Toitu te
Land whenua
Information
New Zealand

New Zealand Geodetic Strategic Business Plan

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Foreword

The rationale for a geodetic system stems from the fact that much human activity is related to, or dependent on, geographic location and information about land resources. Accordingly, a geodetic system is designed to provide a reference system of permanent ground reference points and the associated intellectual and positional data to enable people to acquire, manage, disseminate and exchange information about land and its resources. Geodetic systems make a sustained infrastructural contribution to economic and social growth and development, with benefits accruing and emerging over very long time-spans.

The information age is making society and the economy increasingly dependent on information and knowledge. An important component of information is the spatial relationship between places, resources and people at local, national and global levels. We are also seeing rapid changes in technology which is making positioning a far more accessible capability. This, coupled with the rapidly growing use and exchange of spatial information, places even greater emphasis on the importance of a consistent and comprehensive geodetic framework, but one to which the user of the future can contribute to as well.

In New Zealand, geodesy goes back to the early days of European settlement, although the earlier Polynesian and European explorers made extensive use of the stars for navigation. In the 1870s, as a result of growing and widespread public and government concern at the generally unsatisfactory state of surveys in New Zealand, the government of the day commissioned a review of the surveys of New Zealand.

One of the recommendations was for a general triangulation of the country. Because of costs, terrain, depression and war, it was not completed until 1949, when the New Zealand Geodetic Datum 1949 (NZGD49) was defined. However, extensive minor triangulations were carried out in the interim for land settlement and mapping. Most of these were later connected to the major geodetic triangulation. A significant amount of re-survey and extension was carried out throughout the 1960s, 1970s and 1980s, utilising the new electronic distance-measuring technology. This work, which was to enable a number of major development initiatives, started to identify some of the limitations of the existing datum and control network that we are now actively investigating and overcoming.

The existing datum, however, served New Zealand's development well. It has enabled the provision of an integrated survey or spatial reference system and complete topographical and cadastral mapping database coverage of New Zealand, a somewhat rare situation in international terms. These comprehensive and integrated topographic and cadastral database systems have in recent years enabled a rapidly growing Geographic Information System (GIS) industry in New Zealand with ever-expanding applications. The process of land survey is directly related to land settlement, use and development, and accordingly, the system is relied on and used over and over again. As a result, the geodetic system, which provides the underpinning spatial framework for these activities, needs to be robust and capable of supporting future applications and growth.

Recent major changes, events and user demands indicate that a revision of the geodetic system is necessary. There is now clear evidence that the current datum is inadequate for emerging applications. Apart from the technological changes of the Global Positioning System (GPS) and digital databases, by far the most significant changes have been government reform and the explosion in the use of land information. This is characterised by a focus on broader outcomes to which government departments are required to contribute and moves to reduce government's regulatory interventions, while facilitating economic and social growth.

The history of the system, its evolution, and the enduring nature of land use and occupation indicate that the spatial framework and survey process has very long-term benefits and effects. There is a need to take a fairly long-term view when considering the future of the survey system. This Strategic Business Plan addresses a three-year view, which is being driven by immediate issues such as the automation of the survey and title systems, and a longer, 10-year view which looks beyond current initiatives and technology to assess likely emerging needs as we head into the 21st Century.

This Geodetic Strategic Business Plan provides a high-level overview of the geodetic system and a plan to enable future development of the system. The strategy assumes continuing geodetic resourcing as outlined in the survey and title automation programme business case.

Tony Bevin
Surveyor-General

NEW ZEALAND GEODETIC STRATEGIC BUSINESS PLAN

1 Introduction

1.1 *Departmental Responsibility*

Land Information NZ (LINZ) was established on 1 July 1996, taking over responsibility for the policy, regulatory and core government service delivery functions of the former Department of Survey and Land Information (DoSLI), the Land Titles Office, and for the purchase of core hydrographic services from the New Zealand Defence Force. In July 1998, as part of the restructuring of Valuation New Zealand, the Office of the Valuer-General was established within LINZ.

LINZ is focused on advising the Government, providing core statutory processes and infrastructure, and administering the Crown's interests in land and making government-held land information available to the public. The department is the government's spatial referencing authority, and the steward and standard-setter for core national land databases including the spatial referencing (geodetic) system, cadastral system, land titles, topography, hydrography, Crown property (excluding the Conservation Estate) and valuation.

The territorial extent over which LINZ has responsibility to provide a spatial reference system has been extended from principally the land mass of New Zealand (including the Ross Dependency) to include the area of bathymetric obligations within the Government's area of maritime responsibility.

The core outcomes the Government has set for LINZ are:

Outcome One:
The on-going delivery of an efficient regulatory framework that establishes:

- parameters for definition and dealing in land and property rights: and
- standards and specifications for provision of land data.

Outcome Two:
The establishment of clearly defined, marketable and secure land property rights, and maintenance of the resulting records, to underpin economic activity in New Zealand.

Outcome Three:
The efficient management of Crown land related liabilities and responsibilities through either:

- efficient management and disposal of surplus Crown land assets and land related liabilities; or

- efficient oversight and/or management of Crown land purchase and disposal regulatory instruments.

Outcome Four:
The ongoing maintenance of publicly available core geographic information that supports the constitutional framework, national security and emergency services.

1.2 *The Need for a Geodetic System Strategic Business Plan*

The geodetic system is the infrastructure that provides the ability to define spatial location for a large part of human activity. LINZ has identified key business drivers, including geodetic and cadastral automation, that imply a requirement for the development of, and change to, the geodetic system.

Because the geodetic system has a number of key components, changes to one of these may have complex ramifications for others. Future development of the geodetic system must be in an ordered fashion, to ensure user requirements and departmental outcomes can continue to be met.

The purpose of this Strategic Business Plan is to articulate a vision and plan for the development of the geodetic system. Business drivers and issues have been detailed and a number of short-term (three-year) and long term (10-year) goals identified to enable the business drivers to be satisfied. A process to evaluate progress in implementing this strategy has been devised.

2 Vision and Mission

2.1 *Departmental Vision and Strategic Goals*

The LINZ Vision is:

> *WE WILL PROVIDE WORLD CLASS LAND AND SEA BED INFORMATION SERVICES THAT WILL:*

- *ensure the security of New Zealand land rights and interests;*
- *enable the people of New Zealand to fully enjoy the benefits of our land and sea bed resources;*
- *meet (and often exceed) the expectations of Government and other customers.*

The three operational strategic goals of the department that the geodetic system supports are:

- *a national spatial reference system that meets New Zealand's core land and sea bed information needs*
- *a secure national land title and survey system available from remote locations with a turnaround time of 24 hours for 90% of survey and title transactions*
- *current topographic, hydrographic and bathymetric information that covers new Zealand's area of jurisdiction and is required for public interest purposes*

2.2 *Vision Statement for the New Zealand Geodetic System*

In order to deliver the departmental vision and strategic goals a vision has been developed for the New Zealand Geodetic System. It is:

" to provide a 'world class' geodetic system which underpins New Zealand's economic and social development by providing an authoritative coordinate reference system for the spatial positioning of land and seabed boundaries and physical features"

2.3 *Mission Statement for the New Zealand Geodetic System*

The department's mission for the New Zealand Geodetic System is:

"to ensure the availability of a national reference system that meets New Zealand's core land and seabed information needs by providing and maintaining:

- ***a modern spatial reference system***
- ***geodetic standards and policies***
- ***an accessible geodetic network."***

2.4 *Principles of the Development of a "World Class" Geodetic System*

A "world class" geodetic system is one which satisfies user requirements (including accuracy), is authoritative, cost-effective to operate and maintain, and is capable of accommodating new and future technology.

To realise the vision to be "world class" the department's principles for the future New Zealand Geodetic System are to:

- support government policies and outcomes such as:
  - minimising compliance costs and Crown risk;
  - meeting core government outcomes (e.g. cadastral, electoral, administrative, topographic and hydrographic requirements etc.)
- comply with well-defined policy and standards
- comply with agreed international and government standards
- be compatible with international reference systems
- provide an authoritative geometric coordinate system in terms of specified datums and projections
- be based on a network of points that can be reliably re-occupied for surveying
- be based on reliable survey observations and sound physical and mathematical principles
- provide quality measures for all data (e.g. observations and coordinates) and be auditable
- be able to meet the changing needs of the government and new technology
- account for the effects of geodynamics.

3 The New Zealand Geodetic System

The New Zealand Spatial Reference System is the authoritative spatial referencing system for New Zealand underpinned by the New Zealand Geodetic System. Spatial referencing of legal and administrative features is provided by the land and seabed cadastre and physical spatial referencing by topographic and hydrographic databases.

Note: In this context, the New Zealand Spatial Reference System is limited to LINZ data and systems and does not include the contribution that may be provided by various other external spatial systems.

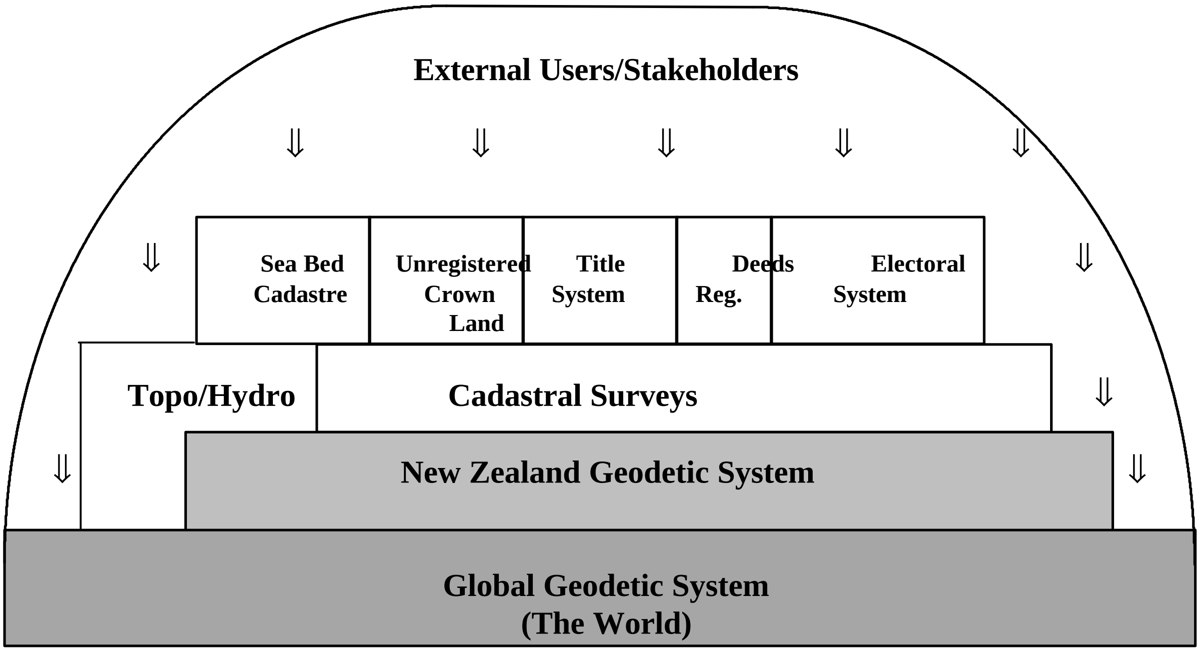
3.1 *Key Components of the Current Geodetic System*

The New Zealand Geodetic System comprises intellectual, physical and data components which provide authoritative coordinate systems for New Zealand's areas of territorial and administrative responsibility.

The diagram below shows the relationship of the geodetic system to internal and external users. The key components of the New Zealand Geodetic System are:

- network design and physical marks (the geodetic database currently identifies more than 30,000 geodetic control marks)
- data (this comprises survey data and associated information)
- intellectual information (business rules, defining parameters and associated constants). Examples of this are:
    - geodetic datum (NZGD 1949 defined by the coordinates of 1st Order triangulation stations and a best-fit reference spheroid - *International Spheroid 1924*)
    - vertical datums (currently LINZ supports 13 major vertical datums tied to different tide gauges together with more than 20 local vertical datums)
    - map projections (the New Zealand Map Grid is used for topographic and cadastral mapping. Other projections are used for specific applications such as the 28 Meridional Circuits for cadastral survey.)
    - transformations between datums and/or projections
    - geoid model (the global geoid model EGM96 is currently used)
- that it is founded in government legislation (e.g. section 11.(1) of the Survey Act 1986).

Dependency of users on the New Zealand Spatial Geodetic System.



3.2 *Major Geodetic Users and Contributors*

The geodetic system supports a wide range of positioning applications and users. It enables diverse applications to contribute to a spatial infrastructure in such a way that the whole is greater than the sum of the parts.

Geodetic system users and contributors fall into two main classes:

- **Primary users:** LINZ is required to provide a geodetic system which meets the geodetic needs of these users to the extent that is necessary to support core government outcomes. Users may still need to undertake some minor geodetic work themselves where their specific requirements exceed the Surveyor-General's geodetic standards and where an extension to these standards cannot be justified in terms of wider costs and benefits.

- **Secondary users:** LINZ is not required to meet the specific geodetic needs of these users, even though many of them are also contributing to core government outcomes. In devising and maintaining a system which meets the needs of the primary users, LINZ generally also meets the needs of the secondary users. The secondary users are separately funded to meet their own specific geodetic needs. However, their level of funding is based on the existence of, and ability to access, the national geodetic system. LINZ needs to recognise the requirements of these users and discuss any significant changes in the system with them.

Contributions to the geodetic system fall into three main groups:

- direct funding to LINZ to develop and maintain the geodetic system.
- data purchasers/providers (generally secondary users), who generate geodetic data which complies with LINZ geodetic standards at their own expense and provide it to LINZ to contribute to the public geodetic record. Where this data is able to substitute for data that LINZ would otherwise have been required to purchase through geodetic contracts, LINZ may enter into cooperative programmes with these users to mutual benefit. Where the data is not specifically required by LINZ but stewardship of the data contributes to government outcomes, it will be accepted by LINZ at no cost.
- other users or members of the public who provide information on the integrity of LINZ geodetic data (often in the form of reports on the condition of geodetic marks).

The latter two groups of contributors highlight the fact that the quality and value of the geodetic system is enhanced every time it is used.

3.2.1 *The Cadastral System*

The cadastral survey system is a primary geodetic user and a direct financial contributor via land survey and transfer transaction fees. This reflects the facts that cadastral system users have more at stake financially than any other user and that the cadastral system generally places the greatest demands on the system in terms of density and, compared with other primary users, accuracy.

The cadastral system user requirements of the geodetic system are:

- nationwide coverage with priority for urban and intensively developed rural areas
- centimetre-relative accuracy of geodetic control stations (at present required over distances of a few hundred metres but in future this accuracy will be required over tens of kilometres as new long range survey technology becomes more efficient for cadastral survey)
- mainly horizontal control requirements, except in the case of strata titles
- sufficient density of connection of geodetic control stations to cadastral marks in order to spatially define and maintain the cadastral fabric

- dynamic monitoring of stations to maintain the accuracy of the cadastral fabric
- sufficient density of well maintained control stations to avoid undue costs and increased compliance costs to cadastral surveyors and their clients.

3.2.2 *Hydrographic and Topographic Mapping*

National hydrographic and topographic mapping is another primary geodetic user. Most of the hydrographic/topographic geodetic requirements in terms of density and horizontal accuracy are met, either by a national geodetic system that meets cadastral requirements or by direct usage of the global geodetic system. However, there are additional requirements - most notably heighting and coverage of areas with low cadastral activity (e.g. Fiordland).

Hydrographic and topographic mapping also includes secondary users such as those involved in project mapping, utility mapping and many other GIS applications.

The general requirements are:

- national coverage, including areas of little or no cadastral activity (e.g. Fiordland, Antarctica and outlying islands), for the national topographic mapping programme with modest accuracy requirements (i.e. a few metres)
- three-dimensional positioning (geodetic horizontal coordinates and orthometric heights)
- coverage for hydrographic charting over New Zealand's area of maritime responsibility, with modest accuracy requirements of a few tens of metres [Note: While GPS can provide absolute spatial positioning offshore to an accuracy of tens of metres, a consistent system should be adopted to map the interface between land and sea to ensure conflicts do not occur.]
- for some localised GIS, higher accuracy requirements to decimetre level.

3.2.3 *Engineering Use*

Engineering applications and users often have greater requirements for accurate heights than cadastral users. These are secondary geodetic users and their needs are broadly met by a system which satisfies cadastral, topographic and hydrographic requirements. To the extent that the current geodetic system does not meet engineering requirements, these specific requirements are met locally by the engineering project. This often results in contributions of data to the geodetic system.

Many engineering applications are interdependent of cadastral and topographic information - i.e. the location of services relative to property boundaries and definition of easements. Engineering requirements include:

- local, high-accuracy vertical and horizontal requirements for deformation monitoring or construction set-out and projects
- high-to-medium accuracy requirements for infrastructural engineering requirements over regional areas (i.e. development of stormwater and sewerage systems)
- medium accuracy requirements over regional or national areas for general engineering works (i.e. roading, electricity transmission and gas pipelines).

3.2.4 *Scientific Studies*

A wide range of scientific applications require spatial referencing. These are secondary geodetic users and often contributors of data which can substitute for LINZ geodetic data purchase.

The general requirements of scientists are variable but some high accuracy applications, such as for monitoring crustal deformation, require:

- millimetre measurement accuracy and stable marks
- large-scale coverage (thousands of kilometres) to link New Zealand into a global framework and to connect to stable areas well away from the tectonic deformation zone.

Other accuracy requirements, such as for soil or geological mapping, may be low and are similar to the requirements for topographic mapping. The geodetic system that supports cadastral and mapping needs will often meet these requirements.

3.2.5 *Navigation and Transport Safety*

Safe navigation requires the following three navigation components to be based on consistent geodetic systems.

1. **positioning of aircraft, ship or vehicle**. The geodetic system provides transformations from global spatial systems (eg WGS84) to national geodetic systems.
2. **positioning of navigation aids such as radio beacons.** To satisfy this application the geodetic system provides a consistent infrastructure and network for users to undertake surveys and to position facilities.

3. **location of hazards to navigation.** The location of hazards is often based on topographical/hydrographic data which itself is based on the geodetic system (see sec. 3.2.2)

Transport safety users (marine and aeronautical charting, positioning of navigational beacons) could be classed as secondary users in that the agencies responsible for these activities are funded to meet their specific geodetic requirements. However, this funding pre-supposes the existence of a national geodetic system linked to international systems which is able to meet their high-level needs. This contributes to core government outcomes of meeting international obligations for marine and air safety.

In the event that the geodetic system was modified in a way that left it unable to allow these users to meet their obligations efficiently (e.g. in terms of providing access to internationally consistent geodetic systems) - they could be considered primary users.

3.2.6 *Defence*

Defence forces are generally secondary users, using the geodetic system for applications such as mapping, planning and artillery ranging. They could become primary users if the geodetic system were modified in such a way that it no longer met their needs (i.e. if it were not compatible with global systems with the result that they could not meet their international obligations).

3.2.7 *Project Surveying*

A large number of others use the geodetic system for a variety of purposes. These secondary geodetic users include surveyors for localised survey work and private individuals who require positioning for various activities. These users often use spatial positioning to correlate land or geographic data with the cadastral or topographic / hydrographic databases. They frequently contribute information on the integrity of LINZ geodetic data and, in some cases, may directly contribute data which complies with LINZ geodetic standards.

The accuracy requirements of this group vary, but the geodetic system that supports cadastral, topographic, and engineering surveying will generally support their needs.

3.2.8 *Other Contributors*

The use of new technology provides potential for non-traditional users of the geodetic system to contribute to it. For example, GPS is now being used in meteorology to measure meteorological parameters through the troposphere and lower atmosphere (e.g. GPS arrays around airports to measure wind shear). GPS is also used for precise time transfer for monitoring national and international time standards and to monitor data communications. These measurements may in future contribute to the geodetic system. As new technologies such as GPS are more widely adopted, other non-traditional suppliers may also become apparent.

3.3 *The Geodetic System and Future Technology*

Satellite-based positioning systems such as GPS have revolutionised geodetic surveying. These have had a major impact on surveying and the ability to determine spatial location. The use of satellite-based systems has seen major development in the accessibility and utility of global spatial frameworks - e.g. the development of the World Geodetic System 1984 (WGS84), and the need for local systems to be connected to these global frameworks. For some lower-accuracy applications - e.g. navigation and hydrographic charting - absolute positioning will be carried out by users directly, using technology such as GPS.

More localised higher-accuracy relative positioning will still be required in terms of regional or national geodetic systems for some time to come. Wide Area Differential GPS (WADGPS) using the navigation capabilities of GPS can deliver sub-metre accuracy in seconds over hundreds to thousands of kilometres. Kinematic GPS can deliver centimetre accuracy in seconds over distances of up to 20 km. There is every reason to expect these technologies to develop and combine to the point where centimetre accuracy can be delivered in seconds over at least hundreds and perhaps thousands of kilometres. This will impact on the New Zealand geodetic system.

New technology can be expected to continue to deliver greater spatial accuracy over greater distances at less cost. The geodetic system will be expected to support efficient use of these new technologies and the expected increases in relative positional accuracy that will be achieved over the greater distances.

3.4 *Earth Deformation and the Geodetic System*

As satellite-based positioning tools allow higher accuracy to be delivered over greater distances, it is apparent that New Zealand’s current geodetic system cannot support applications which take advantage of these increases in accuracy. One reason for this is the effect of crustal deformation on the network. Modern high-accuracy survey data increasingly conflicts with coordinates of points stored in spatial databases. Users requiring 0.5m to several metre accuracy will not need to account for the effects of earth deformation. For higher-accuracy users requiring centimetre to decimetre accuracy the geodetic system will need to be able to accommodate the effects of crustal deformation to ensure that new observations do not conflict with database coordinates.

4 Strategic Drivers and Issues

4.1 *Summary of Strategic Business Drivers and Issues*

The following key strategic business drivers and issues are identified as having a major impact on the development of the geodetic system.

Drivers tend to encourage development of an ideal future geodetic system while issues tend to oppose or complicate implementation of the "ideal" system.

DRIVERS	ISSUES
1. geodetic and cadastral automation	1. information, education and training
2. support core government responsibilities	2. resistance to change
3. need to simplify the management of digital spatial data	3. transitional costs of new technology
4. need to reduce risk to the Government	4. changing database coordinates
5. need to reduce cost to the Government and the level of government intervention	5. continued use of old technology
6. increased public usage of the core spatial infrastructure	6. legacy systems
7. need to facilitate the use of international systems	
8. need to reduce client compliance costs	
9. changing needs of the Government	
10. earth deformation	
11. the need to anticipate future user requirements	

4.2 *Drivers*

1 - Geodetic and cadastral automation

LINZ is committed to the automation of the survey and land title system in New Zealand, including automated geodetic processing. This requires a uniform and spatially accurate geodetic system as the basis for spatial determination and referencing of land and seabed rights. Under the concept of a survey-accurate digital cadastre, the coordinates assigned to boundary points will contribute to their survey definition and facilitate cost-efficient redefinition or recovery of parcel boundaries and right areas.

2 - Support core government responsibilities

The geodetic system must provide spatial referencing for a number of core government responsibilities such as maintaining the cadastral system and administrative mapping, topographic mapping, hydrographic charting, transportation and safety, and defence.

3 - Need to simplify the management of digital spatial data

Current management of digital spatial data is complicated by:

- distortions within the current datum due to the effects of earth deformation and the lower accuracy of the technology used to define the datum
- limited territorial coverage of coordinate systems
- multiple coordinate systems (e.g. use of meridional circuits and separate datums for offshore islands and the Ross Sea region).

4 - Need to reduce risk to the Government

The Government provides the authoritative spatial referencing system for New Zealand upon which the spatial component of the cadastral system, topographic mapping, and hydrographic and aeronautical charting is based. LINZ must reduce risk of loss to the Government through the development of an accurate spatial referencing system that complies with government policies, standards and guidelines, and that is clearly auditable.

5 - Need to reduce cost to the Government and the level of government intervention

LINZ must reduce the cost to the Government through the development of an accurate spatial referencing system that is efficient and meets government needs. The department must deliver, with a minimum of regulation, the maximum benefit for the least cost and that facilitates flexible use by other users of the system.

6 - Increased public usage of the core spatial infrastructure

Since the early 1990s there has been increasing use of the geodetic reference system due to:

- decreasing cost and wide use of spatial referencing tools such as GPS receivers
- development of GIS applications and public use of these systems
- integration of spatial referencing tools with GIS systems and development of emerging services, e.g. the development of on-board car navigation systems.

7 - Need to facilitate the use of international systems

Since the early 1980s there has been an increasing movement towards the globalisation of national spatial systems due to:

- increased use of satellite-based navigation and survey aids such as GPS
- development of a global market in spatial information systems
- recognition of the efficiency gains available through using global systems and adherence to global standards, including global reference systems
- increased use of global systems, including satellite-based positioning and remote-sensing systems to generate global spatial data sets
- global measurement of environmental change.

Development of the geodetic system will see more reliance on, and adoption of, international geodetic reference systems. In using technology such as GPS, LINZ makes use of a global system that is provided at no cost. The department needs to be aware of its responsibility to make appropriate contributions to such systems to obtain the full benefits from them.

[Note: Organisations in New Zealand such as LINZ, the Institute of Geological and Nuclear Sciences and Otago University are already contributing to such systems through the provision of data to the IGS from GPS permanent tracking stations.]

8 - Need to reduce client compliance costs

LINZ should reduce the cost of compliance with regulations and other client costs such as departmental fees and charges.

9 - Changing government needs

The spatial referencing system must be sufficiently flexible to meet changing government requirements. Flexibility may be limited for cost/benefit reasons but should not be limited by a failure to anticipate likely developments.

10 - Earth deformation

The current geodetic datum will not accommodate the effects of earth deformation. This results in distortion of, and the eventual need to replace, the datum which is costly and disruptive. For high-accuracy user needs (e.g. the requirements of survey and title automation) the spatial referencing system should accommodate the effects of:

- slow (5 cm/year) crustal deformation due to the effects of plate tectonics
- catastrophic effects (metres) of earthquakes or volcanic activity.

11 - The need to anticipate future user requirements

Development of the geodetic system must try to anticipate future user requirements before they are needed because of the long lead-times required to develop and enhance the system and long term dependency on a consistent spatial reference system.

4.3 *Issues*

1 - Information, education and training

Information, education and training are key issues because:

- a lack of information, education and training leads to inefficient and ambiguous use of the system
- an existing lack of public and professional understanding about geodetic issues is compounded by increased use of the geodetic system and geodetic tools such as GPS by the wider user community
- geodesy is a specialist field and is changing very fast
- there is often inconsistency in terms used and a lack of definition of many terms
- in the past there has been an inconsistent and non-uniform approach to training and education.

2 - Resistance to change

There is often a resistance to change because of:

- increased short term costs imposed by that change - e.g. the cost of new hardware or software
- new technology which may necessitate retraining of staff
- legacy systems currently in use.

3 - Transitional costs of new technology

There can be increased short-term costs due to new technology, such as:

- development of new field procedures and methodology
- computing (hardware and software) and office costs
- training in the use of the new technology
- increased compliance costs for those who do not acquire the new technology.

4 - Changing database coordinates

For high-accuracy users of the geodetic system database, coordinates should relate to position in the physical world. Database coordinates change because of movement of marks in the physical world due to the slow effects of crustal deformation or events such as earthquakes, landslides or volcanic activity, and more accurate or modern surveys that improve the coordinates of control stations.

Many users may find it difficult to accommodate changing coordinates (e.g. some GIS applications model coordinates as absolute and unchanging and do not manage spatial relationships well). In these systems, changing coordinates can result in different datasets becoming out of terms with each other.

5 - Client use of old technology

The framework of the new system should enable the use of new and future technology. However, if the new system is incapable of accommodating the use of old technology it will become an issue for clients.

6 - Legacy systems

Legacy systems (in this context, use of old coordinate systems) present internal limitations for the department including:

- paper records and existing digital records that are complex and costly to convert
- the need to support and maintain parallel processes.

External use of legacy systems raise issues including:

- the need provide transformation parameters to enable users to continue to use old coordinate systems
- a perceived increase in costs for clients due to changing systems.

5 Strategic Goals

A number of strategic goals have been developed to satisfy the geodetic system vision and business drivers. The strategic goals have been divided into short term (three-year) and longer term (10-year) goals. This is because the geodetic system has an urgent need to immediately satisfy the important departmental business driver "geodetic and cadastral automation". A cost benefit analysis will be carried out and a business case developed and approved before any development work within each goal is carried out.

The short-term strategic goals satisfy this departmental business driver, and in so doing also helps satisfy the other business drivers.

The longer-term strategic goals consider the broader range of business drivers and future development of the geodetic system. Because of rapid advances in technology, the longer-term goals are more generalised. These goals should be continually evaluated to ensure that they meet current and potentially new business drivers and departmental outcomes.

5.1 *Summary of Short-Term (three-year) Strategic Goals*

The short-term (three-year) strategic goal to satisfy the department's business driver "geodetic and cadastral automation" and achieve the geodetic system vision are:

Goal One: To provide a cost-effective system that can generate current geometric (three-dimensional) coordinates of points in terms of a globally accepted system to an acceptable and defined accuracy.

Goal Two: To provide a cost-effective system that can generate orthometric heights of points in terms of a nationally accepted system to an acceptable and defined accuracy.

Goal Three: To support multiple projections, and authoritative transformations of coordinates between those projections and the official geometric (three-dimensional) datum, to an acceptable and defined accuracy.

Goal Four: To support (in the short term) multiple vertical datums and authoritative transformations of heights to an acceptable and defined accuracy.

5.2 *Summary of Long-Term (10-year) Strategic Goals*

The long-term (10-year) strategic goals to satisfy the department's business drivers and achieve the geodetic system vision are [Note: Several of the longer term goals (9 and 10) will commence within the first three years.]:

Goal Five: To enhance the automated cadastral system and extension to include the seabed.

Goal Six: To consider the implementation of a four-dimensional datum.

Goal Seven: To develop a height system to a defined accuracy that enables the generation of orthometric heights from spheroidal heights.

Goal Eight: Where appropriate, to contribute to and become an integral part of, the global geodetic system.

Goal Nine: To adapt the design and management of the physical network to take greater advantage of the potential efficiencies offered by new technology.

Goal Ten: A user community that understands, accepts, obtains benefit from and uses the New Zealand Geodetic System.

Goal Eleven: To reduce geodetic mark installation and maintenance costs.

5.3 *Achieving the Strategic Goals*

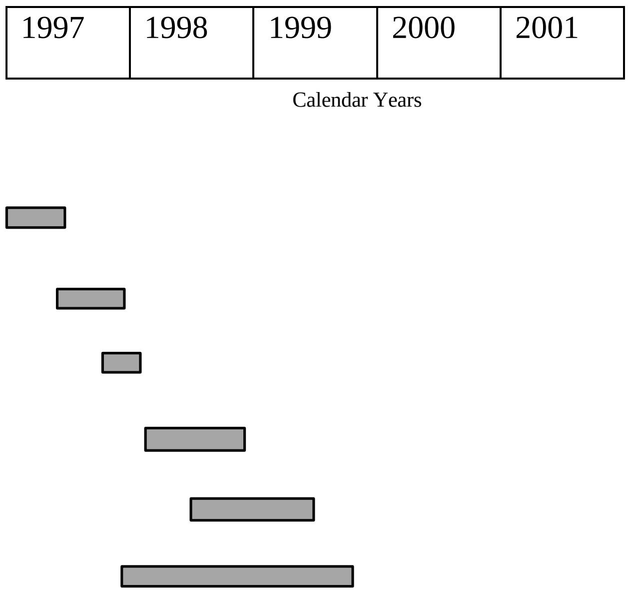
Goal One: To provide a cost-effective system that can generate current geometric coordinates of points in terms of a globally accepted system to an acceptable and defined accuracy.

Purpose

This will provide an accurate geometric spatial reference framework covering New Zealand’s area of land and seabed interests (including New Zealand, Pacific Islands and the Ross Dependency) and facilitate the department's commitment to geodetic and cadastral automation. The reference framework will facilitate the use of modern survey technology and satisfy user needs to work in terms of a global framework and international commitments.

Such a system will:

- reduce the effect of distortions in the official datum to an acceptable level
- reduce the need to maintain multiple coordinate systems
- overcome the limited territorial extent of the current datum
- overcome incompatibly with global datums
- overcome the inability of the existing system to account for earth deformation.



Milestones

1. Solicit user input.
2. Define the geometric system.
3. Develop a business case for implementation.
4. Realise the geometric system.
5. Implement the geometric system.
6. Inform users of the new geometric system.

Goal Two: To provide a cost-effective system that can generate orthometric heights of points in terms of a nationally accepted system to an acceptable and defined accuracy.

Purpose

This will provide an accurate orthometric height framework that will cover New Zealand’s area of land and seabed interests and facilitate the department’s responsibilities for hydrographic charting and increased use and complexity of land and seabed rights.

Such a system will:

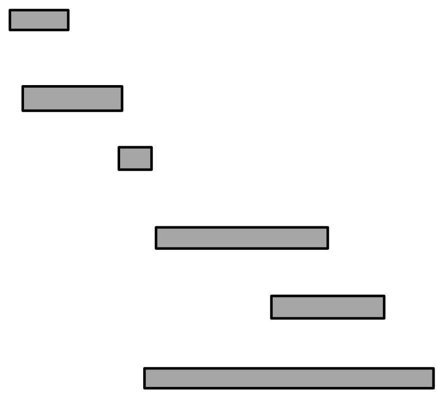
- reduce the need to maintain multiple vertical coordinate systems
- provide a vertical reference system for increased departmental responsibilities such as hydrographic charting
- simplify the management of orthometric vertical data
- integrate tide gauge measurements into the orthometric height network.

1997	1998	1999	2000	2001

Calendar Years

Milestones

1. Solicit user input.
2. Define the vertical system.
3. Develop a business case for implementation.
4. Realise the vertical system.
5. Implement the vertical system.
6. Inform users of new orthometric height system.



Goal Three: To support multiple projections and authoritative transformations of coordinates between those projections and the official geometric (three-dimensional) datum, to an acceptable and defined accuracy.

Purpose

This will provide a set of projections and transformations between those projections and the official datum that will cover New Zealand’s area of land and seabed interests (including New Zealand, Pacific Islands and the Ross Dependency). Multiple projections and transformations will be required to satisfy different user requirements and business needs. [Note: Currently the New Zealand Map Grid (NZMG) is the official projection used by the cadastral database and for national topographic mapping.]

Such projections and transformations will:

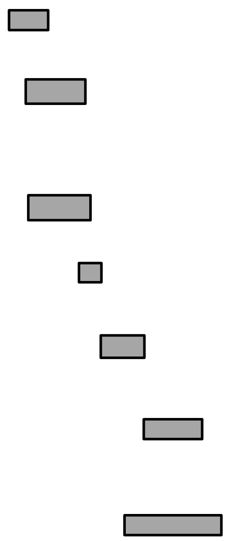
- meet differing user requirements and overcome the limited territorial extent of the current system
- enable transformation at a specified accuracy between the differing projections and the official datum
- be compatible with global systems where appropriate.

1997	1998	1999	2000	2001

Calendar Years

Milestones

1. Solicit user input.
2. Define the extent of LINZ support/maintenance of existing and proposed geometric datums.
3. Define a set of projections that meet user needs.
4. Develop a business case for implementation.
5. Realise new projections and transformations as required.
6. Implement new projections and geometric transformations as required.
7. Inform users of new projections and transformations.



Goal Four: To support multiple vertical datums and authoritative transformations of coordinates to an acceptable and defined accuracy.

Purpose

This will provide a set of transformations between vertical datums that will cover New Zealand's area of land and seabed interests (which include New Zealand, Pacific Islands and the Ross Dependency).

Such transformations will:

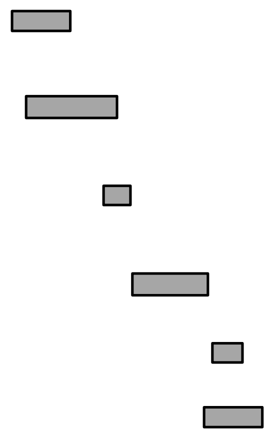
- meet differing user requirements
- enable transformation at a specified accuracy between the differing datums
- be compatible with global system where appropriate.

1997	1998	1999	2000	2001

Calendar Years

Milestones

1. Solicit user input.
2. Define the extent of LINZ support/maintenance of existing and proposed vertical datums.
3. Develop a business case for implementation.
4. Realise new vertical transformations as required.
5. Implement new vertical transformations as required.
6. Inform users of new vertical transformations.



Goal Five: To enhance the automated cadastral system and extension to include the seabed.

Purpose

This will provide a spatial infrastructure to enable future enhancement of the automated cadastral system, both onshore and offshore. Such a system will provide a reference framework with control marks at a specified density and accuracy that will meet future needs and requirements of the cadastral system.

Such a system will:

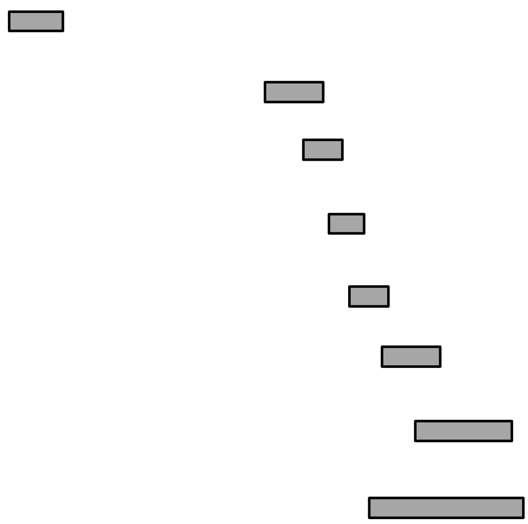
- be flexible to allow for changing cadastral requirements
- facilitate the development and implementation of the seabed cadastre
- meet future cadastral user requirements
- be cost-effective.

1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008

Calendar Years

Milestones

1. Develop the principles of a seabed cadastre.
2. Research requirements of the cadastral system.
3. Solicit user input.
4. Develop a business case for implementation.
5. Design new system.
6. Implement new system.
7. Test and upgrade new system as required.
8. Inform users of new system.



Goal Six: To consider the implementation of a four-dimensional datum.

Purpose

As user requirements change and users adapt to the proposed new datum the adoption of a four-dimensional datum is expected to need consideration.

Such a system will:

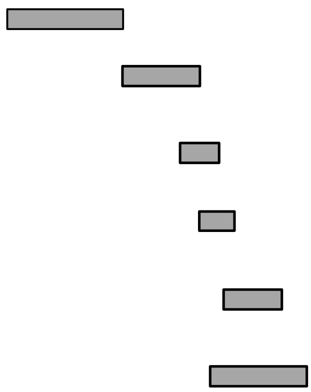
- offer greater spatial accuracy to users
- be part of a global reference system
- account for the effects of crustal deformation.

1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008

Calendar Years

Milestones

1. Evaluate four-dimensional datum.
2. Solicit user input.
3. Develop a business plan for implementation.
4. Design new four-dimensional datum if appropriate.
5. Implement new datum if appropriate.
6. Inform users of new datum.



Goal Seven: To develop a height system to a defined accuracy that enables the generation of orthometric heights from spheroidal heights.

Purpose

This will provide the means for a geometric spatial reference framework to deliver orthometric heights on the fly (in real time). The development of a geoid model to a specified accuracy will enable the determination of orthometric heights from spheroidal heights.

Such a system will:

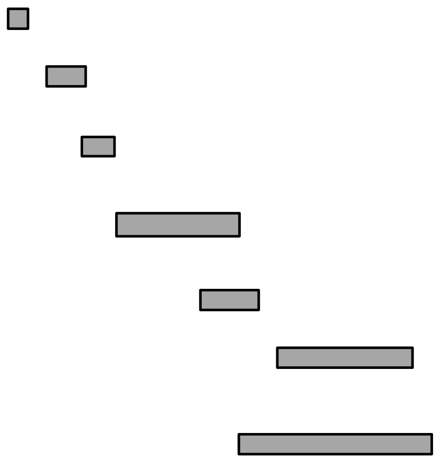
- enable the determination of orthometric heights from spheroidal heights on the fly
- reduce the need to maintain a separate orthometric height network
- reduce the need to maintain multiple height networks and datums.

1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008

Calendar Years

Milestones

1. Determine user accuracy requirements.
2. Determine data requirements.
3. Develop business plan for implementation.
4. Data collection phase.
5. Develop a geoid model to a specified accuracy.
6. Provide a geoid model to spatial data users.
7. Inform users of the new system.



Goal Eight: **Where appropriate to contribute to, and become an integral part of, the global geodetic system.**

Purpose

Development of the geodetic system will see more reliance on, and adoption of, international geodetic reference systems. LINZ will consider its contribution to global geodetic reference systems and, if appropriate, adopt a global geometric reference system as the official reference framework for New Zealand's area of land and seabed interests (which include New Zealand, Pacific Islands and the Ross Dependency).

Such a system will:

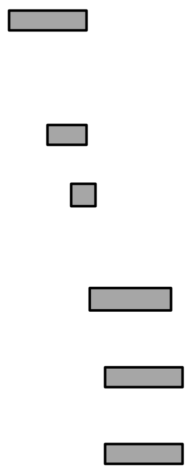
- contribute to a global geometric spatial reference framework
- form part of a global geometric spatial reference framework
- reduce the need for multiple coordinate systems.

1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008

Calendar Years

Milestones

1. Consider the department's contribution to, and implementation of, a global geodetic system as the official New Zealand spatial reference system.
2. Obtain user input.
3. Develop business plan for implementation.
4. Design the implementation of the global reference system.
5. Realise the global reference system.
6. Inform users of the new system.



Goal Nine: To adapt the design and management of the physical network to take greater advantage of the potential efficiencies offered by new technology.

Purpose

This will ensure that the benefits of new technology are regularly reviewed and that efficiency gains are realised as a result of their adoption. The adoption of new technology will only be undertaken after full analysis of the impact on the geodetic system and evaluation of gains to the system. This process is already under way as part of survey and title automation.

Such a system will:

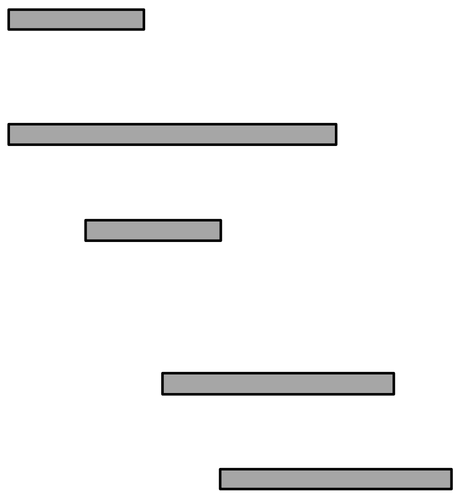
- accommodate new technologies
- reduce maintenance and development costs
- satisfy changing user requirements.

1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008

Calendar Years

Milestones

1. Assess the suitability of the physical network for the automation programme and adapt the design as required.
2. Obtain user input.
3. Review the network design once capture electronic parcel has been completed and modify as required.
4. Assess the suitability of the network post-automation and adapt the design as required.
5. Inform users of modified system.



Goal Ten: A user community that understands, accepts and uses the New Zealand Geodetic System.

Purpose

This will enable greater understanding by the user community of the role of the geodetic system and its various components. Enhancements to the system will be communicated to users to ensure that they understand and can gain maximum benefit from it.

Such a project will:

- ensure that users understand the geodetic system
- ensure that users understand the various initiatives described in this strategy
- ensure that the general public have an appreciation of the geodetic system and its relevant elements
- ensure users gain maximum benefit from using the system.

1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008

Calendar Years

Milestones

1. Produce technical specifications for the new Geodetic System (three months after the completion of each appropriate objective).
2. Produce a cost-benefit report on the new geodetic System.
3. Develop a communication plan.
4. Write a document that describes the role and function of the New Zealand Geodetic System.
5. Implement the communication plan.

Goal Eleven: To reduce geodetic mark installation and maintenance costs.

Purpose

This will reduce costs to the Government through the adoption of new technologies that enable a reduction in the costs for geodetic mark installation and maintenance.

Such a system will reduce government costs for:

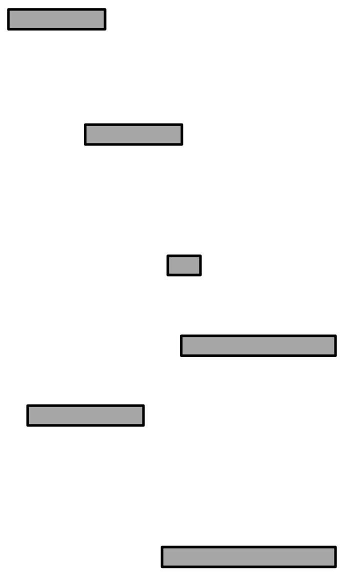
- geodetic control mark installation
- mark maintenance
- survey
- database and service delivery.

1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008

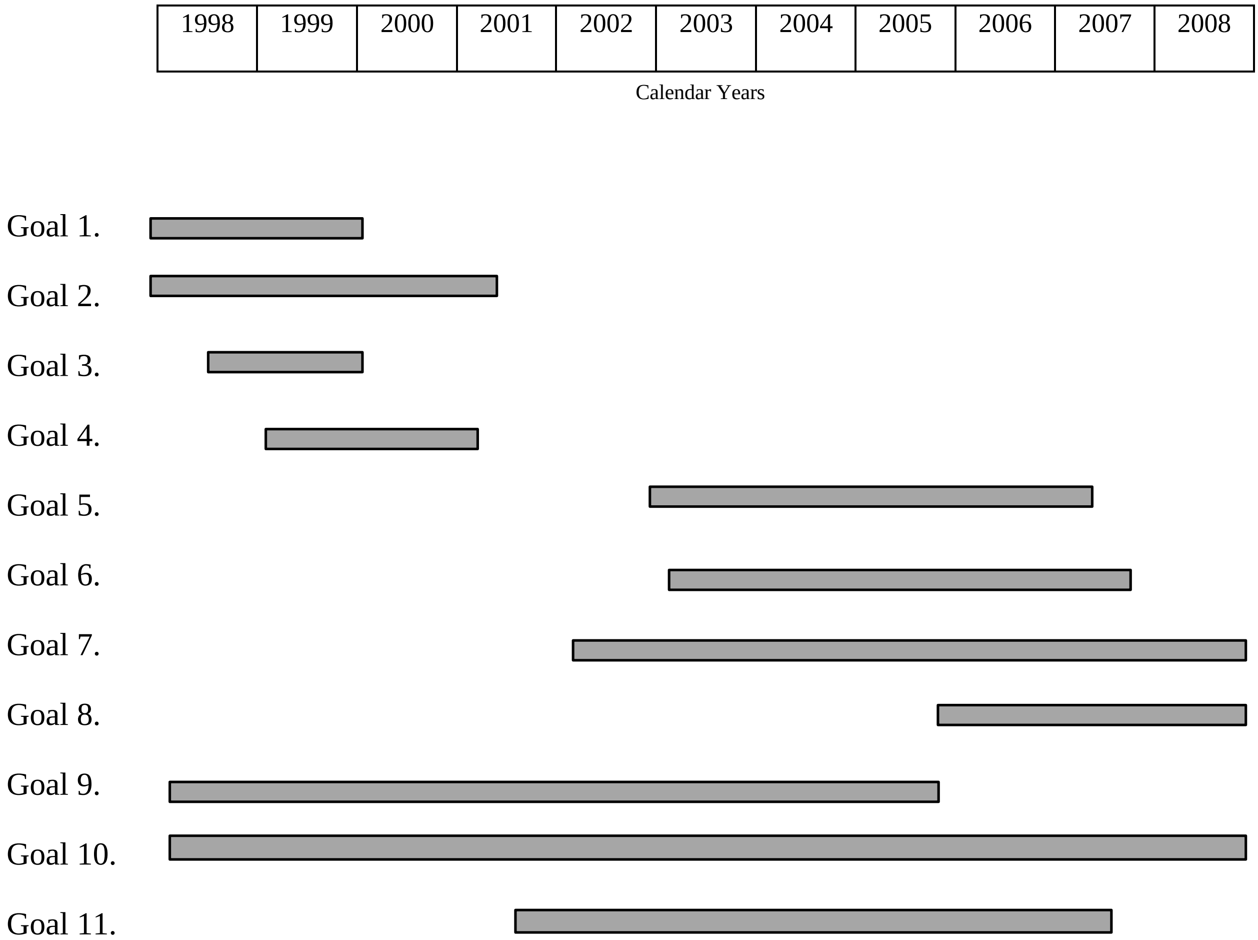
Calendar Years

Milestones

1. Evaluate the density of the current geodetic network.
2. Consider and investigate potential savings in network density and consider the impact on users.
3. Develop a business case for development.
4. Implement a new geodetic network.
5. Monitor mark usage through outputs developed from the automation of the geodetic system.
6. Develop methods for better targeting of maintenance works.



5.4 *Overall Time-Frame for Achieving Strategic Goals*



5.5 *Goals Satisfying Business Drivers*

Goals	Business Driver										
	1 Automa-tion	**2** Support	**3** Simplify	**4** Reduce risk	**5** Reduce cost	**6** Public usage	**7** Internat-ional systems	**8** Reduce complia-nce costs	**9** Needs change	**10** Earth deforma-tion	**11** Future needs
1. Cost-effective geometric coordinates	X	X	X	X	X	X	X	X	X	X	X
2. Cost-effective orthometric heights		X	X	X	X		X		X		X
3. Projections and transformations	X	X	X	X	X	X	X	X	X	X	X
4. Support multiple vertical datums		X	X	X	X		X		X		X
5. Facilitate development of cadastral system	X		X	X	X	X		X	X	X	X
6. Implementation of four-dimensional datum	X		X	X		X	X		X	X	X
7. Generate orthometric heights			X	X	X	X	X		X		X
8. Greater international consistency		X	X	X	X	X	X		X		X
9. Adapt design of physical network			X	X	X				X		X
10. A user community that understands the system			X			X		X			X
11. Reduce mark installation and maintenance costs			X		X						

5.6 *Critical Success Factors*

The following critical success factors, together with a monitoring framework for the implementation of the strategic business plan, will ensure that the vision and goals are fulfilled within 10 years:

Critical Success Factors	**Goal/s Tested**
1. The provision of a cost-effective geometric coordinate reference system	1
2. The provision of a cost-effective orthometric height system	2
3. The provision of a set of projections that satisfies user needs	3
4. The provision of a set of transformations between the official projections and frequently used datums	3
5. The provision of a set of transformations between official vertical datums	4
6. A spatial infrastructure that supports improved efficiency of the cadastral system	5
7. The ability of the geometric coordinate systems to account for earth deformation in a global framework	1, 6, 8
8. The provision of a system to generate orthometric heights on the fly from spheroidal heights	7
9. The provision of contributions to, and consistency with, global geodetic reference systems	8
10. A geodetic system that allows the use of new technology	9
11. An educated user community that understands, uses and accepts the geodetic system	10
12. Reduction in geodetic mark and maintenance costs	11
13. Consultative standard-setting and quality assurance processes that fully involve the user community	All
14. A New Zealand geodetic system that is recognised as a “world class”	All

5.7 *Dependency of Critical Success Factors on Goals*

Goals	Critical Success Factor													
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
1. Cost-effective geometric coordinates	High	Low	Low	Low	Low	Low	Med	Low	Low	Low	Low	Low	High	High
2. Cost-effective orthometric heights	Low	High	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	High	High
3. Projections and transformations	Low	Low	High	High	Low	Low	Low	Low	Low	Low	Low	Low	High	High
4. Support multiple vertical datums	Low	Low	Low	Low	High	Low	Low	Low	Low	Low	Low	Low	High	High
5. Facilitate development of cadastral system	Low	Low	Low	Low	Low	High	Low	Low	Low	Low	Low	Low	Med	High
6. Implementation of four-dimensional datum	Low	Low	Low	Low	Low	Low	High	Low	Low	Low	Low	Low	High	High
7. Generate orthometric heights	Low	Low	Low	Low	Low	Low	Low	High	Low	Low	Low	Low	Med	High
8. Greater international consistency	Low	Low	Low	Low	Low	Low	Med	Low	High	Low	Low	Low	Med	High
9. Adapt design of physical network	Low	Low	Low	Low	Low	Low	Low	Low	Low	High	Low	Low	Med	Med
10. A user community that understands the system	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	High	Low	Med	High
11. Reduce mark installation and maintenance costs	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	High	Med	Med

5.8 *Review and Evaluation of Critical Success Factors*

An evaluation of the current geodetic system and its value to the community is proposed in 1998/99, against which progress towards achieving the critical success factors can be evaluated. This independent evaluation will be carried out by an external reviewer.

Progress towards achievement of the critical success factors will be measured at the estimated time of their completion. Formal overall reviews will be carried out in 2001 when the first stage of the title and survey automation project will be complete and operational, in 2005 when the second phase of automation will be complete and operational and, finally, in 2008 at the completion of the 10-year period.

Key Dates

- July 2001 - review and evaluation of progress towards achieving critical success factors. Modify goals as required.
- July 2005 - review and evaluation of progress towards achieving critical success factors. Modify goals as required.
- December 2008 - review and evaluate achievement of critical success factors.

Review dates

Critical Success Factors	Review Dates									
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1. Geometric coordinate reference system			✓				✓			✓
2. Orthometric height system			✓				✓			✓
3. Set of projections			✓				✓			✓
4. Set of transformations between the official projections and datum			✓				✓			✓
5. Transformations between vertical datums			✓				✓			✓
6. Spatial infrastructure that allows future enhancement of the cadastral system			✓				✓			✓
7. Geometric coordinate systems to account for earth deformation in a global framework			✓				✓			✓
8. Generate orthometric heights on the fly from spheroidal heights			✓				✓			✓
9. Contribute to and be consistent with global reference systems			✓				✓			✓
10. Allows the use of new technology			✓				✓			✓
11. Educated user community that understands, uses and accepts the system			✓				✓			✓
12. Cost-effective network			✓				✓			✓
13. Standard-setting			✓				✓			✓
14. “World class”			✓				✓			✓

6 Risk Analysis

The purpose of this section is to identify the major risks associated with the implementation of the Geodetic System Strategic Business Plan. It outlines the major risks to the implementation of the plan, risk management, and the impact of the risk on each of the goals.

6.1 *Risk Factors*

Risk	Description of Risk	Risk Management
1. Adequacy of human resources	Availability of human resources to implement the strategy is crucial to the development of the geodetic system. Risks are the unavailability of: ▪ skilled staff with the ability to assess technologies and trends, and to develop the new processes and systems described in the goals ▪ staff to manage the geodetic system.	▪ request the department to develop a human resources policy that: - provides for succession planning - recognises the personal skills required to maintain and manage the geodetic system - acquires the required personal skill sets. ▪ encourage training of personnel at Institutions with the skill-sets required to manage and maintain the geodetic system ▪ outsource some aspects of development where appropriate.
2. Adequacy of funding	The adequacy of operating funding to enhance and develop the geodetic system as required. Significant risks to funding for the development are: ▪ changes in government policy ▪ changes in departmental priority.	▪ prepare comprehensive and robust business cases to ensure adequacy of funding for each project ▪ deliver advice to the Government to define the role and value of the geodetic system as a core service ▪ document the benefits and value of the geodetic system to the citizens of New Zealand.

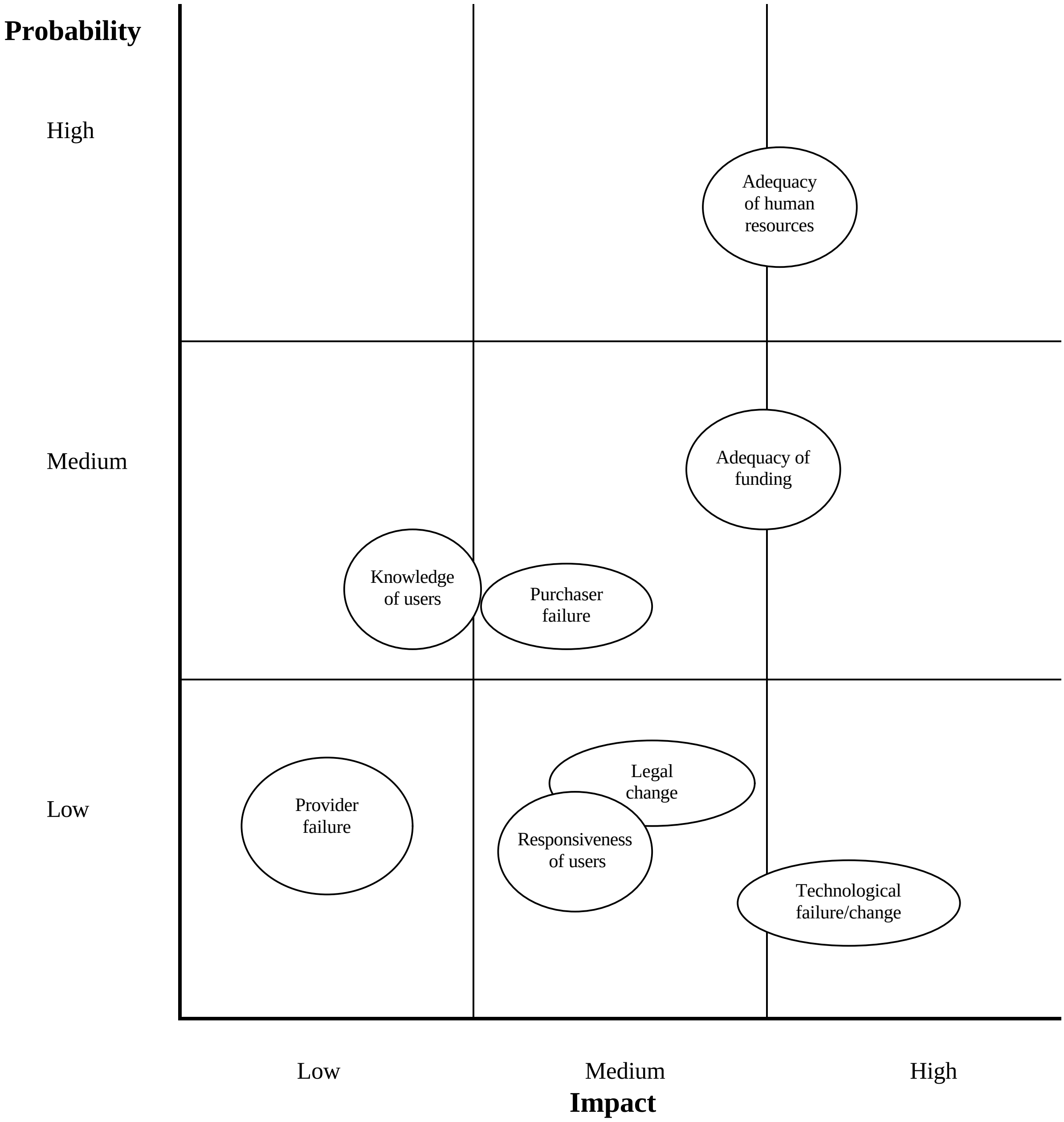
3. Purchaser failure	LINZ is required to successfully manage this strategy through technical development and design, internal standard-setting, purchasing of data from external providers, and quality checking of data. Failure in these areas will create risks in terms of the level, quality and appropriateness of the system that is developed. Purchaser failure may take the form of: ▪ inappropriate designs for the geodetic system being approved ▪ quality standards being set too high or too low ▪ inefficiencies in purchasing practices ▪ failure to identify priorities ▪ funding being diverted into other areas.	▪ audit standards and policy to ensure appropriate requirements are developed ▪ create user input in the process ▪ initiate independent reviews of the geodetic system to ensure user requirements are being met ▪ develop the structures, processes and skills to be an efficient and effective purchaser.
4. Provider failure	Failure of a provider to fulfil a contract with LINZ or to continue to provide a service is a risk. LINZ will contract a number of accredited service providers. Provider failure may take the form of: ▪ insolvency ▪ high prices and low productivity ▪ failure to retain technical competency ▪ failure to meet technical standards ▪ information system failure.	▪ accreditation of providers to ensure the financial viability and technical competency to carry out the work ▪ require providers to carry professional and public liability insurance ▪ ensure a fair price is paid for work done ▪ develop performance monitoring and operate a contract management system ▪ establish a system of identifying best practice in terms of quality and price, and include best practice in service requirements.

5. Legal change	The enhancements to the geodetic system will result in a system that will provide increased spatial accuracy. This does not, however, imply increased departmental legal responsibility. There is a risk that users may assume increased departmental responsibility through increased spatial accuracy delivered by the geodetic system.	■ ensure users and the Government clearly understand the function and role of the geodetic system and the changes that are being implemented.
6. Technological failure/change	A significant driver of the geodetic system has been the availability and use of new technology, particularly computer technology and satellite-based positioning tools such as GPS. The technological risks are: ■ non-compliance with year 2000 technology and related issues ■ failure of new positioning systems such as GPS. This may take the form of failure of the system or inability of the new system developments to cope with some external effects such as increased sun-spot activity during periods of solar maximum ■ new technology that may replace existing technology that cannot be accommodated by the geodetic system ■ failure of LINZ data management systems.	■ develop a system that is technology independent ■ keep abreast of new technology and implement policy to ensure that it can be incorporated in the geodetic system as required ■ ensure that all technology used is year-2000 compliant.
7. Responsiveness of users	The development of the geodetic system is based on the assumption that users will adapt to the use of the new systems. A risk is that users will not adapt to and use the system and will continue to maintain old technology and legacy systems or adopt a wide range of incompatible or inappropriate geodetic systems.	■ create greater user input ■ solicit user input to ensure appropriate systems are developed to meet user needs ■ educate users to ensure that they understand new systems and the benefits of using these systems.

8. Knowledge of users	The use of new technology and systems requires knowledge by the user community. There is a risk that the users will not gain, or have the knowledge to use the new geodetic system. The risk that users are not knowledgeable may be due to the failure of: ■ the department to communicate and educate users about changes to the system ■ educational organisations to educate users ■ users to accept and gain knowledge of new systems.	■ develop a communication plan that includes each element of the geodetic business strategy.

6.2 *Scale and Probability of Risk*

The following diagram identifies the probability of the various risks occurring and their impact.



6.3 *Sensitivity of Goals to Risks*

The table below lists the goals, the major issues (by number) that will impact on each goal, and the possible effect (high, medium, low) of each risk on the goals.

GOAL	Major Issues (Issue #)	RISKS							
		Human resource	Funding	Purchaser failure	Provider failure	Legal change	Technolog-ical failure	Responsi-veness of users	Know-ledge of users
1. Cost-effective geometric coordinates	1, 2, 3, 4, 6	high	high	med	med	high	high	high	med
2. Cost-effective orthometric heights	1, 2, 3, 6	high	high	med	low	med	med	med	low
3. Projections and transformations	1, 2, 6	high	high	med	low	med	med	high	low
4. Support multiple vertical datums	6	high	high	med	low	med	med	med	low
5. Facilitate development of cadastral system	1, 2, 6	high	med	med	med	high	med	high	med
6. Implementation of four-dimensional datum	1, 2, 4, 6	high	low	med	low	med	med	high	med
7. Generate orthometric heights	1, 3, 5	high	high	med	med	med	med	med	low
8. Greater international consistency	1	med	med	low	low	med	low	med	low
9. Adapt design of physical network	3, 5	high	low	med	low	low	low	low	low
10. A user community that understands the system	1	med	med	low	low	med	med	med	med
11. Reduce mark installation and maintenance costs	5	med	med	low	low	med	low	med	low

7 Strategic Planning Process

This Strategic Business Plan was prepared following PA Consultants Business Unit Strategy Methodology. The final draft strategy was reviewed by PA Consultants on 10 June 1998.

7.1 *Steering Committee*

A Steering Committee was established to help guide the Project Team. The committee met three times during the strategic planning process. The objectives of the meetings were:

- 18 April 1998 - consideration and confirmation of the assessment of strategic drivers, issues and draft goals
- 12 May 1998 - presentation and sign-off on the first draft of the strategic plan
- 29 June 1998 - presentation of the final strategic plan.

The Steering Committee members were:

Tony Bevin (Chairman)	Surveyor-General	Land Information NZ
Bob Adam	GM Survey System	Land Information NZ
Peter Chambers	Wellington Regional Manager	Land Information NZ
Sharon Cottrell	GM Policy	Land Information NZ
Robin Pickering	Principal Advisor Topo/Hydro	Land Information NZ
Bruce Manners	Representing the NZ Institute of Surveyors	

7.2 *Project Team*

The Geodetic Strategy was undertaken by a Project Team set up by the Surveyor-General. The project began in December 1997 and was tasked with completing the Strategy Document by 1 July 1998. The Project Team members were:

Graeme Blick (Leader)	Office of Surveyor-General	Land Information NZ
Don Grant	Office of Surveyor General	Land Information NZ
Tadeusz Dawidowski	Automation Project	Land Information NZ
Chris Crook	Survey System	Land Information NZ
Merrin Pearse	Survey System	Land Information NZ
George Williamson	Survey System	Land Information NZ

7.3 *External Review*

This document has been externally reviewed by:

Dr Des Darby	Institute of Geological and Nuclear Sciences
Dr Ian Reilly	Retired
Steve Jones	Steve Jones and Associates Communications Consultancy

7.4 *Analysis Process*

LINZ has solicited information used in the development of this strategy. Much of this information has been gained from informal discussions with surveyors and other spatial data users. A number of forums have been used to disseminate and solicit information. These are listed below.

7.4.1 *Principles for a New Zealand Geodetic System Workshop*

The internal workshop held in 1997 studied the principles for a New Zealand geodetic system to support a New Zealand spatial reference system. The aims of this workshop were to:

- define the New Zealand Geodetic System
- define the New Zealand Spatial Reference System
- define the underlying principles for a New Zealand Geodetic System
- consider the standards required to achieve those principles.

7.4.2 GMS User Requirements

As part of the Survey & Title Automation Programme, the Geodetic Management System (GMS) User Requirements Project Team interviewed a number of key geodetic system users and some overseas agencies that cooperate with LINZ on geodetic issues in Antarctica and in the Australasian region. The questions related to user requirements of the geodetic system. Agencies interviewed were:

- LINZ Geodetic business (General Manager Survey System, Manager Geodetic Survey, Geodetic Survey Advisor)
- LINZ Topographic/Hydrographic business (Chief Topographer Hydrographer)
- LINZ cadastral survey automation (Automation Business Experts)
- NZ Institute of Surveyors
- NZ Survey Board
- NZ Defence Force
- NZ Civil Aviation Authority
- Airways Corporation of NZ
- NZ Antarctic Institute
- Institute of Geological & Nuclear Sciences
- Geology Department, Victoria University
- Telecom NZ
- Terralink NZ
- Australian Survey & Land Information Group
- US National Science Foundation
- US Geological Survey

7.4.3 *Geodesy 2000 Conference*

This conference in 1997 attracted interest from a mixture of private and public sector geodetic users and geodetic experts from Australia, New Zealand and the United States of America. The future of geodesy and expected developments over the next 10 years were discussed.

7.4.4 *Geodesy Working Group of ICSM*

The Australian Geodetic System has been undergoing development similar to that proposed in this strategy. This development has been coordinated between the Australian States through the Geodetic Working Group of the ICSM. New Zealand is a member of this group and has been involved in the coordination process. New Zealand is drawing on the Australian experience gained through the Geodetic Working Group.

7.4.5 *Conference Presentations and Papers*

PhD Research (Dr Merrin Pearse), “A Modern Geodetic Reference System for New Zealand” and the work leading up to it, have been subject to examination and review within the University of Canberra, the University of New South Wales and by other respected geodetic experts in New Zealand, Australia and South Africa.

A number of conference presentations have been made on specific items raised in this strategy, notably the development of a new datum. These include:

D.B. Grant presented a paper entitled “A Dynamic National Geodetic Datum for New Zealand?” to the Annual Research Seminars at the University of NSW in Sydney 1994.

D.B. Grant presented a paper entitled “A Dynamic Datum for a Dynamic Cadastre” to the Cadastre 2000 Conference 1995.

D.B. Grant presented a paper entitled “Proposal for a Dynamic National Geodetic Datum for New Zealand” to an international audience of geodetic experts at the International Association of Geodesy General Assembly 1995.

D.B. Grant presented a paper entitled “Accommodating Change: Development of a Dynamic Geodetic Datum for New Zealand” to the annual conference of the NZ Institute of Surveyors 1995.

M. B. Pearse presented a paper entitled “Dynamic Coordinates for New Zealand: A Progress Report” to the annual conference of the NZ Institute of Surveyors 1995.

G.H. Blick presented a paper entitled “Progress Towards a new Geodetic Datum for New Zealand” to the annual conference of the NZ Institute of Surveyors 1996.

G.H. Blick presented a paper entitled “Possibility of a Dynamic Cadastre for a Dynamic Nation” to an international audience of geodetic experts at the International Association of Geodesy meeting in 1997.

G.H. Blick and Geoff Linnell presented a paper titled “The Design of a New Geodetic Network and Datum for New Zealand” to the joint AIS/NZIS Annual Conference 1997.

D.B Grant and G.H Blick presented papers entitled “Geodetic Cadastral Coordinates - Should they be Carved in Stone Tablets?” and “Do we all Need to Develop Dynamic Datums?” at the Geodesy 2000 Conference 1997.