SUBMISSION ON PROPOSED SOUTHLAND WATER AND LAND PLAN

TO: Southland Regional Council

SUBMISSION ON: Proposed Water and Land Plan

NAME: Horticulture New Zealand

ADDRESS: PO Box 10 232
WELLINGTON

1. Horticulture New Zealand’s submissions, and the decisions sought, are detailed in the attached schedules:

   Schedule 1  Background to horticulture in Southland
   Schedule 2  Submissions on pSWLP.

2. Horticulture New Zealand wishes to be heard in support of this submission.

3. Background to Horticulture New Zealand and its RMA involvement:

   3.1 Horticulture New Zealand was established on 1 December 2005, combining the New Zealand Vegetable and Potato Growers’ and New Zealand Fruitgrowers’ and New Zealand Berryfruit Growers Federations.

   3.2 On behalf of its 5,500 active grower members Horticulture New Zealand takes a detailed involvement in resource management planning processes as part of its National Environmental Policies. Horticulture New Zealand works to raise growers’ awareness of the RMA to ensure effective grower involvement under the Act, whether in the planning process or through resource consent applications. The principles that Horticulture New Zealand considers in assessing the implementation of the Resource Management Act 1991 (RMA) include:

   - The effects based purpose of the Resource Management Act,
   - Non-regulatory methods should be employed by councils;
   - Regulation should impact fairly on the whole community, make sense in practice, and be developed in full consultation with those affected by it;
   - Early consultation of land users in plan preparation;
   - Ensuring that RMA plans work in the growers interests both in an environmental and “right to farm” sense;

Thank you for the opportunity to comment on the Proposed Southland Water and Land Plan.

Angela Halliday
Advisor, Natural Resources and Environment

Date: 1 August 2016

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Schedule 1: Background to horticulture in Southland

Commercial horticulture has been established in Southland since at least the early 1900s. Southland is the primary base of two major root vegetable growers that supply much of the South Island with carrots, parsnips and potatoes. At some stages of the season, particularly during the winter, Southland is the only hub supplying some of these products to the domestic market. Produce is also exported to Australia, Asia, and the Middle East. Southland has approximately 510 hectares of planted vegetables being mostly carrots and potatoes, with a substantial area of parsnips also grown. This is made up of 150ha potatoes, 215ha carrots and 80ha parsnips (as of 2015 this number varies annually).

The horticulture industry in Southland employs approximately 110 people at peak season.

The majority of the growing area is on land leased from sheep and beef farms and is located in the area surrounding Edendale (Mataura FMU) and Woodlands (Oreti FMU). The cooler soil temperatures in Southland provide ideal growing temperatures for root vegetables. Rotations for vegetables are approximately three years in duration, with a series of different vegetables, before being returned to pasture for at least six seasons before the rotation is repeated. Vegetables seldom need to be irrigated in Southland although occasionally it is required during drier months. If so, this is done from ponds and occasionally water is recycled from washing processes for irrigation purposes.

A recent study of horticulture in Southland has demonstrated that appropriate mitigation methods can be used to minimise the effects of horticulture on water quality and Horticulture NZ supports the use of best practice to achieve this.
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<td>1.</td>
<td>New Objective</td>
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<td>The Plan sets out the Freshwater Management Unit (FMU) process and policies to provide direction. A number of objectives (e.g. 7,8) refer to the Freshwater Management Unit process in respect of specific issues. However there is no overall objective that states that the NPSFM will be given effect through the FMU process. In particular Horticulture NZ is concerned that a number of objectives refer to values that are to be recognised through the Water and Land Plan but a key part of the FMU process will be to identify the values for the catchments. It needs to be clear how such values relate to the values that will be part of the FMU process.</td>
<td>Include a new objective: Give effect to the National Policy Statement for Freshwater Management (2014) by undertaking a process for the identified Freshwater Management Units to identify values, establish objectives and set water quality and quantity limits and targets for each Freshwater Management Unit. Clarify in the Plan that the values for freshwater management will be set through the FMU process.</td>
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<td>2.</td>
<td>Objective 4</td>
<td>Support</td>
<td>The objective seeks to identify tangata whenua values and interests and reflect them in the management of freshwater and associated ecosystems. It should be clear that establishing such values is a key part of the FMU process.</td>
<td>Amend Objective 4 as follows: Tangata whenua values and interests are identified through the FMU process and reflected in the management of freshwater and associated ecosystems.</td>
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<td>3.</td>
<td>Objective 9</td>
<td>Support</td>
<td>The objective seeks to safeguard recreational values and historic heritage values. It should be clear that establishing such values is a key part of the FMU process.</td>
<td>Add to Objective 9 as follows: Recreational values and historic heritage values will be identified through the FMU process and reflected in the management of freshwater and associated ecosystems.</td>
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<td>4.</td>
<td>Objective 11</td>
<td>Support</td>
<td>Horticulture NZ support ensuring that water is allocated and used efficiently.</td>
<td>Retain Objective 11.</td>
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<td>5.</td>
<td>Objective 13</td>
<td>Support</td>
<td>Objective 13 seeks to enable the use and development of land and soils provided that potential for adverse effects are appropriately managed. Clause b) seeks that significant or cumulative effects on human health are avoided. Horticulture NZ consider that the policy should refer to adverse effects and also provide forremedying or mitigating the effects.</td>
<td>Rework Obj 13 clause b) the discharge of contaminants to land or water that have significant adverse or cumulative effects on human health are avoided, remedied or mitigated.</td>
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Schedule 2: Submissions on pSWLP
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<td>6.</td>
<td>Objective 18</td>
<td>Support</td>
<td>Objective 18 recognises good management practices as a means to meet the plans objectives. Horticulture NZ supports this approach.</td>
<td>Retain Objective 18.</td>
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<td>7.</td>
<td>Policy 2</td>
<td>Oppose</td>
<td>Policy 2 seeks that any assessment of an activity covered by this must take into account any relevant iwi management plan and assess water quality and quantity based on Ngai Tahu indicators of health. The RMA requires that the plan should take into account iwi management plans but not that individual applicants need to do take iwi management plans into account when preparing an assessment for resource consent. While the Council can require through the plan that iwi management plans are considered at the resource consent stage Horticulture NZ considers that the plan should adequately have regard to iwi management plans which is then implemented through the resource consent process. Requiring applicants to take iwi management plans individually into account adds an additional layer of complexity that is not anticipated in the RMA. In addition Ngai Tahu indicators of health of water quality and quantity should also be incorporated into the plan so consent assessment is against the criteria in the plan not a set of criteria outside the plan.</td>
<td>Delete Policy 2</td>
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<td>8.</td>
<td>Policy 6 – Gleyed Physiographic Zone</td>
<td>Support</td>
<td>Horticulture NZ supports the implementation of good management practices as a means to avoid, remedy or mitigate adverse effects.</td>
<td>Retain Policy 6.</td>
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<td>9.</td>
<td>Policy 10 – Oxidising Physiographic Zone</td>
<td>Support</td>
<td>Horticulture NZ supports the implementation of good management practices as a means to avoid, remedy or mitigate adverse effects.</td>
<td>Retain Policy 10.</td>
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<td>10.</td>
<td>Policy 15 Maintaining and improving water quality</td>
<td>Support in part Oppose in part</td>
<td>Policy 15 seeks to maintain and improve water quality through a range of measure. However the focus of the measures, particularly clause 4, is on ‘avoiding’ discharges, which is to essentially prohibit the discharges given the King Salmon decision. Horticulture NZ considers that there should be greater flexibility as to how water</td>
<td>Amend Policy 15 Clause 4 by adding, ‘unless the adverse effects can be avoided, remedied or mitigated.’ Delete Clauses 3 and 4 requiring compliance with:</td>
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|       | quality will be maintained and improved, not only to avoid discharges. The policy sets a number of standards that water quality is required to meet: |                | - Appendix E water quality standards  
- Drinking water standards  
- ANZECC sediment Guidelines (App C) Horticulture NZ considers that it is inappropriate for all discharges to comply with the Drinking Water Standards for NZ as not all discharges will be in drinking water supply areas and these standards generally related to community drinking water supplies. The ANZECC guidelines are international guidelines. It is considered that Southland has enough science/research based on local circumstances/waterbodies that is more appropriate to be used as a basis for guidelines than applying these international generic standards. | - Drinking Water Standards for NZ 2005 (Revised 2008)  
- ANZECC Sediment Guidelines (App C) |
<p>| 11.   | Policy 16 Farming activities that affect water quality Support in part Oppose in part |                | Objective 13 provides that use and development of land and soils is provided for in the Plan. While there are policies that seek to manage farming activities there is no specific policy which seeks to enable the use of land for farming activities. Policy 16 relates to farming activities that affect water quality but does not actually provide for or enable farming activities. Horticulture NZ supports the use of Management Plans and the use of a register of participants in Independently Audited Self-Management programmes. Programmes such as NZGAP can include the requirements set out in Appendix N and provide audited verification of such management plans. However it needs to be | Add to the beginning of Policy 16: Enable the use of land for farming activities while: |
|       | Add to the beginning of Policy 16: Enable the use of land for farming activities while: |                | Add to the beginning of Policy 16: Enable the use of land for farming activities while: Retain Policy 16 Clause 2 a) but clarify how the Register of Independently Audited Self-Management Participants will operate. | Retain Policy 16 Clause 2 a) but clarify how the Register of Independently Audited Self-Management Participants will operate. |</p>
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<td>clear in the plan how such a register will operate, such as approvals and requirements of programmes. Horticulture NZ does not support the approach in Policy 16 2 b) as it is sets arbitrary measures for managing sediment rather than being risk based and in response to specific site circumstances. For instance there are other mechanisms that may be more appropriate to manage potential sediment run-off than those listed in the policy. Horticulture NZ has developed a Code of Practice for Erosion and Sediment Control Guidelines for Vegetable Production (attached) that sets out a range of mechanisms and is based on a risk assessment of the site. Such an approach is more appropriate and effects based. The Plan has a risk based approach through the identification of critical source areas and such an approach should be included for management of potential for sediment run-off.</td>
<td>Amend Policy 16 2 b) as follows: Actively manage the risk of sediment run off from farming activities and hill country development by identifying critical source areas and assessing the risk associated with the activity to be undertaken and use mechanisms, such as setbacks from water bodies, riparian plantings or sediment control mechanisms to minimise the risk of sediment run off.</td>
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<td>12.</td>
<td>Policy 20 Management of water resources</td>
<td>Support in part</td>
<td>Policy 20 sets out the framework for managing the taking, abstraction, used, damming or diversion of surface water and groundwater and lists a number of matters where adverse effects are to be avoided, remedied or mitigated. Horticulture NZ considers that while recreational use is important the actual ‘recreational values’ will be established through the FMU process so should not be prescribed at the overall plan level. Horticulture NZ supports the recognition of rights of lawful existing users. Reliability of supply is recognised in respect of groundwater, but not surface water. Reliability of supply is an important issue for all water users.</td>
<td>Amend Policy 20 1) c) to ‘recreational uses’ Add to Policy 20 1) g) the rights and reliability of supply for lawful existing users. Retain Policy 20 2) b). Retain Policy 20 3).</td>
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| 13.    | Policy 21 Allocation of water | Oppose in part | Objective 11 seeks that water is allocated and used efficiently. Policy 20 provides for the efficient use of water but no policy specifically seeks efficient allocation of water. Efficient allocation is defined in the NPSFM as including economic, technical and dynamic efficiency. Horticulture NZ seeks that the principle of efficient allocation is included within the policy framework of the Plan. | Amend Policy 21 as follows: Efficient allocation of water  
Manage the allocation of surface water and ground water to ensure efficient allocation by:  
Include a definition of *efficient allocation and use* as including economic, technical and dynamic efficiency |
| 14.    | Policy 25 Priority takes Support in part | Policy 25 sets out the priorities in times of water shortages. It lists ‘reasonable domestic needs’ as priority 1 but the plan does not specific what is considered to be ‘reasonable domestic needs.’ It is considered to be narrower than community water supply which supplies water for a range of uses, not just domestic supply. A water demand management strategy is required to consider reasonable domestic needs and this should be the basis of the priority under water shortage directions. | Clarify that ‘reasonable domestic needs’ will be specific in water demand management strategies and will be the basis of water allocation under water shortage directions. |
| 15.    | Policy 33 Adverse effects on wetlands Support in part | The Plan has a definition for natural wetlands and also wetlands. It needs to be clear the differentiation between the two types of wetlands. It is considered that Policy 33 should apply to ‘natural wetlands’. | Amend Policy 33:  
Prevent the reduction in areas, function and quality of *natural* wetlands, including through drainage and vegetation removal. |
<p>| 16.    | Policy 39A Integrated Management Oppose | Horticulture NZ supports the integrated management in the development of the Plan, as required by the RMA. However the Plan lists integrated management as a consideration of resource consent applications. It is considered that this is an inappropriate consideration as integrated management requires consideration of factors beyond the individual consent application. Integrated management is appropriate at a plan level which is implemented through methods in the Plan but should not be a consideration of individual resource consent applications. | Delete Policy 39A. |</p>
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<td>17.</td>
<td>Policy 45 Priority of FMU policies and rules</td>
<td>Support</td>
<td>in part</td>
<td>Horticulture NZ supports the clarity that is provided in Policy 45 regarding the relationship between the region wide sections of the Plan and the FMU sections. However Horticulture NZ has identified areas which are best addressed through the FMU process rather than the region wide, such as the recognition of values. Such matters are specific to catchments and are best established through a community process than being set in the region wide section of the Plan.</td>
<td>Ensure that values are established in the FMU process and not prescribed in the region wide section of the Plan.</td>
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<td>18.</td>
<td>Policy 47 FMU processes</td>
<td>Support</td>
<td>in part</td>
<td>The first stage of the FMU process should be to identify the values for the FMU as these are then the basis of establishing objectives for the FMU. Policy 44 seeks to implement the NPS by identifying values but this process should be reflected in Policy 47.</td>
<td>Amend Policy 47 by adding a new step 1 and renumber the remaining clauses. 1. Identify values for the FMU as set out in Policy 44.</td>
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<td>19</td>
<td>Rule 5 Discharges to surface waterbodies that meet water quality standards</td>
<td>Support</td>
<td>in part</td>
<td>Horticulture NZ supports the rule based on meeting the Region specific water quality standards in Appendix E but consider that the activity status could be Restricted Discretionary given that there is specific standards against which the activity would be assessed.</td>
<td>Amend Rule 5 to Restricted Discretionary</td>
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<td>20</td>
<td>Rule 6 Discharges to surface waterbodies that do not meet water quality standards</td>
<td>Oppose</td>
<td>in part</td>
<td>Rule 6 will apply if the Water Quality Standards in Appendix E are not able to be met. Horticulture NZ considers that activities that do not meet the water quality standards could be assessed as a discretionary activity as that provides the ability for all matters to be assessed.</td>
<td>Amend Rule 6 to Discretionary</td>
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<td>21</td>
<td>Rule 8 Discharges of surface water</td>
<td>Oppose</td>
<td>in part</td>
<td>It is unclear if Rule 8 only provides for point source discharges or also includes non-point source discharges. It is considered that the rule should be clear as to which lawfully discharges it applies to.</td>
<td>Clarify whether Rule 8 applies to both point source and non-point source discharges.</td>
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<td>22</td>
<td>Rule 9 Discharge of agrichemicals onto or into surface water</td>
<td>Support</td>
<td>in part</td>
<td>Horticulture NZ supports the rule to provide for use of agrichemical for aquatic purposes, including that there are no adverse effects of legally established water takes. However it is considered that a person who is applying agrichemicals to water for aquatic purposes</td>
<td>Add to Rule 9: h) The activity shall comply with best practice for aquatic use as set out in NZS8409:2004 Management of Agrichemicals.</td>
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<td>should be appropriately trained to undertake the activity by having completed the National Certificate in Agrichemical Aquatic strand. Appendix D of the Plan includes a number of extracts from NZS8409:2004 but the rule does not require compliance with the best practice guidance provided. In particular it is important that records are retained for the activity. A note should be added to both Rule 9 and 10 that there are provisions in the Regional Air Plan that will also apply to the discharge of agrichemicals.</td>
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<td>i) Qualifications Discharge of agrichemicals directly into or onto water can be carried out only by persons Holding either: a) a GROWSAFE® Registered Chemical Applicators Certificate (National Certificate in Agrichemical Aquatic strand) or: GROWSAFE® Introductory Certificate and under direct supervision of a person holding a GROWSAFE® Registered Chemical Applicator Certificate (National Certificate in Agrichemical Aquatic strand) b) Aerial application –the pilot must hold a GROWSAFE® Pilots Agrichemical Rating Certificate issued by CAA and the application company must hold AIRCARE™ Accreditation Where spraying is occurring in a public place signs shall be placed within the immediate vicinity of the spraying prior to commencing and maintained until spraying has ceased. j) Records All users must keep records consistent with Appendix C9 of NZS8409:2004 Management of Agrichemicals as evidence and information that provides an authentic record to verify that the application of agrichemical(s) directly to water has been carried out in a safe responsible manner, in particular with respect to notification of any person who may take</td>
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<td>water for their own use. Such records must be provided to Environment Southland when requested. Add a Note: Provisions in the Regional Air Plan will also apply to the discharge of agrichemicals.</td>
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<td>23</td>
<td>Rule 10 Discharge of agrichemicals to land where they may enter water</td>
<td>Support in part</td>
<td>A note should be added to Rule 10 that there are provisions in the Regional Air Plan that will also apply to the discharge of agrichemicals so that it is clear that the provisions in Rule 10 are not the only provisions that apply to the discharge of agrichemicals.</td>
<td>Amend Rule 10 by adding a Note: Provisions in the Regional Air Plan will also apply to the discharge of agrichemicals.</td>
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<td>Rule 11 Discharge of vertebrate pest control poisons</td>
<td>Support in part</td>
<td>Rule 11 is generally supported, but note that clause a) refers to ‘agrichemicals.’ The definition of agrichemicals specifically excludes vertebrate pest control products so agrichemical is not an appropriate term to use in the rule.</td>
<td>Amend Rule 11 Clause a) by replacing agrichemical with ‘vertebrate pest control product’.</td>
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<td>25</td>
<td>Rule 13 Discharge from installed subsurface drainage systems</td>
<td>Oppose</td>
<td>Rule 13 is a permitted activity rule to provide for subsurface drainage systems, which are common in Southland and essential for farming in the Region. Some of the conditions of the rule are linked to s70 of the RMA but do not provide for reasonable mixing but rather sets an arbitrary distance of 20 metres from the point of discharge. It is sought that the rule better reflects s 70.</td>
<td>Amend Rule 13 as follows: a) i) After reasonable mixing: - There is no conspicuous change to the colour and or clarity of the receiving waters and - The discharge does not render freshwater unsuitable for consumption by farm animals. Renumber clauses iii- v) Delete clause vi) Amend Rule 13 b) to Restricted Discretionary activity and include matters of discretion: The standards in Rule 13 that cannot be met.</td>
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<td>Rule 14 Discharge of fertiliser</td>
<td>Oppose</td>
<td>Rule 14 is not effects or risk based but rather sets arbitrary setback distances as a single mechanism to manage risks rather than considering factors such as slope, soil type, and method of application. If the rule cannot be met then it becomes a non-complying activity. The rule is also inconsistent with the cultivation rule in that land can be cultivated for a crop but fertiliser cannot be</td>
<td>Amend Rule 14 a) iii) 2) Does not have riparian planting best management practices as set out in Code of Practice for Nutrient Management (Fertiliser Association 2013) will be used within 10 metres of a bed where the slope is over 10 degrees or within 10</td>
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<td>27.</td>
<td>Rule 20 Farming</td>
<td>Support in part</td>
<td>Horticulture growers are located primarily in the Oxidising and Gleyed Physiographic Zones so the Horticulture NZ interests are in respect of those zones. Rules 20 a) b) c) f) g), i) and j) are particularly relevant for horticulture. ‘Farming activities’ is not defined in the Plan or the RPS. It needs to be clear that the term applies to all primary production land uses. A definition is sought based on the definition of production land in the RMA. Horticulture NZ supports the use of management plans which have a risk based approach and the identification of Independently audited self-management programmes and participants.</td>
<td>Include a definition for farming activity: Any land and auxiliary buildings used for the production (but not processing) of primary products including agricultural, pastoral, horticultural and forestry products). Retain Rule 20 a) Retain Rules 20 b), c), d) f) and g).</td>
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<td>28.</td>
<td>Rule 25 Cultivation on sloping ground</td>
<td>Oppose</td>
<td>Horticulture NZ seeks to ensure that cultivation activities are undertaken according to best practice to minimise the risk of sediment discharges to water. Best practice for cultivation is set out in the ‘Erosion and Sediment Control Guidelines for vegetable production (Horticulture NZ 2014)’ which take a risk based approach to assessing potential effects from the activity and selection of appropriate mechanisms to address such potential effects. The</td>
<td>Amend Rule 25 as follows: a) The use of land for cultivation and associated sediment control mechanisms is a permitted activity provided the following conditions are met: Rule 25 a) i) (1) 3 metres from the outer edge of the bed on land with a slope under 10 degrees</td>
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<td>Plan uses the critical source areas as a risk based mechanism and this should be incorporated into the rule for cultivation rather than relying on arbitrary setbacks.</td>
<td>Support</td>
<td>The rule as currently written would require resource consents for cultivation for vegetable growing even if the activity is undertaking best management practice for the activity. Use of best management practice is sought in Objective 18 and this is a clear instance where efficient resource use and environmental outcomes can be implemented through the use of best practice. The s32 Report does not consider the application of best practice as an option for managing cultivation as it only assess the application of setbacks and slope. Therefore the s32 does not consider an appropriate method for managing potential effects based on the identification of critical source areas and applying best management practices. Rule 59 provides for culverts and Sediment traps which are placed in the bed of a river. However there is not a clear provision for sediment control mechanisms that are not in-stream. It is appropriate that the cultivation rule also include ‘associated sediment control mechanisms’ so they are provided for in the Plan.</td>
<td>Rule 25 a) i) (2) 10 metres from the outer edge of the bed on land with a slope between 10 – 16 degrees. Amend Rule 25 b) as follows: The use of land for cultivation and associated sediment control mechanism, that does not meet the setback distances of Rule 25(a)(i), is a permitted activity provided the following conditions are met: (i) cultivation does not take place within the bed of a lake, river, natural wetland, modified watercourse or artificial watercourse and a distance of 3 metres from the outer edge of the bed; and EITHER (ii) cultivation does not take place more than once in any five year period; and (iii) cultivation is for the purpose of renewing or establishing pasture; and (iv) cultivation does not occur above 700 metres above mean sea level. OR v) the cultivation is undertaken in accordance with the ‘Erosion and Sediment Control Guidelines for vegetable production (Horticulture NZ 2014)’</td>
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<td>29.</td>
<td>Rule 36 Horticulture wash-water</td>
<td>Support in part</td>
<td>Rule 36 is a new rule that permits the discharge of contaminants associated with horticulture wash water and is assessed in 7.6.4 of the s32 Report. The conditions are intended to ensure that the effects of the activity are acceptable.</td>
<td>Amend Rule 36 to add options for management and add a new condition: Before a) insert Either After d) iv) insert</td>
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<td>Sub</td>
<td>Plan provision</td>
<td>Support</td>
<td>Reason</td>
<td>Decision sought</td>
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<td></td>
<td>Horticulture NZ is currently undertaking a project to develop a consistent approach to consenting vegetable washwater. It is proposed that a Code of Practice for vegetable washwater discharge is developed for all New Zealand processing operations which will assess the variety of technologies available to growers to meet food safety requirements for washwater and investigate options for water recycling as well as treatment to meet environmental standards for discharge consents. It is anticipated that the COP for Horticulture Washwater will be available by early 2017 and able to be provided to Council at the hearings on the Plan. Horticulture NZ seeks that Rule 36 recognise the COP as it will include best management practice for managing horticulture wash water.</td>
<td>Oppose</td>
<td>OR meets the requirements of the COP for Horticulture Washwater (Horticulture NZ 2016)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30.</td>
<td>Rule 49 Abstraction, diversion and use of surface water</td>
<td>Support in part</td>
<td>Rule 49 provides for water takes as a permitted activity up to 86 cubic metres a day, subject to a number of conditions. This is supported. Rule 49 b) iii) however seeks that where the total volume of water taken is less than 70 cubic metres per day that restricted discretionary consent is required. It is unclear why consent would be required for less than 70 cubic metres per day.</td>
<td>Clarify Rule 49 b) iii) or amend to stipulate an amount over which resource consent is required.</td>
<td></td>
</tr>
<tr>
<td>31.</td>
<td>Rule 50 Community water supply</td>
<td>Support in part</td>
<td>Rule 50 lists matters over will the Council will exercise control but it does not include how water shortages will be managed.</td>
<td>Include additional matter of control in Rule 50 Management of water shortages</td>
<td></td>
</tr>
<tr>
<td>32.</td>
<td>Rule 54 Abstraction and use of groundwater</td>
<td>Support in part</td>
<td>Rule 54 is generally supported but note that it is based on ‘landholding’ as defined in the Glossary which is based on a common ‘occupier’ rather than owner. It needs to be clear how this would be applied in respect to the rules for water takes.</td>
<td>Clarify how the definition of landholding will be applied in respect of ‘occupier’.</td>
<td></td>
</tr>
<tr>
<td>Subpt</td>
<td>Plan provision</td>
<td>Support</td>
<td>Reason</td>
<td>Decision sought</td>
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<tr>
<td>33.</td>
<td>Rule 76 Vegetation planting</td>
<td>Support in part</td>
<td>Rule 76 provides for vegetation planting and limits what can be planted. It does not address vegetation removal. Horticulture NZ seeks that there is the ability to remove vegetation that is infected by unwanted organisms or pest species from both land and within the bed of a river, lake or modified water course as a permitted activity. If a biosecurity incursion occurs it is important that infected plants can be removed as a permitted activity.</td>
<td>Provide for the removal of vegetation that is infected by unwanted organisms or pest species from both land and within the bed of a river, lake or modified water course as a permitted activity.</td>
<td></td>
</tr>
<tr>
<td>34.</td>
<td>Definition agrichemical</td>
<td>Support in part</td>
<td>The definition of Agrichemical should refer to NZS8409:2004 Management of Agrichemicals as the definition is from the 2004 version of the Standard.</td>
<td>Amend definition of agrichemical as from NZS8409:2004 Management of Agrichemicals</td>
<td></td>
</tr>
<tr>
<td>35.</td>
<td>Definition artificial water course</td>
<td>Oppose in part</td>
<td>It needs to be clear that subsurface drainage systems are not classed as an artificial watercourse.</td>
<td>Amend the definition of artificial watercourse by adding to the exclusions: or subsurface drainage systems.</td>
<td></td>
</tr>
<tr>
<td>36.</td>
<td>Definition cultivation</td>
<td>Oppose in part</td>
<td>Cultivation includes disturbing the soil by mechanical tillage as set out in the definition. However spraying does not disturb the soil so should not be classed as cultivation. In addition harvesting and the provision of sediment control measures should be included as part of the cultivation activity.</td>
<td>Amend the definition of cultivation: Preparing land for the growing and harvesting of pasture of crop by mechanical tillage and includes sediment control measures, but does not include direct drilling.</td>
<td></td>
</tr>
<tr>
<td>37.</td>
<td>Definition Farming activities</td>
<td></td>
<td>Horticulture NZ seeks that a definition is included in the Plan for farming activities as the term is widely used in the Plan but not defined.</td>
<td>Include a definition for farming activity: Any land and auxiliary buildings used for the production (but not processing) of primary products including agricultural, pastoral, horticultural and forestry products).</td>
<td></td>
</tr>
<tr>
<td>38.</td>
<td>Definition fertiliser</td>
<td>Oppose</td>
<td>The draft definition of fertiliser is limited to the application of essential nutrients to plant and soils. Fertiliser includes a number of components that are not specifically essential nutrients so a definition needs to be wider than just</td>
<td>Amend the definition of Fertiliser to either the ACVM definition of fertiliser or the definition as follows: Fertiliser: A substance or biological compound or mix of substances or biological compounds that is described as,</td>
<td></td>
</tr>
</tbody>
</table>
essential nutrients. For instance lime is a soil conditioner and not an
essential nutrient.

Fertilisers are managed through ACVM and HSNO. Each has a
definition of fertiliser that includes a wider range of substances and
includes fertiliser additives.

A fertiliser additive is a non-nutrient substance added to a fertiliser,
or applied by itself to land or plants, that:

- improves the supply and uptake of nutrients or
- increases biological activity or
- modifies the physical characteristics of a fertiliser to make it
  more fit for its purpose.

The definition in the Plan should be linked to the definitions of HSNO
and ACVM.

The ACVM Regulations define fertiliser as:
a) means a substance or biological compound or mix of
substances or biological compounds that is described as, or held
out to be for, or suitable for, sustaining or increasing the growth,
productivity, or quality of plants or, indirectly, animals through the
application to plants or soil of—

(i) nitrogen, phosphorus, potassium, sulphur, magnesium,
calium, chlorine, and sodium as major nutrients; or
(ii) manganese, iron, zinc, copper, boron, cobalt,
molybdenum, iodine, and selenium as minor nutrients; or
(iii) fertiliser additives; and
(b) includes non-nutrient attributes of the materials used in
fertiliser; but

or held out to be for, or suitable for, sustaining or
increasing the growth, productivity, or quality of plants or,
indirectly, animals through the application to plants or
soil of:

   i) essential nutrients and
   ii) fertiliser additives; and
   iii) non-nutrient attributes of the materials used in
       fertiliser.
<table>
<thead>
<tr>
<th>Subpt</th>
<th>Plan provision</th>
<th>Support Oppose</th>
<th>Reason</th>
<th>Decision sought</th>
</tr>
</thead>
<tbody>
<tr>
<td>(c)</td>
<td>does not include substances that are plant growth regulators that modify the physiological functions of plants. Horticulture NZ seeks that the definition in the Plan is either the ACVM definition or an amended version as set out in the Decision sought.</td>
<td></td>
<td>Include a definition for Management Plan as follows: A Management Plan describing on-farm management and best management practices that is prepared in accordance with Appendix N.</td>
<td></td>
</tr>
<tr>
<td>39.</td>
<td>New Definition Management Plan</td>
<td></td>
<td>The term Management Plan is used throughout the Plan but is not defined. It would be useful to have a definition so it is clear what is anticipated by the term.</td>
<td>Amend the definition of natural wetland to add to the exclusions: sediment control measures or artificial wetlands are not natural wetlands.</td>
</tr>
<tr>
<td>40.</td>
<td>Definition natural wetland</td>
<td>Oppose in part</td>
<td>The definition of natural wetland includes a list of exclusions. It should be clear that sediment control measures or artificial wetlands are not natural wetlands</td>
<td></td>
</tr>
<tr>
<td>41.</td>
<td>Definition significant de-vegetation</td>
<td>Oppose</td>
<td>Horticulture NZ is concerned about the application of significant de-vegetation as cultivation activities for horticultural production do result in exposure of bare ground but can be appropriately managed through best management practices. It is unclear where the term is used and how it would be applied.</td>
<td>Delete the definition of significant de-vegetation.</td>
</tr>
<tr>
<td>42.</td>
<td>Definition Surface water body</td>
<td>Oppose in part</td>
<td>It should be clear that water in a subsurface drainage system is not a surface waterbody for the purposes of the Plan.</td>
<td>Add to the exclusion in the definition of surface water body by adding 'or subsurface drainage system.'</td>
</tr>
<tr>
<td>44</td>
<td>Definition water demand management strategy</td>
<td>Support</td>
<td>Horticulture NZ supports the need for a water demand management strategy to consider the needs of other users including rural uses and a drought management plan.</td>
<td>Retain definition water demand management strategy</td>
</tr>
<tr>
<td>45</td>
<td>Definition Wetland</td>
<td>Oppose in part</td>
<td>The plan has a definition for natural wetland and wetland. The definition of natural wetland includes a list of areas which are not regarded as natural wetlands, but such exclusions are not included in the definition of wetland. It needs to be clear that wet and boggy areas are not classed as a wetland.</td>
<td>Include the list of exclusions in the definition of natural wetland in the definition of wetland.</td>
</tr>
<tr>
<td>Subpt</td>
<td>Plan provision</td>
<td>Support</td>
<td>Reason</td>
<td>Decision sought</td>
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</tr>
<tr>
<td>46.</td>
<td>Appendix C ANZECC Sediment Guidelines</td>
<td>Oppose</td>
<td>The ANZECC guidelines are international guidelines. It is considered that Southland has enough science/research based on local circumstances/waterbodies that is more appropriate to be used as a basis for guidelines than applying these international generic standards.</td>
<td>Delete Appendix C and reference to it in the Plan. Include specific sediment guidelines in the FMU sections of the Plan that reflect local circumstances and conditions.</td>
</tr>
<tr>
<td>47</td>
<td>Appendix D Good Spray Management Practices</td>
<td>Support in part</td>
<td>The Appendix sets out a range of best management practices for the use of agrichemicals for information purposes. However Horticulture NZ considers that some of the practices should be required as a means of compliance with a permitted activity rule, not just a list for information purposes. It needs to be clear that the first list of bullet points relates to use over or into water. Bullet point 12 refers to the ‘proper concentration for the application’. There may be a range of opinions as to what is a ‘proper concentration’. What is required is that the concentration is such that it will not lead to adverse effects. The ACVM and HSNO process establishes thresholds for the use of substances and it is these thresholds that should determine the amount of active ingredient in a spray mix.</td>
<td>Amend the Introduction by numbering the bullet point lists as A and B and require that these practices are complied with as a permitted activity best management practices. Label list A: Discharging agrichemicals over or into water Bullet point 4 should also include water taken for irrigation. Amend bullet point 12: dilute spray solutions to concentrations of active ingredient as determined by ACVM and HSNO.</td>
</tr>
<tr>
<td>48</td>
<td>Appendix N Management Plan requirements</td>
<td>Support in part</td>
<td>Horticulture NZ generally supports the requirements set out in Appendix N subject to some changes which are sought. In particular Horticulture NZ supports the use of industry prepared management plan templates. NZGAP is a horticulture industry programme that can provide templates for the farm management plan against which the grower is audited by a third party to ensure that the plan is being implemented and objectives met.</td>
<td>Retain Appendix N Part A. Amend Appendix N as follows: Under 4 Nutrient Budget a) change ‘equivalent model’ to ‘alternative model’. Under 6 Riparian Management Plan a) add: A Riparian Management Plan, which takes into the nature</td>
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<td>Subpt</td>
<td>Plan provision</td>
<td>Support Oppose</td>
<td>Reason</td>
<td>Decision sought</td>
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<td>Horticulture NZ has developed a COP for Nutrient Management that includes best management practices for nutrient management to minimise the potential for adverse effects. This COP is included within the NZGAP framework and would be part of the nutrient budget requirements under Part A of an industry programme. Horticulture NZ supports the principle of inclusion under Nutrient Budget of an 'equivalent model' approved by ES. Overseer is not currently applicable for many horticultural crops and so an alternative model is required for nutrient budgets to be undertaken. Horticulture NZ considers that the wording 'alternative model' to be more appropriate so that justification of 'equivalence' are not required, but rather that appropriateness of the model and what it will deliver are the key considerations in the approval of alternative models. The focus in Section 6 Riparian Plan requirement is on where stock are located. It should be clear than the riparian management plan needs to reflect the nature and scale of the activity. Horticulture NZ has sought changes to the cultivation rule and the provisions in Section 7 Cultivation should be amended accordingly. Part 10 Irrigation Management is written as conditions for the irrigation system – not as a management plan that describes how the system will operate. The section should be reworded to list the information required rather than setting conditions.</td>
<td>and scale of the farming activity, is prepared and implemented and records in written and/or map form:..... Under 7 cultivation amend: ii) 1) 3 metres with a slope under 10 degrees ii) 2) 10 metres where slopes are between 10 – 16 degrees 10 Irrigation management: Write the requirements as matters to be included in the Management Plan, rather than as conditions.</td>
</tr>
<tr>
<td>49</td>
<td>Appendix O</td>
<td>Support in part</td>
<td>Appendix O sets out how reasonable and efficient use of water will be ascertained. The section on irrigation is based on 80% reliability (4 in 5 years). Horticulture NZ considers that 90% reliability is</td>
<td>Amend Appendix O Irrigation a) Replace: 80 percent (4 in 5 year) reliability With: 90 percent (9 in 10 year) reliability.</td>
</tr>
<tr>
<td>Subpt</td>
<td>Plan provision</td>
<td>Support</td>
<td>Oppose in part</td>
<td>Reason</td>
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<td>necessary for horticultural crops and seeks that the reliability is amended to reflect this. A low reliability can significantly affect horticultural operations as it can lead to total crop loss, not just a reduction in product. Replacement resource consents should also consider any changes to the farming system as well as the operation of the irrigation system.</td>
</tr>
</tbody>
</table>
Erosion & Sediment Control Guidelines for Vegetable Production

Prepared by Andrew Barber for:
Horticulture New Zealand
June 2014
Erosion & Sediment Control
Guidelines for Vegetable Production

Good Management Practices

Version 1.1
June 2014

Prepared by
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Cover picture courtesy of Balle Bros - Pukekohe.
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This Guideline has been prepared by Andrew Barber of Agrilink NZ with contributions and reviews by commercial vegetable growers, Horticulture New Zealand, Auckland Council and Environment Waikato their contractors and staff. It has been built upon the FSP Doing it Right and the Code of Practice for Commercial Vegetable Growing in the Horizons Region.
INTRODUCTION

These Guidelines have been built upon many years of grower experience and research trials conducted during the Franklin Sustainability Project (FSP), as well as the more recent Holding it Together (HIT) project and the Code of Practice developed in the Horizon Region. The Guidelines also draw on Auckland Council’s TP90 Erosion and Sediment Control Guidelines for Land Disturbing Activities in the Auckland Region and the 2007 changes, plus TP223 Forestry Operations in the Auckland Region A Guideline for Erosion & Sediment Control.

The recommended volumes and area protected using various sediment control devices differs from those in TP90, reflecting the difference in soil type and runoff factors from cultivated land compared to earthworks. It was concluded, and accepted in submitted evidence to the Environment Court, that on cultivated land 0.5% storage is equivalent to or outperforms 2.0% storage on an earthworks site. The report *Justification of Silt Trap Capacity for Cultivated Land 0.5% vs. 2.0%* (Barber, 2012) describes this in more detail. A copy is available from Horticulture New Zealand.

Table 1 outlines a range of control measures with estimated effectiveness and costs. The estimate of effectiveness was provided by John Dymond (Landcare Research). It assumes that the measures are used within their design limitations. For example a well-constructed Super Silt Fence protecting a small area for a short period of time while having high effectiveness would be extremely ineffective protecting a large area. There is no single silver bullet. Therefore, planning and implementation must include a number of complimentary control measures.

Table 1. Cost and effectiveness of various mitigation measures.

<table>
<thead>
<tr>
<th>Control measure</th>
<th>Range in effectiveness (%)</th>
<th>Cost per hectare ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detailed erosion mgmt plan</td>
<td>90 - 99</td>
<td>$80 - $180</td>
</tr>
<tr>
<td>Cover crop</td>
<td>90 - 99</td>
<td>$80</td>
</tr>
<tr>
<td>Minimum tillage</td>
<td>50 - 80</td>
<td>$100 - $250</td>
</tr>
<tr>
<td>Setback or buffer strip</td>
<td>50 - 80</td>
<td>$100 - $250</td>
</tr>
<tr>
<td>Wind break crop</td>
<td>50 - 80</td>
<td>$70</td>
</tr>
<tr>
<td>Stubble mulching</td>
<td>50 - 80</td>
<td>$70</td>
</tr>
<tr>
<td>Wheel track ripping or dyking</td>
<td>50 - 80</td>
<td>$35</td>
</tr>
<tr>
<td>Contour drains</td>
<td>30 - 70</td>
<td>$75</td>
</tr>
<tr>
<td>Benched headlands</td>
<td>50 - 80</td>
<td>$65</td>
</tr>
<tr>
<td>Super silt fence</td>
<td>80 - 95</td>
<td>$380</td>
</tr>
<tr>
<td>Decanting earth bund</td>
<td>80 - 95</td>
<td>$130</td>
</tr>
<tr>
<td>Silt trap</td>
<td>80 - 95</td>
<td>$750 - $1,300</td>
</tr>
<tr>
<td>Silt trap maintenance</td>
<td>-</td>
<td>$75/ha/year</td>
</tr>
</tbody>
</table>
How to use these Guidelines

The Guideline aims to provide information to growers on a range of possible control measures and options to assist in achieving sustainable land management. The Guideline directs growers to more detailed information contained in FSP Doing it Right, TP90 or TP223.

There are four key steps:

1. Know your paddock – undertake a paddock assessment
2. Measures to stop or control water entering your paddock
3. Erosion control measures
4. Sediment control measures.

Each step is a progression in difficulty, time and energy. It is easier to control water entering a paddock than it is to minimise erosion. Likewise minimising erosion is easier and less costly than managing sediment laden storm water leaving the paddock.

The key to minimising soil erosion is to know your paddock and identify the likely risks. A paddock assessment forms the foundation on which to implement measures that firstly stop or control water entering the paddock, secondly keep the soil on the paddock, and lastly minimise the quantity of soil that is discharged off the paddock.

Minimising erosion and soil loss is about getting each of the four steps right. Within paddock erosion control measures without the planning and risk assessment stage could lead to unforeseen washouts. Likewise erosion control measures without sediment control, leaves the downstream environment vulnerable after cultivation and harvest.

The Soil Resource

Soil is a critical resource for any commercial vegetable growing operation. Natural characteristics such as water holding capacity, soil nutrients, soil structure and biological activity all contribute to the success of a growing operation. When soil moves within or off a paddock, there is a loss in productivity and profitability. Therefore retaining soil and its inherent characteristics is critical to the business of growing.

When soil moves off the property it is not only a loss to the grower, but also creates sediment which ends up on roads, in drains, streams, rivers and lakes. These flow-on impacts create costs which are borne by the whole community.
FOUR STEPS TO MINIMISING SOIL EROSION & SEDIMENT LOSS

1. Paddock assessment

Map and describe the paddock (slope, area, history)
Identify where water is coming from
Identify where water leaves the paddock

2. Implement control measures for stopping or controlling water entering the paddock

Interception drains
Correctly sized culverts
Benched headlands
Bunds
Grassed swales
(controlled overland flow through the paddock)

3. Implement erosion control measures to keep soil on the paddock

Cover crops
Wheel track ripping / Wheel track dyking
Contour drains
Using short row lengths
Cultivation practices including minimising passes
Harvest management – timing / all-weather facilities
Post-harvest field management
Wind break crops (wind erosion)

4. Implement sediment control measures to manage the water and suspended solids that move off the paddock

Ensure access ways are not at the lowest point
Raised access ways / Bunds
Vegetated buffers / Riparian margins / Hedges
Super silt fences
Stabilised discharge points and drains
Decanting earth bunds and silt traps
1. Paddock Assessment

This is a critical step and should be undertaken for every paddock you grow in.

The assessment initially involves walking each paddock, mapping and identifying significant features (drains, culverts, slope, area, etc.) particularly overland flow paths, where water is coming from and going to, and the location and type of existing control measures. Knowing the paddock history is invaluable. This first paddock assessment becomes the basis on which control measures are built as well as future updates planned.

“When we first go into a new block, planning the layout revolves around the lay of the land…where drains logically must go…look at entry and exit points…what is happening around the block…history…row direction etc.” Kevin Balle – Balle Bros

1.1 Paddock Plan

Planning should be done on a paddock by paddock basis, building up to a whole farm plan. Erosion and sediment control measures will then be better integrated with your whole farm system to have maximum impact.

Start the planning process by walking around each paddock, particularly during or after heavy rain, and mark on a paddock map:
- Where water is coming from (e.g. roads, drains, buildings etc.),
- Where water is going or should go (e.g. any overland flow paths),
- Drains and bunds,
- Any existing erosion or sediment control measures.

Also on the map:
- Note the paddock dimensions,
- Mark the direction and steepness of the slope in different parts of the paddock,
- Mark any streams and riparian strips.

A picture is worth a thousand words. It is a good idea to document your actions and keep a photographic record of where you started and what changes you have made. Also many of the erosion control measures, like cover crops and wheel track ripping, may only be visible for a few months. Documenting your use of these erosion control measures is invaluable.

This map and information will be used to plan the most efficient and effective set of erosion and sediment control measures.

Maps can be simple hand drawn diagrams, or based on electronic aerial photographs. Electronic maps are readily available from Google Maps, or the Councils’ GIS systems like http://maps.aucklandcouncil.govt.nz/aucklandcouncilviewer/ or http://www.waikatoregion.govt.nz/Services/Maps/. The advantage of using the electronic mapping systems is that you can easily determine the catchment areas for your various sediment control options.
Figure 1. A simple hand drawn paddock map.

REMEMBER: If you fail to plan, you plan to fail
Figure 2. A digit paddock map.

Table 2. Example silt trap details (accompanying the Figure 2 map).

<table>
<thead>
<tr>
<th>Silt trap</th>
<th>Volume (m$^3$)</th>
<th>Catchment (ha)</th>
<th>Spillway width (m)</th>
<th>Proposed silt trap dimensions (m)$^1$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Width</td>
</tr>
<tr>
<td>A</td>
<td>35</td>
<td>0.69</td>
<td>1.0</td>
<td>3.0</td>
</tr>
<tr>
<td>B</td>
<td>36</td>
<td>0.72</td>
<td>1.1</td>
<td>3.0</td>
</tr>
<tr>
<td>C</td>
<td>61</td>
<td>1.22</td>
<td>1.8</td>
<td>2.0</td>
</tr>
</tbody>
</table>

$^1$ Based on a depth between the silt trap base and spillway of 1.1 m. These are given simply as examples, to get a feel for the trap size.

“When first setting up a paddock we will contact the neighbours, particularly when installing surface drains” Harry Das – B. Das & Sons Ltd
2. **IMPLEMENT CONTROL MEASURES FOR STOPPING OR CONTROLLING WATER ENTERING THE Paddock**

Identifying and then stopping or controlling water entering the paddock is crucial. Drains overtopping can be one of the biggest causes of erosion. In Pukekohe on the 21st January 1999 a short-duration high intensity storm struck. The most severe damage was caused where uncontrolled run-off entered paddocks as a result of overflowing drains. In many places inadequately sized culverts also significantly contributed to the problem of drains overflowing. Keeping clean treated water off the paddock using interception drains wherever possible is crucial. Coordination of drains and erosion and sediment control practices between neighbours and council is essential to minimise soil loss. Meet on site with them to talk through and agree on what needs to be done.

Also:
- Ensure all drains are linked,
- Check that drains and culverts are large enough to cope with the volume of water,
- Carry out regular drain maintenance,
- Discuss with your neighbours linking the drainage systems and know the catchment sizes above you.

Keeping water off the paddock using interception drains or bunds wherever possible is crucial. Where this is not possible, due to the contour, grassed swales through the otherwise cultivated paddock should be considered.

**2.1 Interception Drains**

These need to be built large enough to cope with the flow of water from the catchment above. Where the drain has a steep gradient check dams (energy dissipaters) should be used to slow water flow and minimise drain scouring. Some drains will need to be stabilised with vegetation or rocks otherwise they themselves can become a source of sediment.

**2.2 Culverts**

Culverts in drains are often undersized and either quickly blocks with debris and rubbish or simply cannot cope with the volume of water and overtop. Like the drains themselves culverts need to be correctly sized and should have well-formed headwalls. Generally the bigger the better. The drain at the discharge end of the culvert should be protected with rock to prevent scouring. Table 3 gives an indication of the maximum catchment area for a range of culvert sizes for a 20% (1 in 5 year) and 5% (1 in 20 year) AEP rainfall event. The flow is based on having a 0.2m headwall above the top of the socket end culvert. The quantity of stormwater generated from a certain size catchment will vary depending on rainfall intensity, overland flow length, slope, and surface characteristics. The maximum catchment area given in Table 3 is a guide only, and is based on a stormwater study conducted for the Bombay Hills. The area guide is likely to be conservative for most catchments as culverts in flatter catchments with less intense rainfall events could cope with larger catchment areas.
Table 3. Culvert size and associated flows and catchment area.

<table>
<thead>
<tr>
<th>Culvert size (mm)</th>
<th>Flow (L/sec)</th>
<th>Maximum catchment area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>20% AEP</td>
</tr>
<tr>
<td>300</td>
<td>120</td>
<td>3.4</td>
</tr>
<tr>
<td>375</td>
<td>200</td>
<td>4.8</td>
</tr>
<tr>
<td>450</td>
<td>295</td>
<td>8.1</td>
</tr>
<tr>
<td>525</td>
<td>405</td>
<td>11.3</td>
</tr>
<tr>
<td>600</td>
<td>545</td>
<td>15.0</td>
</tr>
<tr>
<td>675</td>
<td>725</td>
<td>19.3</td>
</tr>
<tr>
<td>750</td>
<td>925</td>
<td>26.9</td>
</tr>
<tr>
<td>825</td>
<td>1100</td>
<td>35.9</td>
</tr>
<tr>
<td>900</td>
<td>1400</td>
<td>48.0</td>
</tr>
<tr>
<td>1050</td>
<td>2000</td>
<td>64.8</td>
</tr>
<tr>
<td>1200</td>
<td>2790</td>
<td>87.5</td>
</tr>
<tr>
<td>1350</td>
<td>3550</td>
<td>115.1</td>
</tr>
</tbody>
</table>

2.3 Benched Headlands

Modifying headlands is a simple and effective way of controlling and managing soil and water runoff from paddock rows, particularly wheel tracks (a major source of sediment). Often called ‘benched’ or ‘contoured’ headlands, the entire headland area is designed to direct water to the side of the paddock or to a drain within the paddock.

The headland slopes away from the rows, sloping towards an earth bund. The headland is still used in the normal manner for access to planting, spraying and harvesting operations.
Grassing headlands will protect them from scouring and encourages silt to drop out before entering surface drains.

The easiest way to construct a benched headland is using a grader blade. Once in place, particularly if it is grassed, the only maintenance is to clear deposited soil and reshape in dry conditions or if major scouring occurs.

Benched headlands are used to good effect in breaking up the length of long paddock runs. If constructed to a broad shallow design, a tractor can be driven across the headland.

When constructing a benched headland attention needs to be paid to:
- Where water from the benched headland is being directed, for example to a permanent drain which will carry it off-site in an effective manner,
- Where silt will be deposited in the benched headland, and further down the drainage system.

Scouring of benched headlands can occur if:
- Excessive water volumes flow into a headland. Use contour drains across the field to reduce this,
- Soil in the headland has not been compacted,
- The slope of the headland is too steep, creating high water speeds during rainfall. Take measures to reduce volumes reaching the headlands by diverting water to drains or vegetate the headland to cope with the high water speed.

Check what happens when the water reaches the end of a headland and make sure the headland connects with a suitable sediment control measure or stabilised discharge point.

2.4 Diversion Bund

Rather than a drain, an earth bund can be used to divert water away from a vulnerable cultivated paddock.
2.5 Grassed Swale (Controlled Overland Flow through the Paddock)

A swale is a surface drain that is often shaped into a shallow saucer. They are used to ensure water flowing along natural overland flow paths through cultivated areas do not cause significant erosion. Clean water can be directed along the swale, following its natural course, to a stabilised discharge point. Once formed the swale needs to be immediately stabilised with grass. The size is based on the catchment area above the paddock. As a minimum the swale should be at least 3m wide. The swale is shaped into a flat shallow saucer about 0.3m deep that can be easily driven across if it needs to intersect the cultivated rows.

![Photo 1. Scouring out along a cultivated overland flow path.](image)

A grassed swale may have prevented the damage shown in Photo 1. An interception drain or bund could not be used to cut this water off due to the contour. The water entering the paddock was clean so does not need any further treatment if it had passed over a grassed swale. Without the grassed swale the volume required in the sediment control measures needs to account for the cultivated paddock as well as the catchment area above the paddock.
Implementing in-paddock erosion control measures to minimise soil movement will retain and even improve soil structure. Although eroded soil caught in a sediment control device like an earth bund or silt trap can be redistributed back over the paddock, it is invariably in very poor condition and certainly no substitute for preventing soil from moving in the first place.

The suite of erosion control measures used will predominantly be dependent upon the paddock slope. For example, flat paddocks will benefit from cover crops but contour drains would be of limited value, while even gently sloping paddocks may benefit from wheel track ripping.

Within paddock control measures include the use of:
- Cover crops
- Wheel track ripping
- Wheel track dyking
- Contour drains
- Paddock length
- Cultivation practices including minimising passes
- Harvest management
- Postharvest management minimising the fallow period (with cover crops or grass)
- Wind break crops

### 3.1 Cover Crops

**What are cover crops?**

Green manure or cover crop describes any crop which is grown to be ploughed into the soil rather than harvested. This incorporation of a crop back into the soil is to improve soil quality, and long term production.

Photo 2. An emerging oats cover crop through the stubble of the previous crop.
Benefits

The use of cover crops is beneficial in all long-term cropping situations for three main reasons:
1. To stabilise soil from erosion and improves water penetration and drainage
2. To produce dry matter which improves organic matter and soil structure
3. To trap and cycle mobile nutrients from the previous crop

Other benefits of using cover crops include:
- Smothering weeds (can help reduce weed control costs)
- Improved soil fertility (improves productivity)
- Stimulating soil biological activity (e.g. earth worms) and assisting in breakdown of previous crop residues to reduce disease carry over and soil-borne diseases
- Providing a habitat for beneficial insects
- Fixation of nitrogen by some species

The use of cover crops suitable for the Franklin District was investigated by FSP on several grower demonstration sites to address issues of soil erosion, soil stability and nitrate leaching. Results are available in a fact sheet that can be downloaded from http://agrilink.co.nz/archive.php.

3.2 Wheel Track Ripping

Wheel track ripping increases rainfall infiltration rates and significantly decrease soil movement. Ripped wheel tracks allow water to percolate into the soil rather than flow down the wheel tracks.

Compacted wheel tracks can act as drainage channels. Shallow ripping of wheel tracks, to just below the cultivation compaction zone can reduce soil and crop loss.

Water flowing down the wheel tracks undermines the adjoining crop beds leading to extensive crop and soil loss. Where the wheel marks are ripped, water is able to infiltrate into the soil with the result that little soil loss and no crop loss occurs.

Photo 3. Ripped wheel tracks beside the unripped sprayer tracks (sprayer tracks are left unripped to ensure sprayer stability).

Wheel tracks in the rows used for spraying should not be ripped, as the resultant loose track makes spraying difficult.
When any runoff reaches the bottom of the paddock, it needs to be dealt with by sediment control measures (e.g. decanting earth bunds or silt traps). The easiest and most effective way to deal with this problem is to minimise runoff in the first place. Ripped wheel tracks minimise runoff and subsequently reduces the pressure on any sediment control device.

Why rip wheel tracks?

Trials have found that wheel tracks are the key zones for initiation of surface runoff and erosion.

Reduction of water movement along wheel tracks is the key to reducing erosion rates. In a Franklin District trial, ripping wheel tracks increased the infiltration rate from 0.5 mm per hour to more than 60,000 mm per hour (Table 4). This reduced the movement of water down the wheel tracks. The erosion rate from the unripped tracks was 21.3 t/ha, compared to 1.1 t/ha on the ripped wheel tracks (Table 5). Ripping wheel tracks following planting was found to be the single most effective measure for reducing soil erosion within the paddock in the Franklin District.

Table 4. Infiltration rate (mm/hour).

<table>
<thead>
<tr>
<th>Treatment</th>
<th>June</th>
<th>October</th>
<th>January</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uncultivated wheel track</td>
<td>0.5</td>
<td>12.7</td>
<td>77.2</td>
</tr>
<tr>
<td>Cultivated wheel track</td>
<td>60,300</td>
<td>12,500</td>
<td>8,600</td>
</tr>
<tr>
<td>Onion beds</td>
<td>400</td>
<td>500</td>
<td>900</td>
</tr>
</tbody>
</table>

Table 5. Erosion rate (t/ha).

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Jun – Aug</th>
<th>Sept – Dec</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uncultivated wheel track</td>
<td>16.7</td>
<td>4.6</td>
<td>21.3</td>
</tr>
<tr>
<td>Cultivated wheel track</td>
<td>0.98</td>
<td>0.13</td>
<td>1.1</td>
</tr>
</tbody>
</table>

Because the infiltration rates are so high in both the ripped wheel tracks and onion beds, runoff would only be generated if the capacity for the soil to store water is exceeded.

As a word of caution, some growers attribute wheel track ripping to increased erosion. This underscores that no single measure will work for everyone in all situations. However, many growers and the research trials show that in most circumstances wheel track ripping will significantly reduce soil erosion.
How to rip wheel tracks?

Wheel track ripping is carried out as soon as possible after planting. A shallow tyned implement pulled behind a tractor is used for this purpose. It has double leg subsoiler shanks with small wing bases, mounted behind the wheels on a straight toolbar. Weights attached to the middle of the toolbar help with penetration of the implement.

Photo 4. Wheel tracking ripping in action (above) and the small torpedo foot (insert).
3.3 Wheel Track Dyking

Dyking is a simple practice that creates a series of closely-spaced soil dams in wheel tracks (pictured below, right). These dams capture water in what amount to small indentations. Water can then soak into the profile, minimising runoff and any associated movement of soil and nutrients. As with wheel track ripping, dyking offers a practical solution to reduce soil erosion before it becomes a bigger issue.

Photo 5. The wheel track dyking implement in action (above).

Photo 6. Small indentations along the wheel track can be seen filled with water (left). These small dams slow the water down and settles the suspended solids. Water also has a longer duration to infiltrate into the soil.

Why dyke wheel tracks?

Initial trials in the Horowhenua and Hawke’s Bay have shown that dyking wheel tracks can be extremely effective in reducing runoff and soil and nutrient loss. In low and high rainfall events dyking eliminated runoff compared to undyked (standard) wheel tracks. This largely reflects the longer retention time water has behind soil dykes.
There is no standing water after a winter rain event.

Alongside the dyked wheel tracks water has ponded in these undyked wheel tracks.

Creating these small dams along the wheel tracks can have clear production benefits too. Ponding within paddocks can be minimised. Recent trials have shown just how costly this type of damage can be. In affected areas there can be total crop loss even as a result of only short-term ponding. Even where crops survive the initial ponding events, crop performance is still often affected.

Areas that are affected by short-term ponding damage (foreground) can significantly reduce profitability.
How to create wheel track dykes?

Soil dykes are created by a propeller-like instrument. A ripper shank works immediately in front of the propellers both to loosen the soil to create the small soil dams and to allow quick drainage (see the previous section). There are several different designs available, though most create soil dams about every 30 to 45 cm. The equipment itself is pulled behind a tractor and is mounted to a standard straight toolbar.

The best time to create the dams is when the soil has been recently worked. It is following this disturbance that soil is most at risk of moving. Soil dykes should be formed slightly below the top of the bed, so that if they overflow during extreme rainfall events the water will flow down the wheel track rather than across the bed. Don’t work the wheel tracks if the soil is too wet – damage to soil structure is likely to outweigh any potential benefits.

In some situations there may be value in reforming dykes several times during the season, where in others once will suffice. Sowing oats at the same time the wheel tracks are dyked can increase the stability of the soil dams, but is not essential. Wheel tracks in the rows used for spraying should not be disturbed.

### 3.4 Contour Drain

Contour drains can be considered if the paddock is on a slope of 2% (equivalent to about 1° degree) or more.

Contour drains are temporary drains used to collect runoff water. They effectively reduce the length of rows that runoff water can flow down, by collecting water in shallow drains that run at a gentle gradient across the slope of the paddock. Water is then channelled into permanent drains or grassed alleyways. Contour drains also control the speed of runoff water when the correct gradient is used.

Contour drains MUST discharge into a permanent drain; otherwise the problem of erosion is simply shifted from within the paddock to the margins. The permanent drain must be capable of handling the volume of water discharged from the contour drains.

To work well, contour drains must be designed and constructed properly, taking the field’s characteristics into account.

#### Contour drain spacing

The steeper the slope, the greater the number of contour drains needed.

<table>
<thead>
<tr>
<th>Paddock slope</th>
<th>Drain spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 10% (i.e. 10m rise per 100m length)</td>
<td>20m</td>
</tr>
<tr>
<td>3 - 10%</td>
<td>30m</td>
</tr>
<tr>
<td>&lt; 3%</td>
<td>50m</td>
</tr>
</tbody>
</table>
As a general rule contour drains should never be more than 80m apart.

Getting the spacing of contour drains right is very important. Getting it wrong can actually create more problems than it solves. The golden rule is to avoid placing drains too far apart, as contour drains spaced too widely can overflow and CAUSE erosion.

Contour drain slope

It is important that contour drains are sloped correctly. If too flat they can silt-up or overflow, if too steep they become gauged-out. The best way to get the slope right is to survey the paddock to get the right fall in the contour drains.

Trials in the Franklin District have found a slope of 1.5 - 2.5% is appropriate for the clay loam soil. Trials in Tasmania found the best results at between 5 to 7% on their clay loam to clay soils and 0.5 to 2.0% on sandy soils.

The most common fault seen with contour drains is that they are too steep and too far apart. To compensate for this they are often deeper than necessary and therefore become a hindrance to sprayers and other field equipment.

Contour drain length

For contour drains, shorter is definitely better. The longer the drain, the more likely it is to overflow. As a guide, the Kindred Landcare Group in Tasmania recommends that contour drains be no longer than 50m.

Contour drain construction

A clinometer, two equal length poles, an assistant and marker pegs should be used to mark out the placement of contour drains.

1. Stand at the top of the paddock halfway between the vertical drains on either side of the paddock or at the far side of the paddock if there is only one vertical drain.
2. Send your assistant to the edge of the paddock, their pole held upright.
3. Set the clinometer to the required angle. Rest it on your pole and look through it.
4. Ask your assistant to move down the paddock until the top of the poles line up with the hairline on your clinometer.
5. Peg both your and your assistant’s position. This is the line for the contour drain.
6. Both move down the paddock 20 - 80m, depending on the paddock’s characteristics, and repeat steps 3 and 4 and 5.

Once pegged out, drains can be constructed with a blade set on an angle. Soil should be pushed to the downhill side. Drains may need to be finished off by hand.

Contour drains should be put in immediately after sowing the crop - not the next week. It may be too late or may not get done at all.
3.5 Paddock Length

Row length is important if the paddock is on a slope of 2% (equivalent to about 1° degree) or more. If the rows are oriented up and down the slope, restricting row lengths to 200m is recommended, potentially broken with several contour drains. In longer rows erosion is often evident.

3.6 Cultivation Practices

Cultivation reduces the stability of most cropping soils over time. Adopting minimum tillage approaches or minimising the number of cultivation passes can be an effective means to reducing soil erosion.

The how, when and where cultivation is done can have a big impact on the erosion potential of your soil. Good cultivation techniques can increase productivity and help conserve soil and keep it in good condition for the future.

Where possible, paddocks should be cultivated in alternating directions in successive years to avoid moving whole fields downhill.

The soil resource can take many years to rebuild once it is lost through erosion. The exposure of less fertile subsoils can require higher inputs of fertiliser (added cost) to maintain crop productivity.

Excessive cultivation with rotary hoes should be avoided.

Maintenance of good soil structure can actually reduce the costs of cultivation – for example, the number of passes needed to achieve the desired seed bed. Good soil structure also protects the health of the soil by allowing better aeration and drainage.

Leave a setback strip or riparian margin between the cultivated area and any drains or streams.

A riparian margin is a means of managing soil that moves off a paddock, but needs to be planned as part of the cultivation so that an adequate area is left uncultivated. Leaving an uncultivated strip forms a filter than can trap sediment in runoff and prevent it entering the waterway. Many Regional Plans require cultivation to have a setback distance from waterways. However one of the problems is that cultivated paddocks often form channelised flow paths, rather than sheet flow, which can cut through these vegetated margins no matter how wide they are.

Refer to Section 4.3 Vegetated Buffers, Riparian Margins and Hedges below for details and examples of setback strip and riparian margins.
Some dos and don’ts for soil cultivation

1. **DO** minimise the number of passes over the paddock wherever possible. Every cultivation pass results in the loss of organic matter through decomposition and can have a detrimental effect on soil structure.

2. **DO** build the organic matter level of your soils. Cultivation reduces organic matter. Building organic matter can be done with the use of cover crops (see the cover crop Section 3.1 Cover Crops) or compost. Organic matter is critical for maintaining the stability of soil aggregates and reducing nitrate leaching. It also allows for easier preparation of seedbeds.

3. **DON’T** cultivate right up to the sides of drains or streams. This will only speed up the loss of soil from paddocks, block up streams and require more maintenance.

4. **DON’T** cultivate when the soil is too wet. The best way of reducing compaction and the formation of pans is to avoid being on the land when it is too wet. Compaction slows the infiltration of water into the soil and increases the risk of soil erosion.

3.7 Harvest Management

At harvest, operations should be carried out in a manner that has least adverse effect on the soil and water resources.

Working paddocks in wet conditions can lead to loss of soil structure, compaction and increased sediment in the runoff. In addition to these effects, it can also increase wear and tear on plant and machinery, reduce labour efficiency, increase pressure on washing systems and increase product reject levels. Also, mud left on the road can create a traffic hazard as well as result in public animosity toward land users.

However, timing of harvest operations can be dictated by the demands of markets or factory requirements (process vegetables). This makes it difficult for growers to always operate under good soil and climatic conditions.

All-weather facilities should be established for loading and marshalling areas to prevent severe compaction, breakdown of soil structure, or any limitation to access.

Where required, metal should be used in gateways and loading pads. Load out may occur in an adjacent paddock.
3.8 Post Harvest Field Management

Where a new crop is not going to be immediately sown following harvest consideration needs to be given to paddock management to prevent soil erosion. One effective approach is to sow a cover crop such as oats.

Bare soil surfaces that can occur in paddocks following harvest are vulnerable to erosion caused by wind and rainfall. Establishing a cover crop soon after harvest can protect the soil and provide other advantages such as increased soil organic matter, slow the breakdown of the soil structure and provide a feed resource for grazing. See Section 3.1 Cover Crops for a detailed description on the use of cover crops.

Where a cover crop cannot be established following harvest, contour cultivation should be considered so that the soil surface is broken up and left in a condition that avoids erosion.

Contour cultivation (right) can provide a similar effect to contour drains. Because crop management no longer needs consideration, there should be greater choice on where such cultivation occurs and whether the whole area is given a breaking up pass or at regular intervals across the slope.

Photo 10. Strip contour cultivation of a fallow paddock following harvest.

Returning paddocks to pasture at regular intervals is an effective way of building up soil organic matter and avoids the build-up of pests, diseases and weeds. When returning pasture paddocks to cropping take care not to undo all of the good work by over cultivating or working the ground in less than ideal conditions.

Rotation of crops is well recognised as a good management practice. The length of the rotation and cropping practices will influence the extent of soil damage that can result from repetitive cropping. Pasture can be an effective ‘recuperation crop’ in the rotation.

To gain the best recuperative effect from pasture in the crop rotation, the pasture needs to be carefully managed. Overgrazing, particularly at times when soil is vulnerable to pugging or drought, can negate many of the benefits that pasture can provide. Soils can erode or compact, which in turn can lead to increased levels of soil loss through sediment runoff.
4. SEDIMENT CONTROL MEASURES TO MANAGE THE WATER AND SUSPENDED SOLIDS THAT MOVE OFF THE PADDOCK

Managing the water that flows off the paddock is about minimising the quantity of soil that enters the wider environment and ensuring that water is discharged in a controlled co-ordinated manner. Water is either kept clean by diversion around the paddock or over a stabilised grassed swale, or it is treated and then discharged. Effective treatment relies on a sufficient time for soil to settle out. Having sufficient capacity is critical.

Managing water leaving the paddock can be achieved using:
- Raised access ways and ensuring they are not at the lowest point
- Benched headlands
- Diversion bunds
- Vegetated buffers, riparian margins and hedges
- Silt fences
- Stabilised discharge points and drains
- Decanting earth bunds
- Silt traps

4.1 Raised Access Ways

Raised access ways should form part of your co-ordinated sediment control practices. All runoff can then be managed and treated before leaving your property, stopping the loss of valuable soil from paddocks onto roads and into waterways.

An access way raised with metal (right) directs water flowing down the track into a small decanting earth bund. Note the black snorkel should be cut below the height of the emergency spillway so that it can act as the primary spillway. Behind the pictured decanting earth bund is a bund protecting the adjacent roadside drain and downstream environment from the paddock above.
The access way in Photo 12 has been raised using a culvert with bunds either side directing water to a Decanting Earth Bund further down the paddock.

The effect of having the access way in the lowest point is graphically shown in the series of photographs below. Sediment is lost from a paddock through the access way at the lowest point, with some of the sediment settling in a dip beside the road.

Photo 13. Erosion from an unprotected paddock.

Photo 14. (below) Sediment settles in a dip just down from the paddock in Photo 13.

Photo 15. Unprotected access way at the lowest point (above).
Remember – access ways are there to provide for vehicle crossings, they are not a discharge point for stormwater.

The following practices, well planned and used together, will avoid or minimise soil losses from access ways:

1. Position access ways away from lowest point
   Never place access ways at the lowest point of the field where water is naturally diverted or concentrates. This may mean “off-setting” it from the bottom corner where a decanting earth bund is installed.

2. Raise access ways
   Raise the access way above the surrounding area to divert water into your sediment control system. This may be as simple as using a load of metal to form a hump over the access way (see Photo 11).

3. Check point
   Use the access way as a check point where you can spend a few minutes removing soil that has become stuck to the tractor. Soil is a valuable resource. Don’t leave it on the road as you drive away. Keep it for your crops.

4. Culvert
   All access ways that go directly onto a road should be piped. The size of the pipes/culverts is important – the BIGGER the BETTER. See Section 2.2 Culverts.

### 4.2 Diversion Bund

Diversion Bunds are raised earth walls prevent water discharging straight off the paddock. Like raised access ways they divert water into a sediment control device like a decanting earth bund or silt trap.

Photo 16. A diversion bund protecting a pond.
4.3 Vegetated Buffers, Riparian Margins and Hedges

Vegetated buffer strips and riparian margins, strips of land adjacent to waterways, filter water by slowing down the flow of water allowing the sediment to settle out. They should be at least 3 to 6m wide. There is the issue of what to do with the trapped sediment as it builds up over time. Digging it out is likely to take the vegetation with it, while leaving it often means it is susceptible to further erosion. Where the flow is channelised, as occurs in the majority of cases on vegetable cropping land, riparian margins may be of limited value as sediment control devices with water and sediment pass straight through. They do however have other benefits such as stabilising banks and shading streams.

Photo 17. A wide grassed riparian margin protecting a stream.

Photo 18 (below). This recently cultivated paddock is protected by the dense grass buffer left alongside the fence.
Photo 19 and 20. Headlands set back from the paddock boundary with a wide crop strip acting as both a barrier to soil moving off the paddock (vegetated and raised beds) and provides room for tractor implements to swing around in.

Well maintained hedges can act as barriers that catch silt before it can leave the paddock. Their application is often to stabilise earth bunds and along benched headlands. Hedges are only part of the erosion control system and need other control measures in place to complement their benefits.

FSP trialled vetiver grass as a soil barrier. Planted at 20cm intervals it will form a dense hedge, approximately 1.5m tall of stiff erect stems in 3 years. Once established it can filter the water leaving sediment to settle in front. It suits temperate regions of New Zealand.

Photo 21. Vetiver grass established along the lower paddock boundary.
4.4 Silt Fences or Super Silt Fences

Silt Fences and Super Silt Fences are considered a temporary measure for trapping sediment-laden runoff from small catchments of usually less than 0.5 ha. When used on larger catchments careful consideration of the site characteristics is needed or other alternative control measures may be more appropriate. For gradients of less than 10% the slope length behind the Super Silt Fence is unlimited, however Silt Fences have a slope restriction of just 40m. FSP used them in trials as an effective means of demonstrating the quantity of soil that was being lost from a paddock. Inasmuch, they can serve as a means of justifying a more permanent, well-constructed silt trap.

In cultivated growing situations Super Silt Fences are the most appropriate. These use a geotextile fastened to a wire fence (e.g. chain link fence). Regular wind or weed matting cloth is not suitable because these materials do not have good filtering characteristics or high flow rates. Details on suitable geotextiles can be found in TP90 Part B 2B and the 2007 changes. The geotextile fabric must meet the following minimum requirements. Grab Tensile Strength: >440N, Tensile Modulus: 0.140 pa, Apparent Opening Size 0.1 – 0.5mm. Suitable fabric can be found at www.permathene.com/htm/erosion.shtml

Table 7. Super Silt Fence Design Criteria.

<table>
<thead>
<tr>
<th>Slope Steepness (%)</th>
<th>Maximum Slope Length (m)</th>
<th>Spacing of Returns (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 10%</td>
<td>unlimited</td>
<td>60</td>
</tr>
<tr>
<td>10 – 20%</td>
<td>60</td>
<td>50</td>
</tr>
</tbody>
</table>

Source: TP90 (2007)

Detailed construction guidelines can be found on the Auckland Council website’s technical publications page. Either TP90 and the 2007 changes or TP223 sediment control for forestry, are excellent guides showing a wide range of erosion and sediment control measures.
4.5 Decanting Earth Bund

A Decanting Earth Bund is often constructed along the flat contour at the bottom of a paddock. By moving the headland itself several meters further up the paddock the full width of the paddock can form a ponding area that will hold runoff long enough to allow sediment to drop out of suspension prior to discharge. This approach can avoid having to build deeper silt traps in the corner of paddocks in order to achieve the required volume.

Photo 22. The cultivated paddock has been pulled back to allow silt detention along the full length the paddock without having to drive tractors into this detention area.

Creating sufficient capacity in Decanting Earth Bunds and Silt Traps is essential for giving sediment sufficient time to settle. The recommended capacity is 0.5% (50 $\text{m}^3$/ha) for catchments of less than 5ha and 1% (100 $\text{m}^3$/ha) for catchments over 5ha. Full details are included in the FSP Soil and Drainage Management Guide. This can be downloaded from [http://agrilink.co.nz/archive.php](http://agrilink.co.nz/archive.php).

Photo 23. Decanting snorkel.

Decanting rate

Decanting Earth Bunds and Silt Traps need to dewater so as to remove the relatively clean water without removing the settled sediment. The decanting rate is critical. Too fast and the sediment will not have time to settle, slush in and slush out. Too slow and the primary and emergency spillways will operate in even moderate sized rainfall events, which will also result in poor sediment capture efficiencies. The recommended decant rate is 3 L/sec/ha.
Table 8 shows the number of 10mm holes required for various lengths of vertical snorkel in order to decant at a rate of 3 L/sec/ha. As the silt trap becomes deeper (longer snorkel) the average flow rate through each hole increases, hence less holes are needed. For example if the Decanting Earth Bund has a 1 hectare catchment; on a 1m snorkel drill 60 10mm diameter holes. This can be done in 6 vertical rows with 65 mm spaces from the top of the snorkel down to 0.3 m from the silt trap floor. A deeper trap with a 1.3m snorkel requires just 54 holes to achieve the same decanting rate of 3 L/sec/ha.

The number of holes will need adjusting based on the catchment area and the snorkel height. Larger catchments may require several vertical pipes or the use of plastic drums has proven to be an effective inexpensive option. The drums provide more surface area to get the required number of holes on larger catchments in shallow silt traps. Getting the height of the drums correct takes a little more work compared to simply cutting a PVC pipe to the correct length. The drums also need a large hole cut in the lid to act as the primary spillway.

Table 8. Snorkel - Number of 10mm holes per hectare.

<table>
<thead>
<tr>
<th>Snorkel height above base (m)</th>
<th>Perforation length (m) (^\text{1})</th>
<th>Average flow per hole (L/hour)</th>
<th>Number of holes per hectare of catchment</th>
<th>Distance between holes (mm) (^\text{2})</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>0.4</td>
<td>2.2</td>
<td>84</td>
<td>25</td>
</tr>
<tr>
<td>0.8</td>
<td>0.5</td>
<td>2.7</td>
<td>66</td>
<td>45</td>
</tr>
<tr>
<td>1.0</td>
<td>0.7</td>
<td>3.1</td>
<td>60</td>
<td>65</td>
</tr>
<tr>
<td>1.3</td>
<td>0.9</td>
<td>3.5</td>
<td>54</td>
<td>90</td>
</tr>
<tr>
<td>1.5</td>
<td>1.1</td>
<td>3.9</td>
<td>48</td>
<td>125</td>
</tr>
<tr>
<td>1.8</td>
<td>1.2</td>
<td>4.2</td>
<td>42</td>
<td>165</td>
</tr>
</tbody>
</table>

1. The bottom 30% of the snorkel does not have any perforations
2. Based on 6 vertical rows

It is recommended that the bottom 30% of the snorkel is not perforated. This will result in a permanent pool at the bottom of the silt trap, which helps sediment settle. 30% of the volume of the trap should be “dead storage” i.e. a pool of water and the other 70% is operating volume i.e. is the volume decanted off through the perforated upstand during and after rainfall events.

Key decanting snorkel requirements
1. The open top of the snorkel also acts as the primary spillway. There should be 100mm gap between the top of the snorkel and the emergency spillway.
2. The decant rate should be 3 L/sec/ha. See Table 8.
3. The bottom 30% of the snorkel should not be perforated in order to leave dead storage
4. Snorkel should be securely fastened to a stake
5. The discharge point should be stabilised by discharging onto rocks or stabilised ground.
**Emergency spillway**

The emergency spillway discharges excess water in major storm events when the perforated snorkel and primary spillway are unable to cope. Position the spillway so that it is not inline for the entrance, baffles may be needed to achieve this. The spillway needs to be stabilised with rock, geotextile or on firm vegetated undisturbed ground. The minimum width is 1.5m/ha of catchment. The spillway must be level and 100mm above the primary spillway. There should be 400mm between the top of the bund and the emergency spillway.

**4.6 Silt Traps**

Silt traps impound runoff water and ensure sufficient time for the suspended soil to settle. Volume is the key attribute.

Whenever possible:

1. Break the paddock into smaller catchments with their own treatment measures and silt trap.
2. Treat runoff from a catchment only once, and discharge it from the paddock into a stabilised drain.

Silt traps work best in combination with other practices that reduce the amount of soil reaching the traps. Silt traps alone are not the only means of controlling soil loss, but are part of an overall system.

Full construction details can be found in the factsheet developed for FSP that can be found at [http://agrilink.co.nz/archive.php](http://agrilink.co.nz/archive.php) or design details are included the in the Auckland Council Technical Publication 90 and the 2007 changes.

The Silt Trap should be 3 times longer than it is wide with inflow entering at one end and the discharging through the outlet at the other. Baffles may be necessary to achieve this. A baffle is a barrier constructed across the pond to direct flows and so maximise the efficiency of the Silt Trap. Its height should be the same as that of the top of the perforated snorkel. It can be constructed from silt fence fabric or shaped when being excavated leaving a clay barrier. The clay barrier is easier for maintenance as cloth barriers are invariably ripped out by the excavator.

Photo 25. A silt trap with the blue snorkel in the foreground for slowly decanting the trap. A mustard cover crop is planted in the immediate paddock along with many of the paddocks in the background.
GLOSSARY

Annual Exceedance Probability (AEP)
A statistical term defining the probability of an event occurring annually. Expressed as a percentage to define rainstorm intensity and frequency. For example, a 5% AEP event has a 5% chance of being exceeded in any one year. This has replaced the return period concept. A 5% AEP event expresses the 20 year return period in more probability terms.

Baffles
Semi-permeable or solid barriers placed in a sediment retention pond to deflect or regulate flow and effect a more uniform distribution of velocities, hence creating better settling conditions.

Batter
A constructed slope of uniform gradient.

Catchment
An area within which surface runoff flows to a common outlet or outlets.

Channel Stabilisation
Stabilisation of the channel profile by erosion control and/or velocity distribution through reshaping, the use of structural linings, rocks, vegetation and other measures.

Clean Water
Any water that has no visual signs of suspended solids, e.g. overland flow (sheet or channelled) originating from stable well-vegetated or protected surfaces.

Contour
A line across a slope connecting points of the same elevation.

Contributing Drainage Area
All of that drainage area that contributes to the flow into a treatment device (e.g. earth bund). A contributing drainage area can include both clean and sediment-laden water flows. Commonly referred to as the catchment area.

Decant Rate
The rate at which water is decanted from a Decanting Earth Bund or Silt Trap. This should be 3 L/sec/ha.

Deposition
The accumulation of material that has settled because of reduced velocity of the transporting agent (water or wind).

Emergency Spillway
An Earth Bund, Silt Trap or Dam spillway designed and constructed to discharge flow in excess of the structure’s primary spillway design discharge.

Energy Dissipater
A designed device such as an apron of rip-rap (rock) or concrete bags placed at the end of a water conduit such as a pipe, paved ditch or flume for the purpose of reducing the velocity and energy of the discharged water.
Rip-rap
Rock or other material used to armour channels, culvert abutments, and spillways against erosion.

Ephemeral Watercourse
A watercourse that flows only part of the year; may include overland flow paths such as grassland swales and dry gullies which only flow during more intensive rainstorms.

Filter Strip
A long, narrow vegetative planting (e.g. vetiver grass) used to retard or collect sediment for the protection of adjacent properties or receiving environments.

Level Spreader
A device used to convert concentrated flow into sheet flow.

Overland Flow Path
The route of concentrated flow.

Perennial Stream
A stream that maintains water in its channel throughout the year

Primary Spillway
The snorkel inlet within a Decanting Earth Bund or Silt Trap.

Riparian margin
An area adjacent to a watercourse designated as a non-disturbance zone to provide a buffer between the watercourse and cultivated paddock.

Sediment
Solid material, both mineral and organic, that is in suspension, is being transported, or has been moved from the original paddock by water or air and has come to rest.

Sediment Yield
The quantity of sediment discharged from a paddock in a given time, measured in dry weight or by volume. When erosion and sediment control measures are in place, sediment yield is the sediment discharged from the site after passing through those measures.

Settling
The downward movement of suspended solids through the water column.

Snorkel
In a Decanting Earth Bund or Silt Trap, a vertically placed pipe which decants water and forms the inlet to the primary spillway.

Spreader (Hydraulics)
A device for distributing water uniformly in or from a channel.
Stabilisation
Providing adequate measures, vegetative and/or structural that will protect exposed soil to prevent erosion.

Surface Runoff
Rain that runs off rather than being infiltrated or retained by the surface on which it falls.

Suspended Solids
Solids either floating or suspended in water.

Swale
A constructed depression or shallow channel across a paddock, that can be used to transport clean stormwater. It is usually heavily vegetated, and normally only flows during heavy storm events.

Water Body
Any type of surface water such as watercourses, lakes and wetlands.

Watercourse
Any pathway for concentrated overland flow, including rivers, streams and ephemeral channels.
Many erosion and sediment control measures refer to different slopes, as a ratio, percentage or in degrees. With the GIS mapping now available for free on the internet it is reasonably easy to calculate the slope of a paddock. Alternatively a clinometer like that described in Section 3.4 Contour Drains can be used. The figures below show some of the steeper paddocks in the Franklin District to give an idea of the slope at the upper end. Apart from a few areas within a paddock, even the steepest cultivated slopes are generally less than 6 degrees or 10%.

**Bombay Hills**

<table>
<thead>
<tr>
<th>Description</th>
<th>ratio</th>
<th>percent</th>
<th>angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>10.5 : 1</td>
<td>9.5%</td>
<td>5.4°</td>
</tr>
<tr>
<td>B</td>
<td>9.4 : 1</td>
<td>10.6%</td>
<td>6.1°</td>
</tr>
<tr>
<td>Description</td>
<td>ratio</td>
<td>percent</td>
<td>angle</td>
</tr>
<tr>
<td>-------------</td>
<td>--------</td>
<td>---------</td>
<td>-------</td>
</tr>
<tr>
<td>A</td>
<td>10.2 : 1</td>
<td>9.8%</td>
<td>5.6°</td>
</tr>
<tr>
<td>B</td>
<td>13.8 : 1</td>
<td>7.2%</td>
<td>4.1°</td>
</tr>
<tr>
<td>C</td>
<td>8.2 : 1</td>
<td>12.1%</td>
<td>6.9°</td>
</tr>
</tbody>
</table>
COMMENTS AND FEEDBACK

We will be regularly reviewing these Guidelines. Please help us keep them accurate and practical. Let us know about any changes that need to be made either by contacting the author Andrew Barber directly or by using this form.

1.0 Errors
Are there any errors in the text or diagrams? If so please tell us:

- Which page and/or figure number it is on
- What the error is and how you would correct it

2.0 Omissions
Have we left out any measures/practices commonly used or which you find useful? If so, please tell us, and if possible any pictures and design guidelines for us to include in a future update.

3.0 Effectiveness
Are these Guidelines and the other material that we have linked to (e.g. FSP – Doing it Right) helpful for understanding and implementing erosion and sediment control measures? If not, please tell us how we can improve these Guidelines.