MITIGATING THE IMPACT OF STORMWATER RUNOFF ON NEW DENVER'S DOMESTIC WATER SUPPLY WELLS

Prepared for the Village of New Denver

JUNE 2004

File #: C03145-003

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February 18, 2005

File: #C03145 - 003

Village of New Denver
P.O. Box 40
115 Slocan Ave
New Denver, BC V0G 1S0

Attn: Carol Gordon, Administrator

RE: MITIGATING THE IMPACTS OF STORMWATER RUNOFF ON NEW DENVER'S DOMESTIC WATER SUPPLY WELLS

Enclosed please find four sets of final documents for the above noted project. The addition of the addendum is the result of adjustments made by the Village of New Denver to the initial report issued in June 2004, and clarified at our last meeting on February 14, 2005.

The report consists of two main sections. The first explores the impacts of stormwater runoff on the domestic water supply wells. The second looks at ways to improve the current stormwater collection and disposal system. The essence of the report is that existing high groundwater flow rates within the aquifer serve to substantially reduce the risk of well contamination from surface sources. This together with ongoing monitoring is currently the guard against the consumption of potentially contaminated well water. This flushing and monitoring to provide early warning appears to be sufficient, such that continued use of the existing drywells is reasonable. That said, we recommend that long term measures be implemented to ultimately replace the lake well with a new source upstream of the storm and sanitary sewer disposal systems. A properly located new well should negate the need for future treatment.

We anticipate that the following document will prove beneficial to you during the B.C. Community Water Improvement Program Grant process. If you have any further questions, please don't hesitate to call.

Sincerely,
WSA ENGINEERING LTD.

Dan Sahlstrom, P. Eng.
DS: bt
Enclosure (s)

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ADDENDUM TO

Mitigating the Impacts of Stormwater Runoff on New Denver's Domestic Water Supply Wells

FEBRUARY 14, 2005

In June 2004, WSA Engineering completed a study identifying possible solutions towards mitigating the impacts of stormwater runoff on New Denver's water supply wells [the study]. In a recent meeting with the Village of New Denver on the above noted date, WSA Staff were made aware of the current actions that the Village has completed in response to the study.

These current actions include the following:

1. Recent improvements in regards to the stormwater collection and disposal system.

As of November 2004, the Village of New Denver has semi-completed this recommendation. The completion of the construction project "Improvements at New Denver Hick's Corner and Hwy No. 6 & 31A Intersection" has produced a stormwater collection and disposal system for the area of concern [Hwy 6 from 7th Ave to Slocan Ave]. The village has installed a new curb, gutter and drywell system along the highway corridor. While WSA had recommended that disposal of the highway runoff be taken to an area that would not pose a contamination threat and not be left upstream within the capture zone for the lake well, the collection disposal system as installed should substantially reduce drainage problems on 6th Ave.

2. Continuous Regular Monitoring of Well Water Quality.

The Village of New Denver continues to provide samples to ALS Environmental for chemical analysis. The last documented date for such samples is December 15, 2004. At this time, both water supply wells are still continuously tested for extractable Hydrocarbons and VOC's. WSA had also recommended that nitrates, chlorides and coliforms should also be continually monitored, especially in the lake well, mainly due to the presence of in-ground sewage disposal

within the capture zone of the unconfined lake well aquifer. A sample was taken on February [__] and the test results show [to be completed upon receipt of results].

3. Retesting of Soil at Previous Underground Storage Tank [UST] Sites.

The Village of New Denver also continues to retest soil material from the previous UST locations. The UST's were removed in 1999. At the time of use, these UST's were located directly upstream of the lake wells' capture zone. This action was recommended by AGRA's 1998 report.

This document is therefore an update to the previous study performed by WSA Engineering, and will be used to inform various interest groups of the Village's efforts to address those recommendations set forth within the above study. It is intended that this addendum be bound in and read with the study.

Sincerely,
WSA ENGINEERING LTD.

Dan Sahlstrom, P. Eng.

DS: bt

Enclosure (s)

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1.0 Introduction & Background

1.1 Purpose

The purpose of this study is to provide recommendations for upgrades to the Village of New Denver stormwater disposal system. These upgrades are designed to mitigate any existing or potential impacts that the system has on the village domestic water supply wells and to solve existing flooding problems due to runoff.

1.2 Background

The Village of New Denver has two drilled wells that supply its domestic water. The Lake Well is located on the bank of Slocan Lake off Eldorado Avenue. The Arena Well is located north of the arena on Kootenay St.

The village does not currently have a formal piped stormwater collection system. Stormwater generally finds its way into the ground or Slocan Lake via the streets and roadside swales. Where problem areas have been identified, drywells have been installed to intercept and directly dispose of the stormwater into the ground. There are eight drywells distributed throughout the village. These drywells are usually made of perforated concrete manhole sections installed in the ground with a grated opening in the cover. Their effectiveness varies and is a subject of this report.

In 1998, the village conducted a wellhead protection study to assess the potential threats of contamination to their water supply aquifer system. The study concluded that stormwater runoff could potentially contaminate the aquifer via the drywells and Slocan Lake. The study identified oils and salts in runoff from Highway 6 as a major threat to aquifer contamination. The Lake Well is the most vulnerable to contamination due to its unconfined aquifer and its location below village development. The Arena Well is not as vulnerable due to its location above most development and to the presence of low permeable layers that isolate its aquifer from the surface.

2.0 Engineering Review and Analysis of the Aquifer System

In order to assess the risk of potential contamination to the New Denver water supply wells and to recommend protective measures, we conducted an engineering study of the aquifer system. We have based our analysis on data from the 1998 Well Head Protection Study by AGRA Earth and Environmental and from the 1974 well drilling and pump testing reports by the consulting groundwater geologist E. Livingston, P.Eng. The Arena Well was completed in November 1974 and the Lake Well was completed in December 1974.

2.1 The Arena Well

The Arena Well was completed in November 1974. It draws water from two aquifers that are separated by a 5-meter thick semi-confining bed of silty sand. The top aquifer is at a depth of about 25 meters and is overlain by various layers of semi-confining materials. Each of the aquifers is approximately 5 meters in depth. These aquifers and the material overlying them were most likely deposited by Carpenter Creek in the course of constructing its delta. The two aquifers consist of sand and gravel that were deposited in former stream channels. In a delta, stream channels shift their locations over time, which results in isolated aquifers that are randomly located and confined by semi-permeable formations. As Livingston stated in his 1974 report: "The various layers are part of a fan delta, and therefore are probably lens-like in form, with semi-permeable boundaries on all sides." The Arena Well aquifers are likely linear features, isolated from their surroundings by less permeable material above, below, and on both sides (a bit like a huge buried pipe). This isolation protects the aquifers and the Arena Well from contamination from the surface.

A pumping test was conducted for the Arena Well at the time of its completion in 1974. The change in well drawdown was recorded as a function of pumping time and plotted. A rough estimate of the aquifer transmissivity and permeability can be computed from these test results using the Cooper-Jacob method. Results indicate a permeability of approximately 6.2×10^{-4} m/s for the aquifers of the Arena Well. Using Darcy's Law, this permeability gives an average lateral groundwater velocity of about 0.7 m/day. Water is thus continually flowing through the aquifers in the direction of the lake at a rate of roughly 0.7 meter per day. This flow has the effect of

constantly "flushing" the aquifer and offers additional protection against contamination of the Arena Well.

2.2 The Lake Well

The Lake Well was completed in December 1974. It draws water from a depth of about 30 meters in a largely unconfined aquifer made up of sand and gravels. Unlike the Arena Well, the Lake Well aquifer does not appear to be overlain by protective, less-permeable materials and is thus more vulnerable to contamination from surface pollutants. However, it does get contamination protection from the flushing action of the groundwater flow toward the lake. The pumping test data was difficult to analyze because the drawdown was small and the recovery of the static water level was very rapid. However, Livingston estimated the permeability of this aquifer to be between 1.3 and 6.0×10^{-3} m/s. This results in average lateral groundwater velocities between 0.4 and 1.7 m/day for the aquifer.

Livingston called attention to the possibility of contamination entering the Lake Well, although he called this possibility "remote". He stated: "- - - I think that conditions favor rapid horizontal movement so that pollution is not likely to reach the part of the aquifer that was screened. Prolonged pumping at very high rates could perhaps alter the natural flow pattern in the aquifer enough to induce contaminants in the upper part of the aquifer to move down toward the well intake". He concluded that certain constituents could be detected in the well water long before there is any hazard to the water quality. We agree with his conclusions.

Nitrate and chloride concentrations measured in the well water will provide an early indicator of aquifer contamination due to salts, fertilizers, and in-ground septic sewage disposal in the surface and sub-surface runoff. Based on AGRA's 1998 report, these concentrations have both increased over the life of the well but they are well below drinking water standards. The impact is currently not significant but may increase over time and regular monitoring of the well water quality should be continued.

Contamination from road runoff would consist of mainly chlorides from salts and volatile organic carbons and extractable hydrocarbons from oil, fuels, and solvents. Hydrocarbon concentrations were measured in 1998 and were below the analytical detection limit, which indicates that no significant contamination has occurred to

date. A pollutant entering the ground from surface runoff would slowly infiltrate down through the overlying material to the saturated aquifer. It would then travel horizontally toward the lake due to the groundwater flow and vertically due to molecular diffusion. Since the groundwater velocities are very high relative to diffusion velocities, it is likely that any pollutant would be "flushed" out of the aquifer before significant concentrations would reach the Lake Well intake at the 30-meter depth.

2.3 Conclusions

Our conclusions are that the Arena Well is protected from surface contamination due to its semi-confined state and to the flushing action of the relatively high groundwater velocity through the aquifer. The high groundwater velocities also protect the Lake Well, flushing out surface pollutants before they can diffuse down to the well screen. Since the Lake Well is located down slope of most of the developed area of New Denver and since it draws water from an aquifer not protected by overlying low-permeable layers, it is the most vulnerable to surface contamination. We recommend that water quality monitoring be regularly conducted in order to catch any rise in pollutant concentrations that might potentially occur in the event of an accident.

We agree with the following recommendations given by Livingston:

- Pump the Arena Well at a rate of 175 US gpm with the pump intakes as low as possible to allow for maximum drawdown
- Equip the Arena Well with a water meter to record consumption and an opening so that regular water level measurements can be taken to ensure that the intake remains submerged
- Use the Lake Well for peak demand in the summer, for emergency use during fires and for standby
- Continue monitoring well water quality with respect to nitrates, chlorides, coliforms, and hydrocarbons as an early warning of any contamination

3.0 Inventory of Existing Stormwater System

The Village of New Denver has no formal piped stormwater collection system. Curb and gutters exist on 6 th Avenue and on some side streets. Many of the streets do not have regular crowns causing stormwater runoff to meander down them towards Slocan Lake. Many of the homes are sitting below the grade of the streets and problems due to flooding and ponding frequently exist. A number of drywells were installed about ten years ago in specific problem areas to dispose of runoff directly into the ground. Some of these drywells are operating effectively to date and some are non-functioning.

3.1 Drywells

An inventory and inspection of the existing drywells was completed in June 2004. Drywell numbers can be referred to in the site plan of ***Figure 1***. Drywells are generally constructed using one or two sections of precast perforated concrete with a solid section on top. The solid section has an open grated cover. Each section is about four feet in diameter and about three feet deep. Each perforated section contains five rows of perforations. The inspection revealed varying amounts of sand and silt deposited in the drywells, which block the perforations and reduce the effectiveness of runoff infiltration. A summary of the drywell inventory is given in ***Table 1*** on the following page.

Drywell	Location	Comments
#1	Corner of Eldorado Ave. and 6 th Ave.	Appears to be made of solid concrete with no perforations. Filled with silt and sand to a depth of approximately 30 inches. 12-inch diameter steel overflow pipe running west to bank of Slocan Lake. Some debris blocking outlet pipe. Intake cover is in an asphalt depression with evidence of debris blockage.
#2	North side of 6 th Ave. just west of Bellevue Ave.	Consists of 1 solid concrete section and 1 perforated section. Filled with sand and silt to a depth of 40 inches with no perforations showing. Non-functioning. Stormwater flows down adjacent driveway to Slocan Lake. Intake cover is in a gravel depression on the road shoulder and is often blocked with with leaves and sand.
#3	West side of Josephine St. in front of liquor store	Filled with sand and silt to a depth of 89 inches. One section of perforated concrete is visible with 5 perforations showing. Intake cover is in an asphalt depression and is partially clogged with debris. During high flows, stormwater may flow past the intake causing yard flooding below.
#4	West side of Kildare St. just South of 6 th Ave.	Filled with sand and silt to a depth of 102 inches. 1-½ sections of perforated concrete are visible with 8 rows of perforations showing. Intake cover is located in a gravel depression on the road shoulder. Appears to be functioning adequately at present.
#5	East side of Kildare St. just south of 6 th Ave.	Filled with sand and silt to a depth of 88 inches. 1-¼ sections of perforated concrete are visible with 6 rows of perforations showing. Intake cover is located in an asphalt depression and was totally blocked with debris at the time of inspection.
#6	North side of Slocan Ave. just west of Hwy. 6.	Filled with sand and silt to a depth of 61 inches. 3 perforations showing. Intake cover is located in the gravel shoulder and is partially blocked with debris.
#7	East side of Josephine St. just south of Slocan Ave.	Consists of a 12-inch steel culvert buried in the road shoulder. Intake cover is and it appears to operate well.
#8	Corner of Bellevue St. and Kildare St.	Not investigated as part of this study.
#9	West of Hwy. 6 in pavement of Racetrack Gas	Private drywell. Collects runoff from gas station. Construction unknown.
#10	Yard on the west side of Hwy. 6 north of 6 th Ave.	Private drywell. Consists of a buried steel culvert with a 12-inch steel pipe entering from the west.

Table 1. Inventory of Existing Drywells

4.0 Recommendations

Recommendations in this report are for modifications and upgrades to the New Denver stormwater collection and disposal system in order to protect the water supply aquifers from contamination and to alleviate flooding and ponding problems within the village. As stated in the engineering analysis of the aquifer system (Section 2.0), the Lake Well is most vulnerable to contamination from surface runoff due to its location and to the unconfined nature of its aquifer. This threat is lessened, however, due to the relative high groundwater velocities that tend to "flush" pollutants out of the aquifer towards Slocan Lake. The Arena Well is not as vulnerable to contamination due to its location upslope of village development and to the semi-confined nature of its aquifer.

Stormwater runoff from Highway 6 represents the most significant threat of aquifer contamination. The application of salts and the chance of fuel spills on the highway could introduce pollutants to the soils and lake within the Lake Well capture zone. This could cause a potential impact to the water quality of the Lake Well. With the proposed improvements to the intersection of Highway 6 and 6 th Ave., and the addition of more pavement, curbs, and gutters, runoff rates and volume will be increased and the potential impacts due to street and yard flooding and aquifer contamination will be intensified. Table 2 shows the upgrade level and corresponding recommended procedures.

Upgrade	Recommended Procedures
Level 1	• Stormwater Collection/ Disposal on Hwy6 [7thAve to Slocan] • Stormwater Collection/ Disposal on 6thAve [Hwy6 to Eldorado Ave] • Improved Grassy Swales/ Check Dams on 6thAve [Hwy6 to Josephine St] • Maintain Existing Drywells #3,7,8,9,10 [Upgrade #3], Eliminate Rest
Level 2	• Stormwater Collection/ Disposal on Hwy6 [7thAve to Slocan] • Improved Grassy Swales/ Check Dams on 6thAve [Hwy6 to Josephine St] • Maintain Existing Drywells #1,2,3,4,5,7,8,9,10 [Upgrade #2,3,4,5], Eliminate #6
Level 3	• Stormwater Collection/ Disposal on Hwy6 [7thAve to Slocan] • Additional Drywells in Identified Problem Areas • Maintain Existing Drywells #1,2,3,4,5,7,8,9,10 [Upgrade #2,3,4,5], Eliminate #6

Table 2. List of Different Level Upgrades.

Our recommendations are given in terms of varying levels of improvements and upgrades. Level I is the highest level, requiring the most involved amount of upgrades and the highest cost. Level III is the lowest level, requiring the least amount of expenditure. These recommendations will address flooding issues and potential aquifer contamination issues.

4.1 Level I Upgrading

This level of recommendation represents the highest level of improvements to the stormwater system. It includes the following:

1. **A stormwater collection and disposal system for Highway 6 from 7 th Avenue to Slocan Avenue.**
   We encourage the Village to work with the Ministry of Transportation to develop a stormwater collection and disposal to follow the recent highway improvement project. This would be a disposal system to take the runoff to an area that would not pose a contamination threat to the water supply wells. Preliminary observations show the dike area north of Carpenter Creek and west of the highway to be a suitable location for the disposal of the highway runoff. The village could build an infiltration basin in this location to safely exfiltrate the stormwater into the subsurface soils. A feasibility study would need to be completed to assess the suitability of this site for an infiltration basin. Characteristics such as soil permeability and depth to the water table must be evaluated. We recommend that a three-chamber water quality inlet (oil / grit separator) be installed at the point of discharge into the disposal area in order to protect the groundwater from contamination due to potential contaminates in the highway runoff.

2. **A stormwater collection and disposal system for 6 th Avenue from Highway 6 to Eldorado Avenue.** This would consist of a formal piped collection system with catch basins located in the curb and gutters along the length of the street. This recommendation would require repaving in order to establish a proper crown to the street. Stormwater would be discharged into an oil/grit separator and then to the bank of Slocan Lake.

3. **An improved system of grassy swales with check dams for Slocan Avenue from Highway 6 to Josephine Street.** Grassy swales are effective site controls for reducing the runoff rate, filtering pollutants and sediments,

and increasing infiltration near the point where rainfall hits the ground. Slocan Avenue already contains some grassy swales on the boulevard and these could be improved and expanded. Some of these grassy shoulders slope towards houses, however, causing potential flooding problems and some do not have a consistent slope down the street.

Grassy swales remove pollutants from stormwater by slowing the water and settling or filtering out solids as the water travels over the grassed area, and by allowing infiltration into the underlying soil. Maintaining a low velocity and shallow depth are key design criteria. Check dams can be added to increase runoff detention and infiltration. A grassy swale designed with a low bottom slope and check dams can remove up to 40% of suspended sediments, phosphorous, nitrogen, and oxygen demand from the runoff. ***Figure 2*** shows a layout plan and a typical cross-section for the proposed grassy swales.

Grassy swales should be constructed with the following guidelines:

- Relatively flat side slopes (3 to 1)
- Vegetated sides and bottom
- Contains contiguous areas of water only following rainfall
- Accessible for regular maintenance (mowing)

4. **<u>An upgrade of existing drywells</u>**. Many of the existing drywells will not be necessary with this level of storm sewer improvements. Since most of the stormwater runoff from Highway 6 and 6 th Avenue will be collected and piped for this level of upgrades, drywells #1, 2, 4, 5, and 6 can be eliminated from the system. Drywells # 3, 7, 8, 9, and 10 will remain. All existing drywells are partially filled with sand and silt and are not operating as effectively as possible. The drywells remaining in operation for this level of upgrade should be cleaned and a regular schedule for inspection and cleaning should be created.

4.1.1 Drywell #3 upgrades

We recommend that an intake catch basin be installed for drywell #3 in order to keep the sand and silt from entering. The catch basin is then easily cleaned when necessary. The catch basin should be installed in an asphalt depression and/or gutter in order to facilitate runoff collection. The drywell cover should be solid. ***Figure 3*** shows a detail of this upgrade to drywell #3.

4.2 Level II Upgrading

This level of recommendation represents a more moderate amount of improvements to the existing stormwater collection system. It includes the following:

1. **A stormwater collection and disposal system for Highway 6 from 7 th Avenue to Slocan Avenue.** This is similar to Level #1.

2. **An improved system of grassy swales with check dams for Slocan Avenue from Highway 6 to Josephine Street.** As described in section 4.1.

3. **An upgrade of existing drywells**. At this level of recommendations, drywell #6 can be eliminated since Highway 6 runoff will be contained in a storm sewer system. Drywells # 1, 2, 3, 4, 5, 7, 8, 9, and 10 will remain and will require cleaning and upgrading. We recommend that an intake catch basin be installed for drywells # 2, 3, 4, and 5. The catch basins should be installed in an asphalt depression or gutter and a solid cover installed on the drywell. Catch basins can be easily cleaned when needed and the drywells will remain free of sediment.

4.2.1 Drywell #2 upgrades

Drywell #2 currently is not functioning due to the amount of sand and silt inside it. It was constructed in an area containing layers of black silty soil with poor drainage characteristics and does not effectively exfiltrate the stormwater even when not filled with sediment. We recommend that a new drywell consisting of two perforated concrete sections be installed in a nearby location where better draining soils are present. An intake catch basin should be installed in an asphalt depression for collecting the runoff and keeping debris and sediments out of the drywell. ***Figure 4*** shows a detailed sketch of the upgrade to drywell # 2.

4.2.2 Drywell #3 upgrades

These upgrades are the same as those described in section 4.1.1 above.

4.2.3 Drywell #4 upgrades

Drywell #4 is located in a gravel shoulder and is partially filled with sediment. It appears that stormwater runoff sometimes flows past the intake cover and down into low-lying areas of the yard to the west. We recommend that the drywell be cleaned out and an intake catch basin be installed nearby in an asphalt depression. ***Figure 5*** shows a detailed sketch of this upgrade.

4.2.4 Drywell #5 upgrades

Drywell #5 is located in an asphalt depression and contains a large amount of sand and silt. It appears that this drywell is subject to a high sediment load and the intake is often blocked with debris. We recommend that the drywell be cleaned out and an intake catch basin be installed in the gutter nearby. ***Figure 5*** shows a detail of this upgrade.

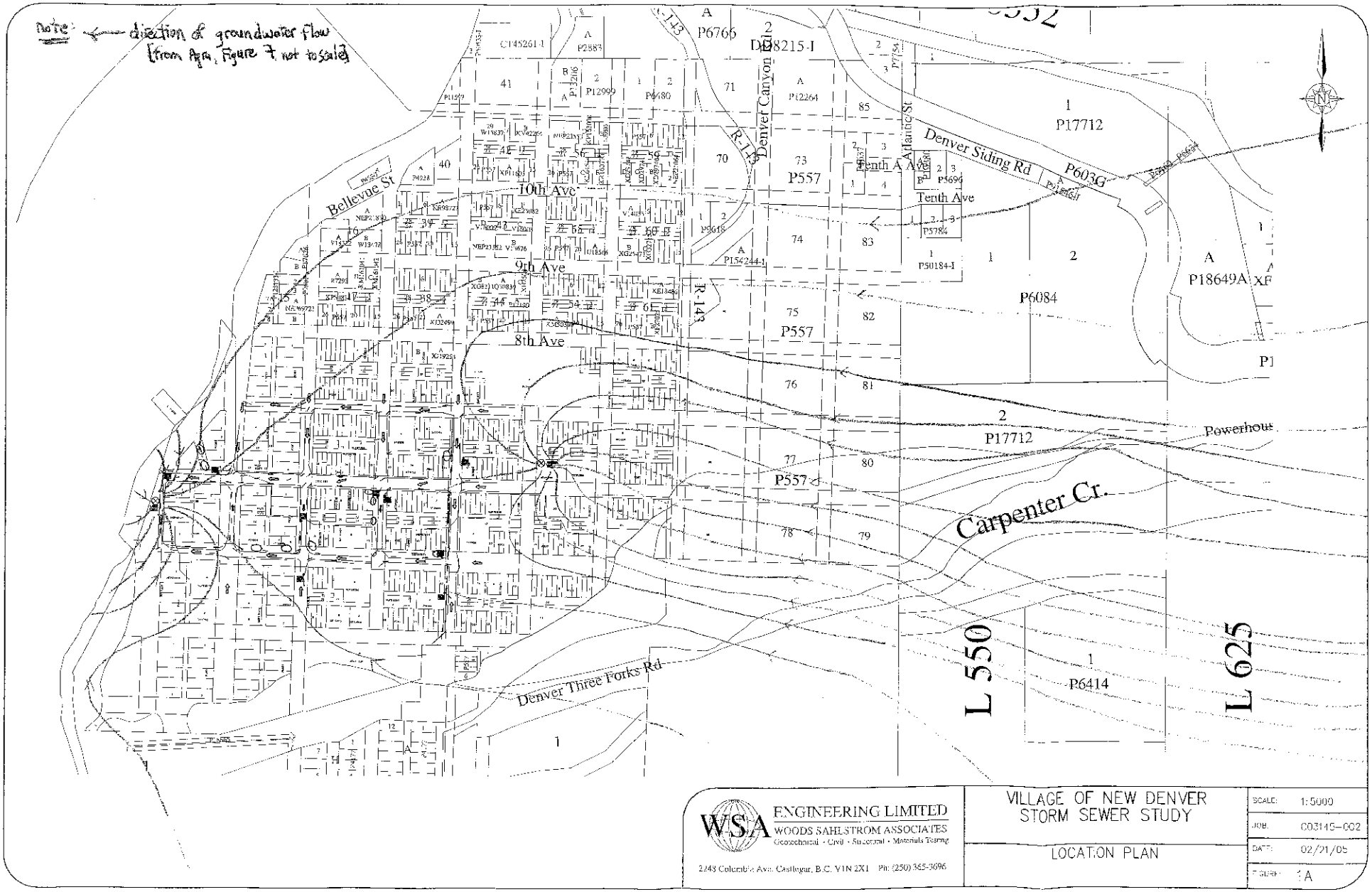
4.3 Level III Upgrading

This level of recommendations includes the following:

1. **A stormwater collection and disposal system for Highway 6 from 7 th Avenue to Slocan Avenue.** This is similar to Level #1 and 2.

2. **The addition of drywells in identified problem areas.** Two low-lying areas at the intersection of Slocan Avenue and Josephine Street are subject to flooding after heavy rains. We recommend that drywells with grated covers be installed at these locations to facilitate the infiltration of this runoff into the subsurface soils. A grassy depression should be created around the intake to facilitate stormwater drainage to the drywell. Since these drywells would be located in grassy swales, sediment would tend to be filtered out before entering the drywell. ***Figure 6*** shows a detail of these two drywells.

3. **An upgrade of existing drywells**. As described in section 4.2.



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VILLAGE OF NEW DENVER
STORM SEWER STUDY

LOCATION PLAN

SCALE:	1:5000
JOB:	03145-002
DATE:	02/21/05
FIGURE:	1A

STM DW ○ STORM SEWER DRYWELL

⇨ GENERAL DIRECTION OF STORM WATER FLOW

→ SPECIFIC DIRECTION OF STORM WATER FLOW

FLOODING AREA

PROPOSED STORM SEWER

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VILLAGE OF NEW DENVER STORM SEWER STUDY

OVERALL SITE PLAN & DRAINAGE

SCALE:	N.T.S.
JOB:	C03145-002
DATE:	02/21/95
FIGURE:	1

5.0 Conclusions

Stormwater runoff poses a potential impact to the domestic water quality of New Denver. Because of the nature of the aquifer system, contaminants contained in the stormwater runoff could theoretically find their way into the water supply wells. The Arena Well supplies most of the domestic water for the village and is operated year-round. The Lake Well is used in the summer months when the demand is higher due to tourism and irrigation of lawns.

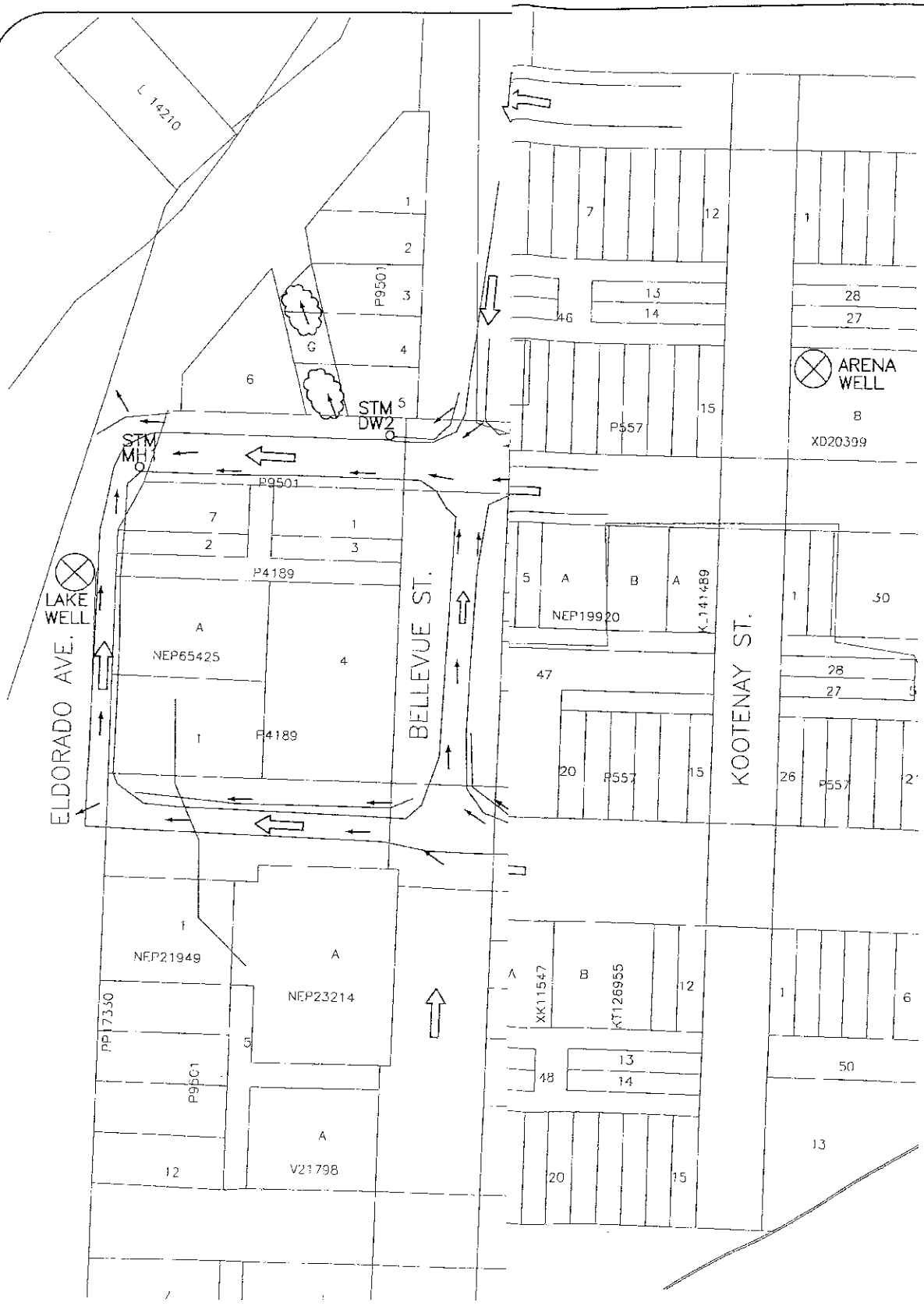
The Arena Well is least susceptible to runoff contamination because of its location and the nature of its aquifer. It is located "upstream" of most village development and storm runoff will enter the surface soils below its capture zone. The aquifer at the Arena Well is semi-confined which protects it from surface contamination. Any contaminates entering the groundwater will tend to be "flushed" away from the well intake due to the relative high lateral groundwater velocity in the aquifer system.

The Lake Well is more vulnerable to runoff contamination due to its location down slope of village development and to its unconfined aquifer. It is, however, protected from contamination due to the depth of its screened intake and to relative high lateral groundwater velocities in the direction of Slocan Lake. Any contaminants entering the aquifer will tend to be "flushed" horizontally before they can disperse down to the level of the well intake.

We recommend that water quality at both wells continued to be regularly monitored for nitrates, chlorides, coliforms, and hydrocarbons as an early warning of any aquifer contamination. The most significant threat of aquifer contamination due to stormwater runoff comes from Highway 6. Salts and oils from the highway will end up in the runoff and can potentially find their way into the water supply aquifers. We recommend that the village work with the Ministry of Transportation to install a stormwater collection and disposal system. This would take the highway runoff to a developed infiltration basin north of Carpenter Creek. An oil/grit separator located at the discharge point will protect the basin from pollutants. The infiltration basin itself is effective in removing both soluble and fine particulate pollutants borne in highway runoff.

The existing system of stormwater catchment drywells needs some maintenance and upgrading. Most drywells are partially filled with runoff sediment, which retards their effectiveness. We have recommended that all drywells be cleaned and that intake catch basins be installed in order to keep them clean. A well-maintained system of drywells can adequately handle the runoff from the village streets and effectively exfiltrate the runoff into the sub-surface soils. As previously stated, any contaminates finding their way from the drywells into the aquifer will most likely be "flushed" past the well intakes due to the high lateral groundwater velocities. We have also recommended the addition of two drywells in specified problem areas.

The existing stormwater system has a serious impact on flooding of streets and yards. We have given recommendations to alleviate these problems. If Hwy. 6 runoff can be contained and disposed of in a proper location, most of the villages flooding problems will be alleviated with only minor maintenance and upgrading of its drywells.



STM DW — STORM SEWER DRYWELL

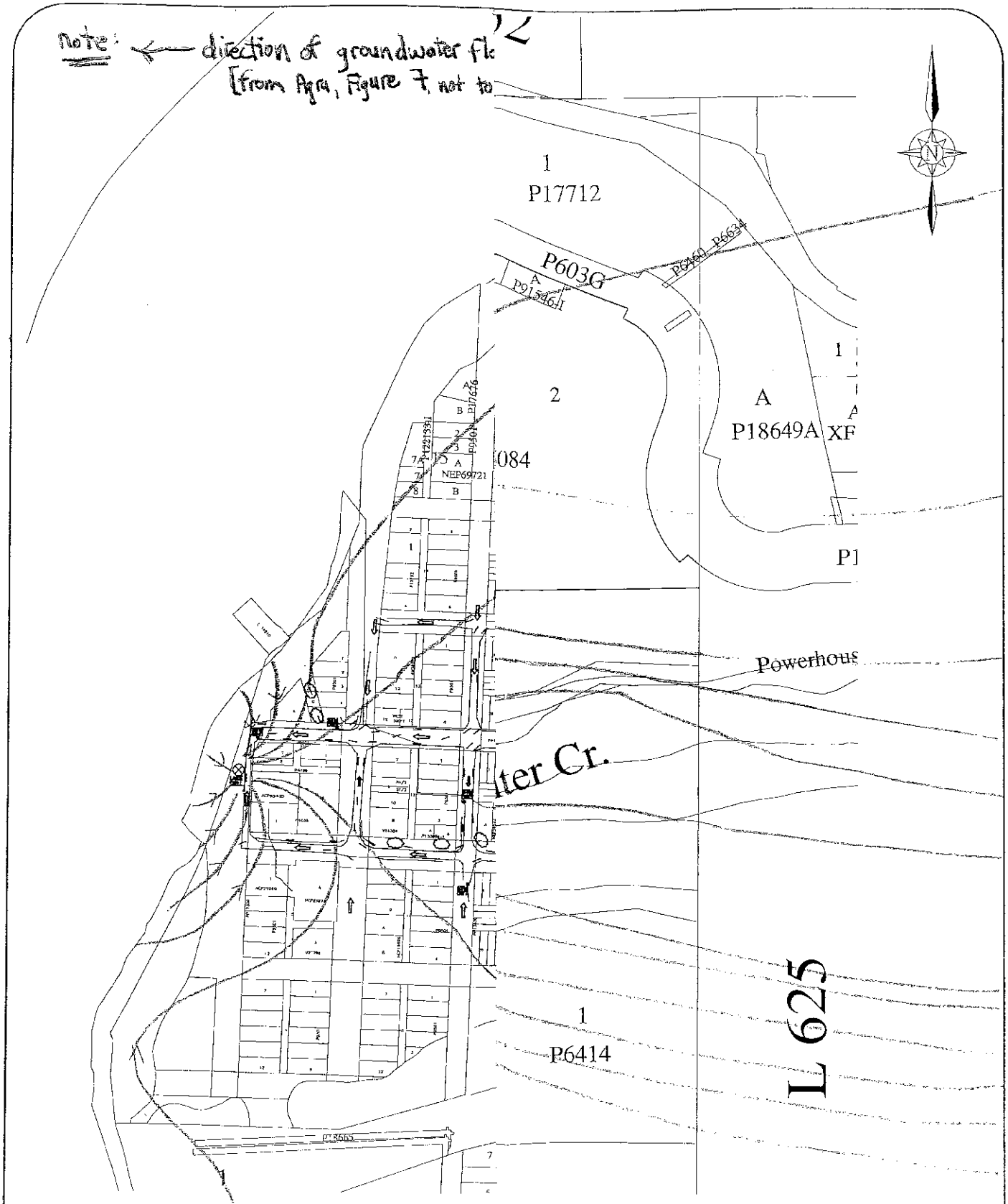
GENERAL DIRECTION OF STORM WATER FLOW

SPECIFIC DIRECTION OF STORM WATER FLOW

LLAGE OF NEW DENVER STORM SEWER STUDY

RALL SITE PLAN & DRAINAGE

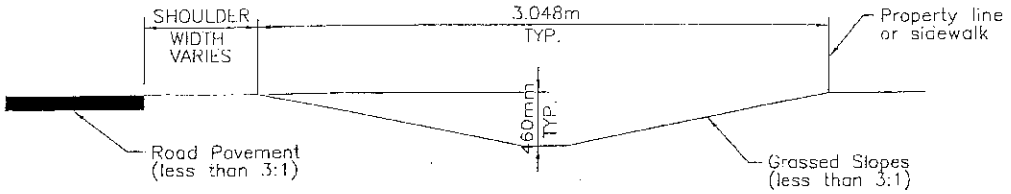
SCALE:	N.T.S.
JOB:	C03145-002
DATE:	02/21/05
FIGURE:	1



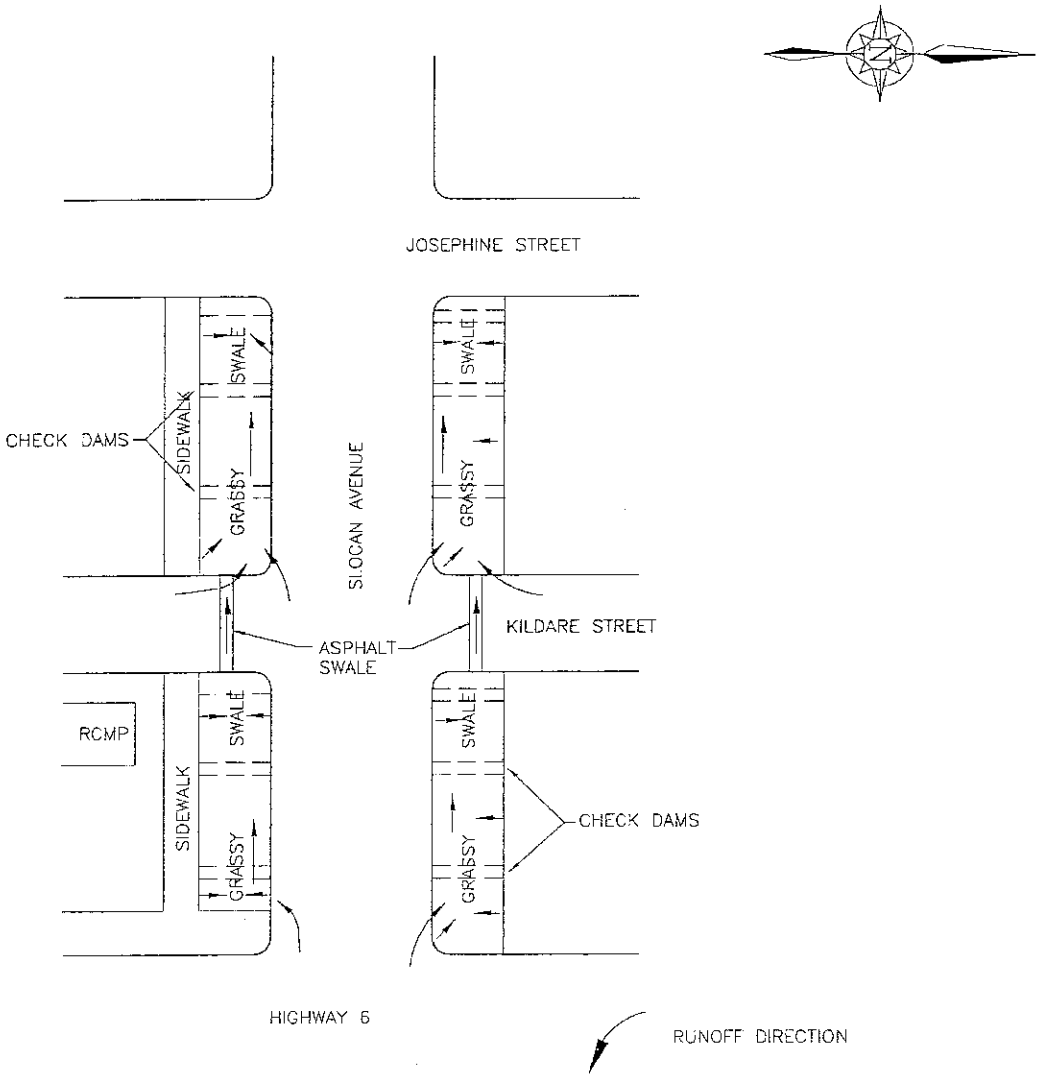
AGE OF NEW DENVER
ORM SEWER STUDY

LOCATION PLAN

SCALE:	1:5000
JOB:	C03145--002
DATE:	02/21/05
FIGURE:	1A



TYPICAL GRASSY SWALE SECTION



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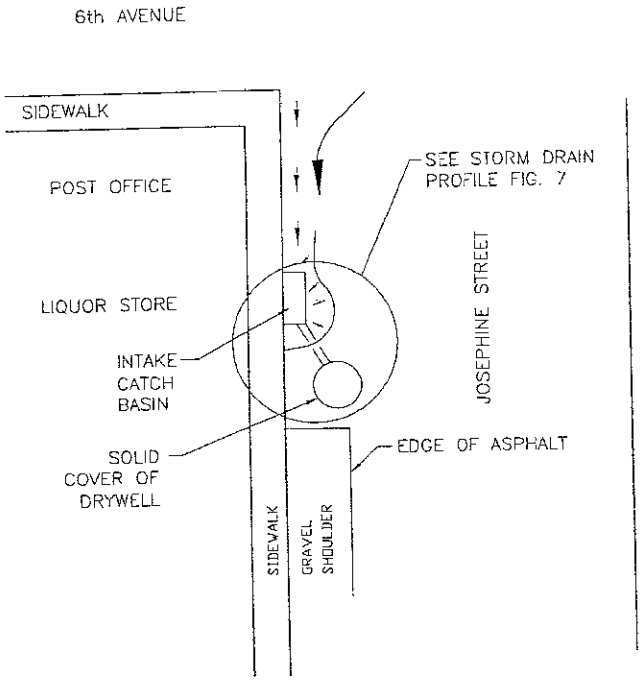
STORM SEWER STUDY

GRASSY SWALES ON SLOCAN AVENUE & TYPICAL SECTION

SCALE:	N.T.S.
DATE:	02/21/05
JOB:	C04145-003
FIGURE:	2



RUNOFF DIRECTION

CATCH BASIN

DRYWELL COVER

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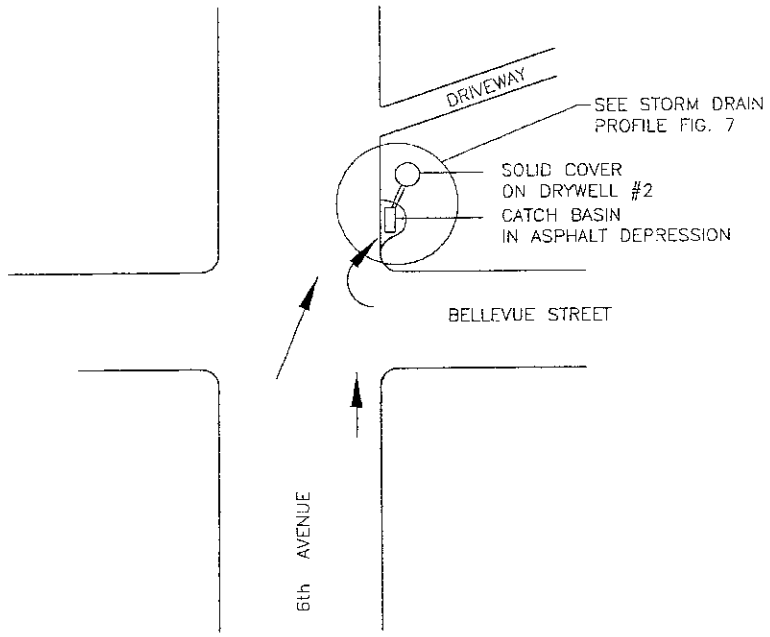
VILLAGE OF NEW DENVER
STORM SEWER STUDY

UPGRADE FOR DRYWELL #3

SCALE:	N.T.S.
DATE:	02/21/05
JOB:	C04145-003
FIGURE:	3



RUNOFF DIRECTION

CATCH BASIN

DRYWELL COVER

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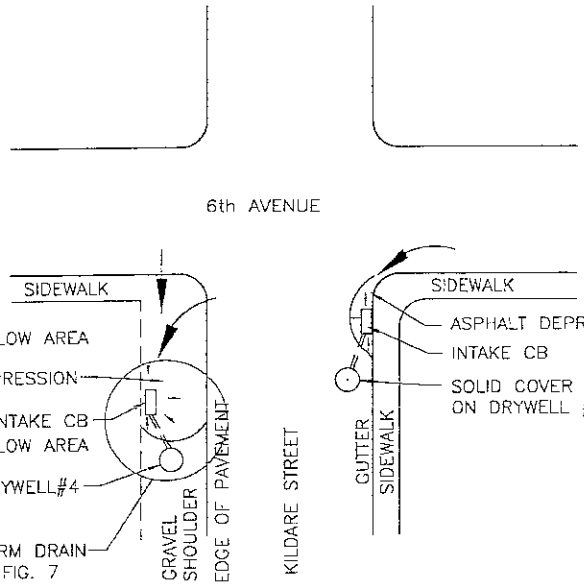
VILLAGE OF NEW DENVER
STORM SEWER STUDY

UPGRADE FOR DRYWELL #2

SCALE:	N.T.S.
DATE:	02/21/05
JOB:	C04145-003
FIGURE:	4



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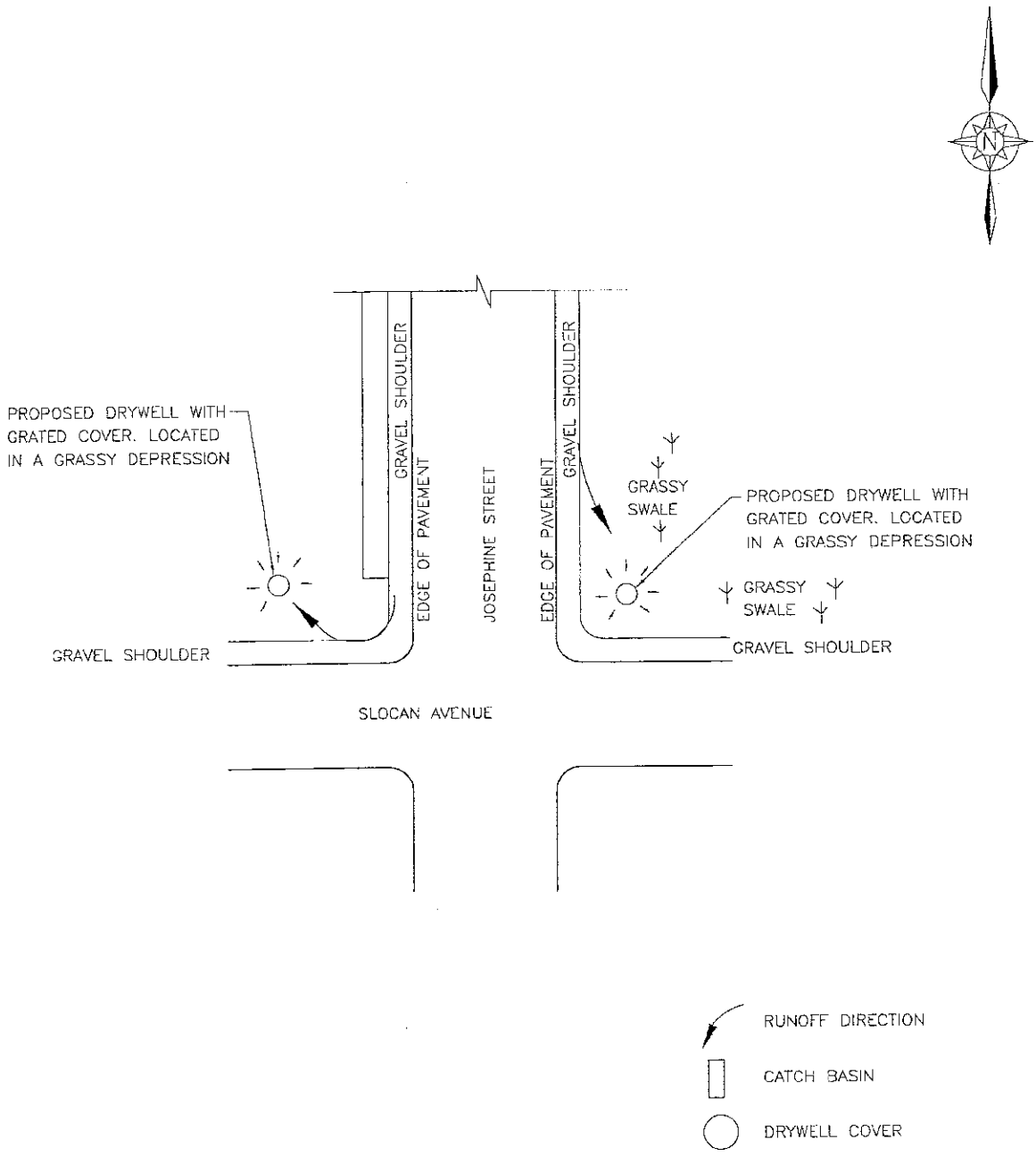
VILLAGE OF NEW DENVER STORM SEWER STUDY

UPGRADES FOR DRYWELLS #4 & #5

SCALE:	N.T.S.
DATE:	02/21/05
JOB:	C04145-003
FIGURE:	5



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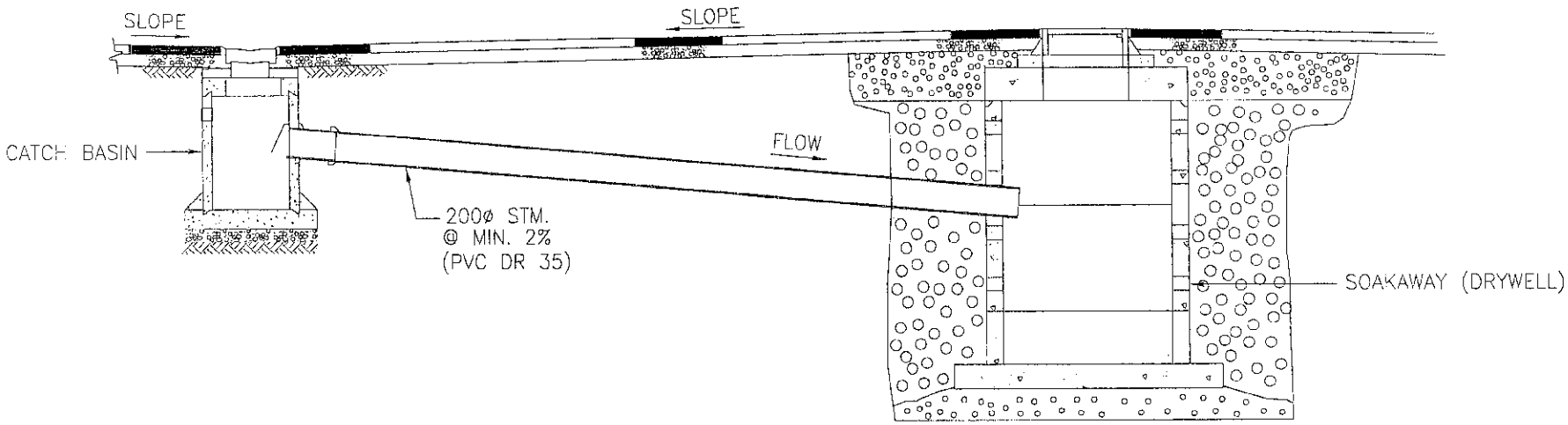
VILLAGE OF NEW DENVER
STORM SEWER STUDY

ADDITIONAL DRYWELLS ALONG SLOCAN AVENUE

SCALE:	N.T.S.
DATE:	02/21/05
JOB:	C04145-003
FIGURE:	6



STORM DRAIN PROFILE

SCALE: 1:30

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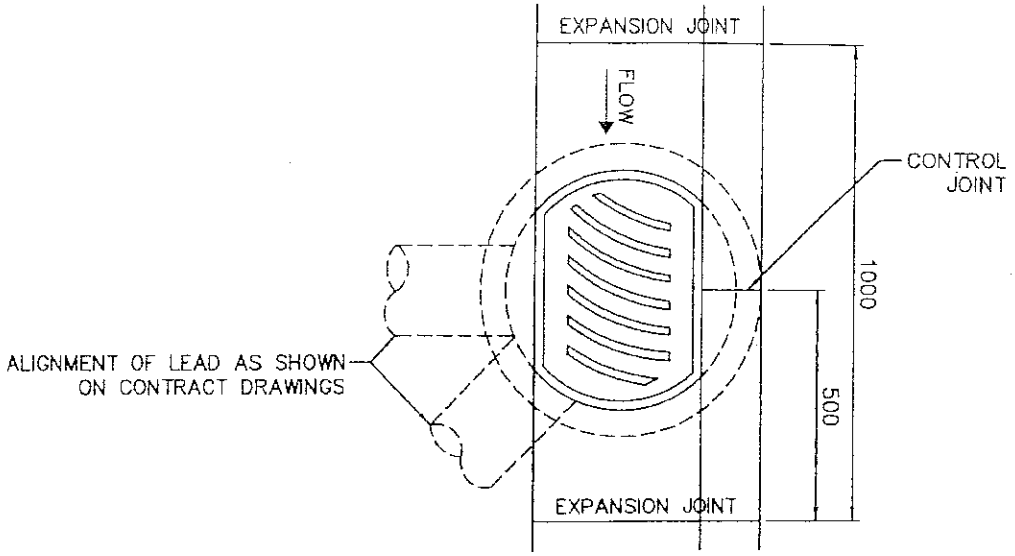
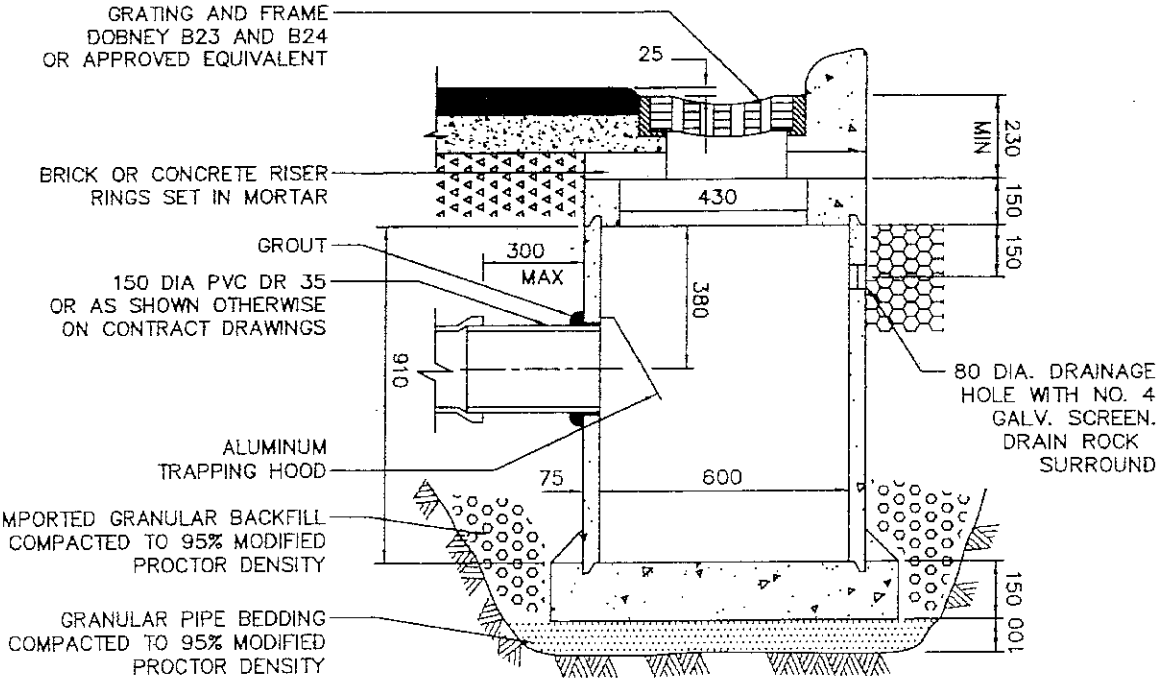
STORM SEWER STUDY

STORM DRAIN PROFILE

SCALE:	N.T.S.
DATE:	02/21/05
JOB:	04145-003
FIGURE:	7



FRAME AND COVER DETAILS



STANDARD CATCHBASIN

NOTE: 1. PRECAST UNITS c/w BASE, APPROVED BY CONTRACT ADMINISTRATOR, ARE ACCEPTABLE.

2. REFER TO CONTRACT DRAWINGS AND SECTION 02725 FOR DETAILED SPECIFICATIONS.

2001

TOP INLET CATCHBASIN

DRAWING NUMBER:

S11