ	-46.5385	169.1388	52	Q330	3ESP/Episensor	VSAT	5/05/2006
Puysegur Point	PYZ	-46.1678	166.6806	257	Q330	3ESP/Episensor	Radio/FR	03/05/2007
The Paps (Stewart Island)	APZ	-46.8334	167.9888	601	Q330	3ESP/Episensor	Radio/FR	8/05/2006