Final Letter Report
Load Reduction Planning Tool
Lake Tahoe Watershed, Nevada & California

June 2009

This Load Reduction Planning Tool was created as a methodology for early planning phase estimation of water quality changes in projects associated with land use change including redevelopment. This methodology was created to assist in the implementation of two simultaneous 20-year master plans within the Lake Tahoe Basin. This specific product is authorized pursuant to Section 234 of the Water Resources Development Act 1996

US Army Corps of Engineers ®
Sacramento District

This product was prepared by:

Huffman & Carpenter, Inc.

2NDNATURE
ecosystem science + design

Final Letter Report

Load Reduction Planning Tool
Lake Tahoe Watershed, Nevada & California

1.0 PURPOSE:

This report presents the development and case study implementation of a new Load Reduction Planning Tool (LRPT) for use in the Lake Tahoe Watershed. The LRPT provides a methodology for early planning phase estimation of the change in water quality pollutant loading associated with land use changes including redevelopment. The LRPT is scalable in application and can be used at the individual or multiple assessors' parcel scale. The LRPT fills a heretofore empty niche in the basin's ability to objectively estimate water quality effects from certain land development proposals.

The LRPT cannot be adapted to a larger watershed scale since unknowns associated with increasing boundary conditions will render the results unreliable. The LRPT is neither a Total Maximum Daily Load (TMDL) program crediting tool nor a substitute for design level calculation of estimated changes to water quality for an individual project.

This effort attempted to estimate the dollar value associated with fine sediment reduction ($/ton) by linking the LRPT and the pro-forma economic redevelopment model being simultaneously developed by others. It became quickly apparent that insufficient date currently exists to make such an estimate within acceptable limits of accuracy.

This effort did not address the issue of "20-year one-hour design storm".

2.0 BACKGROUND:

The Tahoe Regional Planning Agency (TRPA) is in the process of developing a 20-year update to its Regional Plan. Alternatives being considered in the 2010 Regional Plan update include redevelopment within specific concentrated areas to maximize the use of previously developed land. Additionally, the State of Nevada and State of California are jointly developing a TMDL Plan for respective state implementation to meet Clean Water Act goals. Collaborative partnering between stakeholders and these agencies identified a need for a means to conduct planning stage estimation of the water quality affects expected to result from land use change on a project scale, including redevelopment. It was believed that such a tool could bring some objectivity to an otherwise subjective discussion. The LRPT has been designed to be implemented by planning professionals at the conceptual stage or early planning stage of the overall project process. Application of a more rigorous, and more accurate, design level analysis is generally cost prohibitive during the early exploratory stages of any project, and may not provide meaningful information until further detail and decisions have been made about the project.

3.0 PROCESS:

The LRPT is detailed in Appendix A. The LRPT is a method for evaluating average annual runoff and pollutant loading from a site on the basis of land surface cover and flow routing. The LRPT takes advantage of an adaptation of the widely used Rational Method for calculation of runoff (Q=CiA) as well as the Lake Tahoe specific TMDL land use Event Mean Concentrations (EMC's; SWRCB and NDEP 2008). The report includes demonstration of LRPT application to three case studies evaluating water quality pollutant loads associated with existing and planned redevelopment.

The LRPT accounts for pre-project and post-project changes in land use as well as changes in flow routing to produce a composite change in water quality impact. The pollutants of concern that the LRPT accounts for include fine sediment particles (FSP; < 16 µm), total suspended sediment (TSS), dissolved phosphorous (DP), total phosphorous (TP), dissolved inorganic nitrogen (DN) and total nitrogen (TN). The LRPT approach is consistent with other urban pollutant load estimation techniques being developed for the Lake Tahoe TMDL, namely the Pollutant Load Reduction Model (PLRM), but applicable to a smaller spatial scale (i.e., parcel or parcels).

The LRPT approach is scalable in design and can be applied to parcels <0.1 acre in size as well as parcels >1000 acres. While larger parcels will require a greater number of individual "patches" (i.e. distinct drainage subareas) to characterize the site conditions, including surface types and flow routing, the same method is applicable to any landscape area. A constraint to application of the LRPT is the availability of information. For proper application of the LRPT the following information need to be correctly specified based upon site conditions and the proposed conditions:

- Surface types within the site;
- Flow routing across the site;
- Patches to capture site flow routing and surface types characteristics;
- Land use classification and treatment tier (e.g., commercial, multifamily residential, or single family residential); and
- TMDL Pollutant Source Control Treatment (e.g., Existing Condition, Tier 1, or Tier 2).

Having sufficient information to characterize the site is critical to proper application of the LRPT. Misidentification of surface types could lead to the application of the wrong coefficient. Likewise incorrect assumptions about flow routing could lead to either over or under estimation of runoff. <u>Because the land use classification and treatment tier specify the TMDL EMC to be applied, selection of the wrong land use classification, or the wrong treatment tier could lead to incorrect estimation of pollutant loads.</u>

The report uses the application of the following three case studies evaluating water quality pollutant loads associated with existing and planned redevelopment activities to illustrate the LRPT:

1) South Lake Tahoe, a demonstration prototype of a typical highway 50 corridor mixed-use project.
2). Kings Beach, a demonstration prototype of a typical redevelopment area that includes SR 28 frontage; and,
3) Heavenly Village, a previously constructed redevelopment project along Hwy 50 in South Lake Tahoe;

The following resources were utilized to provide pre-project and post-project land use conditions during application of the LRPT:

- Design Workshop, August 1994. Park Avenue Development Plan. Obtained from TRPA February 2008;
- Tahoe Regional Planning Agency, September 2006. *Demonstration Prototype Summary*. Pathway 2007 Place-Based Planning. Prepared by Regional Planning Partners (referred to hereinafter as Prototype Documentation);
- United States Geological Survey, 2004-2005. National Agriculture Image Program (NAIP). The Earth Resources Observation Systems (EROS) Data Center (EDC);
- United States Geological Survey, 1998-1999. National Agriculture Image Program (NAIP). The Earth Resources Observation Systems (EROS) Data Center (EDC)
- United States Geological Survey. Digital Raster Graphics (DRG—USGS TOPO Quadrangle 7.5 minute);
- Google Earth, Image Courtesy of DigitalGlobe and Tele Atlas; and
- ESRI ArcGIS 9.3.

Current aerial photography including Google Earth and USGS NAIP were used to verify the land cover surface types indicated for the Kings Beach and South Lake Tahoe demonstration prototypes. For Heavenly Village, in the absence of as-built documentation, current aerial photography was used to verify the redeveloped conditions presented in the plan set (Design Workshop 1994). Aerial photography from 1999 was used to verify the Heavenly Village conditions prior to redevelopment and provides greater detail than was available in the plan set (Design Workshop 1994).

To determine flow patterns within the site, the USGS and/or contour data denoted on the project plan set was used for pre-project conditions. The flow-patterns for post-project conditions utilized the flow routing denoted on the plan set and demonstration prototype documentation to the greatest extent possible. Where the flow routing would lead to circular flow patterns, changes to the flow routing were made so that the LRPT could be applied. Those changes and assumptions are documented for each site in the findings below.

To select the appropriate EMC Tier for pre-project and post-project conditions, the following rules were applied as presented in Appendix A:

A. If Commercial_CICU > 15% of the project area; land use = Commercial_CICU
B. If Commercial_CICU<15% and Residential_MFR > 15 % = Residential_MFR
C. If Commercial_CICU<15% and Residential_MFR < 15 % = Residential_SFR

The same land use category should be used for both pre and post redevelopment scenarios unless there is a complete land use designation change to the project area as a result of redevelopment and a strong justification for applying different land use category EMCs to pre and post redevelopment loading estimates can be made.

- Existing condition EMCs represent pre redevelopment conditions that include minimal spatial application of TRPA parcel based BMPs to reduce sources and generation of the pollutants of concern.
- Tier 1 EMCs assume the implementation of pollutant source controls (PSC) that reduce the application, generation and/or transport of the sources of pollutants at their source. PSC include the reduction of fertilizer applications, erosion control BMPs, natural vegetative cover, etc.

4.0 FINDINGS:

This section presents a summary of findings from application of the LRPT to three case study sites in the Lake Tahoe Basin. The application of the LRPT demonstrated that the LRPT can be used for planning phase estimation of changes in water quality pollutant loading associated with land use changes including redevelopment. The results of the LRPT methodology demonstrate that redevelopment in all three cases provided water quality benefits by reducing the volume of FSP discharged from each site.

<u>Site 1 – South Lake Tahoe Case Study</u>

The South Lake Tahoe demonstration prototype featured an approximately 8 acre industrial/commercial zoned site under existing conditions, which would be redeveloped as described in the Prototype Documentation to a multi-family and commercial development. Appendix B, Figures 1 and 2 identify the site coverage and flow routing under existing conditions and the proposed redeveloped conditions. Under existing conditions, runoff within the site is primarily directed towards the north. The existing condition was dominated by impervious surface types including roofing and asphalt/concrete pavement. In addition, flow paths were relatively direct to adjacent off-site areas with few pervious surface types to break up the flow path and no infiltration BMPs were included within the project area. Under redeveloped conditions, runoff within the site would be redirected primarily to the south and to a central infiltration BMP located in the southwestern portion of the site. Redeveloped conditions for the site included greater use of pervious surfaces, and buildings would be surrounded by maintained pervious surfaces. Under the redeveloped conditions, runoff would be broken up along the flow path by different surface types. Surface type coverage areas for existing conditions and redeveloped conditions are provided for the South Lake Tahoe prototype in Appendix B, Tables 1 and 2.

A comparison of surface type coverage between existing conditions and redeveloped conditions indicates that coverage of impervious surfaces including roofing and asphalt/concrete pavement would decrease while coverage of pervious surfaces including turf, maintained pervious surfaces, and infiltration BMPs would increase as a result of the proposed redevelopment. In addition to changes in surface type coverage, the redeveloped plan uses different surface types to break up flow along the flow path thereby reducing the volume of runoff from the site. Calculations used to estimate annual runoff volume are contained in Appendix E. While documentation for the demonstration prototype indicated that flow would be routed to the infiltration BMP from both the north and south portions of the site, in order to avoid circular flow, it was assumed for the purpose of this analysis that routing to the infiltration BMP only occurred from the northern portion of the site and the infiltration BMP discharged to the south. The demonstration prototype documentation also indicated capture of flows from the northern, eastern, western, and southern perimeter of the site through a conveyance feature which would discharge to the infiltration BMP from the south. In order to avoid circular routing within the LRPT it was assumed in this analysis that this runoff discharged directly off-site rather than entering the conveyance feature and discharging into the infiltration BMP.

Due to the infiltration of water along the flow path, the estimated annual volume of runoff from the site would be less under redeveloped conditions than under existing conditions as summarized in Table 1 below.

Table 1: South Lake Tahoe Estimated Change in Annual Runoff Volume

Condition	**Total Volume of Runoff (L/yr)**
Existing Conditions	5,630,000
Redeveloped Conditions	3,680,000
Change in Runoff (%)	**- 35**

To estimate expected annual pollutant loads from the site, the TMDL EMC for Commercial CICU was used for both existing and redeveloped conditions. While the documentation for the demonstration prototype states that the redevelopment land use would be multi-family residential, commercial use still accounts for more than 15% of the use within the site. Tier 1 EMC values were selected for the redeveloped conditions because it was assumed that with the redevelopment, land use practices would be improved to be consistent with the Tier 1 EMC's. Estimated pollutant concentration reductions as a result of changes in the TMDL EMC Tier are summarized in Table 2 below.

Table 2: South Lake Tahoe – Estimated Change in EMC Values

Condition	**FSP**	**TSS**	**DP**	**TP**	**TN**	**DN**
Existing Conditions (mg/L)	179.6	296.4	0.078	0.702	2.472	0.293
Redeveloped Conditions (mg/L)	123.6	204	0.050	0.536	2.136	0.195
Change (%)	**- 31**	**- 31**	**- 36**	**- 24**	**- 14**	**- 33**

The estimated annual pollutant load for existing conditions and redeveloped conditions as well as the estimated percentage change in annual load for the South Lake Tahoe site is presented in Table 3 below and Appendix B, Tables 3, 4, and 5. The estimated change in annual load is a result of the change in annual volume of runoff presented in Table 1 above and the change in EMC values presented in Table 2 above.

Table 3: South Lake Tahoe Estimated Change in Annual Pollutant Load

Condition	**FSP (kg)**	**TSS (kg)**	**DP (kg)**	**TP (kg)**	**TN (kg)**	**DN (kg)**
Existing Conditions	1010	1670	0.44	3.96	13.93	1.65
Redeveloped Conditions	455	750	0.18	1.97	7.86	0.72
Expected Reduction	555	920	0.26	1.99	6.07	0.93
Change (%)	**- 55**	**- 55**	**- 59**	**- 50**	**- 44**	**- 56**

Application of the LRPT to the South Lake Tahoe demonstration prototype demonstrates that reduction in impervious surface cover, changes in site drainage patterns to increase infiltration along the flow path, and improvement in land use management as required for Tier 1 EMC values can result in significant water quality improvement.

<u>Site 2 - Kings Beach Case Study</u>

The Kings Beach demonstration prototype featured an approximately 1 acre industrial/commercial zoned site under existing conditions, which would be redeveloped as described in the prototype documentation to a multi-family and commercial development. Appendix C, Figures 1 and 2 identify the site coverage and flow routing under existing and proposed redeveloped conditions. Under both existing and redeveloped conditions, runoff within the site is directed towards the southwest. The existing condition for the Kings Beach site was dominated by impervious surface types including roofing and asphalt/concrete pavement. In addition, the flow path was relatively direct via parking areas to adjacent off-site areas. Redeveloped conditions for the site include increased use of maintained pervious surfaces compared to existing conditions, and an infiltration BMP located within the site. Surface type coverage areas for existing conditions and the redeveloped conditions are provided for the Kings Beach prototype in Appendix C, Tables 1 and 2.

While the Kings Beach redevelopment scenario showed improved use of pervious surfaces compared with existing conditions, better consideration could be given to flow routing within the site. Through implementation of LRPT which considers flow routing, it was noted that the on-site infiltration BMP could be better located to capture and infiltrate runoff. At its current location, the infiltration BMP is capturing less than 5% of runoff within the site. Calculations used to estimate annual runoff volume are contained in Appendix E. The annual volume of runoff for existing and redeveloped conditions is summarized in Table 4 below.

Table 4: Kings Beach - Estimated Change in Annual Runoff Volume

Condition	**Total Volume of Runoff (L/yr)**
Existing Conditions	1,640,000
Redeveloped Conditions	565,000
Change in Runoff (%)	**- 65**

To estimate expected annual pollutant loads from the site, the TMDL EMC for Commercial CICU was used for both existing and redeveloped conditions. While the documentation for the demonstration prototype states that the redevelopment land use would be multi-family residential, commercial use still accounts for more than 15% of the use within the site. The Tier 1 EMC value was selected for post-redevelopment conditions because it is assumed that with the redevelopment, land use practices would be improved to be consistent with the Tier 1 EMC. The estimated pollutant concentration reductions as a result of changes in the TMDL EMC Tier are summarized in Table 5 below.

Table 5: Kings Beach - Estimated Change in EMC Values

Condition	FSP	TSS	DP	TP	TN	DN
Existing Conditions (mg/L)	179.6	296.4	0.078	0.702	2.472	0.293
Redeveloped Conditions (mg/L)	123.6	204	0.050	0.536	2.136	0.195
Change (%)	**- 31**	**- 31**	**- 36**	**- 24**	**- 14**	**- 33**

The expected annual pollutant load for existing conditions and redeveloped conditions, as well as the change in expected annual pollutant load for the Kings Beach site is presented in Table 6 below and Appendix C, Tables 3, 4, and 5. The change in expected annual pollutant load is a result of the change in annual volume of runoff presented in Table 4 above and the change in EMC values presented in Table 5 above. Calculations used to derive the expected change in annual pollutant load are included in Appendix E for the Kings Beach site.

Table 6: Kings Beach - Estimated Change in Annual Pollutant Load

Condition	FSP (kg)	TSS (kg)	DP (kg)	TP (kg)	TN (kg)	DN (kg)
Existing Conditions	294	486	0.13	1.15	4.05	0.48
Redeveloped Conditions	69.8	115	0.03	0.30	1.21	0.11
Expected Reduction	224	371	0.10	0.85	2.84	0.37
Change (%)	**- 76**	**- 76**	**- 77**	**- 74**	**- 70**	**- 77**

The Kings Beach redevelopment prototype successfully incorporated pervious surfaces in the redevelopment plan, and provided opportunities for infiltration within the site. Application of the LRPT for the Kings Beach site demonstrated that the LRPT can be applied effectively to areas approximately 1 acre or less in size. It also demonstrated the benefits of LRPT as a planning tool to identify appropriate locations for infiltration BMPs. A significant reduction in load was estimated for the Kings Beach site as a result of changes in land use to improve infiltration and reduce the volume of runoff, as well as improved land management as required for Tier 1 EMC values.

Site 3 - Heavenly Village Case Study

The Heavenly Village redevelopment site is an approximately 36 acre existing redevelopment site in South Lake Tahoe, CA. The Heavenly Village redevelopment site was included in this study to estimate changes in annual pollutant loading associated with a constructed redevelopment site. It also provided a real world example to test the LRPT methodology.

The Heavenly Village site prior to redevelopment was zoned as commercial (see Prior Site Coverage, Appendix D, Figures 1a and 1b). Under existing redeveloped conditions, the area continues to support commercial use (see Appendix D, Figures 2a, 2b, and 2c). The comparison of the prior development with the existing redeveloped conditions indicates that there was minimal change in total surface cover (Appendix D, Tables 1 and 2). While the total amount of pervious and impervious surfaces did not change substantially, pervious surfaces were incorporated into the redevelopment with the purpose of infiltrating runoff along the flow path. Under historic conditions, no infiltration BMPs were included in the design. Under the existing redevelopment design, an on-site infiltration BMP was included at the south west corner of the site to infiltrate flows within the southern portion of the site. In addition, under existing redeveloped conditions the northern and central portions of the site drain to an off-site infiltration BMP, further decreasing the volume of runoff. The annual volume of runoff for the Heavenly Village site is summarized in Table 7 below.

Table 7: Heavenly Village - Estimated Change in Annual Runoff Volume

Condition	**Total Volume of Runoff (L/yr)**
Prior Conditions	20,100,000
Existing Redeveloped Conditions	5,460,000
Change in Runoff (%)	**- 73**

To estimate expected annual pollutant loads from the site, the TMDL EMC for Commercial CICU land use was used for both prior conditions and existing redeveloped conditions. The Existing Conditions TMDL EMC value was used to represent prior conditions. The Tier 1 TMDL EMC value was selected for existing redeveloped conditions. For the purpose of this case study, it was assumed that the practices at Heavenly Village meet the requirements for Tier 1 EMC. Pollutant reduction as a result of changes in the TMDL EMC Tier alone is summarized in Table 8 below.

Table 8: Heavenly Village - Estimated Change in EMC Values

Condition	**FSP**	**TSS**	**DP**	**TP**	**TN**	**DN**
Historic Development Conditions (mg/L)	179.6	296.4	0.078	0.702	2.472	0.293
Existing Redeveloped Conditions (mg/L)	123.6	204	0.050	0.536	2.136	0.195
Change (%)	**- 31**	**- 31**	**- 36**	**- 24**	**- 14**	**- 33**

The expected annual load for the prior conditions and existing conditions, as well as the change in expected annual load for the Heavenly Village site is presented in Table 9 below and Appendix D, Tables 3, 4, and 5. The change in expected annual load is a result of the change in annual volume of runoff presented in Table 7 above and the change in EMC values presented in Table 8 above. Calculations used to derive the expected change in load are included in Appendix E for the Heavenly Village site.

Table 9: Heavenly Village - Estimated Change in Annual Pollutant Load

Condition	FSP (kg)	TSS (kg)	DP (kg)	TP (kg)	TN (kg)	DN (kg)
Prior Conditions	3610	5960	1.57	14.1	49.7	5.89
Existing Redeveloped Conditions	675	1110	0.27	2.92	11.7	1.06
Expected Reduction	2935	4850	1.30	11.2	38	4.83
Change (%)	**- 81**	**- 81**	**- 83**	**- 79**	**- 76**	**- 82**

The redeveloped Heavenly Village site incorporated pervious surfaces and infiltration BMPs in the site design to improve infiltration along the flow path. The Heavenly Village site at 36 acres represented a larger redevelopment site than both South Lake Tahoe (8 acres) and Kings Beach (1 acre). Application of the LRPT to the Heavenly Village site demonstrated that the LRPT is scalable and can be applied to larger sites, as well as sites with off-site infiltration features. It also demonstrated application of the LRPT for a redevelopment project that has already been constructed. As noted in Tables 7, 8 and 9 above, significant reduction in the volume of annual runoff, TMDL pollutant concentrations, and annual pollutant loads, respectively, were estimated for the Heavenly Village site as a result of land use changes that improved infiltration.

5.0 CONCLUSIONS:

Application of the LRPT in three redevelopment case studies (South Lake Tahoe, Kings Beach, and Heavenly Village) demonstrates that redevelopment can have a benefit to water quality. The South Lake Tahoe case study demonstrated the effective use of use dispersed pervious surface types to infiltrate water and the addition of an on-site infiltration BMP. The South Lake Tahoe case study also provided an example of a site where further information on site drainage would need to be obtained, or the drainage plan would need to be modified to avoid circular routing to apply the LRPT effectively.

The Kings Beach case study also demonstrated that the increased use of pervious surface types provided pollutant load reductions under redeveloped conditions. The Kings Beach redevelopment case study provided an example of a site where further water quality improvements could be achieved through greater attention to flow routing within the site (e.g. placing the infiltration BMP down-gradient of impervious surfaces within the site).

It is important to recognize that both the South Lake Tahoe and Kings Beach demonstration prototypes further demonstrate how changes in land management practices would result in estimated pollutant load reductions as a result of changes in EMC values from Existing Condition to Tier 1 EMCs for Commercial CICU land uses. Estimation of potential load reduction based is highly dependent on the user judgment when applying changes in EMC values.

The Heavenly Village redevelopment project provided a real world example of redevelopment and how it can be used to improve water quality. In addition to on-site measures to improve water quality, such as routing runoff flows across multiple pervious surfaces, the use of both on and off site detention/infiltration basins provided significant reductions in the volume of runoff. A summary of the three redevelopment case studies is presented in Table 10 below.

Table 10: Summary of Three Redevelopment Case Studies

Redevelopment Case Study	Total Project Area (Acres)	Change in Runoff Volume (%)	EMC Change in FSP (%)	Total Change FSP (%)
South Lake Tahoe	8	- 35	- 31	- 55
Kings Beach	1	- 65	- 31	- 76
Heavenly Village	36	- 73	- 31	- 81

The LRPT demonstrated on three case studies that the application of the first two techniques noted above can result in reductions in the volume of runoff from a site. The LRPT provides a standardized and scalable approach to estimating runoff and pollutant loading associated with land use changes. When properly applied, the method can be used as a planning tool to identify opportunities to improve water quality within a site, and to evaluate the potential for impacts to water quality associated with land use changes.

6.0 RECOMMENDATIONS:

The LRPT is a methodology shaped to meet a specific use as stated in the report purpose and background. The LRPT achieves simplicity of use at a cost of wider uncertainty in results. This trade-off is made acceptable by limiting the conditions under which the methodology is employed. The reader is cautioned to carefully consider the constraints of the LRPT.

The LRPT is planning tool. As a planning tool, the LRPT can be applied at the concept plan stage. For land developers and planners the usefulness of the LRPT lies in the ability to easily estimate pollutant loading from proposed land use changes. The LRPT can be used early in the planning phase of a project, to assess potential project related impacts, compare the impacts of alternative proposals, and estimate potential requirements for mitigation. For EIP projects, the LRPT could be used as a prioritization tool to evaluate which projects could provide the greatest benefit to water quality. Regulatory agencies including TRPA, NDEP or Lahontan RWQCB could use the LRPT to assess early in the planning process whether off-site mitigation will be required, or if there is the potential to attain on-site load reduction for projects involving land use changes.

The LRPT does not consider all land use factors. The LRPT excludes factors that would affect runoff and pollutant loads such as, soil types, steepness of slope, vegetation density, etc. Assumptions and limitations of the LRPT are further discussed in Appendix A. Should further development of the LRPT be considered, high priority should be given to incorporation of additional land use condition factors to improve the representativeness of the land use EMCs.

LRPT use of TMDL EMCs. The LRPT relies on the application of the TMDL land use EMC's to estimate pollutant loads. The TMDL land use EMC's come with their own set of assumptions and limitations. Used in the parcel context these EMC values have high uncertainty, and contain abrupt pollutant concentration differences across the typical land use categories (commercial and residential) as indicated in Table 11 below. Recent research on pollutant generation from urban land uses in Lake Tahoe suggest that land use type and land use condition will both influence the expected down slope water quality.

Table 11: Change in TMDL EMC FSP Concentrations With Land Use Changes

Land Use and TMDL EMC Category	TMDL EMC for FSP (mg/L)	% Change from Existing Conditions - Same Land Use	% Change from Commercial_CICU Existing Conditions
Commercial_CICU Existing Conditions EMC	179.6	0	0
Commercial_CICU Tier 1 EMC	123.6	-31	-31
Commercial_CICU Tier 2 EMC	67.9	-62	-62
Residential_MFR Existing Conditions EMC	94.1	0	-48
Residential_MFR Tier 1 EMC	35.4	-62	-80
Residential_MFR Tier 2 EMC	35.4	-62	-80
Residential_SFR Existing Conditions EMC	30.6	0	-83
Residential_SFR Tier 1 EMC	20.6	-33	-89
Residential_SFR Tier 2 EMC	20.6	-33	-89

Use of Judgment. The LRPT was created for use by planning professionals. Those professionals will use judgment in selecting data to be input into LRPT, especially with regard of changing land use types and their respective EMCs and the levels source control (existing condition, Tier 1 or Teir2). A seemingly innocuous error in land use type, or assumption of full Tier 1 implementation may irreparably discredit a project. It is recommended that a conservative approach in matters of judgment is carefully considered until such time that a robust body of knowledge regarding the use of the LRPT in achieved.

Multiple Opportunities for Load Reduction. The LRPT provides four opportunities to reduce pollutant loads associated with improved site design and land management practices. The user should insure that they effectively communicate the relative contribution from these opportunities which include:

- Routing or redirection of untreated site drainage to treatment;
- Improving land management practices to reduce pollutant concentrations;
- Dispersed use of pervious land surface types in the land use plan between impervious surface types; and

- Significant changes to site land use to substantiate a change in EMC land use category (See Appendix A to determine when this may be appropriate and evidence required to substantiate the change).

REFERENCES

California Spatial Information Library, 2002. California base layer [Digital Data]. California Spatial Information Library, Available HTTP: http://www.atlas.ca.gov/download.html

Google Earth, Image Courtesy of DigitalGlobe and Tele Atlas. Accessed February 20, 2009.

Microsoft, Live Map, Image Courtesy of the Nevada Mapping Advisory Committee. http://maps.live.com/#JnE9eXAuaGVhdmVubHkrc291dGgrbGFrZSt0YWhvZStDQSU3ZXNzdC4wJTdlcGcuMSZiYj01MC4yMzMxNTE4MzI0NzIyJTdlLTkwLjcwMzEyNSU3ZTM4LjkzNTQ4NDI4MzU2NDIlN2UtMTUyLjU3ODEyNQ== (02/26/2009)

California State Water Resources Control Board (SWRCB) and Nevada Department of Environmental Protection (NDEP). Lake Tahoe TMDL Pollutant Load Reductions Opportunity Report. March 2008 v.2.0. http://www.waterboards.ca.gov/rwqcb6/water_issues/programs/tmdl/lake_tahoe/docs/presentations/pro_report_v2.pdf

United States Geological Survey, 1998-1999. Digital Orthoimagery Quarter Quadrangles (DOQQ) [Online Digital Imagery], The Earth Resources Observation Systems (EROS) Data Center (EDC), on USGS Web Map Service Website, Available HTTP: http://gisdata.usgs.net

United States Geological Survey, 2004-2005. National Agriculture Image Program (NAIP) [Online Digital Imagery], The Earth Resources Observation Systems (EROS) Data Center (EDC), on USGS Web Map Service Website, Available HTTP: http://gisdata.usgs.net

United States Geological Survey. Digital Raster Graphics (DRG—USGS TOPO Quadrangle) [Online Digital Imagery]. The Earth Resources Observation Systems (EROS) Data Center (EDC), on USGS Web Map Service Website, Available HTTP: http://gisdata.usgs.net

Washoe County, 2006. Washoe County Roads [digital data]. Available HTTP: http://www.co.washoe.nv.us/gis/datawarehouse.htm

APPENDICES

Appendix A Loading Reduction Planning Tool

Appendix B South Lake Tahoe Case Study

Figures
Figure 1 Existing Site Coverage
Figure 2 Redeveloped Site Coverage
Tables
Table 1 Existing Conditions - Land Surface Types and Acreages
Table 2 Existing Conditions - Pollutant Loads
Table 3 Redeveloped Conditions - Land Surface Types and Acreages
Table 4 Redeveloped Conditions - Pollutant Loads
Table 5 Redevelopment Load Reduction

Appendix C Kings Beach Case Study

Figures
Figure 1 Existing Site Coverage
Figure 2 Redeveloped Site Coverage
Tables
Table 1 Existing Conditions - Land Surface Types and Acreages
Table 2 Existing Conditions - Pollutant Loads
Table 3 Redeveloped Conditions - Land Surface Types and Acreages
Table 4 Redeveloped Conditions - Pollutant Loads
Table 5 Redevelopment Load Reduction

Appendix D Heavenly Village Case Study

Figures
Figure 1a Prior to Redevelopment Site Coverage
Figure 1b Prior to Redevelopment Project Area
Figure 2a Existing Redeveloped Site Coverage
Figure 2b Existing Redeveloped Site Coverage (Off-site)
Figure 2c Existing Redeveloped Project Area
Tables
Table 1 Prior to Redevelopment - Land Surface Types and Acreages
Table 2 Prior to Redevelopment - Pollutant Loads
Table 3 Redeveloped Conditions - Land Surface Types and Acreages
Table 4 Redeveloped Conditions - Pollutant Loads
Table 5 Redevelopment Load Reduction

Appendix E Electronic Files

Excel File Containing South Shore Calculations

Excel File Containing Kings Beach Calculations
Excel File Containing Heavenly Village Calculations