

COCHRANE DITCH SURVEY - DECEMBER 2003  
STEAMBOAT DITCH SURVEY - DECEMBER 2003

# Ditch Survey

For:

## Steamboat Ditch & COCHRANE DITCH

RETURN TO  
GENO TORTULLI  
WHEN THEY  
G/08  
RENO PUB WORKS



*Prepared for:*

City of Reno, Public Works Department  
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Reno, Nevada 89505

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December 2, 2003

## **City of Reno Irrigation Ditch Assessment Program**

### **Purpose:**

The City of Reno entered into maintenance agreements with the Steamboat Ditch Company, the Last Chance Ditch Company, the Lake Ditch Company, and the Cochran Ditch Company on September 10, 2002. The agreements state that the City of Reno has historically used these private irrigation ditches as storm drain conduits for many years but has not participated in the maintenance of these ditches. The City agrees to participate in the maintenance in the form of an annual maintenance fee to be paid to the ditch companies on the basis of the actual maintenance performed beyond the normal annual upkeep of the ditches. The agreements state that the City shall perform assessments in both the operational and non-operational ("wet" and "dry", respectively) seasons. The assessments shall help the City to develop a Capital Improvement Plan (CIP) for the "areas of concern" relating to each ditch.

### **Nevada Water Law:**

The four drainage ditches in question were constructed prior to 1980. Prior to 1980, Nevada Water Law was based upon the Civil Law Rule. Under the Civil Law Rule, a lower property owner must accept natural drainage from an upper, adjoining property, but that the upper property owner does not have the right to change the natural drainage so as to increase the burden of the lower property owner. Under *Boynton v. Longley* (1885), the Nevada State Supreme Court ruled that although the lower property owner must accept naturally occurring drainage, the upper property owner does not have the right to alter or augment the water draining onto the lower property by diversion. Furthermore, as this case applies directly to the importation of water for the purpose of irrigation, although the upper property owner had the right to improve his property by irrigating it, he could not do so at the expense of the lower property owner.

The weakness of the Civil Law Rule is that it does not easily accommodate urbanization. When land is urbanized, runoff quantity and velocity is increased as a result of increased impervious surfaces and by concentrating runoff in swales, ditches, culverts, and storm drain pipe networks. By developing land, natural drainage patterns must be altered. Literal enforcement of the Civil Law Rule would make urbanization virtually impossible.

For this reason, since 1980, Nevada Water Law has operated primarily under the Reasonable Use Rule. Under the Reasonable Use Rule, a property owner may alter the course of runoff on his property provided that he does not cause harm to his neighbor. The complication of this rule is the definition of "unreasonable". The courts are required to determine whether damage was unreasonable or not.

Under *County of Clark v. Powers*, the Nevada Supreme Court ruled that the County had participated in the damages to lower property owners by virtue of the fact that their

drainage master planning had effectively made the upstream development possible. Under this case, the Nevada Supreme Court found that a landowner may drain surface waters onto a neighbor's land if:

1. The injurious flow of water is reasonably necessary for drainage
2. Reasonable care is taken to avoid unnecessary injury
3. The benefit to the drained land outweighs the gravity of harm inflicted upon the flooded land
4. The drainage is accompanied, where practicable, by the reasonable improvement and aiding of normal and natural systems of drainage.
5. Where no natural systems of drainage are available, the drainage is accomplished by the use of a reasonable, artificial system of drainage.

### **Brief History:**

The Truckee Meadows history as an agricultural region goes back many generations. To make the desert green, water was transported from the Truckee River to farms and ranches as far south as the Steamboat Hills. Over time, much of the irrigated land was parceled out or subdivided, leaving increasingly smaller tracts of agricultural land. As the land was split, some of the parcels retained their legal rights to the Truckee River's water.

It is the responsibility of the ditch companies to convey the Truckee River water from its point of diversion to the end user. The irrigation ditches were therefore constructed with the sole purpose of conveying Truckee River water at an essentially steady rate from the point of diversion to the end user.

The irrigation ditches traverse the foothills in the western portion of the Truckee Meadows. As such, they tend to intercept runoff that originates uphill of them. Prior to development of the foothills, this runoff was primarily sheet flow and distributed evenly over the length of the ditch. Of course, there were points of concentration where the ditches intersect washes and gullies. It was at these points that excessive runoff typically escaped from the ditch.

As development crept into the foothills, runoff was collected in storm drainage systems of swales, ditches, culverts, and pipe networks. Until the late 1980's, there was little control over the points of discharge or the quantity of runoff discharged from the developments. For many developers, the logical discharge point was the large irrigation canals bisecting their properties. The logic being that if prior to the development of their property, runoff was intercepted by the irrigation ditches, then after development, runoff should also be allowed to enter the ditch. This logic was not unique to land developers. The City of Reno and individual lot owners also used the irrigation ditches as storm-water discharge points.

After the late 1980's, the City took a somewhat more "hard-line" stance relative to the irrigation ditches. The City strongly discouraged the use of irrigation ditches for

drainage. The City would, however, concede to allow storm drainage discharge into the irrigation ditches with the express, written consent of the ditch companies.

### **Opinion of Nevada Water Law as it Applies to the Irrigation Ditches**

Gray & Associates does not employ attorneys, nor does it imply any legal expertise. The following is merely a rhetorical discussion of our interpretation of the portions of Nevada Water Law discussed earlier and how they apply to the Irrigation Ditches.

The irrigation ditches were constructed prior to urbanization of the Truckee Meadows. At the time of their construction, Nevada Water Law was based upon the Civil Law Rule. As the Civil Law Rule was applied in *Boynton v. Longley*, the ditch companies had the right to construct the irrigation ditches for the purpose of adding value to the properties that they served. The construction of the ditches could not, however, cause damage to the properties it crossed or those below it.

The irrigation ditches, by virtue of their slope-traversing nature, alter the course of naturally occurring upstream surface drainage. The test of the Civil Law Rule, then, is whether the alteration of the course of the drainage caused damages to be realized by lower properties. For the most part, runoff intercepted by an irrigation ditch would be transported to the end of the ditch as long as the ditch had sufficient capacity to carry it there. Once at the end of the ditch, the runoff would (in theory) return to the Truckee River where it would have gone prior to construction of the ditch. If the capacity of the ditch were exceeded by storm runoff, then it would overflow. Overflows would most likely occur at crossings of existing streams, gullies, and washes. Again, one could argue that these natural waterways would have ultimately received the runoff, regardless of the construction of the irrigation ditches, and they would have transported that runoff back to the Truckee River.

Over time, development has occurred upstream of the irrigation ditches. One can infer that the Civil Law Rule could be applied to upstream development with respect to the irrigation ditches. Upstream development that causes damages to the irrigation ditches could, in turn, cause damages to either neighboring property owners below the ditches (breaching of the ditch) or to the end users of the irrigation water (loss of ability to grow crops).

In addition, the Reasonable Use Law could be applied to later development above the irrigation ditches. Did the upstream developers make a reasonable effort to protect the irrigation ditches from damages?

The role of the City of Reno would have to come into play in the answer to this question if the surface runoff entering the irrigation ditches was public in nature. Even with the written consent of the ditch companies to accept public drainage, it would be reasonable to assume that the City would be expected to make an effort to minimize damages to the irrigation ditches.

The maintenance agreement seems to imply that the City does recognize a role in the approval of the storm drain connections and that the City recognizes that certain damages are being realized by the irrigation ditches. Whether neighboring properties have realized damages by the construction of the irrigation ditches is an issue to be decided by the courts.

### **Interviews with Ditch Companies**

Over the course of the study period, Gray & Associates has met with Owners and Owners' representatives for the different ditch Companies. In the interviews, the goal of our staff was to gain an understanding of the issues of concern to the ditch companies. We also asked what improvements/changes they would like to see as a result of their agreements with the City of Reno. We found that several themes were common to all of the ditch companies. Other issues were unique to the individual ditch companies.

#### **Cochran Ditch:**

The Cochran Ditch is the lowest of the four irrigation ditches in this study. Its point of diversion from the Truckee River is near the intersection of Sierra Street and Island Avenue in downtown Reno. It currently serves no irrigated land. It is the main source of water for Virginia Lake.

The vast majority of the Cochran Ditch upstream of Virginia Lake is underground and is located in the most urbanized parts of Reno. As such, it probably receives the highest percentage of public runoff in the form of direct pipe connections. It is also the most endangered of the ditches since it no longer serves its original purpose as an irrigation water conveyance vehicle.

The Cochran Ditch Company would like the City of Reno to perform a survey of the drainage connections to the Cochran Ditch and assess their potential for damage to the ditch.

#### **Lake Ditch:**

The Lake Ditch is the next lowest ditch with a point of diversion from the Truckee River in the vicinity of the Mayberry Bridge. The vast majority of the Lake Ditch water is carried in an open ditch. It traverses the lower portions of the Sierra Nevada foothills on the west side of the Truckee Meadows.

Since it is an open ditch and it is the lowest of the three ditches in the foothills, it tends to bear the brunt of problems that originate with the upper ditches. The representative from the Lake Ditch Company indicated that there are a number of instances where developments or individual homeowners have caused leaks in the upper ditches that travel downhill and damage the lake ditch.

The Lake Ditch Company echoed other ditch companies by saying that the majority of damage to the ditch comes from storm water as opposed to normal irrigation flows. They would like the City to catalog the storm water connections to the ditch.

#### Last Chance Ditch:

The Last Chance Ditch has a point of diversion from the Truckee River near Mogul. It follows a path similar to the Lake Ditch, but at a slightly higher elevation.

Like the other ditch companies, the Last Chance Ditch Company feels that the majority of damage to its ditch comes from storm drain runoff at certain points of connection. They would like the City of Reno to inventory all of the storm drain connections on the ditch and come up with a plan to maintain the connection points and improve the erosion protection at those points.

The Last Chance Ditch Company's representative also voiced a large amount of concern about his ditch's ability to carry storm water. He suggested that a series of diversion structures be constructed at the various stream crossings in order to relieve the quantity of storm water being carried by the irrigation ditch.

The representative also spoke of difficulties in serving the most distant users. As the number of users for a given ditch is reduced, the Nevada State Water Master reduces the allowable diversion for the ditch. The Water Master recognizes that there is a certain quantity of water that is required just to overcome the hydraulic losses in the system, and therefore allows for those losses when reducing the allowable diversion. Even still, it is difficult to reach the most distant users. When asked if the ditch company would consider reducing the ditch section in order to improve the hydraulics, the ditch company representative stated concern that the ditch would no longer have the capacity to carry storm water.

#### Steamboat Ditch:

Of the four irrigation ditches under consideration, the Steamboat Ditch is the largest, serves the most land, and is the highest in elevation. Its point of diversion from the Truckee River is at the California State Line. Due to its status as the highest irrigation ditch, it is also the first irrigation ditch to collect storm water. As such, the Steamboat Ditch Company has also voiced a desire to have the City of Reno construct diversion structures at stream crossings.

The Steamboat Ditch Company would also like the City of Reno to inventory all storm drain connection points. Additionally, they would like an inventory of surface drainage structures (including individual lot drainage swales) that drain into the Steamboat Ditch.

## **Summary of Ditch Company Concerns**

The majority of the concerns voiced by the individual ditch companies were shared by the entire group. The following is a list of the major issues:

- The City of Reno needs to inventory all storm drain connections
- Diversion structures should be constructed at major stream crossings
- The City of Reno needs to prepare a Capital Improvement Plan to improve storm drain connection points

## **Recommendations**

The requests from the ditch companies range from the simple to the seemingly impossible. A practical solution falls somewhere between.

The first point of order should be to map the storm drain connection points. The study should be limited to pipes or culverts and large drainage ditches. The Steamboat Ditch Company requested that even the small drainage swales also be mapped. This is probably beyond the intention of the Maintenance Agreement, and would require many times more effort and budget than may seem practical for the purpose of shared maintenance.

The Steamboat Ditch was constructed prior to major development in the western foothills of the Truckee Meadows. It traverses the hills from the California State Line to the Steamboat Hills. In doing so, it is impacted by all runoff originating uphill of the ditch. Over time, development has occurred upstream of the Steamboat Ditch. Much of the runoff originating on the developed properties is collected in storm drain pipes. Of the runoff from the developed areas that is ultimately deposited in the Steamboat Ditch, a large portion reaches the ditches via the storm drain piping systems. A certain amount, however, reaches the ditch as overland flow.

Many properties that are located uphill of the ditch have been graded to drain directly into the ditch. From a hydrologic standpoint, one could argue that runoff entering the ditch via overland flow has been increased over undeveloped conditions due to the increase in impervious area (driveways, parking areas, rooftops, etc.). One could further argue that the development has concentrated runoff in a drainage swale. That runoff would have otherwise drained into the ditch as sheet flow and therefore would have been distributed over a greater length of the ditch. Conversely, one could argue that if the runoff that reaches the street that serves a given property intercepts a portion of the runoff that would have reached the ditch via sheet flow, then the actual flow reaching the ditch at the location of the given property is reduced (or at least concentrated at the point that a storm drain pipe enters the ditch). Simplified, one could argue that development of lands uphill of the Steamboat Ditch may or may not have negative impacts on the Steamboat Ditch depending upon the location of that development.

Although a survey of all surface swales contributing to the Steamboat Ditch is possible from a conceptual standpoint, the cost and legal ramifications would render it infeasible. If one were to survey the pipes that connect to the ditch, it could be argued that such work could be performed within the confines of existing ditch easements. If one were to survey drainage swales, aerial means would not provide sufficient detail, and one would need to get permission from every landowner that abuts the ditch to enter his property and perform field survey work. The probability of getting that many property owners to agree to the project is marginal at best.

The point is that it would probably be in the City's best interest to limit the survey to that which we know to be true and to that which is most accessible. We know that runoff damage tends to occur at connection points for major drainage conduits such as storm drain pipes and large drainage ditches, and we are able to survey those points from within existing access easements.

The second point of order should be a limited hydrologic study of the major drainage channels that are traversed by the ditches. The goal would be to locate possible points for the construction of bypass and overflow structures. There exist some old hydrologic studies that set a baseline for drainage in the existing channels. If one could locate those studies and modify the calculations to meet modern standards, one could create a basis for distribution of intercepted runoff. Included in this study would be a brief survey of downstream collection points for these streams. At some point, all of the major drainage channels enter the urban area and are somehow collected and routed to the river. A responsible approach to the distribution of excessive runoff from the ditches would need to address the ability of downstream facilities to carry the runoff that is diverted toward them.

Also included in the limited hydrology study would be the "wet" assessment that is discussed in the maintenance agreement. In order to establish baseline irrigation flows in the irrigation ditches, it will be necessary to conduct a long-term study of the irrigation flows in the ditches. Data collected could be used to determine the capacity of diversion structures for excessive runoff.

The third point of order would be to prepare a Capital Improvement Plan that combines both the physical survey of the points of connection with the hydrologic study. The points of greatest concern – either with respect to erosion/bank failure, overflow, or economic impact – would be prioritized. It is anticipated that the City's first priority would be to improve the points of storm water discharge into the irrigation ditches. Improvements would include construction of headwalls and erosion protection. This would help solve the primary problem of damage to the ditches. The City could then move on to distribution of runoff. Final phases of the Capital Improvement Plan should address the quality of water being discharged into the ditches. This would be coordinated with the City's overall water quality plan per Phase II of the National Pollution Discharge Elimination System.

The fourth point of order should be the complete take-over of the Cochran Ditch as a storm drain conduit. The Cochran Ditch is singled out for complete take-over because it no longer has any users. It is also the only one of the four ditches that is completely within the City Limits. It can be anticipated that the other three ditches will remain in use indefinitely as transporters of irrigation water.

The fifth point of order would be to write new, specific development requirements relative to the irrigation ditches and for the City of Reno to adopt a strict enforcement policy for these requirements. Currently, the City's code enforcement is fairly strong for large developers, but for private homeowners, enforcement is lax at best. The new requirements should address future expansion of the City Limits and Sphere of Influence.

The sixth and final point of order should be cooperation with unincorporated Washoe County. With the exception of the Cochran Ditch, all of the ditches begin and end outside the current City Limits. Without the cooperation of Washoe County, the hydraulic improvements to the ditches are pointless. The City should encourage the County to adopt the same new development requirements and Code enforcement policies that the City is adopting. In doing so, the City can ensure that its own improvements to the ditches are not damaged by drainage problems originating in another jurisdiction. It will also help assure the City that as it expands its Limits, it does not inherit new drainage problems.

### **Implementation**

#### Mapping Storm Drain Connection Points:

For the Steamboat Ditch, the Last Chance Ditch, and the Lake Ditch, this job can be done by survey crews. We recommend that survey teams walk the lengths of the irrigation ditches during the winter, when the ditches are not used for irrigation. The connection points can be mapped using GPS technology and be tied to the City of Reno GPS system and datum. Each point will describe the spatial location of the connection as well as the size of the pipe or ditch and the material of construction. This information can be tied to aerial photography and topographic mapping that is available from Washoe County for the entire County.

It will also be important to know the quantity of runoff entering the ditch at the connection points. Rather than performing exhaustive hydrology calculations to estimate the quantity of runoff, it will be easier to take a worst-case approach and assume that the connection conduit is running full and base the flow on hydraulic calculations.

While walking the lengths of the ditches, the surveyors can be asked to observe the topography of the land around the ditches and to take note of potential problem areas such as low banks or large drainage basins that enter the ditch.

The Cochran Ditch presents a unique challenge since it is predominantly underground. Currently, there does not exist remote sensing equipment that can be used in non-round

conduit with debris. Most of the conduit for the Cochran Ditch is probably large enough for a man to crawl through. This would be a very dangerous undertaking, but a possible one, if the City of Reno were willing to take on the liability of sending a man in.

#### Limited Hydrology Study:

According to conversations with City of Reno staff in both the Engineering and Public Works Departments, there exist a number of hydrology studies on the canyons of the west side of the Truckee Meadows. It will be necessary to research the City's archives in order to locate these studies. If these studies can be located, they can be used as a basis for determining the ability of the existing drainageways to carry runoff.

In addition to locating the existing drainage studies, it will be necessary to perform a certain amount of fieldwork on the canyons to locate their collection points and assess their abilities to collect the runoff that is directed toward them.

After researching the drainage studies and performing the fieldwork, it may become clear that the only way to determine the capacity of the natural drainageways is to perform comprehensive hydrologic calculations on each drainageway. The scale of such an undertaking could prove too costly and consume more time than is allotted to this project, and performing new hydrologic calculations should be left as a last resort. A compromise solution would be to limit the study to a few key drainage channels. The computations would still be lengthy and expensive, but they would be performed on fewer channels.

The "wet" assessment that is required by the Maintenance Agreement will provide supplemental information to the hydrologic and hydraulic studies listed above. The scope of the wet assessment will be more limited, however. The extent of this work should be to construct weirs in the irrigation ditches to be used as measuring devices. At least three weirs should be constructed in each ditch: one located as close to the point at which the ditch enters the City Limits, a second at the midpoint of travel through the City Limits, and a third just before the ditch leaves the City Limits. The weirs would probably need to be checked twice per week. This study really only needs to be performed on the Steamboat Ditch, the Last Chance Ditch, and the Lake Ditch. Since the Cochran Ditch is effectively non-operational, such monitoring is unnecessary.

#### Capital Improvement Plan:

Once the wet and dry assessments are complete, it will be possible to prepare a Capital Improvement Plan (CIP). Based upon conversations with the ditch companies, the first priority should go to improving the storm drain connection points and thereby protecting the irrigation ditches from primary storm damage. These improvements will likely include the construction of headwalls, slope stabilization, and erosion protection measures. The second priority should be given to creation of overflow structures and/or bypass structures. The reason for delaying these improvements is twofold. First (as mentioned previously) it is important to mitigate damage from the inlets. Second, it may

be necessary to schedule capital improvements to drainage facilities downstream of the overflow/bypass points in order to accommodate the diverted flows prior to actually diverting those flows.

An issue that shouldn't be ignored in the CIP is improvements to the quality of water entering the ditches with respect to Phase II of the National Pollutant Discharge Elimination System. The ability to employ water quality improvements will depend greatly upon the availability of land in which to construct the necessary facilities.

#### Take-over of Cochran Ditch by City of Reno:

This step should probably be considered a Capital Improvement Project and included in the CIP. Although the vast majority of the Cochran Ditch is underground, there do remain sections of open ditch. The City of Reno may want to consider enclosing the entire ditch for safety purposes. Such improvements could be prioritized and amortized over a number of years.

#### Creation and Enforcement of New Development Codes:

Currently, the City's Public Works Design Manual allows for discharge of storm water into irrigation ditches as long as peak runoff is reduced to pre-development conditions, and only with the written approval of the ditch companies. In this application, the irrigation ditches are treated as naturally occurring features from a hydrologic standpoint. The City of Reno should consider revising its position on the classification of the irrigation ditches as drainage facilities. Perhaps a more hard-line approach should be taken with regard to drainage. Direct discharge of concentrated runoff into the irrigation ditches could be limited to situations where there is no alternative way to drain a property. An allowance could also be made for undisturbed portions of the properties that drain directly into the ditches to continue to do so. Another possibility would be to allow for subsurface discharge of runoff similar to the allowances of the Tahoe Regional Planning Agency. Such facilities would be subject to strong input from a geotechnical engineer due to the expansive and often impermeable nature of local soils.

Code enforcement should also be improved, and a citizen reporting system should be implemented. Experience has indicated that Code Enforcement Officers will only respond to violations if they can catch the violator "in the act". If the violations occur before or after working hours or on weekends, the Code Enforcement Officers turn a blind eye. Additionally, the Code Enforcement Officers are often unfamiliar with the Codes that they are charged with enforcing. An emphasis on education of the Code Enforcement Officers should also be a priority.

#### Coordination with Washoe County:

If the City of Reno chooses to implement storm water overflow measures on the irrigation ditches, the simplest form of overflow control is the limitation of storm water that reaches the ditches. As discussed previously, these measures can take the form of

stricter Development Codes and Code Enforcement. Without cooperation from Washoe County, the City will have no control over upstream storm water discharge to the irrigation ditches. The City of Reno and Washoe County should work toward the creation and implementation of the same development standards with respect to the irrigation ditches.

Expansion of the City Limits is an ongoing process. For various reasons, property owners may petition to be annexed or may be forced to annex into the Reno City Limits from previously unincorporated portions of Washoe County. If Washoe County and the City of Reno were utilizing equivalent development standards, the City would not find itself in the position of improving storm drain connections every time it annexes new lands.

### Costs and Time Frames

The Maintenance Agreements are quite clear regarding the time frames for the “dry” and “wet” assessments. The “dry” assessment must be completed prior to the start of the 2003 irrigation season, and the “wet” assessment must be completed prior to the end of the 2003 irrigation season. The time frame for preparation of a CIP is more vague. The Agreement implies that the CIP should occur concurrently with the assessments. A more prudent approach would be to assemble all of the data from the assessments prior to development of a CIP.

#### Steamboat Ditch:

Survey Crew with GPS Unit	+/-30 days	\$60,000
Three Sharp-Crest Weirs		
Engineer to Monitor Weirs	6 months	\$33,000

#### Last Chance Ditch:

Survey Crew with GPS Unit	+/-30 days	\$47,000
Three Sharp-Crest Weirs		
Engineer to Monitor Weirs	6 months	\$33,000

#### Lake Ditch:

Survey Crew with GPS Unit	+/-30 days	\$47,000
Three Sharp-Crest Weirs		
Engineer to Monitor Weirs	6 months	\$33,000

#### Cochran Ditch:

Survey Crew with GPS Unit	+/-15 days	\$11,000
Underground Crew	+/-15 days	\$43,000

Limited Hydrology Study:	+/- 90 days	\$50,000
Development of CIP:	City of Reno to assist.	
Purchase of Cochran Ditch:	City of Reno to assist.	

**Summary:**

For many decades, the City of Reno has used the Cochran Ditch, the Lake Ditch, the Last Chance Ditch, and the Steamboat Ditch as storm drain outfalls. These ditches were constructed not to carry highly variable storm drain flows, but steady-state irrigation flows. Consequently, the ditch companies find that there are maintenance costs that are directly attributable to storm water. The City of Reno recognizes that it must play a role in the maintenance of the irrigation ditches if it is to continue to use them as storm drain conduits.

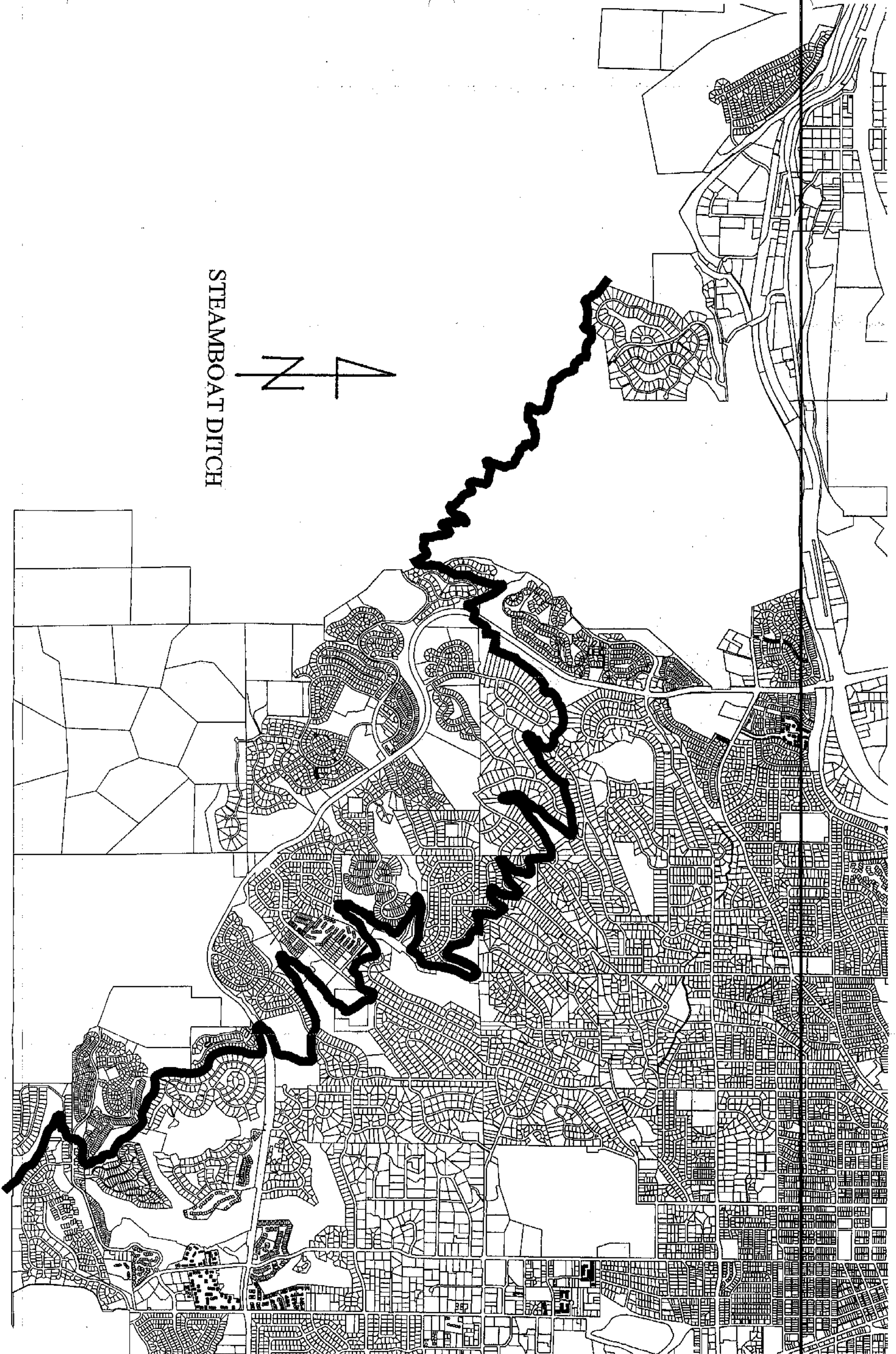
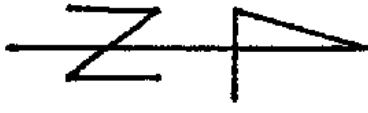
On September 10, 2002, the City of Reno entered into agreements with the individual ditch companies to use and help maintain the ditches. Among the stipulations of the agreements is for the City to perform assessments of the ditches during the irrigation and non-irrigation seasons. From these assessments, the City is to prepare a Capital Improvement Plan (CIP) that will define the improvements that the City will make to the ditches and its time frame for doing so.

In acknowledging that the irrigation ditches are being used as storm drain conduits, the City is also acknowledging that it must attempt to address the concepts of Nevada Water Law. To do so, the City must attempt to minimize property damages to both the ditch companies as well as the landowners near the irrigation ditches.

Assessing potential damages means assessing a baseline of allowable runoff. This can become extremely complex in an urban or suburban area. To simplify the process, the City should focus on transport of runoff from the downstream, up. This will involve both office and field research.

We hope that this document provides some direction for the City of Reno in its fulfillment of the requirements of the Drainage and Maintenance Agreements.

STEAMBOAT DITCH



PHOTOS



STEAMBOAT 1000



STEAMBOAT 1002



STEAMBOAT 1003



STEAMBOAT 1004



STEAMBOAT 1005



STEAMBOAT 1006



STEAMBOAT 1007



STEAMBOAT 1008



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STEAMBOAT 1030



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STEAMBOAT 1142



STEAMBOAT 1143



STEAMBOAT 1144



STEAMBOAT 1146



STEAMBOAT 1147



STEAMBOAT 1150



STEAMBOAT 1151



STEAMBOAT 1154



STEAMBOAT 1155



STEAMBOAT 1156



STEAMBOAT 1156B



STEAMBOAT 1157



STEAMBOAT 1159



STEAMBOAT 1161



STEAMBOAT 1162



STEAMBOAT 1163



STEAMBOAT 1164



STEAMBOAT 1165



STEAMBOAT 1167



STEAMBOAT 1168



STEAMBOAT 1169



STEAMBOAT 1170



STEAMBOAT 1171



STEAMBOAT 1172



STEAMBOAT 1173



STEAMBOAT 1175



STEAMBOAT 1176



STEAMBOAT 1177



STEAMBOAT 1178



STEAMBOAT 1179

POINT DATA

1

STEAMBOAT DITCH

POINT NO.	NORTHING	EASTING	SHAPE	SIZE	MATERIAL	NUMBER OF BARRELS	HEAD-WALL	FES	SLUICE GATE	INLET	OUTLET	ROAD CROSSING	STREAM X-ING	COMMENTS
1000	14857099.74	2256405.98												Bridge TMWA Access
1001	14857109.48	2256425.13												CL 10 WOOD BRIDGE GATE
1002	14857111.11	2256389.93	Squash	21x38	CMP	1	X						X	Hunter-Creek X-ing
1003	14857162.09	2256388.81	Box		RCB			X			X			Drain Gate
1004	14857177.17	22568374.22	Cir.	12"	Steel	1		X			X			Gate Valve (GV)
1005	14856917.22	2257807.79												Short granite section
1006	14856262.92	2258661.64	Box	10"x5.5"	RCB	1	X					X		(Woodchuck Ln.)
1007	14856194.50	2258857.93												Private Bridge
1008	14855984.63	2258959.70	Cir.	12"	Steel			X			X			GV
1009	14855817.60	2258345.42	Cir.	4"	ABS	1			X					Private Yard Drain Erosion
1010	14855779.88	2259017.13	Box	10'x5'	RCB	1						X		(Frankovich Ct.)
1011	14855902.46	2259702.87	Cir.	8"	Steel	2								SS X-ing
1012	14855895.50	2259708.73	Bridge		RC							X		Weser Ln.
1013	14855876.83	2259716.18	Cir.	12"	CMP	1								Severed SD Crossing
1014	14854852.21	2260101.88	Box	10'x6'	RCB	1								Path X-ing
1015	14854877.52	2260545.32	Cir.	6"	Steel	1	X		X		X			GV
1016	14864515.12	2260874.68	Box	10'x5'	RCB	1	X					X		(Caughlin Parkway)
1017	14854437.31	2260552.33	Cir.	18"	PVC	1		X		X				Promotory From MH in Street field
1018	14854071.31	2261098.54	Cir.	8"	Steel	1		X		X				GV
1019	14854063.84	2261100.81	Cir.	18"	CMP	1		X		X				GV
1020	14854041.19	2261106.75	Box	10'x6'	RCB	1								Pathway to SS Access
1021	14854124.77	2261278.97			Conc									Conc. Sect.
1022	14853501.77	2261809.22	Cir.	18"	CMP	1		X			X			GV
1023	14853417.98	2261815.08											X	stream X-ing
1024	14853414.07	2261996.21	Box		RCB	1						X		(Bitterroot) with 12" SD to Box
1025	14853426.91	2262033.68												INIT BITTERROOT XING
1026	14853416.42	2262079.78								X				Inlet through box culvert
1027	14853304.26	2262322.85	Cir.	6"	Steel	1			X		X			GV
1028	14853249.62	2262366.52	Box	9'x2.25'	RCB	1			X			X		Foot Path
1029	14853266.40	2262394.63	Box	9'x2.25'	RCB	1			X				X	(Alum Creek)
1030	14854036.10	2262607.92	Box	10'x5'	RCB	1	X		X			X		(Buck Creek rd.)
1031	14854078.65	2262637.46	Cir.	18"	RCP	1				X				Inlet through headwall
1032	14854454.32	2262672.39	Box	10'x5'	RCB	1	X					X		(Quilic) 1 1/2" Conduit through culvert
1033	14854487.60	2262702.46	Cir.	15"	PVC	1				X				Through headwall of box
1034	14854723.91	2262798.89	Cir.	4"	Flex	1				X				Rockery Drain

POINT NO.	PHOTO NO.	SHAPE	SIZE	MATERIAL	NUMBER OF BARRELS	HEAD-WALL	FES	SLUICE GATE	INLET	OUTLET	ROAD CROSSING	STREAM X-ING	COMMENTS
1036	14854910.80	Cir.	15"	PVC	1	X			X				Storm Drain
1037	14854424.23	Cir.	6"	Steel	1			X					GV
1038	14854386.38			Conc.									Beg. Conc. Sect. (Caughlin Creek)
1039	14854503.37												Conc. Stream FL. Trash Rack
1040	14854557.05	Box	10'x5'	RCB	1	X					X		(W. McCarran) Upstream
1041	14854547.22	Box	10'x5'	RCB	1	X					X		Downstream
1042	14854622.84	Cir.	12"	RCP	1		X						Storm Drain
1043	14854821.96			Conc.									End Conc. Sect.
1044	14854815.92											X	Erosion
1045	14855044.76	Cir.	6"	Steel	1			X					GV
1046	14855645.48					X							Beg. Conc. Sect.
1047	14855450.98					X							End Conc. Sect.
1048	14855776.54	Cir.	12"	RCP	1				X				Storm Drain
1049	14855768.84												Erosion
1050	14855744.72								X				Storm Drain
1051	14855736.62												Erosion
1052	14856745.52												Beg. Wall
1053	14856743.19	Box	10'x5'	RCB	1	X					X		(Southampton) 12" RCP side of box
1054	14856736.93	Box	10'x5'	RCB	1	X							CB S SIDE RD
1055	14856765.26	Box	10'x5'	RCB	1						X		(Southampton) Outlet end
1056	14855195.96												Wash from S. Hampton.
1057	14856286.60	Box	10'x3'	RCB	1	X			X		X		(Meridian) upstream 12" entering Box
1058	14856302.14												CL HD WALL MERIDIAN
1059	14856273.19	Box	10'x3'	RCB	1	X					X		(Meridian) downstream
1060	14856271.03												CB TBC
1061	14856271.20												CL MON
1062	14856182.39												Beg. Keystone Sect.
1063	14856120.59												Private bridge
1064	14856054.36												Private bridge and beg. Of rip rap Sect.
1065	14856932.66												Private bridge w/ 4" drain underneath
1066	14855908.40												CONC DWY OVER DITCH
1067	14855944.66	Cir.	4"	Flex Pipe	1				X				Wall Drain
1068	14855844.51												End Keystone Beg. Rock Sect.
1069	14855803.32												Private bridge
1070	14855796.59	Box	10'x4'	RCB							X		(Susileen)
1071	14855809.26												CL HD WALL SUSILEEN
1072	14855821.25	Cir.	8"	CMP	1				X				Private Drain and beg. Stacked Rock

POINT NO.	PHOTO NO.	SHAPE	SIZE	MATERIAL	NUMBER OF BARRELS	HEAD-WALL	FES	SLUICE GATE	INLET OUTLET	ROAD CROSSING	STREAM X-ING	COMMENTS
1073	14855855.99											End Stacked Rock Wall
1074	14855724.13											Private bridge
1075	14855561.86											Private bridge
1076	14855181.88	Cir.	12"	CMP	1		X					Storm Drain with Erosion
1077	14855121.61	Cir.	15"	RCP	1	X						Storm Drain
1078	14855235.78	Cir.	10"	CMP	1	X						Storm Drain with Erosion
1079	14855302.79											Private bridge
1080	14855305.38											WOODEN BRIDGE
1081	14855585.21	Box	10'x4'	RCB	1	X				X		(Markridge)
1082	14855533.17											CL MON MARKRIDGE
1083	14855522.25											10'x4' BOX
1084	14854963.70	Cir.	12"	CMP	1		X					photo says 1085b
1085	14854923.21	Cir.	12"	CMP	1		X					Private bridge w/ trench drain
1086	14854885.79	Cir.	10"	CMP	1	X						Storm Drain
1087	14855225.84	Box	10'x5'	RCB	1	X				X		(Martham) inlet end
1088	14855025.50	Box	10'x5'	RCB	1	X						photo says (1089) outlet end
1089	14854626.65	Cir.	12"	RCP	1		X					Storm Drain
1090	14854652.63	Box	10'x5'	RCB	1	X				X		(Belford) Upstream
1091	14854650.07											CL BELFORD
1092	14854645.57	Box	10'x5'	RCB	1	X				X		(Belford) Downstream
1093	14853968.42	Cir.	8"	PVC	1		X					Possible SD connect
1094	14853936.68											Conc. Sect
1095	14854113.90											Private Bridge
1096	14854323.66											Conc. Sect
1097	14854124.19											Beg. Stacked Concrete
1098	14854124.22											BEG 100FT STACKED CONC
1099	14854034.92											Beg. Stacked Rock
1100	14853933.83											End Stacked Rock
1101	14853345.15	Box	10'x4'	RCB	1					X		(Cashill)
1102	14853341.13											10'x5' BOX@ CASHILL
1103	14853341.23											BEG DAY 2@CASHILL BOX
1104	14853343.95	Cir.	12"	RCP	1	X						Headwall 10'
1105	14853354.80											DI CB
1106	14853296.40	Cir.	12"	Steel	1							Pipe over ditch
1107	14853264.04											Ditch enters 1' above I.E.
1108	14853264.13	Box	10'x5'	Conc		X						No inlets
1109	14853093.50	Box	10'x5'	Conc		X						No inlets
1110	14853081.45											CL RD
1111	14853067.44					X						BM 2410
1112	14851755.74						X			X		Drainage from above
1113	14851555.28			Conc lined								Beg. Channel

*Station 1085 b*



POINT NO.		PHOTO NO.	SHAPE	SIZE	MATERIAL	NUMBER OF BARRELS	HEAD-WALL	FES	SLUICE GATE	INLET OUTLET	ROAD CROSSING	STREAM X-ING	COMMENTS
1156	14847415.55	2273994.90		5x4'					X				Feed to Lk.Stanley and
1157	NO GPS	NO GPS	Cir	10"	PVC					X			10" PVC over ditch / beg conc Ditch
1158	14847375.59	2274034.23	Cir	12"	ST								2 PIPES IN END CONC
1159	14847101.84	2275012.59			Gumite								End Conc Ditch
1160	14847025.40	2275161.49											Ret. Wall N. Side
1161	14846923.82	2275246.24	Cir	8"	ST			X		X			END GUNNITE N
1162	14846923.77	2275246.46	Cir	1 1/2"	PVC	2				X			GV
1163	14846629.47	2275462.59	Box	5x10'	Conc								Drainage
1164	14846457.14	2275709.43	Cir	8"	ST			X		X			Golf Cart X-ing
1166	14846249.32	2275812.88	Cir	4"	PVC				X				GV also 4" ST. over ditch to pond
1168	14846284.46	2275912.02	Cir	4"	PVC			X		X			French Drain from Golf Course
1167	14846056.04	2275922.69	Box	5x10'	Conc						X		Cart X-ing
1168	14845820.57	2276024.69			Conc								Beg. Conc Ditch
1169	14845747.68	2275678.32			Conc						X		End Conc Ditch
1170	14845557.12	2275431.11	Box	5x10'	Conc								No inlets
1171	14845420.24	2275394.31			Wood								Foot Bridge X-ing
1172	14845273.08	2274991.27	Cir	6"	ST				X				GV
1173	14845218.12	2274893.25			Conc								Beg. Conc Flume
1174	14845171.75	2274914.66											END CONC
1175	14845192.70	2274904.21		4'				X				X	To Creek
1176	14845195.95	2274911.75		5x10'	Conc								Culvert under Flume
1177	14844970.28	2275275.54		8"				X		X			GV
1178	14844274.46	2276392.31	Cir	8"			X	X		X			GV
1179	14844144.60	2276495.05	Cir	6"				X		X			GV

C.I.P.

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STEAMBOAT DITCH - CAPITAL IMPROVEMENT PLAN			
5-POINT RATING SYSTEM			
1 = IMMEDIATE ACTION REQUIRED			
5 = NO ACTION NECESSARY			
PAGE 1			
POINT NO.	RATING	COMMENTS	RECOMMENDED ACTION
1006	5	(Woodchuck Ln.)	None
1009	3	Private Yard Drain Erosion	Rip-rap to flowline of ditch
1010	5	(Frankovich Ct.)	None
1012	3	Weser Ln.	Construct headwall
1014	5	Path X-ing	None
1016	5	(Caughlin Parkway)	None
1017	2	Promotory From MH in Street	Construct concrete or rock splashpad in flowline
1020	5	Pathway to SS Access	None
1024	5	(Bitterroot) with 12" SD to Box	None
1026	5	Inlet though box culvert	None
1028	5	Foot Path	None
1029	5	(Alum Creek)	None
1030	5	(Buck Creek rd.)	None
1031	5	Inlet though headwall	None
1032	5	(Quilici) 1 1/2" Conduit through culvert	None
1033	5	Though headwall of box	None
1034	5	Rockery Drain	None
1035	5		None
1038	4	(Caughlin Creek)	Construct cutoff wall on upstream side
1042	5		None
1043	1	End Conc. Sect.	Rip-rap channel 50+/- downstream of grouted rip-rap
1044	1	Erosion	Construct cutoff wall upstream of drop Stabilize vertical face with concrete or masonry wall Construct splash pad in flowline
1048	1	12" RCP	Construct headwall and rip-rap to flowline
1050	1	24" RCP	Repair undermined/separated pipe sections, construct headwall and rip-rap to flowline of ditch, construct curb on existing access road from Ashfork to route surface drainage into existing drop inlet at east end of access road
1051	4		Rip-rap to flowline of ditch
1053	5	(Southampton) 12" RCP side of box	None
1055	RCB	(Southampton) Outlet end	Rip-rap to flowline of ditch
1056	4	Wash from S. Hampton.	Monitor future upstream development to ensure that steps are taken to minimize erosion at this location
1057	5	(Meridian) upstream 12" entering Box	None
1059	5	(Meridian) downstream	None
1076	1	Susileen at Markridge	Construct headwall and rip-rap to flowline
1077	4		Remove grout and rip-rap to flowline
1078	2		Remove grout, backfill undermined soil, and rip-rap to flowline
1081	5	(Markridge)	None
1084	4	photo says 1085b	Construct headwall and rip-rap to flowline
1085b	3		Construct headwall and splash pad in flowline
1086	3		Re-construct headwall and rip-rap to flowline
1087	5	(Marthiam) inlet end	None
1088	5	photo says 1089 outlet end	None
1089	2		Construct headwall and splash pad in flowline
1090	5	(Belford) Upstream	None
1092	5	(Belford) Downstream	None
1093	4	Possible SD connect	Miter pipe to slope and rip-rap to flowline
1101	4	(Cashill)	Construct wingwalls

1104	5	Headwall 10'	None
1106	4	12" steel pipe overcrossing ditch	Repair failing pipe anchorages
1107	3	Ditch enters 1' above I.E.	Rip-rap to flowline of ditch
1108	5	No inlets	None
1109	5	No inlets	None
1111	5	BM 2410	None
1112	2	Drainage from above	Construct cutoff wall in flowline above drop Construct concrete or masonry wall to stabilize Construct splash pad in flowline
1116	1	Exposed sanitary sewer pipe over ditch	Construct concrete or masonry wall to stabilize Backfill over exposed pipe
1127	5	CL 18' Box Culvert	None
1130	5	CL 18' Box Culvert	None
1134	3	Run off from tank site	Rip-rap to flowline of ditch
1140	5	(Skyline) No inlets	None
1141	4	Bridge over Ditch	Rip-rap sides of ditch
1142	5	Bridge over Ditch	None
1143	1	12" PVC down drain from Cuesta Apts.	Hydraulic analysis required. Major erosion due to overtopping of ex. DI at top of slope. No apparent source of surface runoff to ex. DI indicates that erosion is due to surcharging of upstream storm drain causing discharge from ex. DI.
1144	5	Box across Drainage	None
1146	4	12" PVC down drain from Cuesta Apts.	Source of erosion appears to have been eliminated by Cuesta Apartments. Monitor to make sure erosion isn't increasing.
1147	5	(Manzanita) No inlets	None
1150	5	Beg. Conc Ditch under McCarran	None
1154	5	(McCarran) end McCarran headwall	None
1156B	3	10" PVC over ditch / beg conc Ditch	Stabilize side slope with rip-rap
1163	5	Golf Cart X-ing	None
1167	5	Cart X-ing	None
1170	5	No inlets	None



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**Kennedy/Jenks Consultants**

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GARY GRAY

**Survey of the Steamboat Ditch  
through Washoe County**

23 September 2004

Prepared for

**Steamboat Canal and Irrigation  
Company**

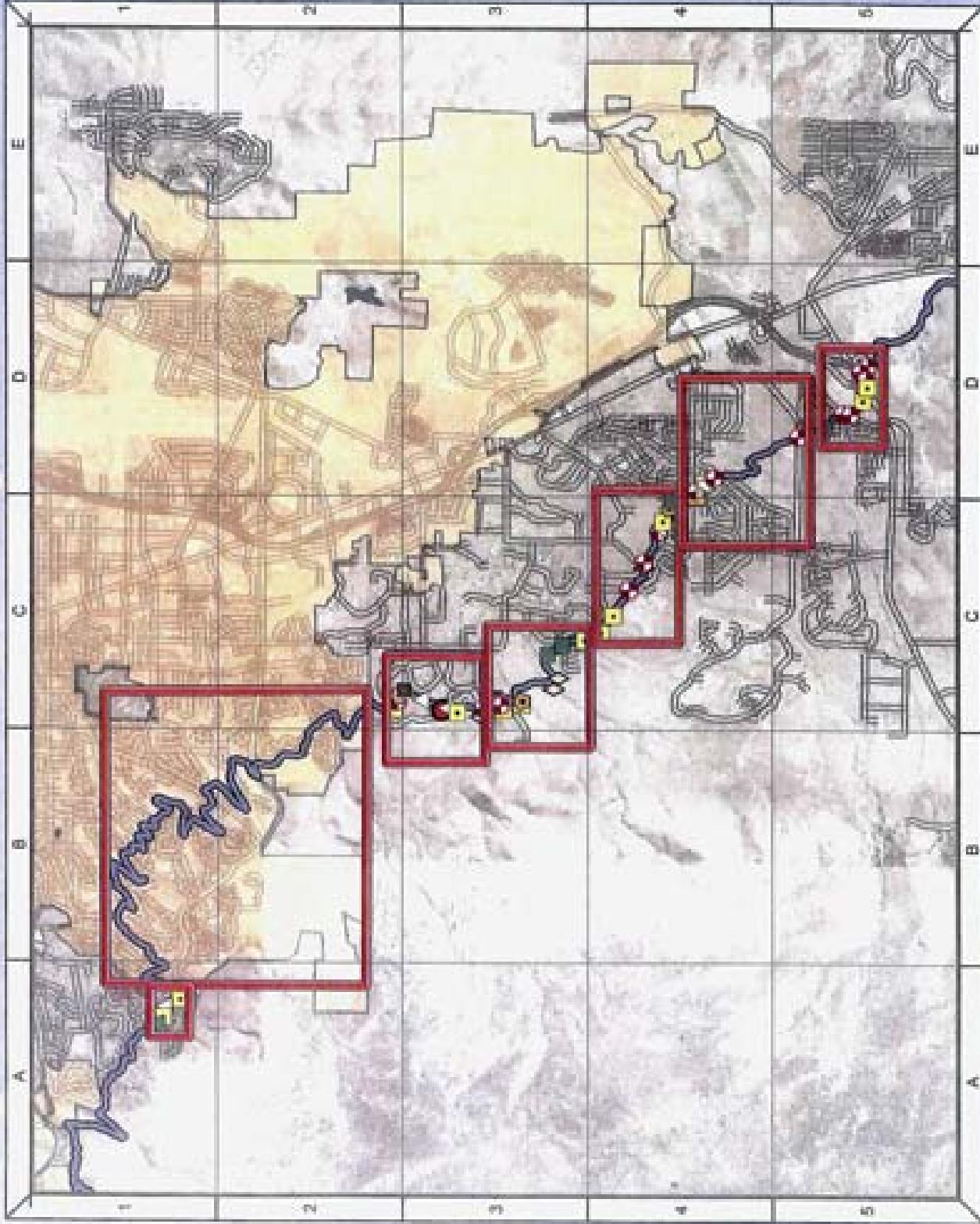
555 Geiger Grade Road  
Reno, Nevada 89511

K/J Project No. 987014.00

# Steamboat Ditch Atlas Cover Sheet

**Legend**

-  Culvert
-  Culvert and Pipe
-  Culvert and Sewer
-  Gate
-  Pipe
-  Stream Crossing
-  Sewer
-  Weir
-  Steamboat Ditch
-  Atlas Grid
-  Reno City Limits
-  Reno Roads



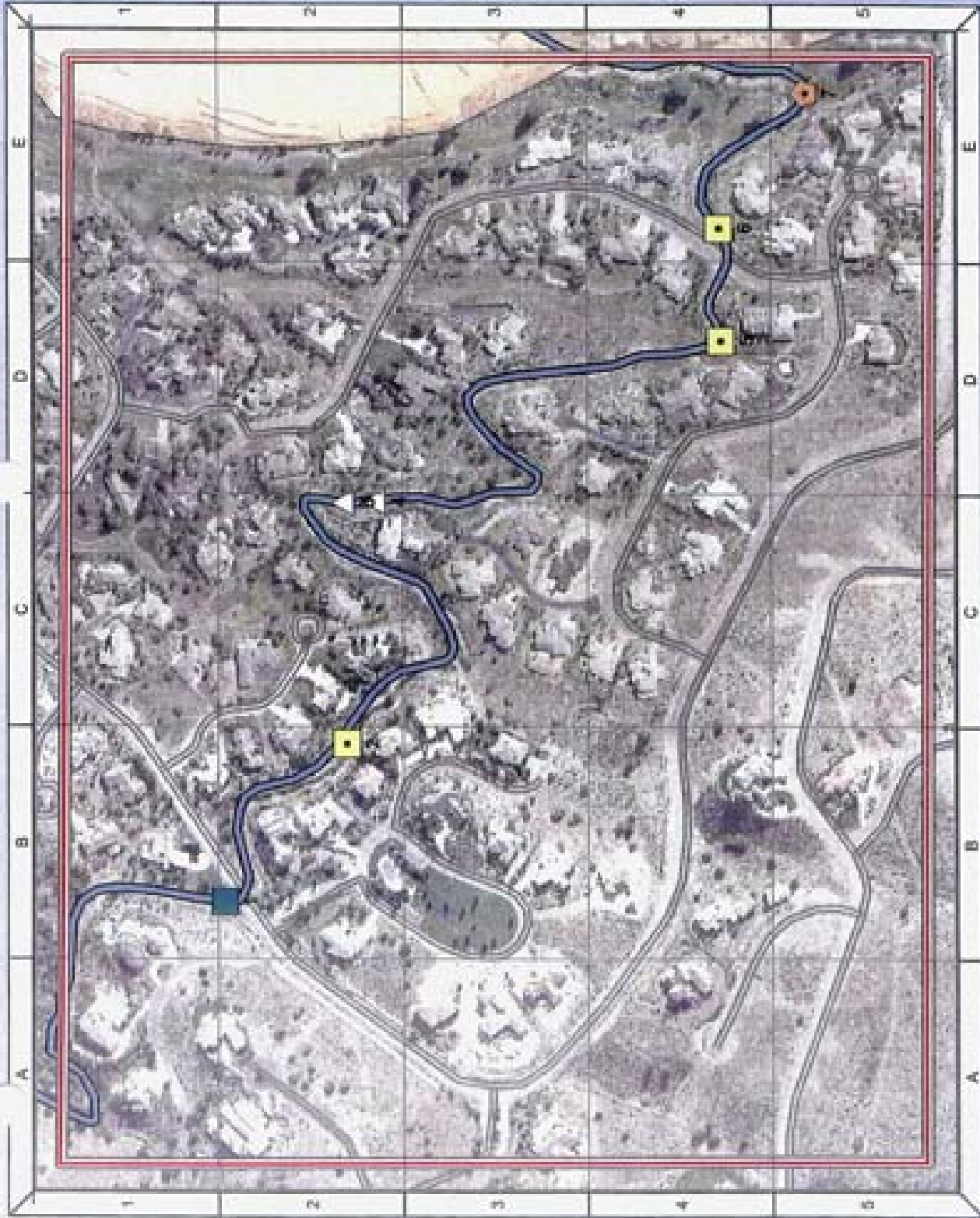
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September 2004

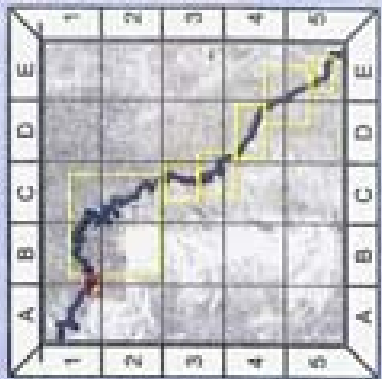
**MAP ATLAS**  
Delineation of Stormwater Contribution  
to the Steamboat Creek

# Map Number 1



**Legend**

-  Culvert
-  Culvert and Pipe
-  Culvert and Swale
-  Gate
-  Pipe
-  Stream Crossing
-  Swale
-  Weir
-  Steamboat Ditch
-  Atlas Grid
-  Reno City Limits
-  Reno Roads



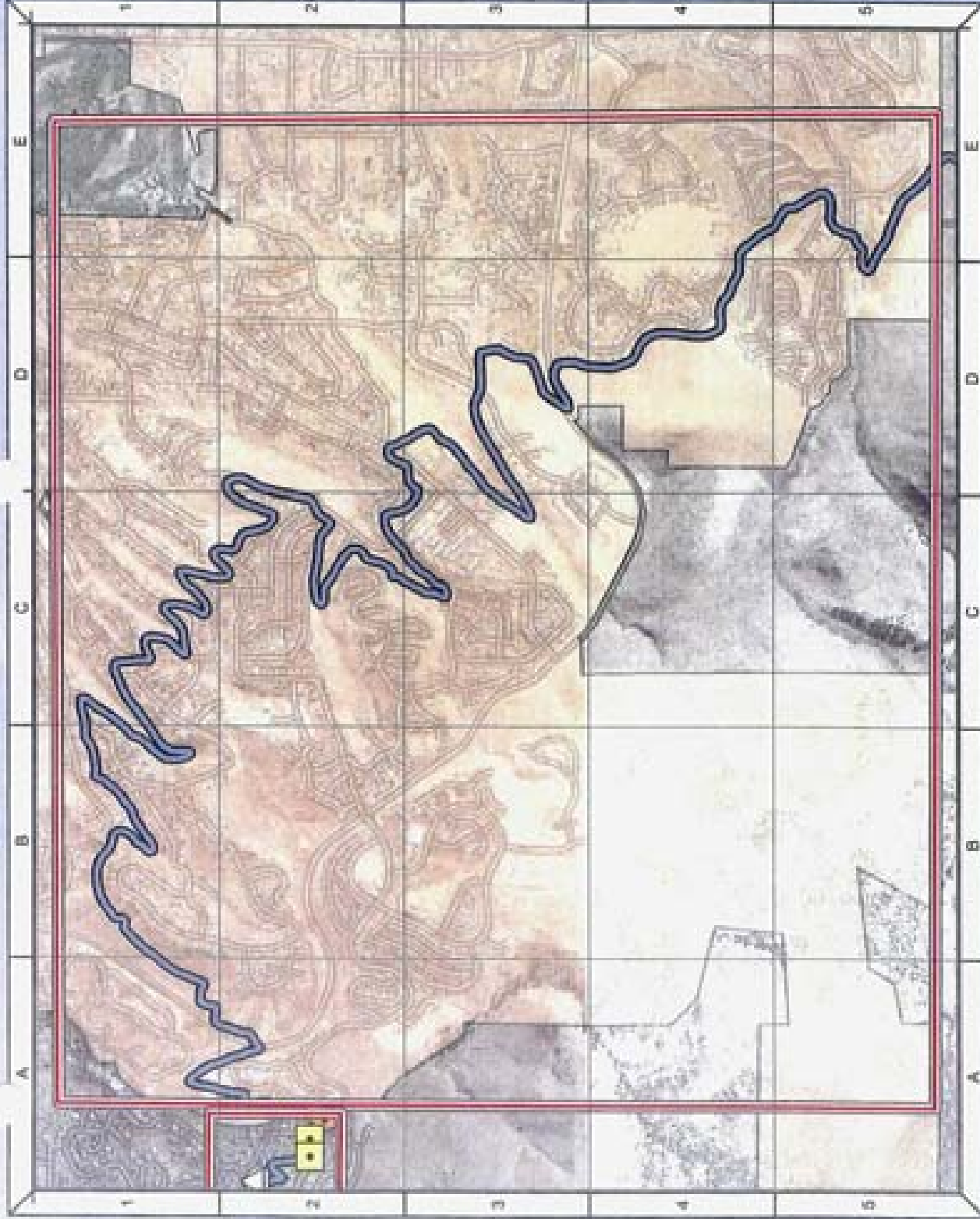
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 K/J 9870-14.00  
 September 2004

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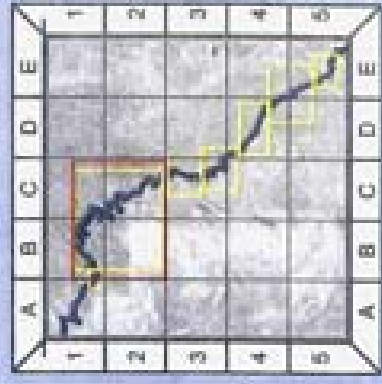
**MAP ATLAS**  
 Delineation of Stormwater Contribution  
 to the Steamboat Creek

# Map Number 2



**Legend**

- Culvert
- Culvert and Pipe
- Culvert and Swale
- Gate
- Pipe
- Stream Crossing
- Swale
- Weir
- Steamboat Ditch
- Atlas Grid
- Reno City Limits
- Reno Roads



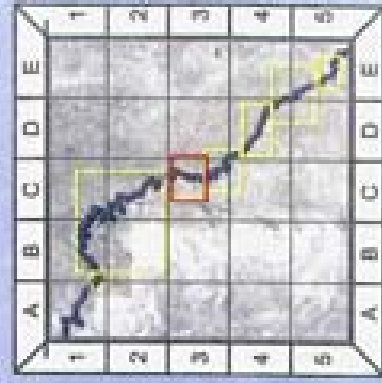
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 September 2004

**MAP ATLAS**  
 Delineation of Stormwater Contribution  
 to the Steamboat Creek

# Map Number3



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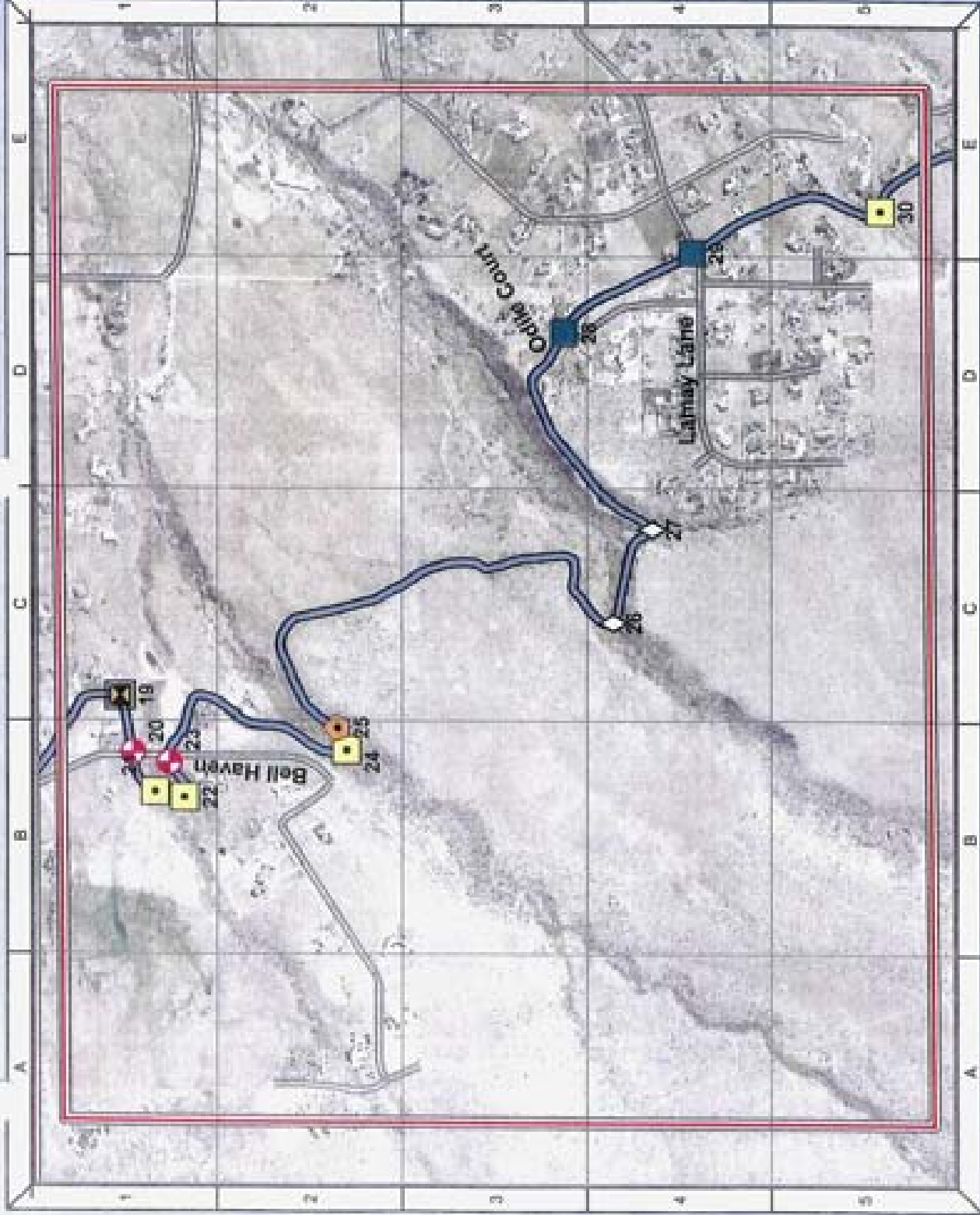
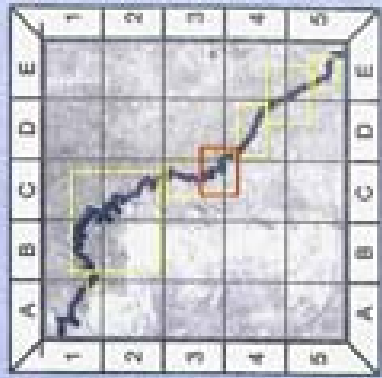


**MAP ATLAS**  
Delineation of Stormwater Contribution  
to the Steamboat Creek

# Map Number4

**Legend**

- Culvert
- Culvert and Pipe
- Culvert and Swale
- Gate
- Pipe
- Stream Crossing
- Swale
- Weir
- Steamboat Ditch
- Atlas Grid
- Reno City Limits
- Reno Roads



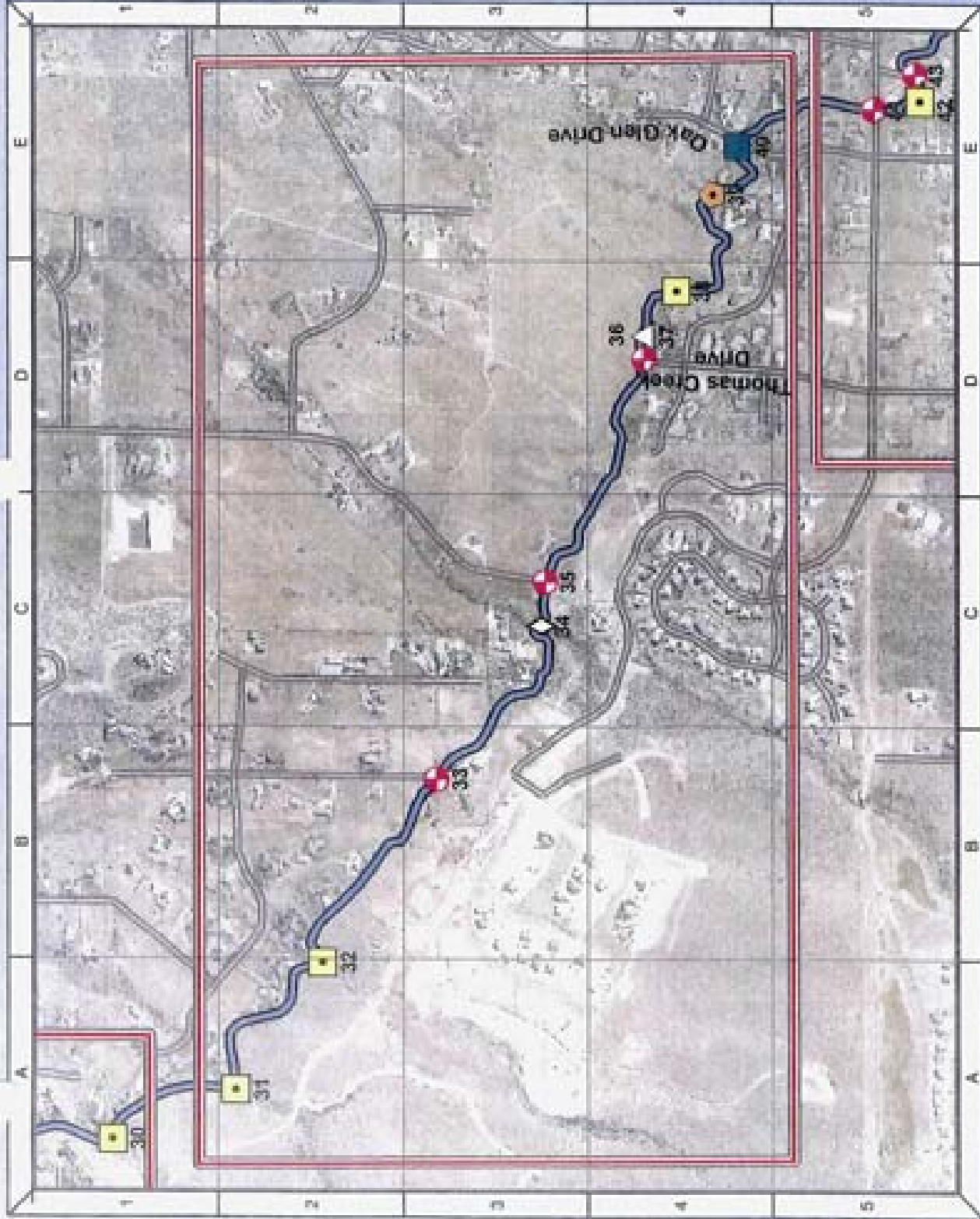
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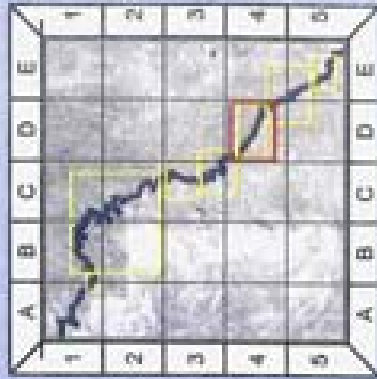
**MAP ATLAS**  
 Delineation of Stormwater Contribution  
 to the Steamboat Creek.

# Map Number 5



**Legend**

- Culvert
- Culvert and Pipe
- Culvert and Swale
- Gate
- Pipe
- Stream Crossing
- Swale
- Weir
- Steamboat Ditch
- Atlas Grid
- Reno City Limits
- Reno Roads



**Steamboat Canal & Irrigation Company**

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KJJ 987014.00  
September 2004



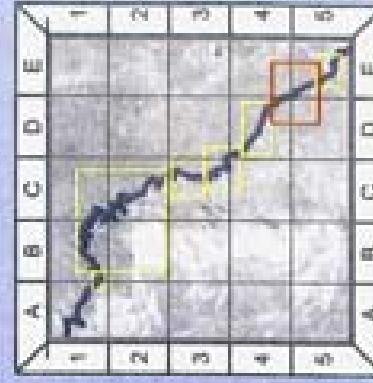
## MAP ATLAS

Delineation of Stormwater Contribution  
to the Steamboat Creek

# Map Number 6

**Legend**

-  Culvert
-  Culvert and Pipe
-  Culvert and Swale
-  Gate
-  Pipe
-  Stream Crossing
-  Swale
-  Weir
-  Steamboat Ditch
-  Atlas Grid
-  Reno City Limits
-  Reno Roads



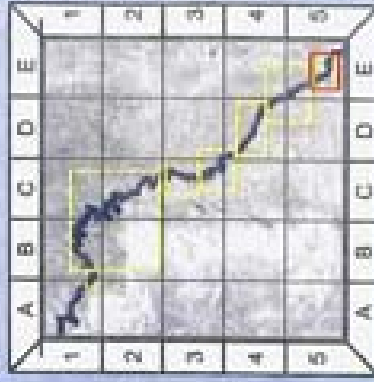
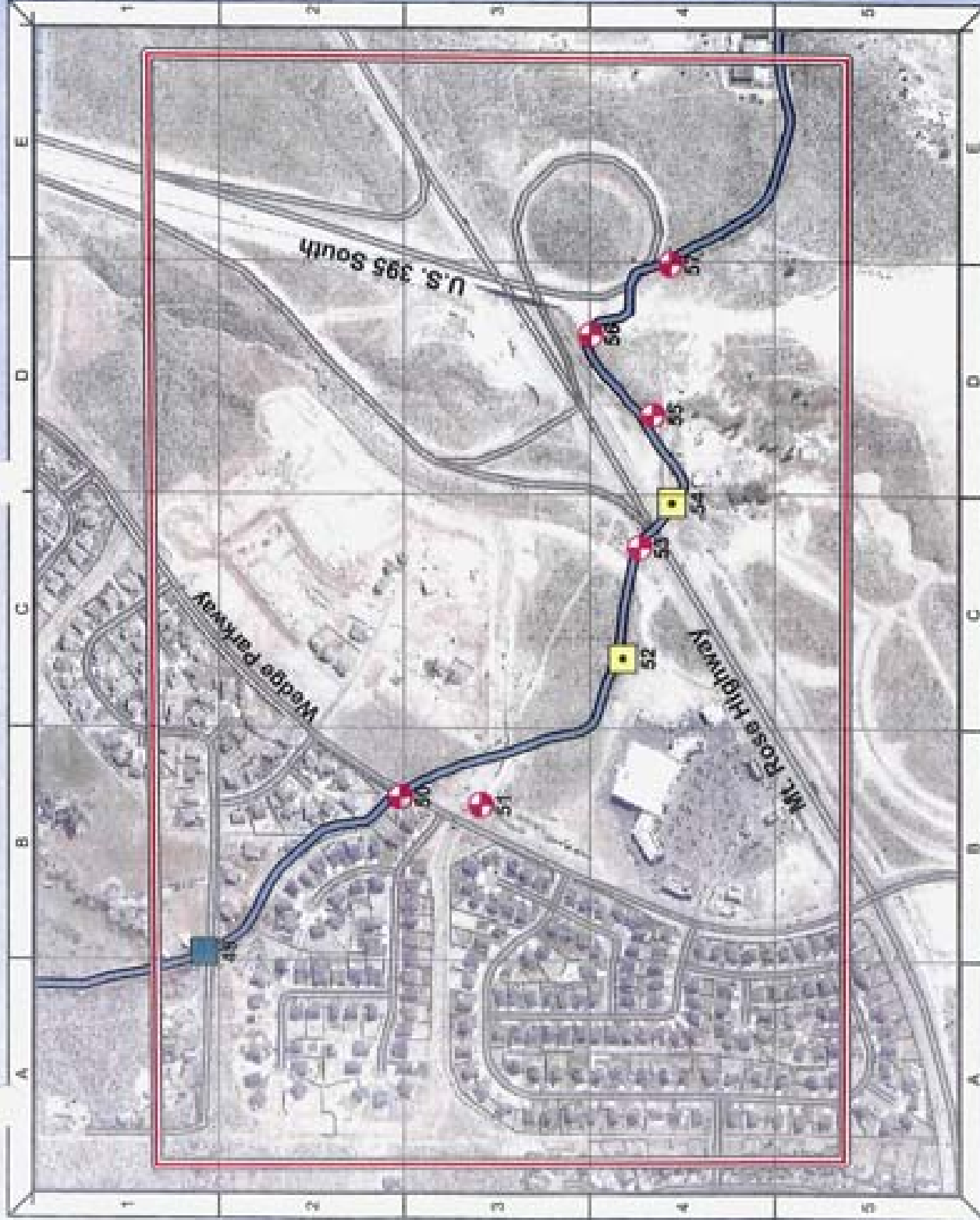
**Steamboat Canal & Irrigation Company**



Kennedy/Jenks Consultants  
 K/J 9870-14.00  
 September 2004

**MAP ATLAS**  
 Delineation of Stormwater Contribution  
 to the Steamboat Creek

# Map Number 7



**Steamboat Canal & Irrigation Company**



Kennedy/Jenks Consultants  
 K/J 987014.00  
 September 2004

## MAP ATLAS

Delineation of Stormwater Contribution  
 to the Steamboat Creek



Point 47. Box culvert conveying flow under Wolf Run Lane. Note the small swales draining into the ditch.



Point 48. Box culvert crossing under Arrow Creek Parkway.



Point 48 cont. Weir structure and sluice gates adjacent to Arrow Creek Parkway.



Point 49. Steamboat Ditch crosses under a one-lane private road through a large CMP pipe. Note the concrete swale funneling stormwater runoff to the ditch. The photo on the right shows erosion along the roadside where stormwater has entered the ditch.



**Point 50,51. Box culvert crossing under Wedge Parkway and under the flood conveyance structure from Whites Creek.**



**Point 51 cont. View of Steamboat Ditch to the right and the flood conveyance channel for Whites Creek to the left. The photo on the right shows the double box culvert for flows from Whites Creek crossing under Wedge Parkway.**



Point 52. Dirt roadway behind Bullys and Raleys off Wedge Parkway. A drainage swale runs from left to right. Note 3, 24" CMP conveying runoff under the road. The photo on the right shows the swale running into the Steamboat Ditch.

The lower photos show the outlet from a detention basin adjacent to the Mt. Rose Highway and the shopping center as well as the outlet of a larger discharge pipe with an unknown origin. The photo on the right looks upstream toward the outlet pipes from the dirt roadway.





Point 52 cont. A view from within the Steamboat Ditch. The stormwater channel is marked by the accumulation of sediments and garbage as well as by erosion. The photo on the right is a different view of the same area.



Point 53. Box culvert conveying the Steamboat Ditch under the Mt. Rose Highway. A large amount of fine sediments and trash have accumulated in this section of the ditch.

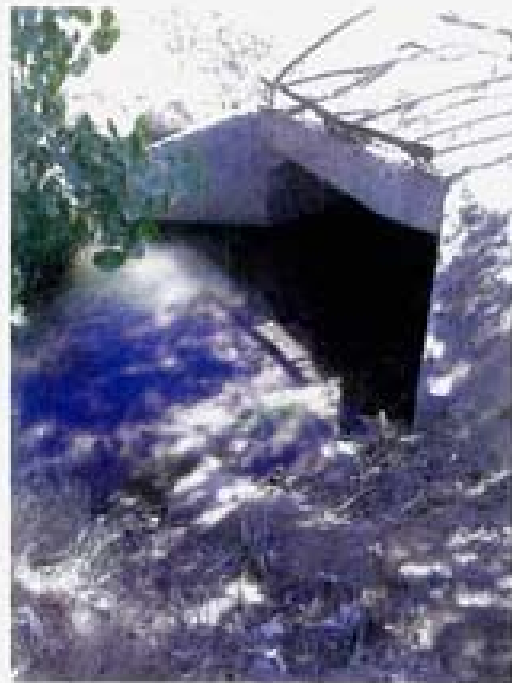




Point 54. Stormwater runoff flowing off the Mt. Rose Highway enters the Ditch through these grates.



Point 55. Outlet of the box culvert on the south side of the Mt. Rose Highway and a view of the Ditch looking downstream.



Point 56. Box culvert located on the south side of the Mt. Rose Highway.



Point 57. Outlet of the box culvert downstream of the Mt. Rose Highway and adjacent to the powerplant.

## Survey of the Steamboat Ditch through Washoe County



Point 1. Small rock lined drainage swale emptying into the Steamboat Ditch adjacent to Caughlin Parkway.



Point 2. Small rock swale drains runoff between 2 private parcels.



Point 3. Small PVC pipe carrying discharge into the Steamboat Ditch.



Point 4. Small PVC pipe discharging from a slope above the Steamboat Ditch. Same property owner as Point 3.



Point 5. Small swale located along the eastern edge of a private parcel. Rocks line the edge of the swale.



Point 6. Small rock lined swale discharging from a private parcel.

Point 7. Sluice gate





Point 8. A large pipe removes water from the ditch to feed a retention area (no photo).

Point 9. The hillslope appears to naturally drain into the Ditch at this point.

Point 10. A private bridge extends over the ditch.



Point 11. Sluice gate with a 4" PVC pipe allowing water to exit the Steamboat Ditch.

Point 12. Weir structure in the Steamboat Ditch.



Point 13. Water is being removed from the ditch and placed into the container shown above.



Point 14. A 12" I.D. concrete pipe empties into the Steamboat Ditch at the box culvert at Anitra Drive.

Point 15. Three small drains exiting the ditch (no photos).



Point 16. A dry stream channel appears to drain the hillslope. However, the dry creek bed is not well enough defined to identify exactly where the flows would enter the ditch. The left hand photo demonstrates where the stream is believed to enter the Steamboat Ditch. The right photo shows the drainage area up gradient of the ditch.

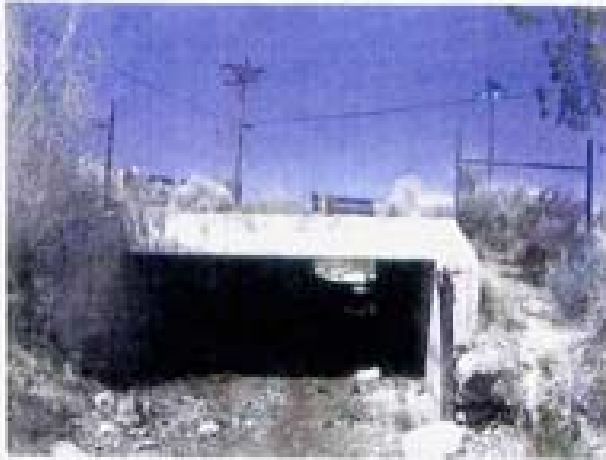


Point 17. At this point, a small creek crosses under the Steamboat Ditch. The Photo on the left is a view of the Ditch from upstream. The photo on the right is a view standing in the ditch looking downstream (south).



Point 17 cont. The above photo look downstream from the Steamboat Ditch crossing towards the creek. Note that the boards have not been placed back in the Ditch. The upper right photo is a view looking upstream at the creek (from up gradient of the ditch). The photo on the right is a view looking upstream at the creek and the Steamboat Ditch crossing. No large undercutting or instabilities were noted.





Point 18. Box culvert located at the intersection of Lone Tree Lane and Bell Haven Road. There is sluice gate on the right hand side of the photo.

Point 19. Concrete support structure at a bend in the Steamboat Ditch.



Point 20. Box culvert on Bell Haven Road where the Steamboat Ditch crosses under the road.



Point 21. Small drainage area marked by grasses. The photo on the right is a view of the Steamboat Ditch in this area.



Point 22. Waters enter the Steamboat Ditch at this point. Although the Ditch is generally dry (4.14.04), standing water with patches of algae occur at this location. Dense brush indicates where the flows enter the ditch.



Point 23. Steamboat Ditch crosses under the Bell Haven Road. Both photos look upgradient. The drainages discussed in Points 14 and 15 can be seen in the photo on the left.



Point 23. cont. A view of the Steamboat Ditch downstream of Bell Haven Road. Note the garbage, baby pool, and the erosion. (#8520 Bell Haven Rd)



Point 24. A view from Bell Haven Road looking towards a creek. The photo on the upper left shows the thick brush located around the streambed. The photo above shows areas of mass wasting and erosion in the watershed. On the left, the thick brush indicates the area where the stream enters the Steamboat Ditch.



Point 24 cont. A view of the natural drainage entering the Steamboat Ditch.



Point 25. A small rip rap lined drainage allows water to exit the Steamboat Ditch. In addition, a sluice gate is located a few meters downstream of the larger gate structure.



Point 25 cont. Views of the gate structure allowing flows to exit the Steamboat Ditch for irrigation purposes.



Point 26. Dry Creek flows under the Steamboat Ditch. The left photo is a view looking upstream while standing in the Steamboat Ditch. The photo on the right shows the open gate allowing water to drain from the ditch.



Point 26 cont. Views of the Steamboat Ditch crossing and a view looking downstream on Dry Creek. Dry creek is a brush filled, incised creek.



Point 27. Views of the Steamboat Ditch crossing a small, deeply incised stream.



Point 27 cont. View under the Steamboat Ditch showing the stability of the creek bed. Photo to the left is a view looking downgradient at the creek running downstream of the Steamboat Ditch crossing.



Point 28. Box culvert under Odile Ct. A shallow, concrete swale drains stormwater from the road into the Steamboat Ditch.



Point 29. Box culvert where Lamay Lane crosses the Steamboat Ditch. Drainage swales along both sides of the road carry discharge into the Steamboat Ditch.



Point 30. A drainage area enters into the Steamboat Ditch at a point marked by rip-rap. The basin is expected to convey a large amount of stormwater as indicated by the double boxed culvert upgradient of the Ditch.





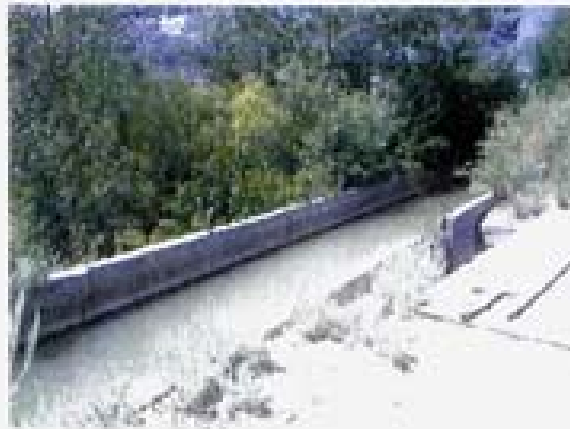
Point 31. The double box culvert indicates that a large volume of stormwater runoff is expected for this area. However, no clearly defined entrance point was noted (see above photo).



Point 32. The area along this section of the Steamboat Ditch was thick with vegetation. The local topography indicates that storm events should provide the Steamboat Ditch with flows, however, no clearly defined channel was noted.



Point 33. Three small bridges crossing the Steamboat Ditch along private properties located on Vincent Lane.



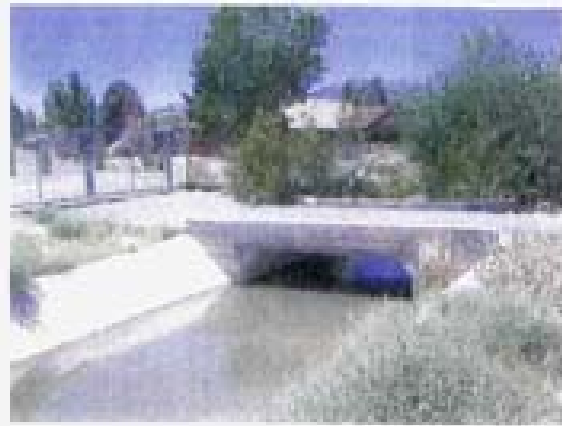
Point 34. Steamboat Ditch crosses over Thomas Creek. The photo on the right is a view of the stream channel downstream of the crossing.



Point 34 cont. Steamboat Ditch crosses Thomas Creek. Upper photos demonstrate stability of the stream channel banks. Lower photo shows a storm drain discharging into Thomas Creek.



Point 35. Bridge crossing near Fricke Lane.



Point 36. Culvert crossing at Thomas Creek Drive.



Point 37. Small green plastic/PVC pipe draining a private parcel close to the cul-de-sac at Thomas Creek Drive.



Point 38. Small natural conveyance where stormwater may enter the Steamboat Ditch.



Point 39. Sluice gate located along the Steamboat Ditch between Oak Glen Dr. and Thomas Creek Dr.



Point 40. Small swale carrying drainage waters from Oak Glen Drive (near Zolezzi Lane) into the Steamboat Ditch.





Point 41. Crossing of the Steamboat Ditch under Zolezzi Lane.



Point 42. Small drainage swale allowing backyard runoff to enter the Steamboat Ditch.

Point 43. Box culvert crossing of the Steamboat Ditch at Edwards Ct.



**Point 44,45. Small plastic piping and drainage swale running off of private property near Wolf Run Lane.**



**Point 46. Plastic drainage pipe exiting private property near Wolf Run Lane.**

# Ditch Survey

For:

## Cochran Ditch



*Prepared for:*

City of Reno, Public Works Department  
P.O. Box 1900  
Reno, Nevada 89505

*Prepared by:*

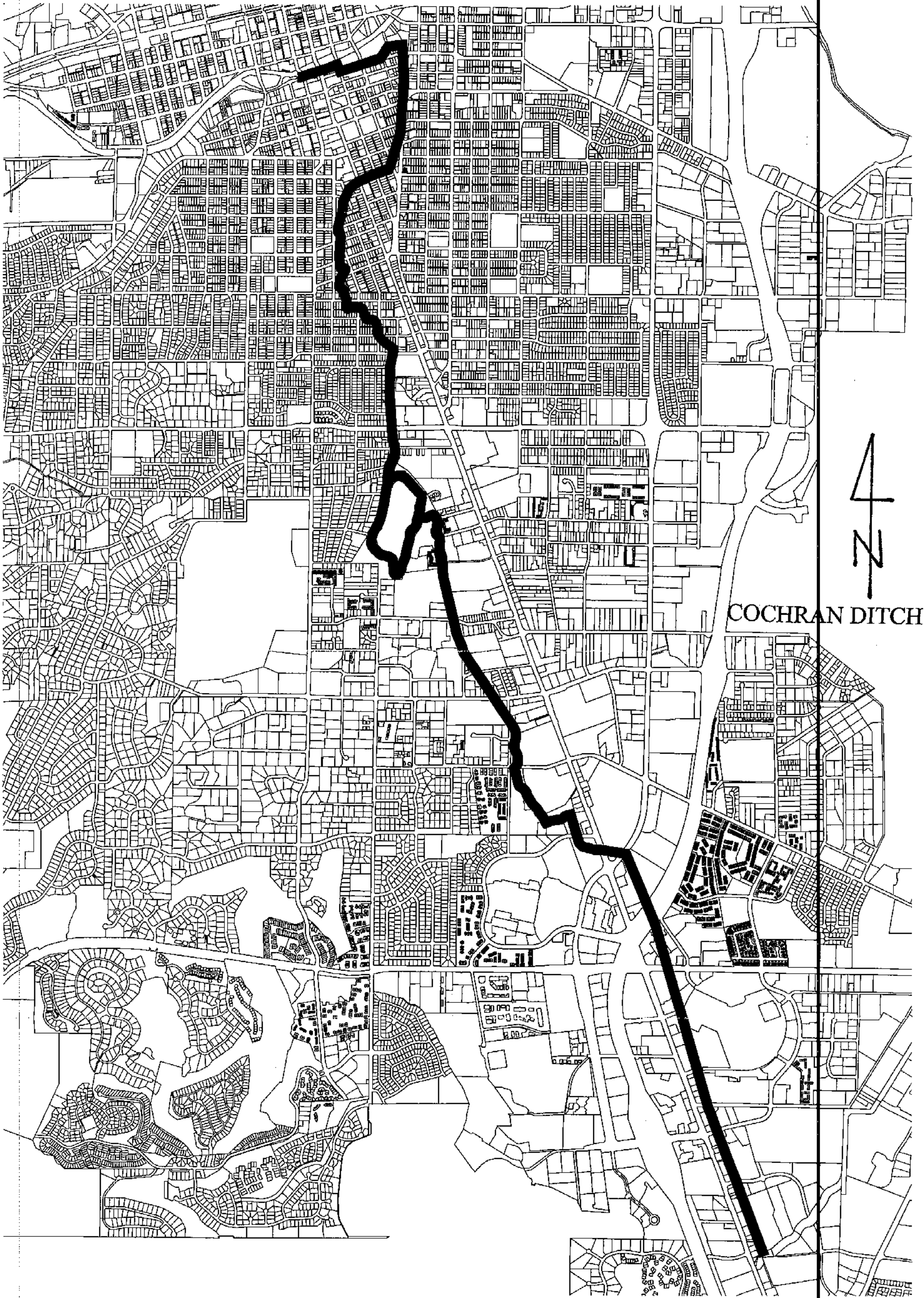


**Gray & Associates** INC.

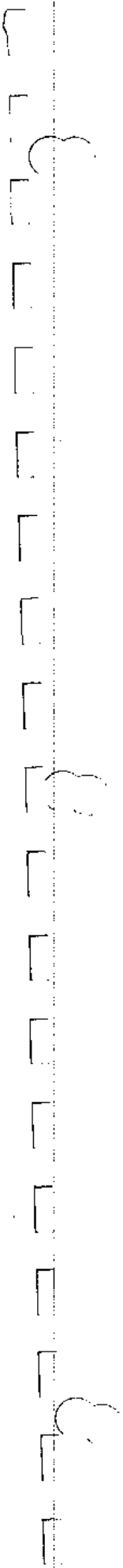
CIVIL ENGINEERS • PLANNERS • SURVEYORS

130 VINE STREET  
RENO, NEVADA 89503

December 2, 2003



PHOTOS





COCHRAN 4200



COCHRAN 4202



COCHRAN 4203



COCHRAN 4204



COCHRAN 4205



COCHRAN 4210



COCHRAN 4211



COCHRAN 4214



COCHRAN 4215



COCHRAN 4216



COCHRAN 4226



COCHRAN 4226B



COCHRAN 4224



COCHRAN 4225



COCHRAN 4222



COCHRAN 4223



COCHRAN 4220



COCHRAN 4221



COCHRAN 4218



COCHRAN 4219



COCHRAN 4228



COCHRAN 4229



COCHRAN 4227



COCHRAN 4227B



COCHRAN 4229B



COCHRAN 4229C



COCHRAN 4230



COCHRAN 4230B

POINT DATA



POINT NO.	NORTHING	EASTING	SHAPE	SIZE	MATERIAL	NUMBER OF BARRELS	HEAD-WALL	FES	SLUICE GATE	INLET	OUTLET	ROAD CROSSING	STREAM XING	COMMENTS
4412	14865788.61	2279990.98												MH Cover
4413	14865148.14	2279815.79												Under Sidewalk
4414	14865079.49	2279773.15												Under Sidewalk
4415	14865049.43	2279689.68												Under Sidewalk
4416	14864997.87	2279558.28												Under Sidewalk
4417	14864962.61	2279475.82												MH Cover
4418	14864818.04	2279167.54												MH Cover
4419	14864562.40	2278956.84												(St. Lawrence) Under Road
4420	14864442.93	2278893.31												Under Parking lot
4421	14863922.15	2278790.04												(Taylor) Under Road
4422	14863305.47	2278821.15												(Martin) Under Road

C.I.P.

CAPITAL IMPROVEMENT PLAN - COCHRAN DITCH			
5-POINT RATING SYSTEM			
1 = IMMEDIATE ACTION REQUIRED			
5 = NO ACTION NECESSARY			
PAGE 1			
POINT NO.	RATING	COMMENTS	RECOMMENDED ACTION
4205	5	Underground	None
4210	3	(Baker Ln) Pipe Ditch open again	Construct headwall
4211	5	(Pecham)	None
4213	4	SD to Ditch	Too overgrown to make assessment. May be priority 5.
4214	4	SD to Ditch	Add splash pad.
4215	4	SD to Ditch	Too overgrown to make assessment. May be priority 5.
4216	5	SD to Ditch	None
4218	3	SD to Ditch/underground S. Side	Rip-rap to flowline
4220	1	SD to Ditch	Construct headwall and rip-rap to flowline
4221	2	SD to Ditch	Construct headwall
4222	2	SD to Ditch	Construct headwall and rip-rap to flowline
4223	5	Underground	None
4224	3	Out of ground here	Construct headwall
4225	5	(Virginia Ln) under grnd past Kietzke	None
4226	5	Break Splits and underground again	None
4227	5	underground break 72" CMP inside	None
4228	2	(Deluchie)	Construct headwall
4229	4	Sluice box over stream	Rip-rap stream
4230	4	With Grate and then drops in EL.	Rip-rap around inlet