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Papers

Anthropic Changes to the Fluvial Landscape of São João Del-Rei, Minas Gerais, Brazil

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Keywords
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Abstract
Anthropogenic interventions in the natural landscape became recurrent from the expansion of nuclei and population increase, causing the relationship established between human beings and nature to move away from the naturalist model and assume an interventionist premise. Among the various interferences in the natural environment, this work establishes a spatial cut in the urban river landscape changes, in particular, those caused by processes of rectification, canalization and plugging of urban rivers. The denaturalization and mischaracterization of this system means that the existence of urban rivers have been ignored, acquiring notoriety only when natural processes, intensified by human beings, cause damage or disaster to the population that usually occupies the floodplain areas. Thus, recognizing these changes and rescuing the relationship of belonging to this environment, which initially supported the formation of most urban centers, becomes essential for local landscape and urban planning. Based on this understanding, this study aimed to carry out a survey of the changes in the river landscape of the São João del-Rei city - Minas Gerais. For this purpose, the descriptive investigative method was used, which made possible the elaboration of a case study. The results obtained by the research indicate that the river landscape has been significantly altered, especially by rectifications, canalizations and plugging of urban rivers, which are presented in a historical context and related to the processes and dynamics of urban waters.

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INTRODUCTION

The presence of water has always been a determining factor for the appearance of cities. Its existence enabled the consolidation of entire civilizations and the development of techniques for feeding and survival. Historically, societies constructed cities on the banks of water courses, such that the presence of rivers frequently designs and composes the urban landscape (ALVES, 2020; PASSOS et al., 2018).

However, as cities expanded and human beings adopted a logic of mastery of nature, the rivers began suffering hydrological and environmental impacts of urban growth (BAPTISTA; CARDOSO, 2013). Thus, the harmonious relationship between the city and the watercourse became antagonistic — "city versus watercourse" — and the rivers became obstacles to expansion, occupation, and development (ALVES, 2020).

It was believed that this problem resulting from the existence of the river in the city, rather than the opposite, could be faced through drastic alteration of the natural structure of the fluvial landscape (COSTA, 2006). Based on this hygienist movement, various interventions have modified the natural landscape and implemented an anthropic landscape composed of reclaimed land, canalizations, and rectifications (CARVALHO et al; 2020; FARIA, 2015; SARTÓRIO, 2018).

Therefore, canalizations, among other public works, came to integrate the urban landscape and denaturalize the fluvial system dynamic (ROCHA, 2008). Its use and implementation are generally justified by the presence of sewage and the possibility of the insertion of interceptors; the desires of the community; road construction; maintenance; flow acceleration and reduced concentration time, preventing overflows (TUCCI, 2005).

Commonly, however, the infrastructure becomes insufficient or ineffective, as projects often fail to consider continued, unplanned, urban expansion. This process increases impermeabilization and, consequently, surface runoff, leading to a higher hydric load than the canal's initial capacity.

Thus, the functionality of urban river canalization may be only temporary as a result of the city's expansion. Furthermore, although canals may mitigate the inconvenience of floods at critical points, this can also transfer the impacts downstream with greater effect than those previously observed (MIGUEZ et al.; 2016). This occurs because the removal of meanders and homogenization of the channel reduces the roughness of the bed, resulting in an absolute increase in flow velocity (GUERRA; MARÇAL, 2006).

Given these consequences and dysfunctions, various cities around the world that previously adopted canalization, rectification, and plugging of their rivers are reverting this process and re-naturalizing, or requalifying, the fluvial channel. This is the case of the Cheonggyecheon River (Seoul), the Isar River (Germany), and the Mapocho River (Chile), among others.

In Brazil, despite the existence of river re-naturalization proposals (e.g., Rio das Velhas in Minas Gerais), as well as re-naturalized canals (e.g., Rio Tijuco Preto in São Paulo; Rio das Velhas in Minas Gerais), the relationship with urban waters remains mostly antagonistic, and canalization persists in cities of all sizes. Examples of this are the canalized rivers, or "encaixotados fluviais" (boxed waterways) (MARQUES; JUNIOR, 2014, p.106), of São Paulo, Curitiba, Goiânia, Presidente Prudente, Belo Horizonte, Caxambu, Chapecó, Crato, Juiz de Fora, and São João del-Rei, among others.

In general, the deployment of these structures often causes the rivers to be forgotten (DIAS; CAMPOS, 2020). As such, they lose their history and the relationship of belonging that they previously provided, only being remembered as the "villain" of the city during exceptional flood events.

Based on this conception, the aim of this study is to retrieve the history of modifications made to the fluvial landscape of São João del-Rei, Minas Gerais, with emphasis on the canalization process of the Lenheiro stream, modification of the Água Limpa creek, and urban flooding. It should be emphasized that the interventions suffered by these channels became routine in the eyes of the city, with both the old characteristics and the transformation process being lost in the oral and documental history. This, therefore, became a historical gap that can be recovered through document retrieval.

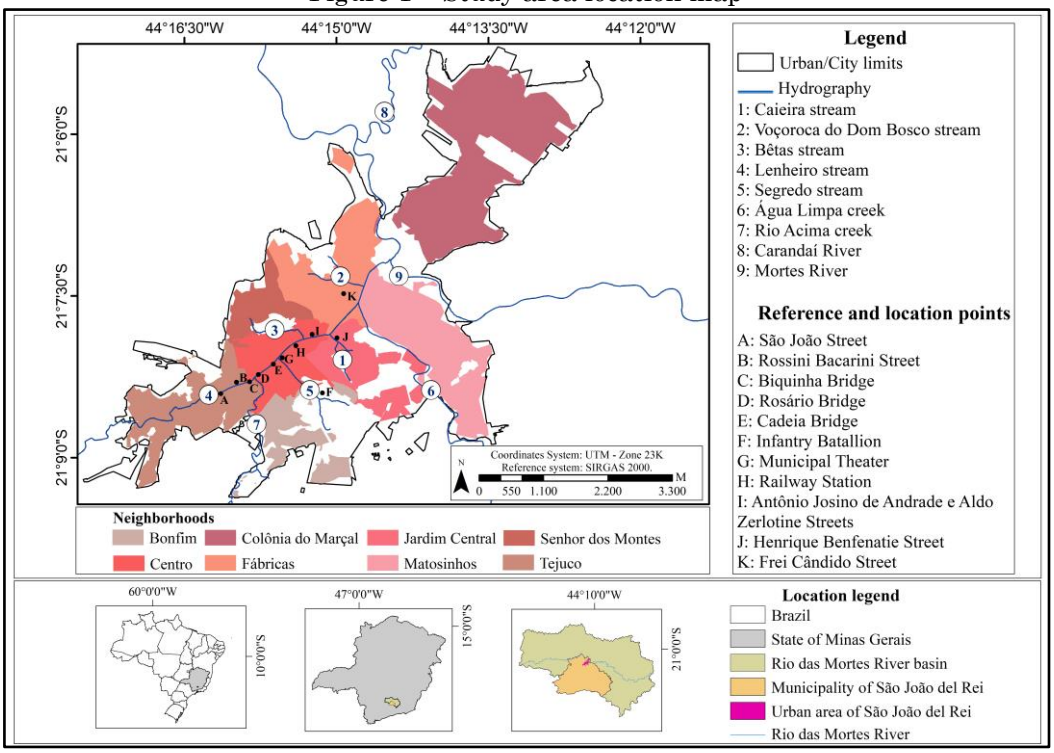
Thus, the results obtained in this study could reinforce the discussion that the human being is an important geomorphological agent, and they could also become a requalification and planning tool for public authorities and professionals such as geographers, architects, and historians.

METHODOLOGY

Study area

The municipality of São João del-Rei is located in the central-south region of the state of Minas Gerais, Brazil, with its municipal headquarters between the geographic coordinates of 21º 9'S and 44º 12'W (Figure 1). According to the Instituto Brasileiro de Geografia e Estatística (Brazilian Institute of Geography and Statistics) (IBGE, 2021) the estimated population is 90,897 inhabitants living in mostly urban areas. The formation history of the populational nucleus dates from the end of the 17th century and is related to the mineral exploration of the period (IBGE, 2021).

Figure 1 – Study area location map



Source: The authors (2022).

The peculiar geomorphology of São João del-Rei contributed to the initial historical formation of the mining town, which is described by various authors as jammed between valleys and slopes that are referential elements in the formation of the urban center (BRASILERO; DANGELO; LEMOS, sd).

Currently, the urban area extends between the slopes of the Lenheiro Range, part of the São José Range, and the fluvial plains of the Lenheiro stream, Água Limpa creek, and the Mortes River. The Mortes River is the main river and provides the name of the river basin in which the city is located. The altitude range between the slopes and valley bottoms is approximately 142 m (1,025 m to 883 m).

The geographic position; the rainfall characteristics of rainy summers with mean rainfalls of 750 mm (BARUQUI et al., 2006); the unplanned land use and occupation; and the lack of effective policies and regulations are factors conducive to the occurrence of disasters caused by floods and landslides.

MATERIALS AND METHODS

The research method used in this study is based on the descriptive investigative perspective, which consists of an in-depth investigation of information on a given phenomenon. This is, therefore, an empirical study developed based on the survey of historical information that enables the exploration or description of current phenomena. When such information is detailed and contextualized, it can provide deep knowledge of the studied environment (YIN, 2009).

To fulfill this scope of research and achieve the study aim, fieldwork and archive searches were carried out at places such as the Hemeroteca Digital da Biblioteca Nacional (Digital Newspaper Library of the National Library) and the Biblioteca Municipal Baptista Caetano d'Almeida (Baptist Caetano d'Almeida Municipal Library). Images and news from Facebook groups such as "Antiga São João del-

Rei", which is composed of historians and scholars of the referred city, were also used.

On the digital platforms, several variations of the written form of keywords such as São João del-Rei were used as filters. Subsequently, in the newspapers that contained the name of the city, the following names and Portuguese terms were also researched: Lenheiro, Rio das Mortes (Mortes River), Água Limpa, obra (work), canalização (canalization), retificação (rectification), and Departamento Nacional de Obras e Saneamento (National Department for Public Works and Sanitation) (DNOS).

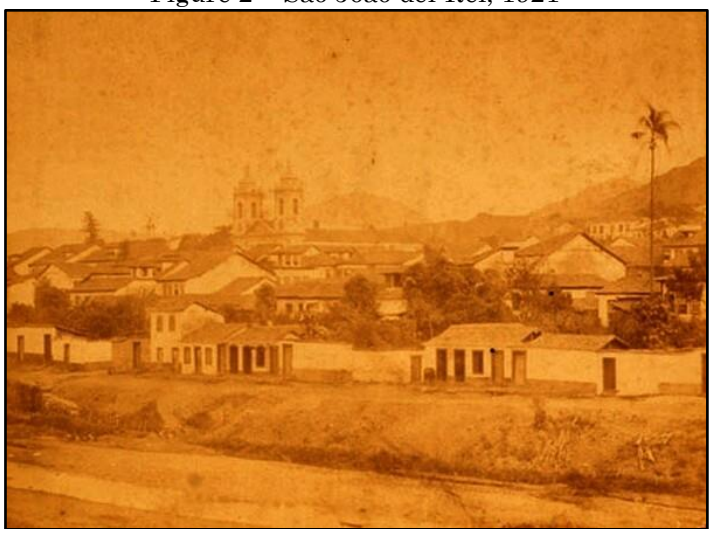
The cartographic representations were developed on the ArcMap application based on the IBGE databases on the Prefeitura Municipal de São João del-Rei (City Council of São João del-Rei) and the georeferencing of partial aerial images (1950s), taking the Ikonos image of São João del-Rei as reference.

RESULTS AND DISCUSSION

Similarly to most cities, São João del-Rei was born, took root, and grew on the banks of a river. Thus, it can be considered that Lenheiro stream stands out as the dorsal spine of the city's expansion.

It appears that the stream composed the local landscape along its lengthy bed, especially on its right bank (Figure 2). This inference is based on the toponym "beira da praia" (edge of the beach), used by the local population to refer to the river. In addition, the Lenheiro was characterized by stony stretches, where the exposed threshold and the slope break produced waterfalls (Figure 3).

Figure 2 – São João del-Rei, 1921



Source: Antiga São João del-Rei (2015).

Figure 3 – Falls of the Lenheiro stream (natural in the black and white photograph and currently concreted)

Source: Antiga São João del-Rei (2015); Authors (2022).

As is customary, the city's expansion occurred without planning, occupying the banks of other rivers and spreading up the slopes. Due to the impermeabilization of the soil, the hydric excess increased and instantly contributed to raising the level of the rivers during rains. Concern over the impacts of impermeabilization of the roads of São João del-Rei led Câmara (1970) to emphasize the strength, durability, and importance of the cobblestones used in the paving since 1924. According to the author (1970), cobblestones have a greater capacity for the infiltration of rainwater and were recommended for cities in a tropical climate, even those with a mild microclimate.

Despite the warning, over time, São João del-Rei adopted asphalt as the main form of paving. This choice, in addition to the urban morphology and a deficient drainage system, increased the occurrence of flooding, which, when recurrent, can lead to disorder for the population, if not disasters.

As such, it can be highlighted that between 1888 and 2021, 37 disastrous events related to urban waters and phenomena such as flash floods and flooding were identified in São João del-Rei (Figure 4).

Figure 4 – Timeline of flood records in São João del-Rei

Source: The authors (2022).

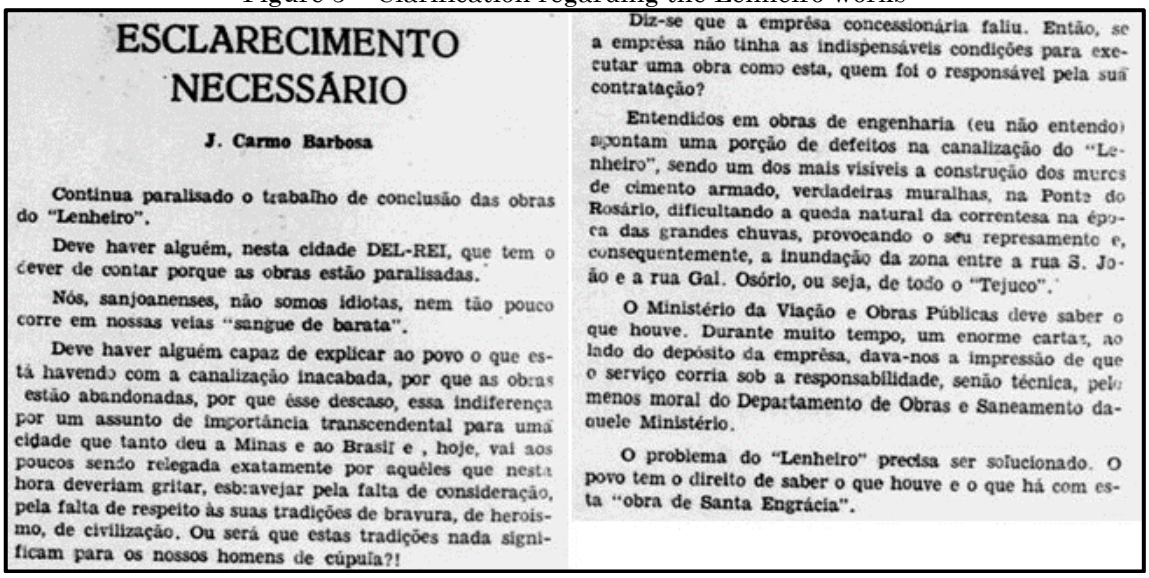
These phenomena, especially inundations, result in deaths and damage, which through history have cost thousands and millions in Brazilian currencies such as Réis (TEMPORAL..., 1917), Cruzeiros (DAMAE..., 1992), and Reais (DEFESA CIVIL, 2015).

Motivated by these factors and the social hygiene movement, work began on the canalization of the Lenheiro stream (NELSON..., 1969b). The process occurred through public bids under the responsibility of the Federal Government with the DNOS (OBRAS..., 1967). This department was responsible for a series of interventions on Brazilian fluvial channels, especially in the Baixada Fluminense, a region in the state of Rio de Janeiro (DIAS; CUNHA, 2017). Among the main aims of the DNOS works were the concreting and enlarging of various rivers to "clean or dry" the flood plains, control flooding, and increase the dry lands (ASSUMPÇÃO; MARÇAL, 2012). The posture and actions of the agency were clearly anthropocentric, based on overcoming the physical aspect and the political geography (border demarcation) of the place. There was, therefore, an effort to shape the space and implement a "human geography" in the sense of being anthropically shaped (SOFFIATI, 2005).

In 1967, the referred work still had not been concluded and was subject to criticism and doubts regarding its functionality. It was said that canalization could bring risks to the municipal heritage, given that, in the previous flood, it would have caused backwaters in the vicinity of the Ponte do Rosário (Rosário Bridge) (Point D – Figure 1), which dates from the 19th century and is part of the architectural ensemble listed in 1947.

In addition, the project was seen as being of doubtful quality with an undersized channel, which would not support the large volume of the Lenheiro during heavy rains (Figure 5) and would intensify the backwater effect (BARBOSA, 1968). These criticisms and grievances were intensified with the bankruptcy declaration of the contractor responsible and the abandoning of the work (Figure 6).

Figure 5 – Clarification regarding the Lenheiro works



ESCLARECIMENTO NECESSÁRIO

J. Carmo Barbosa

Continua paralisado o trabalho de conclusão das obras do "Lenheiro".

Deve haver alguém, nesta cidade DEL-REI, que tem o dever de contar porque as obras estão paralisadas.

Nós, sanjoanenses, não somos idiotas, nem tão pouco corre em nossas veias "sangue de barata".

Deve haver alguém capaz de explicar ao povo o que está havendo com a canalização inacabada, por que as obras estão abandonadas, por que êsse descaso, essa indiferença por um assunto de importância transcendental para uma cidade que tanto deu a Minas e ao Brasil e , hoje, vai aos poucos sendo relegada exatamente por aquêles que nesta hora deveriam gritar, esbravejar pela falta de consideração, pela falta de respeito às suas tradições de bravura, de heroísmo, de civilização. Ou será que estas tradições nada significam para os nossos homens de cúpula?!

Diz-se que a emprêsa concessionária faliu. Então, se a emprêsa não tinha as indispensáveis condições para executar uma obra como esta, quem foi o responsável pela sua contratação?

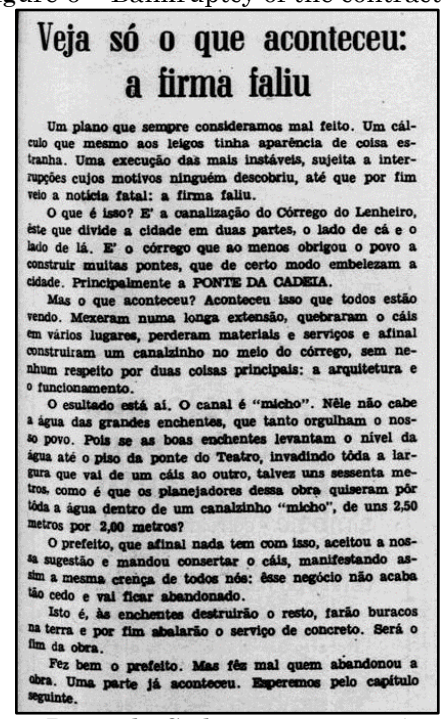
Entendidos em obras de engenharia (eu não entendo) apontam uma porção de defeitos na canalização do "Lenheiro", sendo um dos mais visíveis a construção dos muros de cimento armado, verdadeiras muralhas, na Ponte do Rosário, dificultando a queda natural da correntesa na época das grandes chuvas, provocando o seu represamento e, consequentemente, a inundação da zona entre a rua S. João e a rua Gal. Osório, ou seja, de todo o "Tejuco".

O Ministério da Viação e Obras Públicas deve saber o que houve. Durante muito tempo, um enorme cartaz, ao lado do depósito da emprêsa, dava-nos a impressão de que o serviço corria sob a responsabilidade, senão técnica, pelo menos moral do Departamento de Obras e Saneamento daquele Ministério.

O problema do "Lenheiro" precisa ser solucionado. O povo tem o direito de saber o que houve e o que há com esta "obra de Santa Engrácia".

Source: Barbosa (1968).

Figure 6 – Bankruptcy of the contractor



Veja só o que aconteceu: a firma faliu

Um plano que sempre consideramos mal feito. Um cálculo que mesmo aos leigos tinha aparência de coisa estranha. Uma execução das mais instáveis, sujeita a interrupções cujos motivos ninguém descobriu, até que por fim veio a notícia fatal: a firma faliu.

O que é isso? E' a canalização do Córrego do Lenheiro, êste que divide a cidade em duas partes, o lado de cá e o lado de lá. E' o córrego que ao menos obrigou o povo a construir muitas pontes, que de certo modo embelezam a cidade. Principalmente a PONTE DA CADEIA.

Mas o que aconteceu? Aconteceu isso que todos estão vendo. Mexeram numa longa extensão, quebraram o cáis em vários lugares, perderam materiais e serviços e afinal construiram um canalzinho no meio do córrego, sem nenhum respeito por duas coisas principais: a arquitetura e o funcionamento.

O esultado está aí. O canal é "micho". Nêle não cabe a água das grandes enchentes, que tanto orgulham o nosso povo. Pois se as boas enchentes levantam o nível da água até o piso da ponte do Teatro, invadindo tôda a largura que vai de um cáis ao outro, talvez uns sessenta metros, como é que os planejadores dessa obra quiseram pôr tôda a água dentro de um canalzinho "micho", de uns 2,50 metros por 2,00 metros?

O prefeito, que afinal nada tem com isso, aceitou a nossa sugestão e mandou consertar o cáis, manifestando assim a mesma crença de todos nós: êsse negócio não acaba tão cedo e vai ficar abandonado.

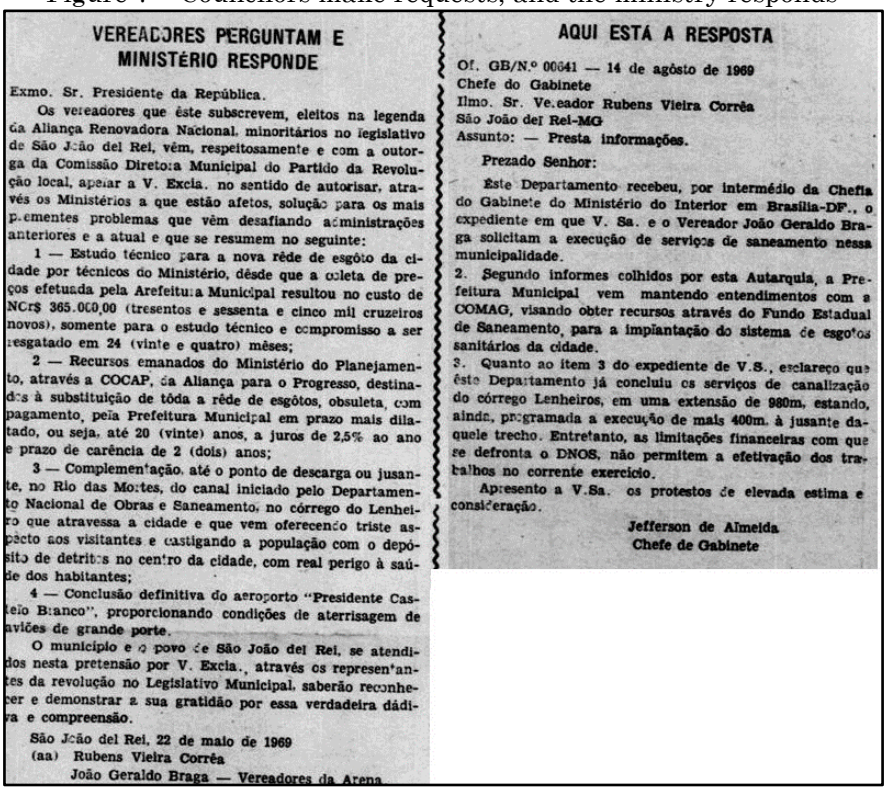
Isto é, às enchentes destruirão o resto, farão buracos na terra e por fim abalarão o serviço de concreto. Será o fim da obra.

Fez bem o prefeito. Mas fêz mal quem abandonou a obra. Uma parte já aconteceu. Esperemos pelo capítulo seguinte.

Source: Ponte da Cadeia newspaper (1969a).

In a letter from the Municipal Legislative Power to the President of the Republic, it was identified that the initial project had foreseen 1,380 meters of canalization, from Tijuco to the discharge point in the Mortes River. However, in four years of work, only 980 m of the river had been canalized, that is, the stretch between the surroundings of the Biquinha Bridge (Point C – Figure 1) and the railway station (Point H – Figure 1). Thus, 400 meters of the initial project remained with no work carried out (Figure 7).

Figure 7 – Councilors make requests, and the ministry responds



VEREADORES PERGUNTAM E MINISTÉRIO RESPONDE

Exmo. Sr. Presidente da República.

Os vereadores que êste subscrevem, eleitos na legenda da Aliança Renovadora Nacional, minoritários no legislativo de São João del Rei, vêm, respeitosamente e com a outorga da Comissão Diretora Municipal do Partido da Revolução local, apelar a V. Excia. no sentido de autorisar, através os Ministérios a que estão afetos, solução para os mais prementes problemas que vêm desafiando administrações anteriores e a atual e que se resumem no seguinte:

1 — Estudo técnico para a nova rêde de esgôto da cidade por técnicos do Ministério, dêsde que a coleta de preços efetuada pela Arefeitura Municipal resultou no custo de NCr$ 365.000,00 (tresentos e sessenta e cinco mil cruzeiros novos), somente para o estudo técnico e compromisso a ser resgatado em 24 (vinte e quatro) mêses;

2 — Recursos emanados do Ministério do Planejamento, através a COCAP, da Aliança para o Progresso, destinados à substituição de tôda a rêde de esgôtos, obsuleta, com pagamento, pela Prefeitura Municipal em prazo mais dilatado, ou seja, até 20 (vinte) anos, a juros de 2,5% ao ano e prazo de carência de 2 (dois) anos;

3 — Complementação, até o ponto de descarga ou jusante, no Rio das Mortes, do canal iniciado pelo Departamento Nacional de Obras e Saneamento, no córrego do Lenheiro que atravessa a cidade e que vem oferecendo triste aspecto aos visitantes e castigando a população com o depósito de detritos no centro da cidade, com real perigo à saúde dos habitantes;

4 — Conclusão definitiva do aeroporto "Presidente Castelo Branco", proporcionando condições de aterrisagem de aviões de grande porte.

O município e o povo de São João del Rei, se atendidos nesta pretensão por V. Excia., através os representantes da revolução no Legislativo Municipal, saberão reconhecer e demonstrar a sua gratidão por essa verdadeira dádiva e compreensão.

São João del Rei, 22 de maio de 1969
(aa) Rubens Vieira Corrêa
João Geraldo Braga — Vereadores da Arena

AQUI ESTÁ A RESPOSTA

Of. GB/N.º 00641 — 14 de agôsto de 1969
Chefe do Gabinete
Ilmo. Sr. Vereador Rubens Vieira Corrêa
São João del Rei-MG
Assunto: — Presta informações.

Prezado Senhor:

Êste Departamento recebeu, por intermédio da Chefia do Gabinete do Ministério do Interior em Brasília-DF., o expediente em que V. Sa. e o Vereador João Geraldo Braga solicitam a execução de serviços de saneamento nessa municipalidade.

2. Segundo informes colhidos por esta Autarquia, a Prefeitura Municipal vem mantendo entendimentos com a COMAG, visando obter recursos através do Fundo Estadual de Saneamento, para a implantação do sistema de esgotos sanitários da cidade.

3. Quanto ao item 3 do expediente de V.S., esclareço que êste Departamento já concluiu os serviços de canalização do córrego Lenheiros, em uma extensão de 980m, estando, ainda, programada a execução de mais 400m. à jusante daquele trecho. Entretanto, as limitações financeiras com que se defronta o DNOS, não permitem a efetivação dos trabalhos no corrente exercício.

Apresento a V.Sa. os protestos de elevada estima e consideração.

Jefferson de Almeida
Chefe de Gabinete

Source: Ponte da Cadeia newspaper (1969c).

A decade later, after a destructive flood at the beginning of 1978, the DNOS requested technical studies to solve the problem in São João del-Rei (DNOS..., 1978a).

Thus, in June of the same year, new work was started as a remediation measure, widening the banks and deepening the bed of the Lenheiro stream, in the region of Tijuco (Figure 8) (OBRAS..., 1978b).

Figure 8 – Work on the Lenheiro stream

Obras no Córrego do Lenheiro

Atendendo antiga aspiração dos moradores do bairro do Tijuco, residentes nas proximidades do Córrego do Lenheiro e que durante as épocas das chuvas permaneciam em constante ameaça de verem seus lares invadidos pelas águas, o Prefeito Otávio de Almeida Neves providenciou no início deste mês importante obra de drenagem do leito daquele ribeirão.

Diversas máquinas estão fazendo o serviço que consta de alargamento das suas margens, sendo que quando concluído será feita a construção de paredões de arrimo e cais e posteriormente será feita a gramagem e arborização.

Essa importante obra, talvez a mais importante já executada pelo atual Prefeito, estará totalmente concluída dentro de alguns meses e solucionará definitivamente o problema das enchentes no populoso bairro.

Source: Tribuna Sanjoanense newspaper (1978b).

Even with the partial canalization and various interventions in the natural condition of the river, there were four serious floods between 1969 and 1983 leading to social and economic damage and one death. Among these events, the flood of 1971 attracted attention for the speed of the water (OBRAS..., 1971), which was possibly a consequence of canalization.

Given the recurrent disasters and the inefficacy of the canalization, in 1986, 80 meters that had been constructed two decades before were demolished. The stretch that was destroyed was between the falls of the Rosário Bridge and the Biquinha Bridge (Figure 9), which was justified by the need to deepen the canal by a meter (LENHEIRO..., 1986a), given that the canal did not support the volume of the river. The work extended the canal network 390 m in the direction of the Rio Acima creek, a tributary of the Lenheiro, including it in the canalization. Initially, the cost of the deployment was 1.5 billion Cruzeiros, which corresponded to 1.8 million minimum salaries at the time (BRASIL, 1986). The company responsible for the work was called Irmãos Vianini (Vianini Brothers in English) (LENHEIRO..., 1986a).

Figure 9 – Lenheiro will have 80 m demolished

Lenheiro terá 80 metros demolidos

Um trecho de oitenta metros do canal do Córrego Lenheiro, abrangendo a chamada "cachoeira" próxima à Ponte do Rosário, centro, será demolida para a realização das novas obras de canalização, de acordo com projeto do Departamento Nacional de Obras e Saneamento (DNOS) a ser executado pela empresa Irmãos Vianini após o verão. A demolição visa ao afundamento em um metro de profundidade do rio, para que seja construído em seguida um novo canal, explica o engenheiro da Vianini, Luiz Alberto Soldati.

Assim como o restante da canalização do Lenheiro, o trecho que será demolido foi feito pelo governo federal em 1966 e não tem profundidade maior porque, na a época da obra, temia-se o comprometimento das fundações da Ponte do Rosário. A demolição, que deverá ser uma das primeiras iniciativas nesta primeira etapa da continuidade da canalização do Lenheiro e do Rio Acima, reduz a ampliação da rede de canais para 310 metros, descontando-se a parte de oitenta metros a ser reconstruída do total de 390 metros anunciado.

A Irmãos Vianini canalizará nessa primeira fase (com custo de Cr$1,5 bilhão) duzentos metros do Lenheiro, até as imediações do Cine Artur Azevedo, no Tejuco, e 190 do Rio Acima. Na obra, que manterá as características da atual canalização (canal de concreto, talude gramado e muros de fechamento), está prevista a utilização de 7 mil 200 sacos de cimento, dezessete toneladas de ferro e 7 mil e 30 metros quadrados de grama batatais (**Paspalum Notatum**). Cerca de sessenta operários deverão fazer o serviço.

O canteiro de trabalhos será montado já em fevereiro e, de acordo com um dos donos da empresa, Oriente Vianini, será "o mais simples possível", já que a construtora possui sede no município. O cronograma da obra e as placas indicativas deverão estar concluídos na próxima semana, quando a Vianini espera também assinar o contrato de subempreiteira com a Empresa de Dragagem e Engenharia Limita (Edel). A empreiteira assinou o contrato com o DNOS no dia 2. no Rio de Janeiro.

Para a realização de obras complementares à canalização de Lenheiro e do Rio Acima, verba de Cr$ 1 bilhão 300 milhões está liberada à Prefeitura desde quarta-feira, 15, quando o prefeito Cid Valério assinou convênio com a Secretaria de Assuntos Especiais do Estado. Os recursos foram fornecidos pelo Ministérios do Desenvolvimento Urbano e Meio Ambiente e entregues à Secretaria em 24 de dezembro. A aplicação da verba não se limitará, porém, à complementação das obras do Lenheiro e Rio Acima, e inclui serviços de saneamento básico na Colônia do Marçal, Caquende e Águas Gerais.

Outras obras com verbas do governo federal serão feitas em São João del Rei nos próximos meses e deverão ter definidas as empresas construtoras até o dia 31. São elas a primeira etapa da Escola Estadual Bárbara Helidora, na rua Oito de Dezembro, centro (verba de Cr$350 milhões do Ministério da Educação); postos de saúde do Caburu e Rio das Mortes (Cr$150 milhões do Ministério da Saúde); e escolas rurais de Fé e Trindade (verba de Cr$210 milhões do Ministério da Educação). A previsão do prefeito Cid Valério é de que as obras estarão prontas entre julho e agosto.

João Ramalho Neto

A "cachoeira", vista da Ponte do Rosário, está incluída na demolição

Source: Jornal de São João del-Rey newspaper (1986a).

The stretch had to be demolished using a jackhammer, as the dynamite was unable to break part of the thick concrete (Figure 10) (APÓS..., 1986b).

Figure 10 – Demolition of the canalization

Após resistir à dinamite, Lenheiro retoma martelo

Com a escavação de um corredor alternativo para o escoamento das águas, a empresa sanjoanense Vianini iniciou os trabalhos de reconstrução e canalização do Córrego do Lenheiro, que corta o centro da cidade, visando terminar com o problema das enchentes no verão.

As quarta e quinta-feira, 19 e 20, foram marcadas por explosões no canteiro de obras, destinadas a remover as placas de concreto existentes no local, que chegam a medir 60 centímetros a um metro de espessura. Os explosivos, colocados por um técnico da empresa Britanit Indústria Química, de Rio Pomba, numa extensão de 60 metros quadrados na base do corredor de concreto do trecho entre a "Cachoeirinha" e a Ponte do Rosário, não surtiram o efeito desejado. Os abalos foram reduzidos, e agora os serviços prosseguem à base de martelo pneumático e retroescavadeira, como no início.

No total da obra, 80 metros do Lenheiro serão reconstruídos e 120 canalizados, além de 190 metros do Rio Acima. No trecho demolido, o novo canal terá a profundidade de 1,2 metros, o que ampliará a vazão das águas, permitindo um escoamento maior no período de chuvas.

A fase final das obras é a que mais precisará de gente, revela o engenheiro Luiz Alberto Soldati, explicando que vinte operários estarão trabalhando somente na montagem de novas placas de concreto.

Carla Duarte Mota

Nem explosivos removeram as placas de concreto

Source: Jornal de São João del-Rey newspaper (1986b).

In 1987, with 2/3 of the canalization work completed and a possible extension of 240 meters, a "flood" destroyed part of the grass and carved pieces from the banks. After the event, according to the Jornal de São João Del-Rey newspaper (1987), the director of the Irmãos Vianini company stated that unless 20 thousand cubic meters of sand under the grass that covered the banks of the Lenheiro stream were excavated, in five years the sediments would be accumulating at the bridges.

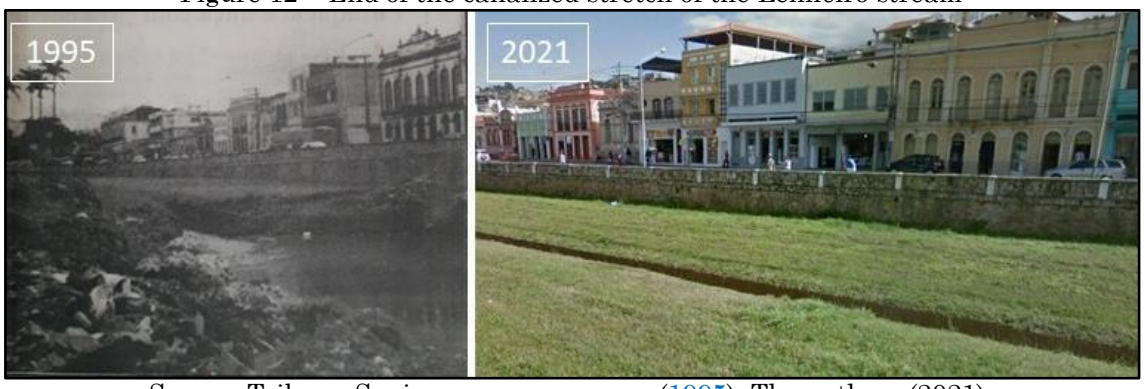
This information emphasizes the capacity of the Lenheiro stream to excavate and deposit sediments. The altimetric gradient of the channel is high, with a variation between the source (1,136 m) and the mouth (885 m) of 251 m in a length of 8.4 km. Based on this, it can be inferred that alterations to the fluvial landscape, added to the urban growth common to most Brazilian cities in the 1980s, accelerated the erosive processes and, consequently, the silting of the canal.

In this period, canalization finished in the vicinity of the railway station (Figure 11), where the concreted channel and the river returned to the natural bed (Figure 12).

Figure 11 –Lenheiro stream in the vicinity of the Railway Station – 1980s

Source: Antiga São João del-Rei (2017).

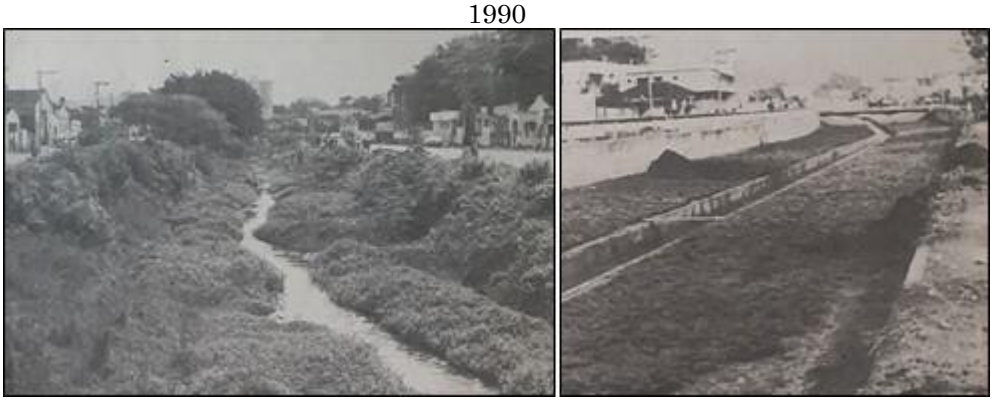
Figure 12 – End of the canalized stretch of the Lenheiro stream



Source: Tribuna Sanjoanense newspaper (1995); The authors (2021).

At the beginning of the 1990s, the canalization work extended upstream, close to the Biquinha Bridge and the confluence with the Rio Acima creek. According to the Tribuna Sanjoanense newspaper (1991), the work was carried out from the Rossini Bacarini street (Point B – Figure 1) in the direction of the Minas Clube, approaching the São João street (Point A - Figure 1), both in the Tijuco neighborhood (Figure 13).

Figura 13 – Canalization of the Lenheiro stream in the Tijuco neighborhood, Rossini Bacarini street, 1990



Source: Tribuna Sanjoanense newspaper (1991).

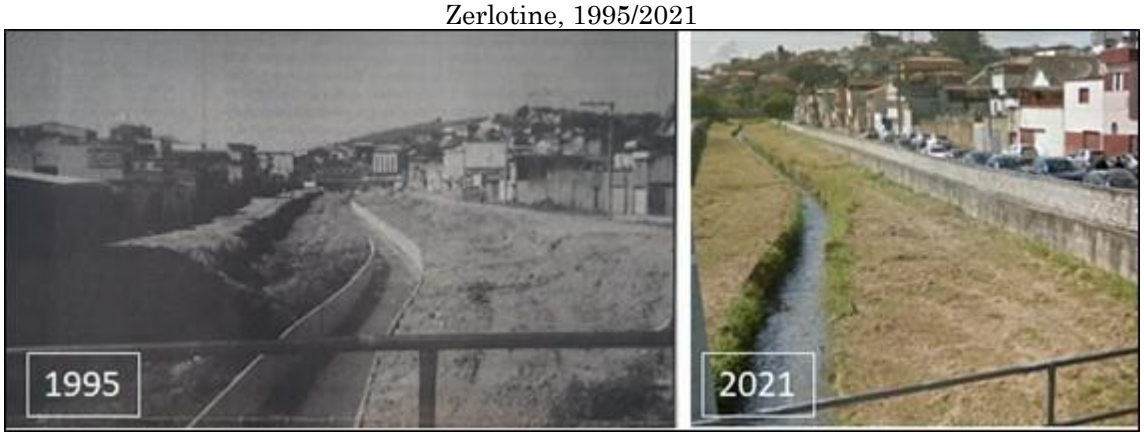
In 1995, the city council announced that it would not wait for federal funds and would resume canalization up to Raul Soares Square using municipal resources (CANALIZAÇÃO..., 1995). The stretch in question was around 200 meters, indicated in red below (Figure 14).

Figure 14 – Extension to the canalization work of the Lenheiro stream, 1995

Source: The authors (2022).

According to the Jornal Tribuna Sanjoanense newspaper (1995), the work was carried out at a rapid pace, and in November 1995, was directed downstream in the direction of the confluence with the Água Limpa creek, and upstream in the direction of Águas Férreas. Figure 15 makes it possible to see that, at that time, the work had already been carried out along the entirety of the banks beside the roads Antônio Josino de Andrade and Aldo Zerlotine, located approximately 1000 m from the confluence.

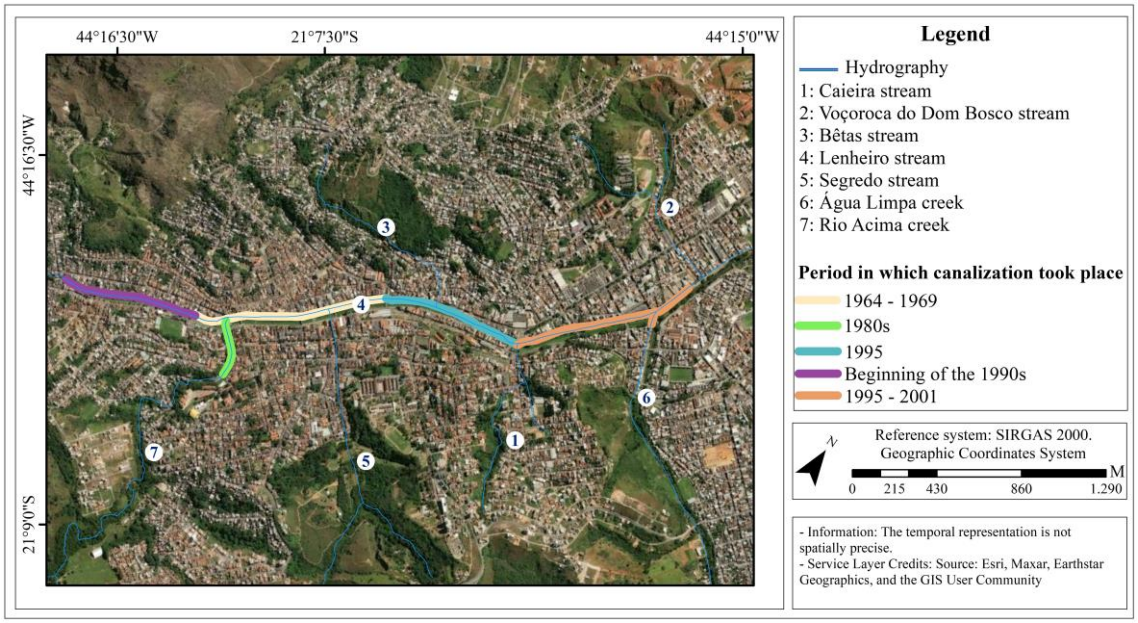
Figura 15 – Canalized stretch of the Lenheiro stream between the roads Antônio Josino and Aldo Zerlotine, 1995/2021



Source: Tribuna Sanjoanense newspaper (1995); Authors (2021).

Despite the rapid pace of the work, the canalization only reached its current state in 2001, when the stretch in the vicinity of the bus terminal was finished. This also included around 32 m of the Água Limpa creek upstream and 180 m downstream of the confluence with the Lenheiro. In summary, the canalization of the Lenheiro stream took 37 years to reach its current state (Figure 16).

Figure 16 - Summary of the canalization history.



Source: The authors (2022).

Among the modifications carried out during the work, the alteration of the base level of the two rivers stands out. As already mentioned, the Lenheiro stream is a tributary of the Água Limpa creek, that is, the former drains into the latter. However, after deepening the bed of the Lenheiro stream for canalization and the removal of accumulated sediments, its base level was lowered and its course anthropically inverted to make the Água Limpa creek drain into the Lenheiro (Figure 17).

Figure 17 – Confluence of the Lenheiro stream with the Água Limpa creek, 2021

Source: The authors (2021).

According to Guerra (1993), any variation in the base level of a river can lead to the resumption of the headward erosion process and erosion along the drainage axes, in addition to alteration of the dynamic balance of the channel (BISHOP, 1995; BOTELHO, 2011). Thus, it can be inferred that the inversion of the base level aggravated the backwater effect in the area of the confluence, given that the Água Limpa creek has a visibly greater volume of water impounding the Lenheiro (Figure 18).

Figure 18 – Volumetric and energetic difference and the backwater effect of the Água Limpa creek on the Lenheiro

Source: Adapted from Resende (2021).

Another explanation for the backwaters is the canalization flowing into a larger receiver (MALHEIROS, 2018), such as the Água Limpa creek, the widening of the channel, and the interventions on the banks (FORNASARI FILHO et al., 1992). This appreciably reduced the carrying capacity for outflows in the projected canal (MALHEIROS, 2018).

In addition to the Lenheiro stream, other rivers in São João del-Rei such as the Morro das Bêtas (ou Bêta do Barracão), Caieira, Segredo, Voçoroça do Dom Bosco, and Dom Bosco and the mouth of the Água Limpa creek have been canalized, rectified, and/or plugged.

The Morro das Bêtas stream (Figure 19) drained parallel to the Mercado Municipal (Municipal Market) and was a tributary to the Lenheiro stream on its left bank. Nowadays, this tributary is canalized under the Travessa Lopes Bahia cross street, and, according to the Tribuna Sanjoanense newspaper (1999), has its water pumped by the Departamento Autônomo Municipal de Água e Esgoto (Autonomous Municipal Department of Water and Sewage) (DAMAE) to supply the 8 de Dezembro Avenue.

Figure 19 –Morro das Bêtas stream in 1930 and 2021.

Source: Antiga São João del-Rei (1930); The authors (2021).

The Caieira stream, a tributary on the right bank of the Lenheiro, drains canalized parallel to the Henrique Benfenatie street (Point J – Figure 1), passing under the buildings (Figure 20). The same happens with the Voçoroca do Dom Bosco stream (Figure 21), which cuts Leite de Castro Avenue (Figure 22) under buildings to subsequently drain into the Água Limpa creek downstream of the confluence with the Lenheiro stream.

Figure 20 – House over the Caieira stream

Source: The authors (2021).

Figure 21 –Voçoroca do Dom Bosco stream

Source: The authors (2021).

Figure 22 –Voçoroca do Dom Bosco stream canalized under Leite de Castro Avenue

Source: Adapted from Resende (2021).

There is also evidence of the existence of another canal, which, until 1940, was part of the landscape of Campus Dom Bosco (Figure 23). However, there are no further records or clear evidence regarding its canalization. Therefore, two possibilities can be inferred: I: the canal may have dried up due to upstream urbanization; or II: it may have been canalized

in the direction of the Frei Cândido street (Point K- Figure 1) to drain into the Água Limpa creek, downstream of the mouth of the Lenheiro stream (Figure 24).

Figure 23 –Dom Bosco stream

Source: Adapted from Antiga São João del-Rei (2013); Google Earth (2021).

Figure 24 – Possible outflow of the Dom Bosco stream

Source: Adapted from Resende (2022).

Regarding the Segredo stream, this is found canalized and plugged under the Andrade Reis street (Figure 25). This canalization starts with a barrier deployed inside the 11º Batalhão de Infantaria (11th Infantry Battalion) (Point F – Figure 1) and drains on the right bank of the Lenheiro stream, close to the Teatro Municipal (Municipal Theater) (Point 6 – Figure 1). During a storm event in 2003, an old bridge (Figure 26) over said canal that had been buried through canalization and reclaimed land was exposed by subsidence.

Figure 25 – Segredo stream

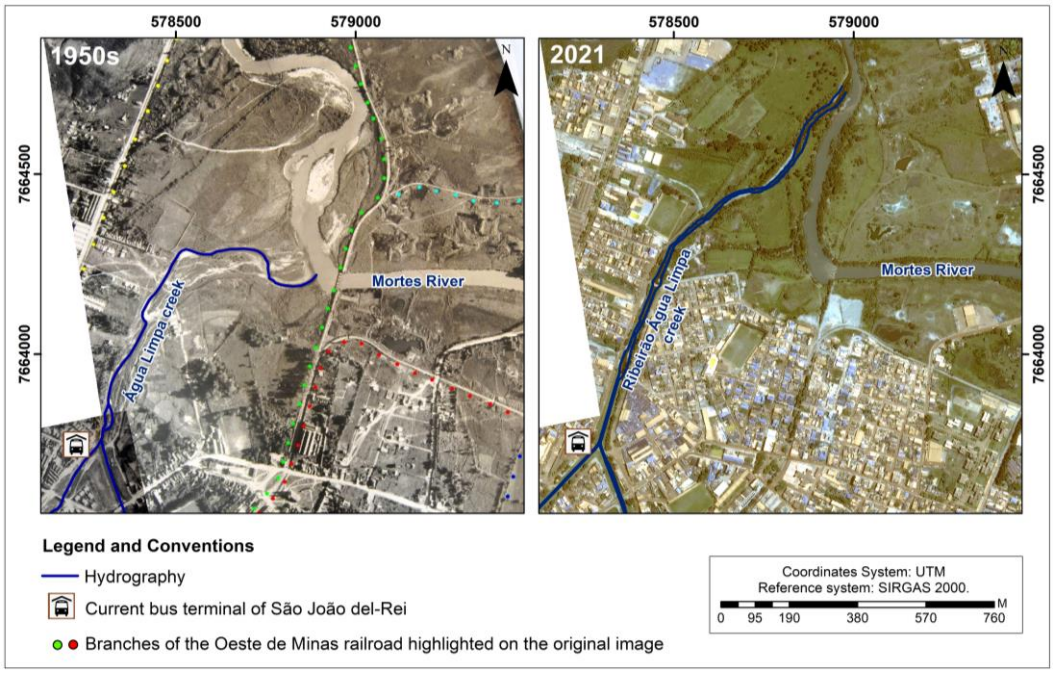
Source: Adapted from Antiga São João del-Rei (2013).

Figure 26 – Misericórdia Bridge

Source: Antiga São João del-Rei (2015)

The modification of the mouth of the Água Limpa creek is noteworthy for the absence of information, records, and even knowledge on the part of the population. Identification of this intervention (Figure 27) occurred through observation of aerial images from the 1950s, available in the Antiga São João del-Rei Facebook group. Access to the image and the use of geotechnology made it possible to identify and represent the modification on the natural landscape of the mouth of the Água Limpa creek.

Figure 27 – Modifocation map of the fluvial landscape of the mouth of the Água Limpa creek



Source: The authors (2022).

It can be noted that the creek makes an inflection to the right close to the mouth and drains into the Mortes River (Figures 28 and 29). With the rectification, the drainage point was displaced approximately 578 meters downstream.

Figure 28 – Plan of Várzea do Marçal, 1893

Source: Adapted from Antiga São João del-Rei (2020).

No specific records of this rectification work were found in the local newspapers and historical materials. However, according to unofficial information from local residents and professional engineers that accompanied the process, the work occurred at the beginning of the 1960s and was carried out by the DNOS with the aim of accelerating the outflow to reduce flooding and backwaters in this section. Furthermore, according to the referred reports,

the work was conducted using a dragline excavator, which executes excavation movements using wire ropes and large buckets.

It is believed that this work was implemented as part of the Lenheiro stream canalization and rectification project. This is because the referred canalization would lead to increased outflow velocity and flow and overflow concentration in the area where the inflection was made. Therefore, this constitutes an area of strangulation.

Topographic mapping of the Lenheiro stream and its floodplain in 1959 provides evidence that reinforces the inference. The work was carried out by the DNOS, digitalized at the request of this study, and made available on the Sistema de Informações do Arquivo Nacional (National Archive Information System) (SIAN) with the title: "Córrego do Lenheiros, afluente do córrego Água Limpa" (Lenheiros stream, a tributary of the Água Limpa creek) (DNOS, 1959 *apud* SIAN, 2022), which reinforces the previously mentioned base level inversion.

Currently, the filled valley and the marginal dykes of the old bed of the Água Limpa can still be identified in the field (Figure 29).

Figure 29 – Filled valley of the Água Limpa creek

Source: The Authors (2021).

Based on this survey and discussion, it is understood that, over time, significant alterations have been made to the natural fluvial landscape of São João del-Rei. A secondary or anthropic fluvial scenario was thus created with no relationship of belonging, given that it has become a plugged and invisible component. However, the invisibility of these pre-existing rivers has been converted into a problem through high rainfall levels, causing flooding at various points of the city.

In the case of São João del-Rei, it is believed that these processes may be motivated by a lack of maintenance and a lack of knowledge in regard to the structures that house the artificial canals. These may be silted, obstructed, and undersized, causing retention, overflow, backflow, and even subsidence. Finally, greater attention, identification, and action on the part of the Municipal public authority is necessary in regard to the urban fluvial landscape (natural and anthropic) of São João del-Rei, beginning with the hydraulic mapping of these systems.

FINAL CONSIDERATIONS

The retrieval and analysis of the anthropic modifications to the fluvial landscape of São João del-Rei contribute to the valuation of the local history from a geographical bias. The surveys presented on the contentious canalization process of the Lenheiro stream, in

addition to the other modifications to the local landscape, reinforce the discussion that human beings constitute an important geomorphological agent.

The results and discussion carried out in the present study indicate that the historical relationship of São João del-Rei with its urban rivers was transformed from a state of existence and growth to a consequence of undue occupation and intervention. Thus, the local waterways have been converted into obstacles to urban growth and social hygiene. As such, the relationship of belonging, and the very knowledge of the historical facts that were milestones of modifications to the dynamic and the natural landscape within which the urban fabric was formed have been lost.

The absence of documents, technical records, and even research on the subject corroborate this loss of a relationship of belonging and loss of knowledge, in addition to generating concerns. One such concern is that if the municipal public authority and the Departamento de Água e Esgoto (Department of Water and Sewage) do not have a map of the canalized drainage, how can maintenance be carried out? Also, does this lack of maintenance intensify the recurrent floods that occur in the city? As such, the historical delineation of the canalization process and the modifications to the natural dynamic of the waterways leads to the emergence of components and facts that cannot remain marginalized from local history.

In addition to depicting the complex mismatch of public works, the knowledge of these facts is an analytical and systemic component of the recurrent flooding processes in São João del-Rei, as well as a basis for requalification, planning, functional urban zoning, and the maintenance of artificially implemented canals and riverbeds.

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REFERENCES

ALVES, V. A. R. **Relação cidade-curso de água:** a canalização do Ribeirão Pirapitinga em Catalão (GO). 2020. 120 f. Dissertação (Mestrado em Geografia) – Universidade Federal de Minas Gerais, Montes Claros, 2020.

A ANTIGA SÃO JOÃO DEL REI! **[Fotos]**. Grupo no Facebook, 2013; 2015; 2017; 2020. Available: https://www.facebook.com/groups/antigasjdr/about. Access on: Feb. 02, 2021.

APÓS resistir à dinamite, Lenheiro retoma martelo. **Jornal de São João Del Rey**, São João del-Rei, ano 2, n. 6, p. 1, 22 mar. 1986b.

ASSUMPÇÃO, A. P.; MARÇAL, M. Retificação dos canais fluviais e mudanças geomorfológicas na planície do rio Macaé (RJ). **Revista de Geografia**, Recife, v. 29, n. 3, p. 18-36, 2012.

BAPTISTA, M. B.; CARDOSO, A. Rios e cidades: uma longa e sinuosa história. **Revista da Universidade Federal de Minas Gerais**, v. 20, n. 2, p. 124-153, 2013. https://doi.org/10.35699/2316-770X.2013.%202693.

BARBOSA, J. C. Esclarecimento necessário. **Ponte da Cadeia**, São João del-Rei, ano 2, n. 77, p. 3, 24 nov. 1968.

BARUQUI, A. M.; NAIME, U. J.; MOTTA, P. E. F.; CARVALHO FILHO, A. **Levantamento de reconhecimento de média intensidade dos solos da zona Campos das Vertentes**. Rio de Janeiro: Embrapa Solos, 2006. Available: https://www.infoteca.cnptia.embrapa.br/%20bitstream/doc/856021/1/bpd962006levantcamposvertentes.pdf. Access on: May. 06, 2020.

BISHOP, P. Drainage rearrangement by river capture, beheading and diversion. **Progress in Physical Geography**, [s.l], v.19, n. 4, p. 449-473, 1995. https://doi.org/10.1177/030913339501900402.

BOTELHO, R. G. M. Bacias Hidrográficas Urbanas. In: GUERRA, A. J. T. (org.).

Geomorfologia Urbana. Rio de Janeiro: Bertrand Brasil, 2011. p. 71-115.

BRASIL. **Decreto-Lei nº 2.284, de 10 de março de 1986**. Mantém a nova unidade do sistema monetário brasileiro, o seguro-desemprego, amplia e consolida as medidas de combate à inflação. Brasília: Presidência da República, 1986. Available: http://www.planalto.gov.br/ccivil_03/decreto-lei/del2284.htm. Access on: Out. 05, 2021.

BRASILERO, V. D.; DANGELO, A. G. D.; LEMOS, C. B. Registros de Memória: Leitura da Paisagem Cultural da Cidade de São João Del-Rei, em Minas Gerais, por meio da Iconografia Histórica. **Centro de Investigação Transdisciplinar:** Cultura, Espaço e Memória, n.d. Available: https://www.citcem.org/3encontro/docs/pdf/part_09/56%20-%20Vanessa%20Brasileiro%20et%20al.%20-%20TEXTO.pdf. Access on: Apr. 21, 2020.

CAMARA, A. L. S. Calçamento. **Ponte da Cadeia**, São João del-Rei, ano 3, n. 144, p. 3, 22 mar. 1970.

CANALIZAÇÃO do Córrego do Lenheiro. **Tribuna Sanjoanense**, São João del-Rei, ano 27, n. 769, p. 1, 21 mar. 1995.

CANALIZAÇÃO do Lenheiro avança 240m em 1 ano. **Jornal de São João Del Rey,** São João del-Rei, ano 2, n. 69, p. 1, 18-20 mar. 1987.

CARVALHO, J. W.; MARANGON, F. H.; SANTOS, I. Recuperação de rios urbanos: da interdependência e sincronicidade dos processos de desnaturalização em rios e bacias hidrográficas urbanas. **Revista do Departamento de Geografia**, v. 40, p. 163-174, 2020. https://doi.org/10.11606/rdg.v40i0.162247.

CÓRREGO do Lenheiro. **Tribuna Sanjoanense**, São João del-Rei, ano 23, n. 637, p. 3, 13 set. 1991.

COSTA, L. M. S. A. Rios urbanos e o desenho da paisagem. In: COSTA, L. M. S. A. (Org.). **Rios e paisagens urbanas em cidades brasileiras.** Rio de Janeiro: PROURB, 2006. p. 9-15.

DAMAE: Danos superam 140 milhões. **Tribuna Sanjoanense**, São João del-Rei, ano 23, n. 662, p. 1, 16-25 fev. 1992.

DAMAE investe em ampliação do abastecimento de água na cidade. **Tribuna Sanjoanense**, São João del-Rei, ano 30, n. 984, p. 3, 22 jun. 1999.

DEFESA CIVIL. **Plano de contingência de proteção e Defesa Civil**. São João del-Rei: Prefeitura Municipal, 2015.

DIAS, L. S. M.; CUNHA, S. B. Mudanças nos canais fluviais da sub-bacia do Canal do Cunha (RJ): intervenções antrópicas. **Revista Equador**, v. 6, n. 2, p. 23-43, 2017. https://doi.org/10.26694/equador.v6i2.6242.

DIAS, S. I. S.; CAMPOS, R. J. As bacias hidrográficas e o planejamento urbano: o caso de cascavel/PR. **Revista Thêma et Scientia**, v. 10, n. 2E, p. 52-91, 2020.

DNOS estuda enchentes do Tejuco. **Tribuna Sanjoanense**, São João del-Rei, ano 10, n. 213, p. 1, 21 jan. 1978a.

FARIA, T. J. P. Os projetos e obras do engenheiro Saturnino de Brito e mudança na paisagem urbana. **Geografia Ensino & Pesquisa**, v. 19, p. 115-122, 2015.

FORNASARI FILHO, N.; BRAGA, T. O.; GALVES, M. L.; BITAR, O. Y.; AMARANTE, A. **Alterações no meio físico decorrentes de obras de engenharia**: Boletim 61. São Paulo: Instituto de Pesquisas Tecnológicas, 1992.

GUERRA, A. J. T. **Dicionário geológico-geomorfológico**. 8. ed. Rio de Janeiro: IBGE, 1993.

GUERRA, A. J. T.; MARÇAL, M. S. **Geomorfologia ambiental**. Rio de Janeiro: Bertrand Brasil, 2006.

INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICAS (IBGE). **IBGE Cidades:** população estimada 2021. Rio de Janeiro: IBGE, 2021. Available: https://cidades.ibge.gov.br/brasil/mg/sao-joao-del-rei/panorama. Access on: Jul. 14, 2022.

LENHEIRO terá 80m demolidos. **Jornal de São João Del Rey**, São João del-Rei, ano 2, n. 2, p. 3, 18-24 jan. 1986a.

MALHEIROS, A. L. **Plano Diretor de Drenagem Urbana do Município de Irati – PR:** Produto 3 – Relatório de Análise da Drenagem Urbana. Irati: Prefeitura Municipal, 2018.

MARQUES, C. P. M.; JUNIOR, A. P. M. Artificialização de cursos d'água urbanos e transferência de passivos ambientais entre territórios municipais: reflexões a partir do caso do Ribeirão Arrudas, Região Metropolitana de Belo Horizonte - MG. **Revista Geografias**, p. 100-117, 2014. https://doi.org/10.35699/2237-549X..13386.

MIGUEZ, M.; VERÓL, A.; REZENDE, O. **Drenagem urbana:** do projeto tradicional à sustentabilidade. Rio de Janeiro: Campus-Elsevier, 2016.

NELSON Lombardi quer o rio canalizado. **Ponte da Cadeia**, São João del-Rei, ano 3, n. 103, p. 1, 8 jun. 1969b.

OBRAS de Mário Lombardi garantem serviço o DNOS. **Ponte da Cadeia,** São João del-Rei, ano 5, n. 229, p. 1, 19 dez. 1971.

OBRAS do Lenheiro prejudicam Tijuco. **Ponte da Cadeia,** São João del-Rei, ano 1, n. 36, p. 1, 11 fev. 1967.

OBRAS no Córrego do Lenheiro. **Tribuna Sanjoanense**, São João del-Rei, ano 10, n. 224, p. 1, 21 jul. 1978b.

PASSOS, M. G.; FACCO, J.; CARASEK, F.; JUNIOR, S. F. O.; SCHEIBE, L. F. Os rios na paisagem urbana: as modificações através do tempo em Chapecó, SC, Brasil. *In*: SIMPÓSIO INTERNACIONAL DE HISTÓRIA AMBIENTAL E MIGRAÇÕES, 5., 2018, Florianópolis. **Anais** [...]. Florianópolis: UFSC/LABIMHA, 2018. p. 669-692.

RESENDE, F. **Possível desembocadura do Córrego do Dom Bosco.** Acervo pessoal. 2022.

RESENDE, P. **Córrego da Voçoroca do Dom Bosco canalizado sob a Avenida Leite de Castro**. Acervo pessoal. 2021.

RESENDE, Paula. **Diferença volumétrica, energética e efeito remanso do Água Limpa sobre o Lenheiro.** Acervo pessoal. 2021.

ROCHA, Y. T. Teoria geográfica da paisagem na análise de fragmentos de paisagens urbanas de Brasília, São Paulo e Rio de Janeiro. **Revista Formação**, v. 1, n. 15, p. 19-35, 2008.

SÃO JOÃO DEL-REI MG. In: GOOGLE Earth. Mountain View: Google, 2021. Available: https://earth.google.com/web/@0,0,0a,22251752.77375655d,35y,0h,0t,0r. Access on: Out. 03, 2021.

SARTÓRIO, M. V. O. **Desnaturalização dos sistemas fluviais urbanos:** o caso do canal da costa e do canal Bigossi, Vila Velha (ES). 2018. 167 f. Dissertação (Mestrado em Geografia) – Universidade Federal do Espírito Santo, Vitória, 2018.

SISTEMA DE INFORMAÇÕES DO ARQUIVO NACIONAL (SIAN). **Fundos/Coleções:** Córrego dos Lenheiros afluente do Córrego Água Limpa, São João del-Rei (MG): levantamento, folha n. 7. DNOS, 1959. Available: https://sian.an.gov.br/sianex/consulta/Pesquisa_%20Livre_Painel_Resultado.asp?v_CodReferencia_id=2411932&v_aba=1. Access on: Jul. 19, 2022.

SOFFIATI, A. DNOS: uma instituição mítica da República Brasileira. **Revista Brasileira de Estudos Urbanos e Regionais**, v. 7, n. 2, p. 61-76, 2005. https://doi.org/10.22296/2317-1529.2005v7n2 p61.

TEMPORAL em São João del-Rey. **O Pharol**, Juiz de Fora, ano 52, n. 15, p. 1, 18 jan. 1917.

TUCCI, C. **Gestão de águas pluviais urbanas**. Brasília: Ministério das cidades, 2005.

VEJA o que aconteceu: a firma faliu. **Ponte da Cadeia,** São João del-Rei, ano 2, n. 98, p. 1, 4 Maio 1969a.

VEREADORES perguntam e ministério responde. **Ponte da Cadeia,** São João del-Rei, ano 3, n. 119, p. 3, 28 set. 1969c.

YIN, R. K. **Case study research:** design and methods. 4. ed. Thousand Oaks: Sage Publications, 2009.

AUTHORS CONTRIBUTION

André Barbosa Ribeiro Ferreira conceived the study, collected and analyzed the data and wrote the text. Andréa Aparecida Zacharias conceived the study, assisted in the data analysis and interpreted the dynamics of the landscape of São João del-Rei. Francielle da Silva Cardozo helped with the collection of historical data, carried out fieldwork, searched historical collections and interpreted the dynamics of the landscape of São João del-Rei. Braúlio Magalhães Fonseca helped with the preparation of the maps, georeferencing, carried out fieldwork, performed data analysis and interpreted the dynamics of the landscape of São João del-Rei.