

# **B.C. SPRINKLER IRRIGATION MANUAL**

## **Appendix C**

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# **LIMITATION OF LIABILITY AND USER'S RESPONSIBILITY**

The primary purpose of this manual is to provide irrigation professionals and consultants with a methodology to properly design an agricultural irrigation system. This manual is also used as the reference material for the Irrigation Industry Association's agriculture sprinkler irrigation certification program.

While every effort has been made to ensure the accuracy and completeness of these materials, additional materials may be required to complete more advanced design for some systems. Advice of appropriate professionals and experts may assist in completing designs that are not adequately covered in this manual.

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# **C. SPRINKLER IRRIGATION DESIGN PLANS**

Appendix Figure C.1 Wheelmove System

Appendix Figure C.2 Solid Set Undertree System

Appendix Figure C.3 Microsprinkler System

Appendix Figure C.4 Travelling Gun System

Appendix Figure C.5 Centre Pivot System

## GENERAL FARM INFORMATION

|  |         |
|--|---------|
| • CROP                                 | ALFALFA |
| • IRRIGATED AREAS (acres)              | 120     |
| • IRRIGATION INTERVAL (days)           | 11      |
| • No. OF IRRIGATION SETS PER WHEELMOVE | 22      |

## PUMP SPECIFICATIONS

|                      |     |
|----------------------|-----|
| • HORSEPOWER (hp)    | 40  |
| • FLOW RATE (US gpm) | 693 |
| • TOTAL DYNAMIC HEAD | 174 |

## NOZZLE SPECIFICATIONS

|                                   |              |
|-----------------------------------|--------------|
| for ①, ②, and ③                   |              |
| • No. OF NOZZLES                  | 33 EACH      |
| • NOZZLE SIZE (in. x in.)         | 11/64 x 3/32 |
| • NOZZLE OPERATING PRESSURE (psi) | 40           |
| • NOZZLE FLOW RATE (US gpm)       | 7.0          |
| TOTAL No. OF NOZZLES              | 99           |
| TOTAL FLOW RATE (US gpm)          | 693          |

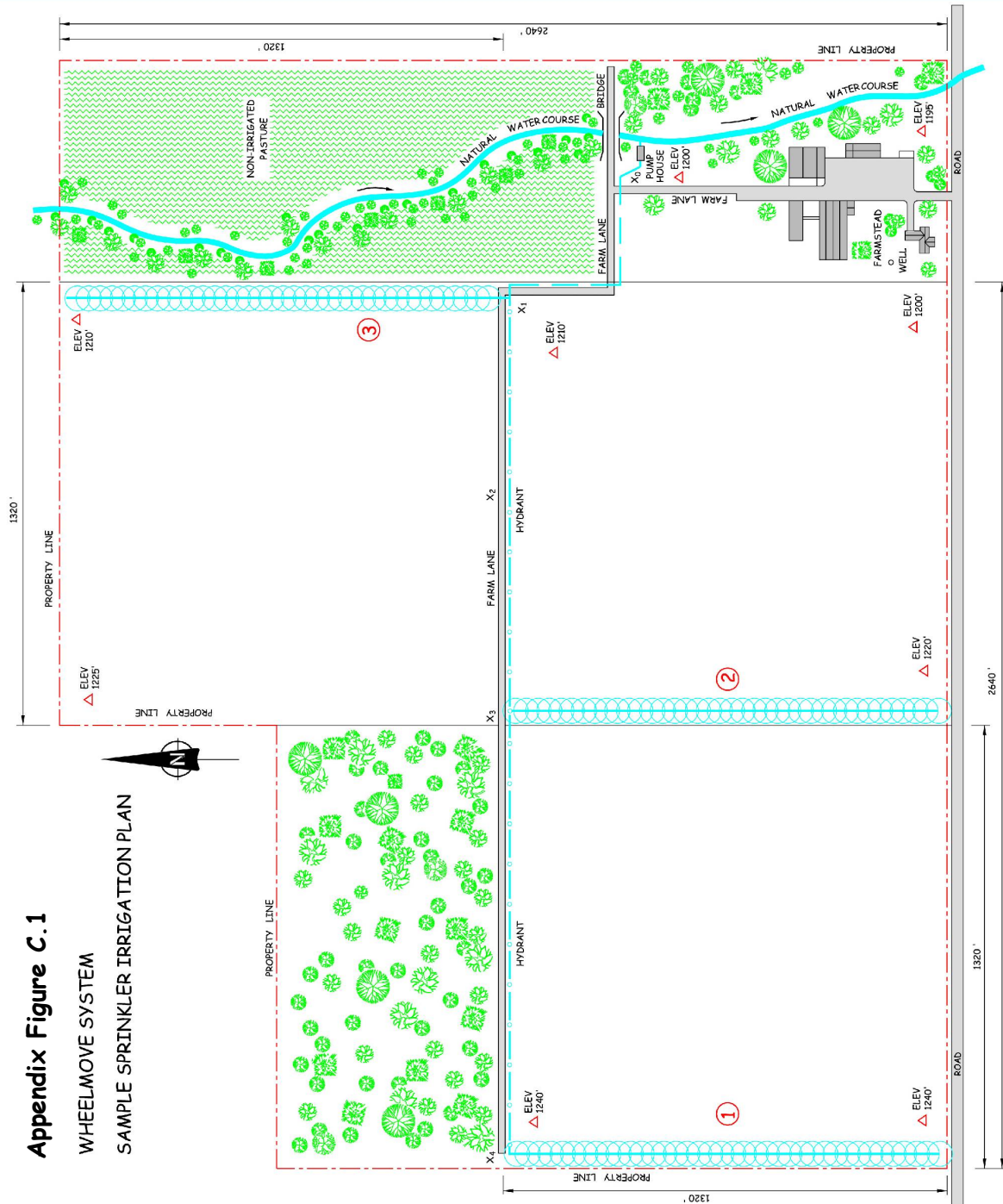
## LEGEND

|     |                        |
|-----|------------------------|
| --- | PROPERTY LINE          |
| △   | ELEVATION              |
| 🌳   | TREES AND BUSH         |
| ▬   | ROAD AND FARM LANE     |
| 🏠   | BUILDINGS              |
| —○— | MAINLINE with HYDRANTS |
| 🌀   | LATERAL WHEELMOVE      |
| ①   | WHEELMOVE NUMBER       |

## Appendix Figure C.1

### WHEELMOVE SYSTEM

#### SAMPLE SPRINKLER IRRIGATION PLAN



## WHEELMOVE IRRIGATION DESIGN PARAMETERS

### SOIL INFORMATION

| Rooting Depth (in) | Soil Texture | AWSC (in/ft) |
|--------------------|--------------|--------------|
| 0 - 12             | Sandy Loam   | 1.5          |
| 12 - 24            | Sandy Loam   | 1.5          |
| 24 - 36            | Sandy Loam   | 1.5          |
| 36 - 48            | Sandy Loam   | 1.5          |
| Total AWSC         |              | = 6.0        |

### DESIGN PARAMETERS

|   |             |
|---|-------------|
| Location                                | Armstrong   |
| Crop                                    | alfalfa     |
| Root depth                              | 4 ft        |
| Soil type                               | sandy loam  |
| Available water storage capacity (AWSC) | 1.5 in/ft   |
| Availability coefficient (AC)           | 50 %        |
| Maximum soil water deficit (MSWD)       | 3.00 in     |
| Maximum application rate (AR)           | 0.45 in/hr  |
| Evapotranspiration rate (ET)            | 0.21 in/day |
| Maximum irrigation interval (MaxII)     | 14 days     |

### DESIGN DATA

|   |                    |
|---|--------------------|
| Field length  | 1,320 ft           |
| Set time  | 11.5 hrs           |
| Number of sets per day  | 2 sets/day         |
| Actual irrigation interval (II)                                 | 11 days            |
| Net water applied per irrigation                                | 2.3 in             |
| Application efficiency (AE)                                     | 72 %               |
| Gross water applied per irrigation                              | 3.2 in             |
| Application Rate ( must be less than maximum application rate ) | 0.28 in/hr         |
| Lateral spacing   | 60 ft              |
| Sprinkler spacing   | 40 ft              |
| Flow rate per nozzle  | 7.0 gpm            |
| Nozzle size   | 11/64 in x 3/32 in |
| Pressure at the nozzle  | 40 psi             |
| Pressure at start of lateral                                    | 46 psi             |
| Number of laterals operating at a time                          | 3 laterals         |
| Maximum number of sprinklers operating at a time                | 99 sprinklers      |

### MAINLINE FRICTION LOSS CALCULATION ( keep velocity below 5 ft/s )

| Pipe Section                          | Flow Rate, Q<br>(US gpm) | Pipe Length, L<br>(ft) | Pipe<br>Diameter, D<br>(in) | Pipe Length<br>per 100 ft<br>(L per 100 ft) | x | Friction Loss<br>per 100 ft, H <sub>f</sub><br>(100) (psi) | = | Friction Loss<br>for Section, H <sub>f</sub><br>(section) (psi) |
|---------------------------------------|--------------------------|------------------------|-----------------------------|---|---|--|---|---|
| X <sub>0</sub> - X <sub>1</sub>       | 693                      | 600                    | 8                           | 6.00  | x | 0.33   | = | 1.98  |
| X <sub>1</sub> - X <sub>2</sub>       | 693                      | 660                    | 8                           | 6.60  | x | 0.33   | = | 2.18  |
| X <sub>2</sub> - X <sub>3</sub>       | 462                      | 660                    | 8                           | 6.60  | x | 0.15   | = | 0.99  |
| X <sub>3</sub> - X <sub>4</sub>       | 231                      | 1,320                  | 6                           | 13.20                                       | x | 0.16   | = | 2.11  |
| Total friction loss in mainline (psi) |                          |                        |                             |   |   |  | = | 7.26  |

### TOTAL DYNAMIC HEAD REQUIRED

|                                       |          |   |        |
|---------------------------------------|----------|---|--------|
| Pressure required at start of lateral | 46 psi   | = | 106 ft |
| Mainline friction loss                | 7.26 psi | = | 17 ft  |
| Elevation above pump                  |          |   | 40 ft  |
| Suction lift or pump set in well      |          |   | 10 ft  |
| Miscellaneous losses (20%)            |          |   | 4 ft   |
| Total dynamic head (TDH)              |          | = | 177 ft |

### PUMP SPECIFICATIONS

|                      |         |
|----------------------|---------|
| Total dynamic head   | 177 ft  |
| Total flow required  | 693 gpm |
| Pump efficiency      | 75 %    |
| Horse power required | 41 hp   |

**Appendix Figure C.2**

**SOLID SET  
UNDERTREE SPRINKLER  
SYSTEM**

**DWARF APPLES**

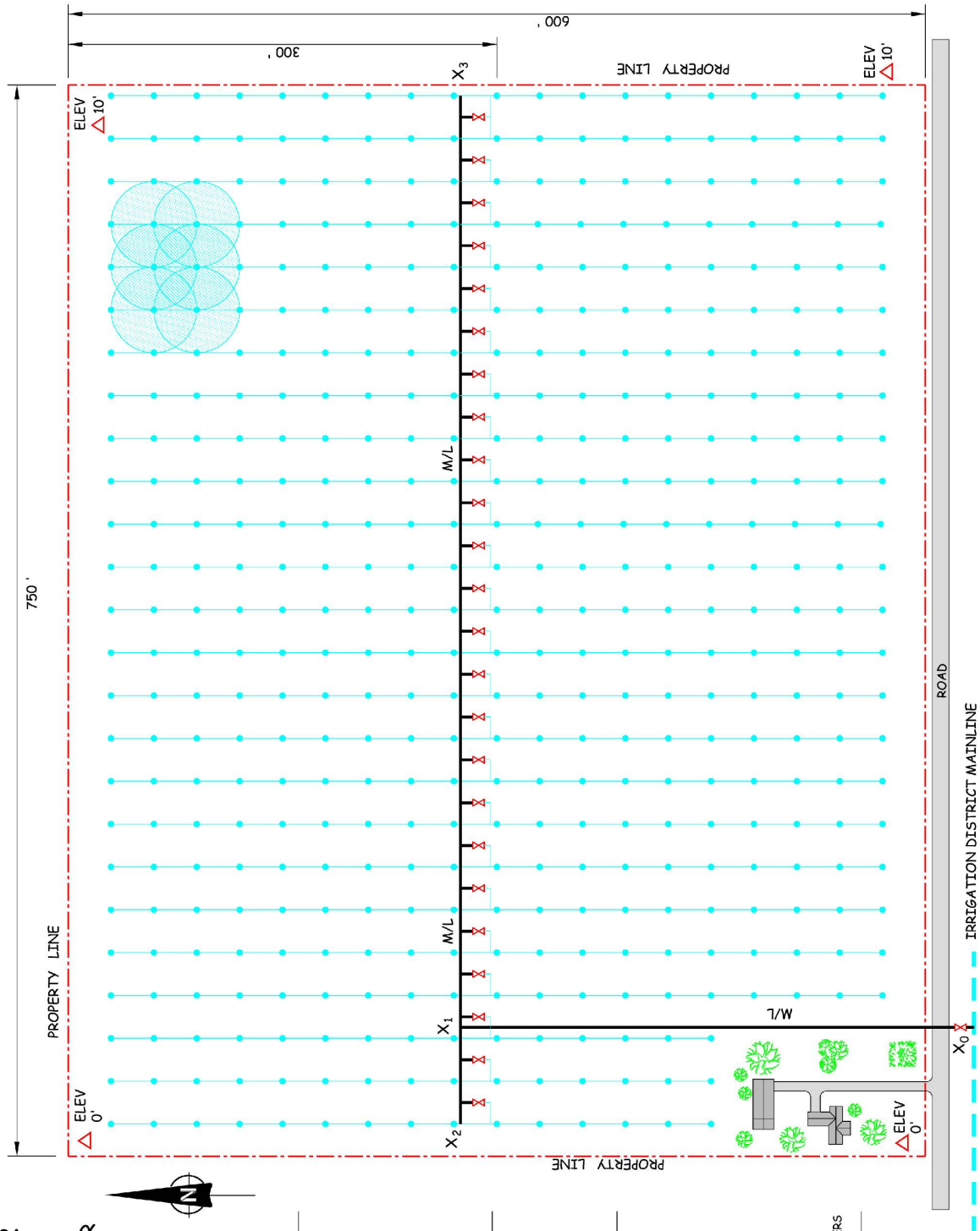


**GENERAL INFORMATION**

- TREE SPACING 7.5 ft
- ROW SPACING 15 ft
- SPRINKLER SPACING 30 ft x 30 ft
- No. of SETS 13
- IRRIGATED AREAS 10 ac
- DISTRICT WATER SUPPLY 80 U.S. gpm

**LEGEND**

- PROPERTY LINE
- △ ELEVATION
- TREES AND BUSH
- ROAD
- BUILDINGS
- CONTROL VALVE
- MAINLINE
- LATERAL and SPRINKLERS



## UNDERTREE SOLID SET IRRIGATION DESIGN PARAMETERS

### SOIL INFORMATION

| Rooting Depth (in) | Soil Texture | AWSC (in/ft) |
|--------------------|--------------|--------------|
| 0 - 12             | Loam         | 2.1          |
| 12 - 24            | Loam         | 2.1          |
| 24 - 36            | Loamy sand   | 1.2          |
| 36 - 48            | -            | -            |
| Total AWSC         |              | = 5.4        |

### DESIGN PARAMETERS

|   |             |
|---|-------------|
| Location                                | Osyoos      |
| Crop                                    | apples      |
| Root depth                              | 3 ft        |
| Soil type                               | loam        |
| Available water storage capacity (AWSC) | 2.1 in/ft   |
| Availability coefficient (AC)           | 40 %        |
| Maximum soil water deficit (MSWD)       | 2.2 in      |
| Maximum application rate (AR)           | 0.35 in/hr  |
| Evapotranspiration rate (ET)            | 0.28 in/day |
| Maximum irrigation interval (MaxII)     | 8 days      |

### DESIGN DATA

|  |                       |
|--|-----------------------|
| Irrigated acreage                                | 10 ac                 |
| District allotment                               | 8.0 gpm/ac            |
| Maximum system flow rate                         | 80 gpm                |
| Total number of laterals                         | 25 laterals           |
| Total number of sprinklers per lateral           | 19 sprinklers/lateral |
| Number of laterals operating at one time         | 2 laterals            |
| Maximum number of sprinklers operating at a time | 38 sprinklers         |
| Set time   | 11.5 hrs              |
| Actual irrigation interval (II)                  | 6.5 days              |
| Net water applied per irrigation                 | 1.8 in                |
| Application efficiency (AE)                      | 75 %                  |
| Gross water applied per irrigation               | 2.4 in                |
| Application Rate                                 | 0.21 in/hr            |
| Lateral spacing                                  | 30 ft                 |
| Sprinkler spacing                                | 30 ft                 |
| Flow rate per nozzle                             | 2.07 gpm              |
| Select nozzle size                               | 7/64 in               |
| Pressure at the nozzle                           | 35 psi                |

### MAINLINE FRICTION LOSS CALCULATION ( keep velocity below 5 ft/s )

| Pipe Section                          | Flow Rate, Q<br>(US gpm) | Pipe Length, L<br>(ft) | Pipe<br>Diameter, D<br>(in) | Pipe Length<br>per 100 ft<br>(L per 100 ft) | x | Friction Loss<br>per 100 ft, H <sub>f</sub><br>(100) (psi) | = | Friction Loss<br>for Section, H <sub>f</sub><br>(section) (psi) |
|---------------------------------------|--------------------------|------------------------|-----------------------------|---|---|--|---|---|
| X <sub>0</sub> - X <sub>1</sub>       | 80                       | 300                    | 3                           | 3.00  | x | 0.52   | = | 1.60  |
| X <sub>1</sub> - X <sub>2</sub>       | 80                       | 750                    | 3                           | 7.50  | x | 0.52   | = | 3.90  |
| Total friction loss in mainline (psi) |                          |                        |                             |   |   |  |   | = 5.50  |

### LATERAL FRICTION LOSS CALCULATION ( keep velocity below 5 ft/s )

| Pipe Section                          | Flow Rate, Q<br>(US gpm) | Pipe Length, L<br>(ft) | Pipe<br>Diameter, D<br>(in) | Pipe Length<br>per 100 ft<br>(L per 100 ft) | x | Friction Loss<br>per 100 ft, H <sub>f</sub><br>(100) (psi) | = | Friction Loss<br>for Section, H <sub>f</sub><br>(section) (psi) |
|---------------------------------------|--------------------------|------------------------|-----------------------------|---|---|--|---|---|
| 1                                     | 19.72                    | 30                     | 1-1/4                       | 0.30  | x | 1.51   | = | 0.45  |
| 2                                     | 17.75                    | 30                     | 1-1/4                       | 0.30  | x | 1.24   | = | 0.37  |
| 3                                     | 15.78                    | 30                     | 1                           | 0.30  | x | 3.11   | = | 0.93  |
| 4                                     | 13.80                    | 30                     | 1                           | 0.30  | x | 2.43   | = | 0.73  |
| 5                                     | 11.83                    | 30                     | 1                           | 0.30  | x | 1.83   | = | 0.55  |
| 6                                     | 9.86                     | 30                     | 1                           | 0.30  | x | 1.30   | = | 0.39  |
| 7                                     | 7.89                     | 30                     | 1                           | 0.30  | x | 0.86   | = | 0.26  |
| 8                                     | 5.92                     | 30                     | 1                           | 0.30  | x | 0.51   | = | 0.15  |
| 9                                     | 3.94                     | 30                     | 1                           | 0.30  | x | 0.24   | = | 0.07  |
| 10                                    | 1.97                     | 30                     | 1                           | 0.30  | x | 0.07   | = | 0.02  |
| Total friction loss in mainline (psi) |                          |                        |                             |   |   |  |   | = 4   |

### TOTAL DYNAMIC HEAD REQUIRED

|                                       |         |   |        |
|---------------------------------------|---------|---|--------|
| Pressure required at start of lateral | 39 psi  | = | 90 ft  |
| Mainline friction loss                | 5.5 psi | = | 13 ft  |
| Elevation above pump                  |         | = | 10 ft  |
| Suction lift or pump set in well      |         | = | 0 ft   |
| Miscellaneous losses (20%)            |         | = | 3 ft   |
| Total dynamic head (TDH)              |         | = | 116 ft |

### PUMP REQUIREMENT

No pump is required as the water is supplied by the irrigation district

# Appendix Figure C.3

## MICRO SPRINKLER SYSTEM

### DWARF APPLES

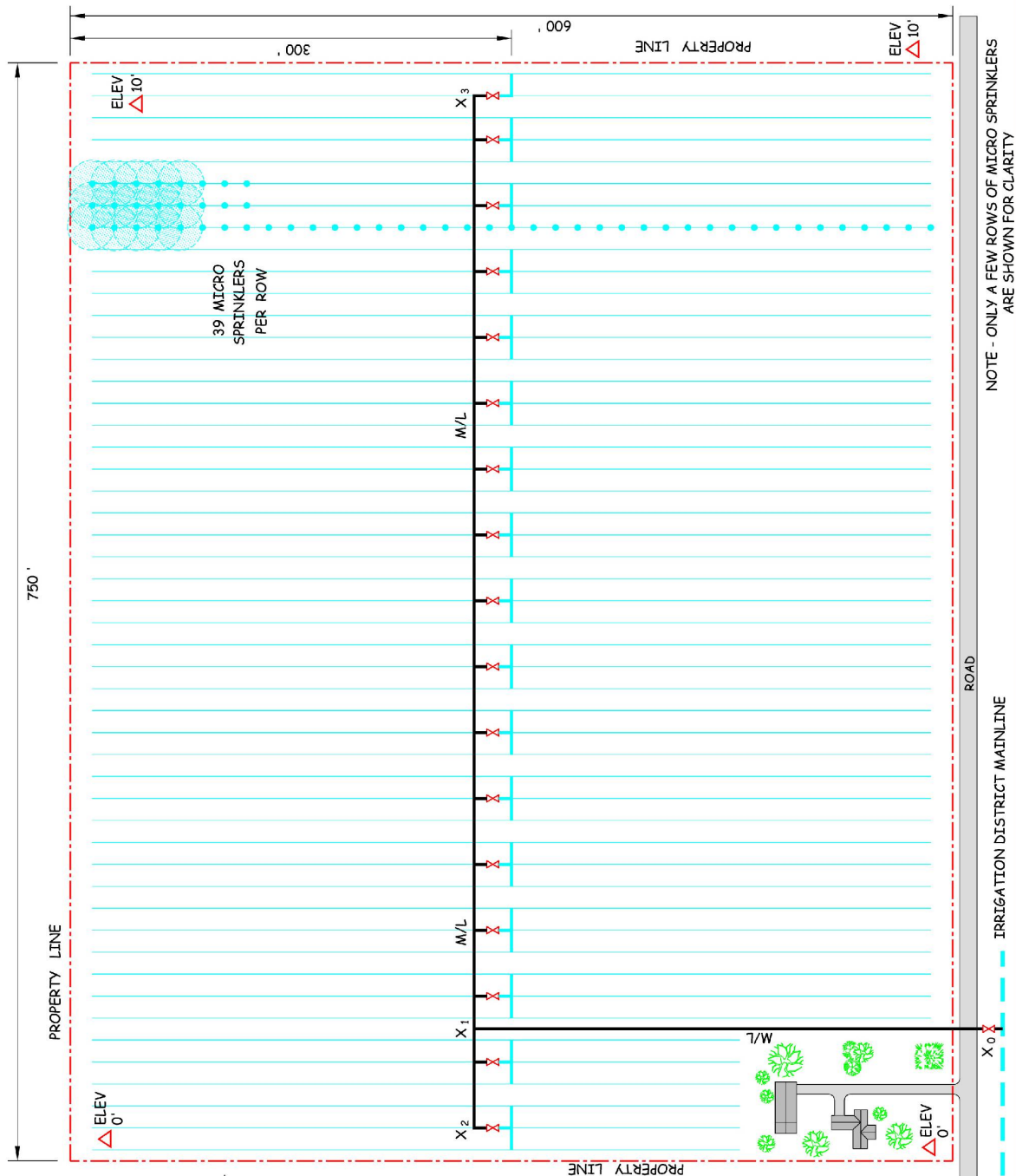


#### GENERAL INFORMATION

- TREE SPACING 7.5 ft
- ROW SPACING 15 ft
- MICRO SPRINKLER SPACING 15 ft x 15 ft
- No. of ZONES 17
- IRRIGATED AREA 10 ac
- DISTRICT WATER SUPPLY 80 U.S. gpm

#### LEGEND

- PROPERTY LINE
- △ ELEVATION
- TREES AND BUSH
- ROAD
- BUILDINGS
- SUBMAIN with VALVE
- MICRO SPRINKLER
- MAINLINE
- LATERAL





## MICROSPRINKLER IRRIGATION DESIGN PARAMETERS

### SOIL INFORMATION

| Rooting Depth (in) | Soil Texture | AWSC (in/ft) |
|--------------------|--------------|--------------|
| 0 - 12             | Loam         | 2.1          |
| 12 - 24            | Loam         | 2.1          |
| 24 - 36            | Loamy sand   | 1.2          |
| Total AWSC =       |              | <u>5.4</u>   |

### DESIGN PARAMETERS

|   |                    |
|---|--------------------|
| Location                                | <u>Osyoos</u>      |
| Crop                                    | <u>apples</u>      |
| Root depth                              | <u>4</u> ft        |
| Soil type                               | <u>loam</u>        |
| Available water storage capacity (AWSC) | <u>2.1</u> in/ft   |
| Availability coefficient (AC)           | <u>40</u> %        |
| Maximum soil water deficit (MSWD)       | <u>2.2</u> in      |
| Maximum application rate (AR)           | <u>0.35</u> in/hr  |
| Evapotranspiration rate (ET)            | <u>0.28</u> in/day |
| Maximum irrigation interval (MaxII)     | <u>8</u> days      |

### DESIGN DATA

|  |                              |
|--|------------------------------|
| Irrigated acreage                                | <u>10</u> ac                 |
| District allotment                               | <u>8</u> gpm/ac              |
| Maximum system flow rate                         | <u>80</u> US gpm             |
| Total number of laterals                         | <u>50</u> laterals           |
| Total number of sprinklers per lateral           | <u>39</u> sprinklers/lateral |
| Number of laterals operating at one time         | <u>3</u> laterals            |
| Maximum number of sprinklers operating at a time | <u>117</u> sprinklers        |
| Set time   | <u>8</u> hr                  |
| Actual irrigation interval (II)                  | <u>6.0</u> days              |
| Net water applied per irrigation                 | <u>1.7</u> in                |
| Application efficiency (AE)                      | <u>80</u> %                  |
| Gross water applied per irrigation               | <u>2.1</u> in                |
| Application rate                                 | <u>0.26</u> in/hr            |
| Lateral spacing                                  | <u>15</u> ft                 |
| Sprinkler spacing                                | <u>15</u> ft                 |
| Flow rate per nozzle                             | <u>0.65</u> gpm              |
| Select nozzle size                               | <u>0.071</u> in              |
| Pressure at the nozzle                           | <u>20</u> psi                |

### MAINLINE FRICTION LOSS CALCULATION ( keep velocity below 5 ft/s )

| Pipe Section                          | Flow Rate, Q<br>(US gpm) | Pipe Length, L<br>(ft) | Pipe<br>Diameter, D<br>(in) | Pipe Length<br>per 100 ft<br>(L per 100 ft) | x | Friction Loss<br>per 100 ft, H <sub>f</sub><br>(100) (psi) | = | Friction Loss<br>for Section, H <sub>f</sub><br>(section) (psi) |
|---------------------------------------|--------------------------|------------------------|-----------------------------|---|---|--|---|---|
| X <sub>0</sub> - X <sub>1</sub>       | 75                       | 300                    | 2-1/2                       | 3.00  | x | 1.09   | = | 3.27  |
| X <sub>2</sub> - X <sub>3</sub>       | 75                       | 750                    | 2-1/2                       | 7.00  | x | 1.09   | = | 7.65  |
| Total friction loss in mainline (psi) |                          |                        |                             |   |   |  |   | <u>10.90</u>  |

### LATERAL FRICTION LOSS CALCULATION ( longest )

| Flow Rate, Q<br>(US gpm)              | Pipe Length, L<br>(ft) | Pipe<br>Diameter, D<br>(in) | Lateral Friction<br>Loss F factor | Pipe Length<br>per 100 ft<br>(L per 100 ft) | = | Friction Loss<br>per 100 ft, H <sub>f</sub><br>(100) (psi) | = | Friction Loss<br>for Section, H <sub>f</sub><br>(section) (psi) |
|---------------------------------------|------------------------|-----------------------------|-----------------------------------|---|---|--|---|---|
| 13                                    | 300                    | 1                           | 0.36                              | 3.00  | x | 2.13   | = | 2.3   |
| Total friction loss in mainline (psi) |                        |                             |                                   |   |   |  |   | <u>2.3</u>  |

### TOTAL DYNAMIC HEAD REQUIRED

|                                       |                  |   |              |
|---------------------------------------|------------------|---|--------------|
| Pressure required at start of lateral | <u>20</u> psi    | = | <u>46</u> ft |
| Mainline friction loss                | <u>10.90</u> psi | = | <u>25</u> ft |
| Lateral friction loss                 | <u>2.3</u> psi   | = | <u>5</u> ft  |
| Elevation above pump                  |                  |   | <u>10</u> ft |
| Suction lift or pump set in well      |                  |   | <u>0</u> ft  |
| Miscellaneous losses (20%)            | <u>2.2</u> psi   | = | <u>5</u> ft  |
| Total dynamic head (TDH)              |                  | = | <u>91</u> ft |

### PUMP REQUIREMENT

No pump is required as the water is supplied by the irrigation district

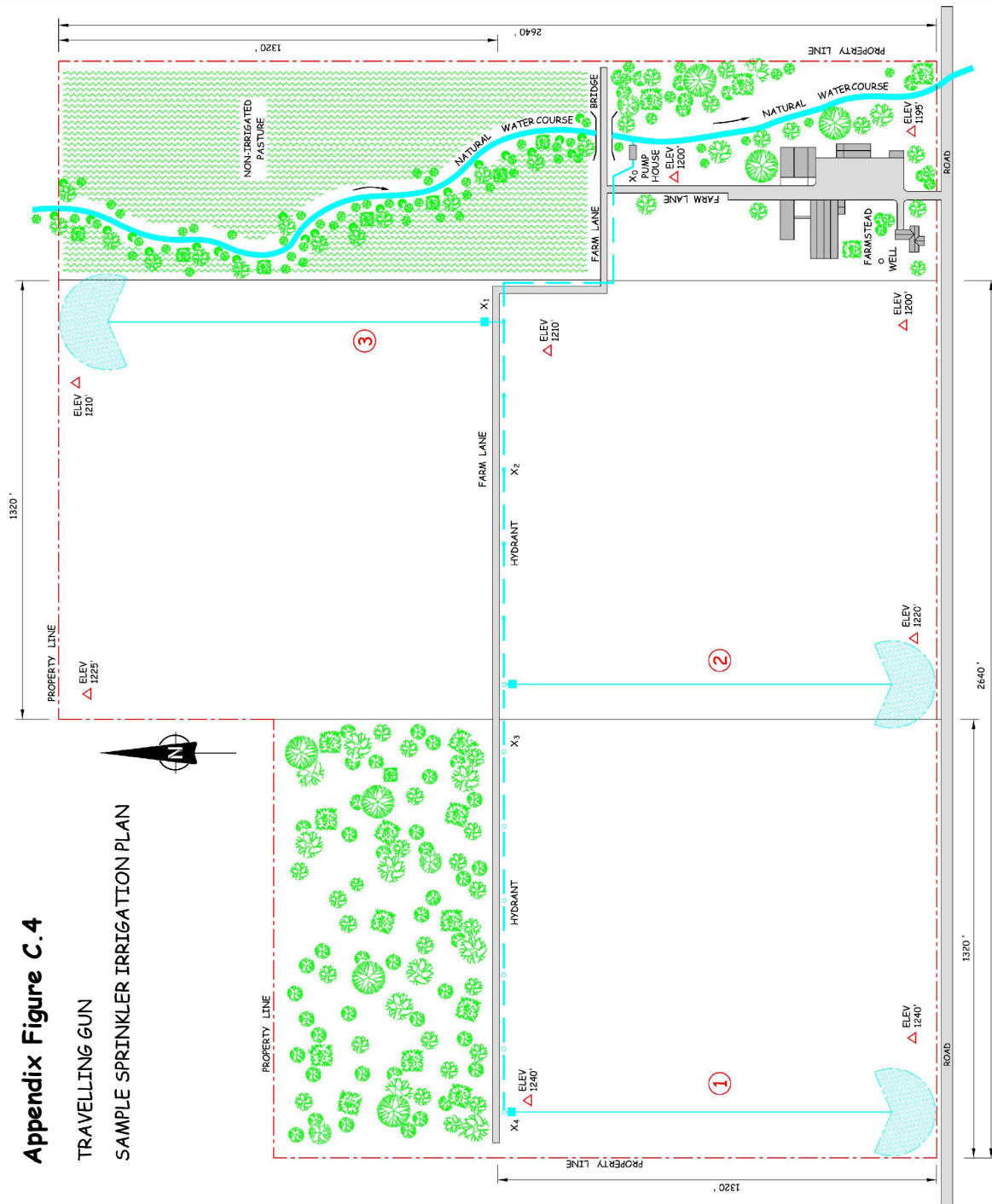
# Appendix Figure C.4 TRAVELLING GUN SAMPLE SPRINKLER IRRIGATION PLAN

| GENERAL FARM INFORMATION           |         |
|------------------------------------|---------|
| • CROP                             | ALFALFA |
| • IRRIGATED AREAS (acres)          | 120     |
| • IRRIGATION INTERVAL (days)       | 6.5     |
| • No. OF IRRIGATIONS SETS PER UNIT | 6.5     |

| PUMP SPECIFICATIONS  |     |
|----------------------|-----|
| • HORSEPOWER (hp)    | 75  |
| • FLOW RATE (US gpm) | 630 |
| • TOTAL DYNAMIC HEAD | 344 |

| NOZZLE SPECIFICATIONS             |                |
|-----------------------------------|----------------|
| for ①, ②, and ③                   |                |
| • NOZZLE SIZE (inches)            | 0.5 TAPER BORE |
| • NOZZLE OPERATING PRESSURE (psi) | 80             |
| • NOZZLE FLOW RATE (US gpm)       | 210            |
| TOTAL No. OF NOZZLES              | 3              |
| TOTAL FLOW RATE (US gpm)          | 630            |

| LEGEND |                        |
|--------|------------------------|
| ---    | PROPERTY LINE          |
| △      | ELEVATION              |
| 🌳      | TREES AND BUSH         |
| —      | ROAD AND FARM LANE     |
| 🏠      | BUILDINGS              |
| —○—    | MAINLINE WITH HYDRANTS |
| —○—    | TRAVELLING GUN         |
| ①      | TRAVELLING GUN NUMBER  |



## TRAVELLING GUN IRRIGATION DESIGN PARAMETERS

### SOIL INFORMATION

| Rooting Depth (in) | Soil Texture | AWSC (in/ft) |
|--------------------|--------------|--------------|
| 0 - 12             | Sandy Loam   | 1.5          |
| 12 - 24            | Sandy Loam   | 1.5          |
| 24 - 36            | Sandy Loam   | 1.5          |
| 36 - 48            | Sandy Loam   | 1.5          |
| Total AWSC         |              | = 6.0        |

### DESIGN PARAMETERS

|   |             |
|---|-------------|
| Location                                | Armstrong   |
| Crop                                    | alfalfa     |
| Root depth                              | 4 ft        |
| Soil type                               | sandy loam  |
| Available water storage capacity (AWSC) | 1.5 in/ft   |
| Availability coefficient (AC)           | 50 %        |
| Maximum soil water deficit (MSWD)       | 3.00 in     |
| Maximum application rate (AR)           | 0.45 in/hr  |
| Evapotranspiration rate (ET)            | 0.21 in/day |
| Maximum irrigation interval (MaxII)     | 14 days     |

### DESIGN DATA

|  |            |
|--|------------|
| Nozzle size per traveling gun  | 0.9 in     |
| Pressure at nozzle   | 75 psi     |
| Nozzle flow rate   | 204 gpm    |
| Wetted diameter  | 164 ft     |
| Part circle gun arc  | 240 degree |
| Instantaneous application rate   | 0.35 in/hr |
| Lane spacing   | 200 ft     |
| Length of field  | 1,320 ft   |
| Set time   | 23.5 hr    |
| Travel speed   | 56 ft/hr   |
| Gross amount water applied   | 1.75 in    |
| Application efficiency   | 65 %       |
| Net amount water applied   | 1.14 in    |
| Actual irrigation interval ( must be less than maximum irrigation interval ) | 5.5 days   |

### MAINLINE FRICTION LOSS CALCULATION ( keep velocity below 5 ft/s )

| Pipe Section                          | Flow Rate, Q<br>(US gpm) | Pipe Length, L<br>(ft) | Pipe<br>Diameter, D<br>(in) | Pipe Length<br>per 100 ft<br>(L per 100 ft) | x | Friction Loss<br>per 100 ft, H <sub>f</sub><br>(100) (psi) | = | Friction Loss<br>for Section, H <sub>f</sub><br>(section) (psi) |
|---------------------------------------|--------------------------|------------------------|-----------------------------|---|---|--|---|---|
| X <sub>0</sub> - X <sub>1</sub>       | 612                      | 500                    | 8                           | 5.00  | x | 0.28   | = | 1.40  |
| X <sub>1</sub> - X <sub>2</sub>       | 612                      | 660                    | 8                           | 6.60  | x | 0.28   | = | 1.85  |
| X <sub>2</sub> - X <sub>3</sub>       | 408                      | 660                    | 8                           | 6.60  | x | 0.14   | = | 0.92  |
| X <sub>3</sub> - X <sub>4</sub>       | 204                      | 1,320                  | 6                           | 13.20                                       | x | 0.14   | = | 1.85  |
| Total friction loss in mainline (psi) |                          |                        |                             |   |   |  | = | 6.00  |

### LATERAL FRICTION LOSS CALCULATION

| Pipe Section                          | Flow Rate, Q<br>(US gpm) | Pipe Length, L<br>(ft) | Pipe<br>Diameter, D<br>(in) | Pipe Length<br>per 100 ft<br>(L per 100 ft) | x | Friction Loss<br>per 100 ft, H <sub>f</sub><br>(100) (psi) | = | Friction Loss<br>for Section, H <sub>f</sub><br>(section) (psi) |
|---------------------------------------|--------------------------|------------------------|-----------------------------|---|---|--|---|---|
| 1                                     | 204                      | 1,200                  | 3.3                         | 12.00                                       | x | 2.70   | = | 32.40   |
| Total friction loss in mainline (psi) |                          |                        |                             |   |   |  | = | 32.40   |

### TOTAL DYNAMIC HEAD REQUIRED

|                                       |           |   |        |
|---------------------------------------|-----------|---|--------|
| Drive friction loss                   | 7 psi     | = | 16 ft  |
| Pressure required at start of lateral | 75 psi    | = | 173 ft |
| Mainline friction loss                | 6.25 psi  | = | 14 ft  |
| Lateral hose friction loss            | 32.40 psi | = | 75 ft  |
| Elevation above pump                  |           |   | 40 ft  |
| Suction lift or pump set in well      |           |   | 10 ft  |
| Miscellaneous losses (20%)            |           |   | 3 ft   |
| Total dynamic head (TDH)              |           | = | 331 ft |

### PUMP SPECIFICATIONS

|                      |         |
|----------------------|---------|
| Total dynamic head   | 331 ft  |
| Total flow required  | 612 gpm |
| Pump efficiency      | 75 %    |
| Horse power required | 68 hp   |

## Appendix Figure C.5

### CENTRE PIVOT SYSTEM SAMPLE SPRINKLER IRRIGATION PLAN

#### GENERAL FARM INFORMATION

|                                     |         |
|-------------------------------------|---------|
| • CROP                              | ALFALFA |
| • AREA IRRIGATED BY PIVOT (acres)   | 94.2    |
| • AREA IRRIGATED BY END GUN (acres) | 9       |
| • TOTAL AREA IRRIGATED (acres)      | 103.2   |

#### PUMP SPECIFICATIONS

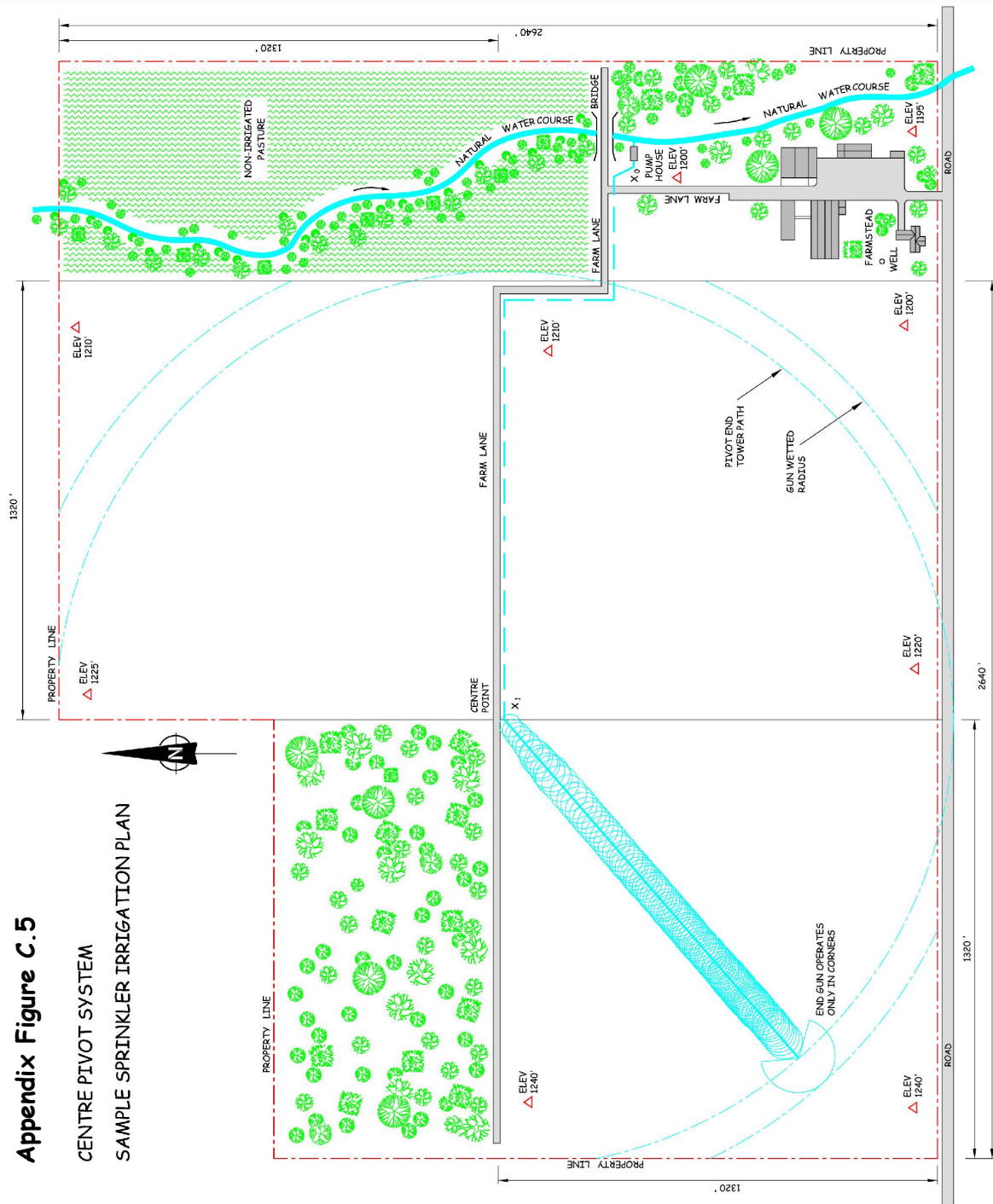
|                             |     |
|-----------------------------|-----|
| • HORSEPOWER (hp)           | 40  |
| • FLOW RATE (US gpm)        | 555 |
| • TOTAL DYNAMIC HEAD (feet) | 197 |

#### PIVOT SPECIFICATIONS

|   |      |
|---|------|
| • LENGTH OF PIVOT (feet)                  | 1320 |
| • MAXIMUM ROTATION SPEED (hrs/revolution) | 32   |
| • MINIMUM TRAVEL SPEED (feet/min.)        | 4.7  |
| • PIVOT FLOW RATE (US gpm)                | 466  |
| • END GUN FLOW RATE (US gpm)              | 89   |

#### LEGEND

|     |                    |
|-----|--------------------|
| --- | PROPERTY LINE      |
| △   | ELEVATION          |
| 🌳   | TREES AND BUSH     |
| ▬   | ROAD AND FARM LANE |
| ▬   | BUILDINGS          |
| --- | MAINLINE           |
| 🌀   | PIVOT WITH END GUN |



## CENTRE PIVOT IRRIGATION DESIGN PARAMETERS

### SOIL INFORMATION

| Rooting Depth (in) | Soil Texture | AWSC (in/ft) |
|--------------------|--------------|--------------|
| 0 - 12             | Sandy Loam   | 1.5          |
| 12 - 24            | Sandy Loam   | 1.5          |
| 24 - 36            | Sandy Loam   | 1.5          |
| 36 - 48            | Sandy Loam   | 1.5          |
| Total AWSC         |              | = 6.0        |

### DESIGN PARAMETERS

|   |             |
|---|-------------|
| Location                                | Armstrong   |
| Crop                                    | alfalfa     |
| Root depth                              | 4 ft        |
| Soil type                               | sandy loam  |
| Available water storage capacity (AWSC) | 1.5 in/ft   |
| Availability coefficient (AC)           | 50 %        |
| Maximum soil water deficit (MSWD)       | 3.00 in     |
| Maximum application rate (AR)           | 0.45 in/hr  |
| Evapotranspiration rate (ET)            | 0.21 in/day |
| Maximum irrigation interval (MaxII)     | 14 days     |

### DESIGN DATA

|  |             |
|--|-------------|
| Effective wetted radius (R) without end gun  | 1,320 ft    |
| Effective wetted radius with end gun         | 1,440 ft    |
| Percentage of a full circle (P)              | 75 %        |
| Area of the pivot (A)                        | 94 ac       |
| Pivot flow rate (Q)                          | 466 US gpm  |
| End gun flow rate (Q <sub>E</sub> )          | 89 US gpm   |
| Radius of largest sprinkler (r), not end gun | 35 ft       |
| Pivot Application Rate (PAR)                 | 1.24 in/hr  |
| Minimum travel speed of pivot (S)            | 4.7 ft/min  |
| Rotation speed of the pivot (N)              | 29 hr/rev   |
| Gross water applied per revolution (GWA)     | 0.32 in/rev |
| Application efficiency (AE)                  | 80 %        |
| Net water applied per revolution (NWA)       | 0.26 in/rev |

### MAINLINE FRICTION LOSS CALCULATION ( keep velocity below 5 ft/s )

| Pipe Section                          | Flow Rate, Q<br>(US gpm) | Pipe Length, L<br>(ft) | Pipe<br>Diameter, D<br>(in) | Pipe Length<br>per 100 ft<br>(L per 100 ft) | x | Friction Loss<br>per 100 ft, H <sub>f</sub><br>(100) (psi) | = | Friction Loss<br>for Section, H <sub>f</sub><br>(section) (psi) |
|---------------------------------------|--------------------------|------------------------|-----------------------------|---|---|--|---|---|
| X <sub>0</sub> - X <sub>1</sub>       | 555                      | 1,920                  | 8                           | 19.20                                       | x | 0.21   | = | 4.03  |
| Total friction loss in mainline (psi) |                          |                        |                             |   |   |  |   | = 4.03  |

### TOTAL DYNAMIC HEAD REQUIRED

|                                       |          |   |        |
|---------------------------------------|----------|---|--------|
| Pressure required at start of lateral | 60 psi   | = | 139 ft |
| Mainline friction loss                | 4.03 psi | = | 9.3 ft |
| Elevation above pump                  |          |   | 40 ft  |
| Suction lift or pump set in well      |          |   | 10 ft  |
| Miscellaneous losses (20%)            | 0.8 psi  | = | 2 ft   |
| Total dynamic head (TDH)              |          | = | 200 ft |

### PUMP SPECIFICATIONS

|                      |         |
|----------------------|---------|
| Total dynamic head   | 200 ft  |
| Total flow required  | 555 gpm |
| Pump efficiency      | 75 %    |
| Horse power required | 37 hp   |

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