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VOLUME 2

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APPENDIX G

Groundwater Take Report, Tonkin and Taylor (2019)

REPORT

Tonkin+Taylor

Bore permit and amenity groundwater take effects report

223 Kohimarama Road and 7 John Rymer Place, Kohimarama, Auckland

Prepared for
Ryman Healthcare Ltd

Prepared by
Tonkin & Taylor Ltd

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1 Introduction

Tonkin & Taylor Ltd (T+T) have prepared this technical report to support a resource consent application for bore installation and a groundwater take for amenity irrigation at a proposed comprehensive care retirement village (the Proposed Village) at 223 Kohimarama Road and 7 John Rymer Place, Kohimarama, Auckland (Site).

To prepare this report, we have used existing published and public information, described within this report, and the results of a site-specific geological/geotechnical ground model[1], where applicable.

Using that information, we have assessed the potential environmental effects of the proposed bore and groundwater take on:

- Neighbouring groundwater users;
- Regional groundwater budget;
- Shallow ground and surface water resources;
- Recharge to other aquifers;
- Potential for subsidence; and
- Potential for saline intrusion.

In conclusion, we consider the environmental effects of the proposed bore and groundwater take are negligible.

2 Proposed Village

The Proposed Village Site Master Plan is shown in Figure 2.1 (below) and is attached in larger format in Appendix A. The Proposed Village will comprise the following main buildings:

- A single 6 level main building (B01), with serviced care suites, care beds and basement car parking;
- Three 5 level apartment buildings (B02, B04, and B06);
- Two 3 level apartment buildings (B03 and B05); and
- A shared basement carpark/podium covering the footprint of buildings B02 to B06, with a bowling green.

A main accessway through the Site from John Rymer Place to Kohimarama Road will be constructed between Building B01 and Building B02-B03.

The design and layout of the Proposed Village is presented in the architectural drawing set prepared by Beca and described in detail in the Assessment of Environmental Effects (AEE). Further, the Civil Design Report by Beca details the earthworks and infrastructure services that will be required to construct and operate the Proposed Village. The Site will be earthworked and terraced to form, in part, Site building platforms, access roads and other amenity areas.

[1] T+T, August 2019, Geotechnical Effects Report, 223 Kohimarama Road and 7 John Rymer Place, Kohimarama, Auckland. 30314.v2.

Figure 2.1: Proposed Village Site Master Plan and proposed bore location (red dot) (September 2019).

2.1 Bore installation and groundwater take for amenity irrigation

A groundwater bore is proposed to irrigate the gardens and turf at the Site. Resource consents are required to:

a Drill and construct a groundwater bore (under rule E7.4.1(A41) in the Auckland Unitary Plan (2019)[2]); and

b Take and use groundwater for amenity irrigation on the Site (under rule E7.4.1(A26)[2]).

2.1.1 Summary of borehole details

The proposed borehole will be located east of Building B03, at or near NZTM 1763960.8E 5918658.3N (see Figure 2.1 for proposed bore location). For flexibility during Site development, we request that the groundwater bore consent expires five years after commencement and that the bore can be located within 50 m of the noted NZTM reference.

The proposed bore will be up to 200 mm in diameter, cased and grouted to a depth of approximately 100 m and be open hole to a total depth of up to 400 m.

2.1.2 Summary of groundwater take for amenity irrigation

The application seeks an irrigation take for an instantaneous rate of 3 L/s, with a maximum 28-day daily rate of 117 m^3/day for the first five years, to establish amenity planting, and then a maximum 28-day daily rate of 90 m^3/day thereafter. Section 4 and Table 4.1 (below) set out the justification for these rates.

The maximum annual volume sought for the first five years is 12,090 m^3/year and then 9,300 m^3/year thereafter.

The details of the maximum Site area requiring amenity irrigation are provided in the Site description section (Section 3).

3 Site description

The Site is shown in Figure 2.1 and described in more detail in the AEE. In brief, the Site falls from Kohimarama Road towards the southeast, and has a series of undulations in the topography. At the western extent, the ground drops steeply (30° to 35°) into a valley that drains into the Orakei Basin. An old, flat playing field is located in the central area of the Site. The northern boundary is generally level with Selwyn College, except for an existing 60 m long, typically up to 1 m high, timber pole retaining wall. The southern and eastern boundaries are bounded by residential developments.

The proposed borehole will be located east of Building B03. While the Site comprises an area of 3.122 ha, the total pervious area[3] requiring amenity irrigation is 1.46 ha (i.e. 47 % of the overall Site area).

4 Groundwater requirement for amenity irrigation – efficient and reasonable use

The reasonable groundwater requirement for amenity irrigation is typically calculated using the Irrigation Reasonable Use Database (IRUD)[4]. However, data is not specifically available for this location in Kohimarama and accordingly we have selected a location in the IRUD (Hobsonville,

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[2] Auckland Unitary Plan Operative in part (Updated 27 September 2019), accessed October 2019.
[3] Ryman Healthcare, October 2019. Ryman Kohimarama Retirement Village Schedules. Drawing 044-RCT-S01-.A0-033.
[4] Irrigation Reasonable Use Database, http://mycatchment.info/, ©2014-2015, Aqualinc Research Limited.

Auckland; Appendix B) for which data is available, and where hydrogeological and climate conditions are similar (e.g. similar annual rainfall and underlying aquifer) to the Site (refer to sections 5.3.1 and 5.3.2.1 for relevant and comparable data).

Pasture has been used as a surrogate for amenity irrigation in the IRUD calculation. Water is assumed to be applied with 80% efficiency, and in general accordance with practices in other regions, for example the Canterbury region. We have allowed for irrigation to meet crop requirements in nine years out of ten, i.e. the annual irrigation volume required for amenity irrigation will be met nine out of ten years (Appendix B).

In addition, from an analysis of the water usage at the Ryman Evelyn Page Retirement Village, Orewa, Auckland (and advice from the irrigation consultants, The Irrigation Warehouse (TIW)) we note that approximately 30% more water was used for establishment of amenity plantings during the first five years of irrigation, than the volume determined by the IRUD. This is because more water is required in the establishment of the gardens and turf, and once the gardens have been established water usage declines.

Therefore, based on the results from the IRUD (Appendix B), the water use requirements recorded at the Ryman Evelyn Page village[5], and irrigation advice, Table 4.1 summarises the efficient and reasonable groundwater volumes and rates required for amenity irrigation at the Proposed Village. The IRUD estimates the irrigation season to be 212 days, from October to April.

Table 4.1: Amenity irrigation rates and volumes sought for the groundwater take

	Instantaneous rate (L/s)	Maximum 28-day daily rate (m^3/day)	Annual volume (m^3/year)	Average daily rate for 212 days (m^3/day)
First five years*	3	117	12,090	57
From six years on (90 percentile)**	3	90	9,300	44

* 30% increase to the IRUD results, to establish amenity plantings.

** Results from the IRUD calculation.

4.1.1 Efficient use of water – best practice

TIW is currently the irrigation designer for all Ryman sites. Based on other Ryman villages around the country, TIW has provided the following description of the equipment and methodology to be used to maximise irrigation efficiency and minimise wastage:

- *'We use Rainbird controllers so that the irrigation runs automatically at night, minimising wind disturbance of sprinklers and evaporative losses due to heat and wind.*
- *All controllers are fitted with Rain Switches which means the irrigation is automatically suspended for a preset period after rainfall.*
- *We use Hunter MP Rotator sprinklers for lawn areas which have the lowest application rate possible – this minimises the risk of over-watering and also prevents run-off on slopes or anywhere the soil doesn't absorb water quickly. They also require less pressure and flow than other sprinkler types so minimise the demand on water supplies & pumps.*
- *Pressure Compensated dripline is used to irrigate garden beds and plantings as it specifically targets the roots of plants and prevents water being applied to any areas that don't need it.*

[5] Refer groundwater take details that form part of the section 92 further information responses for the consent bundled under BUN60331326 – 3 Scott Road, Hobsonville, held by Auckland Council.

The dripline typically applies water at 2 Litres-per-hour per dripper, so there is no pooling or runoff in gardens. We also bury the dripline or cover it in bark/mulch which helps to minimise evaporation.'

Irrigation details from TIW, which were also submitted with the s92 documents for the Ryman Scott Road groundwater take (granted as WAT60331350), are attached as Appendix C.

This description confirms that water conservation and irrigation best practice have been considered for implementation using the equipment and methodology described.

5 Existing environment

5.1 Auckland Council records

Auckland Council provided a summary of all records held by the Council relating to borehole installations, consented groundwater takes and permitted activities within a 2 km radius of the Proposed Village on 08 October 2018. The records indicate that there are 52 consents relating to the installation of boreholes within the search area, but there are no active groundwater take consents.

However, there is one record of a permitted activity (PA) groundwater take for Kohimarama Bowling Club at 30 Melanesia Road, Kohimarama, located approximately 1.2 km northeast of the northern boundary of the Proposed Village. The take is for the irrigation of 0.36 ha of bowling greens, for up to 13 m^3/day and 2,400 m^3/year. The Council data confirms that the Bowling Club groundwater bore (Bore ID 1392) was drilled in 1994, is 280 m deep and cased to a depth of 60 m.

5.2 Published and site-specific geology

A geological and geotechnical ground model has been developed for the Proposed Village. This model is based on previous reports by other consultants, Site observations and walkovers, and intrusive geotechnical investigations and laboratory testing. The details of the ground model are discussed in the T+T (2019) Geotechnical Effects Report[1] and a summary is provided below.

The Site is underlain by a variable thickness of fill, typically with up to 12 m residual soil and moderately weathered East Coast Bays Formation (ECBF) soils overlying siltstone and mudstone rock at approximately 10 m to 19 m depth. Filling is identified along the northern boundary of the Site. The flat area in the middle of the Site comprises an infilled gully that is formed of fill up to 9.4 m thick.

5.3 Hydrogeology

5.3.1 Regional aquifer

Auckland Council[6] has confirmed that the regional groundwater aquifer expected at depth below the Site is the Waitematā Sandstone aquifer, which includes water-bearing rocks of the ECBF. The Waitematā aquifer generally comprises bedded sandstone, silty sandstone, silt and occasional mudstones. Regionally, groundwater is abstracted from fractured, thickly bedded, coarse sandstones. Water yields within this aquifer are variable, ranging from 30 to 200 m^3/day for a 100 mm diameter bore[7]. Groundwater bores in the aquifer are generally drilled to depths between 200 to 400 m, and cased to depths between 100 to 200 m[7].

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[6] Dr Reginald Samuel, Specialist – Coastal and Water Allocation, Auckland Council. pers. comm., 09 October 2018: see Appendix D.
[7] Rosen, M. and White, P. (eds.), 2001. Groundwaters of New Zealand. New Zealand Hydrological Society Inc., Wellington.

Hydraulic parameters of the Waitematā aquifer vary across the region, with transmissivities ranging from 1 to 250 m^2/day and storativities from 0.001 to 0.00001, suggesting that the aquifer is typically confined[7]. The Waitematā aquifer in the Auckland Central Water Resource Area[8] has reported transmissivities ranging from 1 to 360 m^2/day and aquifer thicknesses varying from up to 230 m to greater than 500 m. For the purposes of this assessment, we have conservatively assumed that the specific capacity of the Waitematā aquifer, at the Proposed Village, is approximately 1 m^3/day/m of drawdown.

The site-specific investigations[1] have established that the ECBF rock below the Proposed Village is part of the regional Waitematā aquifer, with groundwater depths in the upper unweathered ECBF observed to be up to 10 m bgl (below ground level) (approximately 30 m RL). Groundwater levels appear to be a muted reflection of the topography.

In addition, the permeability of the unweathered ECBF below the Proposed Village has been estimated[1] to range between 0.007 m/day and 0.16 m/day. Based on these site-specific permeabilities, and our understanding of the regional aquifer, we have assumed (consistent with our experience across Auckland) that the permeability of the ECBF at depths corresponding to the open hole depth of the proposed borehole (100 m to 400 m) will be at the lower end of this range, approximately 0.01 m/day.

Shallow groundwater below the Proposed Village is inferred to flow to the south and southeast, toward Pourewa Creek and the intermittent stream on the Site, following topography.

5.3.2 Groundwater management area

The regional Waitematā aquifer has been divided into smaller management areas across the Auckland Region. However, the extent of the Waitematā aquifer management area where the Proposed Village is located is not provided on the Auckland Council GeoMaps viewer, as it is neither a high use aquifer management area, nor a high use stream management area in terms of the Auckland Unitary Plan (AUP)[2]. Therefore, for the purposes of this assessment, the Waitematā aquifer below the Site is considered to be recharged over the area of the surface water catchments referred to by Auckland Council as Eastern Bays and Hobson Bay (referred to as the 'defined management area' in the sections below). These two catchments total 12.14 km^2 in area (after removing the volcanic aquifers mapped in the catchments), and their location and areal extent are shown in Figure 5.1 (below).

[8] Crowcroft, G., and Bowden, D., May 2002, Technical Publication No. 171, Auckland Water Resource Quantity Statement 2002 – Surface water and groundwater resource information, availability and allocation.

Figure 5.1: Surface water catchments in teal and the Site in red (source: Auckland Council GeoMaps, October 2019).

5.3.2.1 Annual rainfall

The Auckland Council[6] has provided an annual rainfall measurement for the Site of 1300 mm/year.

5.3.2.2 Recharge

We have assessed the recharge area as 12.14 km^2, based on the area of the two surface water catchments described in section 5.3.2. The rainfall recharge rate was provided by Auckland Council and is reported as 5% of annual rainfall[6].

Our recharge estimate is set out below:

• Rainfall recharge (*RF recharge*)	=	5% of annual rainfall
• Rainfall (*RF*)	=	1300 mm/year (1.3 m/year)
• Assumed area of recharge (*area*)	=	12.14 km^2 (12,140,000 m^2)
• Volume of recharge over 12.14 km^2	=	RF recharge x RF x area
	=	0.05 x 1.3 m/year x 12,140,000 m^2
	=	789,100 m^3/year

5.3.3 Groundwater volume available for allocation

Auckland Council[6] has advised us that the Waitematā aquifer below the Site has groundwater available for allocation at 35% of the average annual recharge determined in the section above. On this basis, the volume available for allocation is approximately 276,000 m^3/year.

5.3.3.1 Current groundwater takes

Auckland Council has also advised that there are no consented groundwater takes within a 5 km radius of the Site[6]. However, the Council database search does report one PA within 2 km of the Site that has a groundwater take of 2,400 m^3/year for the irrigation of bowling greens. This is less than 1% of the annual volume available for allocation.

5.3.4 Assessed groundwater availability

After allowing for the annual groundwater take for the PA from the assessed regional groundwater volume available for allocation, we estimate that there is approximately 274,000 m^3/year (rounded) of groundwater available in the Waitematā aquifer management area (refer to Section 5.3.2).

5.3.5 Groundwater quality

The chemical composition of groundwater from the Waitematā aquifer can be generally split into two types[7]. Shallow groundwater (less than 200 m depth) commonly has a near neutral pH, high total hardness/total alkalinity ratio, high total iron (>1.0 g/m^3) and forms hard calcium carbonate waters. Deeper groundwater commonly has a high pH (>8.5), low total hardness/total alkalinity ratio, low total iron (<0.2 g/m^3) and forms soft sodium bicarbonate waters.

Iron dissolved in irrigation water can cause problems when it precipitates on plant leaves or irrigation equipment. It precipitates on aeration and concentrations of less than 5 g/m^3 may produce light brown spotting on plants. Concentrations of less than 0.2 g/m^3 will cause only minor problems, with clogging of trickle or drip type irrigation systems, while concentrations above 1.5 g/m^3 may cause severe problems for these irrigation systems[9]. Dissolved iron concentrations of approximately 10-50 g/m^3 have been reported to reduce plant growth[10].

Therefore, groundwater may be of suitable quality for irrigation, subject to treatment. Water quality testing from the proposed irrigation bore will be required to confirm treatment requirements.

6 Proposed borehole description

The following outline bore specification is intended to yield the estimated volume of water required for irrigation at the Site, which will be confirmed following drilling, construction, and testing. The maximum estimated volume of water required for amenity irrigation is 12,090 m^3/year, for the first five years, averaging 57 m^3/day, with a maximum 28-day daily rate of 117 m^3/day (Section 4).

The proposed bore description includes:

- Constructed in accordance with NZS 4411[11];
- Up to 200 mm diameter steel casing, installed up to 100 mbgl;
- Grouted to base of casing - approximately 100 m bgl - to prevent surface water from entering the aquifer;
- Drilled out to up to 400 m bgl (providing the Waitematā aquifer is sufficiently consolidated at the target depth (100 – 400 m bgl) a screen is unlikely to be required, and the bore could be constructed as an open hole below the steel casing); and
- Assuming a specific capacity of 1 m^3/day/m of drawdown, the estimated long-term drawdown in the borehole will be approximately 57 m at a pumping rate of 57 m^3/day.

We estimate that the available drawdown in the bore will be at least 88 m (depth to base of casing minus static water level, minus 2 m for seasonal variation). Therefore, there will be approximately 30 m of available drawdown remaining when pumping at the average pumping rate.

[9] Australian and New Zealand Guidelines for Fresh and Marine Water Quality, 2000, Volume 3, Primary Industries – Rational and Background Information (Chapter 9), October 2000.
[10] Stansfield, B., and Holwerda, N., 2015, State of the environment monitoring: Auckland water quantity statement 2012/2013, prepared by EIA Ltd for Auckland Council, Auckland Council technical report, TR2015/005.
[11] New Zealand Standard NZS 4411:2001, Environmental Standard for Drilling of Soil and Rock.

The proposed bore will be located at or near NZTM 1763960.8E 5918658.3N (Appendix A) and based on the T+T (2019) ground contamination assessment[12], there are no known offal pits or waste disposal areas within 150 m of the bore. The bore is not located in a Wetland Management Area Overlay[2] or on a Sites and Places of Significance to Mana Whenua Overlay[2]. In addition, the closest neighbouring bore is located further than 150 m from the proposed bore; approximately 1.2 km northeast of the Site (see Section 5.1). Low levels of contaminants have been detected in soil at the Site[12], but concentrations are at or below standards for high density residential land use and below AUP discharge criteria.

There is only one aquifer identified below the Site, the regional Waitematā aquifer. Therefore, there will be no cross-contamination between aquifers, and the proposed bore will not create a hydraulic connection between penetrated aquifers.

6.1.1 Bore location

As reported above, the proposed bore will be located east of Building B03, at or within 50m of NZTM 1763960.8E 5918658.3N (Appendix A). The proposed bore location was chosen for a number of reasons, including:

- Ease of access for bore maintenance;
- Located away from retaining walls and services; and
- Not directly visible to residents and visitors.

6.2 Groundwater monitoring

The monitoring proposed by Ryman is consistent with the consent requirements for the water bore (LUC60338858) and the groundwater take permit (WAT60331350) issued for the Ryman village that is being constructed in Scott Point, Hobsonville. The monitoring conditions specified by these consents include:

- Provision at the top of the bore for water level measurements to be made so that a probe can be lowered vertically into the bore between the riser tube and casing to measure the static water level in the bore;
- If required by Council notification, make provision at or close to the top of the bore for water quality sampling for laboratory analysis;
- Water meter installation and verification of meter accuracy;
- Water meter readings taken at weekly intervals either:
  - Before pumping starts for a day; or
  - At the end of pumping for a day; and
- The date and the water meter reading to be recorded and supplied to the Council in accordance with any reporting conditions.

7 Assessment of effects

7.1 Positive effects

The proposed amenity irrigation will have a positive effect at the Proposed Village. The irrigation of lawns and gardens will enhance the amenity of the village, providing positive effects for residents.

[12] T+T, August 2019, Ground contamination assessment of environmental effects. 30314.001.v1.

The proposal will result in groundwater being used for amenity irrigation, rather than using water available through the municipal town water supply. Water taken from the aquifer for amenity irrigation will reduce reliance of the Proposed Village on the reticulated water supply, conserving it for drinking use and household purposes. While the water is used for irrigation and may require some treatment, it typically does not require the higher level of treatment generally required for a municipal drinking water supply (e.g. filtration, chlorination, and UV).

7.2 Effects on regional groundwater quantity

As outlined in section 5.3.4, the estimated total volume of groundwater available from the Waitematā aquifer in the defined management area is approximately 274,000 m^3/year. The maximum annual volume of water required for irrigation of the Site is approximately 12,090 m^3 (for the first five years), which is approximately 4.5% of the total available groundwater. Therefore, based on these calculated volumes, there is sufficient groundwater available for amenity irrigation at the Site. Overall, the effect on regional groundwater allocation and availability is assessed as negligible.

7.2.1 Recharge to other aquifers

There is only one aquifer encountered below the Site, the regional Waitematā aquifer within the ECBF. The ECBF is interpreted to overlie basement greywacke. However, the greywacke is not considered an aquifer given its low permeability[7] and we are not aware of any groundwater takes from the greywacke basement in the Central Auckland area.

Recharge to the ECBF rocks occurs on a regional scale through rainfall, which will not be inhibited by a groundwater take at a depth of 100 m below ground surface. Therefore, recharge to the Waitematā aquifer will be maintained.

7.2.2 Aquifer consolidation, surface subsidence and ground settlement

The static water level in the Waitematā aquifer is up to 10 m bgl. Given the stiffness of the ECBF rock, the amount of settlement caused at a distance of 50 m from the pumping bore, by pumping for 212 days, is assessed as negligible and will be mitigated by the rebound in groundwater levels expected during the winter. Our evaluation is that the effects of shrinking and cracking of drying residual soils overlying the ECBF rock during a typical summer and rewetting in the following winter may obscure observation of this settlement near the end of the pumping period. We do not expect that ground settlement caused by pumping drawdowns will impact any buildings, structures or services within the vicinity of the bore.

7.3 Effects on shallow groundwater and surface water resources

Groundwater will be taken from a depth of at least 100 m bgl within the Waitematā aquifer. Given the layering within the Waitematā aquifer, which generally comprises interbedded sandstones and finer grained rocks, the pumping of groundwater at depth is not expected to be observed in the shallow groundwater and surface water bodies. Therefore, the effect of pumping from the Waitematā aquifer on shallow groundwater and surface water resources is considered negligible.

7.4 Effects on terrestrial and freshwater ecosystem habitat

The proposed take is up to 12,090 m^3/year from a total recharge estimate of 789,100 m^3/year (refer to Section 5.3.2.2), i.e. 1.5% of the annual rainfall recharge. The layering within the Waitematā aquifer, which generally comprises bedded sandstone, silty sandstone, silt and occasional mudstones, will delay vertical movement of water to the deeper layers where groundwater will be taken. We consider that the effect on stream baseflows will be similar to the proportion of rainfall recharge (1.5%), or smaller considering the depth of the groundwater take and layering within the aquifer, and therefore, effects on terrestrial and freshwater ecosystems will be negligible.

7.5 Saltwater intrusion

Saline intrusion occurs when groundwater in an aquifer near the coast is replaced by seawater from the ocean. The Ghyben-Herzberg relation[13] predicts that the depth below sea level to the saline interface is approximately 40 times the height of the freshwater table above sea level. This height is based on the assumption that the density of freshwater is 1,000 kg/m^3 and 1,025 kg/m^3 for seawater.

The proposed bore is located at an approximate elevation of 31 m above mean sea level (amsl) and the deepest measured static groundwater level in the unweathered ECBF (Waitematā aquifer) at the Site is approximately 10 m bgl. The nearest saltwater body, the Orakei Basin, is located approximately 2 km west of the centre of the Site.

By applying the simplified Ghyben-Herzberg approximation: $z = 40h$,

where z is the depth to the sea water interface and h is the head of water above mean sea level (21 m in this case), we estimate the sea water interface would be approximately 840 m below mean sea level (bmsl). Based on this assessment, the effect of saline intrusion at the proposed borehole is considered negligible.

7.6 Effects on neighbouring groundwater users

As reported in Section 5.1, there is one PA for a groundwater take at the Kohimarama Bowling Club, approximately 1.2 km northeast of the Site. We have estimated the drawdown effects potentially caused by the proposed groundwater take on this neighbouring bore, and the results of our assessment are summarised below (Table 7.1) and reported in Appendix E.

The drawdown effect on the neighbouring bore was estimated using the Theis equation[14] and the following assumptions:

- The aquifer parameters are constant across the local area;
- The seasonal water level variation is 2 m;
- The bore will penetrate the same aquifer as the Bowling Club bore;
- The bore will be of similar depth as the Bowling Club bore;
- The drawdown in the Bowling Club bore from its own pumping has been determined from the discharge test reported in the driller's log form[15] for the Bowling Club bore (a copy of the form is attached as Appendix G); and
- The maximum proposed take will be approximately 57 m^3/day for 212 days per year, for the first five years (approximately 0.66 L/s).

The aquifer transmissivity value used in this assessment of effects is a conservative value from published data (refer Section 5.3) for the Waitemat āaquifer of 1 m^2/day, and we have used a storativity of 0.0001 from the published data, assuming the aquifer is confined. The drawdown effect is calculated based on abstraction from the proposed Ryman irrigation bore only and does not include effects of any other groundwater abstraction in the area. However, Auckland Council records show that there is no other known groundwater abstraction in the area.

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[13] Fetter, C. W. (1994). Applied Hydrogeology. Third edition. Prentice Hall Inc., New Jersey, USA, p. 370.
[14] Environment Canterbury, groundwater tools and resources: https://www.ecan.govt.nz/your-region/your-environment/water/tools-and-resources/. Drawdown tool.
[15] Driller's log form, no. 1392-12839. Obtained from Auckland Council September 2019.

Table 7.1: Estimated cumulative drawdown effect in the Kohimarama Bowling Club groundwater production bore.

Item	Evaluation
Bore	Kohimarama Bowling Club
Approximate distance from Ryman bore (m)	1200
Depth of Bowling Club bore (m bgl)	280
Static water level	Artesian (July 1994 static level reported as 0.5 m)
Estimated available drawdown (m)	200
Estimated drawdown from own pumping determined from the driller's log form	80
Estimated drawdown effect from proposed Ryman irrigation bore after 212 days (m) using the Theis equation	6.2
Assumed seasonal variation (m)	2
Cumulative total estimated drawdown after 212 days (m)	80 + 6.2 + 2 = 88.2
Estimated remaining drawdown after 212 days (m)	112

The maximum projected drawdown from the assumed abstraction in the Ryman irrigation bore, after 212 days of continuous abstraction at a rate of 0.66 L/s, may result in an additional drawdown of 6.2 m in the bowling club bore, as shown in Table 7.1. While this interference drawdown represents a reduction in the available drawdown in the bowling club bore of approximately 3%, we estimate that approximately 112 m of available drawdown remains in the Bowling Club bore after taking into account the assumed cumulative drawdown effects (Table 7.1). This means that the Bowling Club will still be able to obtain its lawfully authorised supply providing it has a suitably constructed bore. After the first five years of irrigation at the Site, the groundwater take will be reduced to approximately 44 m^3/day, which will reduce the drawdown effect on the Bowling Club bore.

In addition, based on our analysis of other groundwater monitoring data for groundwater take consents from the regional Waitematā aquifer across Auckland, recharge of the aquifer will take place over the winter months, with groundwater levels recovering to pre-pumping levels.

7.7 Ability of proposed bore to extract groundwater volume sought

Assuming a specific capacity of 1 m^3/day/m of drawdown, the estimated long-term drawdown in the borehole will be approximately 57 m at a pumping rate of 57 m^3/day (for the first five years and then 44 m^3/day thereafter). We estimate that the available drawdown in the bore will be at least 88 m (depth to base of casing minus static water level, minus 2 m for seasonal variation). Therefore, there will be approximately 30 m of available drawdown remaining.

8 Conclusions

The annual volume of water required for amenity irrigation of the Site is estimated as 12,090 m^3/year (averaging 57 m^3/day) for the first five years, for amenity planting establishment, and then 9,300 m^3/year (averaging 44 m^3/day) thereafter. The requested maximum irrigation rates are for an instantaneous rate of 3 L/s, with a maximum 28-day daily rate of 117 m^3/day for the first five years and then a maximum 28-day daily rate of 90 m^3/day for future years (after the first five years). Water conservation and irrigation best practice has been considered and will be implemented.

Sufficient groundwater (274,000 m^3/year, after allowing for existing users) is calculated to be available from the Waitematā aquifer for the Ryman amenity irrigation requirements and groundwater levels are expected to recover in the Waitematā aquifer during the winter months when irrigation is not required.

The proposed irrigation bore will be constructed in accordance with NZS 4411, and finished with up to 200 mm diameter casing, grouted down to approximately 100 m bgl, with an open hole up to 400 m below ground (i.e. up to 300 m of open hole). The proposed bore location is at or within 50 m of NZTM 1763960.8E 5918658.3N. Groundwater monitoring has been proposed, consistent with the Ryman village in Hobsonville, Auckland.

The effects of the proposed groundwater take on groundwater allocation and availability, on recharge to overlying aquifers, on nearby surface water and shallow groundwater bodies, saltwater intrusion effects, settlement effects, and effects on nearby groundwater users are assessed as negligible.

9 Applicability

This report has been prepared for the exclusive use of our client Ryman Healthcare Ltd, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

We understand and agree that this report will be submitted as part of an application for resource consent and that Auckland Council as the consenting authority will use the report for the purpose of assessing that application.

Tonkin & Taylor

Report prepared by: Authorised for Tonkin & Taylor Ltd by:

....	....
Hannah Ross	Pierre Malan
Hydrogeologist	Project Director

Technical review by:

....

Tony Reynolds

Senior Hydrogeologist

HARO
\\ttgroup.local\files\aklprojects\30314\issueddocuments\hydrogeology\20191023 ryman kohimarama borehole and irrigation final v2.docx

Appendix A: Proposed Village Master Concept Plan

Drawing Plotted: 27/09/2019 6:17:35 PM

LEGEND

- Site Boundary
- Proposed B01 Building
- Proposed B02 - B07 Buildings
- Road
- Swale / Intermittent Stream
- Pedestrian Path
- Retaining Wall
- Pedestrian Sky Bridge

RESOURCE CONSENT
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
A	RESOURCE CONSENT	MJK	NZE	AOM	13.09.19

Drawing Originator: Beca

Original Scale (A1) 1 : 500	Design	AOM	13.09.19
Reduced Scale (A3) Half A1	Drawn	JRW	13.09.19
	Dsg Verifier	LH	13.09.19
	Dwg Check	NZE	13.09.19

Client: RYMAN HEALTHCARE LTD

Project: Kohimarama Retirement Village
223 Kohimarama Road - 7 John Rymer Place

Title: Site Master Plan

Discipline: Architecture

Drawing No. 044-RCT-S01-A0-010 Rev. A

DO NOT SCALE

IF IN DOUBT ASK

www.beca.com

Document No. BIM 360://044 - Kohimarama/044-RCT_S01_SITE.rvt

Appendix B: Irrigation Reasonable Use Database results

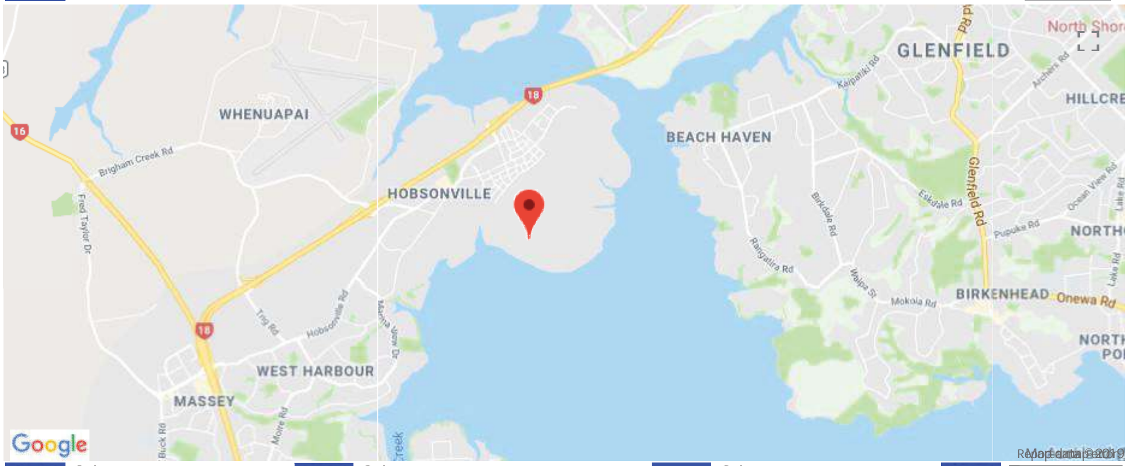
IRRIGATION REASONABLE USE DATABASE

5 STEPS - TO GET THE IRRIGATION REQUIREMENTS INFORMATION YOU NEED FOR IRRIGATION PLANNING, CONSENTING AND DESIGN

IRRIGATION NEW ZEALAND — Ministry for Primary Industries Manatū Ahu Matua — Sustainable Farming Fund — LGA — aqualinc

1 Enter the address or coordinates (latitude, longitude) of your farm and click 'Locate' or click on the map

-36.804 , 174.660 [Locate]



2 Select Crop: Pasture | **3** Select Plant Available Water: (a) Most likely PAW in this area | **4** Select Irrigation Method: 80% Efficient Irrigator | **5** Fetch Data

100%

Farm Details		Plant Available Water Details			Irrigation Requirements					
Description		PAW(mm)	Indicative Likelihood	Area (hectares)		Per Hectare		Total Area	
Latitude	-36.804	90	32.3	1.46	System Capacity	0.61	(l/s/ha)	0.89	(l/s)
Longitude	174.66			0	System Capacity	5.3	(mm/day)		
Council	Auckland			0	Daily Volume	53	(m^3/ha)	77	(m^3)
Climate Site ID	P174217			0	7 Day Volume		(m^3/ha)		(m^3)
Distance to Climate Site (km)	3.49			0	28 Day Volume		(m^3/ha)		(m^3)
Rainfall (mm)	1297		Total area =	1.46	90% ile Annual Volume	6,353	(m^3/ha)	9,275	(m^3)

These estimates of irrigation requirements are based on the assumption that the crop you selected can be grown and irrigated at the site you have selected. Constraints such as topography and crop-specific climate requirements are not taken into account.

Irrigation requirements may be less than reported here if your soils are poorly drained or the water table is close to the soil surface.

[Detailed Results] [Save this Page] [Background Information]

Background Information

The provision of a national database of irrigation requirements was an Irrigation NZ initiative and was made possible through funding from the Sustainable Farming Fund and a number of Local Government Authorities.

The database and website were developed by Aqualinc Research Ltd. If you require more information on the methods and data used than is provided below, or if you require detailed analyses specific to your property, please email John Bright at j.bright@aqualinc.co.nz

The irrigation water requirements database was developed by computer simulating the operation of irrigation systems over the period 1 July 1972 to 30 June 2012 using Aqualinc's irrigation calculator 'IrriCalc'. IrriCalc uses daily climate data, along with soil, crop and irrigation system data, to calculate a daily soil water balance using methods described in FAO Irrigation and Drainage Paper 56. The climate data was sourced from NIWA, the soils data from Landcare Research, and the crop data is either from research conducted by Plant and Food Research or Aqualinc, or from FAO Paper 56.

Irrigation water requirements are greatly influenced by the type of irrigation method used and how it is managed. The irrigation water requirements presented here are based on the assumption that Good Management Practice is applied. Good Management Practice depends on the combination of irrigation method, soil and crop chosen for a particular land-holding. It aims to maximise production and achieve the highest level of irrigation system efficiency that is reasonably achievable for the chosen irrigation method and soil. Lower irrigation water use than is presented here can be achieved by, for example, applying a more aggressive deficit irrigation management strategy. If you wish to investigate the benefits of using alternatives to Good Management Practice please contact Dr John Bright.

The irrigation water requirements are presented as statistics that are relevant to the planning, design and consenting of irrigation systems in New Zealand. These are summarised in the following table:

System Capacity (Litres/sec/ha)	The flow rate required per hectare irrigated to fully meet the daily irrigation requirement 80% of the time, and partially meet it the remaining 20% of time.
Daily Volume (m^3/ha)	The daily volume required, per hectare irrigated, to fully meet the daily irrigation requirement 80% of the time, and partially meet it the remaining 20% of time.
7 Day Volume (m^3/ha)	Seven times the daily volume. Irrigation systems need to operate at system capacity continually for 7 days or more to 'keep up with evapotranspiration' during the peak of the irrigation season, in most years.
28 Day Volume (m^3/ha)	The water volume that fully meets irrigation requirements over any 28 day period in 8 years out of 10.
Monthly Volume (m^3/ha)	The water volume that fully meets irrigation requirements in the calendar month of interest in 9 years out of 10 (i.e. the 90 percentile).
Annual Volume (m^3/ha)	The water volume that fully meets the annual irrigation requirement in 5 years out of 100 (5 percentile), 10 years out of 100 (10 percentile), ..., 90 years out of 100 (90 percentile), 95 years out of 100 (95 percentile).

Close

Detailed Results: Annual and Monthly Volumes

Annual Volumes (m^3/ha)

Average Annual	5 %ile	10 %ile	20 %ile	30 %ile	40 %ile	50 %ile	60 %ile	70 %ile	80 %ile	90 %ile	95 %ile
4,970	2,890	3,460	4,620	4,620	4,620	5,200	5,200	5,200	5,780	6,352	6,350

Monthly Volumes (m^3/ha)

Month	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Average	0	0	0	270	650	1,100	1,140	1,080	530	190	0	0
90 Percentile	0	0	0	580	1,160	1,730	1,730	1,730	1,160	580	0	0

7 Day Volumes (m^3/ha)		28 Day Volumes (m^3/ha)			
Mean Annual	580	Mean Annual	1,650	Average System Efficiency (%)	82
90 Percentile	580	90 Percentile	1,730	% of time Soil Moisture > 50% full	96

Close

Appendix C: Equipment supporting efficient use – provided by The Irrigation Warehouse

Tony Reynolds

From: Darcy Cresswell <darcy@tiw.co.nz>
Sent: Monday, 4 March 2019 12:09 PM
To: Tony Reynolds
Subject: Irrigation efficiency & total flow estimates
Attachments: MP_BROCHURE_METRIC.pdf; Hunter Wireless RainClik.pdf; RIV_BR_HydroPC-PCND-Brochure_R6_EN_W17_0633-1.pdf

Hi Tony,

Following up on our conversation on Friday I have attached some product brochures detailing some of the ways we maximise irrigation efficiency for Ryman Healthcare sites.

Some of the measures we use to maximise irrigation efficiency and minimise wastage are:

- We use Rainbird controllers so that the irrigation runs automatically at night, minimising wind disturbance of sprinklers and evaporative losses due to heat and wind.
- All controllers are fitted with Rain Switches which means the irrigation is automatically suspended for a preset period after rainfall.
- We use Hunter MP Rotator sprinklers for lawn areas which have the lowest application rate possible –this minimises the risk of over-watering and also prevents run-off on slopes or anywhere the soil doesn't absorb water quickly. They also require less pressure and flow than other sprinkler types so minimise the demand on water supplies & pumps.
- Pressure Compensated dripline is used to irrigate garden beds and plantings as it specifically targets the roots of plants and prevents water being applied to any areas that don't need it. The dripline typically applies water at 2 Litres-per-hour per dripper, so there is no pooling or runoff in gardens. We also bury the dripline or cover it in bark/mulch which helps to minimise evaporation.

Below are some calculations we have used in the past to estimate total annual demand for retirement village irrigation.
In practice there are a lot of complicating factors – especially as the dripline irrigation in the garden beds is targeted directly on a plant-by-plant basis as opposed to total "blanket" coverage like the lawn areas – but these figures should allow for getting new plants and lawns established and thriving quickly in spring/summer.
The calculation below is based on allowing for 4mm per day over the driest 3 months of the irrigation season, and 2mm per day over the remaining 5 months,

Total Annual Demand Estimate:

Peak of season:

13730m2 total landscaped area (approx)
X 4mm/day
= 55m3/day

x 90 days (3 month "peak irrigation season")
= 4950m3

Remainder of season:

13730m2 total landscaped area (approx)

x 2mm/day
= 27.5m3/day

x 150 days (5 month “off-peak irrigation season”)
= 4125m3

Total annual requirements:

4950m3 + 4125m3 = 9075m3

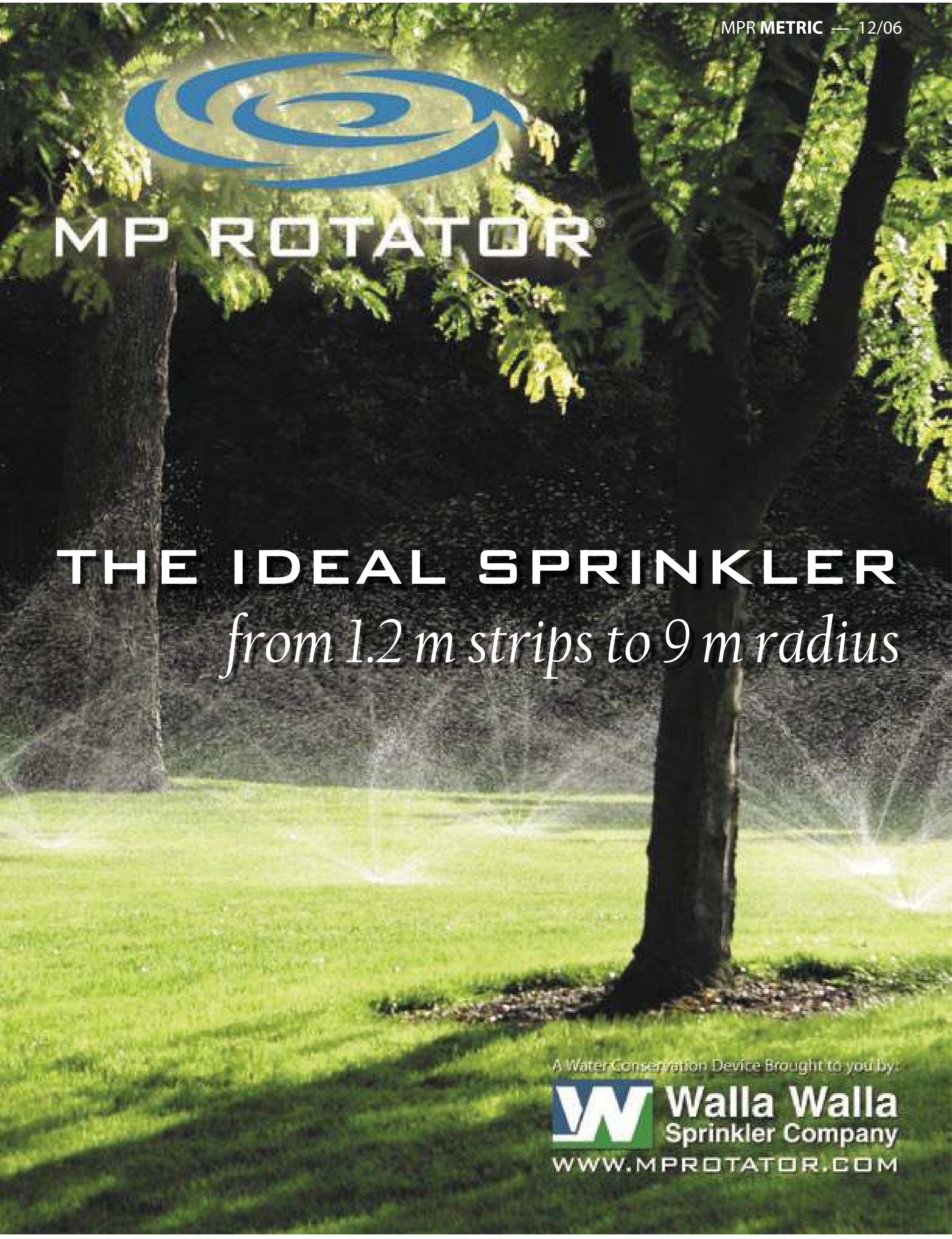
Please let me know if you have any thoughts/questions or if I can help further,

Cheers,

Darcy Cresswell
Design Technician
The Irrigation Warehouse

308 Flaxton Road
RANGIORA

Ph: 03 313 0408
Fx: 03 313 0420
Cell: 021 441727


MPR METRIC — 12/06
MP ROTATOR®
THE IDEAL SPRINKLER
from 1.2 m strips to 9 m radius
A Water Conservation Device Brought to you by:
Walla Walla
Sprinkler Company
WWW.MPROTATOR.COM

MP ROTATOR®

The MP Rotator. A revolutionary sprinkler setting a new standard for water efficiency in the turf & landscape industry. It is a multi-stream rotor the size of a spray nozzle. It fits any conventional spray head body or shrub adapter, transforming it into a high uniformity, low precipitation rate sprinkler with matched precipitation even after arc and radius adjustment.

MP Rotator shown popped up, in operating mode; when watering cycle ends MP Rotator pops down before spray head retracts

patented "double pop" keeps sprinkler free from external debris

color-code system for identifying models (see page 4)

removable inlet filter keeps sprinkler free from internal debris

A WATER CONSERVATION TOOL

- Multiple rotating streams provide superior uniformity
- Automatic matched precipitation even after arc & radius adjustment
- Low precipitation rate reduces runoff on slopes & tight soils

A FLEXIBLE DESIGN TOOL

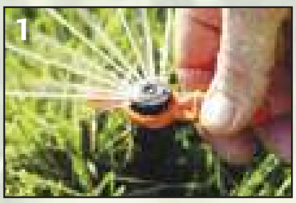
- Ideal for 1.2 m strips to 9 m spacings — **any model can be combined on the same zone**
- Eliminates the uncertainty associated with nozzle trees and rotor nozzling

PROVEN DURABILITY & RELIABILITY

- Rotator® Technology proven in demanding agricultural conditions since 1987
- One moving part
- "Double-pop" flushes on start-up and shut-down

SIMPLE AND QUICK ADJUSTMENTS*

- Easy arc adjustment (1)
- Easy radius adjustment (2) — up to 25%
- No nozzle to change



*see page 7

SAVE WATER — SOLVE PROBLEMS

> NEW SYSTEMS

— *Ultimate design flexibility*
— *Lower installed costs*
— *Better system efficiency*

> REVITALIZE OLD SYSTEMS

— *Solve low pressure problems*
— *Solve coverage problems*

> SLOPES & TIGHT SOILS

— *Low precipitation radically reduces runoff*

Compared to fixed-arc sprays and rotors, MP Rotators deliver significant performance advantages, great design flexibility and impressive cost savings. Any of the MP Rotator models can be combined on the same zone and **maintain a matched precipitation rate — even after arc and radius adjustment**.

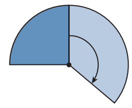
On existing systems, the MP Rotator's **unique combination of low flow and high uniformity** makes it possible to solve spray head coverage problems — whether the problem is low pressure, too many spray heads on a line or "stretched" spacing.

Maintain Matched Precipitation — *Any Model*, Any Arc, Any Radius

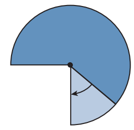
Specify Model & Arc. Add "T" to Model Name to specify Male Thread.

Example: **MP2000** **90-210**

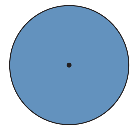
Model *Arc*



90-210°



210-270°

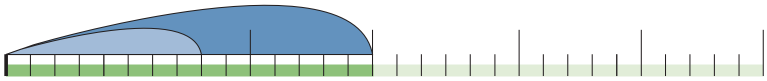


360°

ADJUSTABLE RADIUS / ADJUSTABLE ARC

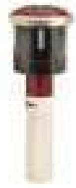
MP1000

stream height @ 2 bar = 0.4 m



2.5 m ← 4.6 m
RADIUS REDUCTION

MP1000 90-210



Maroon

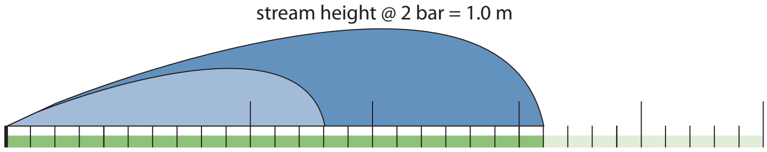
Not Available

MP1000 360

Olive

MP2000

stream height @ 2 bar = 1.0 m



4 m ← 6.4 m
RADIUS REDUCTION

MP2000 90-210

Black

MP2000 210-270

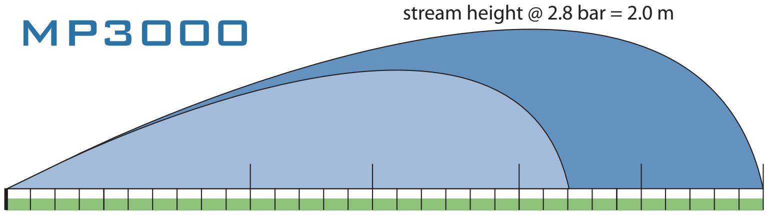
Green

MP2000 360

Red

MP3000

stream height @ 2.8 bar = 2.0 m



6.7 m ← 9.1 m
RADIUS REDUCTION

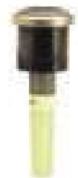
MP3000 90-210

Blue

MP3000 210-270

Yellow

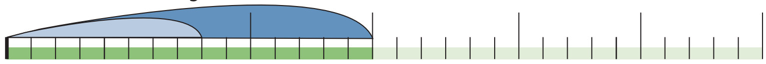
MP3000 360



Gray

MP CORNER

stream height @ 2 bar = 0.25 m

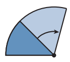


2.5 m ← 4.5 m
RADIUS REDUCTION

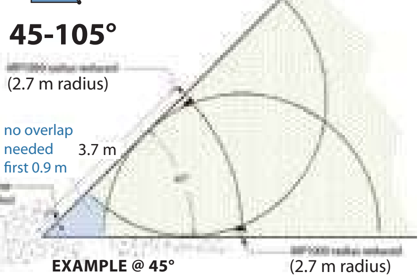
The MP Corner is designed for tight corners that are difficult to irrigate properly with conventional sprinklers. It has an adjustable arc from 45° to 105°, maintains MPR at any arc, any radius and can be placed on the same zone with any other MP Rotator model.

MP Corner

Turquoise

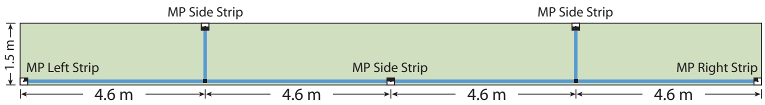


45-105°



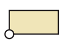
MP STRIP

▲ EXAMPLE WITH TRIANGULAR SPACING



The three new MP Strip models of the MP Rotator family offer an exciting alternative to conventional spray heads to meet the challenges of irrigating strip areas. Strip models offer improved uniformity and excellent wind-fighting ability. The reduced flow rate compared to conventional sprays makes longer runs and/or fewer zones possible.

MP LEFT STRIP

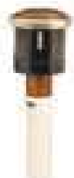


Ivory

MP SIDE STRIP

Brown

MP RIGHT STRIP



Copper

MP1000*

Arc Setting	Color	kPa	bar	Rad. (M)	LPH	LPM	mm/hr ■	mm/hr ▲
90°	MAROON = 90-210°	—	—	—	—	—	—	—
		200	2.00	3.7	36	0.61	11	12
		225	2.25	3.8	38	0.63	10	12
		250	2.50	4.0	41	0.68	10	12
		275	2.75	4.1	42	0.70	10	11
		300	3.00	4.3	44	0.73	10	11
		325	3.25	4.3	45	0.75	10	11
		350	3.50	4.4	47	0.78	10	11
		375	3.75	4.6	49	0.81	9	11
180°		—	—	—	—	—	—	—
		200	2.00	3.7	72	1.20	11	12
		225	2.25	3.8	76	1.27	10	12
		250	2.50	4.0	81	1.35	10	12
		275	2.75	4.1	84	1.40	10	11
		300	3.00	4.3	88	1.46	10	11
		325	3.25	4.3	91	1.51	10	11
		350	3.50	4.4	94	1.56	10	11
		375	3.75	4.6	97	1.62	9	11
210°		—	—	—	—	—	—	—
		200	2.00	3.7	85	1.41	11	13
		225	2.25	3.8	89	1.48	10	12
		250	2.50	4.0	95	1.58	10	12
		275	2.75	4.1	98	1.63	10	11
		300	3.00	4.3	102	1.71	10	11
		325	3.25	4.3	106	1.76	10	11
		350	3.50	4.4	109	1.82	10	11
		375	3.75	4.6	113	1.89	9	11
270°								
360°	OLIVE = 360°	—	—	—	—	—	—	—
		200	2.00	3.5	144	2.40	12	14
		225	2.25	3.8	153	2.55	11	13
		250	2.50	4.0	161	2.69	10	12
		275	2.75	4.1	169	2.81	10	12
		300	3.00	4.3	177	2.94	10	11
		325	3.25	4.3	183	3.05	10	11
		350	3.50	4.4	190	3.17	10	11
		375	3.75	4.5	195	3.25	10	11

MP2000*

Arc Setting	Color	KPA	bar	Rad. (M)	LPH	LPM	mm/hr ■	mm/hr ▲
90°	BLACK = 90-210°	175	1.75	5.2	71	1.18	11	12
		200	2.00	5.5	74	1.23	10	11
		225	2.25	5.6	80	1.33	10	12
		250	2.50	5.8	86	1.43	10	12
		275	2.75	6.1	91	1.52	10	11
		300	3.00	6.4	94	1.57	9	11
		325	3.25	6.6	97	1.62	9	10
		350	3.50	6.7	101	1.68	9	10
		375	3.75	6.7	106	1.77	9	11
180°		175	1.75	4.9	133	2.22	11	12
		200	2.00	5.2	141	2.35	11	13
		225	2.25	5.3	150	2.50	11	13
		250	2.50	5.5	160	2.67	11	12
		275	2.75	5.8	168	2.80	10	12
		300	3.00	6.1	174	2.90	10	11
		325	3.25	6.2	182	3.03	9	11
		350	3.50	6.4	189	3.15	9	10
		375	3.75	6.4	193	3.22	9	11
210°	GREEN = 210-270°	175	1.75	4.9	155	2.58	11	12
		200	2.00	5.2	165	2.75	11	13
		225	2.25	5.3	175	2.92	11	13
		250	2.50	5.5	185	3.08	10	12
		275	2.75	5.8	195	3.25	10	12
		300	3.00	6.1	205	3.42	10	11
		325	3.25	6.2	214	3.57	9	11
		350	3.50	6.4	222	3.70	9	10
		375	3.75	6.4	228	3.80	10	11
270°		175	1.75	4.9	199	3.32	11	12
		200	2.00	5.2	212	3.53	11	13
		225	2.25	5.3	225	3.75	11	13
		250	2.50	5.5	238	3.97	10	12
		275	2.75	5.8	249	4.15	10	12
		300	3.00	6.1	261	4.35	10	11
		325	3.25	6.2	272	4.53	9	11
		350	3.50	6.4	282	4.70	9	10
		375	3.75	6.4	293	4.88	9	11
360°	RED = 360°	175	1.75	4.9	265	4.42	11	12
		200	2.00	5.2	283	4.72	11	13
		225	2.25	5.3	300	5.00	11	13
		250	2.50	5.5	317	5.28	10	12
		275	2.75	5.8	333	5.55	10	12
		300	3.00	6.1	348	5.80	10	11
		325	3.25	6.2	362	6.03	9	11
		350	3.50	6.4	375	6.25	9	10
		375	3.75	6.4	384	6.40	9	10

MP3000**

Arc Setting	Color	KPA	bar	Rad. (M)	LPH	LPM	mm/hr ■	mm/hr ▲
90°	BLUE = 90-210°	175	1.75	7.6	158	2.63	11	13
		200	2.00	8.2	166	2.77	10	11
		225	2.25	8.4	175	2.92	10	12
		250	2.50	8.5	185	3.08	10	12
		275	2.75	9.1	195	3.25	9	11
		300	3.00	9.1	203	3.38	10	11
		325	3.25	9.1	212	3.53	10	12
		350	3.50	9.1	220	3.67	11	12
		375	3.75	9.1	228	3.80	11	13
180°		175	1.75	7.6	329	5.48	11	13
		200	2.00	8.2	353	5.88	10	12
		225	2.25	8.4	373	6.22	11	12
		250	2.50	8.5	393	6.55	11	12
		275	2.75	9.1	413	6.88	10	11
		300	3.00	9.1	431	7.18	10	12
		325	3.25	9.1	449	7.48	11	12
		350	3.50	9.1	466	7.77	11	13
		375	3.75	9.1	481	8.02	12	13
210°	YELLOW = 210-270°	175	1.75	7.6	384	6.40	11	13
		200	2.00	8.2	411	6.85	10	12
		225	2.25	8.4	436	7.27	11	12
		250	2.50	8.5	459	7.65	11	12
		275	2.75	9.1	481	8.02	10	11
		300	3.00	9.1	502	8.37	10	12
		325	3.25	9.1	523	8.72	11	12
		350	3.50	9.1	542	9.03	11	13
		375	3.75	9.1	562	9.37	12	13
270°		175	1.75	7.6	501	8.35	12	13
		200	2.00	8.2	530	8.83	10	12
		225	2.25	8.4	560	9.33	11	12
		250	2.50	8.5	589	9.82	11	12
		275	2.75	9.1	619	10.32	10	11
		300	3.00	9.1	646	10.77	10	12
		325	3.25	9.1	673	11.22	11	12
		350	3.50	9.1	701	11.68	11	13
		375	3.75	9.1	727	12.12	11	13
360°	GRAY = 360°	175	1.75	7.6	659	10.98	11	13
		200	2.00	8.2	703	11.72	10	12
		225	2.25	8.4	745	12.42	11	12
		250	2.50	8.5	786	13.10	11	12
		275	2.75	9.1	825	13.75	10	11
		300	3.00	9.1	862	14.37	10	12
		325	3.25	9.1	897	14.95	11	12
		350	3.50	9.1	931	15.52	11	13
		375	3.75	9.1	964	16.07	12	13

*To obtain full radius reduction for the MP1000 and MP2000, operate at a maximum of 2 bar. ** When operating the MP3000 at full radius reduction maintain a minimum pressure of 2.8 bar to assure reliable operation. Radius measured on a 10 cm high riser. Precipitation rates are based on head-to-head throw coverage.

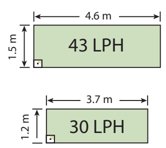
MP CORNER

Arc Setting	Color	kPa	bar	Rad. (M)	LPH	LPM
45°	TURQUOISE = 45-105°	—	—	—	—	—
		200	2.00	3.5	36	0.61
		225	2.25	3.8	38	0.63
		250	2.50	4.0	41	0.68
		275	2.75	4.1	42	0.70
		300	3.00	4.3	44	0.73
		325	3.25	4.3	45	0.75
		350	3.50	4.4	47	0.78
		375	3.75	4.5	49	0.81
90°		175	1.75	3.2	69	1.15
		200	2.00	3.5	76	1.27
		225	2.25	3.8	79	1.31
		250	2.50	4.0	84	1.40
		275	2.75	4.1	86	1.44
		300	3.00	4.3	94	1.57
		325	3.25	4.3	98	1.63
		350	3.50	4.4	100	1.67
		375	3.75	4.5	104	1.73
105°		175	1.75	3.2	80	1.34
		200	2.00	3.5	89	1.48
		225	2.25	3.8	92	1.53
		250	2.50	4.0	98	1.63
		275	2.75	4.1	102	1.70
		300	3.00	4.3	110	1.83
		325	3.25	4.3	113	1.88
		350	3.50	4.4	117	1.94
		375	3.75	4.5	120	2.00

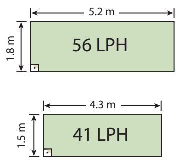
MP LEFT STRIP

kPa	bar	Unadjusted Radius LPH	Reduced Radius LPH	Precip Rate*** mm/hr
200	2.00	43	30	12
225	2.25	45	33	12
250	2.50	48	35	12
275	2.75	50	36	12
300	3.00	52	38	12
325	3.25	54	40	12
350	3.50	56	41	12
375	3.75	58	43	12

200 kPa



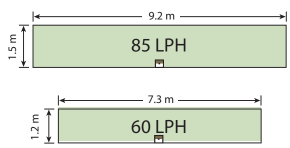
350 kPa



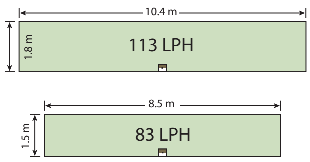
MP SIDE STRIP

kPa	bar	Unadjusted Radius LPH	Reduced Radius LPH	Precip Rate*** mm/hr
200	2.00	85	60	12
225	2.25	90	66	12
250	2.50	95	69	12
275	2.75	100	73	12
300	3.00	104	76	12
325	3.25	108	79	12
350	3.50	113	83	12
375	3.75	117	86	12

200 kPa



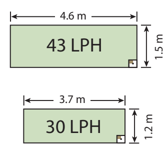
350 kPa



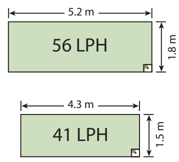
MP RIGHT STRIP

kPa	bar	Unadjusted Radius LPH	Reduced Radius LPH	Precip Rate*** mm/hr
200	2.00	43	30	12
225	2.25	45	33	12
250	2.50	48	35	12
275	2.75	50	36	12
300	3.00	52	38	12
325	3.25	54	40	12
350	3.50	56	41	12
375	3.75	58	43	12

200 kPa



350 kPa



****Precip. rate at rectangular spacing.* The slightly higher precipitation rate of the MP Strips is intentional. It compensates for the significant proportion of edge watering in strip applications.

MP ROTATOR VS. SPRAYS

- Lower precipitation rate
  - *radically less runoff*
- Higher uniformity
  - *even after radius reduction*
- Superior close-in water
- Superior wind resistance
- Reduced misting at higher pressure

Lower installed cost!

1/3 the flow rate of a spray head

FEWER ZONES

LESS MATERIAL

LESS LABOR

MP ROTATOR VS. ROTORS

THE MAGIC OF MULTIPLE ROTATING STREAMS

- Better uniformity after radius reduction
  - *no diffuser screw to cause stream distortion*
- Superior performance in windy conditions
  - *tight, high-energy streams penetrate the wind*
- Quick, easy arc & radius adjustments
  - *no nozzle to change ... no nozzle tree hassle*
  - *faster installation*
  - *New! MP Matchstick saves your back & knees*
- Lower cost

**Built-in slip clutch prevents damage from over adjustment.*
***While water is on, use orange tool to engage built-in ratchet; move past the left or right stop until left edge is aligned.*

WE TAKE THIS CLAIM VERY SERIOUSLY

The water savings potential is real ...
it is big ... and the MP Rotator® is the future.

The multi-trajectory, rotating streams of the MP Rotator apply water more slowly and uniformly than conventional sprays and rotors — especially after arc and radius adjustment. **Independent water audits now document water savings of 30% when conventional sprays are replaced with MP Rotators.** Additional water-saving advantages include better wind-resistance, less misting and virtually no run-off. *Visit **www.mprotator.com** to learn more.*

Walla Walla Sprinkler Company

A subsidiary of Nelson Irrigation Corporation
(A world leader in water application solutions for agriculture)

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Walla Walla, WA 99362-2271, U.S.A.

Tel: +1 509-525-7660
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Hunter®
The Irrigation Innovators

Wireless Rain-Clik™

The first reliable wireless rain sensor provides fast installation on any system

Wireless Rain-Clik Sensor

Wireless Rain-Clik Receiver

If the thought of running wires from a controller has kept you from adding rain sensors to your systems, now there's a hassle-free alternative. The Hunter Wireless Rain-Clik™ attaches quickly and easily—simply install the receiver unit next to your irrigation controller, then install the transmitter anywhere that the device can receive representative rainfall. No ladders needed to attach to a high outcropping on a building, no messy wires to hide out of view. What also sets a Hunter Rain-Clik apart are features no other rain-sensing device offers. The unique Quick Response™ feature allows the product to shut off immediately when it starts to rain.

And, unlike its competition, Hunter's sophisticated sensing mechanism cannot be fouled by debris, giving the Wireless Rain-Clik the most highly accurate operation.

PROVEN WATER SAVER

Features & Benefits

Improved metal mounting mechanism easily installs on fences or eaves.

Hassle-free, wire-free easy installation
Simple to add on to a new or existing installation

Hunter's unique Quick Response feature
No need for water to accumulate for shutoff

Rugged construction
Heavy-duty polycarbonate housing and metal extension arm

Set a maximum dry-out period
Adjust the irrigation re-start to account for varying amounts of rain

Operates up to 300 meters from the receiver unit
Typical wired system limitations vanish

Maintenance-free design
With a 10-year battery life there is no need to replace batteries

Built-in bypass switch on receiver panel
Adds flexibility to the system

Instant Shut Off When it Rains

There are a lot of rain-sensing devices on the market today, but all of them shut off an irrigation system only when a pre-set level of accumulated water is reached. That means that even after it has started raining, a system will continue to operate, an action that can give the impression water is being wasted (not the image that a municipality wants to give its constituents as they pass by parks, roadways, and other city-owned lands). Only the Hunter Rain-Clik products, with their unique Quick Response feature, allow an irrigation system to shut off immediately when it starts to rain.

Models

WRC – Wireless Rain-Clik (315 MHz for United States)

WRC-INT – Wireless Rain-Clik (433 MHz for Europe, Australia, and other markets)

SGM – Sensor gutter mount

Dimensions

- 8 cm diameter x 10 cm high

Operating Specifications

- Wiring: normally closed or normally open
- Time to turn off irrigation system: 2 to 5 minutes for Quick Response
- Time to reset Quick Response unit: 4 hours maximum under dry sunny conditions
- Time to reset: 3 days maximum under dry sunny conditions for the total rainfall compensation unit
- Operating temperature: 0˚C to 54˚C
- Vent ring allows for adjustment of reset delay
- UV colorfast and stable
- UL listed, FCC/DOC approved, suitable for use in Australia, CUL (CSA), CE
- Rain sensor transmitting range: up to 300 meters line of sight*
- Optional gutter mount for Rain-Clik (order SGM)
- 10 year maintenance-free battery

Electrical Specifications

- Receiver power: 22-28VAC, 100 mA (from timer transformer)
- Receiver includes built-in bypass switch, no extra switch required
- Works with all standard controllers

* Range estimate is for WRC (U.S. models)

Easy to Test, Easy to Install

(A) Mount the receiver adjacent to the controller. Activate a station manually in the area where you will be mounting the sensing unit.

(B) Go out to the area where you want to mount the sensing unit. Press the interrupt on the sensing unit to verify if the zone turns off. You are now ready to permanently mount the sensing unit.

A

B

C

(C) Fence mounting is a simple procedure, with no wires to string. Simply attach the sensor and test the system.

(D) For optional gutter mounting (model SGM), a single thumb screw makes attachment easy. Just twist and it will firmly secure to the gutter.

D

SPECIFICATION GUIDE

EXAMPLE: **WRC-INT**

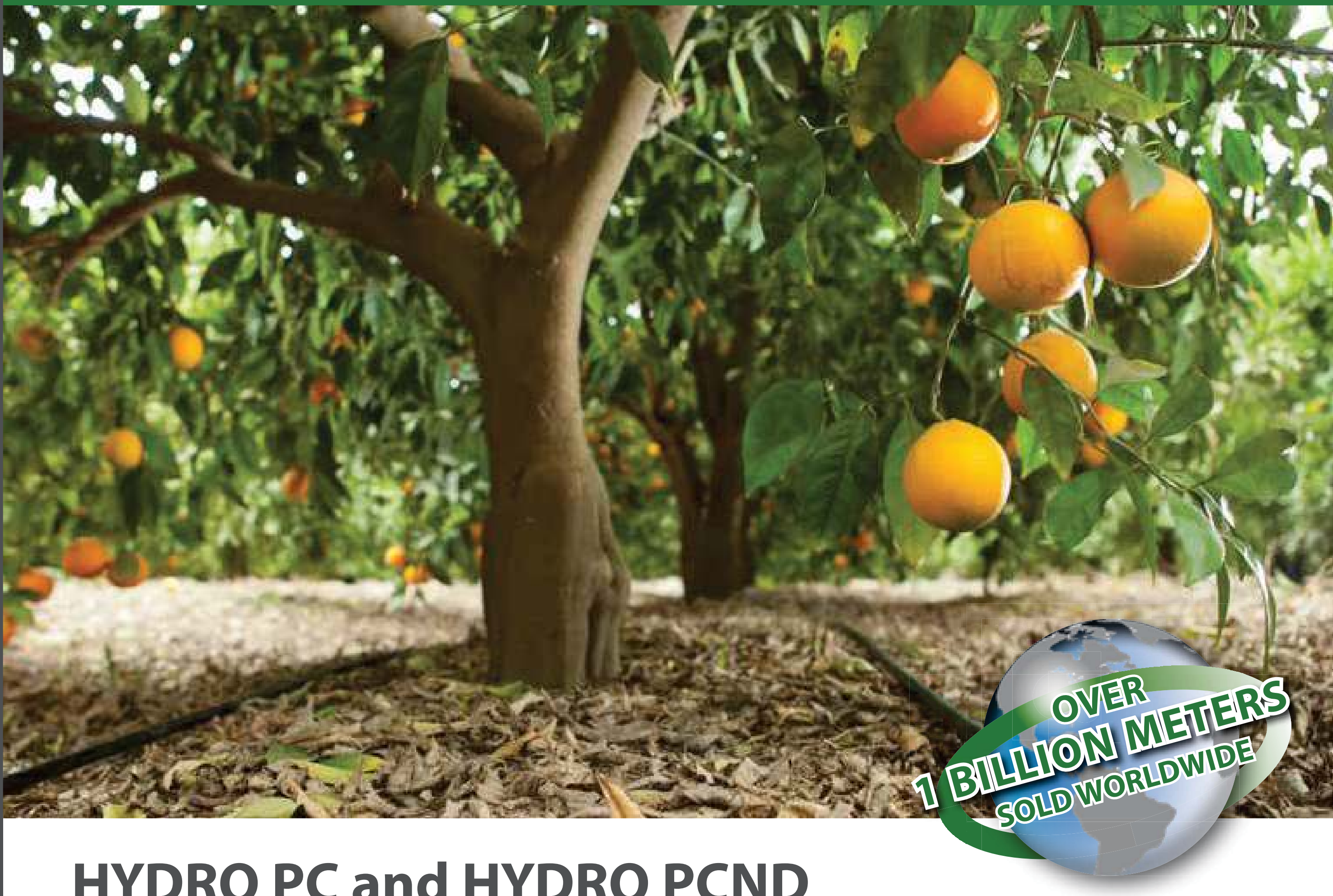
MODEL	OPTION
WRC = Wireless Rain-Clik™ (315 mHz operating frequency)	**INT** = Europe/Australia and other markets (433 mHz operating frequency)*
SGM = Optional Gutter Mount	

* Consult with factory for compatibility in export markets.

The Wireless Rain-Clik or Wireless Rain/Freeze-Clik can also be installed with an outdoor controller. Just use the included weatherproof rubber cover.

HYDRO PC / PCND
DRIP LINES

RELIABILITY AND DEPENDABILITY



HYDRO PC / PCND DRIP LINES

HYDRO PC and HYDRO PCND

Flow Regulating Drip Line

Drip Line	Hydro PC		Hydro PCND			
Dripper Type	Cylindrical					
Pressure Compensating	✔		✔			
No Drain	✘		✔			
Flow Rates (lph)	1.05	1.2, 1.6, 2.2, 3.6	1.05	1.35, 1.75, 2.35, 3.75	1.35, 1.60, 2.35, 3.75	1.20, 2.35, 3.60
Drip Line Diameter (mm)	12	16, 17, 18, 20	12	16	17, 18	20
Drip Line Wall Thickness	12 mm : 35, 40 mil | 16 mm: 35, 40, 45 mil | 17, 20 mm: 40, 45, 47 mil					
Outlet	2 hole top and bottom outlet (above 15 cm spacing configurations)					

Rivulis

www.**rivulis**.com

HYDRO PC / PCND DRIP LINES

RELIABILITY 20 YEARS AND COUNTING

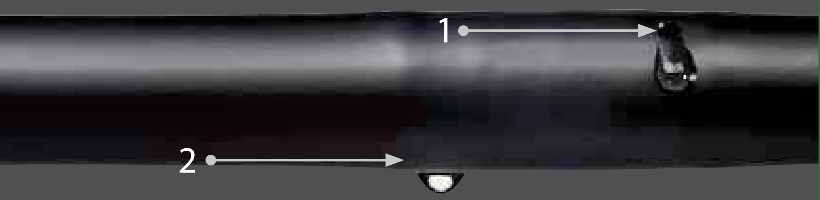
For over 20 years, Hydro PC has been synonymous with reliability.

Farmers from Europe, to Chile, to the USA trust the Hydro PC range of products for long-term horticultural applications including orchards, vineyards and greenhouses.

Manufactured in 7 countries, and exported globally, Hydro PC remains one of the most popular drip lines in the world for one simple reason – you can depend on it season after season.

CYLINDRICAL EMITTER: **EXTRA TOUGH DESIGN**

The Hydro PC range cylindrical drippers are large, tough and can tolerate harsh environments. That's why you will see Hydro drip line used everywhere from the vineyards in Europe, to orchards in Australia.



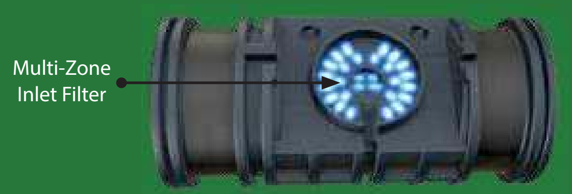
DUAL OUTLETS: BUILT-IN REDUNDANCY

Unlike other emitters with just one outlet, if a Hydro PC emitter outlet becomes blocked, a second outlet on the opposing side provides redundancy to the emitter. An additional benefit of the dual outlets is that it doesn't matter what direction you lay the tube.

Dual outlets are standard in all Hydro PC configurations with 15 cm and greater spacing.

MULTI-ZONE INLET FILTER: PROTECTING YOUR EMITTERS YEAR AFTER YEAR

Due to its unique cylindrical design, Hydro PC is built with a larger inlet filter than most competing drip lines.



Did you know Hydro PC has ***600% more effective filtration area*** *than the leading competitor?*

PC OR PCND: WHAT TO USE?

PC

Stands for: Pressure compensating

What does it do: Within a relatively large pressure range, PC ensures the same flow per dripper regardless of what the pressure is at that point of the tube. So the dripper at lower elevation will emit the same amount of water as the dripper at the highest point

Where to use: Undulating ground and long-run lengths

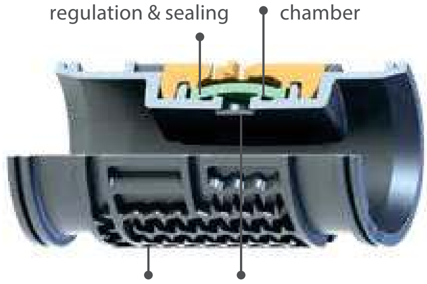
PCND

Stands for: Pressure compensating & no-drain

Also known as: CNL

What does it do: In addition to pressure compensating, the dripper seals when pressure falls below 1 m pressure (1.2 m pressure in 12 mm Hydro PCND) to stop water draining out of the tube at shut-off

Where to use: Pulse irrigation, sub-surface and highly undulating ground. Also ideal for greenhouse applications.



WHITE DRIP LINE: **DISCOVER THE BENEFITS**

For your next drip line installation, consider the many benefits of using WHITE drip line. Available for all Hydro PC and PCND configurations.

• Absorbs less radiation than black tube.

• Gets your water temperature lower in your drip line. Very helpful in pulsing applications where water remains in the tube between irrigating.

• Co-extruded strong and durable manufacturing process.

• Great for greenhouses where the white tube provides additional reflective surfaces.

HYDRO PC **PERFORMANCE DATA**

Nominal Ø	Wall Thickness		Internal Ø	Outside Ø	Flow Rate	Operating Pressure Range	Roll Length	Maximum Run Length (10% FV) Spacing between Drippers (cm)							
								15	20	30	40	50	60	75	100
(mm)	(mil)	(mm)	(mm)	(mm)	(l/h)	(bar)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)
12	25	0.64	10.4	11.7		0.75 - 2.5		54	70	99	127	152	176	209	260
12	35	0.89	10.4	12.2	1.05	0.75 - 3.0	600	59	76	109	138	166	192	229	284
12	40	1.02	10.4	12.4		0.75 - 3.5		63	82	117	149	179	206	246	306
16	35	0.89	13.8	15.6		0.6 - 3.0		90	117	166	211	253	292	347	431
16	40	1.02	13.8	15.8	1.2	0.6 - 3.5	400	97	125	178	227	272	314	374	464
16	45	1.14	13.8	16.1		0.6 - 3.5		97	125	178	227	272	314	374	464
17	35	0.89	15.3	17.1		0.6 - 3.0		114	147	207	261	312	359	425	525
17	40	1.02	15.3	17.3	1.2	0.6 - 3.5	350	122	157	222	281	336	386	458	565
17	45	1.14	15.3	17.6		0.6 - 3.5		122	157	222	281	336	386	458	565
17	47	1.19	15.3	17.7		0.6 - 3.5		122	157	222	281	336	386	458	565
20	40	1.02	17.6	19.6		0.75 - 3.5		160	206	289	364	434	499	590	727
20	45	1.14	17.6	19.9	1.2	0.75 - 3.5	300	160	206	289	364	434	499	590	727
20	47	1.19	17.6	20.0		0.75 - 3.5		160	206	289	364	434	499	590	727
16	35	0.89	13.8	15.6		0.75 - 3.0		75	97	137	175	210	242	288	358
16	40	1.02	13.8	15.8	1.6	0.75 - 3.5	400	80	104	148	188	226	260	310	385
16	45	1.14	13.8	16.1		0.75 - 3.5		80	104	148	188	226	260	310	385
17	35	0.89	15.3	17.1		0.75 - 3.0		94	121	172	217	259	298	353	437
17	40	1.02	15.3	17.3	1.6	0.75 - 3.5	350	101	130	184	233	278	320	380	470
17	45	1.14	15.3	17.6		0.75 - 3.5		101	130	184	233	278	320	380	470
17	47	1.19	15.3	17.7		0.75 - 3.5		101	130	184	233	278	320	380	470
20	40	1.02	17.6	19.6		0.75 - 3.5		133	170	240	302	360	415	490	604
20	45	1.14	17.6	19.9	1.6	0.75 - 3.5	300	133	170	240	302	360	415	490	604
20	47	1.19	17.6	20.0		0.75 - 3.5		133	170	240	302	360	415	490	604

HYDRO PC **PERFORMANCE DATA**

Nominal Ø	Wall Thickness		Internal Ø	Outside Ø	Flow Rate	Operating Pressure Range	Roll Length	Maximum Run Length (10% FV) Spacing between Drippers (cm)							
								15	20	30	40	50	60	75	100
(mm)	(mil)	(mm)	(mm)	(mm)	(l/h)	(bar)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)
16	35	0.89	13.8	15.6	2.2	0.75 - 3.0	400	61	78	112	142	171	197	234	291
16	40	1.02	13.8	15.8		0.75 - 3.5		65	84	120	153	183	212	252	313
16	45	1.14	13.8	16.1		0.75 - 3.5		65	84	120	153	183	212	252	313
17	35	0.89	15.3	17.1	2.2	0.75 - 3.0	350	77	99	139	176	211	243	287	355
17	40	1.02	15.3	17.3		0.75 - 3.5		82	106	149	190	227	261	309	382
17	45	1.14	15.3	17.6		0.75 - 3.5		82	106	149	190	227	261	309	382
17	47	1.19	15.3	17.7		0.75 - 3.5		82	106	149	190	227	261	309	382
20	40	1.02	17.6	19.6	2.2	0.75 - 3.5	300	108	138	195	246	293	337	398	492
20	45	1.14	17.6	19.9		0.75 - 3.5		108	138	195	246	293	337	398	492
20	47	1.19	17.6	20.0		0.75 - 3.5		108	138	195	246	293	337	398	492
16	35	0.89	13.8	15.6	3.6	0.75 - 3.0	400	44	57	81	103	124	143	171	212
16	40	1.02	13.8	15.8		0.75 - 3.5		47	61	87	110	133	154	184	228
16	45	1.14	13.8	16.1		0.75 - 3.5		47	61	87	110	133	154	184	228
17	35	0.89	15.3	17.1	3.6	0.75 - 3.0	350	55	71	101	128	153	176	209	259
17	40	1.02	15.3	17.3		0.75 - 3.5		59	77	108	138	165	190	224	279
17	45	1.14	15.3	17.6		0.75 - 3.5		59	77	108	138	165	190	224	279
17	47	1.19	15.3	17.7		0.75 - 3.5		59	77	108	138	165	190	224	279
20	40	1.02	17.6	19.6	3.6	0.75 - 3.5	300	78	100	141	179	213	245	290	358
20	45	1.14	17.6	19.9		0.75 - 3.5		78	100	141	179	213	245	290	358
20	47	1.19	17.6	20.0		0.75 - 3.5		78	100	141	179	213	245	290	358

HYDRO PCND **PERFORMANCE DATA**

Nominal Ø	Wall Thickness		Internal Ø	Outside Ø	Flow Rate	Operating Pressure Range	Roll Length	Maximum Run Length (10% FV) Spacing between Drippers (cm)							
								15	20	30	40	50	60	75	100
(mm)	(mil)	(mm)	(mm)	(mm)	(l/h)	(bar)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)
12	25	0.64	10.4	11.7	1.05	0.75 - 2.5	600	54	70	99	127	152	176	209	260
12	35	0.89	10.4	12.2		0.75 - 3.0		59	76	109	138	166	192	229	284
12	40	1.02	10.4	12.4		0.75 - 3.5		63	82	117	149	179	206	246	306
16	35	0.89	13.8	15.6	1.35	0.6 - 3.0	400	84	108	154	195	234	271	322	399
16	40	1.02	13.8	15.8		0.6 - 3.5		90	116	165	210	252	291	347	430
16	45	1.14	13.8	16.1		0.6 - 3.5		90	116	165	210	252	291	347	430
17	35	0.89	15.3	17.1	1.35	0.6 - 3.0	350	106	136	191	242	289	333	394	486
17	40	1.02	15.3	17.3		0.6 - 3.5		113	146	206	260	311	358	424	523
17	45	1.14	15.3	17.6		0.6 - 3.5		113	146	206	260	311	358	424	523
17	47	1.19	15.3	17.7		0.6 - 3.5		113	146	206	260	311	358	424	523
20	45	1.14	17.6	19.9	1.2	0.75 - 3.5	300	160	206	289	364	434	499	590	727
20	47	1.19	17.6	20.0		0.75 - 3.5		160	206	289	364	434	499	590	727
16	35	0.89	13.8	15.6	1.75	0.75 - 3.0	400	70	91	130	165	198	229	272	338
16	40	1.02	13.8	15.8		0.75 - 3.5		76	98	139	177	213	246	293	363
16	45	1.14	13.8	16.1		0.75 - 3.5		76	98	139	177	213	246	293	363
17	35	0.89	15.3	17.1	1.6	0.75 - 3.0	350	94	121	172	217	259	298	353	437
17	40	1.02	15.3	17.3		0.75 - 3.5		101	130	184	233	278	320	380	470
17	45	1.14	15.3	17.6		0.75 - 3.5		101	130	184	233	278	320	380	470
17	47	1.19	15.3	17.7		0.75 - 3.5		101	130	184	233	278	320	380	470
20	45	1.14	17.6	19.9	1.75	0.75 - 3.5	300	125	160	226	285	340	391	462	570
20	47	1.19	17.6	20.0		0.75 - 3.5		125	160	226	285	340	391	462	570
16	35	0.89	13.8	15.6	2.35	0.75 - 3.0	400	58	75	107	136	163	189	224	279
16	40	1.02	13.8	15.8		0.75 - 3.5		62	81	115	146	176	203	242	300
16	45	1.14	13.8	16.1		0.75 - 3.5		62	81	115	146	176	203	242	300
17	35	0.89	15.3	17.1	2.35	0.75 - 3.0	350	73	94	133	169	202	233	275	340
17	40	1.02	15.3	17.3		0.75 - 3.5		79	101	143	182	217	250	296	366
17	45	1.14	15.3	17.6		0.75 - 3.5		79	101	143	182	217	250	296	366
17	47	1.19	15.3	17.7		0.75 - 3.5		79	101	143	182	217	250	296	366
20	45	1.14	17.6	19.9	2.35	0.75 - 3.5	300	103	132	187	236	281	323	382	472
20	47	1.19	17.6	20.0		0.75 - 3.5		103	132	187	236	281	323	382	472

HYDRO PCND **PERFORMANCE DATA**

Nominal Ø	Wall Thickness		Internal Ø	Outside Ø	Flow Rate	Operating Pressure Range	Roll Length	Maximum Run Length (10% FV) Spacing between Drippers (cm)							
								15	20	30	40	50	60	75	100
(mm)	(mil)	(mm)	(mm)	(mm)	(l/h)	(bar)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)
16	35	0.89	13.8	15.6	3.75	0.75 - 3.0	400	43	55	79	100	121	140	167	207
16	40	1.02	13.8	15.8		0.75 - 3.5		46	59	84	108	130	150	179	222
16	45	1.14	13.8	16.1		0.75 - 3.5		46	59	84	108	130	150	179	222
17	35	0.89	15.3	17.1	3.75	0.75 - 3.0	350	73	94	133	169	202	233	275	340
17	40	1.02	15.3	17.3		0.75 - 3.5		79	101	143	182	217	250	296	366
17	45	1.14	15.3	17.6		0.75 - 3.5		79	101	143	182	217	250	296	366
17	47	1.19	15.3	17.7		0.75 - 3.5		79	101	143	182	217	250	296	366
20	45	1.14	17.6	19.9	3.6	0.75 - 3.5	300	78	100	141	179	213	245	290	358
20	47	1.19	17.6	20.0		0.75 - 3.5		78	100	141	179	213	245	290	358

Hydro PC Drip Line

"We have over 1.2 million metres of Hydro PC drip line that was installed in our almond crop seven years ago. The emitters are still performing like the day they were first installed"

Tim Orr, Lake Cullulleraine, Australia

Rivulis

www.**rivulis**.com

W17_0633

Appendix D: Auckland Council communication

From: Reginald Samuel <Reginald.Samuel@aucklandcouncil.govt.nz>
Sent: Tuesday, 9 October 2018 3:15 PM
To: Hannah Ross
Subject: RE: Groundwater availability and groundwater management area - Kohimarama

Hi Hannah
Below are my answers in Red.
Regards
Reginald

From: Hannah Ross [mailto:HRoss@tonkintaylor.co.nz]
Sent: Monday, 8 October 2018 3:11 p.m.
To: Reginald Samuel
Cc: Environment; Tony Reynolds
Subject: Groundwater availability and groundwater management area - Kohimarama

Hi Reginald,

We're assessing the groundwater availability for a client in the vicinity of Kohimarama Road, Kohimarama. The site does not lie within a High-Use Aquifer Management Area or a Quality-Sensitive Aquifer Management area according to the GIS overlays on the September 2018 planning maps viewer. I have attached a plan showing our general area of interest (red circle).

Could you please advise the following:-

- What the groundwater availability is in the groundwater catchment that includes Kohimarama Road, Kohimarama – at the St Thomas's School end of the road?
  There is no current water availability calculated. Assuming 223 is the site, Recharge is 5% of rainfall (1300mm) x $1km^2$ = 65,000m3/year.
  Availability is 35% of Recharge = 22,000m3/year.
- What is the name of the aquifer management area/groundwater catchment that this area lies in?
  Aquifer is Waitemata Sandstone and comes under Auckland Isthmus groundwater management area.
- Is there a map of the groundwater management/catchment area?
  No
- Are there any consented groundwater takes within this aquifer management area?
  Yes, but no groundwater takes within a radius of 5km from 223 Kohimarama Road.

If you are not the correct person to be contacting, could you please let me know the contact details of who I should be in touch with?

Many thanks for your time and help!

Kind regards,

Hannah

Hannah Ross | Hydrogeologist
PhD
Tonkin + Taylor - *Exceptional thinking together*
Level 2, 105 Carlton Gore Rd, Newmarket, Auckland 1023 | PO Box 5271, Wellesley Street, Auckland 1141, New Zealand
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To send me large files you can use my file drop

Appendix E: Drawdown assessment in the Bowling Club bore

Drawdown Calculations

Notes

1. This workbook calculates drawdown vs time and drawdown vs distance for radial flow to a well under confined or leaky conditions. If the Leakage coefficient (B) is defined the Hantush-Jacob function is used; otherwise calculations are done using the Theis function.

2. Values in the colour shaded cells can be updated by the user; all other cells are protected. Data entry cells are validated e.g. Storativity (S) must be between 0 and 1.0

3. Units of transmissivity (T) and pumping rate (Q) can be selected.

4. The plotted curves are colour coded to indicate the time (or drawdown) option

Disclaimer

This workbook is supplied on an as-is basis. Environment Canterbury offers no warranty, expressed or implied, as to its accuracy or completeness and are not obligated to provide the user with any support, consulting, training or assistance of any kind with regard to its use, operation, and performance nor to provide the user with any updates, revisions, new versions or "bug fixes".

The user assumes all risk for any damages whatsoever resulting from loss of use, data, or profits arising in connection with the access, use, quality, or performance of this software.

Acknowledgement

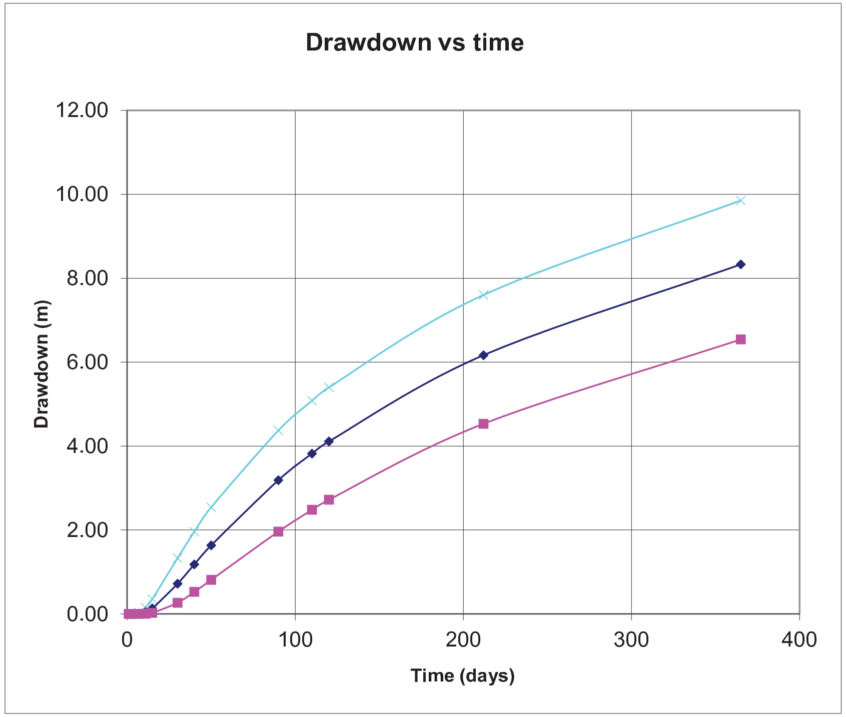
This workbook uses Visual Basic functions supplied by Dr Bruce Hunt (University of Canterbury, Christchurch, New Zealand).

David Scott
Environment Canterbury
February 14, 2001
Ph: +64 3 365 3828
Email: david.scott@ecan.govt.nz

Time-drawdown calculations using Theis equation

Aquifer parameters		
T	1	m2/d
S	1.00E-04	
B		
Pumping rate		
Q	0.66	l/s

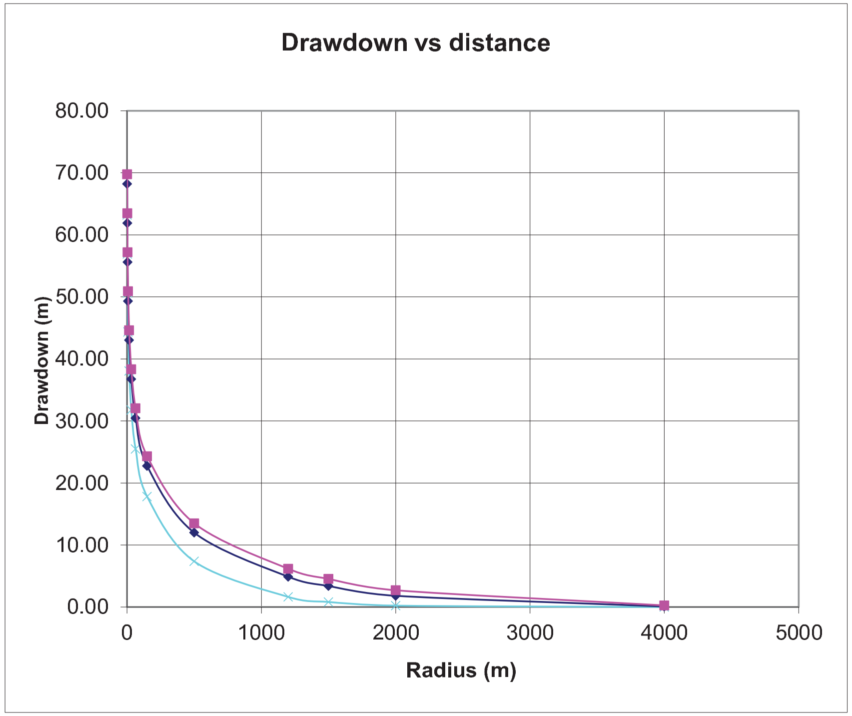
Radius (m)	1000	1200	1500
Time (days)	Drawdown (m)	Drawdown (m)	Drawdown (m)
1	-	-	-
3	0.000	0.000	-
7	0.029	0.004	0.000
11	0.153	0.042	0.005
15	0.355	0.129	0.023
30	1.328	0.719	0.264
40	1.961	1.181	0.522
50	2.540	1.633	0.810
90	4.371	3.187	1.961
110	5.080	3.821	2.479
120	5.397	4.110	2.721
212	7.601	6.166	4.530
365	9.852	8.329	6.540



Distance-drawdown calculations using Theis equation

Aquifer parameters		
T	1	m2/d
S	0.0001	
B		
Pumping rate		
Q	0.66	l/s

Time (days)	50	150	212
Radius (m)	Drawdown (m)	Drawdown (m)	Drawdown (m)
1	63.219	68.204	69.774
2	56.928	61.913	63.483
4	50.637	55.622	57.192
8	44.346	49.332	50.901
16	38.056	43.041	44.611
32	31.767	36.751	38.320
64	25.483	30.462	32.031
150	17.795	22.746	24.311
500	7.367	11.989	13.505
1200	1.633	4.884	6.166
1500	0.810	3.386	4.530
2000	0.222	1.808	2.703
4000	0.000	0.091	0.260



Appendix F: Drillers log form 1392-12839

[redacted] 1392 - 12839 Kevin Brown P.O Box 400 Ohaurea. ph 025-735-033.

Bowling Club

WATER RIGHT NO. Appl ...

WELL NO. 1

JOB NO. 1303.

DRILLER'S LOG FORM

Well Owner: Mission Bay Womens	Drilling Firm: Kiwi N.Z.
Address: 20 Melanesia Rd.	Driller: Kevin Brown.
Location of Bore: Kohimarama Auck	Drilling Method: Rotary.
Map Sheet No.: R11	Date of Starting: —
Grid Reference: 748 - 818	Date of Finishing: 28-7-94.
Reduced Level of Bore Site (m): 2 -	Purpose of Bore: Irrigation.

Bore Log

Depth from Surface Top	Depth from Surface Bottom	Description of Ground Passed Through
0		fine,
		Sands.
	10.00	
		Grey sticky.
		mudstone, marl
	30.00	silt zones
		Grey mudstone,
		fine, sticky.
		Soft, med-
		waist -
	280.00m.	

WELL CONSTRUCTION

Depth of bore (m): 280.00

Depth of casing (m): 60.00.

Diameter of casing (mm): 100 / P/v/c

Screens: 5223-1261 Not Required

— diameter(s): 25.8.94

GROUNDWATER A.R.W.B.

— interval(s) from Ag

NAME Mission Bay Womens B/c

to

TECHNICAL FILES

C5n/12/1/303

Slot size and type 10 AUG 1994

ACTIONED

RELOG ✓

PUMP TEST

PUMP TEST

WATER QUAL

Drilling water loss at: Nill.

Method of development: air Induction.

Static water level before pumping in metres: Art- Head of .50m.

75% of airline = 22cmpd

Test discharge (m^3/hr): .2 max.

Drawdown level at that discharge (m): 30.00 Approx

Pump Depth 10.00m

Duration of pumping at that discharge in hours: 4

Pump flow of 1 m^3/hr at 90.00m only rec.

WATER QUALITY

Observation on site: Good.

Sample taken: NO.

Analysed by:

Remarks: Tested at 150.00m to produce only .6 of M^3/hr cover To BE finished of By Client with Marble www.tonkintaylor.co.nz